

STACK-X



MICROTRAIN'S
DEV BOOTCAMP

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MicroTrain's Dev Bootcamp

Resources for MicroTrain's Developer Bootcamp.

Dev Environment

In the section you will learn:

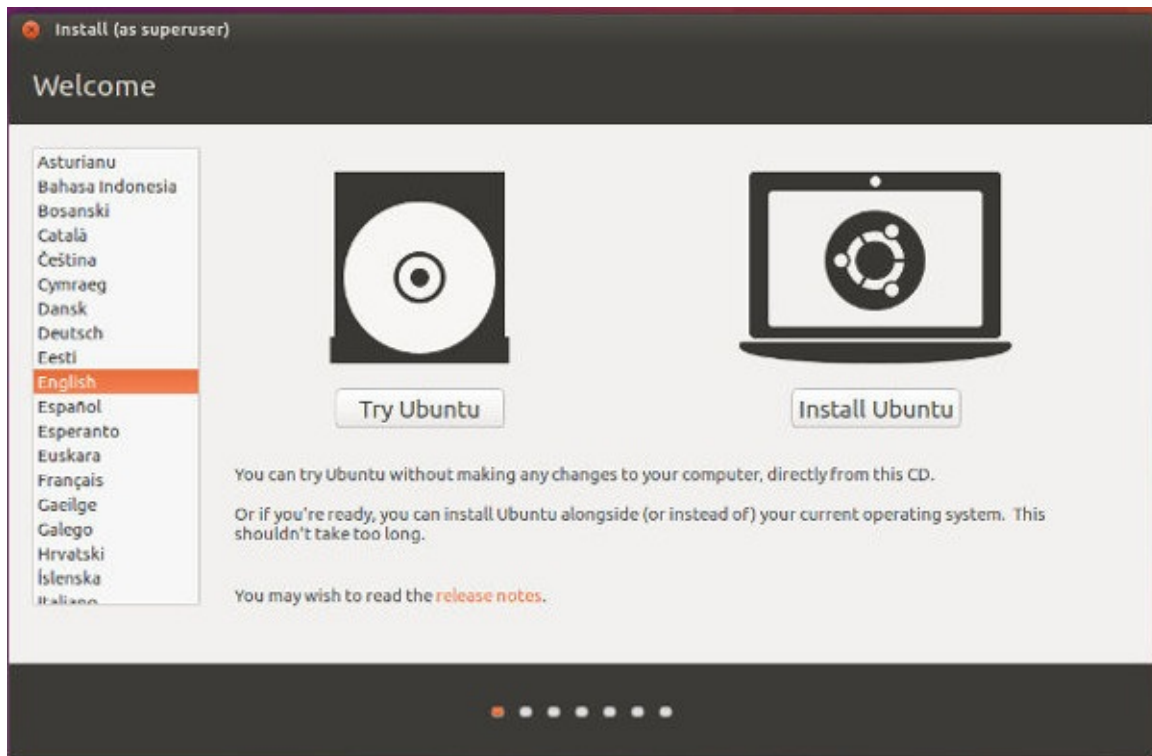
- How to a dev enviroment from scratch.
- Linux basics.
- How to install Linux software.
- How to install the LAMP stack.
- The basics of NodeJS and NPM.
- The basics of Git and GitHub.
- How to use and SSH key for authentication.

Install Ubuntu 18.04

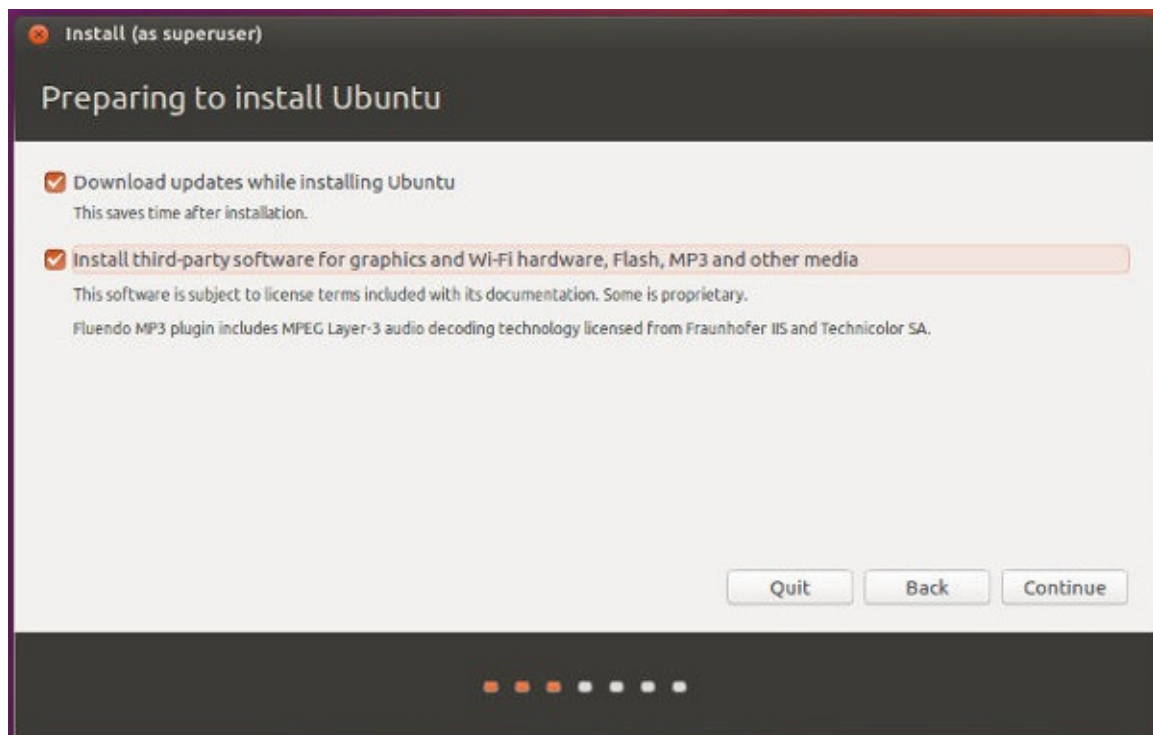
Your development (dev) environment is any system upon which you develop your applications. When possible, building your dev environment as close to production (prod) as possible is helpful. When this is not possible running tests in an emulator is a good option. This course will make use of both methods. Let's start by installing the operating system; Ubuntu Linux.

Insert the preloaded Ubuntu 18.04 dongle into an open USB port and power up the system. Press f12 when the Dell splash screen appears and choose *USB Storage Device* under legacy boot legacy.

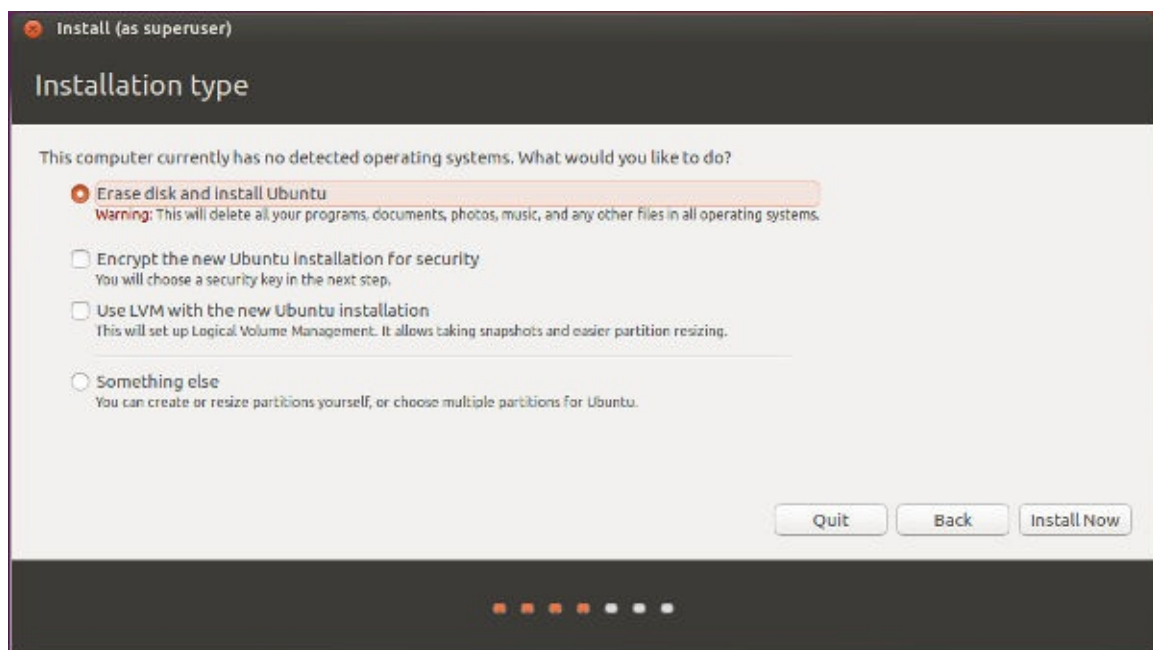
You will see a window titled *Install (as superuser)* from this window choose English and click the *Install Ubuntu* button.



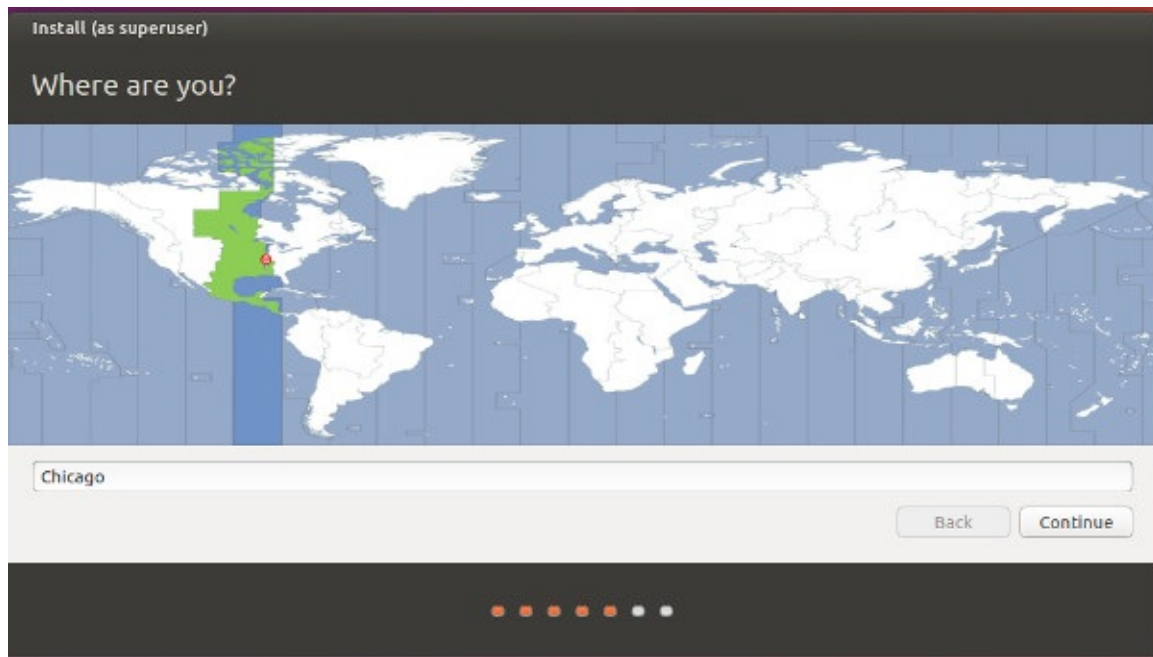
You will now be given two options *Download updates while installing Ubuntu* and *Install third-party software...* select both of these options.



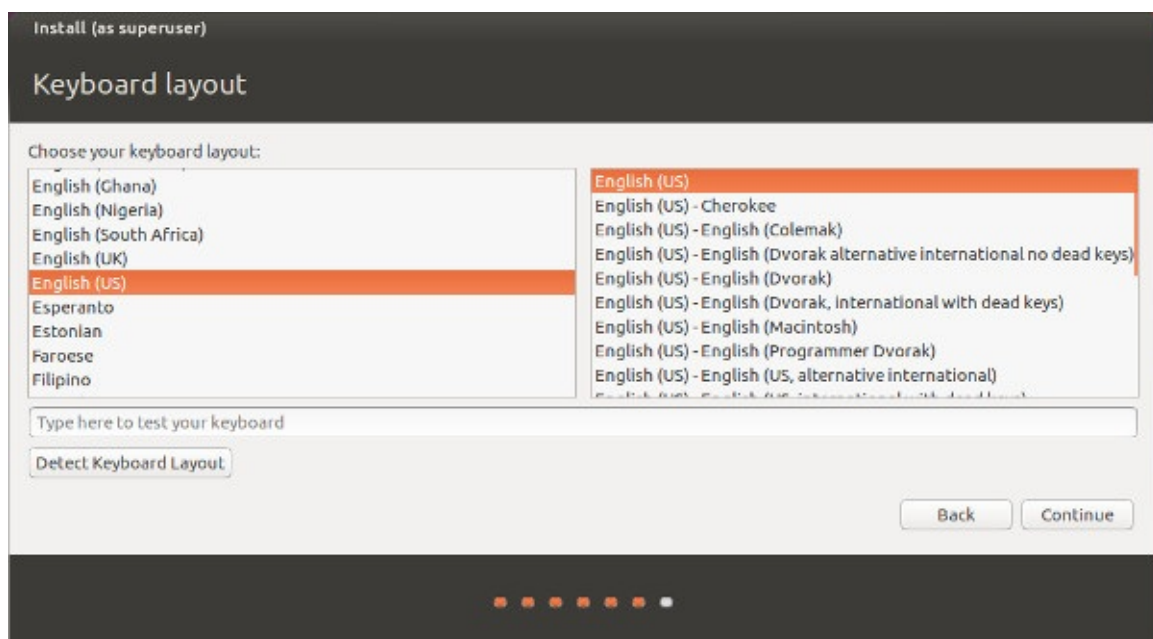
Now it's time to install the system. To keep things simple we will do a simple install. Be sure the *Erase disk and install Ubuntu* option is selected and click the *Install Now* button. You may see a dialog that asks *Write changes to disk?* with some additional details, simply click the *continue* button.



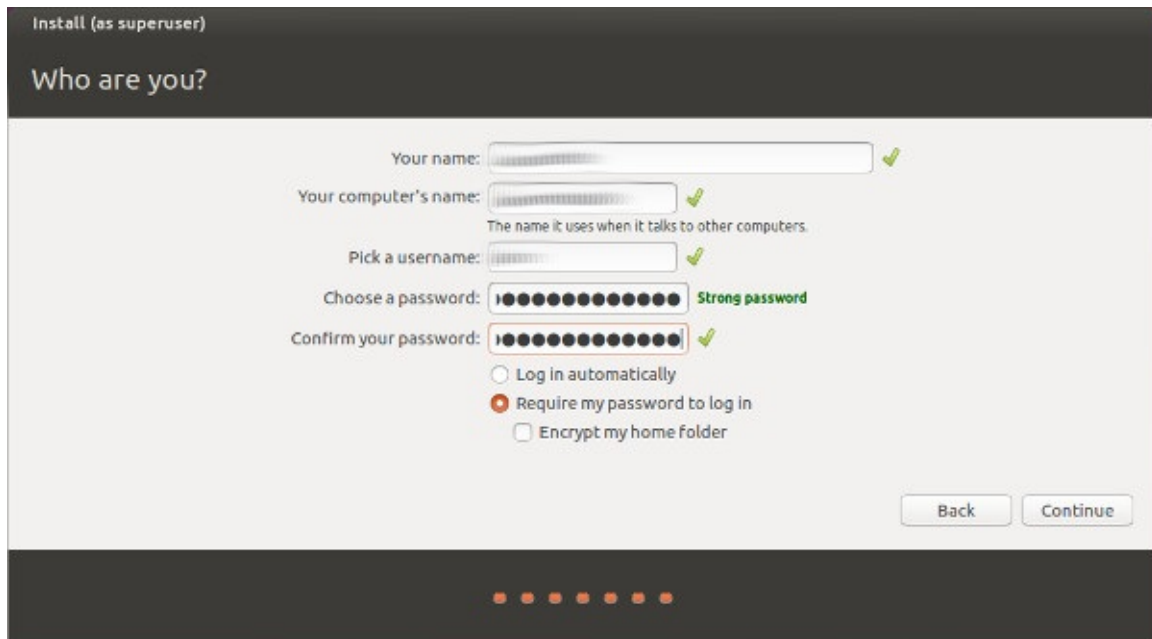
You will now see the *Where are you?* screen. This should default to Chicago (or your default location), if not choose Chicago (or your default location) as your location and click the *Continue*.



This sets your systems local timezone. For *Keyboard layout* choose English (US) and English (US) and click the continue button.



On the *Who are you?* screen enter *Your name*: as your first and last name, accept the default computer and usernames and choose a password. Do not forget your password, we are not able to recover this for you. Be sure the *Require my password to log in* option is selected and that the *Encrypt my home folder* option **IS NOT** selected. Click the continue button and wait for the system to install.



Install (as superuser)

Who are you?

Your name: ✓

Your computer's name: ✓
The name it uses when it talks to other computers.

Pick a username: ✓

Choose a password: Strong password

Confirm your password: ✓

☐ Log in automatically

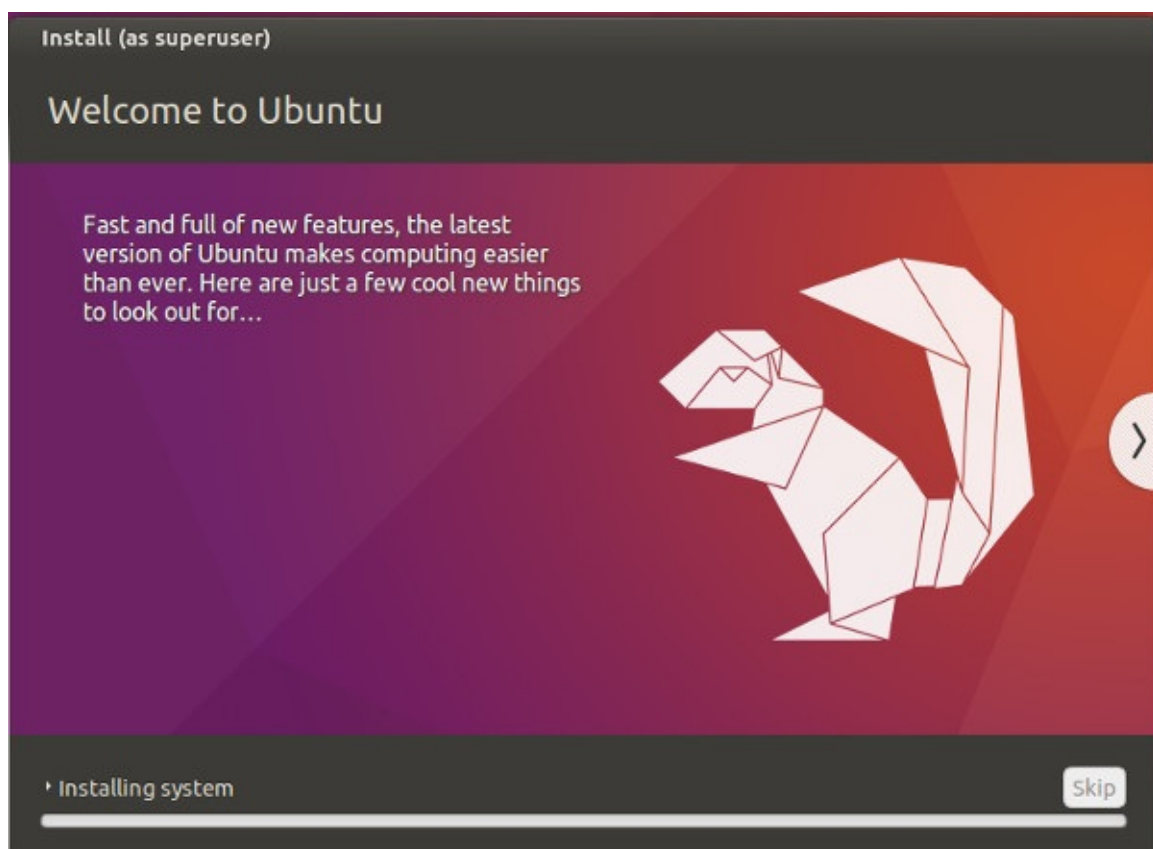
☒ Require my password to log in

☐ Encrypt my home folder

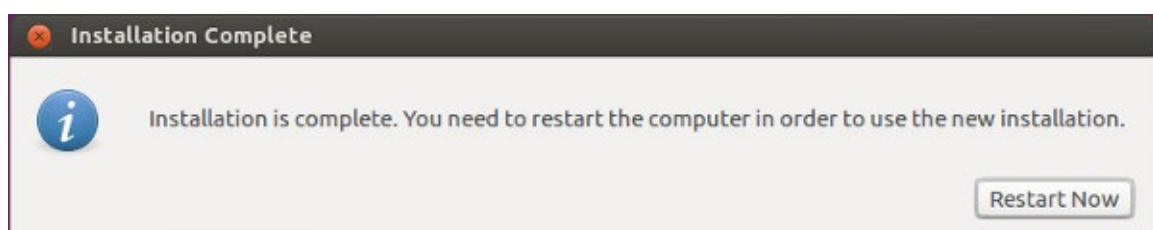
Back Continue

Progress indicator: 6 dots, 5th dot highlighted

While the system installs, you will see series of flash screens telling you the features of Ubuntu.



One installation has completed you will be prompted to restart your system. Click the *Restart Now* button.



You should see a prompt that says *Please remove the installation medium, then press Enter:.* Pull the dongle from the USB drive and press the enter key.

