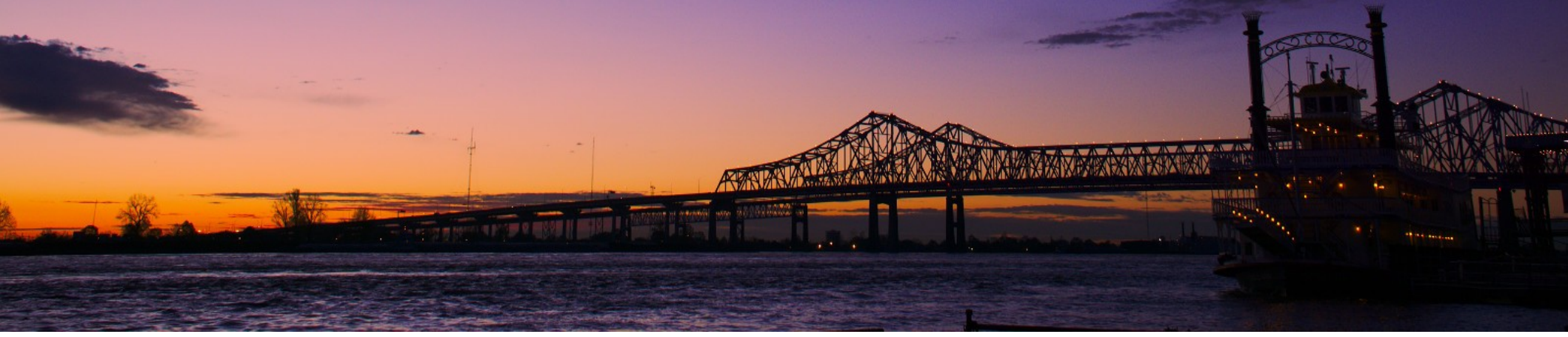


# 新しい学習アルゴリズムの開発

Development of Active learning and  
Neocortex model Neural Network



RSTAR



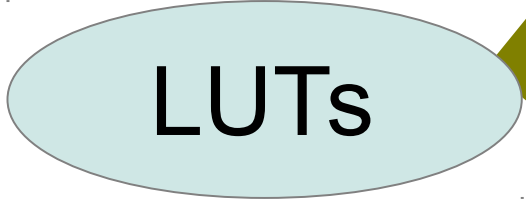
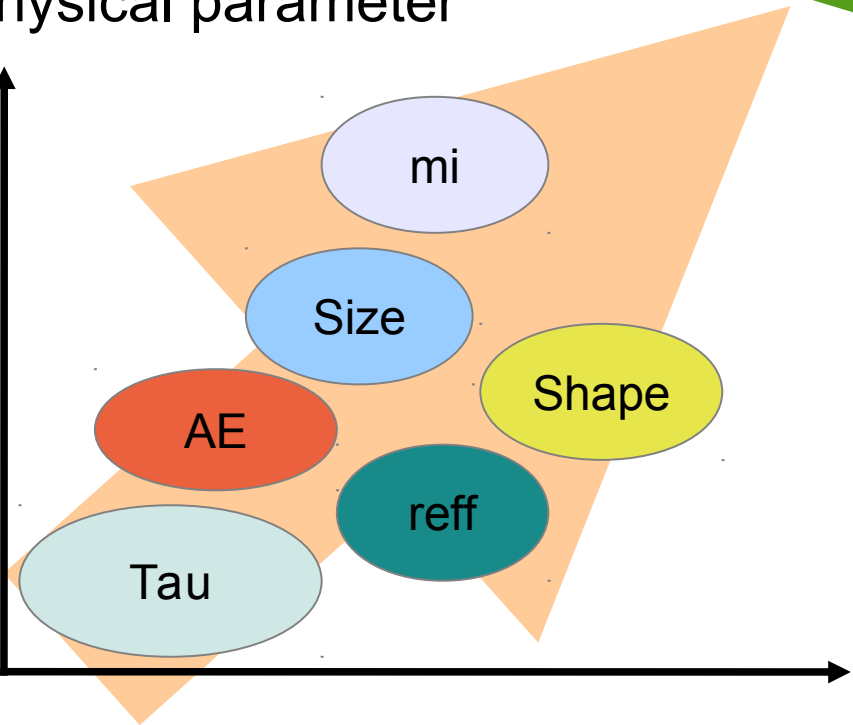
CAPCOM, REAP



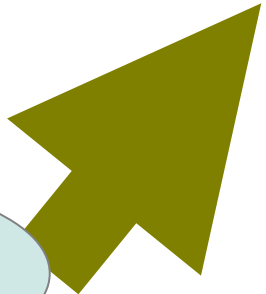
J-Sim



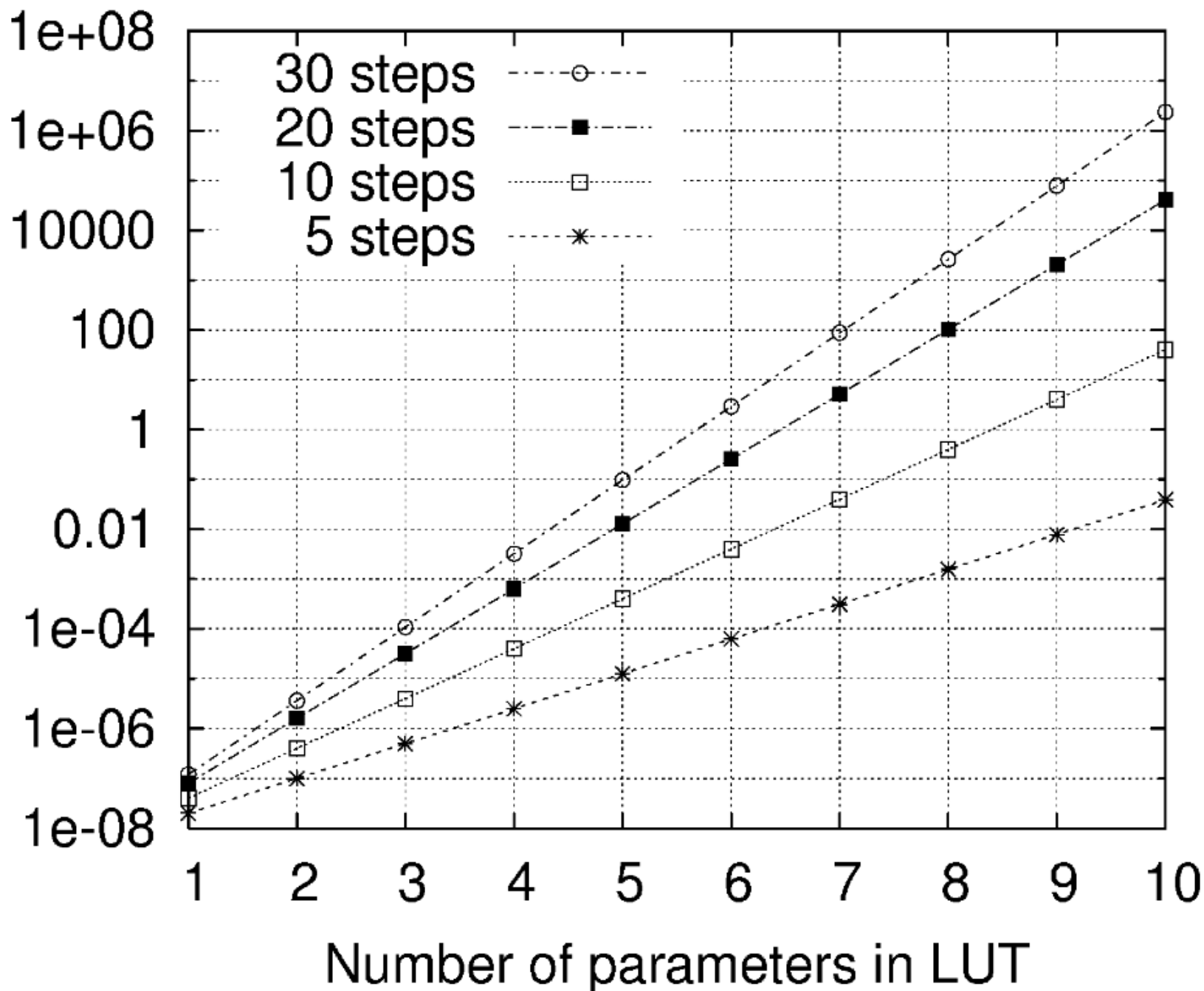
Physical parameter



Wavelength, Channel



LUT volume [Giga Byte]

