

Hello Java World

Hello world

...

Execution starts in **main()**
public: anyone can call
static: don't need to instantiate
void: no return value
main: function run at start.

```
/**  
 * Demonstrate use of main() and calling a static function.  
 */  
public class HelloWorld {  
  
    public static void main(String[] args) {  
        String courseName = "CMPT213";  
        System.out.println("Hello " + courseName + " World!");  
    }  
}
```

System.out.println(): prints with linefeed

System: class for accessing system data.

out: field to write to console.

println(): method which write

Function

```
/**
 * Demonstrate use of main() and calling a static function.
 */
public class HelloWorld {
    public static void main(String[] args) {
        String courseName = "CMPT213";
        displayDisclaimer(courseName);
    }

    private static void displayDisclaimer(String courseName) {
        System.out.println();
        System.out.println("No warranty for " + courseName);
        System.out.println("or other \"persons\".");
    }
}
```

Create and call own functions.
- May call a function anywhere in the file
(no need for function prototypes).

Classes

- **Class Name**
 - Class **HelloBob** is in file **HelloBob.java** (case sensitive).
 - Constructor is same name as class; no return type.
 - *Convention*...
- **Field**
 - a **member variable** or data stored by an object.
 - Called..
- **Method**
 - a **member function** of the class which may operate on fields.

Instantiating an object

```
public class GreetingsSelf {  
    private String name;  
    public GreetingsSelf(String name) {  
        this.name = name;  
    }  
    public void setName(String name) {  
        this.name = name;  
    }  
    public String getGreeting() {  
        return "Hello der Java World, from " + name;  
    }  
    public static void main(String[] args) {  
        GreetingsSelf greeter = new GreetingsSelf("CMPT 213");  
        System.out.println(greeter.getGreeting());  
    }  
}
```

Private field

Constructor

Good practice:..

Instantiate new object.

One Name

- Use **this** to..
 - All objects are accessed by **references**.
 - References are like pointers but Java automatically dereferences when needed.
- Give each idea one name
 - Name field and constructor parameters the same.
 - **Ex:** name both **numStudents**, vs using each of:
 - **studentCount**
 - **numStudents**
 - **n**
 - **numberStds**

```
public class Course {  
    private int numStudents;  
    public Course(int numStudents) {  
        this.numStudents = numStudents;  
    }  
}
```

Classes & Visibility

```
public class GreetingsWorld {  
    private String name;  
  
    public GreetingsWorld(String name) {  
        this.name = name;  
    }  
  
    public String getGreeting() {  
        return makeGreeting();  
    }  
    private String makeGreeting() {  
        return "Hello Java World, from " + name;  
    }  
}
```

Make all fields private whenever possible.

Public method can call private method
private:

..

public:

..

Classes & Visibility

```
public class GreetingsWorld {  
    private String name;  
    public GreetingsWorld(String name) {...}  
    public String getGreeting() {...}  
    private String makeGreeting() {...}  
}
```

```
/**  
 * Test the GreetingsWorld class  
 * as a unit test.  
 * Some code won't work!  
 */
```

```
public class GreetingsWorldTest {  
    private static final int TRIES = 5;  
  
    public static void main(String[] args) {  
  
        for (int i = 0; i < TRIES; i++) {  
            GreetingsWorld greeter = new GreetingsWorld("Round " + i);  
            String message = greeter.getGreeting();  
            System.out.println("Name is: " + greeter.name);  
            System.out.println("Name is: " + message);  
            System.out.println("Name is: " + greeter.makeGreeting());  
        }  
    }  
}
```

Which code won't work?

Cannot access private field or method from a different class!

Comments

- **JavaDoc:**
commenting syntax used to generate documentation.
 - on a **class**: above a class to describe purpose of class
 - on a **method**: above a method (or field) to explain it
 - **Suggest only using for API methods:**
stable interface and requires solid documentation for external users.
- **Commenting Rules (this course):**
 - RULE 1:**..
 - RULE 2:** Name fields, methods, and parameters well so
 - ..