Summary

In this lesson you learned

- how to install Ubuntu Linux (Ubuntu, Linux)

[Next: Linux Basics](#)

Linux Basics

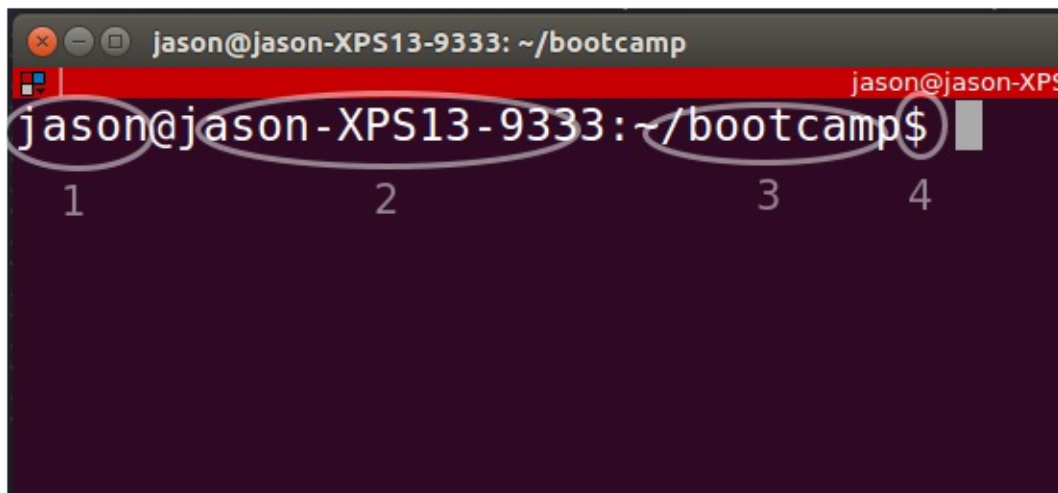
This section is intended to provide a reference for the basic commands needed to navigate a Linux system from the command line. We will take a deeper dive and use these commands in later lessons. While we call these commands, they are really programs. In other words, when you type a command in Linux, you are really invoking a program. Most programs can be invoked with out any additional arguments (aka parameters), but in most cases, you will want to pass additional arguments into the program.

For example `vim filename.txt` would use an editor called vim to open a file that is named filename.txt. Some programs expect arguments to be passed in a specific order while others have predefined arguments. All Linux programs predefine `--help` so you might type `chown --help` to learn how to use the chown command (or program).

The Linux File System

Linux does not use drive letters as you may be used to if you come from a Windows environment, rather everything is mounted to a root name space. `/`.

- `/` - root
- `/etc` - sytem configuration
- `/var` - installed software
- `/var/log` - log files
- `/proc` - real time system information
- `/tmp` - temp files, cleared on reboot



1. The user name of the logged in user
2. The name of the current machine
3. The current working directory (CWD)
4. User level (\$ for standard user, # for root user)
 - The space immediately to the right of # or \$ is the command line entry point.

Item 3, the current working directory is what we want to focus on at the moment. This tells us how to navigate. The tilde `~` is a short hand for the home directory of the current user which would be `/home/[username]` in my case this would be `/home/jason` which says start at root `/` and find the *home* directory from there find a directory called *jason*. The CWD in the above image `~/bootcamp`. The `cd` (change directory) is how you navigate the file system using a terminal window (aka - console, cli, command line). If i say `cd 01-DevEnvironment` it will look for the *01-DevEnvironment* directory inside on

`/home/jason/bootcamp` as that is my current working directory and the lack of a preceding `/` tells the system to look on a relative file path. If however I add a `/` so that the command reads `cd /01-DevEnvironment` it tells the system to look at the absolute path so the system will look for `01-DevEnvironment` directory to exist directly under root.

Basic Commands

- `[command] --help` - Returns a help file for any command (or program).
- `sudo` - Super-user do (elevates privs to admin).
- `chown` - CHange OWNership, changes the ownership of a file.
- `chown user1:group1 some-file` - Changes the ownership of some-file to user1 and group1.
- `chmod` - CHange MODe, changes file permissions.
- `chmod +x filename` - Makes a file executable.
- `apt-get` - Retrieves and maintains packages from authenticated sources.
- `apt-get install [package]` - Installs a target package from a repository.
- `apt-get update` - Update your package list.
- `apt-get upgrade` - Upgrade all packages from the updated list
- `apt-get remove` - Remove all packages.
- `apt-get purge` - Remove all packages and their config files.
- `dpkg` - A package manager for Debian-based systems, this is primarily used to deal with files ending with a `.deb` extension.
- `sudo dpkg --install some-pkg.deb` - Installs some-pkg.deb.
- `pwd` - Print working directory (where am I?).
- `ls` - List (a list of files and directories).
- `ls -l` - List long format (file permissions, owner, group, size, last mod, directory name).
- `ls -a` List all (show hidden files).
- `ls -la` List all in long format(`ls -l + ls -a`).
- `ls -R` List recursive (shows all child files).
- `cd` - Change directory.
- `cd ~` - Change directory to home (a shortcut to your home directory).
- `cat` - Concatenate (dumps a file to the console, a handy read only hack).
- `cat [filename]|less` - Pipe the cat command into a paginated CLI (`less --help`).
- `cat [filename]|tail` - Last line of the file, great for looking at log files.
- `cat [filename]|tail -f` - Last line of the file, great for looking at log files.
- `find -name [x]` Find all file for whom the name matches x.
- `find -name [x] Print|less` find all files for which the name matches x and print them to a paginated CLI.

On this system Apache writes log files to `/var/log/apache2`. For this example I only want to retrieve a list of the error logs.

- `cd /var/log/apache2` - Change to the Apache error log directory.
- `find *error.log.*` - Find all error logs in the current working directory (CWD).
- `cd / && locate access.log` - Locate all access logs (recursively) under the root directory.
- `grep` - Globally Search a Regular Expression and Print (Uses Regular Expressions (regex) to search inside of files).
- `*` - wildcard
- `/^d{1,3}\.d{1,3}\.d{1,3}\.d{1,3}z/` - Check an ip address regex in code.

Beyond Linux: Regex in code.

```
//Returns 1 if $string matches a valid IP, returns 0 if it does not.  
$valid = preg_match('/^d{1,3}\.d{1,3}\.d{1,3}\.d{1,3}z/', $string);
```

- `grep ssl error*|less` - Find all ssl errors.
- `grep '\s404\s' access*|less` - Find all 404 errors in the access logs, this is 404 surrounded by whitespace.
- `grep '^127' access*|less` - Find every line that begins with 127 (access logs begin with an IP).
- `sudo grep -ir error /var/log | less` - Find all errors (-i case insensitive) in all logs, we sudo because some log files are only accessible to root.
- `pgrep` - Returns a list of process id(s) for given processes. The process can be requested using regex.
- `pgrep chrome` - Returns a list of all chrome process ids.
- `pgrep chrome | xargs kill -9` - Kills all running chrome processes.
- `cat /etc/passwd|less` - A nice hack to get a list of all users on a system.

tip: Use tab expansions to auto-complete a command or an asterisk as a wild card. The up and down arrows can allow you to browse your command history and replay previous commands. Use `ctrl + r` to search your command history by entering partial commands.

Summary

In this lesson you learned

- about the Linux file system (Linux)
- basic Linux commands (Linux)

Additional Resources

- [Ten Steps to Linux Survival](#)
- [Linux Fundamentals](#)

[Next: System Basics](#)

System Basics

In this section we will learn use some of the basic Linux commands from the previous section to install a few basic software packages.

Login in to your system and open a terminal window using `Ctrl + Alt + T`. Then type the following commands. Pressing enter after each command.

```
sudo apt update
sudo apt upgrade
```

Lets look at these commands a little closer.

- `sudo` - in short `sudo` will run what ever commands that follow it with root level privileges.
- `apt` - `Apt` is a package manager for Linux. This works by maintaining a list of remote repositories from which packages can be installed. Most of the management is done automatically.
 - `apt update` - tells the system to update everything it knows about the repositories.
 - `apt upgrade` - tells the system to upgrade all packages to their latest versions.

Terminator

Terminator is a terminal emulator that allows for multiple tabs and split screens. This makes life a lot easier when you are dealing with several command line applications and background processes all at once.

```
sudo apt install terminator
```

Now close your terminal window and use `Dash` to find and open Terminator. Open Dash `Super + F` and type `terminator` into the search field. Click the Terminator icon to launch Terminator. You'll notice the Terminator icon is now in the `Launcher` right click the Terminator icon and select `Lock to Launcher` from the context menu.

VIM

An old school command line text editor. This is really nice to know when you need to edit files on a server or directly on a command line.

```
sudo apt install vim
```

Google Chrome

Download Google Chrome from <https://www.google.com/chrome/browser/desktop/index.html> be sure to save the file. If this returns no errors then your good to go, however, this sometimes fails and if it does you can clean it up with using Apt.

```
cd ~/Downloads
```

- `cd` - Changes your working directory (Change Directory)
- `~` - Tilde Expansion in this case it's a short cut to the home directory (`~` evaluates to `/home/jason`). So `cd ~/Downloads` will change my current working directory to `/home/jason/Downloads`.

You will have downloaded a file called `google-chrome-stable_current_amd64.deb`. `.deb` files are software packages designed for Debian based Linux distros.

```
sudo dpkg --install google-chrome-stable_current_amd64.deb
```

- `dpkg` - A package manager for Debian based systems. Primarily used to work with locally installed `.deb` packages.

```
sudo apt install -f
```

Use [Dash](#) to find and open Chrome. Open Dash `Super + F` and type `chrome` into the search field. Click the Chrome icon to launch the Chrome browser. You'll notice the Chrome icon is now in the [Launcher](#) right click the Chrome icon and select *Lock to Launcher* from the context menu. Now right click the FireFox icon in the launcher and click choose *Unlock from Launcher* from the context menu.

Visual Studio Code

Visual Studio Code (VSC) is the IDE we will be using to write code. Install Atom using the same steps you used to install Chrome. Remember to pin VSC to your launcher after the install. If you cannot find Atom using Dash try launching it from the commandline by typing `atom`.

Cleanup

Check the contents of your Downloads directory by typing `ls` at the command prompt. You should see the two files we just downloaded and installed.

```
ls ~/Downloads
code*.deb  google-chrome-stable_current_amd64.deb
```

Now type `ls -l` and note the difference between the two result sets.

```
$ ls -l
total 129080
-rw-rw-r-- 1 jason jason 86270030 Feb 16 16:11 code_1.20.0-1518023506_amd64.deb
-rw-rw-r-- 1 jason jason 45892904 Feb 16 16:18 google-chrome-stable_current_amd64.deb
```

Since they have been installed we no longer need the files let's remove them from the system.

```
rm ~/Downloads/*
```

- `rm` - removes a file or a folder
- `-f` - Force Recursive
 - `-f` - ignore nonexistent files and arguments, never prompt ^{fn1}
 - `-R` - remove directories and their contents recursively. ^{fn1}
- `*` - A [wildcard](#) for matching all characters and strings. `rm ~/Downloads/*` will remove everything on the `~/Downloads` path

Now typing `ls ~/Downloads` into the command line will return an empty result set.

Meld

Meld is a visual diff tool. This is the default tool called by Atom when doing a file comparison.

```
sudo apt install meld
```

Filezilla

Filezilla is my goto [FTP](#) client. While FTP by itself is insecure and not recommended, running FTP over [SSH](#) is secure and Filezilla allows us to do just that. We work with FTP and SSH in later lessons.

cURL

The best way to think of cURL is as a browser that is used by code.

```
sudo apt install curl
```

Enable new file creation via right click

```
touch ~/Templates/Empty\ Document
```

Summary

In this lesson you learned

- how to install programs using apt (Linux)
- how to install Debian package using dpkg (Linux)
- how to force a broken install using apt (Linux)

Additional Resources

- [VIM Book](#)
- [Chrome Dev Tools](#)
- [VSC Docs](#)
- [Filezilla Docs](#)
- [SSH Man Page](#)

Next: [LAMP Stack](#)

Apache Basics

Open a browser and navigate to <http://localhost> and you will land on your machines default apache landing page. That is because the default Apache's configuration points to the path `/var/www/html`, `html` is folder that contains a single file called `index.html`. By default Apache looks for files named `index.*` (where `*` can be any file extension). Let's configure Apache's default path to `/var/www` and see what happens.

First, open a command line and navigate to `sites-available`. On Debian based systems this is where Apache stores per site configurations also known as `vhost` (virtual host) files, on non-Debian systems these may be part of a larger configuration file. Once in the `sites-available` directory run the command to list the directory contents.

```
cd /etc/apache2/sites-available
ls
```

The `ls` command should yield the following results.

```
000-default.conf  default-ssl.conf
```

`000-default.conf` is the default configuration for Apache on Debian based systems. Let's take a look at it's contents. You can read this file without `sudo` but we want to make some changes to it, so lets `sudo`.

```
sudo vim 000-default.conf
```

You will notice a few default settings more commonly called directives in Apache terms. Right now we are only concerned with the `DocumentRoot` directive. Move your cursor down to line 12 and remove `/html` from the end of this line. Remember `i` enters insert mode and `Esc` followed by `:x` saves the file.

The final result will be.

```
DocumentRoot /var/www
```

Now we want to tell apache to reload the configuration. This is a four step process.

- Disable the site configuration `sudo a2dissite 000-default`
- Reload Apache `sudo apache reload`
- Enable the new site configuration `sudo a2ensite 000-default`
- Reload Apache `sudo service apache2 reload`

You can execute all four commands at once with the following.

```
sudo a2dissite 0* && sudo service apache2 reload && sudo a2ensite 0* && sudo service apache2 reload
```

The double ampersand `&&` appends two commands running them one after the other. For example

```
cd /etc/apache2/sites-available && vim 0*
```

Would change your current working directory to `/etc/apache2/sites-available` && `vim 0*` and use `vim` to open any files that match the pattern `0*` in this case it would only one file `000-default.conf`. Using wild cards can save a few key strokes and cut down on typos. But be careful you don't open the wrong files.

Once you have reloaded the configuration, open your browser and return to <http://localhost>. Now, rather than the default Apache landing page you will see a directory listing with a link to the `html` directory. Clicking this will open the default Apache landing page.

mod_ssl

`Mod_ssl` extends the Apache webserver allowing it to work with TLS (Transport Layer Security) connections. While TLS long ago replaced SSL (Secure Sockets Layer), SSL is still the common term used for referring to secure connections be it over SSL or TLS.

In your browser navigate to <https://localhost> notice the `s` in `https` this tells the Apache we want to request a secure version of the website. The page should crash, this is because we haven't told Apache we want to enable a secure version of the site. Now let's open the other configuration in the `sites-available` directory.

```
cd /etc/apache2/sites-available
sudo vim default-ssl.conf
```

As in the previous configuration we are only concerned with the `DocumentRoot` directive. Move your cursor down to line with this directive and remove `/html` from the end of this line. Remember `i` enters insert mode and `Esc` followed by `:x` saves the file.

While the `DocumentRoot` is all we need to change let's take another look at the file. Reopen the file but this time without `sudo`. Around line 25 you will see the `SSLEngine` directive is set to `on`. This tells Apache that this configuration wants to use the SSL module, which we have not enabled yet. Notice lines 32 and 33

```
SSLCertificateFile    /etc/ssl/certs/ssl-cert-snakeoil.pem
SSLCertificateKeyFile /etc/ssl/private/ssl-cert-snakeoil.key
```

These directives tell Apache where to find information about our SSL certificates. By default Apache creates a snake oil certificate. This is an invalid certificate that offers encryption without verification from a CA (certificate authority) such as DigiCert or RapidSSL. While this is an invalid SSL certificate, it is adequate for testing an SSL connection. Let's enable the SSL module and load the new configuration. To exit vim without saving any changes press `ESC` followed by `:quit!`.

Now that you have returned to the command line load `mod_ssl` (the SSL module).

```
sudo a2enmod ssl
```

Now load the new configuration and restart apache. This time we will enable the site using *restart* instead of *reload*. *Reload* is a graceful restart that allows minor configuration without killing existing connections. *Restart* is a hard restart of the server that kills all existing connections. *Restart* covers *reload* but *reload* does not cover *restart*.

```
sudo a2dissite d* && sudo service apache2 reload && sudo a2ensite d* && sudo service apache2 restart
```

Now when you navigate to <https://localhost> you will get an insecure warning. Accept the warning and proceed to the site against the browser's advice. You will now see the same file listing you saw when navigating to <http://localhost>

mod_rewrite

`Mod_rewrite` provides a rules-based rewriting engine to Apache. This allows the server's admin to rewrite a user's request to do something else. Let's use `mod_rewrite` to force SSL connections when the user makes an http request.

Be sure the `mod_rewrite` is enabled

```
sudo a2enmod rewrite
```

Open the Apache's default configuration.

```
cd /etc/apache2/sites-available && sudo vim 000-default.conf
```

Find the following lines

```
ServerAdmin webmaster@localhost
DocumentRoot /var/www
```

and change them to

```
ServerAdmin webmaster@localhost

RewriteEngine On
RewriteCond %{HTTPS} !=on
RewriteRule ^ https://%{HTTP_HOST}%{REQUEST_URI} [R=301,L]

# DocumentRoot /var/www
```

- `RewriteEngine On` - Activates `mod_rewrite`
- `RewriteCond %{HTTPS} !=on` - Check for a conditions, in this case the https protocol is not active
- `RewriteRule ^ https://%{HTTP_HOST}%{REQUEST_URI} [R=301,L]` - If the condition is true http is rewritten to https as a permanent redirect.
- `# DocumentRoot /var/www` - Comment out the `DocumentRoot` directive. While not required it would guarantee no files get served should the redirect fail (in theory).

In a browser navigate to <http://localhost/> and you will be redirected to <https://localhost/>

Summary

In this lesson you learned

- how to reload and Apache configuration using `a2dissite` and `a2ensite` (Linux, Apache)
- how to restart the Apache web server using service directives (Linux)
- how to enable Apache modules (Apache)
- how to use Mod Rewrite (Apache)
- how to force a site to use SSL (Apache)

Next: [NPM](#)

NPM

Non-Parametric Mapping or (as it is most commonly but incorrectly known) Node Package Manager (NPM) is a package management system for managing Node.js (JavaScript) packages. This is akin to Gems in relation Ruby platform, Composer as it relates to PHP or Python's PIP. Under the hood these may be very different in terms of how they operate but practically speaking they all accomplish the same goal; package management.

Node.js is an insanely popular platform that allows you to build cross-platform applications using web technology. As a result many web development tools are written in Node. These tools can be installed using NPM. We will need to install Node.js to get started with these tools. Follow the [Debian and Ubuntu Based Linux Distribution](#) instructions from the Node.js web site. Install the latest greatest version.

After install run the following commands

```
node -v
npm -v
```

These should return versions ≥ 8.10 and 5.7.1 respectively.

Summary

In this lesson you learned

- how to install Node.js (Linux, Node)

Additional Resources

- [Debian and Ubuntu Based Linux Distribution](#)

Next: [Git](#)

GIT

Git is a free and open source distributed [version control system](#) (VCS). Google Trends suggested git is the [most popular](#) VCS in the world. Git is now a part of the Ubuntu standard installation so there is nothing to install.

For a list of git commands type

```
git --help
```

GitHub

GitHub is a hosted solution popular among both open and closed source developers and will be the solution we use in this course. While we do not need to install Git we will want to bind our GitHub account to our dev machine.

Setup

The following tutorials will walk you through the process of binding your development machine to your GitHub account using an SSH key. An SSH key uses public key crypto to authenticate your machine against your GitHub account. This allows you to push and pull to and from GitHub without needing to provide a username and password.

Generating a new SSH key and adding it to the ssh-agent

Accept the defaults for the following. Do not change the file paths, do not enter any passwords.

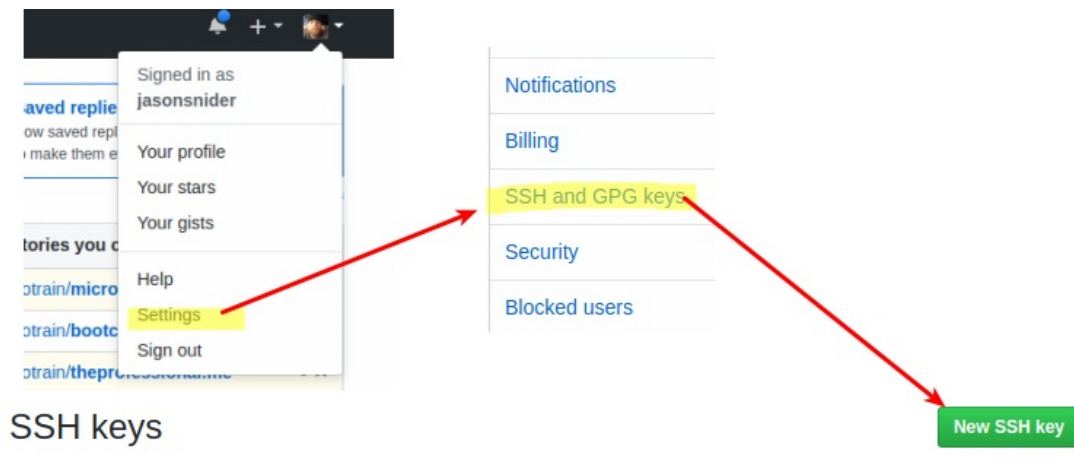
```
ssh-keygen -t rsa -b 4096 -C "YOUR-EMAIL-ADDRESS"
eval "$(ssh-agent -s)"
ssh-add ~/.ssh/id_rsa
```

Adding a new SSH key to your GitHub account

Install xclip and copy the contents of the key to your clipboard

```
sudo apt install -y xclip
xclip -sel clip < ~/.ssh/id_rsa.pub
```

Log into your GitHub account and find *Settings* in the top right corner under your avatar. Then click on SSH and GPG Keys in the left hand navigation and click the green **New SSH Key** button. Enter a title, this should be something that identifies your machine (I usually use the machine name) and paste the SSH key into the key field.



