

# 95-702 Distributed Systems

## Project 1

Assigned: Saturday, January 19, 2019  
Due: Friday, February 8, 11:59 PM

This project has five objectives:

First, you are introduced to GlassFish. GlassFish is an open source application server that implements the latest JEE specification. This tool is used throughout the course. The NetBeans integrated development environment is used to build source code and interact with GlassFish.

Second, you build your first set of distributed systems. These are three small web applications using Servlets and Java Server Pages.

Third, you are introduced to simple mobile device awareness and adapting content to be suitable for either desktop or mobile devices.

Fourth, you are introduced to the MVC pattern if you have not used it before.

And finally, as in all projects this semester, you should reflect on the functional and non-functional characteristics (e.g. security, scalability, failure handling, interoperability) of your solutions. There will be questions on the midterm and final exam concerning these characteristics. You should be able to demonstrate a nuanced comprehension of course content and be able to explain the technical aspects in relation to potential real-world applications.

For each project task, software documentation is required. The software that you write (Java files and so on) must contain comments that describe what each significant piece of code is intended to accomplish. Points will be deducted if code is not well documented. Read the documentation-related links provided on the course schedule (for class #1) to understand what is expected.

Be sure to consult the rubric linked from the course schedule for details on grading.

### Task 1

Use the NetBeans Project Name: Project1Task1

Create an index.jsp page that asks the user to enter a string of text data, and to make a choice of two hash functions using radio buttons. The hash function choices should be MD5 and SHA-256, with MD5 being the default. When the submit button is pressed a request is sent to a servlet. The servlet must be named ComputeHashes.java. The servlet will compute the requested cryptographic hash value (MD5 or SHA-256) from the text transmitted by the browser. You will need to employ the Java crypto API to compute the hash of the text. The original text will be echoed back to the browser along with the name of the hash, and

the hash value. The hash values sent back to the browser should be displayed in two forms: as hexadecimal text and as base 64 notation. We will discuss the use of such hash values later in the course.

To compute the MD5 and SHA-256 hashes, use these standard java packages:

```
import java.security.MessageDigest;
import java.security.NoSuchAlgorithmException;
```

To print the Base64 encoding, use the following method:

```
javax.xml.bind.DatatypeConverter.printBase64Binary
```

To print the hexadecimal encoding, use the following method:

```
javax.xml.bind.DatatypeConverter.printHexBinary
```

Be sure to provide a simple and user friendly interface.

If you are unfamiliar with HTML forms, a simple explanation can be found at:  
[http://www.w3schools.com/html/html\\_forms.asp](http://www.w3schools.com/html/html_forms.asp) .

Be sure to create screen shots of your working application and submit them as described in the Submission section at the end of this document.

## Task 2

Use NetBeans Project Name: Project1Task2

You can choose one of two alternative tasks, Task 2a or Task 2b

### Task 2a

For task 2a, build a web application that searches for images of butterflies and moths from the “Butterflies and Moths of North America” web site at

<https://www.butterfliesandmoths.org/gallery>

Screen scraping is programmatically processing the HTML that typically is displayed by a browser and can be a useful tool when your data source does not have an API that provides structured data. Instead, you can search or parse the HTML to find and extract the data that you need.

(For more information, see [https://en.wikipedia.org/wiki/Web\\_scraping](https://en.wikipedia.org/wiki/Web_scraping))

Your task is to build a web app for use by mobile and desktop browsers, that will allow the user to search and see examples of lepidoptera, within a given range of criteria.

By experimenting with the search functionality, you can infer the URLs needed to make searches. In particular, explore:

- How to search specifically for species (e.g. *Phocides pigmalian*), or no species specified.
- How to restrict the search to a region (e.g. Panama)
- How to restrict the search to a stage. (e.g. adult)

Your application should work similarly to InterestingPicture, but instead of searching Flickr, it should search the Butterfly and Moth collection.

Requirements:

- A welcome page
  - The page should allow for input of:
    - Species – optional, default is “All”; use a **text field**: All and blank are the same
    - Region – required, but can be “All”; use a **drop-down box**. The site uses a string code for each region; see the list of regions and their codes below.
    - Stage – required, but can be “All”; use **radio buttons** with choices: adult, egg, caterpillar, pupa, All (default value)

Set the other fields (Family, subfamily, type, view, and sex) to All (note: the site’s search boxes say “Any”, but the parameter is actually “All”).

