

# ECSE 321 Introduction to Software Engineering

***Hands-on Tutorials***

McGill University

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- [PDF version](#)

Sections of the tutorial will continuously be published at this web page.

# 1. Preliminaries

## 1.1. Getting Started

Steps for signing up for GitHub classroom:

1. Log in/Register on GitHub.
2. Open link <https://classroom.github.com/g/o9gWNZis>
3. Select your McGill ID from the list

The screenshot shows a user interface for joining a classroom roster. At the top, there is a button labeled "Join the classroom roster" with a user icon. Below this, a message states: "Your teacher has configured this classroom to pair GitHub accounts with identifiers. Please select yourself from the list below. You can also skip this step for now." A scrollable list box displays a series of McGill IDs:

McGillID
260238916
260485177
260493293
260551876
260609638
260632353
260632542

At the bottom left of the list box is a "Skip" button.

4. Join team *All students*

The screenshot shows a user interface for accepting a course organization assignment. At the top, there is a button labeled "Accept the Signup for ECSE321 course organization assignment" with a user icon. Below this, a message states: "Accepting this assignment will give your team access to the assignment repository in the @McGill-ECSE321-Winter2019 organization on GitHub. Please be certain that the team you are selecting is the correct team as you cannot change this later".

The interface then asks the user to "Join an existing team". It lists a single team named "AllStudents 0 students" with a "Join" button next to it. This "Join" button is highlighted with a red rectangle. Below this, there is a section for creating a new team, with a "Create a new team" button and a "+ Create team" button.

# 1.2. Project Management Tools for Agile Development

## 1.2.1. GitHub Projects

First, we create a new repository under everyone's own account to demonstrate the basic features of "GitHub Projects".

1. Visit <https://github.com/> then click on *New repository* (green button on the right).
2. Set your user as the owner of the repository.
3. Give a name for the repository (e.g., ecse321-tutorial-1), leave it *public*, then check *Initialize this repository with a README*. Click on *Create repository* afterwards. At this point the remote repository is ready to use.

### Create a new repository

A repository contains all the files for your project, including the revision history.

Owner                          Repository name

 **ecse321testuser** / **ecse321-tutorial-1** 

Great repository names are short and memorable. Need inspiration? How about **furry-octo-journey**.

Description (optional)

---

 **Public**  
Anyone can see this repository. You choose who can commit.

 **Private**  
You choose who can see and commit to this repository.

---

**Initialize this repository with a README**  
This will let you immediately clone the repository to your computer. Skip this step if you're importing an existing repository.

Add .gitignore: **None** | Add a license: **None** | 

---

**Create repository**

Once the repository is ready, associate a new GitHub Project and see how their features work. Create a project:

A screenshot of a GitHub repository page. At the top right, there is a user icon and a dropdown menu. The dropdown menu is open, showing options: 'New repository', 'Import repository', 'New gist', 'New organization', 'This repository', 'New issue', and 'New project'. The 'New project' option is highlighted with a blue background.

Select Basic Kanban project style:

A screenshot of the 'Create a new project' form on GitHub. The form includes fields for 'Project board name' (set to 'Tutorial 1') and 'Description (optional)'. Below these, there is a section for 'Project template' with a dropdown menu. The 'Basic kanban' template is selected, highlighted with a blue background. Other templates listed include 'None', 'Automated kanban', 'Automated kanban with reviews', and 'Bug triage'. At the bottom of the page, there are links for 'Terms', 'Privacy', 'Contact GitHub', 'Pricing', 'API', 'Training', 'Blog', and 'About'.

Tasks to complete:

1. Create a few issues to outline the tasks for the first deliverable. Assign them appropriate labels and add yourself as the assignee!

The screenshot shows the GitHub Issues page for a repository. At the top, there are navigation links for Code, Issues (5), Pull requests (0), ZenHub, Projects (1), Wiki, Releases, More, and Settings. Below the header, there are search filters: 'Filters' (dropdown), a search bar with the query 'is:issue is:open sort:updated-desc', and buttons for 'Labels' and 'Milestones'. A green 'New issue' button is located in the top right corner. A link to 'Clear current search query, filters, and sorts' is also present. The main content area displays five open issues:

- Create UML Class diagram in UML Lab** (#1) - Created 2 days ago by imbur, updated 2 days ago. Labels: documentation.
- Add UML Diagram** (#2) - Created 2 days ago by imbur, updated 2 days ago. Labels: documentation.
- Create database layer** (#5) - Created 2 days ago by imbur, updated 2 days ago. Labels: epic.
- Write project deliverable 1** (#4) - Created 2 days ago by imbur, updated 2 days ago. Labels: epic.
- Report individual and teamwork** (#3) - Created 2 days ago by imbur, updated 2 days ago. Labels: documentation.

2. Create a milestone for the issues.

The screenshot shows the GitHub Issues page for the same repository, but with the 'Milestones' tab selected. The top navigation and search filters are identical to the previous screenshot. The 'New milestone' button in the top right corner is highlighted with a red box. The main content area shows the same five issues, but the 'Milestones' tab is active.

3. Create cards from the issues on the project board.

4. See how GitHub track the project progress as you move the cards from the different columns.

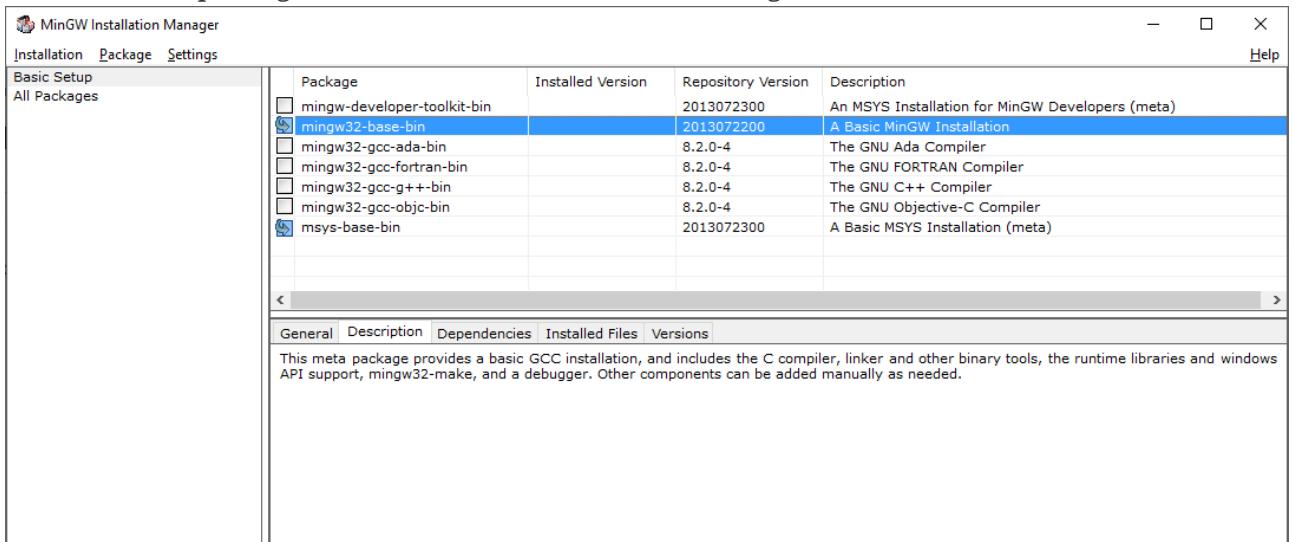
# 1.3. Command Line Basics

This section shows a few handy terminal commands.

## 1.3.1. Windows prerequisites

This step can be skipped if you are using MacOS or Linux. However, if you are using Windows, you need to have a terminal that supports the execution of basic Linux commands. Such programs are Git Bash or MinGW, for example. You can find below a few helper steps to get MinGW running on your system.

1. Get the [MinGW installer from here](#)
2. Install it to wherever you like, the default installation folder is *C:\MinGW*
3. Once the setup finishes, open the MinGW Installation Manager
4. Select the two packages for installation as shown in the figure below



5. Click on *Installation/Apply Changes*. This will take a few moments to fetch and install the required packages.
6. You can open a terminal window by running the executable *C:\MinGW\msys\1.0\bin\bash.exe*

## 1.3.2. Basic file system operations

1. Open a terminal, and try the following commands:

- **pwd**: prints the present working directory

Example:

```
$ pwd  
/home/ecse321
```

- **ls**: lists the content of a given folder

Example:

```
$ ls /home  
ecse321 guest-user admin
```

- **cd**: navigates the file system

Example:

```
$ cd ..  
$ pwd  
/home  
$ cd ecse321  
$ pwd  
/home/ecse321
```

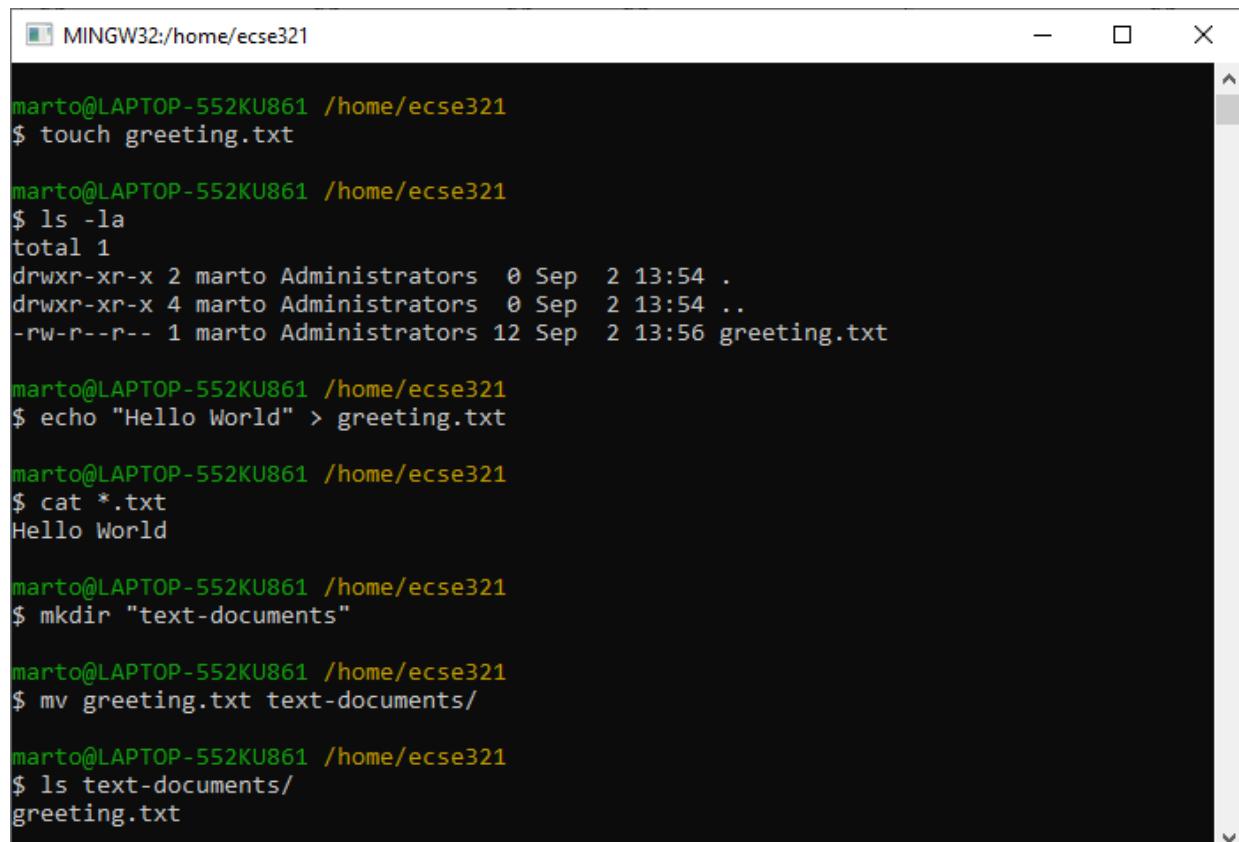
**NOTE**

The following steps will include images that illustrate the commands and their output to prevent easy copy-paste. Sorry! :)

## 2. Creating files and reading/writing their contents

- **touch**: creates a file
- **mkdir**: creates a directory
- **mv**: moves a file (or directory) from its current location to a target location
- **echo**: prints a string
- **cat**: prints the contents of a file

Example:



```
marto@LAPTOP-552KU861 /home/ecse321  
$ touch greeting.txt  
  
marto@LAPTOP-552KU861 /home/ecse321  
$ ls -la  
total 1  
drwxr-xr-x 2 marto Administrators 0 Sep  2 13:54 .  
drwxr-xr-x 4 marto Administrators 0 Sep  2 13:54 ..  
-rw-r--r-- 1 marto Administrators 12 Sep  2 13:56 greeting.txt  
  
marto@LAPTOP-552KU861 /home/ecse321  
$ echo "Hello World" > greeting.txt  
  
marto@LAPTOP-552KU861 /home/ecse321  
$ cat *.txt  
Hello World  
  
marto@LAPTOP-552KU861 /home/ecse321  
$ mkdir "text-documents"  
  
marto@LAPTOP-552KU861 /home/ecse321  
$ mv greeting.txt text-documents/  
  
marto@LAPTOP-552KU861 /home/ecse321  
$ ls text-documents/  
greeting.txt
```

### 1.3.3. Finding files

The versatile `find` command allows us to find files based on given criteria. Take look at its manual page with `man find`!

Example:

```
MINGW32:/home/ecse321
marto@LAPTOP-552KU861 /home/ecse321
$ ls -la
total 0
drwxr-xr-x 3 marto Administrators 0 Sep  2 23:05 .
drwxr-xr-x 4 marto Administrators 0 Sep  2 13:54 ..
drwxr-xr-x 2 marto Administrators 0 Sep  2 23:05 text-documents

marto@LAPTOP-552KU861 /home/ecse321
$ find ./ -iname *txt
./text-documents/greeting.txt
```

### 1.3.4. Batch file operations

- `sed`: stream editor; changes a given string to a replacement

Combining `find` with an additional command (e.g., `sed`) can greatly speed up your repetitive tasks.

Example:

```
MINGW32:/home/ecse321
marto@LAPTOP-552KU861 /home/ecse321
$ ls -la text-documents/
total 2
drwxr-xr-x 2 marto Administrators 0 Sep  2 23:26 .
drwxr-xr-x 3 marto Administrators 0 Sep  2 23:05 ..
-r--r--r-- 1 marto Administrators 14 Sep  2 23:26 greeting.txt
-rw-r--r-- 1 marto Administrators 12 Sep  2 23:21 helloworld.txt

marto@LAPTOP-552KU861 /home/ecse321
$ touch temp

marto@LAPTOP-552KU861 /home/ecse321
$ sed "s/World/ECSE321/g" text-documents/greeting.txt temp
Hello ECSE321

marto@LAPTOP-552KU861 /home/ecse321
$ cat temp

marto@LAPTOP-552KU861 /home/ecse321
$ sed "s/World/ECSE321/g" text-documents/greeting.txt > temp

marto@LAPTOP-552KU861 /home/ecse321
$ cat temp
Hello ECSE321

marto@LAPTOP-552KU861 /home/ecse321
$ mv temp text-documents/greeting.txt

marto@LAPTOP-552KU861 /home/ecse321
$ find ./ -iname *txt -exec sed "s>Hello/Hi/g" {} \;
Hi ECSE321
Hi World
```

**NOTE**

The file `helloworld.txt` in the example is initially a copy of `greeting.txt`.

### 1.3.5. Some additional useful commands

- `rm`: removes a file
- `cp -r`: copies a directory recursively with its contents
- `rmdir`: remove an empty directory

- `rm -rf`: force to recursively delete a directory (or file) and all its contents
- `nano`: an easy-to-use text editor (not available by default in MinGW)
- `grep`: finds matches for a string in a given stream of characters
- `ag`: takes a string as argument and searches through the contents of files recursively to find matches of the given string (this tool is included in the *silver searcher-ag* package)

## 1.4. Git and GitHub

### 1.4.1. Installing Git

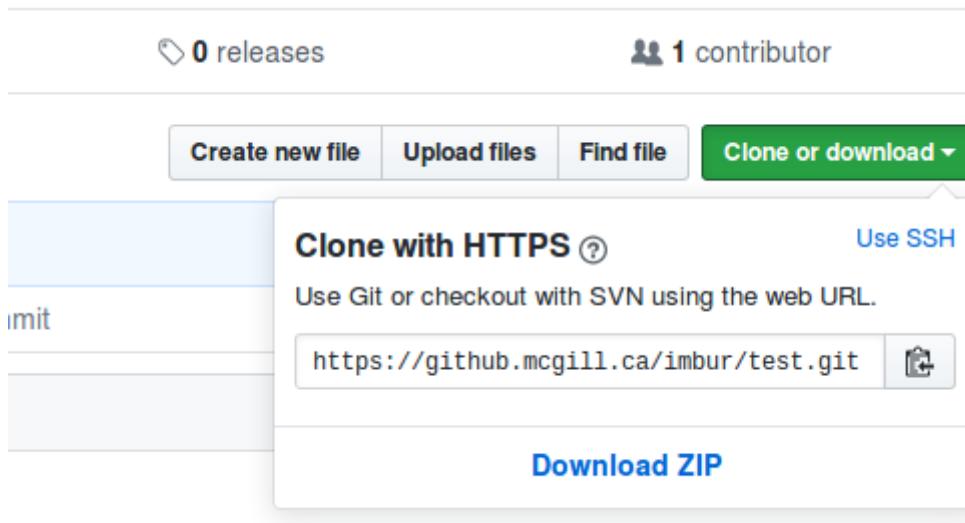
Install the Git version control system (VCS) from <https://git-scm.com/downloads>.

### 1.4.2. Creating a remote git repository on GitHub

1. Go to <https://github.com/new>
2. Set *test* as the name of the repository
3. Check the checkbox *Initialize this repository with a README*
4. Click on create repository

### 1.4.3. Cloning to a local repository

1. Open up a terminal (Git bash on Windows).
2. Navigate to the designated target directory (it is typical to use the `git` folder within the home directory for storing Git repositories, e.g., `cd /home/username/git`).
3. Using a Git client, clone this newly created *test* repository to your computer. First, get the repository URL (use HTTPS for now).



Then, issue `git clone https://url/of/the/repository.git`

You should get an output similar to this:

```
Shabbir@SHABBIR-LAPTOP ~/Documents/code/university
$ git clone git@github.com:mcgill-ecse321/class-notes.git
Cloning into 'class-notes'...
remote: Counting objects: 290, done.
remote: Compressing objects: 100% (4/4), done.
remote: Total 290 (delta 0), reused 0 (delta 0)Receiving objects: 96% (279/290), 5.68 MiB | 314 KiB/s
Receiving objects: 100% (290/290), 5.91 MiB | 313 KiB/s, done.
Resolving deltas: 100% (59/59), done.
Shabbir@SHABBIR-LAPTOP ~/Documents/code/university
$
```

- Verify the contents of the *working copy* of the repository by `ls -la ./test`. The `.git` folder holds version information and history for the repository, while the `README.md` is an auto-generated text file by GitHub.

#### 1.4.4. Git basics

- Open up a terminal and configure username and email address. These are needed to identify the author of the different changes.

```
Shabbir@SHABBIR-LAPTOP ~/Documents/code/university/myfirstrepo (master)
$ git config --global user.name "shabbir-hussain"
```

```
Shabbir@SHABBIR-LAPTOP ~/Documents/code/university/myfirstrepo (master)
$ git config --global user.email shabbir.hussain@outlook.com
```

Glossary—Part 1:

- **Git** is your version control software
  - **GitHub** hosts your repositories
  - A **repository** is a collection of files and their history
  - A **commit** is a saved state of the repository
- Enter the working directory, then check the history by issuing `git log`. Example output:

```
commit 2a0735092cealb7f7c850a48b86e8847bf979236
Author: Shabbir Hussain <mohd.husn001@gmail.com>
Date: Thu Aug 28 15:33:09 2014 -0400

    almost finished seat checking

commit 90bfbac1c8134a87d16caf89c9ff66104f8b7fb7
Author: Shabbir Hussain <mohd.husn001@gmail.com>
Date: Thu Aug 28 14:30:07 2014 -0400

    fixed wishlist null ptr exception

commit ca4a6921005e89dace34226560921c9770a82574
Author: Shabbir Hussain <mohd.husn001@gmail.com>
Date: Thu Aug 28 11:03:19 2014 -0400

    grade checker hotfix
```

- Adding and committing a file: use the `git add` and `git commit` commands.

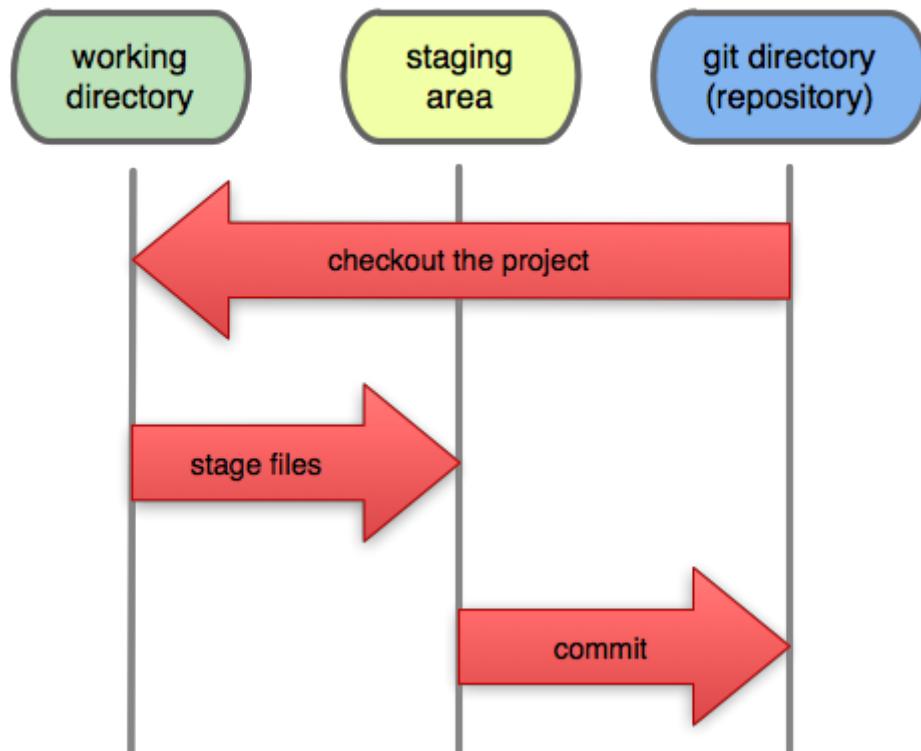
```
Shabbir@SHABBIR-LAPTOP ~/Documents/code/university/myfirstrepo (master)
$ touch helloworld.java
```

```
Shabbir@SHABBIR-LAPTOP ~/Documents/code/university/myfirstrepo (master)
$ git add helloworld.java
```

```
Shabbir@SHABBIR-LAPTOP ~/Documents/code/university/myfirstrepo (master)
$ git commit -m 'added hello world file to the project'
[master (root-commit) f4a1ddc] added hello world file to the project
 1 file changed, 0 insertions(+), 0 deletions(-)
 create mode 100644 helloworld.java
```

The effect of these commands are explained on the figure below:

## Local Operations



Glossary—Part 2:

- **Working Directory:** files being worked on right now
- **Staging area:** files ready to be committed
- **Repository:** A collection of commits

4. Checking current status is done with `git status`.

```
Shabbir@SHABBIR-LAPTOP ~/Documents/code/university/myfirstrepo (master)
$ git status
# On branch master
# Changes not staged for commit:
#   (use "git add <file>..." to update what will be committed)
#   (use "git checkout -- <file>..." to discard changes in working directory)
#
#       modified:   helloworld.java
#
# no changes added to commit (use "git add" and/or "git commit -a")
```

5. Staging and unstaging files: use `git add` to add and `git reset` to remove files from the staging area.

```
Shabbir@SHABBIR-LAPTOP ~/Documents/code/university/myfirstrepo (master)
$ git add .
```

```
Shabbir@SHABBIR-LAPTOP ~/Documents/code/university/myfirstrepo (master)
$ git status
# On branch master
# Changes to be committed:
#   (use "git reset HEAD <file>..." to unstage)
#
#       new file:   helloworld.class
#       modified:   helloworld.java
#
```

```
Shabbir@SHABBIR-LAPTOP ~/Documents/code/university/myfirstrepo (master)
$ git reset helloworld.class
Shabbir@SHABBIR-LAPTOP ~/Documents/code/university/myfirstrepo (master)
$ git status
# On branch master
# Changes to be committed:
#   (use "git reset HEAD <file>..." to unstage)
#
#       modified:   helloworld.java
#
# Untracked files:
#   (use "git add <file>..." to include in what will be committed)
#
#       helloworld.class
```

**CAUTION** Only staged files will be included in the next commit.

6. To display detailed changes in unstaged files use `git diff`, while use `git diff --staged` to show changes within files staged for commit.

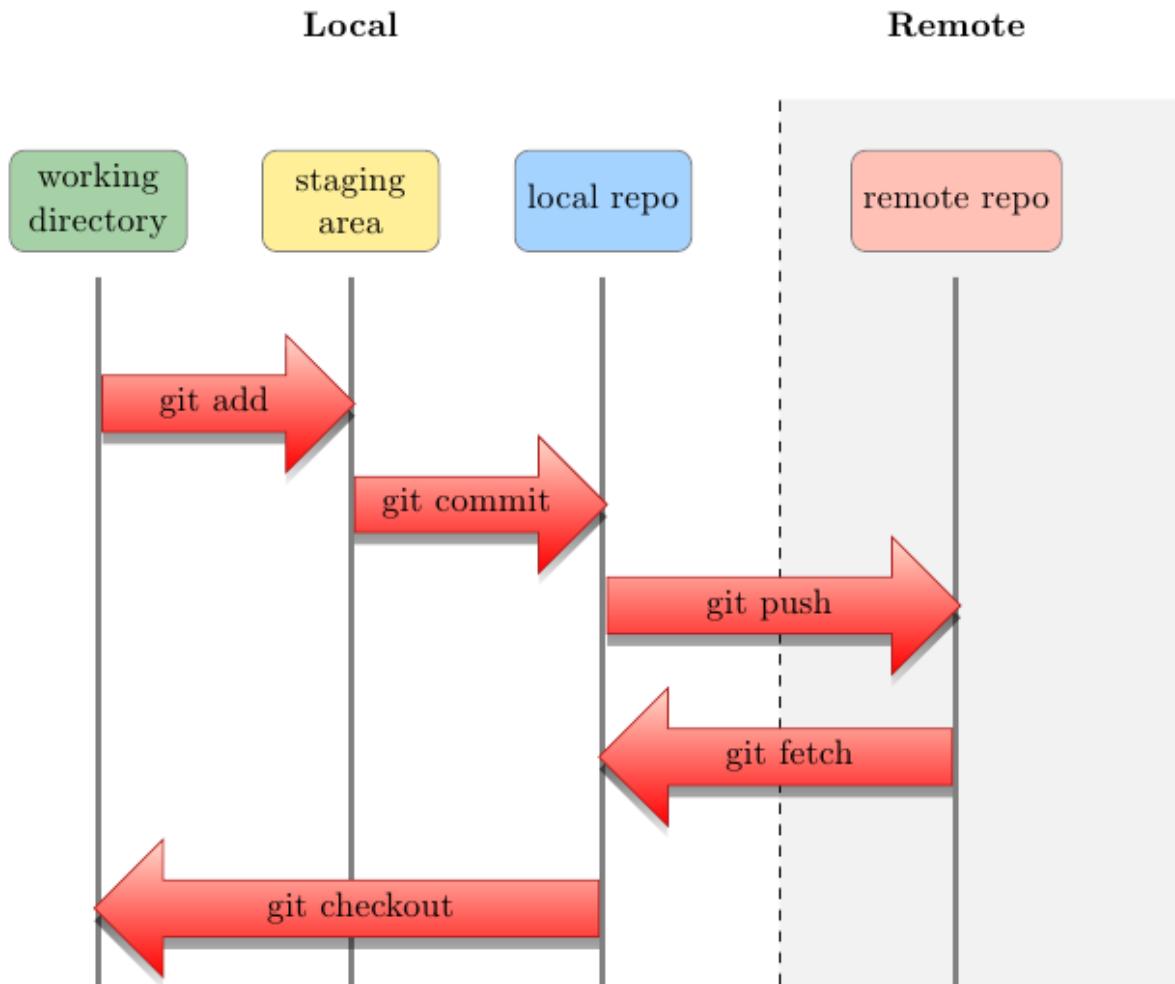
```
Shabbir@SHABBIR-LAPTOP ~/Documents/code/university/myfirstrepo (master)
$ git diff helloworld.java
diff --git a/helloworld.java b/helloworld.java
index 28fe9d9..de3a7d2 100644
--- a/helloworld.java
+++ b/helloworld.java
@@ -1,6 +1,6 @@
 public class helloworld{

        public static void main(String[] args){
-            System.out.println("Hello World");
+            System.out.println("Hello World")
}
```

7. Reverting to a previous version is done using `git checkout`.

```
Shabbir@SHABBIR-LAPTOP ~/Documents/code/university/myfirstrepo (master)
$ git checkout helloworld.java
```

8. The commands `git pull` (or the `git fetch + git rebase` combination) and `git push` are used to synchronize local and remote repositories.



#### 1.4.5. Browsing commit history on GitHub

1. You can browse pushed commits in the remote repository online using GitHub. You can select the *commits* menu for a repository.

This screenshot shows a GitHub repository page for 'ECSE321-2018-Winter / EventRegistration'. The top navigation bar includes links for 'Enterprise', 'This repository', 'Search', 'Pull requests', 'Issues', 'Gist', and user profile icons. Below the header, the repository name 'ECSE321-2018-Winter / EventRegistration' is displayed, along with 'Watch 0', 'Star 0', 'Fork 0' buttons. The main content area shows a summary: '4 commits', '1 branch', '0 releases', and '1 contributor'. A note states, 'This repository contains the initial sources needed for the first assignment.' At the bottom, there are buttons for 'Branch: master ▾', 'New pull request', 'Create new file', 'Upload files', 'Find file', and 'Clone or download ▾'.

To get a link for a specific commit, click on the button with the first few characters of the hash of the commit.

The screenshot shows a GitHub Enterprise interface for the repository 'ECSE321-2018-Winter / EventRegistration'. The top navigation bar includes links for 'Pull requests', 'Issues', and 'Gist'. On the right, there are buttons for 'Watch' (0), 'Star' (0), and 'Fork' (0). Below the navigation, a menu bar offers options like 'Code', 'Issues (0)', 'Pull requests (0)', 'Projects (0)', 'Wiki', 'Pulse', 'Graphs', and 'Settings'. A dropdown menu indicates the current branch is 'master'. The main content area displays a list of commits grouped by date: 'Commits on Jan 10, 2018', 'Commits on Jan 8, 2018', and 'Commits on Jan 7, 2018'. Each commit card includes the author's profile picture, the commit message, the date it was committed, and three action buttons: a copy icon, the commit hash, and a diff icon. The commit hash '58c992b' from January 8, 2018, is highlighted with a red rectangle.

- Fixing default Android IP address in the props.  
imbur committed on GitHub Enterprise 2 hours ago
- Patching URL for CORS mapping  
imbur committed on GitHub Enterprise 5 hours ago

- Adding initial Java Spring project seed  
imbur committed 3 days ago

- Initial commit  
imbur committed 3 days ago

The source for most of the images in the Git documentation: <https://github.com/shabbir-hussain/ecse321tutorials/blob/master/01-githubTutorial1.pptx>

## 1.5. Travis CI

1. Go to <https://travis-ci.com/>, click on Sign up with GitHub.
2. Click on the green authorize button at the bottom of the page.
3. Activate Travis-CI on your GitHub account

The screenshot shows the Travis CI account settings page for a user named 'ecse321testuser'. The top navigation bar includes links for 'Travis CI', 'About Us', 'Status', and 'Help'. On the right, the user's name 'ecse321testuser' is displayed next to a green profile icon. The main area is titled 'MY ACCOUNT' and shows the user's GitHub handle 'ecse321testuser'. A 'Sync account' button is present. Below it, there's a section for 'ORGANIZATIONS' stating 'You are not currently a member of any organization.' and a link to 'MISSING AN ORGANIZATION? Review and add your authorized organizations.'. The central part of the page is titled 'GitHub Apps Integration' with the sub-instruction 'Activate the GitHub Apps integration to start testing and deploying on Travis CI.' It explains that the integration supports both private and open source repositories and provides enhanced security. A prominent green 'Activate' button is shown, which is highlighted with a red rectangular box. Below the button, a note states: 'We are only able to migrate accounts that have 50 or fewer repositories using the Legacy Services Integration. Please refer to our documentation on how to migrate your account.'

4. Select the repositories you want to build with Travis (make sure to include your repository that you created for this tutorial). You can modify this setting anytime later as well.
5. In your working copy of your repository, create a default Gradle java project.
  - Make sure you have `Gradle` installed (`gradle --version`).
  - Issue `gradle init --type java-library`
  - Add a `.gitignore` to ignore generated resources by Git:

```
.gradle/  
build/
```

- Make sure your application is compiling by running `gradle build`
6. Create a file called `.travis.yml`:

```
language: java  
script:  
- gradle build
```

7. Commit and push your work. If everything is set up correctly, the build should trigger and

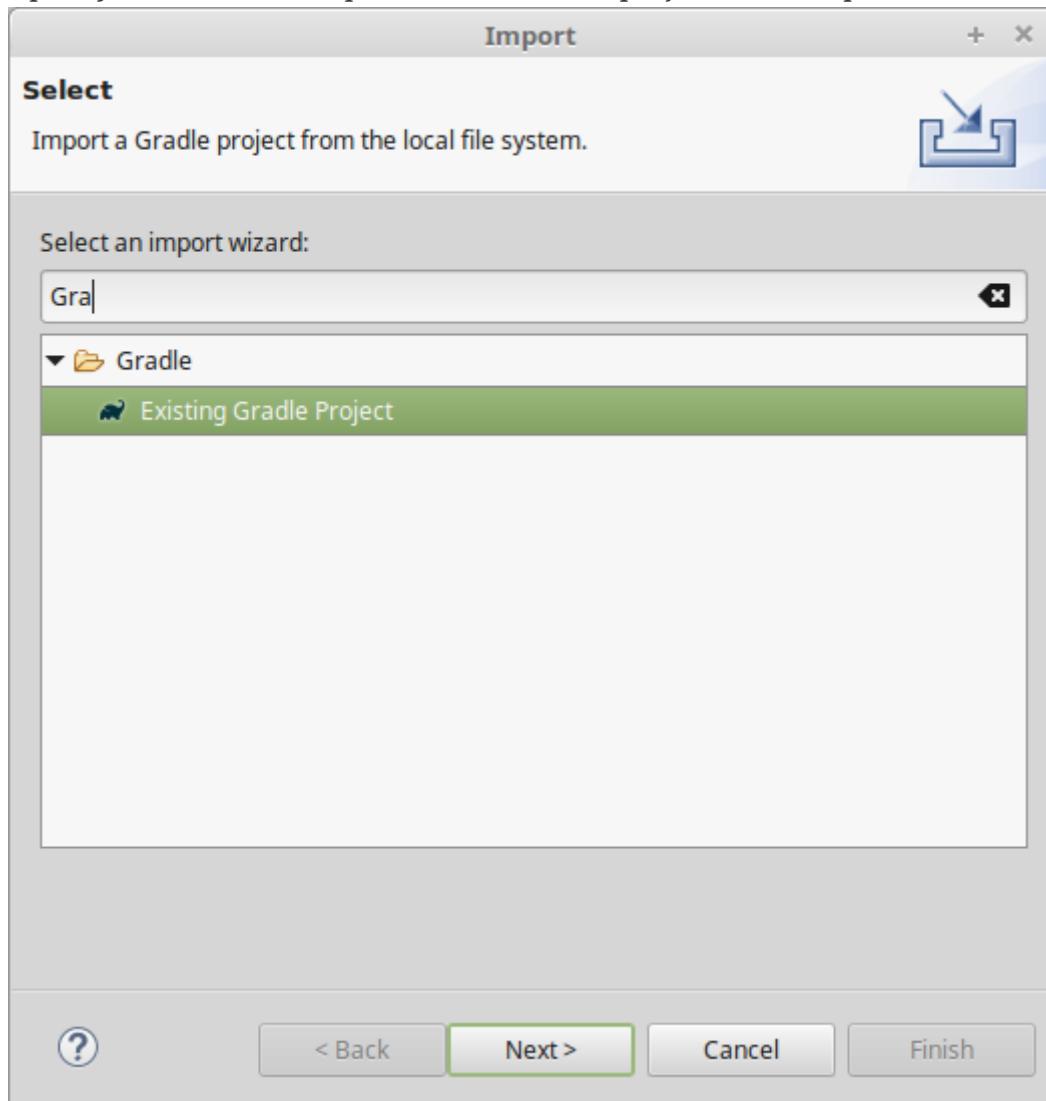
Travis should run your build using Gradle.

# 1.6. Gradle: A Build Framework

## 1.6.1. Example Gradle application

This section focuses on writing a Gradle (<https://gradle.org/>) build script that builds a single Gradle project referred to as *computation*. The project with the below gradle structure is available for you to download and import in your IDE.

1. Go to this [link](#) and download the *computation.zip*. Once it is downloaded, extract the project from zip.
2. Open your IDE and import the extracted project(from step 1) as *Existing Gradle Project*.



3. After importing the project, check that your imported project has the required structure as shown below:

```

computation
├── build.gradle
└── src
    ├── main
    │   └── java
    │       ├── application
    │       │   └── CompApp.java
    │       ├── computation
    │       │   └── Computation.java
    │       └── view
    │           └── ComputationPage.java
    └── test
        └── java
            └── computation
                ├── AllTests.java
                ├── ComputationTestAddSubtract.java
                └── ComputationTestDivideMultiply.java

```

4. Open the *build.gradle* file and check for the relevant parts as discussed in the steps (5 to 9) below.
5. **java** and the **application** plugins are added in the build configuration script *build.gradle*.

```

apply plugin: 'java'
// This plugin has a predefined 'run' task that we can reuse to use Gradle to
// execute our application
apply plugin: 'application'

```

6. JUnit libraries are added in the **dependencies** section.

```

repositories {
    mavenCentral()
}
dependencies {
    testImplementation "junit:junit:4.12"
}

```

7. A task **compile(type: JavaCompile)** has been added to specify all source files (both application and test) and set the *build/bin* as destination dir to put all compiled class files in.

```

task compile(type: JavaCompile) {
    classpath = sourceSets.main.compileClasspath
    classpath += sourceSets.test.runtimeClasspath
    sourceSets.test.java.outputDir = file('build/bin')
    sourceSets.main.java.outputDir = file('build/bin')
}

```

**NOTE** One can specify source sets and their variables the following way:

```
/*
 * specifying sourceSets is not necessary in this case, since
 * we are applying the default folder structure assumed by Gradle
 */
sourceSets {
    main {
        java { srcDir 'src/main/java' }
    }
    test {
        java { srcDir 'src/test/java' }
    }
}
```

8. The main class has been specified as shown below. Now, you can proceed and run the application.

```
mainClassName='application.CompApp'
```

In the command line issue `gradle run`

9. The `jar` Gradle task (defined by the `java` plugin) has been added to produce an executable jar file into `distributable/`.

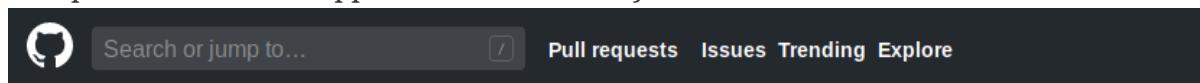
```
jar {
    destinationDir=file('distributable')
    manifest {
        // It is smart to reuse the name of the main class variable instead of
        hardcoding it
        attributes "Main-Class": "$mainClassName"
    }
}
```

**NOTE** The `settings.gradle` and its usage is to be shown later.

## 2. Backend

## 2.1. Setting up a Spring/Spring Boot backend app with Gradle

1. Install the [Spring Boot CLI](#)
2. Create a new repository under your account on GitHub for an example application that we are going to develop throughout the semester. Name the repository **eventregistration**. See more on the specification of the application functionality later.



### Create a new repository

A repository contains all the files for your project, including the revision history.

Owner      Repository name \*

imbur / eventregistration ✓

Great repository names are short and memorable. Need inspiration? How about [cuddly-octo-parakeet](#).

Description (optional)

ECSE321 tutorial - EventRegistration example

Public

Anyone can see this repository. You choose who can commit.

Private

You choose who can see and commit to this repository.

Initialize this repository with a README

This will let you immediately clone the repository to your computer. Skip this step if you're importing an existing repository.

Add .gitignore: None ▾

Add a license: None ▾



**Create repository**

3. Clone it somewhere on your disk. We assume you cloned it to `~/git/eventregistration`.
4. Navigate to that folder in the terminal: `cd ~/git/eventregistration`.
5. Create a project for the backend application using Spring Boot CLI in this repository.

```
spring init \
--build=gradle \
--java-version=1.8 \
--package=ca.mcgill.ecse321.eventregistration \
--name=EventRegistration \
--dependencies=web,data-jpa,postgresql \
EventRegistration-Backend
```

#### NOTE

Backslashes in this snippet indicate linebreaks in this one liner command typed in the terminal. You can select and copy-paste this snippet as-is.

6. Navigate to the `EventRegistration-Backend` folder

7. For future use, locate the *application.properties* file in the *src/* folder and add the following content:

```
server.port=${PORT:8080}

spring.jpa.properties.hibernate.temp.use_jdbc_metadata_defaults = false
spring.jpa.database-platform=org.hibernate.dialect.PostgreSQLDialect
```

**NOTE**

Source: <https://vkuzel.com/spring-boot-jpa-hibernate-atomikos-postgresql-exception>

**NOTE**

It may be the case that the `PostgreSQLDialect` needs to be changed for certain database instances (e.g., to `PostgreSQL9Dialect`).

8. Locate the Java file containing the main application class (`EventRegistrationApplication.java`) and add the following content

```
package ca.mcgill.ecse321.eventregistration;

import org.springframework.boot.autoconfigure.SpringBootApplication;
import org.springframework.boot.SpringApplication;
import org.springframework.web.bind.annotation.RestController;
import org.springframework.web.bind.annotation.RequestMapping;

@RestController
@SpringBootApplication
public class EventRegistrationApplication {

    public static void main(String[] args) {
        SpringApplication.run(EventRegistrationApplication.class, args);
    }

    @RequestMapping("/")
    public String greeting(){
        return "Hello world!";
    }

}
```

9. Verify that it builds with `gradle build -xtest`.

10. Commit and push the files of the new Spring project.

```
git add .
git status #verify the files that are staged for commit
git commit -m "Initial commit of the backend application"
git push
```

## 2.2. Heroku

### 2.2.1. Preparations

1. Sign up/log in on Heroku by visiting <https://www.heroku.com/>.
2. Install the command line client for Heroku: [Heroku CLI](#)

**NOTE**

The Travis client might also be useful at later stages of the course, you can install it from here: [Travis CLI](#)

3. Log in to Heroku CLI by opening a terminal and typing: `heroku login`.

### 2.2.2. Creating a Heroku app

We are creating a Heroku application and deploying the *Hello world!* Spring example. Additionally, the steps below will make it possible to store multiple different applications in the same git repository and deploy them individually to Heroku. Steps will be shown through the example EventRegistration application, and should be adapted in the course project.

**NOTE**

All actions described here for configuring Heroku applications using the Heroku CLI could also be done via the web UI.

1. Once you are logged in with the Heroku-CLI, create a new Heroku application: in the root of the git repository of your repository (assumed to be `~/git/eventregistration`), issue the below command to create an application named "eventregistration-backend-<UNIQUE\_ID>".

```
heroku create eventregistration-backend-<UNIQUE_ID> -n
```

**NOTE**

In Heroku, the application name should be unique Heroku-wise, that is, each application in Heroku's system should have a unique name. If you don't provide a name parameter for the command, Heroku will randomly generate one.

1. Add the [multi procfile](#) and [Gradle](#) buildpacks to the app.

```
heroku buildpacks:add -a eventregistration-backend-<UNIQUE_ID>  
https://github.com/heroku/heroku-buildpack-multi-procfile  
heroku buildpacks:add -a eventregistration-backend-<UNIQUE_ID> heroku/gradle
```

**CAUTION**

Order is important.

### 2.2.3. Adding a database to the application

1. Open the Heroku applications web page and go to *Resources*, then add the Heroku Postgres add-on.



Personal



eventregistration-backend-123



Open app

More ▾

Overview

Resources

Deploy

Metrics

Activity

Access

Settings

Dynos

This app has no process types yet

Add a Procfile to your app in order to define its process types. [Learn more](#)

Add-ons

[Find more add-ons](#)

The addon `heroku-postgresql` has been installed. Check out the documentation in its Dev Center article to get started.

 Quickly add add-ons from Elements


Heroku Postgres :: Database

Hobby Dev (Free) ▾

Estimated Monthly Cost

\$0.00

2. Click the entry for Postgres within the list of add-ons, then go to *Settings*. You can see the database credentials there.



DATA



Datastores

&gt; postgresql-regular-49049

SERVICE heroku-postgresql

PLAN hobby-dev

BILLING APP

eventregistration-backend-123

Overview

Durability

Settings

## ADMINISTRATION

## Database Credentials

[Cancel](#)

Get credentials for manual connections to this database.

**Please note that these credentials are not permanent.**

Heroku rotates credentials periodically and updates applications where this database is attached.

Host

[REDACTED]

Database

d57cs3lflfpdh

User

[REDACTED]

Port

5432

Password

[REDACTED]

URI

[REDACTED]

Heroku CLI

heroku pg:psql postgresql-regular-49049 --app eventregistration-backend-123

**NOTE**

The credentials are periodically updated and changed by Heroku, so make sure that you are using the actual credentials when manually connecting to the database. (E.g., during manual testing.)

#### 2.2.4. Extending the build for the Heroku deployment environment

1. Before deploying, a top level *build.gradle* and *settings.gradle* need to be created in the root of the repository (i.e., in *~/git/eventregistration*)

*build.gradle*:

```
task stage () {  
    dependsOn ':EventRegistration-Backend:assemble'  
}
```

*settings.gradle*:

```
include ':EventRegistration-Backend'
```

2. Generate the Gradle wrapper with the newest Gradle version

```
gradle wrapper --gradle-version 5.6.2
```

3. Create a *.gitignore* file for the *.gradle* folder:

*.gitignore*:

```
.gradle/
```

4. Add all new files to git

```
git add .  
git status #make sure that files in .gradle/ are not added
```

Expected output for *git status*:

```
On branch master
Your branch is ahead of 'origin/master' by 2 commits.
  (use "git push" to publish your local commits)

Changes to be committed:
  (use "git reset HEAD <file>..." to unstage)

    new file:  .gitignore
    new file:  build.gradle
    new file:  gradle/wrapper/gradle-wrapper.jar
    new file:  gradle/wrapper/gradle-wrapper.properties
    new file:  gradlew
    new file:  gradlew.bat
    new file:  settings.gradle
```

Commit changes:

```
git commit -m "Adding Gradle wrapper"
```

## 2.2.5. Supply application-specific setting for Heroku

1. Within the *EventRegistration-Backend* folder, create a file called *Procfile* (**not** Procfile.txt, name it **exactly** Procfile) with the content:

```
web: java -jar EventRegistration-Backend/build/libs/EventRegistration-Backend-
0.0.1-SNAPSHOT.jar
```

2. Add the Procfile to a new commit
3. Configure the multi-procfile buildpack to find the Procfile:

```
heroku config:add PROCFILE=EventRegistration-Backend/Procfile --app
eventregistration-backend-<UNIQUE_ID>
```

## 2.2.6. Deploying the app

1. Obtain and copy the *Heroku Git URL*

```
heroku git:remote --app eventregistration-backend-<UNIQUE_ID> --remote backend-
heroku
```

Output:

```
set git remote backend-heroku to https://git.heroku.com/eventregistration-backend-<UNIQUE_ID>.git
```

- Verify that the `backend-heroku` remote is successfully added besides `origin` with `git remote -v`.  
Output:

```
backend-heroku  https://git.heroku.com/eventregistration-backend-123.git (fetch)
backend-heroku  https://git.heroku.com/eventregistration-backend-123.git (push)
origin  git@github.com:imbur/eventregistration.git (fetch)
origin  git@github.com:imbur/eventregistration.git (push)
```

- Deploy your application with

```
git push backend-heroku master
```

**NOTE**

If it fails to build, make sure you try understanding the output. Typical issue: buildpacks are not added/are not in the right order.

- Visit the link provided in the build output. It may take some time (even 30-60 seconds) for the server to answer the first HTTP request, so be patient!
- Save your work to the GitHub repository, too: `git push origin master`  
Final layout of the files (only two directory levels are shown and hidden items are suppressed):

```
~/git/eventregistration
├── build.gradle
├── EventRegistration-Backend
│   ├── build
│   │   ├── classes
│   │   ├── libs
│   │   ├── resources
│   │   └── tmp
│   ├── build.gradle
│   ├── gradle
│   │   └── wrapper
│   ├── gradlew
│   ├── gradlew.bat
│   ├── Procfile
│   ├── settings.gradle
│   └── src
│       ├── main
│       └── test
└── gradle
    └── wrapper
        ├── gradle-wrapper.jar
        └── gradle-wrapper.properties
├── gradlew
├── gradlew.bat
└── README.md
```

## 2.3. Domain modeling and code generation

### 2.3.1. Installing UML Lab

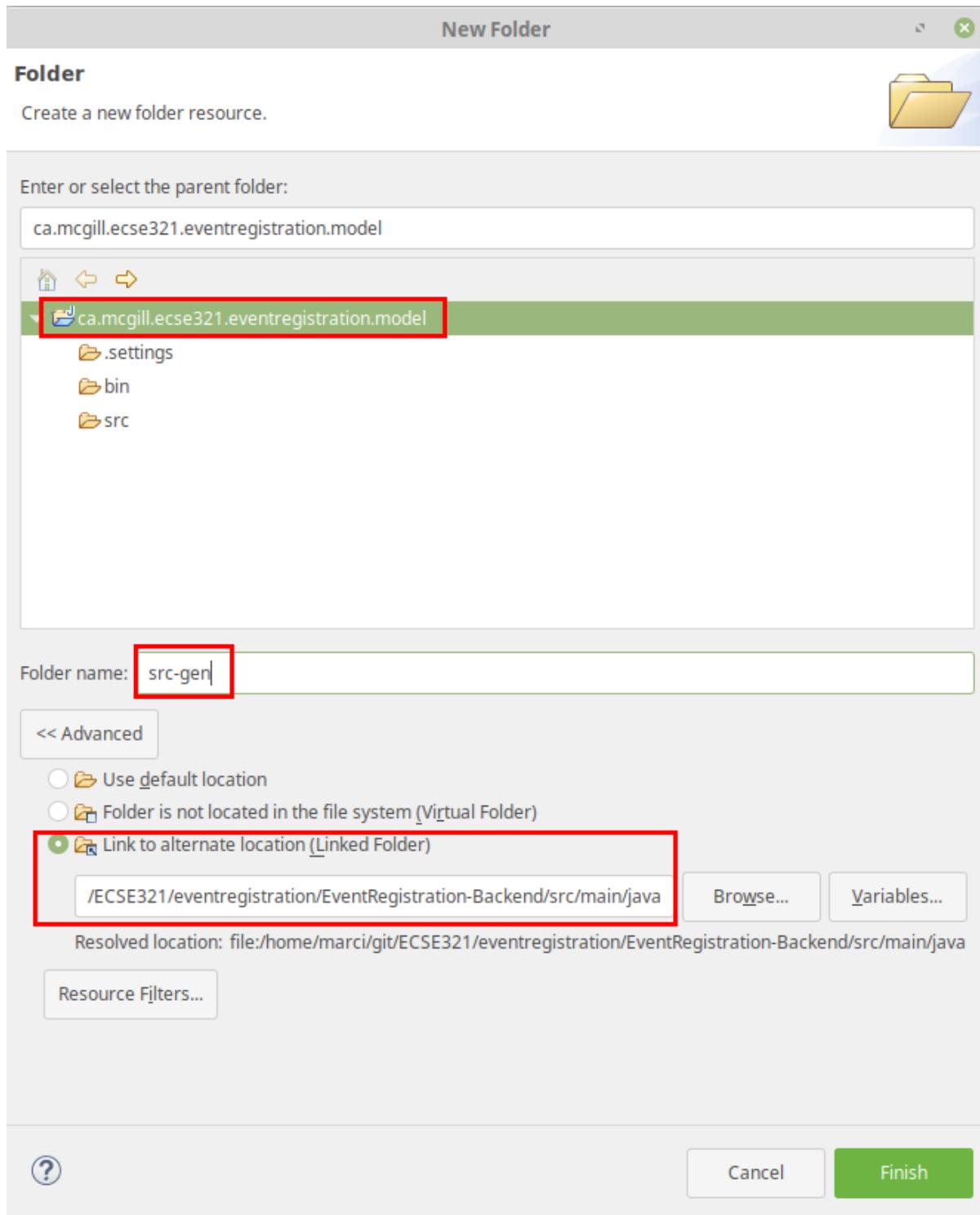
Go to [the download page of UML Lab](#) and install it on your machine. To activate it, use the licence key shared in the MyCourses announcement.

**NOTE** By the time of the fourth tutorial, we may not have the license key ready. You should be able to work with a 30-day trial version in this case and activate your license later.

### 2.3.2. UML Lab project setup

**NOTE** Once you start UML Lab, there are some useful tutorials that help you learn about the features of the modeling tool. Furthermore, there is an introduction on how to use and configure UML Lab [among the resources of Rice University](#).

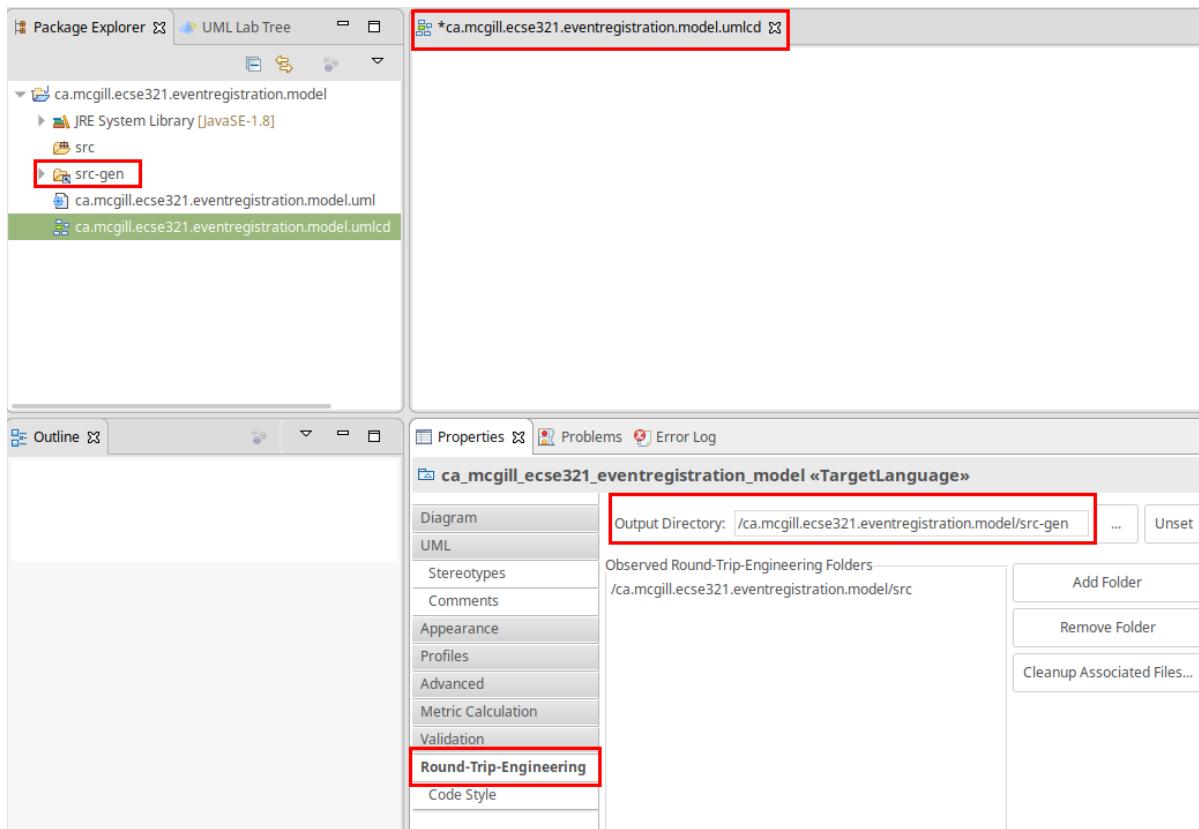
1. Create a new UML Lab Java project with the name `ca.mcgill.ecse321.eventregistration.model` with the default project settings.
2. Within the project, create a linked folder (Select Project → New Folder → Click Advanced Button → select "Link to alternate location (linked folder)" option) that points to the `src/main/java` folder of your `Eventregistration-Backend` project. Name the folder as `src-gen`. It will be used as the target for generating model code.



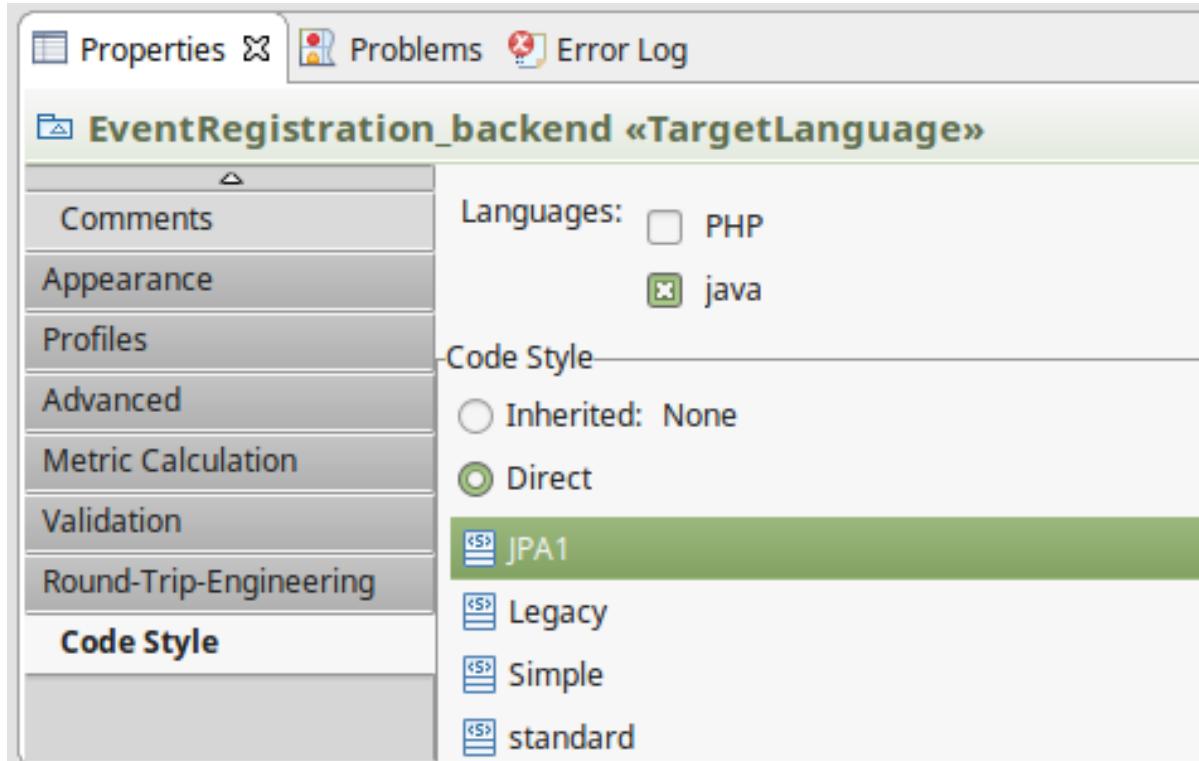
### CAUTION

Links to folders will not be versioned, so each team member needs to set this link individually after cloning the project.

3. Open the `ca.mcgill.ecse321.eventregistration.model.umlcd` diagram file by double clicking it. It is an empty diagram by default.
4. Click on the empty diagram editor canvas and open the *properties view* and configure code generation path.

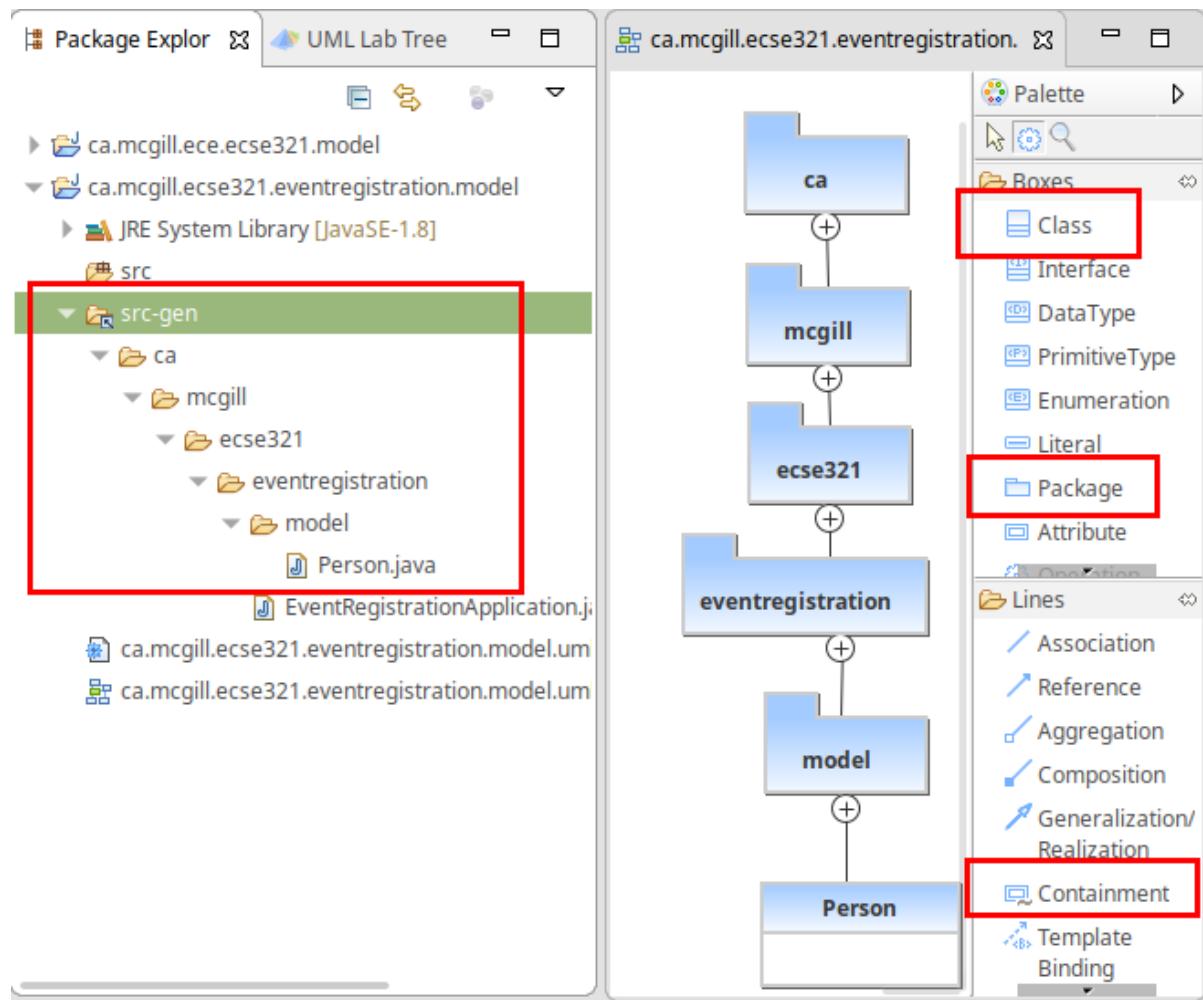


5. In the same *Properties* view, apply the *Direct > JPA1* code style.



### 2.3.3. Domain modeling exercise: the Event Registration System

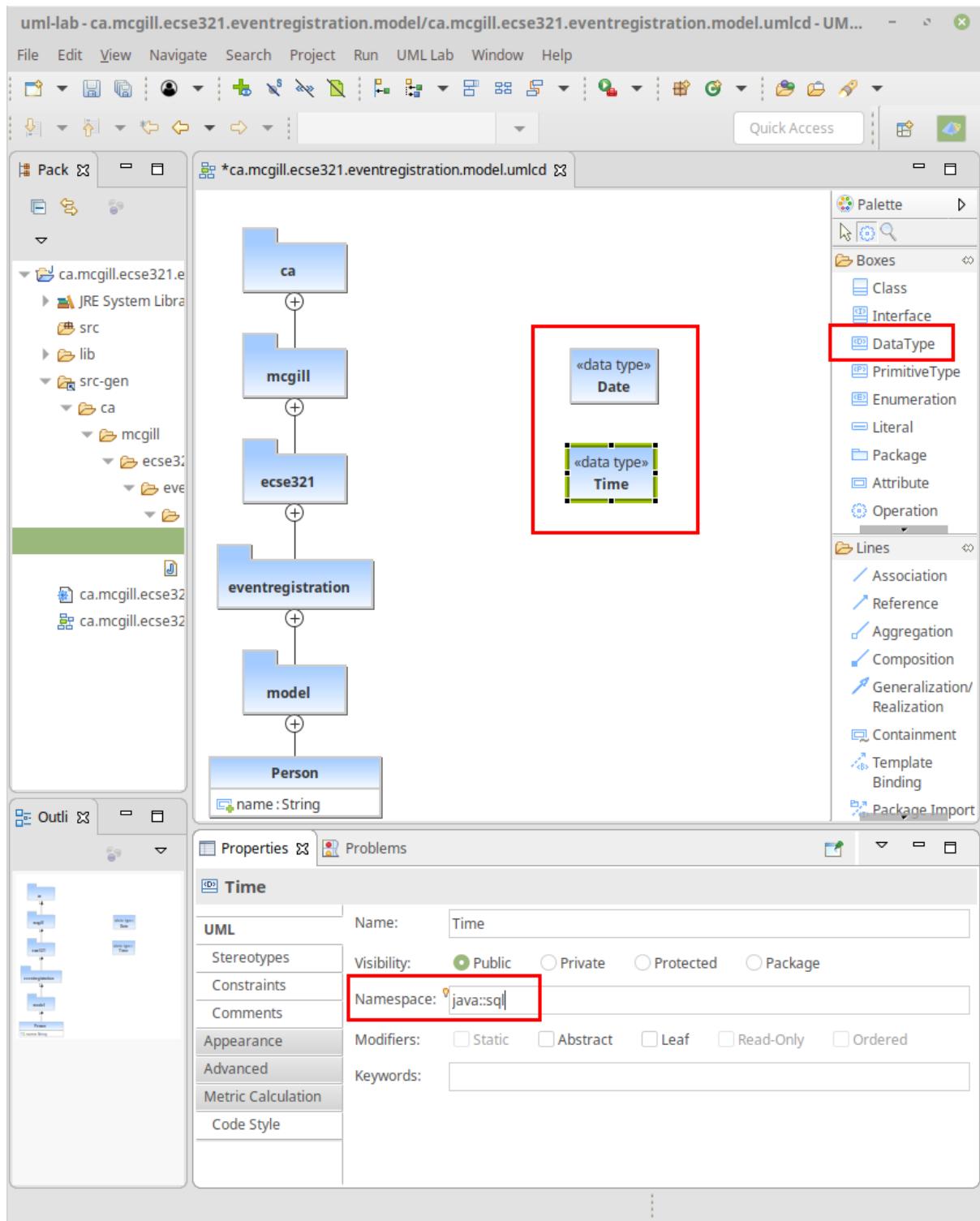
1. Using the *Palette* on the left hand side of the class diagram editor, create the following package structure and the **Person** class, and connect them with the *Containment* line. Once you save the diagram, the code should be generated to the *src-gen* folder (left part of the figure below).



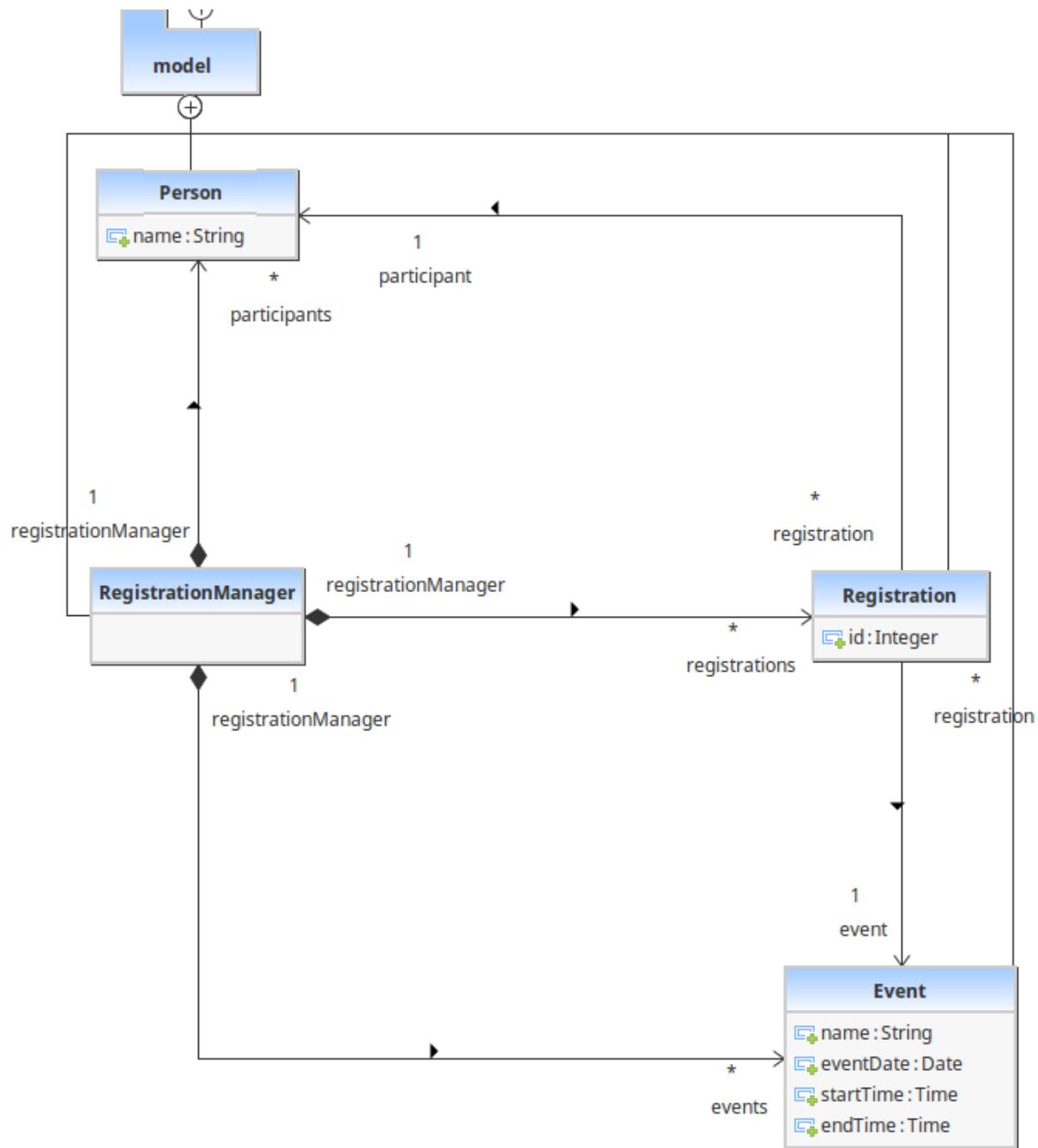
#### NOTE

If you disabled the automatic code generation on file save action, then you need to do *right click the diagram → generate code* manually.

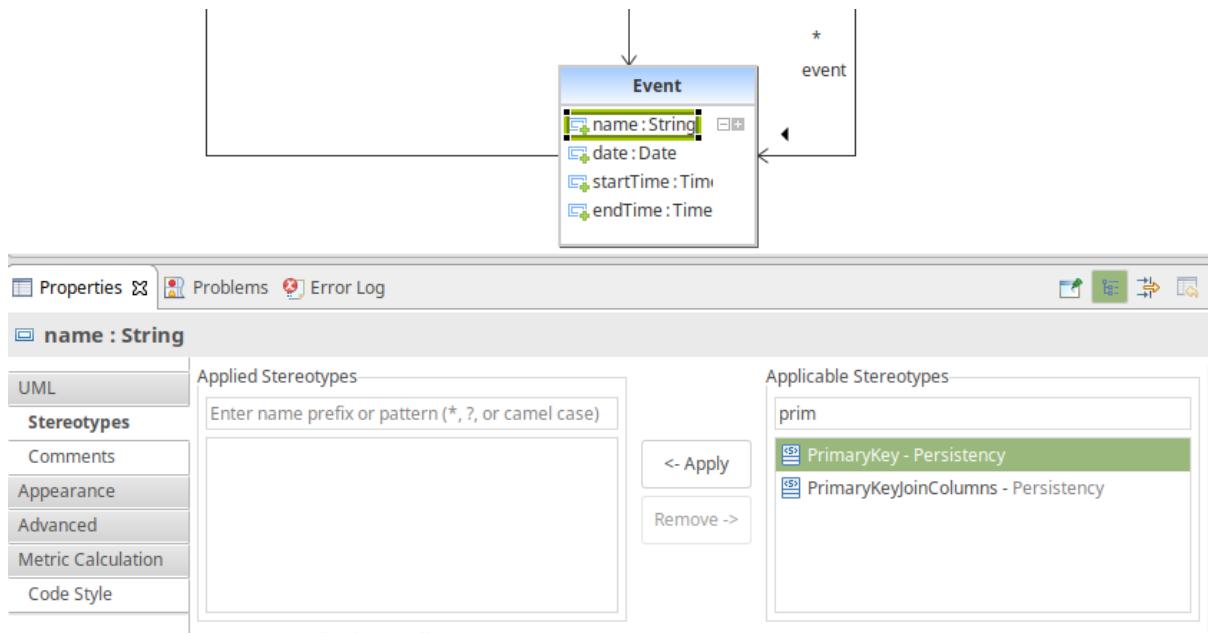
2. Study the generated `Person` class in the `ca/mcgill/ecse321/eventregistration/model` package (folder)!
3. In the upcoming steps, we will use the `java.sql.Time` and `java.sql.Date` data types from the Java Runtime Library, so we need to add them to the model as datatypes.



4. Extend the diagram by adding more classes and association and composition relations as shown below. Pay extra attention to the navigability and multiplicity of the references.



5. Select attributes to be primary keys (**Person**: id is `name`, **Event**: id is `name`, **Registration**: id is `id`)



#### NOTE

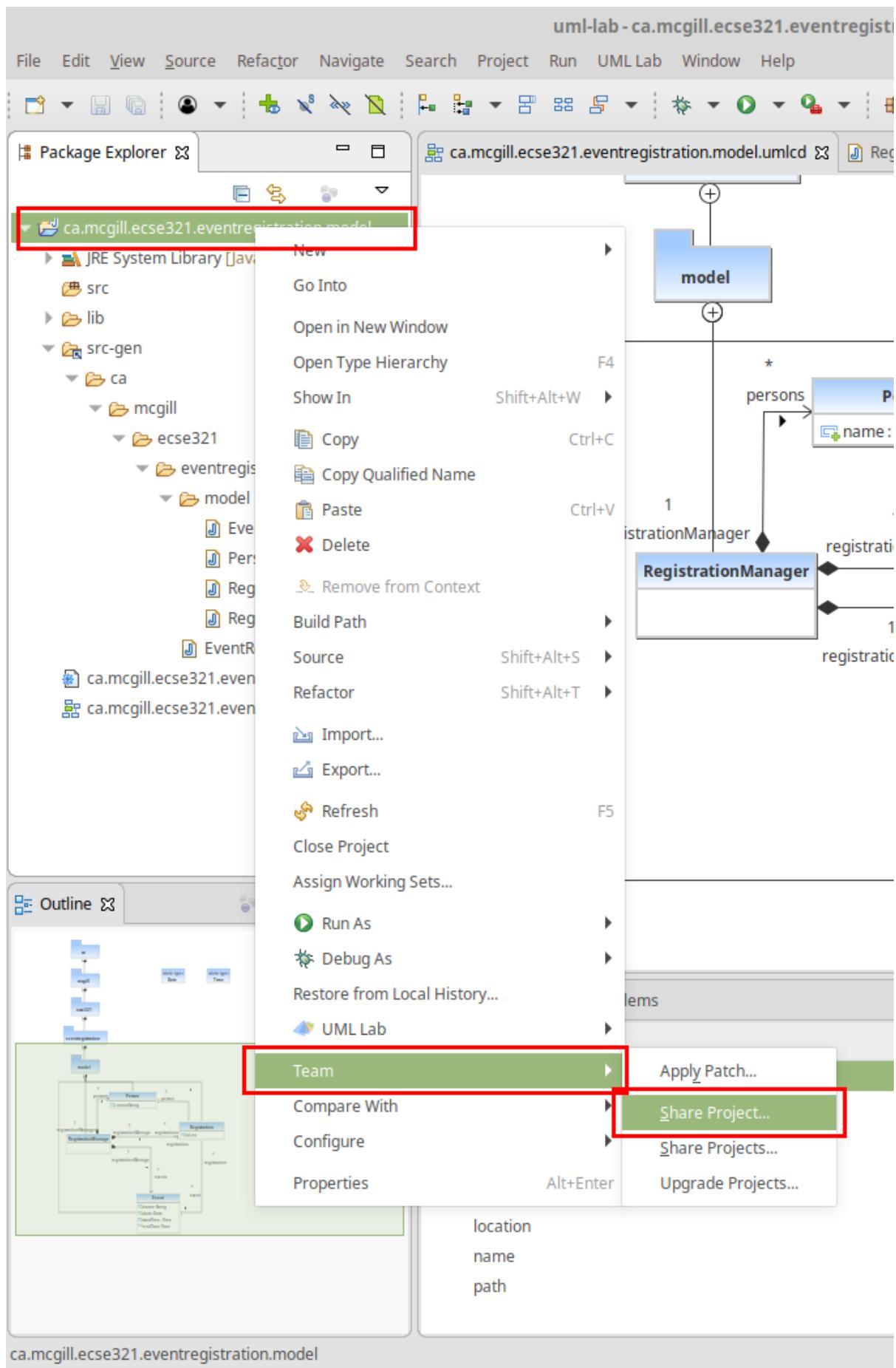
Verify the generated code: remove any `@OneToOne` annotations from getters associated with `Date` and `Time` from the `Event` class.

6. Create an extra `int` attribute for the `RegistrationManager` as well and set it as the ID (similarly to the other three classes).

#### CAUTION

If you forget to supply an ID to **any of your entities**, Hibernate will throw an exception and your application will fail to start.

7. Share the modeling project to git. You can use the command line git client or EGit.

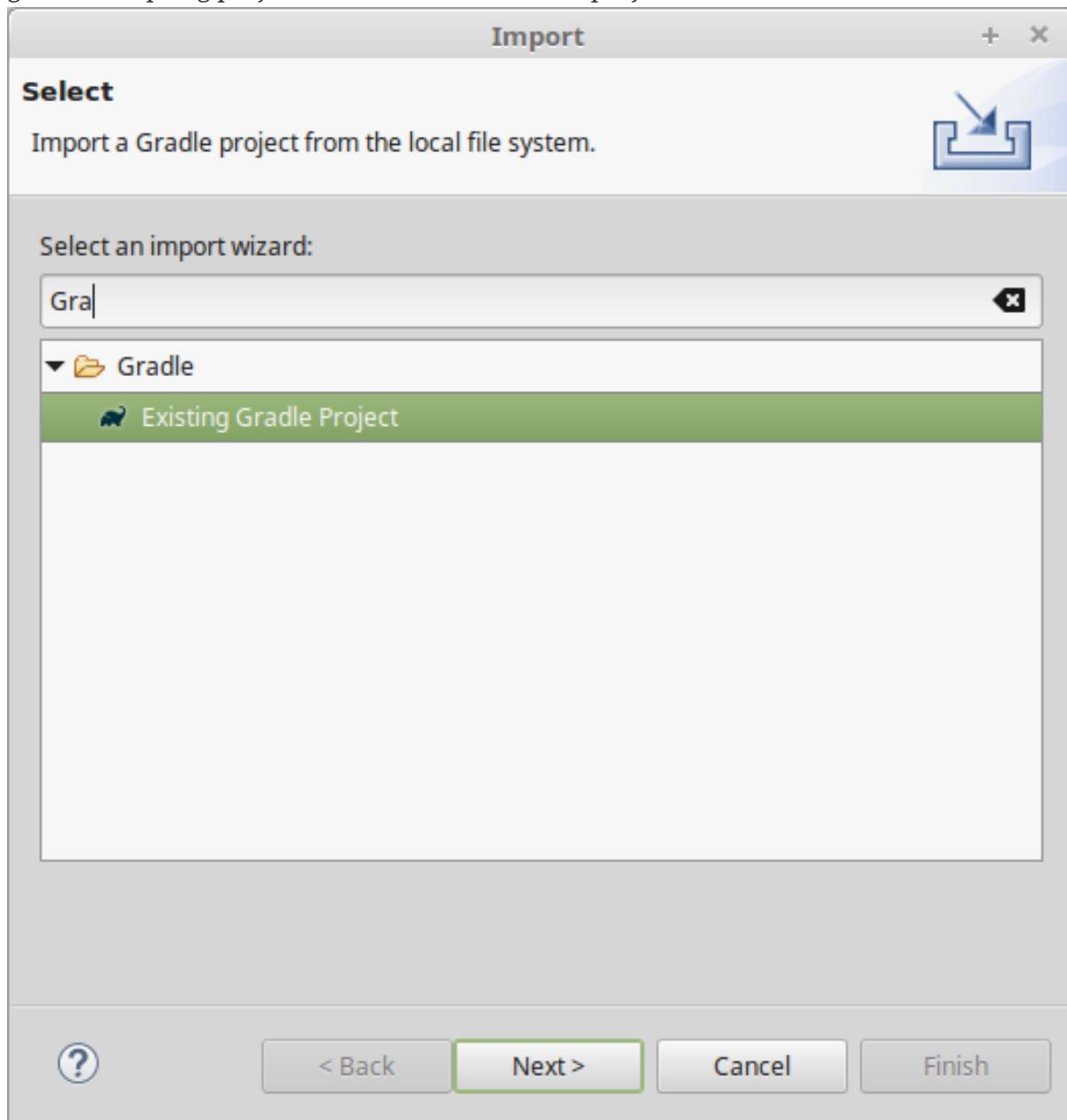


## 2.4. Setting up a Spring-based Backend

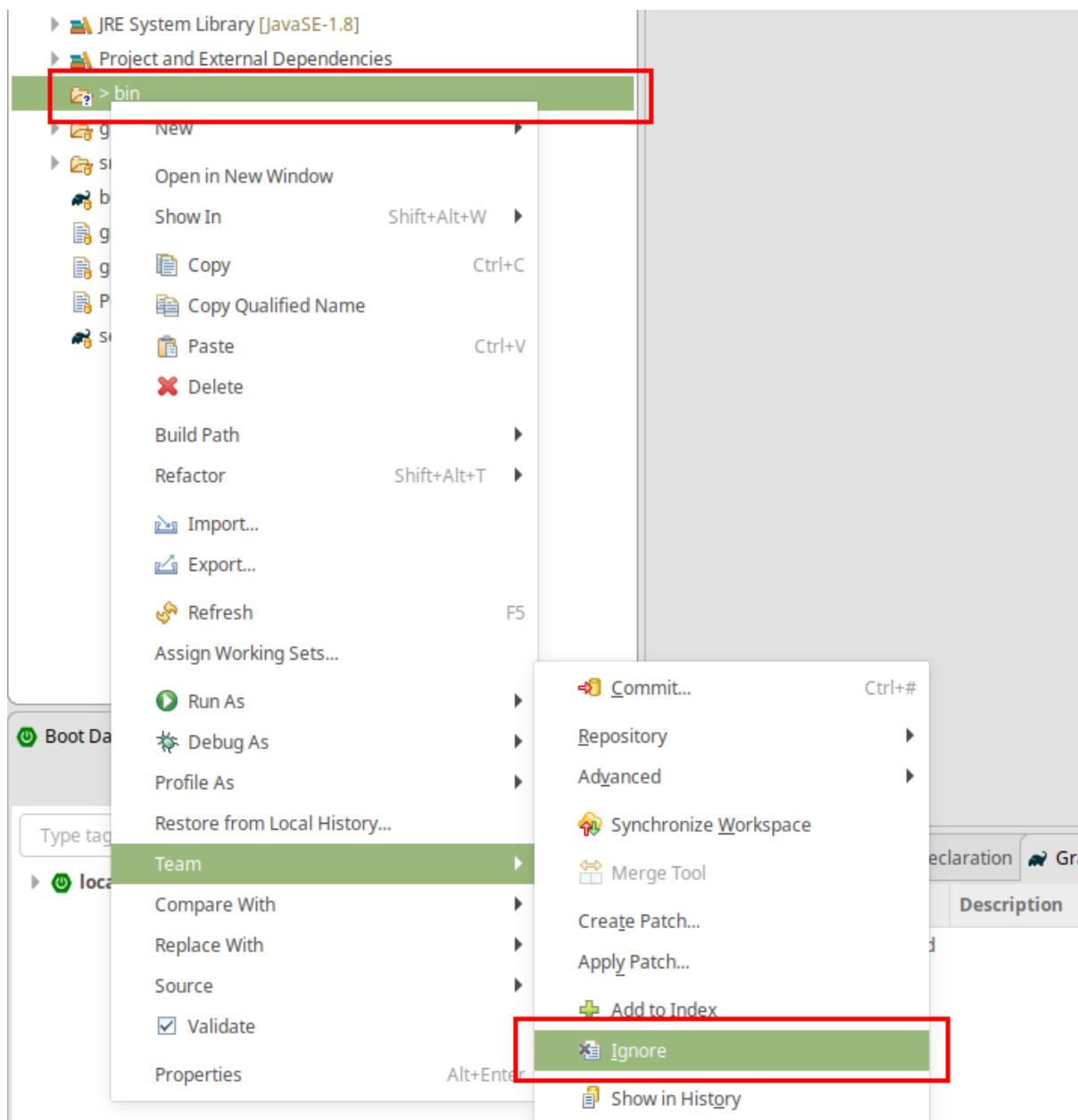
You can download the Spring Tools Suite IDE from [here](#).

### 2.4.1. Running the Backend Application from Eclipse

1. Import the **EventRegistration-Backend** Spring Boot project as a Gradle project from *File > Import... > Gradle > Existing Gradle project* using the default settings. Select the previously generated Spring project folder as the root of the project.



2. Ignore the bin folder.



3. Find the `EventRegistrationApplication.java` source file, then right click and select *Run As > Spring Boot App*. The application will fail to start, since the database is not yet configured, but this action will create an initial run configuration. Example console output (fragment):

```
[...]
*****
APPLICATION FAILED TO START
*****
```

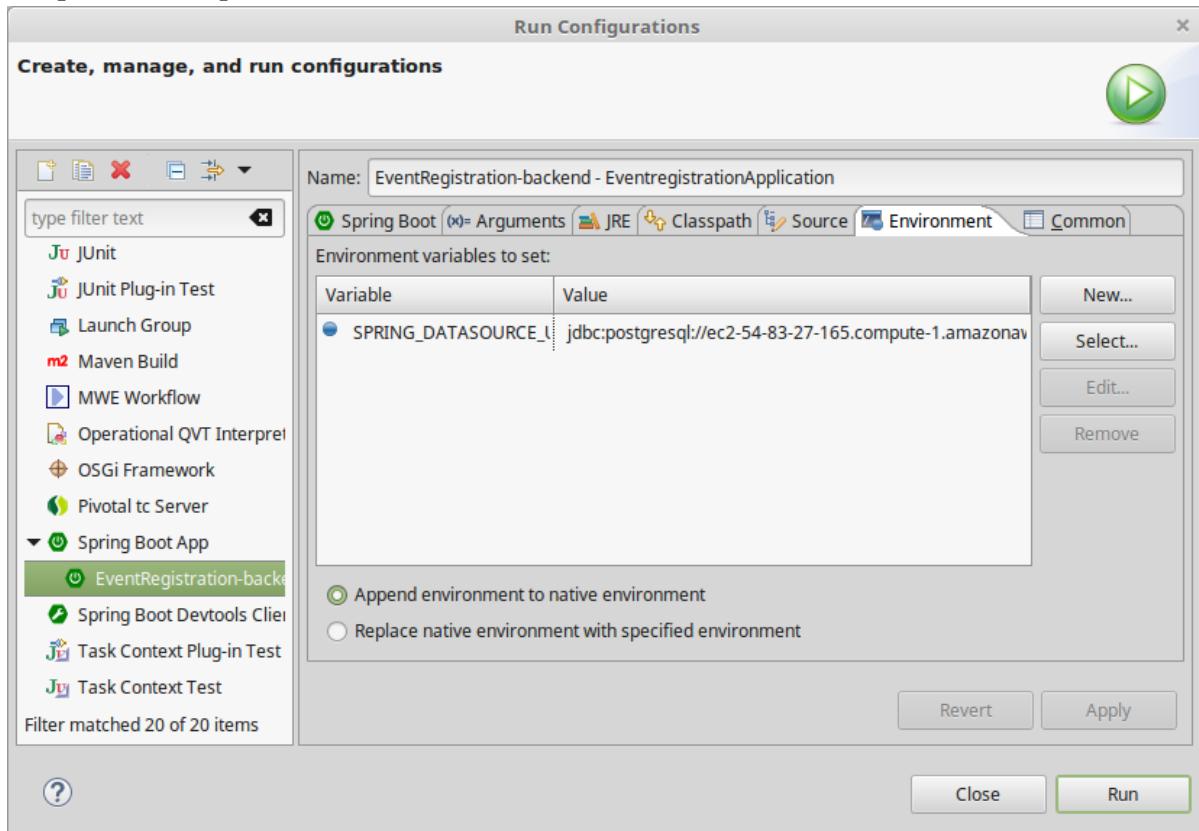
Description:

Failed to configure a DataSource: 'url' attribute is not specified and no embedded datasource could be configured.

Reason: Failed to determine a suitable driver class

[...]

4. Obtain the database URL to access the database remotely, e.g., by opening up a terminal and running: `heroku run echo \$JDBC_DATABASE_URL --app=<YOUR_BACKEND_APP_NAME>`.
5. In Eclipse, open the *EventRegistration-Backend - EventregistrationApplication* run configuration page and add an environment variable called `SPRING_DATASOURCE_URL` with the value obtained in the previous step.



6. Add the `spring.jpa.hibernate.ddl-auto=update` to `application.properties`. The database content along with the tables this way will be deleted (as necessary) then re-created each time your application starts.

**IMPORTANT**

In production, the value of this property should be `none` (instead of `update`). Possible values are `none`, `create`, `validate`, and `update`.

7. If needed: troubleshooting:

- If you get an error message saying something similar to `createClob() is not yet implemented`, then you can try setting the `spring.jpa.properties.hibernate.jdbc.lob.non_contextual_creation=true` variable in your `application.properties`. It could be a workaround for an issue with Postgres.
- Sometimes environment variables don't work with Spring apps. In this case you can set the `spring.datasource.url`, the `spring.datasource.username`, and the `spring.datasource.password` variables in the application properties as an alternative to setting the `SPRING_DATASOURCE_URL` environment variable.
- Make sure no other apps are running on `localhost:8080`. You can test it by opening the browser and entering `localhost:8080` as the address.

## 2.4.2. Spring Transactions

1. Verify the contents of the `EventRegistrationApplication` class:

```
package ca.mcgill.ecse321.eventregistration;

import org.springframework.boot.autoconfigure.SpringBootApplication;
import org.springframework.boot.SpringApplication;
import org.springframework.web.bind.annotation.RestController;
import org.springframework.web.bind.annotation.RequestMapping;

@RestController
@SpringBootApplication
public class EventRegistrationApplication {

    public static void main(String[] args) {
        SpringApplication.run(EventRegistrationApplication.class, args);
    }

    @RequestMapping("/")
    public String greeting() {
        return "Hello world!";
    }
}
```

2. Create a new package in `src/main/java` and name it `ca.mcgill.ecse321.eventregistration.dao`.
3. Create the `EventRegistrationRepository` class within this new package

```
package ca.mcgill.ecse321.eventregistration.dao;

import java.sql.Date;
import java.sql.Time;
import java.util.List;

import javax.persistence.EntityManager;
import javax.persistence.TypedQuery;

import org.springframework.beans.factory.annotation.Autowired;
import org.springframework.stereotype.Repository;
import org.springframework.transaction.annotation.Transactional;

import ca.mcgill.ecse321.eventregistration.model.Person;
import ca.mcgill.ecse321.eventregistration.model.Event;

@Repository
public class EventRegistrationRepository {

    @Autowired
    EntityManager entityManager;
```

```

@Transactional
public Person createPerson(String name) {
    Person p = new Person();
    p.setName(name);
    entityManager.persist(p);
    return p;
}

@Transactional
public Person getPerson(String name) {
    Person p = entityManager.find(Person.class, name);
    return p;
}

@Transactional
public Event createEvent(String name, Date date, Time startTime, Time endTime)
{
    Event e = new Event();
    e.setName(name);
    e.setDate(date);
    e.setStartTime(startTime);
    e.setEndTime(endTime);
    entityManager.persist(e);
    return e;
}

@Transactional
public Event getEvent(String name) {
    Event e = entityManager.find(Event.class, name);
    return e;
}

}

```

4. Add a new method that gets all events before a specified date (**deadline**). Use a typed query created from an SQL command:

```

@Transactional
public List<Event> getEventsBeforeADeadline(Date deadline) {
    TypedQuery<Event> q = entityManager.createQuery("select e from Event e where
e.date < :deadline",Event.class);
    q.setParameter("deadline", deadline);
    List<Event> resultList = q.getResultList();
    return resultList;
}

```

**NOTE**

To try the methods, you can create a JUnit test under `src/test/java`. Currently the methods in `EventRegistrationRepository` directly access the objects stored in the database via the `EntityManager` instance and these methods should implement both database operations and service business logic (including input validation—which we omitted in this part). In later sections, however, we will see how we can easily separate the database access and the service business logic in Spring applications.

### 2.4.3. Debugging: connecting to the database using a client

There are cases when a developer wants to know the contents of the database. In this case, a database client program can be used to access the database schema and table contents. Here are the general steps to access the Postgres database provided by Heroku:

1. Obtain the database URL to access the database remotely, e.g., by opening up a terminal and running: `heroku run echo \$JDBC_DATABASE_URL --app=<YOUR_BACKEND_APP_NAME>`.
2. The returned value follows the format that holds all main important parameters that are needed for accessing the database server:

```
jdbc:postgresql://<HOST>:<PORT>/<DATABASE_NAME>?user=<USERNAME>&password=<PASSWORD>  
&sslmode=require
```

These parameters are:

- Database host: the URL for the server
  - Port: the port on which the DB server is listening
  - Database name: the first section after the URL
  - Username: the first parameter value in the provided URL
  - Password: the second parameter value in the provided URL
3. With these parameters you can use any Postgres client you prefer to connect to the database. Here is an example for such a connection from Linux using `postgres-client`:

```
$> psql postgresql://ec2-54-243-223-245.compute-  
1.amazonaws.com:5432/d4412g60aaboa7?user=hdjnflfirvkmmr  
Password:  
psql (10.6 (Ubuntu 10.6-0ubuntu0.18.04.1))  
SSL connection (protocol: TLSv1.2, cipher: ECDHE-RSA-AES256-GCM-SHA384, bits: 256,  
compression: off)  
Type "help" for help.
```

```
d4412g60aaboa7=> \dt
```

Schema	Name	Type	Owner
public	event	table	hdjnflfirvkmmr
public	person	table	hdjnflfirvkmmr
public	registration	table	hdjnflfirvkmmr
public	registration_manager	table	hdjnflfirvkmmr
public	registration_manager_events	table	hdjnflfirvkmmr
public	registration_manager_persons	table	hdjnflfirvkmmr
public	registration_manager_registrations	table	hdjnflfirvkmmr

(7 rows)

```
d4412g60aaboa7=> select * from event ;  
 name | date | end_time | start_time  
-----+-----+-----+-----  
 e1 | 3899-10-09 | 12:00:00 | 10:00:00  
(1 row)
```

```
d4412g60aaboa7=> \q  
$>
```

## 2.5. CRUD Repositories and Services

Previously, in the `ca.mcgill.ecse321.eventregistration.dao.EventRegistrationRepository` class we used an instance of `javax.persistence.EntityManager` from Hibernate to directly implement the required operations related to saving/retrieving data to/from a database (Create, Read, Update, and Delete operations, shortly, CRUD). This section will introduce the Spring framework's inbuilt support for such CRUD operations via the `org.springframework.data.repository.CrudRepository` interface and will show how to use such repositories to implement your use cases in so-called *service* classes.

If you would like to, you can obtain a version of the project that already has the changes from the previous tutorials [here](#).

### 2.5.1. Creating a CRUD Repository

1. Create a new interface `PersonRepository` in the `ca.mcgill.ecse321.eventregistration.dao` package and extend the `CrudRepository<Person, String>` interface
2. Create a new method `Person findByName(String name)`

```
package ca.mcgill.ecse321.eventregistration.dao;

import org.springframework.data.repository.CrudRepository;

import ca.mcgill.ecse321.eventregistration.model.Person;

public interface PersonRepository extends CrudRepository<Person, String>{

    Person findPersonByName(String name);

}
```

3. Since Spring supports automated JPA Query creation from method names (see [possible language constructs here](#)) we **don't need to implement the interface manually**, Spring JPA will create the corresponding queries runtime! This way we don't need to write SQL queries either.
4. Create interfaces for the `Event` and `Registration` classes as well  
`EventRepository.java`:

```

package ca.mcgill.ecse321.eventregistration.dao;

import org.springframework.data.repository.CrudRepository;

import ca.mcgill.ecse321.eventregistration.model.Event;

public interface EventRepository extends CrudRepository<Event, String> {

    Event findEventByName(String name);

}

```

*RegistrationRepository.java:*

```

package ca.mcgill.ecse321.eventregistration.dao;

import java.util.List;

import org.springframework.data.repository.CrudRepository;

import ca.mcgill.ecse321.eventregistration.model.Event;
import ca.mcgill.ecse321.eventregistration.model.Person;
import ca.mcgill.ecse321.eventregistration.model.Registration;

public interface RegistrationRepository extends CrudRepository<Registration, Integer> {

    List<Registration> findByPerson(Person personName);

    boolean existsByPersonAndEvent(Person person, Event eventName);

    Registration findByPersonAndEvent(Person person, Event eventName);

}

```

## 2.5.2. Implementing Services

We implement use-cases in *service classes* by using the CRUD repository objects for each data type of the domain model.

1. In *src/main/java*, create a new package **ca.mcgill.ecse321.eventregistration.service**.
2. In this package, create the **EventRegistrationService** class as shown below

```

package ca.mcgill.ecse321.eventregistration.service;

import java.sql.Date;
import java.sql.Time;

```

```

import java.util.ArrayList;
import java.util.List;

import org.springframework.beans.factory.annotation.Autowired;
import org.springframework.stereotype.Service;
import org.springframework.transaction.annotation.Transactional;

import ca.mcgill.ecse321.eventregistration.dao.EventRepository;
import ca.mcgill.ecse321.eventregistration.dao.PersonRepository;
import ca.mcgill.ecse321.eventregistration.dao.RegistrationRepository;
import ca.mcgill.ecse321.eventregistration.model.Event;
import ca.mcgill.ecse321.eventregistration.model.Person;
import ca.mcgill.ecse321.eventregistration.model.Registration;

@Service
public class EventRegistrationService {

    @Autowired
    EventRepository eventRepository;
    @Autowired
    PersonRepository personRepository;
    @Autowired
    RegistrationRepository registrationRepository;

    @Transactional
    public Person createPerson(String name) {
        Person person = new Person();
        person.setName(name);
        personRepository.save(person);
        return person;
    }

    @Transactional
    public Person getPerson(String name) {
        Person person = personRepository.findPersonByName(name);
        return person;
    }

    @Transactional
    public List<Person> getAllPersons() {
        return toList(personRepository.findAll());
    }

    @Transactional
    public Event createEvent(String name, Date date, Time startTime, Time endTime)
    {
        Event event = new Event();
        event.setName(name);
        event.setDate(date);
        event.setStartTime(startTime);
        event.setEndTime(endTime);
    }
}

```

```

        eventRepository.save(event);
        return event;
    }

    @Transactional
    public Event getEvent(String name) {
        Event event = eventRepository.findEventByName(name);
        return event;
    }

    @Transactional
    public List<Event> getAllEvents() {
        return toList(eventRepository.findAll());
    }

    @Transactional
    public Registration register(Person person, Event event) {
        Registration registration = new Registration();
        registration.setId(person.getName().hashCode() *
event.getName().hashCode());
        registration.setPerson(person);
        registration.setEvent(event);

        registrationRepository.save(registration);

        return registration;
    }

    @Transactional
    public List<Registration> getAllRegistrations(){
        return toList(registrationRepository.findAll());
    }

    @Transactional
    public List<Event> getEventsAttendedByPerson(Person person) {
        List<Event> eventsAttendedByPerson = new ArrayList<>();
        for (Registration r : registrationRepository.findByPerson(person)) {
            eventsAttendedByPerson.add(r.getEvent());
        }
        return eventsAttendedByPerson;
    }

    private <T> List<T> toList(Iterable<T> iterable){
        List<T> resultList = new ArrayList<T>();
        for (T t : iterable) {
            resultList.add(t);
        }
        return resultList;
    }

}

```

## 2.6. Unit Testing Persistence in the Backend Service

1. In a fresh Spring Boot project, there is already a single test class `EventRegistrationApplicationTests` in the `src/test/java` folder that looks like the following:

```
package ca.mcgill.ecse321.eventregistration;

import org.junit.Test;
import org.junit.runner.RunWith;
import org.springframework.beans.factory.annotation.Autowired;
import org.springframework.boot.test.context.SpringBootTest;
import org.springframework.test.context.junit4.SpringRunner;

@RunWith(SpringRunner.class)
@SpringBootTest
public class EventRegistrationApplicationTests {

    @Test
    public void contextLoads() {

    }
}
```

2. Run this test that checks if the application can successfully load by *right clicking on the class – Run as... → JUnit test*

**IMPORTANT**

You need to set the `SPRING_DATASOURCE_URL` for the test run configuration as well if you use an environment variable to set datasource URL. See step 5 in section 3.3.1.

3. Add a new test class `ca.mcgill.ecse321.eventregistration.service.TestEventRegistrationService` and implement tests for the service

```
package ca.mcgill.ecse321.eventregistration.service;

import static org.junit.Assert.assertEquals;
import static org.junit.Assert.fail;

import java.sql.Date;
import java.sql.Time;
import java.time.LocalTime;
import java.time.format.DateTimeFormatter;
import java.util.Calendar;
import java.util.List;

import org.junit.After;
import org.junit.Test;
```

```

import org.junit.runner.RunWith;
import org.springframework.beans.factory.annotation.Autowired;
import org.springframework.boot.test.context.SpringBootTest;
import org.springframework.test.context.junit4.SpringRunner;

import ca.mcgill.ecse321.eventregistration.dao.EventRepository;
import ca.mcgill.ecse321.eventregistration.dao.PersonRepository;
import ca.mcgill.ecse321.eventregistration.dao.RegistrationRepository;
import ca.mcgill.ecse321.eventregistration.model.Event;
import ca.mcgill.ecse321.eventregistration.model.Person;

@RunWith(SpringRunner.class)
@SpringBootTest
public class TestEventRegistrationService {

    @Autowired
    private EventRegistrationService service;

    @Autowired
    private PersonRepository personRepository;
    @Autowired
    private EventRepository eventRepository;
    @Autowired
    private RegistrationRepository registrationRepository;

    @After
    public void clearDatabase() {
        // First, we clear registrations to avoid exceptions due to inconsistencies
        registrationRepository.deleteAll();
        // Then we can clear the other tables
        personRepository.deleteAll();
        eventRepository.deleteAll();
    }

    @Test
    public void testCreatePerson() {
        assertEquals(0, service.getAllPersons().size());

        String name = "Oscar";

        try {
            service.createPerson(name);
        } catch (IllegalArgumentException e) {
            // Check that no error occurred
            fail();
        }

        List<Person> allPersons = service.getAllPersons();

        assertEquals(1, allPersons.size());
        assertEquals(name, allPersons.get(0).getName());
    }
}

```

```

}

@Test
public void testCreatePersonNull() {
    assertEquals(0, service.getAllPersons().size());

    String name = null;
    String error = null;

    try {
        service.createPerson(name);
    } catch (IllegalArgumentException e) {
        error = e.getMessage();
    }

    // check error
    assertEquals("Person name cannot be empty!", error);

    // check no change in memory
    assertEquals(0, service.getAllPersons().size());
}

// ... other tests

@Test
public void testRegisterPersonAndEventDoNotExist() {
    assertEquals(0, service.getAllRegistrations().size());

    String nameP = "Oscar";
    Person person = new Person();
    person.setName(nameP);
    assertEquals(0, service.getAllPersons().size());

    String nameE = "Soccer Game";
    Calendar c = Calendar.getInstance();
    c.set(2016, Calendar.OCTOBER, 16, 9, 00, 0);
    Date eventDate = new Date(c.getTimeInMillis());
    Time startTime = new Time(c.getTimeInMillis());
    c.set(2016, Calendar.OCTOBER, 16, 10, 30, 0);
    Time endTime = new Time(c.getTimeInMillis());
    Event event = new Event();
    event.setName(nameE);
    event.setDate(eventDate);
    event.setStartTime(startTime);
    event.setEndTime(endTime);
    assertEquals(0, service.getAllEvents().size());

    String error = null;
    try {
        service.register(person, event);
    }
}

```

```

        } catch (IllegalArgumentException e) {
            error = e.getMessage();
        }

        // check error
        assertEquals("Person does not exist! Event does not exist!", error);

        // check model in memory
        assertEquals(0, service.getAllRegistrations().size());
        assertEquals(0, service.getAllPersons().size());
        assertEquals(0, service.getAllEvents().size());

    }

    // ... other tests
}

```

4. See the [complete test suite here](#).
5. Run the tests and interpret the test error messages! You should see only a few (at least one) tests passing.
6. Update the implementation (i.e., replace the current service method codes with the ones provided below) of the following methods with input validation in the `EventRegistrationService` service class to make the tests pass (Test-Driven Development)

```

@Transactional
public Person createPerson(String name) {
    if (name == null || name.trim().length() == 0) {
        throw new IllegalArgumentException("Person name cannot be empty!");
    }
    Person person = new Person();
    person.setName(name);
    personRepository.save(person);
    return person;
}

```

```

@Transactional
public Person getPerson(String name) {
    if (name == null || name.trim().length() == 0) {
        throw new IllegalArgumentException("Person name cannot be empty!");
    }
    Person person = personRepository.findPersonByName(name);
    return person;
}

```

```

@Transactional
public Event getEvent(String name) {
    if (name == null || name.trim().length() == 0) {
        throw new IllegalArgumentException("Event name cannot be empty!");
    }
    Event event = eventRepository.findEventByName(name);
    return event;
}

```

```

@Transactional
public Event createEvent(String name, Date date, Time startTime, Time endTime) {
    // Input validation
    String error = "";
    if (name == null || name.trim().length() == 0) {
        error = error + "Event name cannot be empty! ";
    }
    if (date == null) {
        error = error + "Event date cannot be empty! ";
    }
    if (startTime == null) {
        error = error + "Event start time cannot be empty! ";
    }
    if (endTime == null) {
        error = error + "Event end time cannot be empty! ";
    }
    if (endTime != null && startTime != null && endTime.before(startTime)) {
        error = error + "Event end time cannot be before event start time!";
    }
    error = error.trim();
    if (error.length() > 0) {
        throw new IllegalArgumentException(error);
    }

    Event event = new Event();
    event.setName(name);
    event.setDate(date);
    event.setStartTime(startTime);
    event.setEndTime(endTime);
    eventRepository.save(event);
    return event;
}

```

```

@Transactional
public Registration register(Person person, Event event) {
    String error = "";
    if (person == null) {
        error = error + "Person needs to be selected for registration! ";
    } else if (!personRepository.existsById(person.getName())) {
        error = error + "Person does not exist! ";
    }
    if (event == null) {
        error = error + "Event needs to be selected for registration!";
    } else if (!eventRepository.existsById(event.getName())) {
        error = error + "Event does not exist!";
    }
    if (registrationRepository.existsByPersonAndEvent(person, event)) {
        error = error + "Person is already registered to this event!";
    }
    error = error.trim();

    if (error.length() > 0) {
        throw new IllegalArgumentException(error);
    }

    Registration registration = new Registration();
    registration.setId(person.getName().hashCode() * event.getName().hashCode());
    registration.setPerson(person);
    registration.setEvent(event);

    registrationRepository.save(registration);

    return registration;
}

```

```

@Transactional
public List<Event> getEventsAttendedByPerson(Person person) {
    if (person == null ) {
        throw new IllegalArgumentException("Person cannot be null!");
    }
    List<Event> eventsAttendedByPerson = new ArrayList<>();
    for (Registration r : registrationRepository.findByPerson(person)) {
        eventsAttendedByPerson.add(r.getEvent());
    }
    return eventsAttendedByPerson;
}

```

7. Run the tests again, and all should be passing this time.

## 2.7. Creating RESTful Web Services in Spring

Previously, we used CRUD repository objects for each data type of the domain model and implemented use-cases in service classes. In this section, we will Implement REST API for eventregistration (people, events and registrations) and expose Sping Data.

If you would like to, you can obtain a version of the project that already has the changes from the previous tutorials [here](#).

### 2.7.1. Preliminaries

1. Set database URL to start application and accessing the database remotey. You can do the same by either adding an environment variable called `SPRING_DATASOURCE_URL` or by specifying `spring.datasource.url`, `spring.datasource.username`, and `spring.datasource.password` in `src/main/resources/application.properties`.
2. Add the dependency 'spring-boot-starter-data-rest' in `build.gradle` file of your backend. It is required to expose Spring Data repositories over REST using Spring Data REST.

```
implementation 'org.springframework.boot:spring-boot-starter-data-rest'  
implementation 'org.springframework.boot:spring-boot-starter-data-jpa'  
implementation 'org.springframework.boot:spring-boot-starter-web'  
  
runtimeOnly 'org.postgresql:postgresql'  
testImplementation 'org.springframework.boot:spring-boot-starter-test'
```

### 2.7.2. Building a RESTful Web Service

We will discuss two ways to build RESTful web service for our Spring Boot project.

#### Building a RESTful Web Service Using Controller and DTOs

1. We will first create a new package in EventRegistration-Backend and then create `EventRegistrationRestController` class inside it. We have added the annotation `@RestController` above the controller class so that HTTP requests are handled by `EventRegistrationRestController`. In addition, we enabled the Cross-Origin Resource Sharing at the controller level using '`@CrossOrigin`' notation.

```
package ca.mcgill.ecse321.eventregistration.controller;  
  
{@CrossOrigin(origins = "*")}  
{@RestController}  
public class EventRegistrationRestController {  
}
```

2. We further create another package `ca.mcgill.ecse321.eventregistration.dto` and create the below files inside that package. First we create `EventDto.java`.

```

package ca.mcgill.ecse321.eventregistration.dto;

import java.sql.Date;
import java.sql.Time;

public class EventDto {

    private String name;
    private Date eventDate;
    private Time startTime;
    private Time endTime;

    public EventDto() {
    }

    public EventDto(String name) {
        this(name, Date.valueOf("1971-01-01"), Time.valueOf("00:00:00"),
Time.valueOf("23:59:59"));
    }

    public EventDto(String name, Date eventDate, Time startTime, Time endTime) {
        this.name = name;
        this.eventDate = eventDate;
        this.startTime = startTime;
        this.endTime = endTime;
    }

    public String getName() {
        return name;
    }

    public Date getEventDate() {
        return eventDate;
    }

    public Time getStartTime() {
        return startTime;
    }

    public Time getEndTime() {
        return endTime;
    }

}

```

3. Next, we create **PersonDto** Java class.

```
package ca.mcgill.ecse321.eventregistration.dto;

import java.util.Collections;
import java.util.List;

public class PersonDto {

    private String name;
    private List<EventDto> events;

    public PersonDto() {
    }

    @SuppressWarnings("unchecked")
    public PersonDto(String name) {
        this(name, Collections.EMPTY_LIST);
    }

    public PersonDto(String name, List<EventDto> arrayList) {
        this.name = name;
        this.events = arrayList;
    }

    public String getName() {
        return name;
    }

    public List<EventDto> getEvents() {
        return events;
    }

    public void setEvents(List<EventDto> events) {
        this.events = events;
    }

}
```

4. Finally, we create **RegistrationDto** Java class.

```

package ca.mcgill.ecse321.eventregistration.dto;

public class RegistrationDto {

    private PersonDto person;
    private EventDto event;

    public RegistrationDto() {
    }

    public RegistrationDto(PersonDto person, EventDto event) {
        this.person = person;
        this.event = event;
    }

    public PersonDto getperson() {
        return person;
    }

    public void setperson(PersonDto person) {
        this.person = person;
    }

    public EventDto getEvent() {
        return event;
    }

    public void setEvent(EventDto event) {
        this.event = event;
    }
}

```

- Now, we will add the methods in the controller class. Also, we will add annotations to map web requests.

```

@PostMapping(value = { "/persons/{name}", "/persons/{name}/" })
public PersonDto createPerson(@PathVariable("name") String name) throws
IllegalArgumentException {
    // @formatter:on
    Person person = service.createPerson(name);
    return convertToDto(person);
}

```

@RequestMapping annotation is used to map web requests to Spring Controller methods. Since, @RequestMapping maps all HTTP operations by default. We can use @GetMapping, @PostMapping and so forth to narrow this mapping.

Moreover, in the above snippet, we use "value" and @PathVariable to bind the value of the query

string parameter name into the name parameter of the createPerson() method.

1. You can add other methods similarly with appropriate mappings.

```
@PostMapping(value = { "/events/{name}", "/events/{name}/" })
public EventDto createEvent(@PathVariable("name") String name, @RequestParam Date
date,
@RequestParam @DateTimeFormat(iso = DateTimeFormat.ISO.TIME, pattern = "HH:mm")
LocalTime startTime,
@RequestParam @DateTimeFormat(iso = DateTimeFormat.ISO.TIME, pattern = "HH:mm")
LocalTime endTime)
throws IllegalArgumentException {
    Event event = service.createEvent(name, date, Time.valueOf(startTime),
Time.valueOf(endTime));
    return convertToDto(event);
}

@GetMapping(value = { "/events", "/events/" })
public List<EventDto> getAllEvents() {
    List<EventDto> eventDtos = new ArrayList<>();
    for (Event event : service.getAllEvents()) {
        eventDtos.add(convertToDto(event));
    }
    return eventDtos;
}

@PostMapping(value = { "/register", "/register/" })
public RegistrationDto registerPersonForEvent(@RequestParam(name = "person")
PersonDto pDto,
@RequestParam(name = "event") EventDto eDto) throws IllegalArgumentException {
    Person p = service.getPerson(pDto.getName());
    Event e = service.getEvent(eDto.getName());

    Registration r = service.register(p, e);
    return convertToDto(r, p, e);
}

@GetMapping(value = { "/registrations/person/{name}",
"/registrations/person/{name}/" })
public List<EventDto> getEventsOfPerson(@PathVariable("name") PersonDto pDto) {
    Person p = convertToDomainObject(pDto);
    return createEventDtosForPerson(p);
}

@GetMapping(value = { "/events/{name}", "/events/{name}/" })
public EventDto getEventByName(@PathVariable("name") String name) throws
IllegalArgumentException {
    return convertToDto(service.getEvent(name));
}

private EventDto convertToDto(Event e) {
```

```

    if (e == null) {
        throw new IllegalArgumentException("There is no such Event!");
    }
    EventDto eventDto = new
EventDto(e.getName(),e.getDate(),e.getStartTime(),e.getEndTime());
    return eventDto;
}

private PersonDto convertToDto(Person p) {
    if (p == null) {
        throw new IllegalArgumentException("There is no such Person!");
    }
    PersonDto personDto = new PersonDto(p.getName());
    personDto.setEvents(createEventDtosForPerson(p));
    return personDto;
}

private RegistrationDto convertToDto(Registration r, Person p, Event e) {
    EventDto eDto = convertToDto(e);
    PersonDto pDto = convertToDto(p);
    return new RegistrationDto(pDto, eDto);
}

private Person convertToDomainObject(PersonDto pDto) {
    List<Person> allPersons = service.getAllPersons();
    for (Person person : allPersons) {
        if (person.getName().equals(pDto.getName())) {
            return person;
        }
    }
    return null;
}

private List<EventDto> createEventDtosForPerson(Person p) {
    List<Event> eventsForPerson = service.getEventsAttendedByPerson(p);
    List<EventDto> events = new ArrayList<>();
    for (Event event : eventsForPerson) {
        events.add(convertToDto(event));
    }
    return events;
}

```

### 2.7.3. Test the Service

We can test the application using, e.g., the RESTClient browser plugin, Advanced Rest Client, Postman or curl.

Once you launch the client, you can specify the path and select the method as shown in the below figures.

Advanced REST client

### Request

Method: POST Request URL: http://localhost:8081/person/rijul saini

SEND ::

Parameters ^

Headers	Body	Variables
<input type="checkbox"/> <input type="button" value="Toggle source mode"/> <input type="button" value="Insert headers set"/>		
Header name: content-type	Header value: application/json	<input type="button" value="X"/> <input type="button" value="Edit"/>

[ADD HEADER](#)

Headers are valid Headers size: 30 bytes

200 OK 132.84 ms

DETAILS ^

```
{
  "name": "rijul saini"
}
```

Once we use POST, the record is persisted and then we can use the GET method to retrieve the same.

Advanced REST client

### Request

Method: GET Request URL: http://localhost:8081/persons

SEND ::

Parameters ^

Headers	Variables
<input type="checkbox"/> <input type="button" value="Toggle source mode"/> <input type="button" value="Insert headers set"/>	
Header name: content-type	Header value: application/json

[ADD HEADER](#)

Headers are valid Headers size: 30 bytes

200 OK 116.99 ms

DETAILS ^

```
[Array[1]
 -0: {
   "name": "rijul saini"
 }
]
```

Similarly, we can test the other methods.

## 2.7.4. Spring Data - an Alternative to Exposing the Database

The advantage of using Spring Data Rest is that it can remove a lot of boilerplate that's natural to REST services. Spring would automatically create endpoints like /events, /people as we saw above and these endpoints can be further customized.

