

# ECSU-NAM 2008 STUDENT RESEARCH INSTITUTE IN COMPUTATIONAL SCIENCE- SCIENTIFIC VISUALIZATION

## **Programming in Java: Problem Solving**

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## Java Resources

- All Presentation Programs:  
<http://www.mcs.lugave.net/CSSVC>.
- Developer Resources for Java Technology:  
<http://java.sun.com/>
- Java Tutorials:  
<http://java.sun.com/docs/books/tutorial/index.html>
- Java SE Downloads:  
<http://java.sun.com/javase/downloads/index.jsp>
- Java Standard API & Documentation:  
<http://java.sun.com/javase/reference/api.jsp>

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# Java Books/References

- A good reference book

Title: Thinking In Java

Author: Bruce Eckel

Publisher: Prentice Hall

ISBN-10: 0131872486

ISBN-13: 9780131872486

A free electronic copy is supplied with this presentation.

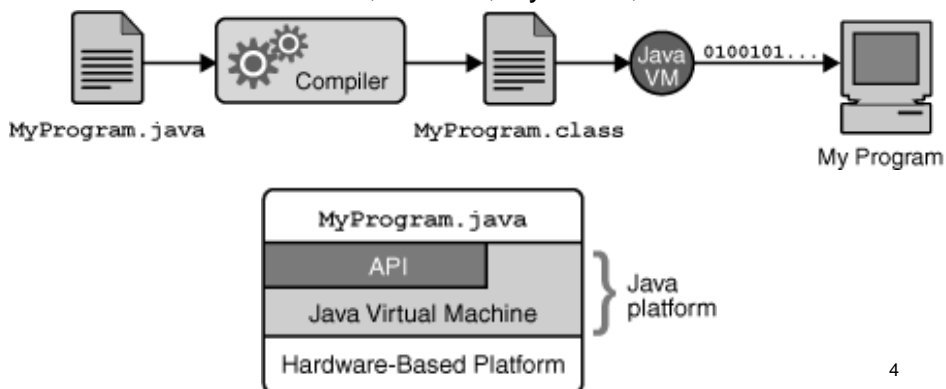
- Free Java Programming Books:  
<http://www.techbooksforfree.com/java.shtml>
- Java Programming Resources:  
<http://www.apl.jhu.edu/~hall/java/>

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# Why and How of Java Programs

- Characteristics:

- Rich API, Simple, Architecture neutral, Object oriented, Portable, Distributed, High performance, Multithreaded, Robust, Dynamic, Secure



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# WelcomeProg.java

```
class WelcomeProg {  
    public static void main(String[] args) {  
        System.out.println("Welcome to Java!");  
    }  
}
```

- Java is case sensitive!!! At least 80% of mistakes in beginners programs: due to inconsistencies in capital and small letters.

WelcomeProg ≠ Welcomeprog ≠ welcomeprog ≠ Welcome Prog

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## Errors, Errors, Errors.

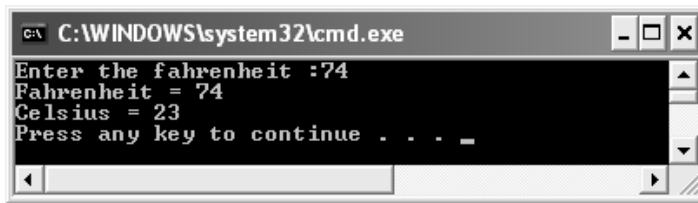
- Click on : **Hello.java** and copy the code.
- Create a TextPad file and paste. Save as **Hel l o. j ava**
- Compile it.
  - Where (line number) is the FIRST error?
  - READ it and Double click on the line number?
  - Correct the error.
  - Compile the program and repeat the process.

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## Variables, objects, output, input

- **Example 1: FahrToCelsius.java**

- Reads in a fahrenheit value
- Converts it to celsius
- Outputs both fahrenheit, celsius values.



```
C:\WINDOWS\system32\cmd.exe
Enter the fahrenheit :74
Fahrenheit = 74
Celsius = 23
Press any key to continue . . . -
```

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## Variables, objects, output, input

- **Exercise 1:**

Studies have shown that adults strive to maintain a Body Mass Index, BMI between 20 and 24.

Write a program that **reads** in the height and weight. The program should use the formulas below to calculate the index:

meters = height\_inches/39.36

kilograms = weight\_pounds/2.2

index = kilograms/(meters\*meters)

The program should **print** the body mass index.

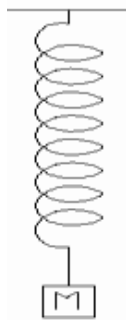
How many variables should be declared?

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## Math & Random classes, iteration

- **Example 2: Spring.java**

- Generate random degrees, convert degrees to radians, get cosine, print in 2 ways.
- Use loops to print height at various times.



```
C:\WINDOWS\system32\cmd.exe
Degrees: 44, cosine: 0.7193398003386512
Rounded to 3d.p. Degrees: 44, cosine: 0.719
Bouncing ball Height at different Times
Time      Height
0         0.00
15        -0.50
30        -0.87
45        -1.00
60        -0.87
75        -0.50
90        -0.00
105       0.50
120       0.87
135       1.00
150       0.87
165       0.50
180       0.00
195       -0.50
210       -0.87
225       -1.00
240       -0.87
255       -0.50
```

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## Math class, Selection & Iteration

- **Exercise 2:** As in Example 2, Simulate a bouncing ball with damping:
  - Do not start off degrees from 0 (Why not), instead start from 15.

$$Height = \cos(7x + 1.5) / x$$

- How different are results from **Example 2**?

