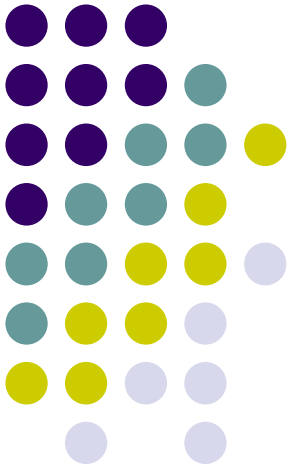
Java 100/105

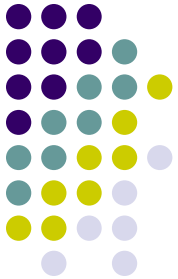
procedural coding



Java 100/105 course structure

- 5 days
- Java 100
  - For non-programmers
  - Thorough programming instruction
- Java 105
  - For programmers / Java 100 students
  - Review of programming
  - Focus on OO

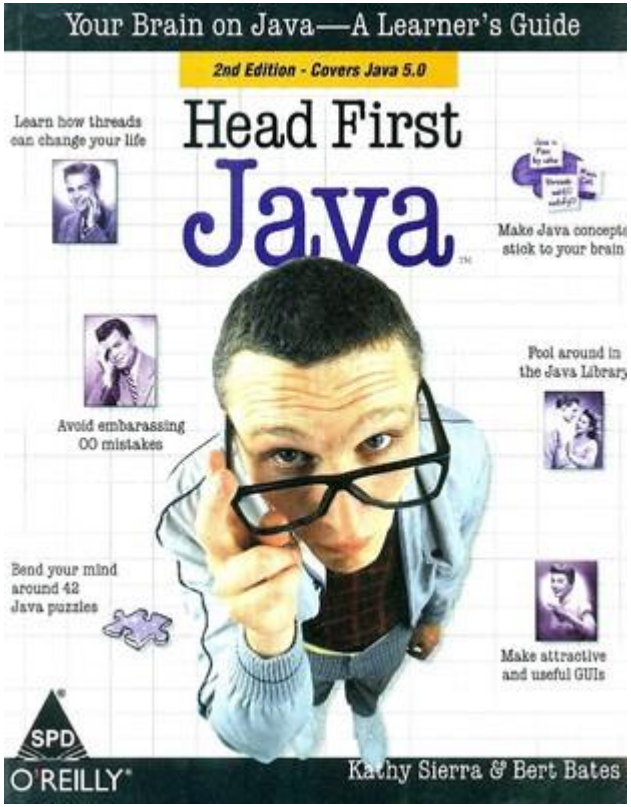
Books - required



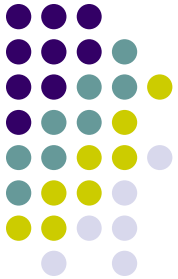
- Required for 100
  - **Beginning Programming With Java For Dummies**
- Required for 105
  - **Java: A Beginner's Guide,** 5th Ed., Herbert Schildt, McGraw Hill, Aug 2011, $40
- Required for 200
  - **Java The Complete Reference**, 8th Ed., Herbert Schildt, McGraw Hill, Jun 2011, $60

Books - recommended

- O'Reilly's Head First series
  - Head First Java
  - Head First Servlets & JSPs
  - Head First Design Patterns



Web site resources



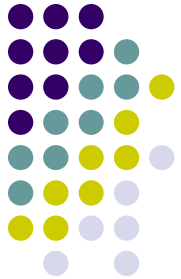
- http://github.com/doughoff
- Java
  - download either 32 or 64 bit Java 8 SE JDK if you aren't using an IDE
- Text editors
  - Notepad++ - simple, popular

Tools - IDEs

- Eclipse – open source
  - EE for web sites
  - Classic for smaller install, smaller menus
- jDeveloper – Oracle
- IntelliJ – IDEA $
- WAD (Websphere App Dev) – IBM $
  - RAD (Rational App Dev)

Download

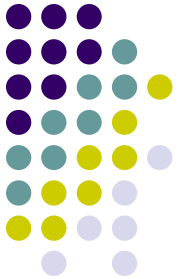
- Get **Java 9** 64-bit JDK (SE works fine)
  - Search for “Java 9 download”
- Get the **Eclipse** IDE for Java **EE** Developers 64-bit ()
  - Neon – June 2016
  - Oxygen - now



History, comparisons

LANGUAGE BACKGROUND

Origins

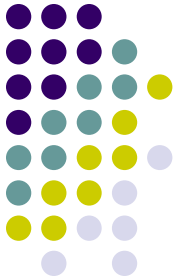


- C, C++
- Interactive TV, networked devices
- Internet
- 1991, public release 1.0a2 1995
- Managed by open source Java Community Process since 1.4

Transitions

- Sun Microsystems developed
- Netscape partnered to embed Java engine in browser.
- Microsoft lawsuit ended browser possibilities
  - Sun originally sued against J++
  - Microsoft forced users to download IE plug-in
  - Sun forced Windows to have JRE
- Sun open-sourced all Java code
- Sun bought MySQL

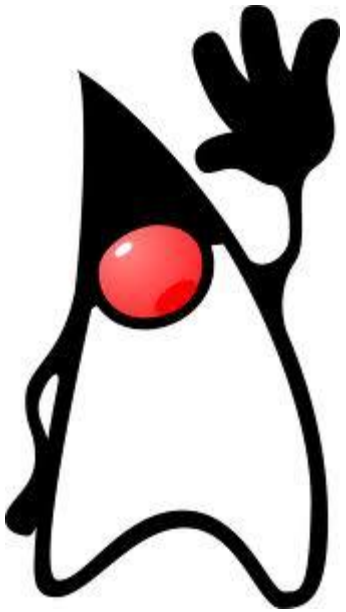
New owner



- Sun purchased by Oracle
  - IBM was a possible buyer
- Oracle uses Java extensively
  - Back end integration (Financials, Fusion)
- Oracle and MySQL
  - An upgrade path – free without support

Duke

- The Java mascot
- born May 23, 1995,
  the first demo of Java
  technology publicly
  released.
- Updated each year for a theme
  - JavaOne – Sep, 201?,
    San Francisco



Similar languages

- C++ - procedural & OO
- C#
  - Microsoft's revised version of J++
  - Has been adding features while Java was laying low.
  - 80% of keywords/syntax borrowed from Java
- JavaScript
  - executes in and manages the browser
  - several libraries copied
  - 70% of keywords/syntax borrowed from Java

Java structure - SE

- Java SE – standard edition
  - Java 1.1
  - J2SE 1.2, 1.3, 1.4, 5.0
  - Java SE 6, 7, 8, 9
- Some packages moved out of or into SE over time.
- Represents most common usage for console / GUI / middleware apps

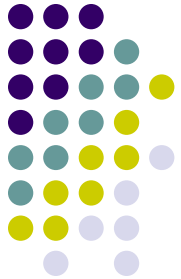
Java structure - EE

- Java EE – enterprise edition 1998
  - J2EE -> Java EE 5, 6
  - Web – servlets, applets, JSP, JSF, Tomcat (web server)
  - Networking, database (persistence, JDBC), email, web services, XML, components (EJBs)
  - Typically used with application servers
    - A web server with additional features
    - GlassFish, JBoss, Oracle WebLogic, IBM WebSphere

Development process

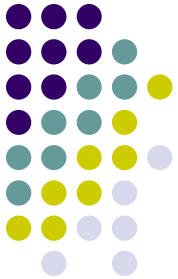
- Write code in text file
  - source code
  - file name ends with **.java**
- Compile source code
  - compiles to bytecode, binary machine language
  - file name ends with **.class**
  - builds (javac.exe) with Java's code libraries
- Move bytecode to destination platform
- Run bytecode (java.exe)

JDK

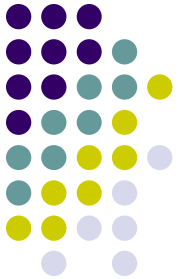


- Java Development Kit
  - JRE – Java Runtime Environment
    - java.exe – runs bytecode, different for each platform
    - APIs – Java code libraries
  - javac.exe – compiles source code
  - javadoc.exe – makes html documentation from source code with special comments

JVM



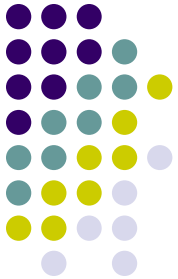
- or just VM (virtual machine)
- the engine that executes the code
  - java.exe
  - The sandbox



