INTRODUCTION TO JAVA FOR JAS

LECTURE 1

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EC910 – L1

Information

- Module EC910
- Schedule
  - Lecture: Monday 12-2pm (5N.3.10)
  - Lab: Monday 3-5pm (PC Lab R)
- Email s.giansante@bath.ac.uk

- Readings
  - Handbook of Computational Economics
  - The Java Tutorial
  - …
- Materials
  - Lengnick (2013)
  - Markose et al., 2012
  - Markose & Bewaji, 2013
  - …

…detailed list in the syllabus

Schedule

Week	Topics	Reference	
		Lecture	Lab
1	Introduction to Java	Arnold, Deitel	Sun Microsystems
2	Object-Oriented Programming		
3	Introduction to JAS	Sonnessa (2004a)	Random Model
4	Simulations with JAS		Agent-based macroeconomics: A baseline model
5		Handbook of Computational Economics, Gaffeo et al. (2008)	
6	JAS Statistics	Sonnessa (2004b), Lengnick (2013), Gaffeo et al. (2008)	
7	Network Statistics in JAS	Boero (2004), Krause & Giansante (2012)	Banking Network model
8			
9	Database-driven model	Markose et al. (2012)	FDIC Financial Network Models
10			

Software

- Java Editor: Eclipse
  - Web: www.eclipse.com
  - Local file: xxx
- Agent-Based Simulator: JAS
  - Web: http://jaslibrary.sourceforge.net
  - Local file: xxx

Introduction/Course Description

- Introduction
  - **Aims:** the student will be taught how to build, debug and run JAS models - how to access JAS libraries that simplify the programming needed to set up multi-agent economic models as well as dealing with BIG DATA and visualization.
  - **Method:** a step by step method will be used for the student to learn how to prepare and implement a number of specific ACE models.

…more info in the syllabus

Objectives and Results

- Objectives
  - to provide a first step assistance to students towards the development of software development for agent based economics and policy simulation
  - to design complex GUI and more advanced threading mechanism for macroeconomic models
- Results
  - design, write, compile, debug and run simple Java Agent-Based Macroeconomic Model (ABMM) programs
- Skills developed
  - understand the connection and interaction between ABMM objects
  - understand microfoundations for emergent macroeconomics
  - be capable of translating simple macroeconomic models into a ABMM

Lecture 1 outline

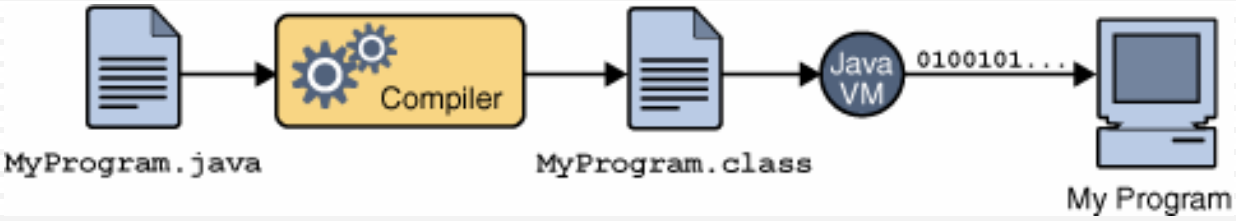
- Java features
  - properties
  - Language
  - Java VM
- Object-Oriented Programming
  - Characteristics
  - Variables
  - Arrays
  - Operators
  - Control Flow Statements

Java features

- Features
  - Simple
  - Object oriented
  - Distributed
  - Multithreaded
  - Dynamic
  - Architecture neutral
  - Portable
  - High performance
  - Robust
  - Secure

