

# CS 106A, Lecture 21

## Classes

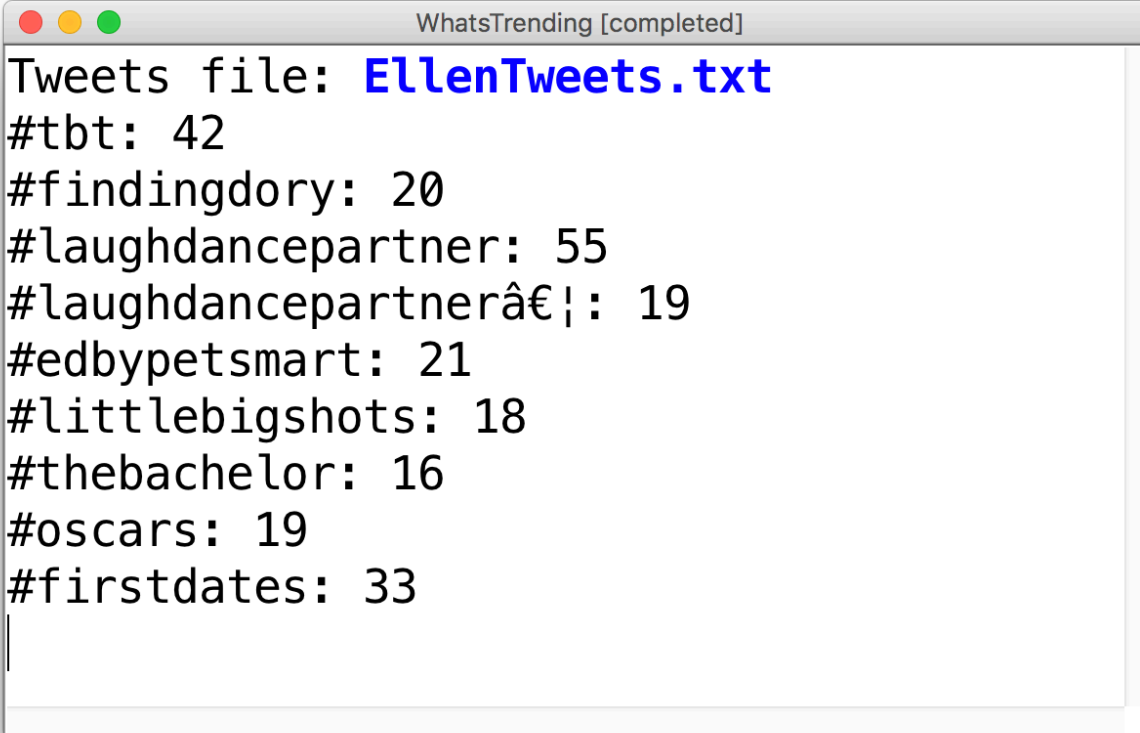
suggested reading:

*Java Ch. 6*

# Plan for today

- Recap: HashMaps + What's Trending
- Classes
- Recap

# Recap: HashMaps

A terminal window titled "WhatsTrending [completed]" with three colored window control buttons (red, yellow, green) in the top-left corner. The window contains a list of tweets and their frequencies. The text is as follows:

```
Tweets file: EllenTweets.txt
#tbt: 42
#findingdory: 20
#laughdancepartner: 55
#laughdancepartnerâ€¦: 19
#edbypetsmart: 21
#littlebigshots: 18
#thebachelor: 16
#oscars: 19
#firstdates: 33
|
```

# Plan for today

- Recap: HashMaps + What's Trending
- Classes
- Recap

# Large Java Programs

There are some *large* programs written in Java!



# Defining New Variable Types

Inbox Database

Email Sender

Login Manager

Email

User

Inbox

# What Is A Class?

A class defines a new variable type.

# Why Is This Useful?

- A student registration system needs to store info about students, but Java has no **Student** variable type.
- A music synthesizer app might want to store information about different types of instruments, but Java has no **Instrument** variable type.
- An email program might have many emails that need to be stored, but Java has no **Email** variable type.
- **Classes** let you define new types of variables, which lets you decompose your program code across different files.



