A2IC 2018

ARTIFICIAL INTELLIGENCE INTERNATIONAL CONFERENCE

NOVEMBER 21-23, 2018 | BARCELONA

BOOK OF ABSTRACTS

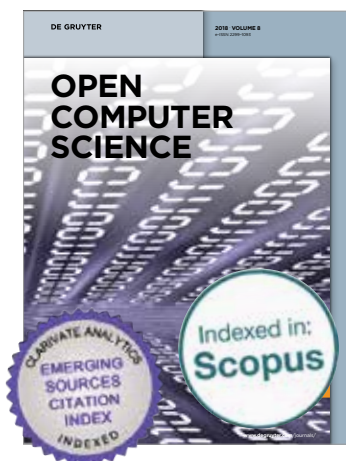premc.org/a2ic

PremC

Conferences, Events & Workshops

Table of Contents

Mocap as a Service: Video Motion Capture Makes Human Motion Analysis for Everyone

Wednesday, 21st November @ 09:05: Plenary Speech (Auditorium) - Oral - Abstract ID: 201

Prof. Yoshihiko Nakamura [1]

1. *University of Tokyo*

Robotics, especially humanoid robotics, has thrown light over the human attribution. The control of stable bipedal walk revealed the property of human motion. The interaction with human required the interpretation of human body movements. The computational foundation in humanoid robotics includes the simulation of complex mechanical systems, the optimization of many-variables systems, and the statistical classification and reasoning of motion data. Combined with recent advance of artificial intelligence in image recognition and natural language processing, the computational foundation of humanoid robotics finds its spin-off in human services. We have developed the technology of 3D reconstruction of human movements from multiple-camera video data and connected with the humanoid technology. This talk will introduce the scope of "Mocap as a Service."

The Role of Interaction and Embodied Cognition in Computational Ontology

Wednesday, 21st November @ 09:45: Plenary Speech (Auditorium) - Oral - Abstract ID: 312

Dr. Marco Schorlemmer [1]

1. *Artificial Intelligence Research Institute, IIIA-CSIC*

Computational ontology based on symbolic logic has proven to be very useful for many application domains based on scientific knowledge (medicine, biology, genetics, environmental sciences, pharmaceutical engineering, etc.). However, its application to more 'mundane' and 'down-to-earth' human activities seems to be much more difficult to pin down, as meaning in these domains is very dynamic, changing, adaptable, and evolving.

In this talk I shall address a couple of concerns with respect to the traditional, mainstream approaches for capturing semantics by means of ontologies, namely,

1. the underlying disembodied, conceptual-propositional theory of meaning on which computational ontology is founded;
2. the assumption that ontology should be prior to interaction in order to guarantee successful knowledge sharing.

In particular I will show how these two concerns have shaped my research with my collaborators over the last years, as carried out in the scope of two EU-funded projects: the Marie-Curie Training Network *ESSENCE* (2013-2017), and the FET Open Collaborative Project *COINVENT* (2013-2016).

I shall conclude my talk with the research directions we want to pursue in the context of the forthcoming EU-funded FET Proactive Research and Innovation Action *WeNet* (2019-2023) on providing a diversity-aware, machine-mediated paradigm of social relations.

Plenary speech title _TBD

Wednesday, 21st November @ 10:45: Plenary Speech (Auditorium) - Oral - Abstract ID: 317

**Dr. Silvia Chiappa** [1]

1. *DeepMind*

TBD

Data Science for Efficient Building Energy Management

Wednesday, 21st November @ 11:25: Plenary Speech (Auditorium) - Oral - Abstract ID: 311

Dr. Juan Gómez-Romero [1]

1. University of Granada

Buildings account for more than one third of the worldwide primary energy consumption and they are an equally important source of contaminant emissions. Non-residential buildings are major contributors to this issue, mostly because of the ineffective operation of their HVAC (heating, ventilation, and air conditioning) systems. These figures are expected to increase in the future due to inadequacy of aging infrastructures, impact of climate change in weather, and economic growth in emerging countries. Data Science, encompassing several technologies for collecting, processing and learning from data, offers great opportunities to save energy by improving building management procedures; e.g. forecasting of energy loads, HVAC and lighting operation, retrofitting, fault detection and prediction, and prevention of non-technical losses. Furthermore, the development of the Internet of Things and the advances in Deep Learning will give raise to a new generation of more autonomous and intelligent building energy systems. This talk discusses the state-of-the-art methods for efficient building energy management and the challenges lying ahead.

Service Optimization of Charging Stations Using Reinforcement Learning

Wednesday, 21st November @ 13:30: Poster Session & Exhibition (Gallery) - Poster - Abstract ID: 278

__Dr. Jonas Hellgren__ [1], __Prof. Sebastien Gros__ [2]

1. *AB Volvo,* **2.** *Chalmers University of Technology*

Plugin hybrids and electric vehicle (PHEVs & EVs) use energy resources from the electric grid, and occupy space and time at charging stations. With the fast development of electric mobility and of electric power based on renewable energies, these shared and limited resources will have to be efficiently managed. Even in a future scenario where an extensive network of charging stations is available, it is likely that vehicles will often compete for the utilization of the charging services, both in terms of charging time slot and energy. The charging of EV and PHEV will, therefore, become a resource-allocation problem. The problem in this study aims at: how can we design smart charging policies for charging stations?

We consider here the problem of pricing the charging of EVs according to 1) the number of available slots for the vehicles and 2) The power/energy request. To make the problem as simple as possible, we consider that all vehicles have the same occupancy time but have different acceptable prices. The EV acceptable prices are random, uniformly distributed in a fixed interval. The Electric Vehicle Charging Stations (EVCS) must then strike the optimal pricing to maximize revenue over time. If the pricing is low, vehicles will often accept the price but revenue per charging is low. High pricing risks that no charging, i.e. zero revenue, often is present.

The problem is attacked with reinforcement learning, based on a stochastic policy gradient. The objective of the problem is to maximize the accumulated reward which is the charging revenue minus the charging station depreciation cost.

A resulting policy is presented below; the maximum number of charging slots is three. High action-values correspond to a high pricing. Pricing is high when: 1) many slots are occupied and/or 2) the energy request is low. A trend that is well in line with intuition.

The strength of the proposed method is an automated process for charging station electricity price setting.
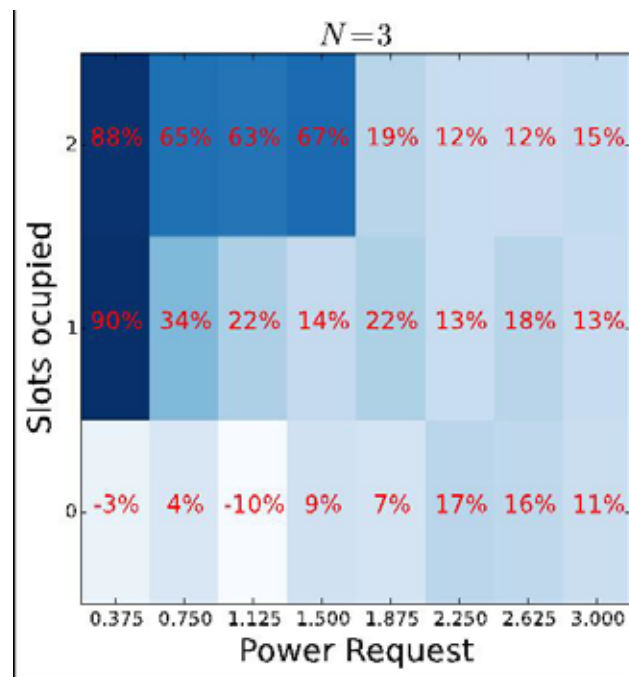
Charging policy.jpg

A path planning method for fast target striking in terminal of the combat aircraft

Wednesday, 21st November @ 13:30: Poster Session & Exhibition (Gallery) - Poster - Abstract ID: 220

Mr. Hongbo Xin [1], *Dr. Qingyang Chen* [1], *Dr. Yujie Wang* [1], *Dr. Gaowei Jia* [1], *Prof. Zhongxi Hou* [1]

1. National University of Defense Technology

For combat aircraft (like Loitering Unit), the strike trajectory must be calculated quickly after the target is determined in order to ensure the timeliness of the attack process. Aiming at the requirement of three-dimensional trajectories at the end of strike missions, a trajectory planning method is proposed in this paper. The shortest path of target striking can be calculated in real time using two tangential circles. In the first part of this paper, the method of path planning with two tangential circles is presented in detail at the two-dimensional plane. Then, the feasibility of the proposed method is analyzed in detail under various conditions, which satisfy the requirement of calculating in real time. In the third part, the optimality of the two tangential circles method of target striking is discussed and the shortest path of striking in the projection plane can be calculated. Next, aiming at the problem of target striking in three-dimensional space, the kinematic constraints of the aircraft must be considered, such as downslide angle and so on. Radius adjustment, downslide angle adjustment and hover maneuver methods are employed to achieve three-dimensional target striking. Finally, the simulation results under various conditions are given, to verify the performance of the proposed method.
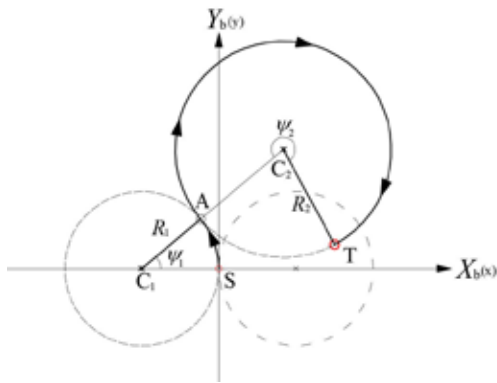
Schematic diagram of two tangential circles method.jpg
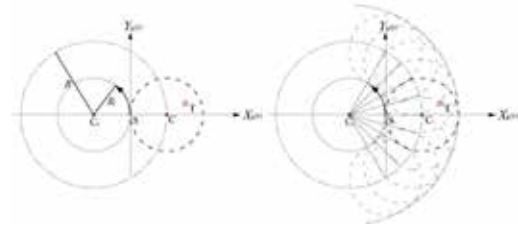
The feasibility of the two tangential circles method for target inside the minimal circle.jpg
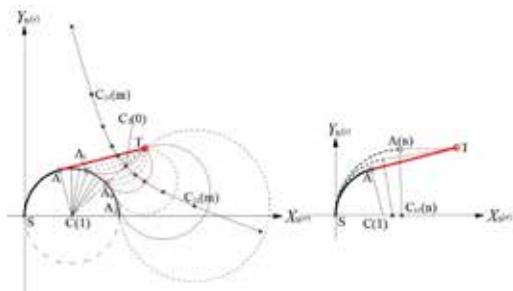
The optimality of the two tangential circles method for target point outside the minimal circle.jpg
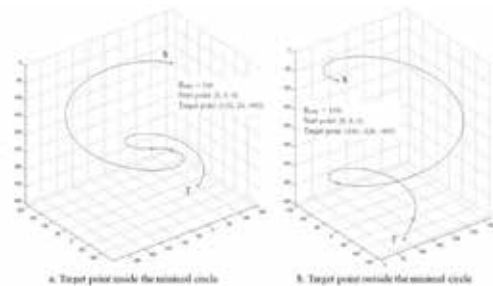
Three-dimensional trajectories.jpg

Defuzzification for polar coordinate transformed periodic membership function

Wednesday, 21st November @ 13:30: Poster Session & Exhibition (Gallery) - Poster - Abstract ID: 72

Dr. Takashi Mitsuishi [1]

1. _University of Marketing and Distribution Sciences_

This study presents the properties of periodic membership function (PMF) and defuzzification method. In the case that the periodic state, for example, the angle, the time, the color and the like, is inferred by fuzzy approximate reasoning, the membership function in the consequent part of the IF–THEN rule is a periodic function. The integral calculation in the center of gravity method depends on the domain of the membership function. Therefore, the determination of finite domain of membership function is required. However, If the fuzzy grade of PMF is greater than zero with respect to all variables, the interval of the domain of PMF is not determined uniquely.

In this study some of the difficulties of defuzzifying of a PMF are shown, and the use of polar coordinate transformation to address these difficulties is introduced. A defuzzication method in which the radius on the polar coordinates is obtained as the defuzzified value from the PMF using discretisation is proposed. The polar coordinate transformation and the defuzzification make it possible that the defuzzified value is unique and rational. The proposed method is one of the effective methods in fuzzy logic control as part of approximate reasoning. In the future, it is necessary to verify the accuracy of discretization which is for simplicity of computation.

Quadcopter System Applied to Visual 3D SLAM

Wednesday, 21st November @ 13:30: Poster Session & Exhibition (Gallery) - Poster - Abstract ID: 56

Mr. Hong-Rae Kim [1] *, Prof. Tae-Yong Kuc* [1]

1. SungKyunKwan University

We propose a Visual 3D Simultaneous Localization and Mapping (SLAM) technique by quadcopter using an RGB-D camera. Quadcopter which is called by Unmanned Aerial Vehicle (UAV), is applied to various fields. One of the important tasks of quadcopter is autonomous navigation. Outdoor navigation can be easily solved by using Inertial Measurement Unit (IMU) sensors to estimate attitudes and using GPS to localize the quadcopter. However, navigating indoors can cause many problems such as errors of magnetic sensors in IMU sensors and malfunction of GPS. The proposed quadcopter system first estimatesits present attitude by combining IMU sensors with Visual odometry, then reaches target attitude and maintains the attitude by double-loop PID control algorithm. Also, it detects key points based on the ORB-SLAM and extracts keyframes to progress the Visual SLAM. Visual odometry can estimate present attitude by differences between present frames and past frames. We use it to improve indoor-measured yaw axis accuracy, which can use inaccurate IMU values, and measure an altitudeof UAV. The double-loop PID control algorithm uses target angle errors to calibrate target angular velocities and calculates target angular velocity errors to generate control errors, instead of using target angle errors to calculate control errors directly. This process makes the PID control more adaptable to models with rapid changes like hovering, because the vibration may occur when the angular velocity is different from the target even if the target attitude is reached. Therefore, it is necessary to reach the target attitude and the target angular velocity simultaneously. Results show the robust performance of the proposedquadcopter system.
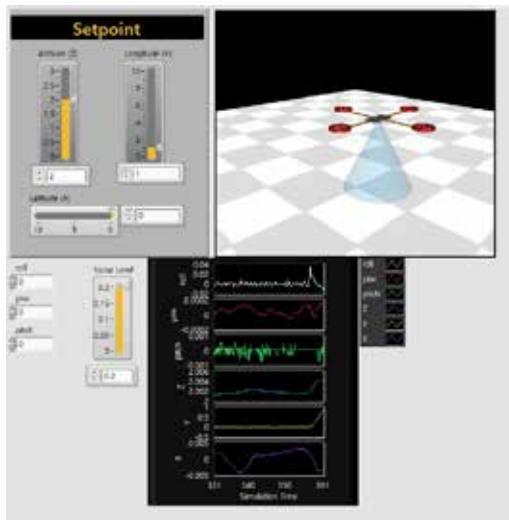
Pid control.png

Hovering test.jpg

Novel Bioinformatics Approaches to Unravel the Epigenetic Basis of Crop Plasticity

Wednesday, 21st November @ 13:30: Poster Session & Exhibition (Gallery) - Poster - Abstract ID: 244

__Mr. Eslam Ibrahim__ [1], Dr. Abdul Baten [2], Dr. Nedeljka Rosic [3], Prof. Graham King [1]

1. *Southern Cross Plant Science, Southern Cross University,* **2.** *1Southern Cross Plant Science, Southern Cross University, Australia & 2Knowledge & Analytics Group, Agresearch, New Zealand,* **3.** *1School of Health and Human Sciences; Southern Cross University, Gold Coast, Qld, 4225, Australia; 2Marine Ecology Research Centre; Southern Cross University, Lismore, NSW, Australia*

Introduction

Understanding the role of epigenetic mechanisms in crop plasticity can enhance our ability to develop climate resilient crop varieties, as well as increasing food production. Crop plasticity is the ability of the crop to produce different phenotypes in response to changes in environmental conditions. Epigenetic marks, including DNA methylation, histone modifications affect nucleosome positioning and are critical for regulating gene expression without changing the paired DNA sequence. An association between epigenetic and phenotypic variation is well established in mammals and some plants.

Materials and Methods

Datasets are available that describe different tissue and environment-specific patterns of epigenetic marks and differential gene expression, as well as well-defined annotated genomes and predictive models that describe variation in physiochemical properties of DNA. However, there are still significant research gaps in understanding the relationship between the pattern of DNA methylation, physiochemical properties of DNA and nucleosome positioning. In this project a computational model will be developed, based on datasets associated with *Brassica*crop genomes, to test a series of hypotheses related to ancestral genome duplication events and the consequences in terms of orthologous and paralogous gene structure variation. This initial study will allow for a more detailed analysis of the impact of DNA methylation, and detection of selection signatures associated with DNA sequence-derived physiochemical properties that may affect nucleosome positioning.

Results and Discussion

The initial outcome from this project has been to develop an enhanced database schema with GUI based on the Ensembl genome database. This allows management of different data types of sequence-derived features of DNA, DNA methylation and nucleosome positioning in different levels (e.g. base pair resolution and transcription), in the context of gene structural annotation. Based on extensive query of this system a machine learning classifier will used to test a series of hypotheses in relation to dynamic relationships between patterns of DNA methylation, nucleosome positioning and DNA physiochemical properties that are likely to be associated with epigenetic mechanisms underpinning phenotypic plasticity.

A study on heat and fluid flow in a regenerative oxy-fuel combustion system using deep learning

Wednesday, 21st November @ 13:30: Poster Session & Exhibition (Gallery) - Poster - Abstract ID: 141

Dr. Daegeun Hong [1], *Mr. Yongtaek Lim* [2], *Prof. Changwoo Park* [3]

1. POSTECH, *2.* Institute for Advanced Engineering, *3.* Seoul National University

The regenerative burner system has been shown to provide significant reduction in energy consumption (up to 60%), downsizing of the equipment (about 30%) and lower emissions (about 30%), while maintaining high thermal performance of the system since 1993. A pure oxygen combustion technology is crucial in Carbon Capture and Storage (CCS) technology especially in capturing of CO2, where CCS will reduce 9 GtCO2 by 2050, which is 19% of the total CO2 reduction amount. To make pure oxygen combustion feasible, a regenerative system is required to enhance the efficiency of pure oxygen combustion system. However, an existing air combustion technology is not directly applicable due to the absence of nitrogen that occupies the 78% of air. This study, therefore, is to investigate the parametric characteristics on regenerative system with oxy-fuel combustion by using deep learning technology in the field of artificial intelligence. We performed a deep running of the regenerative oxy-fuel combustion condition based on the CNN (Convolution Neural Network)-based model using numerical data and 10850 images. As a result, we obtained a condition classification accuracy of 92.76% for the test data. The CNN-based deep-running approach accurately detects and classifies the burning state of the oxy-fuel combustion system under various lighting conditions and complex background conditions compared with the conventional image processing method. Also, we constructed a web based user interface that displays combustion condition information according to the images and data generated by a regenerative oxy-fuel combustion system in real time.
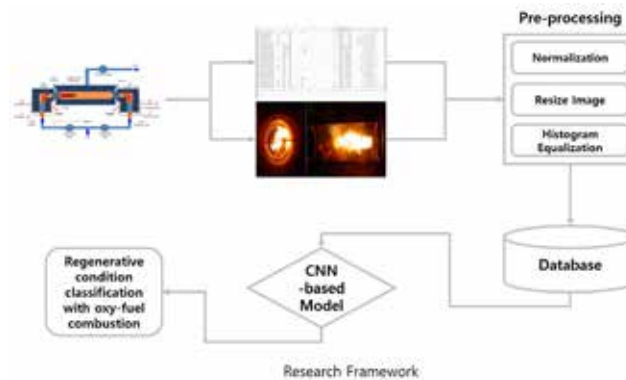
Research framework.jpg

Creating a Model for Predicting Next Senior Positions Using Work Experience Information in Resumes

Wednesday, 21st November @ 13:30: Poster Session & Exhibition (Gallery) - Poster - Abstract ID: 198

Mr. Sercan Çakır [1], *Ms. Merve Tunçer* [1], *Dr. Aşkın Karakaş* [1]

1. Kariyer.net

I. INTRODUCTION

People often intend taking new steps for achieving more success in their careers. In this way, they are in need of a career guidance. Emerging and growing job seeking activities through human resources websites encourage these websites to provide new functions to their users. Herewith, this study aims at recommending new senior positions to job seekers for guiding them in their career journeys by executing a classification algorithm namely a supervised machine learning method.

II. METHOD

The data set used in this work is acquired by examining the information which indicates Kariyer.net users' movements from one position to another (i.e. position transition). In this way, a list including 4 million position transitions with experience years and number of people taken the transitions is generated based on Markov chain model.

Based on the transition list, sequence numbers indicating levels of two different positions according to each other are found out by comparing the number of people taken the transitions. These sequence numbers, ratio by the sum of number of people and suchlike parameters are used to extract features in order to train and test machine learning classification algorithm. For classifying position transitions as *senior* and *not senior*, Decision Jungle classification algorithm, which we obtained the best results, is used in this work.

III. RESULTS

For evaluating the success of the classification model, following two criteria are taken into consideration. Firstly, it is expected that the number of true labelled position transitions are predicted as false at the fewest, and secondly, the number of false labelled position transitions are predicted as true at the fewest. Decision Jungle classification algorithm achieved 87.4% accuracy, 88.2% precision, 91.9% recall and 90.0% F1-score. The trained and tested model is used to predict unknown labels of unlabeled position transitions. Examples of those obtained results are illustrated in below table.

IV. DISCUSSION

In this work, the aim of guiding people on taking new steps in their career journeys is actualized. As a future work, it is intended to expand and improve position lists of Kariyer.net, and find out position levels of much more specialized sub-branched positions.

Civil Engineer	→ Construction Manager
Senior Business Analyst	→ Project Manager
Personnel Affairs Chief	→ Human Resources Manager
Senior System Administrator	→ Information Technologies Manager

Sample senior positions.png

The universal algorithmic solution for the implementation of a machine consciousness.

Wednesday, 21st November @ 13:30: Poster Session & Exhibition (Gallery) - Poster - Abstract ID: 300

Mr. Richard Pastor [1]

1. *SFB Science for Business GmbH*

In order that something (be it an „I ", a"consciousness", a sensor or a perception organ) is able to perceive something else, it has to fulfil a minimum condition: the perceiver, which has a certain initial state, must change its present material state, if it wants to perceive what is happening around or to perceive the objects surrounding it. There is no other method conceivable to perceive something. I call this condition the sensor minimum. The sensor minimum, a necessary and therefore universal condition of the perception process, is a descendant of Kant's Thing in Itself. By using the implications of the sensor minimum not merely as an epistemological restriction in relation to the objectivity of reality, we obtain the a priori bottleneck as a constant of the perception equation that explains perception, consciousness, self-consciousness, thinking, feeling, qualia and free will. A task also known under the term of strong artificial intelligence. The solution follows this line of milestones:

1. Identifiying a programming loop that serves as Homunculus in the architecture of the human perception process, which is a worthy carrier of a valid consciousness experience.

