DUNMAN HIGH SCHOOL
General Certificate of Education Advanced Level
Higher 2
JC2 Preliminary Examination

COMPUTING 9754/02

Paper 2 **29 Sep 2009**

Thu 0830 – 1100 **2 hours 30 minutes**

Additional Materials: Writing Paper

READ THESE INSTRUCTIONS FIRST

Write your centre number, index number and name on all the work you hand in.
Write in dark blue or black pen on both sides of the paper.
You may use a soft pencil for any diagrams, graphs, tables or rough working.
Do not use staples, paper clips, highlighters, glue or correction fluid.

Answer **all** questions. Total marks is 100.

At the end of the examination, fasten all your work securely together.
The number of marks is given in brackets [ ] at the end of each question or part question.

Answer **all** questions.

Dunman Higher School is a premiere co-educational institution in Singapore offering a 6-year integrated programme leading up to the International Baccalaureate. It has a steady staff strength of 250 (200 teaching and 50 support) and student population of 2400 (400 across each level).

The school wishes to harness infocomm technologies to drive its key academic and administrative processes. It has engaged Computing@DHS, a promising startup comprising graduating Computing students from its partner school, Dunman High School to provide technical consultancy services.

1 The school library currently adopts the following operations:

- Each book is assigned a tag with a barcode bearing a unique book identification number.
- Each user is assigned a membership card with a barcode bearing a unique user identification number.
- Each user is allowed to borrow a maximum of 6 books over a 14-day period.
- When a book is loaned both the book and borrower's barcodes are scanned and the loan recorded in a database.
- When a book is returned only the book barcode needs to be scanned.
- A check is made to see whether the book is on the overdue list.
- If the loan is not overdue the return is complete, else a fine amount is computed based on 10 cents per book for each overdue day.
- A receipt is generated upon payment of the overdue amount and the overdue loan and payment details recorded.

The overdue process is as follows:

- A day before a book is due a system generated reminder email is sent to the user's email.
- If a book is overdue, a daily system generated reminder is emailed to the user indicating the overdue details as well as the fine amount payable.
- If a book is more than 7 days overdue, in place of the daily reminder email, a warning email will be sent to the user, with a notification email also sent to the user's class form teacher, and a notification sms sent to one of the user's parents.
- If a user has more than 4 books overdue for more than 14 days, his/her particulars will be recorded in a blacklist. Users on the blacklist must return all loaned books immediately and will be barred from future loans until all outstanding overdue payments are made.
- If a user's name persistently appears on the blacklist for 3 or more times in a semester, he/she will be required to attend a social responsibility counseling session before he/she can continue to loan any library books.

(a) Draw a system flowchart depicting how the current system works. [5]

(b) Create a decision table showing all possible outcomes and results for the overdue process. [4]

(c) Simplify the decision table by removing redundancies. [3]

2 The library maintains a growing collection of 50,000 books. Users can query the availability of a book by entering search terms relating to the title or author of the book into the school's online library information system. It is proposed that a random file organization be used to store the book records.

(a) Justify why a random file organization is suitable and describe how the random access file is to be organized. [4]

(b) Devise an appropriate hashing function for the random file organization. How would your hashing function minimize collision? [3]

(c) Describe two collision resolution methods for the proposed random file organization. [4]

3 Computing@DHS has proposed the use of Radio Frequency IDentification (RFID) technology to monitor the attendance of the students in school and their presence during lessons.

(a) Explain what RFID is and how it can be used for attendance monitoring. [4]

(b) Discuss the advantages and disadvantages of employing RFID. [4]

(c) Propose an alternative automated solution besides RFID. [2]

(d) Describe the necessary fallback safeguards should a computerised solution fails. [2]

4 The school currently has 200 desktop computers and 300 notebook computers distributed across its 8 buildings. Most of the computers will be linked to the school network using Local Area Network (LAN). Some of these computers are reserved for staff, while others are available for students' use. Some staff and students also bring their own computing devices to connect to the school network.

(a) Discuss the relative pros and cons of using bus, ring or star topologies in connecting the computers to the LAN. Your answer should include diagrammatic illustrations of these topologies and a proposed recommendation for Dunman Higher School. [8]

(b) State with reason the type of device needed to perform to connect the network from one building to another? [2]

To facilitate anytime anywhere easy access to online resources and facilities, the school intends to implement a wireless network. This should be of sufficient bandwidth to support the day-to-day teaching and learning needs of users across a wide range of mobile devices, and be reasonably secure. In addition, provision for basic file and print sharing services and real-time utilization monitoring facilities should also be included.

(c) Suggest a suitable hardware and software configuration for the wireless infrastructure satisfying the above requirements. [6]

(d) Errors can occur in data transmission between the computers in the network. Explain the use of parity checks and check sums in detecting these errors [2]

5 A core requirement of the International Baccalaureate programme is the Creativity, Action, Service (CAS) component, where students embark on non-academic projects for an equivalent of 3 hours each week during their last 2 senior years. The project can be in the arena of artistic pursuits, sports or community service work. A varied range of projects is provided by a school CAS coordinator in a CAS master file. Additional projects may be proposed by the students and subject to approval by the CAS coordinator.

It is intended to implement an online proposal system for students to submit their CAS activities. During a 2-week window, students may create, view, update and delete possible CAS proposals. Approved projects will be eventually merged with the CAS master file. A final collated list of endorsed CAS activities will be generated and made available for student registration.

