Chapter 1. JAVA Fundamentals

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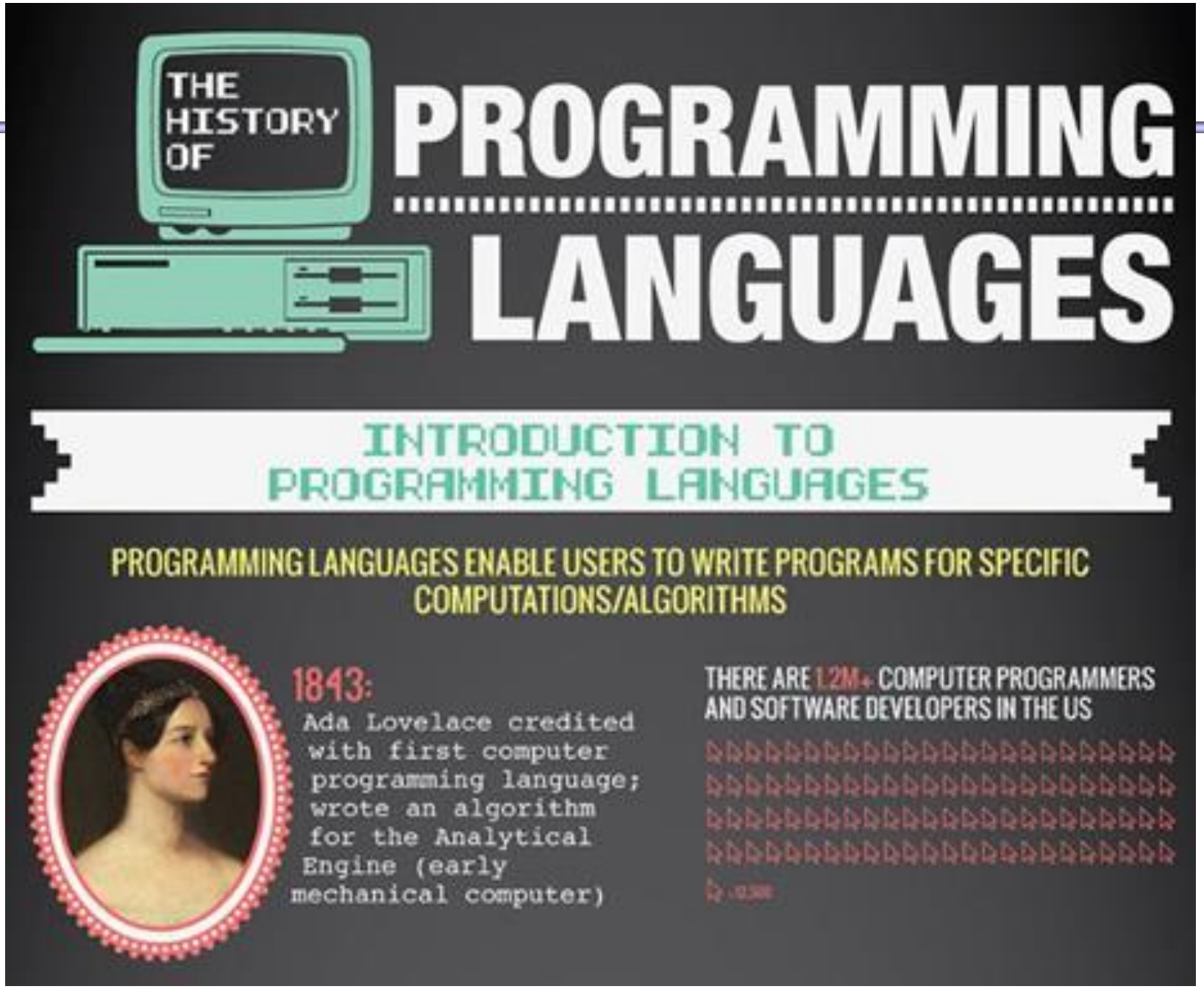
Course Objectives

- Computer Languages
- Describe key language features
- Compile and run Java application
- Describe language syntactic elements and constructs
- Understand object-oriented paradigm and use object-oriented language features
- Understand and use exceptions
- Develop a graphical user interface
- Describe AWT (abstract window toolkit) for GUI (graphical user interface)
- Develop a program to take input from a GUI
- Understand event handling
- Develop Java applets
- Read and Write to files and other data resources
- Understand the basics of multithreading
- Data structure using Java


THE HISTORY OF
PROGRAMMING LANGUAGES
INTRODUCTION TO PROGRAMMING LANGUAGES
PROGRAMMING LANGUAGES ENABLE USERS TO WRITE PROGRAMS FOR SPECIFIC COMPUTATIONS/ALGORITHMS
1843:
Ada Lovelace credited with first computer programming language; wrote an algorithm for the Analytical Engine (early mechanical computer)
THERE ARE 1.2M+ COMPUTER PROGRAMMERS AND SOFTWARE DEVELOPERS IN THE US

TIOBE Index 2023

Aug 2023	Aug 2022	Change	Programming Language	Ratings	Change
1	**1**		**Python**	**13.33%**	**-2.30%**
2	2		C	11.41%	-3.35%
3	4	↑	C++	10.63%	+0.49%
4	3	↓	Java	10.33%	-2.14%
5	5		C#	7.04%	+1.64%
6	8	↑	JavaScript	3.29%	+0.89%
7	6	↓	Visual Basic	2.63%	-2.26%
8	9	↑	SQL	1.53%	-0.14%
9	7	↓	Assembly language	1.34%	-1.41%
10	10		PHP	1.27%	-0.09%

Language History

1957-1959

FORTRAN (FORMULA TRANSLATION), LISP (LIST PROCESSOR), AND COBOL (COMMON BUSINESS-ORIENTED LANGUAGE)

Considered the oldest languages that are still used today. High-level languages created for scientific, mathematical, and business computing.

PRIMARY USES

Supercomputing applications, AI development, business software

USED BY

NASA, credit cards, ATMs

NASA

FUN FACT

Action movie The Terminator used samples of Cobol source code for the text shown in the Terminator's vision display.