Testing your SSH connection

```
ssh -T git@github.com
```

First-Time Git Setup

Setup your git identity, replace my email and name with your own. For this class we will use VI as our Git editor.

```
git config --global user.email "YOUR-EMAIL-ADDRESS"  
git config --global user.name "YOUR-FIRST-LAST-NAME"  
git config --global core.editor "vim"
```

In this lesson you learned how to

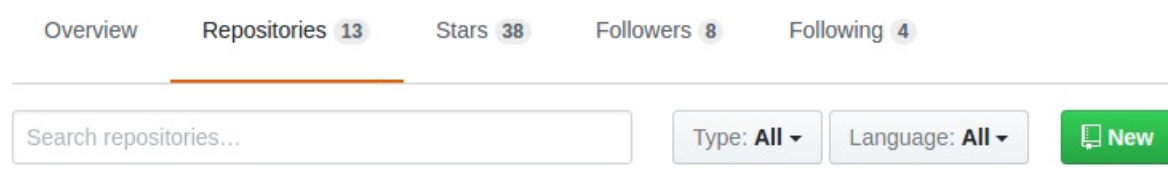
- create an SSH key
- add an SSH key to your GitHub account
- establish a Git identity on your local machine

Exercise 1 - Create a repository

For this exercise we will create your working directory for this course on GitHub and clone into your local environment. You will do most your work from this repository and push the results to GitHub.

Create a new repository

Login to your GitHub account and click on the repositories tab then find the *New Repository* button.



Create a project called mtbc (MicroTrain Bootcamp). This is the project you will use for much of this course.

- Create a description, something like *My working directory for MicroTrain's Dev Bootcamp* (you can change this later).
- Be sure *Initialize this repository with a README* is checked.
- Choose a License, for this course I would recommend the MIT License. Since this isn't product it really doesn't matter. Then

click the create button.

Create a new repository

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

Owner

 jasonsnyder ▾

Repository name

mtbc ✓

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

Description (optional)

My working repository for MicroTrain's Dev bootcamp.

☒  **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: **MIT License** ▾



Create repository

Clone the repository

Now you will want to pull the repository from GitHub onto your local machine. Then clone your fork onto your local machine. After creating your repository you should be directed to the new repository. If not, you can find it under the repositories tab. Find the *Clone or Download* and copy the URL which will look something like `https://github.com/[your-github-user-name]/mtbc`

jasonsnyder / mtbc

Add RepoUnwatch1Star0Fork0

[Code](#)Issues0Pull requests0Projects0WikiSettingsInsights


My working repository for MicroTrain's Dev bootcamp.


Edit


1 commit1 branch0 releases1 contributor

Branch: master ▾New pull request

Create new fileUpload filesFind fileClone or download ▾

 LICENSEInitial commit

 README.mdInitial commit

 README.md

Clone with SSH ⓘUse HTTPS

Use an SSH key and passphrase from account.

git@github.com:jasonsnyder/mtbc.git

Download ZIP

Now we will clone this repository into the root directory of our web server. This will allow us to access all of our work through the browser by way of *localhost*.

```
cd /var/www
git clone https://github.com/[your-github-user-name]/mtbc
```

Now use the `ls` command to verify the existence of `mtbc`. If you open your browser and navigate to <http://localhost/mtbc> you will see the following directory structure.

Index of /mtbc

<u>Name</u>	<u>Last modified</u>	<u>Size</u>	<u>Description</u>
 Parent Directory		-	
 LICENSE	2017-06-13 09:08	1.0K	
 README.md	2017-06-13 09:08	60	

Apache/2.4.18 (Ubuntu) Server at localhost Port 80

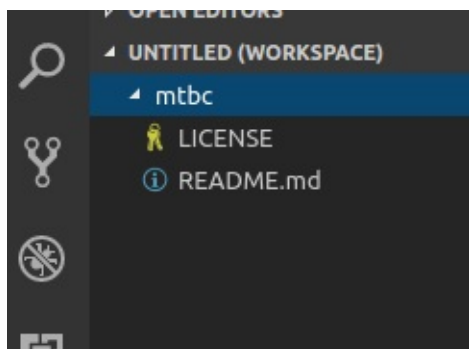
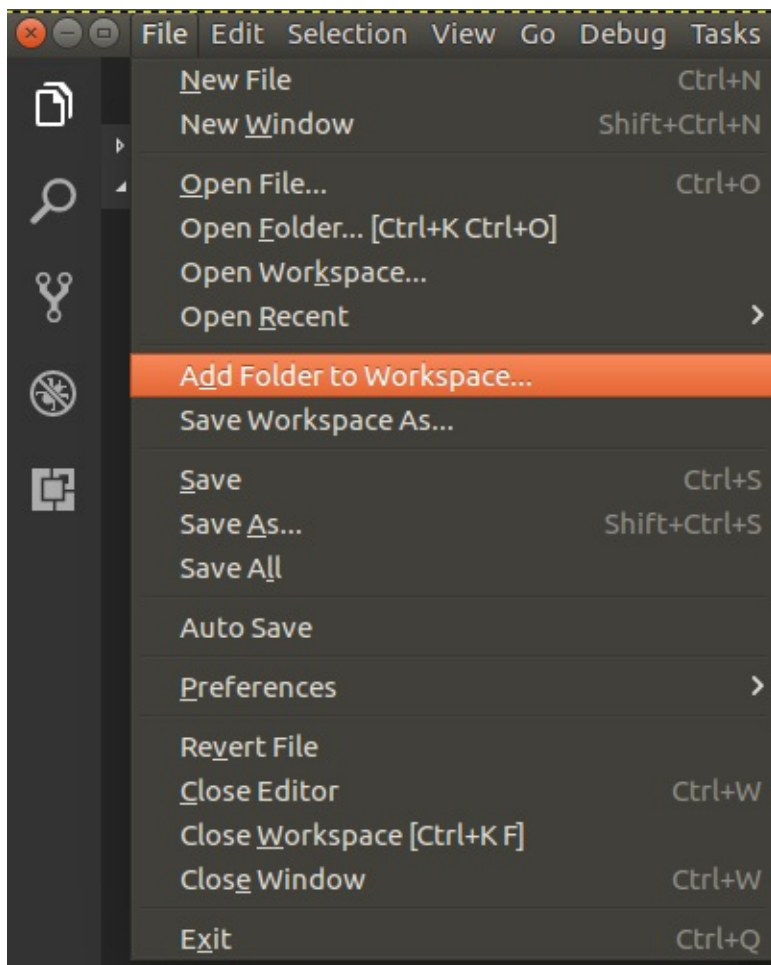
Summary

In this exercise you learned how to

- create a Git repository on GitHub (Git)
- clone a repository (Git)

Exercise 2 - Commit a Code Change

Now open VS Code and click into the workspace. Right click choose add a new folder to the workspace. Navigate to `/var/www/mtbc` and press `OK`.



Now click on the file `README.md` from the `mtbc` project folder. README files are a best practice in software development. README files are human readable files that contain information about other files in a directory or archive. The information in these files range from basic information about the project team to build instructions for source code. A emerging defacto standard is to write in a format called Markdown (.md). A raw Markdown file should be human readable but if you want a formatted version you can use VS Code's *Markdown Preview* by opening the file and pressing `Shift + Ctrl + v`.

Open the file `README.md` from the `mtbc` project folder in the VSCode sidebar and open the *Markdown Preview*. Change the content of the level 1 heading `# mtbc` to `# MicroTrain's Dev Boot Camp`. Save your changes with the keyboard shortcut `[Ctrl + S]`.`# MicroTrain's Dev Boot Camp`

Open a terminal (command line or CLI) and navigate to the `mtbc` directory.

```
cd /var/www/mtbc
```

Check your repository for changes, this will return a list of dirty files. A dirty file is any file containing a change.

```
git status
```

Commit your code changes

```
git commit README.md
```

VI will open and ask you to enter a commit message.

1. Press the letter [i] to enter insert mode.
2. Then type the message *Proof of concept version*.
3. Press [esc] followed by [:x] and enter to save the commit message.

Push your changes to the master branch.

```
git push origin master
```

You will see a message that indicates the README.md file has been changed.

```
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:   README.md
```

```
git commit README.md
```

This will open an editor window that asks you to enter a commit message. Enter *Changed the header* and save the file. You will see a message that indicates the changes to README.md file have been committed.

```
jason@jason-XPS13-9333:/var/www/mtbc$ git commit README.md
[master 67e5568] Changed the header
1 file changed, 3 insertions(+), 2 deletions(-)
```

Finally, push your changes to GitHub.

```
git push origin master
```

```
Counting objects: 3, done.
Delta compression using up to 4 threads.
Compressing objects: 100% (3/3), done.
Writing objects: 100% (3/3), 342 bytes | 0 bytes/s, done.
Total 3 (delta 0), reused 0 (delta 0)
To git@github.com:jasonsnider/mtbc.git
   0da48cc..67e5568  master -> master
```

In the previous example we committed our code changes directly to the master branch. In practice you will never work on a master branch. At the very least you should have a development branch (we call it dev). I like to create branches using the *checkout* command.

```
git checkout -B dev
```

You will see the message *Switched to a new branch 'dev'*.

- `checkout` - This tells git to switch to a different branch.
- `-B` - When following the *checkout* command this tells git to create a new branch. This is a copy of the branch you are

currently on.

- `dev` - The name of the new branch.

In plain English `git checkout -B dev` says make a copy of the branch I am on, name it `dev` and switch me to that branch.

If your are working directly on your dev branch and wanted to push those changes into master it might look like this.

```
git checkout master
git pull origin master
git checkout dev
git rebase master
git checkout master
git merge dev
```

1 `git checkout master` - Switch to the master branch. 1 `git pull origin master` - Pull any new changes into master. 1 `git checkout dev` - Switch back to the dev branch. 1 `git rebase master` - Apply outside changes from master into the dev branch. This will rewind the branch and apply the outside changes. All commits you made after branch deviation will applied on top of the branch deviation. 1 `git checkout master` - Move back to the master branch. 1 `git pull origin master` - Recheck for changes, if any new changes have been applied return to step 3 and repeat. 1 `git merge dev` - Once you have a clean pull, merge your changes into master. 1 `git push origin master` - Push your new changes to the repository.

There is no right way to use git. The only real wrong way to use git is to deviate from that projects branching model. [The Diaspora* Project](#) has a very well defined branching model that is typical of what you will see in the real world. I had to come up with one and only one rule it would be to never build on the master branch.

Git Guidelines

A set of guidelines for working with a git repository. See [RFC 2119](#) for keyword usage.

- master - pristine
 - You MUST NOT work on or apply changes directly to dev
 - Only approved changes SHALL be merged into master
- dev - main working branch
 - You SHOULD NOT work on or apply changes directly to dev
 - You SHOULD create a feature/bug (working) and commit changes to that branch
 - The working branch SHOULD always be a decendent of dev

Replace `GITHUB-USER_NAME` with your GitHub user name.

```
#Clone an existing repository
git clone origin git@github.com:GITHUB-USER_NAME/mtbc.git
cd mtbc

#If there IS NOT a dev branch, create one
git checkout -B dev
git push origin dev

#If there IS a dev branch, fetch it
git fetch origin dev:dev
git checkout dev

git checkout -B feature/some-feature
git push origin feature/some-feature

# After you have made you conde changes
# Add and commit the new feature
git add .
git commit -a
git push origin feature/some-feature
```

```
# Integrate the new feature with dev
git checkout dev
git pull origin dev
git checkout feature/some-feature
git rebase dev
git checkout dev
git merge feature/some-feature
git push origin dev

## After integration testing
## Integrate the changes with your production branch
git checkout master
git pull origin master
git checkout dev
git rebase master
git checkout master
git merge dev
git push origin master

## Cleanup
# Delete the remote branch
git push origin :feature/some-feature

#Delete the local branch
git branch -D feature/some-feature
```

Summary

In this exercise you learned

- how to create a new branch with the checkout command (Git)
- basic Git commands (Git)

Additional Resources

- [Documentation](#)
- [ProGit](#)
- [3 Git Commands I use every day](#)

[Next: Programming Basics](#)

Introduction

In this section you will be introduced to the most basic concepts of programming; variables, data structures, and control statements.

Programming is little more than reading data and piecing together statements that take action on that data. This is typically done by making a [decision tree](#). In programming these decision trees are constructed using [control-structures](#) which tend to flow based upon the current value of a memory addresses most commonly known as a [variable](#).

Scripting Basics

In this section you will learn

- Basic control structures
- The basics of Bash scripting

GitHub Pages

GitHub provides a free hosting service called [GitHub Pages](#). This is a standard GitHub repository that is hosted as a website. This allows you to post static web content (HTML, CSS, JavaScript, images, videos, etc) to a repository and that content will be served as a live webpage. This is a front-end only service. The exercises in this section will focus on building a website personal web site tailored to developing a personal brand, building a portfolio, etc.

Exercise 1 - Create your GitHub Pages Repository.

1. Login to github
2. Create a new repository
 - Repository Name: **YOUR-GITHUB-USERNAME.github.io**
 - Description: *My GitHub Pages Site.*
 - [x] Public
 - [x] Initialize this repository with a README
 - Add a license: MIT License
3. Clone the repository

```
cd /var/www
git clone git@github.com:YOUR-GITHUB-USERNAME/YOUR-GITHUB-USERNAME.github.io.git
cd YOUR-GITHUB-USERNAME.github.io.git
```

4. Add YOUR-GITHUB-USERNAME.github.io.git to your VSCode workspace.
5. Create the file index.html
6. Add the minimal template with your name as title content

```
<!DOCTYPE html>
<html>
  <head>
    <title>Jason Snider</title>
  </head>
  <body>
  </body>
</html>
```

7. `</>` Commit your changes.
8. Push your changes to master
9. Navigate to <http://localhost/YOUR-GITHUB-USERNAME.github.io/> to view your changes locally.
10. Navigate to YOUR-GITHUB-USERNAME.github.io/ to view your changes in production.

Summary

In this section you learned how to

- launch a GitHub Pages site

Exercise 2 - Getting Started

This portfolio site will start off with three pages.

- index.html - Your home page, an introduction.
- resume.html - An HTML based resume.

- `contact.html` - A form that will allow people to contact you.

We will start by adding navigation and an header to our form. This version of your site might look a bit odd. Don't worry, we will add some CSS later, this will make it look a modern website.

`</>` `code` First add navigation to `index.html`.

```
<nav>
  <ul>
    <li><a href="index.html">Home</a></li>
    <li><a href="resume.html">Resume</a></li>
    <li><a href="contact.html">Contact</a></li>
  </ul>
</nav>
```

`</>` `code` Make two copies of `index.html` and rename them to `resume.html` and `contact.html`. Locally you will no be able click through all three pages. Commit your changes and push master. Go to the production version of you website and test your changes.

Exersice 3 - HTML Validation

Sometimes our pages do not display as we expect, this is often due to invalid HTML. You can check the validity of your HTML using the [W3C Markup Validation Service](#).

1. Open a browser and go to the [W3C Markup Validation Service](#).
2. Select the third tab *Validate by URI*
3. Enter the [address](#) of your GitHub pages site and press the *Check* button.

Meta Data

Meta data is data about data. For a typical web page, the data is the content that falls between the opening and closng heade tags. Meta data helps to describe and classify that data and/or the functionality of your web page. Meta data can be an attribute of a single element or added to the `head` of a document in the form of a meta tag.

Best practices are things that ought to be done given there is not a good reason not to and provided their is not an alternative that better suits a given situation. If I had to pick three pieces of meta data that should always be implemented, they would be as follows.

- `<html lang="en">` - Defines the language of the web page. This would most likely be used by assistive technologies such as screen readers or an automated translator.
- `<meta charset="UTF-8">` - Defines the character set you are using so that there will be no confusion between your source code and the rendering engine. For a data driven web site you will want your websites encoding to match that of your database; UTF-8 is the most common encoding.
- `<meta name="viewport" content="width=device-width, initial-scale=1.0">` - Used by the browser to allow the developer of the site to declare how the site should be viewed across devices.

Exercise 4 - Meta Data Best Practices

`</>` `code` Update all pages on your GitHub site so that

- The language is declared as *English*.
- The charset is declared as *UTF-8*.
- The view port is declared as *content="width=device-width, initial-scale=1.0"*.

Commit all changes and push all changes to master

HTML Elements

As stated in the previous lesson; HTML elements more commonly know as tags are bits of markup that provide semantic meaning to text and objects. This markup is interpreted by outside programs (such as browsers, bots, spiders, crawlers, etc) which will often act on your content based on that contents markup. For example `<h1>title</h1><h2>Sub Title</h2>` tells the program reading your page that *Sub Title* belongs to *title* and that *title* should be treated as title of the page (or all content until the next `<h1>` tag is encountered) while **Sub Title** identifies the next block of or all content until the next `<h2>` or `<h1>` tag is encountered. The original goal of HTML was to provide a common format in which we could send academic research papers over the wire. In short, HTML was designed to mimic a word processor. The body of one of those documents may resemble the following. In most cases your HTML elements will have both an opening and a closing tag. Elements open with `<[element]>` and close with `</[element]>` the difference here is `<` vs `</`.

Sample Markup

Just a quick review.

```
<h1>HTML Elements</h1>
<p>HTML elements more commonly know as tags are bits of markup...</p>
<h2>HTML Global Attributes</h2>
<p>Attributes bring your markup to life. Attributes allow for programming...</p>
<h3>Event Handler Attributes</h3>
<p>Event Handler Attributes (UI Events) allow a user to interact...</p>
<p>Here a list of...</p>
<ul>
  <li>Item one</li>
  <li>Item two</li>
  <li>Item three</li>
</ul>
<h2>Summary</h2>
<p>In summation...</p>
```

Lets review some of these tags.

- h1, h2, h3, h4, h5, h6 - HTML supports 6 header levels, these should always be nested.
- p - Identifies text as a paragraph.
- ul - Identifies an unorganized list. This will create a bulleted list. An unorganized MUST contain one or more list items ``.
- ol - Identifies an organized list. This will create a numbered list. An organized MUST contain one or more list items ``.
- li - A list item, represents an item in either an unorganized or organized list. This MUST be wrapped in a `` or `` element.
- div - Divs are block level elements that are used to represent divisions in an HTML document. These are typically used to divide a page into sections. These may be used for a logical page division or as anchor to apply style and attributes.
- a - An anchor tag. This is used to create links and is arguably the foundation of the World Wide Web. An anchor tag becomes a link by adding a href ([Hypertext REference](#)) attribute `Example`.

Sample Markup

Just a quick review

```
<!DOCTYPE html>
<html lang="en">
  <head>
    <meta charset="UTF-8">
```

```

<title>World</title>
<meta name="viewport" content="width=device-width, initial-scale=1.0">
</head>
<body>
  <h1>Hello World</h1>
  <p>Welcome to my web site.</p>
  <h2>HTML Elements</h2>
  <p>
    To paraphrase the lesson text [...] For example <h1>h1</h1>h2</h2>title</h1>... Notice the use of
    character entities when wanting show the tags in HTML.
  </p>
  <h2>Character Entities</h2>
  <p>Since the keyboard does not have a &copy; key we need a way to reference this so we say &amp;copy;. Addi
    tionally, greater than and less than are interpreted as HTML tags. These are examples of symbols that we may wa
    nt to display but will not be able to with out a work around. This is where character entities come into play.
  </p>
  <ul>
    <li><a href="https://stackoverflow.com/questions/1016080/why-are-html-character-entities-necessary">A S
    tack Overflow thread on the topic.</a></li>
    <li><a href="https://en.wikipedia.org/wiki/List_of_XML_and_HTML_character_entity_references">A Wikipedi
    a article on the topic.</a></li>
    <li><a href="https://dev.w3.org/html5/html-author/charref">The W3C reference.</a></li>
  </ul>
  <h2>Summary</h2>
  <p>In summation...</p>
</body>
</html>

```

HTML Global Attributes

Attributes bring your markup to life. Attributes allow for programming hooks, style and meta-data to be applied to your web page. While HTML has defined a number of standard attributes it allows for custom attributes to be defined. Attributes are key to value pair that can add additional semantics, style or functionality to a element. We learn more about attributes as needed.

Image Tag

When it comes to working with attributes, the image (img) element is a great place to start. Image is a self-closing tag. Self-closing tags do not require a closing tag because they do not contain any content, they only use attributes to mark content to the screen.

Image has two required attributes src and alt ``. Src tells the document where to find the image to be displayed while alt displays alternative text in case the image cannot be displayed. In most cases an attribute will always have a value, this is written as attribute="Some Value". This is often referred to as a key-value pair. The attribute or left side of the equation is the key and the right side of the equation is the value (conceptually speaking it's key="value").

Before you can add an image, you will need an image to link to. Lets use a Gravatar. Gravatar is a free service that allows a user to upload an avatar that will follow them from site to site by hashing the users email address into the name of a file. This is popular in the dev community and used by other services such as GitHub.

Head over to [Gravatar](#) and create a profile and use the provided URL, if you do not want to create a Gravatar account use the following URL.

- <https://www.gravatar.com/avatar/4678a33bf44c38e54a58745033b4d5c6?d=mm&s=64>

You would mark this up as:

```



```

Exercise 5 - Introduce Yourself

`</>` Update index.html such that

- The title tag reads *Hello, I am YOUR-NAME*
- Add an H1 element to the body of the document.
 - The contents of this tag SHOULD read *Hello I am YOUR-NAME*
- Create a paragraph tag and say a few sentences about yourself.
- Add an image element to the paragraph tag above the text you just added.
 - The src attribute MUST point to a Gravatar image
 - The value of alt attribute SHOULD be YOUR-NAME

The Style Attribute

Cascading Style Sheets (CSS) is a language for describing the style of an element. The style attribute in HTML allows you to add a CSS description to a single HTML element. Describing a font's color is a common use of CSS. In CSS we describe style using property's which are key to value pairs separated by a colon [key]:[value]. Using the color property will allow me to describe the font color of an element. We will do a deep dive on CSS later, for now we will give you what you need.