1. We have already added the dependency 'spring-boot-starter-data-rest' in preliminary section to expose Spring Data repositories over REST using Spring Data REST.
2. Next, we can go to repository interfaces and add @RepositoryRestResource annotation.

```

@RepositoryRestResource(collectionResourceRel = "participants", path =
"participants")
public interface PersonRepository extends CrudRepository<Person, String>{

    Person findPersonByName(String name);

}

```

3. Finally, we can access this REST API in the browser or REST Client and will receive the JSON as shown below.

The screenshot shows the Advanced REST client interface. The request method is set to GET and the URL is http://localhost:8080/participants. The Headers section contains a single entry: content-type: application/json. The response status is 200 OK with a duration of 904.71 ms. The response body is a JSON object:

```
{
  "_embedded": {
    "participants": [Array[0]]
  },
  "_links": {
    "self": {
      "href": "http://localhost:8080/participants"
    },
    "profile": {
      "href": "http://localhost:8080/profile/participants"
    },
    "search": {
      "href": "http://localhost:8080/participants/search"
    }
  }
}
```

## 2.8. Testing Backend Services

We implement a first unit test for testing the application service logic.

### 2.8.1. Preparations

1. Open the project and ensure that you add *JUnit 5* and *Mockito 2+* to the project dependencies in `build.gradle`:

```
dependencies {
    // Add these lines to the dependency configuration, don't replace the existing
    dependencies
    testImplementation "junit:junit:4.12"
    testRuntime('org.junit.jupiter:junit-jupiter-engine:5.3.1')
    testImplementation('org.mockito:mockito-core:2.+')
    testImplementation('org.mockito:mockito-junit-jupiter:2.18.3')
}
```

**NOTE**

Finding configuration settings for your Gradle/Maven project is very simple by searching for them on MVNRepository: <https://mvnrepository.com/>

2. If you also would like to run your project from Eclipse, add an additional dependency:

```
testImplementation group: 'org.junit.platform', name: 'junit-platform-launcher',
version: "1.3.1"
```

3. Create a test class (in case you don't already have one) `EventregistrationServiceTests` in the corresponding package under `src/test/java`:

```
package ca.mcgill.ecse321.eventregistration;

@RunWith(MockitoJUnitRunner.class)
public class EventregistrationServiceTests {

}
```

4. Build your project to ensure its dependencies are correctly loaded.

### 2.8.2. Writing tests

1. First, update/optimize the `createPerson` service method:

```

@Transactional
public Person createPerson(String name) {
    if (name == null || name == "") {
        throw new IllegalArgumentException("Person name cannot be empty!");
    }
    Person person = personRepository.findPersonByName(name);
    if ( person == null ) {
        person = new Person();
        person.setName(name);
        personRepositroy.save(person);
    }
    return person;
}

```

2. Add the following imports to the test class:

```

import org.junit.Before;
import org.junit.Test;
import org.junit.runner.RunWith;
import org.mockito.InjectMocks;
import org.mockito.Mock;
import org.springframework.boot.test.context.SpringBootTest;
import ca.mcgill.ecse321.eventregistration.dao.EventRepository;
import ca.mcgill.ecse321.eventregistration.dao.PersonRepository;
import ca.mcgill.ecse321.eventregistration.dao.RegistrationRepository;
import ca.mcgill.ecse321.eventregistration.service.EventRegistrationService;
import org.mockito.invocation.InvocationOnMock;
import org.springframework.test.context.junit4.SpringRunner;
import
ca.mcgill.ecse321.eventregistration.controller.EventRegistrationRestController;
import ca.mcgill.ecse321.eventregistration.model.Person;

```

3. Add the following static imports for methods:

```

import static org.junit.Assert.assertEquals;
import static org.junit.Assert.assertNotNull;
import static org.mockito.ArgumentMatchers.anyString;
import static org.mockito.Mockito.mock;
import static org.mockito.Mockito.when;

```

4. Create the DAO mock for person

```
@Mock
private PersonRepository personDao;

@InjectMocks
private EventRegistrationService service;

private static final String PERSON_KEY = "TestPerson";
private static final String NONEXISTING_KEY = "NotAPerson";

@Before
public void setMockOutput() {
    when(personDao.findPersonByName(anyString())).thenAnswer( (InvocationOnMock
invocation) -> {
        if(invocation.getArgument(0).equals(PERSON_KEY)) {
            Person person = new Person();
            person.setName(PERSON_KEY);
            return person;
        } else {
            return null;
        }
    });
}
```

## 5. Add test cases

```

@Test
public void testCreatePerson() {
    assertEquals(0, service.getAllPersons().size());

    String name = "Oscar";

    try {
        person = service.createPerson(name);
    } catch (IllegalArgumentException e) {
        // Check that no error occurred
        fail();
    }

    assertEquals(name, person.getName());
}

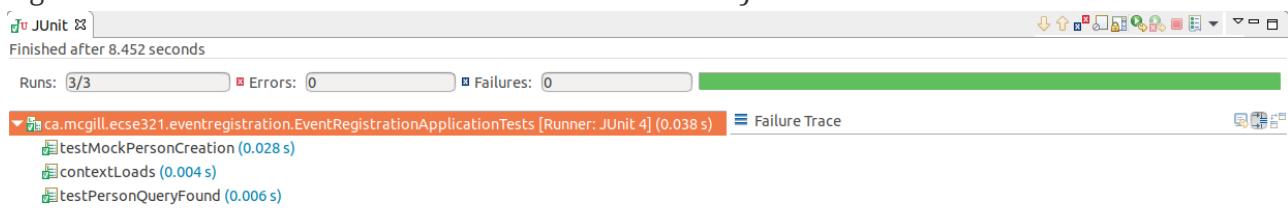
@Test
public void testCreatePersonNull() {
    String name = null;
    String error = null;

    try {
        person = service.createPerson(name);
    } catch (IllegalArgumentException e) {
        error = e.getMessage();
    }

    // check error
    assertEquals("Person name cannot be empty!", error);
}

```

6. Run the tests with **gradle test** from the command line in the root of the project, or in Eclipse, right click on the test class name then select *Run As... > JUnit test*.



## 2.9. Code Coverage using EclEmma

This tutorial covers the basics of EclEmma and retrieves code coverage metrics using it.

### 2.9.1. Preliminary

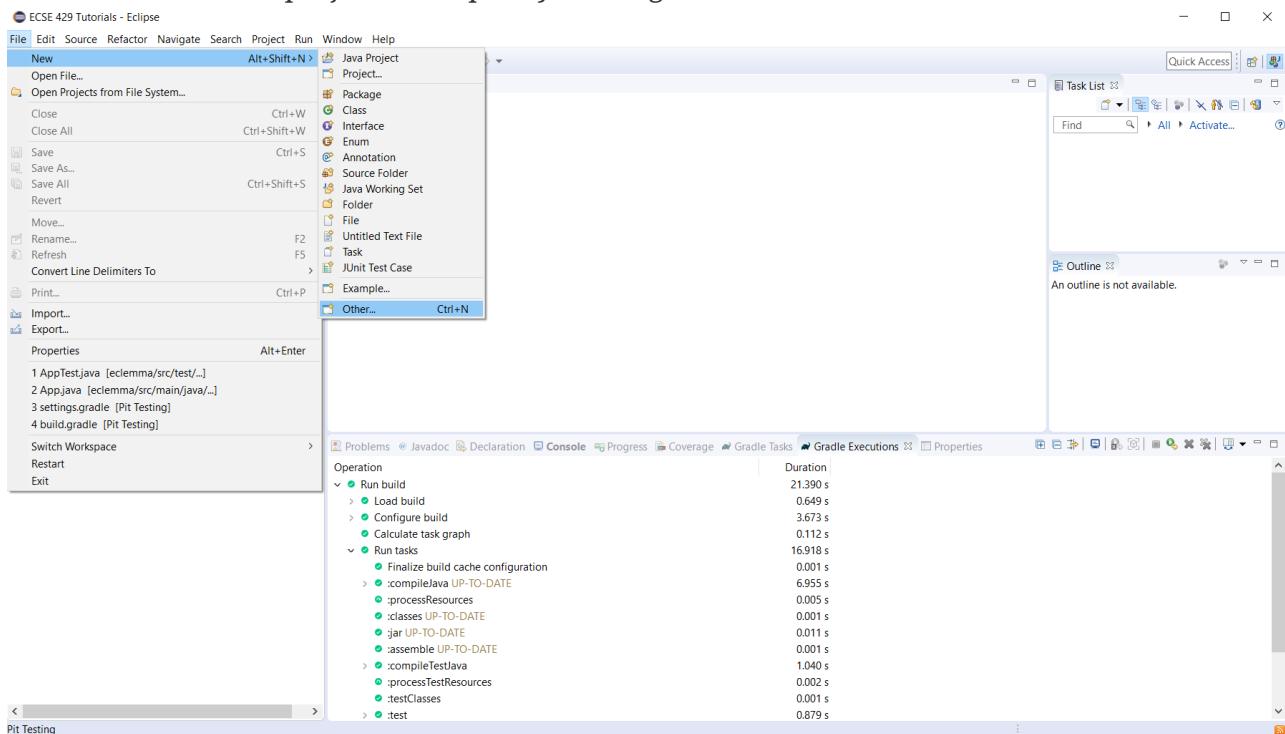
1. Install EclEmma as a plugin in your Eclipse IDE from [here](#).

### 2.9.2. Creating a Gradle Project

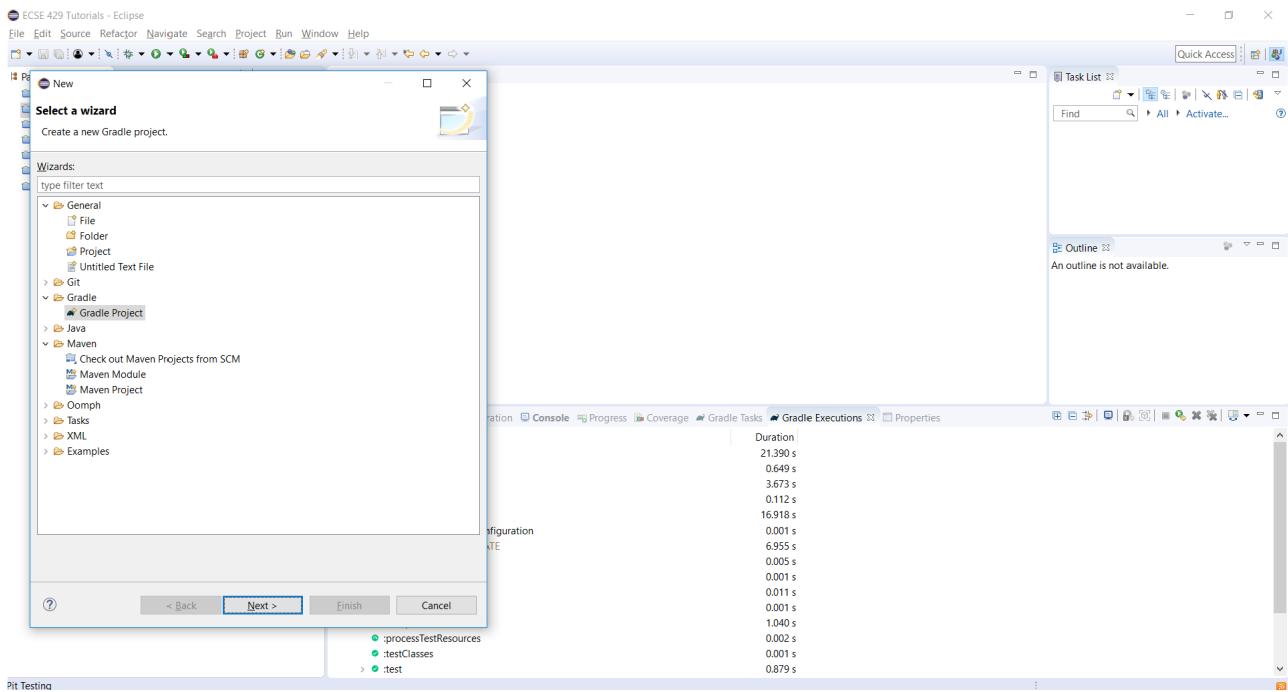
**NOTE**

We will create a Gradle project from scratch and be testing a simple method `returnAverage(int[], int, int, int)`.

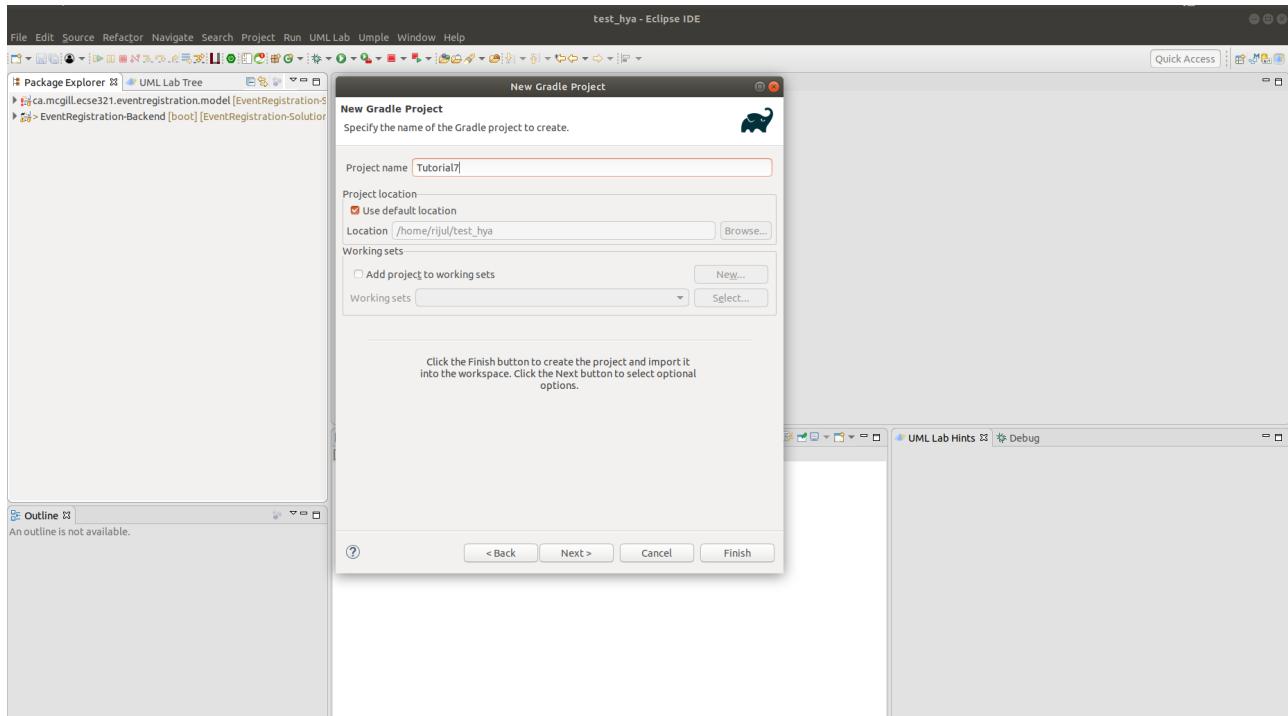
1. Create a new Gradle project in Eclipse by clicking on *File > New > Other*



2. Under *Gradle*, choose *Gradle Project*



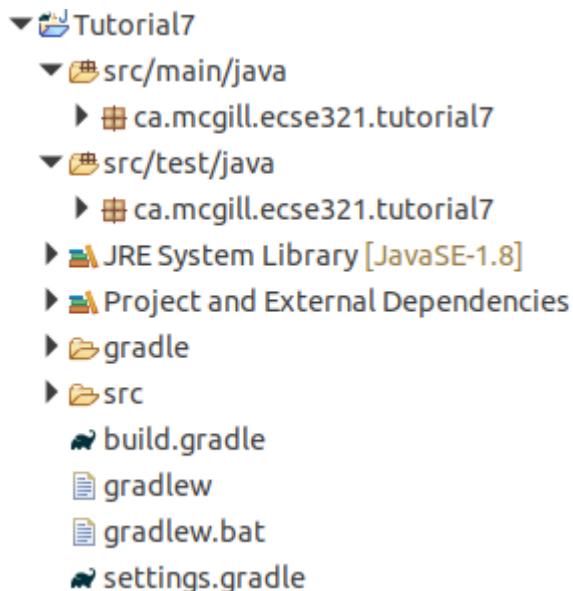
- Click on *Next*, then name your project *tutorial7*, click on *Finish*



#### NOTE

The project may take some time to be created.

- Create a new package instead of the default ones for both the source and test folders (e.g `ca.mcgill.ecse321.tutorial7`) and move the default generated classes (`Library` and `LibraryTest`) to this package.



## 5. Change the code in the `Library` class

```
package ca.mcgill.ecse321.tutorial7;

public class Library {

    public static double returnAverage(int value[], int arraySize, int MIN, int MAX) {
        int index, ti, tv, sum;
        double average;
        index = 0;
        ti = 0;
        tv = 0;
        sum = 0;
        while (ti < arraySize && value[index] != -999) {
            ti++;
            if (value[index] >= MIN && value[index] <= MAX) {
                tv++;
                sum += value[index];
            }
            index++;
        }
        if (tv > 0)
            average = (double) sum / tv;
        else
            average = (double) -999;
        return average;
    }
}
```

## 6. Change the code in the `LibraryTest` class

```

package ca.mcgill.ecse321.tutorial7;

import static org.junit.Assert.assertEquals;

import org.junit.Test;

public class LibraryTest {

    @Test
    public void allBranchCoverageMinimumTestCaseForReturnAverageTest1() {
        int[] value = {5, 25, 15, -999};
        int AS = 4;
        int min = 10;
        int max = 20;
        double average = Library.returnAverage(value, AS, min, max);
        assertEquals(15, average, 0.1);
    }

    @Test
    public void allBranchCoverageMinimumTestCaseForReturnAverageTest2() {
        int[] value = {};
        int AS = 0;
        int min = 10;
        int max = 20;
        double average = Library.returnAverage(value, AS, min, max);
        assertEquals(-999.0, average, 0.1);
    }
}

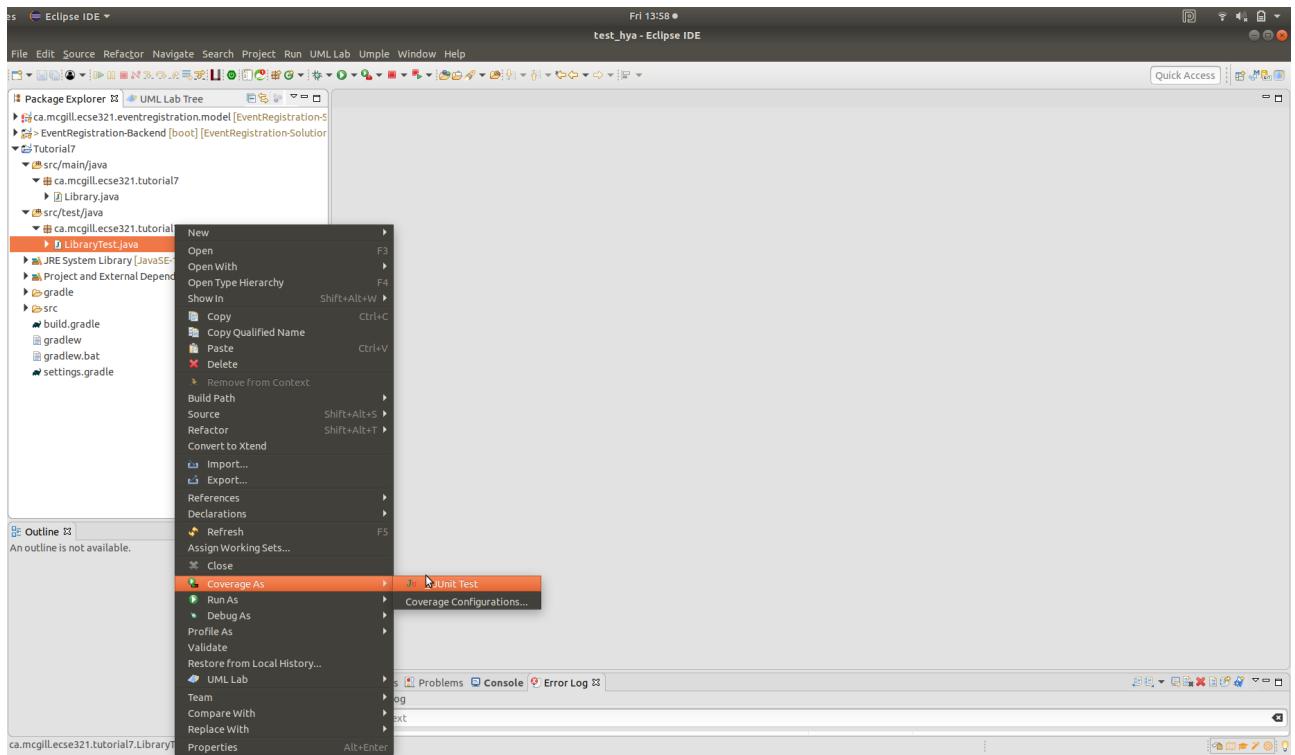
```

### 2.9.3. Retrieving Test Coverage Metrics

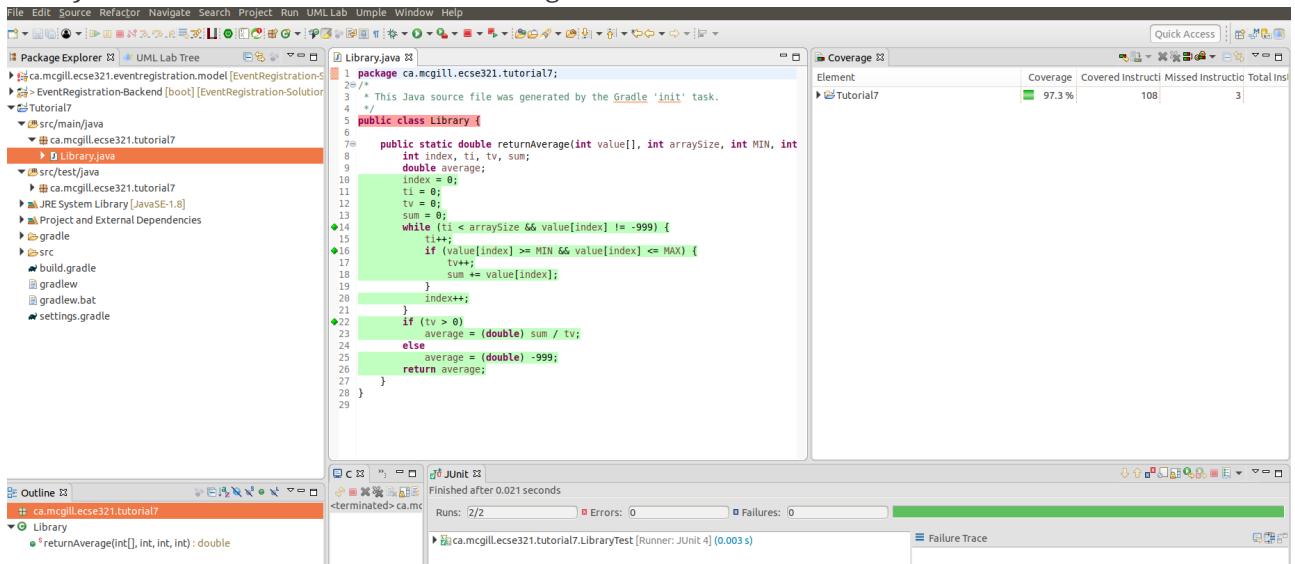
**NOTE**

We can straightforwardly manage code coverage using JaCoCo inside Eclipse with no configuration if we are using EclEmma Eclipse plugin.

1. Run the Test in coverage mode using EclEmma. Click on *LibraryTest, Coverage As, 1 JUnit Test*



## 2. Verify that we have 100% branch coverage.



## 3. Web Frontend

## 3.1. Installation Instructions: Vue.js

Vue.js is a popular web frontend for building user interfaces in Javascript, which is considered to be easier to learn compared to React and Angular.

### 3.1.1. Install Vue.js

1. Open a shell (or run **cmd.exe** in Windows)
2. Check that you successfully installed **node.js** and **npm** e.g. by checking their versions:

```
$ node -v  
v8.10.0  
$ npm -v  
3.5.2
```

3. Install the command line interface (CLI) for Vue: `sudo npm install --global vue-cli`

### 3.1.2. Generate initial Vue.js project content

1. Navigate to your local Git repository of the Event Registration System

```
$ cd ~/git/eventregistration
```

1. Generate initial content as follows

- Hit **Enter** after each line if not indicated otherwise
- Detailed instructions at <https://github.com/vuejs-templates/webpack> and <https://bootstrap-vue.js.org/docs>

```
$ vue init bootstrap-vue/webpack eventregistration-frontend  
? Project name (EventRegistration-Frontend) EventRegistration-Frontend  
? Project description (A Vue.js project) A Vue.js frontend for Event  
Registration App  
? Author (varrodan <daniel.varro@gmail.com>)  
? Vue build (Use arrow keys):  
> Runtime + Compiler  
Runtime-only  
? Install vue-router (Y/n): Y  
? Use ESLint to lint your code (Y/n): n  
? Setup unit tests with Karma + Mocha (Y/n) n  
? Setup e2e tests with Nightwatch (Y/n) Y  
  
vue-cli · Generated "EventRegistration-Frontend".
```

2. Now execute the following commands (one after the other)

```
$ cd EventRegistration-Frontend  
$ npm install  
$ npm run dev
```

3. As a result A sample web page should appear at <http://localhost:8080>
4. You can stop this development server by pressing **Ctrl+C** in the shell

### 3.1.3. Install additional dependencies

1. Install JQuery and Axios (we will use these dependencies for issuing REST API calls):

```
npm install --save axios  
npm install --save jquery
```

### 3.1.4. Setting up your development server

1. We change the default port to **8087** (instead of the default 8080) and the default IP address by using a configuration file. The rationale behind this step is that other Tomcat servers may already listen at the default localhost:8080 port which may clash with our development server.
2. Open **./config/index.js** and add **port: 8087** to **module.exports** (both **build** and **dev** part)
  - The development server is set up at localhost, i.e. <http://127.0.0.1:8087>
  - The production server is set up in accordance with the virtual machines
  - We also store the host IP address and port of the backend server in similar environment variables (**backendHost** and **backendPort**).

```
module.exports = {  
  build: {  
    env: require('./prod.env'),  
    host: 'eventregistration-frontend-123.herokuapp.com',  
    port: 443,  
    backendHost: 'eventregistration-backend-123.herokuapp.com',  
    backendPort: 443,  
    //...  
  },  
  dev: {  
    env: require('./dev.env'),  
    host: '127.0.0.1',  
    port: 8087,  
    backendHost: '127.0.0.1',  
    backendPort: 8080,  
    //...  
  }  
}
```

3. Open `./build/dev-server.js`, and change the `uri` assignment as follows:

- The original line of code can be commented or deleted.

```
//var uri = 'http://localhost:' + port  
var host = config.dev.host  
var uri = 'http://' + host + ':' + port
```

4. Start again your development server by `npm run dev`. The same web application should now appear at <http://127.0.0.1:8087/>

5. Stop the development server by `Ctrl+C`.

### 3.1.5. Commit your work to Github

1. If everything works then commit your work to your Github repository.
2. Notice that many libraries and files are omitted, which is intentional. Check the `.gitignore` file for details.

## 3.2. Create a Static Vue.js Component

Vue.js promotes the use of **components** which encapsulate GUI elements and their behavior in order to build up rich user interfaces in a modular way. A component consists of

- **template:** A template of (a part of) an HTML document enriched with data bindings, conditional expressions, loops, etc.
- **script:** The behavior of the user interface programmed in JavaScript.
- **style:** The customized graphical appearance of HTML document elements.

We will first create a new Vue.js component and then connect it to a backend Java Spring service via a Rest API call.

### 3.2.1. Create a component file

**NOTE**

We use **.** below to refer to the **EventRegistration-Frontend** directory.

1. Create a new file **EventRegistration.vue** in **./src/components** with the following initial content:

```
<template>
</template>
<script>
</script>
<style>
</style>
```

2. Create some static HTML content of the template part starting with a **<div>** element corresponding to your component. We

```

<template>
  <div id="eventregistration">
    <h2>People</h2>
    <table>
      <tr>
        <td>John</td>
        <td>Event to attend</td>
      </tr>
      <tr>
        <td>
          <input type="text" placeholder="Person Name">
        </td>
        <td>
          <button>Create</button>
        </td>
      </tr>
    </table>
    <p>
      <span style="color:red">Error: Message text comes here</span>
    </p>
  </div>
</template>

```

- Customize the `<style>` part with your designated CSS content. A detailed CSS reference documentation is available at <https://www.w3schools.com/CSSref/>. The final result of that part should like as follows.

```

<style>
  #eventregistration {
    font-family: 'Avenir', Helvetica, Arial, sans-serif;
    color: #2c3e50;
    background: #f2ece8;
  }
</style>

```

### 3.2.2. Create a new routing command

- We need to route certain HTTP calls to a specific URL to be handled by **EventRegistration.vue**.
- Open `./src/router/index.js` and add a new route by extending the existing `routes` property.

```
export default new Router({
  routes: [
    {
      path: '/',
      name: 'Hello',
      component: Hello
    },
    {
      path: '/app',
      name: 'EventRegistration',
      component: EventRegistration
    }
  ]
})
```

- You should not change the number of spaces used as indentation otherwise you get error messages, if you have LInt enabled in your project.
- Import the new component `EventRegistration.vue` at the beginning of `./src/router/index.js` after all existing imports!

```
// add import after all existing imports
import EventRegistration from '@/components/EventRegistration'
```

3. Start the development server and navigate your browser to <http://127.0.0.1:8087/#/app>. Your new Vue.js component should be rendered (with the static HTML content).

## 3.3. Vue.js Components with Dynamic Content

### 3.3.1. Add data and event handlers

Next we add event handling and dynamic content to our EventRegistration.vue component.

1. Create another file **registration.js** in the same folder which will contain the Javascript code for the EventRegistration.vue component.
2. Create constructor methods:

```
function PersonDto (name) {
  this.name = name
  this.events = []
}

function EventDto (name, date, start, end) {
  this.name = name
  this.eventDate = date
  this.startTime = start
  this.endTime = end
}
```

3. Add data variables to the export declaration of the component.

```
export default {
  name: 'eventregistration',
  data () {
    return {
      people: [],
      newPerson: '',
      errorPerson: '',
      response: []
    }
  },
  //...
}
```

4. Add an initialization function below the data part.

```
created: function () {
  // Test data
  const p1 = new PersonDto('John')
  const p2 = new PersonDto('Jill')
  // Sample initial content
  this.people = [p1, p2]
},
```

## 5. Add event handling method `createPerson()`:

```
methods: {
  createPerson: function (personName) {
    // Create a new person and add it to the list of people
    var p = new PersonDto(personName)
    this.people.push(p)
    // Reset the name field for new people
    this.newPerson = ''
  }
}
```

### 3.3.2. Create dynamic data bindings

1. Open `EventRegistration.vue` and link the Javascript file as script:

```
<script src="./registration.js">
</script>
```

2. Change the static template content for the person list to dynamic bindings:

- We iterate along all people in data property `people` and dynamically print their name by `{{ person.name }}` (see [list rendering](#))
- We print the (currently empty) list of events to which a person is registered to.

```
<table>
  <tr v-for="person in people" >
    <td>{{ person.name }}</td>
    <td>
      <ul>
        <li v-for="event in person.events">
          {{event.name}}
        </li>
      </ul>
    </td>
  </tr>
<!-- ... -->
</table>
```

3. Link input field content with data variable `newPerson` and button clicks for **Create Person** for event handler method `createPerson()`.

```

<table>
  <!-- ... -->
  <tr>
    <td>
      <input type="text" v-model="newPerson" placeholder="Person Name">
    </td>
    <td>
      <button @click="createPerson(newPerson)">Create Person</button>
    </td>
  </tr>
</table>

```

4. Bind the error message to the corresponding variable `errorPerson` by extending the `<span>` tag with [conditional rendering](#).

- The error message will only appear if the data property `errorPerson` is not empty.
- You may wish to further refine error handling in case of empty string content for `newPerson` by adding `&& !newPerson` to the condition.

```
<span v-if="errorPerson" style="color:red">Error: {{errorPerson}} </span>
```

5. Run your frontend application and observe that two people are listed.

## 3.4. Calling Backend Services

Next we change our frontend to issue calls to the backend via the Rest API provided by the Java Spring framework. Please refer to the section 3.6.2 where we enabled the Cross-Origin Resource Sharing at the controller level using '@CrossOrigin' notation.

### 3.4.1. Calling backend services in from Vue.js components

We need to modify our frontend to make calls to backend services.

1. Open **registration.js** and add the following content to the beginning:

- Note that instead of hard-wired IP addresses and ports, details are given in a configuration file.

```
import axios from 'axios'
var config = require('../config')

var frontendUrl = 'http://' + config.dev.host + ':' + config.dev.port
var backendUrl = 'http://' + config.dev.backendHost + ':' +
config.dev.backendPort

var AXIOS = axios.create({
  baseURL: backendUrl,
  headers: { 'Access-Control-Allow-Origin': frontendUrl }
})
```

2. Now navigate to the **created** function, and replace existing content with the following lines:

```
created: function () {
  // Initializing people from backend
  AXIOS.get('/persons')
    .then(response => {
      // JSON responses are automatically parsed.
      this.people = response.data
    })
    .catch(e => {
      this.errorPerson = e;
    });
}
```

3. Navigate to the **createPerson()** method and change its content as follows:

```
createPerson: function (personName) {
  AXIOS.post('/persons/' + personName, {}, {})
    .then(response => {
      // JSON responses are automatically parsed.
      this.people.push(response.data)
      this.newPerson = ''
      this.errorPerson = ''
    })
    .catch(e => {
      var errorMsg = e.message
      console.log(errorMsg)
      this.errorPerson = errorMsg
    });
}
```

4. Run the frontend application and check that

- New people can be added
- They immediately appear in the people list.

## 3.5. Build and Travis-CI

The project should build using `npm run build`. This will create a `build/` directory in the frontend folder, where you can run the frontend server using `node build/dev-server.js`.

Travis-CI supports [building nodejs projects](#). However, we do not want to run the default `npm test` command. Instead, the build should do `npm install` and `npm run build` only.

## 3.6. Additional steps in the tutorial

### 3.6.1. Steps to complete

The description of the next steps is intentionally high-level and sketchy to force you to face and solve several emerging problems.

You need to provide the following functionality by extending the Vue.js component:

#### 1. List all events (name, date, startTime, endTime)

- Introduce an array **events** in the frontend data store
- Call the appropriate backend service to fill the contents
- Provide a dynamic list in the component and bind it to **events**

#### 2. Create a new event (name, date, startTime, endTime)

- Introduce an object **newEvent** in the frontend data store with four properties (e.g. name, date, startTime, endTime).
  - Set the initial values of these properties to something
- Provide a button to initiate creating a new event
- Provide HTML input fields to set event details
- Create a call to the appropriate backend service, i.e. **createEvent()**
- Introduce an object **errorEvent** for error message related to event creation
- Provide corresponding HTML field for displaying the error message (e.g. `<span>`), and set its appearance condition to the content of the error message
- **Hint:** you can use the following input types for setting date and time

```
<input type="date" v-model="newEvent.eventDate" placeholder="YYYY-MM-DD">
<input type="time" v-model="newEvent.startTime" placeholder="HH:mm">
```

#### 3. Register a person to an event (when a new event should occur in the list of events printed next to a person)

- Provide a selection of people
  - You need a corresponding data variable (e.g. **selectedPerson**)
  - You can use the HTML `<select v-model="selectedPerson">` tag where each option (`<option>` tag with **v-for** Vue.js parameter) is filled dynamically from the list of people.
  - **Hint:** You can add a first disabled option as follows:

```
<option disabled value="">Please select one</option>
```

- Provide a selection of events in a similar way.
- Provide a button to initiate registration

- Enable the button only if both a person and an event are selected
4. In all use cases,
- Report application specific errors if the backend service fails
  - Prevent to enter invalid data to backend

### 3.6.2. Further documentation

- Vue.js guide: <https://vuejs.org/v2/guide/>
- Vue.js API: <https://vuejs.org/v2/api/>
- Build commands: <http://vuejs-templates.github.io/webpack/commands.html>
- Vue.js and Webpack integration: <http://vuejs-templates.github.io/webpack/env.html>
- Html-Webpack: <https://github.com/jantimon/html-webpack-plugin>
- Vue Router: <https://github.com/vuejs/vue-router>
- Vue Router tutorial: <https://scotch.io/tutorials/getting-started-with-vue-router>

## 4. Mobile Frontend

## 4.1. Setting up your repository

1. Navigate to the directory where the EventRegistration application resides, e.g.,  
`/home/user/git/eventregistration`
2. Initialize a new, orphan branch with the following commands

```
git checkout --orphan android  
git reset  
rm ./* .gitignore
```

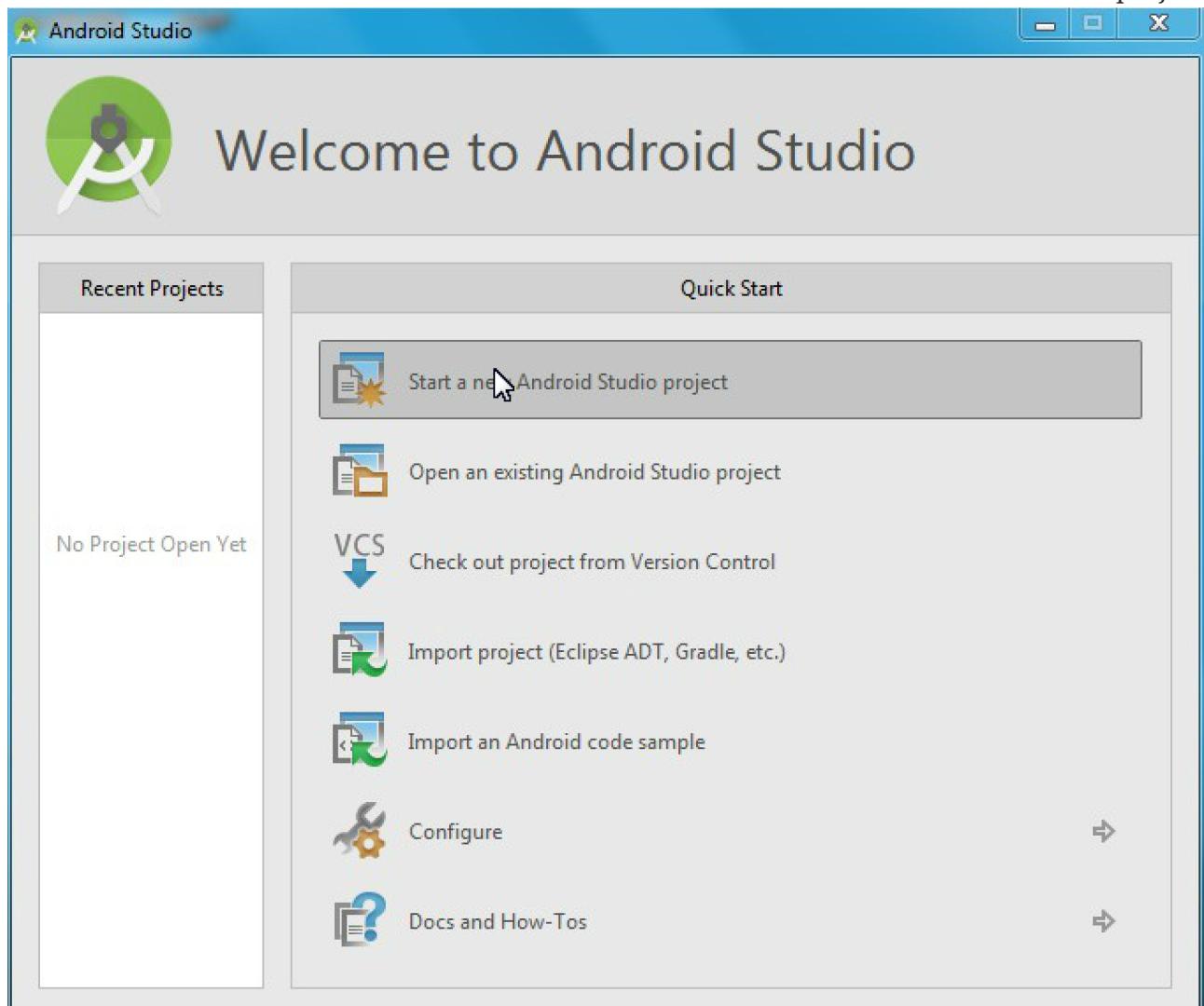
**NOTE**

One-liner command that does the same for those who like living dangerously:

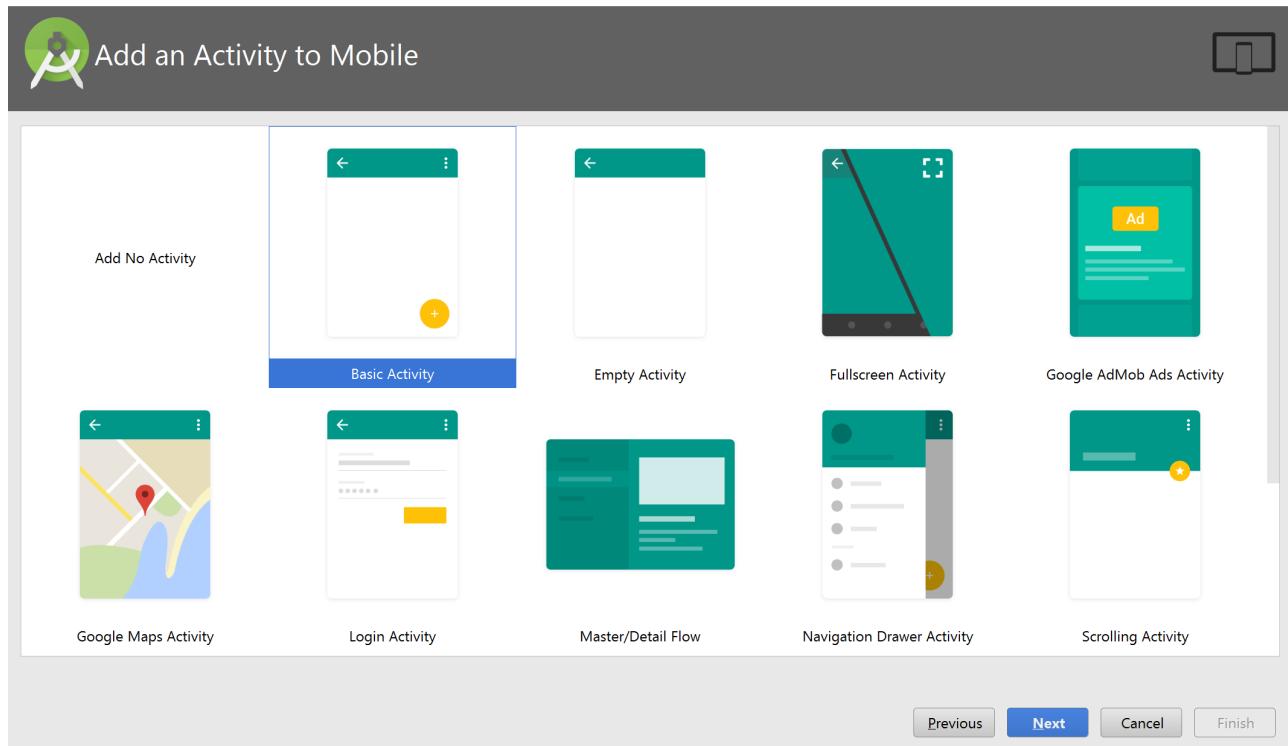
```
git checkout --orphan android && git reset && rm ./* .gitignore
```

## 4.2. Create an Android project

1. Start a new Android project

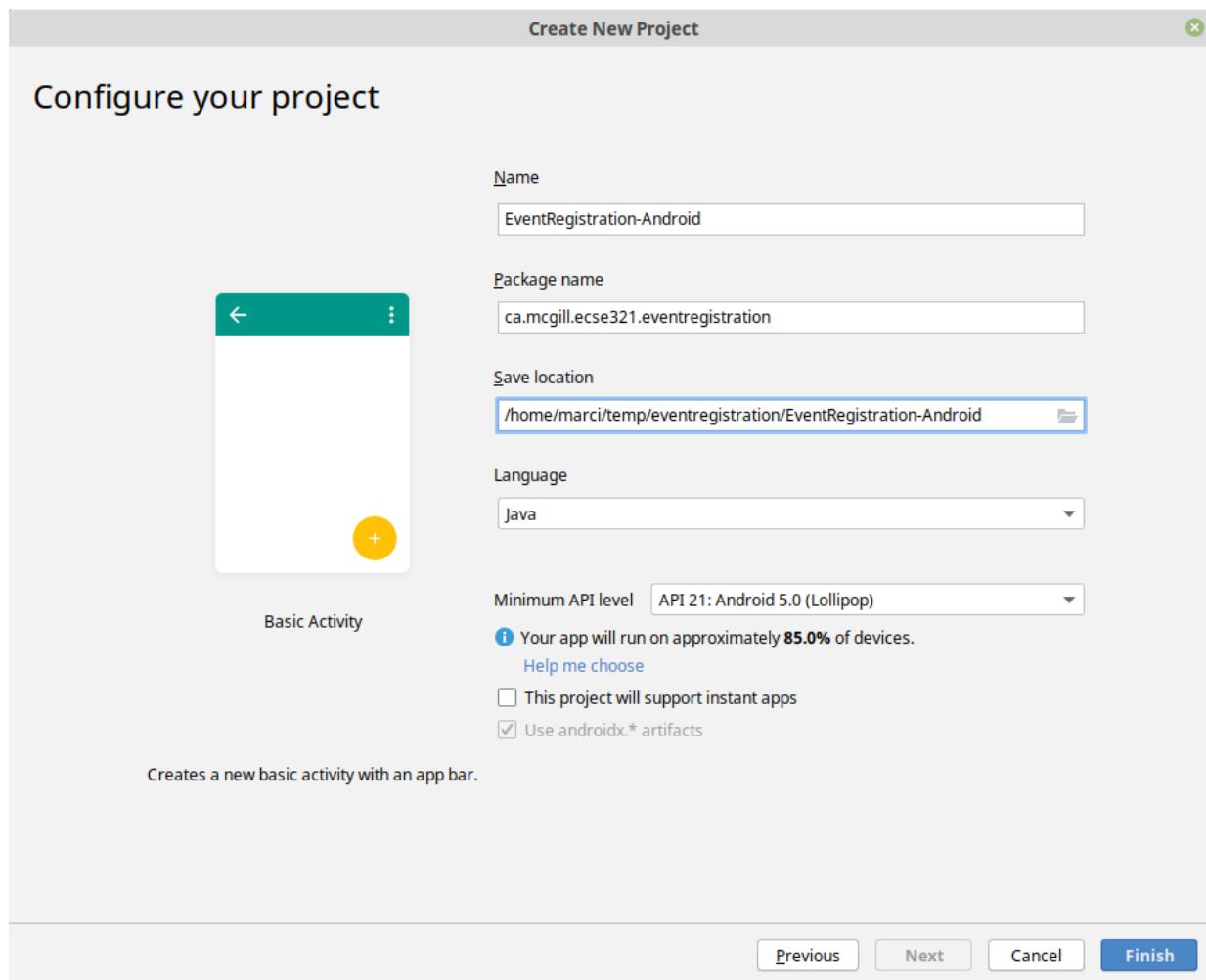


2. Select a **Basic Activity** and click **Next**



### 3. Specify project details and click on **Finish**

- Application name: **EventRegistration-Android**
- Package name: **ca.mcgill.ecse321.eventregistration**
- Project location: create the project within the prepared working copy of the git repository say, `/home/user/git/eventregistration/EventRegistration-Android``)
- Select *Java* as language
- Click on **Finish**

