WIX3001 SOFT COMPUTING TEAM YKBOSS

Ong Jia Aun WEA150022

Liew Jen Wai WEA150006

Wong Yu Kang WEA150028

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LECTURER: DR. WOO CHAW SENG

FSKTM, University of Malaya

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Methodology

In order to complete this assignment, PBL (Problem-based) classroom learning method is applied.

With PBL, a problem is presented by the lecturer without any content. That is why students would have the freedom to discover and work out with the contents of the assignment that we determined to be necessary to solve the problem.

In this learning method, a number of steps are followed to solve the problem given. The learning experience is then recorded below.

Learning Experience

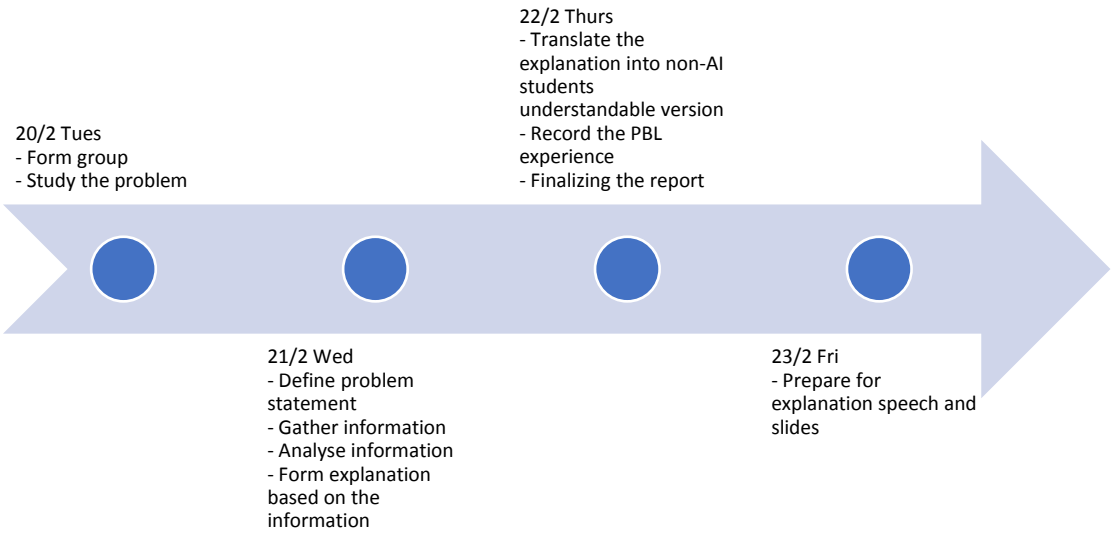
The first step of this learning method is to explore the issues. The lecturer presented the problem which is 'Perceptron'. The definition of perceptron is first studied and reviewed. Then, the significant parts of the problem are identified.

The second step involves gathering knowledge. All team members reviewed what each of them know about the problem. All team members have learnt about the components of artificial and biological neuron in the previous lesson. All agree that perceptron is largely relate to neuron. After that, all members start to search for any background knowledge about perceptron to have a basic understanding about the problem. The information is then gathered and a general concept is formed to solve the problem.

Step three is about developing and write out the problem statement. After knowing what a perceptron is, the members learn that it is a technical term in neural network, in artificial intelligence which is hard to be explained to a non-technical individual. That is why the members defined 'How to explain the topic of "Perceptron" in the context of neural computing to non-AI students' as the problem statement.

Step four is about listing out all possible solutions for the problem. After a discussion, the most feasible solution is by gathering information about the topic then translate them into non-technical terms that can be easily understood by non-AI students.

Step five is to list actions to be taken with a timeline.



Step six is about listing and learning what the team members need to know to solve the problem. After listing what is needed to explain the topic of perceptron, the team search for concepts, history, purpose and application of perceptron in order to answer the five main questions of 'What', 'Who', 'When', 'How' and 'Why' about a perceptron. These information are largely come from the websites and google book. Meanwhile, research tasks and deadlines are assigned and scheduled. Each of the member is responsible for explaining 2 of the 5 main questions. The deadline for documentation is fixed on Friday, 23 February 2018, so that there will be time creating the speech and slides for explanation.

Step seven is documentation. All the information about the problem are record in the report together with the learning experience with PBL.

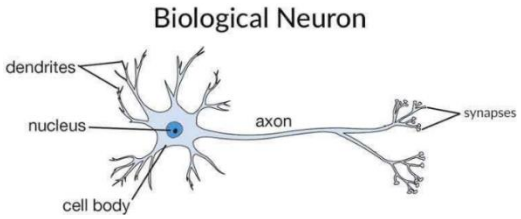
Problem Statement

How to explain the concept of perceptron to non-AI students.

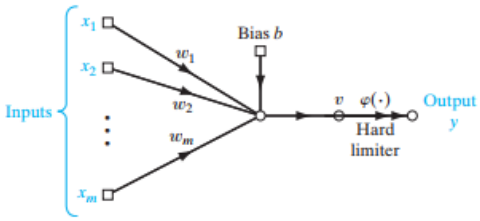
Questions

What is perceptron?