Exercise 6 - Style an Element

This exercise introduces you to inline styles. Due to their blocking nature we will not use these in production. We will learn more about inline styles in later lessons.

`</>` Change index.html such that

- Text wraps around the image.
- The image provides some margin between itself and the text.
- The image is presented as a circle.

CSS Attributes

- border-radius: 50%; - Rounds the corners of a given element. A value of 50% makes a complete circle.
- float: right; - Floats an element to a given position. All surrounding content flows around that float.
- margin-right: 1em; - Provide 1em of margin to the right side of an element.

```

```

Contact Form

Traditionally, forms have been the most common way to collect data from a user. A form submission is the simplest way to post data to a server. This section will start with a simple POST request and end with complex processing.

Form tags `<form></form>` are used for creating forms in HTML. Every form should have at least two attributes *action* and *method*.

- *action* - the web [address](#) to which the form data will be sent.
- *method* - the type of request the form should make (probably GET or POST).

Form Elements

While HTML has a slew of form elements you can mostly get by with just a few.

- [input](#) - uses the type attribute morph into various fields.
 - [text](#) - covers single line input fields
 - [date](#) - provides a date picker
 - [hidden](#) - a hidden field
 - [checkbox](#) - provides checkboxes
 - [radio](#) - provides a radio option
 - [file](#) - upload files to the server
 - [button](#) - provides a submit button
- [textarea](#) - a large field for entering multiline text.
- [select](#) - Provide a picklist.
- [label](#) - Provides a label for a given element.

Label elements use the [for attribute](#) to associate a label to given form field. The form field requires an **id** attribute with a value that matches that of a given **for** attribute. While visually there is no advantage to using **for** and **id** it helps screen readers communicate to visually impaired users.

Never omit form labels. If you want to hide use `display:none;` in CSS. This will hide it from the UI while keeping it visible to screen readers.

Additional Form Fields Attributes

- *name* - provides a data key to the form element. This is the name of the field passed in the payload (required).
- *type* - defines the type on input field (input fields only) (required).
- *value* - allows you to prepopulate the value of an input field (optional).
- *checked* - auto checks a checkbox (optional).
- *selected* - pre-selects a picklist option (optional).

[CodePen Demo](#) Accessible Form Examples

```
<!-- Plain text input -->
<div>
  <em>Sample plain text entry</em>
  <label for="name">Name</label>
  <input id="name" name="name" type="text">
</div>
<!-- Datepicker -->
<label for="date">Date</label>
<input id="date" name="date" type="date">

<!-- Textarea -->
```

```
<label for="description">Description</label>
<textarea id="description" name="description"></textarea>

<!-- Picklist-->
<label for="pickOne">Choose an option</label>
<select id="pickOne" name="pickone">
  <option>Please Choose an Option</option>
  <option value="option1">Option 1</option>
  <option value="option2" selected>Option 2</option>
  <option value="option3">Option 3</option>
</select>

<!-- Radio Options -->
<fieldset>
  <legend>Choose yes or No</legend>

  <label for="r1">Yes</label>
  <input id="r1" name="yn" value="y" type="radio">

  <label for="r2">No</label>
  <input id="r2" name="yn" value="n" type="radio">
</fieldset>

<!-- Checkbox Options -->
<fieldset>
  <legend>Choose all that apply</legend>
  <label for="c1">Option 1</label>
  <input id="c1" name="all" value="0" type="checkbox">

  <label for="c2">Option 2</label>
  <input id="c2" name="all" value="1" type="checkbox">
</fieldset>

<!-- Form Buttons -->
<input type="submit" name="submit" value="Submit">
<input type="reset" name="reset" value="Reset">
```

Formspree

Normally you would implement a contact form by implementing some backend code on your webserver. Since GitHub Pages does not allow you to execute server side (aka backend) code we will use a free service called Formspree. This will allow upto 1000 emails per month through our web form. Head over to [Formspree](#) and give it a test, you will be sent a confirmation email which you must confirm to continue using the product.

By adding your email [address](#) to this form you are making it publicly available(or you could say potentially increasing it's public exposure). If this is an issue for you create an email account for solely for this purpose or even a service such as <https://www.mailinator.com/>. If you choose the latter be aware that these inboxes are temporary and public.

Exercise 1 - Basic Form

When building a contact form think about what information you need. This will be a simple form so we will only ask for a few things: name, email and a message. This gives us a total of three form fields.

`</>` `code` Open `contact.html` and add opening and closing `form` tags.

```
<form action="https://formspree.io/YOUREMAIL@EXAMPLE.COM" method="POST"></form>
```

`</>` `code` Collect the name of the person contacting you. We use N/name as the label content, for, id, and name values. Note the div tags, they are not required but they will help us later when we go to style the form.

```
<div>
  <label for="name">Name</label>
  <input id="name" type="text" name="name">
</div>
```

`</>` Collect the email of the person contacting you. We use E/email as the label content, for and id values but we will change the name to `_replyTo` this will allow us to access Formspree's `replyTo` feature of setting the `replyTo` [address](#) to the user supplied value.

```
<div>
  <label for="email">Email</label>
  <input id="email" type="text" name="_replyto">
</div>
```

`</>` We will create a label and a text area to collect the message from the person contacting us.

```
<div>
  <label for="message">Message</label>
  <textarea id="message" name="message"></textarea>
</div>
```

`</>` We will create a hidden form field with the name of `_subject`. This will access another feature for dealing with the email subject. We will make this a hidden field so that we can control what it looks like in our inbox.

```
<div>
  <input type="hidden" name="_subject" value="New submission!">
</div>
```

`</>` Finally, we will add a submit button.

```
<div>
  <input type="submit" value="Send">
</div>
```

Add the file `thanks.html` (this should be a copy of `contact.html`) to your GitHub Pages site. Add a header and message thanking the user for contacting you.

Exercise 2 - Thank You

`</>` Make a copy of the file `resume.html` and name it *thanks.html*. Change the title to say "Thank You" and add a nice message for the user.

`</>` Add a hidden field to your form and set the name to `_next` add a value attribute the points to the `thanks.html` page on your GitHub pages site. This uses another special feature of Formspree that sends the user to a target page after the form submit.

```
<input type="hidden" name="_next" value="//YOUR-GITHUB-USERNAME.github.io/thanks.html">
```

Exercise 3 - Captcha and Honeypots

Completely Automated Public Turing (Captcha) is any test that would be trivial for a human to solve but difficult if not impossible for a computer to solve. We use these to reduce spam and wasted resources by attempting to filter out robots (or non-human traffic) all Formspree forms provide captcha by default.

`</>` [code](#) Add a hidden field to your form and set the name to `_next` add a value attribute the points to the `thanks.html` page on your GitHub pages site. This uses another special feature of Formspree that rejects any form for which the `honeytoken` is not empty. This is a second layer on top of Captcha making it redundant but we show it to demonstrate another technique for dealing with spam.

Any bot that is aware of Formspree has likely been updated to account for the `_gotcha` name field. This would be more effective on a custom form, we will discuss this in later lessons.

```
<input type="text" name="_gotcha" style="display:none">
```

Summary

In this lesson you learned how to

- create a webform
- interact with a third party service

Additional Resources

- [Creating Accessible Forms](#)

MetaData

MetaData comes in many forms from the `meta` elements in the the document head to microdata and aria attributes applied directly to your HTML tags or even in a separate text file.

HTML

Improve SEO with `<meta>`

Search Engine Optimization (SEO) is the practice of improving your site compatibility with a search engine which, in theory, should help to increase your traffic. Meta data is one ingredient. We will start with the classics *description* and *keywords*. When writing a site description your looking to sum up a page in 25 words or less the description MUST be relevant to the content on the page. The same idea applies to keywords 25 or less comma separated words or short phrases that are relevant to the page in question. Google will penalize you if you try to cheat. In both cases we will use the meta tag with the name and description attributes.

The name attribute denotes the type of meta data while the content attribute contains the description, keywords, etc.

```
<meta name="description" content="The best thing about hello world is the greeting">
<meta name="keywords" content="">
```

MicroData

A search engine is the most common classifier of web pages. Typically, web pages are classified using seed data against a machine learning type of algo. Some of these are very good while others are not. Applying a micro data schema to your pages markup can help these algos better classify your data. Typically these will be waited against some sort of AI as a means of fraud detection. For instance, Google will likely honor meta data so long as it doesn't think you you are trying to game the system, if it detects something of that sort, it may de-index your site.

A good example would be a [job posting](#). If I'm posing job ads I would want to apply this schema assuming other services are interested in pull in job ads and making use of its data.

Aria

Accessible Rich Internet Applications (ARIA) is a standard for helping a web page work with a screen reader. You saw a sample of this earlier with `role="navigation"` .

.txt

robots.txt

robots.txt is a file that sits in your sites root directory. This tells allows you to provide a set of preferences to well behaved search engines. At the very least you should allow all bots until you have a reason not to. Bad bots will ignore this so trying to keep those out using a robots.txt file is pointless, keep it simple and assume all bots are good. This will prevent you from making mistakes that block the good bots.

Exercise

Create the path `/var/www/robots.txt` and add the following lines.


```
User-agent: *  
Disallow:
```

humnas.txt

humans.txt is a file that gives credit to the sites creators. While it is not required it's a nice touch and if they solve the spam problem they will give you a way to submit your site to there directory, which is a link back so that is always good.

humans.txt requires a tag in the head plus the text file with all of the content

```
<link rel="author" href="humans.txt" />
```

```
/* TEAM */  
Your title: Your name.  
Site: email, link to a contact form, etc.  
Twitter: your Twitter username.  
Location: City, Country.  
  
/* THANKS */  
Name: name or url  
  
/* SITE */  
Last update: YYYY/MM/DD  
Standards: HTML5, CSS3,..  
Components: Modernizr, jQuery, etc.  
Software: Software used for the development
```

security.txt

security.txt lets security researchers know how to get hold of you should an issue be found.

Images

[favicon.ico](#) This is the image that appears in the browser tab beside the title. This is found in your websites root directory.

[browserconfig.xml](#) For creating custome tiles in windows.

```
<?xml version="1.0" encoding="utf-8"?>  
<!-- Please read: https://msdn.microsoft.com/en-us/library/ie/dn455106.aspx -->  
<browserconfig>  
  <msapplication>  
    <tile>  
      <square70x70logo src="tile.png"/>  
      <square150x150logo src="tile.png"/>  
      <wide310x150logo src="tile-wide.png"/>  
      <square310x310logo src="tile.png"/>  
    </tile>  
  </msapplication>  
</browserconfig>
```

- tile.png
- tile-wide.png
- icon.png

[manifest.json](#)

```
{
```

```
"icons": [{
  "src": "icon.png",
  "sizes": "192x192",
  "type": "image/png"
}],
"start_url": "/"
}
```

Additional Resources

- [What's in the head? Metadata in HTML](#)
- [Steps to a Google-friendly site](#)
- [The Beginner's Guide to SEO](#)
- [How to write meta descriptions for SEO](#)
- [Getting started with schema.org using Microdata](#)
- [WAI-ARIA Overview](#)

CSS

In this section you will learn the basics of

- CSS
- Sass
- Gulp
- CSS Based Layouts

CSS

Cascading Style Sheets (CSS) is a language that describes the style of a web page. CSS uses selectors and definitions to apply the these style descriptions or styles to a page.

Lets look at [CSS Zen Garden](#), click on the download example html file link and open the file in your browser. This is just a plain HTML file, now download the example CSS file and refresh the page. This is what you can do with a few CSS definition. Now go the the [design gallery](#) each of these examples uses the came HTML file the only changes here are to the style definitions.

Selectors correspond to HTML elements, there attributes, decedents and and siblings.

Common Selectors

These are the most common selectors. While there are many more

- Class Selector `.danger` - (.) + (CLASS-NAME)
- Tag Selector `p` - (TAG-NAME)
- ID Selector `#mastHead` - (#) - (ID-NAME)

```
/* All paragraph elements have a blue font */
p{
  color: blue;
}

/* All paragraph elements with a class attribute of danger will have a red font */
p.danger{
  color: red;
}

/* All div elements with any child element that has with a class attribute of
danger will have a red font */
div > *.danger{
  color: red;
}

/* This will also work as described above */
div *.danger{
  color: red;
}

/* So will this */
div .danger{
  color: red;
}

/* You can apply a single description to multiple selectors with comma separation */
p,
.info,
div > *.info{
  color: blue;
}
```

Specificity Rules

The following list from the weakest to stringest selectors when it comes to implementing css rules. Inline style trump all, while `!important` can force an override of a higher lower level selector; this should be used sparingly.

- universal selector (*)
- element selector (h1, p, a)
- class selector (.blue, .link, .content)
- attribute selector ([href], [target], [src])
- psuedo selector (:link, :hover, :visited)
- id selector (#firstName, #lastName, #phoneNumber)
- inline style (style="text-align: center;)

```
/* Make all font for all elements red */
* {
  color: red;
}

/* overrides * */
p, a {
  color: blue;
}

/* overrides p */
p.green {
  color: green;
}

/* overrides *, a, p */
.indigo {
  color: indigo;
}

/* overrides a */
a[href="/"] {
  color: aquamarine;
}

/* overrides a */
a:link,
a:visited{
  color: maroon;
}

/* overrides a:link, a:visited */
a.indigo:link,
a.indigo:visited,{
  color: purple;
}

/* overrides everything */
#home{
  color: #efefef;
}
```

Add a Stylesheet

`</>` [code](#) In your GitHub Pages project create the directory path *dist/css* and add the file *main.css*. To the document head in *index.html* use the [link](#) element to reference the stylesheet.

```
<link rel="stylesheet" type="text/css" href="./dist/css/main.css">
```

You can verify the file loads by checking networking tab in dev tools.

Remove the Inline Styles

`</>` code We will start by removing the inline style we added to our index.html file. We will start by adding an avatar class to our stylesheet.

dist/css/main.css

```
.avatar {  
  border-radius: 50%;  
  float: left;  
  margin-right: 1em;  
}
```

Reset the body element

Now we can start building a layout, we will start by resetting the body elements, adding a base font and then we will move on to navigation.

It's common practice to remove the default padding and margin from the body, add the following to main.css.

```
body{  
  padding: 0;  
  margin: 0;  
}
```

Set a base font

Next we will add a base font. To assure consistency across all platforms we will pull a font from a font foundry, we will use [Google Fonts](#) and use [Open Sans](#). We will import the font style into our style sheet and use a universal selector to set all elements to this font by default.

```
@import url('https://fonts.googleapis.com/css?family=Open+Sans');  
  
* {  
  font-family: 'Open Sans', sans-serif;  
}
```

Header and Navigation

Now we are ready to tackle navigation, let's start by wrapping the `nav` elements in a `header` element. We will add a `span` element with a class of `.logo` outside of the `nav` with the navigation. We will align all navigation links horizontally and pull them to the top right corner of the screen.

```
<header>  
  <span class="logo">My WebSite</span>  
  <nav>  
    <ul>  
      <li><a href="index.html">Home</a></li>  
      <li><a href="resume.html">Resume</a></li>  
      <li><a href="contact.html">Contact</a></li>  
    </ul>  
  </nav>  
</header>
```

```
header {  
  height: 50px;  
  background: #000;  
  color: #fff;  
  padding: 0 0.5em 0 1em;
```

```
}

header .logo{
  line-height: 50px;
  font-weight: bold;
}

nav {
  float: right;
}

nav ul {
  margin: 0;
  padding: 0;
  list-style: none;
}

nav ul li{
  display: inline;
}

nav ul li a,
nav ul li a:link,
nav ul li a:visited{
  display: inline-block;
  padding: 0 .5em;
  color: #fff;
  line-height: 50px;
  text-decoration: none;
}

nav ul li a:hover{
  background: #444;
}
```

Main Content (set a landmark)

Add a `main` element and center the page content.

```
<main>
  <h1>Hello, ...
</main>
```

```
main {
  /* Use a margin to center the page */
  margin: 0 auto;

  /* Set the width of the content */
  width: 960px;

  /* For smaller screens to not exceed the max screen width */
  max-width: 100%;
}
```

Make it Responsive

Use dev tools to toggle the device toolbar (enter mobile testing mode) and choose the responsive option. Set the width to 960px and drag in and out crossing back and fourth over that 960px mark. Notice the padding, we loose all of padding under 960px meaning the text runs to the edge of the screen. Popular opinion is that makes for a better read if you can get some separation from the edge of the screen. You could use a media query and change the page width on a break point such as below.

Add Gutters to Small Screens

```
@media only screen and (max-width: 960px) {
  main {
    max-width: 90%;
  }
}
```

</> code Or you could set the default `max-width` to **90%** which is what we will do here.

```
/* For samller screens to not exceed the max screen width */
max-width: 90%;
```

Switch to Veritcal Navigation on Small Devices

</> code It's common practice, on smaller screens, to change from a horizontal navigation in the header to a hidden vertical navigation that appears on a button press. We can do this by setting the `nav` display to none.

```
@media only screen and (max-width: 960px) {
  nav {
    nav {
      display:none;
    }
  }
}
```

</> code Add an anchor element to the `header` element right before the `nav` element. This will act as the control to toggle the menu on smaller screens. Give this element and `id` attribute with a value value of *toggleMenu*.

```
<a id="toggleMenu">Menu<a>
```

Create a CSS selector for the `toggleMenu` attribute. This style will be similar to but set breakpoints opposite to that of `nav` meaning this will only appear on smal

```
#toggleMenu {
  display: none;
}

@media only screen and (max-width: 960px) {
  #toggleMenu {
    display: block;
    float: right;
    line-height: 50px;
  }
  ...
}
```

</> code We will cover JavaScript in great detail later, for now copy and paste the following into `index.html` right before the closing `body` tag.

```
<script>

var toggleMenu = document.getElementById('toggleMenu');
var nav = document.querySelector('nav');
toggleMenu.addEventListener(
  'click',
  function(){
```



```

        if(nav.style.display=='block'){
            nav.style.display='none';
        }else{
            nav.style.display='block';
        }
    }
    );
</script>

```

</> code Now if you reload the page, move the width to less than 960px and press menu, you notice not much has changed. We will fix this by setting the nav to a block level component.

```

@media only screen and (max-width: 960px) {

    #toggleMenu {
        display: block;
        float: right;
        line-height: 50px;
    }

    nav {
        display: none;
        background: #000;
    }

    nav ul li a,
    nav ul li a:link,
    nav ul li a:visited{
        display: block;
        border-bottom: 1px solid #777;
    }

}

```

Reload the page and make sure the resolution is under 960px, press the Menu button. It's now more closely resembles a traditional flyout menu. Make the resolution small and you'll notice the position of the menu changes. To fix this you will absolutely position nav relative to header .

Start by making assigning the relative position to the header element. Then assign an absolute position to the nav element. When an absolute element is the child a relative element the positioning of the absolute element is relative to that of its parent.

```

@media only screen and (max-width: 960px) {

    header {
        position: relative;
    }

    nav {
        position: absolute;
        display: none;
        background: #000;
    }

    ...
}

```

</> code Next you will want to position the menu. By default the menu will want to position itself in the top left corner. If you were to think of a box as having four boundaries: top, left, right and bottom; then top , left , right , bottom are commands that move the top left corner of a target element a set distance from the specified boundaries. In this case we will set top to 50px this will allow it to clear the 50px height of the header element. By setting left and right to 0 you will stretch nav element to the width of the entire screen.

```

@media only screen and (max-width: 960px) {

```

```
header {  
  position: relative;  
}  
  
nav {  
  position: absolute;  
  display: none;  
  background: #000;  
  top: 50px;  
  left: 0;  
  right: 0;  
}  
...
```

Exercise - Restyle All Pages

Apply the new navigation to all pages.

Additional Resources

- [Specificity](#)
- [CSS Tricks](#)
- [MDN - CSS](#)
- [Why do navigation bars in HTML5 as lists?](#)
- [Nav Element](#)
- [Bad Design vs. Good Design](#)

Udemy

- [Flexbox Tutorial](#)

SASS

SASS is a CSS preprocessor is a superset of CSS which means all CSS syntax is considered valid .scss it's a superset because because it extends CSS with programming like capabilities; variables and limited control statements. This is advantageous especially when building large front-end frameworks such [Bootstrap](#) or creating a product with a customizable theme. For example, Bootstrap has a default shade of red `#dc3545`¹. If we were to change that color globally we would have to track down every instance of the color and change it manually or we could make a single change to the [variable](#) that holds that color.

Install Sass

Install ruby-sass via apt.

```
sudo apt-get install ruby-sass
```

Variables in Sass. Sass denotes variables with a \$ dollar sign. For these lessons we will use the newer SCSS syntax for writing our sass files. These files must have the .scss extensions.