Development environment

ECLIPSE OXYGEN

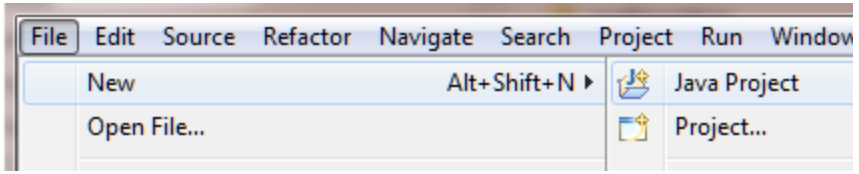
Eclipse



- IBM donated code to public domain from VisualAge
- IBM now maintains versions as Rational Application Developer (RAD) for the WebSphere suite (WAD)
  - WebSphere is the brand used for server products
- Many plug-ins allow feature additions
- Uses SWT and not Swing for GUI
  - SWT is simpler and preferred for GUI dev

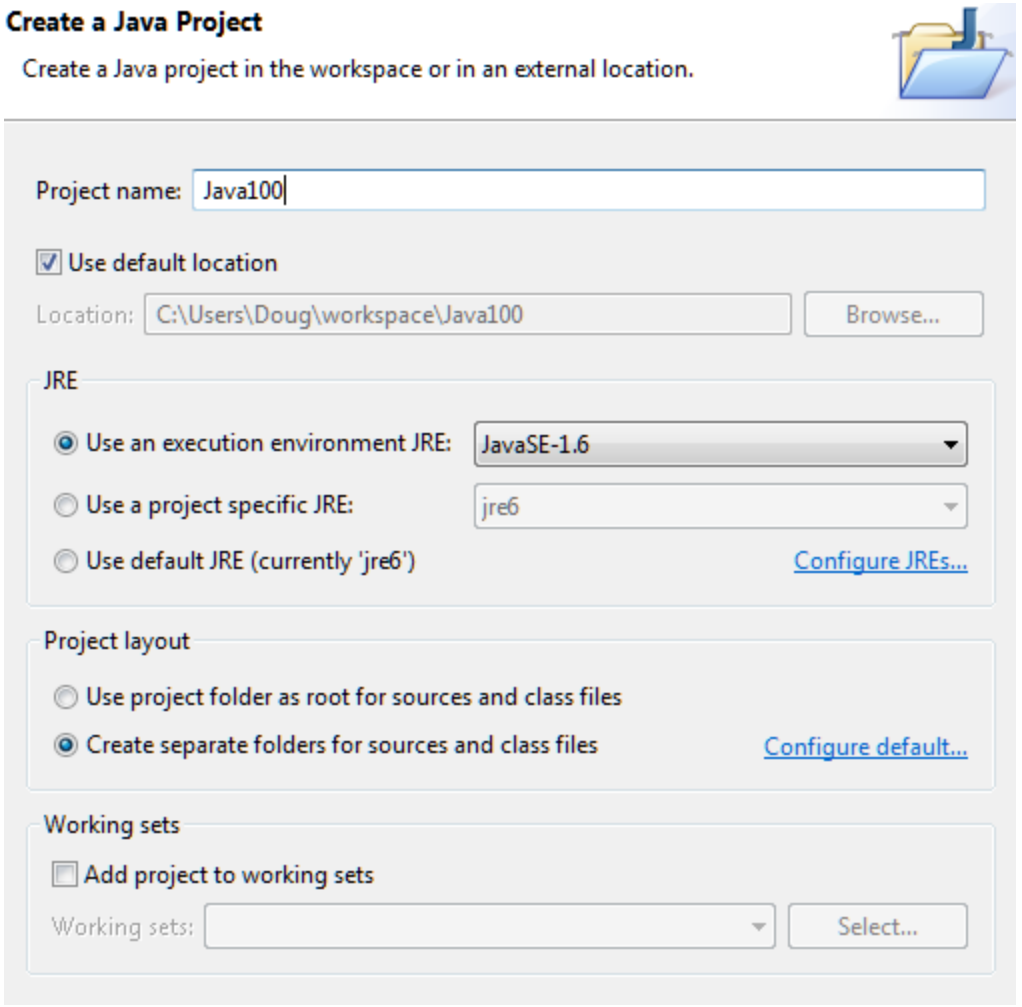
Projects

- Workbench – the development area
  - Project explorer – logical view of your files, not Windows Explorer view
- Project
  - Eclipse file information
  - Run configurations
- File / New / Java Project



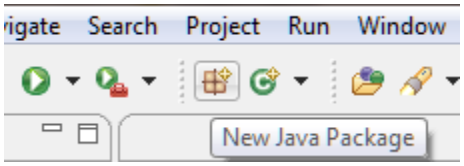
Class project

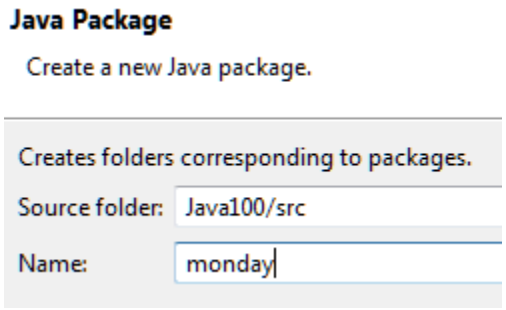
- Project name
- Location
  - for backups
- JRE
  - for older environments
- Separate folders
  - for zips/jars to server

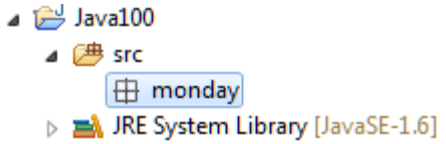


Packages

- Categories of files
- Creates a directory to hold files
- Lower case first letter

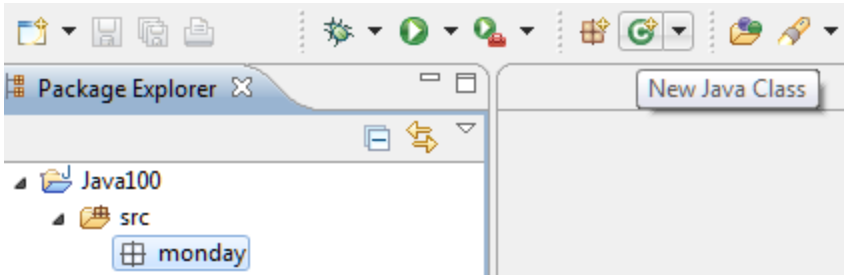






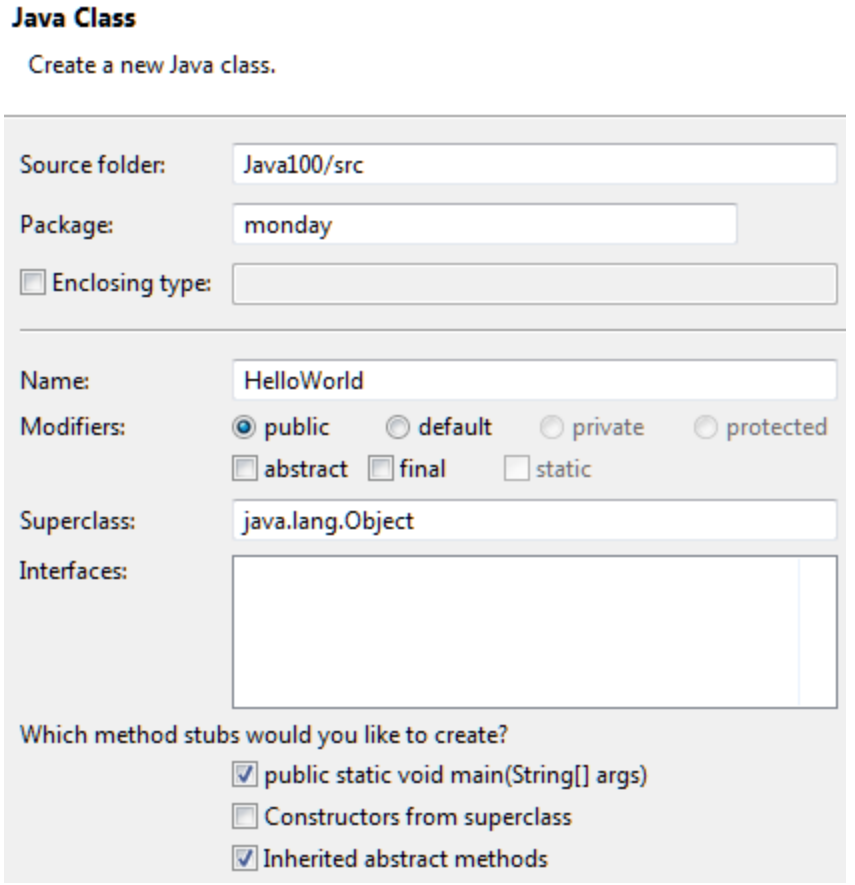
Class creation

- Modules of code
- Highlight package
- Click icon



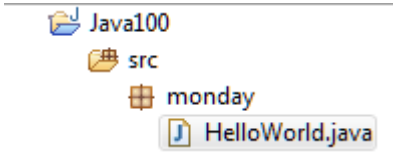
Class configuration

- Confirm package
- Name starts with a capital letter



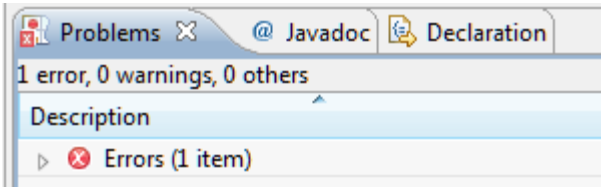
Class code

- Comments can be deleted.
  - /** comment */
  - // comment
- Type code in main() { }
- `System.out.println("Hello, world!");`
- **Save** or **Save All** to build
  - errors will show at bottom

