Group Exercise #1

Due 11:59PM, Monday February 8

Instructions:

1) Find which group you are in from the following list.
    - Group 1: Megan, Nemed, Garrett
    - Group 2: Alejandra, Talha, Nicole
    - Group 3: Graylin, Tuva, Oksana
    - Group 4: Jonah, Malachi, Liam
    - Group 5: Aiden, ANDY, Luke
    - Group 6: Hayden, Eddie, Keith
    - Group 7: Cale, Alex, Kevin
    - Group 8: Jonathan, David M, Kyleigh
    - Group 9: Marshall, Alora, David S, Jacobo
2) Go to the discord server, introduce yourself in the channel for your group, and work out among your group who will work on which questions. Note that all channels are public.
3) Before the deadline discuss answers for each question in the group until there is consensus.
4) Create a video or videos going over the answers and upload to your channel.

Questions

1) Determine the computational complexity of the following four loops:

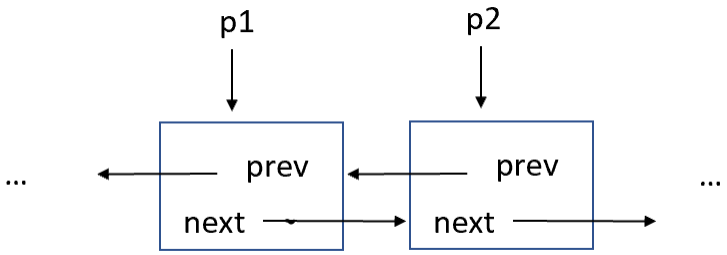
```
a. for (cnt1 = 0, i = 1; i <= n; i++)
       for (j = 1; j <= n; j++)
             cnt1++;

b. for (cnt2 = 0, i = 1; i <= n; i++)
       for (j = 1; j <= i; j++)
             cnt2++;

c. for (cnt3 = 0, i = 1; i <= n; i*=2)
       for (j = 1; j <= n; j++)
             cnt3++;

d. for (cnt4 = 0, i = 1; i <= n; i*=2)
       for (j = 1; j <= i; j++)
             cnt4++;
```

2) Determine the Big-O runtime for this recursive function (note it does not do anything useful)

```
int foo(int[] a, int n)
{
   if (n > 1)
   {
         if (a[n/2]==1)
               return 1;
         return foo(a, n/2);
   }
   return 0;
}
```

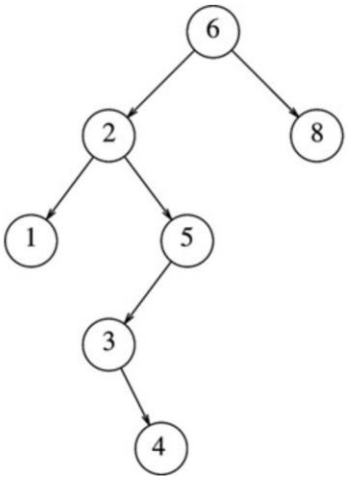
3) Let Q be a non-empty queue, and let S be an empty stack. Using only the stack and queue ADT functions and a single element variable X, give an algorithm to reverse the order of the elements in Q.

4) Consider the doubly linked list depicted below, where pointers p1 and p2 point to consecutive nodes. Although not shown, there are nodes to the left of p1 and to the right of p2 (i.e. neither is the head nor the tail).



Write the code that will properly swap the nodes pointed to by p1 and p2 in the doubly-linked list.

5) Given the following binary search tree:



a. Using the algorithm described in the colab notebook, show the resulting tree if the key with the value 2 is deleted
b. Using the algorithm described in the colab notebook, show the resulting tree if a new element with the value 7 is inserted (use the original tree)
c. Give the order that nodes are visited if using post-order traversal

6) You must keep track of some data. Your options are:
   a. A linked list in sorted order
   b. A linked list in unsorted order
   c. A binary search tree
   d. An array maintained in sorted order
   e. An array in unsorted order

   For each of the following scenarios, which of these choices would be best?

   i. The records are guaranteed to arrive already sorted from lowest to highest (i.e., whenever a record is inserted, its key value will always be greater than that of the last record inserted). A total of 1000 inserts will be interspersed with 1000 searches
   ii. The records arrive with values having a uniform random distribution. 1,000,000 insertions are performed, followed by 10 searches.
   iii. The records arrive with values having a uniform random distribution. 1000 insertions are interspersed with 1000 searches.
   iv. The records arrive with values having a uniform random distribution. 1000 insertions are performed, followed by 1,000,000 searches.