JavaDoc Example

```
/**
 * Helper class to compute useful properties of a right-triangle.
 * @author Brian Fraser
 */
public class RightTriangle {
    /**
     * Compute the length of the hypotenuse of a right-triangle.
     * @param a Length of the first side (height); must be >=0.
     * @param b Length of the second side (base); must be >=0.
     * @return Length of hypotenuse.
     */
    public static double computeHypotenuse(double a, double b) {
        // ... Code omitted.
    }
}
```

Our code won't (usually) have
method comments though!

Primitive Types

- Primitive Types..
- char is..
2 bytes per character
 - Escape sequences:
"\\", "\n", "\t", "\""
- boolean holds value..
- Everything else is an object reference

```
/**
 * Show the different primitive types.
 */
public class PrimitiveTypeDemo {
    public static void main(String[] args) {
        byte next8Bits = 0x30;
        short dayOfMonth = 13;
        char firstLetter = 'A';
        int age = 42; // 32 bit signed
        long numberAtoms = 25000000000000L; // 64 bit signed

        float weight = 150.15F;
        double timeSinceStart = 1.1;

        boolean isAwesome = true;
    }
}
```

Type conversion

- **Type..**
 - Converting from a smaller type to a larger one.
 - OK to do implicitly.
`double weight = 200;`
- **Type..**
 - Converting from a larger type to a smaller one.
 - Must cast because can lose data:
`int height = (int) 10.99;`
`float length = (float) 12.0; // Why needed?`
- **Constants**
`final int MAX_LENGTH = 100;`
 - **RULE:..**
0, 1, (& sometimes -1 or 2) are often non-magical.

Multiple Object Reference

- = on an object reference..

- Example

```
GreetingsSelf phoneMsg = new GreetingsSelf("Einstein");  
GreetingsSelf emailMsg = phoneMsg;  
  
emailMsg.setName("Albert");
```

Variables on stack:

phoneMsg

emailMsg

Reference

Objects on heap:

a GreetingsSelf
object

Name: Einstein

- Automatic Garbage Collection
 - Objects with no references to them are automatically deleted.

Control Structures

- Same control structures as C/C++.

- Note **boolean** is not an **int**, so **if (j = 10) { ... }** is a..

```
public static int demoControlStructures() {  
    final int MAX = 10;  
    boolean isHappy = true;  
  
    for (long i = 0; i < MAX; i++) {  
  
        int j = (int) i;  
        while (j < MAX) {  
  
            if (j == i + 1 && !isHappy) {  
                break;  
            } else {  
                isHappy = false;  
                j++;  
            }  
        }  
    }  
    return 0;  
}
```

Static, Exceptions, & Debugging

Static

- **Static method**
 - Can be called on the class (no object required).
 - Also called..
- **Static field**
 - Shared by all instances of the class.
 - Also called..
 - Often used for constants:
`public static final int DAYS_PER_WEEK = 7;`
- **Static local**
 - Not supported in Java.

Static: What fails to compile?

```
public class StaticFun {  
    public static final int TARGET_NUM_HATS = 10;  
    private static int countNumMade = 0;  
    private int favNum = 0;  
    public static void main(String[] args) {  
        changeFavNum(42);  
        displayInfo();  
        favNum = 10;  
        countNumMade = 9;  
    }  
    private void changeFavNum(int i) {  
        favNum = TARGET_NUM_HATS + i;  
        displayInfo();  
    }  
    private static void displayInfo() {  
        System.out.println("TARGET_NUM_HATS: " + TARGET_NUM_HATS);  
        System.out.println("countNumMade: " + countNumMade);  
        System.out.println("favNum: " + favNum);  
    }  
}
```