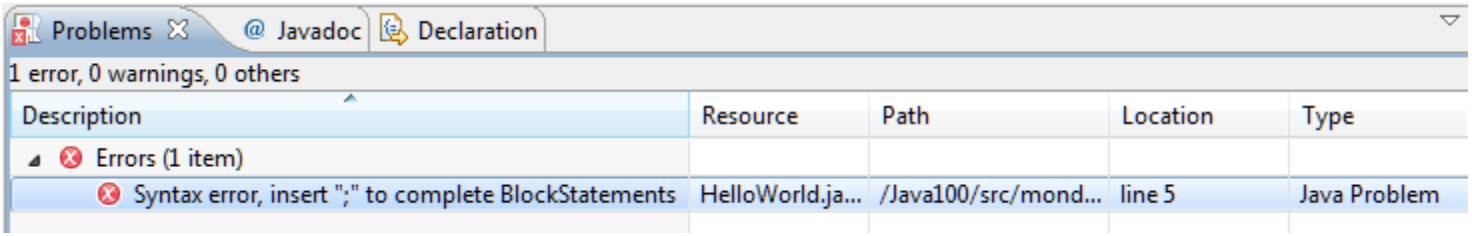



```
package monday;
public class HelloWorld {

    public static void main(String[] args) {

    }

}
```

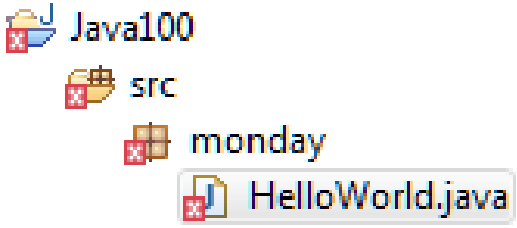
```
   public static void main(String[] args) {
       System.out.println("Hello, world!");
   }
```

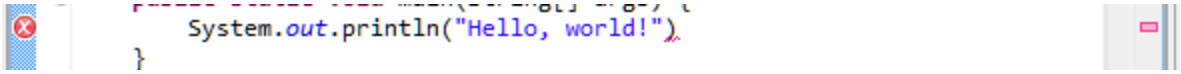


Error fixing



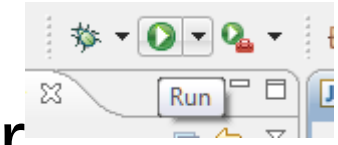
- Double click error to go to line
- Error icons will show from class up to project until built
- Error icon on left ribbon is at line
  - Grays out when fixed before build
- Error icon on right ribbon shows all errors in file



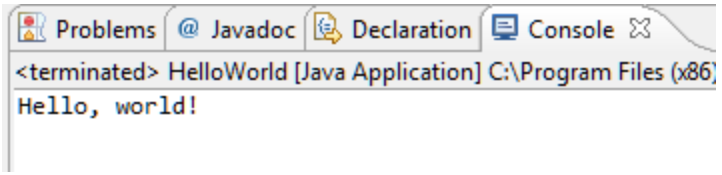


Class execution

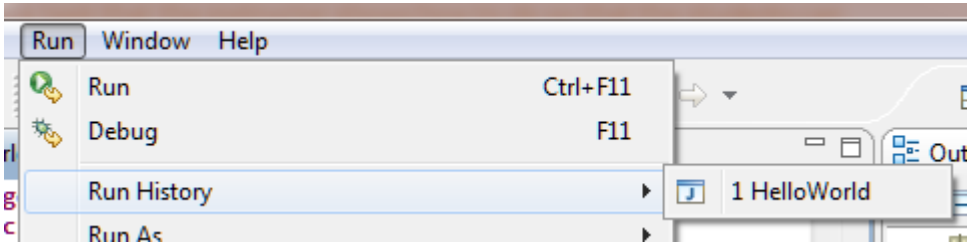
- Click icon

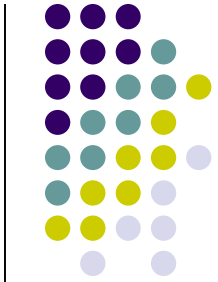


- **Console** will appear with your output



- Configuration was saved in **Run History** and can be run anytime

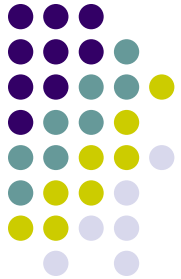




Simple keywords: if, for, code blocks…

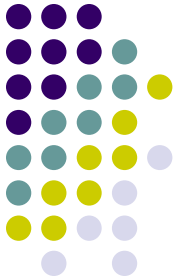
SYNTAX

Code blocks



- Any group of statements between { }
- Can be nested
  - {
    - { }
  - } // end of ?
- Used to organize code as one unit

Statement



- One line of Java code
- Almost always enclosed in a code block
  - package
  - import
- Always ends in a semicolon;
- Use as much white space as you want

Statement types

- Value assignment
  - direction is right to left
  - y = 5;
  - z = 0;
  - x = y;
  - y = z;
- Execute a method
  - System.out.println(“Hello, world!”);

Keywords

- Words reserved by Java
- Colored in purple

```
package monday;
public class HelloWorld {

    public static void main(
```

Identifiers

- Names you define for variables, class names, package names, method names
- Remains in black

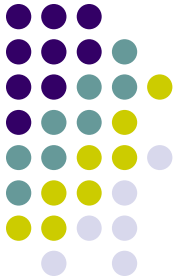
```
int x = 5;
```

- Rules
  - first letters are a-z, A-Z, $, and _
    - _ is not valid by itself in SE 8
  - no spaces
  - hardly any length limit
  - case sensitive

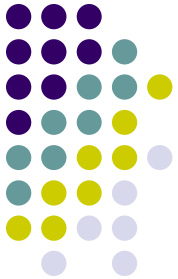
Java style

- Class names
  - first letter capitalized, no _, first letter of any word is capitalized
  - ThisIsALongClassNameExample
- Method names, variables, packages
  - first letter is not capitalized , first letter of any word is capitalized (Camel case)
    - thisIsAnExampleOfALongVariableName

Java APIs



- The pre-written class libraries supplied by Oracle
- Versioned
- Needs to be declared before use
  - except for java.lang classes
- Search for “Java API docs 9”



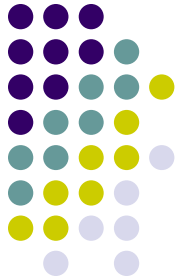
Order of execution of process steps

PROGRAM FLOW 1

Program flow

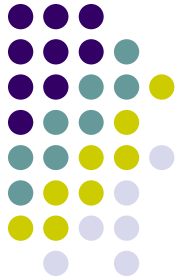
- What controls the execution of one task after another task.
  - A to do list
  - A fork in the road
  - A TV channel selector
  - Wash, rinse, repeat.
  - A task given to many people at the same time

Program flow types



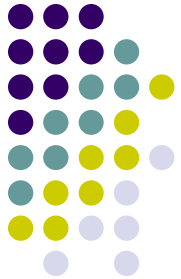
- Script
  - Execute each line until end of main( ).
- Units
  - Execute reusable modules of code in another place as needed.
- Controller
  - Call units of code to do all the work.

Program flow types

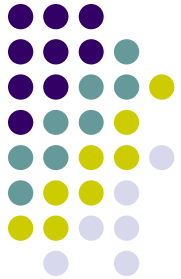


- Branching
  - Check the state of a rule (test) and execute code based on results
- Iteration
  - Execute a unit of code multiple times all at once until a rule is met (test).

