1.00 Lecture 3

Operators, Control

Reading for next time: Big Java: sections 5.1-5.4
Skip all the advanced topics
Download Java code (Lecture 4 on Web site) for next class

main()

- In each Java program there is a just a single main() method, no matter how many classes there are.
  - The main() method is often in a class that has no other methods, by convention. It can be in any class, though some choices would seem unnatural.
- main() tells Java where to start the program; it s just a naming convention
  - It could easily have been called startHere()
- In early examples we have only one class, so it will seem there s a main() method in each class. Not so.
- main() at a later point in the term will be minimalist:
  - main() does the least possible work to get the program running and then hands off all the remaining work to objects and their methods.
  - For now, since we haven t covered classes and objects, we ll do everything in main() for a little while longer.

Logical operators

- Produce results of type boolean
- Comparisons use 9 operators:

Equal	==	Not equal	!=
Less than	<	Less than or equal	<=
Greater than	>	Greater than or equal	>=
Logical and	&&	Logical or	||
Not	!		

```
// Example
int c= 0, b= 3;
if (c != 0 && b/c > 5) System.out.println("Buy the stock");
// Short circuit evaluation: quit after answer determined
boolean buy= true;
if (!buy || c == 0) System.out.println("Don't buy the stock");
```

Assignment operators

- Assignment is not the same as equality
  - = is not the same as ==
  - Assignment places right hand side into left hand side
- Assignments are expressions:

```
int x, y;
x= y= 5;          // Same as x = (y= 5); associate from R to L
```

- Shortcut forms exist:

```
int x= 5, y= 3;
x += y;             // Same as x= x + y;
// This means take current value of x (5), add y (3), and
// set x to a new value of 8
```

- Shortcut forms include +=, -=, *=, /=, %= :

```
x /= y;             // Same as x= x / y;
x %= y;             // Same as x= x % y; % gives remainder
```

- Other shortcut forms are ++ and -- :

```
x++;                // Same as x= x + 1;
y= --x;             // Same as x= x-1; y = x;
```

Operator exercise

- **Create a new project Lecture3**
- **Create a new class VelocityTest with a main method**
  - **We will compute train velocities from Boston to New York (which are 225 miles apart) with various improvements**
  - **On the very first line of your program write:**
    ```
    import javax.swing.*;        // Allow GUI input
    ```
  - **Accept an int input from the user, in main():**
    ```
    String input= JOptionPane.showInputDialog("Enter time");
    int time= Integer.parseInt(input);   // Enter 4 (hrs)
    ```
  - **Define double d= 225;   // Miles**
  - **Decrease d by 25   // Shorten route thru realignment**
  - **Compute velocity v**
  - **Print whether v > 60:   System.out.println(v>60? +______);**
- **If you have time to do these steps (no ifs required):**
  - **Decrement time by 1 and recompute v // Faster trains**
  - **Print whether v > 60 and d < 225**
  - **Print whether v > 70 or d < 175 or time <= 3**

Control structures: branch

General form	Example

if (boolean)
statement;
	`if ( psgrs == seats)`
	`  carFull= true;`
	`if (psgrs >= seats) {`
	`  carFull= true;`
	`  excess= psgrs - seats;   }`

if (boolean)
statement1;
else
statement2;
	`if ( psgrs >= seats )  {`
	`  carFull= true;`
	`  excess= psgrs - seats;  }`
	`else`
	`  carFull= false;`

if (boolean1)
statement1;
…
else if (booleanN)
statementN;
else
statement;
	`if ( psgrs < seats)`
	`  carFull= false;`
	`else if (psgrs == seats) {`
	`  carFull= true;`
	`  excess= 0;  }`
	`else {`
	`  carFull= true;`
	`  excess= psgrs - seats; }`

There are no semicolons after if or else clauses

Control exercise

- Create a class ControlTest with a main method
- Write in main():
  - Declare and initialize five double variables d, s, p, a and b
    - d= 100
    - s= 50
    - p = 10
    - a= .1
    - b= .2
  - Then write code so that:
    - If demand d > supply s, raise price p by a*(d-s)
    - If demand == supply, do nothing
    - If demand d < supply s, lower price p by b*(s-d)
  - Use the debugger to step through your program:
    - Set breakpoint at first executable line in main()
    - Run-> Debug As-> Java Application
  - If you have extra time, read s from a JOptionPane

