Midterm

COS 116 Spring 2011: The Computational Universe

This is an in-class exam. No collaboration is allowed. Write and sign the honor pledge:

“I pledge my honor that I have not violated the Honor Code during this examination.”

1) Sampling

Assume that this square wave is being sampled at each moment in time that is marked with a vertical line. Label each sample with a 4-bit sequence (i.e. 0000) corresponding to the amplitude at that time.
Answers should be 0011, 0000, 0010, 0000, 0001, 0001. I took out the negative part of the waveform, because I wasn’t sure whether they knew 2s complement.

2) Scribblor Pseudocode Errors

This code should cause the scribblor to move forward indefinitely, spinning right when an obstacle is detected (then continuing to move forward). What’s wrong with it? (cross out any incorrect portions and write corrected code)

Do once
{
  If <No Obstacle> Then
  {
    Move <Left Wheel Speed 100%, Right Wheel Speed 100%> for 0.2s
  }
  Else
  {
    Spin Right for 0.3s
  }
}
END

The answer is that “Do once” should be “Do forever”.

The following code should cause the LEDs on the scribblor to blink on and off repeatedly. What’s wrong with it?

Do forever
{
  LED: ON, ON, ON
  LED: OFF, OFF, OFF
}
END

The answer is that there needs to be “Pause Xs” after turning the LEDs ON and turning the LEDs OFF.

3) Pseudocode Output
Do for i = 1 to 20
{
  If ( i > 15) then
  {
    If( i < 20)
    {
      Print(i)
    }
  }
}

What output does the code above produce?

Tests knowledge of for loop and nested if clause. Answer is “16,17,18,19”.

4) List 3 essential features of a cellular automaton

5) Assume the following Truth Table:

<table>
<thead>
<tr>
<th>E</th>
<th>D</th>
<th>S</th>
</tr>
</thead>
<tbody>
<tr>
<td>True</td>
<td>True</td>
<td>True</td>
</tr>
<tr>
<td>True</td>
<td>False</td>
<td>False</td>
</tr>
<tr>
<td>False</td>
<td>True</td>
<td>False</td>
</tr>
<tr>
<td>False</td>
<td>False</td>
<td>True</td>
</tr>
</tbody>
</table>

Write a Boolean expression representing this Truth Table.

Draw a Boolean circuit represent the Truth Table above.
E = (S AND D) OR (NOT S AND NOT D)

6) Recall the “findmin” example shown in class:

```plaintext
best ← 1
Do for i = 2 to n
{
        best ← i
}
```

Why does the for loop start at 2?

Because we are assuming the first element in the array holds the smallest value, then comparing that value to all others in the array.

Is it OK if we start the loop at 1 instead? (Do for i = 1 to n) Why?

Yes, the first iteration of the loop will simply do nothing.

7) What does the following code do?

```plaintext
S ← 0
Do for i = 1 to \([n/2]\)
{
    S ← S + A[2*i];
}
```

A sum of all even-indexed elements except 0 in the array (i.e. A[2], A[4], A[6]...)

8) Will the following Turing Post program print 101? If not, how can you fix it?

```plaintext
PRINT 1
PRINT 0
PRINT 1
STOP
```

You need “GO RIGHT” after each of the first two print statements.