Program flow types



- Asynchronous calls
  - Execute a unit of code anytime in the near future and get a reply whenever.
  - Overlapping
  - Two types
    - Distributed – AJAX
    - Non-distributed - Threading



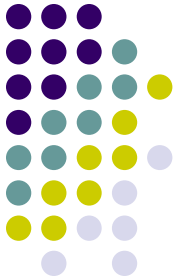
the for loop, while, do-while

LOOPS 1

Loops / Iteration control

- A loop is the syntax used to repeat a set of statements to
  - Execute a task on each one of many things
  - Continue to do something until a limit is reached
  - Do something forever like wait for a request to send something (web server)

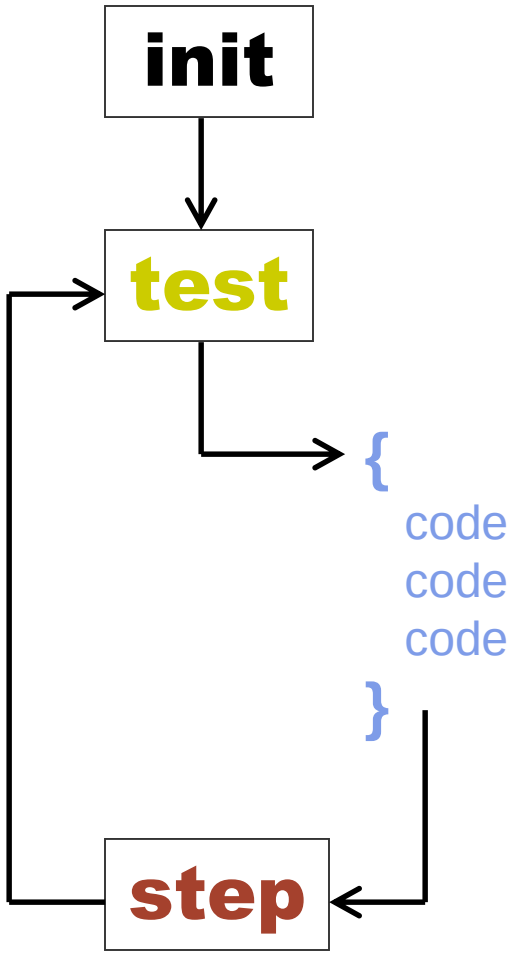
Java loop syntax types



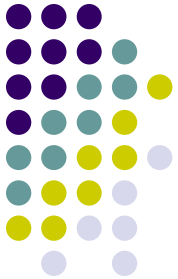
- for
- while
- do-while
- for each (enhanced for)
- functional style for with streams

for loop logic

- **init**ialization before 1st iteration
- conditional **test**ing
- code block or statement iterations
- "**step**ping" statements



for syntax



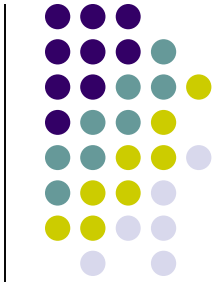
```
for( init ; test ; step ) {
        code
        code
        code
}
```

for syntax - init

for (**init** ; **test** ; **step**)

- local variables declared and initialized
- multiple variables separated by commas
- can be empty
- Examples:
  - int i = 0
  - int i = 0, j = 1
  - Iterator iterator = list.iterator( )

for syntax - test



for (init ; test ; step)

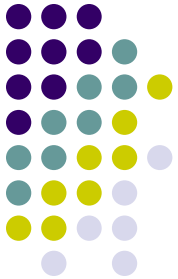
- result is true or false
- occurs before each iteration
- false result goes to end of code block
- Examples:
  - i <=10
  - i < array.length
  - iterator.hasNext( )

for syntax - step

for (init ; test ; step)

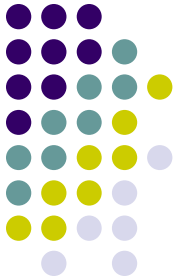
- occurs at the end of each iteration
- Examples:
  - i=i+1
  - i++
  - j = i * 2

for loop 1



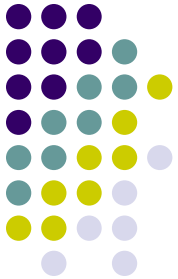
```
public class Count {
   public static void main (String[ ] args) {
         for ( int i = 0; i < 10 ; i=i+1 ) {
            System.out.println("i = " + i);
         }
   }
}
```

for loop 2



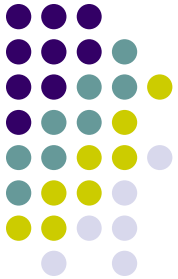
```
public class Count {
   public static void main (String[ ] args) {
        for ( int i = 0; i >= 10 ; i=i+1 ) {
           System.out.println("i = " + i);
        }
   }
}
```

for loop 3



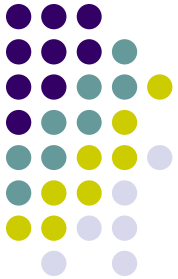
```
public class Count {
   public static void main (String[ ] args) {
        for ( int i = 0; i <= 10 ;    )
           System.out.println("i = " + i);
           i = i + 1;
   }
}
```

for loop 4



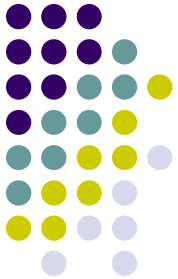
```
public class Count {
   public static void main (String[ ] args) {
        for ( int i = 0; i <= 10 ;  ) {
           System.out.println("i = " + i);
            i = i + 1;
         }
   }
}
```

for loop 5



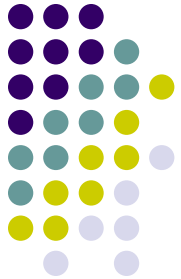
```
public class Count {
   public static void main (String[ ] args) {
         int i = 0;
         for (   ; i <= 10 ; i=i+1 ) {
            System.out.println("i = " + i);
         }
         // i is usable here
   }
…
```

for turned into a while



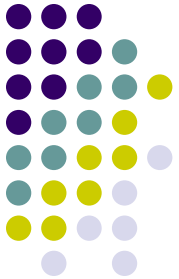
```
public class Count {
   public static void main (String[ ] args) {
         int i = 0;
         while ( i <= 10) {
            System.out.println("i = " + i);
             i=i+1;
         }
   }
…
```

for loop summary



- most used iterative control
- used for counting
- used for operations on each element of an array or collection
- only control that uses variable declaration
- semicolon operator & parentheses for grouping 3 parts are unique to **for**

Exercise (CountingLoops)

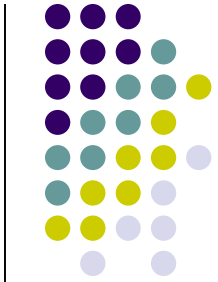


- Print out a list of numbers that:
  - Print from 1 to 25
  - Print from 25 to 1
  - Print from 1 to 50 by 2's
  - Print from 1 to 10 by .5

Loop keywords - structure

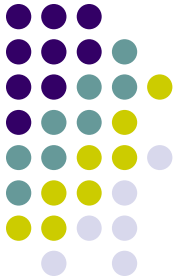
- **while**
  - like **for** loop but no **init** or **step**
  - only declares a test
  - do **init** above loop, **step** as last statement in loop.
- **do-while**
  - one iteration guaranteed
  - then, same as while loop

Ending code



- Statements end in a semi-colon
- Loops end in a code block with a curly brace pair

Exercises (PowerTests)

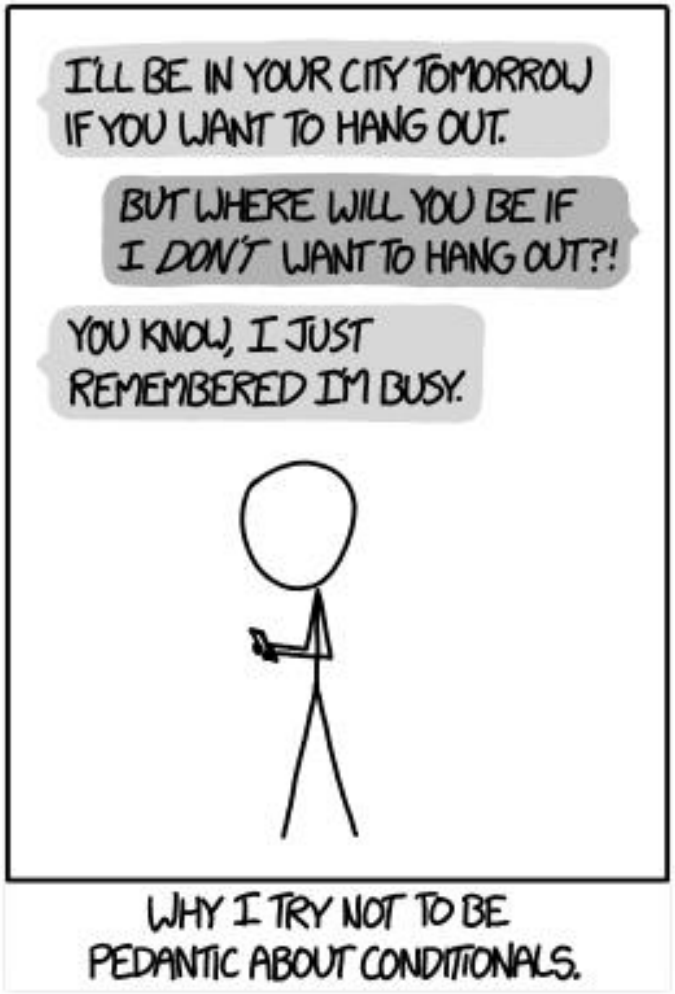


- Use a loop to print the powers of 2 from 0 to 50.
  - `2 ^ 0 = 1`
  - `2 ^ 1 = 2`
  - `2 ^ 2 = 4`
  - `2 ^ 3 = 8 ...`
  - Use a **long** variable to store your results.
  - For an advanced version, use Math.pow(number,power)

