CSE12 - Lecture 26

Friday, December 8, 2023 8:00 AM

PA8 Late/Resubmit due slip day - tomorrow 8am
Final Exam - Monday @ 8am - Room change - Peterson 108
Student Evaluation of Teaching (SET)
- Please submit your SET for the course at https://academicaffairs.ucsd.edu/Modules/Evals
by Saturday at 8am

Lecture 26

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 >();

A, D, E -> cause compiler errors

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?

front -> [B, A, D, C] <- back

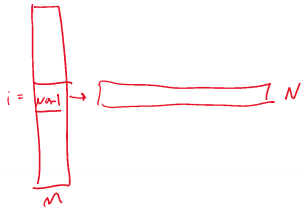
```
ALStack<String> myS = new ALStack<>();
myS.push("A");
myS.push("A");
myS.pop();
myS.push("C");
myS.push("B");
myS.push(myS.pop());
myS.push("D");
myS.push(myS.pop());
System.out.println(myS.toString());
```

What is printed?

[A, C, B, D] <- top

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? $O(m+n) \rightarrow \Theta(N)$

What is the best case runtime of findPair given it returns false? $O(m) \rightarrow \Theta(N)$

Name: _____ PID: _____ Code: _____

Time Complexity Review

Check which of the following are true:

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

C -> true

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 $\Omega(n^3)$
B. $n * log(n) + n^2$ is $\Omega(log(n) * n^2)$
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 $\Theta(1)$
F. $(n^4)/log(n)$ is $\Theta(n^4)$

A, E -> hold

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 $\Theta(1)$
B. f1 is $\Theta(n)$
C. f1 is $\Theta(n^2)$
D. f2 is $\Theta(1)$
E. f2 is $\Theta(log(n))$
F. f2 is $\Theta(n)$
G. f3 is $\Theta(1)$
H. f3 is $\Theta(n)$
I. f3 is $\Theta(n^2)$

C, E, I -> true

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? 3

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

b, c, a, d, f, e

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?

2 * $\log_2(N)$

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) LF → 0.75 size / capacity

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

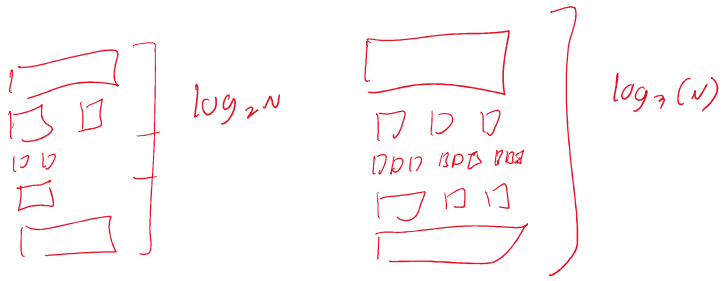
Hash table just before expandCapacity is called:

0. - null
1. - {"greetings" : 6} 9%8→1 9%16→9
2. - {"hi" : 5} 2%8 2%16
3. - {"bye" : 9} 9%8 9%16
4. - {"happy week 7" : 3} 12%8→4 12%16→12
5. - {"hello" : 2} 5%8 5%16
6. - null
7. - null

8 16

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

L.F. → .75
4 buckets

```
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?

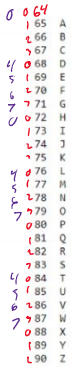
A. add('A', 56); add('B', 5); add('C', 65); add('D', 2); → 0 collisions

B. add('E', 43); add('F', 7); add('K', 6); add('L', 160); → 0

C. add('M', 58); add('Q', 14); add('U', 20); add('W', 37); → 2 collisions

D. add('N', 7); add('R', 24); add('V', 92); add('Z', 100); → 3

E. add('Z', 91); add('R', 604); add('P', 9); add('L', 5); → 2



Hash Table - Linear Probing

LF → .67
4 items

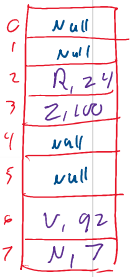
```
int hash(char key) {
   return (int) key;
}
```

Also refer to the following sequence of insertions:

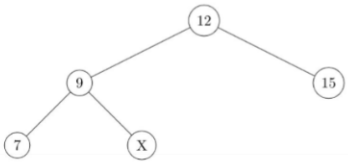
```
add('N', 7);
add('R', 24);
add('V', 92);
add('Z', 100);
```

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?



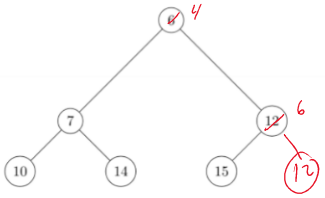
BST



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?

6 7 12 10 14 15

[4 7 6 10 14 15 12]

12

Iterator

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

Iterable<E>, Iterator<E>

Iterator<E> iterator() E next(), boolean hasNext()

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