Data Structure Design I
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Interactors
Button

Piech, CS106A, Stanford University
JButton button = new JButton("Press me");
JButton button = new JButton("Press me");
JButton button = new JButton("Press me");
add(button, SOUTH);
JButton button = new JButton("Press me");
add(button, SOUTH);
addActionListeners();
public void actionPerformed(ActionEvent e) {
    String actionCmd = e.getActionCommand();
    if(actionCmd.equals("Press me")) {
        println("Tehehe");
    }
}
public void actionPerformed(ActionEvent e) {
    String actionCmd = e.getActionCommand();
    if (actionCmd.equals("Press me")) {
        println("Tehehe");
    }
}

JButton
public void actionPerformed(ActionEvent e) {
    String actionCmd = e.getActionCommand();
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    }
}
public void actionPerformed(ActionEvent e) {
    String actionCmd = e.getActionCommand();
    if (actionCmd.equals("Press me")) {
        println("Tehehe");
    }
}
End review
Some *large* programs are in Java
How?
Define New Variable Types

Inbox Database

Email Sender

Login Manager

Email

User

Inbox

Piech, CS106A, Stanford University
Even small programs define new variable types
Can you do this?
Bouncing Balls
• A student registration system needs to store info about students, but Java has no **Student** type.

• A music synthesizer app might want to store information about users' accounts, but Java has no **Instrument** type.

• However, Java does provide a feature for us to add new data types to the language: **classes**.
  – Writing a class defines a new data type.
Classes are like blueprints

class: A template for a new type of variable.
#key: Classes define new variable types
#key: Classes decompose your program across files
Classes are like blueprints

To design a new variable type you must specify three things:
1. What subvariables make up this new variable type?
2. What methods can you call on a variable of this type?
3. What happens when you make a new instance of this type?
What is a class?
A class defines a new variable type
Kenya has used mobile banking for 10 years.
Classes: Take 1

This goes in BankAccount.java!

```java
public class BankAccount {
    // the instance variable define what makes up the class
    public String name;
    public double money;
}
```

Instance variables have a special meaning
public class BankAccount {
    // the instance variable define what makes up the class
    public String name;
    public double money;
}

public class Benmo{
    public void run() {
        BankAccount chris = new BankAccount();
        BankAccount nick = new BankAccount();
        chris.name = "Chris";
        chris.money = 100;
        nick.name = "Nick";
        nick.money = 50;
    }
}
public class BankAccount {
    // the instance variable define what makes up the class
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    public void run() {
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public class Benmo{
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        BankAccount chris = new BankAccount();
        BankAccount nick = new BankAccount();
        chris.name = "Chris";
        chris.money = 100;
        nick.name = "Nick";
        nick.money = 50;
    }
}

run
chris
  name
  money 100.0
nick
  name
  money
"Nick"
public class BankAccount {
    // the instance variable define what makes up the class
    public String name;
    public double money;
}

public class Benmo {
    public void run() {
        BankAccount chris = new BankAccount();
        BankAccount nick = new BankAccount();
        chris.name = "Chris";
        chris.money = 100;
        nick.name = "Nick";
        nick.money = 50;
    }
}
What is a class?
A class defines a new variable type
Wall of abstraction

run

withdraw

deposit

Bank account data
• **encapsulation**: Hiding implementation details of an object from its clients.
  
  – Encapsulation provides *abstraction*.
    • separates external view (behavior) from internal view (state)
  – Encapsulation protects the integrity of an object's data.

• A class's instance variables should be declared *private*.
  – No code outside the class can access or change it.
This goes in its own file!

```java
public class BankAccount {
    // the instance variable define what makes up the class
    public String name;
    public double money;
}
```

Instance variables have a special meaning.
public class BankAccount {
    // 1. What variables make up the class
    public String name;
    public double money;
}
public class BankAccount {
    // 1. What variables make up the class
    private String name;
    private double money;
}
public class BankAccount {
    // 1. What variables make up the class
    private String name;
    private double money;

    // 2. What methods can a user call on a BankAccount?
    public void deposit(double amount) {
        ...
    }
    ...

    public boolean withdraw(double amount) {
        ...
    }
    ...
}
public class BankAccount {
    // 1. What variables make up the class
    private String name;
    private double money;

    // 2. What methods can a user call on a bankAccount?
    public void deposit(double amount) {
        money += amount;
    }

    public boolean withdraw(double amount) {
        ...
    }
}
public class BankAccount {
    // 1. What variables make up the class
    private String name;
    private double money;

    // 2. What methods can a user call on a bankAccount?
    public void deposit(double amount) {
        this.money += amount;
    }

    public boolean withdraw(double amount) {
        ...
    }
}
this
public class BankAccount {
    // 1. What variables make up the class
    private String name;
    private double money;

    // 2. What methods can a user call on a bankAccount?
    public void deposit(double amount) {
        this.money += amount;
    }

    public boolean withdraw(double amount) {
        ...
    }
}
public class BankAccount {
    // 1. What variables make up the class
    private String name;
    private double money;

    // 2. What methods can a user call on a bankAccount?
    public void deposit(double amount) {
        this.money += amount;
    }

    public boolean withdraw(double amount) {
        if(amount <= this.money) {
            this.money -= amount;
            return true;
        }
        return false;
    }
}
```java
public class BankAccount {
    // 1. What variables make up the class
    private String name;
    private double money;

    // 2. What methods can a user call on a bankAccount?
    public void deposit(double amount) {
        this.money += amount;
    }

    public boolean withdraw(double amount) {
        if (amount <= this.money) {
            this.money -= amount;
            return true;
        }
        return false;
    }

    // 3. How do you make a new one?
    public BankAccount(String name, double amount) {
        this.money = amount;
        this.money = name;
    }
}
```
Venmo
The easiest way to pay your friends.
You must define three things

1. What **variables** does each instance store?

2. What **methods** can you call on an instance?

3. What happens when you make a **new** one?
1. What variables make up this new super variable type?

   Instance variables

2. What methods can you call on a variable of this type?

   It’s public methods

3. What happens when the user makes a new instance?

   The “constructor”

* Don’t forget that all methods and constructors have access to a this reference
What is a class?
A class defines a new variable type
Bouncing Balls
A Ball Variable Type

1. What variables does each instance store?
   - Each ball has its own Goval (let’s call it shape)
   - Each ball has its own dx
   - Each ball has its own dy

2. What methods can you call on an instance?
   - heartbeat();
   - getShape();

3. What happens when you make a new one?
   - Sets initial values for all the “instance” vars

*details on how to define these three things coming soon
What classes?
What classes?