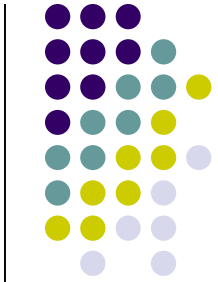
the if and switch statements

BRANCHING

If you're done being pedantic, we should get dinner.'
'You did it again!' 'No, I didn't.'

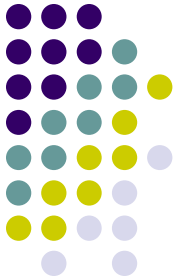


Branching types



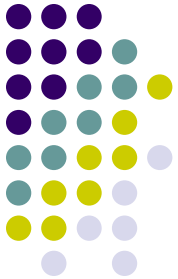
- 1-way
  - if-then
- 2-way
  - if-then
  - else
- 3-way
  - if-then
  - else if-then
    - else
- 4-way…

Branching types



- Multiple branches
  - switch – case 1, case 2, case 3…
- Branching with events
  - tie code to any event

Conditionals



- **if** (this is true) execute this statement;
- **if** (this is true) {
  execute this entire code block;
  }
- **if** (this is true)
  { execute this block; }
  else
  { execute this block; }

Loop keywords – test in loop

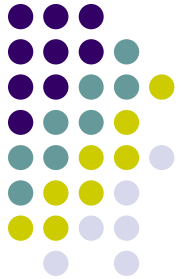
- Used with condition/rule
- **break**
  - halt all iterations of loop; go to end of code block
  - abort
- **continue**
  - like break but will start on the next iteration of the loop
  - skip this iteration

A real life bug in iOS

- Goto fail bug existed Sep 2012 - Feb 2014
- C
- `if ((err = SSLHashSHA1.update(&hashCtx, &signedParams)) != 0)`
  - `goto fail;`
  - `goto fail;`
  - `more code`

Nested ifs

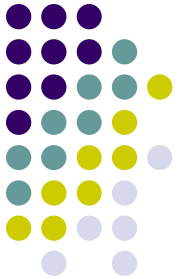
- if (condition 1) {
  - true condition 1
- }
- else {
  - if (condition 2) {
    - true condition 2 and false condition 1
  - }
  - else { false condition 1 and false condition 2 }
- }



Exercise (ThreeChoices)

- Set up three print statements for possible value ranges of any negative value, 0, or any positive value which will print out a unique result.
  - if (i < 0) { System.out.println(“It’s negative”); …

switch

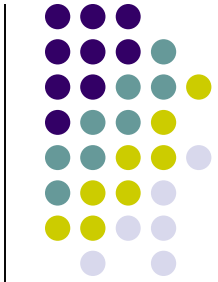


- a multiple result check for **one** test
  - switch (expression or test) {
  - case expressionA:
  - statements; break;
  - case expressionB:
  - statements; break;
  - default:
  - statements;
  - }

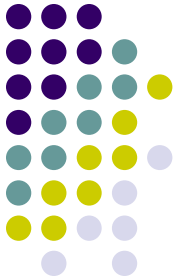
switch

- switch on whole numbers
  - byte, short, int, long, char
  - enums
  - Strings in 1.7
- Use break; to stop execution for each case
- Don’t use break to group cases (fall-through or empty cases)
- **Eclipse**: type switch, Ctrl-spacebar

Exercise



- Set up a unique print statement for any value from 1 to 5.
- Set up a unique print statement for any value under 10, between 10 and 20 and over 20 using a switch.



Exercise (LoopTests)

- Print out numbers 0 to 99
  - Formatted to look like:
    - 0 1 2 3 4 5 6 7 8 9
    - 10 11 12 13 14 15 16 17 18 19
    - 20 …
  - One loop only

Working with variables

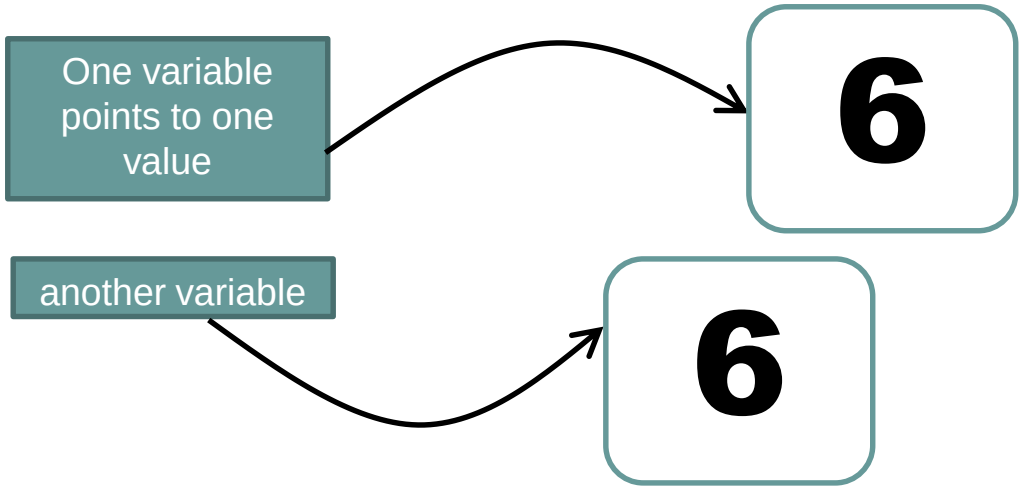
DATA TYPES

Introduction

- A data type
  - Constrains min/max if **whole number**
  - Constrains significant digits if **floating point**
  - Constrains data structure if **class**
  - Constrains data indices and structure if **array**
- The JVM
  - Checks for validity when building (compile time check)

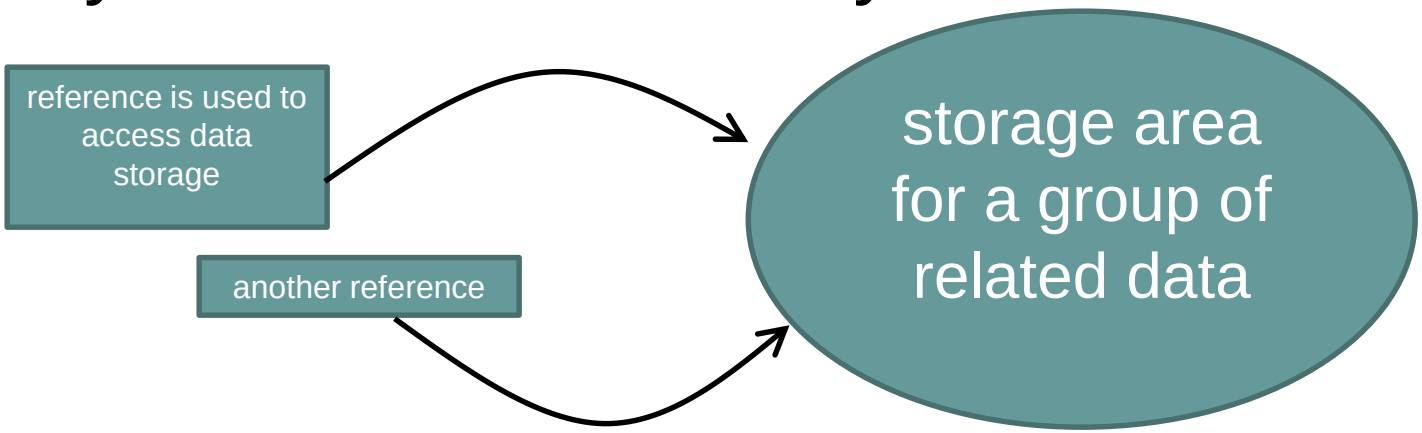
Value types

- Two types – value (primitive) and reference
- Values point to stack storage.