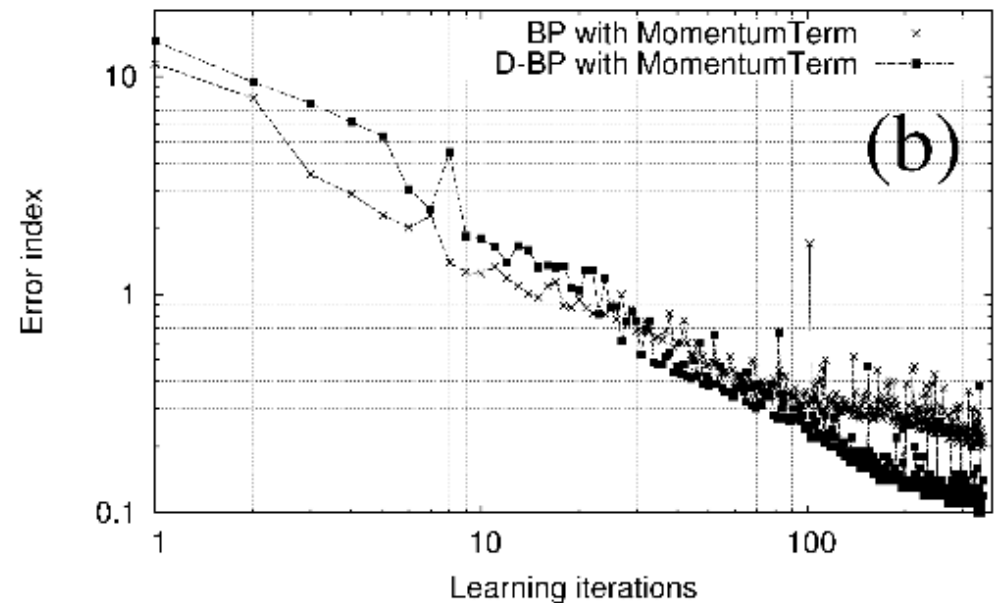
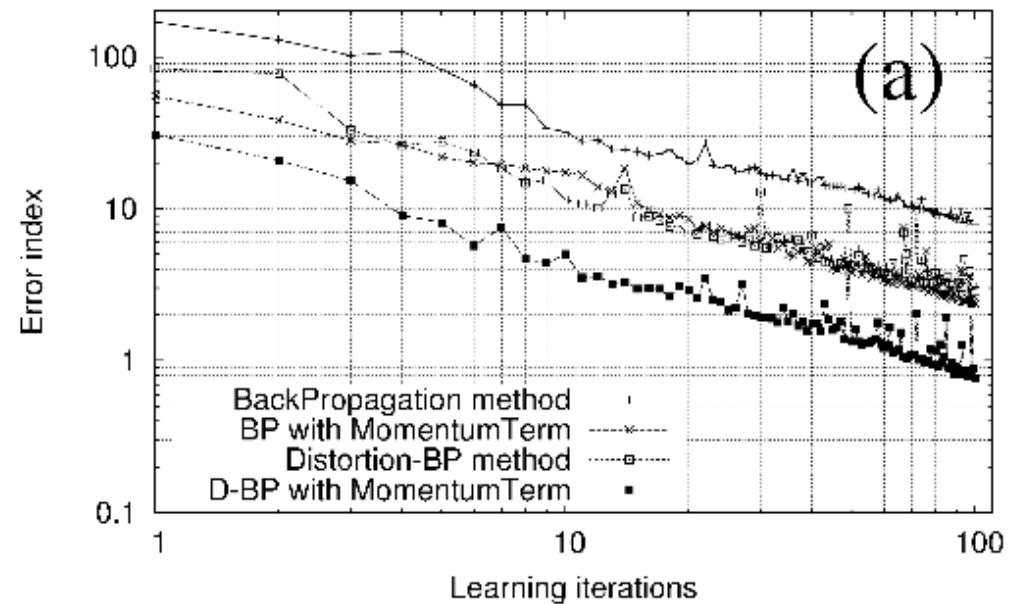
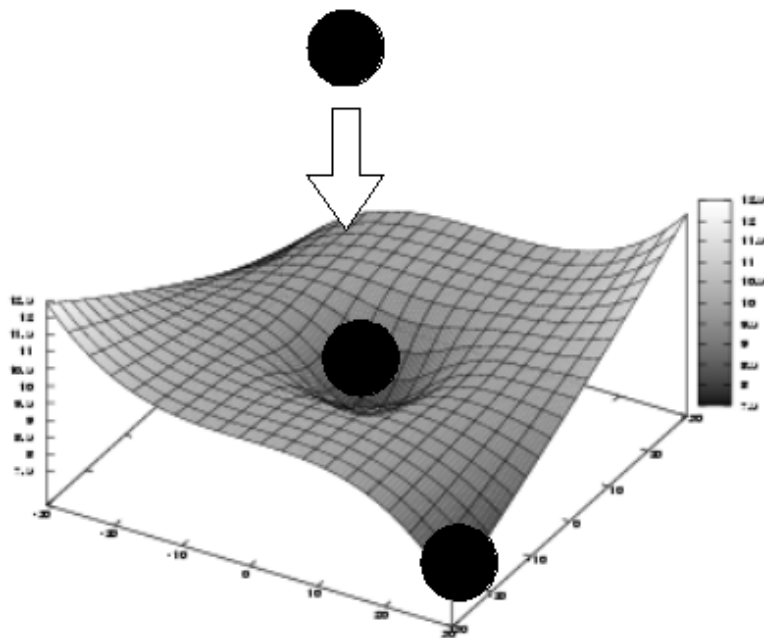