Exceptions and Debugging

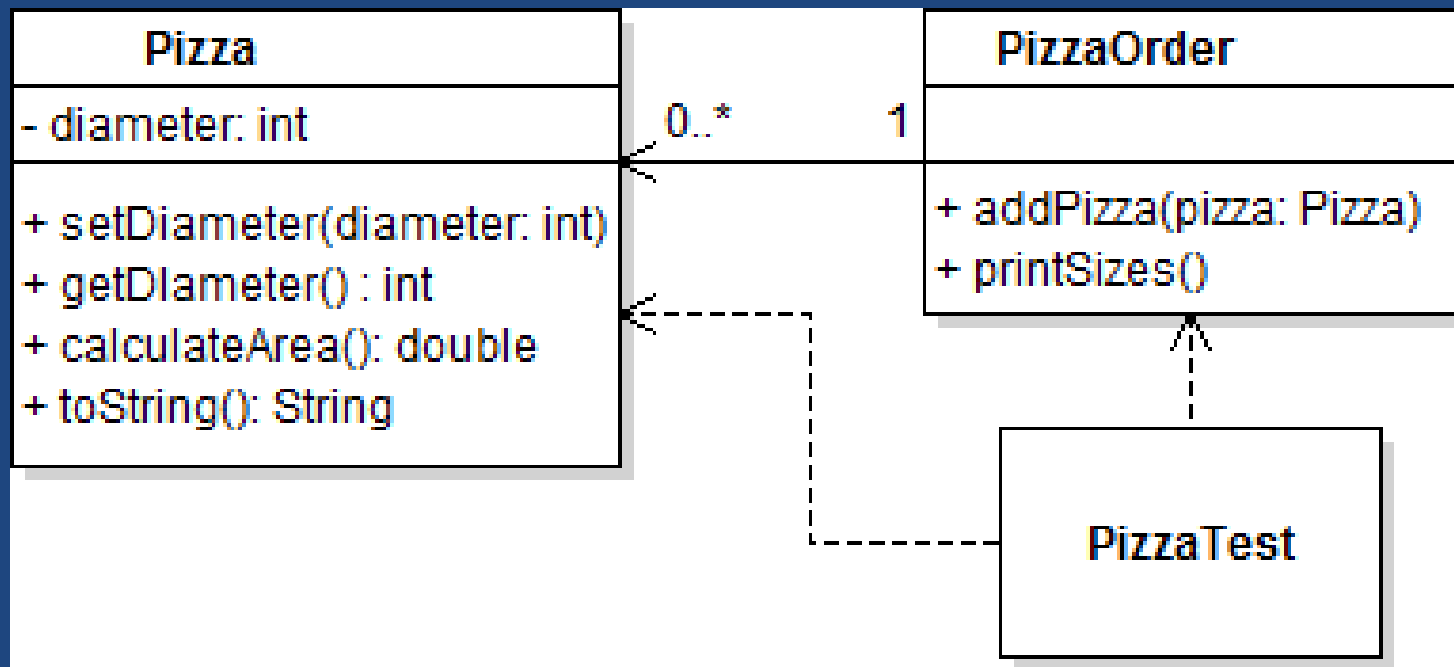
- Java.. on some errors
- Examples:
 - HelloWorld c;
c.xyz(); // Throws null pointer ex.
 - int oops = 10 / 0; // Throws div. zero ex.
 - // Throw your own, they are objects.
throw new RuntimeException("Busted!");
- Exercise
 - Debug Rectangle.java with IDE.
 - Use debug, breakpoints, step over/into, watch variable

Break on Uncaught Exception
Run --> View Breakpoints:
enable "Any Exception" for
"Uncaught exception"

Pizza Class Example

(package, Math, toString(), pass by...,
array, ArrayList, for each)

- We will create the following classes in this section of the slides.