2. Using the Homunculus as a core to divide the world in subject and object. (dataperspective and subject-orientated programming)

3. Building a Hegelian concept ontology.

4. Performing the Cartesian Theater.

5. The requirement of general computability.

6.Factory patterns of self-simulation.

7. Abductive logic.

8. Homeostatic projection.

9. And the value pump.

They all are the direct and logical consequences of the sensor minimum. At the end I provide in pseudocode an implementable instruction for building a machine consciousness. I also illustrate how the property of general computability affects performance and feasibility. At its core, we're talking about a single compression algorithm that allows you to implement a first real consciousness within two years on a computer from the shelf. This is not only a guide to build strong artificial intelligence, but also a guide to improve all weak-artificial-intelligence programs in their performance.

ARTIFICIAL DIGITALITY

Wednesday, 21st November @ 13:30: Poster Session & Exhibition (Gallery) - Poster - Abstract ID: 178

Mr. Kuldeep Gohel [1]

_1._ _American Museum of Natural History_

This project was the result of the need felt by the author as a musician. Having dabbled with Artificial Intelligence in the past and being a self taught musician, the author tried to utilize Artificial Intelligence as a co-creator after a 5 year creative hiatus. AI is seen as not just a technical tool, but an extension of the artist that they can share their soul with by training them in their creative process. The outcome of this process is an album, which is the narrative artefact.

This paper discusses the creation of narratives using the medium of music along with AI; AI as a co-creator of narrative schema uses user's creation schema as a training set. Three compositions are created to form a narrative of how AI started its takeover of the world, using AI and user input narrative variable values. The narratives are seen as a mathematical structure in this approach, composed of keys, chords and melodies which are quantifiable in nature. The three compositions created are created by the author, the author and the AI and lastly, just the AI. The three compositions together narrate the story of the growth of AI.

The process involved an analytical approach to the art of music making. I analyzed the process of making music, then converted the process into data; which can be used to generate a system that will mimic my music making. I started by dividing the music album in three compositions; the content each composition draws inspiration from the story of the development of A.I. to date. The story involves the 'World before A.I.', 'Current World' and 'Future (Singularity)'. For 'Current World' and 'Future (Singularity)', C# Melodic Minor (111 bpm) and G# Hungarian Gypsy (128 bpm) scales were used to emote intelligence, while the 'World before A.I.' used C Natural Minor to narrate Sentimental and Tragic. Each of the compositions were generated from the total of 15 keys offered in two octaves of their scale.
Full Compositions:
https://soundcloud.com/psychoactive13/sets/artificial-digitality
Full Documentation:

https://www.kuldeepgohel.com/artificial-digitality

Ableton live composition .jpg

Finla-album-cover-for-web-full-resolution-.jpg
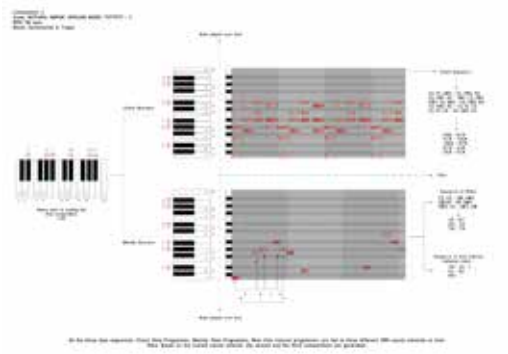
Midterms poster a3 final wensti eposter.jpg

Simbrain.png

INVITED TALK - AI might operate with false notions about learning and ethics

Wednesday, 21st November @ 14:15: Ethics in AI (Auditorium) - Oral - Abstract ID: 272

Mr. Chitro Majumdar [1]

1. RsRL

Debate starts between with current Machine Learning (ML) approach and currently developed Machine Ethics (ME) approach. This criticism is based on mathematicians and philosophers about learning and ethics that inexplicably never properly made it into science and mathematics. There is a news floating that 'Famed mathematician claims proof of 160-year-old Riemann hypothesis' (RH), of course mathematician Michael Atiyah is not like all the others who have "proved" the RH. Some of these proofs were bluntly wrong, some of these proofs have well hidden mistakes. But recently Atiyah has made some errors he would not have made 20 years ago (dixit famous colleagues). So we must wait what the referees say. Machine Ethics (ME) preliminary points we could portrait here as follows:

1. learning ethical
2. ethical is inversely proportional to decision process. i.e. ethics is also the inversely propositional to algorithm
3. critique of utilitarianism

INVITED TALK - Gender Bias in Natural Language Processing

Wednesday, 21st November @ 14:15: Natural language processing (Room 201) - Oral - Abstract ID: 304

Prof. Marta R. Costa-jussà [1]

1. *Universitat Politècnica de Catalunya*

Gender stereotypes (among others) are unfortunately quite frequent in our society and in the data/information produced. Natural Language Processing (NLP) aims at programming computers to learn and manage human languages. Several NLP systems have been proven to be a great tool towards revealing unconscious bias.

The hypothesis of gender bias being present in sports interviews (Fu et al. 2016) or in book reviews (Madaan et al. 2018) has been confirmed by using language modeling, word embeddings and coreference approaches.

However, since most of current NLP systems learn from large quantities of data, these systems are also highly affected by the gender biases which are inherent in the training data. There have been several studies that focus on this problem from different perspectives.

One perspective is data curation, which works towards reducing the bias present in the currently available data. Zhao et al. (2018) construct an additional training corpus where all male entities are swapped for female entities and vice-versa.

A different perspective is algorithmic-based. Bolukbasi et al. (2016), Vera (2018) and Chakraborty et al. (2018) propose to mitigate the amplification of gender bias that standard algorithms like Word2Vec (Mikolov et al. 2013) or Glove (Pennington et al. 2014) tend to produce. One strategy is identifying the direction of the gender and showing that gender-neutral words are linearly separable from gender definition words.

This talk gives an overview of both how NLP is used to uncover unconscious bias and how NLP algorithms can be neutralized from this bias on which they are trained on. These approaches are both progressing while discussions on the relevance of uncovering bias or debiasing NLP are still going on. Should NLP systems reflect our society? Given the harm produced by some stereotypes, maybe we should work towards neutralizing them. If it is difficult to change society itself, why not employing automatic systems for making a more inclusive world for all of us?

[Time extension for the invited speaker]

Wednesday, 21st November @ 14:32: Ethics in AI (Auditorium) - Oral - Abstract ID: 323

__Mr. Chitro Majumdar__ [1]

__1.__ R-square RiskLab

This presentation has been created to extend the time allocated to MR. CHITRO MAJUMDAR for his presentation "AI might operate with false notions about learning and ethics".

Time extension for the invited speaker

Wednesday, 21st November @ 14:32: Natural language processing (Room 201) - Oral - Abstract ID: 324

Prof. Marta R. Costa-jussà [1]

1. Universitat Politècnica de Catalunya

This presentation has been created to extend the time allocated to PROF. MARTA RUIZ for his presentation "Gender Bias in Natural Language Processing"

Dynamic Ethical Settings: Teaching Moral Compromise in Multi-Agent Human-Machine Decisions

Wednesday, 21st November @ 14:49: Ethics in AI (Auditorium) - Oral - Abstract ID: 281

Mr. Charles Peterson [1]

1. New York University

Introduction:

While the need to encode human ethics into machine learning systems goes beyond vehicles, self-driving cars are a good test case to derive principles to use in other multi-agent AI interaction systems. I propose using convolutional neural networks to create per-user personalized ethical settings that allow an AI-enhanced moral compromise between cars in the event of a crash or conflict. This individual approach allows faster adoption, better distributes accountability, and is honest to the value pluralism that defines democratic ethics.

Methods:

Gogoll and Müller (2017) propose a mandatory framework where all agents have the same ethical requirements. This utilitarian system requires self-sacrifice. I argue systems like this fail, both metaethically and on their own utilitarian terms since they do not account for the moral reality of blended roads where machines and humans both make decisions. I show that blended decisions create an incentive to maintain human control and that these mandatory systems will stall the adoption of self-driving cars. Since adopting safer AI will save lives even if the system is imperfect, this cannot be allowed. Philosophically, I give the Infant Tunnel Case to show that mandatory ethics utilitarian frames fail to allow space for the healthy pluralism that defines modern democratic ethics.

Results:

I propose Dynamic Ethics Settings that, akin to a human process of compromise, allows AI agents to change their behavior depending on location and interaction partners. Cars exchange ethical preferences during a crash to arrive at a solution that minimizes the probability of post-crash litigation. Rather than centralized pre-crash ethical optimization, I argue for in-crash moral compromise.

Discussion:

This approach succeeds in utilitarian frames, pluralist non-consequentialist frames, allows for systematic distribution of liability in vague scenarios and reduces the ethical burden on programmers. Finally, I generalize a framework for thinking about how to express moral intentions in AI in a theoretically robust enough way to apply to other ethically-laden machine learning applications. This account functions in any technology in which machine decision making is safer than human decision making, potentially including medical diagnostic software and software that interacts with multiple nations and legal systems.

Reading China: Measuring Policy Change with Machine Learning

Wednesday, 21st November @ 14:49: Natural language processing (Room 201) - Oral - Abstract ID: 116

Dr. Weifeng Zhong [1]

1. *American Enterprise Institute*

While China's industrialization process has long been a product of government direction, until now there has been no quantitative measures of the Chinese government's policy priorities over a long period of time. We fill this gap by devising the first of such measures, the Policy Change Index (PCI) of China, which runs from 1952 to the present. We use the full texts of the *People's Daily*, the official newspaper of the Communist Party of China, as raw data to construct the PCI. Our method is based on LSTM networks (à la Hochreiter and Schmidhuber, 1997) and the CUSUM test (à la Page, 1954) to detect significant changes in the policy-importance of *People's Daily* articles. This method allows us to infer the shift in the priorities of the Chinese government's policies. The constructed PCI not only matches important policy changes that have taken place in China—such as the Great Leap Forward, the Cultural Revolution, and the economic reform program—but is also able to make short-term predictions about China's future policy directions.

Trust in AI: The role of private governance

Wednesday, 21st November @ 15:06: Ethics in AI (Auditorium) - Oral - Abstract ID: 101

**Dr. Asuncion Lera St.Clair** [1], _**Dr. Elisabeth Traiger**_ [1], _**Dr. Andreas Hafver**_ [1], _**Ms. Kaja Kvello**_ [1], _**Dr. Erik Stensrud**_ [1]

1. _DNV GL_

Literature on ethics and AI focuses on business-related issues such as ethically-driven software development, automatization of unfair and biased practices, displacement of jobs, privacy, or duties of technology giants. Additional ethical questions emerge with the fast adoption of AI by any business, given AI disrupts existing accountability mechanisms.

Business transactions of any type are layered and mediated by both public and private accountability mechanisms. These governance systems integrate ethical principles into business practices. Risk management, industry standards, or assurance services, are instances of private governance mechanisms that self-regulate the behavior of companies, align business practices with widely held ethical principles, and enable societal trust. Assurance services are of particular importance, ensuring products (e.g., a ship, a food product, or a management system) are safe, do not cause unacceptable harm to society and the environment, and respect established principles such as human rights. These layers of trust, (e.g., environmental standards and assurance methods to assess industries compliance with such standards), enable the well-functioning of business transactions.

As most businesses implement AI systems with learning and decision making capabilities, these layered systems of trust are disrupted. Products and services based on AI are very different from traditional products and services. A ship is no longer a physical asset, it is a cyber-physical system; a medical treatment is no longer a doctor's judgment but an algorithm's; and a management system becomes a hybrid machine-human decision system. This disrupts existing private governance mechanisms given, for example, there is less transparency in how are decisions made, difficulties in assigning responsibility or in assuring algorithms. Understanding this disruption is critical not only because AI applications are primarily driven by efficiency gains and cost savings rather than safety or the common good, or because public governance and social norms lag AI research. It is also crucial because AI systems change well-established risk profiles of industries and creates new ethical challenges.

Drawing from experience providing assurance services to multiple industries, research on AI, philosophy and ethics, this paper outlines some of the ethical challenges AI poses for private governance mechanisms and explores the role of assurance.

Hospital-associated infection classification based on clinical notes and codes

Wednesday, 21st November @ 15:06: Natural language processing (Room 201) - Oral - Abstract ID: 68

Prof. Tiago Andres Vaz [1] *, Prof. Elizabeth Obino Cirne-lima* [1] *, Prof. Rodrigo Pires Dos Santos* [2] *, Prof. Fernanda Dos Santos Oliveira* [2]

1. *Universidade Federal do Rio Grande do Sul,* **2.** *Hospital de Clínicas de Porto Alegre*

Introduction: Classification of hospital-associated infections may be enhanced with the introduction of Artificial Intelligence into Electronic Health Records. To investigate this possibility a data science platform was tested to simulate automatic notification of pneumonia cases using Machine Learning.

Methods: To determine pneumonia a set of epidemiological criteria defined by regulatory agencies in Brazil was analyzed using a cohort with 109,422 records from inpatient admissions at Hospital de Clínicas de Porto Alegre. Clinical notes and codes were gathered from 2011 to 2015 without patient identification and labeled with multiple cases of infections to train and evaluate three different types of predictive algorithms: Random Forrest, Logistic Regression, and Recurrent Neural Networks. The experiment was conducted by a multidisciplinary team of experts that assessed the usability of the classification system following the state-of-the-art processes proposed for automatic and manual surveillance of infections.

Results: The experiment shows that is possible to produce with Machine Learning, sensitive models to classify pneumonia with AUC-ROC = 97,2%. Simulation of use shows that is feasible to reduce by 82.9% the working hours required by professionals to manually evaluate data from all inpatients and then classify cases without losses.

Discussion: Our model using a Random Forrest presented better sensibility and slightly superior performance results than average AUC-ROC of 95% from other studies that used clinical notes and codes for healthcare data analysis. Automated data preparation, and pre-processing services supported by cloud computing infrastructure were noticed as important requirements that may be contributing to outperform previous results. There is a need to produce new knowledge contributing not only to simulate and test AI environments before and after adoption but also to improve data governance and other data related subjects inside healthcare institutions that are being challenged by privacy concerns. This experiment was applied in a single center and external validation is still necessary to test the performance in different scenarios. Surveillance processes and risk management inside hospitals can be revamped by Artificial Intelligence, directing professional's time and actions straight to other necessary healthcare improvements.
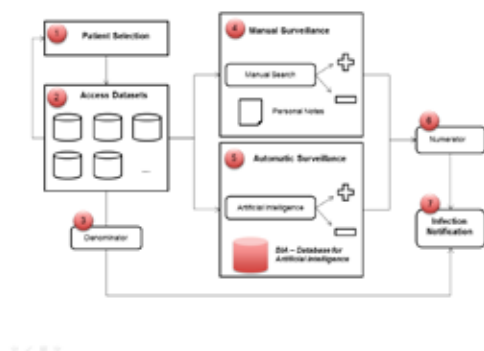
Figure 1 - automatic surveillance adoption with ai.png
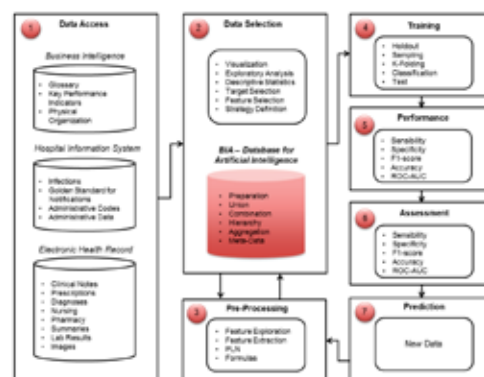
Figure 2 - machine learning process flow.png

Table 1 - Sources of data with number of records per year.

Datasets	2010	2011	2012	2013	2014	2015	Total
Admissions	21,794	22,531	22,392	22,674	24,538	25,345	109,422
Infections	6,771	5,901	5,059	5,314	4,215	4,262	31,522
Clinical Codes	29,266	30,372	30,231	30,733	33,232	34,172	188,006
Clinical Notes*	925,899	1,009,909	1,102,854	1,103,186	1,092,476	1,104,217	6,338,541
Exams**	722,503	922,115	1,302,935	1,761,224	1,747,486	1,718,733	8,175,006

* Multidisciplinary notes done by physicans, nurses, nutritionists and others. ** Laboratory and radiology results

Table1 - sources of data with number of records per year.png

Affective Ambient Intelligence: from Domotics to Ambient Intelligence

Wednesday, 21st November @ 15:23: Ethics in AI (Auditorium) - Oral - Abstract ID: 298

Mrs. Maria Luiza Recena Menezes [1], Dr. Anita Sant'anna [1], Dr. Misha Pavel [2], Dr. Holly Jimison [2], Dr. Fernando Alonso-Fernandez [1]

1. *Halmstad University,* **2.** *Northeastern University*

Imagine a family that has a very agitated child with severe autism, Johnny. The family not always knows what can trigger his anxiety bursts. While they are watching a children's movie, crescendo music accompanies the epilogue of the story. Unnoticed by the family, the anxiety levels of the child increase as he cannot communicate his state or lower the volume himself. As a result he has an outburst and can remain distressed for several days. If their home was equipped with an intelligent system that can monitor the child's stress levels and learn to set ambient scenarios where the child is more relaxed, the system could have perceived the situation and adapted. Lowering the volume of the television and setting the living room light levels to one that is known to calm Johnny, for example. The outburst could have been reduced or prevented all-together.

Yet, typical implementations of AmI do not seem to solve this problem. One common shortcoming of current approaches is underestimating how different people's reactions may be to the same stimuli. In reality it is very difficult to know what may have a positive or negative impact on the user. Responses are not only based on personal preferences but also on context. An appropriate response today may not be appropriate tomorrow. To shed light on this problem, we suggest that the knowledge of the user's affective state should be used to achieve an efficient interpretation of user's intentions.

It is also important to think about the consequences of an Affective Ambient Intelligence. In our example, just like the system tries to learn and influence the affective state of the user; the child can also learn and manipulate the behavior of the system. Johnny may learn that his outbursts lead the system to a calming scenario that he much appreciates. Poorly designs can create "spoiled" users and work as an impairing agent, rather than a helping agent. Systems empowered to influence humans' emotions should always take into consideration psychological evaluations and models to ponder how its actions can influence the user, in the short and long time.
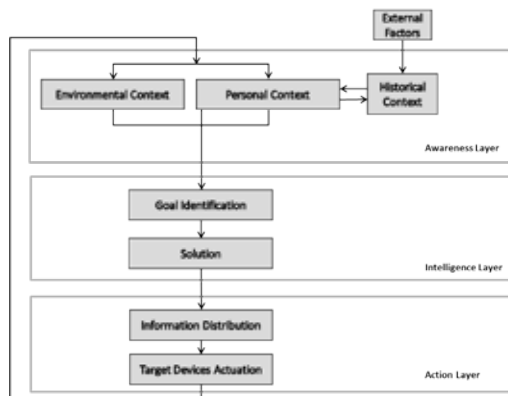
Aaistructure.png
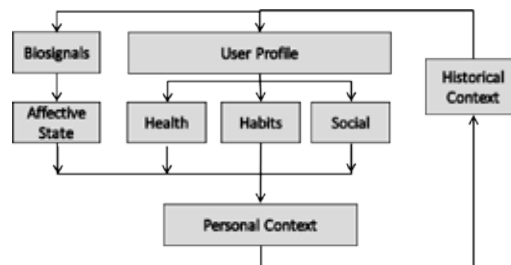
Personalcontext.png

Mapping Distributional Semantics to Property Norms with Multilayer Perceptrons

Wednesday, 21st November @ 15:23: Natural language processing (Room 201) - Oral - Abstract ID: 147

Dr. DANDAN LI [1], Dr. Douglas Summers-Stay [1]

1. *U.S. Army Research Laboratory*

Introduction:

In recent years, distributional semantic models have shown great success in many natural language processing tasks, but they characterize the meaning of a word/concept by uninterpretable "context signatures". In cognitive psychology, concepts are represented by their relations with properties. In this work, we present a neural network-based method for mapping a distributional semantic space onto a human-built property space automatically. We evaluate our method on word embeddings learned with different types of contexts, and report state-of-the-art performances on the widely used McRae norms.

Methods:

We model the problem of learning the property-based representation of a concept as a multinomial classification problem. Existing works estimate the function using the partial least square regression(PLSR) method, which models the relationship between two spaces as a linear function. But linearity is a strong assumption. Multilayer perceptrons (MLP) can learn very complicated relationships between their inputs and outputs because nonlinear transformations are introduced to the hidden layers of the architecture.

Results:

We compare our MLP model with two baselines: partial least square regression (PLSR) and k-nearest neighbor (KNN). We explore the performances of distribution models with different types of contexts on this task by qualitative and quantitative analyses. Table 1 and Table 2 report the average precision and recall across 138 test concepts by each method matched against the McRae gold standard. Four kinds of word embeddings W2V1, W2V5, W2V10 and DEP are used in the experiments. From the average precision and recall, we can obtain the following order of the methods: MLP>> PLSR>>KNN, where >> indicates that the method on the left-hand side is significantly better than the one on the right-hand side. Table 3 and Table 4 show the further evaluation for the quality of property inference.

Discussion:

Using a publicly available dataset of property norms, we show that high-quality property norms can indeed induced from standard distributional data. In future work, we will do further analysis about prediction performance on different types of properties. We are also interested in exploring how to generalize property-based representations to a large-scale dataset.

Methods	Parameters	Distributional Models (Precision)			
		W2V1	W2V5	W2V10	DEP
MLP	Dropout	**42.46**	42.10	41.15	41.59
	No Dropout	40.72	40.65	**40.86**	40.79
PLSR	c=50	**38.26**	37.75	37.75	37.53
	c=100	37.31	**38.26**	38.18	37.68
KNN	k=5	**36.01**	34.63	34.85	35.79
	k=10	36.01	35.86	36.37	**36.66**

Table 1: The percentage average precisions for all methods.

Table1.png

Methods	Parameters	Distributional Models (Recall)			
		W2V1	W2V5	W2V10	DEP
MLP	Dropout	**32.40**	32.06	31.28	31.95
	No Dropout	30.90	30.86	**31.27**	31.11
PLSR	c=50	**29.04**	28.43	28.72	29.01
	c=100	28.60	29.06	**29.12**	28.98
KNN	k=5	**27.76**	26.47	26.74	27.26
	k=10	27.89	27.73	27.95	**28.08**

Table 2: The percentage average recalls for all methods.