Four byte floating point :  $y = f(x_{number})$

# Improved learning algorithm

## “Distortion-BP”

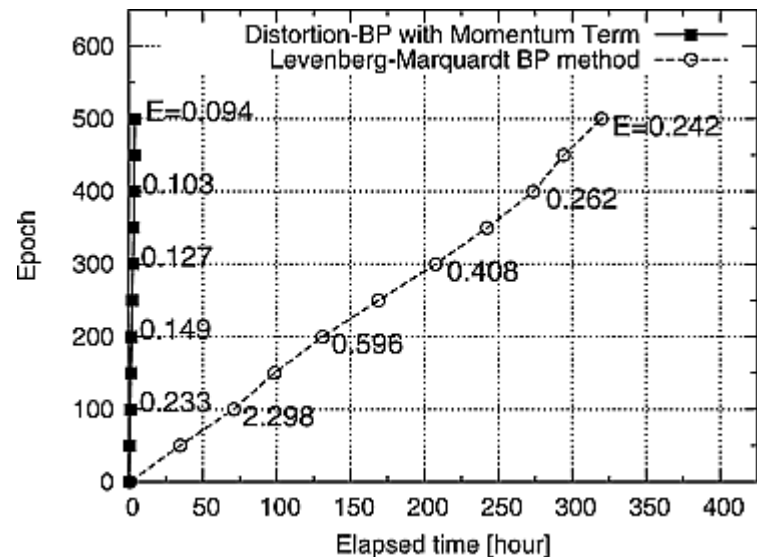
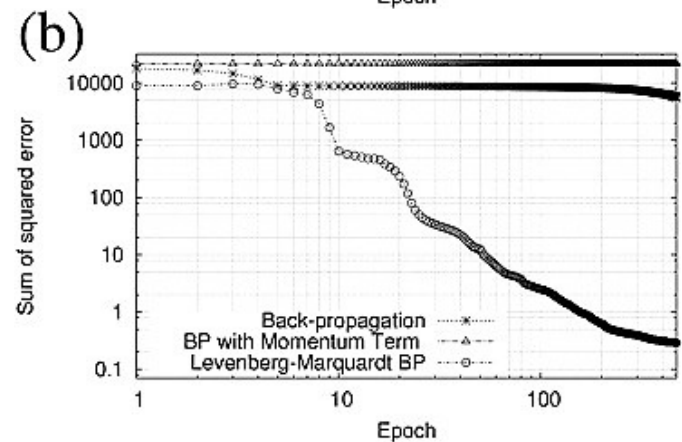
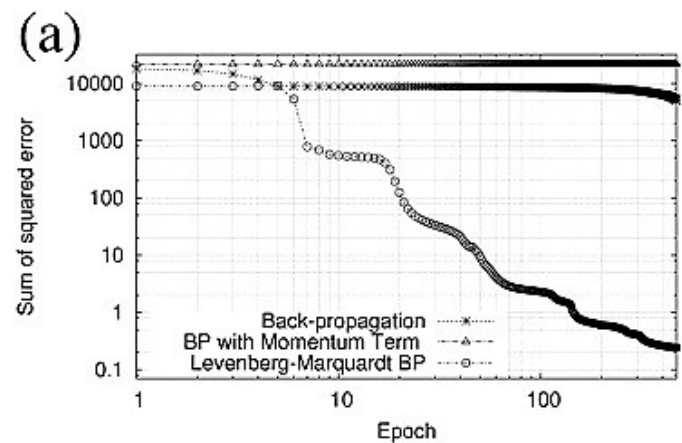
$$\left[ \begin{array}{l} \Delta W^{(s+1)} = -\eta \frac{\partial E}{\partial W} \Big|_{W=W^{(s)}} + \alpha \Delta W^{(s)} \\ \Delta V^{(s+1)} = -\zeta \frac{\partial E}{\partial V} \Big|_{V=V^{(s)}} + \beta \Delta V^{(s)} \end{array} \right.$$

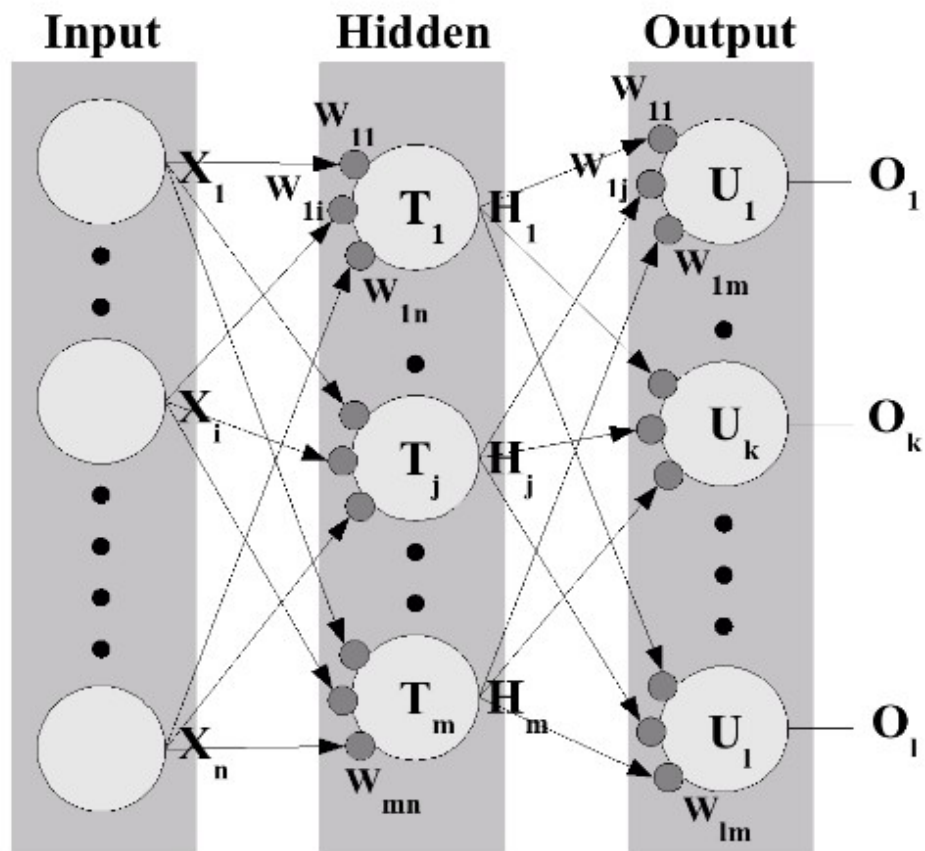


$$\begin{aligned}\Delta W &= -[\nabla^2 E]^{-1} \nabla E \\ &= -[H]^{-1} g \\ &\approx -[J^T J + \eta I]^{-1} J^T e.\end{aligned}$$

$$J = \begin{bmatrix} \frac{\partial e_{1|1}}{\partial W_1} & \frac{\partial e_{1|1}}{\partial W_2} & \frac{\partial e_{1|1}}{\partial W_3} & \cdots & \cdots & \frac{\partial e_{1|1}}{\partial W_n} \\ \frac{\partial e_{2|1}}{\partial W_1} & \frac{\partial e_{2|1}}{\partial W_2} & \frac{\partial e_{2|1}}{\partial W_3} & \cdots & \cdots & \frac{\partial e_{2|1}}{\partial W_n} \\ \vdots & \vdots & \vdots & & & \vdots \\ \frac{\partial e_{1|2}}{\partial W_1} & \frac{\partial e_{1|2}}{\partial W_2} & \frac{\partial e_{1|2}}{\partial W_3} & \cdots & \cdots & \frac{\partial e_{1|2}}{\partial W_n} \\ \frac{\partial e_{2|2}}{\partial W_1} & \frac{\partial e_{2|2}}{\partial W_2} & \frac{\partial e_{2|2}}{\partial W_3} & \cdots & \cdots & \frac{\partial e_{2|2}}{\partial W_n} \\ \vdots & \vdots & \vdots & & & \vdots \\ \frac{\partial e_{k|q}}{\partial W_1} & \frac{\partial e_{k|q}}{\partial W_2} & \frac{\partial e_{k|q}}{\partial W_3} & \cdots & \cdots & \frac{\partial e_{k|q}}{\partial W_n} \\ \vdots & \vdots & \vdots & & & \vdots \\ \frac{\partial e_{l|N}}{\partial W_1} & \frac{\partial e_{l|N}}{\partial W_2} & \frac{\partial e_{l|N}}{\partial W_3} & \cdots & \cdots & \frac{\partial e_{l|N}}{\partial W_n} \end{bmatrix}$$

$$e = \begin{bmatrix} e_{1|1} \\ e_{2|1} \\ \vdots \\ e_{1|2} \\ e_{2|2} \\ \vdots \\ e_{k|q} \\ \vdots \\ e_{l|N} \end{bmatrix} = \begin{bmatrix} t_{1|1} - O_{1|1} \\ t_{2|1} - O_{2|1} \\ \vdots \\ t_{1|2} - O_{1|2} \\ t_{2|2} - O_{2|2} \\ \vdots \\ t_{k|q} - O_{k|q} \\ \vdots \\ t_{l|N} - O_{l|N} \end{bmatrix}$$





