UNIVERSITY OF OTAGO EXAMINATIONS 2017

INFORMATION SCIENCE

INFO 201

Developing Information Systems 1
Semester One

(TIME ALLOWED: 3 HOURS)

This examination paper comprises 10 pages.

Candidates should answer questions as follows:

Section A (short-answer questions): Answer ALL questions (total 50 marks)
Section B (practical questions): Answer ALL questions (total 50 marks)

The following material is provided:

NIL

Use of calculators:

No calculators permitted.

Candidates are permitted copies of:

NIL

Other Instructions:

NIL

TURN OVER

Section A

ANSWER ALL QUESTIONS
Questions in this section (total 50 marks) are short-answer questions.

1. *Rewrite* the following "requirement" to meet the guidelines for good properties of written requirements as outlined in the lectures.

   - "The system shall validate and accept payment options such as EFT-POS, credit card, etc. To make sure this happens, the system shall process all mouse clicks very fast to ensure users don't have to wait too long. Finally, a report needs to be generated calculating summary statistics for the day (including total number of sales, average amount of a sale etc.) and this report needs to be produced very quickly."

   (4 marks)

2. eXtreme Programming (XP) embodies 12 practices. *Name* four of them and for each named practice *describe* its advantages. (4 marks)

3. The first phase of the Integrated Modelling Method is to identify Business Functions:

   (a) *Explain* the differences between a Business Function and a Mechanism. (3 marks)

   (b) *Provide* two written examples of a Mechanism and its corresponding Business Function. (2 marks)

4. Entity Relationship Diagrams (ERDs) may include strong and weak entities:

   (a) *Define* what a strong entity and a weak entity are in an ERD. (2 marks)

   (b) *Provide* an example of how strong entities and weak entities are modelled in an ERD drawing using Information Engineering notation. (3 marks)

5. Java developers are often advised to declare the attributes in a class to be `private` and to provide `public` access methods to get or set the values of these attributes. *Explain* why the approach is beneficial and *provide* two benefits. (4 marks)

6. *Name* three benefits of using the `PreparedStatement` class instead of the standard `Statement` class when executing SQL commands against a database. (3 marks)

7. By *what* mechanism(s) does Java implement the concept of polymorphism and *how* does polymorphism simplify and clarify program design and coding? (4 marks)

8. When designing and modelling object-oriented applications, the time period over which an object is executing based on a message is known as an activation lifeline.

   Explain how an activation lifeline is used on an *UML* Sequence Diagram and *provide* a drawn example using *UML* to illustrate this concept. (5 marks)

9. *Identify* three ways that the use of an effective software development methodology can protect software manufacturers from legal liability for defective software. For *each* example, identify the relevant artefacts and processes involved in the methodology that provide the protection, and include a brief discussion on how these might be used to protect the manufacturer. (6 marks)

10. *Briefly* describe direct, parallel, and phased deployments. *State* one advantage and one disadvantage of each deployment approach. (6 marks)

11. Controls are mechanisms and procedures that are built in to a system to safeguard the system and the information within it.

    Compare and *contrast* integrity controls and security controls. *Why* isn't the actual activity of designing these controls separate and distinct from other design activities? (4 marks)

[SECTION A TOTAL 50 MARKS]

Section B

ANSWER ALL QUESTIONS FROM THIS SECTION

Questions in this section (total 50 marks) are practical and relate to scenarios presented in Questions 12 & 13 respectively on pages 4 to 5 and a case study presented in § 1.1 to § 1.4 respectively on pages 7 to 10.

12. Consider the following scenario for a doctor's office that has a patient record system for scheduling appointments and keeping track of payments:

    Patients come to the doctor's office and make appointments with the receptionist. This consists of accessing the database to schedule appointments and to check that patient's details are up to date. Occasionally, a new patient visits the office. If this happens, then a new record is added. At the end of a visit, the patient pays their bill to the receptionist. Sometimes the payment can be deferred when a patient requires further treatment.

    Using Figure 1 which shows a Use Case Diagram to depict this scenario, *draw* the corresponding *UML* Activity Diagram.

    The diagram should follow these conventions:

    - Make use of swim lanes, transitions, synchronisation bars (splits and joins), and decision points.