Tabel2.png

Concept	Method	Top 5 Predicted Properties
jar	McRae	has_a_lid, made_of_glass, used_for_holding_things, a_container, is_breakable,
	MLP	used_for_holding_things, made_of_plastic, made_of_glass, has_a_lid, is_breakable
	PLSR	made_of_plastic, *found_in_kitchens, *made_of_metal, *is_round, used_for_holding_things
	KNN	*made_of_metal, made_of_plastic, *found_in_kitchens, used_for_holding_things, *a_utensil
sparrow	McRae	a_baby_bird, beh_flies, has_feathers, beh_lays_eggs, has_wings
	MLP	a_baby_bird, beh_flies, has_wings, has_feathers, beh_lays_eggs
	PLSR	a_baby_bird, beh_flies, has_feathers, has_wings, has_a_beak
	KNN	a_baby_bird, beh_flies, has_feathers, has_wings, has_a_beak
spatula	McRae	a_utensil, has_a_handle, made_of_plastic, used_for_cooking, is_flat,
	MLP	a_utensil, made_of_plastic, made_of_metal, found_in_kitchens, *used_for_eating
	PLSR	made_of_metal, found_in_kitchens, made_of_plastic, *a_tool, a_utensil
	KNN	made_of_metal, found_in_kitchens, *a_tool, made_of_plastic, has_a_handle
sofa	McRae	found_in_living_rooms, furniture, is_comfortable, used_by_sitting_on, has_cushions
	MLP	is_comfortable, furniture, is_soft, used_by_sitting_on, has_cushions
	PLSR	is_comfortable, *made_of_wood, is_soft, used_by_sitting_on, used_for_sleeping
	KNN	is_comfortable, is_soft, *made_of_wood, *worn_for_warmth, used_for_sleeping
bracelet	McRae	worn_on_wrists, made_of_gold, made_of_silver, a_fashion_accessory, a_jewelry
	MLP	*worn_around_neck, made_of_silver, a_fashion_accessory, a_jewelry, made_of_gold
	PLSR	made_of_metal, made_of_gold, made_of_silver, *worn_around_neck, is_round
	KNN	*worn_for_warmth, *clothing, *is_long, *worn_by_women, *different_colours
doll	McRae	has_own_clothes, used_for_playing, a_toy, used_by_girls, has_hair
	MLP	*is_small, *is_soft, *is_white, *is_comfortable, *is_large
	PLSR	*is_small, *is_white, *worn_by_women, *different_colours, *clothing
	KNN	*is_comfortable, *worn_for_warmth, *worn_at_night, *is_warm, *clothing
walrus	McRae	an_animal, is_large, beh_swims, lives_in_water, is_fat
	MLP	an_animal, a_mammal, hunted_by_people, *has_a_tail, beh_swims
	PLSR	an_animal, is_large, lives_in_water, beh_swims, *a_baby_bird
	KNN	an_animal, *has_a_tail, has_teeth, *is_green, *is_furry
platypus	McRae	an_animal, lives_in_water, a_mammal, beh_swims, has_a_bill
	MLP	an_animal, beh_swims, *has_a_tail, *has_4_legs, *is_brown
	PLSR	an_animal, *is_small, *has_a_tail, *has_4_legs, *is_large
	KNN	an_animal, *is_green, *has_4_legs, *beh_eats, *has_a_tail

Table 3: Top 5 Properties returned by MLP, PLSR and KNN. Properties annotated with * are not listed in McRae.

Table3.png

Concept	Method	Top 5 Neighbors
jar	MLP	jar, bucket, plate, spatula, whistle
	PLSR	bucket, spatula, plate, pan, skillet
	KNN	spatula, tongs, bucket, grater, pan
sparrow	MLP	sparrow, raven, finch, buzzard, parakeet
	PLSR	raven, sparrow, finch, buzzard, parakeet
	KNN	sparrow, raven, finch, buzzard, parakeet
spatula	MLP	spatula, fork, tongs, grater, bucket
	PLSR	spatula, tongs, grater, pan, hatchet
	KNN	spatula, tongs, hatchet, grater, bucket
sofa	MLP	sofa, cushion, bench, jeans, cabinet
	PLSR	sofa, cushion, cabinet, bench, jeans
	KNN	sofa, cushion, socks, bench, cabinet
bracelet	MLP	bracelet, tie, crown, fork, plate
	PLSR	bracelet, tongs, bucket, crown, thimble
	KNN	skirt, socks, cape, tie, jacket
doll	MLP	rice, cottage, cushion, shrimp, bear
	PLSR	sparrow, finch, butterfly, sheep, raven
	KNN	socks, bracelet, cape, skirt, bench
walrus	MLP	platypus, buffalo, elk, walrus, caribou
	PLSR	walrus, ox, buffalo, platypus, otter
	KNN	walrus, ox, platypus, otter, cougar
platypus	MLP	otter, platypus, walrus, ox, buffalo
	PLSR	ox, walrus, platypus, buffalo, elk
	KNN	cougar, ox, buffalo, elk, walrus

Table 4: Top 5 Neighbors returned by MLP, PLSR, and KNN.

Table4.png

Towards inclusive AI in Recruiting. Multi-agent systems architecture for ethical and legal compliance

Wednesday, 21st November @ 15:40: Ethics in AI (Auditorium) - Oral - Abstract ID: 266

Ms. Carmen Fernández [1], *Dr. Alberto Fernández* [1]

1. Universidad Rey Juan Carlos-Cetinia

In this paper we examine the state-of-the-art and current applications of domain-specific AI for human resources and whether due to the experimental state of the algorithms and the nature of training test samples further control and auditing in the research community should be needed in order to guarantee a fair and accurate AI and target possible discrimination of some sort in the job market, like gender and racial discrimination. We find the positive and negative consequences of the usage of video-interview analysis via Artificial Intelligence in recruiting processes and the main Machine Learning techniques used and its degrees of efficiency. We finally focus on some controversial characteristics that could lead to ethical and legal consequences for candidates, companies and states and analyse if there is a deficit of regulation with these systems reinforcing the idea of necessary external and neutral auditing of the types of analysis in each and every interview. We present a Multiagent Systems Architecture that leads to total legal compliance and more effective Human Resources processes Management.

Context based Text-generation using LSTM networks

Wednesday, 21st November @ 15:40: Natural language processing (Room 201) - Oral - Abstract ID: 309

Mr. Sivasurya Santhanam [1]

1. *German Aerospace Center(DLR)*

Introduction:

Long short-term memory(LSTM) units on sequence-based models are being used in translation, question-answering systems, classification tasks due to their capability of learning long-term dependencies. Text generation models, an application of LSTM models are recently popular due to their impressive results. LSTM models applied to natural languages are great in learning grammatically stable syntaxes. But the downside is, the system has no basic idea of the context and it generates text given a set of input words irrespective of the use-case.

Method:

The proposed system trains the model to generate words given input words along with a context vector. Depending upon the use-case, the context vector is derived for a sentence or for a paragraph. A context vector could be a topic (from topic models) or the word having highest tf-idf weight in the sentence or a vector computed from word clusters. Thus, during the training phase, the same context vector is applied across the whole sentence for each window to predict successive words. Due to this structure, the model learns the relation between the context vector and the target word. During prediction, the user could provide keywords or topics to guide the system to generate words around a certain context.

Results & Discussions:

Apart from the syntactic structure in the current text-generation models, this proposed model will also provide semantic consistency. Based on the nature of computing context vectors, the model has been tried out with two variations (tf-idf and word clusters). The proposed system could be applied in question-answering systems to respond with a relevant topic. Also in Text-generation of stories with defined hints. The results should be evaluated manually on how semantically closer the text is generated given the context words.

Machine learning and legal causality: A proposal for the legal regulation of criminal liability in the case of accidents involving autonomous vehicles

Wednesday, 21st November @ 15:57: Ethics in AI (Auditorium) - Oral - Abstract ID: 126

Prof. luciano butti [1]

1. *University of Padua - Department of Engineering*

Thanks to machine learning, computers are given the ability to learn and improve their experience with data. To an often large extent, such computers can take autonomous decisions, which can, sometimes, cause harm to humans. This is precisely where machine learning becomes relevant to criminal law. If the decision causing harm was taken by an autonomous system, who is to blame? The software developer? The manufacturer of the device in which the computer is embedded? The robot itself? Or perhaps no-one is responsible? In most cases, civil compensation will be covered by insurers under a strict liability regime, but criminal liability remains an unsolved problem.

Driverless technology is a field where this problem will become very sensitive as soon as fully autonomous vehicles are on the road. Legislators and ethics scholars have not achieved consensus on the regulation to be created in order to address such a scenario. This paper presents a proposal for the legal regulation of criminal liability in cases of accidents involving fully autonomous vehicles. According to this proposal, criminal liability should rest on the shoulders of the legal representative of the software developer and/or of the car manufacturer, provided that: i) There is a casual link between some technological failure of the autonomous system and the accident, and ii) The accident occurred in the presence of at least one of the following conditions:

- Noncompliance with relevant guidelines for AI development;
- Unreasonable decision of the autonomous system, taking into account its level of information and experience;
- The driverless technology in question was marketed or kept in the market with no significant improvement in the overall safety (probabilistic aspect);
- There was violation of the non-discrimination rule.

By presenting a concrete proposal to solve the ethical and legal conundrum arising from autonomous driving, this paper makes a timely and relevant contribution which will help to effectively manage the introduction of this innovative technology in the market.

Size Matters: A Study on the Impact of Training Corpus Size when Enriching Word Embeddings with Taxonomic Information

Wednesday, 21st November @ 15:57: Natural language processing (Room 201) - Oral - Abstract ID: 299

Dr. Alfredo Maldonado [1] *, Mr. Filip Klubička* [2] *, Prof. John Kelleher* [2]

1. *ADAPT Centre at Trinity College Dublin,* **2.** *ADAPT Centre at Dublin Institute of Technology*

Raw-text word embeddings excel in detecting topically-related word pairs such as 'coffee' and 'cup' or 'movie' and 'critic' (Baroni 2014). However, they struggle on taxonomic similarity pairs like synonyms 'cup' and 'mug' or same-class members 'car' and 'train' (Hill et al. 2015). Performance on both tasks (topic and taxonomic) can be increased by enriching embeddings with taxonomic information, from resources like WordNet (Faruqui et al. 2015). Moreover, purely taxonomy-based embeddings (e.g. those trained on a random-walk of WordNet's structure) outperform enriched embeddings in taxonomic similarity but underperform them in topic relatedness (Goikoetxea et al. 2015, 2016). This work shows that both, the raw-corpus size and the random-walk coverage of the WordNet structure, play a crucial role in the performance of enriched vectors in both tasks. Although performance varies as a function of the training data size (both in terms of raw-corpus size and random-walk WordNet coverage), we show that if the performance of the raw-corpus embeddings is comparable to the performance of taxonomy-based embeddings on their own, then enriched vectors will outperform pure raw-text and pure taxonomic vectors on topical relatedness and will perform at least as well as pure taxonomic vectors on taxonomic similarity. Conversely, if the performance of the individual vectors (raw-text and taxonomic) is dissimilar, then the enriched vectors' performance will be approximately the average of the individual performance scores.

We train skip-gram embeddings on sentences randomly sampled from Wikipedia and combine them with WordNet information by concatenating them with skip-gram embeddings trained on a pseudo-corpus generated by a random-walk of WordNet. We evaluate the enriched embeddings as well as the Wikipedia and WordNet embeddings separately on topic relatedness (WS-353) and taxonomic similarity (SimLex-999) benchmarks. We repeat the experiment for different sample sizes of Wikipedia and random-walk WordNet pseudo-corpus in order to assess the effect of corpus size.

The implication of this is that it is possible to have vectors that perform well at both tasks, but care has to be taken in controlling the size of the raw corpus and the size of the pseudo-corpus (and thus the number of visited synsets) used to train vectors.
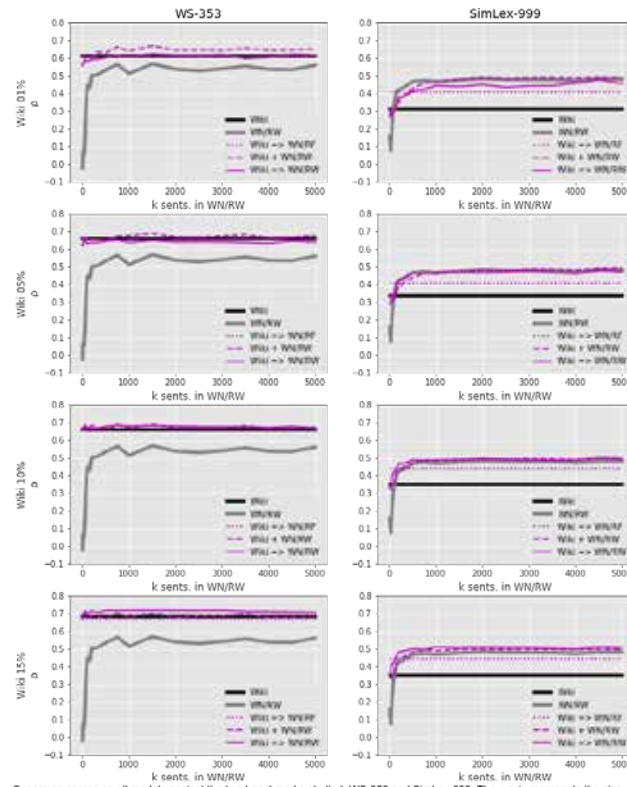
Spearman scores on all models against the two benchmarks studied: WS-353 and SimLex-999. The x axis represents the size of the generated WordNet random walk (WN/RW) pseudo-corpus in thousands of sentences. The models (lines in graphs) being evaluated are: 1) vectors trained on the base corpus only drawn as thick black lines, 2) vectors trained purely on the WN/RW pseudo-corpora only (thick grey lines), 3) the original WordNet retrofitting method <base> => WN/RF by Faruqui et al. (2015) (dotted thin magenta line), 4) fine-tuning training method <base> => WN/RW (solid thin magenta line) and 5) concatenation retrofitting method <base> + WN/RW (dashed thin magenta line). Notice that for vectors which do not depend on the size of the WN/RW pseudo-corpus a constant horizontal line is drawn. Notice as well that pure WN/RW results (thick grey line) do not depend on the Wikipedia sample size, so the WN/RW graphs on the top row are identical to their corresponding graphs on the bottom row.

Corpus size vs performance.png

Quality Assurance of AI Systems

Wednesday, 21st November @ 16:14: Ethics in AI (Auditorium) - Oral - Abstract ID: 250

Mr. Kishore Durg [1] ***, Mr. Mahesh Venkataraman*** [1] ***, Ms. Mallika Fernandes*** [1]

1. *Accenture*

Introduction

With increasing adoption of AI in software and cyber-physical systems, the system behavior is rapidly evolving from a rule driven response to intelligence driven response. Such a response is dynamic and data driven and is never deterministic thus rendering the conventional testing and monitoring paradigms ineffective. Moreover, since the system behavior is autonomous at run time, there are ethical, transparency, regulatory and compliance issues that need to be validated, monitored and assured before the system is deemed fit for production

In this presentation, we explain the business and technical challenges in developing, testing and continuously monitoring AI driven systems and our proposed solution

The Challenge

Conventional testing has been primarily focused on creating test cases based on requirements and executing them to detect bugs. These requirements are converted to 'Test Oracles' which in turn are used to detect incorrect behavior and report bugs. This process assumes that the system behavior is rule based and deterministic. For AI based systems, this testing approach is ineffective because the non-deterministic, dynamic, data driven response of AI based systems have the following implications:

- The system decision and response may have inherent bias (gender, race etc.), safety and fairness issues and may also potentially violate regulatory and compliance requirements.
- System response may be misaligned to business intent and may cause adverse business impact
- Diagnosis of an observed failure is not easy or straightforward

Proposed Solution

The solution consists of the following techniques and tools used in three different phases stringed together by a 'Teach and Test' framework

- Training data cleansing and de-biasing (pre-training)

  – Training data bias visualization and de-biasing

  – data preparation and cleansing

- Model validation and evaluation (post training)

  – Fairness evaluation

  – Model validation using metamorphic testing techniques

  – Adversarial data synthesizer to 'stress' test the model

  – Prediction sensitivity evaluation

- AI model transparency and interpretability (continuous monitoring in production)

  – Failure diagnosis using knowledge representation and reasoning techniques

  – re-training threshold analysis

Deployment examples

The presentation also covers the following case scenarios:

- Image recognition and visual reasoning
- Sentiment Analysis
- Autonomous Vehicles
- Fraud detection
- Suitability and eligibility decisioning
- Conversational & virtual agents

English–Spanish Multi–Domain Translation: Neural vs. Statistical Machine Translation

Wednesday, 21st November @ 16:14: Natural language processing (Room 201) - Oral - Abstract ID: 96

Dr. Benyamin Ahmadnia [1], Prof. Javier Serrano [1], Prof. Parisa Kordjamshidi [2]
*__**1.**__ Universitat Autónoma de Barcelona, **2.** Tulane University*

Data-driven Machine Translation (MT) systems are generally trained on specific domains by selecting the large training datasetsas well as applying proper domain adaptation techniques. In this paper, we explore that if the target domain is not predefined, the system should be able to translate text from multiple domains. We compare the performance of a Neural Machine Translation (NMT) system and a Statistical Machine Translation (SMT) system by training them on a parallel corpus consists of different domains texts. The results on English-Spanish

language pair demonstrate that the SMT outperforms the NMT counterpart.

INVITED TALK - Understanding Human Behavior Using AI – A Practical Example

Wednesday, 21st November @ 17:00: AI applications in industry and engineering (Auditorium) - Oral - Abstract ID: 321

Mr. Rob Käll [1]

1. Cien

Rob Käll is the Co-Founder and CEO of Cien, a startup at the intersection of technology sales and behavioral psychology. As a serial entrepreneur, Rob's presentation is a first-hand account on the ins and outs of building an artificial intelligence startup. He will dig deep into the challenges associated with measuring, modeling and predicting complex human behavior. Rob will also offer advice for entrepreneurs, researches and corporates leaders looking to tie AI technology to business value. For more information, visit www.cien.ai or follow @robertkall

Cien logo.png

Rob kall ceo cien.ai.png

INVITED TALK - Understanding Human Behavior Using AI – A Practical Example

Methodology for Subject Authentification and Identification through EEG signal: equipment's and positioning artifacts

Wednesday, 21st November @ 17:00: Bioinformatics & Biometric authentication (Room 201) - Oral - Abstract ID: 293

Mrs. Maria Luiza Recena Menezes [1], Dr. Anita Sant'anna [1], Dr. Fernando Alonso-Fernandez [1]

1. Halmstad University

The study of Subject Authentification and Identification through encephalography is especially interesting both to security systems and to neuroscience. It is one of the rare personal data that cannot be stolen or emulated. It also sheds light to the comprehension of the complex neurological functioning and structure. Some characteristics defy this method: difficulty in acquiring good signal in a non-controlled environment; complex processing of the signal not suitable for real-time systems; among others.

The research community has gone a long way trying to fix these matters. But the complexity of the EEG signal still remains unraveled even for researchers of the field. We need to make sure to separate and differentiate not only spikes and blinks, but also artifacts inherent of the equipment or the positioning of the electrodes. Also, to properly identify components that are inherent and permanent of each subject, we need to test the models over different emotional states, tasks and days.

We used from simple correlation models to random forests to identify subjects using the most common features used by the community. The tests involved two different datasets. One with 32 subjects over 40 different emotional states, while subjects were performing the same task (watching a musical video) along one day. The other dataset involves 8 subjects performing different mental tasks along two different days (arithmetic tests in one day and memory tests in another) and the same task (rest) in both days.

The results show for all methods extremely high accuracy for both datasets when using metrics close to the literature. But when we try to model the characteristics of a subject in one day only and use that model to identify the same subject in another day, the results are quite different, even for the same task.

Is possible that artifacts from each trial are so important that the results are misleading and this has been mostly unconsidered by the research community. To identify intrinsic characteristics of a subject and features that are unique and constant, the test data must be from a completely different trial than the data used to make the model.
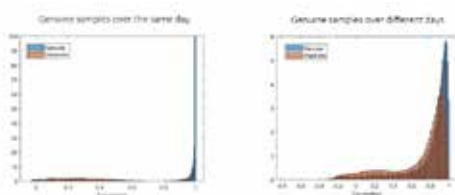
Genuinevsimposter oversameday diffdays.png

Averageaccuracies.png

[Time extension for the invited speaker]

Wednesday, 21st November @ 17:17: AI applications in industry and engineering (Auditorium) - Oral - Abstract ID: 325

Mr. Rob Käll [1]

1. Cien

This presentation has been created to extend the time allocated to MR. ROB KALL for his presentation "Understanding Human Behavior Using AI – A Practical Example"

Quokka: a comprehensive tool for rapid and accurate prediction of kinase family-specific phosphorylation sites in the human proteome

Wednesday, 21st November @ 17:17: Bioinformatics & Biometric authentication (Room 201) - Oral - Abstract ID: 121

Mr. Fuyi Li [1], Dr. Jiangning Song [1]

1. *Monash University*

Introduction: Kinase-regulated phosphorylation is a ubiquitous type of post-translational modification (PTM), which plays fundamental roles in many signalling pathways and biological processes. Experimental studies have revealed that signalling defects caused by aberrant phosphorylation are highly associated with a variety of human diseases, especially cancers. In light of this, a number of computational methods aiming to accurately predict protein kinase-specific phosphorylation sites have been established.

Methods and Results: In this work, we present Quokka, a novel bioinformatics tool that allows users to rapidly and accurately identify human kinase family-regulated phosphorylation sites. The 5-step overall framework of Quokka is shown in Figure 1. These steps include data collection and pre-processing, sequence scoring, model construction and optimization, performance comparison, and webserver construction. In the first step, the benchmark and independent tests datasets were collected from Phospho.ELM and UniProt database separately. In the second step, a variety of sequence scoring functions and their combinations were utilised to calculate scores for each protein, which were then used as the input features of the Logistic Regression (LR) model. An optimization algorithm (Figure 2) was performed in the third step, based on the benchmark datasets to train the optimal LR for each kinase family. These optimized LR models were subsequently used for five-fold cross-validation test. In the fourth step, the optimized LR models were validated using the independent test datasets and the performance comparison with other existing methods was conducted. The results (Figure 3) demonstrate Quokka models' competitiveness by outperforming existing tools. Using the optimized LR models, we further performed human proteome-wide prediction of phosphorylation sites and gene ontology enrichment analysis (Figure 4). The Quokka server was constructed in the final step, to facilitate public high-throughput prediction of phosphorylation sites.

Discussion: The improved performance of Quokka can be attributed to three major factors: 1) Extraction of the most-recent experimental datasets that provide up-to-date knowledge on kinase-specific phosphorylation; 2) Inclusion of a variety of sequence-scoring functions for calculating scores for each phosphorylation site; 3) Use of an optimization algorithm to build the optimized logistic regression models which showed robust predictive power for each kinase family.

Figure 1.png

Algorithm 1 Optimization procedure of the Logistic Regression models

Input:
  Training feature set, T;
Output:
  Optimal Logistic Regression model, *optimisedLR*.