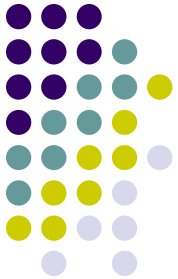


Reference types

- Variables refer to a storage area. They NEVER refer to other references.
- Storage area must be created first.
- Absence of a storage area means reference points to **null**
- Any reference can modify data.

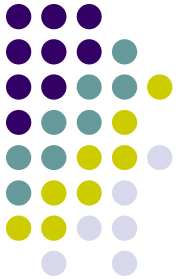


Value (primitive) types



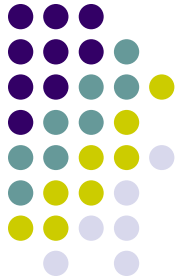
- Whole numbers
  - **byte, short, int, long**
- Floating point
  - **float, double**
- Logical
  - **boolean** (**true, false**)
- **Char**
  - any one character
  - literals must be enclosed in single quotes: ‘a’
  - really a **short** that is only positive (unsigned)

Basic steps of variable use



- Declare a variable
  - datatype and identifier
  - only declared once
- Reserve the memory for the data
  - only for references
- Initialize the values
  - local variables must be initialized before use

Declaring variable names

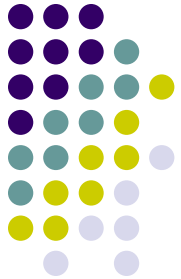


- Datatype must be declared only once
  - int i;
  - double d;
- Variable will then be compile-time checked.

Initializing variables

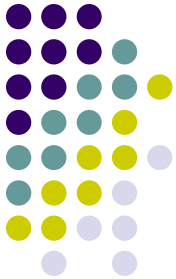
- Reserving memory for values is automatic.
- Literals or other variables of the same type are assigned to variables with =
  - int i;
  - i = 0;
- Declaring and initializing can be combined
  - int i = 0;

Default types for literals



- Whole number literals are **int**s
  - int i = 128;
  - byte b = 128; (out of range)
- Floating point number literals are **double**s
  - double d = 128.0;
  - float f = 128.0 (can not change datatype)

Other number formats



- Hex – starts with 0x
  - 0xABCDEF123
- Octal – starts with 0
  - 076543
- Scientific notation – ends with e and exponent for base 10 multiplier
  - 1.234567e22

Casting

- changing the data type
- place the new datatype in ( ) before the value
  - byte b = (byte) 128;
  - float f = (float) 128.0;
- Shortcuts
  - float f = 128.0f;
  - float f = 128.0F;
  - double d = 5d;

Floating point inaccuracy

- Create a new class FunnyMoney with a main( ) to run this:
- double dollar = 1.00;
- double dime = dollar/10;
- double total = 0;
- total = dime + dime + dime + dime + dime + dime + dime + dime + dime + dime;
- System.*out*.println(total);

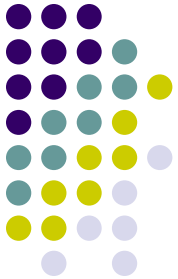
Currency

- Don’t use a double for currency
  - use a rounding strategy if you do, be careful
- Use BigDecimal class
  - Also available is a BigInteger class for higher values.

Scope

- Variables declared in a code block are only visible (usable) in that code block or nested code blocks, not outside.
  - `int i = 0;`
  - `{ int j = i ; j++; }`
  - `System.out.println(j);`
- Also called lifetime or visibility
- Local variables live only in the code block when declared.

Exercise (DivisionTests)

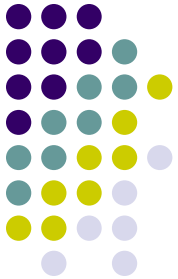


- What is the output?
  - System.out.println(1/1);
  - System.out.println(1/0.0);
  - System.out.println(1/2);
  - System.out.println(2/3);
  - System.out.println(2/3.0);

Text

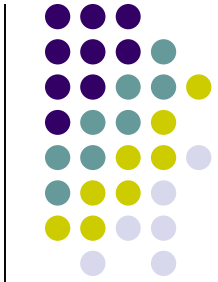
- Allows for both value and reference type forms of creation.
- Uses the **String** datatype
  - String s = “text”;
- Stores text in Unicode not ASCII
  - Output to console is based on platform’s native character set

String variables



- Almost like a value type
- Can be declared and initialized at once
- Create variables like primitives
  - String s = “Text”;

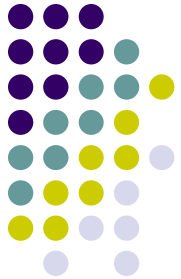
String literals



- Uses double quotes to delimit value
  - “dog”
- Can use concatenation operator
  - “Rover the ” + “dog”
  - will convert any thing to text if adding to text
  - 1 + 2 + “3” + 4 + 5
  - “” + 10 + 11
- Escape sequences use \
  - “1\n2”, “1\t2” , “c:\\users\\doug”

Exercises (PrintTests)

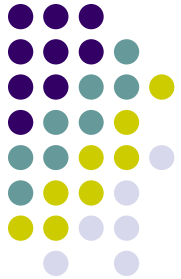
- What is the output?
  - System.out.println('A');
  - System.out.println(0 +'A');
  - System.out.println((char)(1 + 'A'));
  - System.out.println('A' + 'B' + 'C');
  - System.out.println("A" + "B" + "C");
  - System.out.println("The alphabet starts with " + 'A' + 'B' + 'C');
  - System.out.println(0 + 1 + 2 + 3 + 4 + "OK" + 1 + 2 + 3 + 4);



Symbols that take action

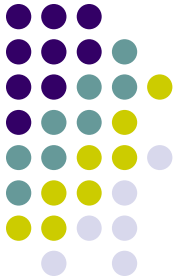
OPERATORS

Arithmetic



- **+**, **-**, *******, ***/***
- **%** modulus
  - 5 % 3
  - 15 % 4
  - 5 % 9
- **++**, **--**
  - X++ , ++X
  - `int x = 0;`
  - `System.out.println(x++);`
  - `System.out.println(++x);`

Relational



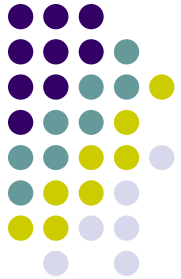
- **==** is equal to?
- **!=** is not equal to?
- > , <, >=, <=

Logical

- Any TRUE in a OR (union) expression makes result TRUE
- TRUE | TRUE | FALSE | TRUE | TRUE

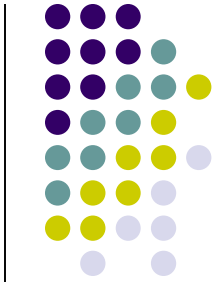
- Any FALSE in an AND (intersection) expression makes result FALSE
- TRUE & TRUE & FALSE & TRUE & TRUE

Logical



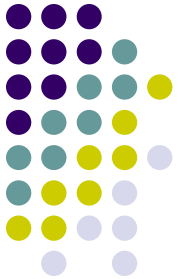
- Bit-wise
  - will execute always
  - **&** and, **|** or, **^** xor, **!** Not
  - mostly for graphics, subnetting
- Short-circuit
  - will stop if useless to continue
  - **&&** and, **||** or
  - (true || false || false || true)
  - (false && true && false && true)

Other



- Assignment =
- Compound
  - **+=, -=, *=, /=, %=**
  - **x = x + 1** or **x++** or **x += 1**
  - **x = x + 2** or **x += 2**
  - **String s = “a”; s += “bc”;**
  - x+=10
  - x*=.90

Operator precedence

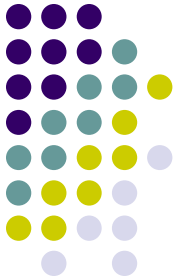


- Order in which operator is executed when other operators are present.
- Directional
- Don’t memorize, use parentheses
  - 1 + 2 * 3 + 4
  - (1+2) * (3+4)

If-else replacement (ternary op)

- (expression) **?** value if true **:** value if false
- int policies = 0;
- System.out.println(policies + " polic" +
  ((policies ==1) ? "y" : "ies")); // handle plural
- Results
  - 0 policies
  - 1 policy
  - 2 policies

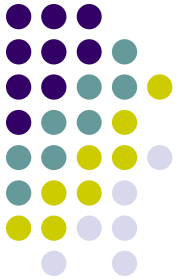
Exercise – desk check



- boolean needsCookie = false;
- int time = 2;

