

Server-Side Options

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Princeton University

Objectives

- We will cover:
 - Some server-side options
 - Java: Servlets
 - Java: The Spring web app framework
 - JavaScript: The Express web app framework

Agenda

- **Prelim: packages**
- Prelim: library management
- Java server-side programming
- Java server-side programming: Servlets
- Java server-side programming: Spring
- JavaScript server-side programming
- JavaScript server-side programming: Express

Packages

- **Python packages**
 - A *package* is a named group of modules (and other packages)
 - A *module* is stored in a *file*
 - A *package* is stored in a *directory*

Packages

- **Python packages (cont.)**
 - **Using** a Python package

```
import intmath.euclid
...
intmath.euclid.gcd(x, y)
...
```

Packages

- **Python packages (cont.)**
 - **Defining a Python package**

```
intmath
  __init__.py
  euclid.py
...
```

Packages

- **Java packages**
 - A ***package*** is a named group of classes/interfaces (and other packages)
 - A *class/interface* is stored in a file
 - A *package* is stored in a *directory*

Packages

- **Java packages (cont.)**
 - **Using** a Java package

```
...  
java.lang.Math.sqrt(x);  
...
```

```
import java.lang.Math;  
...  
Math.sqrt(x);  
...
```


Packages

- **Java packages (cont.)**
 - **Defining a Java package**

```
// Book.java

package edu.princeton.penny;

// All names defined subsequently are
// in the edu.princeton.penny package.

public class Book { ... }
```

Defines class `edu.princeton.penny.Book`

`Book.java` **must be in** `edu/princeton/penny` directory

Agenda

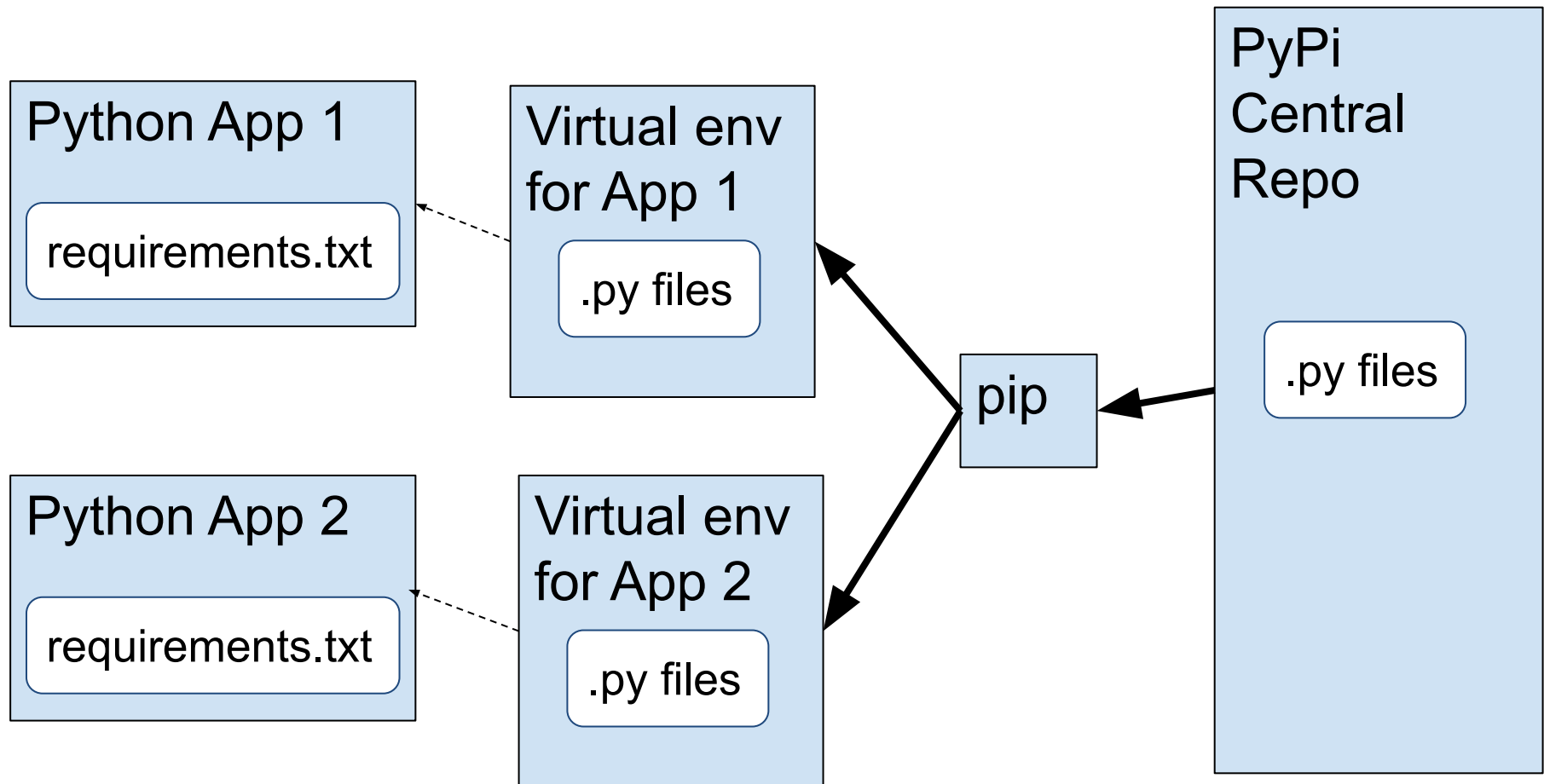
- Prelim: packages
- **Prelim: library management**
- Java server-side programming
- Java server-side programming: Servlets
- Java server-side programming: Spring
- JavaScript server-side programming
- JavaScript server-side programming: Express

Library Management

- **Python** library management
 - **pip** and **PyPi** central repo

Library Management

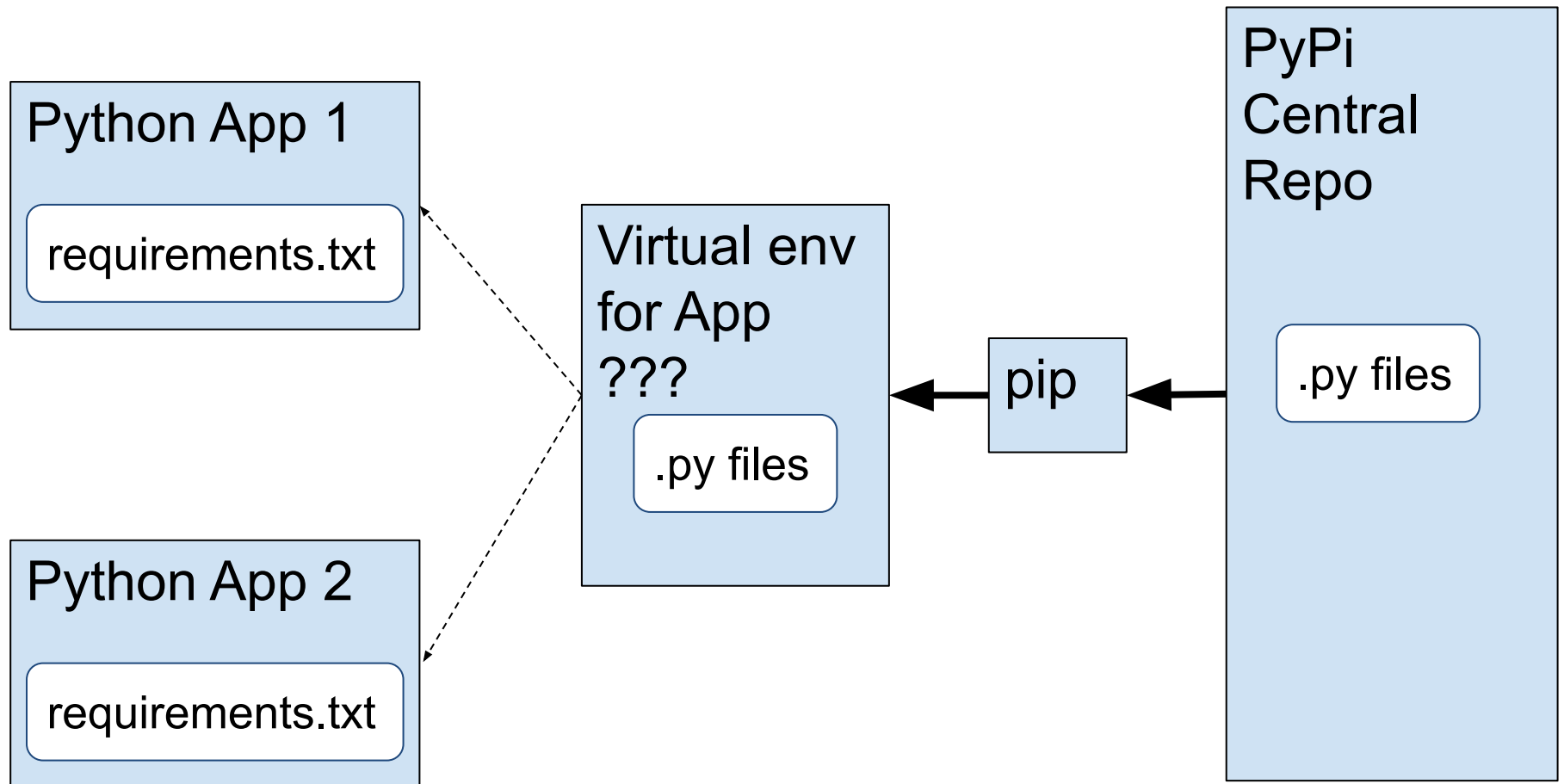
Python library management (cont.)



(Activate virtual env for App X)
`pip install -r requirements.txt`

Library Management

Python library management (cont.)

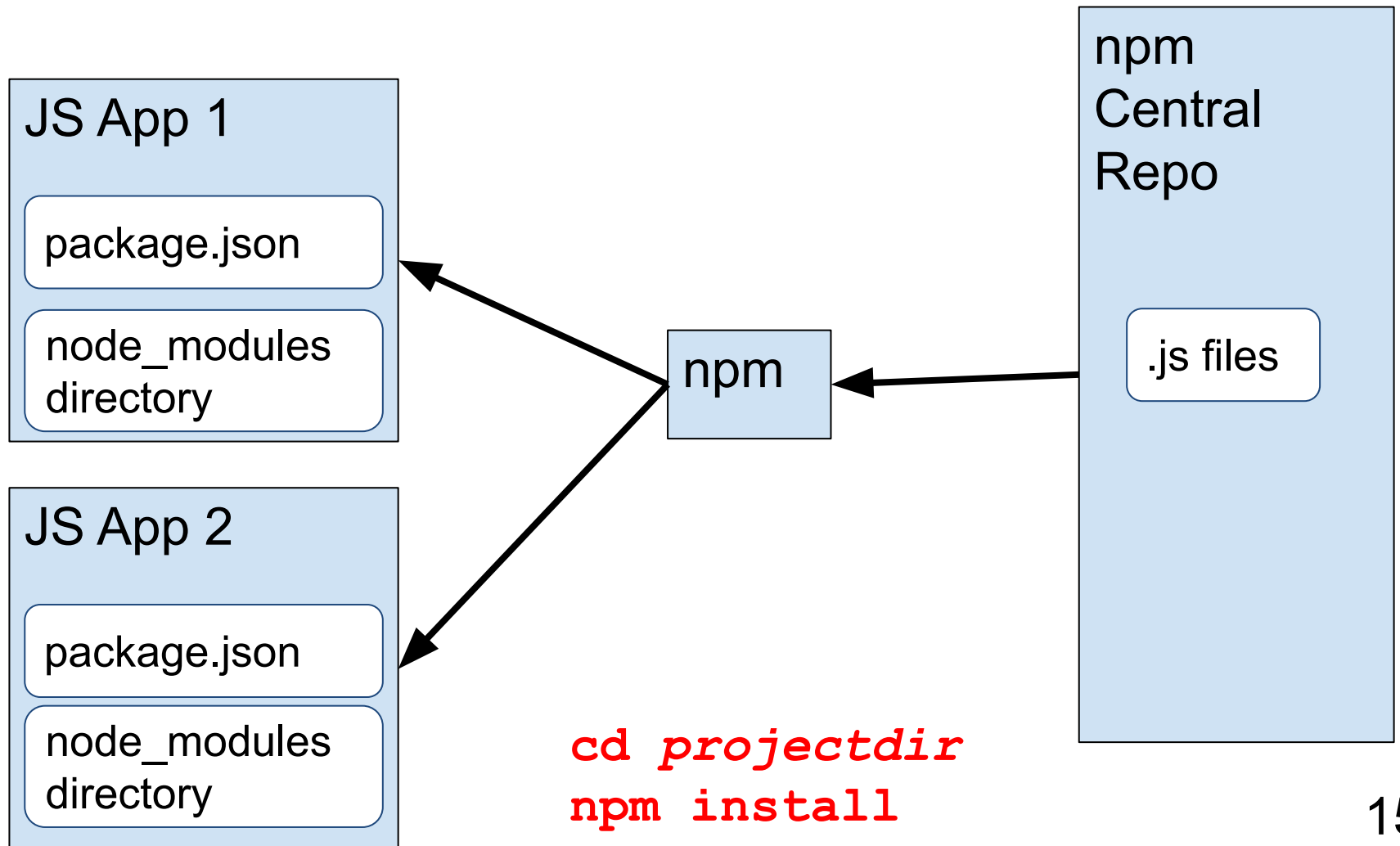


Library Management

- **JavaScript** library management
 - **npm** and **npm central repo**

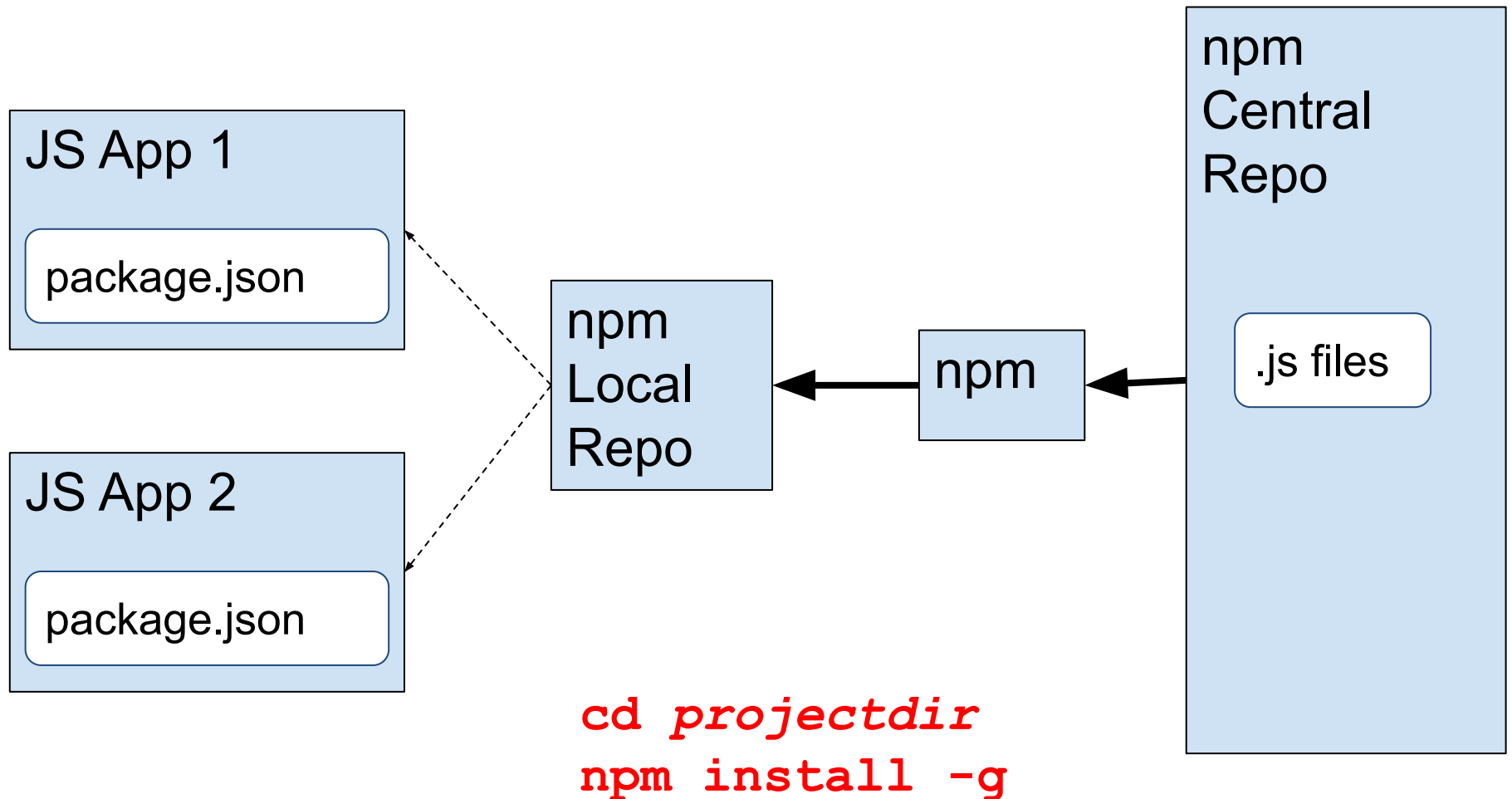
Library Management

JavaScript library management (cont.)



Library Management

JavaScript library management (cont.)

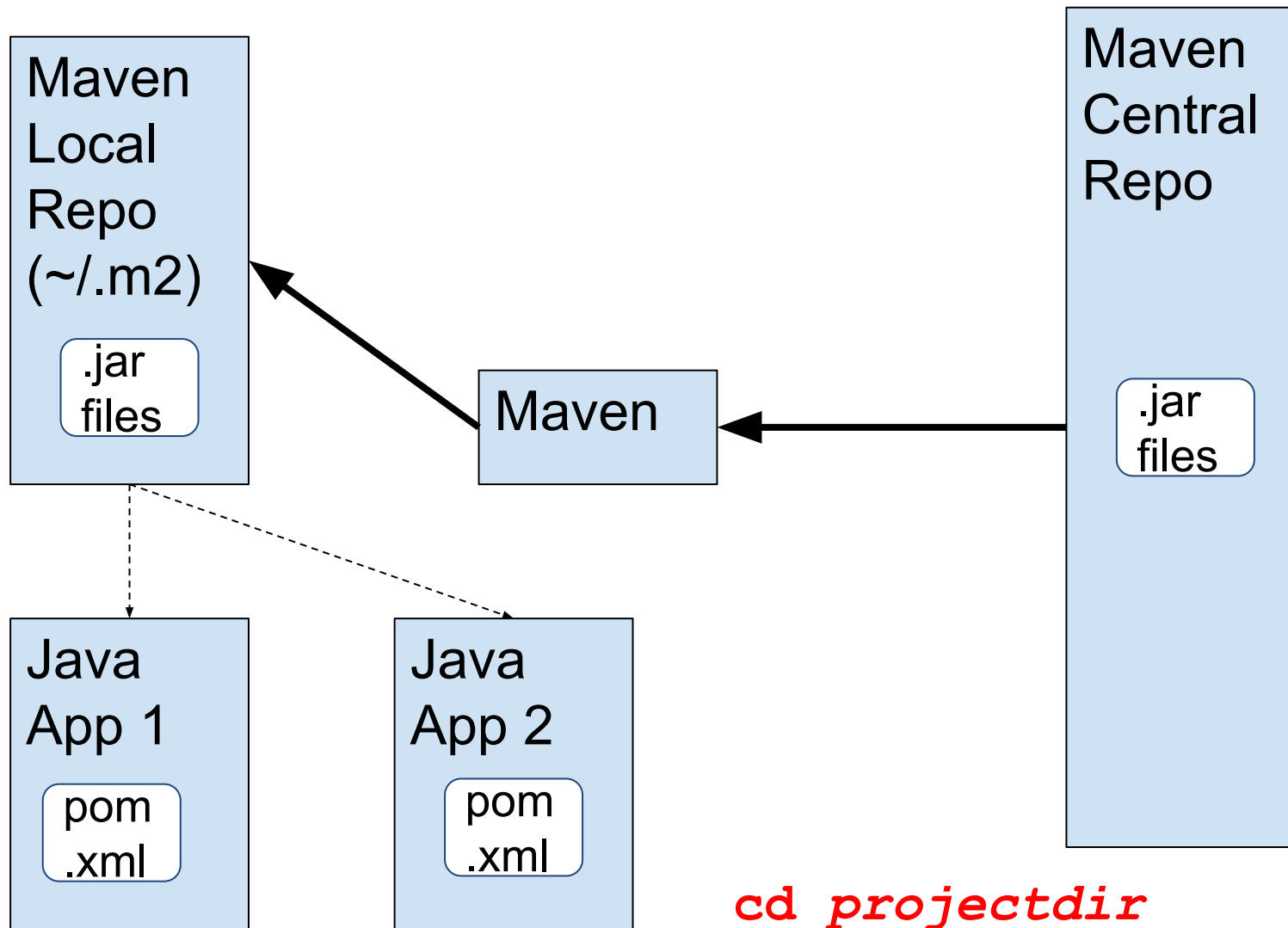


Library Management

- **Java** library management
 - *Maven* and central Maven repo
- Maven is a:
 - Library management tool
 - Build tool
 - C : make
 - Java : Maven

Library Management

Java library management (cont.)



```
cd projectdir  
mvn compile
```

Library Management

- Installing Maven

- Mac:

- `brew install maven`

- MS Windows

- <https://maven.apache.org/guides/getting-started/windows-prerequisites.html>

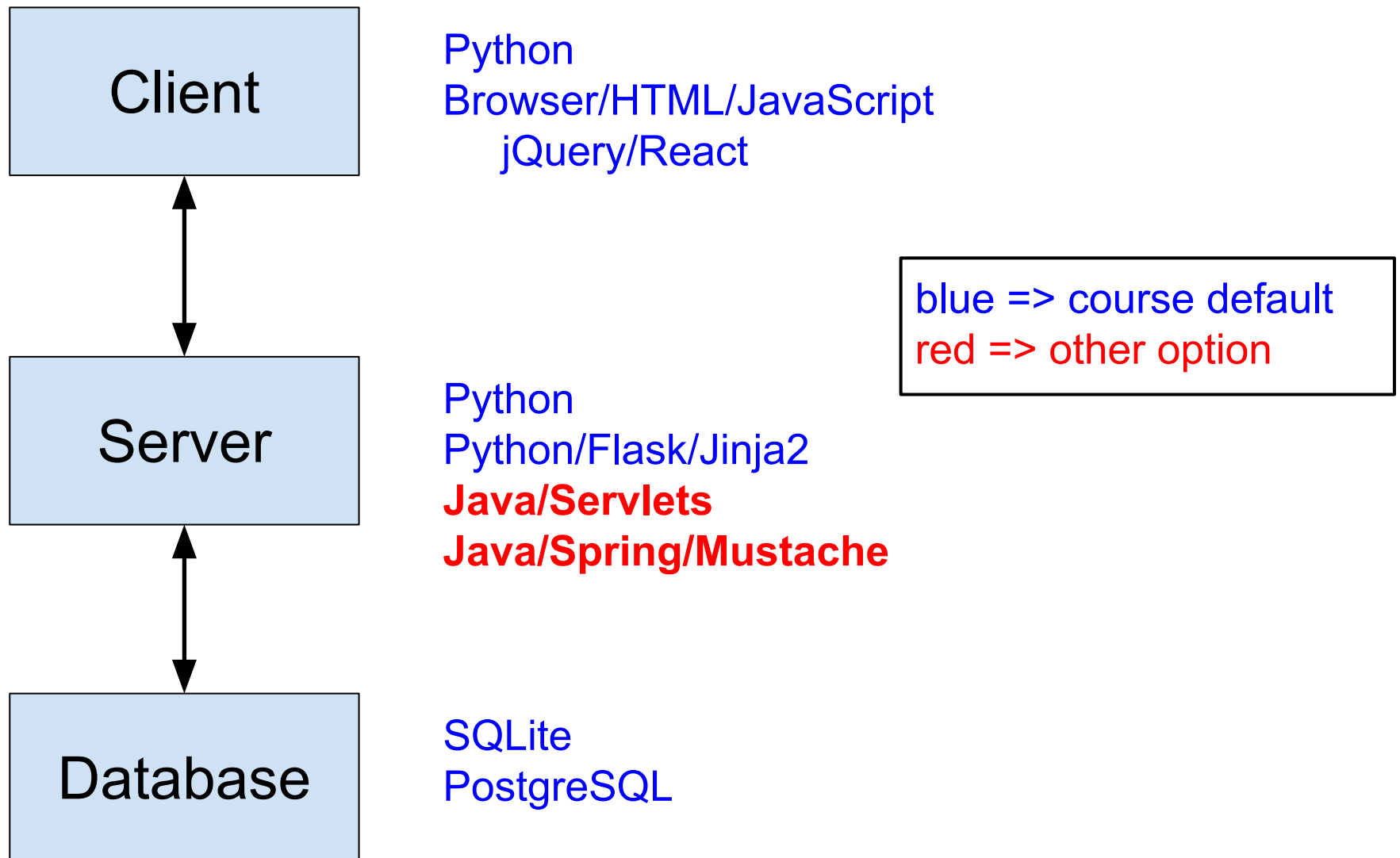
- Linux

- Use your package mgr

Agenda

- Prelim: packages
- Prelim: library management
- **Java server-side pgmming**
- Java server-side pgmming: Servlets
- Java server-side pgmming: Spring
- JavaScript server-side pgmming
- JavaScript server-side pgmming: Express

Java Server-Side Web Pgmming



Java Server-Side Web Pgmming

- **Question:** Why study Java server-side web programming?
- **Answer 1:** Help you better understand server-side web programming
- **Answer 2:** Give you a sense of how Java is used in the “real world”

Java Server-Side Web Pgmming

- **Question:** Why study Java server-side web programming (cont.)?
- **Answer 3:** Show realistic use of some advanced features of Java
- **Answer 4:** Popular and important...

Java Server-Side Web Pgmming

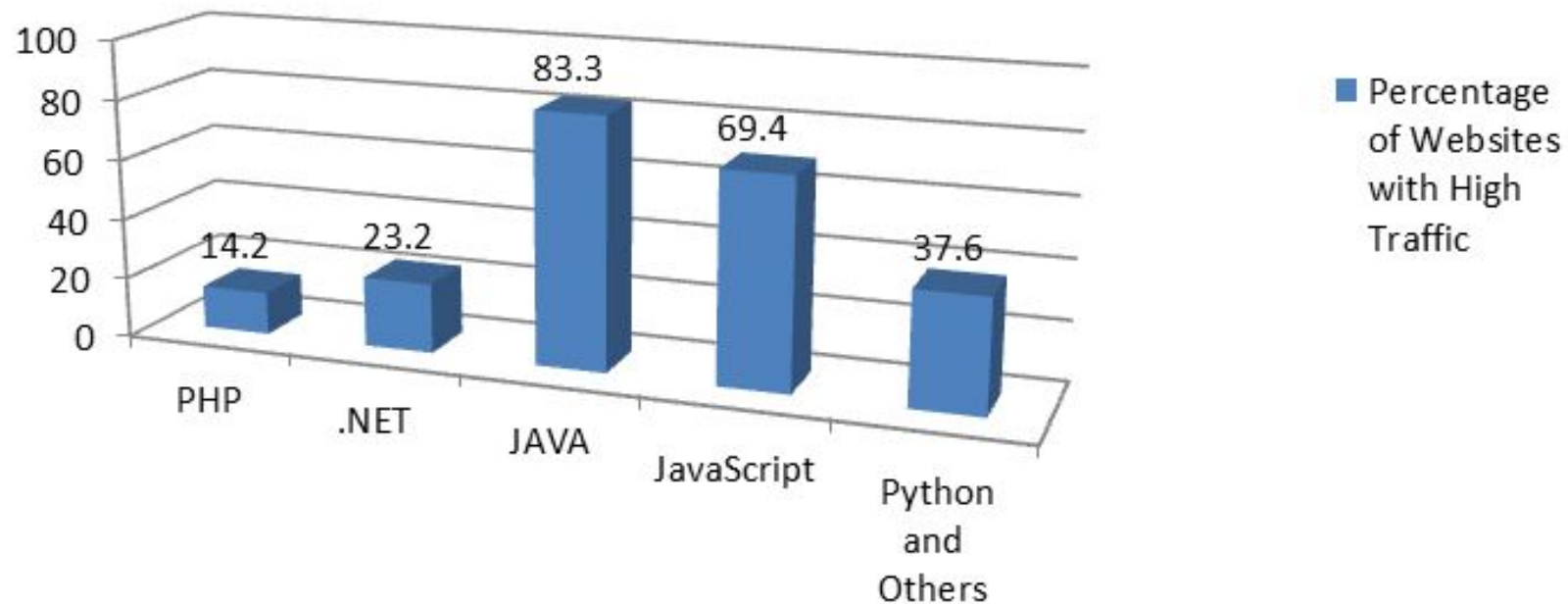
Website	Front End	Back End
Google	JavaScript	C, C++, Go, Java , Python, Node
Facebook	JavaScript TypeScript Flow	Hack, HHVM, Python, C++, Java , Erlang, D, Haskell
YouTube	JavaScript TypeScript	Python, C, C++, Java , Go
Yahoo	JavaScript	PHP
Etsy	JavaScript	PHP
Amazon	JavaScript	Java , C++, Perl
Wikipedia	JavaScript	PHP
Fandom	JavaScript	PHP
X	JavaScript	C++, Java , Scala, Ruby
Bing	JavaScript	C++, C#
eBay	JavaScript	Java , JavaScript, Scala

<https://en.wikipedia.org/wiki/>

Programming_languages_used_in_most_popular_websites (July 2024)

Java Server-Side Web Pgmming

Programming Language vs High Traffic Websites



-- <http://blog.stoneriverelearning.com/top-5-programming-languages-used-in-web-development/>

Agenda

- Prelim: packages
- Prelim: library management
- Java server-side programming
- **Java server-side programming: Servlets**
- Java server-side programming: Spring
- JavaScript server-side programming
- JavaScript server-side programming: Express

Servlet Programming

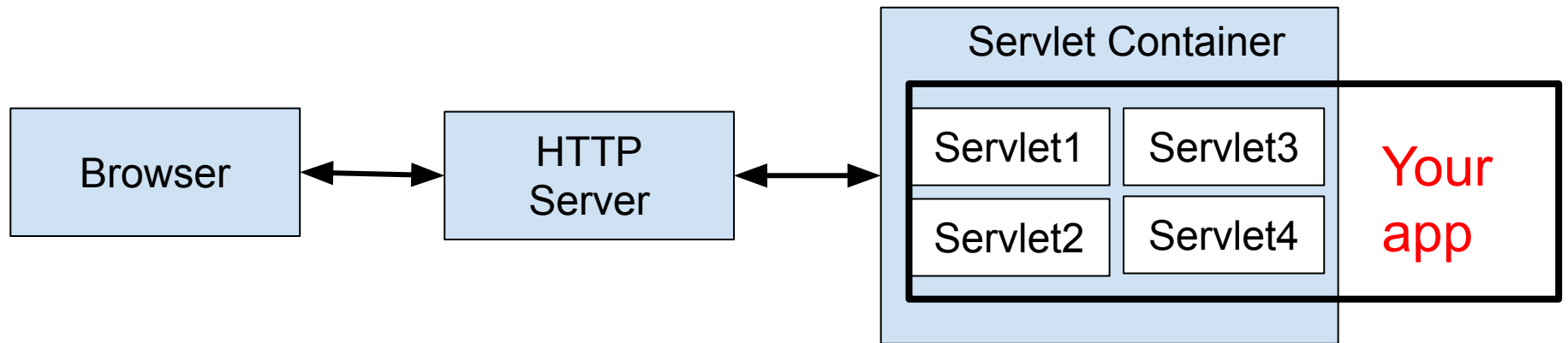
- **Question:** How does one do web programming in Java?
- **Answer 1:** Use Servlets
- **Answer 2:** Use a Java web app framework

Servlet Programming

- **Servlets**

- “A servlet is a Java technology-based Web component, managed by a **container**, that generates dynamic content.”
 - Servlet specification at:
 - http://download.oracle.com/.../servlet-3_0-final-spec.pdf

Servlet Programming

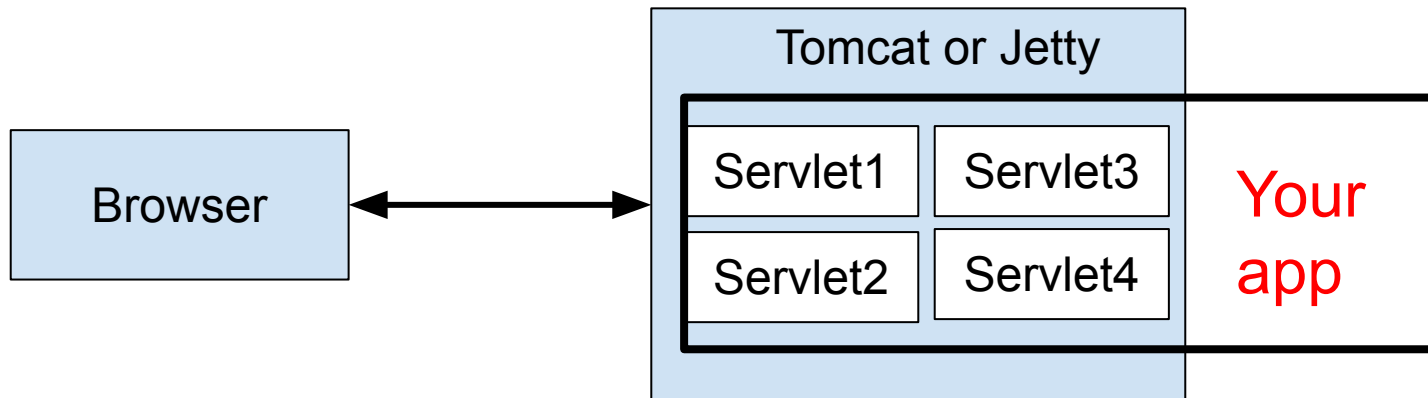


Popular servlet containers:

Apache Tomcat

Eclipse Jetty

Servlet Programming



Tomcat or Jetty can be both servlet container and HTTP server

We'll use that configuration

We'll use Jetty for Servlets, Tomcat for Spring

Servlet Programming

- **Python:**
 - *WSGI specification* connects HTTP server and your Python app
- **Java:**
 - *Servlet specification* connects HTTP server and your Java app

Servlet Programming

- See **PennyServlets** app

On Linux or Mac:

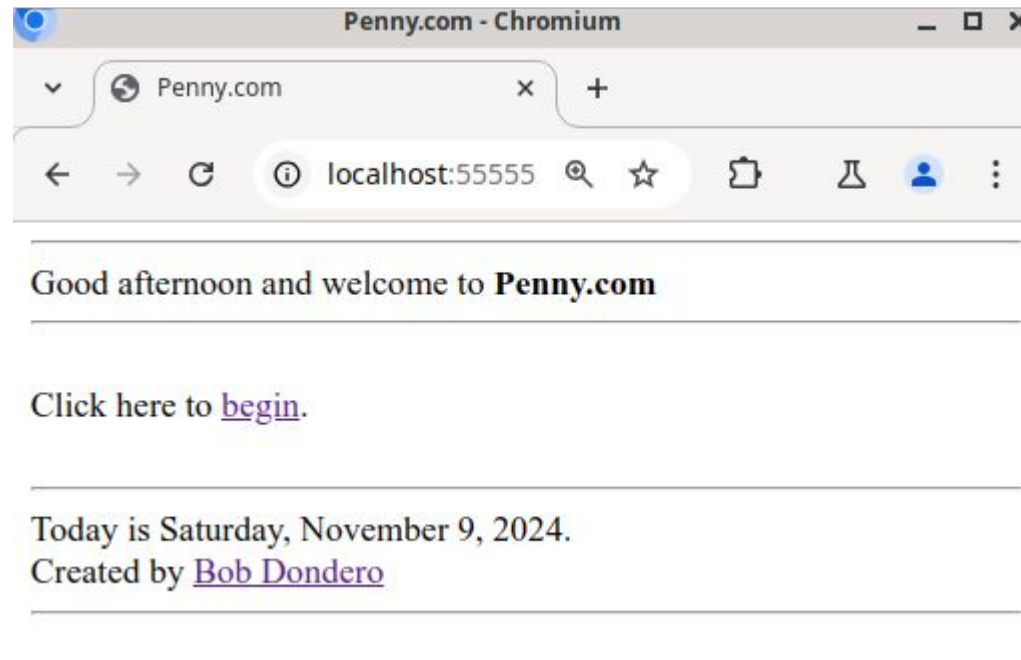
```
$ ./runserver 55555
```

On MS Windows:

```
C:\>runserver.bat 55555
```

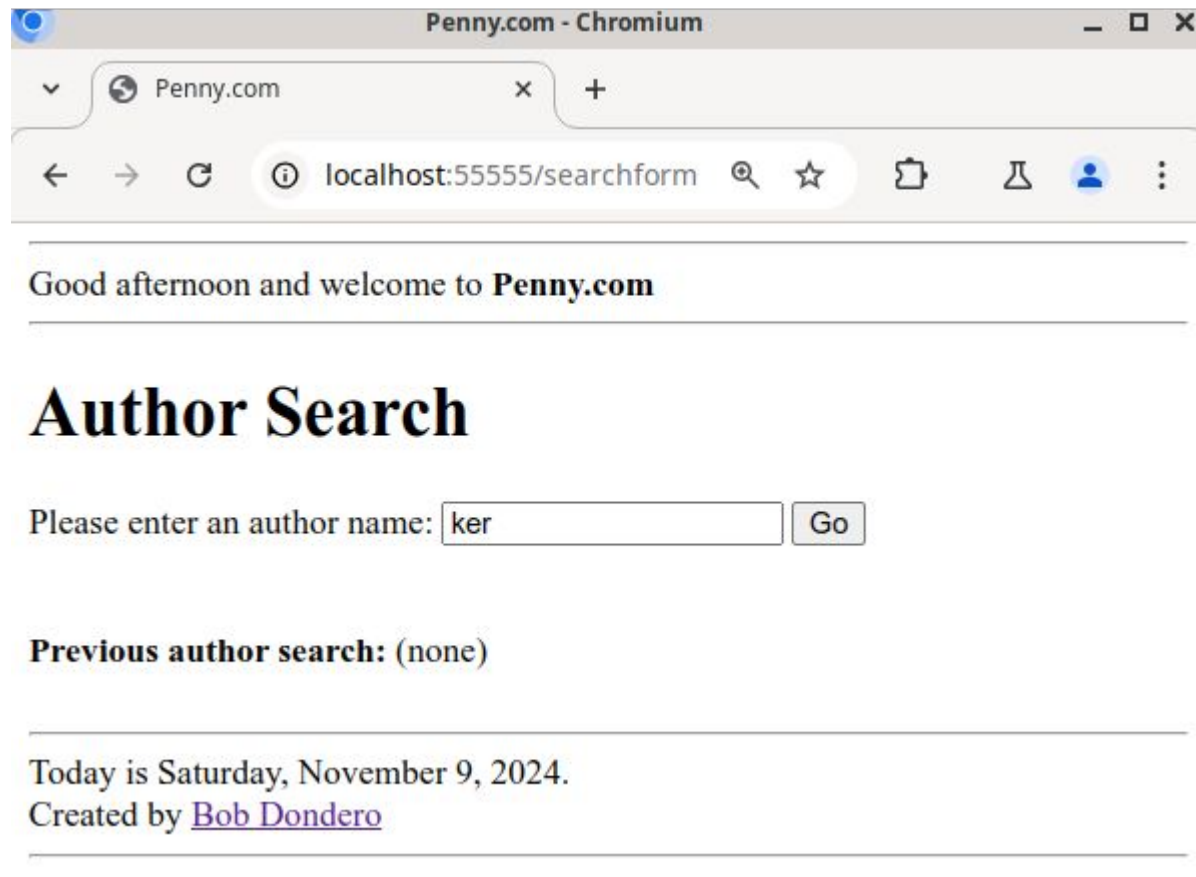

Servlet Programming

- See **PennyServlets** app (cont.)



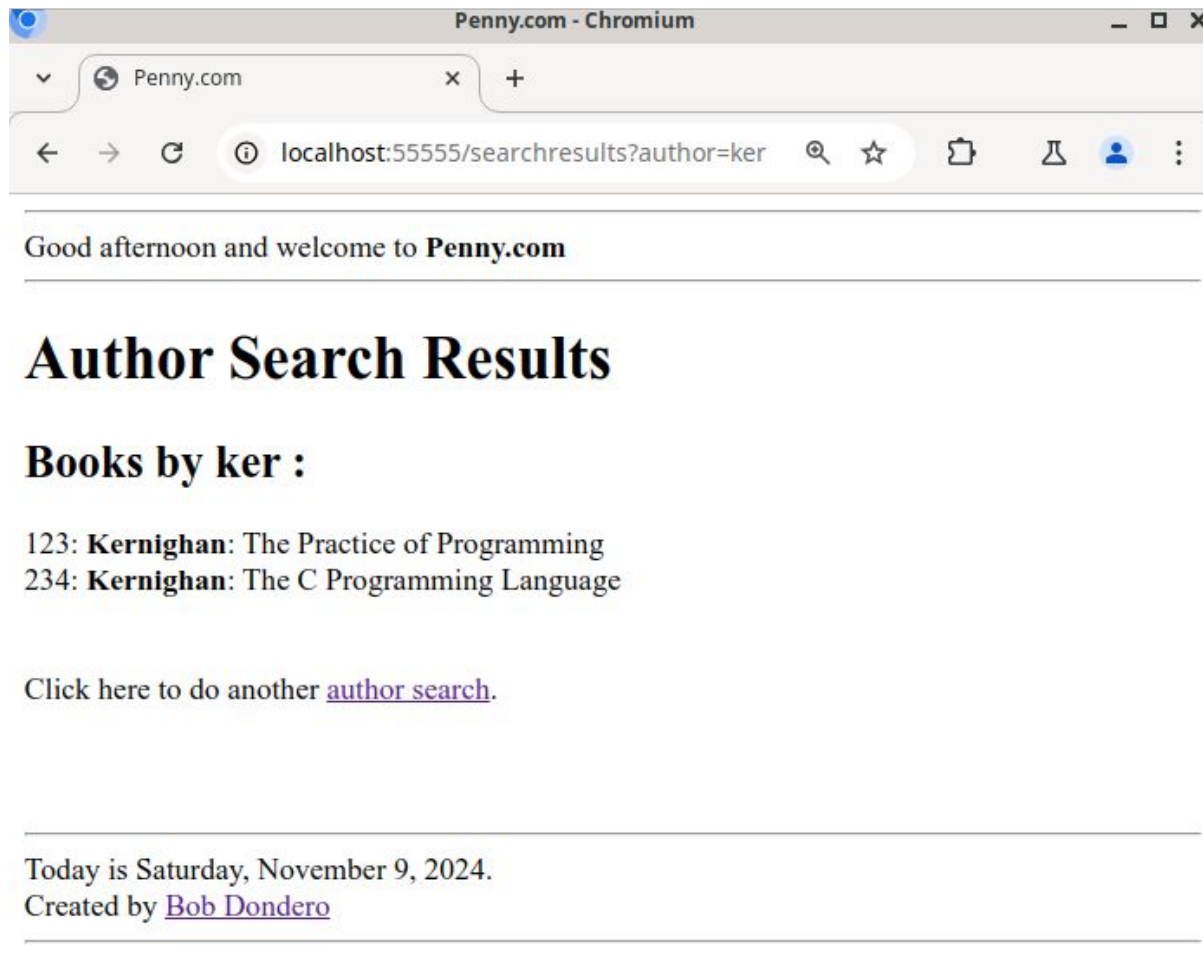
Servlet Programming

- See **PennyServlets** app (cont.)



