This document is organized by CT100 learning outcome categories. Each section below is preceded by the name of the learning outcome category and followed by a collection of sample questions. These are only samples and not intended to complete assessment instruments. A complete listing of the specific learning outcomes associated with each category is included as an appendix to this document. Of course, the learning outcomes are NOT an exhaustive list of material covered in lectures, so some additional questions can be expected.

CT100 Learning Outcome Category 1: What is computation?
1. Computer science graduates might work in any of the following jobs, but which one is closest to the focus of computer science education?
   a) designing computer electronic circuits
   b) managing a company that sells laptop computers
   c) writing computer software
   d) repairing computer hardware
   e) working at a computer center help desk

2. Which one of the following is the greatest contribution of Hollerith's census machine in the history that lead to computers?
   a) It was the first programmable device
   b) It demonstrated how much faster a computational device could solve a problem.
   c) It was one of the earliest calculators for solving mathematical formulas.
   d) It proved the value of the stored program concept.
   e) It used the first transistor.

3. Moore's law states that computer circuits will grow in complexity (and correspondingly decrease in size and increase in speed) by doubling every ____ years.

4. Place the following measures of data amount in order from smallest to largest:
   gigabyte
   kilobyte
   terabyte

5. What is the decimal value equivalent to the following binary (base-2) number: 11001011?

6. Convert the following decimal number into its binary (base-2) equivalent: 91

7. The term “pixel” is associated with data that represents what kind of information?
   a) graphics/pictures
   b) sound/music
   c) integer-valued numbers
   d) real numbers
   e) text characters

CT100 Learning Outcome Category 2: Logic
8. Complete a truth table for the following logical expression: (NOT P) AND (Q OR R)

9. Which of the following logical expressions is an accurate translation of the following English sentence, using the propositional variables listed below: If Mom doesn’t send money, then I have no friends.
   Let M denote “Mom sends money.”
   Let F denote “I have a friend.”

   a) (NOT M) AND (NOT F)
   b) (NOT M) AND F
   c) (NOT F) IMPLIES (NOT M)
   d) (NOT M) IMPLIES F
   e) none of the above
10. Exactly when does the logical expression \( P \) implies \( Q \) have a false value?
   a) Whenever \( P \) is false.
   b) Whenever \( Q \) is false.
   c) When \( P \) is true and \( Q \) is false.
   d) When \( P \) is false and \( Q \) is true.
   e) When both \( P \) is false and \( Q \) is false.

11. Each part below contains a pair of logical expressions. Circle every pair of expressions are equivalent. Note that there may be none or many.
   a) \( P \) ... \( P \) AND \( P \)
   b) \( P \) AND (NOT \( P \) ... \( P \) OR (NOT \( P \))
   c) \( P \) IMPLIES \( Q \) ... \( Q \) IMPLIES \( P \)
   d) \( P \) AND \( Q \) ... \( P \) IMPLIES \( Q \)
   e) \( P \) OR (\( Q \) AND \( R \)) ... (\( P \) OR \( Q \)) AND (\( P \) OR \( R \))

12. How would you describe the truth table for an expression is a tautology?

13. What logical expression should be written in place of ??? below?

\[
\begin{array}{c|c|c}
A & B & ??? \\
\hline
\text{NOT} & \text{AND} & \text{OR} \\
\end{array}
\]

   a) \( (A \ OR \ (\text{NOT} \ B)) \ AND \ B \)
   b) \( (B \ AND \ (\text{NOT} \ A)) \ OR \ B \)
   c) \( (A \ AND \ (\text{NOT} \ B)) \ OR \ B \)
   d) \( A \ OR \ ((\text{NOT} \ B) \ AND \ A) \)
   e) \( A \ AND \ ((\text{NOT} \ B) \ OR \ B) \)

14. Which of the following is a proper Google search expression to search for all web pages containing (the word "Boolean" OR the word "math") AND NOT the word "help"?
   a) \( (\text{Boolean OR math}) \ NOT \text{ help} \)
   b) \( (\text{Boolean math}) \ NOT \text{ help} \)
   c) \( (\text{Boolean OR math}) \ -\text{help} \)
   d) \( \text{Boolean math help} \)
   e) \( (\text{Boolean math}) \ -\text{help} \)

**CT100 Learning Outcome Category 3: Problem Solving**

15. Which of the following Alice program buttons or tabs must be used in order to cause some object to turn around when you run the program?
   a) ![if]
   b) ![Functions]
   c) ![assign]
   d) ![Procedures]
Assume that in your Alice program you have declared four integer (whole number) type variables, called \( \text{cowCount}, \text{pigCount}, \text{chickenCount}, \) and \( \text{maxCount} \) in order to complete exercises 16 through 18.

16. Suppose that your program contains the three instructions below. Reorder these instructions so that following their execution, all three variables store the value 100;

\[
\begin{align*}
\text{cowCount} & \leftarrow \text{pigCount} \\
\text{pigCount} & \leftarrow 100 \\
\text{chickenCount} & \leftarrow \text{cowCount}
\end{align*}
\]

17. What value is stored in the cowCount variable at the time that that following Alice code completes execution?

18. What value is stored in the pigCount variable at the time that that Alice code from Exercise 18 completes execution?
CT100 Learning Outcome Category 5: *Models of Computation*

20. Which of the following is(are) the rough form of the flow diagram depicting a loop?

a) ![Diagram A](image1)

b) ![Diagram B](image2)

c) ![Diagram C](image3)

d) Both a) and b) depict loops.

e) All three depict loops.