1970

PASCAL (AFTER FRENCH MATHEMATICIAN/PHYSICIST BLAISE PASCAL)

High-level. For teaching structured programming and data structuring. Commercial versions widely used throughout the '80s.

CREATOR

NIKLAUS WIRTH

PRIMARY USES

Teaching programming

Object Pascal, a derivative, is commonly used for Windows application development

USED BY

Apple Lisa (1983), Skype

skype

1972

C (BASED ON AN EARLIER LANGUAGE CALLED "B")

General-purpose, low-level. Created for Unix systems. Second most popular language (behind Java). Many leading languages are derivatives, including C#, Java, JavaScript, Perl, PHP, and Python.

CREATOR

DENNIS RITCHIE

Bell Labs

PRIMARY USES

Cross-platform programming, system programming, Unix programming, computer game development

USED BY

Unix (rewritten in C in 1973), early WWW servers and clients

UNIX®

1983

C++ (FORMERLY "C WITH CLASSES"; ++ IS THE INCREMENT OPERATOR IN "C")

Intermediate-level, object-oriented. An extension of C, with enhancements such as classes, virtual functions, and templates.

CREATOR

BJARNE STROUSTRUP
Bell Labs

PRIMARY USES

Commercial application development, embedded software, server/client applications, video games

USED BY

Adobe, Google Chrome, Mozilla Firefox, Microsoft Internet Explorer

Adobe

1983

OBJECTIVE-C (OBJECT-ORIENTED EXTENSION OF "C")

General-purpose, high-level. Expanded on C, adding message-passing functionality based on Smalltalk language.

CREATOR

BRAD COX AND TOM LOVE
Stepstone

PRIMARY USES

Apple programming

USED BY

Apple's OS X and iOS operating systems

1987

PERL ("PEARL" WAS ALREADY TAKEN)

General-purpose, high-level. Created for report processing on Unix systems. Today it's known for high power and versatility.

CREATOR

LARRY WALL
Unisys

PRIMARY USES

CGI, database applications, system administration, network programming, graphics programming

USED BY

IMDb, Amazon, Priceline, Ticketmaster

IMDb

amazon

1991

PYTHON (FOR BRITISH COMEDY TROUPE MONTY PYTHON)

General-purpose, high-level. Created to support a variety of programming styles and be fun to use. Tutorials, sample code, and instructions often contain Monty Python references.

CREATOR

GUIDO VAN ROSSUM
CWI

PRIMARY USES

Web applications, software development, information security

USED BY

Google, Yahoo, Spotify

Google

YAHOO!

1993	**RUBY (THE BIRTHSTONE OF ONE OF THE CREATOR'S COLLABORATORS)** General-purpose, high-level. A teaching language influenced by Perl, Ada, Lisp, Smalltalk, etc. Designed for productive and enjoyable programming.	**CREATOR** YUKIHIRO MATSUMOTO 	**PRIMARY USES** Web application development, Ruby on Rails	**USED BY** Twitter, Hulu, Groupon hulu GROUPON
1995	**JAVA (FOR THE AMOUNT OF COFFEE CONSUMED WHILE DEVELOPING THE LANGUAGE)** General-purpose, high-level. Made for an interactive TV project. Cross-platform functionality. Currently the world's most popular programming language.	**CREATOR** JAMES GOSLING Sun Microsystems 	**PRIMARY USES** Network programming, web application development, software development, Graphical User Interface development	**USED BY** Android OS/Apps
1995	**PHP (FORMERLY "PERSONAL HOME PAGE," NOW IT STANDS FOR "HYPERTEXT PREPROCESSOR")** Open-source, general-purpose. For building dynamic web pages. Most widely used open-source software by enterprises.	**CREATOR** RASMUS LERDORF 	**PRIMARY USES** Building/ maintaining dynamic web pages, server-side development	**USED BY** Facebook, Wikipedia, Digg, WordPress, Joomla facebook digg
1995	**JAVASCRIPT (FINAL CHOICE AFTER "MOCHA" AND "LIVESCRIPT")** High-level. Created to extend web page functionality. Used by dynamic web pages for form submission/validation, interactivity, animations, user activity tracking, etc.	**CREATOR** BRENDAN EICH Netscape 	**PRIMARY USES** Dynamic web development, PDF documents, web browsers, desktop widgets	**USED BY** Gmail, Adobe Photoshop, Mozilla Firefox Gmail

Software – System and Application

- System Software: consists of programs that are used to manage the hardware resources of a computer and perform required information processing tasks.

  3 categories: operating system, system support, system development

  - Operating System: provides services such as a user interface, file and database access, and interfaces to communication system.

Microcomputers Operating System: MS-DOS, OS/2, Machintosh, Windows

Mid-range Computers: UNIX on Workstations

OS/400 for IBM AS/400

VMS on DEC's VAX-machine

Software – System and Application

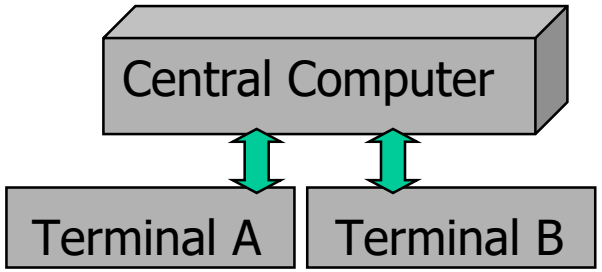
- System Support Software: provides system utilities such as disk format programs, performance statistics, and security programs.
- System Development Software: includes language translators and debugging tools

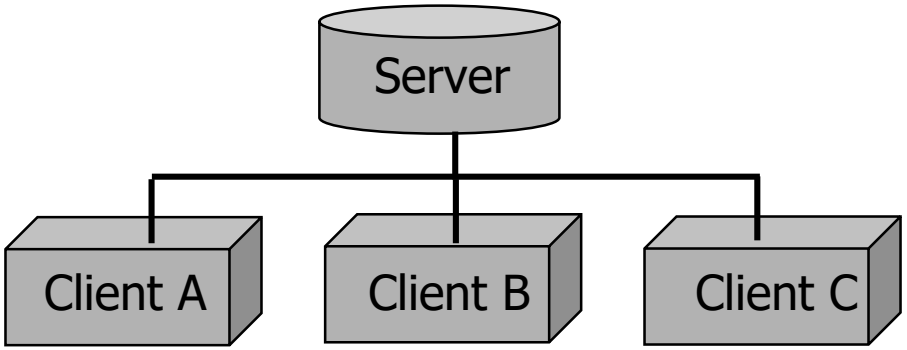
– Application Software

- General Purpose Software: word processors, database management systems, computer-aided design systems
- Application-specific Software: program for accountants, ...

