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COMP 141: Compilers and Interpreters, Trends in PLs

Instructions: In this lab, we are going to learn how to use prevalent compilers and interpreters for C and Java in Unix-based systems[1]. You may need to search online! Next, you will explore trends in PLs.

1 GCC

GCC (GNU Compiler Collection) provides a set of compilers for various PLs in Unix-based systems. The collection include C, C++, Objective-C, Fortran, Ada, and Go. Originally, it was only handling C language (the original name was GNU C Compiler). In this exercise, we are going to investigate how we can compile C programs using this tool.

Assume that we have a C program named hello.c. For each of the following, give at proper command using GCC.

1. GCC can be used to compile a C program to object files and link them into an executable, in a singlestep. (input: hello.c, output: executable binary)

   gcc -o hello hello.c

2. GCC can directly compile the source code to object files. (input: hello.c, output: hello.o)

   gcc -c hello.c

3. GCC includes the capability to invoke the linker that collects a bunch of object files into an executable. (input: hello.o output: executable binary)

   gcc -o hello hello.o

4. GCC can compile the source code to Assembly language. (input: hello.c, output: the Assembly code hello.s)

   gcc -S hello.c

5. GCC includes the capability to invoke the assembler that translates the Assembly code into object files. (input: the Assembly code hello.s, output: hello.o)

   gcc -c hello.s

[1] Unix-based systems is a huge family of operating systems including different distributions of Linux, MacOS, Solaris, iOS, Android, Chrome OS, BSD, etc.

2 Java

Java is a PL that is first compiled into Java bytecode. Then, the Java interpreter that resides in Java Virtual Machine executes the bytecode in a single step.

1. What is the name of Java compiler program in Unix-based systems (used in command line interface)?

   The Java compiler in Unix-based systems is typically invoked using the **javac** command in the command line interface.

2. How it can be invoked to produce the bytecode?

   To compile a Java source file (**.java**) and produce the corresponding bytecode (**.class**), we would use the **javac** command followed by the filename. For example, to compile a file named **Example.java**, we would use:

   javac Example.java

3. What is the Java bytecode file's extension?

   The extension for Java bytecode files is **.class**.

4. What is the name of Java interpreter program in Unix-based systems (used in command line interface)?

   The Java interpreter, which is part of the Java Virtual Machine (JVM), is typically invoked using the **java** command in the command line interface.

5. How it can be invoked to execute the bytecode?

   To execute the bytecode file, we use the **java** command followed by the name of the class (without the **.class** extension). For example, to run the **Example.class** bytecode file, we would use:

   java Example

3 Trends in PLs and Beyond

Check the most recent Stack Overflow annual survey at https://survey.stackoverflow.co/2022/ and answer the following questions.

1. Considering experience in coding (in years) among all the respondents, which group has the biggest share?
   29.28% of respondents have been coding for 5-9 years.

2. Considering the developer type among all the respondents, which group has the largest share?

   Full-stack developers account for most of all respondents at 46.82%.

3. What are the top three countries from which respondents come from?

   - United States of America: 18.88%
   - India: 9.26%
   - Germany: 7.52%

4. What percentage of respondents are men vs. women?

   The percentage of respondents are men is 91.88%, The percentage of respondents are women is 5.17%.

5. For how many consecutive years, Javascript has become the most popular PL?

   10 years.

6. What are the top five most popular database technologies?

   - MySQL
   - PostgreSQL
   - Microsoft SQL Server
   - SQLite
   - MongoDB

7. What are the top five most popular web frameworks and technologies? Specify which PL aligns with each of these frameworks and technologies.

   1. Node.js : Javascript

   2. React.js: Javascript

   3. jQuery: Javascript

   4. Express: Javascript

   5. Angular:Javascript

8. What are the top five most popular IDEs?

   1. Visual Studio Code

   2. Visual Studio

   3. IntelliJ

   4. Notepad++

   5. Vim

9. What are the top five most loved PLs?

    1. Rust

    2. Elixir

    3. Clojure

    4. TypeScript

    5. Julia

10. What are the top five most dreaded PLs?

    1. Fortran
    2. Objective-C
    3. VBA
    4. COBOL
    5. MATLAB

11. What are the top five highest paying PLs? Specify the major programming paradigm that each ofthese PLs support.

    1. **Clojure**: Functional Programming. It is a dialect of Lisp and emphasizes immutability and functional programming features.
    2. **Erlang**: Concurrency-Oriented Programming. It is known for its support of concurrent, distributed, and fault-tolerant applications.
    3. **F#**: Multi-Paradigm, primarily Functional Programming. It also supports imperative and object-oriented programming.
    4. **LISP**: Multi-Paradigm, primarily Functional Programming. It's one of the oldest programming languages and supports procedural and symbolic programming.
    5. **Ruby**: Object-Oriented Programming. It also has aspects of functional programming and is known for its flexibility and productivity.

4 TIOBE Index

While PYPL is created by analyzing how often language tutorials are searched on Google, TIOBE index counts the number of web pages with the language name. What are the top five most popular PLs according to TIOBE index?

As of January 2024, according to the TIOBE index, the top five most popular programming languages are Python, C, C++, Java, and C#.