Sample all Sections

CS 204 Midterm Wedneday October 4 2000
Write all answers in the space provided.
Time: 45 minutes.   Total Marks: 20

Instructor: Ryan Hayward

1. $(1 + 3 + 2 = 6$ marks)

   (a) Give **a** precise mathematical definition of $O(\sqrt{n})$.

   (b) For each of the following functions, give (a) the simplest Θ expression (b) its rank by increasing order of complexity (the smallest gets rank 1; functions with the same order get the same rank).

	$9n^2 + 5(n^3)/(\lg n)$	$6 \lg n + 7\sqrt{n}$	$4^{\lg n}$	$(1 + \ln n)(1 + n)^2$	$\sum_{j=1}^{n} j$
(a)					
(b)					

2. $(2 + 2 = 4$ marks) (a) Draw the decision tree for the following nonsense algorithm. Label each internal node with the comparison being made, and each leaf with the value returned. (b) Give the best, worst, and average case (assuming each outcome is equally likely) number of comparisons.

```
proc zzz(a,b,c,d)
  if a<b then
    if a<c then
       if c<b then return 1
       else          return 2
    else
       return 3
  else
    if b<d then return 4
    else          return 5
```

3. $(1 + 1 + 3 + 2 = 7$ marks)

```
proc zippity(x)
  for j <- 1 to x do
    print(x)

proc doodah(n)
  j <- 1
  while j<n do
    zippity(j)
    j <- j+j
```

(a) To the right of the above code, show the output from doodah(15).

(b) Justify each answer. Give the simplest form for an exact expression for the number of numbers output by

(i) zippity(x).

(ii) doodah(n), for $n = 2^k$ with $k \geq 1$.

(c) Assuming a log cost RAM model of computation, give the big Θ running time of zippity(n). Justify carefully.

4. (3 marks) Explain in detail why any comparison based sort takes $\Omega(n \lg n)$ time, assuming a uniform cost RAM model of computation.