

COP 3530  
Data Structures

Midsemester Exam

Name: \_\_\_\_\_

Email: \_\_\_\_\_

June 23, 1997

This exam has 4 questions. Each question starts on a new page. Each page is worth 50 points. Please answer each question on its page. You may write on the back of a page.

1. This question refers to the function `FindTriples` defined below. `FindTriples` returns true if there are three equal integers in the array `A`. Ignore all syntax errors.

```
int FindTriples( const Vector<int> & A )
{
    for( int i = 0; i < A.Length( ); i++ )
        for( int j = i + 1; j < A.Length( ); j++ )
            for( int k = j + 1; k < A.Length( ); k++ )
                if( A[ i ] == A[ j ] && A[ i ] == A[ k ] && A[ j ] == A[ k ] )
                    return 1;

    return 0;
}
```

- (a) What is the running time of this function?
- (b) If it takes ten seconds to run `FindTriples` on an array of 100 elements, approximately how long will it take to run on an array of 400 elements?
- (c) Describe a more efficient algorithm than the one above and give its running time. You may not use any code in your description.

2. Write a complete generic queue class using an efficient implementation of your choice. If you use an `Vector` implementation, you must include `Vector-doubling` code.

3. (a) Write a function to reverse a linked list. Use the following algorithm: Declare a local stack, push items onto the stack, then repeatedly pop the stack. Make no assumptions about `Input` or `Output`. You may assume a template `Stack` and `ListItr`.
- (b) What is the running time of your algorithm?

```
template <class Etype>
void
Reverse( const List<Etype> & Input, List<Etype> & Output )
{

}
}
```

4. (a)  $N$  items are inserted into an initially empty binary search tree. What is the total time spent for the entire insertion sequence
- i. on average
  - ii. in the worst case
- (b) What are the worst-case and average-case running times for insertion sort, mergesort, and quicksort? In instances where the worst-case and average-case differ, give an example of how the worst-case occurs.