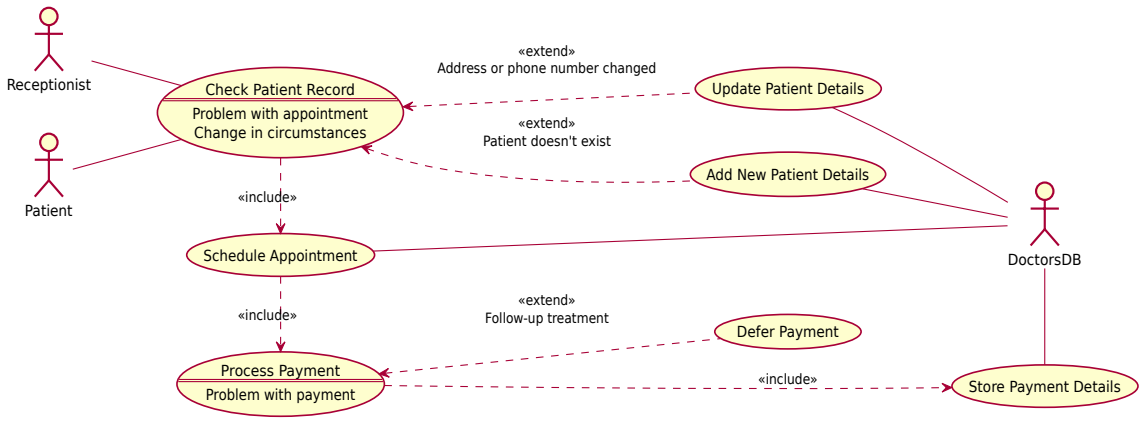

Figure 1: *Use Case Diagram for making an appointment at a doctor's office*

(10 marks)

13. To represent the relevant data requirements for the same doctor's office, an Entity Relationship Diagram (ERD) has been created and depicted in Figure 2.

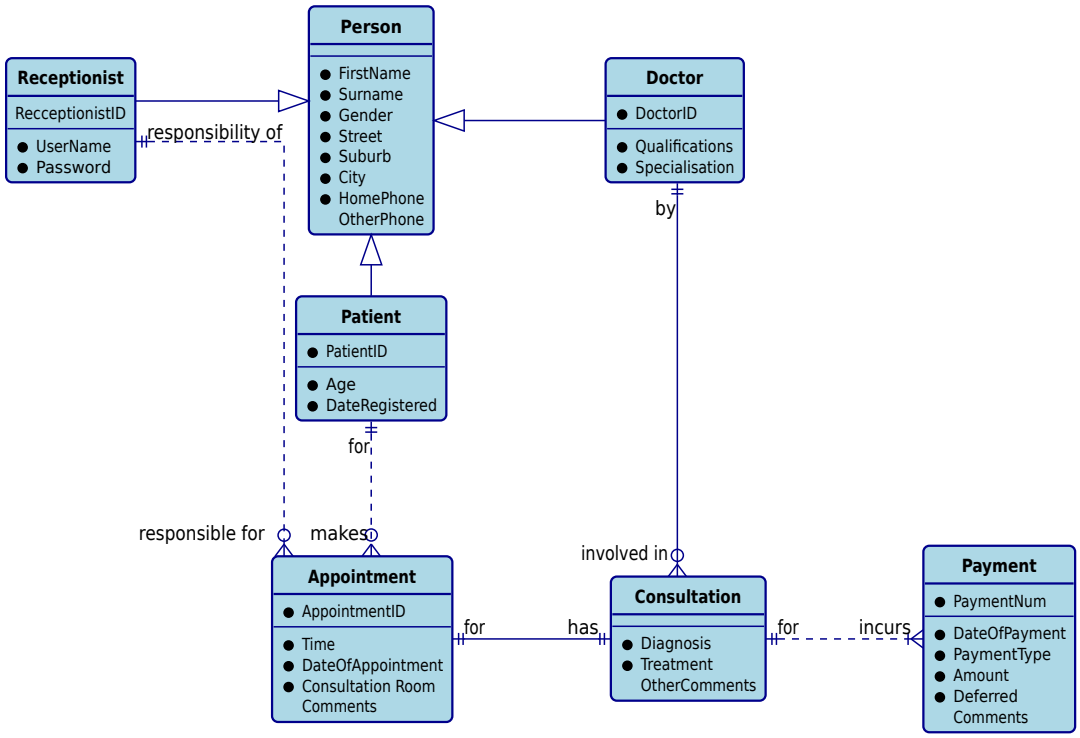

Figure 2: *ERD for the doctor's office*

(a) *Why* is there no unique identifier specified as part of the `Person` entity? (2 marks)

