



Closed book/closed notes. Be sure to *read each problem carefully*. You should answer all five questions. Note: The exam is double-sided.

1. (15 points) Concisely and precisely explain what an adaptor class does. Give examples when appropriate.

2. (10 points) Concisely and precisely explain the similarities between mathematical induction and recursive functions.

3. (10 points) Recall that the definition of big-oh notation is:

An algorithm is $O(g(n))$ if there exists some constants c and n_0 , such that:

$$f(n) < c \cdot g(n), \text{ for all } n > n_0$$

where $f(n)$ is a function that describes the exact execution time of some algorithm with input size n .

Concisely and precisely explain the role of c and n_0 in the definition. I.e., What do they do? Why are they needed?

4. Consider the following class.

```
class List : public std::list<double> {  
2 public:  
    ... // constructors, destructor, assignment operator  
4 double& operator[](unsigned int index);  
    const double& operator[](unsigned int index) const;  
6 // no data members  
};
```

(a) (15 points) Implement the subscript operator for the List class defined on line 5.

Consider the following function:

```
void fillContainer(istream& is, std::vector<double>& cont)
2 {
  double num;
4  while(is >> num) {
    cont.push_back(num);
6  }
}
```

(b) (10 points) Give the worst case asymptotic time complexity for this function **and** concisely and precisely explain your reasoning.

(c) (10 points) Suppose the `std::vector<double>` in the above function were replaced with `List`. Would the the function work? If so, give the worst case asymptotic time complexity for this function **and** concisely and precisely explain your reasoning.

Consider the following function:

```
void printContainer(ostream& os, std::vector<double>& cont)
2 {
  unsigned int sz = cont.size() // assume this is a O(1) operation
4   for(unsigned int i=0; i<sz; ++i) {
    os << cont[i];
6  }
}
```

(d) (10 points) Give the worst case asymptotic time complexity for this function **and** concisely and precisely explain your reasoning.

(e) (10 points) Suppose the `std::vector<double>` in the above function were replaced with `List`. Would the the function work? If so, give the worst case asymptotic time complexity for this function **and** concisely and precisely explain your reasoning.



5. (10 points) Concisely and precisely explain how you determined the beginning and end of each message header and message body in your solution to the second laboratory assignment.