Internship Asssignment

AGENT MODELING WITH NEURAL NETWORKS

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Overview of the Paper

- This paper proposes a new model for studying the **new product development** process in an artificial environment
- We show how **connectionist models** can be used to simulate the adaptive nature of agents' learning exhibiting similar behavior as practically experienced learning curves.
- Impact of incentive schemes (local, hybrid, and global) on the new product development process for different types of organizations.
- A key finding of this analysis is that the firms' organizational structure and agents' incentive system significantly interact.

Things I learnt : Connectionist models, Different types of Organizational Structure, Quality Function Deployment (House of Quality) & Resource-based view







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The Enviornment

Production function X → Y is captured by : **Y = 1/(1 + e^−AX)**, where A is a matrix of production function describing fundamental technical relationships.

As compared to **Cobb-Douglas function**, our production function has the advantage that **-ve correlations** between technical features Y are allowed

Costs of production are **linear function of X**, with c as the vector of costs: C = (c^T).X. The vector c is constant in time and the same for all organizations

To map technical features Y to product attributes Z, a nonlinear function is implemented as a **2 layer neural network with sigmoid transfer** function

In this environment, firms simultaneously develop products and compete on the same market. Thus, attractiveness of a product is perceived relative to the attractiveness of all products on the market. The attractiveness of a product is a function of the product position relative to an ideal point, Z∗

Life-cycle return (LCR) can be calculated as **sum of profits over all periods**

Agent Modelling with Neural Networks

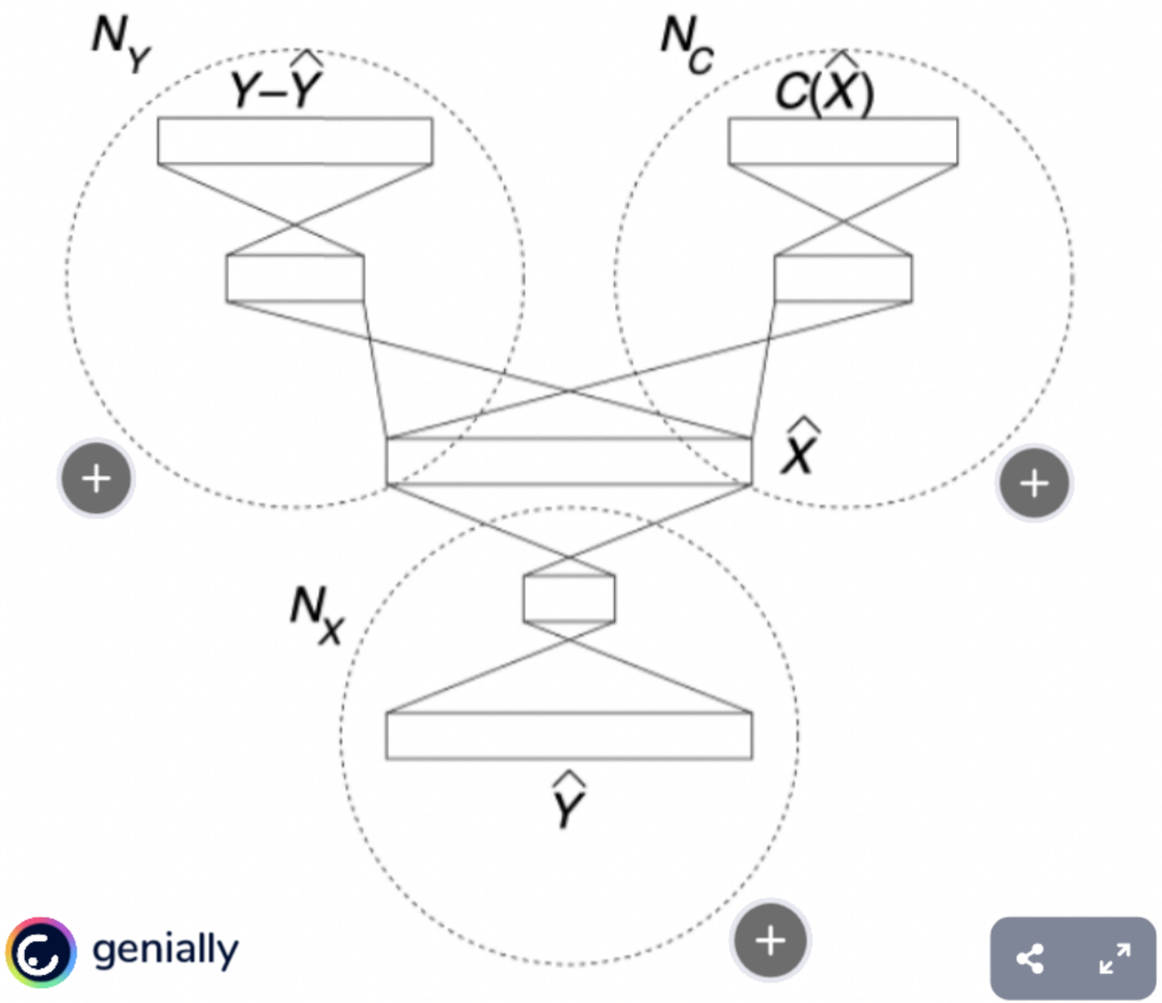
In Agent-based modelling, system is modelled as a **collection of autonomous decision-making entities** called agents. Each agent individually assesses its situation and makes decisions on the basis of a set of rules.

