AE2223-2 Experimental Research 2020 – Assignment 3

This is the third group assignment on the topic Experimental Research in the course AE2223-2. It contributes 10% towards your final grade and is a group grade.

INSTRUCTIONS

You must complete this assignment jointly with the students in your group in course AE2223-2. The assignment has been divided in 4 questions so that you can work in sub-groups of 2-3 students on the different questions.

Title page. 1 page. On the front cover of the assignment, you must include the following information:

- Course Number and Name
- Assignment Number
- Your Group Name
- Student IDs and Names of all students in your group
- Brief description of the contribution of each student the group to completing the assignment.

Answer pages.

- Start each answer on a new page
- Required length per question is between 1½ and 3 pages
- You are expected to research your own material to answer some parts of the questions
- You may include pictures, graphs if it helps in answering the question

References

- You are expected to include references to your sources
- Maximum of 1 page for references

ASSIGNMENT QUESTIONS

Q3a. Data Representation (25% of assignment grade)

This question explores the different ways your Group name could be represented in a computer.

- Numerical. In this part of the question the letters represent hex digits. Convert your group number and express it in (i) binary, (ii) integer decimal, (iii) integer floating point and (iv) hex.
- Character. In this part of the question letters and numbers are ASCII characters. (v) Convert and express your group number in 16-byte hex.
- Multimedia. Express your group number in either image, sound or video format. Explain how you did this. What is the file size? (vi) Sample this multimedia file to express your group number in an unambiguous way in 16-byte hex? Discuss if the How you could you sample this multimedia file to express your group number in an unambiguous way in 16-byte hex?
- Consider the six different digital representations of your group number in the sub-questions above. What do you consider are the most and least efficient in terms of data storage. Which format is the most efficient format for processing student grades?

Q3b. Logic Computation (25% of assignment grade)

This question is about further processing of the (v) and (vi) 16-byte hex numbers from Q3a.

- Make a truth table of hex-numbers (v) and (vi) for the operations ‘conjunction’, ‘disjunction’, ‘implication’, ‘equivalence’ and ‘negation’. Comment on the results or any problems you find.
- Make a truth table of hex-numbers (v) and (vi) for the operations ‘add’, ‘subtract’, ‘multiply’ and ‘divide’. If necessary label the output as ‘overflow’, ‘underflow or ‘NaN’.
- To avoid error codes, convert (v) and (vi) 16-byte hex numbers to tri-state logic (0,1,U). Repeat the operations ‘add’, ‘subtract’, ‘multiply’ and ‘divide’ and make a new truth table. Comment on the results you obtain

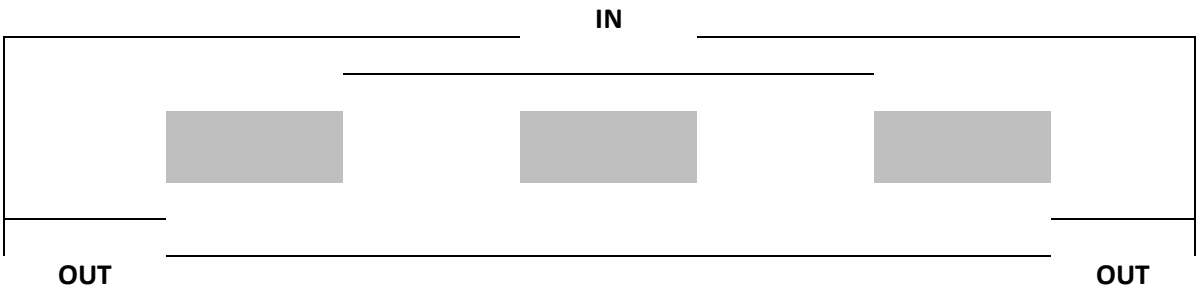
Q3c. Job Shop Scheduling (25% of assignment grade)

This question is about job shop scheduling. You are responsible for scheduling maintenance tasks in an aircraft hangar. The hanger operates from 8am to 6pm and 20 maintenance jobs which take from 1 to 4 hours arrive per day. Each new maintenance job that arrives is randomly allocated to a technician. You may assume that there is an adequate supply of tools for each technician.

- First you schedule the maintenance jobs using random scheduling. Calculate the number of technicians you need to employ to complete all jobs within 1 working day.
- Draw a flowchart of flowchart of your random scheduling procedure. Discuss how you would implement this calculation in a maintenance hangar.
- Next you use a greedy algorithm to allocate maintenance jobs to the the technician who can start on the job earliest . Calculate the number of technicians you need to employ to complete all jobs within 1 working day.
- Draw a flowchart of flowchart of your greedy algorithm scheduling procedure. Discuss the relative efficiencies of the random and greedy algorithms for this task.

Q3d. Genetic Algorithm (25% of assignment grade)

This question is about using the genetic algorithm to reposition security guards in an airport security area, see diagram below. The map scale is 5 mm = 1m (on A4 paper). Walls are indicated by lines. Tables are marked grey.



- Four guards start at random locations within the security area. What % of the airport security area can they see? Provide a the % as a number and a map showing the areas that can be viewed.
- To move the guards you will use the following code. 00 means move forward 1 m, 01 means move left 1 m, 10 means move right 1 m and 11 means move backward 1 m. The first 2 bits are for guard 1, the next 2 for guard 2, etc. The starting code to move the 4 guards is: 01010101. This means all guards move left 1 m. Apply the starting code to the random starting positions of the guards and check if the new position has a better % coverage.
- Modify the moving code using a genetic algorithm. Explain the procedure you use the modify the code.
- You will now implement the genetic algorithm to move the guards in 5 steps to try to find the best location for them. At each step, modify the code and test the different options to find the one with the best % of coverage.

DEADLINE:

Sunday 15th March 2020 at midnight (24:00)

DELIVERY

Answer all questions in the assignment and complete a written report, using figures if necessary. The report must be uploaded as a PDF to BrightSpace by the deadline.