# Classes Are Like Blueprints

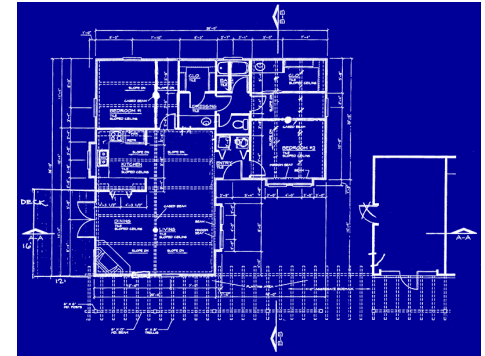
## iPod blueprint (class)

### state:

current song  
volume  
battery life

### behavior:

power on/off  
change station/song  
change volume  
choose random song



*constructs*

## iPod (variable) #1

### state:

song = "1,000,000 Miles"  
volume = 17  
battery life = 2.5 hrs

### behavior:

power on/off  
change station/song  
change volume  
choose random song



## iPod (variable) #2

### state:

song = "Letting You"  
volume = 9  
battery life = 3.41 hrs

### behavior:

power on/off  
change station/song  
change volume  
choose random song



## iPod (variable) #3

### state:

song = "Discipline"  
volume = 24  
battery life = 1.8 hrs

### behavior:

power on/off  
change station/song  
change volume  
choose random song



# What Is A Class?

A class defines a new variable type.

# Creating A New Class

Let's define a new variable type called **BankAccount** that represents information about a single person's bank account.

## A **BankAccount**:

- contains the name of account holder
- contains the balance
- can deposit money
- can withdraw money

# What if...

What if we could write a program like this:

```
BankAccount nickAccount = new BankAccount();  
nickAccount.setName("Nick");  
nickAccount.deposit(50);
```

```
BankAccount rishiAccount = new BankAccount();  
rishiAccount.setName("Rishi");  
rishiAccount.deposit(50);  
boolean success = rishiAccount.withdraw(10);  
if (success) {  
    println("Rishi withdrew $10.");  
}
```

# Creating A New Class

- 1. What information is inside this new variable type?** These are its private instance variables.

# Example: BankAccount

```
// In file BankAccount.java
public class BankAccount {
    // Step 1: the data inside a BankAccount
    private String name;
    private double balance;
}
```

Each BankAccount object has its *own copy* of all instance variables.

# Creating A New Class

- 1. What information is inside this new variable type?** These are its instance variables.
- 2. What can this new variable type do?** These are its public methods.

# What if...

What if we could write a program like this:

```
BankAccount nickAccount = new BankAccount();  
nickAccount.setName("Nick");  
nickAccount.deposit(50);  
println(nickAccount);
```

```
BankAccount rishiAccount = new BankAccount();  
rishiAccount.setName("Rishi");  
rishiAccount.deposit(50);  
boolean success = rishiAccount.withdraw(10);  
if (success) {  
    println("Rishi withdrew $10.");  
}
```



# Example: BankAccount

```
public class BankAccount {  
    // Step 1: the data inside a BankAccount  
    private String name;  
    private double balance;  
  
    // Step 2: the things a BankAccount can do  
    public void deposit(double amount) {  
        balance += amount;  
    }  
  
    public boolean withdraw(double amount) {  
        if (balance >= amount) {  
            balance -= amount;  
            return true;  
        }  
        return false;  
    }  
}
```

# Defining Methods In Classes

Methods defined in classes can be called **on an instance of that class.**

When one of these methods executes, it can reference **that object's copy** of instance variables.

```
ba1.deposit(0.20);  
ba2.deposit(1000.00);
```

ba1

```
name    = "Marty"  
balance = 1.45  
  
deposit(amount) {  
    balance += amount;  
}
```

ba2

```
name    = "Mehran"  
balance = 901000.00  
  
deposit(amount) {  
    balance += amount;  
}
```

This means calling one of these methods on different objects has *different effects*.

# Getters and Setters

Instance variables in a class should *always be private*. This is so only the object itself can modify them, and no-one else.

To allow the client to reference them, we define public methods in the class that **set** an instance variable's value and **get** (return) an instance variable's value. These are commonly known as **getters** and **setters**.

```
account.setName("Nick");  
String accountName = account.getName();
```

Getters and setters prevent instance variables from being tampered with.

