Intelligent Manufacturing Systems

Assignment 2

Due Date: Nov. 5, 2020

Please hand in the "*MSWord*" and "*Code*" files with zipped file name: **IMS_Assignment2_NAME_ID.zip** to *Moodle* by due.

Questions (30%)

Please answer the following questions and justify your answer.

1. What is the algorithm? What is heuristic? What is greedy algorithm? What is meta-heuristic algorithm?

2. In computational complexity theory, a decision problem can be categorized into P, NP, NP-complete, and NP-hard.
   i. What is P, NP, NP-complete, and NP-hard, respectively?
   ii. Please give definitions to P, NP, NP-complete, and NP-hard, respectively.
   iii. Please **find and describe** one "typical" problem (eg. travelling sales problem, TSP) belonging to P, NP, NP-complete, and NP-hard, respectively.

Programming Questions (70%)

Please use *Python* (**other languages are not allowed**) to answer the following questions. Provide your code and justify your answer. Show all your work in detail including specific algorithm and parameter design. You should hand in *TWO files (one for Tabu and one for Genetic Algorithm)* regarding to each meta-heuristic algorithm, respectively. The result should include ***optimal solution (i.e., job sequence), optimal function (i.e. fitness) value, running time, average tardiness, number of tardy jobs.*** For the parameter settings (eg. tabu size, crossover rate, mutation rate, etc.), please give a simple ***design of experiment*** for sensitivity analysis.

Single-Machine Scheduling Problem

Please answer following single-machine total weighted tardiness problem. The objective function is to minimize the total weighted tardiness.

Jobs	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Processing Time	10	10	13	4	9	4	8	15	7	1	9	3	15	9	11	6	5	14	18	3
Due Date	50	38	49	12	20	105	73	45	6	64	15	6	92	43	78	21	15	50	150	99
Weights	10	5	1	5	10	1	5	10	5	1	5	10	10	5	1	10	5	5	1	5

(a) Please use Tabu Search (TS) algorithm to solve the problem. Show your design and the "result".
(b) Please use Genetic Algorithm (GA) to solve the problem. Show your design and the "result".
(c) Please give a comparison between Tabu and GA. You may try different parameters to see the change of the results (i.e., sensitivity analysis) in your developed algorithm. What's the "insight" or

interesting things you found?

Note

1. Show all your work in detail. **Innovative** idea is encouraged.
2. If your answer refers to any external source, please “must” give an academic citation. Any “plagiarism” is not allowed.