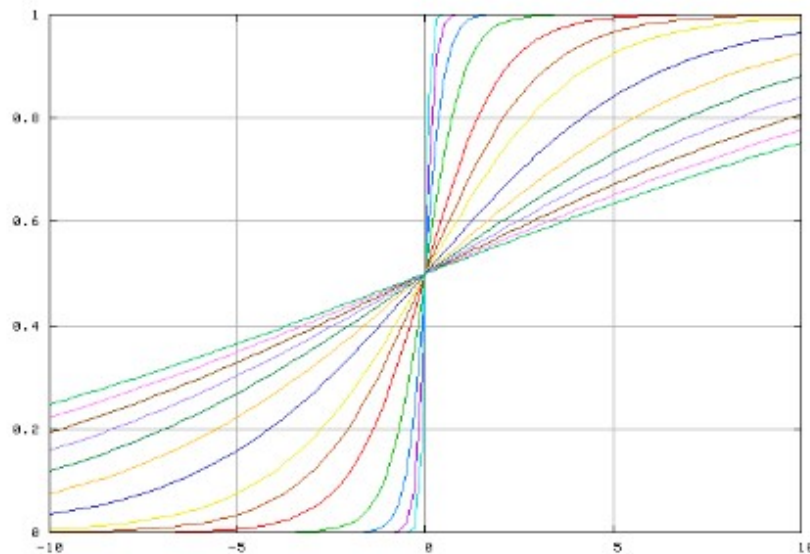
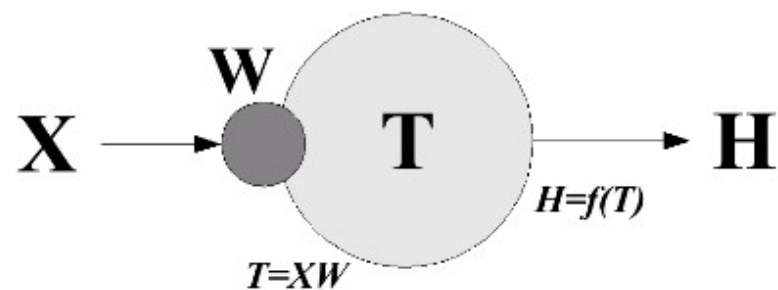
# Three layer network

$$T_j = \sum_{i=0}^n X_i W_{ji} \quad f(T) = \frac{1}{1 + e^{-\frac{T}{a}}}$$

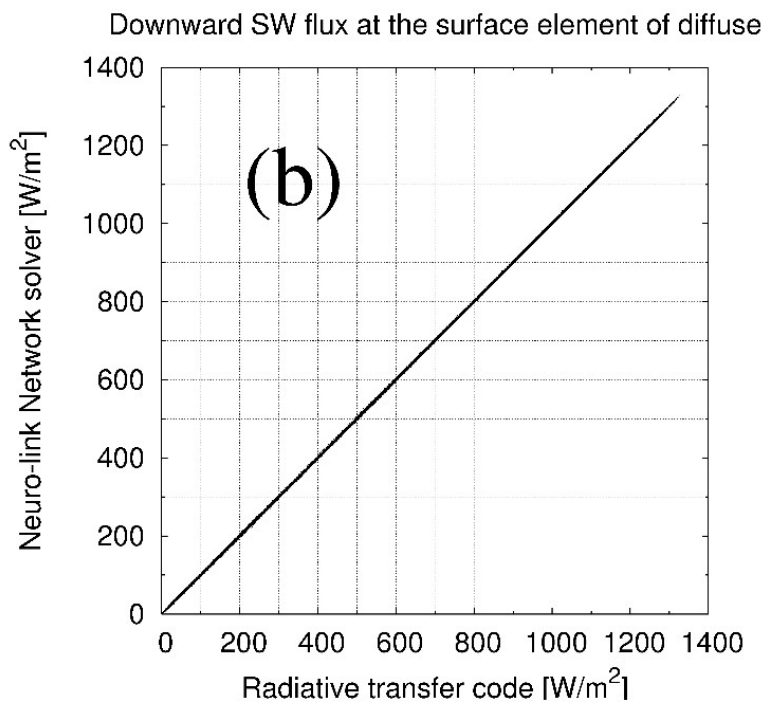
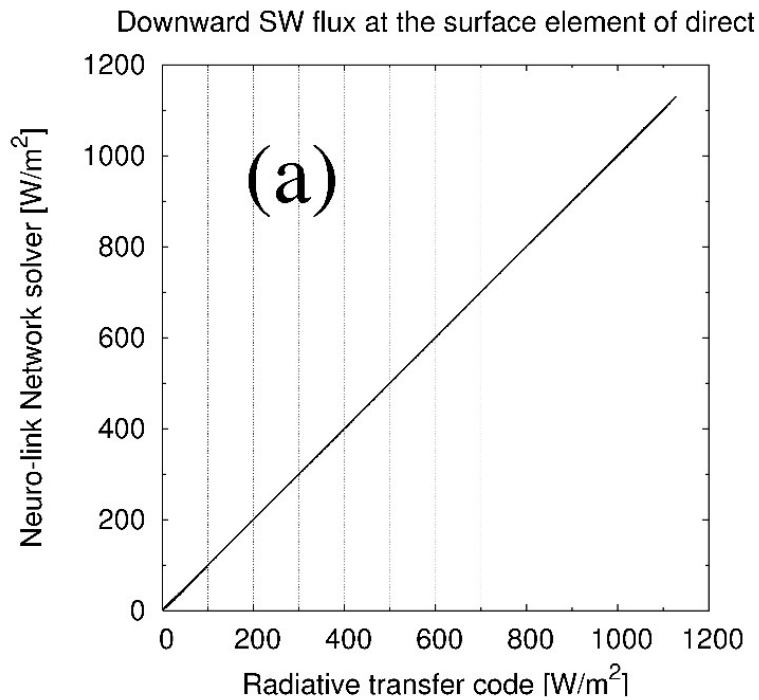
$$H_j = f(T_j, V_j)$$

