

# Web Technologies: Final

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## 1 Prerequisites

- We are using secure HTTP (HTTPS) through use of a self-signed certificate and as such, our personal certificate authority must be added to your chosen browser. This root CA can be found here '*site/secrets/rootCA.pem*'.
- We are utilising Docker containers in our website to isolate nodejs jobs, and although not required, it is recommended that this is installed and running. If installed, ensure Docker is running by checking the systemd unit is running '*systemctl start docker*' on Linux or that the '*Docker.app*' process is running on MacOS. Failing this, the server will fall back to utilising the local userspace however, this is not the intended execution.
- Once '*server.js*' is running, the server can be reached at '*https://localhost:8080*'

## 2 Introduction

This website is designed to be an educational tool for users to learn to program JavaScript. This is primarily done by users completing a set of JavaScript programming tasks where their progress is tracked. A supporting forum is included whereby users are able to create forum 'threads' where they are able to ask questions or have general discussions with the community. Some games are also included to demonstrate the possibilities of what the user will be able to create once the user has completed the website tasks and furthered their ability to code using JavaScript.

Although the user is able to browse the website, much of the functionality requires the user to have signed up and have an active session. This grants the user the ability to post and reply on the forum as well as attempt the challenges.

## 3 HTML and CSS - A

- EJS for dynamic webpages, html templating and generation
- XHTML delivery to browser and ran HTML files through an XHTML validator jar.
- Examples

Figure ?? shows use of css animation keyframes including basic 2D translation and 3D rotations, box shadows for popin/popout effect, absolute positioning with z-index manipulation to manipulate layers etc.

Figure ?? shows use of background color linear gradients, a css backdrop filters (specifically a blur), a popup by attaching javascript show/hide handlers to the popup container in html etc.

## 4 JavaScript

Client-side JavaScript has been used to create 3 games that the user can play. These being Snake, Tetris and Asteroids. Whilst Snake and Asteroids have been created without the use of a library, Tetris has been developed using the P5.js open source library.

The 3D animated background seen in ?? was rendered using a WebGL Renderer with the help of the three.js API for the rendering of 3D objects into the scene.

Using a pinhole camera projection model, the 3D locations of lights, pivots, rings and circles were initially defined. Circles and Rings were defined as the primary visible objects in the scene. 4 rings were created of different radii and circles for each ring generated between the region that accounts for its (the ring's) radius and the radius of the next smallest ring. Associated circles and rings were then grouped and a simple lambert texture applied with different base colors, most notably pink, yellow, green and blue.

Individual pivots were defined for each group at the center of the canvas where their rotation matrix was updated accordingly each frame to create the seen animation. In addition a mouse even handler was attached and camera made to move in the direction of the mouse while facing (looking) in the direction of the structure creating 2 affects namely the rings spinning in the direction opposite to the mouse and the zooming in/out of the camera.

## 5 PNG - A

Two images were made in GIMP as seen in ?? and ???. ?? and ?? were used as the backgrounds respectively and ?? and ?? were used as the foregrounds respectively.

The associated images for each graphic were first resized, manipulated (colors edited, portions removed/moved etc.) and background thresholded from foreground before being replaced by an alpha channel.

The cleaned imaged were then imported as individual layers.

A new text layer was created to write the "success" or "wrong", a blur filter subsequently then applied to a duplicate layer obtain the 3D text affect. A gradient color was created and applied to the original text layer (only coloring the front facing side of the text).

The layers were then combined and exported as a PNG. This was done for each image.