The regions and their codes are: All all; Barbados 45172; Belize 45159; Bermuda 45157; Bonaire 45170; Canada 45153; Cayman\_Islands 45167; Costa\_Rica 45156; Cuba 45155; Dominican\_Republic 45161; El\_Salvador 45160; Guatemala 45169; Haiti 45162; Honduras 45165; Jamaica 45171; Mexico 45154; Nicaragua 45163; Panama 45158; Puerto\_Rico 45166; St.\_Kitts 45164; The\_Bahamas 45168; United\_States 45152

□ A results page

- Show one randomly chosen image.
  - The image on mobile should be the small medium thumbnail image.
  - The image on desktop should be the full-sized image. This is the image that you see in the browser after clicking on a thumbnail. You should display this larger image but displayed (using the HTML img tag attribute width) not wider than 460 pixels.
  - The image should be randomly chosen with each request (and therefore change each time).
  - You should search for 40 images. You do not have to fetch images beyond the first 40. Also, if fewer than 40 images are found, that is fine, as long as your search would allow for up to 40.

- Your result should work for all number of found images:
  - One image, such as when searching for species “Astraptes alector”
  - Multiple images, such as when searching for region “Panama”
  - Zero images, such as when searching for species “Mertzmoth”
- All pages must credit the original site as the source of the mages.
- If, for some reason, the Butterfly and Moth site is down, then your web app should fail gracefully.
  - It is OK to just report zero images.
  - We will test this by turning off wifi
- Your code should exhibit good separation of concerns using the MVC pattern.

Your application should work and look acceptable on a desktop and mobile browser.

Adapting to mobile:

There are two ways to adapt your web app to mobile.

- Device detection: The server detects, using the user-agent header, whether the client is a mobile device or a desktop device. This is how InterestingPicture works. This is **not** best practice, but it is acceptable for this assignment.
- Feature detection and responsive design: The client (browser) adapts the displayed content given its own characteristics (e.g. screen size). This is the current best practice and requires the use of JavaScript and/or CSS. We will provide to you an example client solution that you can adapt if you choose. Watch for it to be announced via Piazza.

Notes and hints:

- Refer to <http://www.w3schools.com> for good help on the basic HTML you need for this task.
- You are allowed to and encouraged to build your solution based on the InterestingPicture code you have been given in class. You **MUST** refactor it, however, to have project, variable, and class names that make sense for your application. For example, you will lose points if your class is still named InterestingPictureServlet.
- You do not need to, but you are welcome to, use jsoup (<https://jsoup.org/>) which is a Java HTML Parser.
  - The downsides of using jsoup are you will first need to understand the Document Object Model (DOM) and CSS Selectors. These are both useful to know.
  - The upside of using jsoup is that it makes it much easier to find and select content from HTML (i.e. screen scrape).

- `SSLHandshakeException`
  - `butterfliesandmoths.org` requires you to make https, not http requests. When you do so from your Java program, you will hit an `SSLHandshakeException`. We will be covering SSL and related topics in a few weeks. In the meantime, you will have to deal with this exception.
    - If you use jsoup, you should use `validateTLSCertificates(false)`. (Refer to the jsoup API to understand this when you need it.)
    - If you do not use jsoup, here is a code to replace the fetch method in `InterestingPictureModel` to ignore the exception:  
<https://gist.github.com/joemertz/d4336933c1902de66af5f27a45dd1ab0>
- Track Piazza for additional hints and answers to questions. Produce screen shots demonstrating all of the above requirements.

Alternatively, you can create a screencast video of your working web app, again demonstrating all of the above requirements.

- The video cannot be more than 3 minutes long
- You may use an audio voiceover, but you do not need to
- You should publish the video as 'Unlisted' to YouTube. (See more discussion on this in the Submission section below.)
- Include the URL of the YouTube video in a document in the Project1Task2 Description folder that you submit.