Packages

- Java organizes code into **packages**.
Ex: **ca.cmpt213.as1** or **com.ibm.db2.query**
 - Set the package:
package ca.sfu.webreg.login;
 - Save .java files into:
src\ca\sfu\webreg\login\...
 - Can use code from a different package:
import ca.sfu.webreg.login;
or
import ca.sfu.webreg.*;

Pizza (step 1)

- Create a **new Java project** in IDE (IntelliJ).
- Create a **Pizza class** inside a **new package**.
- **Pizza Class features**
 - Store the **diameter** as an **int**; use constructor to set.
 - Create **accessors** and **mutators** for diameter.
 - Do we need a mutator?
- Create a **PizzaTest** class
 - Give it a **main()**.
 - Create new function to test Pizza so far.

- **Math** class has useful static fields and methods
 - ..
 - **Math.pow()**
 - **Math.ceil()**, **Math.floor()**, **Math.round()**
 - **Math.abs()**
 - **Math.min()**, **Math.max()**,
 - **Math.signum(x)** // 1.0 if $x > 0$, -1.0 if $x < 0$, 0 if 0.
 - **Math.random()**
 - **Math.toDegrees()**, **Math.toRadians()**
- **Pizza Example**
 - Create & test method to get the pizza's area.

toString()

- All Java objects have a **toString()** method
 - All classes inherit from Object, which implements **toString()**
- Returns a **String** object which..
 - Used for debugging, ..
 - Recommended format:

```
@Override
public String toString() {
    return getClass().getName()
        + " [daField1=" + daField1
        + ", daField2=" + daField2 + "];"
}
```

getClass().getName() returns
class name of current object.

@Override Annotation:
method overrides a
base class's method.
(optional)

- **Pizza:** Implement meaningful **toString()**;

Pass by value

- Java uses pass by value
 - Passing a **primitive** type passes its value.
 - Passing an **object** passes (by value)..
- What this means
 - When passed a primitive type, changes inside a method have no effect outside the method.
 - When passed an object, you *can* modify its state.
 - You *cannot* change..

Passing Example

```
void demoPassByValue() {  
    int myFavNum = 42;  
    changeNumber(myFavNum);  
    System.out.println("Number: " + myFavNum);  
  
    Pizza myPizza = new Pizza(20);  
    modifyPizza(myPizza);  
    System.out.println("Area (1): " + myPizza.calculateArea());  
    changeWhichPizza(myPizza);  
    System.out.println("Area (2): " + myPizza.calculateArea());  
}  
  
void changeNumber(int x) {  
    x = 0;  
}  
  
void modifyPizza(Pizza pizza) {  
    pizza.setDiameter(2);  
}  
  
void changeWhichPizza(Pizza pizza) {  
    pizza = new Pizza(10);  
}
```

What is the effect of each method?

= PizzaTest_DemoPassByValue

Arrays

- Arrays have a fixed size when created:

```
int[] ages = new int[10];  
Hat[] hats = new Hat[2];
```

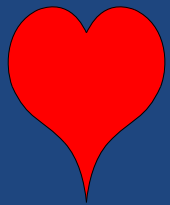
- 0 indexed.

- Bounds checked!

```
int size = ages.length;    // it's a field, not size() method  
int first = ages[0];  
int oops = ages[size];    // throws exception; why?
```

- Demo: Show PizzaOrder

- store up to *N* Pizzas (argument to constructor)
- implement `Pizza.add(Pizza)` and `Pizza.printSizes()`
- Test with `PizzaTest`



for-each loop

- Java includes the “enhanced for loop”

- Previously

```
for (int i = 0; i < hats.length; i++) {  
    Hat hat = hats[i];  
    System.out.println("Hat: " + hat.getColour());  
}
```

- Enhanced Loop

```
for (Hat hat: hats) {  
    System.out.println("Hat: " + hat.getColour());  
}
```

- No need to manage loop index (can't get it wrong!)

..