1: $initialLR = trainLR(T)$;
2: $initialSummary = summary(initialLR)$;
3: $T' = T$;
4: $initialAUC = getAUC(initialLR)$;
5: **for each** $i \in [1, n]$ **do**
6:   $Pvalues[i] = getCoefficientsPvalues(initialSummary, i)$;
7:   **if** $Pvalues[i] > 0.05$
8:     $T' = removeFeature(i, T')$;
9:   **end if**;
10: **end for**;
11: $reducedLR = trainLR(T')$;
12: $reducedAUC = getAUC(reducedLR)$;
13: $chiSquareValue = chisqTest(initialLR, reducedLR)$;
14: **if** $(reducedAUC \geq initialAUC)$ && $(chiSquareValue > 0.05)$
15:   $optimisedLR = reducedLR$;
16: **end if**;
17: **else**
18:   $optimisedLR = initialLR$;
19: **end else**;
20: **return** *optimisedLR*;

Figure 2.png

Figure 3.png

Figure 4.png

INVITED TALK - Invited speech title _TBD

Wednesday, 21st November @ 17:34: AI applications in industry and engineering (Auditorium) - Oral - Abstract ID: 320

Mr. Angel Esteban Soto [1]

1. RESTB.AI

TBD

An SVM-based evaluation method of tracheal-intubation skill level before and after medical experience of one month

Wednesday, 21st November @ 17:34: Bioinformatics & Biometric authentication (Room 201) - Oral - Abstract ID: 78

Mr. Shinichi Inagaki [1], Dr. Ryota Sakamoto [2], Prof. Yoshihiko Nomura [1], Prof. Masataka Kamei [2], Dr. Yosuke Sakakura [2], Prof. Motomu Shimaoka [1]

1. Mie University, 2. Mie University Hospital

In medical treatment, tracheal intubation operation is one of the important skills necessary for doctors. Tracheal intubation is an airway securing process for general anesthesia, etc. However, the objective assessment criteria are not established for the tracheal intubation skill. There is a direct evaluation method of measuring contact pressures on oral cavity skin-surface. Yet, the method couldn't apply to an actual patient, and requires a patient mannequin in which pressure sensors are to be embedded. Otherwise, sensor-embedded tracheas can be developed. Still, it also raises up another problem of not using ready-made tracheas that are desired on hygienic grounds. Task completion time is a commonly used index for evaluating skills. It shows a comprehensive evaluation, but is not suitable for education. Because the total time does not include information on which moments should be improved. Therefore, we have aimed at establishing a discrimination method of tracheal intubation skill level based on a series of doctor's motion data. Using Perception Neuron motion capturing system, we obtained motion data of the tracheal intubation procedure for a patient mannequin, and discriminated the motion data into experts and novices using an SVM classifier. Considering measurement accuracies of physical properties with the capturing system, we employed the position, velocity, acceleration, and angular velocity as feature vectors for the SVM. First, we constructed an SVM by using two training data sets: one set is comprised of motion data by 13 expert doctors and the other by 13 novice ones. Next, we applied the trained SVM to two test data sets of 5 novice doctors other than those employed in the training, and obtained the two outputs by the trained SVM: one data set was the motion data of the novice doctors with no tracheal intubation experience, and the other data set was those of the identical novice doctors after several times of tracheal intubation experiences during one-month. Then, we decided each of the skill-levels before and after the tracheal intubation experiences based on the outputs. Finally, we confirmed the effectiveness of the proposed skill-level discrimination method by verifying an improvement of the skill-level.

Fig. 1 Left: Tracheal intubation to a mannequin; Right: Visualization of captured motion.

Motion capture device.png
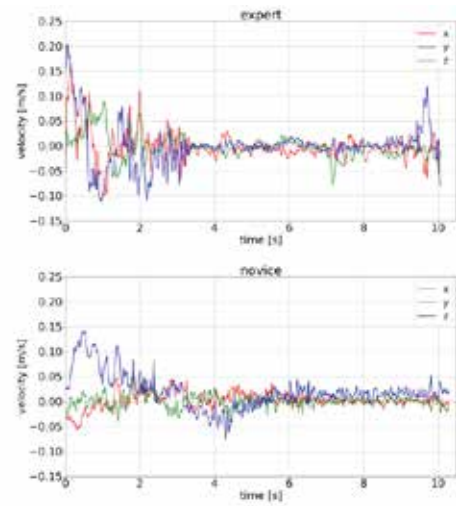
Fig. 2 Velocity profiles of the left wrist in tracheal intubation procedure of an expert and a novice.

Velocity profiles of left wrist in tracheal intubation procedure of an expert and a novice.png

A human vision on the AI learning process

Wednesday, 21st November @ 17:51: AI applications in industry and engineering (Auditorium) - Oral - Abstract ID: 326

Mr. Angel Esteban Soto [1]

1. RESTB.AI

Every day tons of data are analyzed by algorithms that sometimes, become experts on some tasks. Learning from pictures, text, financial data, or others, thanks to the advances in computational power and speed, we are executing thousands and millions of learning and inference processes per second today.

The explosion of AI in the industry is so real. We are starting to see that these algorithms are sometimes, performing better than humans in a lot of tasks. It's a new paradigm in the industry.

In our human brain, we have an approximate value of 100 billion neurons each one connected to 10.000 other neurons, giving a total of 1 quadrillion connections for a three-year-old kid. How is the learning process of this kid, compared to the algorithms that we are training every day? Are these algorithms really learning as we are?

In this talk I want to give a human vision over the AI learning process of the different training methods and how machines and humans make decisions based on the experience (knowledge) once are trained (growing from a kid to an adult, or from random weights to an expert deep neural network).

Fuzzy & Annotated Semantic Web Languages

Thursday, 22nd November @ 09:00: Plenary Speech (Auditorium) - Oral - Abstract ID: 2

__Prof. Umberto Straccia__ [1]

__1.__ ISTI - CNR

The aim of this talk is to present the state of the art in representing, reasoning and querying fuzzy knowledge in Semantic Web Languages such as triple languages RDF/RDFS, conceptual languages of the OWL 2 family and rule languages.

We further show how one may generalise them to so-called annotation domains, that cover also e.g. temporal and provenance extensions.

Plenary speech title _TBD

Thursday, 22nd November @ 09:40: Plenary Speech (Auditorium) - Oral - Abstract ID: 316

Dr. Lluís Màrquez [1]

1. *Amazon Research, Spain*

TBD

Importance of field-specific knowledge in machine learning applications in biology

Thursday, 22nd November @ 10:45: Plenary Speech (Auditorium) - Oral - Abstract ID: 314

Dr. Jean Fred Fontaine [1]

1. *Johannes Gutenberg University Mainz*

Advances in biotechnologies and computer science technologies, have transformed molecular biology into a data driven science. The sequencing and proteomics technologies are used to produce the biggest datasets in biology. Although the human genome project took 13 years to be completed, nowadays genomes can be sequenced in a few hours. Availability of many genomes from different species, cells or experimental conditions enable scientists to address new problems and to solve unanswered questions. The sequencing technology is also used to derive other types of data such as gene expression or protein-DNA interactions. Talented data scientists, statisticians and computer scientists are therefore critical to develop state-of-the-art machine learning methods able to cope with the amount and heterogeneity of the data. Nevertheless, the importance of field-specific knowledge should not be under-estimated, as taking it into account can produce better performing solutions.

Plenary speech title _TBD

Thursday, 22nd November @ 11:25: Plenary Speech (Auditorium) - Oral - Abstract ID: 315

Dr. Mariarosaria Taddeo [1]

1. *University of Oxford*

TBD

Effects of Dataset composition on the training of Generative Adversarial Networks

Thursday, 22nd November @ 13:30: Poster Session & Exhibition (Gallery) - Poster - Abstract ID: 179

Mr. Ilya Kamenshchikov [1], *Prof. Matthias Krauledat* [1]

1. *Hochschule Rhein Waal*

Generative Adversarial Networks are a new family of generative models, frequently used for generating photo-realistic images. The theory promises for the GAN to eventually reach an equilibrium where generator produces pictures indistinguishable from the training set. In practice, however, a range of problems frequently prevents the system from reaching this equilibrium, where the training shows no further progress due to instabilities or mode collapse. This paper describes a series of experiments to identify patterns in the effect of the features of the training set on the dynamics and eventual outcome of the training.

We set up experiments to let the Generative Adversarial Networks create images based on different benchmarking datasets, and analyze how complexity of the dataset affects the behavior and convergence properties of the model. The results are interpreted and rated according to the following criteria: visual quality, diversity and control over the kind of image produced. We show limitations of generators with simplistic structures in failing to mimic more complex data. Concludingly, we analyze typical failure modes in detail and suggest remedies.
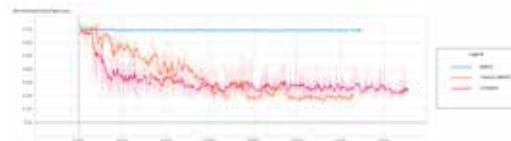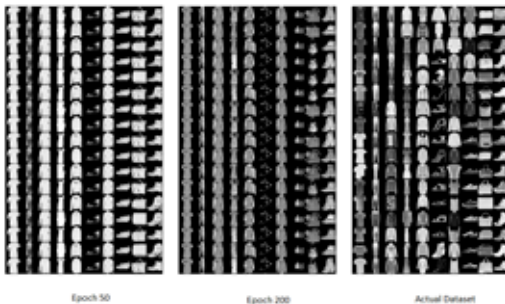
Cifar.png

Discriminator loss.png

Fashion mnist.png

Zoom in.png

Cancer Risk and Type Prediction Based on Copy Number Variations with LSTM and Deep Belief Networks

Thursday, 22nd November @ 13:30: Poster Session & Exhibition (Gallery) - Poster - Abstract ID: 232

Mr. Md. Rezaul Karim [1] *, Mr. Md Ashiqur Rahman* [2] *, Prof. Stefan Decker* [1] *, Dr. Oya Beyan* [1]

1. *Fraunhofer FIT,* **2.** *RWTH Aachen University*

Introduction: Cancer is caused by abnormal behaviors of genes that control cell division and growth. Copy Number Variations(CNVs) have been associated with the risk toward individual cancers. Thus, CNVs can help to reveal the genetic predisposition toward cancer before it grows. In this paper, we design and implement two prediction algorithms using CNVs that predicts: i) the existence of cancer, ii) types of cancer for the diagnosed patients.

Methods: First, we collect the genomics data of 15,699 samples (7,895 tumors and 7,804 healthy) about 14 cancer types from The Cancer Genome Atlas(TCGA). Then we identify CNVs by simultaneous analysis of samples including genomic deletions and duplications across individuals. We then train Long Short-term Memory(LSTM) and Deep Belief Networks(DBN) using two different representations of CNVs: based on oncogenes (578 genes) and all human genes (20,308 genes). Finally, we pre-train the DBN in an unsupervised way and fine-tune both feed-forward and LSTM networks in a supervised way.

Results: With LSTM and DBN networks, we achieved state-of-the-art results with an accuracy of 74.12% and 72.83%, respectively, for the cancer type prediction based on oncogenes. Using all genes, slightly lower accuracies of 72.48% and 70.50% were achieved using LSTM and DBN, respectively. For the cancer risk prediction task, DBN shows an accuracy of 91.83% (with an AUC of 0.912 and Matthews Correlation Coefficient-MCC of 0.843) and 92.02% (with an AUC of 0.918 and MCC of 0.852) using oncogenes and all genes, respectively. LSTM network, oppositely, shows an accuracy of 93.10% (with an AUC of 0.928 and MCC of 0.861) and 92.54% (with an AUC of 0.915 and MCC of 0.854) using oncogenes and all genes, respectively.

Discussion: Albeit, prediction accuracies were fairly higher across different cancer types but a few (e.g. Thyroid carcinoma, Stomach adenocarcinoma, and Prostate adenocarcinoma) exhibited high-correlations. The study also suggests that constitutional CNVs are useful for predicting cancer types and their association with cancer growth. However, it is not yet clear whether certain CNVs are associated with specific cancer types. In future, we intend to apply robust CNV extraction techniques (e.g. MSeq-CNV) and train the models with tuned hyper-parameters.

Figure cnv selection from oncogenes and all genes.png

Figure confusion matrix for cancer type prediction using all genes with lstm dbn.png
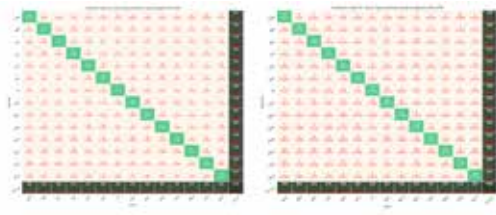
Figure confusion matrix for cancer type
prediction using onco genes with lstm dbn.png
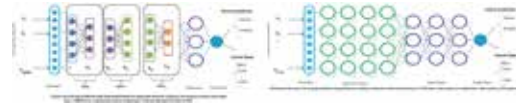
Figure lstm dbn architectures for cancer risk and
type prediction based on all genes.png

CNN based Multi-floor Navigation System applied in real-time SLAM

Thursday, 22nd November @ 13:30: Poster Session & Exhibition (Gallery) - Poster - Abstract ID: 52

Mr. LEE UNGHEE [1] _, **Ms. Li Ling** [1], **Prof. Tae Yong Kuk** [1], **Prof. Jong Ku Park** [1]_

1. _SungKyunKwan University_

With the recent development of robotics, robots are applied in various fields. Nowadays the environment where we live and work is almost multistory buildings, so it becomes important that the robot can freely navigate in such space. Therefore, how the robot can navigate in multistory environment by using elevator becomes a hot issue in robotics.

Conventional algorithms of robot multi-floor navigation include moving to other floor by stairs directly or by elevator with remote control. However, these methods are limited in application: the method of moving by stairs is not efficient, and the method by elevator needs to install other systems in elevator. Therefore, in this paper, we propose a mobile robot system that robot can navigate to other floors autonomously by manipulating the elevator directly in multi-story building.

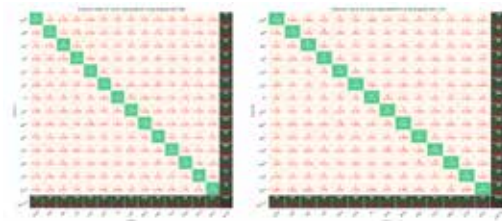Our proposed system is based on real-time SLAM (Simultaneous Localization And Mapping) using an RGB-D camera. The mobile robot estimates the position by using ORB (Oriented FAST and Rotated BRIEF), ICP (Iterative Closest Point), and BA (Bundle Adjustment) on the data obtained from the RGB-D camera, and simultaneously creates two-dimensional and three-dimensional maps. The two-dimensional map describes the movable area of the mobile robot in the form of a grid map, and the three-dimensional map represents the interior of the building in the form of a point cloud.

Moreover, the mobile robot learns and recognizes the components of the elevator through the CNN algorithm before taking elevator, and registers the positions of components, which are recognized by RGB-D camera, on the two-dimensional and three-dimensional map. Then, registered elevator components are used in pressing elevator button and robot autonomous navigation in multi-story buildings.

We experiment by using a 2-wheel mobile robot and a 4-bar linkage Manipulator, which is used to manipulate elevator components (especially buttons), to verify the algorithm presented above. Our mobile robot system can be applied to any multi-story building with an elevator.

TBD

Thursday, 22nd November @ 14:15: Deep Learning meets Computer Vision (Auditorium) - Oral - Abstract ID: 331

Prof. Dimosthenis Karatzas [1]

1. *Computer Vision Center and Universitat Autonoma de Barcelona*

TBD

Adaptive Backstepping Dynamic Control based Visual Servo for Robot Arm

Thursday, 22nd November @ 13:30: Poster Session & Exhibition (Gallery) - Poster - Abstract ID: 55

*__Mr. Ji Min Lim__ [1], **Mr. Sang Hyun Bae** [1], **Prof. Tae Yong Kuk** [1], **Prof. Jong Ku Park** [1]*

1. *SungKyunKwan University*

Smart factory means complete automation and unmanned production facility. Therefore, this factory automation is required to use sensors that can make current situation into data, control technology to correct errors, and precision control technology for work efficiency.

In the case of the existing factory automation, a method of receiving the encoder value of the conveyor belt and calculating the work object on the conveyor belt is proposed. This method not only causes the inaccuracy of time calculations, but also has no solution for exceptional situations. In addition, when the workpieces are put on the conveyor belt, the time gap between the workpieces on the conveyor belt must be equal and so as the positional gap between the workpieces.

In order to overcome these issues, it is necessary to attach a visual sensor to the robot arm to detect and track the workpiece directly, and a controller is required to precisely control the robot arm. In this paper, we propose a visual servoing based on backstepping dynamics controller to control the robot arm precisely. In addition, CNN (convolutional neural network) can be used to distinguish the objects.

In the dynamics controller, the target torque is generated by using the regression matrix, the estimated value, and the error value based on the dynamic equation of the manipulator. We can know the position of the current manipulator from the encoder, then calculate the error, and it will be the feedback of the dynamics controller. We can transform the position of the object in the image plane into the position of the object in the robot coordinate system through the image jacobian and calculate the position where each joint should move through the inverse kinematics. When the position of the object changes in the image plane, the error made by the target position on the image plane is calculated then used as the feedback of the control law. As a result, it has a dual loop structure with a dynamics controller and a vision system controller. CNN is used to identify and distinguish objects.

A Probabilistic Multiclass Support Vector Machines with Error Correcting Output Codes Applied to Speaker Recognition.

Thursday, 22nd November @ 13:30: Poster Session & Exhibition (Gallery) - Poster - Abstract ID: 89

**Dr. Mounia Hendel** [1] , **Prof. Fatiha Hendel** [2]

1. _Higher School of Electrical Engineering and Energetic (ESG2E) of Oran.,_ **2.** _University of Science and Technology Mouhamed Boudiaf (USTO-mb) of Oran._

Currently, a large number of scientific fields employ the automatic classification in order to categorize their data into homogeneous classes for decision-making purpose. So, for an appropriate decision making, it is necessary to choose a powerful discrimination approach which minimizes as much as possible the error risk. Thus, it is necessary that the classifier be able to interpret these outputs in terms of posterior probabilities, so that the obtained classification results can be statistically interpreted. In this study we select to implement a Multi-class Support Vector Machines (MSVM) based on Error-Correcting Output Codes (ECOC) due to their ability: to engender high generalization accuracies, to avoid the over-learning and the curse of dimensionality.

Nevertheless, the standard SVM principe does not allow them to estimate posterior probabilities. To overcome this problem, we purpose a new metric to process the outputs of an MSVM based on ECOC approach, in terms of probability measures. The obtained discriminator is used for automatic text independent speaker recognition. The voice signals are very complex in nature: random, contaminated with artifacts, and non-linear; which accentuates the complexity of the study of such signals. Therefore, the performances of the speaker recognition system are not related only to the classification method, but also are linked to the technique used for features extraction.

In this context, we propose a new hybrid features extraction scheme based on Mel-Frequency Cepstrum Coefficients (MFCC) and self organizing maps (SOM). The vocals signals are first subdivided into segments, then, MFCC method is applied to characterize each segment, finally, an unsupervised learning using SOM is done to cluster segments and model each speaker. The obtained descriptors are presented as inputs to the classifier.

It is reported from the study that the proposed classification and parameter extraction systems, may be excellent models to improve the recognition decision of speaker identification, with an average accuracies that exceed 98%. We also note that the obtained results are provided with a calibrated measure of reliability, in fact, a speaker is considered correctly identified, if the probability of its associated class is higher than 0.75, otherwise the decision is rejected.

Simulation of the propagation of zero-day malware using cellular automata on graphs

Thursday, 22nd November @ 13:30: Poster Session & Exhibition (Gallery) - Poster - Abstract ID: 183

Dr. Angel Martin del Rey [1], Dr. Gerardo Rodriguez Sanchez [1], Dr. Araceli Queiruga Dios [1], Dr. Ascension Hernandez Encinas [1], Dr. Jesus Martin Vaquero [1]

1. *Universidad de Salamanca*

Introduction: Zero-day malware is one of the basic tools used by Advanced Persistent Threats (APTs). The fight against it is mainly based on the design of machine learning techniques and protocols to successfully detect it. Nevertheless, it is also important to simulate in an efficient way its propagation. This is the main goal of this work: to introduce de basis of a novel model based on Cellular Automata on Graphs (CAG) to simulate zero-day spreading.

Methods: The model presented in this work is based on a particular type of finite state machine called cellular automata on graphs; they can be also considered as a simple kind of multiagent systems. The environment considered is a critical infrastructure network where the different devices stand for the cells of the CAG. The neighborhood of each cell/node is defined by the different types of communications that can be stablished between them. Such network topology evolves with time and the dynamics is governed by the local transition rules of the CAG that include centrality measures.

Results: From the computational implementation of the theoretical model, several simulations are obtained where different behaviors of the dynamics of the model (endemic and disease-free steady states) are presented. Moreover, some efficient control measures are derived. Finally, a detailed analysis of the role of the different nodes is done using some complex network analysis techniques.

Discussion: This is a novel computational model to simulate zero-day malware spreading. It is an individual-based model based on cellular automata that implements a compartmental SI (susceptible-infected) epidemiological model. The model is one of the most realistic ones since they capture the temporal evolution of the topology connections and the individual characteristics of the devices from both, the epidemiological and the network structure points of view.

TBD

Thursday, 22nd November @ 14:47: Deep Learning meets Computer Vision (Auditorium) - Oral - Abstract ID: 332

Prof. Xavier Giró-i-nieto [1]

1. Universitat Politecnica de Catalunya (UPC)

TBD

Sentiment Analysis of Developer Comments: Exploring Influencing Factors on Emotional Expressiveness in Software Engineering Projects

Thursday, 22nd November @ 13:30: Poster Session & Exhibition (Gallery) - Poster - Abstract ID: 330

Mrs. Lisa Branz [1], *Mrs. Ligia Pastran Reina* [1], *Mr. Julian Richter* [1], *Mr. Bastian Waizmann* [1], *Ms. Patricia Brockmann* [1]

1. *Technische Hochschule Nuremberg*

Sentiment Analysis of large amounts of text data opens up entirely new possibilities for exploring the dynamics of team members interacting and working on software engineering projects. In this research a dataset containing around 1.6 million developer comments on the issue tracking system JIRA related to four popular open source systems was analyzed in regards to gender ratio of commenters, day of the week and emotional content of comments. The Gender API tool was used to determine a commenter's gender based on their first name. Using the WEKA AffectiveTweets package Sentiment Analysis of the comment content was performed based on several sentiment lexicons. In a first step, IBM's SPSS Statistics was then used to statistically explore a possible connection between a commenter's gender and emotion displayed in comments using an independent samples t-test. Female commenters were found to display more overall sentiment in comments across a number of emotion categories. Further, a possible connection between sentiment and day of the week was explored. A One-Way ANOVA and Tukey post-hoc analysis revealed that expression of emotion differed significantly between days of the week across a number of emotion categories. However, some gender differences were found in regards to emotional expression on different week days. In a second step, machine learning algorithms will be applied in WEKA in order to find out whether a commenter's gender can be classified based on their emotional expressiveness. Another aim of this research is to find clusters in emotion categories in order to assess whether there are different types of users showing different types and levels of emotional expression. The results could help shed some light on how emotional expression of team members in software development teams could influence a team's success and efficiency as well as team member's satisfaction.

