University of Nevada, Las Vegas Computer Science 477/677 Fall 2013

Practice Examination for November 13, 2013

The entire practice examination is 170 points.

Name:_____

No books, notes, scratch paper, or calculators. Use pen or pencil, any color. Use the rest of this page and the backs of the pages for scratch paper. If you need more scratch paper, it will be provided.

1. True or False. [5 points each] If the question is currently open, write "O" or "Open."

   (a) _____ The worst case expected time complexity of randomized quicksort is $O(n \log n)$.

   (b) _____ There is a polynomial time algorithm for the knapsack problem.

2. Fill in the blanks. [5 points each blank.]

   (a) In a _____ hash table, there are no collisions.

   (b) A graph is called _____ if the number of edges is asymptotically less than n^2.

3. Solve the recurrences. Give asymptotic answers in terms of n, using either O, Ω, or Θ, whichever is most appropriate. [10 points each.]

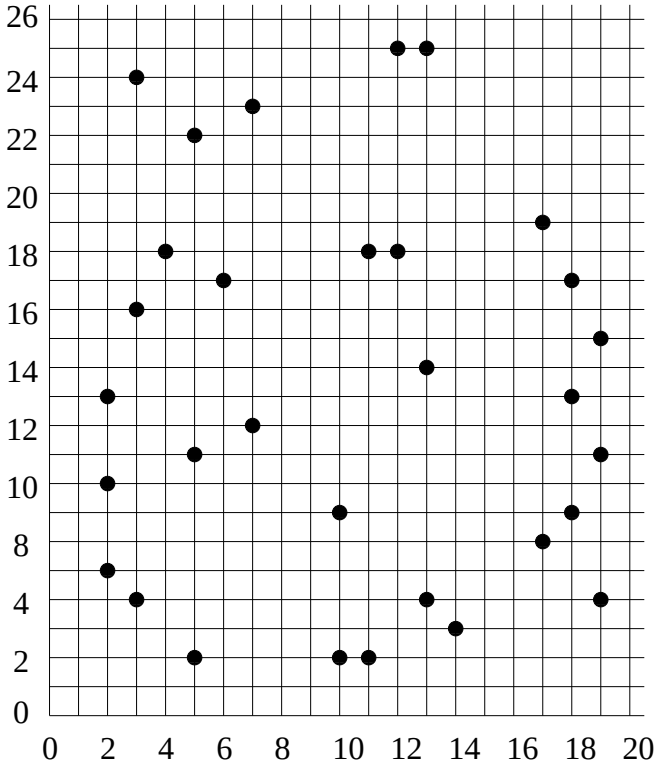
   (a) $F(n) = 2F\left(\frac{n}{3}\right) + F\left(\frac{n}{2}\right) + n^2$

   (b) $F(n) \leq F(\log n) + 1$

4. [20 points] In the code below, the function `george` has Boolean type, and takes one time unit to evaluate. You know nothing else about `george`. Use amortized analysis to show that the time complexity of the following code fragment is $O(n)$.

```
int i = 0;
int m = 0;
while(i < n){
   i = i+1;
   m = m+1;
   while ((m > 0) and george(m,i))
      m = m-1;
   }
```

5. [20 points] Use Graham scan to find the convex hull of the set of points shown below. (Note: if there is a Graham scan problem on the actual test, it will be smaller.)



6. [30 points]

Unexpectedly, a set of seven rookies becomes available, and three teams are allowed to draft up to two rookies each. Each team has a list of rookies, in order of preference, while each rookie has a list of teams, also in order of preference. These lists are given below. Find a stable draft assignment. Which rookie is not picked up by any team?

Rookies' Preference Lists:

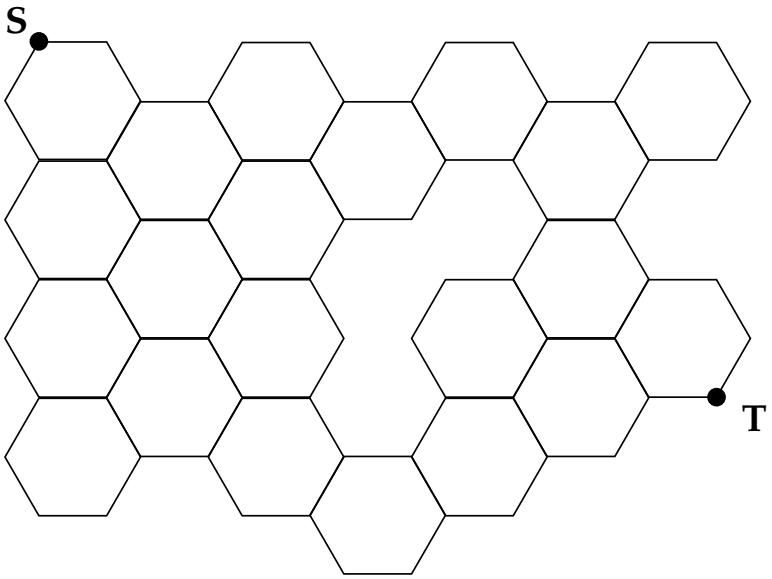
Bob	Tom	Sam	Dan	Hal	Ned	Ted
Rams	Rams	Bears	Rams	Rams	Bears	Saints
Bears	Saints	Rams	Bears	Saints	Rams	Rams
Saints	Bears	Saints	Saints	Bears	Saints	Bears

Teams' Preference Lists:

Rams	Saints	Bears
Bob	Bob	Sam
Hal	Tom	Hal
Tom	Hal	Bob
Ted	Sam	Tom
Dan	Ned	Dan
Ned	Ted	Ted
Sam	Dan	Ned

7. [30 points] Let A be a 3-dimensional array, where $A[i, j, k]$ is defined if $i \in [0 \ldots 5]$, $j \in [3 \ldots 8]$, and $k \in [1 \ldots 9]$. Each entry of A takes three memory locations, and the entires are stored in column-major order, with base address 1024. What are the three addresses used to store $A[3, 5, 6]$?

8. [30 points] In the Duchy of Hexia, land has been partitioned into hexagons one krosh on each side, and roads are along the boundaries of those hexagons. The graph below shows the current map of a region of Hexia. Note that two roads were washed out during the last mawsin.

   Use the A* algorithm to find the shortest path from S to T, taking into account that those three roads are closed. Use the obvious natural heuristic, which is distance before the roads were washed out.

   You must label those nodes that you need (not all the nodes) and show your work.