Major goal : Demonstrate behaviour of complex systems guided by boundedly rational agents. This means of bounded rationality is achieved by recognizing that knowledge & learning is limited for humans, and modelling this accordingly.

2 kinds of agents used :

1. **Marketing agent** – Learns relationship between technical product features & customer perceptions as well as the relationship between perceptions & attractiveness of the product perceptions.

2. **Production agent** – Builds models on relationships between production processes & technical product features. It also has to learn the relationship between production processes and costs.

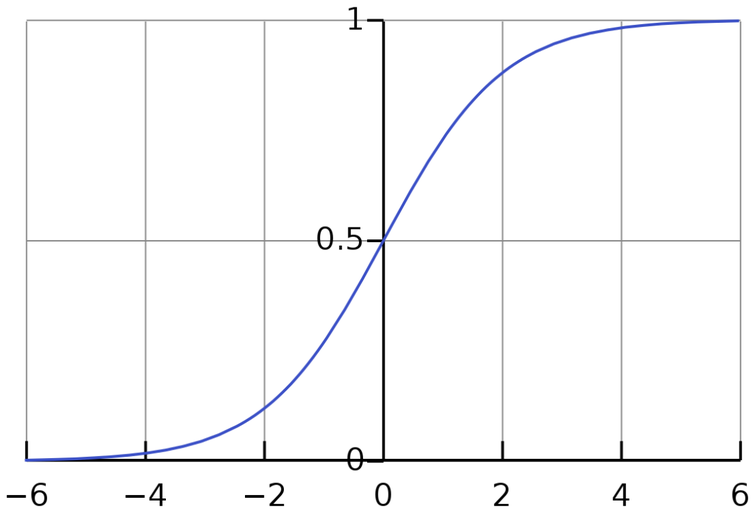


We chose most simple form: **Feed-forward neural network** to learn desired behaviour of an agent as an unknown nonlinear function.
Using neural networks, only long-term learning & knowledge is being modelled.

Production Agent: The basic task is to learn the nonlinear relationship between required technical features (Y) and production processes (X). This is done through a multilayer perceptron NX with one hidden layer

Networks Ny & Nc constitute agent's knowledge about how a given set of production processes lead to a final product & what its costs would be. These networks represent a kind of general knowledge about production, whereas NX represents expertise to turn requests into an optimal product.