$$U_k = \sum_{j=0}^m H_j W_{kj}$$

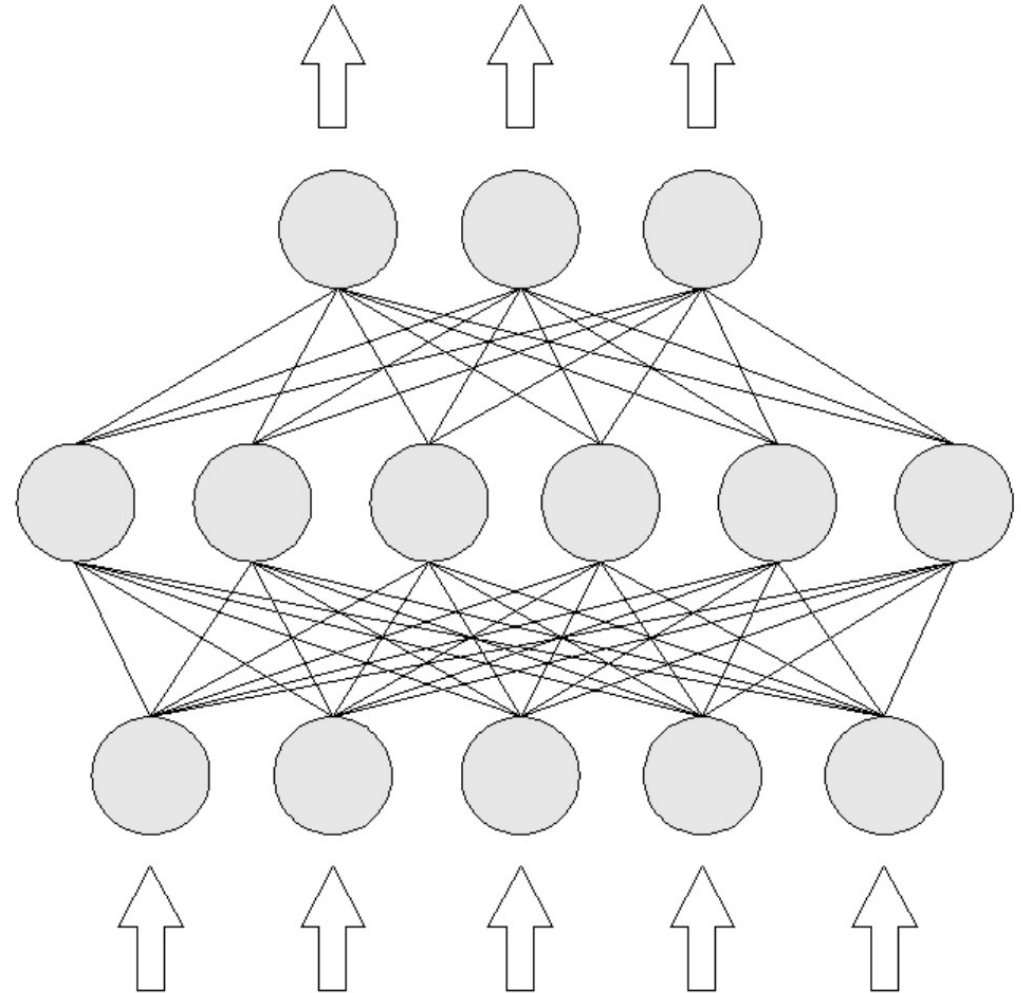
$$O_k = f(U_k, V_k)$$







# Solar radiation



# Radiative parameters

**Particle optical characteristics**  
**Absorption gasses amount**  
**etc.**

# Deep learning

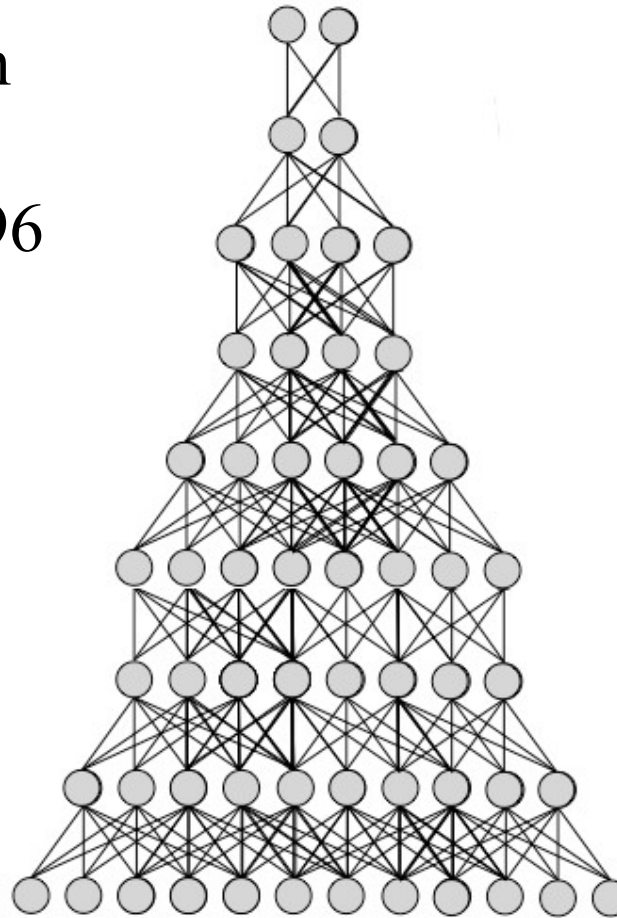
Rumelhart et. al., 1986  
Error Back-propagation