Exercise 1 - Sass Variables

Create the paths `/var/www/mtbc/scss/index.html` and `/var/www/mtbc/scss/main.scss` and add the following to `index.html`,

```
<!DOCTYPE html>
<html>
  <head>
    <title>SASS DEMO</title>
    <link href="/main.css" type="text/css" rel="stylesheet">
  </head>
  <body>
    <h1>SASS DEMO</h1>

    <h2>FOUR COLUMN GRID</h2>
    <div class="row">
      <div class="col">ONE</div>
      <div class="col">TWO</div>
      <div class="col">THREE</div>
      <div class="col">FOUR</div>
    </div>
    <div class="row">
      <div class="col">FIVE</div>
      <div class="col">SIX</div>
      <div class="col">SEVEN</div>
      <div class="col">EIGHT</div>
    </div>

    <h2>TEXT CLASSES</h2>
    <div class="text-success">Success Text</div>
    <div class="text-error">Error Text</div>
    <div class="text-warning">Warning Text</div>

    <h2>MESSAGE CLASSES</h2>
    <div class="message">Default Message</div>
    <div class="message-success">Success Message</div>
    <div class="message-error">Error Message</div>
    <div class="message-warning">Warning Message</div>

  </body>
</html>
```

Load the page <https://localhost/mtbc/sass>. Then add the following to *main.scss*

```
/* variables */

$primary-font-stack: "Helvetica Neue", Helvetica, Arial, sans-serif;
$primary-color: #333;

/* universal settings */

* {
  box-sizing: border-box;
}

body {
  font: 100% $primary-font-stack;
  color: $primary-color;

  margin: 0 auto;
  padding: 0;
  width: 1170px;
}
```

Compilation is the next step. From the command line we will compile sass into css.

```
sass /var/www/mtbc/scss/main.scss /var/www/mtbc/css/main.css
```

This will create the file *main.css* which is a compiled version of your scss file.

```
* {
  box-sizing: border-box;
}

body {
  font: 100% "Helvetica Neue", Helvetica, Arial, sans-serif;
  color: #333;

  margin: 0 auto;
  padding: 0;
  width: 1170px;
}
```

Exercise 2 - Live Reload / Watch a File

The downside to a preprocessor is the compilation step. This takes time and slows down development. We remedy this by creating a *watcher* this watches a target file for changes and rebuilds it's CSS version in the background. This is one less thing you need to think about which can help keep you in flow. Open a split console window and run the following command in one of the panels.

```
sass --watch /var/www/mtbc/scss/main.scss:/var/www/mtbc/css/main.css
```

You will see the following output

```
>>> Sass is watching for changes. Press Ctrl-C to stop.
directory ~/scss
  write ~/scss/main.css
  write ~/scss/main.css.map
```

In the second panel open the scss file in vim, make a change and save it using [esc] then `:x` ; You'll notice a change in the first console window with the following output.

```
>>> Change detected to: main.scss
      write ~/scss/main.css
      write ~/scss/main.css.map
```

Open the file `/var/www/mtbc/scss/main.css` and verify your changes.

Mixins

Later we will learn about the Bootstrap framework. Bootstrap is among the most popular frameworks and as such it gets a lot of criticism. One of the those criticisms is the practice of calling multiple class on a single element. The claim is that this can increase load time. For example styling a button in Bootstrap often looks as follows `class="btn btn-default btn-xs"`. The idea is that it would be faster to combine all of those classes into a single definition in which case something like `class="btn-default btn-xs"` would load faster. In native CSS this would mean having a lot of duplicate code. SASS allows us to reuse style definitions, meaning we can write them once and call them as many times as we need to. This means we can globally change an entire style sheet by changing only one line of code. Rather than calling multiple classes we can define mixins and extend base classes making all of our code reusable.

Clearfix

I have always viewed `.clearfix` as a containment element for any number of floats. Meaning if you apply `clearfix` to a parent element any child element, that is has a float property, cannot escape the parent element. `.clearfix` is a common hack used by front end developers to solve the problem of using floats in a way they were never intended to be used².

- [CodePan](#) Floating grid without a clearfix
- [CodePan](#) Floating grid with clearfix

Exercise 3

Create a `.clearfix` mixin by adding the following to the top of `main.scss`.

```
/* mixins */
/* clear floats */
@mixin clearfix() {
  &:after {
    content: "";
    display: table;
    clear: both;
  }
}
```

Then you can create two classes applying `clearfix()` to both classes. We will go ahead and add a column class. We will discuss columns in greater detail in later lessons. For now we will use to demo other concepts.

```
/* Utility Classes */

.clearfix {
  @include clearfix();
}

/** Rows and Columns */
.row {
  @include clearfix();
}

.col {
```

```
float: left;
width: 25%;
padding: .5rem;

/* debug */
border: 1px solid #990000;
background: #fff;
}
```

Extend/Inheritance

Other examples of calling multiple classes is in the footer navigation as well as the #Content and #Sidebar divs.

```
<ul class="nav-inline pull-right" role="navigation">
```

Another method of reuse in SASS is `@extend` so `.sample{@extend .example;}` would apply the `.example`'s style declaration to `.sample`.

Exercise 4 - Add Response Classes (Quick Lab 15 minutes)

Add the following classes to main.scss update the style declarations so that redundant values are called as variables.

```
.text-success {
  color: #3c763d;
}

.text-error {
  color: #8a6d3b;
}

.text-warning {
  color: #a94442;
}

.message {
  border: 1px solid #ccc;
  border-radius: 4px;
  padding: 10px;
  color: #333;
}

.success {
  @extend .message;
  border-color: #3c763d;
  color: #3c763d;
}

.error {
  @extend .message;
  border-color: #8a6d3b;
  color: #8a6d3b;
}

.warning {
  @extend .message;
  border-color: #a94442;
  color: #a94442;
}
```

Exercise 5 - Implement sass in your project

Move *dist/css/main.css* to *src/scss/main.scss*

```
cd /var/www/YOUR-GITHUB-USERNAME.github.io
mkdir -p src/scss
mv dist/css/main.css src/scss/main.scss
```

Then compile the sass file

```
sass src/scss/main.scss dist/css/main.css
```

Additional Resources

- [SASS Reference](#)
- [MDN CSS Clear](#)

References

1. [bootstrap/scss/_variables.scss](#)
2. [What Does the Clearfix Class Do in Css?](#)

Gulp

Gulp allows you to build workflows for optimizing your frontend assets. As with SASS you can create a watcher to auto build on save. Gulp offers additional features such as combining and minifying files. Since Gulp is a JavaScript package and the config file is written in JavaScript you can add any functionality you want.

Globally install Gulp

```
cd ~
sudo npm install -g gulp
```

Configure NPM for your local project

Add a file named package.json to your GitHub Pages project. This must be added to the project's top level directory. Gulp is built in NodeJS and lives in the NPM ecosystem. You run a series of NPM commands to initialize your project as an NPM project and install each dependency manually or you can use a prebuilt config file. The latter is the path we will take for this project. Add the following to your package.json file.

```
{
  "name": "YOUR-GITHUB-USERNAME.github.io",
  "version": "0.0.0",
  "private": true,
  "scripts": {
    "start": "gulp watch"
  },
  "dependencies": {},
  "devDependencies": {
    "gulp": "^3.9.1",
    "gulp-clean-css": "^3.9.2",
    "gulp-concat": "^2.6.1",
    "gulp-rename": "^1.2.2",
    "gulp-scss": "^1.4.0",
    "gulp-uglify": "^3.0.0",
    "gulp-watch": "^5.0.0",
    "merge-stream": "^1.0.1"
  }
}
```

Install all Packages

By virtue of having a package.json file your project is an NPM project. At this point we have defined the project dependencies; now we need to install them. Run the following from the command line.

```
cd /var/www/YOUR-GITHUB-USERNAME/github.io
npm install
```

.gitignore

Git will stage every file it sees. There are cases in which your project requires files that you will never want to stage and commit. You can try to track these manually but that will inevitably fail. Add a file called .gitignore to your project and these files will not be available for staging. Create a file called .gitignore in the top level of your project and add the following.

```
node_modules
.gulp-scss-cache
```



```
.sass-cache
```

gulpfile.js

Gulp is an ES6 (JavaScript) script designed for frontend compilations. These are typically written as small, single script programs.

```
var gulp = require('gulp');
var watch = require('gulp-watch');
var cleanCSS = require('gulp-clean-css');
var uglify = require('gulp-uglify');
var rename = require('gulp-rename');
var concat = require('gulp-concat');
var merge = require('merge-stream');
var scss = require('gulp-scss');

gulp.task('default', ['watch']);

gulp.task('build-css', function(){
  //Create an unminified version
  var full = gulp.src([
    'src/scss/main.scss'
  ])
  . pipe(scss())
  . pipe(concat('main.css'))
  . pipe(gulp.dest('dist/css'));

  //Create a minified version
  var min = gulp.src([
    'src/scss/main.scss'
  ])
  . pipe(scss())
  . pipe(cleanCSS())
  . pipe(concat('main.min.css'))
  . pipe(gulp.dest('dist/css'));

  return merge(full, min);
});

gulp.task('watch', function(){
  gulp.watch('./public/src/scss/**/*.scss', ['build-css']);
});
```

Run any of the following commands execute your Gulp script.

```
gulp
gulp watch
gulp build-css
```

Since we defined `gulp watch` as our NPM start up script you can use `npm start` execute the watcher.

```
npm start
```

CSS Layouts

Three ways to do one layout.

Floats

- [CodePen](#) Base Layout Example

Additional Floating Grid Examples

- [CSS Floating Grid with Clearfix](#)

Flexbox

- [CodePen](#) Base Layout Example

Additional Flexbox Examples

- [Flexbox with fixed and scrolling columns](#)

CSS Grid

- [CodePen](#) Base Layout Example

Additional CSS Grid Examples

- [CSS Responsive 3 to 2/1 Column Grid](#)
- [CSS Responsive 6 Column Grid](#)

Lab - Add Gulp to Your GitHub Pages site

- Add Gulp to your GitHub pages project
- Your GitHub Pages project must now contain an src and a dist directory
- All new CSS must be written to src and compiled into dist

Using all the techniques we have learned thus far style your resume so that it looks like the template.

Additional Reading

- [Modern CSS Explained For Dinosaurs](#)

JavaScript

JavaScript Basics

JavaScript is simple programming language created by Netscape's Brendan Eich in 1995. The goal was to make web pages more interactive by allowing the browser to execute native code without the need of a plugin. JavaScript was standardized by ECMA thus providing a standard implementation reference. While we still call it JavaScript the reference standard is [ECMA-262](#)

Exercises

Modern browsers make use of DevTools (aka Web Console). While Chrome, FireFox and Edge have similar definitions for their DevTools, I'll steal this line from Chrome's documentation "Use the DevTools to iterate, debug, and profile your site".

- [Chrome](#)
- [FireFox](#)
- [Edge](#)

Create the file `/var/www/mtbc/js/console.html` that contains the following markup.

```
<!DOCTYPE html>
<html>
  <head>
    <title>Using the development console.</title>
  </head>
  <body>
    <p>Using the development console. Press [f12] and click the console tab.</p>
    <script>
      console.log();
    </script>
  </body>
</html>
```

Exercise 1 - Print data to the console

Exercise 1.1 - Pass a static string as an argument

Find the `<script>` tags in the markup you just added to the new file. You will see a single line of code that reads `console.log()`. Modify this line to read `console.log('Hello world');`. Then open a browser and navigate to <http://localhost/mtbc/js/console.html> (<http://localhost/mtbc/js/console.html>). Once the page opens, press [f12] and click on the console tab. You will see the text *Hello World* followed by the file name and line number.

Notes

The command `console.log()` call the `log()` function from the console API. This is what is know as dot concatenation, in this case `log()` is a property (method, function or [variable](#)) of the `console` API. This syntax is also used in object oriented programming (OOP) in which it would read something like `objectX.propertyY` or `objectX.methodZ()`. Some languages such a PHP use `->` instead of a dot, but the idea is the same `$objectX->propertyY` or `$objectX->methodZ()`.

While not required, most function (or method) calls will accept an argument. In this case, the console APIs `log()` method accepts a single parameter, the data to be printed to the screen. This data may be of any type number, string, array, object, etc. In exercise 1.1 we passed a static string. You can read more about JavaScript data types [here](#).

Exercise 1.2 - Pass a variable as an argument

Modify the contents of the script tags to read as follows.

```
var msg = 'Hello World';
console.log(msg);
```

In this exercise we are creating the `variable` `msg` (which is a common `variable` name for message) and assigning it a value of *Hello World*.

Exercise 1.3 - Working with strings

Modify the contents of the script tags to read as follows.

```
var greeting = 'Hello';
var who = 'World';
var msg = greeting + ' ' + who;

console.log(msg);
```

In this example we are combining the value of two variables and assigning the result to the `msg` `variable`.

Exercise 1.4 - Working with numbers

Modify the contents of the script tags to read as follows.

```
var num1 = 35;
var num2 = 7;
var result = num1 + num2;

console.log(result);
```

In this example we are adding the values of `num1` and `num2` .

Notes

Notice we are not adding quotes to the value of these variables. That is because we want to treat these values as numbers not strings. This will only work with numbers, if we were to set the value of `num1` to *ab* instead of *'ab'* we would get an error, this is because *ab* is not a number. If on the other hand, we had a `variable` named `ab` and that `variable` had a numeric value, it would treat `ab` as a numeric data type.

Exercise 1.4 - Working with mixed data types

Modify the contents of the script tags to read as follows.

```
var num1 = '35';
var num2 = 7;
var result = num1 + num2;

console.log(result);
```

As in the previous example we are adding 7 to 35, only this time we have added quotes to 35. Adding quotes changes the data type from a number to a string so rather than adding two numeric values we are concatenating two strings.

Notes

JavaScript is loosely typed, meaning it will try to resolve the data type in to something that makes sense to a given problem. Since, in this case we are adding a number to a string the JavaScript interpreter will conclude (since a number can always fit into a string, but a string cannot always fit into a number) that we are attempting to concatenate two strings rather than add two numbers which

will result in a value of 357.

Exercise 2 - Write to the page

Duplicate `/var/www/mtbc/js/console.html` to `/var/www/mtbc/js/write.html` that contains the following markup and add an element of type `div` to the body of the HTML document. Give the `div` an attribute of type `id` with a value of `MyText` `<div id="MyText"></div>` .

Exercise 2.1 - Working with mixed data types

Replace the contents of the script tags with the following.

```
var msg = 'Hello World';

document.getElementById('MyText').innerHTML = msg;
```

Check your changes at <http://localhost/mtbc/js/write.html>

In this exercise we are calling the `getElementById()` method of the `document` API. This accepts a single attribute and that is the id of the element we want to access. `innerHTML` is a property of the element. This property represents all of the content that appears between the opening and closing tags of the target element. In the exercise we are setting the value of `innerHTML` .

Exercise 2.1 - Working with mixed data types

In the `js.html` file change `<div id="MyText"></div>` to `<div id="MyText">Hello World</div>` and add a new element `<div id="NewText"></div>`

Inside the script tags, write some JavaScript that will read the content of `MyText` and write it to `NewText`.

Notes

The `innerHTML` property holds the content of a target element.

Additional Resources

- [MDN - JavaScript](#)
- [Eloquent_JavaScript](#)
- [Douglas Crawford](#)

JavaScript Control Structures

Programming is little more than reading data and piecing together statements that take action on that data. Every language will have its own set of control structures. For most languages a given set of control structures will be almost identical. In the Bash and PHP lessons we learned a few control structures most of which exist in JavaScript. While the syntax may be a little different, the logic remains the same.

Exercise - If, Else If, Else

Create the following path `/var/www/mtbc/js/if_else.html` and open it Atom. Then add the following lines.

```
<script>

//Initialize your variables
var label = null;
var color = null;
var GET = {};

//parse the GET params out of the URL
if(document.location.toString().indexOf('?') !== -1) {
    var query = document.location
        .toString()
        // get the query string
        .replace(/^.*\?\/, '')
        // and remove any existing hash string (thanks, @vrijdenker)
        .replace(/#.*$/, '')
        .split('&');

    for(var i=0, l=query.length; i<l; i++) {
        var aux = decodeURIComponent(query[i]).split('=');
        GET[aux[0]] = aux[1];
    }
}

//Check for get parameters
if(GET['color'] !== 'undefined'){
    color = `#${GET['color']}`;
}

//Can we name the color by it's hex value
if(color == "#ff0000") {
    label = "red";
} else if(color == "#00ff00") {
    label = "green";
} else if(color == "#0000ff") {
    label = "blue";
} else {
    label = "unknown";
}

//Output the dataa
document.write(`<div style="color:${color}">The color is ${label}</div>`);

</script>
```

Now open a browser and navigate to https://localhost/js/if_else.html and you will see the message *The color is unknown*. Now add the following string to the end of the URL `?color=ff0000`. Now your message will read *The color is red* and it will be written in red font. That string you added to the end of the URL is known as a [query string](#). A query string allows you to pass arguments into a URL. A query string consists of the query string Identifier (a question mark) `?` and a series of key to value pairs that are separated

by an ampersand (&). In our example the the *key* is *color* and the *_value* is *ff0000*. If you wanted to submit a query of a first and last name that might look like *?first=bob&last=smith* where first and last are your keys (aka your GET params) bob and smith are your values.

Now let's take a close look at the code. Initializing your variables is a [good practice](#).

```
//Initialize your variables
var label = null;
var color = null;
```

JavaScript does not have a `$_GET` super global like PHP so we will build one by parsing out the URL

```
//parse the GET params out of the URL
if(document.location.toString().indexOf('?') !== -1) {
    var query = document.location
        .toString()
        // get the query string
        .replace(/^\.*?\?/, '')
        // and remove any existing hash string (thanks, @vrijdenker)
        .replace(/#.*$/, '')
        .split('&');

    for(var i=0, l=query.length; i<l; i++) {
        var aux = decodeURIComponent(query[i]).split('=');
        GET[aux[0]] = aux[1];
    }
}
```

If `GET['color']` is defined then the set the [variable](#) `color` to the value of `GET['color']`

```
//Check for get parameters
if(!empty($_GET['color'])){ //This is a control statement
    //This is the body of the statement
    color = `#${GET['color']}`; //ES^ String literal
}
```

The user has submitted a hex value in the form of a get parameter. Do we know what to the call that hex value? If the answer is yes set the value of `label` to that color. Otherwise set the value of `label` to *Unknown*. Or you could say *if the hex value is red then say it is red; otherwise if it green then say it is green; otherwise if it blue then say it is blue; otherwise say unknown*.

```
//Can we name the color by it's hex value
if(color == "#ff0000") {
    label = "red";
} else if(color == "#00ff00") {
    label = "green";
} else if(color == "#0000ff") {
    label = "blue";
} else {
    label = "unknown";
}
```

Finally we will print some output back to the screen. This time we will wrap the output in some HTML and give it a little style by setting the font color to that of the user input.

```
document.write(`<div style="color:${color}">The color is ${label}</div>`);
```

Exercise - For Loop

Add the following to the path `/var/www/mtbc/js/for.html`.

```
<script>
var items = [
    'for',
    'do...while',
    'for...in',
    'for...of'
];

var msg = 'JavaScript supports ' + items.length + ' types of loop.';

var li = '';
for(i=0; i<items.length; i++){
    li += '<li>${items[i]}</li>';
}

msg += '<ul>${li}</ul>';

document.write(msg);
</script>
```

Exercise - For...in Loop

Add the following to the path `/var/www/mtbc/js/forin.html`.

```
<script>
var items = {
    0:'for',
    1:'do...while',
    2:'for...in',
    3:'for...of'
};

var msg = 'JavaScript supports ' + items.length + ' types of loop.';

var li = '';
for(var item in items){
    li += '<li>${items[item]}</li>';
}

msg += '<ul>${li}</ul>';

document.write(msg);
</script>
```

Exercise - For...of Loop

Add the following to the path `/var/www/mtbc/js/forof.html`.

```
<script>
var items = [
    'for',
    'do...while',
    'for...in',
    'for...of'
];

var msg = 'JavaScript supports ' + items.length + ' types of loop.';

var li = '';
```

```
for(var item of items){
    li += `<li>${item}</li>`;
}

msg += `<ul>${li}</ul>`;

document.write(msg);
</script>
```

Exercise - While Loop

```
<script>
var items = [
    'for',
    'do...while',
    'for...in',
    'for...of'
];

var msg = 'JavaScript supports ' + items.length + ' types of loop.';
var i=0;
var li = '';
while(i < items.length){
    li += `<li>${items[i]}</li>`;
    i++;
}

msg += `<ul>${li}</ul>`;

document.write(msg);
</script>
```

Exercise - Do...While

Add the following to the path `/var/www/mtbc/js/do_while.php`.

```
<script>
var items = [
    'for',
    'do...while statement',
    'labeled statement',
    'break statement',
    'continue statement',
    'for...in statement',
    'for...of statement'
];

var msg = 'JavaScript supports ' + items.length + ' types of loop.';
var i=0;
var li = '';
do {
    li += `<li>${items[i]}</li>`;
    i++;
} while (i < items.length)

msg += `<ul>${li}</ul>`;

document.write(msg);
</script>
```

Exercise - Switch Statement

```
<script>

var color = null;
var GET = {};

//parse the GET params out of the URL
if(document.location.toString().indexOf('?') !== -1) {
    var query = document.location
        .toString()
        // get the query string
        .replace(/^\.*?\?/, '')
        // and remove any existing hash string (thanks, @vrijdenker)
        .replace(/#.*$/, '')
        .split('&');

    for(var i=0, l=query.length; i<l; i++) {
        var aux = decodeURIComponent(query[i]).split('=');
        GET[aux[0]] = aux[1];
    }
}

//Check for get parameters
if(GET['color'] !== 'undefined'){
    color = `#${GET['color']}`;
}

switch (color) {
    case 'ff9900':
        console.log('The color is red');
        break;
    case '00ff00':
        console.log('The color is green');
        break;
    case '0000ff':
        console.log('The color is blue');
        break;
    default:
        console.log('Sorry, I cannot determine the color');
        break;
}

</script>
```

Additional Resources

- [Control Flow and Error Handling](#)
- [Loops and iteration](#)
- [Switch](#)

Walking the DOM

The Document Object Model (DOM) is an API that treats markup languages (xml, xhtml, html, ect) as a tree structures. A easier way to think of this might be as an interface that allows a programmer to access tags and the attributes of tags. Later we will learn about jQuery; a library for querying the DOM (among other things). First we will learn basic manipulation using straight JavaScript.

In the previous lesson we used `document.getElementById()`; this method queries the DOM for an element with a matching id. There are many similar methods.

Collection Live vs Static (not live)

A collection is an object that represents a lists of DOM nodes. A collection can be either live or static. Unless otherwise stated, a collection must be live.¹

If a collection is live, then the attributes and methods on that object must operate on the actual underlying data, not a snapshot of the data.¹

When a collection is created, a filter and a root are associated with it.¹

The collection then represents a view of the subtree rooted at the collection's root, containing only nodes that match the given filter. The view is linear. In the absence of specific requirements to the contrary, the nodes within the collection must be sorted in tree order.¹

By ID

document.getElementById(id_string)

Return a element object.