(a) Justify suitable modes of processing for proposal submission and generation of finalized CAS activities list. [4]

(b) Design an appropriate user interface for the CAS coordinator to approve students' submitted proposals. Justify the use of suitable controls in your design. [5]

(c) Outline an efficient algorithm to update the CAS master file with the approved projects transaction file to produce the final collated CAS activities list. Comment on the efficiency of your algorithm. [5]

6 Computing@DHS intends to harness the potential of social networks to connect all staff and students of Dunman High School and Dunman Higher School.

(a) What is a social network? Suggest two appropriate applications of this in education compared to traditional face-to-face interaction and online communication means such as email and instant messaging. [3]

(b) Discuss the relative benefits and pitfalls of connecting users using existing open platforms such as Facebook or Twitter vs creating or adopting a Dunmanian-exclusive social platform.[4]

(c) What measures can be put in place to prevent or minimize the chances of

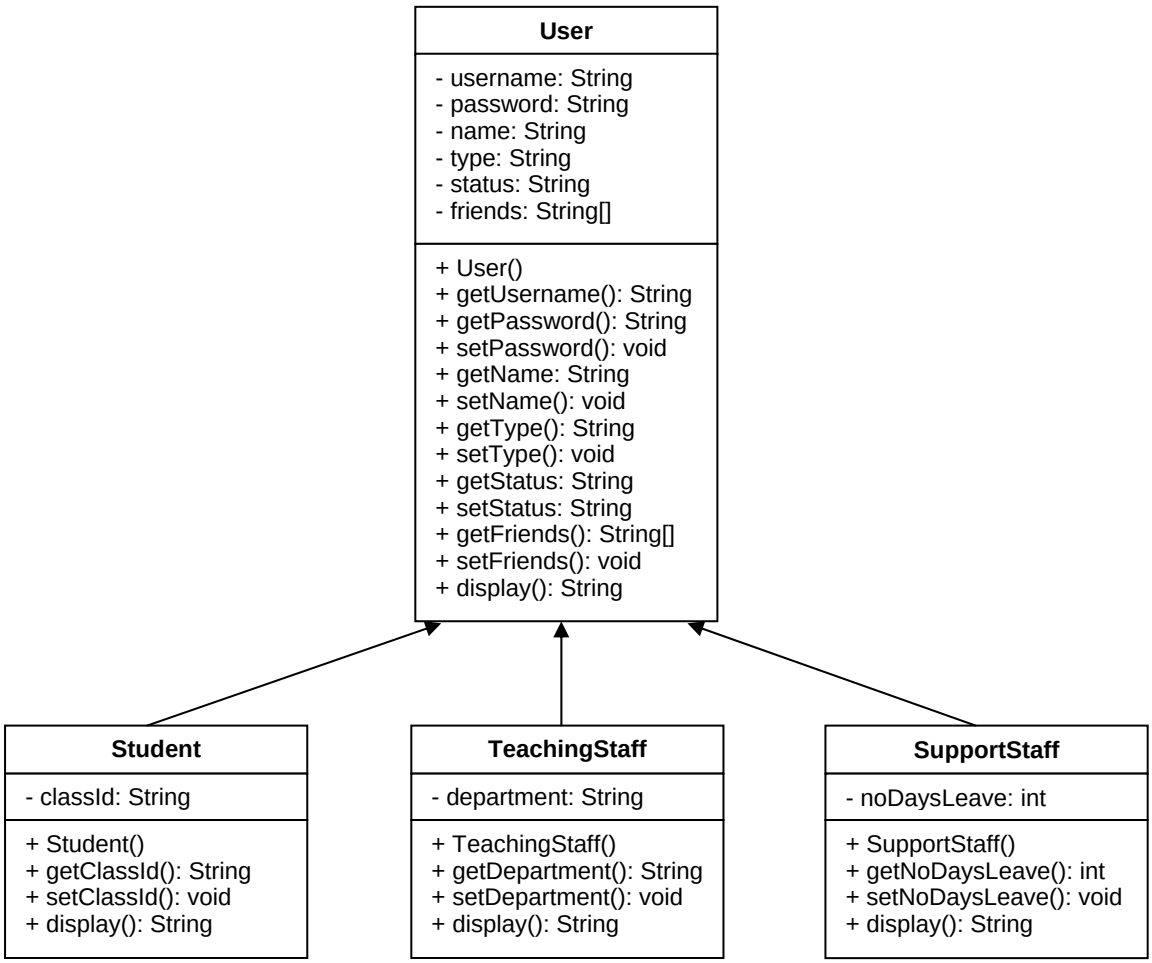
(i) Denial of Service (DOS) attacks.

(ii) unintentional leakage or deliberate hacking of users' private information?

[4]

(d) Explain why the Object-Oriented Programming (OOP) paradigm is well suited to implement a social network? [2]

The following class diagram shows the inheritance hierarchy for the super class User and sub classes Student, TeachingStaff and SupportStaff.



(e) Using appropriate examples related to this context, explain the OOP concepts of:

(i) encapsulation

(ii) inheritance

(iii) polymorphism

[6]

7 The user records in the social network will be stored in a linked structure. Each node contains a key field, a data field which stores the user's profile and friends' list details, and a link field.

(a) Why is a linked structure more suitable than an array structure for a social network application? [2]

(b) Outline suitable algorithms for a user to

(i) create a new account and update his/her profile and status message; [2]

(ii) search for friends and add it to his/her friends' list (before and after friend's confirmation), assuming that a user's friend list is stored in alphabetical name order; [3]

(iii) be shown a random list of friends' friends for adding to his/her friends' list, with an option to view more. [5]

(c) Suggest and justify one circumstance where an array structure is more appropriate than a linked structure. [2]

- The End -