Control structure: iteration

General form	Example

while (boolean)
  statement;
	while (balance < richEnough) {
	  years++;
	  balance *= (1+ interestRate);
	}

do
  statement;
while (boolean);
// Always executes stmt at least once
	do {
	  years++;
	  balance *= (1+ interestRate);
	} while (balance < richEnough);

for (start_expr; end_bool; cont_expr)
  statement;
	for (years= 0; balance < richEnough;
	        years++) {
	  balance *= (1+ interestRate);
	}

There are no semicolons after while, do or for clauses

for loops

for (start_expr; end_bool; cont_expr)
  statement;
	for (yrs= 0; yrs < 20; yrs++)
	    balance *= (1 + rate);

is equivalent to:	

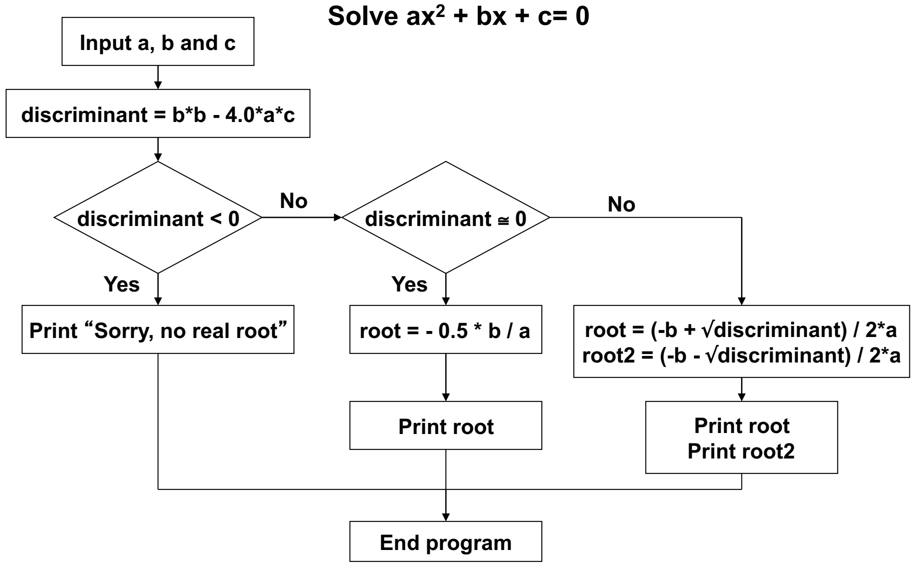
start_expr;
while (end_bool) {
  statement;
  cont_expr;
}
	yrs= 0;
	while (yrs < 20) {
	  balance *= (1+rate);
	  yrs++;
	}

Iteration exercises

- Create a class IterationTest
  - Exercise 1: Write code in main() that prints out every third number between 11 and 47, including 11 and 47.
  - Exercise 2: Also print out whether each number output is odd or even.
    - Use the remainder (%) operator. If remainder is 0 after dividing by 2, number is even; otherwise it's odd.
  - Remember to declare the variables you use in your loops before you loop (e.g., `int i;`)
- If you finish, look at the control example that follows
  - Find the bug

Control example

Solve $ax^2 + bx + c= 0$



Control example

```
import javax.swing.*;                // To support simple input
public class Control {               // Quadratic formula
    public static void main(String[] args) {
        final double TOL= 1E-15;     // Constant (use ‘final’)
        String input= JOptionPane.showInputDialog("Enter a");
        double a= Double.parseDouble(input);
        input= JOptionPane.showInputDialog("Enter b");
        double b= Double.parseDouble(input);
        input= JOptionPane.showInputDialog("Enter c");
        double c= Double.parseDouble(input);
        double discriminant= b*b - 4.0*a*c;
        if ( discriminant < 0)
            System.out.println("Sorry, no real root");
        else if (Math.abs(discriminant) <= TOL) {
            double root= -0.5 * b / a;
            System.out.println("Root is " + root); }
        else {      // Redefine ‘root’; blocks have own scopes
            double root=(-b + Math.sqrt(discriminant))/ (2.0*a);
            double root2=(-b- Math.sqrt(discriminant))/ (2.0*a);
            System.out.println("Roots: " + root + “ , " + root2);  }
        System.exit(0);  } }
```

Control example

- The previous program has a deliberate, subtle bug
  - Can you see it?
  - Is it likely that you d find it by testing?
  - Is it likely you d find it by using the debugger and reading the code?
- Fix the error by rearranging the order of the if-else clauses
- By the way, this is a terrible way to solve a quadratic equation—see Numerical Recipes, section 5.6
- A note on format: we compress code examples to fit on slides, by putting multiple }}} on one line, for example. Don t do this in your code; use Eclipse to indent and format well. (ctrl-A, ctrl-I)