

Data Structures and Fundamentals of Programming

Problem 1

In C++ implement a **generic** class, called `Queue<T>`, that uses a **single-linked list** implementation. This should implement the **queue** abstract data type (ADT). It should be generic on the type of the data to be stored. Give all class definitions and implement the following for `Queue`:

- Default constructor
- Destructor
- Copy-constructor
- Assignment operator – using standard copy semantics
- `enqueue (T)` – takes an parameter of type T and adds it to the queue
- `T dequeue ()` – removes a node from the queue

Your implementation can **NOT** use STL or any other libraries (standard or otherwise).

Problem 2

In C++, implement a **string** abstract data type (ADT) using a **dynamically allocated array**. The array of char should be null terminating. You must implement the following methods:

- Default constructor (allocates 128 characters as capacity) and sets the string to empty
- Constructor that takes an integer value as the capacity to allocate and sets the string to empty
- Length
- Capacity
- Copy constructor
- Destructor
- Swap – swaps two strings in constant time regardless of the size of the array.
- Assignment operator using standard copy semantics
- Concatenation (overload the + operator) that returns a string that is the concatenation of any two strings regardless of the resulting size

Your implementation can **NOT** use STL or any other libraries (standard or otherwise). You can not use `std::string`.

Problem 3

In C++ implement a **binary search tree** abstract data type (ADT) that uses **dynamic memory allocation**. Make it a simple tree of integers. Along with the class definition(s), you must implement the following methods for the class:

- Default constructor
- Destructor
- Copy-constructor
- `insert` which takes a parameter of type integer and creates a new node that is added to the tree in the correct position based on the rules of a binary search tree.

Your implementation can **NOT** use STL or any other libraries (standard or otherwise).