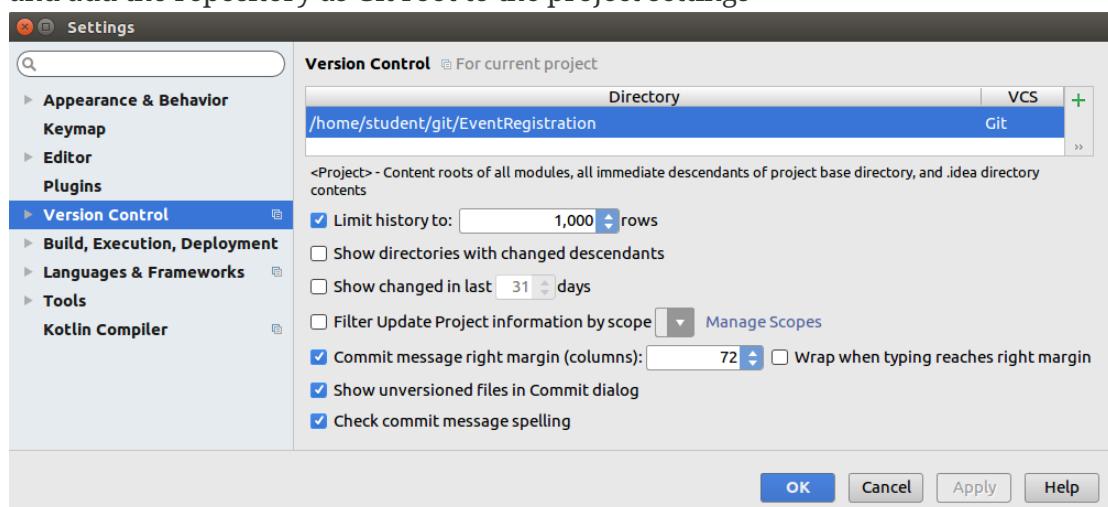


4. Wait until the project is built by Gradle, this takes a minute or two

5. Optional step.

Optionally, to setup version control integration, go to *File/Settings.../Version Control* and add the repository as Git root to the project settings

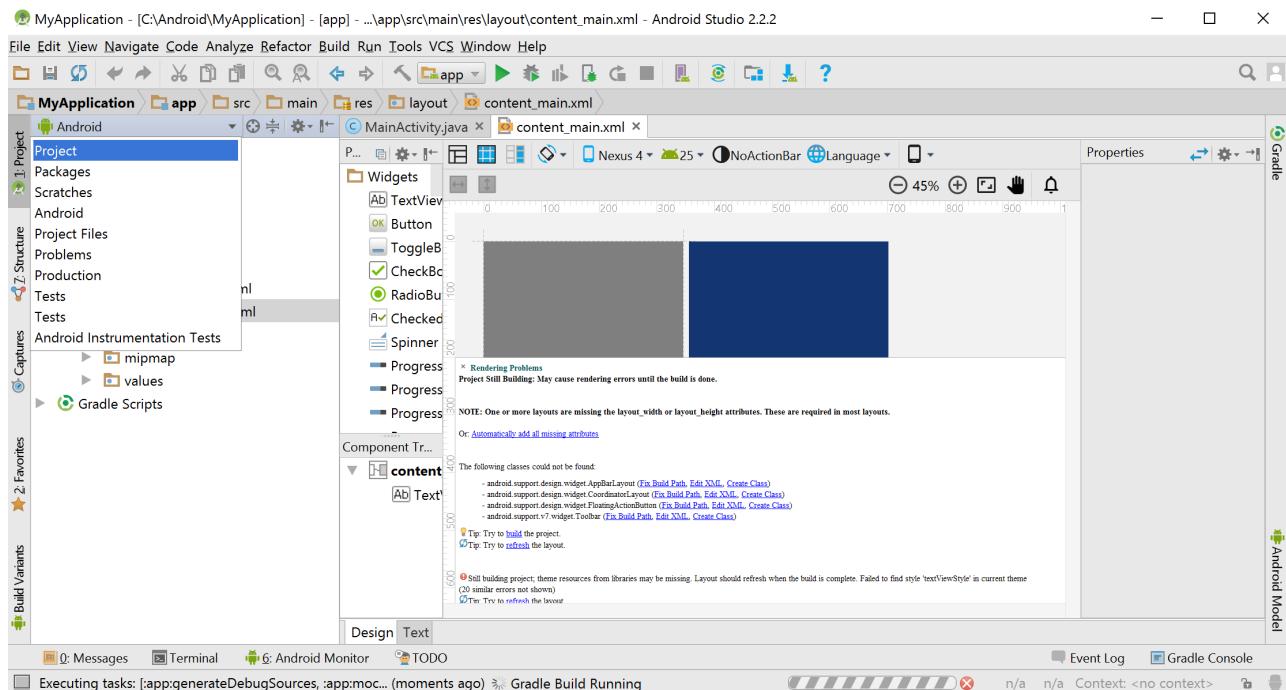
**TIP**



Then, you can issue Git commands from the VCS menu in Android Studio while developing the application. Regardless whether you complete this step or not, you can still use git from the command line, since the project is created in the working directory of your git repository.

6. Select the **Project** view in the left pane (instead of the default **Android** view) and observe three

files:



- **MainActivity.java**: application code is written here (located in **app/src/main/java**)
  - **content\_main.xml**: layout specifications of the UI are provided in XML (located in **app/src/main/res/layout**)
  - **strings.xml**: naming of resources (located in **app/src/main/res/values**)
7. Include a dependency for network communication by adding the following line to the **build.gradle** file located in the *app* folder to the end within the **dependencies{ ... }** part (see figure, but the content is different).

```
implementation 'com.loopj.android:android-async-http:1.4.9'
```

8. Open the **AndroidManifest.xml** file (located in **app/src/main** within the Android project), and add the following XML tag for setting permissions appropriately (before the existing **<application>** tag)

```
<?xml version="1.0" encoding="utf-8"?>
<manifest xmlns:android="http://schemas.android.com/apk/res/android"
    package="ca.mcgill.ecse321.eventregistration">

    <uses-permission android:name="android.permission.INTERNET"/>
    <!-- Existing content with <application> tag -->
</manifest>
```

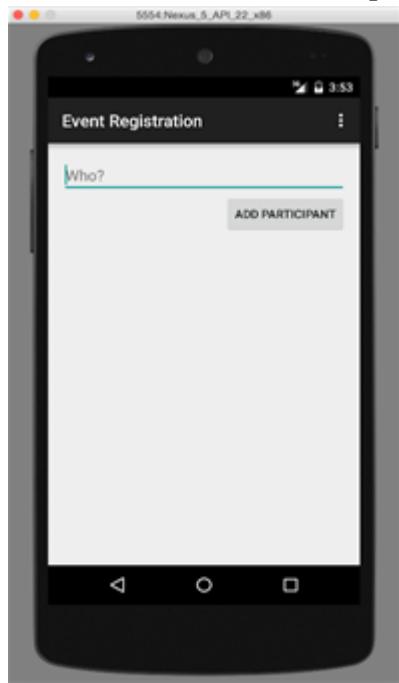
9. As the gradle build file has changed, click on the **Sync** link.  
10. Re-build the project by **Build | Make Project** if still needed.

# 4.3. Developing for Android: Part 1

## 4.3.1. Developing the View Layout

In the next steps, we will develop a simple GUI as the view for the mobile EventRegistration app with (1) one text field for specifying the name of a person, and (2) one **Add Person** button

The GUI will look like as depicted below.



1. Open the **content\_main.xml** file, which contains a default **Hello World** text.
2. Replace the highlighted default content with the following XML tags.

```
<?xml version="1.0" encoding="utf-8"?>
<RelativeLayout xmlns:android="http://schemas.android.com/apk/res/android"
    xmlns:app="http://schemas.android.com/apk/res-auto"
    xmlns:tools="http://schemas.android.com/tools"
    android:layout_width="match_parent"
    android:layout_height="match_parent"
    android:paddingBottom="16dp"
    android:paddingLeft="16dp"
    android:paddingRight="16dp"
    android:paddingTop="16dp"
    app:layout_behavior="android.support.design.widget.AppBarLayout$ScrollingViewBehavior"
    tools:context="ca.mcgill.ecse321.eventregistration.MainActivity"
    tools:showIn="@layout/activity_main">
    <TextView
        android:layout_width="wrap_content"
        android:layout_height="wrap_content"
        android:text="Hello World!" />
</RelativeLayout>
```

```

<LinearLayout
    android:layout_width="match_parent"
    android:layout_height="wrap_content"
    android:orientation="vertical"
    app:layout_constraintLeft_toLeftOf="parent"
    app:layout_constraintRight_toRightOf="parent"
    app:layout_constraintTop_toTopOf="parent">

    <TextView
        android:id="@+id/error"
        android:layout_height="wrap_content"
        android:layout_width="wrap_content"
        android:visibility="gone"
        android:text=""
        android:textColor="@color/colorAccent"/>

    <EditText
        android:layout_width="match_parent"
        android:layout_height="wrap_content"
        android:id="@+id/newperson_name"
        android:hint="@string/newperson_hint"/>

    <Button
        android:layout_width="wrap_content"
        android:layout_height="wrap_content"
        android:layout_gravity="end"
        android:text="@string/newperson_button"
        android:onClick="addPerson"/>
</LinearLayout>

```

- **LinearLayout** declares a vertical layout to hold the GUI elements;
- **EditText** adds a textfield to enter the name of the person;
- **Button** provides a button to add a person.

Some erroneous tags are marked in red, which will be corrected in the following steps.

### Specifying a text field and a button

#### 1. We place new literals in the **strings.xml**

```

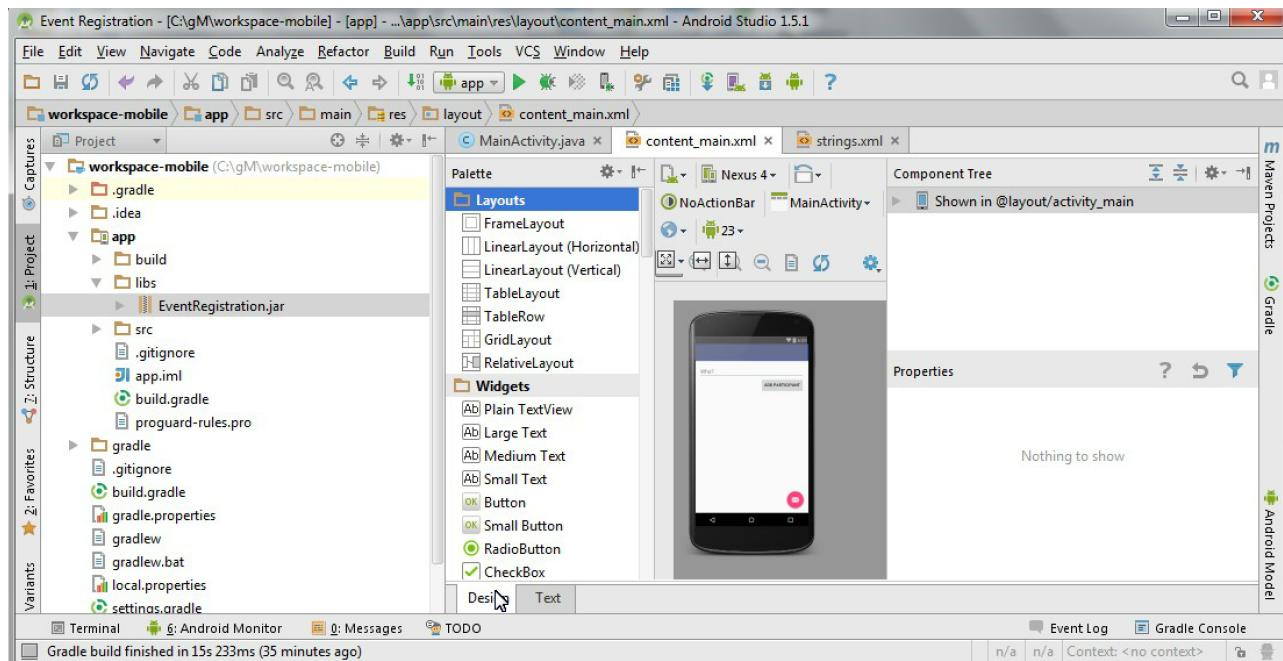
<string name="newperson_hint">Who?</string>
<string name="newperson_button">Add Person</string>

```

#### 2. Save **strings.xml**

## Observing the view

1. Save the file **content\_main.xml**.
2. Click on the **Design** tab to check the graphical preview of the app.



### 4.3.2. Connecting to backend via RESTful service calls

As a next step, we define a view depicted below and add Java code to provide behavior for the view, e.g. what should happen when the different buttons are clicked. The key interactions of our application are the following:

- a. What to do when the application is launched? (`onCreate()`)
- b. What to do when a button is clicked? (`addPerson()`)

#### Create a utility class for communicating with HTTP messages

1. Make sure you have the implementation '`com.loopj.android:android-async-http:1.4.9'` dependency (among others) in the `build.gradle` file for the `app` module (see the section on project setup for more details)
2. Create the `HttpUtils` class in the `ca.mcgill.ecse321.eventregistration` package and add missing imports as required with `Alt+Enter`

**TIP**

You may need to wait a few minutes after dependencies have been resolved to allow the IDE to index classes

```

public class HttpUtils {
    public static final String DEFAULT_BASE_URL = "https://eventregistration-
backend-123.herokuapp.com/";

    private static String baseUrl;
    private static AsyncHttpClient client = new AsyncHttpClient();

    static {
        baseUrl = DEFAULT_BASE_URL;
    }

    public static String getBaseUrl() {
        return baseUrl;
    }

    public static void setBaseUrl(String baseUrl) {
        HttpUtils.baseUrl = baseUrl;
    }

    public static void get(String url, RequestParams params,
    AsyncHttpResponseHandler responseHandler) {
        client.get(getAbsoluteUrl(url), params, responseHandler);
    }

    public static void post(String url, RequestParams params,
    AsyncHttpResponseHandler responseHandler) {
        client.post(getAbsoluteUrl(url), params, responseHandler);
    }

    public static void getByUrl(String url, RequestParams params,
    AsyncHttpResponseHandler responseHandler) {
        client.get(url, params, responseHandler);
    }

    public static void postByUrl(String url, RequestParams params,
    AsyncHttpResponseHandler responseHandler) {
        client.post(url, params, responseHandler);
    }

    private static String getAbsoluteUrl(String relativeUrl) {
        return baseUrl + relativeUrl;
    }
}

```

## Further helper methods

1. Open the **MainActivity.java** file.
2. Add a new attribute to the beginning of the class for error handling.

```
// ...
public class MainActivity extends AppCompatActivity {
    private String error = null;

    // ...
}
```

3. Implement the `refreshErrorMessage()` method to display the error message on the screen, if there is any.

**NOTE** Again, add imports with `Alt+Enter` (import is needed for `TextView`)

```
private void refreshErrorMessage() {
    // set the error message
    TextView tvError = (TextView) findViewById(R.id.error);
    tvError.setText(error);

    if (error == null || error.length() == 0) {
        tvError.setVisibility(View.GONE);
    } else {
        tvError.setVisibility(View.VISIBLE);
    }
}
```

4. Add code to initialize the application in the `onCreate()` method (after the auto-generated code).

```
@Override
protected void onCreate(Bundle savedInstanceState) {
    // ...
    // INSERT TO END OF THE METHOD AFTER AUTO-GENERATED CODE
    // initialize error message text view
    refreshErrorMessage();
}
```

## Creating a handler for Add Person button

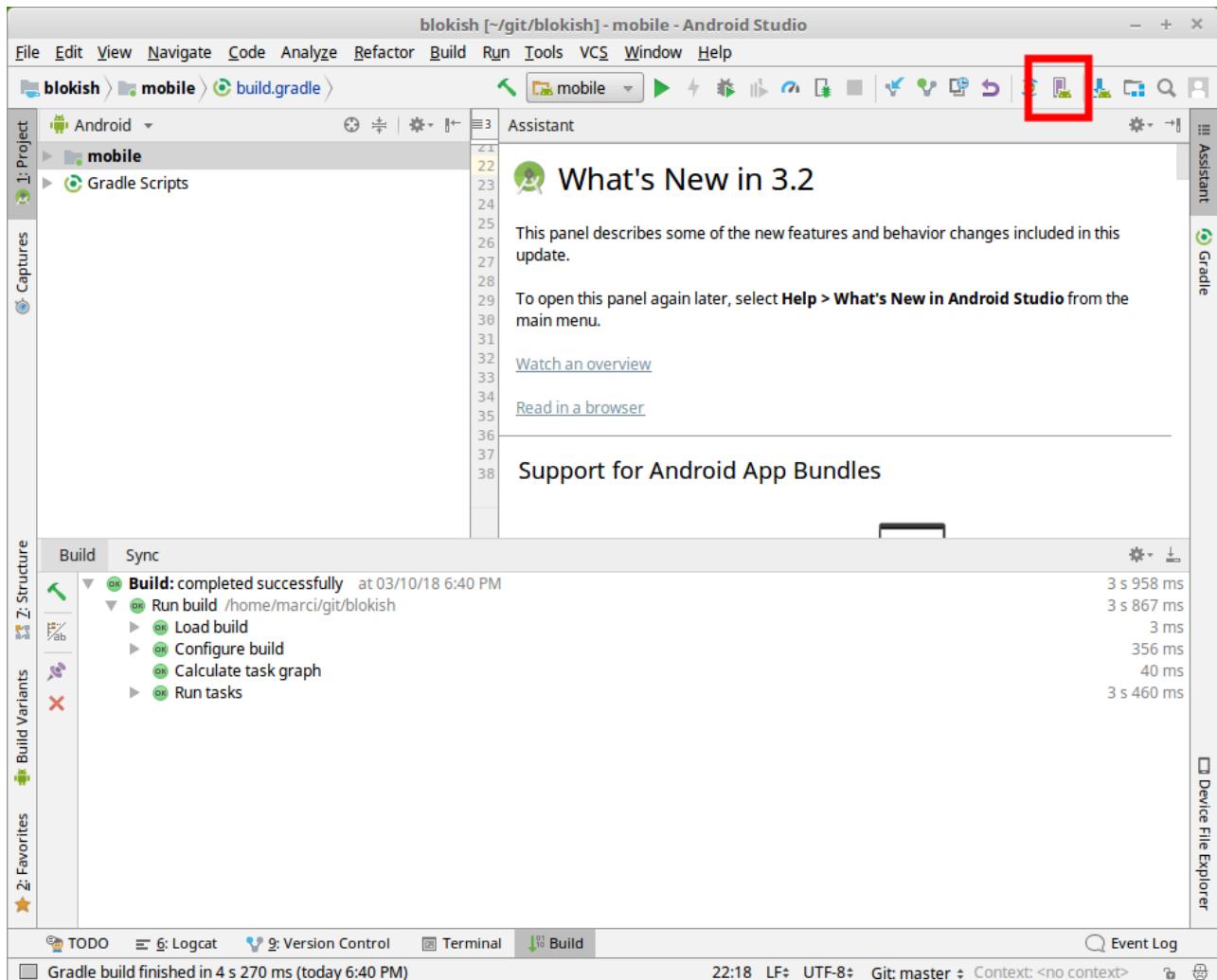
1. Implement the `addPerson()` method as follows

```
public void addPerson(View v) {
    error = "";
    final TextView tv = (TextView) findViewById(R.id.newperson_name);
    HttpUtils.post("persons/" + tv.getText().toString(), new RequestParams(), new
JsonHttpResponseHandler() {
        @Override
        public void onSuccess(int statusCode, Header[] headers, JSONObject response)
{
            refreshErrorMessage();
            tv.setText("");
        }
        @Override
        public void onFailure(int statusCode, Header[] headers, Throwable throwable,
JSONObject errorResponse) {
            try {
                error += errorResponse.get("message").toString();
            } catch (JSONException e) {
                error += e.getMessage();
            }
            refreshErrorMessage();
        }
    });
}
```

2. Import the missing classes again with **Alt+Enter**. There are multiple **Header** classes available, you need to import the **cz.msebera.android.httpclient.Header** class.

## 4.4. Running and Testing the Application on a Virtual Device

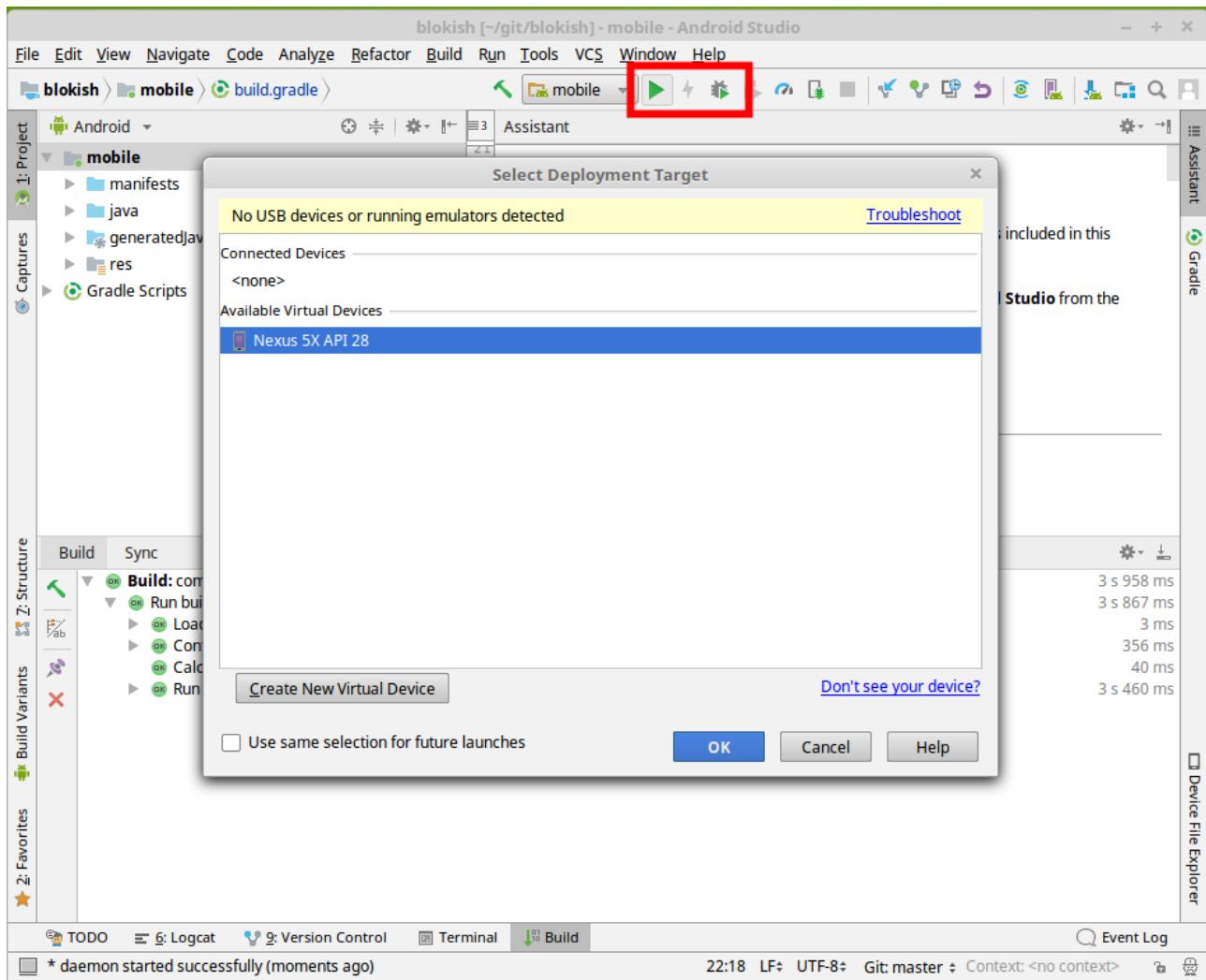
1. Start the Spring backend application on Heroku, while ensure that the `DEFAULT_BASE_URL` in `HttpUtils` is configured accordingly.
2. Click on the *AVD manager* button in Android Studio near the top right corner of the window



3. Add a new device with default settings.

**NOTE** You might be asked to download emulator files. If this happens, click OK.

4. Start/Debug the application using the buttons highlighted on the figure below



5. After you select the device (in this case Nexus 5X) as deployment target, the application will automatically be deployed and started within an Android VM, and it is ready to use. Be patient, deployment and startup may take a few seconds.
6. Leave the text field empty, then try adding a person. You should get an error message on screen saying a person cannot be added with no name.
7. Supply a name for a new person, then try adding it. Upon successful completion, the text field and the error message should clear.