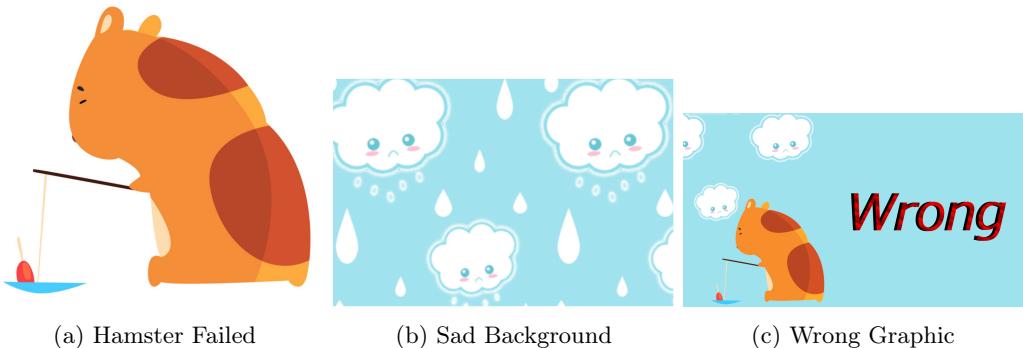


Figure 1

## 6 SVG - A

?? is our site logo made in Inkscape. In creating each component of the logo circles, rectangles and polygons were first draw, these shapes were then converted into paths using the "stroke to path" tool. In creating more complex shapes the "bezier curve" tool was used. The "edit paths by node" was used to manipulate the curve trajectories, carefully inserting/removing nodes along the outline to obtain the desired shape. Several individual components were then grouped together and flipped horizontally to obtain a symmetrical look. A linear gradient was finally applied along the vertical axis.

## 7 Server - A

The server has been expanded upon from the original server.js file given.

- Use of URL validation and redirection.

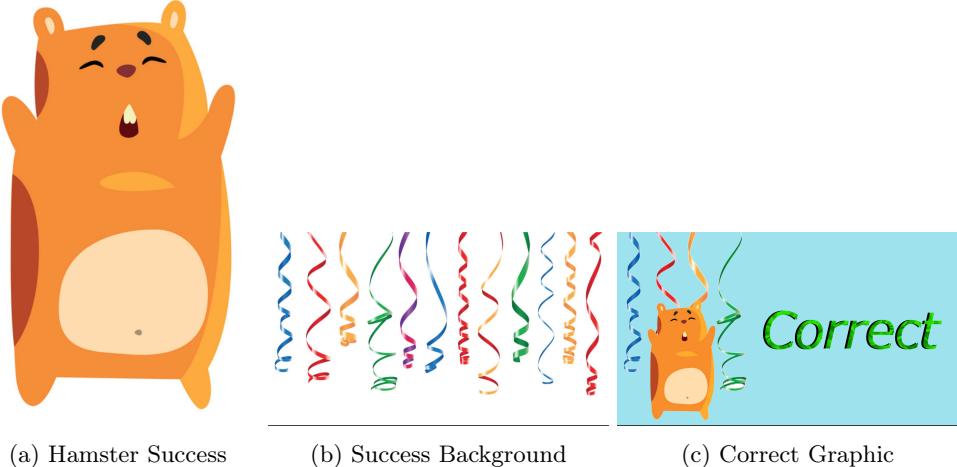


Figure 2

- Sign up and reply/post field validation.
- Handling various user data including text, code and images.
- Generation and validation of captcha to prevent malicious botting of sign up requests as well as user submitted forum posts and replies.
- Extensive use of our own written modules with both private and public exposed functions providing APIs to applications of the server.
- Use of a standard page delivery flow in conjunction with our modules to provide server with ease of extensibility. This is achieved through use of so called ‘pre functions’ and main data delivery functions that allow dynamic data delivery to the EJS HTML template library resulting in dynamic pages based on the state of the server and database.
- Providing HTTPS connection to ensure a secure connection. This is using a self-signed certificate which is enabled as described in the perquisites.
- Use of internally generated and managed cookies to provide user sessions.
- Passwords stored using a salted hash preventing storing passwords as plain text in the database.
- In order to isolate code given by the client, the use of Docker containers have been used to execute the code, preventing malicious code being run in the server namespace. The code will be run in a Docker container whereby it’s stdout/err will be captured and saved to file. This file is copied out of the container and is checked against the relevant solution file. As described in the perquisites, the use of the local userspace will be used instead, in the event of the Docker image failing to build, preventing this feature.

