

# Midterm (Sample)

CS105: Great Insights in Computer Science  
Michael L. Littman, Fall 2007

## 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 x 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. Logical Construction

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

A.

A	B	C
False	False	True
False	True	True
True	False	False
True	True	False

B.

A	B	C
False	False	True
False	True	False
True	False	True
True	True	True

## 3. 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?

## 4. Binary Addition

Add these numbers, show the carries.

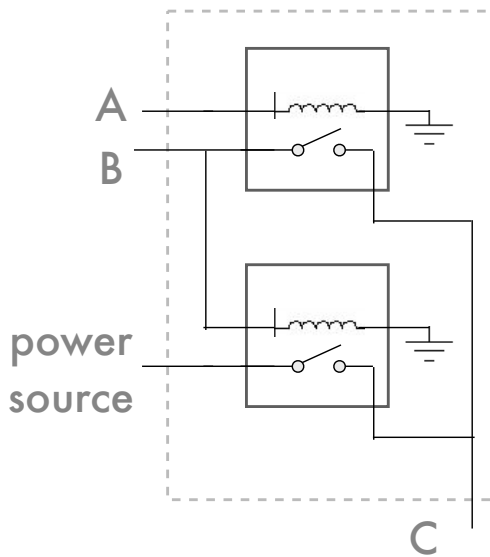
$$\begin{array}{r} 00100111 \\ + \underline{11001010} \end{array}$$

$$\begin{array}{r} 10000011 \\ + \underline{11010111} \end{array}$$

## 5. Relay Circuit

Fill in the truth table for this relay circuit.

A	B	C
False	False	
False	True	
True	False	
True	True	



## 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**.

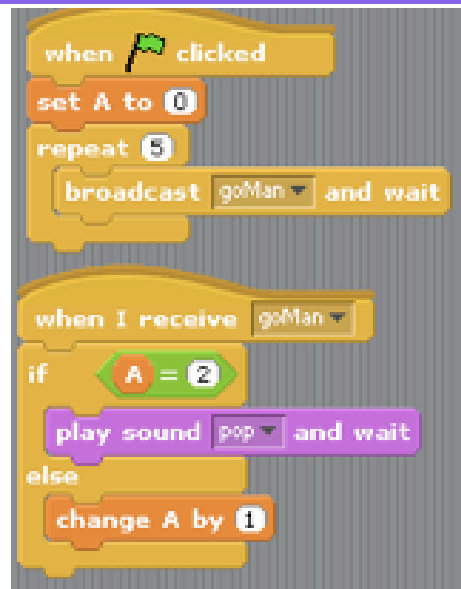
If we generalize to an “if-then-else- $k$ ” gate, A is still one bit, but B and C are now  $k$  bits each. It produces  $k$  bits of output, which are equal to B if A is True and C if A is False. It can be constructed out of  $k$  separate “if-then-else” gates.

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?



```
when green flag clicked
  set A to 0
  repeat 5
    broadcast goMan and wait
  when I receive goMan
    if A = 2
      play sound pop and wait
    else
      change A by 1
```

The code consists of two main event-driven blocks. The first block, triggered by 'when green flag clicked', sets a variable 'A' to 0 and enters a 'repeat 5' loop. Inside this loop, it broadcasts a message 'goMan' and waits. The second block, triggered by 'when I receive goMan', contains an 'if' statement. The condition is 'A = 2'. If true, it plays a 'pop' sound and waits. If false, it changes the value of 'A' by 1.

## 8. What's Missing?

(A) 0-70420-00710-? (gefilte fish)

(B) 0-53?39-65583-4 (CHiPS movie)

(C) ?-52695-23657-0 (Halloween kit)

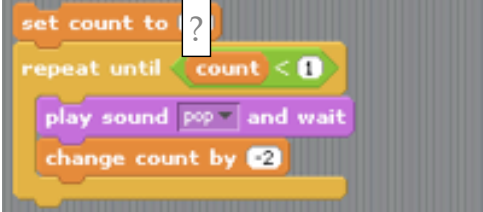
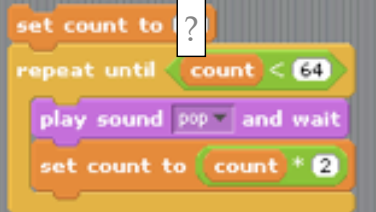
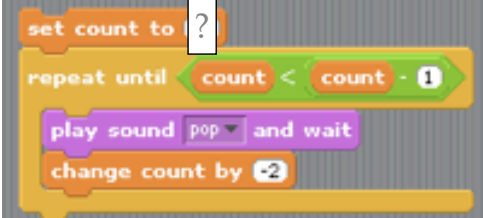
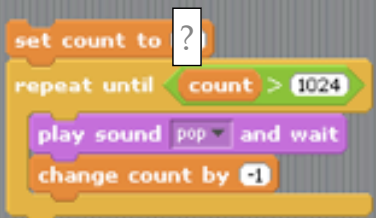
## 9. A Machine Says What?

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

- |     |                                 |     |                                  |
|-----|---------------------------------|-----|----------------------------------|
| (A) | $\text{acc} = \text{not } A$    | (B) | $\text{acc} = C$                 |
|     | $E = \text{acc}$                |     | $\text{acc} = \text{acc or } D$  |
|     | $\text{acc} = B$                |     | $\text{acc} = \text{acc and } A$ |
|     | $\text{acc} = \text{acc or } C$ |     | $\text{acc} = \text{acc and } B$ |
|     | $E = \text{acc and } E$         |     | $E = \text{acc}$                 |

## 10. Halt or Not?

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

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