### Alternative Task 2b

You may choose to develop your own web app idea that uses screen scraping. Your application should do the following:

1. Have a welcome page that gives the user directions. The welcome page should include text field(s) or selection menu(s) and a submit button.
2. Based on the input from the user, your web app should screen scrape some web site and:
  - a. Extract some information from it,
  - b. Manipulate, combine, analyze, sum, or in some way do something with the extracted information,
  - c. Return the results of this to the user for display.
3. Allow the user to change their input and submit again from the results page.
4. Handle failure gracefully

For example, you might screen scrape cricket information from `cricruns.com` and allow the user to select a country and range of years and return the combined win/loss record over those years.

You should check the Terms of Use of any site you intend to use to make sure that the site does not explicitly disallow screen scraping. For example, the official NHL web site disallows any use to "Engage in unauthorized spidering, scraping, or harvesting of content or information, or use any other unauthorized automated means to compile information" (<https://www.nhl.com/info/terms-of-service>)

It is acceptable to use a site that has an API, but you are not allowed to use the API to return structured data. For this assignment you must fetch HTML and process it (i.e. screen scrape).

Because your web app will work differently than the default one, it is in your best interest to explain to the grading TA exactly how it works. Therefore, create a document that includes:

1. Screen shots of your working web application
2. Screen shot of your web application gracefully failing (to test, turn off your wifi so that the HTTP request to source of your data fails).
3. A description of how the web application meets requirements 1-4 above.

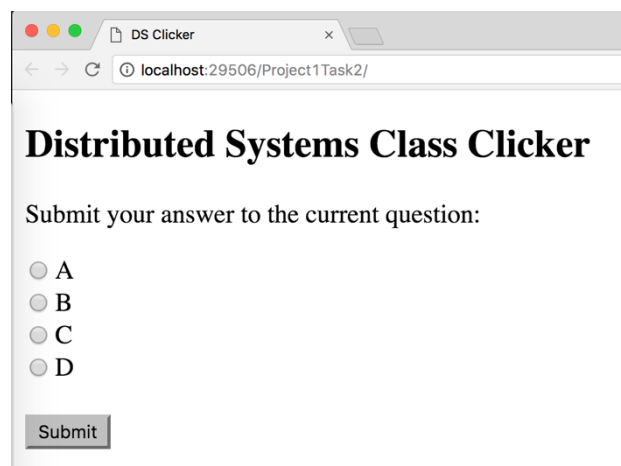
Alternatively you can create a screencast video of your working web app.

- The video cannot be more than 3 minutes long
- An audio voiceover should explain what your application does and how it meets requirements 1-4 above.
- You should publish the video as 'Unlisted' to YouTube. (See more discussion on this in the Submission section below.)
- Include the URL of the YouTube video in a document in the Project1Task2 Description folder that you submit.

**Task 3a – Default task (You may do this regardless of whether you did Task 2a or 2b)**  
Use the NetBeans Project Name: Project1Task3

Implement a web application that implements simple desktop and mobile “clicker” for class. app should allow users to submit answers to questions posed in class, and should provide separate URL end point for getting the results of the submitted responses.

The welcome page for your app should be similar to the picture on the right. You can make it more stylish if you like, but it is not required.



DS Clicker

localhost:29506/Project1Task2/

### Distributed Systems Class Clicker

Submit your answer to the current question:

☐ A

☐ B

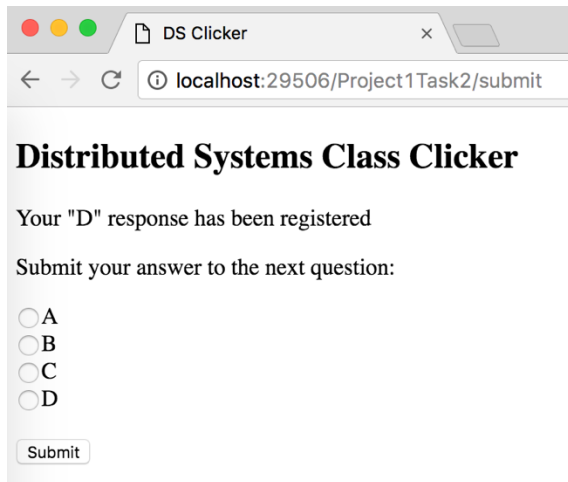
☐ C

☐ D

Submit

a  
Your

a



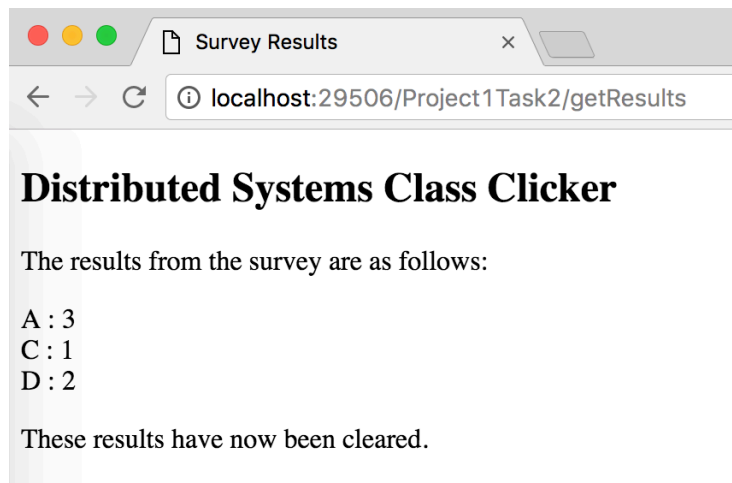
When the user makes a choice and hits “submit”, their answer should be stored in your MVC model. The response should be similar to the picture on the left.

Notice that it is **required** to provide feedback to the user regarding the choice that they made (i.e. “D” in this example).

The user should also have the ability to submit another answer as shown in the screenshot.

You can test the application by repeatedly submitting answers and allowing your model to tally the results.

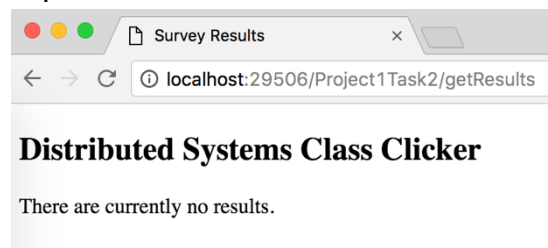
Your web app should also have a URL path “/getResults” (shown on the right) for listing the results of user voting.



Requirements for the /getResults path:

1. List each answer that has been given, and the number of times a user has submitted that answer.
2. You do not have to list options that have been chosen zero times.
3. The results should be displayed sorted in alphabetical order.
4. /getResults should also clear the results so that a new question can be
5. If there are no results available, then this as shown on the right.

Note that requirement 4 does not adhere to the HTTP standard for a GET request. You should understand why this is bad behavior according to the standard, and how you could fix it (It might be on the exam).



stored  
posed.  
report

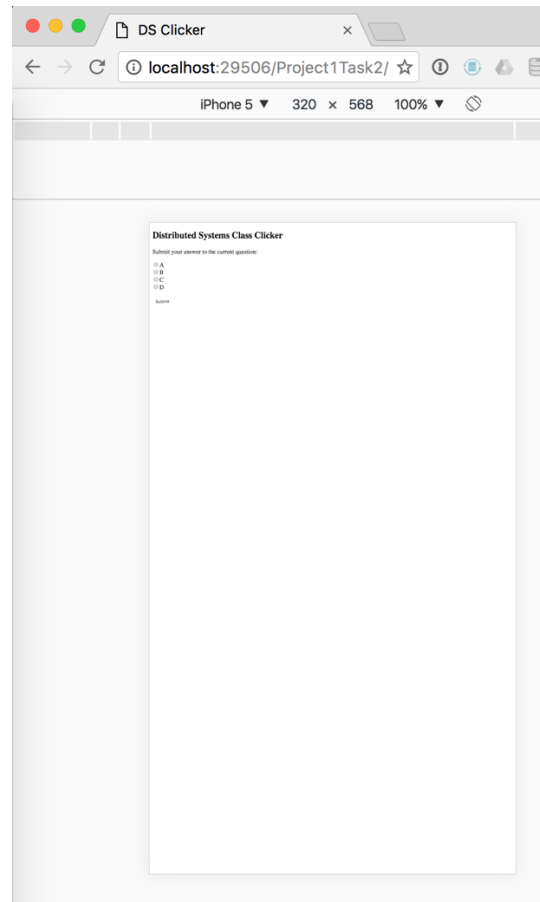
the

The web app should work with a mobile browser. For this project you can use a simple check like the one that was used in InterestingPicture and then use an appropriate mobile doctype.

