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?

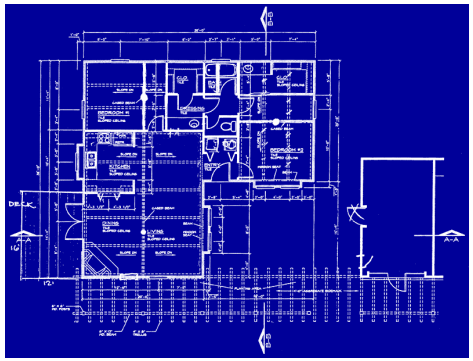
- A student registration system needs to store info about students, but Java has no **Student** variable type.
- A music synthesizer app might want to store information about different types of instruments, but Java has no **Instrument** variable type.
- An email program might have many emails that need 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

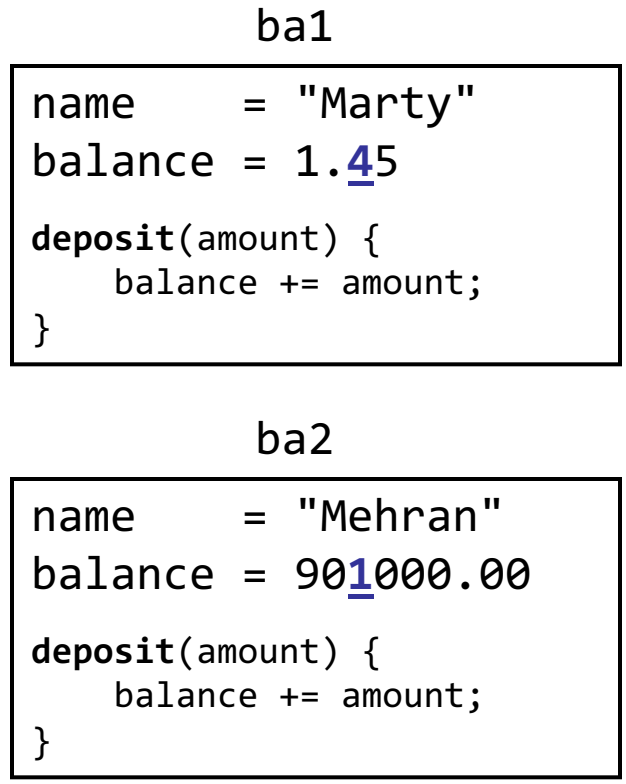
```
public class BankAccount {
	// Step 1: the data inside a BankAccount
	private String name;
	private double balance;

	// 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);
```



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

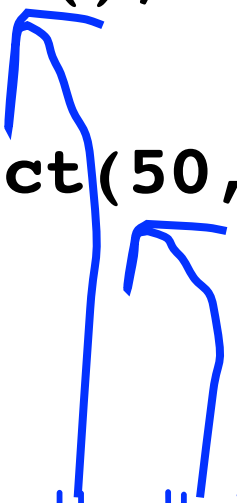
```
public class BankAccount {
	private String name;
	private double balance;

	...
	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);
```

ba1

```
name    = "Marty"
balance = 1.25

BankAccount(nm, bal) {
    name = nm;
    balance = bal;
}
```

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

ba2

```
name    = "Mehran"
balance = 900000.00

BankAccount(nm, bal) {
    name = nm;
    balance = bal;
}
```

- 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.