Computing environments

- Personal Computing Environments (micro-computer): Processor (Pentium, Motorola), 64-M DRAM, 2-G Hard disk, 17” Monitor, Keyboard, Mouse, Printer, Modem (internal or external), floppy disk, CD-ROM drive, Network card, Cables, …….
- Time-sharing Environment: Many users are connected to one or more computers. Terminals are usually non-programmable. (example: printer)
- Client / Server Environment: splits the computing function between a central computer and users’ computers. User’s computers are personal computers or workstations.





Compilers vs. Interpreters

- A compiler reads the entire program and converts it into object code, which is a translation of the program source code into a form that the computer can execute directly. Object code is also referred to as binary code or machine code.
  - One time cost
  - Very fast
  - PASCAL, C

- An interpreter reads the source code of your program one line at a time, performing the specific instructions contained in that line. (C interpreter for debugging aids)

  - Slow process
  - Run each time you want to use it
  - BASIC

Definitions

- **Source Code** ; The text of a program that a user can read, input to C compiler
- **Object Code** ; Translation of the source code of a program into machine code, which the computer can read and execute directly. Object code is input to linker.
- **Linker** ; A program that links separately-compiled functions into one program. It combines the functions of the standard C library with the code you wrote. The output of the linker is the executable program.
- **Library** ; The file containing the standard functions that your program may use. These functions include all I/O operations as well as other useful routines.
- **Compile Time** ; The events that occur while your program is being compiled. A common occurrence during compile time is a syntax error.
- **Run Time** ; The events that occur while your program is executing.

Origin of Java

- Developed by James Gosling at SUN Micro-System in1990 for controlling electric goods

- In the early stage of development, Pascal was the basic model, but later changed to C++ type

- As Internet gets developed, JAVA become very popular

  Java's applet program is automatically executed in Web Browser (Netscape 2.0)

  => Important role in *Homepage*

- IBM, Borland, Symantic, Microsoft … JAVA License

Property of Java

- **Machine-free language**
  - JAVA provides platform independence.
    you can use the same code on Windows, Solaris, Linux, Macintosh, and so on.
- **Simple to code**
  - Simple syntax
  - Removal of header in C++
  - If C++ source codes are converted to JAVA, it is not too much to say that JAVA code size gets smaller in half.
- **Easy to learn**
  - Elimination of unnecessary code, simplicity of grammar
  - A clean-up version of the syntax for C++
- **Object Oriented Programming Language**
  - Object-oriented design is a technique for programming that focuses on the data(=objects) and on the interfaces to that object.
    Almost everything in *Java* is either a class, a method or an object.

- **High ability of networking**
  - Usefulness in Internet
  - More excellent than other languages in networking

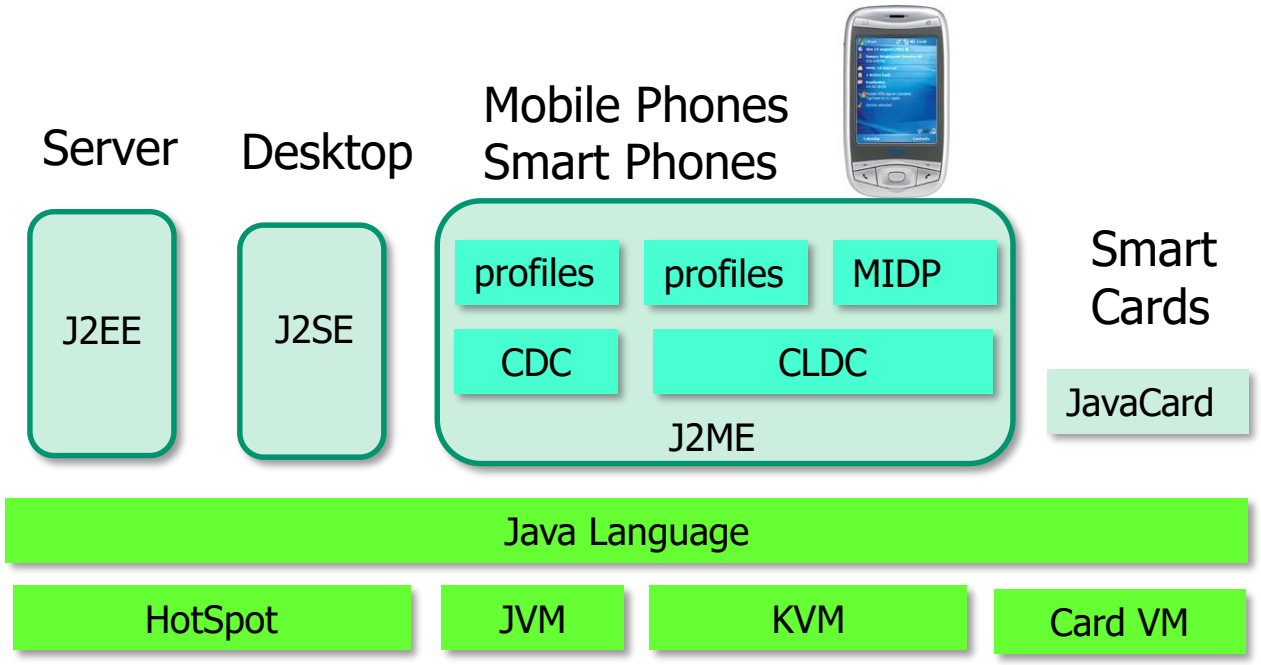
Java is secure than others!

