NOTE: the exam will also have true/false, fill in the blank, and multiple choice questions. You would be wise to study all the terminology we have learned in the class thus far; a set of definitions can be found at [https://quizlet.com/csci101/folders/csci101-fall-2018/sets](https://quizlet.com/csci101/folders/csci101-fall-2018/sets). For each FULL page completed (and brought to class on Oct 3rd), 0.5 point extra credit will be earned.

1. Assume your computer uses 8-bit 2’s complement signed numbers. Find the sum of the two binary numbers below; give the result in binary and in (signed) decimal, and discuss your answer

\[
\begin{array}{c}
0 & 0 & 1 & 0 & 1 & 0 & 1 & 1 \\
+ & 0 & 1 & 0 & 0 & 1 & 0 & 1 \\
\hline
1 & 0 & 1 & 0 & 0 & 1 & 1 & 0 \\
+ & 1 & 1 & 1 & 1 & 0 & 0 & 1 \\
\end{array}
\]

2. If our machine stores a number in 4 bits. What is the smallest and largest number we can represent
   a. in unsigned binary
   b. in sign/magnitude
   c. in 2’s compliment

3. Assume your computer stores fractional numbers using 16 bits, 5 bits for the exponent (bias = 15) and 10 bits for the mantissa. How would your computer store the decimal number -17.25?

4. Given the following 8-bit binary number: 1000 1001. What is its decimal representation in each of the following notations?
   a. Unsigned binary notation
   b. Sign/magnitude notation
   c. Two’s complement
5. Create a truth table for the optimized circuit shown below.

![Circuit Diagram]

6. Give a Boolean expression in the format of your choice (using only AND, OR, and NOT) that produces the truth table from problem #6.

7. Using the sum-of-products algorithm discussed in class, give a circuit made only of AND, OR, and NOT gates that produces the truth table below. Do NOT optimize your circuit. You should show each step of the algorithm in your answer.

<table>
<thead>
<tr>
<th>a</th>
<th>b</th>
<th>output</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>0</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>1</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
</tbody>
</table>

8. What color is the following RGB pixel? 00000000 11111111 11111111

9. Suppose Jo’s digital camera has a storage capacity of 256MB. How many photographs could be stored in her camera if each picture is 1024 by 1024 pixels, and it each pixel requires three bytes of storage (RGB)?
10. Complete the table below.

<table>
<thead>
<tr>
<th>Decimal</th>
<th>Binary</th>
<th>Octal</th>
<th>Hex</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>0000 0010</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>30</td>
<td>0001 1010</td>
<td>52</td>
<td></td>
</tr>
</tbody>
</table>

11. Write pseudocode that computes the area and circumference of a circle given the radius \( r \), if and only if the radius is greater than or equal to 1.0; if the radius is less than 1.0, the code will compute the circumference only.

12. Use the algorithm for the shuffle left algorithm on the following data. What is the data list when the algorithm ends? What is the value of \( right \) when the algorithm ends?

1. Get values for \( n \) and the \( n \) data items
2. Set the value of \( legit \) to \( n \)
3. Set the value of \( left \) to 1
4. Set the value of \( right \) to 2
5. While \( left \) is less than or equal to \( legit \) do Steps 6 through 14
6. If the item at position \( left \) is not 0 then do Steps 7 and 8
7. Increase \( left \) by 1
8. Increase \( right \) by 1
9. Else (the item at position \( left \) is 0) do Steps 10 through 14
10. Reduce \( legit \) by 1
11. While \( right \) is less than or equal to \( n \) do Steps 12 and 13
12. Copy the item at position \( right \) into position \( (right - 1) \)
13. Increase \( right \) by 1
14. Set the value of \( right \) to \( (left + 1) \)
15. Stop

<table>
<thead>
<tr>
<th>0</th>
<th>14</th>
<th>27</th>
<th>0</th>
<th>41</th>
<th>0</th>
<th>9</th>
<th>12</th>
<th>52</th>
<th>16</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
13. Suppose the following sorted numbers exist in some list. Suppose you are looking for the number 1234 via the binary search algorithm. What numbers would 1234 be compared with to determine whether it is in the list or not.

24, 1234, 3584, 4968, 7965, 9493, 10325, 15694, 20586, 54687, 78576, 496854, 558674

14. Give the order of magnitude for each of the following equations:

a. \(n^3 + n^2\)

b. 15

c. 156 \(n^2\)

d. \(n + 387573\)

15. Write the output from the following pseudocode:

```plaintext
count = 0
while count is NOT 5
    count = count + 2
    print count
```

16. Suppose a program has a user input a value for \(n\). The program then executes the following pseudocode. What is the time complexity of this algorithm?

1: read in a list of \(n\) values from a file
2: set counter to 0
3: for i from 0 to \(n-1\)
4: print value[i]
5: if value[i] is greater than 100
6: add one to counter
7: for j from 0 to \(n-1\)
8: divide value[j] by 2
9: print value[j]
10: print counter

17. Here is a message in ASCII. What does it say?

```plaintext
01000111 01101111 00100000 01110011
01110100 01110101 01100100 01111001
00100000 01101101 01101111 01100010
01100101 00100001
```