UIT2201: Computer Science and Information Technology Revolution  
(Spring Semester 2013)

MID TERM TEST  (1 hour)

INSTRUCTIONS:

1. This Mid-Term Test is CLOSED BOOK / CLOSED NOTES.

2. Answer ALL questions in this answer book.

3. Make sure you write down your NAME and MATRIC NUMBER

Name: _________________________________________________________

Matric Number: ____________________

<table>
<thead>
<tr>
<th>QUESTION</th>
<th>POSSIBLE</th>
<th>SCORE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Q1</td>
<td>20</td>
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<td>Q2</td>
<td>15</td>
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<td>Q3</td>
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<td>Q4</td>
<td>10</td>
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<tr>
<td>TOTAL</td>
<td>60+1</td>
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Fun Question: (1 bonus point)

Name the university I visited in Jakarta during the one-week break. Or make a guess.

(a) __________________________________________________________

(Now, please relax and enjoy the Quiz, OK?)
Question 1: (20 points)

True-False (2 point each)

(z) (Sample) The course UIT2201 is taught by Prof. Leong Hon Wai  

_TRUE_

(a) Computer Science is the study and use of computers and computer programs and applications.

(b) Computing the sum of squares of \( n \) numbers \((X_1, X_2, \ldots, X_n)\), namely, finding \((X_1^2 + X_2^2 + \ldots + X_n^2)\) can be done in \( \Theta(n) \) time, namely, in linear time.

(c) One important virtue of an algorithm is that if we can specify an algorithm to solve a problem, then we can automate the solution.

(d) In Scratch, a sprite A can ask another sprite B to start executing, then wait until B finishes before A executes the next action.

(e) An algorithm A with running time \( 2.013n^2 \) will be faster than an algorithm B with running time \( 2013n(lg \ n) \) when \( n \) is sufficiently big.

(f) The binary search algorithm is so-named because it uses only binary operations and binary numbers.

(g) When answering SQL queries, the join operation is usually the most expensive operation.

(h) Each row of a database table is called an attribute.

Fill in the blanks: (2 points each)

(i) Name the fun feature/characteristic of Scratch that you personally like the most.

Answer: __________________________________________________

(j) Name one aspect of Scratch that you like to be improved upon. Give short description.

Answer: __________________________________________________
Question 2: (15 points)

In the USP, there are 5 committees, each committee consisting of different faculty and staff members (represented by letters A, B, C, D, E, G, H, J), as given below:

\[
\begin{align*}
 DDC &= \{ A, B, G \} & CRC &= \{ B, C, E \} & SLC &= \{ C, D, H \} \\
 ORC &= \{ A, D, J \} & BWC &= \{ A, E, J \}
\end{align*}
\]

Each committee wants to schedule a 1-hour meeting every Monday morning. However, because some committee members belong to multiple committees, some of the meetings cannot be held concurrently. A simple way is to schedule each meeting at a different time slot (using 5 time slots). However, it is better to finish all the meetings in the fewest number of time slots possible (so that the members can have time do other work every Monday morning). Thus, the Meeting Scheduling Problem (MSP) is to schedule the 1-hour meetings for all the committees (and each member is able to attend all the committee meetings) with the fewest number of time slots.

(i) [3] Show how we can model the conflicts in this problem with a graph \( G = (V, E) \). Each vertex in \( V \) in the graph models a committee in the USP. Explain clearly how the edges are defined, namely, under what condition do we connect two vertices \( u \) and \( v \)?

(b) [5] Draw the graph for the example of the 5 committees in the USP.

(c) [3] Explain how to solve the meeting scheduling problem using the graph model.

(d) [4] Give a meeting schedule that uses the minimum number of time slots.
Question 3: (15 points)

A “big” company, BB has a (sorted) customer list LL with 10 names and uses binary search algorithm for searching. A “small” company, SS, has an unsorted customer list TT with 5 names and uses sequential search algorithm for searching. (The numbers are intentionally kept small for this Quiz; else these are likely to be 1,000,000 and 1,000, respectively.)

When the companies BB and SS merged to form BSBS, they want to combine their customer lists. You are brought in to develop algorithms for searching the combined list. But, you only have a short time to develop the algorithms, so your initial approach is to “combine” the searches with a quick-and-dirty solution.

Your quick-and-dirty idea, which you call Hybrid-BB-SS, is to first search list LL (using BB’s binary search algorithm). If it is unsuccessful, then search the list TT. (using SS’s sequential search algorithm). The resulting pseudo-code is as follows:

```
Algorithm Hybrid-BB-SS (aName) (*aName is a given name to search*)
1. Use binary search to search for aName in the list LL;
2. If unsuccessful, use sequential search to search for aName in the list TT;
```

(a) [4] Draw the search tree that is used to visualize this Hybrid-BB-SS algorithm applied to the sorted list LL of size 10 and unsorted list TT of size 5. (Include the “square” nodes for unsuccessful searches).
(b) [4] What is the number of comparisons needed for a successful search in (i) the worst-case and (ii) average-case? (Assume that all names are equally likely to be searched.) [You can leave your answers in fractions.]

Worst Case: ____________ comparisons

Average Case: (Hint: sum and divide by 15)

(c) [2] What is the number of comparisons needed, in the worst case, for an unsuccessful search?

Worst Case: ____________ comparisons

(d) [3] Now, suppose that you have more time to develop a much better algorithm than the Hybrid-SS-BB algorithm given above. Informally, describe your better algorithm or give a high-level pseudo-code of the algorithm (similar to pseudo-code for (a).) [There is no need to give detailed code for this problem.]

(e) [2] What is the number of comparisons needed for a successful search using your algorithm in the worst-case?

Worst Case: ____________ comparisons
Question 4: (10 points)

Given a database with the following 3 tables: \{SI, CI, EN\}. You should use these short table names to save space and writing. (Use the reverse blank pages, if necessary)

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<thead>
<tr>
<th>Student.ID</th>
<th>Name</th>
<th>NRIC.No</th>
<th>Address</th>
<th>Tel.No</th>
<th>Faculty</th>
<th>Major</th>
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<tr>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Course.ID</th>
<th>Name</th>
<th>Day</th>
<th>Hour</th>
<th>Venue</th>
<th>Instructor</th>
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</thead>
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<table>
<thead>
<tr>
<th>Student.ID</th>
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<tbody>
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</tbody>
</table>

For (a) and (b) below, give the appropriate (i) SQL query, and (ii) a sequence of basic database primitives (using \textit{e-project, e-select, e-join}):

(a) [4 pts] List the Student-ID, Name, Major of all students whose major is “UBW”.

(i) SQL Query:

(ii) Using Basic Primitives:

(b) [6 pts] List the Course-ID, Student-ID, Name (of student), Major of students whose Major are “SSS” and have class on “Wed”.

(i) SQL Query:

(ii) Using Basic Primitives: