CMPE 152: Compiler Design
August 24 Class Meeting

Department of Computer Engineering
San Jose State University

Fall 2017
Instructor: Ron Mak

www.cs.sjsu.edu/~mak

Basic Info

- ☐ Office hours
  - ▪ TuTh 3:00 – 4:00 PM
  - ▪ ENG 250

- ☐ Website
  - ▪ Faculty webpage: http://www.cs.sjsu.edu/~mak/
  - ▪ Class webpage: http://www.cs.sjsu.edu/~mak/
  - ▪ Syllabus
  - ▪ Assignments
  - ▪ Lecture notes

Permission Codes?

- If you need a permission code to enroll in this class, see the department's instructions at https://cmpe.sjsu.edu/content/Undergraduate-Permission-Number-Requests

- Complete the Google form at https://docs.google.com/a/sjsu.edu/forms/d/e/1FAIpQLSe9YgAea-QsgLZof-KIMmuQthoChL4micudyRukgWneiByN2A/viewform

Goals of the Course

☐ Understand the <u>concepts</u> of compilers and interpreters.

- Parser, scanner, tokens
- Symbol tables, intermediate code
- Executors, code generators
- Compiler-compilers

Goals of the Course*, cont'd*

- ☐ Learn important job skills that employers want!

- ☐ Work on a small programming team.

- ☐ Understand and modify a Big Hairy Legacy Application.

- ☐ Use modern software engineering practices to develop a complex application.

Course Overview

- **First half:** Modify a Pascal interpreter.

  - The interpreter is written in Java
    (the implementation language).

  - The source programs are written in Pascal
    (the source language).

  - The implementation code for the interpreter
    will be presented to you incrementally.

- *Midterm*

Course Overview, *cont'd*

- **Second half:** Your compiler project.

  - ANTLR 4 compiler-compiler
  - Java Virtual Machine (JVM) architecture
  - Jasmin assembly language
  - Back end code generator

- *Final*

Required Textbooks

□ *Writing Compilers and Interpreters,* 3rd edition
- Author: Ronald Mak
- Publisher: Wiley
- ISBN: 978-0-470-17707-5
- Source code: http://www.cs.sjsu.edu/~mak/CMPE152/sources/ (Java and C++)

Use during the entire semester.

□ *The Definitive ANTLR 4 Reference*
- Author: Terence Parr
- Publisher: Pragmatic Bookshelf
- ISBN: 978-1934356999
- URL: http://www.antlr.org

Use during the second half of the semester.

Project Teams

- Projects will be done by small project teams.
  - Projects will be broken up into assignments.

- Form your own teams of 4 members each.

- Choose your team members wisely!
  - Be sure you'll be able to meet and communicate with each other and work together well.
  - No moving from team to team.

- Each team member will receive the same score on each team assignment and team project.

Project Teams, *cont'd*

- Each team email to ron.mak@sjsu.edu by Wednesday, August 30:

    - Your team name
    - A list of team members and email addresses

- Subject: **CMPE 152 Team** *Team Name*

    - Example: **CMPE 152 Team Hyper Hackers**

Individual Responsibilities

You are personally responsible for participating and contributing to your team's work, and for understanding each part of the work for every assignment whether or not you worked on that part.

Postmortem Assessment Report

- At the end of the semester, each student will <u>individually</u> turn in a short (one page) report:

    - A brief description of <u>what you learned</u> in the course.

    - An assessment of your <u>personal accomplishments</u> for your project team.

    - An assessment of the contributions of each of your <u>project team members</u>.

- This report will be seen only by the instructor.

Your Individual Overall Class Grade

- 30% assignments
- 35% project
- 15% midterm
- 20% final

Your final class grade will be adjusted up or down depending on your level and quality of participation, as reported by your teammates' postmortem reports.

- During the semester, keep track of your progress in Canvas.

- At the end of the semester, students with the median score will get the B grade.

- Higher and lower grades will then be assigned based on how the scores cluster above and below the median.

- Therefore, your final class grade will be based primarily on your performance relative to the other students in the class.

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Participation is Important

- Can move your final grade up or down, especially in borderline cases.

- Participation in class.
- Participation in your team.
  - As reported by the postmortem assessment reports.

Take roll!

Compiler Magic?