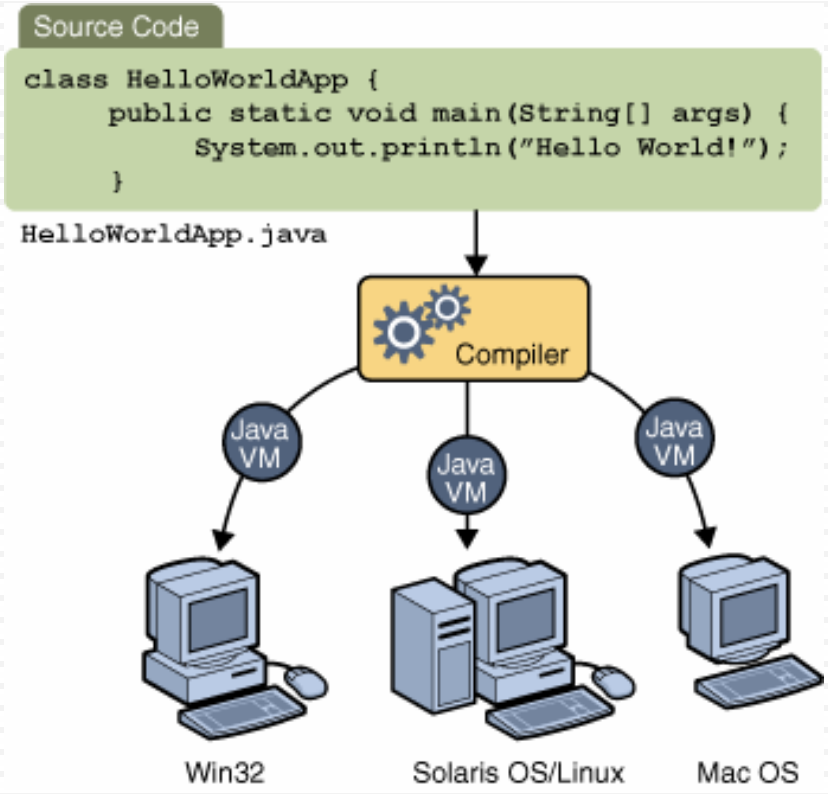
The Java Programming Language

- The source code is written in text files with extension .java
- They are compiled in .class files by the javac compiler
- The binary codes in the .class files are converted in native code of your processor by the Java Virtual Machine (Java VM)



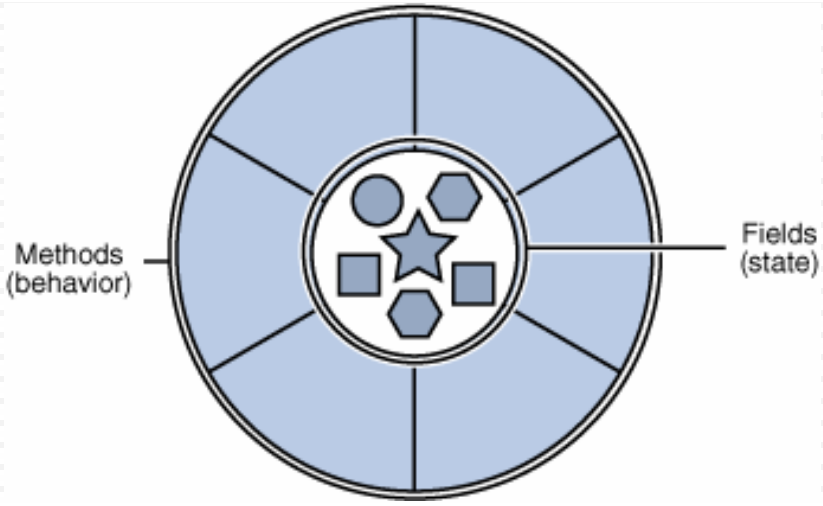
Java VM

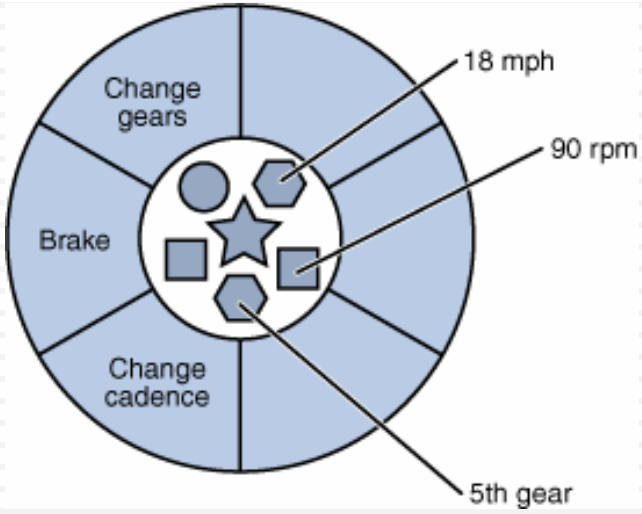
As Java VM is available on many different operating systems, the same .class files are capable of running on multiple platforms