- Java & C++

Java is developed on the basis of C++. But JAVA is different from C++.

- Elmination of Pointer
- Structure in C, C++ -> Class
- JAVA is composed of classes.
  The smallest unit of code is class
  => object-oriented Programming language

Java



Java virtual machine: interface software between compiled Java binary code and hardware (microprocessor or hardware platform)

KVM (Kilobyte Java Virtual Machine): Java virtual machine for mobile phone

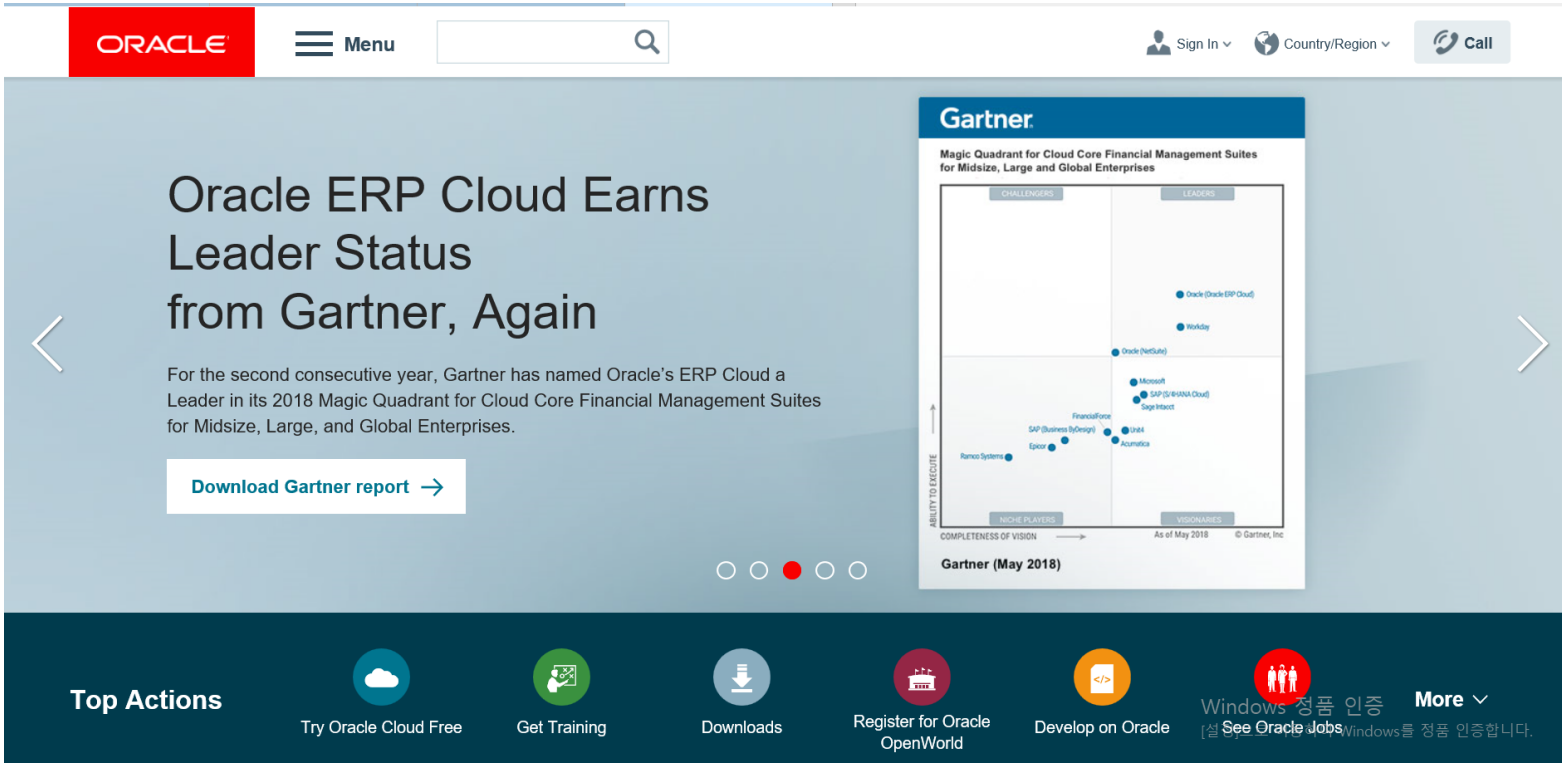
- JEE (Java Enterprise Edition)
  - Link to database, JSP (Java Server Page), Servlet, EJB (Enterprise Java Bean)
- JSE (Java Standard Edition)
  - PC, Web browser
- JME (Java Micro Edition)
  - Mobile Platform

JAVA API (application programming interface)

- Java.lang
  - Object oriented language features (C with class)
- Java.awt
  - AWT (abstract window toolkit) for graphic and user interface
- Java.applet
  - Applet java code for web browser application
- Java.io
  - Input/Output functions
- Java.net
  - Network functions
- Javax : Java is a programming language, which has been influenced by the C language. Java and Javax are essentially packages that are used with the context of the Java programming language. Practically there is no difference between Java and Javax. It is just the name that differs.
- Java bean: A Java Bean is a reusable software component that can be manipulated visually in a builder tool