- (5 == 6) || (true != false)
- (5 == 6) && (true != false)
- (time >= 2) || needsCookie || --time ==1
- (time >= 2) && !needsCookie

Exercise – (OperatorTests)

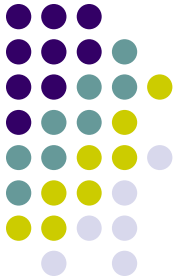


- **1**
  - int i = 0, j = 1, k = 15;
  - k = i++j;
  - System.out.println(i + " " + j);
  - System.out.println("k = " + k);
- **2**
  - int myInt = 128;
  - byte myByte;
  - myByte = (byte) myInt;
  - System.out.println(myByte);

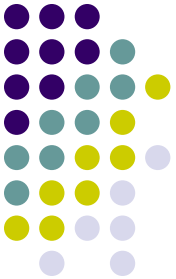
Reading user data & outputting admin info

CONSOLE INPUT / OUTPUT

Console input - old style



- class ReadConsole
- System.in.read( );
  - will wait for a character
- int c = System.in.read( );
  - will wait for a character and store it as an int
- char c = (char) System.in.read( );
  - will wait for a character and store it as a char

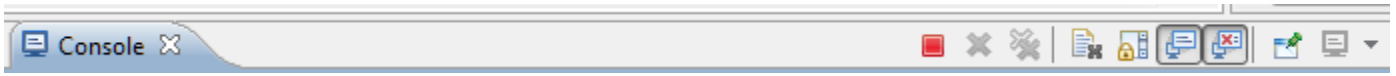


Console input - better

- Scanner inputStream = new Scanner(System.in);
- String inputLine = "";
- System.out.print("Enter your string: ");
- while ((inputLine = inputStream.nextLine( )).length() > 0) {
- System.out.println("You said: " + inputLine);
- System.out.print("Keep typing to continue... (<Enter> to quit)");

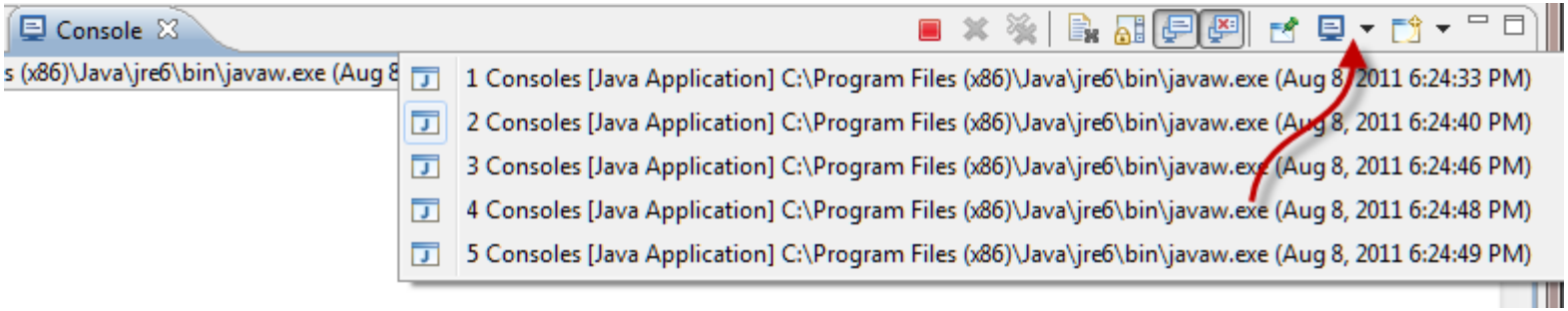
Consoles

- Red button on console menu lit up means program is executing
  - Abort program by clicking red button
- **Eclipse** - Type on the console to input data.

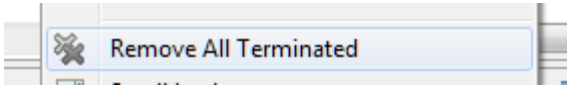


Console management

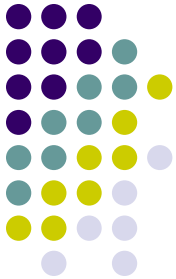
- Multiple consoles can hide so look for enabled console button
- Drop down will select active console.



- After killing an app, remove it with right-click, Remove All Terminated.

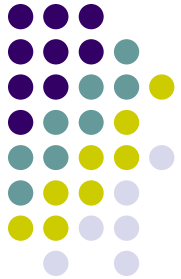


Console output streams



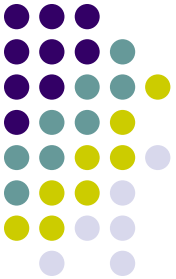
- System.out.**println**(“text”);
  - will print out and go to next line
- System.out.**print**(“text”);
  - will print out and wait at end of line
- System.**err**.println(“text”);
  - will print out to error stream
  - directed to console for Windows
  - Eclipse will use red text

Eclipse terminal



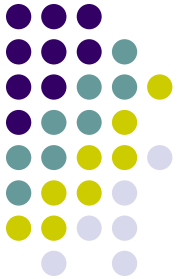
- Open a Terminal (under Refactor)
- Navigate to workspace/project/bin directory
- Execute: java packageName.ClassName

Running from the command line

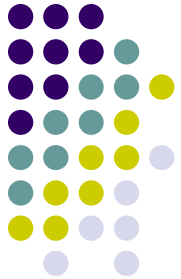


- Navigate in Windows to the package that holds the byte code (classes in bin folder)
- Shift + r-click the directory holding the package
- Select Open command window/ PowerShell here
- Type: java <packageName>.<ClassName> command line arguments

O/S stream redirection



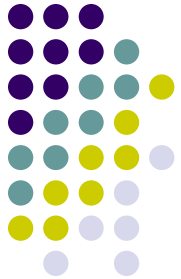
- java wednesday.program 2> error.log
  - Sends error output to file



Static methods and variables

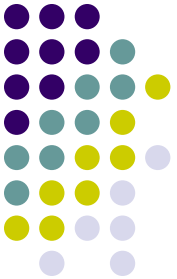
METHODS

Definition



- A method is a function, a procedure, a subroutine, or a named unit of code.
- It can take multiple values of input to work on
- It can output one value
- It must be nested in a class