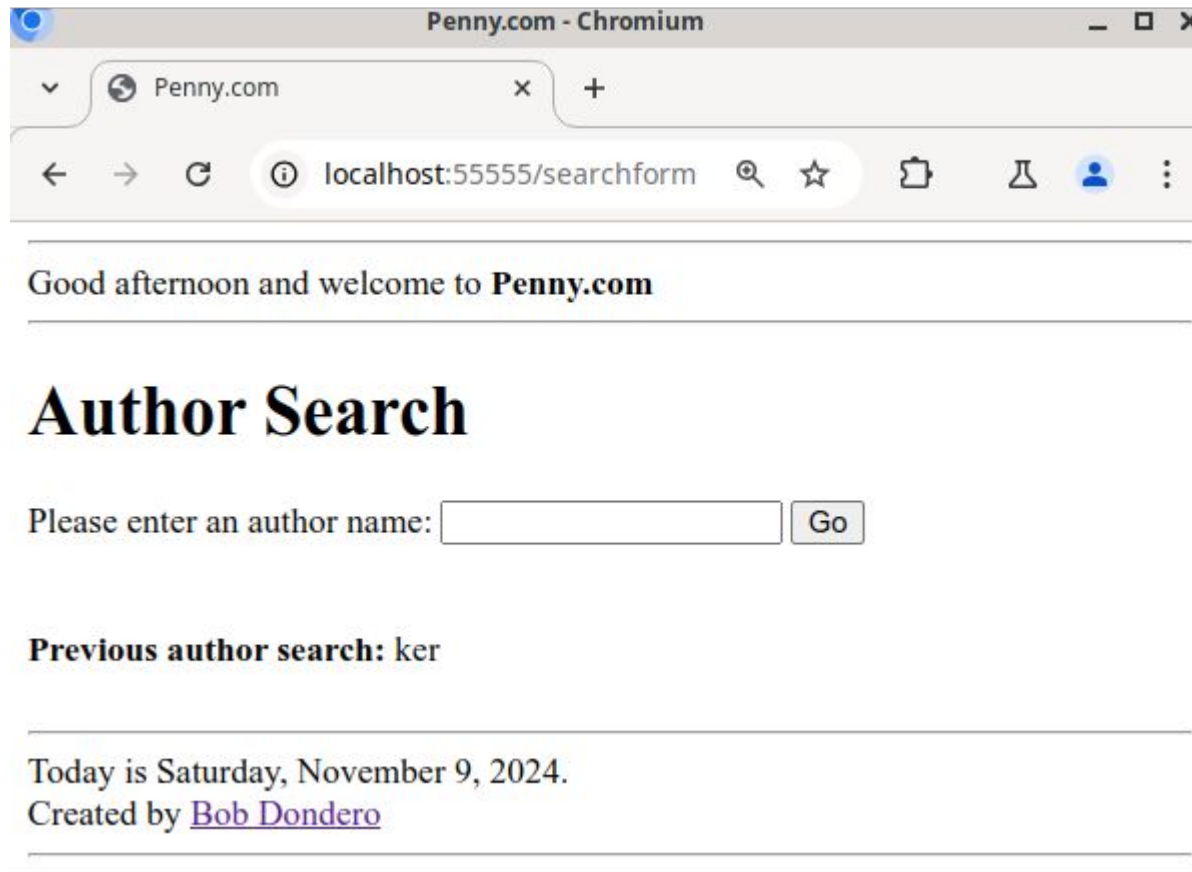
Servlet Programming

- See **PennyServlets** app (cont.)



Servlet Programming

- See **PennyServlets** app (cont.)



Servlet Programming

```
PennyServlets/  
  pom.xml  
  runserver  
  runserver.bat  
  src/  
    main/  
      java/  
        edu/  
          princeton/  
            penny/  
              Book.java  
              Common.java  
              Database.java  
              IndexServlet.java  
              Penny.java  
              SearchFormServlet.java  
              SearchResultsServlet.java  
              Util.java  
    resources/  
      penny.sql  
      penny.sqlite
```

Servlet Programming

- See **PennyServlets** app (cont.)
 - **runserver, runserver.bat**
 - **pom.xml**
 - **penny.sql, penny.sqlite**
 - **Book.java, Database.java**
 - **Common.java, Util.java**
 - **IndexServlet.java**
 - **SearchFormServlet.java**
 - **SearchResultsServlet.java**
 - **Penny.java**

Agenda

- Prelim: packages
- Prelim: library management
- Java server-side programming
- Java server-side programming: Servlets
- **Java server-side programming: Spring**
- JavaScript server-side programming
- JavaScript server-side programming: Express

Spring

- **Question:** How does one do web programming in Java?
- **Answer 1:** Use Servlets
- **Answer 2:** Use a Java web app framework

Spring



Rod
Johnson

Spring

- ***Spring Boot***

- Wikipedia: “Spring Boot is a convention-over-configuration extension for the **Spring** Java platform intended to help minimize configuration concerns while creating Spring-based applications.”

Spring

- Why study Spring / Spring Boot?
 - (Instead of some other framework)

Spring

Some popular server-side web app frameworks:

Rank	Framework	GitHub Stars
1	Laravel (PHP)	74.9K
2	Django (Python)	73.4K
3	Flask (Python)	64.5K
4	Express (JavaScript)	62.0K
5	Ruby on Rails (Ruby)	53.6K
6	Spring (Java)	53.3K
7	Meteor (JavaScript)	43.8K
8	Symfony (PHP)	28.7K

According to GitHub as of 10/4/23

Spring

- See **PennySpring** app

On Linux or Mac:

```
$ ./runserver
```

On MS Windows:

```
C:\>runserver.bat
```

[All pages identical to those of PennySpring app]

Spring

- See **PennySpring** app (cont.)
 - Browse to <https://start.spring.io/>
 - Complete as shown on following slides, and click *Generate* to download `PennySpringBoot.zip`

Spring

Spring Initializr — Mozilla Firefox

COS 333, Spring 2024: Gene X Spring Initializr

https://start.spring.io

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☰ spring initializr

Project

Gradle - Groovy Gradle - Kotlin Java Kotlin Groovy

[Maven](#)

Spring Boot

3.4.0 (SNAPSHOT) 3.4.0 (M1) 3.3.3 (SNAPSHOT) 3.3.2 3.2.9 (SNAPSHOT) 3.2.8

Project Metadata

Group

Artifact

Name

Description

Dependencies [ADD DEPENDENCIES... CTRL + B](#)

Spring Web WEB

Build web, including RESTful, applications using Spring MVC. Uses Apache Tomcat as the default embedded container.

Mustache TEMPLATE ENGINES

Logic-less templates for both web and standalone environments. There are no if statements, else clauses, or for loops. Instead there are only tags.

⌂

[GENERATE CTRL + G](#) [EXPLORE CTRL + SPACE](#) [SHARE...](#)

Spring

Spring Initializr — Mozilla Firefox

COS 333, Spring 2024: Gene X Spring Initializr

https://start.spring.io

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Project

Language

Gradle - Groovy Gradle - Kotlin Java Kotlin Groovy

Maven

Spring Boot

3.4.0 (SNAPSHOT) 3.4.0 (M1) 3.3.3 (SNAPSHOT) 3.3.2

3.2.9 (SNAPSHOT) 3.2.8

Project Metadata

Group

Artifact

Name

Description

Package name

Packaging Jar War

Java 22 21 17

Dependencies ADD DEPENDENCIES... CTRL + B

Spring Web WEB

Build web, including RESTful, applications using Spring MVC. Uses Apache Tomcat as the default embedded container.

Mustache TEMPLATE ENGINES

Logic-less templates for both web and standalone environments. There are no if statements, else clauses, or for loops. Instead there are only tags.

