CS 202: Introduction to Computation
Fall 2010: Exam #1

Name: _____Answers_____

Question	Possible Points	Received Points
1	20	
2	20	
3	20	
4	20	
5	20	
Total	100	

This exam is closed notes.

You have 50 minutes to complete the 5 questions on this exam.

Please write your answers clearly.

Good luck!

Question 1: Why watch TV when you could be Programming?

A) A friend of yours has created the Scratch program shown in the appendix. (You may remove it for reference.) The program recommends a TV show based upon how the user answers a series of questions. On the back of the previous page, draw the **decision tree** corresponding to the scripts. Give a descriptive name to each node of the tree, label the transitions between nodes, and show the outputs of the program.

4 pts

B) How many different TV shows can this program recommend (across multiple runs of the program)?

8 2 pts

C) In any one run of the program, what is the fewest number of questions the user could be asked (i.e., the best case)? What TV show will be recommended in this case?

1, Glee 2 pts

D) In any one run of the program, what is the greatest number of questions the user could be asked (i.e., the worst case)? What TV show will be recommended in this case?

7 1 pt, House or Bones 1 pt

E) If the user receives the recommendation to watch Lost, what do you know about him or her?

Likes islands – 1 pt dislikes musicals, vampires, superheroes, realtime – 1 pt

F) Did your friend create a program that resulted in "good" decision tree? What qualities are good or bad about the resulting decision tree?

Bad tree – not 'balanced'. Each question only eliminates one possible question; requires too many questions in the worst case 4 pts

G) If you were to write a different Scratch program to recommend a TV show, what would be your goal in terms of the number of questions asked? How many questions would it ask in the worst case?

Goal: least #questions for all possible answers 2 pts
worst case: 3 questions because 2^3 = 8 2 pts

Question 2: Some of these things are not like the others…

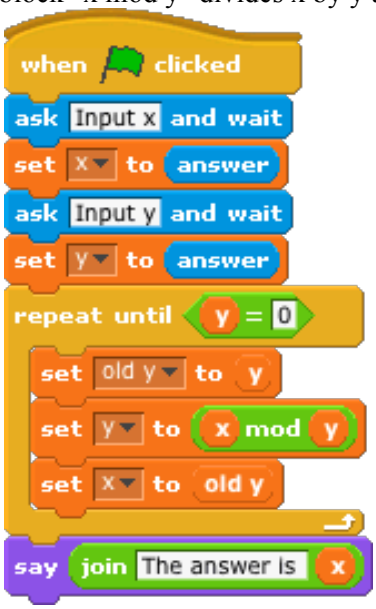
Assume you have a cat who is running the following script.

For each of the following scripts activated by "When Green Flag clicked", say whether or not it results in the same behavior as the original script. If it has different behavior, state **how** the behavior is different and **why**.

1. Same 2 pts
2. different 1 pt
    1. how: meow not played, color not changed 1pt
    2. why: variable = 0, repeat variable means repeat 0 1 pt
3. different 1 pt
    1. how: meow played, color changed only 2 times 1pt
    2. why: variable starts at 1 1pt
4. different 1 pt
    1. how: meow played, color changed forever 1 pt
    2. why: variable never increased 1pt
5. same 2pts
6. same 2pts
7. different 1 pt
    1. how: meow played, color changed forever 1 pt
    2. why: 1 can never = 2 1 pt
8. same 2 pts

Question 3: How do the variables vary?

Consider the following Script which has access to three variables called x, y, and old y. Remember that the block "x mod y" divides x by y and returns the remainder. For example, 7 mod 2 =1 and 6 mod 2 =0.



For the following input values, fill in the table to show the value of each variable at the end of each iteration of the repeat loop. You may not need all of the rows of the table. You may find it useful to show the initial values of each variable in the header row of the table.

A) x=20, y =5.

Loop #	**old y**	**y**	**x**
1	5	0	5
2			
3			
4			

B) x=21, y =14.

Loop #	**old y**	**y**	**x**
1	14	7	14
2	7	0	7
3			
4			

C) x=8, y =3.

Loop #	**old y**	**y**	**x**
1	3	2	3
2	2	1	2
3	1	0	1
4			

Extra Credit (No stress, please): What mathematical function is this script computing? (Hint: It is difficult to figure this out from looking at the code itself; you may find the function easier to uncover by looking at many different inputs and the resulting outputs.)
Gcd – greatest common divisor

Question 4: Do you know a little bit?

Specify whether each of the following statements is true or false. Feel free to explain your answers if you desire.

_F____ The binary number 00110 is 8 in decimal.

__F___ The decimal number 19 is 010111 in binary.

__F___ The binary number 001000 is the same as the binary number 100.

__T___ 8 unique unsigned integers can be represented in 3 bits.

__F___ 31 unique unsigned integers can be represented in 5 bits. (also accepted T)

__T___ 2^N different unsigned integers can be represented in N bits.

__F___ N^2 different unsigned integers can be represented in N bits . (also accepted T)

__T___ The largest (unsigned) integer that can be represented in 4 bits is 15 (decimal).

___T__ The number 0110 is larger in base 10 than in base 2.

___T__ The binary number 0010 divided by 2 (decimal) is 0001.

___F__ The binary number 01000 divided by 2 (decimal) is 00110.

___T__ The binary number 011001000 divided by 2 (decimal) is 001100100.

__T___ 3021 is a valid number in a base-4 representation.

__F___ 1008 is a valid number in a base-8 (octal) representation.

___T__ 49abc is a valid number in a base-16 (hexadecimal) representation.

Question 5: Can you handle the truth?

