CSCI 136:
Data Structures
and
Advanced Programming

Lecture 6

Vector API

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Williams

Outline

1. Quiz
2. Vector
3. Lab tips

Quiz

Did you run into obstacles on Lab 1?

Did you run into obstacles on Lab 1?

Did these obstacles feel like somebody else's fault?

Study tip #2: reflection

Suppose you had a time machine and could time-travel back to last Monday.

What would you tell yourself to do differently?

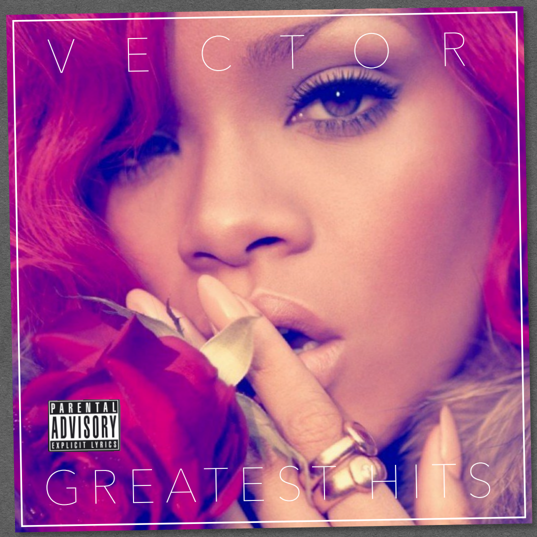
Take a moment and write (privately).

Study tip #2: reflection

Unforeseen obstacles are common.

Study tip #2: reflection

Think about how your advice will help with future labs.

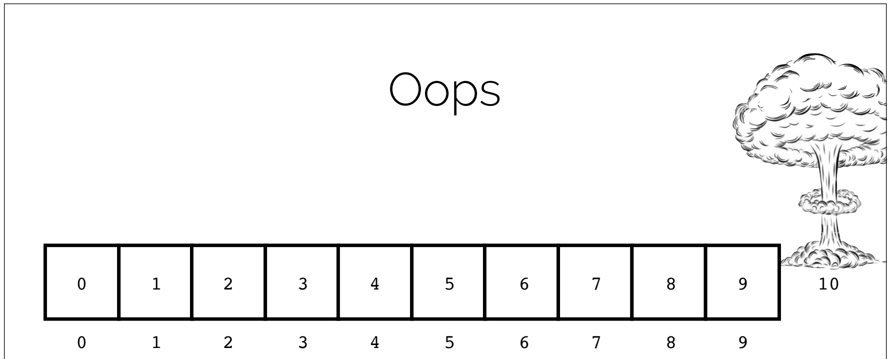


What is a Vector?

What's wrong with this program?

```
class NotAVector {
  public static void main(String[] args) {
    int[] a = new int[10];
    for (int i = 0; i < 11; i++) {
        a[i] = i;
    }
    for (int i = 0; i < a.length; i++) {
        System.out.println(a[i]);
    }
  }
}
```

Oops



```
Exception in thread "main"
java.lang.ArrayIndexOutOfBoundsException: 10
   at NotAVector.main(NotAVector.java:7)
```

Vector solves this problem

```
import structure5.*;

class VectorDemo {
  public static void main(String[] args) {
    Vector<Integer> v = new Vector<Integer>();
    for (int i = 0; i < 10000; i++) {
        v.add(i);
    }
    for (int elem : v) {
        System.out.println(elem);
    }
  }
}
```

Vector **grows** when more space is needed.

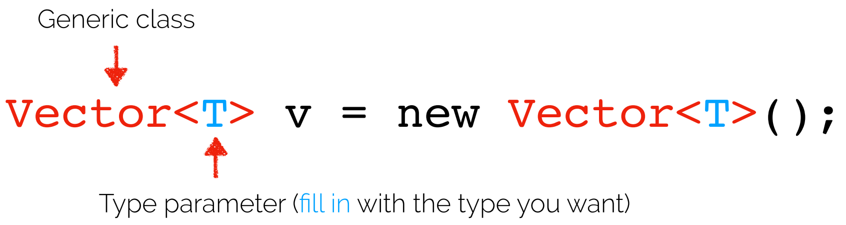
Vector is a generic class

`Vector<T> v = new Vector<T>();`

Generic types

A **generic type** is a placeholder (a **type variable**) for a type **to be specified later**. Generic types permit the creation of common algorithms and data structures (e.g., a generic sequence), thus **reducing code duplication**. Generics allow for **data type abstraction**.

Vector is a generic class; it works with any type.★


Generic class

`Vector<T> v = new Vector<T>();`

Type parameter (fill in with the type you want)

(Vector documentation)

How does `Vector` work?

(code)

get

(code)

set

(code)

indexOf

(code)

add

(code)

many more methods!

see `Vector` documentation

Lab 2 tips

Biased sampling

What does this program do?

```
Random r = new Random();
int num = r.nextInt(10);
```

Chooses a value between 0 and 9 inclusive with uniformly random probability.

I.e., all values are equally likely.

What if we want to specify the likelihood?

letter	likelihood
‘a’	1
‘b’	6
‘c’	3

A naïve algorithm

‘a’	‘b’	‘b’	‘b’	‘b’	‘b’	‘b’	‘c’	‘c’	‘c’
0	1	2	3	4	5	6	7	8	9

```
char[] arr = new char[10];
// … code to fill array …
Random r = new Random();
int num = r.nextInt(10);
char c = arr[num];
```

A better algorithm

letter	likelihood
‘a’	1
‘b’	6
‘c’	3

1. Compute the **sum of the likelihoods** (here: **10**).
2. Choose a number **n** between **0 … sum** (exclusive) uniformly randomly.
3. For each letter, subtract the **likelihood** from **n**.
4. When **n becomes negative**, you’ve “found” the right letter.

Try it at home!

Notice that you get the **same answer**
had you used the naïve method.

‘a’	‘b’	‘b’	‘b’	‘b’	‘b’	‘b’	‘c’	‘c’	‘c’
0	1	2	3	4	5	6	7	8	9

1. Compute the **sum of the likelihoods** (here: **10**).
2. Choose a number **n** between **0 … sum** (exclusive) uniformly randomly.
3. For each letter, subtract the **likelihood** from **n**.
4. When **n becomes negative**, you've “found” the right letter.

Recap & Next Week

Today we learned:

- Vectors
- Hand-wavy worst-case time analysis

Next class:

- Recursion