

This question paper consists
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Number (COMP292101)

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School of Computing

January 2018

COMP292101

Systems Thinking

Answer all THREE questions

Time allowed: 2 hours

Question 1

- (a) In Cybernetics, what is Ashby's Law of Requisite Variety? **[1 mark]**
- (b) Give a quick example of "thinking outside the box". **[1 mark]**
- (c) Give an example to explain your understanding of the difference between reductionism and holism. **[2 marks]**
- (d) Students receive a large amount of information during lectures. Describe three possible outcomes for the information that students receive and illustrate the route to each outcome with a relevant example. **[3 marks]**
- (e) Use the frameworks from systems theory to describe the environment, boundary, emergent properties, component subsystems, inputs, process, outputs, feedback and control of both a frog and the ecosystem of a pond that the frog lives in. **[6 marks]**
- (f) In Soft Systems Method (SSM), Peter Checkland suggests three EEEs for defining how the performance of an activity should be monitored. A student has given a muddled explanation of the three EEEs:
 "Effectiveness is concerned with whether the activity produces its intended outcome. Efficacy asks whether the box produces its intended outcome with the maximum use of resources in terms of time, effort, cost etc. Ethics measures whether the activity is consistently failing."
 Write a corrected version of the explanation. **[3 marks]**
- (g) A restaurant on a busy street has finite pool of available customers. Customers are attracted to the restaurant because it looks busy and they believe that a busy restaurant must be a good quality restaurant. However when the restaurant is full, customers have to queue for tables and the length of the queue will put off some of the available customers. Draw a Systems Dynamics diagram to model the re-enforcing and balancing loops described. **[4 marks]**

[Question 1 total: 20 marks]**Question 2**

- (a) A hospital is interested in the promise of big data. You are a consultant who has been asked to talk to them about the opportunities of big data but, on a short tour of the hospital before your meeting, you notice widespread use of paper forms and other documents. Give a short summary of the advice you might give them. **[5 marks]**
- (b) A student has proposed a final year project where they would build an app that would give patients the ability to create, read, update and delete their patient records. The student was unaware that patient data is federated across multiple care organisations so there is no single central database.
- i) Draw a diagram to show the software components and data flow that would be needed to verify the app user's identity using an Authentication and Access Service and then read and display patient records collected from two different organisations' record systems. You may annotate your diagram to explain the data flow. **[5 marks]**
- ii) Briefly explain to the student why giving patients the option to delete data is inadvisable. **[2 marks]**

- (c) Peter Senge of MIT Sloan School of Management argues that traditional organisations are no longer “viable systems”. Give three reasons why you might agree or disagree with his perspective. **[3 marks]**
- (d) An experienced software engineer tells you that they believe that all problems can be reduced through good engineering methods to requirements that can be developed into perfect solutions (a “hard systems” approach). They are not convinced by what little they have heard of Soft Systems Method (SSM) but are willing to listen to an explanation of its value. Give an example of a problematic situation where a hard systems approach might not work and briefly explain how SSM might lead to novel improvements. **[5 marks]**

[Question 2 total: 20 marks]

Question 3

This Question is based on the attached scenario which has been made available to students prior to the exam.

- (a) One purposeful activity of the Administration team might be reasonably called “Help identify and support struggling students”. Describe this activity using the CATWOE framework (Customers, Actors, Transformation, Worldview, Owners, Environment). **[5 marks]**
- (b) Characterise the roles, norms and values of the Lecturers in the scenario. **[3 marks]**
- (c) Draw a Rich Picture that could be used to support a discussion with the IT Department to outline the problems with the Attendance Monitoring System. **[6 marks]**
- (d) You have been asked to design a workshop that generates new ideas to help the resign of the attendance monitoring system. A number of Thinking Differently approaches were studied in this course, Choose two of these Thinking Differently approaches, briefly describe them and explain how you might use them to structure the workshop. Which stakeholders would you invite? **[6 marks]**

[Question 3 total: 20 marks]

SCENARIO FOR QUESTION 3

This scenario is for use with Question 3. It has been made available to students prior to the exam.

An electronic attendance system for a university

A large and popular university introduced a novel electronic attendance system to track student attendance at lectures. Unfortunately the system was considered to have failed and was withdrawn recently with a return to paper attendance sheets. The university plans to re-implement the system and they are interested in how a systems thinking approach might help them understand what has proved to be a problematic situation.

The previous system was based on small battery powered, Bluetooth devices stuck high up on the walls in each lecture room (around 60 rooms in total). The devices are very simple, they are battery operated and broadcast an encrypted unique identifier which can be picked up by an attendance recording app that students are asked to install on their personal smartphones. The app can be installed on Android and iPhone platforms and requires the student to log on with their student id to install it. When the app is activated it picks up the Bluetooth signal of the nearest device and sends the device id and student id (via Wi-Fi or phone based internet) to the main server-based Attendance Recording system. This application links to the Student Timetable system which has records of each student's personal timetable. If the student is detected in the right room at the right time it records the student as present on the attendance database. Students were given the option of just recording their attendance using an online system (Web-based) user interface if they preferred. The attendance database is used for Administration reports but wasn't available to the lecturers.

The initial implementation was troubled. The Attendance system and the Student Timetabling system were co-located on the same server which was crashed by peak load on the first day of term. Some students felt the electronic monitoring was invasive and objected. Others were worried about their phone's battery life and regularly switched off their phone, network or Bluetooth meaning that they inadvertently failed to register their attendance and this also became a regular excuse. Lecturers liked not having to manage the paper forms but found that they could no longer monitor attendance themselves so lost vital feedback about who was attending. They also noted that the approach had legitimised "phone fiddling" during lectures which was distracting for them and damaging to the student experience. The Administration team like the electronic flow of data but found that the error rates were too high and that time was spent dealing with problems with the technology, complaints and students worried about attendances that had not been recorded. Problems were compounded by the devices running out of battery power and there were no systems or procedures in place to quickly identify a failing device so that the battery could be immediately replaced.

The university has a legal duty to record attendance effectively for International students and believes that attendance monitoring fosters good practice for all students and can help identify and support struggling students. The current plan is to re-implement the system largely unchanged but there is an opportunity to reflect and improve and systems thinking approaches (including Soft Systems Method) may be one way to do that.

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