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Theory of Machine Learning Based on Non Relativistic Quantum Mechanics

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Machine Learning through the Mitchell's criteria establishes the following for any universal system:

- 1.- All system has a concrete or various tasks that justifies its existence.
- 2.- The system makes a (correct or wrong) choice of a concrete performance to accomplish the task.
- 3.- Once the performance is done, then the system experience a success or fail. If it is a fail then the system can go back to reconfigure the performance.

The probability for finding a particle at time "t" is a finite value

$$P(t) = \langle B(t) | A(t) \rangle$$

This probability: $0 < P(t) < 1$

Success = 1 Fail ≈ 0

The Task:
To find the value of probability at time "t"

The Performance:
The best choice of the evolution operator containing the system Hamiltonian.

$$\langle B(t) | A(t) \rangle = \langle B(t) | U(t - t') | A(t') \rangle$$

$$\hat{U} = \text{Exp} \left[-\frac{i}{\hbar} \left[\frac{P^2}{2M} + V(X) \right] (t - t') \right] = \hat{G}(X, P)$$

$$\begin{aligned} \langle B(t) | A(t) \rangle &= \langle B(t) | \int dp | p \rangle \langle p | \hat{G}(P) | \int dp' | p' \rangle \langle p' | A(t') \rangle \\ &= \int dp dp' \langle B(t) | p \rangle \langle p | \hat{G}(P) | p' \rangle \langle p' | A(t') \rangle \end{aligned}$$

If $P(t) \ll 1$
 The Hamiltonian is reconfigured with variation:



$$\hat{U}' = \text{Exp} \left[-\frac{i}{\hbar} \left[\frac{(P + \lambda P)^2}{2M} + V(X + \lambda X) \right] (t - t') \right] = G'(X, P)$$

Such variations lead to an improved Green's function.



$$|\Psi'(t')|^2 = \int dp dp' \langle B(t) | p \rangle \langle p | \hat{F}(P) | p' \rangle \langle p' | A(t') \rangle$$

Estimation of Machine Learning Experience



$$\mathcal{E}(t'') = \frac{|\Psi(t'')|^2}{|\Psi(t)|^2 + |\Psi(t'')|^2}$$

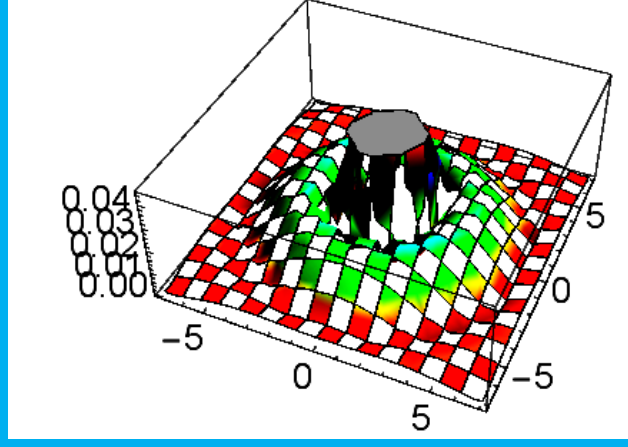
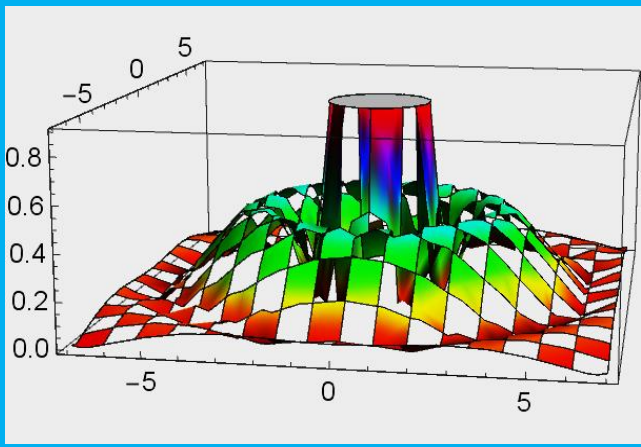
The experience is estimated at a time $t'' \gg t$

The Experience can be integrated for subsequent times where is perceived a kind of improvement:

$$\mathcal{E} = \int \mathcal{E}(t'') dt'' = \int dt'' \frac{|\Psi(t'')|^2}{|\Psi(t)|^2 + |\Psi(t'')|^2}$$

The full integration requires of a path at the complex plane. This action can also be perceived as a kind of performance. The resulting path would keep the probability to be high enough that guarantees to the system keeps its stability and minimal energy.

Illustration of possible 3D distributions with and without variations



[1] T. Mitchell, IEEE International Workshop Artificial Intelligence, 1989 Pages: 77 - 84.
 [2] P. Teng, <https://arxiv.org/pdf/1710.03213>, 2018.