Exam 2  
(Final)

🖥️  
⌨️🖱️

🧠

*This is a cover page*

*Congratulations on getting this far!*

**Write the output of the code below.** You can just make up the address of each variable, but the addresses printed should be consistent. (Addresses can’t change between prints)

**int** n = 42;

**int**\* ptr = &n;

**int**\*\* ptrcept = &ptr;

cout << &n << '\n';

cout << n << '\n';

cout << &ptr << '\n';

cout << ptr << '\n';

cout << \*ptr << '\n';

cout << ptrcept << '\n';

cout << \*ptrcept << '\n';

**Complete the algorithm, drawing each step.** You are running a search and remove on a linked list, with the search key “K”. Start at the step described by the image below, then complete the algorithm by drawing each additional step.

HEAD TRAVEL

**Explain** the difference between single linking and double linking. **Furthermore**, explain some advantages and at least one disadvantage of double-linking.

**Stacks’** behavior is described using which of the following acronyms?

1. TIOF
2. LIFO
3. FOLI
4. FIFO

And that acronym stands for ? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**Queues’** behavior is described using which of the following acronyms?

1. TIOF
2. LIFO
3. FOLI
4. FIFO

And that acronym stands for ? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Suppose we have some abstractly defined **stack** of emojis. **Write** out the contents of the stack **after** the following operations are performed.

PUSH(🙂)  
PUSH(😈)  
PUSH(❤)  
POP()  
POP()  
PUSH(💯)  
PUSH(🙃)

Suppose we have some abstractly defined **queue** of emojis. **Write** out the contents of the queue **after** the following operations are performed.

ENQUEUE(🙂)  
ENQUEUE(😈)  
ENQUEUE(❤)  
DEQUEUE()  
DEQUEUE()  
ENQUEUE(💯)  
ENQUEUE(🙃)

**Match** the following algorithms with their Big-O complexity. Some algorithms will share the same Big-O complexity.

Linear Search \_\_\_ a. O(1)

Binary Search \_\_\_ b. O(lgN)

Bubble Sort \_\_\_ c. O(N)

Selection Sort \_\_\_ d. O(N2)

Insertion Sort \_\_\_ e. O(NN)

f. O(N!)

g. O(N\*M)

**Explain** when you might prefer to use linear search instead of binary search. Why? (What is the limitation of binary search?)

**Draw** each step needed to **bubble sort** the following items:

[42 19 -6 **|** ]

Clearly demonstrate when the algorithm decides to swap and when it decides not to swap. Also include a vertical line to mark which section of the array is sorted.

**Draw** each step needed to **selection sort** the following items:

[ **|** -5 -16 -25]

Clearly demonstrate which items the algorithm is selecting and what items it is swapping them with. Also include a vertical line to mark which section of the array is sorted.

**The remainder of this exam will consist of writing real C++ code. Below is a list of code features, functions, methods, etc. that you will need to complete. Provided at the back of this exam is grid paper which you may use to write your code.**

1. Write a few lines to dynamically allocate a 2D array containing only 0s, then deallocate it to prevent memory leaks.
2. Write the header file for a linked list, assuming a few simple methods such as append, search, and remove. Make sure to include the node class!
3. List-based Stack Methods (You may assume all other typical properties/methods exist on the stack and node; including a constructor for node)
   1. Write the push method for a list-based stack.
   2. Write the destructor for a list-based stack.
4. Write the pop method for an array-based stack.
5. Write the enqueue method for a circular array-based queue.
6. Implement a recursive function which returns factorial of a positive integer.

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