## 8 Database - A

The SQLite relational database has been used as our database.

- A number of tables are used to store user data, user voting data, user challenge progress data, challenge data as well as forum data.
- Each group of associated tables are accessed through use of separate modules, acting as APIs, all in turn interacting with the main database\_api module that manipulates data in the database.
- Tables are created relational so to provide extensibility to data such as the forum replies table relating to the forum post table.

- Passwords are stored as a salted hash along with the salt in the users table to prevent storing as plain text.
- Modular tables have been used in an effort to reduce read and write access of the database.

## 9 Dynamic Pages - A

- Use of the EJS templating framework to build HTML pages based upon delivery data from the server.
- Delivery data is made from database query data as well as non-sensitive user data based on the session.
- The use of Asynchronous JavaScript + XML (AJAX) to create dynamic changes to the web page such as error response to invalid form data or changing the current captcha and voting on posts and replies.

## 10 Depth

The goal of this website was to investigate and implement various technologies such as Docker, AJAX, SQLite, and EJS, that when paired together, create an iterative, interesting user experience for users aiming to learn how to program in JavaScript.

A focus was taken on security to ensure that user data has been protected in the form of reducing user data leakage, storing passwords as a salted hash as well as protecting the server itself, by means of isolating user submitted code and with use of captchas.

The forum has been created whereby replies on posts are displayed in a tree like structure, facilitating different discussion threads in a single forum post. These posts and replies are then able to be voted on by others in the website community. Users are also able to sort these posts through subject, top and new.

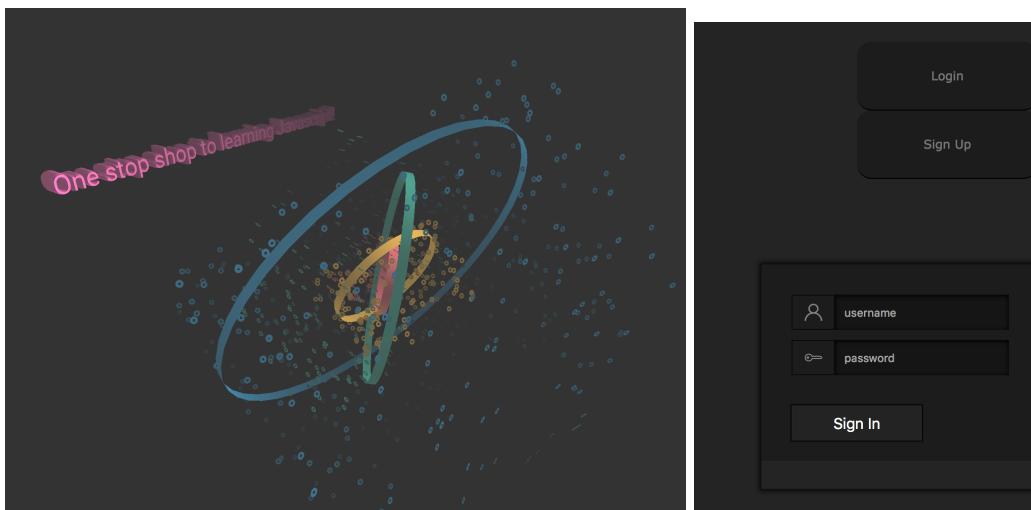
An extensive API and matching backend database has been developed to create a feature rich frontend whilst organised as such to ensure ease of extensibility for future development.

Our site logo ?? took inspiration from the existing node JS logo ???. In rendering the front page animation, a 3D WebGL renderer was used as opposed to a standard HTML canvas for cross-browser compatibility and an optimized rendering pipeline to sustain a high frame rate. Advanced CSS features including the use of CSS 3D animations and backdrop filters coupled with layer manipulation using z-index to create interesting affects.