An easy way to check your web app for mobile is use the Google Chrome DevTools

Using the Google Chrome browser.

- Browse to your web application in Chrome
- Access the Chrome DevTools



to

(<https://developers.google.com/web/tools/chrome-devtools/?hl=en#access-devtools>).

- Toggle device mode to mobile and choose an Android or iPhone device (<https://developers.google.com/web/tools/chrome-devtools/iterate/device-mode/?hl=en>)
- Reload the page.
- In addition to testing, you use this to produce a screen shot showing your web app working for mobile.

If your page looks like the one on the right, even after reloading, then the doctype is not being set correctly.



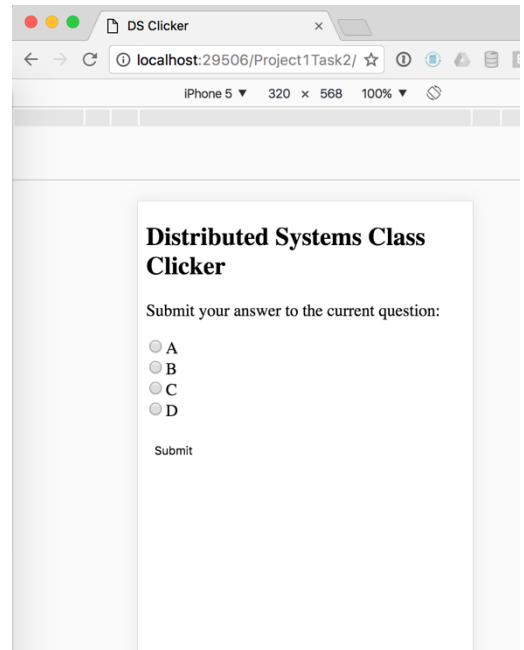
This is what the web app should look like for mobile if the doctype is set correctly.

Overall web app requirements:

- You must use MVC to separate concerns.
- Use appropriate HTTP methods (i.e. not just GET)
- Implement only one HttpServlet

Hints:

- You can have multiple URL patterns in a WebServlet annotation. For example, you can indicate that a servlet can be called by two paths such as:  
`urlPatterns = {"/submit", "/getResults"}`
- In order to determine within the servlet which path was actually requested, you can use `request.getServletPath();`



Produce screen shots of your application:

- With the answer options on desktop
- With the getResults on desktop
- With the answer options on mobile
- With the getResults on mobile

Alternatively you can create a screencast video of your working web app.

- The video cannot be more than 3 minutes long
- You may use an audio voiceover, but you do not need to
- You should publish the video as 'Unlisted' to YouTube. (See more discussion on this in the Submission section below.)
- Include the URL of the YouTube video in a document in the Project1Task3 Description folder that you submit.

**Alternative Task 3b (You may do this regardless of whether you did Task 2a or 2b)**

Implement all requirements of Task 3a, but instead of asking “Submit your answer to the current question” and providing alternatives “A, B, C, and D”, give the user alternatives from the information you have screen scraped and ask them to vote for one.

For example, if you implemented Task 2a, then Task 3b could give several images from NASA matching a search string and allow the user to vote for their favorite.

If you did Task 2b screen scraping statistics of badminton players from a given country, then you could have the user choose their favorite badminton player.

All other requirements for Task 3 apply.

Because your web app will work differently than the default task, it is in your best interest to explain to the grading TA exactly how it works. Therefore create a document that includes:

1. Screen shots of your working web application.
2. A description of how the user should use it (e.g. what would be valid input).

Alternatively you can create a screencast video of your working web app.

- The video cannot be more than 3 minutes long
- An audio voiceover should explain what your application does and how to use it.
- You should publish the video as 'Unlisted' to YouTube. (See more discussion on this in the Submission section below.)
- Include the URL of the YouTube video in a document in the Project1Task3 Description folder that you submit.