TreeWalk: a novel Open Information Extraction system for Italian language

Thursday, 22nd November @ 13:30: Poster Session & Exhibition (Gallery) - Poster - Abstract ID: 271

Dr. Martina Manfrin [1], Dr. Filippo Mela [1], Dr. Martin Cimmino [1], Dr. Marco Siciliano [1], Dr. Francesco Paolo Albano [1], Dr. Dimos Kapetis [1]

1. *Accenture*

Open Information Extraction (OIE) is one of the most active research areas in artificial intelligence which enable computers read and comprehend unstructured textual data. OIE goal is to extract a large set of verb-based triples (or propositions) from unstructured text. An OIE system reads in sentences and rapidly extracts one or more textual assertions, consisting in a verb relation and two arguments (Arg1, Rel, Arg2) which try to capture the main relationships in each sentence. Relation triples produced by IE systems are useful for question answering, inference, and other IE tasks. Nevertheless, implementation of such a system requires language-specific information. So far, all relevant work has been done for English. In this paper, we present TreeWalk, a relation extraction algorithm for Open IE in Italian. TreeWalk is a pattern-based framework for predicate-argument extraction. It employs a set of morphosyntactic rules defined over Universal Dependency (UD) parses to extract predicate-argument dependencies. In doing so, TreeWalk employs a recursive-based approach to parse the dependency tree, where a special dependency is built between the head token of a predicate and the head tokens of its arguments, while the original UD relations are preserved within predicate and argument phrases. We evaluated the algorithm by using a 2x2 confusion matrix for error classification and doing manual tests over 200 samples showed an accuracy of 74% of relation extraction. We demonstrated that our method is able to discover for predicate-argument with high precision for Italian language. In future work, we will extend our methodology and the verify the validity of this methodology by testing in other languages.

Deep learning approaches for medical image analysis

Thursday, 22nd November @ 15:19: Deep Learning meets Computer Vision (Auditorium) - Oral - Abstract ID: 333

Prof. Karim Lekadir [1]

1. *Universitat Pompeu Fabra*

TBD

Uncertainty-aware Food Analysis by Deep Learning

Thursday, 22nd November @ 15:51: Deep Learning meets Computer Vision (Auditorium) - Oral - Abstract ID: 334

__Prof. Petia Radeva__ [1] *, Mr. Eduardo Aguilar* [2] *, Mr. Marc Bolaños* [2]

__1.__ University of Barcelona, __2.__ Universitat de Barcelona

Recently, computer vision approaches specially assisted by deep learning techniques have shown unexpected advancements that practically solve problems that never have been imagined to be automatized like face recognition or automated driving. However, food image recognition has received a little effort in the Computer Vision community. In this project, we review the field of food image analysis and focus on two research lines: uncertainty-aware multi-task food recognition and cross-modal retrieval. After discussing our methodology to advance in this direction, we comment potential research, social and economic impact of the research on food image analysis.

Some Cross-disciplinary Studies on Reinforcement Learning

Thursday, 22nd November @ 17:00: Robotics (Auditorium) - Oral - Abstract ID: 322

**Dr. Bojun Huang** [1]

1. _Ascent Robotics inc._

TBD

Some Cross-disciplinary Studies on Reinforcement Learning

Vision-based inspection system employing computer vision & neural networks for detection of fractures in manufactured components

Thursday, 22nd November @ 17:00: Neural networks and deep learning (Room 201) - Oral - Abstract ID: 215

__Mr. Sarthak Shetty__ [1]

__1.__ R.V. College of Engineering, Bengaluru

Abstract

We are proceeding towards complete automation of our manufacturing lines. Effective quality-control systems have to be put in place to maintain the quality of manufactured components. We present a computer-vision based quality-control system, that detects the presence of defects, and predicts the presence of surface fractures on a given component. We use OpenCV, a computer-vision framework, and TensorFlow, a machine-learning framework, to accomplish the tasks of detection and prediction of presence of surface defects.

Method

As mentioned earlier, the VBI system that we have developed (Pipeline_Overview) is based on two parts: a) A computer-vision system that subjects the image of the component through convolution filters which highlight fractures. b) An Inception V3 TensorFlow prediction model. The final layers of this model are retrained on a dataset of two categories: normal & fractured gears.

In this paper, a filter bank of 4 convolution-filters are used: Sobel X, Sobel Y, Laplacian & Sharpen. These filters are applied on a gray-scale version of the image. Through simple convolution operations with the grayscale image, the filters generate an output image in which the fractures are highlighted (Convolution_Results_Table). The original image is then passed to the prediction model, which presents a probabilistic prediction of a fracture being present.

Results

The computer-vision highlights the edges and fractures on the surface of the component as shown in Convolution_Results_Table.
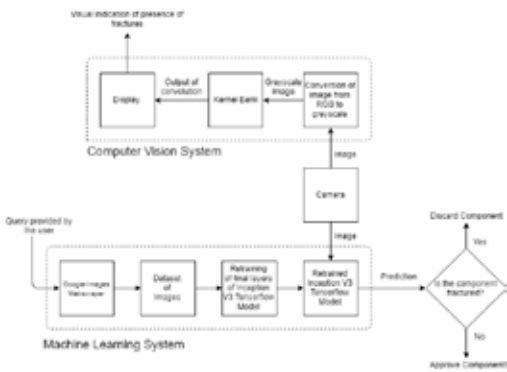
In most the cases the model correctly predicts the label of the component, as shown below in the table (Prediction_Results_Table). In some cases a label may be wrongly assigned to the given component (Result 2 in Prediction_Results_Table). This feature of the system has been highlighted in the table as well.

Discussion

As seen in the second result of Prediction_Results_Table, the model can incorrectly label a given component. This is due to the size of our dataset used to retrain the model. In order to improve the predictions, we have to not only increase the size of the dataset, but also introduce greater variety of samples.

In order to further improve the detection of fractures by the computer-vision subsystem, we can incorporate a wider array of edge-detecting filters.

Serial No.	Images obtained after convolution	
	Kernel Applied	*Result of convolution*
1.	Sharpen	Filter: Sharpen Mode: Gray
2.	Sobel X	Filter: Sobel X Mode: Gray
3.	Sobel Y	Filter: Sobel Y Mode: Gray
4.	Laplacian	Filter: Laplacian Mode: Gray

Convolution results table.png

Pipeline overview.png

Serial No.	Prediction obtained from VBI	
	Input Image	*Predictions*
1.	Original Image	[INFO]The results of the retrained model are as follows: [INFO]Probability that the given image is a normal gear is: 0.91759664 [INFO]Probability that the given image is a broken gear is: 0.08240334 [INFO]The given component is a: normal gear
2.	Original Image	[INFO]The results of the retrained model are as follows: [INFO]Probability that the given image is a broken gear is: 0.86653554 [INFO]Probability that the given image is a normal gear is: 0.1334645 [INFO]The given component is a: broken gear
3.	Original Image	[INFO]The results of the retrained model are as follows: [INFO]Probability that the given image is a broken gear is: 0.969334 [INFO]Probability that the given image is a normal gear is: 0.030661962 [INFO]The given component is a: broken gear
4.	Original Image	[INFO]The results of the retrained model are as follows: [INFO]Probability that the given image is a broken gear is: 0.83579001 [INFO]Probability that the given image is a normal gear is: 0.16420001 [INFO]The given component is a: broken gear

Prediction results table.png

[Time extension for the invited speaker]

Thursday, 22nd November @ 17:17: Robotics (Auditorium) - Oral - Abstract ID: 327

Dr. Bojun Huang [1]

1. Ascent Robotics inc.

This presentation has been created to extend the time allocated to DR. BOJUN HUANG for his presentation "TBD"

A leap into stakeholder perceptions: artificial neural network to build a long-term strategy for rural development

Thursday, 22nd November @ 17:17: Neural networks and deep learning (Room 201) - Oral - Abstract ID: 213

Dr. Maurizio Prosperi [1], **_Dr. Antonio Lopolito_** [1]

1. _University of Foggia_

1. Introduction to the topic

We illustrate an application of artificial neural network (ANN) to support bottom-up decision making process, by a direct involvement of stakeholders in the development of biorefinery industry in rural areas. In practice, it is a multidisciplinary application of ANNs to economics, where the SWOT-Sor tool, which is traditionally used to formulate long-term strategies, is integrated with an ANN to simulate the role of some relevant drivers.

In particular, we adopted a semi-qualitative method called SWOT-SOr, that is the combination of the Strength, Weakness, Opportunity and Threat matrix,with the Strategic Orientation analysis, which is suitable to promoting the interactive dialogue among different stakeholders. This methodology was developed in Philips company, with the help of Igor Ansoff and the French consulting firm Societé Euréquip as an approach to strategy development.

The data collected at this stage, have been analyzed through a specific type of multilayer artificial network (White et al., 1992), which is capable to disentangle the complex perception of different groups of stakeholders and opinion makers towards the possible development scenario of biorefinery schemes in the province of Foggia (Southern of Italy).

The application of neural network models is still a novel field in the domain of bottom-up policy making. There is a great potential, as participatory approaches are considered very important especially to promote innovative projects and to raise the social acceptance from local communities. However, the representation of the knowledge is in most of cases of qualitative nature, which is hard to use to perform analysis, comparison, and simulations. This type of analysis may support the public intervention aimed at the promotion of innovative projects in rural areas.

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A ROS-based Autonomous Tour Guide Robot with a NAO T14 Humanoid on a Mobile Platform

Thursday, 22nd November @ 17:34: Robotics (Auditorium) - Oral - Abstract ID: 47

Dr. Liya Grace Ni [1]_, Mr. Michael Sandy_ [2]_, Mr. Stephen Yoder_ [3]_, Mr. Janvier Uwase_ [4]_, Mr. Jesus Martin_ [5]

1. _California Baptist University,_ **2.** _the Boeing Company,_ **3.** _The Raytheon Company,_ **4.** _California Department of Transportation,_
5. _Ansaldo STS_

An autonomous tour guide robot is developed to provide tours in the new college of engineering building at California Baptist University. The main goals are to enhance student learning experience through building the robotic tour guide system, as well as to showcase the state of art technologies to the public, especially to inspire younger generation in pursuing STEM career.

The torso-only T14 model of the humanoid robot NAO was integrated with a wheeled mobile platform so that the built-in functionalities of NAO, such as speech and gesture, voice recognition, facial recognition, etc. can be utilized for tour guide service. The autonomous navigation was implemented based on the Robot Operating System (ROS) using open source code for the Simultaneous Localization And Mapping (SLAM) algorithm. The hardware of the system consists of a Raspberry Pi 3 and an ARM Cortex OpenCR board, an IMU sensor and two LIDAR sensors, two DC motors with optical encoders, and a linear actuator for height adjustment.

The development of this system has involved several undergraduate capstone design projects and has gone through several iterations. Various options were explored including vision-based room recognition, RFID-based localization, obstacle avoidance with sonar array measurement, etc. Additional features were developed including telepresence with live video streaming for virtual tours, wireless communication between the mobile base and the NAO robot, database for classroom/laboratory description entry, etc.

Although this work has been focused more on development rather than research so far, it provides a platform for undergraduate students majored in Electrical and Computer Engineering and Mechanical Engineering to apply their knowledge and skills to the design and implementation of a robotic system. Our future work will be devoted towards the improvement of human-robot interaction in the context of tour guide service. We plan to integrate artificial intelligence and machine learning technologies in order to make this system a "smart" tour guide robot. From the educational point of view, we will leverage the new graduate programs in Electrical and Computer Engineering and Software Engineering, and continue to engage undergraduate students in further development.

Robot picture.jpg
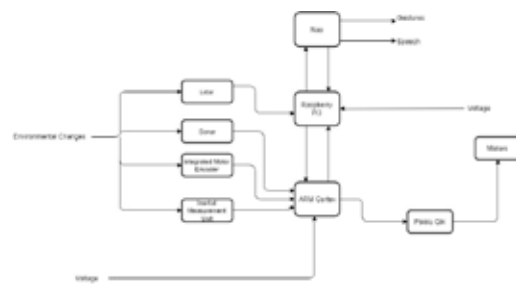
Electrical flow chart.png
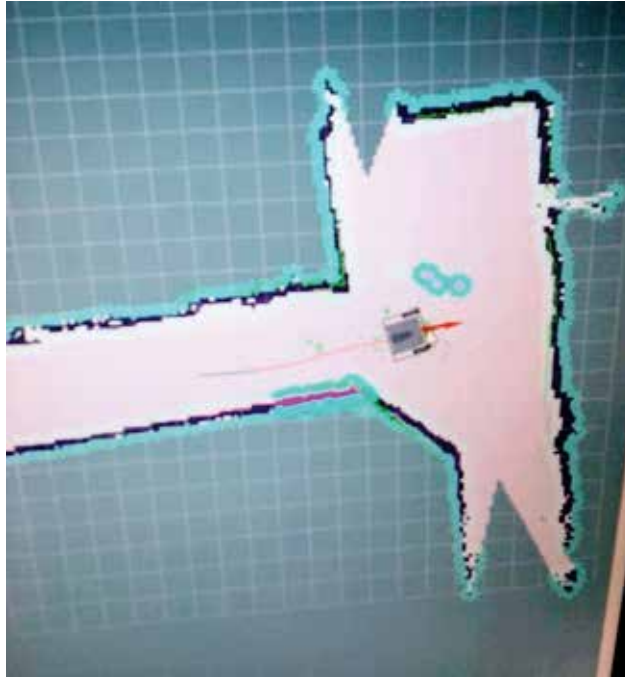
Navigation map.png

High Representation based GAN defense for adversarial attack

Mr. Richard Evan Sutanto [1], **_Prof. Suk Ho Lee_** [1]

1. *Dongseo University*

Recently, adversarial examples have become one of the most concern problems in neural networks. If adversarial examples are used as tools for attacking the neural network systems, they can lead the system to serious mis-functions. For example, adversarial examples can be used to fool the image recognition system by adding adversarial noise to a normal image. There have been some researches that try to remove the adversarial noise from the image by utilizing the GAN (generative adversarial network) as a defense tool. These methods try to remove the adversarial noise by approximating the noisy data by the image generated by the generator network. However, the approximation is done by producing an image which is close to the clean image only in the low feature level. This approach can be effective to remove normal noise. However, adversarial noise is different from normal noise, and can survive the approximation process. Therefore, we propose a method which utilizes also the high level representation in the classifier by using a trained network with U-Net architecture. The minimization of the high representation term in the loss function tries to minimize the difference in the high representation level between the clean data and the approximated output of the noisy data in the training set. Therefore, it checks whether the output generated by the generator shows minimum error when compared to the true label. The U-Net networks is trained with the true label, so it could be used to make sure the generated data gives minimum error. Figure 1 shows the training process of the proposed method. Due to the minimization high representation term, the generator is trained to remove the remaining adversarial noise that survives the low level approximation, and thus shows better performance than existing GAN based methods.
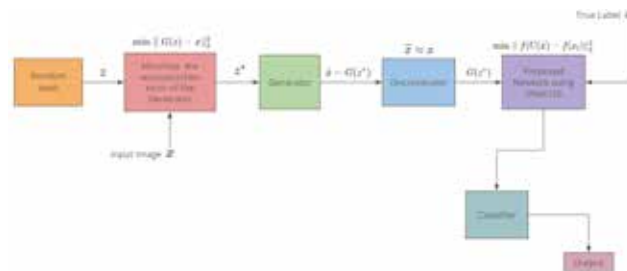

Figure 1.png

An experimental evaluation of Grammar-directed Automatic Programming Algorithms for Robotic Maze Exploration

Thursday, 22nd November @ 17:51: Robotics (Auditorium) - Oral - Abstract ID: 43

Dr. Chris Headleand [1], Mr. Syed Aslam [2], Dr. William Teahan [2]

1. *Lincoln University,* **2.** *Bangor University*

In this paper, we describe the experimental evaluation of three grammar-directed automatic programming algorithms applied to the problem of evolving the behaviour of more-exploring robots – Grammatical Evolution (GE), swarm-based Grammatical Herding (GH) which is based on the herding behaviour of horses, and swarm-based seeding of Grammatical Evolution (sGE). These three algorithms use a context-free grammar and the standard GE mapping process for generating the phenome code from a genome bitstring for each member of the population. sGE is designed in two stages, the seeding stage where GH is used to generate an initial population and the optimising stage where GE is used. This system also determines when GH should handover to GE. For this purpose, two threshold based criteria were utilised – a fitness threshold and an iteration threshold. The design of sGE is shown in Figure 1.

We compare these three automatic programming algorithms against three simple maze challenges (labelled "Spiral", "Path" and "Junction") containing multiple changes of direction. Behaviours were first evolved in the agent-based programming language NetLogo before being ported to the robot which was designed using the Lego MINDSTORM robot kit. In our simulation experiments, 450 experiments were conducted with 50 runs being made in each maze using each algorithm. Results are shown in Table 1, with the average number of iterations and steps representing the successful results for that algorithm only. If the algorithm failed to find a solution, this is recorded in the final column. The results show that on average GH was able to solve the mazes faster than the other two algorithms confirming results in previous studies. However, in general sGE was able to find competitive solutions (as determined by the number of steps or actions performed by the robots) more quickly than GE. GE and GH both had 11 failed attempts each whereas sGE had only 1 failed attempt.

The final evolved NetLogo code was transferred to a Mindstorm robot placed within a real-world maze for validation. The real-life robot was able to solve the maze using the same evolved code in each of the experiments that were conducted.
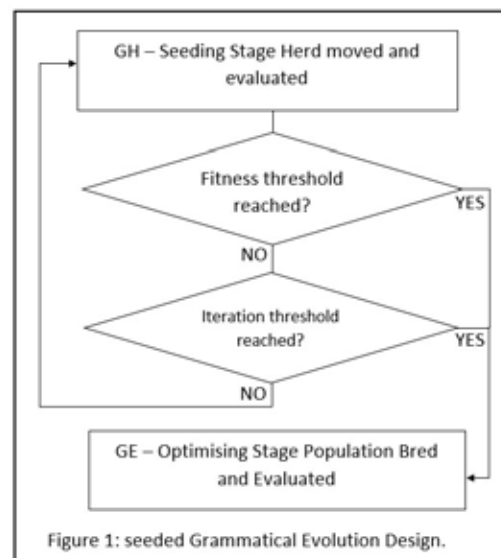

Table 1.jpg

Figure 1: seeded Grammatical Evolution Design.

Figure 1.jpg

Deep Learning for Stereo-Vision-based Satellite Navigation and Control System

Thursday, 22nd November @ 17:51: Neural networks and deep learning (Room 201) - Oral - Abstract ID: 229

Mr. Tao Sun [1], ***Mr. Zhicheng Xie*** [1], ***Dr. Xiaofeng Wu*** [1]

1. *The University of Sydney*

Image recognition and classification based on CNN (Convolutional Neural Networks) and Deep Learning are recognized as one of the most popular research areas in Artificial Intelligence. With the development of a large amount of algorithm of Deep Learning improvement and update these years, highly accurate recognition and classification result could be achieved when using an extensive dataset for training. By identifying the texture or illuminance features in the bottom convolutional layers, CNN could be regarded as a pixel-based classifier from the top full connected layers. It is applied in a variety of engineering, financial, and medicine industries. However, the application of Deep Learning in the aerospace domain mainly concentrate on geoscience and remote sensing based on earth observation data.

In this paper, a stereo-vision-based CNN model is presented for the navigation, guidance and attitude control system of a 1U CubeSat. This method will benefit the missions like space docking and satellites formation flying. The CNN model that was trained from the images of a 1U CubeSat can precisely identify the features of the different surfaces of the satellite, which could be used to estimate the initial pointing directions of two spacecraft. With the stereo camera, the relatively high accurate attitudes of the CubeSats could be obtained from the disparity algorithms. Therefore, the CNN model is used to avoid the confusion and ambiguity, while the stereo disparity brings the accurate attitude result. As a result, the conventional inertial navigation system for satellites is replaced by our stereo-vision-based CNN method.

An Organizational Theory Based Model for Long-Term Adaptivity in Distributed Intelligent Systems

Thursday, 22nd November @ 18:08: Robotics (Auditorium) - Oral - Abstract ID: 286

Mr. Arturs Ardavs [1], *Ms. Mara Pudane* [1], *Dr. Egons Lavendelis* [1], *Dr. Agris Nikitenko* [1]

1. *Riga Technical University*

Due to the increasing need for autonomy, the complexity of modern robotic systems' has escalated rapidly. Higher complexity leads to higher production costs and possibly lower robustness of systems; another implication is increased inner technical and non-technical dependencies, which turns a design stage into a very complex multidisciplinary project. To tackle these issues, new design paradigms are needed that address requirement for higher autonomy and robustness. Many studies have considered adaptivity in technical (including robotic) systems, yet in general, long-term autonomy still remains a challenge. Although it is partly caused by implementation issues, overall management and control of the system have a significant impact on the system's adaptive and functional capabilities.

There are paradigms and approaches that treat highly adaptive robotic systems as technical systems but this is not the only area in which high-level adaptivity has been investigated. Viable Systems Model (VSM) is a systems theory model that specifies the functions and information flow needed to ensure the system's long-term autonomy (see the overall structure of VSM in Fig.1). VSM is a well-acknowledged tool for identifying flaws in complex systems that involve people, e.g., enterprises. If adapted properly, it could serve for the same purpose in technical systems.

The goal of the paper is to study the application of VSM in multi-robot system design by using simulation environment. To achieve this goal, high-level functions of VSM are mapped on multi-agent systems domain and implemented via agent development framework JADE (see mappings of concepts in different domains in Fig.2). The resulting simulation environment (see the interface in Fig.3) follows a typical production line, where each agent contributes to the overall production process. Production intensity and product types vary over time, and agents have to adapt to changing tasks and changes in the system itself; this is achieved through the application of VSM principles.