Olshausen & Field, 1996  
Sparse coding

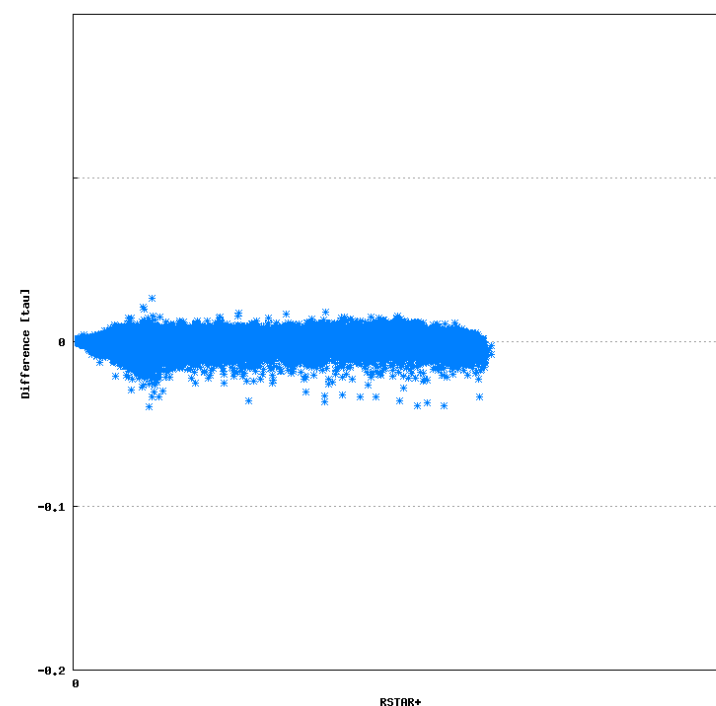
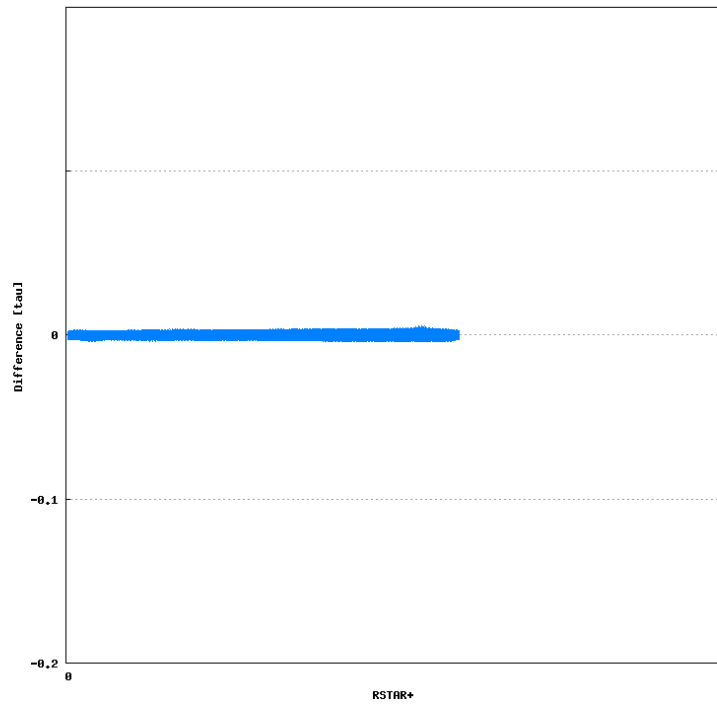
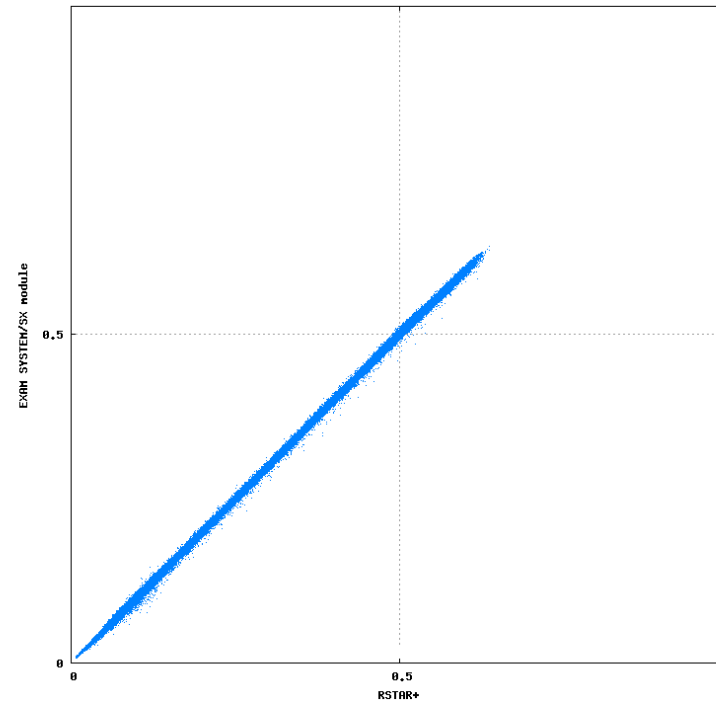
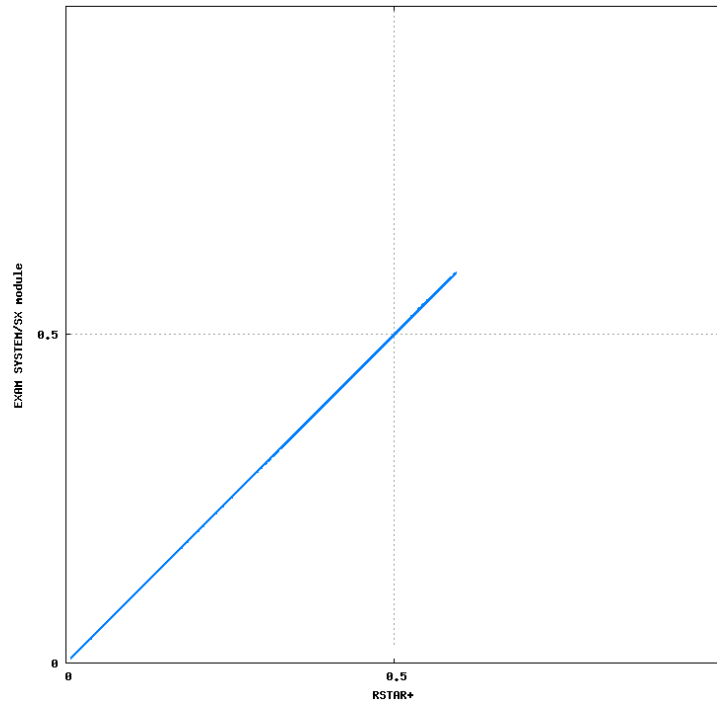
Hinton et. al., 2006  
Deep belief nets