List and ArrayList

- **Generic**: works with..
- Java includes many generic Collections.
 - **ArrayList** implements the **List** interface and is backed by an array (fast), and dynamically resizes.

```
List<Hat> hats = new ArrayList<>();  
hats.add(new Hat("Blue"));  
for(Hat hat: hats) {  
    ...  
}
```

Don't need to put <Hat>, the type, because already specified on left-side.

- Collections only store objects...
 - To store primitives, use built in.. Integer, Long, Double, etc.
- **Demo**: Change **PizzaOrder** to **ArrayList**.

“Strings”

Strings

- **String Class**
 - Stores strings in Unicode: 2 bytes per character.
`String msg = "Hello";`
`char first = msg.charAt(0);`
- String literals are..
`int length = "Hello".length();`
- **Many methods on String**
 - `.length()`, `.contains(...)`, `.endsWith(...)`, `.isEmpty()`,
`.replace(...)`, `.split(...)`, `.toLowerCase()`, `.trim()`

Comparing Strings

- Compare strings using..

```
String password = getDaUsersPassword();  
if (password.equals("12345")) {  
    System.out.println("The air-shield opens.");  
}
```

- Don't use ==

- == compares the..

```
if (password == yourGuess) {  
    String msg = "Wow! The program stores the "  
        + "password and your guess at the same "  
        + "memory location! Crazy!";  
    System.out.println(msg);  
}
```

Immutable

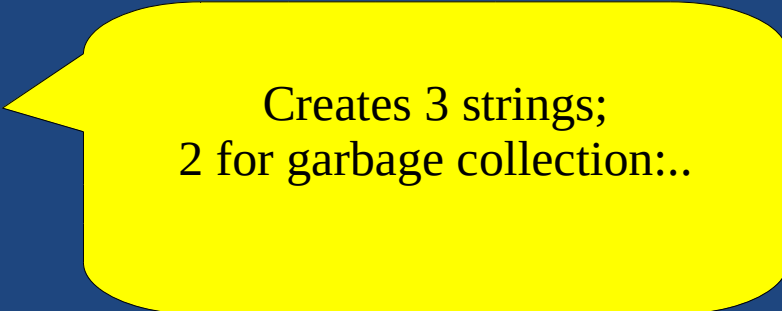
- Strings are Immutable

Once created,...

- To “change” a string,...

- Example

```
String msg = "H";  
msg = msg + "i";  
msg += '!';  
int count = msg.length();
```



Creates 3 strings;
2 for garbage collection:..

- Java does not support overloaded operators in general, except for **+** and **+=** on Strings.
 - String still immutable, even with **+=**

String Demo

```
static void demoStringConcat() {  
    String guess1 = "hello " + 42;  
    String guess2 = "hello " + 4 + 2;  
    String guess3 = 42 + "hello";  
    String guess4 = 4 + 2 + "hello";  
    String guess5 = new Integer(42).toString();  
}
```

```
static void demoStringToNumber() {  
    String myInput = "42";  
    int theValue = Integer.parseInt(myInput);  
  
    // Current date/time to string  
    Date now = new Date();  
    String msg = "Currently " + now;  
    System.out.println(msg);  
  
    // Demo bad conversion  
    int oops = Integer.parseInt("Oops");  
}
```

What does each String hold?

Also have:
Double.parseDouble(...)
Boolean.parseBoolean(...)
Long.parseLong(...)

Date.toString() gives:
Thu Jan 16 13:49:46 PST 2014

Date in java.util.Date

Throws
NumberFormatException

= DemoStrings.java

Keyboard Input

Scanner

- **Scanner class**
 - Keyboard input done via the **Scanner** class (in **java.util.Scanner**)
- **Example**

```
// Setup
Scanner daScanner = ..

// Use:
System.out.println("Enter your age: ");
int age = ..
```

Scanner for bad type

- Reading wrong type of data..