Object-Oriented Programming

- Objects have two characteristics:
  - State (Fields or Variables)
  - Behavior (Methods)





Variables of a primitive type (1)

Name	Size	Min	Max
byte	8-bits	-128	127
short	16-bits	-32,768	32,767
int	32-bits	-2,147,483,648	-2,147,483,647
long	64-bits	-9,223e^9	9,223e^9
float	32-bits	7 bytes of storage, 52 binary digits of precision	
double	64-bits	4 bytes of storage, 23 binary digits of precision	
boolean	1-bits	False	true
char	16-bits	--	

Variables of a primitive type (2)

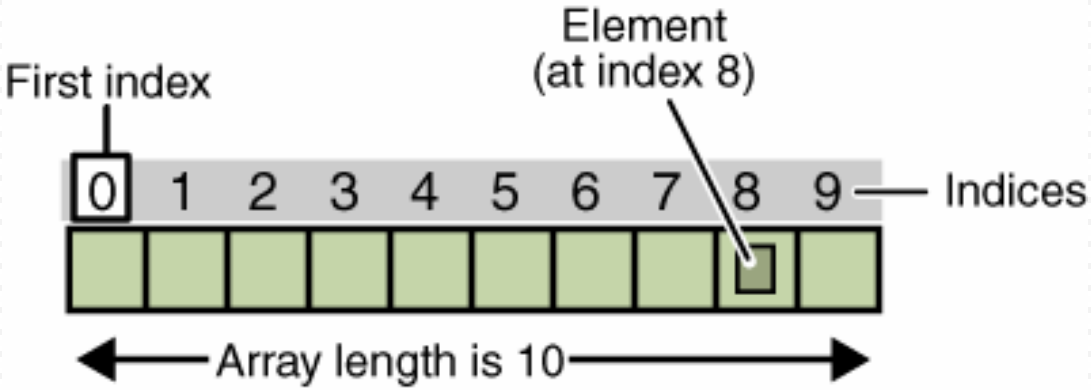
- Declaration:
  - *Boolean result = true;*
  - *char capitalC= 'C';*
  - *byte b = 100;*
  - *short s = 10000;*
  - *int i = 100000;*
  - *double d1 = 123.4;*
  - *double d2 = 1.234e2; // same value as d1, but in //scientific notation*
  - *float f1 = 123.4f;*

Generic variables

- Every variable, a part of those that refer to primitive types, is an instance of a specific class.
- The declaration is the following:
  - type NameOfVariable;
  - i.e.: *Agent agent;*
- The creation of variables, in order to allocate memory, requires the operator ***new***
  - *NameOfVariable= **new** type ();*
  - *i.e.: agent = **new** Agent ();*

Arrays (1)

- An **array** is a container object that holds a fixed number of values of a single type
- each item in an array is called an **element**



Arrays (2)

- *int[ ] anArray; // declare an array of integers*
- *anArray= new int[10]; // create an array of integers*
- *anArray[0] = 100; // initialize first element*
- *anArray[1] = 200; // initialize second element*
- *anArray[2] = 300; // etc.*

- **shortcut syntax:**
  - *int[ ] anArray= {100, 200, 300, 400, 500};*

Operators (1)

- The Arithmetic Operators:
  - + additive operator (also used for String concatenation)
  - - subtraction operator
  - * multiplication operator
  - / division operator
  - % remainder operator

Operators (2)

Example 1:

```
public static void main (String[] args){
   int result = 1 + 2; // result is now 3
  System.out.println(result);
  result = result-1; // result is now 2
  System.out.println(result);
  result = result* 2; // result is now 4
  System.out.println(result);
  result = result/ 2; // result is now 2
  System.out.println(result);
  result = result+ 8; // result is now 10
  result = result% 7; // result is now 3
  System.out.println(result);
}
```

Example 2:

```
public static void main(String[] args){
  String firstString= "This is";
  String secondString= " a concatenated string.";
  String thirdString= firstString+secondString;
  System.out.println(thirdString);
}
```

Operators (3)