The perceptron is the simplest form of a neural network used for the classification of patterns said to be linearly separable. Basically, it consists of a single neuron with adjustable synaptic weights and bias.



Rajah 1 Biological Neuron



Rajah 2 Signal-flow graph of perceptron

In a biological neuron, the main components are the dendrites which act as the input receiver, the nucleus which act as the processor, and the axon which act as the output transmitter. This translate to the artificial neuron developed. The corresponding components are dendrites – inputs, nucleus – summation functions + activation function, axon – output.

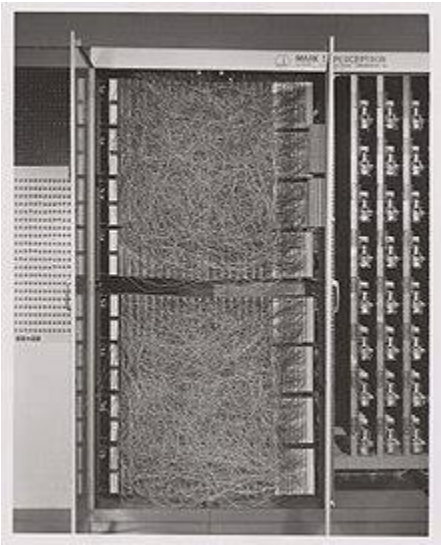
Who invented perceptron and where is it invented?

Frank Rosenblatt is an American psychologist. He was a researcher at Cornell Aeronautical Laboratory in Buffalo New York. He was successively a research psychologist, senior psychologist and head of cognitive systems section. It was at there where he came up with perceptron, which ultimately culminated to Mark 1 Perceptron, the first computer that can learn through trial and error.

When perceptron is invented?

In 1943, the idea of a neural network is published in a paper by McCulloch and Pitts. The neuron proposed is what used by Frank Rosenblatt in his development of perceptron.

In 1949, Donald Hebb proposed the first rule of self-learning machine, the Hebb's rule. It provides an algorithm to update weight of neuronal connection within neural network. Hebb's rule provides a simplistic physiology-based model to mimic the activity dependent features of synaptic plasticity and has been widely used in the area of artificial neural network.



In 1957, Frank Rosenblatt devised the perceptron algorithm. And in 1960, a hardware perceptron, Mark I Perceptron, is constructed.

How the perceptron works?

Frank Rosenblatt devised an algorithm to do supervised learning. The algorithm allows the adjustments of weightage of each input of the neuron. This algorithm has come to known as perceptron. Rosenblatt came up with the algorithm based on biological principles of human psychology which he has a PhD in.

$$f(x) = \begin{cases} 1 & \text{if } w \cdot x + b > 0 \\ 0 & \text{otherwise} \end{cases}$$

where w is a vector of real-valued weights, $w \cdot x$ is the dot product of $\sum_{i=1}^{m} w_i x_i$ where m is the number of inputs to the perceptron, and b is the bias.

The artificial neuron of the perceptron can be summarized to the above function. The output of the neuron is based on the summation function and activation function. The summation function is the sum of the dot products of input with its respective weightage, add with a bias, whereas the activation function determines the output based on a function, for example a step function.

Rosenblatt first demonstrated the ability to do image recognition with the custom built hardware Mark 1 Perceptron". The perceptron is used for Binary Classification which is a task to classify elements into 2 groups using basic classification rules. E.g. a medical testing to test if a person has a disease or not.

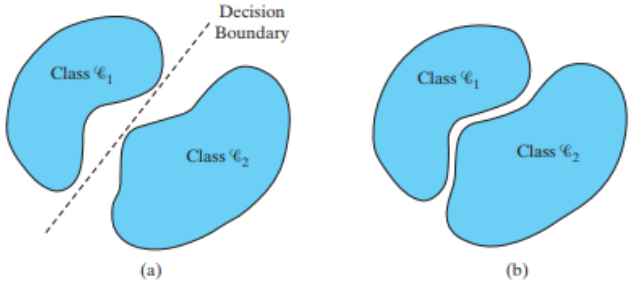


FIGURE 1.4 (a) A pair of linearly separable patterns. (b) A pair of non-linearly separable patterns.

Rajah 3 Comparison between linearly separable classes and non-linearly separable classes

In order for the perceptron to function correctly, the desired output classes must be linearly separable. This, in turn, means that the outputs must be sufficiently separable from each other to ensure that the decision made is on a hyperplane. If the two outputs are too close to each other, then the perceptron will not be functioning properly as it is beyond the computing capability of a perceptron. The most famous example of this is the XOR logic gate problem, which was pointed out in Marvin Minsky and Seymour Papert's book entitled “Perceptrons”.

Why use perceptron?

The goal of the perceptron is to correctly classify the set of externally applied stimuli into one of the two classes of the intended classification problem. By using Perceptron, we can train the machine to do Binary Classification and decreasing the error by adjusting the weight and bias

References/Appendix

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https://en.wikipedia.org/wiki/Perceptron

http://web.mit.edu/mcraegroup/wwwfiles/ChuangChuang/thesis_files/Appendix%20D_Artificial%20Neural%20Network.pdf