(b) *How* are mandatory values denoted for attributes in these entities? (2 marks)

(c) *What* do the solid relationship lines in the ERD represent? (2 marks)

(d) *How* do relationship labels add meaning to this ERD and *why* are there two labels for each relationship? (2 marks)

(e) *What* does the optionality and cardinality of the relationship between the `Consultation` entity and the `Payment` entity imply? (2 marks)

14. Draw a *UML* Class Diagram that represents the data requirements of the case study presented on pages 7 to 10. The Class Diagram should follow these conventions:

    - Label the classes with relevant stereotypes (e.g. <<`entity`>> or <<`abstract`>>).
    - Contain attributes, an appropriate data type for each attribute, & appropriate visibility for each attribute.
    - Do **NOT** model behaviour i.e. method definitions (e.g. `set` or `get` operations).
    - Associations must include names & multiplicity.
    - Include at least one example of inheritance (generalisation).
    - Include Aggregation & Composition where appropriate.
    - Include role names and navigability where appropriate.

    Describe any assumptions that you consider necessary to complete the design, or to clarify any ambiguity you believe exists. (30 marks)

CASE STUDY: Art-in-a-Minute

1 Background

The **Art-in-a-Minute** loan agency is a small business that loans out art to galleries nationwide. They have a number of galleries listed in their books to whom they loan artworks, as well as various artists who produce the artworks. As business has picked up, the manual system for tracking the inventory of artwork, and the loan of these artworks to galleries, has begun to prove unsatisfactory due to various kinds of problems plaguing the system. These include inaccuracy in transaction related information, poor performance, and loss of information. Consequently, they have asked you to provide conceptual designs for a new computerised solution to replace this manual system. These designs will be based on the components of the requirements specification (see § 1.1, § 1.2, § 1.3 and § 1.4) prepared by a senior analyst hired earlier by the company.

1.1 Interview transcript

Below is the transcript resulting from the interview between senior analyst, *Alan Vertiente* and owner of **Art-in-a-Minute**, *Pam Pluto*.

ANALYST Hi, I have been asked to talk to you about the main business activities of *Art-in-a-Minute*, however, for the purposes of today's interview, I want to focus specifically on the management of loans of artworks to galleries.

CLIENT Sure, where do we start?

ANALYST How about from the first thing *Art-in-a-Minute* does, when a gallery wants to borrow an artwork.

CLIENT Righto, well the gallery requests the artwork or artworks they require ...

ANALYST You mention artworks there, so I take it they can borrow more than one artwork at a time?

CLIENT Yes, that's correct. It doesn't matter whether they borrow one or five artworks, it is still part of the same loan transaction.

ANALYST Oh right, I understand. Next question. What specific information do you keep about each loan transaction?

CLIENT Well, we currently write down information about the loan manually, which is very tedious. However, the things we keep track of are, the date of the loan, the artworks involved in the transaction, the date due for each artwork, and the charge for each artwork rented out. We also leave space for recording the date for when the artwork is eventually returned.

ANALYST Well, that's a lot of information. Can I clarify a few points regarding your description?

CLIENT Sure, go ahead.

ANALYST Okay, why do you need to store the due date for each artwork?

CLIENT Well some artworks are more important so we may give these artworks an earlier due date, as they tend to be more popular. It just gives us that extra flexibility as we can ensure the artworks are in good condition and available for other galleries to borrow. Is this kind of thing possible?

ANALYST It shouldn't be a problem. Your answer though, brings me to my next question. Why would you need to store a separate charge for each artwork involved in a loan transaction? I

would have thought that each artwork would have it's own set charge assigned to it.

CLIENT Good point! You are right, each artwork does have a set charge assigned to it but sometimes we may charge a gallery a lesser amount to loan out a particular artwork to them, especially when they are good borrowers.

ANALYST Oh, I see that makes sense. Would it also be useful to document when a gallery is a good borrower?

CLIENT Yes, that would be very handy.