C compiler:

```
int main()
{
    printf("Hello, C world!\n");
}
```
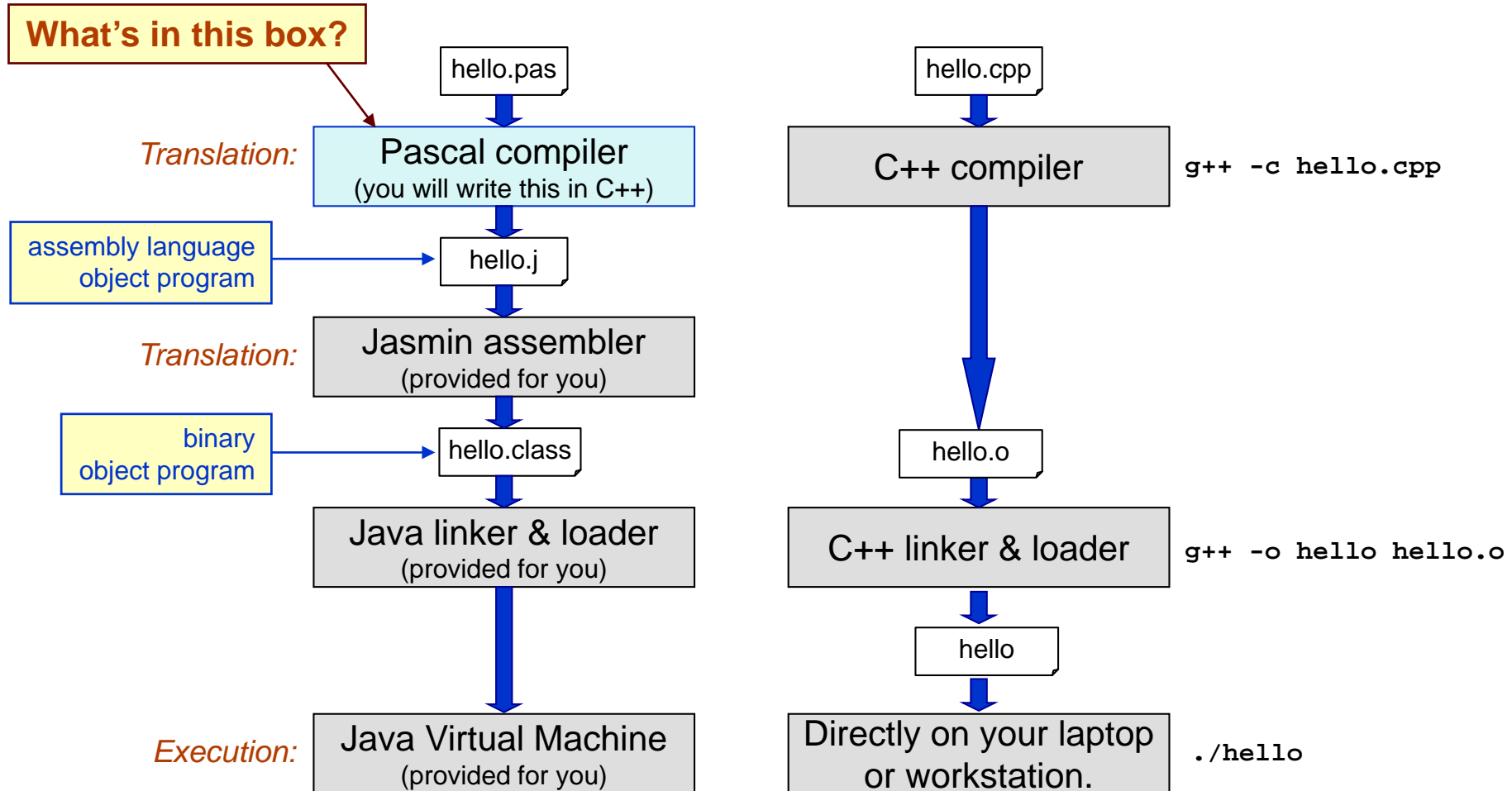
Pascal compiler:

```
PROGRAM hello;

BEGIN
    writeln('Hello, Pascal world!');
END.
```

Java compiler:

```
public class Hello
{
    public static void main(String args[])
    {
        System.out.println("Hello, Java world!");
    }
}
```

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Overview of the Compilation Process

What's in this box?

| hello.pas | | hello.cpp |

Translation: → Pascal compiler (you will write this in C++)   C++ compiler `g++ -c hello.cpp`

assembly language object program → hello.j

Translation: Jasmin assembler (provided for you)

binary object program → hello.class   hello.o

Java linker & loader (provided for you)   C++ linker & loader `g++ -o hello hello.o`

hello

Execution: Java Virtual Machine (provided for you)   Directly on your laptop or workstation. `./hello`

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What is a Compiler?

- A software utility that is extremely important for developing applications …

- … usually overlooked and taken for granted ...

- *UNLESS* you can't get your program to compile!

A Compiler is a Translator

- A compiler translates a program that you've written

- ... in a high-level language
  - C, C++, Java, Pascal, etc.

- ... into a low-level language
  - assembly language or machine language

- ... that a computer can understand and eventually execute.

Assignment #1

☐ Posted to the class web page:
http://www.cs.sjsu.edu/~mak/CMPE152/index.html

☐ Write a simple Pascal program.

☐ An <u>individual</u> (not team) assignment.

- You may work together to learn the language.
- But what you turn in must be your own work.

☐ Due Friday, September 1.

Assignment #1, *cont'd*

- Download and install the Lazarus/Free Pascal IDE for Pascal: https://www.lazarus-ide.org

- Online Pascal tutorials:
  - https://www.tutorialspoint.com/pascal/
  - http://www.taoyue.com/tutorials/pascal/

Assignment #1*, cont'd*

- ☐ Sample Pascal program:
  http://www.cs.sjsu.edu/~mak/CMPE152/assignments/1/EmployeeListing.pas

  - ■ Input file:
    http://www.cs.sjsu.edu/~mak/CMPE152/assignments/1/employees.txt