Midterm Exam: CMPS 10

(20%) Light Bot 2.0 Programming:

Given that the instructions for the light bot are:

S-Step, J-Jump, L-Left, R-Right, P-Power

1. (10%) Solve the following puzzle, make sure your solution is optimized and you use the iteration notation (e.g. 2:L) whenever possible:

2. (10%) Given the definition of DoStack function:

```java
// Jump Jump Jump Power
F.DoStack() J J J P.
```

Solve the above puzzle by calling the given DoStack function. This is to say, you can use any instructions, but you should call DoStack whenever possible. Make sure your solution is optimized.
(40%) Bits and Bytes

3. (4%) Conversion to binary:
   a. (5%) Convert decimal 57 to binary

   b. (3%) How many bits do we need to represent 57?

   c. (2%) What is the largest decimal number that can be represented with 5 bits?

4. (4%) Binary number arithmetic: compute the following summations and leave your results in binary. Show your work including carry bits.

   a. (5%) \( \begin{array}{c} 1011_2 \\ + 10001_2 \end{array} \)

   b. (5%) \( \begin{array}{c} 1111_2 \\ + 11010_2 \end{array} \)

5. (4%) On a CD-ROM, we read off the following sequence (first bit read is on the left), you are told each number is represented by 5 bits.

   Start:
   
   ____________

   a. (2%) How many numbers does the above sequence of bits represent? _______

   b. (2%) Convert the very first number recorded on this CD ROM to decimal. _______

   c. (1%) Draw 3 circles around the bits representing the first three numbers. Each circle should surround the bits representing one of the first three numbers. You do not need to convert these numbers to decimal, just draw the circles around the bits that represent each number.

6. (4%) For floating point RGB color representation, connect the following color description to the best RGB values:

   Almost black    ____    A.  fill(200, 200, 200)
   Bright red      ____    B.  fill(255, 175, 175)
   Light red       ____    C.  fill(50, 255, 200)
   Not a red color ____    D.  fill(25, 25, 25)
   Almost white    ____    E.  fill(255, 0, 0)

7. (4%) Deleting a file on a computer (using normal delete) is like
   a. Using whiteout to cover up some words in a printed document.
   b. Erasing writing on a chalk/white board.
   c. Shredding a document in a document shredder.
   d. Removing an entry from the table of contents or index of a magazine without removing the actual article from the pages.
   e. Tearing a page out of a book or magazine.
8. (4%) Decode the following ASCII values using the ASCII code table provided below. For example, the ASCII value for the letter “A” is “01000001”.

```
01000110, 01000001, 01001100, 01001100, 00110001, 00110010
```

<table>
<thead>
<tr>
<th>ASCII</th>
<th>0</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>9</th>
<th>:</th>
<th>&lt;</th>
<th>=</th>
<th>&gt;</th>
<th>?</th>
</tr>
</thead>
<tbody>
<tr>
<td>0011</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
<td>6</td>
<td>7</td>
<td>8</td>
<td>9</td>
<td>;</td>
<td>&lt;</td>
<td>=</td>
<td>&gt;</td>
<td>?</td>
</tr>
<tr>
<td>0100</td>
<td>@</td>
<td>A</td>
<td>B</td>
<td>C</td>
<td>D</td>
<td>E</td>
<td>F</td>
<td>G</td>
<td>H</td>
<td>I</td>
<td>J</td>
<td>K</td>
<td>L</td>
<td>M</td>
<td>N</td>
</tr>
<tr>
<td>0101</td>
<td>P</td>
<td>Q</td>
<td>R</td>
<td>S</td>
<td>T</td>
<td>U</td>
<td>V</td>
<td>W</td>
<td>X</td>
<td>Y</td>
<td>Z</td>
<td>[</td>
<td>\</td>
<td>]</td>
<td>^</td>
</tr>
<tr>
<td>0110</td>
<td>~</td>
<td>a</td>
<td>b</td>
<td>c</td>
<td>d</td>
<td>e</td>
<td>f</td>
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<td>h</td>
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<td>n</td>
</tr>
<tr>
<td>0111</td>
<td>p</td>
<td>q</td>
<td>r</td>
<td>s</td>
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<td>u</td>
<td>v</td>
<td>w</td>
<td>x</td>
<td>y</td>
<td>z</td>
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<td></td>
<td></td>
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</tr>
</tbody>
</table>

9. (4%) Fill out the truth tables for each of the following logical statements.

a. 