Use the picture to the right to complete Exercises 21 through 23.

21. Is this picture an activity diagram or a state diagram?
22. What is the first value of X output when this algorithm executes?
   a) 0
   b) 1
   c) 999
   d) 1000
   e) 1001

23. When this algorithm executes how many times has the Output X action been executed?

26. Circle all of the directed graphs below that are trees.
   a) 
   b) 
   c)
27. Which one of the following is true regarding the number of vertices and arcs of a tree organization?
   a) The number of vertices and arcs connecting the vertices is the same.
   b) There is one more arc in the tree than there are vertices.
   c) There is one more vertex than there are arcs in the tree.
   d) The tree contains at least one cycle.

28. What is the mathematical model for the following directed graph?
29. Write the Alice code that is depicted in the following activity diagram:

![Activity diagram with nodes and arrows]

```
WhileNumber wagCount ← 0

[NOT wagCount < 3]
[wagCount < 3]

butch roll RIGHT, 1.0

wagCount ← wagCount + 1

[NOT (butch isFacing sam)]
[butch isFacing sam]

sam say "Bark"

sam move LEFT, 2.0

[butch think "I'm hungry"]
```
Appendix A - CT Outcomes

1. What is computation?
   a. Students can explain the stored program concept and how this is essential for computers to execute software that manipulates data.
   b. Students can apply Moore’s law to predict technological advancement.
   c. Students can explain the limitations and advantages of digital devices by comparison to their analog counterparts.
   d. Students can describe the relationship of information to data.
   e. Students understand that data can always be represented as sequences of bits, and can apply encoding schemes to represent various kinds of information as bit strings.
   f. Students can identify the relative sizes of byte, kilobyte, megabyte, gigabyte, terabyte and petabyte.
   g. Students can translate decimal numbers to binary and binary to decimal.
   h. Students understand that data has alternative forms (numeric, textual, code, image, sound) and can explain why different encodings are largely incompatible.
   i. Student will be familiar with the concept of data compression and the implications of the difference between lossy and nonlossy compression and can perform a simple compression algorithm.
   j. Students know about commonly available forms of computer storage and can identify the relative size and performance differences among them.
   k. Students can explain the process of program compilation and execution (source code and executables).

2. Logic
   a. Students can describe that one bit of data may store a Boolean value (true or false).
   b. Students can analyze a Boolean expression involving the operations of NOT, AND, OR, IMPLIES and EQUIVALENCE.
   c. Students can express factual English sentence in the form of propositional logic.
   d. Students can express Google-like queries using propositional logic.

3. Problem Solving
   a. Students understand the nature of software development as a problem solving activity and can write simple programs.
   b. Students can apply divide and conquer strategies to basic problems.
   c. Students can apply story boarding to solving real world scenarios.
   d. Students understand the problem solving approach of prototyping and can apply prototyping to implement simple sequential algorithms.
   e. Students can translate simple storyboards into algorithms involving objects and a solution as a sequence of method calls

4. Control
   a. Students can explain the concept of software and program execution.
   b. Students can write simple programs involving sequences of methods applied to different objects.
   c. Students understand that algorithms involve choices and can express choices take the form of selections involving logical conditions.
   d. Students understand that algorithms often involve repetition and can express simple repetitious algorithms.
   e. Students can apply modularization to decompose simple problems.

5. Models of Computation
   a. Students can define basic digraph terminology, including vertex, arc, cycle, and path.
   b. Students recognize models of computation as graphical abstractions.
   c. Students can interpret the function of activity diagram elements for imperative statements, selection and repetition.
   d. Students can interpret a state diagram, including do, entry and exit actions, along with event-driven transitions.
   e. Students can model simple, sequence algorithms of ten or less states.

** These items have not yet been covered in CT100.
Appendix B - Answers

1. c

2. b

3. 1.5 years (18 months)

4. kilobyte, gigabyte, terabyte

5. 203

6. 1011011

7. a

8. D J F (NOT D) AND (J OR F)

<table>
<thead>
<tr>
<th>D</th>
<th>J</th>
<th>F</th>
<th>(NOT D) AND (J OR F)</th>
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9. e -- the correct expression is (NOT M) IMPLIES (NOT F)

10. c

11. both a and e should be circled

12. The expression always has a value of true.

13. c

14. c

15. d

16. pigCount <- 100
cowCount <- pigCount
chickenCount <- cowCount
17. -1
18. 1
20. both a and b
21. activity diagram
22. c
23. 1001
26. only part a is a tree
27. c
28. vertices = \{a, b, c, d, e, f, h, j\}
   arcs = \{(a,c), (b,a), (b,c), (d,e), (d,f), (e,a), (e,d), (f,b), (f,c), (f,f), (j,h)\}
29. 