The discussed model and the simulation environment is part of an ongoing research project. After successful experiments in the simulated environment, the model will be implemented in a multi-robot system to ensure its adaptability (see general scheme in Fig.4).
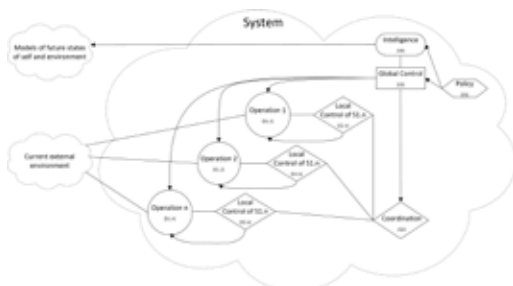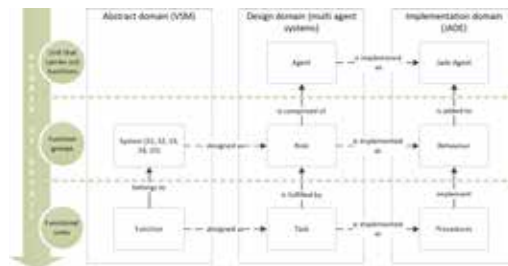

Fig1. viable systems model scheme.png

Fig2. mappings of concepts in abstract design and implementation domains.png
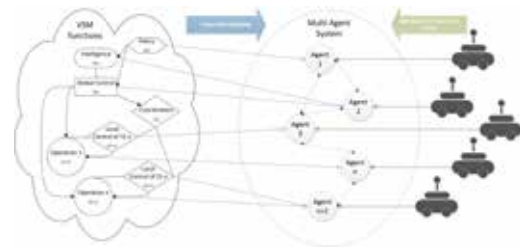
Fig3. simulation environment.png

Fig4. vsm-based adaptive multi-robot system.png

Using Convolutional Neural Networks to Distinguish the Deaf-Blind Alphabet

Thursday, 22nd November @ 18:08: Neural networks and deep learning (Room 201) - Oral - Abstract ID: 297

*Mr. Stephen Green* [1], *Prof. Ivan Tyukin* [1], *Prof. Alexander Gorban* [1]

1. University Of Leicester

Within the past decade, using Convolutional Neural Networks (CNN)'s to create Deep Learning systems capable of translating Sign Language into text has been a breakthrough in breaking the communication barrier for deaf-mute people. Conventional research on this subject has been concerned with training the network to recognize the fingerspelling gestures of a given language and produce their corresponding alphanumerics. This work aims to present a technology that aims to apply these advances in Deep Learning to the Deaf-blind Manual Alphabet by combining a pretrained legacy AI system for a generic object recognition task with a corrector method to uptrain the legacy network utilising Stochastic Separation theorems.

Implementing recent results on method concentration, namely the stochastic separation theorem, an AI system is supposed as an operate mapping an input present in the set of images u in U to an output that exists in set of predicted class labels q in Q of the letter in the tactile Dead-Blind Alphabet that q represents. These inputs and outputs, along with the interval variables z in Z represent the system's current state which implies a mapping that assigns an element x in $\square^n$ to the triple (u, z, q). As all x_i are i.i.d vectors drawn from a product mean distribution, over a period of time the AI generates a large set of measurements x_i called S that are grouped into two categories: the correct predictions M and the incorrect predictions Y.

Once the network has made its predictions, a corrector can then be applied through centering S and Y by subtracting their means. The data is then regularized by applying the Kaiser rule to the resulting eigenmatrix and then whitened before being split into pairwise, positively correlated clusters. Each of these clusters produces a unique hyperplane and if any element x falls outside the region bounded by these lines then it is reported as an error.

As a result of this methodology, a self-correcting recognition process is created that can identify the twenty-six Deaf-Blind gestures and successfully produce the correct corresponding letter which no other neural network has been able to replicate.
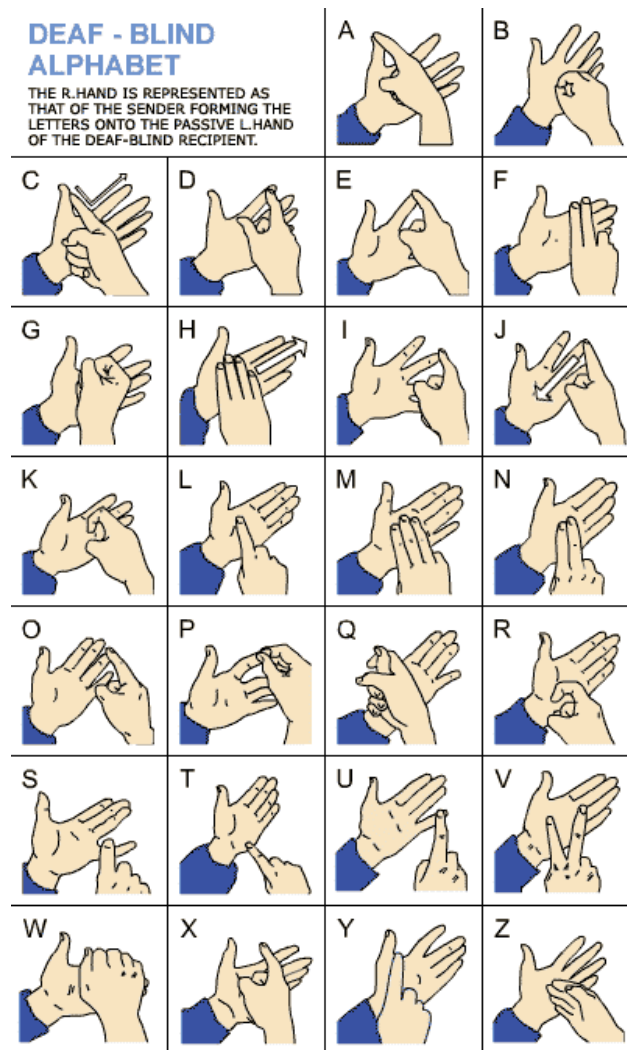
Matrix fs db.png

Experiential Robot Learning with Accelerated Neuroevolution

Thursday, 22nd November @ 18:25: Robotics (Auditorium) - Oral - Abstract ID: 127

Mr. Ahmed Aly [1] *, Prof. Joanne Dugan* [1]

1. University of Virginia

Introduction

In order for robots to scale and become ubiquitous, especially in areas that require human interaction, they have to acquire the skill of learning. That is, they have to be able to learn from their experiences in the environment. We propose a gradient-free method called Accelerated Neuroevolution (ANv1) in attempt to address this problem. It describes the algorithm used to evolve artificial neural networks instead of training them using Stochastic Gradient Descent derivatives. The advantages of Advanced Neuroevolution are suitability for physical implementations, no differentiability requirement, fast convergence, and integrability with SGD-trained networks. We demonstrate those advantages through a simple discrete-control physical experiment.

Method

Accelerated Neuroevolution is an evolutionary algorithm based on the concept of entropy. It features the concept of hybrid populations that result from Crossover + Mutation and pure Mutation, called Royal Family. It also features the concept of Mutation Resistance. That is, the magnitude and scale of mutations in the genome is now dynamic, based on the entropy in the reward signal. If the algorithm is unable to get rewards, it increases its range and magnitude of mutations. This mimics exploration in the search space.

Results

We first test the method on a computer game called Flappy Bird. It features 3 inputs comprising the state of the agent, and 1 output as the action. This essential step ensures that ANv1 behaves as we expect. The evolved network converges on agents capable of playing the game in a relatively low number of generations (50). Following this, we use a physical NAO robot on a simple discrete-control task. The robot is required to increment its head's position left or right, or take no action, in order to center a single object in its field of vision. We use an SGD-trained Convolutional Neural Network, built by us, to pronounce where the object is. The robot converges on the policy in a low number of generations (5).

Discussions

The results indicate the method is plausible for physical learning. The introduced features are utilized to improve convergence. We see ANv1 as a compliment, not a competitor, to SGD.

Anv1 algorithm outline.png
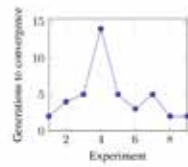
Anv1 computer game performance.png

Figure 5: Performance of the ANv1 algorithm in the static object centering task. We ran 9 experiments, three for each possible starting location, Left, Right and Center. The algorithm terminates when 7 out of the 15 populations collect maximum rewards. The algorithm converges in less than 5 generations, with one exception.

Anv1 physical experiment performance.png

Figure 1: The NAO robot learns to visually center the object, ie. sign, by moving its head.

Physical task outline.png

Deep Learning for the Autonomous Orbit and Attitude Correction of a satellite

Thursday, 22nd November @ 18:25: Neural networks and deep learning (Room 201) - Oral - Abstract ID: 267

Mr. Samanvay Karambhe [1] *, Dr. Xiaofeng Wu* [1]

1. *The University of Sydney*

With the growing demands of the space industry, there is an increasing need for an intelligent remote agent that can operate a spacecraft without the input of on-ground engineers, thereby freeing up resources and by-passing the issue of communication delays for long interplanetary missions. Intelligent control, active health monitoring & maintenance and autonomous navigation are three key fields that need to be integrated to create this agent. The present work explores the application of a deep learning framework to aid in autonomous orbit and attitude correction of a satellite following an impact from a foreign object or orbital decay. A back-propagation neural network is applied and trained. The input for the neural network as defined in the training set consists of orbit and attitude position residues generated with reference to a predefined orbit as provided by an orbit propagator, containing the simulated orbital perturbation following an impact. The output is the thrust and control values needed to correct the perturbations. The algorithm performance is evaluated based on a result comparison to a fine tuned traditional dynamic control system. After training, the neural network is computationally more efficient than the control system. A benefit of the deep learning approach is the ability to refine the system model used to define the control system by continuously adapting the control parameters. The present work is the first step towards creating an intelligent remote agent that can be integrated into any class of satellite with the minimum required hardware capability. This approach has great potential to be used for the autonomous operation of a distributed satellite network.

Heterogeneous Robot Map Merging: State of the Art

Thursday, 22nd November @ 18:42: Robotics (Auditorium) - Oral - Abstract ID: 296

**Dr. Ilze Andersone** [1]

1. _Riga Technical University_

Multi-robot mapping and environment modelling has several advantages that make it an attractive alternative to the mapping with a single robot: faster exploration, possibility to create more accurate models and maps, higher fault tolerance, richer data due to different sensors being used by different systems.

However, environment modelling with several simultaneous robotic systems operating in the same area causes problems of higher order – acquired knowledge fusion and synchronization over time, revealing the same environment properties using different sensors with different technical specifications. While the existing robot map and environment model merging techniques allow to merge certain homogeneous maps, the possibility to use sensors of different physical nature and different mapping techniques is still limited. The resulting maps from robots with different specifications are heterogeneous (see Figure 1 for example), and even though some research on how to merge fundamentally different maps exists, it is limited to specific applications with no simple way to extend it to new cases.

This research reviews the state of the art in heterogeneous map merging and illustrates the main research challenges in the area. Six factors are identified that influence the outcome of map merging: 1) Robotic platform hardware configurations, 2) Map representation types, 3) Mapping algorithms, 4) Shared information between robots, 5) Relative positioning information, 6) Sharing level of resulting global maps.

Based on the analysis of these factors, the main two heterogeneous map merging steps are defined:

- Exchange of meta information. This step is necessary to determine whether the map merging is possible and which algorithm should be used.
- Merging of maps. This is the most complex step, where the main challenge is the development of heterogeneous map merging algorithms. As there is no universal solution, case specific as well as more general algorithms must be created.

Heterogeneous robot map merging is a novel research field and currently there are very few solutions even for the most common map types. However, the rising importance of robotic technologies in both industry and household motivates the development of more universal and cooperative systems in the future.
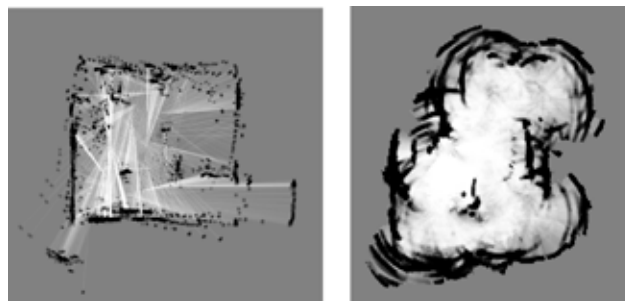
Heterogeneous maps.png

Intelligent Collaborative Systems and their Application to Emergency Rescue Scenarios

Friday, 23rd November @ 09:00: Plenary Speech (Auditorium) - Oral - Abstract ID: 13

Prof. Patrick Doherty [1]

1. _University of Linköping_

After several decades of research development, we are now experiencing widespread use of unmanned aircraft in both the civil and commercial sectors. Much of the focus of previous research has been on conventional autonomy which targets autonomous flight, navigation and sensor capabilities. New application areas, such as package delivery, border monitoring and emergency rescue response are making it increasingly clear that additional levels of autonomous capability will be required, in particular, shared autonomy between human operators and teams of heterogeneous unmanned aircraft systems and the use of on-board automated planning and reasoning techniques.

In this talk, I will present a delegation-based collaborative robotics framework that can be used with teams of robots and humans to leverage their distinct capabilities in solving complex mission goals. Instantiations of the framework will be considered using various scenarios involving teams of humans and unmanned aerial vehicles.

Human Authentication Using Facial Cues

Friday, 23rd November @ 09:40: Plenary Speech (Auditorium) - Oral - Abstract ID: 313

Dr. Fernando Alonso-Fernandez [1]

1. _Halmstad University_

Ocular biometrics (which includes iris, sclera, periocular and retina) has seen significant progress in the last decades, primarily due to efforts in iris recognition since late 80s, resulting in large-scale deployments. Iris provides very high accuracy in near infrared lightning and controlled environments, but deployment to non-controlled environments such as at-a-distance or on-the-move is not yet mature. Retina is referred as the most secure modality, but acquisition requires high cooperation too. Similar considerations apply to face, despite research on face recognition spans over 3 decades too. For example, partially covered faces due to hair, clothes or helmets severely affects performance of recognition systems based on full-facial analysis.

Since 2009, the periocular modality has rapidly evolved, surpassing face in case of occlusion or iris under low resolution. Periocular is the region around the eye (sclera, eyelids, lashes, brows and surrounding skin). With a surprisingly high discrimination ability, it is the ocular modality requiring the least constrained acquisition. It appears over a wide range of distances, even under partial face occlusion (close distance) or low resolution iris (long distance), making it very suitable for unconstrained/uncooperative scenarios. This region can be easily obtained with existing setups for face and iris, and the requirement of user cooperation can be relaxed, thus facilitating the interaction. It also avoids the need of iris segmentation, an issue in difficult images. In forensics analysis, faces of crime perpetrators may be covered, while in some religions, cultures, or professions, face is intentionally covered. Therefore, in many of these cases, the region around the eyes might be the only visible biometrics trait from the facial region.

In this talk, we will give an overview of past and current research in periocular biometrics. Since the periocular region appears in face or iris images, it can be used also in conjunction with these modalities. Features extracted from the periocular region have been also used successfully for gender classification, ethnicity classification, expression recognition, and to study the impact of gender transformation or plastic surgery in the recognition performance. Future research trends in the topic will also be briefly discussed.

Plenary speech _TBD

Friday, 23rd November @ 10:45: Plenary Speech (Auditorium) - Oral - Abstract ID: 329

__Mr. Enric Delgado__ [1]

1. IBM

TBD

Neuromorphic computing with emerging memory devices

Friday, 23rd November @ 11:25: Plenary Speech (Auditorium) - Oral - Abstract ID: 318

Prof. Daniele Ielmini [1]

1. Politecnico di Milano

TBD

INVITED TALK - Why Dynamic Pricing is the winning use case in AI

Friday, 23rd November @ 14:00: Machine Learning and AI applications in industry (Auditorium) - Oral - Abstract ID: 70

Dr. Manu Carricano [1]

1. _ESADE Business School_

In a recent survey, O'Reilly (2016) stated that Pricing is the 3rd top priority in Big Data & Advanced Analytics, after fraud detection and IoT. Interestingly, as many companies have started to invest in fraud detection, very few have moved after the pilot stage when it comes to modern pricing. The main reasons are the complexity of the subject, due to its cross-functional dependencies, interactions and a lack of maturity, both in terms of data & processes. Complexity and high potential make pricing the perfect table stake for AI.

At the same time, after years of deployment in the travel industry, online and e-commerce, traditional companies are looking with new eyes and appetite at dynamic pricing, being a traditional retailer willing to keep up with Amazon, a car manufacturer exploring new revenue models through direct selling or a consumer bank looking for additional efficiency levers in a very competitive environment.

For these reasons, this workshop aims to gear up data scientists with the correct methods and tools to tackle adequately this challenge.

The workshop is organized in three main sections to foster a lively discussion among participants:

1) Pricing, the winning use case: this section focuses on the importance of pricing from a business point of view, in order to prepare your case. We will also follow a pragmatic reverse engineering approach to best practices such as Uber, AirBnB and Amazon among others.

2) The ideal AI toolkit for dynamic Pricing: in this section we will explore several steps to build your perfect toolkit. A) Setting the right experimental design: from A/B tests to Multi-Armed Bandit. B) Learning effects: how to combine the right analytical bricks: clustering methods, association rules, forecasting, etc. C) Optimization methods: stochastic optimization, Adaptative Multi-Agent Systems, Network flow algorithms.

3) Measuring Impacts: We will focus on this last section on providing recommendation on how to deploy at scale similar projects, how to isolate price variance to demonstrate direct impacts, an how to communicate correctly the case to a business audience, based on recent examples of implementations.

Memristive Based Explainable Pattern Recognition

Friday, 23rd November @ 14:00: Pattern recognition & Cognitive systems (Room 201) - Oral - Abstract ID: 184

__Prof. Martin Klimo__ [1] , Dr. Ondrej Šuch [1], Dr. Ondrej Skvarek [1], Dr. Karol Frőhlich [2], Dr. Milan Ťapajna [2], Mr. Ivan Kundrata [2], Dr. Marian Precner [2]

1. *University of Zilina,* **2.** *Slovak Academy of Sciences*

Introduction

The success of deep machine learning opened up the question of decision explainability. The user wishes not only to know which decision was made but also to understand why, especially when responsible. If we focus on pattern recognition, the system can be deconstructed into feature extraction and classification subsystems. Explainability of features means that an inverse transformation to feature extraction exists, i.e., the user can learn how the feature changes impact the input data and classification. For the classification part, we introduce logical explainability, which means that the decision can be written in the form of a logical statement (Boolean or fuzzy), and the user can assign the logical value to each elementary decision.

Methods

Our approach is based on the fact that memristors are a passive element, which transmits information bi-directionally in contrast to the transistor. The feature extraction is based on the memristive implementation of the neuronal vocoder, and the classifier is based on the fuzzy or Boolean logic memristive circuit (Fig. 1.). Neural compressors and decompressors are trained together to obtain feature extraction and inverse transform as precisely as possible. Thanks to memristive passivity and the memristor thresholds, the input values set the memristors to the states of a predefined logical function. The under-threshold values connected to the output give the argument function values at the input.

Results

The system has not yet been implemented as a whole. Only partial solutions are designed and tested. The ReLU neuronal network is proposed. Contrary to the neuromorphic approach, ON/OFF states and the binary form are applied for memristive implementation of the weights (Fig. 2.). Memristive circuits of elementary fuzzy logic functions were tested on hafnium oxide - HfO2 (Fig. 3.) and tantalum oxide - Ta2O5 (Fig. 4.) technology.

Discussion

Bidirectionality of the memristive circuits offers explainability tools, but on the other hand, it may lead to a chaotic nature. Bidirectionality is suitable for complex behaviour, but it may cause unexpected attractors or block some state transitions. Therefore, detailed simulation and measurement are needed before the implementation.
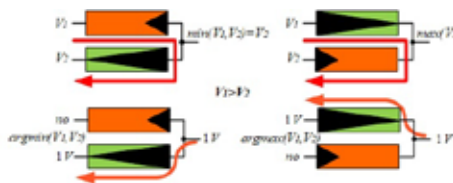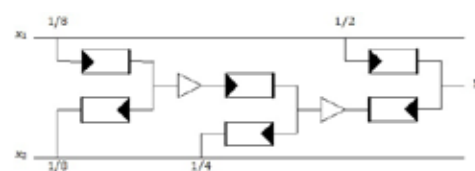

Fig1 fuzzy logic implementation.jpg

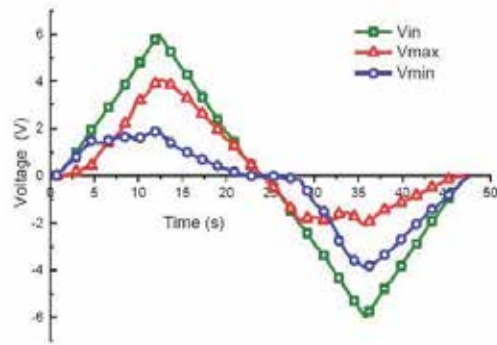
Fig2 principle of binary weighting.jpg
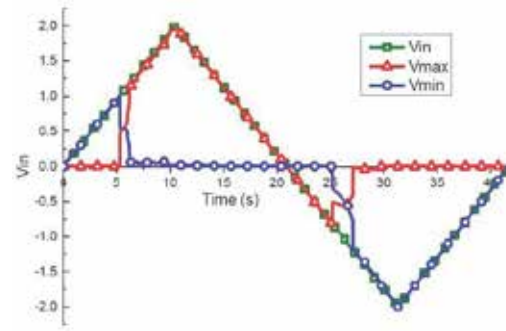
Fig3 hfo2 min max gate.jpg

Fig4 ta2o5 min max gate.jpg

[Time extension for the invited speaker]

Friday, 23rd November @ 14:17: Machine Learning and AI applications in industry (Auditorium) - Oral - Abstract ID: 328

**Dr. Manu Carricano** [1]

1. _ESADE Business School_

This presentation has been created to extend the time allocated to DR. MANU CARRICANO for his presentation "Why Dynamic Pricing is the winning use case in AI"

Can advanced machine learning techniques help to reconstruct barn swallows' long-distance migratory paths?

Friday, 23rd November @ 14:17: Pattern recognition & Cognitive systems (Room 201) - Oral - Abstract ID: 115

**Mr. Mattia Pancerasa** [1], **Mr. Matteo Sangiorgio** [1], **Prof. David Ward Winkler** [2], **Prof. Roberto Ambrosini** [3], **Prof. Nicola Saino** [3], **Prof. Renato Casagrandi** [1]

1. *Politecnico di Milano*, **2.** *Cornell University*, **3.** *Università degli Studi di Milano*

Introduction

Light level geolocators are a well-established technology to track migratory animals (like passerine birds) that are too small to carry satellite tags. Recently, different methods to reconstruct migration paths from geolocator data have been developed (e.g. *FLightR R-p*ackage). All of these require preprocessing of raw data: light measurements are often affected by differential shading, and twilight events showing unnatural variation in light levels and timing need to be corrected (Fig. 1). Here we propose and implement advanced machine learning (ML) techniques to automate this procedure (Fig. 2) and compare performance to that of expert human editors.

Methods

We rely on nearly 37,000 expert-classified twilight events from almost a hundred geolocators applied to a long-distance migratory bird: the barn swallow (*Hirundo rustica*). We selected as predictors 8 intra-twilight luminosity measurements (first/last 8 light measurements after sunrise/before sunset), 18 inter-twilight values (both twilight times of each night on a moving window of 9 days), and 4 expert-defined aggregated statistics of these. Implementing a Logistic Regression (LR) classifier as benchmark, we next considered advanced machine learning models such as a Random Forest (RF) and a deep Neural Network (NN). We investigated different architectures such as the effect of adding to the classical fully connected structure some 1D convolutional layers, which usually turn out to be efficient in dealing with time series.

Results

Our analysis shows that ML can help to correctly filter geolocator data. The complex models here proposed outperform the LR considering both overall accuracy (LR: 77.91%, RF: 89.15%, NN: 89.40%) and confusion matrix as metrics (Fig. 3). Comparison between migratory tracks of a test individual estimated by *FLightR* using twilights classified according to different methods shows that ML algorithms can delete noisy twilight events that could significantly distort the result (Fig. 4).