### Questions:

If you have questions, you can post them to the class Piazza and tag them as “Project1”.

### Summary & Submission:

Be sure to review the Rubric linked on the course schedule for the first day.

**Video sharing rights:** If you are creating screencast videos, then you should set the YouTube sharing rights 'Unlisted' when publishing to YouTube. There are three types of sharing rights on YouTube: Public, Private and Unlisted. You do not want other students to be able to see your video (that would be cheating), and 'Unlisted' restricts viewing to only those who have your URL.

Be sure you have named your NetBeans project folders correctly.

For each NetBeans project, File->Export Project->To Zip... each. **You must export in this way and NOT just zip the NetBeans project folders.**

You should also have three description folders:

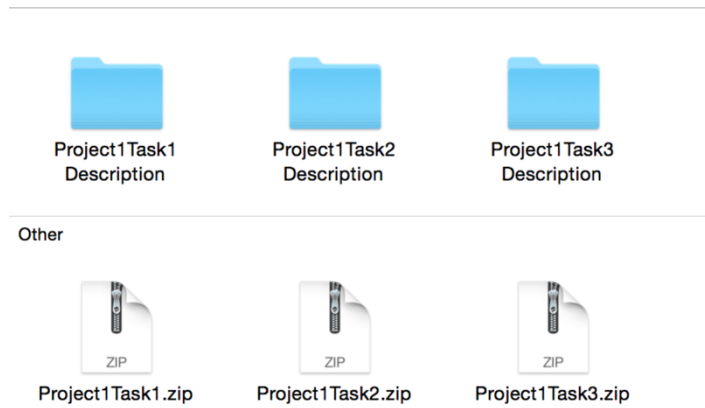
Project1Task1 Description

Project1Task2 Description

Project1Task3 Description

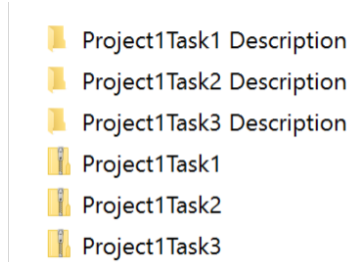
The description folders contain the mandatory screenshots and the optional descriptions if you chose to customize the task2 and task3. An optional description can either be a single document or a link to the video showing your work. (If you upload your video to YouTube, make sure your video is selected as 'unlisted'.)

Now you should have for .zip files and three description folders:

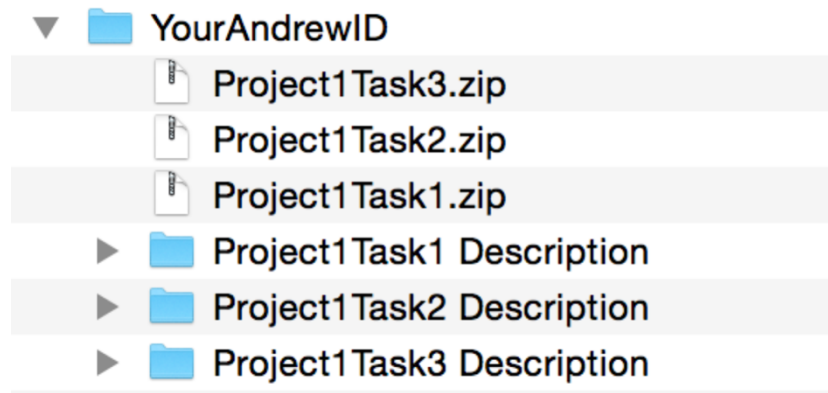


Mac OS

Create a new empty folder named with your Andrew id (very important). Put all files mentioned above in to the new folder you created.



Windows 10



Mac OS

Zip that folder, and submit it to Canvas. The submission should be a single zip file.  
Now you should have only one .zip file named with your Andrew id:



YourAndrewID.zip

Submission File Structure:

YourAndrewID.zip

--- Project1Task1.zip

--- Project1Task2.zip

--- Project1Task3.zip

--- Project1Task1 Description

--- Project1Task2 Description

--- Project1Task3 Description