Final Review

Pointers
- Referencing with 
- Dereferencing with *
- Pointer Independence
- Assigning through *
- Pointers as Variables

Linked List
- The node class
- Iterating through a Linked List
- Making a Linked List
- Operations (add to head, remove from head, etc)

Stacks
- LIFO
- Top, Push, Pop
- Depth First Search
- Applications

Queues
- FIFO
- Front, Push (enqueue), Pop (dequeue)
- Breadth First Search
- Applications

Analysis of Algorithms
- Selection Sort
- Insertion Sort
- Fisher-Yates
- Binary Search
- Merge Sort
Analysis of Algorithms

- Big O Simplification
- Dominance Relations
- Arithmetic Series \( \sum_{n=0}^{n} = \frac{n(n + 1)}{2} \)
- Analysis of simple functions (iterative and recursive)

Recursion

- What is recursion?
- Basics
- Backtracking
- Minimax

Types of Questions

- multiple choice/conceptual
- multiple choice/find the bug
- what does this code do/print?
- analysis of simple functions (as on worksheet W10)
- coding - could require the use or manipulation of:
  -- linked lists
  -- stacks
  -- queues
  -- simple recursion (no backtracking, minimax)

Sets

- Holds unique elements
- Ordered Set
- Unordered Set
- Iterate via iterators
- Efficient at find, insert, remove

Maps

- Associating keys with values
- Keys must be unique; values may be anything
- Ordered / Unordered Maps
- Efficient at getting a value given a key, putting a key/value pair, remove key/value pair, update value given key, and determine if map has a key
- Pair class
- Difference between .insert(), .emplace(), []
- Editing values without making copies

Hashtables

- O(1) table lookups
- Basic idea: convert key to hash code, find index, store key at index
- Collisions (and chaining)
- What constitutes a 'good' hash function?
- What data structures use hashtables?
Dynamic Allocation of Memory

• Array variables are pointers
• Pointer arithmetic
• Array limitations conquered by Dynamic Array Allocation
• Where does memory come from?
• Difference between creating new objects in Stack vs Heap
• Dynamic Memory Don’ts
• Deleting Dynamically Allocated Memory

Operator Overloading

• Member vs Non-member functions
• Mixed Overload
• How to overload

Big 3

• Copy Constructor
• Assignment Operator
• Destructor
• Shallow vs Deep Copy
• Default behaviors and how to fix them

Templates

• Purpose of templates
• Function vs Class Templates
• How to apply templating

Binary Trees

• Is empty, or a root node with a left child and a right child, each of which is a binary tree
• Pre, in, and post order traversals
• Count number of nodes

Binary Search Trees

• Data structure for holding comparable elements
• Underlying structure for sets, maps (BSTs)
• Nodes hold unique data values and pointers to child nodes
• Search, insert, remove operations and their complexity
• Understanding of self-balancing trees
Inheritance

- Inheritance serves various functions
  - Modeling of class relationships
  - Code reuse
  - Subtyping/polymorphism
  - Override
  - Virtual and Polymorphism
  - Pure virtual and abstract classes