<table>
<thead>
<tr>
<th>p</th>
<th>q</th>
<th>p OR q</th>
<th>p AND (p OR q)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>0</td>
<td>1</td>
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<tr>
<td>1</td>
<td>0</td>
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<tr>
<td>1</td>
<td>1</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

b. 

<table>
<thead>
<tr>
<th>p</th>
<th>q</th>
<th>r</th>
<th>NOT r</th>
<th>p OR q</th>
<th>(p OR q) OR (NOT r)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>0</td>
<td>0</td>
<td></td>
<td></td>
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<tr>
<td>0</td>
<td>1</td>
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</tr>
</tbody>
</table>

10. (4%) Decode this message 110000100110 given this Huffman Tree. _________________
11. (4%) Create a Huffman tree for these letter frequencies g:2, r:4, m:5, o:5, e:11. Be sure to label the branches.

12. (2%) UTF-8 is like Huffman coding because (circle all that apply):
   a. It is a super set of the ascii encoding scheme.
   b. No code (for a single letter) is a prefix of another code (for a single letter).
   c. It is a variable length coding scheme. That is, different letters are coded using different numbers of bits.
   d. It is the optimal coding scheme for single letters.

13. (2%) This circuit is used as a building block in doing what basic computer operation? The upper logic gate is XOR (exclusive-or) and the lower is AND.
(25%) Programming:

14. (5%) Given the following code, what are the values of x, y, and z after the code executes?

```cpp
int x, y, z;
x = 3;
y = 7;
z = x + y;
y = y + z;
x = x + x;
```

15. (10%) What does this program display?

```cpp
void setup() {
    size(500, 500);
    noFill();
}
int diameter = 0;
void draw() {
    ellipse(width/2, height/2, diameter, diameter);
    diameter = diameter + 15;
}
```

a. nothing (a circle with diameter 0)
b. many nested circles (like a target) growing in size
c. a white circle growing in size
d. a black circle growing in size
e. a pulsing images of circles growing and shrinking

16. (10%) What does this program display?

```cpp
void setup() {
    size(200, 200);
}
void draw() {
    background(255);
    int xPos = 0;
    ellipse(xPos, height/2, 20, 20);
    xPos = xPos + 1;
}
```

a. half-circle on the left edge not moving
b. circle moving across the screen left to right
c. circle moving across the screen right to left
d. circle moving across the screen top to bottom
e. circle moving across the screen bottom to top
(15%) Others

17. (5%) Which of these is NOT one of the “Seven Big Ideas” in computing defined by the College Testing Board for the new AP Computing Principles course?
   a. Computing is a creative human activity that enables innovation
   b. Abstraction is a way to understand and solve problems
   c. The video game industry is now more important (larger) than the film industry.
   d. Data and information help to create knowledge
   e. Algorithms are tools for developing and expressing solutions to computational problems
   f. Programming is a creative process that produces computational artifacts
   g. Digital devices, systems, and the networks that interconnect them enable and foster computational approaches to solving problems
   h. Computing enables innovation in other fields, like science, engineering, humanities, etc.

18. (5%) The invention of the transistor___
   a. fundamentally changed how computers compute.
   b. allowed computers to be smaller and faster.
   c. both a and b.

19. (5%) Which of these are NOT part of a person’s digital footprint (circle all that apply).
   a. What you post on Facebook.
   b. What you buy at Safeway using a credit card.
   c. A cash purchase at a pizza palor.
   d. What websites you visit.
   e. What ATMs you use and when.
   f. Web queries you have made.
   g. Where you go when carrying a “smart” phone.