Computer Science 302 001 Fall 2006
Additional Sample Problems for Final Examination
May 11, 2006

1. By hand, walk through the algorithm Graham Scan to find the convex hull of the set of points in the plane shown in figure 1.

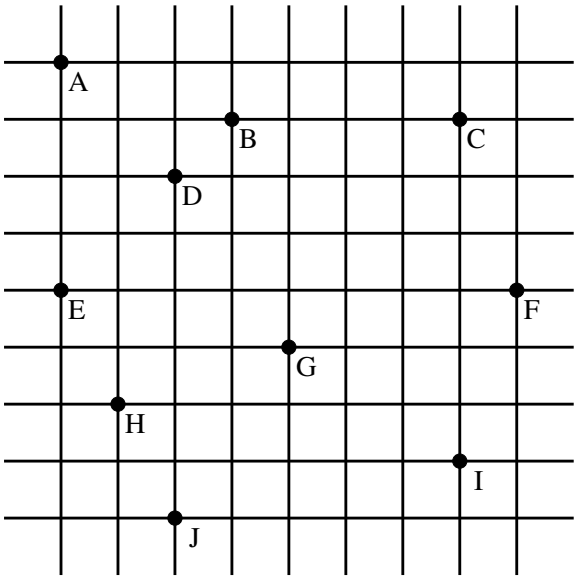


Figure 1: Point Set for Problem 1

2. Write pseudocode for the array implementation of the ADT "stack of integer." Your code should include procedures that implement pop, push, and empty.

3. For each of the following code fragments, express the asymptotic time complexity by choosing the best of the following answers: $O(n)$, $O(n^2)$, $O(n \log n)$, $O(\log n)$,

   (a)
```
for (int i = 0; i < n; i++)
 for (int j = i; j < n-i; j++)
  cout << "Hi there.";
```

(b)
```
george(int n)
 {
  if (n > 1)
   {
    for (int i = 0; i < n; i++)
     cout << "Hi there.";
    george(n / 2);
   }
 }
```

(c)
```
martha(int n)
 {
  if (n > 1)
   {
    for (int i = 0; i < n; i++)
     cout << "Hi there.";
    martha(n / 2);
    martha(n / 2);
   }
 }
```

4. Show what a Patricia tree containing the following five items looks like. Be sure not to forget whatever information you need in the internal nodes to guide a search.

```
APPLE
BANANA
APE
BONOBO
APEX
```

5. One of the problems below is in the class of polynomial time problems. Another is $\mathcal{NP}$-complete. Another is undecidable. Which is which? (No explantion needed: just guess.)

   (a) The lab movers problem. Movers wish to move an odd-shaped piece of machinery into a lab and put it into a certain position. Unfortunately, the lab already has a number of odd-shaped machines and other fixtures in it, and they're all bolted to the floor and cannot be moved. Can the movers do their job?

   (b) The chip designer's problem. A chip designer wishes to place a number of electronic components of given sizes and shapes onto a chip of a certain size. They must all be connected to each other in specified ways. Can this be done?

   (c) The grader's problem. A student has written a program which is supposed to read two numbers from the keyboard and then show the sum of those two numbers on the screen. Is the program correct?

Clarification: Obviously, the answer to each of the above three problems could be either "yes" or "no," depending on the instance. The issue is how hard it is to compute a "yes" or "no" answer for a given instance of each problem.