Create the path *mtbc/js/dom/by_id.html*, then open the source file in your editor. Add the following lines to the script tags then refresh the page and note the changes.

```
var elem = document.getElementById("a"); // Get the elements
elem.style = 'color: #FF0000;'; // change color to red
```

By Tag

document.getElementsByTagName(tag_name)

Return a live HTMLCollection (an array of matching elements).

The tag_name is "div", "span", "p", etc. Navigate to *mtbc/js/dom/by_tag_name.html*, then open the source file in your editor. Add the following lines to the script tags then refresh the page and note the changes.

```
var list = document.getElementsByTagName('blockquote'); // get all p elements
list[0].style = 'color: #FF0000;';
```

By Class

```
document.getElementsByClassName("class_values")
```

Return a live `HTMLCollection`.

The `class_values` can be multiple classes separated by space. For example: "a b" and it'll get elements, where each element is in both class "a" and "b". Navigate to *mtbc/js/dom/by_class_name.html*, then open the source file in your editor. Add the following lines to the script tags then refresh the page and note the changes.

```
// get all elements of class a
var list = document.getElementsByClassName('b');

// Make it red
list[0].style = 'color: #FF0000;';

// get all elements of class a b
var list2 = document.getElementsByClassName('a b');

//Make them bold and apply the color from list[0]
list2[0].style = 'font-weight: bold; color:' + list[0].style.color;
```

By Name

`document.getElementsByName("name_value")` Return a live `HTMLCollection`, of all elements that have the `name="name_value"` attribute and value pair.

Navigate to *mtbc/js/dom/by_name.html*, then open the source file in your editor. Add the following lines to the script tags then refresh the page and note the changes.

```
//Get all elements with a name of a
var list = document.getElementsByName('a');

//Loop through all of the matching elements
for (var i=0; i<list.length; i++) {
    //Make them red
    list[i].style = 'color: #FF0000;';
}
```

By CSS Selector

```
document.querySelector(css_selector)
```

Return a non-live `HTMLCollection`, of the first element that match the CSS selector `css_selector`. The `css_selector` is a string of CSS syntax, and can be several selectors separated by comma.

Navigate to *mtbc/js/dom/by_css_selector.html*, then open the source file in your editor. Add the following lines to the script tags then refresh the page and note the changes.

```
//Find the element with an id of bold
var bold = document.querySelector('#bold');

//Make it bold
bold.style = 'font-weight: bold;';

//Find all elements with a class of blue
var blues = document.querySelectorAll('.blue');

//Loop through all of the matching elements
for (var i=0; i<blues.length; i++) {
    //Make them blue
```

```
    blues[i].style = 'color: #0000FF;';  
  }
```

Additional Resources

- ¹[Collections](#)

Udemy

[Javascript Intermediate level 1 - Mastering the DOM](#)

Events

Events allow a user to interact with a web page. Listeners are used to detect an event being triggered. One might say the web page listens for a click event.

Click Event

In your browser navigate to *mtbc/js/events/onclick.html* and open to corresponding file in your editor. Add the following to the body tag of the document and refresh the page.

Exercise 1 - Catch the Click

```
<div id="demo"></div>
<button onclick="document.getElementById('demo').innerHTML = Date()">What time is it?</button>
```

The tag *div#demo* loads with no content. The button's on click attribute is an event listener for a mouse click. The value of onclick is the code that will be executed when the click event is triggered.

Exercise 2 - Refactor the Code

You can execute JavaScript directly in the HTML tag but this is considered bad practice. Let's Add some script tags and function that accepts the target element as an argument.

```
<button onclick="showDate('demo');">What time is it?</button>
<script>
  function showDate(element) {
    document.getElementById(element).innerHTML = Date();
  }
</script>
```

This is looking pretty good but some circles even argue against using the HTML elements onclick attribute. Let's write a listener in JavaScript.

```
<button id="time">What time is it?</button>
<script>
  function showDate(element) {
    document.getElementById(element).innerHTML = Date();
  }

  // Function to add event listener to button#time
  var btn = document.getElementById("time");
  btn.addEventListener("click", function(){showDate('demo')}, false);
</script>
```

Now let's change this to an arrow function. Arrow functions use shorter syntax and do not bind *this*.

```
<button id="time">What time is it?</button>
<script>
  function showDate(element) {
    document.getElementById(element).innerHTML = Date();
  }

  // Function to add event listener to button#time
  var btn = document.getElementById("time");
```

```
btn.addEventListener("click", ()=>{showDate('demo')}, false);
</script>
```

Change Event

A change event listens for a change to a target element. Change events are typically used for picklists.

Exercise 3 - Catch a Change

In your browser navigate to <mtbc/js/events/events/onChange.html> and open to corresponding file in your editor. Add the following to the body tag of the document and refresh the page.

Add the following to the form tag. Be sure to start the list with an empty option.

```
<select id="options">
  <option>--Pick an Option--</option>
  <option value="a">A</option>
  <option value="b">B</option>
  <option value="c">C</option>
</select>
```

Add the following to the script tag.

```
function setValue(element) {
  let option = document.getElementById('options').value;
  document.getElementById(element).innerHTML = option;
}

// Function to add event listener to button#time
var list = document.getElementById("options");
list.addEventListener("change", ()=>{setValue('demo')}, false);
```

Intervals

While an interval is not technically an event, it does provide a trigger for an interaction to occur. In this case we will use it with a click event to grow another form element on the screen.

In your browser navigate to <mtbc/js/events/interval.html> and open to corresponding file in your editor. Add the following to the script tags of the document and refresh the page. Be sure to read the comments and understand the reasoning behind each line of code.

```
function Grower() {
  //Get current width of the target element
  this.width = document.getElementById('demo').offsetWidth;

  //Set a counter to the current width
  this.num = this.width

  //Execute the counter on a set interval
  this.timer = setInterval(() => {
    //Increment the counter
    this.num++;

    //Add one pixel to the width of the target element
    document.getElementById('demo').style = 'width:' + this.num + 'px;';

    //After fifty iterations, kill the loop.
    if(this.num === this.width + 50){
```



```
        clearInterval(this.timer);
    }
    }, 1);
}

// Function to add event listener to button#time
var btn = document.getElementById("GrowBtn");
btn.addEventListener("click", function(){new Grower()}, false);
```

Additional Resources

[Arrow Functions for Beginners](#) [Arrow Functions](#) [Mastering the Module Pattern](#)

Canvas

The `canvas` element was introduced in HTML5, it can be used to draw graphics via JavaScript. This can be used for many purposes including games, visualizations, charts, graphs, etc.

Create a GitHub project called draw.

- Use the [HTML Starter package](#) from GitHub.
- Add your new GitHub project as the origin remote.
- Add a canvas tag to the body.
- Change the README file.

```
<canvas id="canvas" height="600px" width="800px"></canvas>
```

Then you will need to write some JavaScript, for the sake of brevity we will add this directly to the HTML using `script` tags.

Start by defining a canvas, this tells JavaScript which element to use as the canvas. This MUST always be a `canvas` element.

```
<script>
var canvas = document.getElementById('canvas');
</script>
```

Then add a context, we will start with the 2D context. A canvas may have only one context so everything you draw gets merged into a single bitmap. Once drawn it is a ll a single image. When the canvas was created it was stored in the object we named `canvas` to apply a fill color access the `getContext()` method of the `canvas` object.

```
<script>
var canvas = document.getElementById('canvas');
var ctx = canvas.getContext('2d');
</script>
```

We will start by drawing a rectangle, the first thing you will want to do is choose a fill color for your rectangle. Let's choose this at random. When the context was created it was stored in the object we named `ctx` to apply a fill color access the `fillStyle` property of the `ctx` object.

```
<script>
var canvas = document.getElementById('canvas');
var ctx = canvas.getContext('2d');
ctx.fillStyle = '#' + Math.floor(Math.random()*16777215).toString(16);
</script>
```

Finally, we will access the `fillRect()` of our `ctx` object.

```
<script>
var canvas = document.getElementById('canvas');
var ctx = canvas.getContext('2d');
ctx.fillStyle = '#' + Math.floor(Math.random()*16777215).toString(16);
ctx.fillRect(10, 10, 100, 100);
</script>
```

Save the follow to `/var/www/mtbc/draw/rand.html`. We will use `Math.random()` to draw a square in a random location in the canvas. We will set this to be 100 pixels shy of the canvas height and width so that the box will always appear in range. Navigate to <http://localhost/mtbc/draw/rand.html> and refresh the screen a few times to watch the box move.

```

<!DOCTYPE html>
<html lang="en">
  <head>
    <meta charset="UTF-8">
    <title>Hello World</title>
    <meta name="viewport" content="width=device-width, initial-scale=1.0">
  </head>
  <body>

    <canvas id="canvas" height="600px" width="800px"></canvas>

    <script>

      //Plot a random x
      var x = Math.random() * 700;

      //Plot a random y
      var y = Math.random() * 500;

      //Initialize the canvas
      var canvas = document.getElementById('canvas');

      //create a context
      var ctx = canvas.getContext('2d');

      //Create a random color
      ctx.fillStyle = '#' + Math.floor(Math.random()*16777215).toString(16);

      //Create the rectangle
      ctx.fillRect(x, y, 100, 100);

    </script>
  </body>
</html>

```

Add a circle

`CanvasRenderingContext2D.arc()` is the method used for drawing a circle. For a rectangle the x,y coordinates represent the top left corner of a the rectangle for a circle x,y represents the center of a circle. Where the third and fourth arguments of `fillRect` represent the height and width the third and fourth arguments represent the start and ending point of the arc to be drawn, for a complete circle you will always start at 0 and end at tau or π^2 (2π).

Add the following to the bottom of the script tags in your `/var/www/mtbc/draw/rand.html` file and refresh the page.

```

//Create a circle
ctx.beginPath();
ctx.arc(230, 400, 83, 0, 2 * Math.PI);
ctx.stroke();

```

Drawing Program

For this exercise we will create a drawing program. This will allow the user to choose shapes and colors then they will be able to drop images onto the canvas.

Create the paths

- `/var/www/draw/program.html`
- `/var/www/draw/src/js/main.js`
- `/var/www/draw/src/css/main.css`

Add the following to program.html. In this exercise we load [Normalize.css](#) to maintain consistency across browsers.

```
<!DOCTYPE html>
<html lang="en">
  <head>
    <meta charset="UTF-8">
    <title>Draw</title>
    <meta name="viewport" content="width=device-width, initial-scale=1.0">
    <link rel="stylesheet" href="https://cdnjs.cloudflare.com/ajax/libs/normalize/7.0.0/normalize.min.css">
    <link rel="stylesheet" href="src/css/main.css">
  </head>
  <body>
    <div class="wrapper">
      <nav>
        <ul>
          <li id="trackX"></li>
          <li id="trackY"></li>
        </ul>
      </nav>
      <main></main>
    </div>
    <script src="src/js/main.js"></script>
  </body>
</html>
```

Add the following to `/var/www/draw/src/js/main.js`

```
//Get the height and width of the main we will use this set canvas to the full
//size of the main element.
var mWidth = document.querySelector('main').offsetWidth;
var mHeight = document.querySelector('main').offsetHeight;

//Create the canvas
var canvas = document.createElement("canvas");
canvas.width = mWidth;
canvas.height = mHeight;
document.querySelector('main').appendChild(canvas);

//Create the context
var ctx = canvas.getContext("2d");

//Draw some sample rectangles
ctx.fillStyle = "rgb(200,0,0)";
ctx.fillRect (10, 10, 55, 50);

ctx.fillStyle = "rgba(0, 0, 200, 0.5)";
ctx.fillRect (30, 30, 55, 50);
```

Add the following to `/var/www/draw/src/css/main.css`.

```
html {
  font-family: sans-serif;
}

.wrapper {
  display: flex;
}

nav {
  flex: 0 0 300px;
  background: #ccc;
  min-height: 100vh;
}

main {
```

```

    flex: 1;
  }

  nav ul {
    list-style-type: none;
    padding: 0;
    margin: 0;
  }

  nav ul li {
    padding: 0;
    margin: 0;
  }

  nav ul li span,
  nav ul li button {
    display: block;
    padding: 1em;
    text-align: center;
  }

  nav ul li button {
    width: 100%;
  }

```

Navigate to <http://localhost/draw/program.html> and you'll see a canvas beside a space for a side nav. The canvas will have two rectangles.

In order to be able to draw we will need to know where our cursor is on the canvas. Let's start by tracking our mouse movements adding an [event listener](#) to the canvas. The listener will trigger functionality every time the pixel position changes by a pixel. We will use [Element.getBoundingClientRect\(\)](#) to get the position of the cursor.

```

//Track the x,y position
canvas.addEventListener('mousemove', function(evt) {

  //Calculate the x,y cords.
  var rect = canvas.getBoundingClientRect();
  let x = evt.clientX - rect.left;
  let y = evt.clientY - rect.top;

  //Write the cords back the UI.
  document.getElementById('trackX').innerHTML = 'X: ' + x;
  document.getElementById('trackY').innerHTML = 'Y: ' + y;

}, false);

```

As you move your mouse around the canvas you'll notice the x,y cords now appear in your sidebar.

Refactoring

So far all of our code has been written out in the global name space which means the data also lives in the global name space. It is considered good practice to restrict access to your program data and methods (functions) to a non-global scope. For this we will use a (closure)[<https://developer.mozilla.org/en-US/docs/Web/JavaScript/Closures>]. To be more precise we will use a [closure that emulates private data](#).

Replace your JavaScript with the following closure.

```

var draw = (function() {

  //Get the height and width of the main we will use this set canvas to the full
  //size of the main element.

```

```
var mWidth = document.querySelector('main').offsetWidth,
    mHeight = document.querySelector('main').offsetHeight,

    //Create the canvas
    canvas = document.createElement("canvas"),

    //Create the context
    ctx = canvas.getContext("2d"),

    //Create the initial bounding rectangle
    rect = canvas.getBoundingClientRect(),

    //current x,y position
    x=0,
    y=0;

return {
    //Set the x,y coords based on current event data
    setXY: function(evt) {
        x = (evt.clientX - rect.left) - canvas.offsetLeft;
        y = (evt.clientY - rect.top) - canvas.offsetTop;
    },

    //Write the x,y coords to the target div
    writeXY: function() {
        document.getElementById('trackX').innerHTML = 'X: ' + x;
        document.getElementById('trackY').innerHTML = 'Y: ' + y;
    },

    //Draw a rectangle
    drawRect: function() {
        //Draw some sample rectangles
        ctx.fillStyle = "rgb(200,0,0)";
        ctx.fillRect (10, 10, 55, 50);
    },

    getCanvas: function(){
        return canvas;
    },

    //Initialize the object, this must be called before anything else
    init: function() {
        canvas.width = mWidth;
        canvas.height = mHeight;
        document.querySelector('main').appendChild(canvas);
    }
};

})();

//Initialize draw
draw.init();

//Add a mousemove listener to the canvas
//When the mouse reports a change of position use the event data to
//set and report the x,y position on the mouse.
draw.getCanvas().addEventListener('mousemove', function(evt) {
    draw.setXY(evt);
    draw.writeXY();
}, false);

//draw a sample rectangle
draw.drawRect();
```

The previous code creates a draw object which will live on the global name space. The advantage is that the objects data and methods are encapsulated within the closure so they are protected from manipulation from any code that might share a common property name. For example, `x` might be a [variable](#) name in a third party library you have included in your project, the value of that library's `x` could interfere (or collide) with the value of your program's `x`. Encapsulating as `draw.x` reduces the chance of collision; treating this as a private property protects this even further. You could further protect the draw method by creating a namespace. Reversing your domain name is a common practice for namespacing. The real goal is to try and create something that is as unique as possible, a domain name you own should accomplish this, but it is not required. For the sake of this exercise we will forgo the use of a namespace.

```
var com.example.app = com.example.app || {};
com.example.app.draw = (function() {});
```

So far we have created a draw object which creates a canvas, draws a rectangle and reports any mouse movement that occurs on the canvas. It's time to let the user decide what to draw. We will start by removing the command to draw the red rectangle.

Remove the following from your JavaScript

```
//draw a sample rectangle
draw.drawRect();
```

In order to draw a rectangle we need to know the x,y coordinates of the top left corner as well as the desired height and width. The `mousemove` event tells us where we are on the canvas but we need to know where the user wants to draw the triangle and how big they want it. We can figure this out by using two more events `mousedown` and `mouseup`. This will give us the starting and ending points of a mouse drag. `mousedown` gives us the starting x,y coordinates or `x1,y1`. `mouseup` gives us the ending x,y coordinates or `x2,y2`. From this we can calculate the height and width as $width=x2-x1$ and $h=y2-y1$.

We will start by adding variables for `x1,y1,x2,y2`.

Change

```
//current x,y position
x=0,
y=0;
```

to

```
//current x,y
x=0,
y=0,

//starting x,y
x1=0,
y1=0,

//ending x,y
x2=0,
y2=0;
```

Update the `drawRect()` method as follows.

```
drawRect: function(x,y,h,w) {

    //Start by using random fill colors.
    ctx.fillStyle = '#' + Math.floor(Math.random()*16777215).toString(16);

    ctx.fillRect (x1,y1, (x2-x1), (y2-y1));

}
```

Now we need to add two methods to set the starting and ending coordinates. Add the following below the `writeXY()` function. In OOP this kind of method is typically referred to a setter. In that the purpose of this method is to set/change the value of a property, typically a private property.

```
setStart: function() {
    x1=x;
    y1=y;
},

setEnd: function() {
    x2=x;
    y2=y;
},
```

That covers the draw object's implementation details for drawing a rectangle, now all that is left is for us to allow our user to draw the rectangle. We will start by adding a `mousedown` listener to the canvas. When this event is triggered we simply call the `setStart()` method to record the starting position, this defines the top left corner of the triangle. Add the following to the end of your JavaScript.

```
//Set the starting position
draw.getCanvas().addEventListener('mousedown', function() {
    draw.setStart();
}, false);
```

To get the ending position we add a `mouseup` listener to the canvas and call the `setEnd()` method. At this point `x1,y1,x2` and `y2` are all set, this all we need to draw the rectangle, so we will also call the `drawRect()` function. Add the following to the end of your JavaScript.

```
draw.getCanvas().addEventListener('mouseup', function() {
    draw.setEnd();
    draw.drawRect();
}, false);
```

At this point your JavaScript should read as follows.

```
var draw = (function() {

    //Get the height and width of the main we will use this set canvas to the full
    //size of the main element.
    var mWidth = document.querySelector('main').offsetWidth,
        mHeight = document.querySelector('main').offsetHeight,

    //Create the canvas
    canvas = document.createElement("canvas"),

    //Create the context
    ctx = canvas.getContext("2d"),

    //Create the initial bounding rectangle
    rect = canvas.getBoundingClientRect(),

    //current x,y position
    x=0,
    y=0,

    //starting x,y
    x1=0,
    y1=0,
```



```
//ending x,y
x2=0,
y2=0;

return {
  //Set the x,y coords based on current event data
  setXY: function(evt) {
    x = (evt.clientX - rect.left) - canvas.offsetLeft;
    y = (evt.clientY - rect.top) - canvas.offsetTop;
  },

  //Write the x,y coords to the target div
  writeXY: function() {
    document.getElementById('trackX').innerHTML = 'X: ' + x;
    document.getElementById('trackY').innerHTML = 'Y: ' + y;
  },

  //Set the x1,y1
  setStart: function() {
    x1=x;
    y1=y;
  },

  //Set the x2,y2
  setEnd: function() {
    x2=x;
    y2=y;
  },

  //Draw a rectangle
  drawRect: function() {
    //Start by using random fill colors.
    ctx.fillStyle = '#' + Math.floor(Math.random()*16777215).toString(16);
    ctx.fillRect (x1,y1,(x2-x1),(y2-y1));
  },

  getCanvas: function(){
    return canvas;
  },

  //Initialize the object, this must be called before anything else
  init: function() {
    canvas.width = mWidth;
    canvas.height = mHeight;
    document.querySelector('main').appendChild(canvas);
  }
};

})();

//Initialize draw
draw.init();

//Add a mousemove listener to the canvas
//When the mouse reports a change of position use the event data to
//set and report the x,y position on the mouse.
draw.getCanvas().addEventListener('mousemove', function(evt) {
  draw.setXY(evt);
  draw.writeXY();
}, false);

//Add a mousedown listener to the canvas
//Set the starting position
draw.getCanvas().addEventListener('mousedown', function() {
  draw.setStart();
}, false);

//Add a mouseup listener to the canvas
```

```
//Set the end position and draw the rectangle
draw.getCanvas().addEventListener('mouseup', function() {
  draw.setEnd();
  draw.drawRect();
}, false);
```

At some point we want to draw shapes other than a rectangle. Let's start by creating a button that allows to choose a rectangle then we can add more buttons for more shapes. Let's by adding a rectangle button to the navigation list. We will give this button an id of *btnRect*.

```
<li><button id="btnRect">Rectangle</button></li>
```

We will need to two things to make this work (1) wire the button up to an `onclick` event listener and (2) wire that `onclick` event up draw object so that the object knows what to do. Let's start by adding a shape *variable* as a private property of the draw object.

