Closed book/closed notes. Show all of your work clearly in the space provided or on the additional page at the end of the exam. If the additional page is used, be sure to clearly label the content for each problem. Be sure to *read each problem carefully*. You should answer all 5 questions. Note: The exam is double-sided.

1. (10 points) List at least four containers available in the Standard Template Library.

2. (15 points) Agree or disagree with the following statement. Be sure to explain your reasoning.

> PASSING AN OBJECT BY VALUE INSTEAD OF BY REFERENCE MAY HAVE A SIGNIFICANT EFFECT ON THE ASYMPTOTIC TIME COMPLEXITY OF AN ALGORITHM.

3. Consider the following function.

```
#include <list>
#include <string>

using namespace std;
void midterm(const list<string>& words)
{
  list<string>::const_iterator itr = words.begin();
  while(itr!=words.end()) {
    string word = *itr;
    for(int i=0; i<word.size()/2; ++i) {
      char tempChar = word[i];
      word[i] = word[word.size()-1];
      word[word.size()-i] = tempChar;
    }
  }
}
```

(a) (15 points) Using big-oh notation, describe the overall worst case time complexity for the function. Assume that the words contained in the list are no more than 50 characters long. Be sure to explain your reasoning and state any additional assumptions that you make.

(b) (10 points) Using big-oh notation and the same assumptions as in part (a), describe the overall worst case time complexity for the function if the container used was a vector instead of the list. Be sure to explain your reasoning.

4.

(a) (15 points) Write an efficient algorithm that given a $base$ and an $exponent$ will return $base^{exponent}$. You may assume that $exponent$ is an integer and $base$ is a floating point number.

(b) (10 points) Using big-oh notation, describe the overall worst case time complexity for your algorithm. Be sure to explain your reasoning.

5.

(a) (15 points) Write a recursive function which accepts an `unsigned int`, j, as input and returns the value $j!$. Note $j! = 1 \times 2 \times 3 \times \cdots \times j$.

(b) (10 points) Using big-oh notation, describe the overall worst case time complexity for your algorithm. Be sure to explain your reasoning.

Additional work area for any problem. Clearly identify to which problem the work on this page is related.

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