# CSE12 - Lecture 27a

Friday, June 9, 2023 8:00 AM

**Generics**

Which of the following AList declarations will result in a compile error? Check all that apply:

- A. AList<int> myList= new AList<int>();
- B. List< Integer > myList = new AList< Integer >();
- C. AList<AList< String >> myList = new AList<AList< String >>();
- D. AList myList< Integer > = new AList< Integer >();
- E. AList<E> myList = new AList<String>();
- F. AList< Object> myList = new AList< Object >();

**Queue / Stack**

```
ALQueue<String> myQ = new ALQueue<>();
myQ.enqueue("A");
myQ.enqueue("A");
myQ.dequeue();
myQ.enqueue("C");
myQ.enqueue("B");
myQ.enqueue(myQ.dequeue());
myQ.enqueue("D");
myQ.enqueue(myQ.dequeue());
System.out.println(myQ.toString());
```

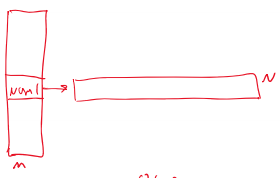
What is printed?

```
ALStack<String> myS = new ALStack<>();
myS.push("A");
myS.push("A");
myS.pop();
myS.push("C");
myS.push("B");
myS.push(myS.pop());
myS.push("D");
myS.push(myS.pop());
System.out.println(myS.toString());
```

What is printed?

**Run-Time**

```
// This method returns whether or not a pair of numbers, num1 and num2, are between 1-m and 1-n, respectively
boolean findPair(int num1, int num2, int m, int n) {
  for (int i = 1; i <= m; i++) {
    if (num1 == i) {
      for (int j = 1; j <= n; j++) {
        if (num2 == j) {
          return true;
        }
      }
    }
  }
  return false;
}
```




What is the worst case runtime of findPair?

What is the best case runtime of findPair given it returns false?

Name: _____ PID: _____ Code: _____

**Time Complexity Review**

Check which of the following are true:

- A. n + 5n^3 + 8n^4 = O(n)
- B. n! + n^2 = O(nlog(n))
- C. 2^n + nlog(n) = O(n!)
- D. 1/(n^2) + 5 = O(1/n)

Which of the following relationships hold? [Extra practice: come up with values for n0 and C for those that do]

- A. n^2 + n^3 is Ω(n^3)
- B. n * log(n) + n^2 is Ω(log(n) * n^2)
- C. 1/n + log(n) * n^2 is O(n^2)
- D. n + log(n) is O(log(n))
- E. 1/(n^10) + 100 is Θ(1)
- F. (n^4)/log(n) is Θ(n^4)

Refer to the following methods:

```
public static void f1(int n) {
  int a = 0;
  for (int i = 0; i < n; i++) {
    for (int j = i; j < n; j++) {
      a = i;
    }
  }
}

public static void f2(int n) {
  for (int i = 0; i < n; i += 1) {
    n = n / 2;
  }
}

public static void f3(int n) {
  int a = 0;
  int x = Math.abs(100 - n) * n;
  for (int i = 0; i < x; i++) {
    a = i;
  }
}
```

Which of the following big-theta statements are true:

- A. f1 is Θ(1)
- B. f1 is Θ(n)
- C. f1 is Θ(n^2 )
- D. f2 is Θ(1)
- E. f2 is Θ(log(n))
- F. f2 is Θ(n)
- G. f3 is Θ(1)
- H. f3 is Θ(n)
- I. f3 is Θ(n^2)

**Partition**

Consider the following code and the implementation of partition() discussed in lecture.

```
String[] b = {"b", "f", "a", "e", "c", "d" };
System.out.println(partition(b, 0, 6));
System.out.println(Arrays.deepToString(b));
```

What return value would partition() method print out for the above array, low and high?

What would the array look like after the above call to partition()?

**MergeSort**

Consider the merge sort from class. How many times will the element at index 0 be copied when sorting an array of length n over the entire run of the algorithm?

Which of the following statements about sorting are true?

- A. The best case time of all sorts is O(1) because of the case when an array is length 1
- B. Merge sort has best and worst cases of O(nlg(n))
- C. If arrays are split into thirds instead of halves in merge sort, the best case would still be O(nlg(n)) {HINT: look up the rules of logs!}
- D. Quicksort is O(n^2) only when an array is in reversed order
- E. The worst cases for selection sort and insertion sort occur when an array is in reversed order

**Hash Table (using separate chaining)**

```
int hash(String key) {
   return key.length;
}
```

Hash table just before expandCapacity is called:

0. - null
1. - {"greetings" : 6}
2. - {"hi" : 5}
3. - {"bye" : 9}
4. - {"happy week 7" : 3}
5. - {"hello" : 2}
6. - null
7. - null

After expandCapacity is called, which of the following elements will have a different index in the new array after rehashing?

- A. {"greetings" : 6}
- B. {"hi" : 5}
- C. {"bye" : 9}
- D. {"happy week 7" : 3}
- E. {"hello" : 2}

**Hash Table - Separate Chaining**

```
int hash(char key) {
   return (int) key;
}
```

Which of the following sequences of insertions would cause the most collisions for a hash table with four buckets and assuming expandCapacity is not called during the adds?

- A. add('A', 56); add('B', 5); add('C', 65); add('D', 2);
- B. add('E', 43); add('F', 7); add('K', 6); add('L', 160);
- C. add('M', 58); add('Q', 14); add('U', 20); add('W', 37);
- D. add('N', 7); add('R', 24); add('V', 92); add('Z', 100);
- E. add('Z', 91); add('R', 604); add('P', 9); add('L', 5);

**Hash Table - Linear Probing**

```
int hash(char key) {
   return (int) key;
}
```

Also refer to the following sequence of insertions:

```
add('N', 7);
add('R', 24);
add('V', 92);
add('Z', 100);
```

Z should have been 4

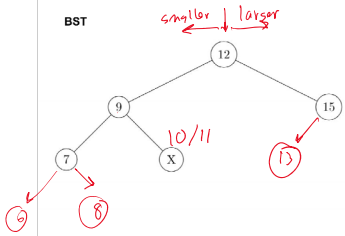
What is the contents of the bucket array right before calling expandCapacity()?

What is the contents of the bucket array after the sequence has ended?

Belongs -->

(Z, 92) should be at 5
Hashed to index 4, +1 due to collision

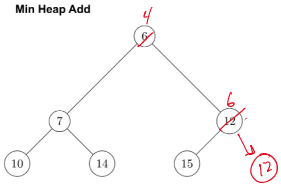
**BST**




If X is the fifth value added to the BST below, which of the following are possible values of X? Select all that apply.

- A. 6
- B. 8
- C. 10
- D. 11
- E. 13

**Min Heap Add**




If the value 4 is added to the min heap below, what number will end up in the new bottom right leaf node?

**Iterator**

Which interfaces are required by Java to use a data structure in an enhanced for loop?

Which is the proper way to implement next() for an Iterator:

- A. return value
- B. save value, update to next element, return saved value
- C. update to next element, return value
- D. save value, return saved value
- E. return value, update to next element