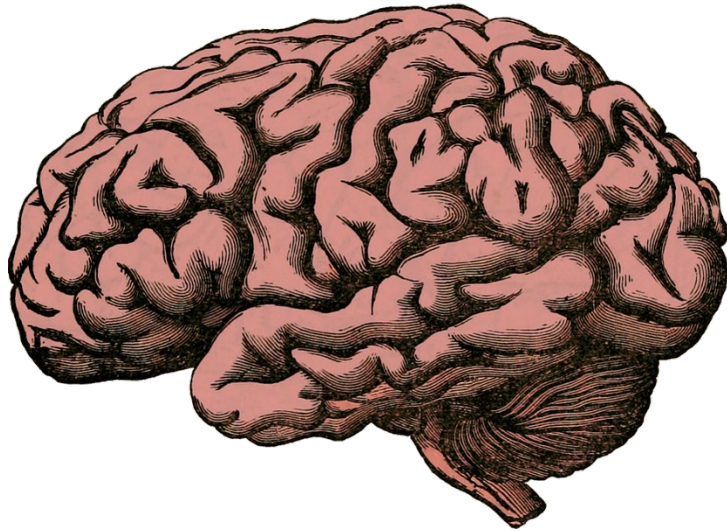
PC evolution  
1989 ~ 2001 ~ 2017

*Deep network and  
layerwise pretraining*

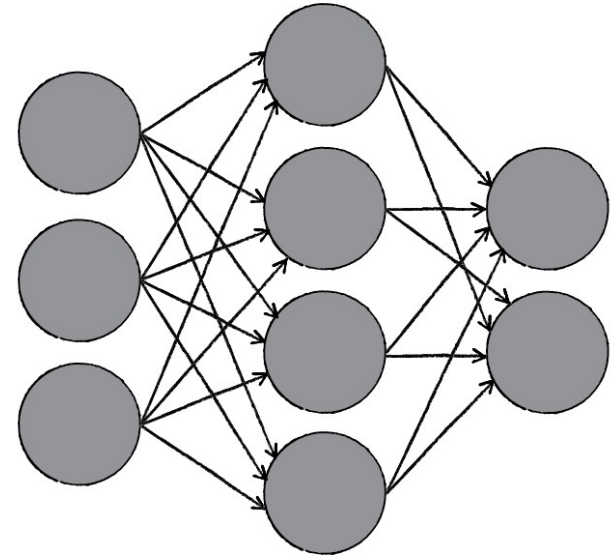






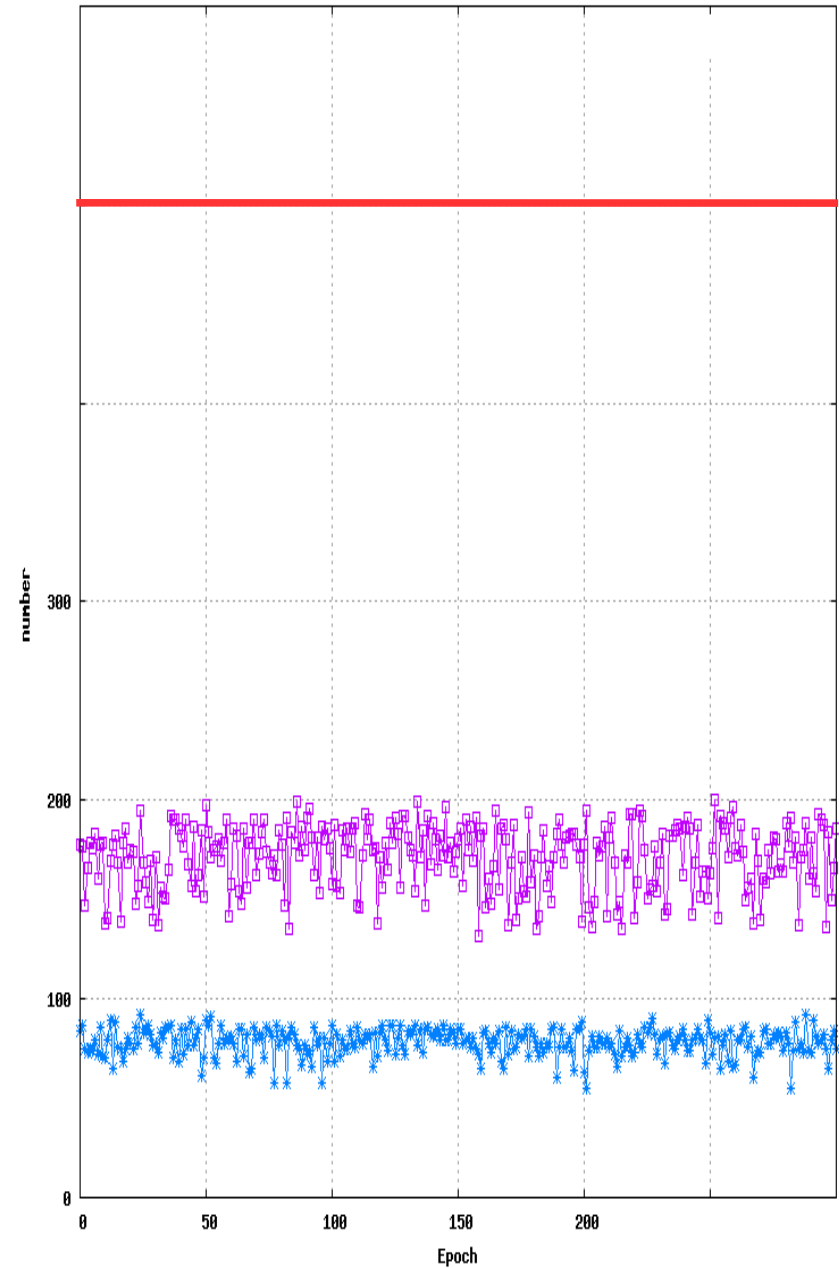
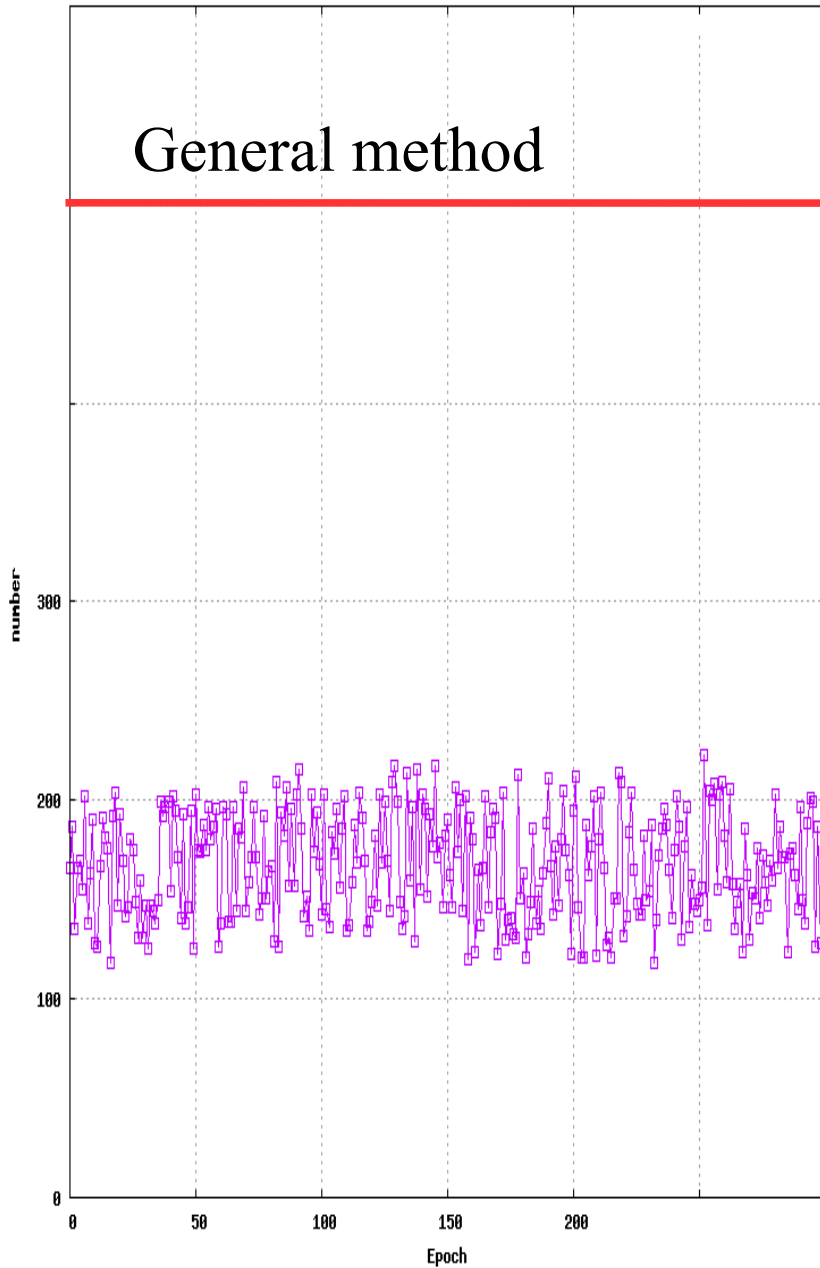


