COS 126	General Computer Science	Spring 2004

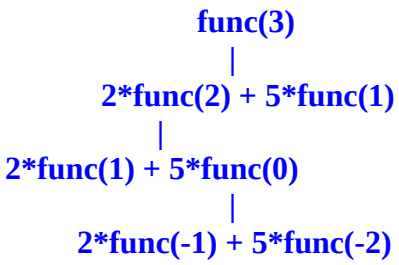
Exam 1 Solutions

1. Loops and conditionals. (5 points)

```
*****
*+*+*
*****
```

2. Recursion, debugging (6 points)

(a)



(b)

Change "if (j==1) return 1;" to "if (j<=1) return 1;"

3. Arrays. (7 points)

(a)

7942

(b)

{0, 2, 4, 6, 9, 7, 8, 1, 5, 3};

4. Recursion: (9 points)

(a)

```
System.out.println(ping(2));     false
System.out.println(pong(4));     true
```

(b)

ping(n) tells if n is odd and pong(n) tells if n is even.

(c)

stack overflow

(d)

if (n < 0) n = -n;

(e)

-1 is represented as (2^n - 1) in 2's complement. (2^n - 1) is odd regardless of the number n of bits. Therefore, pong(-1) will return false.

5. Number Representations (4 points)

(a)

012C

(b)

FFC7

(c)

163

(d)

–32

6. Combinational Circuits (8 points)

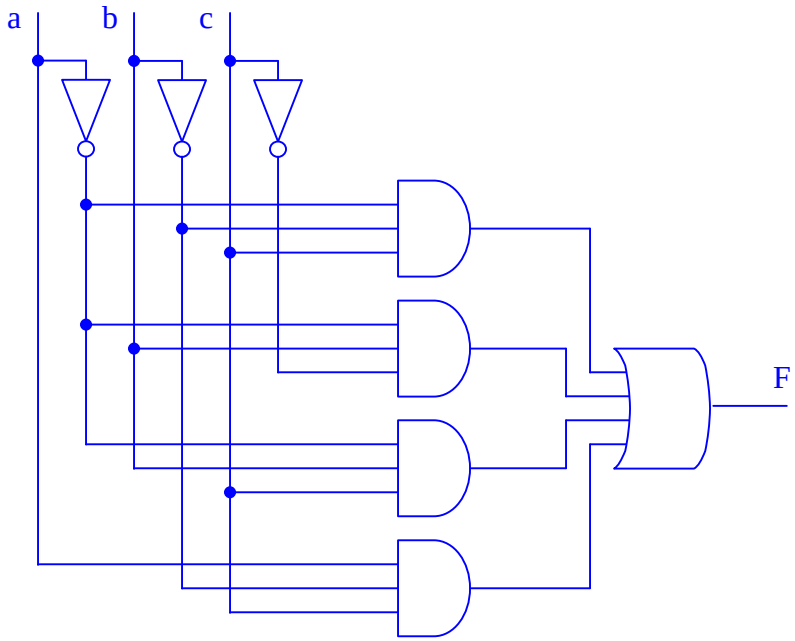
(a)

a b c	F
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	0

(b)

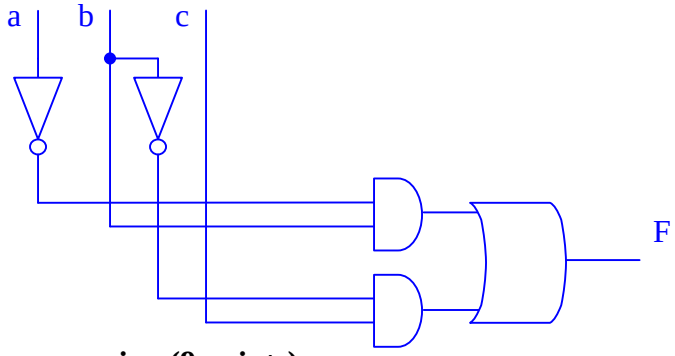
F = a'b'c + a'bc' + a'bc + ab'c

(c)



(d) For a tiny amount of extra credit, simplify the formula and the circuit.

F = a'b + b'c



7. TOY programming (9 points)

(a)

```
1110      R[1] <- R[1] + R[0]
2110      R[1] <- R[1] - R[0]
D010      if (R[0] > 0 ) PC <- 10
3111      R[1] <- R[1] & R[1]
```

(b)

(b.1)

```
10: 7101    R[1] <- 01
11: 884F    R[8] <- mem[4F]
12: 7250
13: 1328    R[3] <- R[2] + R[8]
14: 2331    R[3] <- R[3] - R[1]
15: 2423    R[4] <- R[2] - R[3]
16: D41E    if (R[4] > 0) PC <- 1E
17: A502    R[5] <- mem[R[2]]
18: A603
19: B503    mem[R[3]] <- R[5]
1A: B602
1B: 1221    R[2] <- R[2] + R[1]
1C: 2331    R[3] <- R[3] - R[1]
1D: C015    if (R[0] == 0) PC <- 15
1E: 0000    halt

4F: 0005
50: 1141
51: 092C
52: 0653
53: 1EAD
54: 0EEF
```

(b.2)

It reverses the array.

```
4F: 0005                length of array
50: 0EEF                first array element
51: 1EAD
52: 0653
53: 092C
54: 1141                last array element
```