JDK(Java Development Kit) installation

- http://www.oracle.com

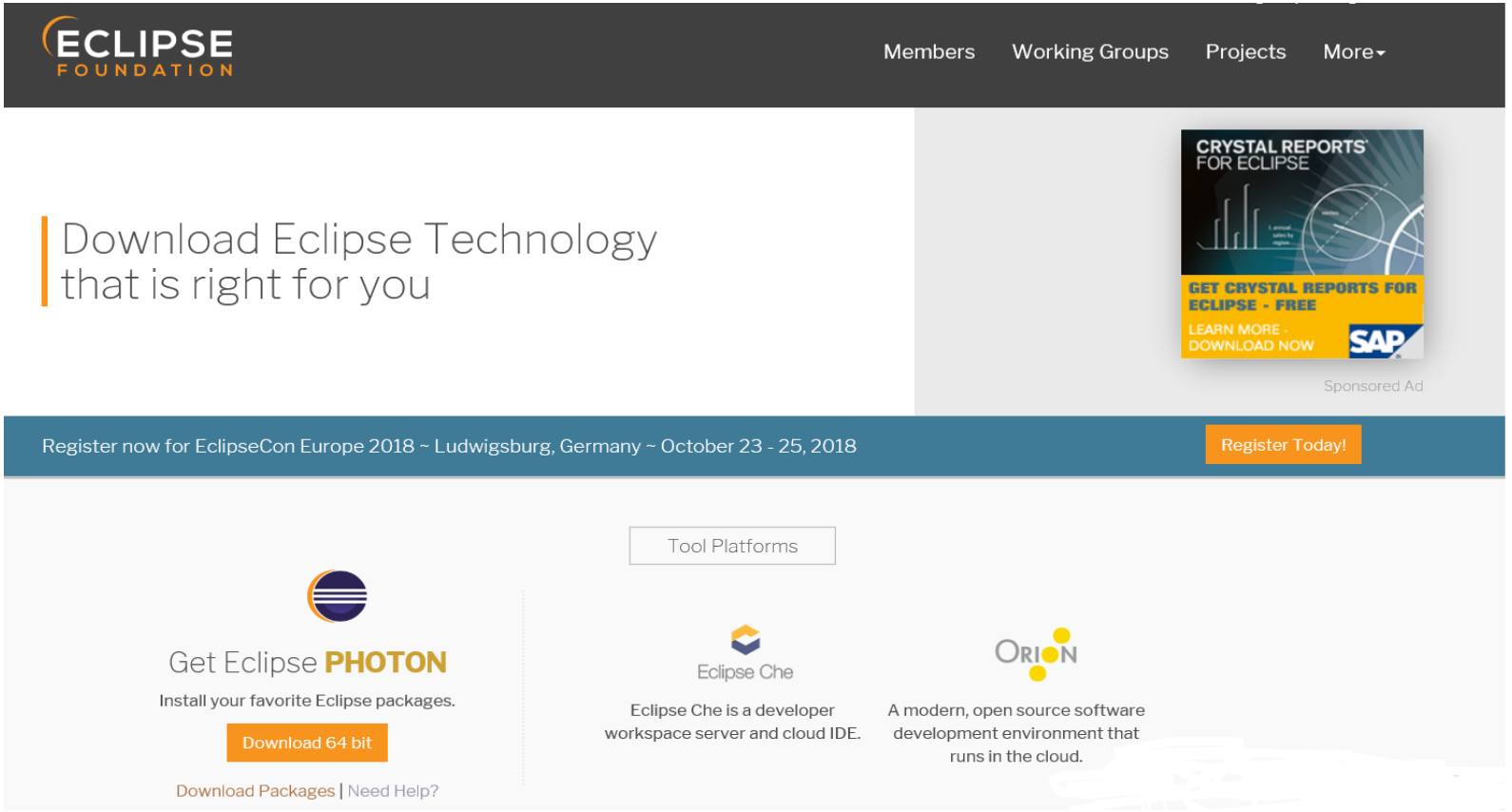


Java installation

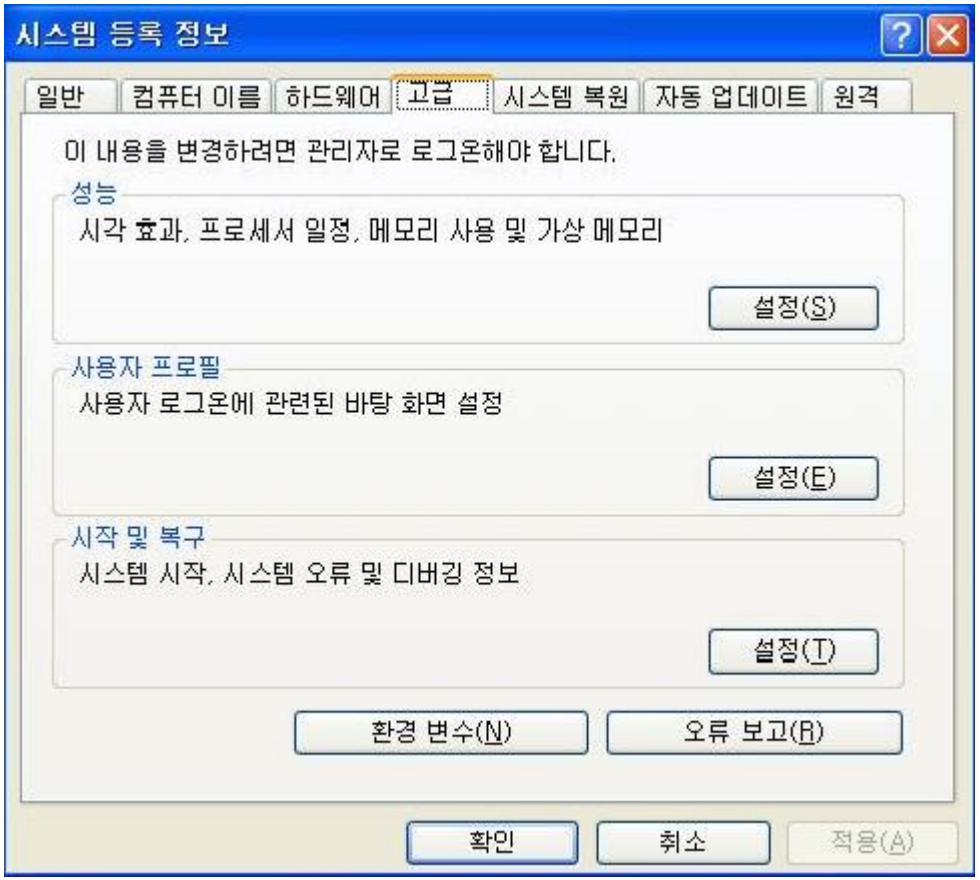
- Menu>Developers>Downloads
- Java > Java(JDK) for Developers proper spec. JDK download
- Installation confirm; in cmd window java –version command

