MSc Primer Course Test

Friday, 25th September 2015 @ 6:30pm
Duration: 60 mins (75 minutes allowed)

• Attempt ALL 8 questions on the paper.
• There are a varying number of marks for each question.
• Simplicity and clarity of expression in your answers is important.
• You NOT are allowed to use electronic calculators and other such devices.

<table>
<thead>
<tr>
<th>Question:</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Marks:</td>
<td>20</td>
<td>13</td>
<td>12</td>
<td>10</td>
<td>9</td>
<td>10</td>
<td>12</td>
<td>14</td>
<td>100</td>
</tr>
</tbody>
</table>

Answer the questions in the spaces provided on the question sheets. If you run out of room for an answer, continue on the back of the page.

Name: (In BLOCK CAPITALS) __________________________________________

Contact Email: _____________________________________________________

College login username (if you have it): _______________________________
Question 1 .......................................................... Total: 20 marks
Questions in this section can be answered in either pseudo-code or using the Python programming language.

(a) Write a program that asks the user for a number \( n \) and prints the product of the numbers 1 to \( n \).

(b) Write a program that prints a multiplication table for the numbers 1 to 12.

(c) Write a function that returns the smallest element in a list.

(d) Write a function that returns the elements that are in even positions in a list.
Question 2 ................................................................. Total: 13 marks

Where AND = \&,  OR = \lor, and \text{ NOT} = \neg

(a) Write an expression equal to \( p \land (q \lor r) \) and show, using truth tables, that your answer is correct. Do the same for \( p \lor (q \land r) \).

(b) Given

\[ p \lor \neg q = \neg(p \land q) \lor \neg p \]

show which values of \( p \) and \( q \) make both sides of the equation have the same value. Hint: use appropriate truth tables.
Three people called Alf, Beth, and Gemma, sit together in the same room.

One of them always tells the truth.
One of them always tells a lie.
The other one tells truth or lies at random.

In each of the following situations, your task is determine how each person acts.

(a) Suppose that Alf says “I always tell lies” and Beth says “Yes, thats true, Alf always tells lies”.

Who always tells the truth? Who always lies? Briefly explain your answer.
(b) Suppose instead that Gemma says “Beth always tells the truth” and Beth says “That’s wrong”.
Who always tells the truth? Who always lies? Briefly explain your answer.

(c) Suppose instead that Alf says “Beth is the one who behaves randomly” and Gemma says “Alf always lies”. Then Beth says “You have heard enough to determine who always tells the truth”.
Who always tells the truth? Who always lies? Briefly explain your answer.
Question 4 ...................................................... Total: 10 marks
Convert the following:
(a) $21314_5 = (\cdots)_{10}$

(b) $4369_{10} = (\cdots)_8$

(c) $1001100_2 = (\cdots)_8$
Using the “box and arrow” representation we discussed in class provide memory diagrams for the following:

(a) \[[[4, [5, [2]]], [6, [3], 5], [4, 5, []], [12, 6]], 8\]

(d) $B2F_{16} = (\cdots)_8$
Let \( A = \{0, 1\} \) be the input alphabet. Consider the set \( A^3 \) of all binary strings of length 3. These will be the states. Let 001 be the initial state and 010 the
terminal state. Let $a_1a_2a_3$ be the current state and let $a$ be the input symbol. Then the next state is $aa_1a_2$; so we shift everything along one place to the right, the right-hand bit drops off and is lost and the left-hand bit is the input symbol. Draw a state transition diagram for this specification together with the appropriate transition table.

**Question 7** ......................................................... Total: 12 marks

(a) Why is an operating system important in managing a modern day computer? 3 marks

(b) Why should we use virtual memory as against solely physical memory? 5 marks
(c) How do multi-core computers assist with parallelism?  

(a) Briefly describe the main components of a modern day computer and their purpose. You should include references to the CPU and ALU in your answer. A diagram may help support your answer.
(b) Briefly describe the differences between interpreted and compiled computer code. What are the advantages and disadvantages of each approach.