GENERATE CTRL + G **EXPLORE** CTRL + SPACE **SHARE...**

Spring

- See **PennySpring** app (cont.)
 - Unzip `PennySpringBoot.zip` to generate this directory structure:

Spring

```
demo
  HELP.md
  mvnw
  mvnw.cmd
  pom.xml
  .gitignore
  src/
    main/
      java/
        edu/
          princeton/
            demo/
              DemoApplication.java
      resources/
        static/
        templates/
      application.properties
    test/
      ...
  .mvn/
  ...
```

Spring

- See **PennySpring** app (cont.)
 - Edit to create this directory structure:

Spring

PennySpring

```
HELP.md
mvnw
mvnw.cmd
pom.xml
.gitignore
src/
  main/
    java/
      edu/
        princeton/
          penny/
            resources/
```

```
Book.java
Database.java
PennyApplication.java
PennyController.java
```

```
resources/
  static/
    templates/
      footer.html
      header.html
      index.html
      searchform.html
      searchresults.html
    application.properties
    penny.sql
    penny.sqlite
```

```
test/
  ...
.mvn/
  ...
```

Spring

- See **PennySpring** app (cont.)
 - **runserver, runserver.bat**
 - **pom.xml**
 - **application.properties**
 - **header.html, footer.html, index.html, searchform.html, searchresults.html**
 - **penny.sql, penny.sqlite**
 - **Book.java**
 - **Database.java**
 - **PennyApplication.java**
 - **PennyController.java**

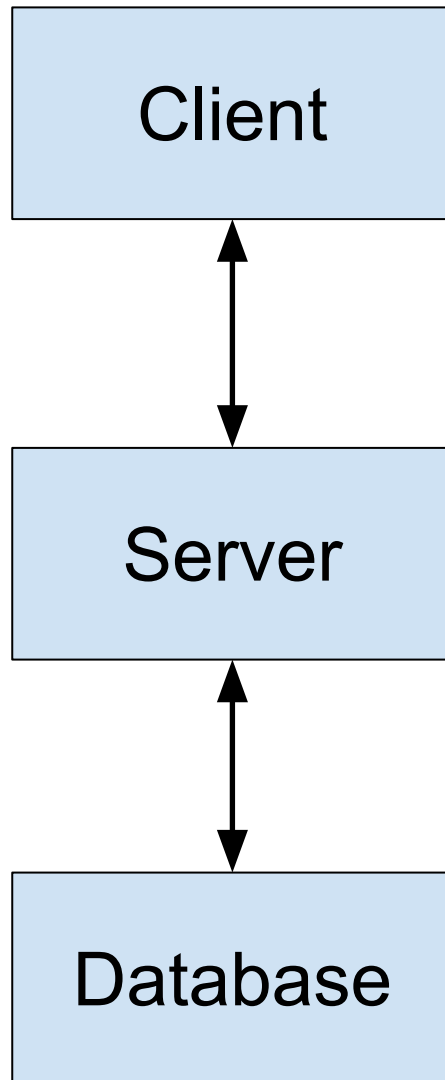
Spring

- There is much more to Spring and Mustache
 - Spring website:
 - <https://spring.io/>
 - Spring Boot website:
 - <https://spring.io/projects/spring-boot>
 - Mustache website:
 - <https://www.baeldung.com/mustache>

Agenda

- Prelim: packages
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- Java server-side programming
- Java server-side programming: Servlets
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- **JavaScript server-side programming**
- JavaScript server-side programming: Express

JavaScript Server Web Pgmming



Python
Browser/HTML/JavaScript
jQuery/React

Python
Python/Flask/Jinja2
Java/Servlets
Java/Spring/Mustache
JavaScript/Express/Mustache

SQLite
PostgreSQL

blue => course default
red => other option

JavaScript Server Web Pgmming

- Why study JavaScript server-side pgmming?

JavaScript Server Web Pgmming

Website	Front End	Back End
Google	JavaScript	C, C++, Go, Java, Python, Node
Facebook	JavaScript TypeScript Flow	Hack, HHVM, Python, C++, Java, Erlang, D, Haskell
YouTube	JavaScript TypeScript	Python, C, C++, Java, Go
Yahoo	JavaScript	PHP
Etsy	JavaScript	PHP
Amazon	JavaScript	Java, C++, Perl
Wikipedia	JavaScript	PHP
Fandom	JavaScript	PHP
X	JavaScript	C++, Java, Scala, Ruby
Bing	JavaScript	C++, C#
eBay	JavaScript	Java, JavaScript, Scala

<https://en.wikipedia.org/wiki/>

Programming_languages_used_in_most_popular_websites (July 2024)

JavaScript Server Web Pgmming

- Why study server-side JavaScript pgmming (cont.)?
 - Introduces additional aspects of JavaScript
 - Database programming
 - Becoming more popular

Agenda

- Prelim: packages
- Prelim: library management
- Java server-side programming
- Java server-side programming: Servlets
- Java server-side programming: Spring
- JavaScript server-side programming
- **JavaScript server-side programming:
Express**

Express

- Why study server-side JavaScript programming using **Express** (instead of some other framework)?

Express

Some popular server-side web app frameworks:

Rank	Framework	GitHub Stars
1	Laravel (PHP)	74.9K
2	Django (Python)	73.4K
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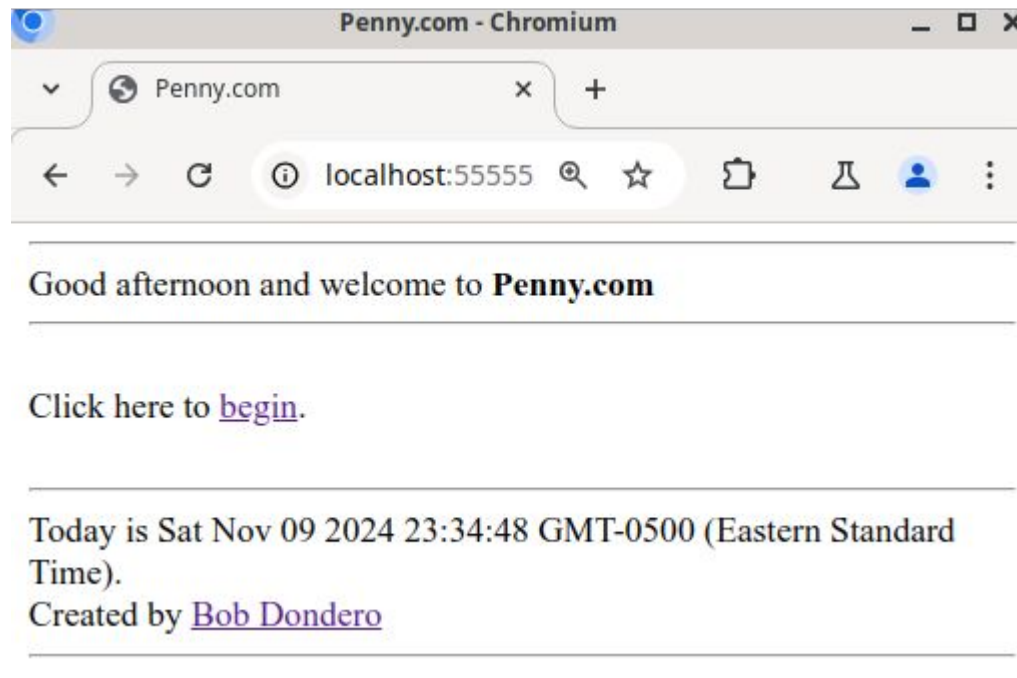
Express

- See PennyExpress app

```
$ cd PennyExpress  
$ npm install  
$ node runserver.js 55555  
Listening at port 55555
```

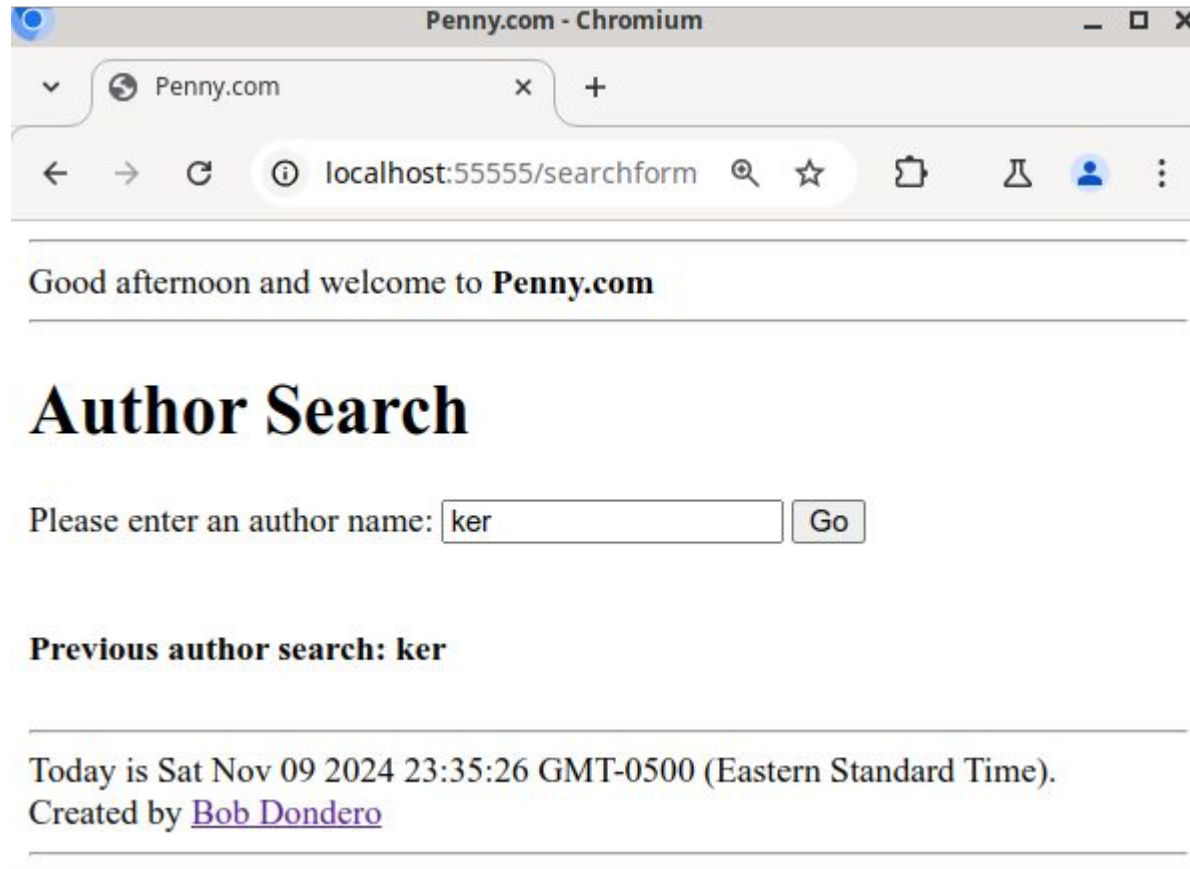
Express

- See PennyExpress app (cont.)