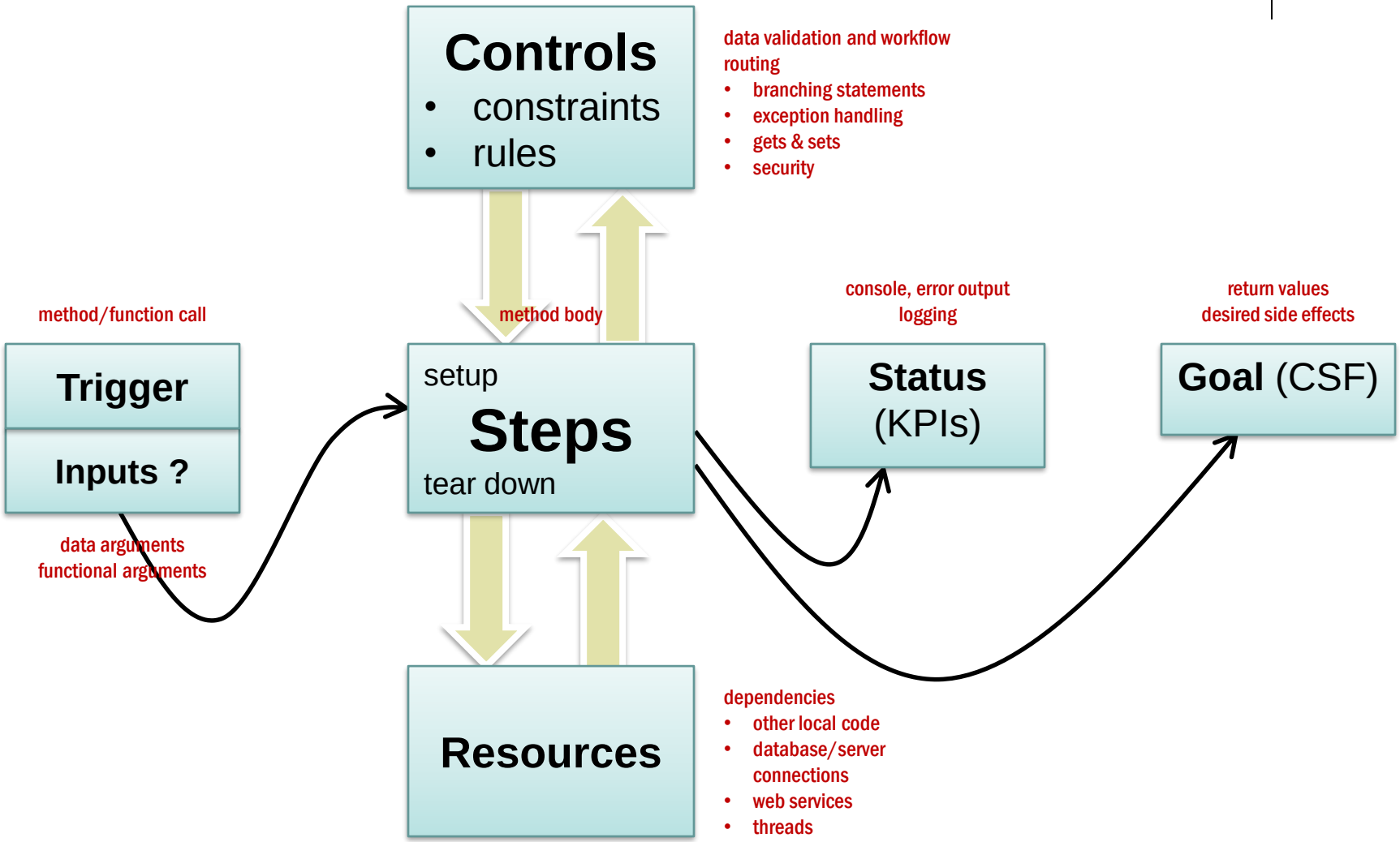
Business requirements to code



- Business processes equate to methods/functions.
- The best designed methods follow requirements based on them in
  - clarity - naming and readability
  - sequence - steps in the workflow
  - reusability (low coupling / high cohesion)
  - uniqueness of effect (idempotency)

A process model

the process parts in computer language



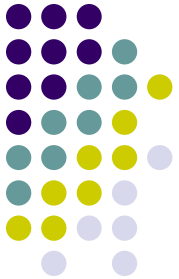
Method syntax

- access modifier (public, private)
- static (optional)
- return type (output datatype)
- method name
- parameters – in parentheses (input datatype and local variable identifier)
- exception handling syntax
- method body – in curly braces

Access modifiers

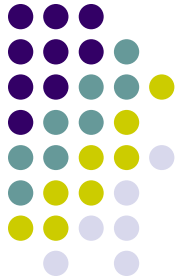
- Programmatic restriction based on where you are calling the method
- Must have physical access first
- **Private** – only accessed in the class
- none – only accessed in the package
- **Protected** – only accessed in the package and by classes with inheritance relationship
- **Public** – no restrictions

Access modifiers



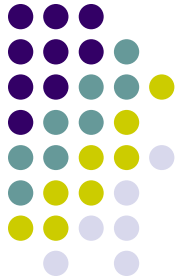
- Methods should be **public** as a rule
  - public void printForm( )
- Any public method is part of the class interface (the exposed behavior)
  - javadocs will summarize
- Methods can be **private** so that no one outside of its nesting class can access it.

Static methods



- Called directly from the class they are nested in
- Procedural in nature.
  - Do not use objects
- These methods must use the word **static**
  - **public static void printForm( ) { … }**

main

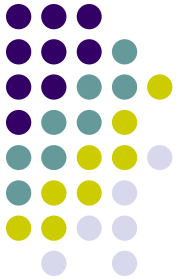


- The main method is called by the JVM when starting an application
  - **public static void main**(String[ ] args) {…}
  - args is a traditional name but not required
- Use for unit testing of class methods
  - Improve unit testing with jUnit or other frameworks
- One class will contain the “real” main method of the project.

Exercise (MainController)

- Write a main method that calls other main methods from classes in all of the packages that you have created so far.
  - Use the value of null for the String[ ] args argument.

Method naming

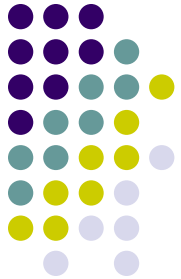


- Follows identifier rules
- Use a strong verb to describe
  - calculateTax( )
  - printForm( )

Method output

- No output requires the keyword **void**
  - void printForm( )
- Any output requires
  - the return type before the method name
  - a **return** statement in the method code block that returns data matching the return type
- The call to this method becomes this value
- public double calcTax(double rate, double price) {
  - return rate * price; }

Method input

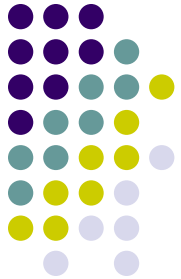


- If input is needed, a temporary variable name and the acceptable data type are used (a parameter)
  - calcTax(double taxRate)
- Multiple parameters can be used
  - calcTax(double taxRate, String state)

Process – Test driven development

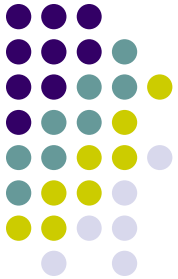
- Write the method call so it's readable and says what you want to do.
  - Run – it **fails**
- Add the method stub (nothing in the code block except a return if necessary)
  - Run – it **passes**
- Implement the method
  - Run – it **passes**

Let Eclipse write the method



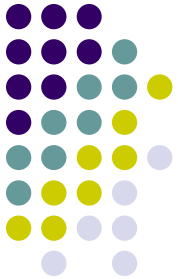
- Write the call to a method that doesn't exist
- Click the lightbulb on the left side
  or
  hover on method and click link
- Choose the **Create Method** option
- Move the method to where you want.

Method signature



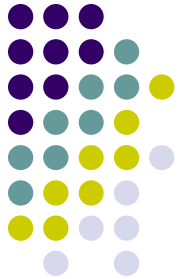
- The way that the JVM matches up the execution call to the right method.
- Includes
  - Name
  - Any parameters (match order and type)
- Does not include
  - Access modifier
  - Any output

Overloading methods



- Overloading is using the same name but different parameters (order or type)
  - calcTax( )
  - calcTax(int ratePercent)
  - calcTax(double rate)
  - calcTax(double rate, String state)
  - calcTax(String state, double rate)
- This allows flexibility
  - System.out.println( ), System.out.println(6), etc.

Method code block



- The code block immediately follows the method name and parentheses
- The code block is executed when the method name is called
- The implementation

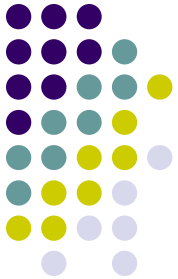
Calling a method

- In order to call (execute) a method you must
  - invoke it with the right method name
  - invoke it with the right inputs (arguments)
  - have physical & logical access to the method
    - reference to code in project
    - **import** that code in class
- A static call uses the enclosing class name
  - Reports.printForm( );
  - Revenue.calcTax( );

Calling a method - shortcuts

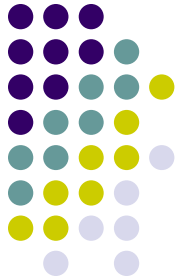
- A full call to a method with package name
  - animals.Dog.printSpecies( );
  - monday.HelloWorld.main(null);
- If you call within the scope of the enclosing package
  - Dog.printSpecies( );
- If you call within the scope of the enclosing class
  - printSpecies( );

After the call



- A void method is only called
  - Reports.printForm( );
- A method call with output becomes a value.
  - double tax = Revenue.calcTax( );
- The value can be an input to another method
  - ShoppingCart.add(Inventory.find(“SZA123”));

Math

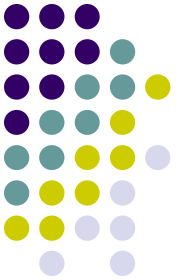


- Math contains many static math functions
  - Math.sqrt(4)
  - Math.random()
  - Math.pow(2,8)
  - Math.round(2.4)
  - Math.abs(-2.7)
- Math contains static values
  - Math.E
  - Math.PI

Exercise (MathTests)

- Call in a main method
- Calculate the area of a circle (pi * r^2)
- Calculate the volume of a sphere (4/3 * pi * r^3)
- initialize variables
- call methods
  - double result = calcAreaOfCircle(radius);
  - // print
  - result = calcVolumeOfSphere(radius);
  - // print

Exercise (StaticMethods)



- Write and call a static method that
  - has no inputs and no outputs
  - has a String input and no output
  - has no input and a String output
  - has a String input and a String output
  - has two String inputs and a String output
- print return results
- print parameter values in method
- print status message in method (debug)

Exercise – exercise headings

- Create a class(Exercise) with a method (printGroupWithHeading( )) that takes one String and calls a group of exercises. Before each exercise is output, print a formatted heading that uses the string in the heading. Use another class (PrintExercises) with a main method to start the printing process.