Let's change

```
//ending x,y
x2=0,
y2=0;
```

to

```
//ending x,y
x2=0,
y2=0,

//What shape are we drawing?
shape='';
```

Now we will need a setter, add the following below the `setEnd()` method.

```
//Sets the shape to be drawn
setShape: function(shp) {
  shape = shp;
},
```

Now add a listener to the bottom of the JavaScript file. This is listen for a `click` on *btnRect*.

```
document.getElementById('btnRect').addEventListener('click',function(){
  draw.setShape('rectangle');
}, false);
```

Now that we have set the shape, we need it to cause an effect in the draw object. Add the following below the `setShape()` method.

```
draw: function() {
  if('shape'==='rectangle')
  {
    this.drawRect();
  } else {
    alert('Please choose a shape');
  }
},
```

and replace the call to `draw.drawRect()` in the `mouseup` listener with `draw.draw()` as follows.

```
draw.getCanvas().addEventListener('mouseup', function() {
  draw.setEnd();
  draw.draw();
}, false);
```

Since drawing on the canvas can change the underlying grid it is a good practice to reset the grid before the next item is drawn on the canvas. This is easily achieved using `ctx.restore()` and `ctx.save()`. The most efficient way to implement this is by adding it to the draw method, that way all future shapes will automatically perform these tasks. You can read more about save and restore [here](#).

```
//Draws the selected shape
draw: function() {
  ctx.restore();
  if(shape==='rectangle')
  {
    this.drawRect();
  } else {
    alert('Please choose a shape');
  }
  ctx.save();
},
```

Now we want to add more shapes, let's start with a [line](#). To begin drawing a line you need to begin a path, set x1,y1 and x2,y2, then call the stroke method to draw the line. Which looks like the following.

```
ctx.beginPath();
ctx.moveTo(x1, y1);
ctx.lineTo(x2, y2);
ctx.stroke();
```

We will start by creating a `drawLine()` method and adding it to our draw method add the following below the `draw()` method.

```
//Draw a line
drawLine: function() {
  //Start by using random fill colors.
  ctx.strokeStyle = '#' + Math.floor(Math.random()*16777215).toString(16);
  ctx.beginPath();
  ctx.moveTo(x1, y1);
  ctx.lineTo(x2, y2);
  ctx.stroke();
},
```

and change the draw method as follows.

```
//Draws the selected shape
draw: function() {
  ctx.restore();
  if(shape==='rectangle')
  {
    this.drawRect();
  } else if(shape==='line') {
    this.drawLine();
  } else {
    alert('Please choose a shape');
  }
  ctx.save();
},
```

Add a line button the the nav list.

```
<li><button id="btnLine">Line</button></li>
```

Then a listener for the click event.

```
document.getElementById('btnLine').addEventListener('click',function(){
    draw.setShape('line');
}, false);
```

Repeat the previous steps but in the context of drawing a circle. The `drawCircle()` will simply create an `alert()` stating it doesn't do anything. At this point your JavaScript should read as follows.

```
var draw = (function() {

    //Get the height and width of the main we will use this set canvas to the full
    //size of the main element.
    var mWidth = document.querySelector('main').offsetWidth,
        mHeight = document.querySelector('main').offsetHeight,

        //Create the canvas
        canvas = document.createElement("canvas"),

        //Create the context
        ctx = canvas.getContext("2d"),

        //Create the initial bounding rectangle
        rect = canvas.getBoundingClientRect(),

        //current x,y position
        x=0,
        y=0,

        //starting x,y
        x1=0,
        y1=0,

        //ending x,y
        x2=0,
        y2=0,

        //What shape are we drawing?
        shape='';

    return {
        //Set the x,y coords based on current event data
        setXY: function(evt) {
            x = (evt.clientX - rect.left) - canvas.offsetLeft;
            y = (evt.clientY - rect.top) - canvas.offsetTop;
        },

        //Write the x,y coords to the target div
        writeXY: function() {
            document.getElementById('trackX').innerHTML = 'X: ' + x;
            document.getElementById('trackY').innerHTML = 'Y: ' + y;
        },

        //Set the x1,y1
        setStart: function() {
            x1=x;
            y1=y;
        },

        //Set the x2,y2
        setEnd: function() {
            x2=x;
            y2=y;
        }
    };
})();
```

```
    },

    //Sets the shape to be drawn
    setShape: function(shp) {
        shape = shp;
    },

    //Draws the selected shape
    draw: function() {
        ctx.restore();
        if(shape==='rectangle')
        {
            this.drawRect();
        } else if( shape==='line' ) {
            this.drawLine();
        } else if( shape==='circle' ) {
            this.drawCircle();
        } else {
            alert('Please choose a shape');
        }
        ctx.save();
    },

    //Draw a circle
    drawCircle: function() {
        alert('I don\'t do anything yet.');
```

```
    },

    //Draw a line
    drawLine: function() {
        //Start by using random fill colors.
        ctx.strokeStyle = '#' + Math.floor(Math.random()*16777215).toString(16);
        ctx.beginPath();
        ctx.moveTo(x1, y1);
        ctx.lineTo(x2, y2);
        ctx.stroke();
    },

    //Draw a rectangle
    drawRect: function() {
        //Start by using random fill colors.
        ctx.fillStyle = '#' + Math.floor(Math.random()*16777215).toString(16);
        ctx.fillRect (x1,y1,(x2-x1),(y2-y1));
    },

    getCanvas: function(){
        return canvas;
    },

    //Initialize the object, this must be called before anything else
    init: function() {
        canvas.width = mWidth;
        canvas.height = mHeight;
        document.querySelector('main').appendChild(canvas);

    }
};

})();

//Initialize draw
draw.init();

//Add a mousemove listener to the canvas
//When the mouse reports a change of position use the event data to
//set and report the x,y position on the mouse.
draw.getCanvas().addEventListener('mousemove', function(evt) {
    draw.setXY(evt);
```

```

    draw.writeXY();
  }, false);

//Add a mousedown listener to the canvas
//Set the starting position
draw.getCanvas().addEventListener('mousedown', function() {
  draw.setStart();
}, false);

//Add a mouseup listener to the canvas
//Set the end position and draw the rectangle
draw.getCanvas().addEventListener('mouseup', function() {
  draw.setEnd();
  draw.draw();
}, false);

document.getElementById('btnRect').addEventListener('click', function(){
  draw.setShape('rectangle');
}, false);

document.getElementById('btnLine').addEventListener('click', function(){
  draw.setShape('line');
}, false);

document.getElementById('btnCircle').addEventListener('click', function(){
  draw.setShape('circle');
}, false);

```

and the HTML

```

<!DOCTYPE html>
<html lang="en">
  <head>
    <meta charset="UTF-8">
    <title>Draw</title>
    <meta name="viewport" content="width=device-width, initial-scale=1.0">
    <link rel="stylesheet" href="https://cdnjs.cloudflare.com/ajax/libs/normalize/7.0.0/normalize.min.css">
    <link rel="stylesheet" href="src/css/main.css">
  </head>
  <body>
    <div class="wrapper">
      <nav>
        <ul>
          <li><span id="trackX"></span></li>
          <li><span id="trackY"></span></li>
          <li><button id="btnRect">Rectangle</button></li>
          <li><button id="btnLine">Line</button></li>
          <li><button id="btnCircle">Circle</button></li>
        </ul>
      </nav>
      <main></main>
    </div>
    <script src="src/js/main.js"></script>
  </body>
</html>

```

We have everything we need to draw a **circle** which in this context is a 360 degree arc. Our starting x,y position (x1, y1) represents the center of the circle our stopping point (x2,y2) rests on the circumference of the circle. With these two points we can use Pythagoreans theorem $A^2 + B^2 = C^2$ to calculate the radius of the circle.

In code this might look like.

```

let a = (x1-x2)
let b = (y1-y2)
let radius = Math.sqrt( a*a + b*b );

```

I think the first three arguments in the `arc()` method are pretty clear $x,y,radius$. x,y defines the center of the circle and of course $radius$ is what we just calculated. That leaves us with $startAngle$ and $endAngle$. Since we are drawing a complete circle the angle will always start where it ends. This is represented as 0 and 2 times pi `2*Math.PI`.

Update your `drawCircle()` method to the following.

```
//Draw a circle
drawCircle: function() {

    ctx.strokeStyle = '#' + Math.floor(Math.random()*16777215).toString(16);
    ctx.fillStyle = '#' + Math.floor(Math.random()*16777215).toString(16);

    let a = (x1-x2)
    let b = (y1-y2)
    let radius = Math.sqrt( a*a + b*b );

    ctx.beginPath();
    ctx.arc(x1, y1, radius, 0, 2*Math.PI);
    ctx.stroke();
    ctx.fill();
},
```

Drawing Paths

We will define a path as a line the follows your cursor during a *mousedown* (drag) event. There is no context method for this so we will need to create one. How would we define this in code? We start by understanding what it is we want to do.

1. Select a shape called *path* this will tell the object that we want to draw a path.
2. On *mousedown* we will start drawing.
3. On *mouseup* we will stop drawing.
4. Between the *mouseup* and *mousedown* we will draw a line every time the mouse reports a move event.
 - i. This line will connect the previously reported coordinates to the current coordinates.
 - OR you could say we a drawing a one pixel by one pixel line everytime the mouse moves by one pixel in any direction.

We will start by adding a new button and listener for drawing the path.

The button

```
<li><button id="btnPath">Path</button></li>
```

and the listener.

```
document.getElementById('btnPath').addEventListener('click', function(){
    draw.setShape('path');
}, false);
```

As in the previous example we will add a `drawPath()` method and add `drawPath()` to the draw method.

`drawPath()`

```
drawPath: function() {
    alert('I don\'t do anything yet.');
```

`draw()`

```
//Draws the selected shape
draw: function() {
  ctx.restore();
  if(shape==='rectangle')
  {
    this.drawRect();
  } else if( shape==='line' ) {
    this.drawLine();
  } else if( shape==='circle' ) {
    this.drawCircle();
  } else {
    alert('Please choose a shape');
  }
  ctx.save();
},
```

At this point, for all previous draw* methods we would complete our implementation details by hooking a few context methods and we would be done with it. For this method to work we need to track the previous x,y state and draw on *mousemove* instead of *mouseup* which means we also need to capture a drawing state (we will call that *isDrawing*).

Lets start with by tracking the previous coordinates, we will call these lx,ly (short hand for *last x* and *last y*).

Add the following variables to as private properties.

```
//Tracks the last x,y state
lx = false,
ly = false,
```

Update your setXY() method so that it updates lx,ly.

```
//Set the x,y coords based on current event data
setXY: function(evt) {

  //Track the last x,y position before setting the current position.
  lx=x;
  ly=y;

  //Set the current x,y position
  x = (evt.clientX - rect.left) - canvas.offsetLeft;
  y = (evt.clientY - rect.top) - canvas.offsetTop;
},
```

Now we need to call the draw method from our *mousemove* listener but only if we have chosen to draw a path. This means we need to expose the private *path* property through a public api we will call this *getShape()*.

```
getShape: function() {
  return shape;
},
```

Now that the draw object has a way to report its shape we can use that call the *draw()* method from the *mousemove* listener.

```
draw.getCanvas().addEventListener('mousemove', function(evt) {
  draw.setXY(evt);
  draw.writeXY();
  if(draw.getShape()=='path') {
    draw.draw();
  }
}, false);
```


Now let's implement our *drawPath()* method. This is almost identical to the *drawLine()* method. Instead of drawing from x1,y1 to x2,y2 we will draw from lx,ly to x,y.

```
drawPath: function() {
  //Start by using random fill colors.
  ctx.strokeStyle = '#' + Math.floor(Math.random()*16777215).toString(16);
  ctx.beginPath();
  ctx.moveTo(lx, ly);
  ctx.lineTo(x, y);
  ctx.stroke();
},
```

Now choosing the path shape and mousing over the canvas will start drawing without a mouse click. We want a drag to define whether or not the mouse movement should draw we will do this by capturing a state called *isDrawing*.

Add the *isDrawing* variable as a private property.

```
isDrawing=false;
```

Now we will create a setter and getter to allow us access through a public interface.

```
setIsDrawing: function(bool) {
  isDrawing = bool;
},

getIsDrawing: function() {
  return isDrawing;
},
```

Now that we have an accessible *isDrawing* property that we can be toggled from true to false we can use this with our *mousedown* and *mouseup* events to control when and how the path is drawn.

```
draw.getCanvas().addEventListener('mousemove', function(evt) {
  draw.setXY(evt);
  draw.writeXY();
  if(draw.getShape()=='path' && draw.getIsDrawing()===true) {
    draw.draw();
  }
}, false);
```

At this point your JavaScript should appear as follows.

```
var draw = (function() {

  //Get the height and width of the main we will use this set canvas to the full
  //size of the main element.
  var mWidth = document.querySelector('main').offsetWidth,
      mHeight = document.querySelector('main').offsetHeight,

  //Create the canvas
  canvas = document.createElement("canvas"),

  //Create the context
  ctx = canvas.getContext("2d"),

  //Create the initial bounding rectangle
  rect = canvas.getBoundingClientRect(),

  //current x,y position
  x=0,
  y=0,
```

```
//starting x,y
x1=0,
y1=0,

//ending x,y
x2=0,
y2=0,

//Tracks the last x,y state
lx = false,
ly = false,

//What shape are we drawing?
shape='',

//Are we drawing a path?
isDrawing=false;

return {

//Set the x,y coords based on current event data
setXY: function(evt) {

    //Track last x,y position before setting the current posiiton.
    lx=x;
    ly=y;

    //Set the current x,y position
    x = (evt.clientX - rect.left) - canvas.offsetLeft;
    y = (evt.clientY - rect.top) - canvas.offsetTop;
},

//Write the x,y coods to the target div
writeXY: function() {
    document.getElementById('trackX').innerHTML = 'X: ' + x;
    document.getElementById('trackY').innerHTML = 'Y: ' + y;
},

//Set the x1,y1
setStart: function() {
    x1=x;
    y1=y;
},

//Set the x2,y2
setEnd: function() {
    x2=x;
    y2=y;
},

//Sets the shape to be drawn
setShape: function(shp) {
    shape = shp;
},

getShape: function() {
    return shape;
},

setIsDrawing: function(bool) {
    isDrawing = bool;
},

getIsDrawing: function() {
    return isDrawing;
},

//Draws the selected shape
```

```
draw: function() {
  ctx.restore();
  if(shape==='rectangle')
  {
    this.drawRect();
  } else if( shape==='line' ) {
    this.drawLine();
  } else if( shape==='path' ) {
    this.drawPath();
  } else if( shape==='circle' ) {
    this.drawCircle();
  } else {
    alert('Please choose a shape');
  }
  ctx.save();
},

//Draw a circle
drawCircle: function() {

  ctx.strokeStyle = '#' + Math.floor(Math.random()*16777215).toString(16);
  ctx.fillStyle = '#' + Math.floor(Math.random()*16777215).toString(16);

  let a = (x1-x2)
  let b = (y1-y2)
  let radius = Math.sqrt( a*a + b*b );

  ctx.beginPath();
  ctx.arc(x1, y1, radius, 0, 2*Math.PI);
  ctx.stroke();
  ctx.fill();
},

//Draw a line
drawLine: function() {
  //Start by using random fill colors.
  ctx.strokeStyle = '#' + Math.floor(Math.random()*16777215).toString(16);
  ctx.beginPath();
  ctx.moveTo(x1, y1);
  ctx.lineTo(x2, y2);
  ctx.stroke();
},

drawPath: function() {
  //console.log({x1:x,y1:y,x2:x2,y2:y2});
  //Start by using random fill colors.
  ctx.strokeStyle = '#' + Math.floor(Math.random()*16777215).toString(16);
  ctx.beginPath();
  ctx.moveTo(lx, ly);
  ctx.lineTo(x, y);
  ctx.stroke();
},

//Draw a rectangle
drawRect: function() {
  //Start by using random fill colors.
  ctx.fillStyle = '#' + Math.floor(Math.random()*16777215).toString(16);
  ctx.fillRect (x1,y1,(x2-x1),(y2-y1));
},

getCanvas: function(){
  return canvas;
},

//Initialize the object, this must be called before anything else
init: function() {
  canvas.width = mWidth;
  canvas.height = mHeight;
```

```

        document.querySelector('main').appendChild(canvas);

    }
};

})();

//Initialize draw
draw.init();

//Add a mousemove listener to the canvas
//When the mouse reports a change of position use the event data to
//set and report the x,y position on the mouse.
draw.getCanvas().addEventListener('mousemove', function(evt) {
    draw.setXY(evt);
    draw.writeXY();
    if(draw.getShape()=='path' && draw.getIsDrawing()===true) {
        draw.draw();
    }
}, false);

//Add a mousedown listener to the canvas
//Set the starting position
draw.getCanvas().addEventListener('mousedown', function() {
    draw.setStart();
    draw.setIsDrawing(true);
}, false);

//Add a mouseup listener to the canvas
//Set the end position and draw the rectangle
draw.getCanvas().addEventListener('mouseup', function() {
    draw.setEnd();
    draw.draw();
    draw.setIsDrawing(false);
}, false);

document.getElementById('btnRect').addEventListener('click', function(){
    draw.setShape('rectangle');
}, false);

document.getElementById('btnLine').addEventListener('click', function(){
    draw.setShape('line');
}, false);

document.getElementById('btnCircle').addEventListener('click', function(){
    draw.setShape('circle');
}, false);

document.getElementById('btnPath').addEventListener('click', function(){
    draw.setShape('path');
}, false);

```

your HTML should read as follows

```

<!DOCTYPE html>
<html lang="en">
  <head>
    <meta charset="UTF-8">
    <title>Draw</title>
    <meta name="viewport" content="width=device-width, initial-scale=1.0">
    <link rel="stylesheet" href="https://cdnjs.cloudflare.com/ajax/libs/normalize/7.0.0/normalize.min.css">
    <link rel="stylesheet" href="src/css/main.css">
  </head>
  <body>
    <div class="wrapper">
      <nav>
        <ul>

```

```
<li><span id="trackX"></span></li>
<li><span id="trackY"></span></li>
<li><button id="btnRect">Rectangle</button></li>
<li><button id="btnLine">Line</button></li>
<li><button id="btnCircle">Circle</button></li>
<li><button id="btnPath">Path</button></li>
</ul>
</nav>
<main></main>
</div>
<script src="src/js/main.js"></script>
</body>
</html>
```

and your CSS

```
html {
  font-family: sans-serif;
}

.wrapper {
  display: flex;
}

nav {
  flex: 0 0 300px;
  background: #ccc;
  min-height: 100vh;
}

main {
  flex: 1;
}

nav ul {
  list-style-type: none;
  padding: 0;
  margin: 0;
}

nav ul li {
  padding: 0;
  margin: 0;
}

nav ul li span,
nav ul li button {
  display: block;
  padding: 1em;
  text-align: center;
}

nav ul li button {
  width: 90%;
  margin: 0 auto;
}
```

LAB

Now that you can add basic shapes to the canvas lets work on the colors.

- Add color pickers that will allow the user to select the stroke and fill colors for various objects they are using.
 - Hint: HTML5 has a built in form element that spawns a color picker.

- Can you figure out how to draw a triangle?
- A value of 0 should load the the *trackX* and *trackY* divs when at page render.

Additional Resources

- [Canvas API](#)
- [Understanding save\(\) and restore\(\) for the Canvas Context](#)
- [Random Hex Color Code Generator in JavaScript](#)

Khan Academy

- [Radius, diameter, circumference & \$\pi\$](#)
- [Pythagorean Theorem](#)

Udemey

- [Introduction to HTML5 Canvas basics of drawing](#)
- [Search Canvas](#)

Toolkits

Utilizing a toolkit can reduce the time it takes to get your product to market. Toolkits often take care of the repetitive tasks that while necessary change very little from project to project. These often employ "best" or "common" practices. While we will discuss a few toolkits our focus will be on only one; [Bootstrap](#).

HTML Boilerplate

I would describe HTML5 Boilerplate as a collection of good practices, especially for those using Apache and it comes with a nice .htaccess file that explains each setting in great detail.

Material Design Light

Material Design is Google's take on UI.

Bootstrap

A responsive, mobile first front end library.

Templates Etc.

This section will introduce the student to the idea of a template engine and provide a few final details that should be considered when launching a basic website.

- A basic template engine
- SEO and meta data
- Miscellaneous items for rounding out a website.

PHP Basics

PHP (the P in LAMP stack) is a popular server side scripting language. Once you have a LAMP server up and running, getting started with PHP is pretty easy.

Since this is a dev environment we want to be able to debug errors. Let's tell Apache to show us errors when accessing PHP files.

```
sudo vim /etc/php/7.0/apache2/php.ini
```

Find the `display_errors` directive by typing `\display_errors =` in vim. This will be around line 426 enter insert mode and change `display_errors = Off` to `display_errors = On` then restart Apache.

Security Check Point

It is never advisable to show errors in a production environment. This provides information to hackers that can be used to compromise your system.

Hello World

Since you can mix PHP and HTML in the same file the parser will need a way to know if it is being asked to parse PHP or HTML. We tell the parser what to expect by using PHP tags `<?php` where `<?php` is in the opening tag and `?>` is the closing tag. Any text outside of the

Exercise 1 - Hello World

Create the path `/var/www/mtbc/php` and that as a project to Atom's side bar. Then from Atom create the file `hello.php`. Add the following lines.

```
<?php
/**
 * Greet the user with the current date and time.
 */

//Create a date object http://php.net/manual/en/book.datetime.php from PHP's built
$date = new DateTime();

#Format the date http://php.net/manual/en/datetime.formats.date.php
$formattedDate = $date->format('Y-m-d h:i:s');

echo "Hello World it is {$formattedDate}";
```

Open a browser and navigate to <https://localhost/php/hello.php>. You will see the string *Hello it is x* where x is the current date and time.

Now let's have another look at what we wrote, don't worry if you do not get this, we will go over it all again when we dive into the programming lessons.

The first line is `<?php`, this tells the server to begin interpreting PHP. PHP tags open with `<?php` and close with `?>` if there is no closing tag it is assumed all text after the opening PHP tag is to be interpreted as PHP.

Line 2 is a comment there are three types of comments in PHP.

- `# This is a comment`
- `// This is a comment`

- `/* this is a comment */`

Line 4 creates an object¹, in the case the object is an instance of the date class `$date = new DateTime();`

- `$date` - this is a [variable](#) that will hold an instance of the `DateTime()` class (`$date` holds the instantiated object)
- `new` - says I want to create a new copy (instantiation) of a class.
- `DateTime()` - the class to be instantiated. The parenthesis indicate an empty constructor².