Discussion

In this work we showed how ML algorithms can perform better than classical statistical learning in a complex classification task. Migratory paths obtained after preprocessing with the structures proposed are closely similar to the ones computed after manual editing by an expert. This work could constitute the missing part to the complete automation of geolocator data analysis.
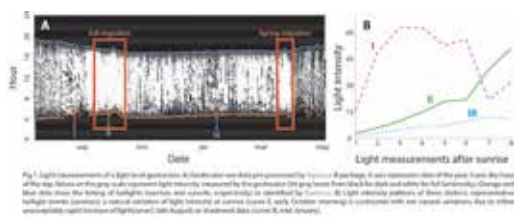
Fig1 twilight selection procedure.jpg
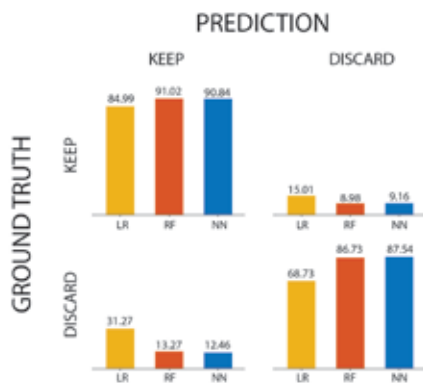

Fig2 track estimation workflow.jpg

Fig 3. Confusion matrix and overall accuracy for the three different methods applied in this work: Logistic Regression (LR, yellow); Random Forest (RF, orange); deep Neural Network (NN, blue). RF and NN overperform LR in particular on the recognition of bad twilights.
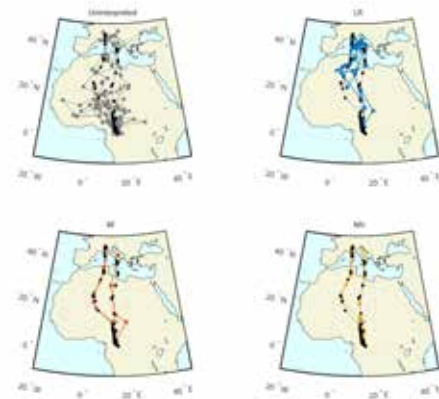
Fig3 confusion matrix.jpg

Fig4 comparison of estimated tracks.jpg

Predictive Maintenance algorithm for woodworking Industrial Machines

Friday, 23rd November @ 14:34: Machine Learning and AI applications in industry (Auditorium) - Oral - Abstract ID: 308

Dr. matteo calabrese [1], _Dr. Dimos Kapetis_ [1], _Dr. Martin Cimmino_ [1], _Dr. Donato Concilio_ [1], _Dr. Giuseppe Toscano_ [2], _Dr. Giancarlo Paccapeli_ [1], _Dr. Marco Siciliano_ [1], _Dr. Andrea Forlani_ [2], _Dr. Alberto Carrotta_ [2]

1. _Accenture,_ **2.** _Biesse_

Abstract—In this paper we describe a machine learning methodology for Predictive Maintenance (PdM) applied on woodworking industrial machines. PdM is a prominent strategy consisting in all the operational techniques and actions required to ensure machine availability and to prevent a machine-down failure. One of the challenges with PdM approach is to design and develop of an embedded smart system to enable the health status of the machine. The proposed approach allows to screen simultaneously multiple connected machines, thus providing in real-time monitoring that can be adopted with maintenance management. This is achieved by applying temporal feature engineering techniques and training an ensemble of classification algorithms to predict Remaining Useful Lifetime of woodworking machines. The effectiveness of the methodology is demonstrated by testing an independent sample of additional woodworking machines without presenting machine down event.

Learning Embedding Space for Clustering From Deep Representations

Friday, 23rd November @ 14:34: Pattern recognition & Cognitive systems (Room 201) - Oral - Abstract ID: 165
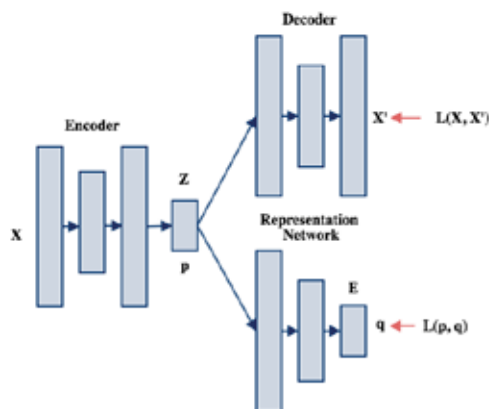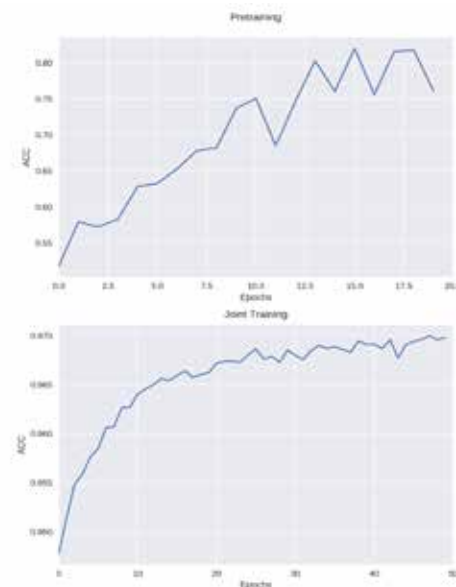
Mr. Paras Dahal [1]

1. *Marax AI*

Clustering is one of the most fundamental unsupervised tasks in machine learning and is elementary in the exploration of high volume data. Recent works propose using deep neural networks for clustering, owing to their ability to learn powerful representations of the data. Many methods manipulate the representation space with an unsupervised clustering objective to make it suitable for clustering. However, with such direct manipulation it is difficult to learn representation that is both a valid feature representation and is clustering friendly. This is because of the trade off involved between preserving the feature space and preserving the local structure of the data, which is crucial for clustering.

In this work, we present a novel clustering approach using deep neural networks that simultaneously learns feature representations and embeddings suitable for clustering by encouraging separation of natural clusters while preserving local structure in the embedding space. More specifically, an autoencoder is employed to learn representations of the data. Then a mapping from autoencoder representation space to an embedding space is learnt using a deep neural network we call representation network. This representation network causes separation between natural clusters by minimizing cross entropy between two probability distributions that denote pairwise similarity in autoencoder latent space and representation network's embedding space. The resultant optimization problem can be solved effectively by jointly training the autoencoder and the representation network end-to-end using mini-batch stochastic gradient descent and backpropagation. Ultimately we obtain a K-Means friendly embedding space.
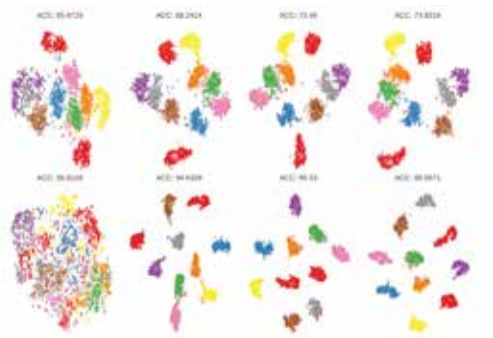
Experimental results show that the proposed approach outperforms a broad range of recent approaches on Reuters dataset, other autoencoder based models on MNIST dataset and produces consistently good results that are very competitive with other complex and hybrid models.

Architecture.png

Acc.png

Clusters.png

Performance table.jpg

AI and Machine Learning driven Testing - transformation to Quality Engineering

Friday, 23rd November @ 14:51: Machine Learning and AI applications in industry (Auditorium) - Oral - Abstract ID: 158

*Mr. Mahesh Venkataraman* [1], *Mr. Kishore Durg* [1]

1. Accenture

Introduction

Conventional testing has been primarily focused on creating test cases based on requirements and executing them to detect bugs. Testing is often considered a 'routine' task that has limited scope beyond test execution, automation and defect reporting. In this paper, we examine the broader opportunities for redefining the mandate and boundaries of testing that will enable it to play a critical role in improving agility of program delivery and enhancing run time reliability of the system. New techniques like data mining, artificial intelligence,machine learning, natural language processing are suggested to bring about this transformation.

Business Need

IT organizations are under increasing pressure to shift from 'IT is only an enabler' thinking to 'IT is the business' mindset. With disruptions in every industry, IT groups are under great pressure to increase agility, contain risks and lower cost of ownership even as they leap through technological discontinuities. Consequently, this necessitates paradigm shifts from the traditional testing mindset to a more business driven mindset that can enhance quality and agility

Problem and solution approach - use of AI and ML in Testing

- **Speed of test automation:** Manual automation of test cases is slow and laborious and this results in test automation lagging behind the rapid changes in the system under test. We propose AI/ Natural Language Processing techniques to accelerate the speed of automation
- **Ineffective automation**- Often automated execution is ineffective and needs manual intervention. We propose transformation from automated testing to 'autonomous testing' using AI techniques that enable automated test script selection, self healing, intelligent exception handling and reporting capabilities thus significantly reducing human intervention
- **Test optimization:**Often testing is either over engineered (expensive over-coverage) or under-engineered (risky under-coverage). We propose the use of AI and Machine Learning techniques to optimize test coverage thereby improving the defect uncovered per unit cost
- **Run time behavior mining and anomaly detection**: we propose data mining and AI techniques that can extract insights on usage and failures that can be used to improve run time reliability
- **Visualization**: we propose visualization techniques that can enable data driven decisions to improve reliability and agility
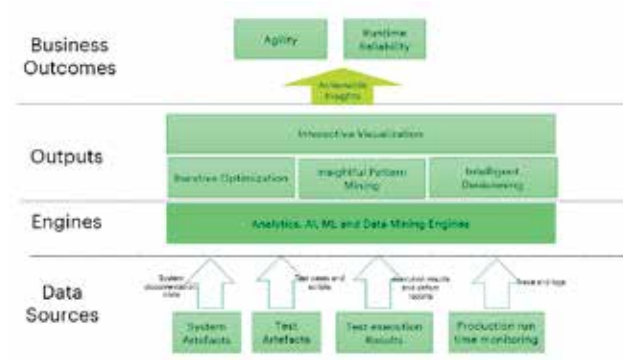
Picture for abstract.png

Detection of Exomoon Candidates in Light Curves Using 1D ConvNet with Total Variation Loss

Friday, 23rd November @ 14:51: Pattern recognition & Cognitive systems (Room 201) - Oral - Abstract ID: 222

__Dr. Rasha Al Shehhi__ [1]

__1.__ New York University

We have detected over 180 moons around the eight solar system planets. But while over 3,500 planets around different stars have been detected in the last two decades, there have only been hints at possible moons around those planets (exomoons). The manual interpretation of potential exomoon candidates is labor intensive and subject to human error. The main challenge of detecting exomoon candidates is due to the presence of systematic noise of the telescope and to the astrophysical variability of the star. Here we simulate light curves with exomoons and without exomoons to train a Convolution Neural Network.

Convolution Neural Networks have successfully contributed to the improvement of the classification accuracy in different fields. Typically, network optimization has been performed with L2-loss and without considering the impact of noise in training data. It is also optimized with regularization by penalizing the L2-norm of the weight vector. However, these type of regularization constraints are very general and do not exploit the characteristics of structures present in that data.

In this work, we propose a 1D convolution Neural Network to classify light curves into exomoon or non-exomoon candidates, and achieve robustness by minimizing mean square error and total variation loss. The architecture consists of 5 1D convolution layers, followed by two fully connected layers using the proposed loss function to train the network.

The aim of using the total variation as a loss function is the removal of noise or unwanted variations in the data (e.g., from stellar activity, systematic or instrumental effect) and the conservation of most details of the original data at the same time. It penalizes the L2-norm of the gradient of label probabilities with respect to input data. It can be seen as a regularization term that promotes smoothness of the label probabilities.

We demonstrate a significant improvement of our method over the use of traditional loss functions. Furthermore, we show that the use of the proposed smoothness constraint in the learning phase significantly outperforms other per-whitening approaches.

Comparison of the performance of four different machine learning binary classification algorithms for predicting locoregional recurrences in early-stage oral tongue cancer

Friday, 23rd November @ 15:08: Machine Learning and AI applications in industry (Auditorium) - Oral - Abstract ID: 283

Mr. Rasheed Alabi [1] , _Prof. Mohammed Elmusrati_ [1]

1. University of Vaasa

Introduction: It is important to properly estimate recurrences in oral tongue squamous carcinoma (OTSCC). However, this remains a challenge in the field of head and neck oncology. Therefore, we examined four different machine learning algorithms to find out the best algorithm that effectively predicts recurrences (_high-risk_ or _low-risk_) in patients with OTSCC. These algorithms are Neural Network, Bayes Point Machine, Boosted Decision Tree, and Decision Forest. **Methods:** A cohort study was established primarily with cases from University Hospitals in Finland and from a cancer center in Brazil. To compare the algorithms, we used the estimated areas under the receiver-operating characteristic (ROC) curve (AUC), and accuracy values. The data were analyzed using Microsoft Azure. Additionally, the algorithm with the best AUC curve and accuracy value was tested with 59 new cohort of cases. **Results:** Boosted decision tree algorithm gave AUC of 98.8%, and accuracy of 92.8%. The neural network showed an AUC of 97.3%, and accuracy of 88.2%. Similarly, the decision forest had 98.5% AUC, and accuracy of 94.1%. Bayes point machine with AUC of 98.3%, and 92.8% accuracy. Therefore, the boosted decision tree algorithm gave the best AUC value, conversely, the decision forest had the highest accuracy value. When tested with the new cohort of cases, boosted decision tree showed 88.1% prediction accuracy, while the decision forest showed 84.7% prediction accuracy. **Discussion:** The accurate prediction of locoregional recurrences is essential to the effective management of OTSCC. Boosted decision tree algorithm produced the best AUC value. Similarly, it had the highest prediction accuracy when tested with new cases. Hence, AUC of ROC seems to be a better measure than accuracy because it is a trade-off between false positive and true positive rates. In conclusion, this study demonstrated that the higher the AUC value, the better the algorithm. Thus, boosted decision tree algorithm seems to properly estimate locoregional recurrences, thereby adding value for the management of OTSCC.

KEYWORDS: Artificial Intelligence; Oral tongue cancer; Artificial Neural Network; Machine Learning; Locoregional recurrence; Boosted Decision Tree; Decision Forest; Bayes Point Machine; Prediction.

Precipitation Measurement Based on Raindrop Imaging Analysis with High-speed Camera and Artificial Intelligence

Friday, 23rd November @ 15:08: Pattern recognition & Cognitive systems (Room 201) - Oral - Abstract ID: 208

Dr. Chih-Yen Chen [1] , **_Prof. Chi-Wen Hsieh_** [2], **_Mr. Po-Wei Chi_** [3], **_Dr. Chun-jen Weng_** [1], **_Dr. Lijuan Wang_** [4]

1. _Instrument Technology Research Center, NARLabs,_ **2.** _National Chiay University,_ **3.** _National Chiayi University,_ **4.** _University of Kent_

Background

Observation of the precipitation and raindrop distribution by means of low cost and feasible scheme is still a complex and challenging issue in the meteorological measurement. This measurement of precipitation is of crucial importance for meteorology, hydrology, and agriculture. Therefore, a proposed raindrop disdrometer which comprises the high-speed COMS camera with the proposed algorithm for the raindrop image velocimetry, aimed at investigating free falling raindrops and the atmosphere characteristics associated with the weather type.

Material and Methods

At first, a high-speed COMS camera (acquisition rate of 500 frames per second) is used to acquire the free falling raindrops in an outdoor environment. To keep the sizes of the images constant, a field of view covering 640 pixels times 480 pixels (with sensor size of 3.1 mm times 2.3 mm) was mounted to a telescope lens with a working distance of 226 mm and extended depth of 192 mm was employed. Then, an artificial intelligence model has been conducted to identify each raindrop in the grabbing frames. Here, an algorithm with artificial neural network (ANN) kernel with back propagation was used for the raindrop pairing and tracking for any two consecutive frames. In an outdoor field, a 48 hours rainfall event has been recorded by the proposed raindrop disdrometer, and a commercial PARSIVEL[2] disdrometer was also used at the same area for the comparison. Later, characteristics of the raindrops can be extracted accordingly, such as the raindrop size distribution and the rainfall rate, to evaluate the capability of the proposed system. The result is shown that the rainfall rate measured by the developed system is highly correlated to PARSIVEL[2] disdrometer, and the precision and the recall of the recognition are 87.8% and 98.4% respectively.

Results and Discussion

Our results also suggest that the image processing based estimation methodology provides a good approach for the development of raindrop disdrometer. Furthermore, the proposed system facilitates the measurement of the rainfall characteristics, such as falling velocity, equivolume diameter, raindrop concentration, and rainfall rate, to real-time monitoring of the rainfall status with stable and reliable analysis.
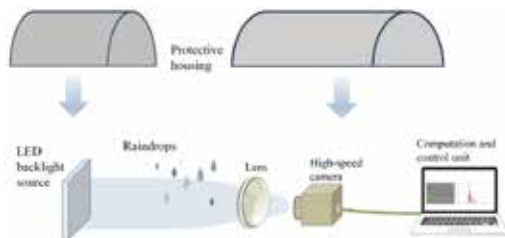

Figure1- Experiment setup of the proposed HSIV system.

Fig-1.png

Figure 2- Flowchart of the proposed raindrop pairing and tracking algorithm.
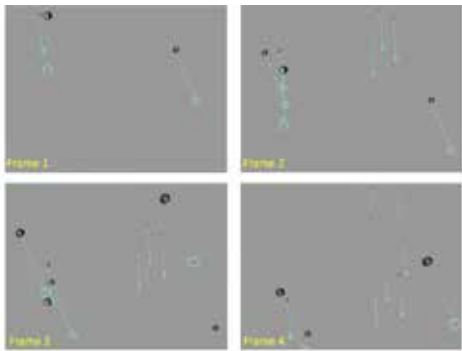
Fig-22.png

Figure 3- Application of raindrop tracking algorithm for a sequence of 4 grabbing frames.
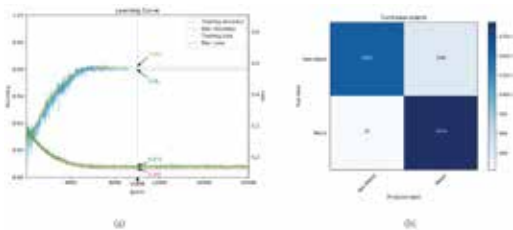
Fig-3.png

Figure 4- Results of (a) learning curves for the ANN kernel, and (b) the confusion matrix for raindrop pairing and matching algorithm.

Fig-4.png

A Path Planning Approach Based on the Motion Prediction of Dynamic Obstacles

Friday, 23rd November @ 15:25: Machine Learning and AI applications in industry (Auditorium) - Oral - Abstract ID: 93

Mr. Antonio Alejandro Matta-Gómez [1] *, Dr. Jonay Tomás Toledo Carrillo* [1] *, Dr. Leopoldo Acosta* [1]

1. Universidad de La Laguna

In this conference paper, a novel path planner for an autonomous vehicle is introduced. The originality of this planner is its ability to generate a trajectory based not only on the current position and orientation of a detected dynamic object, but also on its future ones. In this way the mobile vehicle is capable of navigating avoiding obstacles, taking into consideration the future position of a dynamic object.

This is possible because the proposed path planner is attached to a motion prediction module capable of estimating the future state of a detected moving object. The motion prediction is computed by combining the physical properties of the detected objects with their occupancy probabilities stored in a layered costmap. This allow us to get accurate predictions in the order of a mid-term range.

The proposed path planner is connected to a Global and a Local planners previously developed by our research team for the Verdino autonomous mobile platform, a driverless platform aimed to navigate in dynamic and unstructured scenarios such as pedestrian streets or tourists resorts. The Global Planner obtains the most achievable global path from the vehicle's current position to a desired goal, and the Local Planner selects a winning trajectory from a set of tentative trajectories generated in terms of different criteria.

This winning trajectory defines the best local path that the mobile platform must follow in order to move according to the global path. Therefore, the proposed path planner works together with the Local Planner in order to generate a more accurate winning trajectory, which enables both obstacle avoidance and safe navigation to the Verdino platform.

In the same way as the rest of the modules of the Verdino software architecture, the obtained path planner was implemented as a *ROS* node following the *ROS framework* guidelines. It has been tested in simulated environments using synthetic data within the Gazebo simulaton engine.

Figure 1: The Verdino autonomous mobile platform.
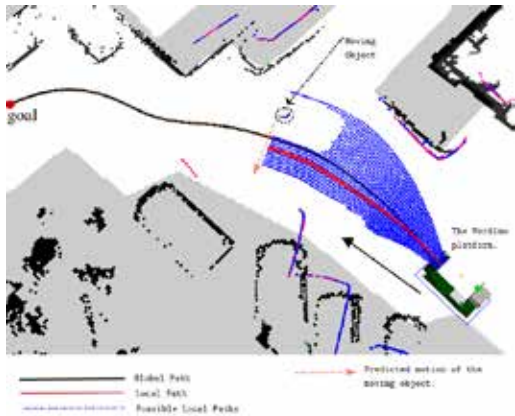
Figure-1-final.png

Figure 2: The Local Planner selects the best local path that the autonomous mobile platform can follow in order to move according to the global path generated by the Global Planner.
The Motion Prediction module detects the moving object and predicts its future motion.
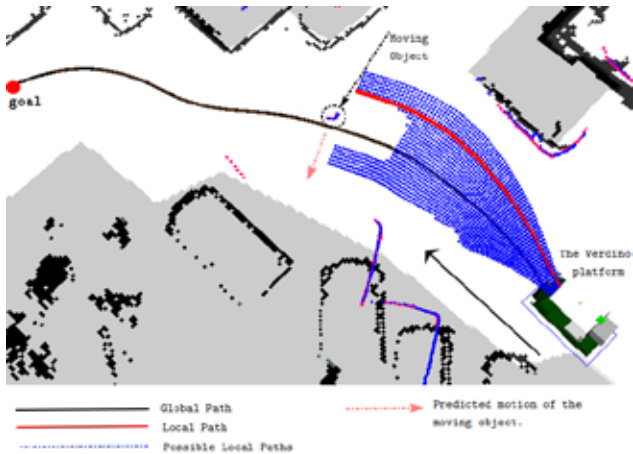
Figure-2-final.png

Figure 3: The Motion Prediction module predicts a collision with the moving object. The Local Planner selects a new local path so that the autonomous platform can both avoid the moving object and still move according to the global path.

Figure-3-final.png

Multi-Merge Budget Maintenance for Coordinate Ascent SVM Training

Friday, 23rd November @ 15:25: Pattern recognition & Cognitive systems (Room 201) - Oral - Abstract ID: 259

Ms. Sahar Qaadan [1], *Dr. Tobias Glasmachers* [2]

1. Ruhr-Universität Bochum, 2. Ruhr University Bochum

Coordinate Ascent (CA) is a technique for training large-scale kernelized SVM in its dual representation. The budget constraint is maintained incrementally by merging two points whenever the pre-defined budget is exceeded. The process of finding suitable merge partners is costly; it can account for up to 45% of the total training time. In this paper we investigate computationally more efficient schemes that merge more than two points at once. We obtain significant speed-ups without sacrificing accuracy.