Java editor Elipse installation

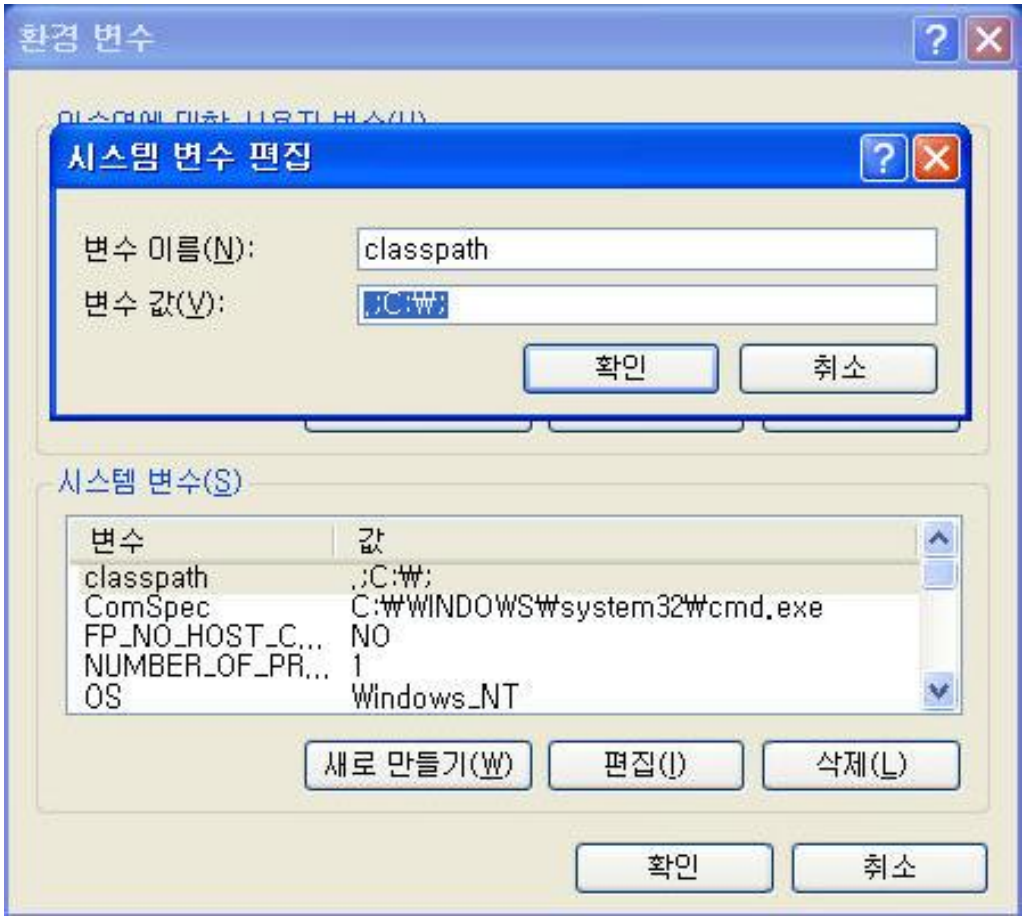
- http://www.eclipse.org/downloads > Download Packages click



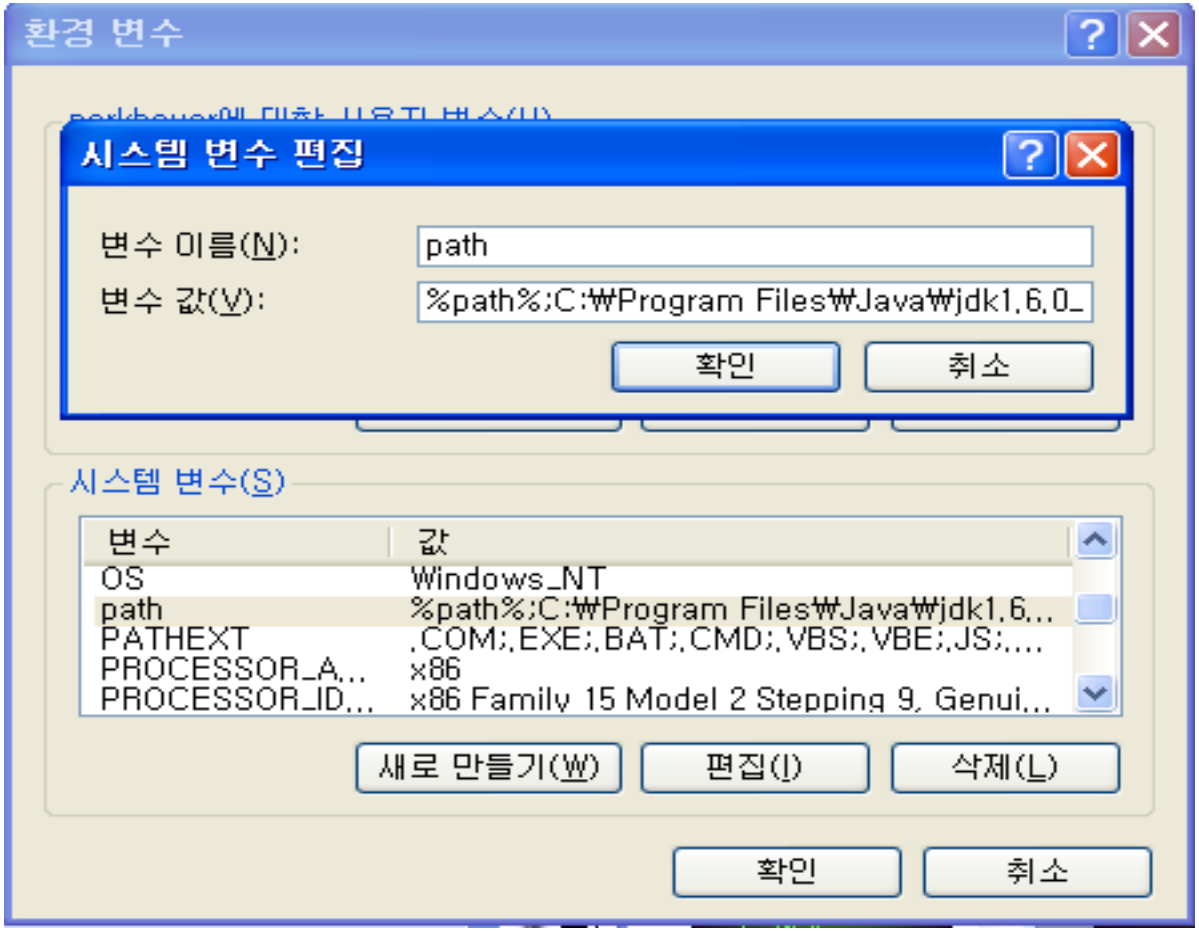
- Java Editor install and Example program
  - Jdk-6u16: download (http://java.sun.com/javase/downloads/index.jsp#jdk) and install
  - EditPlus: download and install
  - Store environment variables
    - Windows xp, 2000