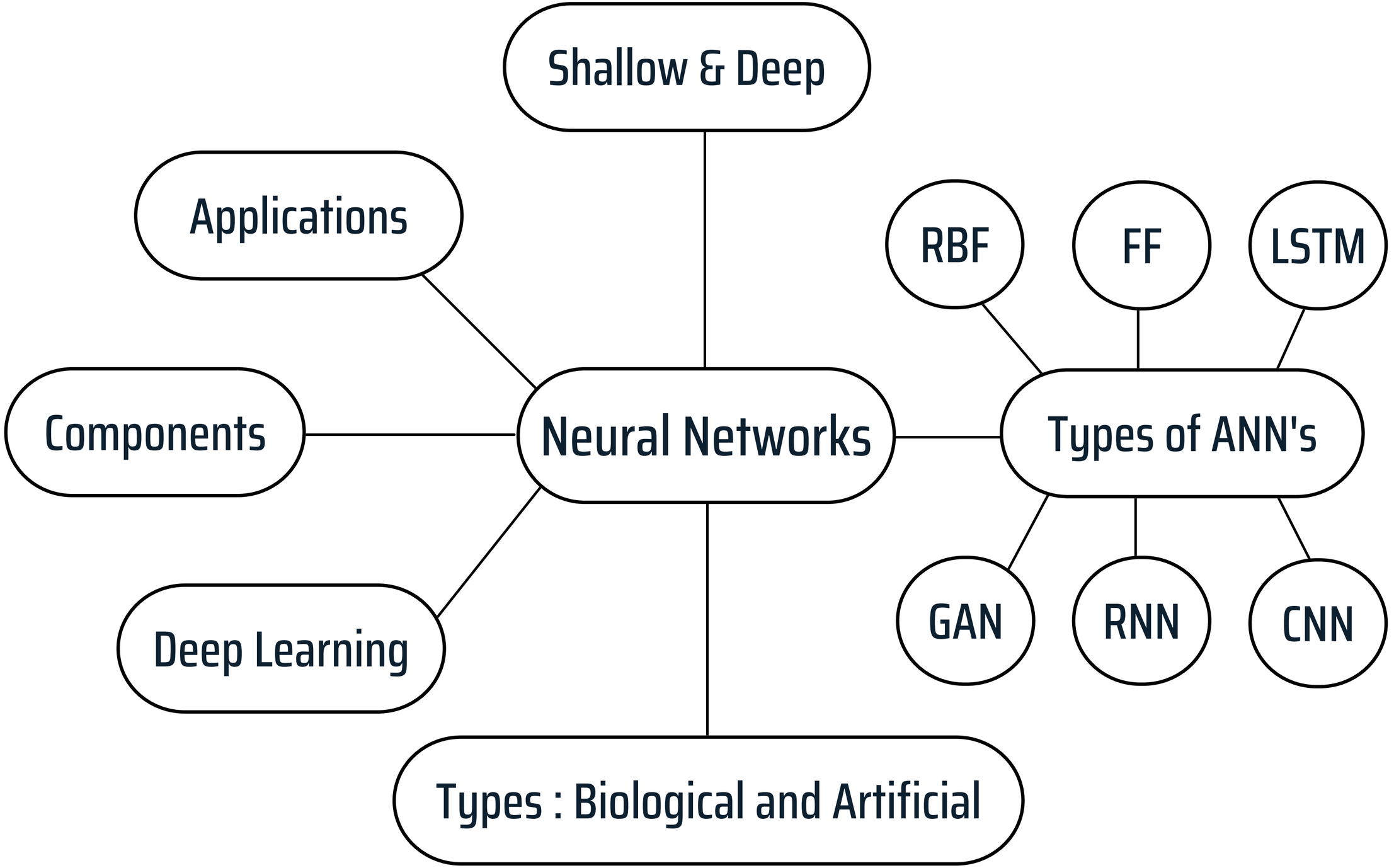
All multilayer perceptron consist of hidden units & output units with **sigmoid activation functions**. Sigmoid is the S-curve outputs a value between 0 and 1.