- Example

```
int diameter = scanner.nextInt(); // but Type "hi!"
```

- Two ways to avoid this exception:

```
int diameter = 0;
try {
    diameter = scanner.nextInt();
} catch (InputMismatchException ex){
    System.out.println("int only!");
}
```

```
int diameter = 0;
if (scanner.hasNextInt()) {
    diameter = scanner.nextInt();
} else {
    System.out.println("int only!");
}
```

Scanning Line Feeds

- Read a line with `.nextLine()`
String fullLine = myScanner.nextLine();
- Linefeed Complication
 - Scanner.nextInt()..

like a linefeed.

```
System.out.print("Enter age: ");  
int age = scanner.nextInt();  
  
System.out.print("Enter name: ");  
  
String name = scanner.nextLine();  
System.out.println("Hello " + name  
                  + " of age " + age);
```

Closing Scanner

- Java does garbage collection on unused objects, but some objects..
 - **Example**: File, network socket, input stream.
 - Must explicitly close these objects or suffer a..
- **However, System.in need not be closed**
 - It is provided by the OS, so don't close a **Scanner** created from **System.in**.
 - Other **Scanners** must be closed (such as for files).
 - Can hide the warning with annotation: **@SupressWarnings("resource")**

Text Files

Java Classes for Text Files

- **File(filePath)**
 - Represents a single file on disk (by path).
 - Package: **java.io.File**
- **Scanner(File)**
 - Does reading, use **.hasNextInt() .nextInt()**
 - Package: **java.util.Scanner**
- **PrintWriter(File)**
 - Does writing, use **.println()**
 - Package: **java.io.PrintWriter**
 - Use **PrintWriter** for a file or the screen:
PrintWriter myWriter = new PrintWriter(System.out);

Write to file

Create a File object for target file.

Catch exception:
FileNotFoundException

Write to the file via the
PrintWriter

Close the PrintWriter

```
File targetFile =  
    new File("C:/dos/run/test.txt");  
  
try {  
    PrintWriter writer =  
        new PrintWriter(targetFile);  
  
    writer.println("Run DOS run!");  
    writer.println("Ok.. old joke...");  
  
    writer.close();  
} catch (FileNotFoundException e) {  
    // TODO: Handle this!  
    e.printStackTrace();  
}
```

Read from file

Create a File object for source file.

Open a new Scanner.
Catch exception:
FileNotFoundException

Read all data from file via Scanner

Close the Scanner

```
File sourceFile =  
    new File("C:/dos/run/test.txt");  
  
try {  
    Scanner scanner =  
        new Scanner(sourceFile);  
  
    while (scanner.hasNextLine()) {  
        String text = scanner.nextLine();  
        System.out.println("Read:" + text);  
    }  
  
    scanner.close();  
} catch (FileNotFoundException e) {  
    // TODO: Do something better here?  
    e.printStackTrace();  
}
```

Static Factory Method

- Static Factory Method

- A..
- Like a constructor, but more flexible:
can give it a..
- A common..

- Example

- In **Pizza** class:

```
public static Pizza makePizzaFromFile(File file) {  
    // Open file and read in values  
    // Create new Pizza object  
    // Return the Pizza  
}
```

When is your code done? Coding Standards

Clean Code

- **Correct Code**
 - Implements the requirements.
 - Has no (few) bugs.
- **Clean Code**
 -
 - Conforms to..
 -
 -
- Professionals write clean code.

Coding Standard

- Course (and most companies) has a coding standard (See web page)
 - Your code *must* conform to this style guide.
 - Each assignment may mention some specifics.
- Activity
 - Read Coding Standard.
 - Go through the **Person** class and clean it up.

Summary

- **Classes**: public, private, static, constructor, package, JavaDocs, toString()
- **Primitive types**, type conversion, wrappers
- **Arrays**, **ArrayList**, for-each
- **String**: **Immutable** class for working with all strings.
- **Scanner** for input (file or keyboard)
- **PrintWriter** for output to file
- Coding standard enforced for **clean code**.