# Example: BankAccount

```
public class BankAccount {  
    private String name;  
    private double balance;  
  
    ...  
    public void setName(String newName) {  
        if (newName.length() > 0) {  
            name = newName;  
        }  
    }  
  
    public String getName() {  
        return name;  
    }  
}
```

# Creating A New Class

- 1. What information is inside this new variable type?** These are its instance variables.
- 2. What can this new variable type do?** These are its public methods.
- 3. How do you create a variable of this type?** This is the constructor.

# Constructors

```
GRect rect = new GRect();
```

```
GRect rect2 = new GRect(50, 50);
```

This is calling a special method! The **GRect constructor**.

# Constructors

```
BankAccount ba1 = new BankAccount();
```

```
BankAccount ba2 = new BankAccount("Nick", 50);
```

The constructor is executed when a new object is created.

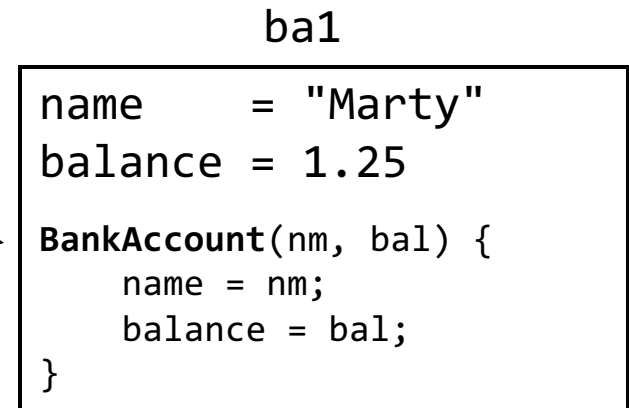
# Example: BankAccount

```
public class BankAccount {  
    // Step 1: the data inside a BankAccount  
    private String name;  
    private double balance;  
  
    // Step 2: the things a BankAccount can do (omitted)  
    // Step 3: how to create a BankAccount  
    public BankAccount(String accountName, double startBalance) {  
        name = accountName;  
        balance = startBalance;  
    }  
  
    public BankAccount(String accountName) {  
        name = accountName;  
        balance = 0;  
    }  
}
```

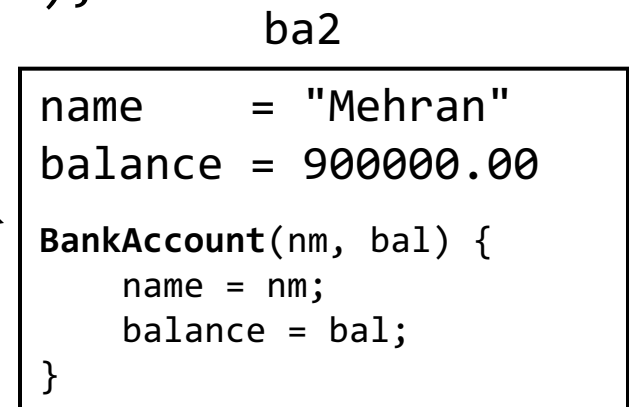


# Using Constructors

```
BankAccount ba1 =  
    new BankAccount("Marty", 1.25);
```



```
BankAccount ba2 =  
    new BankAccount("Mehran", 900000.00);
```



- When you call a constructor (with **new**):
  - Java creates a new object of that class.
  - The constructor runs, on that new object.
  - The newly created object is returned to your program.

# Constructors

- **constructor**: Initializes the state of new objects as they are created.

```
public ClassName(parameters) {  
    statements;  
}
```

- The constructor runs when the client says `new ClassName(...)`;
- no return type is specified; it "returns" the new object being created
- If a class has no constructor, Java gives it a *default constructor* with no parameters that sets all fields to default values like `0` or `null`.

# Plan for today

- Recap: HashMaps + What's Trending
- Classes
- Recap

# What Is A Class?

A class defines a new variable type.

# Creating A New Class

- 1. What information is inside this new variable type?** These are its instance variables.
- 2. What can this new variable type do?** These are its public methods.
- 3. How do you create a variable of this type?** This is the constructor.

# Recap

- Recap: HashMaps + What's Trending
- Classes
- Recap

**Next time:** more classes