

School of Computing and Information Systems  
**SWEN30006 Software Modelling and Design**

**2017 End of Semester 2**

**Reading Time: 15 minutes**

**Writing time: 120 minutes**

**This paper has 7 pages including this page.**

**Authorised Materials**

**Calculators:** Not permitted.

**Dictionaries:** Paper-based language translation dictionaries are permitted provided they are not annotated in any way.

**Notes:** Two double-sided A4 sheets of notes are permitted.

**Instructions to Invigilators**

- The examination paper is to remain in the examination room
- Students are to be provided with one script book
- Provide extra script books on request

**Instructions to Students**

- Total marks for this paper is 120
- Ensure your student number is written on all script books during writing time
- Attempt all questions
- The marks for each question are indicated at the beginning of each question
- The marks are an indication of how much time should be spent on the question
- Answer all questions on the right-hand lined pages of the script book
- Clearly number each question
- Start the answer to each question on a new page in the script book
- The left-hand unlined pages of script books are for draft working and notes and will not be marked
- State clearly and justify any assumptions made
- Write legibly in blue or black pen
- Draw diagrams legibly – pencil is permitted for drawing diagrams
- Mobile phones, tablets, laptops, and other electronic devices, wallets and purses must be placed beneath your desk.
- All electronic devices (including mobile phones and phone alarms) must be switched off and remain under your desk until you leave the examination venue. No items may be taken to the toilet.

Paper to be lodged with Baillieu Library

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### Question 1. [5 marks]

Independent of any particular domain of expertise:

1. Define the term “pattern”.
2. State three advantages of patterns.

### Question 2. [6 marks]

1. In the context of object-oriented software design, define “visibility” and briefly state why it is important.
2. List and provide examples for two forms of non-global visibility.

### Question 3. [6 marks]

Consider a weather station which is made up of various devices that provide sensor readings. In using the weather station, we can write either of the following code alternatives:

```
// Fragment 1
public float getValueDependingonTemp() {
    Thermometer thermometer = station.getThermometer();
    // Use temperature from weather station thermometer
    return ... thermometer.getTemperature() ...;
}
```

```
// Fragment 2
Public float getValueDependingonTemp () {
    // Use temperature from weather station thermometer
    return ... station.getTemperature() ...;
}
```

Explain in terms of patterns why we might prefer one of these fragments over the other.

### Question 4. [8 marks]

Describe the purpose of UML sequence diagrams and UML communication diagrams, explain how they differ, and provide reasons why a software engineer might choose one over the other.

### Question 5. [10 marks]

1. Describe the Singleton pattern, including how it is implemented in Java.
2. Describe the Factory pattern, including how and why it is combined with the Singleton pattern.

### Question 6. [8 marks]

Below is a list of three software requirements.

1. For security purposes, all users must successfully authenticate as the first step in accessing the system.
2. The government's tax department has provided details of a complex report that businesses of our type must provide to them as a legal requirement. The system must be able to generate this report.
3. Every time a user interacts with the system to conduct a transaction that involves an incoming or outgoing payment, the details of the interaction must be logged.

Which of these requirements is most likely to be architecturally significant? Explain your answer.

### Question 7. [6 marks]

List three elements present in UML design class diagrams but not present in UML domain class diagrams, and explain why they should not appear in a domain class diagram.

### Question 8. [8 marks]

Does following an Agile development process impact on the modelling we should do as part of a software development project? Make sure you explain and justify your answer.

### Question 9. [8 marks]

1. Describe the Strategy pattern, and the role polymorphism has in the pattern.
2. Explain what a strategy context object is, and how and why we use it.

### Question 10. [10 marks]

Consider the following passage.

A museum has installed tablet computers throughout for use by visitors. Currently the tablets (a) show visitors information about the adjacent exhibit (presented section by section with the option to skip a section at any stage), with the possibility of a search for exhibits related to the current on-screen topic (b) let visitors browse current topics of interest from the media, with the possibility of a search for exhibits related to the current on-screen topic, and (c) allow visitors to request urgent assistance from museum staff. An update of the system is under development which improves (c) to also allow visitors to request urgent assistance from paramedics.

Ignoring the issue of how information is placed in the system, provide a use case diagram to model the information in this passage.

### Question 11. [15 marks]

The passage below describes a medical domain. The sentence numbering is provided to make it easier for you to track the various elements of the description. Draw a domain class diagram modelling the elements of the description.

1. For all persons of interest in the domain, we need to know their name, address, gender, phone number, and (primary) language.
2. For staff we also need to know when they joined our organisation
3. There are two kinds of staff, Medical staff and Admin staff.
4. It is important for us to keep track of which Medical staff member treats which patient, and whether that staff member is a doctor or a nurse.
5. Each time a patient is treated by one or more staff members (patients are only seen one at a time), we need the date/time, and activity type for that treatment.

## Question 12. [30 marks]

The passage below describes a simple microwave oven. The sentence numbering is provided to make it easier for you to track the various elements of the description.

1. The oven has a door, a light, a tube (microwave emitter for cooking), a rotating platform on which the food is placed, a timer, a beeper, and a single button.
2. The oven platform rotates if and only if the tube is on (i.e. if the oven is cooking).
3. The light is on if and only if the door is open or the oven is cooking.
4. If the door is open, the oven is not cooking.
5. If the door is open, the timer is set to zero.
6. If the door is closed and the button is pressed, the timer is set to one minute and cooking starts.
7. If the button is pressed while cooking, one minute is added to the timer.
8. If the timer counts down to zero while cooking, the oven will stop cooking and the beeper will sound once; the beeper will continue to sound again once at one-minute intervals until the oven door has been opened.
9. If the controller detects a fault (e.g. in the tube), the beeper will sound continuously until the power is switched off; no other elements will operate in the fault state.

### Question 12 Part 1. [20 marks]

Draw a state machine diagram for the oven controller, based on this description.

### Question 12 Part 2. [10 marks]

Draw a sequence diagram for the oven covering the following scenario. The diagram should include the behaviour of the various components of the oven, as described in the passage above.

The oven is on with the door closed. A user places food in the oven and cooks it for two minutes. After the second beep she opens the oven and checks it, then decides to cook it for another minute. After 30 seconds, she removes the food and closes the door.

***End of the Exam Questions***

***End of the Exam Paper***



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