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## Iteration and if-else statement

- **Example 3: LineEquations.java** Write a program that computes the equations of a line, given any 2 points. The program prints the equations of the line.

```
C:\WINDOWS\system32\cmd.exe
Enter x1, y1, x2, y2 (To stop press ^Z): 3 5 7 4
Equation is: y = -0.25x + 5.75
Enter x1, y1, x2, y2 (To stop press ^Z): 4 5 4 6
Equation is: x = 4.0
Enter x1, y1, x2, y2 (To stop press ^Z): ^Z
Thank you
Press any key to continue . . . _
```

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## Iteration and if-else statement

- **Exercise 3:** Write a program that computes and **prints** the area of several rectangles drawn in the x-y coordinate system. The program **reads** x1 and y1 of the top left corner and x2 and y2 of the bottom right corner. If the coordinates are collinear, the program should indicate it.



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# Classes and objects

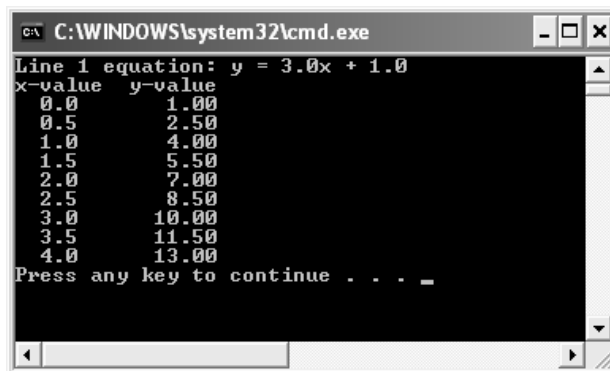
- **Example 4: Line.java**

- Line class represents a line blue print. Can place everything we need to do for a line. The class has.
  - Data kept is slope and y-intercept
  - Can construct a line using slope and y-intercept
  - Can construct a line using any two points
  - Can print equation of line
  - Can calculate the y-value given any x-value.
- **LineTest.java**: Construct several lines (Line objects).

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# Classes and objects

- **Example 4:**



```
C:\WINDOWS\system32\cmd.exe
Line 1 equation: y = 3.0x + 1.0
x-value  y-value
0.0      1.00
0.5      2.50
1.0      4.00
1.5      5.50
2.0      7.00
2.5      8.50
3.0      10.00
3.5      11.50
4.0      13.00
Press any key to continue . . . _
```

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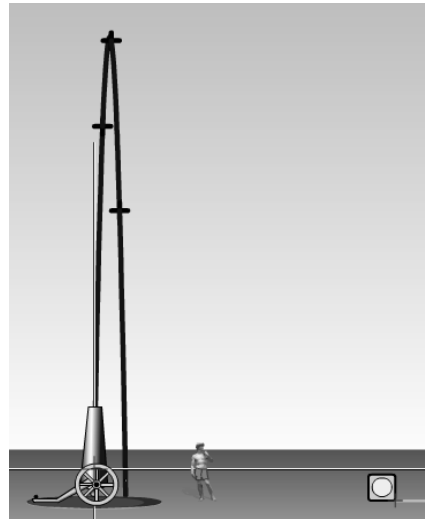
## Classes and objects

- **Exercise 4:** Represents a rectangle. Complete the Rectangle class and test it.
  - Rectangle class in **Rectangle.java**:
    - Has integer data as width and height.
    - Can construct a rectangle using given integer width and height.
    - Can construct a rectangle given data representing top left and bottom right: TLx, TLy, BRx, BRy.
    - Can print the width and height.
    - Can return area and perimeter.
  - Test class with **RectangleTest.java**

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## Projectile flight: **Projectile.java**, **ProjectileTest.java**

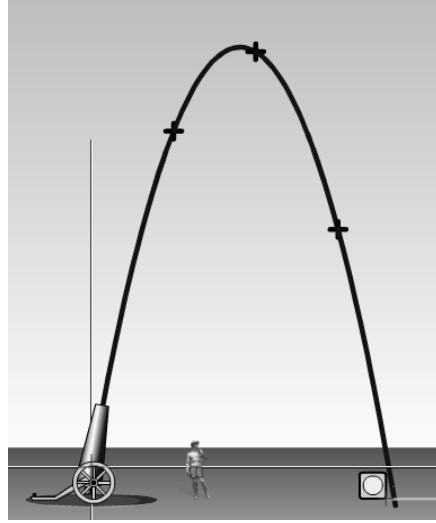
- **Simulate distance at different times.**
- Starting velocity:  $v_0$
- Gravity constant:  $g$
- Simulation with small time intervals:  $\Delta T$ 
  - Distance increases
  - Velocity decreases
- Equations:
  - $s = s + v \cdot \Delta T$
  - $v = v - g \cdot \Delta T$



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## Exercise: Projectile flight

- **Simulate vertical and horizontal distances at different times**
- In addition throw at an angle  $\alpha$ .
- Dynamics equations:
  - Vertical
  - Horizontal
  - $g$  acts vertically



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## Exercise: Projectile flight

- Dynamics

Initially:

$$s_y = 0, s_x = 0, v_y = v_0 \sin \alpha, v_x = v_0 \cos \alpha$$

Time dynamics:

$$s_y = s_y + v_y \Delta t$$

$$v_y = v_y - g \Delta t$$

$$s_x = s_x + v_x \Delta t$$

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## References

- Presentation:  
<http://www.mcs.lugave.net/CSSVC/>
- *Cay S. Horstmann*,  
Big Java: Programming and Practice.