- Open Windows environment variables editor (Control Panel - System – Advance – Environment Variable – System Variable – New)
- Set a Variable Name and Value attribute like figure below



- Set the environment variables again like figure below



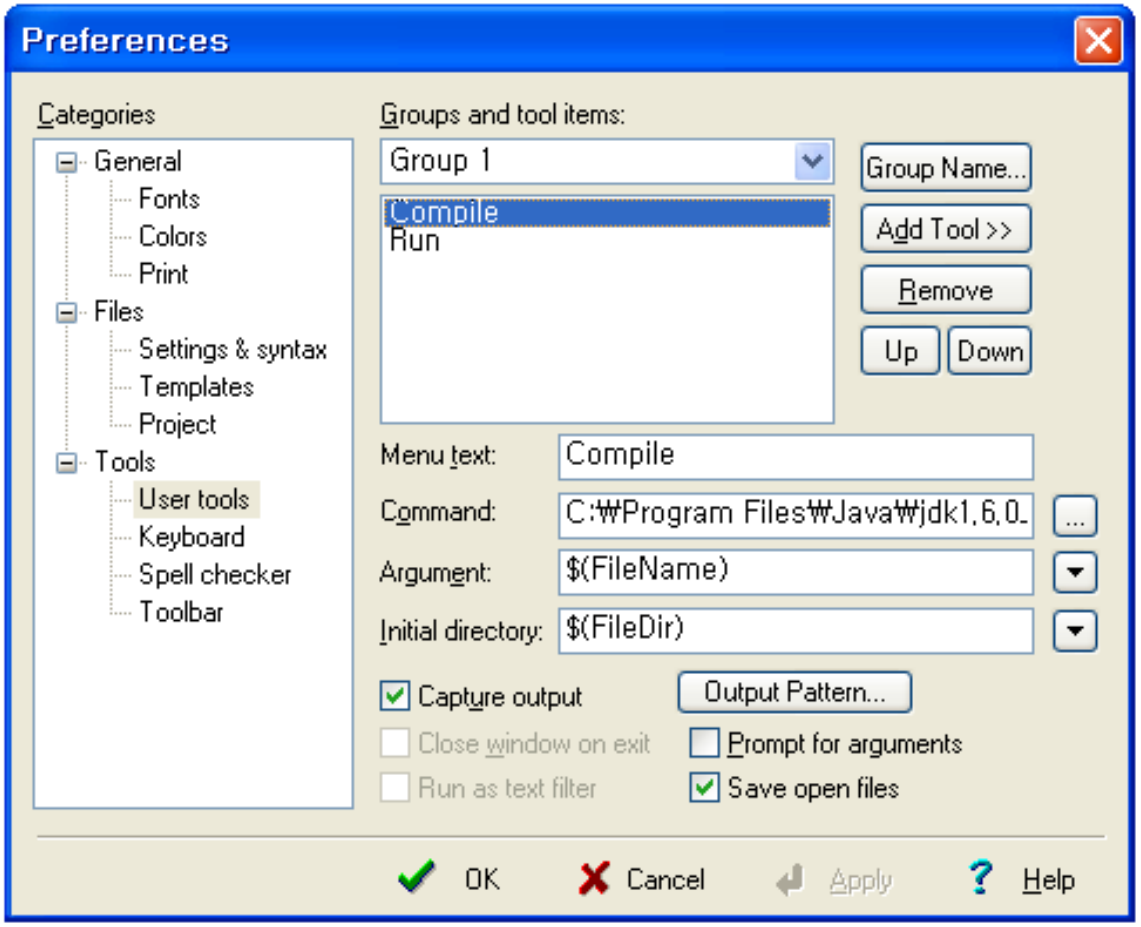
- Steps of Java programming
  - Programming in MS-DOS
    - Write a Java program (ex. a.java)
    - Compile (ex. C:□javac a.java)
      - Generate “a.class”
    - Run (ex. C:□java a)

- Setup Java development environment using EditPlus
  - Editplus does not have any compiler by default

  - **1) Setting for Compile**

    - Open the Configuration Window (Tools - Configure User Tools – Tools – User tools)
    - Click the "Add Tool" and then select "Program"
    - And then set each textbox like below

