IM 39003
OHM Term project

Due Date: 30/03/2022 Max. Points: 30 (+Bonus Points: 10)

In the individual term project, you have an option of choosing one project from the following. You need to submit your code in Matlab/R/Python along with a report. Report should consist of your approach and discussion on key results. For report you can either prepare a docx or pptx file You need to make this submission via MS teams.

You may be asked to a demo on March 31, during lab hours.

Project 1: Optimizing Bank Lending Decisions Using Metaheuristics

Reference Paper

Metawa, N., Hassan, MK., Elhoseny, M. (2017) Genetic algorithm based model for optimizing bank lending decisions [Journal: Expert Systems with Application Expert Systems With Applications 80 (2017) 75–82

Task

Read the reference paper and learn about the bank lending decision as well as GA implementation.

1. Code this problem on Data provided below using GA (Maximum marks you can obtain is 20)
   or
2. Code this problem using GA and one more algorithm covered in the course and compare the results (Maximum marks you can obtain is 30)
   or
3. Code this problem using GA and amalgamation of algorithms covered in the course and compare the results (Maximum marks you can obtain is 30, 10 bonus points for using amalgamation of algorithms)

Data to be used

D	60									
K	0.15									
Loan Size	10	25	4	11	18	3	17	15	9	10
Interest	0.021	0.022	0.021	0.027	0.025	0.026	0.023	0.021	0.028	0.022
Rating	AAA	BB	A	AA	BBB	AAA	BB	AAA	A	A
Loss (λ)	0.0002	0.0058	0.0001	0.0003	0.0024	0.0002	0.0058	0.0002	0.001	0.001

Project 2: Remaining Useful Life Prediction

Experimental Setup and Data

Drilling process, one of the most commonly used machining processes, is selected here as a test-bed. The objective is to predict the Remaining Useful Life (RUL) of drill-bit during the machining process by utilizing **thrust-force** and **torque** signals captured by a dynamometer during the drilling cycle (constituting a logical sensor signal segment). Tests were conducted on HAAS VF-1 CNC Machining Center with Kistler 9257B piezo-dynamometer (sampled at 250Hz) to drill holes in ¼ inch stainless steel bars. High-speed twist drill-bits with two flutes were operated at feed rate of 4.5 inch/minute and spindle-speed at 800 rpm without coolant. Each drill-bit was used until it reached a state of physical failure either due to excessive wear or due to gross plastic deformation of the tool tip due to excessive temperature (resulting from excessive wear). Data is provided as a mat file (MATLAB). Once, you load this in the workspace, you can see many arrays with names such as 'd1h1' representing drill bit 1, hole 1. All together there are 14 drill bit with varying number of holes drilled.

Task

You are expected to predict the remaining-useful-life (RUL). In terms of data, RUL can be understood as follows: Let's consider Drill bit 1. It has drilled 19 holes before failure. So, when it is drilling 4^{th} hole we can calculate actual RUL (before it fails) as 19-4 = 15. Now, your task is to build a prediction model that can predict RUL in the real life. You can divide this dataset as first 10 drill bits and last 4 drill bits for training and testing respectively.

1. Use neural network to predict RUL GA (Maximum marks you can obtain is 30)
   or
2. Use neural network and any of the metaheuristics to optimize number of hidden states/#of neurons (Maximum marks you can obtain is 30, 10 bonus points for using amalgamation of algorithms)

Performance criteria

Median RMSE for testing dataset made up of just the last five holes for each drill bit. Whereas, error can be calculated as = (Actual RUL – Estimated RUL).

Reference

Kumar, A., Tseng, F., Guo, Y., and Chinnam, R. B., (2019) "An HMM and polynomial regression based approach for remaining useful life and health state estimation of cutting tools," Computers & Industrial Engineering, Volume 128, February 2019, Pages 1008-1014