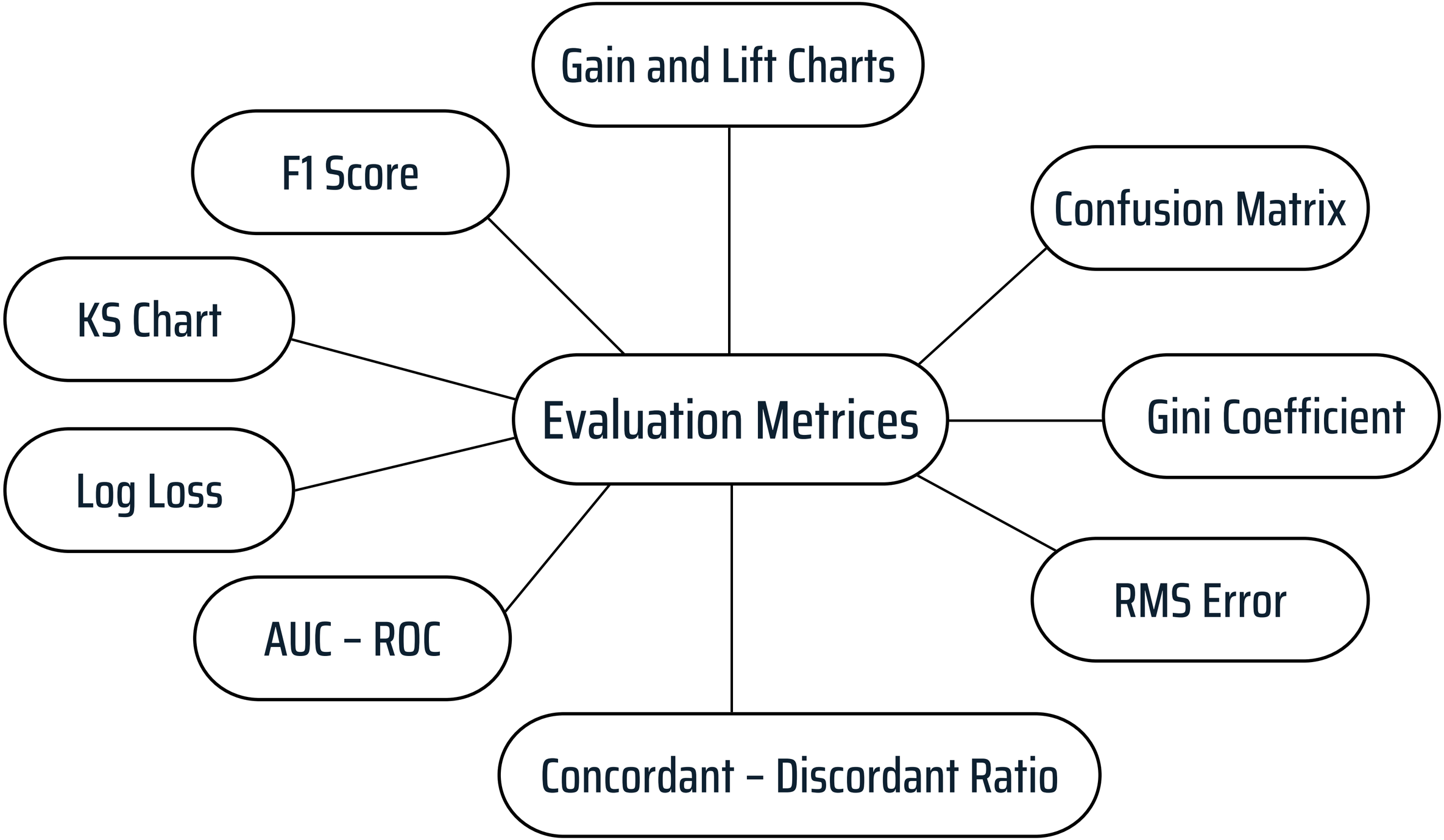


While most connectionist models use standard backpropagation as learning algorithm, we chose **SCG** for reasons of better performance.

SCG or **Scaled version of the conjugate gradient optimization** (SCG) algorithm is a supervised learning algorithm for feedforward neural networks. It is **considerably faster** than standard backpropagation and then other CGMs

The marketing agent is modelled in a fashion **similar to the production agent**. It consists of 2 multilayer perceptron designed to learn the functions between product features Y and product attributes Z, as well as between product attributes and attractiveness. The properties of the networks and of learning are analogous to the production agent.


Shallow & Deep
Applications
Components
Neural Networks
Deep Learning
Types : Biological and Artificial
RBF
FF
LSTM
Types of ANN's
GAN
RNN
CNN


Gain and Lift Charts
F1 Score
Confusion Matrix
KS Chart
Evaluation Metrices
Gini Coefficient
Log Loss
AUC – ROC
RMS Error
Concordant – Discordant Ratio

References

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