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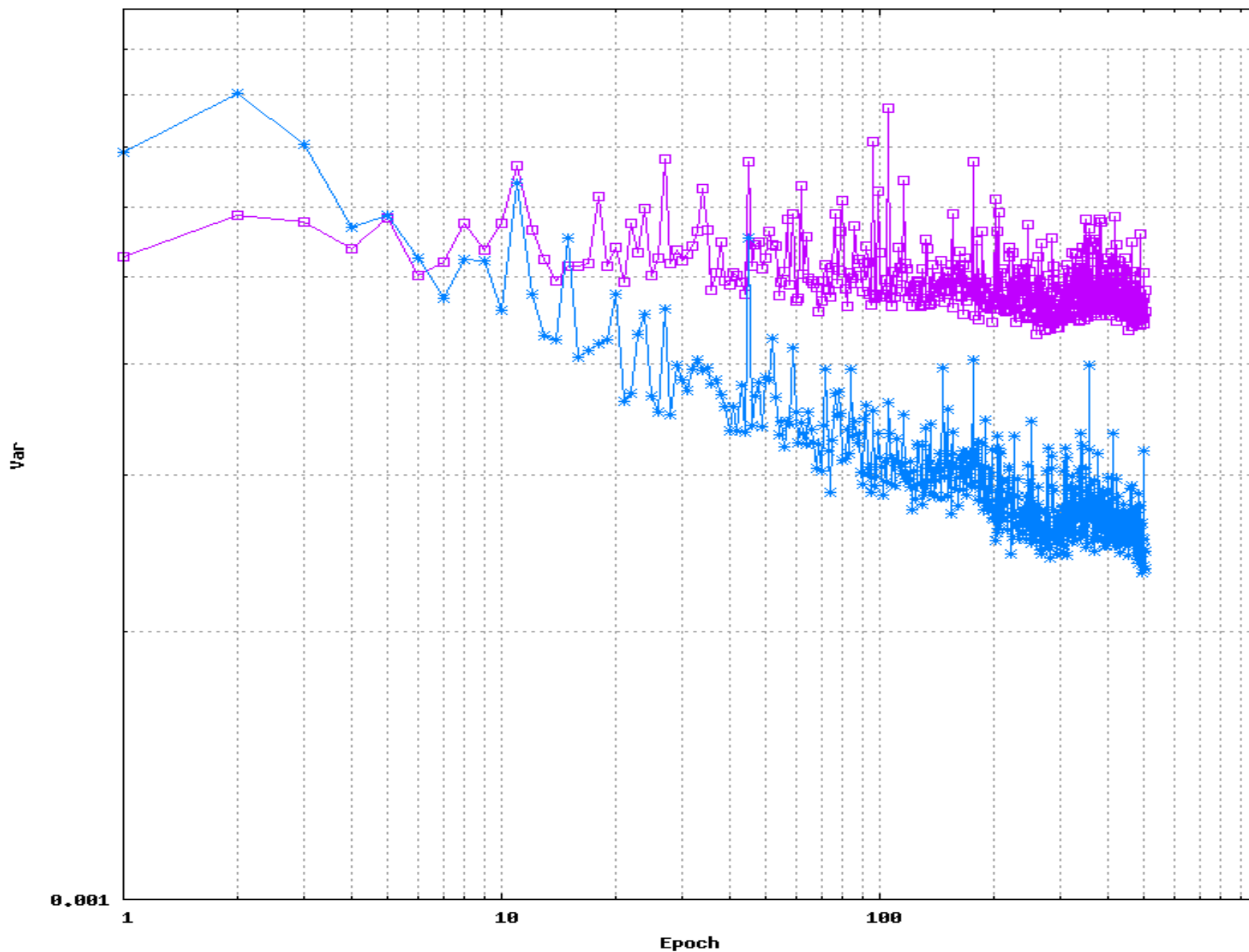


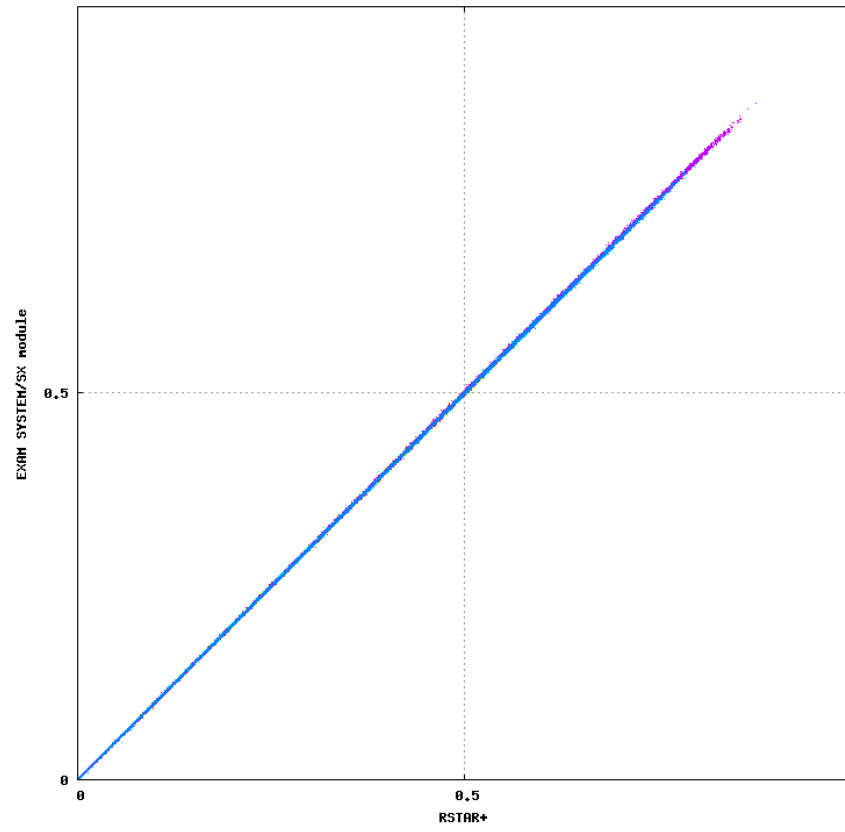
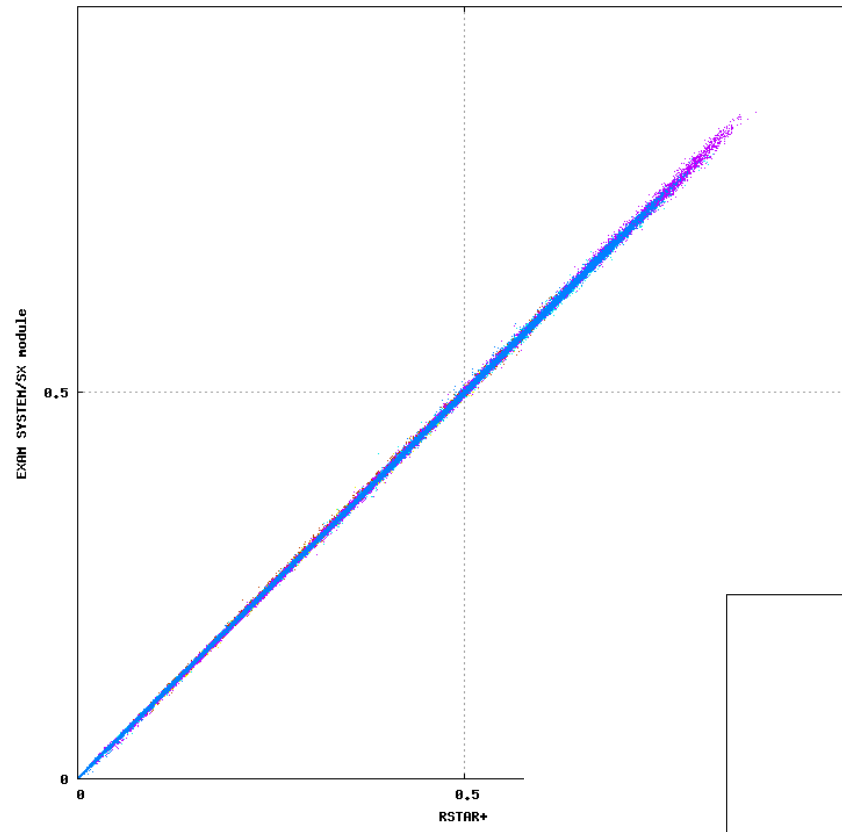
What is an “Artificial” Neural Network?  
Nobody knows Non-Artificial Neural Network.  
It's just a numerical model.

# Calculation cost is reduced by Active learning



This method encourages acceleration of learning.







# Summary

**We develop the new learning algorithm Active learning and NNN.**

- 1. High speed learning (2or3 times from old version)**
- 2. High accuracy more than old version.**
- 3. It's applicable to more complicated calculation.**