The main benefit of merging M > 2 points is that the costly budget maintenance step is triggered only once for M=1 training points that violate the target margin. This means that with large enough M, the fraction of computation time that is spent on budget maintenance can be reduced, and the lion's share of the time is spent on actual optimization steps. However, for too large M there may be a price to pay since merging many points results in a large approximation error (weight degradation). Also, the proceeding can only pay off if the computational complexity of merging M > 2 points is not much larger than merging M = 2 points.

In this work we propose a simple yet effective computational improvement and theoretical proof of this scheme. Finding good merge partners, i.e., SVs that induce a low approximation error when merged, is a rather costly operation. Usually, O(B) candidate pairs of vectors are considered, and for each pair an optimization problem is solved with an iterative strategy. Most of the information on these pairs of vectors is discarded, and only the best merge is executed. We propose to make better use of this information by merging more than two points at a need. The main effect of this technique is that merging is required less frequently, while the computational effort per merge operation remains comparable. Merging three points improves training times by 30% to 50%, and merging up to 10 points can speed up training by a factor of five. As long as the number of points to merge is not excessive, the same level of prediction accuracy is achieved.
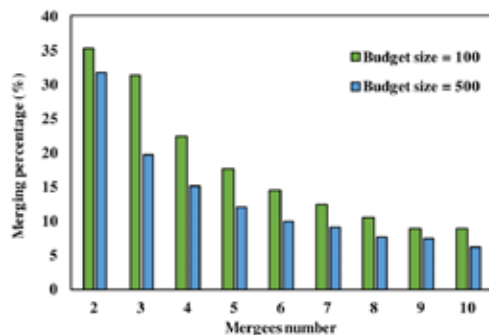
Ijcnnmerge-1.png
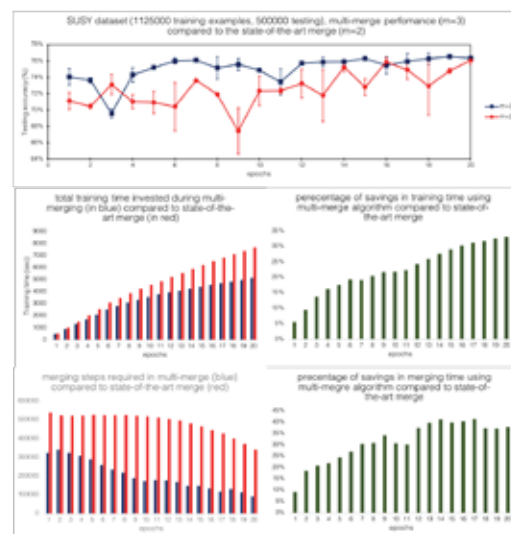
Susymutlimergeanalysis.png

Adultmutlimergeperformanceandmerging-
steps.png

Figure ijcnnmerge-1.png: percentage of merging time w. r. to total training time in IJCNN dataset (50000 training examples) at two different budget size. Merge number = 2; means that two SVs are merged into one SV, or = 3; three SVs are merge into one ... up to 10 merges at one activation in the budget maintenance step.

Figure susyMultimergeAnalysis.png: complete analysis of testing accuracy, training time, merging time and merging steps, when merge number = 2 (current state-of-the-art method in merging) and the adaptive merge number = 3 (which not only means that we merge three SVs at a need but also merge the partners if they have an error that is within 5% of the minimum error). The study is done for 20 epochs. The data set has 1255000 training examples.

Figure adultMultimergeAnalysis.png: another Benchmark in the study with a middle size.

Figuresexplanation.png

The Research and Development for Craftsmen's Know-How Transfer into Robot Cell

Friday, 23rd November @ 15:42: Machine Learning and AI applications in industry (Auditorium) - Oral - Abstract ID: 230

Ms. Yu-Yi Chen [1] , **_Mr. Chih-hsuan Shih_** [2] , **_Dr. Sue Huang_** [3]

1. _Industrial Technology Research Institute /National Chiao Tung University,_ **2.** _National Taiwan University,_ **3.** _Industrial Technology Research Institute_

Introduction

Taiwan's traditional metal craft skills are facing a crisis of disappearance which will affect some industries includes faucet, metal process, precision machining , electronic parts, automobile manufacturing, aerospace etc. Although machine automation can handle some metalworking process, the general robot is not able to deal with the complex and variable shape. As usual, an apprentice spends six months to be trained to learn the basic skills and then quickly give up this kind of job before finishing their training, because they always work in the high temperature and dust environment where will hurt their eyes, lung and body. In order to solve the above problems, we try to build an artificial intelligence robot and system with the masters' craftsmanship.

Methods

Our user experience researcher/ use interface designer, robot engineer and artificial intelligence developer work together for designing this A.I. robotics and system. Especially, we build the multidisciplinary approach which integrates user experiences research, industry demand survey, IoT data and system analysis, function definition and machine learning. The key is how to translate all implicit know-how from the masters into the functional specifications for sensors, robot system and deep-learning model. Our methodology and concept are shown in Figure 1.

Results

It's the most difficult skill to grind and polish the metal curved surface for the craftsman. In general, human must spend fourteen days in teaching the programmable robot arm to learn how to grind and polish a new work piece. However, our grinding and polishing A.I. robot system only need one day to learn and complete a new metal object. Our A.I. robot and system are used to the factory in Hocheng Corporation. There are more features and innovations of our technologies are listed in Figure 2.

Discussion

Facing global trends and problems include diversification manufacturing, batch production, composite or lightweight material, lack of labor and so on. It's the big challenge that how to transform humans' experiences and skills into robots or machines to complete the complicated task.

Figure 1 methodology and concept.jpg
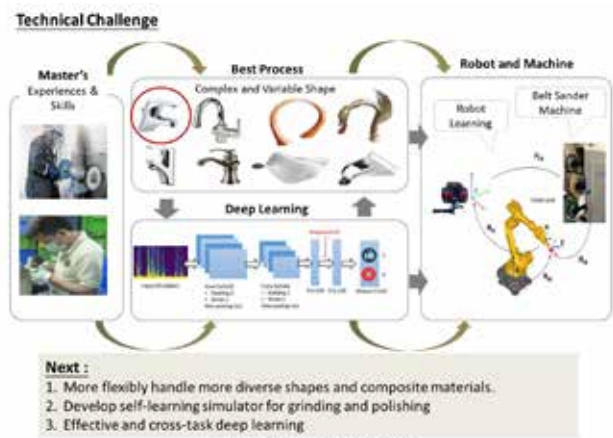

Figure 2 result list.jpg

Figure 3 our challenge and next plan.jpg

E-Nose based Pattern Recognition methods to Improve Pizza Toppings Classification

Friday, 23rd November @ 15:42: Pattern recognition & Cognitive systems (Room 201) - Oral - Abstract ID: 210

Prof. Aziz Amari [1], Dr. Rachida Belloute [2], Prof. Mohammed Diouri [2]

1. Mohammed V University In Rabat, 2. Moulay Ismaïl University

The aim of this work is to set up an electronic nose (e-nose) system for the safety and quality evaluation in food industries. The final goal is to evaluate the potential application of the e-nose technology based on MQ-type gas sensors as a continuous monitoring and controlling tool in food processing. E-nose has been developed using six metal oxide semiconductors (MOS), MQ-type from Henan Hanwei Electronics Co., the sensing element of these gas sensors is a tin dioxide (SnO_2) semiconductor which has low conductivity in clean air. An Arduino Mega microcontroller was used for sensors data acquisition. The E-nose system was programmed with Labview software to control the electronics and to acquire data from the sensors.

As application, the developed E-nose was used to differentiate among different pizza toppings. Four pizza topping types were prepared in this study: P_1(100% of minced beef + Edam cheese), P_2(50% of minced beef - 50% of minced Kadid + Edam cheese), P_3(100% of minced Kadid + Edam cheese) and P_4(100% of minced beef + parmesan cheese). Kadid (air-dried salted meat) was similar to plain meat with respect to perception and preference. For this purpose, an improved feature selection approach, based on One-way ANOVA, was applied in order to select the most significant features that contained discriminative information. By applying Principal Component Analysis (PCA), Cluster Analysis (CA) and Support Vectors Machines (SVMs) on the features selected database, a good separation of the four pizza toppings was achieved. CA Results show that olfactory disturbance with lemon smell significantly affect order of topping identification capability by the electronic nose, especially for cheese.
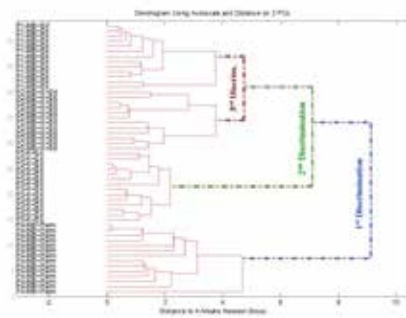
Keywords-Electronic nose; Gas sensors; Pizza; Data analysis; One-way ANOVA; PCA; Cluster analysis; Feature selection.
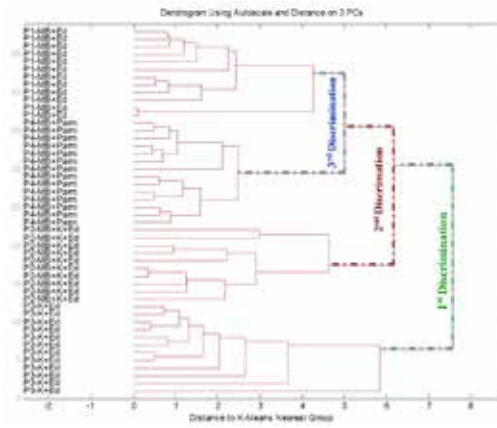
Schematic representation of the used mq sensor array.jpg
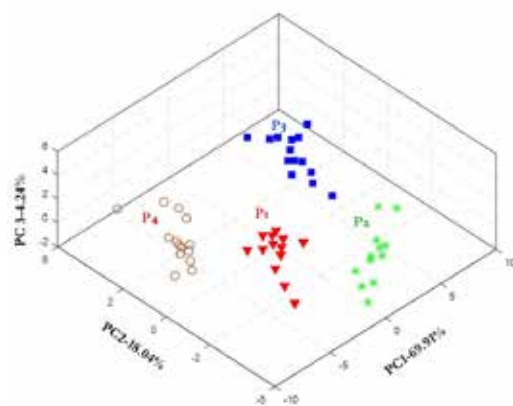
Three-dimenional pca plot performed on four pizza topping using one-way anova selected features.jpg

K-means cluster analysis dendrogram performed on the one-way anova variable selected data.jpg

K-means cluster analysis ca dendrogram performed on the one-way anova variable selected data obtained with disturbing odour.jpg

Labeling of topic in Independent Topic Analysis using Search Engine

Friday, 23rd November @ 15:59: Machine Learning and AI applications in industry (Auditorium) - Oral - Abstract ID: 238

Dr. Takahiro Nishigaki [1] *, Prof. Takashi Onoda* [1]

1. Aoyama Gakuin University

In recent years, the number of document data has been increasing since the spread of the Internet. Many methods have been studied for extracting topics from large document data. We proposed Independent Topic Analysis (ITA) to extract topics independent of each other from large document data such as newspaper data. ITA is a method for extracting the independent topics from the document data by using the Independent Component Analysis. The topic represented by ITA is represented by a set of words. However, the set of words is quite different from the topics the user imagines. For example, the top five words with high independence of a topic are as follows. Topic1 = {"scor", "game", "lead", "quarter", "rebound"}. This Topic 1 is considered to represent the topic of "SPORTS". This topic name "SPORTS" has to be attached by the user. ITA cannot name topics. Therefore, in this research, we propose a method to obtain topics easy for people to understand by using the web search engine, topics given by the set of words given by independent topic analysis. Therefore, we propose a method to give ITA topics a name easy for users to understand using the Web search engine. And we also use the proposed method for some data and verify its effectiveness.

Ethics for Artificial Intelligence

Friday, 23rd November @ 15:59: Pattern recognition & Cognitive systems (Room 201) - Oral - Abstract ID: 28

Dr. Knud Thomsen [1]

1. *Paul Scherrer Insitut*

Ethics is a topic for AI in at least two respects: 1) in considerations, which aims and steps constructing AI capabilities would meet ethical standards, and also 2) which are the ethical demands applicable for any working AI. This second aspect is in the focus of this contribution.

It can convincingly be argued that justice is a central cornerstone and basis of human ethics.

In an impressive philosophical undertaking John Rawls in the last century has reasoned that justice is best understood as fairness, and his view has been highly acclaimed. Rawls devised a procedure how to establish fairness in a democratic society by harnessing his famous veil of ignorance, where decisions are taken and goods distributed by everyone involved in complete ignorance of their own status. Each individual has to consider the possibility that he/she is the worst off, and therefore tries his/her best to further the not so lucky members. Alas, this runs completely counter to another central idea, indispensable for just decisions at a court. There, it is most important, that publicly known (accepted) rules are followed in a fully transparent manner, and that decisions can be explained and they are justified by showing how they take into unbiased account all available evidence as good as any possible.

A recently proposed cognitive architecture, the Ouroboros Model, lays strong emphasis on widest possible coverage and consistency of evidence and on the dimension of time. While cognitive structures build up endlessly, expansion affecting the real world finds its limits at hard boundaries.

A "Negative Imperative" can be formulated, stating in coarse terms, that with tight common restrictions and interlaced complex links and dependencies between partners any violent action with high probability has negative impacts also on an actor and the whole world and thus should be avoided for his/her own most intrinsic self-interests.

The above does not see humans (forever) in any privileged position: Any actor, single human, state, alien or artificial with a certain minimum of general cognitive (and effective) capabilities is bound by the negative imperative; some constrained flexibility is a direct general consequence and self-consistently mandatory.

Understanding ratings with hesitant terms and consensus: An application to hotel recommendations

Friday, 23rd November @ 16:16: Machine Learning and AI applications in industry (Auditorium) - Oral - Abstract ID: 80

Ms. Jennifer Nguyen [1], Dr. Jordi Montserrat-Adell [1], Dr. Núria Agell [2], Dr. Mónica Sánchez [1], Dr. Francisco Ruíz [1]

1. Universitat Politècnica de Catalunya, 2. ESADE Business School

Introduction

Recommendation systems often present similar items with the same ratings. Users must discern the best choice using other information, including customer reviews. We propose a methodology to synthesize reviews into an overall rating and consensus measure, facilitating a comparison between ratings and reviews across items.

Method

We combine ratings and reviews into an interval rating by means of hesitant fuzzy linguistic term sets (HFLTS) according to Figure 1. First, for each item and each review we generate a HFLTS from ratings and semantic analysis performed on reviews. Next, for each item we compute the centroid of all HFLTS reviews. Third, we measure the degree of consensus for each item using the distance between the reviews and centroid. Then, each item is expressed as a combination of the centroid and consensus measure enabling us to "totally" order the item reviews.

A real case example is provided from 966 TripAdvisor reviews of twenty hotels in Rome.

Results

To assess our methodology, we provide the processing time for the given example using an extended data set of 70,000 reviews. Secondly, we compare the HFLTS ratings with the median TripAdvisor hotel ratings. Two potential benefits are identified. First, users can discriminate between hotels with the same overall rating, such as "5 stars", by reviewing the associated centroids. For example, a centroid [4,5] indicates reviewers have negative impressions different from "5 stars". Second, given a centroid {5}, users can infer from the consensus measure on which hotel reviewers agree the most. Refer to Table 1 for details.

Before the proposed methodology, 19% of the hotels could be differentiated by the ratings. Afterwards, using our system, 99.5% of the hotels could be differentiated

Discussion

There are three contributions. First, hesitancy is introduced to each review by means of sentiment analysis. Second, a centroid fuses information from the reviews and rating. Third, a consensus measure identifies hotels with less variability in their reviews. From a general perspective, intelligent personal assistants may benefit from the ability to suggest a single alternative rather than a list of items, a process reflective of a conversation between friends.
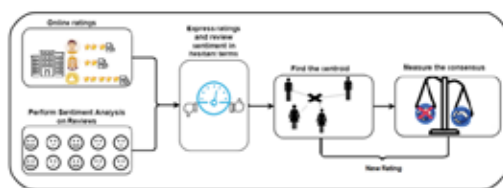

Figure 1 methodology.png

Hotel	# of reviews	TripAdvisor median rating	Centroid	Consensus
#14	30	5	{5}	0.850
#6	41	5	{5}	0.835
#15	30	5	{5}	0.808
#13	34	5	{5}	0.801
#2	32	5	[4,5]	0.875
#5	60	5	[4,5]	0.838
#20	32	5	[4,5]	0.773
#10	100	5	[4,5]	0.770

Table 1: Sample output of real case

Table 1 real case.png

Stochastic Variance Reduction for Deep Q-learning

Friday, 23rd November @ 20:00: Online Presentations (Online) - Video - Abstract ID: 310

Mr. Weiye Zhao [1] *, Dr. Jie-lin Qiu* [2]

1. University of California, 2. Carnegie Mellon University

Recent advances in deep reinforcement learning have achieved human-level performance on a variety of real-world applications. However, the current algorithms still suffer from poor gradient estimation with excessive variance, resulting in unstable training and poor sample efficiency. In our paper, we proposed an innovative optimization strategy by utilizing stochastic variance reduced gradient (SVRG) techniques. With extensive experiments on Atari domain, our method outperforms the deep q-learning baselines on 18 out of 20 games.

A more effective way to use crowd sourcing for text analysis

Friday, 23rd November @ 20:15: Online Presentations (Online) - Video - Abstract ID: 280

Dr. Hyunzoo Chai [1]

1. Donnelley Financial Solutions

Crowd sourcing has become a popular research approach for annotation tasks in recent years and been used successfully in many projects. Crowd sourcing has several advantages: Complex annotation tasks can be accomplished quickly and affordably, and often with high quality, however researchers believe (often with good reason) that crowd sourcing does not provide high-quality results for tasks requiring a high level of domain expertise.

While conducting an National Science Foundation(NSF) project looking at trends in what gets funded by the NSF, we used one of well-established NLP approaches, Named Entity Recognition(NER) which relies on annotated data.

In this talk, we'll compare two experiments through Amazon's Mechanical Turk to show how to use crowd sourcing effectively.

- Providing contextual information. We randomly selected 100 word-phrases from the list of potential method names. Each word was shown to five different Mechanical Turk workers, within a sentence taken from an National Science Foundation(NSF) proposal. For example, the word "case study" is presented with the sentence: *Case studies in this effort are designed to help transition the theoretical principles developed into practical algorithms.*
- Providing information from the web. In our second experiment, instead of displaying a sentence from an NSF proposal, I displayed Google search results for the word-phrase. Workers could see the first page of search results and click on the links if they desired. (see Figure 1. Amazon's Mechanical Turk interface)
- Surprisingly, the second approach resulted in much higher inter-rater reliability, with a Krippendorff's alpha of 0.71 compared to 0.36 of the first experiment (typically alpha above 0.8 is taken as an indicator of high reliability, alpha between 0.667 and 0.8 is acceptable for some purposes). Accuracy was improved also. Workers were also faster with the second approach, with each task taking on average 7 minutes 50 seconds compared to 10 minutes 27 seconds previously.

Crowd sourcing platforms such as Mechanical Turk now allow researchers to get data labelled online quickly and cheaply, allaying some of the limitations of hand-coding. However, they are not always so. Providing the right kind of extra information to Mechanical Turk workers can significantly improve quality.

Figure1-amazon mechanical turk interface.png

A Survey of Attacks Against Twitter Spam Detectors in an Adversarial Environment

Friday, 23rd November @ 20:30: Online Presentations (Online) - Video - Abstract ID: 227

Mr. NIDDAL IMAM [1]

1. *University of York*

INTRODUCTION.

Online Social Networks (OSNs), such as Facebook and Twitter, have become a very important part of many people's daily lives. Unfortunately, the high popularity of these platforms makes them very attractive to spammers. Machine-learning techniques have been widely used as a tool to address many cybersecurity application problems (such as spam and malware detection). However, most of the proposed approaches do not consider the presence of adversaries that target the defense mechanism itself. Adversaries can launch sophisticated attacks to undermine spam detectors either during training or the prediction (test) phase. Not considering these adversarial activities at the design stage makes OSNs' spam detectors prone to a range of adversarial attacks. Most recent studies addressing adversarial attacks examine the use of applications, such as email spam filters, malware detection, or intrusion detection systems, whereas only a few discuss the adversarial attacks against OSNs' spam detectors. Existing surveys of OSNs' spam detectors provide various methodologies used for detecting spam without analyzing the performance of these methodologies in an adversarial environment. This paper thus surveys the attacks against Twitter spam detectors in an adversarial environment. In addition, a general taxonomy of potential adversarial attacks is proposed by applying common frameworks from the literature. Examples of adversarial activities on Twitter were provided after observing Arabic trending hashtags. A new type of spam tweet (*Adversarial spam tweet*), which can be used to undermine deployed classifiers, are found. Additionally, possible countermeasures that could increase the robustness of Twitter spam detectors against such attacks are investigated.

METHOD.

Different hypothetical attack scenarios against Twitter spam detectors are proposed.These attack scenarios are modeled as follows:

- Categorizing attacks based on their influence and type of violation (e.g. causative integrity attack).
- Identifying attacks' settings, which include an adversary's goal, knowledge and capability.
- Defining attacks' strategy that provides potential attack steps.

CONCLUSION.

The main goal of this paper is to present a comprehensive overview of different possible attacks, which is the first step towards evaluating the security of Twitter's spam detectors in an adversarial environment. Future research needs to focus on studying the effect of adversarial spam tweets on spam detectors.

An example of probing attack.png
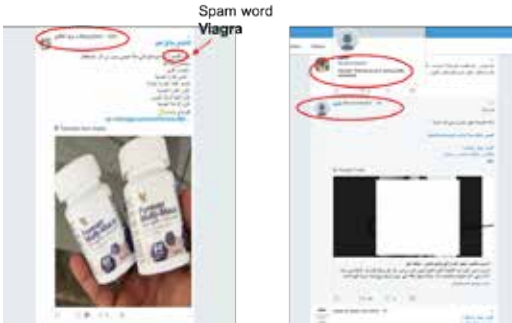
Examples showing the effect of adversarial attacks.png

Taxonomy of potential attacks against twitter spam detectors.png
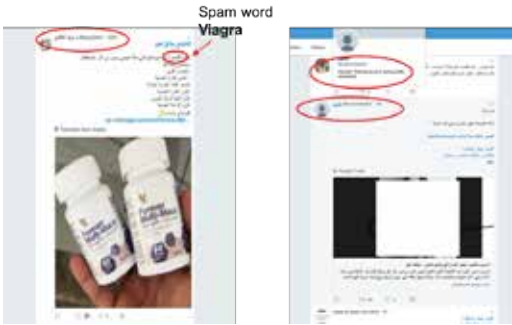
Spam tweets bypass the detection system due to the availability attack.png

Authors Index