

Midterm (Sample)

CS105: Great Insights in Computer Science
Michael L. Littman, Fall 2008

Rules

- Please write your answers directly on the pages.
- You may use your notes, your book, a calculator.
- You may **not** discuss the test with anyone else, including online sources (via cell phone, computer).
- You may ask clarification questions during the exam.

1. Pictures

A. A 4MP digital camera has an image size of 2289×1712 pixels. How many bits is a picture from this camera?

B. The Octopus Song is 3 minutes and 1 second long. If the audio is stored at “CD quality” (192 Kbps), how many bits does it take to store the audio portion of the song?

2. Binary Numbers

(A) What is the decimal number 157 in binary?

(B) What is 11100111 in decimal?

(C) What is the two’s complement of 11100111?

3. Logical Construction

A. Fill in the truth table, then write a logical expression (C = something that can include As, Bs, nots, ands, and ors) to match.

A = Has sail on back. B = Walks on four legs.

Which prehistorical creatures do I like?

C =

A	B	C
False	False	
False	True	
True	False	
True	True	

True



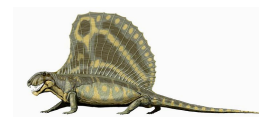
False



True



False



3. continued

B. Fill in the truth table, then write a logical expression (C = something that can include As, Bs, nots, ands, and ors) to match.

A = Diet. B = Lime.

Which combinations do they make?

C =

A	B	C
False	False	
False	True	
True	False	
True	True	

True



True



True



4. Binary Arithmetic

Solve these problems, show carries and borrows.

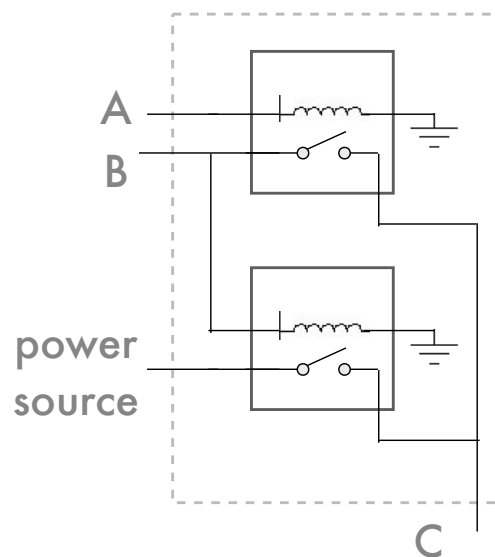
$$\begin{array}{r} 00100111 \\ + \underline{11001010} \\ \hline \end{array}$$

$$\begin{array}{r} 11000011 \\ - \underline{10010111} \\ \hline \end{array}$$

5. Relay Circuit

What logical formula does this circuit compute?

C =



6. If-Then-Else-32

An “if-then-else” gate takes three bits as input, A , B , and C . It produces one bit of output, which is equal to B 's value if A is True and C 's if A is False. It can be constructed out of 1 **not**, 2 **ands**, and an **or**.

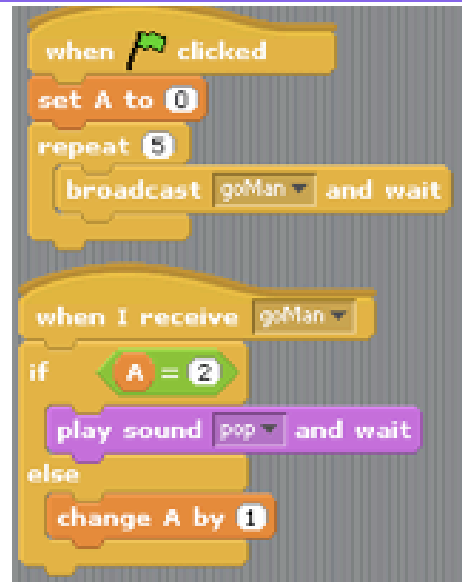
If we generalize to an “if-then-else- k ” gate, A is still one bit, but B and C are now k bits each. It produces k bits of output, which are equal to B if A is True and C if A is False. It can be constructed out of k separate “if-then-else” gates.

How many **nots**, **ands**, and **ors** does it take to make an “if-then-else-32” gate?

7. How Many Pops?

A. When the flag is clicked, how many times will the pop sound happen before everything stops?

B. What value will A have at the end?



8. Halloween Lights

- **A:** not A and B
- **B:** A
- **C:** not C

(a) What sequence of values do the state variables take starting from $A=T$, $B=T$, $C=T$?

(b) What is the period of this pattern?

9. A Machine Says What?

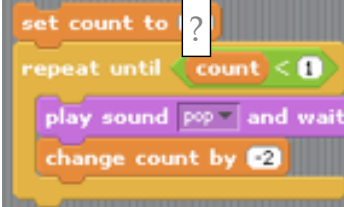
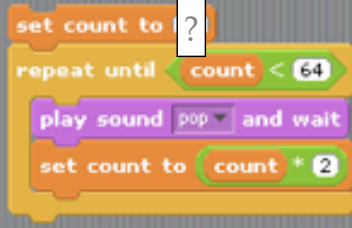
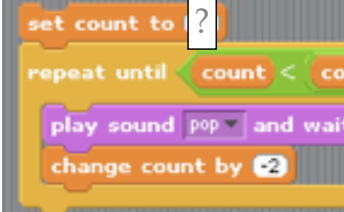
What will E be after each of these short machine-language programs are executed?

(A) $acc = not\ A$
 $E = acc$
 $acc = B$
 $acc = acc\ or\ C$
 $E = acc\ and\ E$

(B) $acc = C$
 $acc = acc\ or\ D$
 $acc = acc\ and\ A$
 $acc = acc\ and\ B$
 $E = acc$

10. Halt or Not?

For what values of “?” does each of these Scratch scripts halt? (“*” means multiplication.)

- (A)  (C) 
- (B)  (D) 