## A Images



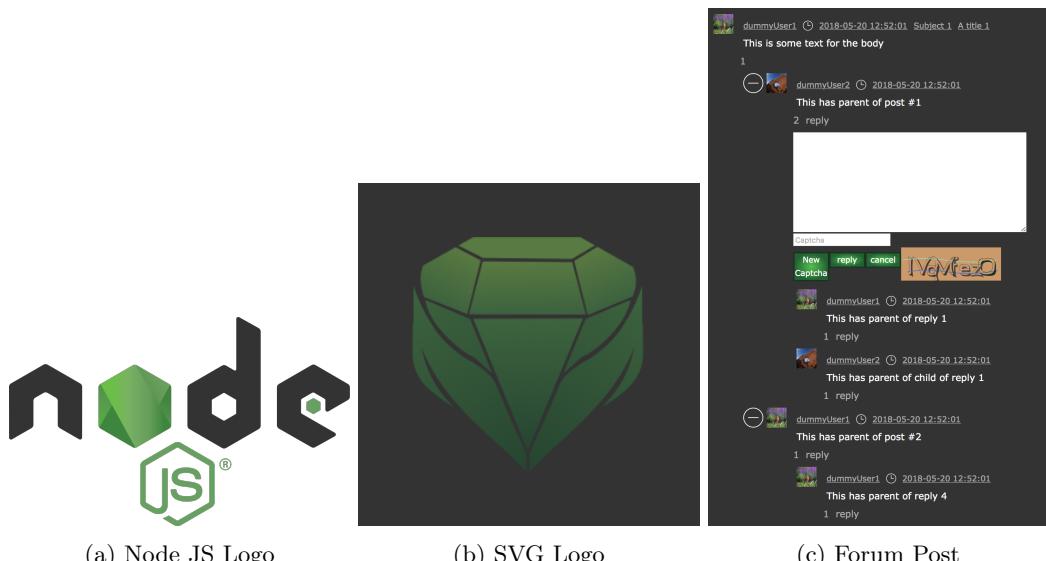
Figure 3: Header



(a) 3D Background

(b) Settings Popup and Login

Figure 4

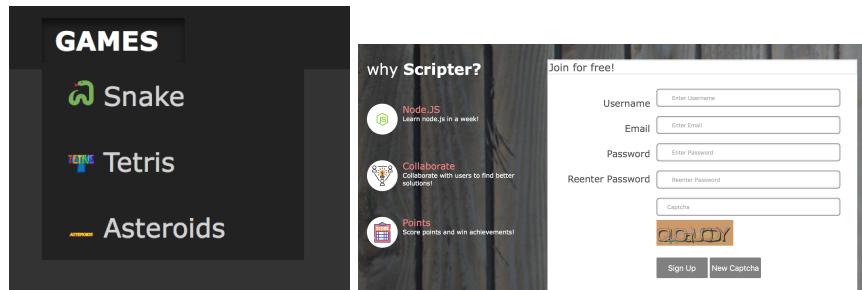


(a) Node JS Logo

(b) SVG Logo

(c) Forum Post

Figure 5



(a) Games Dropdown

(b) Sign-Up RE-CAPTCHA Popup

Figure 6

(a) Editor Default

```
1 //fibonacci
2
3 print("Enter number of terms")
4 n = int(input())
5
6 a = 0
7 b = 1
8
9 for i in range(0, n):
10    print(a)
11    c = a + b
12    a = b
13    b = c
14
15 print("Fibonacci Sequence")
16
```

(b) Editor Success

```
1 //fibonacci
2
3 print("Enter number of terms")
4 n = int(input())
5
6 a = 0
7 b = 1
8
9 for i in range(0, n):
10    print(a)
11    c = a + b
12    a = b
13    b = c
14
15 print("Fibonacci Sequence")
16
```

Your answer is ...

Correct

(c) Editor Failure

```
1 //fibonacci
2
3 print("Enter number of terms")
4 n = int(input())
5
6 a = 0
7 b = 1
8
9 for i in range(0, n):
10    print(a)
11    c = a + b
12    a = b
13    b = c
14
15 print("Fibonacci Sequence")
16
```

Your answer is ...

Wrong

Figure 7