    - **Menu text:** Compile(any text available)
    - **Command:** Select the location of the Java compiler (ex, C:□Program Files□Java□jdk1.6.0_16□bin □javac.exe)
    - **Argument:** Click the ▼ button and select "File Name"
    - **Initial directory:** Click the ▼ button and select "File Path"
    - Check on the checkbox "Capture output"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Group Name...
Add Tool >>
Remove
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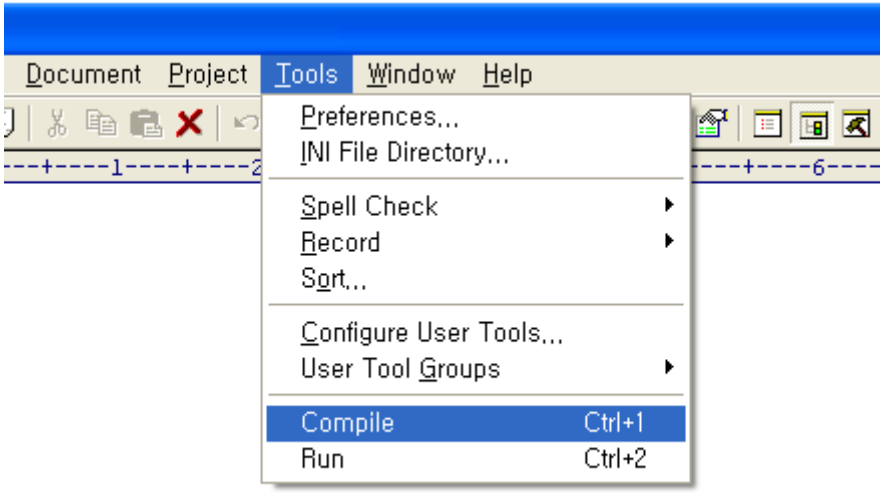
Down
Menu text:
Compile
Command:
C:₩Program Files₩Java₩jdk1.6.0_
Argument:
$(FileName)
Initial directory:
$(FileDir)
Capture output
Output Pattern...
Close window on exit
Prompt for arguments
Run as text filter
Save open files
OK
Cancel
Apply
Help

- **2) Setting for program execution**

  - Open the Configuration Window (Tools - Configure User Tools – Tools – User tools)
  - Click the “Add Tool” and then select “Program”

  - **Menu text:** Run(any text available)
  - **Command:** Select the location of the Java.exe (ex, C:□Program Files□Java□jdk1.6.0_16□bin □java.exe)
  - **Argument:** Click the ▼ button and select “File Name Without Extension”
  - **Initial directory:** Click the ▼ button and select “File Path”
  - Check on the checkbox “Capture output”

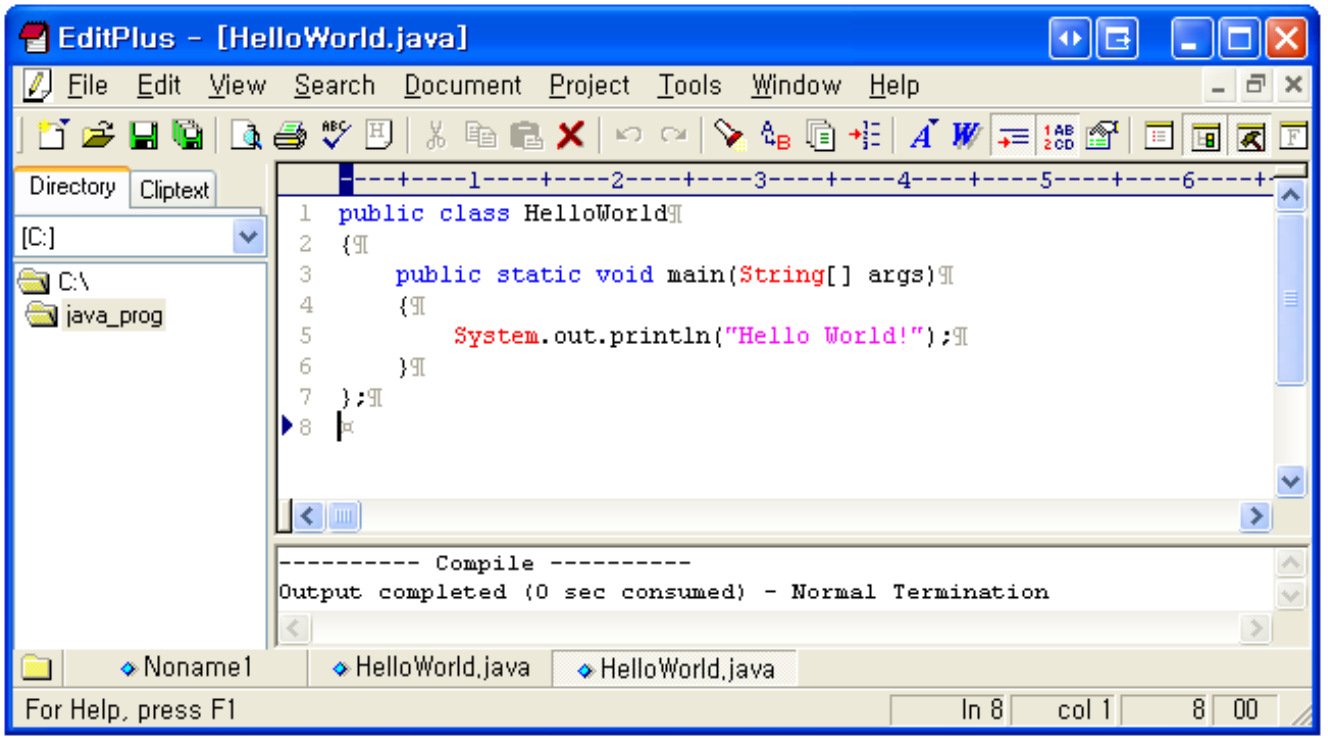
- **3) If all of the previous steps were performed correctly the Tools menu will show the "Compile" and "Run" (their hotkey is Ctrl+1 and Ctrl+1) options**



– Creation and execution of a program using EditPlus

- Write a java program using EditPlus
  - Filename must same as your class name (ex, ClassName.java)
  - The class name is case sensitive
- Compile the program by click on the "Tools" menu and then "Compile"
- Execute the program by click on "Run"
- Confirm the result on the Output Window

- Example program



- Example program