You are hired at a company where your boss only understands truth tables and cannot understand Boolean expressions or circuits. Every time a Boolean expression or circuit crosses his desk, he asks you to convert it to a truth table in standard form (where all input combinations are exhaustively enumerated **in order**).

A) Draw the truth table for the Boolean expression:
D = (NOT A and B and C) OR (NOT A and NOT B) OR (NOT C).

A	B	C	D
0	0	0	1
0	0	1	1
0	1	0	1
0	1	1	1
1	0	0	1
1	0	1	0
1	1	0	1
1	1	1	0

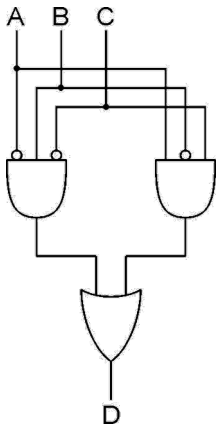
This question carried 3 points. Points were taken off if output obtained were incorrect (0.5 for each output value). Also, if you have not shown all the eight rows some points were taken off (0.5 for each row not shown).

B) Draw the truth table for the Boolean expression: C = NOT (A and B).

A	B	C
0	0	1
0	1	1
1	0	1
1	1	0

This question carried 3 points. Most of the students interpreted the equation as NOT A and B which is different than NOT(A and B). 0.5 marks were taken off for each incorrect row.

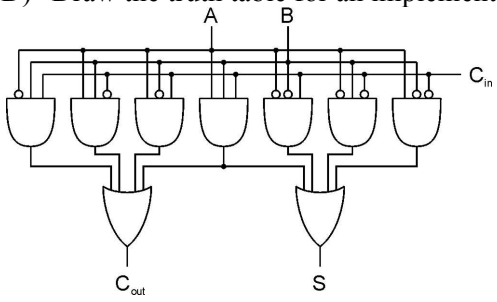
C) Draw the truth table for this combinational circuit with three inputs, A, B, and C, and one output, D.



A	B	C	D
0	0	0	0
0	0	1	0
0	1	0	1
0	1	1	0
1	0	0	0
1	0	1	1
1	1	0	0
1	1	1	0

This question also carried 3 points. Like question 1, 0.5 marks were taken off for each incorrect output value.

D) Draw the truth table for an implementation of a one-bit full adder.

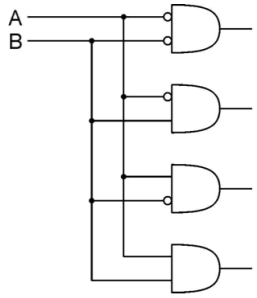


A	B	C	Cout	S
0	0	0	0	0

0	0	1	0	1
0	1	0	0	1
0	1	1	1	0
1	0	0	0	1
1	0	1	1	0
1	1	0	1	0
1	1	1	1	1

This question carried 4 points. If you have just showed either C or S you receive 2 points. For two incorrect rows 0.5 marks has been taken off.

E) Label the four outputs of this circuit and draw the corresponding truth table.

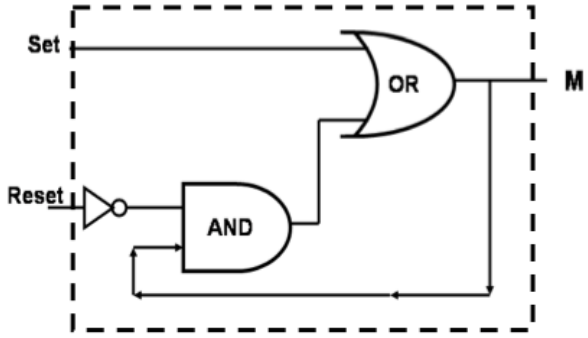


Each output is labeled C, D, E and F (from top to bottom) and the corresponding truth table for C, D, E, F is shown below

A	B	C	D	E	F
0	0	1	0	0	0
0	1	0	1	0	0
1	0	0	0	1	0
1	1	0	0	0	1

This question carried 3 points. If the labeling is not present 0.5 marks were taken off. If you have labeled it, 1 marks was awarded. 0.5 marks were taken off if you messed up either of C, D, E, F's truth table.

F) Consider the following sequential circuit with two inputs Set and Reset and one output M. Note that this circuit has a feedback loop and can therefore remember values. Draw the corresponding truth table; make sure you consider the output of the circuit also as an additional input.



M = (NOT R AND M) OR S

R	M	S	M
0	0	0	0
0	0	1	1
0	1	0	1
0	1	1	1
1	0	0	0
1	0	1	1
1	1	0	0
1	1	1	1

This question carried 4 marks. 0.5 marks were taken off for each incorrect output value.

Appendix for Question 1. **2**This page may be removed for reference.