- The Unary Operators:
  - **+** Unary plus operator; indicates positive value
  - **-** Unary minus operator; negates an expression
  - **++** Increment operator; increments a value by 1
  - **--** Decrement operator; decrements a value by 1
  - **!** Logical complement operator; inverts the value of a boolean

Operators (4)

Example 1:

```
public static void main (String[] args){
  int result = +1; // result is now 1
  System.out.println(result); result--; // result is
                                        //  now 0
  System.out.println(result); result++; // result
                                        //is now 1
  System.out.println(result); result = -result;
                              // result is now -1
  System.out.println(result);
  boolean success = false;
  System.out.println(success); // false
  System.out.println(!success); // true
}
```

Example 2:

```
public static void main(String[] args){
  int i = 3;
  i++;
  System.out.println(i); // "4“
  ++i;
  System.out.println(i); // "5“
  System.out.println(++i); // "6“
  System.out.println(i++); // "6“
  System.out.println(i); // "7“
}
```

Operators (5)

- The Equality and Relational Operators:
  - == equal to
  - != not equal to
  - > greater than
  - >= greater than or equal to
  - < less than
  - <= less than or equal to

Operators (6)

- Example

```
public static void main (String[] args){
  intvalue1 = 1; intvalue2 = 2;
  if(value1 == value2) System.out.println("value1 == value2");
  if(value1 != value2) System.out.println("value1 != value2");
  if(value1 > value2) System.out.println("value1 > value2");
  if(value1 < value2) System.out.println("value1 < value2");
  if(value1 <= value2) System.out.println("value1 <= value2");
}
```

Operators (8)

- The Conditional Operators:
  - **&&** equal to
  - **||** not equal to

- Example:

```
public static void main (String[] args){
  int value1 = 1; intvalue2 = 2;
  if((value1 == 1) && (value2 == 2)) System.out.println("value1 is 1 AND value2 is 2");
  if((value1 == 1) || (value2 == 1)) System.out.println("value1 is 1 OR value2 is 1");
}
```

Control Flow Statements (1)

- **if-then statement**
  - The if-then statement tells your program to execute a certain section of code **only if** a particular test evaluates to true.

- Example:

```
void applyBrakes(){
  if (isMoving) {          // the "if" clause:
                           // bicycle must moving
    currentSpeed--; // the "then" clause:
                    // decrease current speed
  }
}
```

Control Flow Statements (2)

- **if-then-else statement**
  - The if-then-else statement provides a secondary path of execution when an "if" clause evaluates to false.

- Example:

```
void applyBrakes(){
  if (isMoving) {
    currentSpeed--;
  }
  else {
    System.err.println("Thebicycle has already stopped!");
  }
}
```

Control Flow Statements (3)

- **switch statement**
  - Unlike if-then and if-then-else, the switch statement allows for any number of possible execution paths.

- Example:

```
public static void main(String[] args) {
  int month = 8;
  switch (month) {
    case 1: System.out.println("January"); break;
    case 2: System.out.println("February"); break;
    case 3: System.out.println("March"); break;
    case 4: System.out.println("April"); break;
    case 5: System.out.println("May"); break;
    case 6: System.out.println("June"); break;
    case 7: System.out.println("July"); break;
    case 8: System.out.println("August"); break;
    case 9: System.out.println("September"); break;
    case 10: System.out.println("October"); break;
    case 11: System.out.println("November"); break;
    case 12: System.out.println("December"); break;
    default: System.out.println("Invalid month.");break;
  }
}
```

Control Flow Statements (4)

- **while statement**
  - The while statement continually executes a block of statements while a particular condition is true.

- Example:

```
while (expression)
{
  statement(s);
}
```

Control Flow Statements (5)

- **do-while statement**
  - The do-while evaluates its expression at the bottom of the loop instead of the top. Therefore, the statements within the do block are always executed at least once.

- Example:

```
public static void main(String[ ] args){
  int count = 1;
  do {
    System.out.println("Count is: " + count);
    count++;
  }
  while (count <= 11);
}
```

Control Flow Statements (6)

- **for statement**
  - The for statement provides a compact way to iterate over a range of values.
  - *for (initialization; termination; increment) {*
    statement(s);
    }

- Example:

```
public static void main(String[ ] args){
  for(int i=1; i<11; i++){
    System.out.println("Countis: " + i);
  }
}
```