

## Assignment 2

due Monday, January 29, 2006

1. (*Horner's Rule*) Exercise 2.3, p 39, part a only. [3 points]
2. What is the running time for the following code, which multiplies two  $n \times n$  matrices  $A$  and  $B$ , storing the result in  $C$ ? [4 points]

```
for i=1 to n
  for j=1 to n {
    C[i,j] = 0
    for k=1 to n
      C[i,j] = C[i,j] + A[i,k]*B[k,j]
    }
```

3. Determine the run times of the following two pieces of code, which do pretty much nothing. [6 points]

```
sum =0
for i = 1 to n*n
  for j=1 to i*i
    sum += i*j
```

and

```
sum =0
for i = 1 to n*n
  j=i
  while j>1
    sum++
    j /= 5
```

4. Show that  $\sum_{i=1}^n \lceil \log i \rceil = \Theta(n \log n)$ . Do this directly, without recourse to Stirling's approximation [6 points]
5. Suppose that each row of an  $n \times n$  array  $A$  consists of 1's and 0's in such a way that, for any row, all the 1's come before any 0. Assuming that  $A$  is already in memory, describe how to find which row of  $A$  which contains the most 1's. Aim to do this in  $O(n)$  time, not  $O(n^2)$ . [6 points]
6. Occasionally, multiplying the sizes of nested loops can give an over-estimate for the big-O running time. This happens when an innermost loop is infrequently executed. With this in mind, determine the running time of the following piece of code. [8 points]

```
for( int i = 0; i < n; i++ )
    for( int j = 0; j < i * i; j++ )
        if( j % i == 0 )
            for( int k = 0; k < j; k++ )
                sum++;
```

7. (*Recurrence Relations*) Exercise 4.3-1, p 75. [**6 points**]
8. (*Recurrence Relations*) Exercise 4.3-2, p 75. [**3 points**]
9. Describe a non-recursive method for finding, by link hopping, the (approximate) middle node of a singly-linked list. This method must use only link hopping; it cannot use a counter. What is the running time of your method? [**4 points**]
10. (*Reverse a linked list in constant space*) Exercise 10.2-7, p 209 [**8 points**]
11. Describe how to implement the stack ADT using two queues. What is the running time of the push() and pop() methods in this case? [**6 points**]

**Total: 60 points**