ANALYST I think I understand the date of return information as well. Different artworks could conceivably come back at different times so you want to be able to keep individual return dates for each artwork involved in a particular loan transaction.

CLIENT That's absolutely right. We also flag whether an artwork is available so that we know instantly if an artwork is currently loaned out.

ANALYST Right, so if a gallery requests an artwork, you can check a list of your artworks or something, and see if it has been flagged as 'not available'.

CLIENT Yes, correct.

ANALYST And I guess you would set the availability of an artwork to 'not available' at the time of the loan transaction. Is this right?

CLIENT Yes, that is also correct.

ANALYST We could probably store some kind of flag against each artwork for just this purpose.

CLIENT Excellent!

ANALYST The next logical direction would be the artworks themselves. What kind of information do you currently keep about them?

CLIENT Well, the title of the piece, the year it was made, the type of artwork it is ...

ANALYST Can I stop you there. I'm not sure what you mean exactly by type?

CLIENT Oh, basically it's whether the artwork is a painting, a sculpture, a photograph, etc. This is essentially a list of classifications that we assign each artwork, depending on what it is.

ANALYST Does this list change much over time?

CLIENT Not really but every artwork must be of a certain type.

ANALYST Thanks for clearing that up for me, is there any other information you keep with regards to artworks?

CLIENT Yes. The artist who produced the artwork is extremely important to us so we keep personal information about them as well. Things like contact details so we can reach them with queries about their art when required.

ANALYST I assume that you keep different artworks from the same artist?

CLIENT Yes, some of them are quite prolific actually.

ANALYST Do you bother to keep details about artists who don't have artworks with you?

CLIENT No, as we don't really see any point.

ANALYST Okay, and what about your customers - the galleries, do you keep information about them too?

CLIENT Sure do, we need contact details for them so that we can get in touch with them, especially if they are late returning artworks.

ANALYST That sounds suspiciously like a requirement for a report but I will leave that for now and come back to it in a follow-up interview. For now, what happens when a new gallery makes a request, that is, you don't have any information about them?

CLIENT The first thing we do in these cases is record their contact details such as their address, phone number, fax numbers and email addresses, if they have them. We also get them to identify a principal contact person at the gallery that we can contact when required.

ANALYST Okay, excellent. Would you be able to explain what currently happens when an artwork is returned?

CLIENT Sure thing. It is a very similar process to a library system. The gallery brings back the artwork, a staff member enters the date of return in our records, and flags the specific artwork as 'available'.

ANALYST Right, I see that we will need to keep information about *Art-in-a-Minute* staff as well. Excellent, I think I have more than enough information now. Thank you very much for your time.

CLIENT No, problem.

1.2 Business rules

1. All new galleries requesting artworks must have their name and contact details on record.
2. There must be a separate due date for each artwork involved in a particular loan transaction.
3. When renting out artworks, the availability must be checked first.
4. A loan transaction is always the responsibility of one staff member.

1.3 Glossary

Artwork A piece of art such as painting, sculpture, etc. produced by an artist.

Artist A person who manufactures art.

Gallery A room or series of rooms where works of art are exhibited.

1.4 Form

Figure 1.4 on shows a mock-up form that details a loan transaction between **Art-in-a-Minute** and a gallery.

ART-in-a-Minute Loan Agency
100 Freehold St, Dunedin, New Zealand Ph: 6555492 Fax:655908

ART WORK LOAN RECORD

LOAN NO:	1235	DATE:	17/02/2017
STAFF:	Chris Waddle		

GALLERY ID: 21
NAME: TestStrip Gallery
ADDRESS: 101 Karangahape Road
SUBURB: Central
CITY: Auckland
PHONE: 09 432 9870
FAX: 09 432 9823
EMAIL:

ARTWORK CODE	TITLE	TYPE	ARTIST	YEAR	DUE DATE	RETURN DATE	CHARGE
CH4573	Archeotechnic	Painting	Liubov Popova	1917	24/04/2017		500.00
NJ7854	Black Light	Sculpture	Ralph Hotere	1988	18/04/2017		2100.00
EJ769	Double Negative	Photo	Ronnie Van Hout	2000	01/06/2017		150.00
						GST	$343.75
						TOTAL	$2750.00

Figure 3: *A mock-up of an Art-in-a-Minute Loan record*

[SECTION B TOTAL 50 MARKS]

END