COS 126 General Computer Science Spring 2004

Exam 2 Solutions

1. **Java programming. (4 points)**

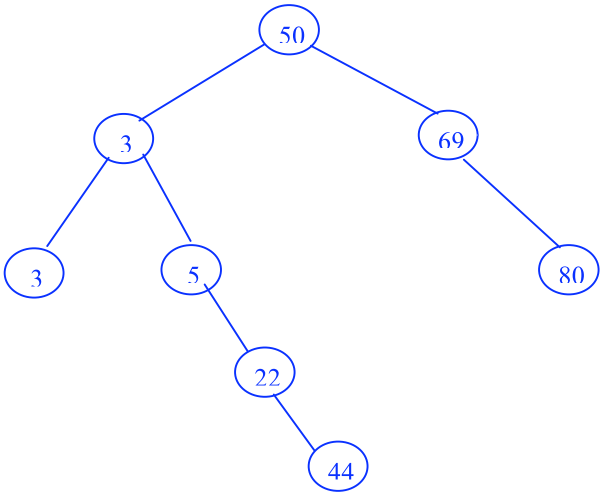
```
real = 18.0, imag = -1.0
real = -2.0, imag = 9.0
```

2. **Linked List, Recursion. (5 Points)**

```
public class List{
      . . .
      public void PrintReverse() {
            if (this==null) return;
            if (this.next!=null) this.next.PrintReverse();
            System.out.println(this.value);
      }
```

3. **Tree. (7 points)**

(a)



(b) **50 3 3 5 22 44 69 80**

4. Algorithm Analysis (4 points)

1) `if (list[j] < list[j-1])`
f

2) `list[j] = list[j-1]` (For this one only, the answer depends on the input. List all possibilities)
a,b,c,d,e,f

3) `System.out.println(list[i])`
c

5. Abstract Data Type, Linked List (7 points)

```
public void addFrame(String name)  {
      Frame newFrame = new Frame();
      newFrame.frameName = name;

      // insert the new frame into the frame list
      if (frameList == null)
         frameList = newFrame;
      else
         lastFrame.next = newFrame;

      lastFrame = newFrame;
} //end AddFrame()


public void play(int screenSize)   {
      Frame currFrame = frameList;
      double middle = screenSize/2.0;

      if (currFrame == null)
          return;
     Turtle.clear();
     Turtle.fly(middle, middle);

      //display each frame in sequence
      while (currFrame != null);
      {
          Turtle.spot(currFrame.frameName);
          Turtle.pause(100);
          currFrame = currFrame.next;
      }
} //end Play()
```

6. TOY Architecture (6 points)

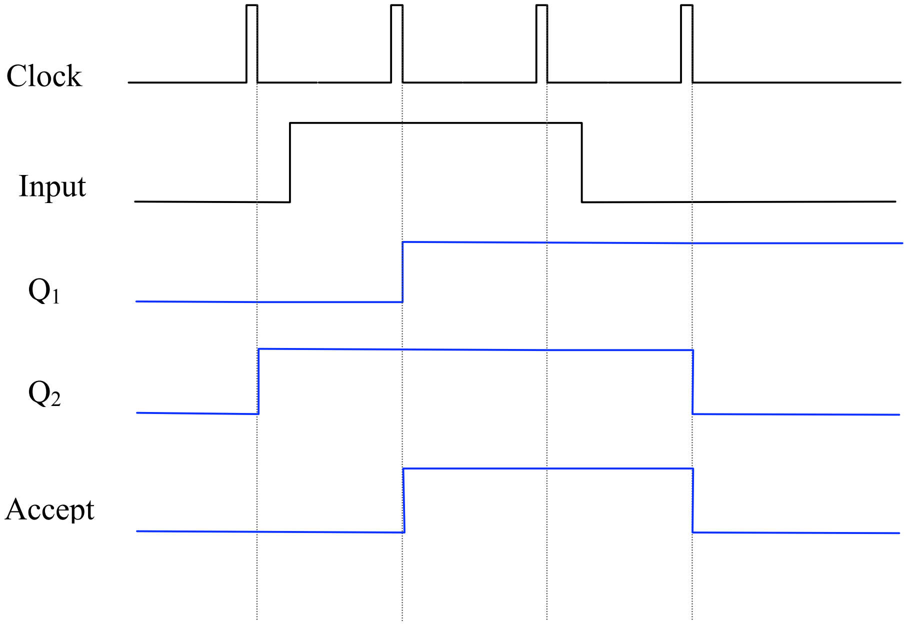
```
03: 0033
04: 000E
10: 8A03    (R[A]<-mem[03])
11: 8B04    (R[B]<-mem[04])        ____c,e,b,i__________
12: 1CAB    (R[C]<-R[A]+R[B])      ____c,g,h,m,a________
13: 0000    (HALT)
```

7. DFA, Regular Expression and Sequential Circuit (6 points)

(a)

1) **e** 2) **c** 3) **b**

(b)



Your answer: ___________3____________

8. Programming Assignments and Analysis of Algorithms (4 points)

a._4^N_ HTree from the recursive graphics assignment, but where N=0 generates a single H, N=1 generates 2 levels (1H with 4 smaller H's at the corners), etc.
Each level i adds 4^i H's. N=0, 4^0 or 1 H. N=1, 4^1 + 4^0 H's, N=2, 4^2 + 4^1 + 4^0 H's.

b._N^2_ One picture of the brute force NBody simulation as done in assignment 2. (i.e., for one picture, each body's position is updated using the gravitational effect from each of the other individual bodies in the simulation).
For each body, sum the effects of (N-1) other bodies. Do it N times. N*(N-1) operations.

c._N__ The algorithm from the decode program of the Hamming Code assignment where N = number of sets of bits. (i.e., read 7N bits, check their integrity, and output 4N corrected message bits.)
For each set of 7 bits, there are a finite number of operations. Do these operations N times.

d._N!_ Brute force algorithm for TSP (Traveling Salesperson Problem). (i.e., check all possible permutations).
There are N! possible permutations of N items.

e._N_ Compute the TSP tour distance for a given tour of N points.
Compute and sum N distances.

f._N^2_ Smallest Heuristic for TSP (insert each point where it makes the smallest change in the tour).
Compare the change in distance of inserting each point between each pair of adjacent points already on the tour. 1 + 2 + 3 + ...+ (N-1) distance computations and comparisons.

g._1__ HelloWorld program from Assignment 0.
There is no input. The running time is a constant.

h._N^2_ Compute the edit distance to two strings of length N using dynamic programming, as in the DNA sequence alignment assignment.
Compute each element of the N by N opt matrix.

9. Computability, mostly (5 points)

1. **F** 2.**T** 3. **F** 4. **F** 5. **F** 6. **F** 7.**F** 8.**T** 9.**F** 10.**T**