BINUS University

Academic Career: *Undergraduate* / Master / *Doctoral* *)			Class Program: *International*/Regular/*Smart Program*/*Global Class**)		
☐ **Mid Exam** ☐ **Short Term Exam**	✓ **Final Exam** ☐ **Others Exam : _____**		**Term : Odd**/~~Even~~/~~Short~~ *)		
✓ **Kemanggisan** ☐ **Senayan**	☐ **Alam Sutera** ☐ **Bandung**	☐ **Bekasi** ☐ **Malang**	**Academic Year :** __**2021**__ / __**2022**____		
Faculty / Dept. : BGP / Magister Teknik Informatika			Deadline	Day / Date :	Friday, 25 February 2022
				Time :	13.00 WIB
Code - Course : COMP8038041 Selected - Topics in Computational Intelligence I			Class	:	LTY1, LTZ1
Lecturer : Team Teaching			Exam Type	:	Take Home Exam
*) *Strikethrough the unnecessary items*					
The penalty for CHEATING is DROP OUT!!!					

1. **[50%] Case: Particle Swarm Optimization (PSO) and Artificial Bee Colony (ABC)**

    Given the following Rosenbrock Function:

    $$f(x,y) = (1 - x)^2 + 100(y - x^2)^2$$

    Find its <u>global minimum</u> value and the point (x, y) that produces it using **Particle Swarm Optimization (PSO)** and **Artificial Bee Colony (ABC)** algorithm. You can use any library or publicly available code to implement it (please cite the source if you do). Alternatively, you may create your own program. Conduct a number of experiments by tuning its hyperparameters in order to achieve the most optimum result you can get. Please be careful in defining the decision space (search space). Otherwise, you might end up getting result that is far away from optimum. Compare and analyze the results produced by the two algorithms. Submit the code along with your explanation regarding the code and the experimental results, along with your analysis and conclusions. *(Code without explanation and analysis won't get full mark even if the code produces the correct answer)*

2. **[25%] Case: Artificial Neural Network with GA-Optimization**

    Train **a single neuron adaline** on the following training set:

   Input X = [0.08, 0.72], [0.26, 0.58], [0.45, 0.15], [0.60, 0.30],

    [0.10, 1.0], [0.35, 0.95], [0.70, 0.65], [0.92, 0.45]
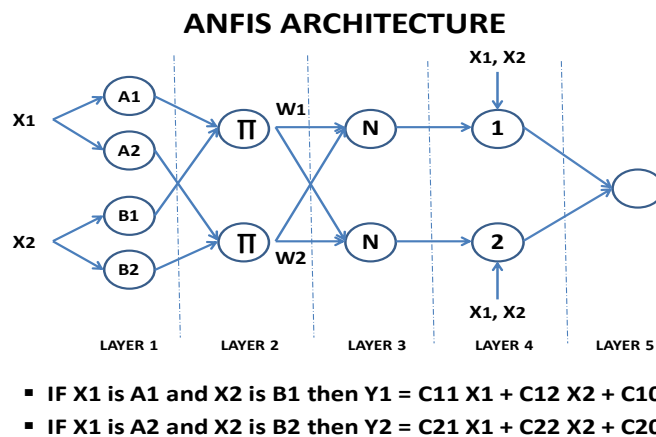
    Target output y = [1, 1, 1, 1, -1, -1, -1, -1]

Use LMS learning rules with learning rate 0.1 and initial weights including the bias of the neuron are zeros. You may need python and its relevant libraries to perform 100 epochs calculation to get the MSE curve and the boundary decision line as shown in the figure below. Derive the corresponding linear decision function equation and give your analysis if the adaline could achieve generalization on the model. As Genetic Algorithm (GA) is one of the promising optimization techniques in CI, please perform as well **the adaline optimization using simple GA with 100 generation and compare the results with the one obtained from LMS training.** Credit will be given if you succeed in employing GA on adaline optimization.
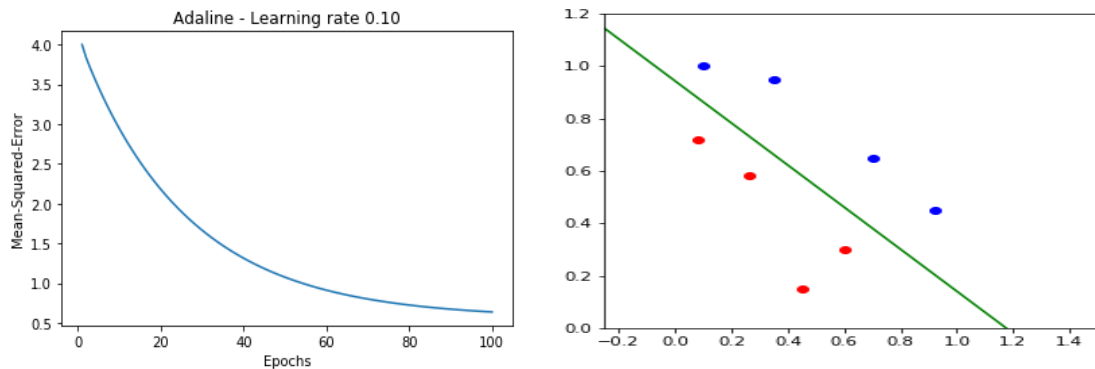
3. [25%] Case: ANFIS Model

Given a set of data pair as shown in **_anfis_dataset.text_** (_link to download:_ https://bit.ly/anfisdata) where 2nd and 3rd columns are variable inputs x_1 and x_2 and 4th column is variable target outputs y_o respectively. Further if Sugeno based ANFIS model with the given rules below is used to predict target outputs y_p, calculate the MAE (mean absolute error) and show side by side to see how close your ANFIS model prediction y_p with the ground truths (target outputs y_o). Relevant python libraries such as **_numpy, scikitlearn, anfis_**, **matplotlib**, etc might be needed to perform the calculation. Your corresponding codes written in python notebook will be much credited.

ANFIS ARCHITECTURE

- **IF X1 is A1 and X2 is B1 then Y1 = C11 X1 + C12 X2 + C10**
- **IF X1 is A2 and X2 is B2 then Y2 = C21 X1 + C22 X2 + C20**