The University of Nottingham

SCHOOL OF COMPUTER SCIENCE

A LEVEL 4 MODULE, SPRING SEMESTER 2018

SIMULATION AND OPTIMISATION FOR DECISION SUPPORT (G54SOD)

Time allowed ONE hour

Candidates may complete the front cover of their answer book and sign their desk card but must NOT write anything else until the start of the examination period is announced

Section A: Answer Question 1
AND
Section B: Answer ONE of the remaining two questions

Dictionaries are not allowed with one exception. Those whose first language is not English may use a standard translation dictionary to translate between that language and English provided that neither language is the subject of this examination. Subject specific translation dictionaries are not permitted.

No electronic devices capable of storing and retrieving text, including electronic dictionaries, may be used.

DO NOT turn your examination paper over until instructed to do so

ADDITIONAL MATERIAL:
NONE

INFORMATION FOR INVIGILATORS:
NONE

SECTION A

Question 1: Conceptual Modelling [overall 60 marks]

You are employed by the Heathrow Airport management board to conduct a simulation study for them. The passport check area at Heathrow is supposed to be updated. As more and more people nowadays have an ePassport the number of ePassport gates should be increased, to reduce complaints about long waiting times at the passport check. The aim is to optimise the ratio between ePassport Gates and manned passport check positions, so that at least 90% of ePassport passengers are served in under 5 minutes and 95% of the standard passport passengers are served in under 10 minutes. Staff costs should be minimised, and the simulation should allow setting the proportion of ePassport holders at the beginning of the simulation run.

Currently there are 5 ePassport gates and 10 manned passport check positions. There are some space constraints and the maximum number of ePassport gates that can be installed is 10. Passengers arrive from two directions at the security check area. There is one "pre-check" point at which all passengers are told to go either to ePassport gates or to manned passport check positions. Authorities are also keen to use the resulting simulation model for staff training purposes.

a) What simulation method would you use for this case study? Give some methodological reasons for your choice.

(5 marks)

Numbers in {} indicate the number of items required to receive full marks!

b) Define the conceptual model by describing [2 marks for each item]:
   - Objectives, including performance measures (where appropriate) {3}
   - Inputs {3}
   - Outputs {3}
   - Content (defining model scope and level of detail) {5}
   - Assumptions {1}
   - Simplifications {1}

(32 marks)

c) Provide a graphical representation of your conceptual model, using a diagram type that is appropriate for the simulation method chosen under 1a) and provide a class definition or class diagram where applicable. KEEP IT SIMPLE!

(15 marks)

d) If the simulation is used for optimisation what would a relevant objective function look like? Briefly explain the purpose and operation of your proposed objective function.

(8 marks)

 Continue on next page

SECTION B

Question 2: Simulation [overall 40 marks]

In this module we discussed three simulation methods: System Dynamics Simulation (SDS Discrete Event Simulation (DES), and Agent-Based Simulation (ABS).

a) Classify each of them. Are they...

- Static or Dynamic?
- Deterministic or Stochastic?
- Discrete or Continuous?

(6 marks)

b) You are hired as a consultant by a company that owns several Fitness Studios. Your task is to help them with the planning of a new fitness studio, using simulation. Provide a typical application example for each of the simulation methods listed above (related to fitness studio planning) and provide some methodological reasons for your choice.

(12 marks)

c) Validation and verification happens at many stages of a simulation study.

i. Define the terms "validation" and "verification" in relation to simulation [8 marks].

ii. Name and briefly describe **TWO** types of validation. In your description also consider how you would apply those during a simulation study [6 marks each]?

iii. What are known difficulties of verification and validation that you might come across? Provide **TWO** examples [2 mark each].

(22 marks)

 End

Question 3: Heuristic Optimization [overall 40 marks]

Please ask my colleague Dario Landa-Silva for details.