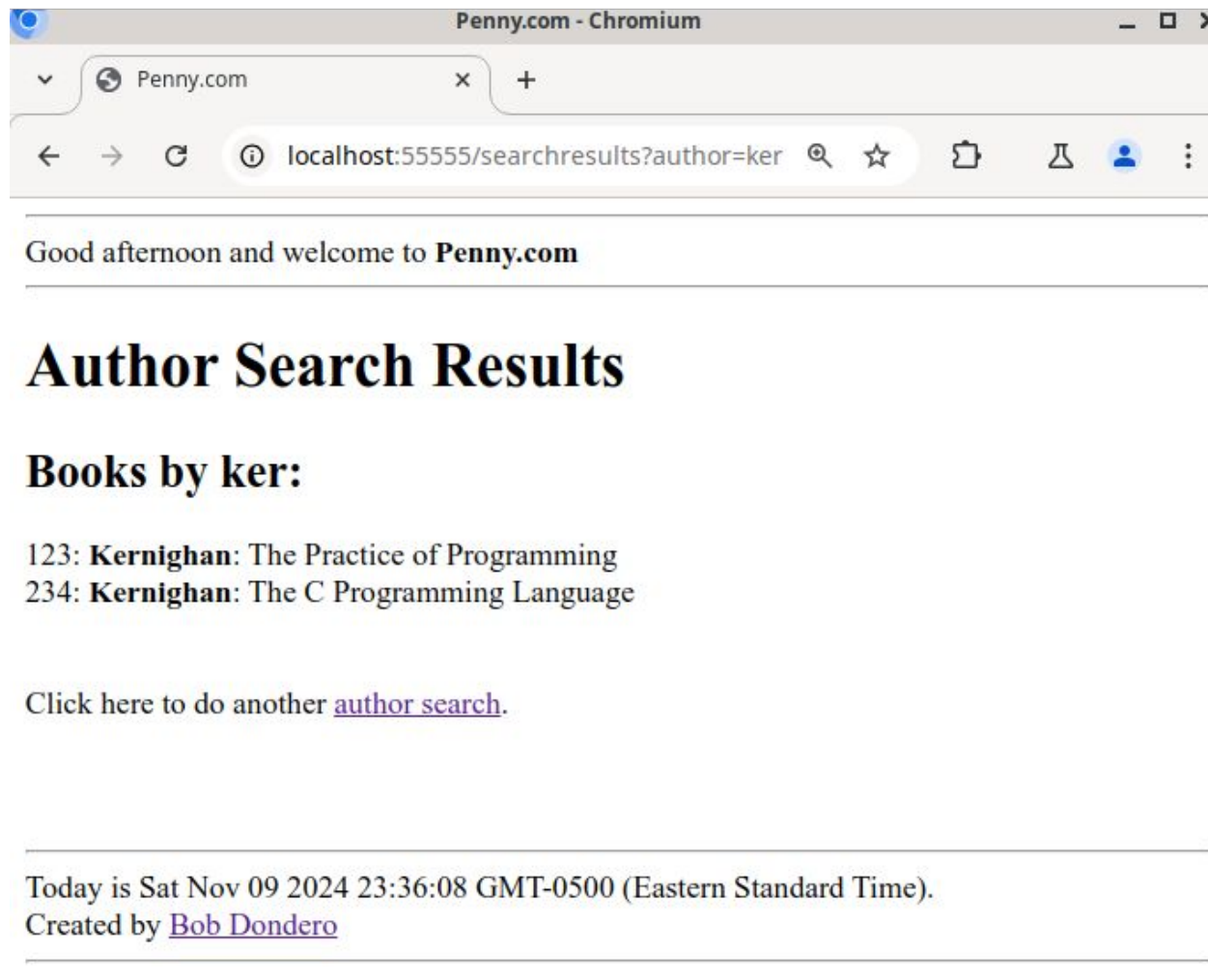
Express

- See PennyExpress app (cont.)



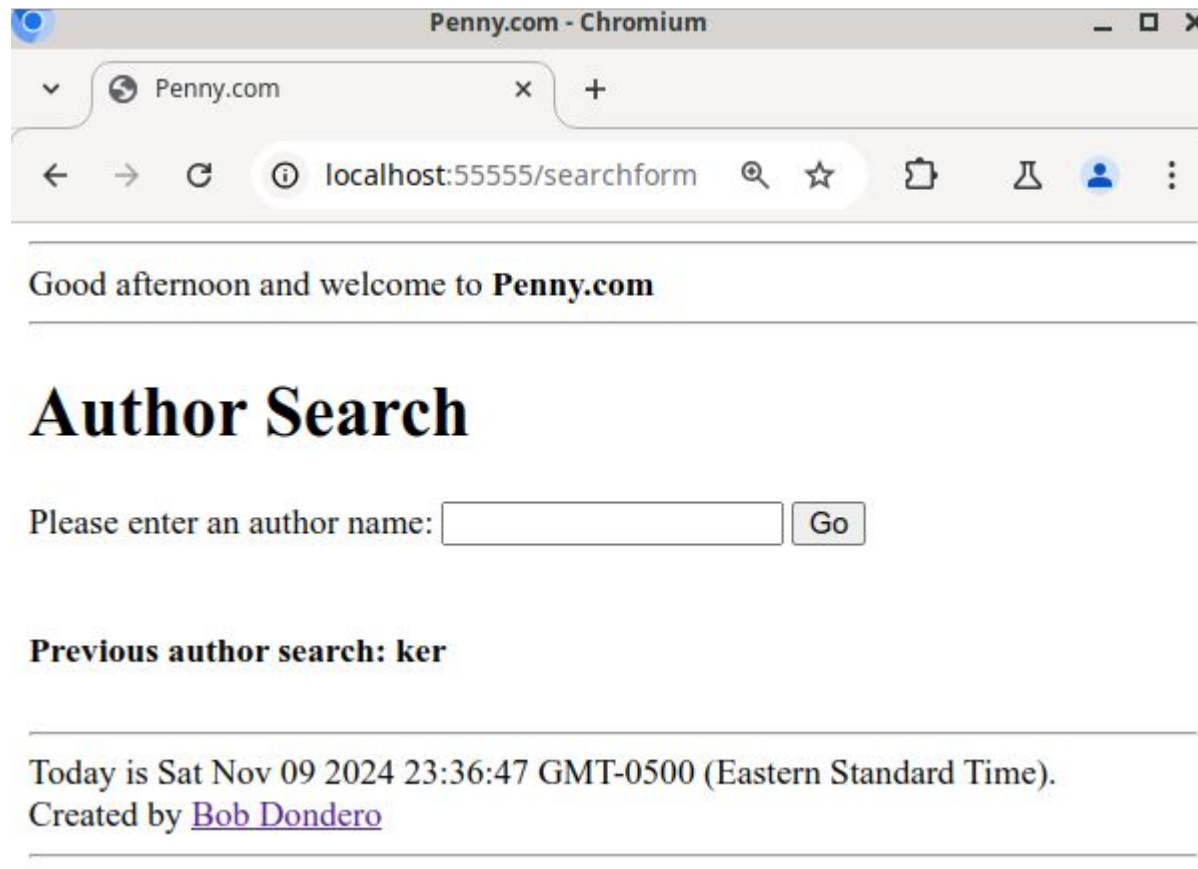
Express

- See **PennyExpress** app (cont.)



Express

- See **PennyExpress** app (cont.)



Express

- See **PennyExpress** app (cont.)
 - **runserver.js**
 - **package.json**
 - penny.sql, penny.sqlite
 - **database.js**
 - **header.html, footer.html, index.html, searchform.html, searchresults.html**
 - **penny.js**

Express

- There is much more to Express and Mustache-express
 - Express website:
 - <https://expressjs.com/>
 - Mustache-express website:
 - <https://www.npmjs.com/package/mustache-express>

Commentary

	Small Apps	Medium Apps	Large Apps
PHP	✓		
Python/Flask		✓	
JavaScript/Express		✓	
Java/Spring			✓

Summary

- We have covered:
 - Some server-side options
 - Java: Servlets
 - Java: The Spring web app framework
 - JavaScript: The Express web app framework