Line 7 stores the result of an operation in a [variable](#) called `$formattedDate`.

A method is a property of an object in PHP we can access a property of an object using an arrow `->`. `format()` is a method (a type of property) of the `DateTime()` class. Here the operation is simply formatting the current Unix timestamp to a human readable format. `$date->format('Y-m-d h:i:s')` says I want to call the `format()` method of the `$date` object with the following parameters `'Y-m-d h:i:s'`.

- `$formattedDate` - A [variable](#) that holds a formatted date string.
- `=` - Sets the value of the left to that of the right.
- `$date` - The instantiated date object.
- `->` - Object operator, this is used to request properties from an instantiated object. In most languages use dot concatenation `..`.
- `format()` - A method of the `DateTime()` class, a property of the instantiated object.
- `'Y-m-d h:i:s'` - A parameter for the format method. In this case we are providing a string representation of what we want the formatted date to look like.

In the final line we are printing results to the screen.

- `echo` - Tells PHP to write something to a web page.
- `""` - Defines the string to be written, everything inside the quotes will be printed.
- `$formattedDate` - The formatted date string.
- `{}` - Not required, but makes it easier to separate variables from strings.

PHP Classes

Object Oriented Programming (OOP) has been supported by PHP (at least in some fashion) since version 4. OOP support has improved with each version. Generally speaking a class is blue print for an object. If we were to compare this to the physical world the source code contained in the class would be akin to an architects blue prints say for a house. Upon instantiation the class is used to build the object. In short, you could view a house as an instantiation of a set of blue prints. I give the blue prints to the builder (in this case a compiler) and the builder goes of and does its thing. The end result is that builders interpretation of the blue prints.

A class has properties comprised of instance variables, methods. A class may be dependent on other classes, this is known as a dependency and is often dealt with using dependency injection. A class may inherit from other classes this is known as either a parent class to a child class or super class to sub class.

The classic example of a class and class properties is to think of a person. A person class would have properties such as a head, arms, legs, etc. I prefer to think in terms of completing work as this is really what we want our classes to do. For example if I were to have a class for reading and writing to and from the database I might call it `DBWorker`. Now the question is what do I need `DBWorker` to do?

I'll need my `DBWorker` class to

- connect to the database
- know which table to access
- write new records to the database
- read records in from the database

- update records in the database
- delete records from the database

So far my properties would be as follows

- Instance *Variable* - *table*
- Method - *connect()*
- Method - *create()*
- Method - *read()*
- Method - *update()*
- Method - *delete()*

In PHP this might look like the following

```
class DBWorker
{
    private $table = null;

    public function __construct($connection, $table) {
        $this->connect($connection);
        $this->$table = $table;
    }

    private function connect($connection){//do something}

    public function create($data) {//do something}

    public function read($whereClause) {//do something}

    public function update($data, $whereClause) {//do something}

    public function delete($whereClause) {//do something}

}
```

Instantiation may look like this

```
// This would probably be in a config file somewhere.
$config = [];
$config['db'] = ['db':'sample_db', 'user':'sample_user', 'password':'123456', 'host':'localhost'];

// Instantiate DBWorker with a given db configuration.
$dbw = new DBWorker($config['db'], 'People');

// Read from the database with given parameters.
$results = $dbw->read(['email':'%@example.com']);

//Process the results
foreach($results as $result){
    //do something
}
```

Exercise 2 - Hello Class

Create the path `/var/www/mtbc/php/hello_class.php`.

```
<?php

/**
 * A mock up of session data
 */
class Session
```

```

{
    /**
     * Returns the current user session
     * @return array Session Data
     */
    public function read()
    {
        return ['id'=>'1234', 'name'=>'YOUR-NAME'];
    }
}

/**
 * Returns a greeting to a given user
 */
class Hello
{
    /**
     * An instance variable to hold the name of the user
     * @var string
     */
    private $who;

    /**
     * A constructor method - Constructor injection with type hinting. Constructor injection is a form of type hinting.
     * @param Object $session A user session
     */
    public function __construct(Session $session) {

        $sessionData = $session->read();

        $this->setWho($sessionData['name']);
    }

    /**
     * A setter method for Hello::who
     * @param String $who - The name of a given user
     */
    public function setWho($who)
    {
        $this->who = $who;
    }

    /**
     * Returns a greeting to a target user
     * @param {[type]} $message [description]
     * @return {[type]} [description]
     */
    public function greet($message)
    {
        return "{$message} {$this->who}";
    }
}

//Instantiate the Session class
$session = new Session();

//Instantiate the Hello class. Inject the $session object into the constructor.
$greeting = new Hello($session);

//Provide a message for the user (Ternary Logic)
$message = 'Good ' . (date("H")<12?'Morning':(date("H")<17?'Afternoon':'Evening'));

echo $greeting->greet($message);

```

Exercise 3 - example.com

Start by making a copy of your GitHub pages project

```
cd /var/www
mkdir -p example.com/public
cp /var/www/YOUR-GITHUB-USERNAME /var/www/example.com
```

Move src, dist and all html files into the public directory.

Additional Resources

- [Object Oriented PHP for Beginners](#)
- [PHP Shorthand If/Else Using Ternary Operators \(?\)](#)
- [Dependency Injection in PHP](#)

Footnotes

¹ PHP supports both procedural (functional) programming and object oriented programming (OOP). In OOP an instantiated class is an object. A class could be considered a blue print for an object. PHP has a built in class for working with dates called *DateTime*. PHP instantiates classes with the `new` operator. The line `$date = new DateTime();` stores an instance of the *DateTime* object in a [variable](#) called `$date`. PHP uses an arrow `->` as it's [Object Operator](#). To access the *format* method of the *DateTime* class you would say `$date->format();`. In this case we are storing the formatted date in the [variable](#) *formattedDate*. As in Bash, PHP uses *echo* to write content to the screen. In this case, a web page.

² An empty constructor, constructor with no argument. In programming arguments allow us to pass data into objects, methods and functions.

[Next: PHP Control Structures](#)

PHP Control Structures

Programming is little more than reading data and piecing together statements that take action on that data. Every language will have its own set of control structures. For most languages a given set of control structures will be almost identical. In the Bash lesson we learned a few control structures most of which exist in PHP. While the syntax may be a little different, the logic remains the same.

Exercise 3 - If, Else If, Else

Create the following path `/var/www/mtbc/php/if_else.php` and open it Atom. Then add the following lines.

```
<?php

//Initialize your variables
$label = null;
$color = null;

//Check for get parameters
if(!empty($_GET)){
    $color = "#{$_GET['color']}";
}

//Can we name the color by it's hex value
if($color == "#ff0000"){
    $label = "red";
}elseif($color == "#00ff00"){
    $label = "green";
}elseif($color == "#0000ff"){
    $label = "blue";
}else{
    $label = "unknown";
}

//Output the data
echo "<div style=\"color:{$color}\">The color is {$label}</div>";
```

Now open a browser and navigate to https://localhost/php/if_else.php and you will see the message *The color is unknown*. Now add the following string to the end of the URL `?color=ff0000`. Now your message will read *The color is red* and it will be written in red font. That string you added to the end of the URL is known as a [query string](#). A query string allows you to pass arguments into a URL. A query string consists of the query string Identifier (a question mark) `?` and a series of key to value pairs that are separated by an ampersand (`&`). In our example the key is `color` and the value is `ff0000`. If you wanted to submit a query of a first and last name that might look like `?first=bob&last=smith` where `first` and `last` are your keys (aka your GET params) `bob` and `smith` are your values.

Now let's take a close look at the code. Initializing your variables is a [good practice](#).

```
//Initialize your variables
$label = null;
$color = null;
```

In PHP `$_GET` is a [superglobal](#) so it is always available, this is NOT something you want to try to initialize. `empty()` is used to determine if a [variable](#) is [truthy or falsey](#) where falsey values equate to empty or falsey returns true. Prefixing `empty()` with an `!` reverses the return values. In plain English `if(!empty($_GET['color']))` would read *if `$_GET['color']` is not false then do something* or you could say *if `$_GET['color']` has any value then do something*. You will see a lot of curly braces in PHP code due to its use of [C style syntax](#).

If `$_GET['color']` has any value then set the *variable* `$color` to the value of `$_GET['color']`

```
//Check for get parameters
if(!empty($_GET['color'])){ //This is a control statement
    //This is the body of the statement
    $color = "#{$_GET['color']}";
}
```

The user has submitted a hex value in the form of a get parameter. Do we know what the call that hex value? If the answer is yes set the value of `$label` to that color. Otherwise set the value of `$label` to *Unknown*. Or you could say *if the hex value is red then say it is red; otherwise if it green then say it is green; otherwise if it blue then say it is blue; otherwise say unknown.*

```
//Can we name the color by it's hex value
if($color == "#ff0000"){
    $label = "red";
}elseif($color == "#00ff00"){
    $label = "green";
}elseif($color == "#0000ff"){
    $label = "blue";
}else{
    $label = "unknown";
}
```

Finally we will print some output back to the screen. This time we will wrap the output in some HTML and give it a little style by setting the font color to that of the user input.

```
echo "<div style=\"color:{$color}\">The color is {$label}</div>";
```

Exercise 4 - For Loop

Add the following to the path `/var/www/mtbc/php/for.php`.

```
<?php

$items = array(
    'for',
    'foreach',
    'while',
    'do-while'
);

echo 'PHP Supports ' . count($items) . ' of loops.';

$li = '';
for($i=0; $i<count($items); $i++){
    $li .= "<li>{$items[$i]}</li>";
}

echo "<ul>{$li}</ul>";
```

Exercise 5 - Foreach Loop

Add the following to the path `/var/www/mtbc/php/foreach.php`.

```
<?php

$items = array(
```



```
'for',
'foreach',
'while',
'do-while'
);

echo 'PHP Supports ' . count($items) . ' of loops.';

$li = '';
foreach($items as $item){
    $li .= "<li>{$item}</li>";
}

echo "<ul>{$li}</ul>";
```

Exercise 6 - While Loop

```
<?php

$items = [
    'for',
    'foreach',
    'while',
    'do-while'
];

$count = count($items);

echo "PHP Supports {$count} of loops.";

$i = 0;
$li=null;
while ($i < $count) {
    $li .= "<li>{$items[$i]}</li>";
    $i++;
}

echo "<ul>{$li}</ul>";
```

Exercise 7 - Do While Loop

Add the following to the path `/var/www/mtbc/php/do_while.php`.

```
<?php

$items = [
    'for',
    'foreach',
    'while',
    'do-while'
];

echo 'PHP Supports ' . count($items) . ' of loops.';

$i = 0;
$li=null;
do {
    $li .= "<li>{$items[$i++]}</li>";
} while ($i > 0);
```

Additional Reading

- [Which Loop](#)

HTML Forms with PHP Validation

Traditionally, forms have been the most common way to collect data from a user. A form submission is the simplest way to post data to a server. This section will start with a simple POST request and end with complex processing.

Form tags `<form></form>` are used for creating forms in HTML. Every form should have at least two attributes *action* and *method*.

- action - the web [address](#) to which the form data will be sent.
- method - the type of request the form should make (probably GET or POST).

Exercise 1 - Create and Inspect a Contact Form

Rename `public/contact.html` to `public/contact.php` and complete the following three steps.

1. Change the action to contact.php

```
<form action="contact.php" method="POST">
```

2. Remove the lines

```
<input type="hidden" name="_next" value="https://YOUR-GITHUB-USERNAME.github.io/thanks.html">
<input type="text" name="_gotcha" style="display:none">
```

3. Change `_subject` to `subject` and `_replyTo` to `email`

```
<input type="hidden" name="_subject" value="New submission!">
...
<input id="email" type="text" name="_replyto">
```

The end result will be as follows

```
<!DOCTYPE html>
<html lang="en">
  <head>
    <meta charset="UTF-8">
    <title>Contact Me - YOUR-NAME</title>
    <meta name="viewport" content="width=device-width, initial-scale=1.0">
    <link rel="stylesheet" href="../dist/css/main.css" type="text/css">
  </head>
  <body>
    <header>
      <span class="logo">My Website</span>
      <a id="toggleMenu">Menu</a>
      <nav>
        <ul>
          <li><a href="index.html">Home</a></li>
          <li><a href="resume.html">Resume</a></li>
          <li><a href="contact.html">Contact</a></li>
        </ul>
      </nav>
    </header>
    <main>

      <h1>Contact Me - YOUR-NAME</h1>
      <form action="contact.php" method="POST">
```

```
<input type="hidden" name="subject" value="New submission!">

<div>
  <label for="name">Name</label>
  <input id="name" type="text" name="name">
</div>

<div>
  <label for="email">Email</label>
  <input id="email" type="text" name="email">
</div>

<div>
  <label for="message">Message</label>
  <textarea id="message" name="message"></textarea>
</div>

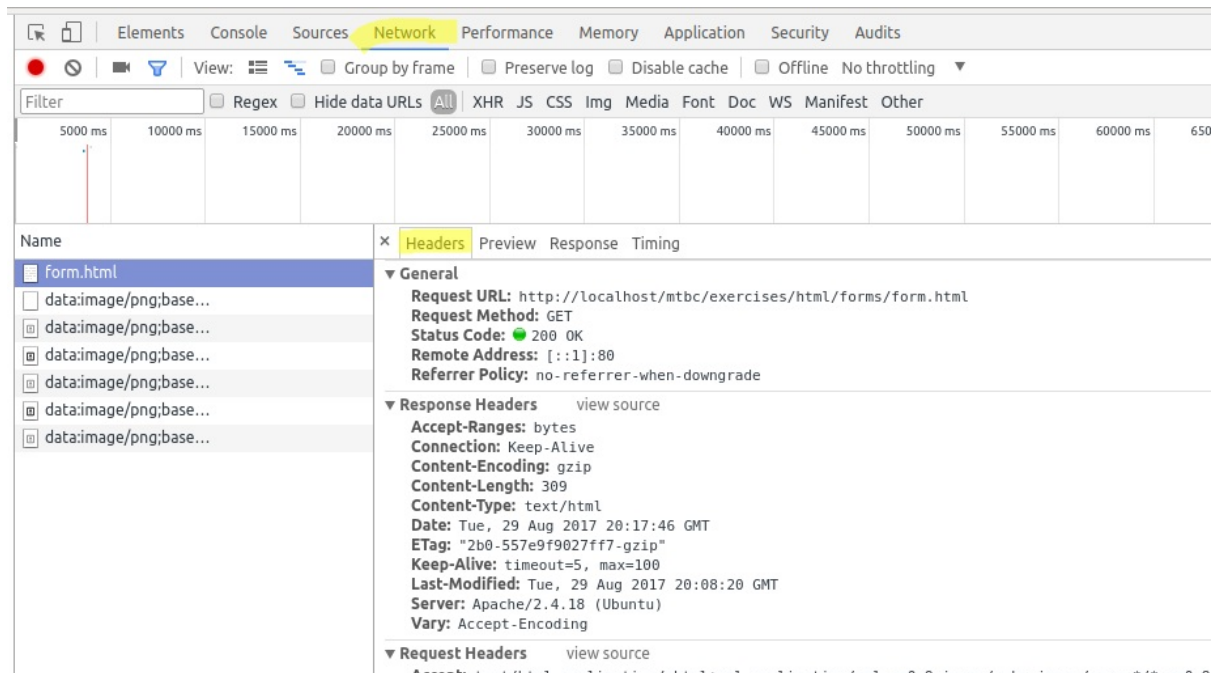
<div>
  <input type="submit" value="Send">
</div>

</form>

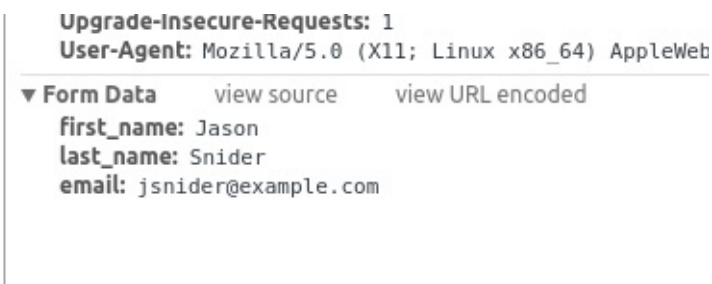
</main>
<script>
var toggleMenu = document.getElementById('toggleMenu');
var nav = document.querySelector('nav');
toggleMenu.addEventListener(
  'click',
  function(){
    if(nav.style.display=='block'){
      nav.style.display='none';
    }else{
      nav.style.display='block';
    }
  }
);
</script>
</body>
</html>
```

Now, lets inspect a post request.

- Open the Chrome browser and navigate to <http://loc.example.com>.
- Press the [f12] key to open Chrome's developer tools.
- Click on the network tab.
- Refresh the page.
- Find and click on contact.php
- The headers tab should now be highlighted.



- Fill out the web form and submit the data.
- Once again, find and click on form.html from the network panel.
- Under the headers tab you will see the contents of your web form as key to value pairs. This is how the data will be given to the server.s



Find the opening form tag and set the action attribute as follows. `action="contact.php"`

Add the following to the top of the document, above the DOCTYPE declaration.

```
<?php

$data = $_POST;

foreach($data as $key => $value){
    echo "{$key} = {$value}";
}
?>
```

Validation and Basic RegEx

Regular Expressions (RegEx) are strings of text that describe a search pattern. You may be familiar with wild cards in which a search for `b*` would return all words that start with the letter b. Now lets say you want your wild card search to still return all words starting with the letter b but only if the word does not contain a number; this is where RegEx comes in `\b(b)+([a-z])*\b`.

- `\b` - a word boundary, the beginning of a word. This would return all words.
- `\b(b)*` - MUST start with the letter b. This would return all words starting with the letter b.

- `\b(b)+([a-z])*` - MAY also contain any lower case letters after the first letter.
- `\b(b)+([a-z))*\b` - Stops each match at the end of a word

[Try It](#)

Exercise 2 - RegEx

`/var/www/example.com/public/contact.php`

```
<?php
//Create a RegEx pattern to determine the validity of the use submitted email
// - allow up to two strings with dot concatenation any letter, any case any number with _- before the @
// - require @
// - allow up to two strings with dot concatenation any letter, any case any number with - after the at
// - require at least 2 letters and only letters for the domain
$validEmail = "/^[_a-z0-9-]+(\\.[_a-z0-9-]+)*@[a-z0-9-]+(\\.[a-z0-9-]+)*(\\.[a-z]{2,})$/";

//Extract $_POST to a data array
$data = $_POST;

//Create an empty array to hold any error we detect
$errors = [];

foreach($data as $key => $value){
    echo "{$key} = {$value}<br><br>";

    //Use a switch statement to change your behavior based upon the form field
    switch($key){
        case 'email':
            if(preg_match($validEmail, $value)!=1){
                $errors[$key] = "Invalid email";
            }

            break;

        default:
            if(empty($value)){
                $errors[$key] = "Invalid {$key}";
            }
            break;
    }
}

var_dump($errors);
?>
```

RegEx is extremely powerful, flexible and worth learning. Having said that there are a million and one libraries for validating form submissions. I would advise finding a well supported library that meets your projects needs. As of PHP5 [data filters](#) have been natively supported by the language.

Security Check Point *Never trust user input. User input is anything come into the server from the client. Even if you have written client side JavaScript to filter out malicious code, the filtered input is still left alone with the client and can be manipulated prior to transit (or even in transit). If it has ever existed outside of the server it CANNOT be trusted.*

Exercise 3 - Adding a Validation Class

Replace the contents of `/var/www/example.com/public/contact.php` with the following.

Explain the code to the class.

1. The user completes and submits a web form
2. The system
 - i. Validates each field for errors
 - i. If error return a message to the user
 - i. Show a page level message
 - ii. Show each field level mesasge
 - iii. Do not clear the form data on error
 - ii. If no errors, send the user to a thank you page

2.1 - Loop through each form feild and test that field for errors.

2.2 - Set truthy/falsey value or a boolean on error. This will tell the system how to rpoceed after the form is processed.

2.2.1 - See 2.2

2.2.2 - Store each error in an array using the the name of the field as the array key. The value will be the error message to display to the user. The form will call a method in the validate array using the name of the field as the argument. This will retireve any error messages for that field.

2.2.3 - Store POST data in an instance varaible using key value pairs in which the key is the name of the form field and value is the user submitted data. Set the value attribute of each form field to a method in the Validate class and pass the name of the field as the methods argument. This will retrieve the original data as submitted by the user and pre-populate that form field.

```
<?php

class Validate{

    public $validation = [];

    public $errors = [];

    private $data = [];

    public function notEmpty($value){

        if(!empty($value)){
            return true;
        }

        return false;
    }

    public function email($value){

        if(filter_var($value, FILTER_VALIDATE_EMAIL)){
            return true;
        }

        return false;
    }

    public function check($data){

        $this->data = $data;

        foreach(array_keys($this->validation) as $fieldName){

            $this->rules($fieldName);
        }
    }
}
```

```

    public function rules($field){
        foreach($this->validation[$field] as $rule){
            if($this->{$rule['rule']}($this->data[$field]) === false){
                $this->errors[$field] = $rule;
            }
        }
    }

    public function error($field){
        if(!empty($this->errors[$field])){
            return $this->errors[$field]['message'];
        }

        return false;
    }

    public function userInput($key){
        return (!empty($this->data[$key])?$this->data[$key]:null);
    }
}

$valid = new Validate();

$input = filter_input_array(INPUT_POST);

if(!empty($input)){

    $valid->validation = [
        'email'=>[[
            'rule'=>'email',
            'message'=>'Please enter a valid email'
        ]],[
            'rule'=>'notEmpty',
            'message'=>'Please enter an email'
        ]],
        'name'=>[[
            'rule'=>'notEmpty',
            'message'=>'Please enter your first name'
        ]],
        'message'=>[[
            'rule'=>'notEmpty',
            'message'=>'Please add a message'
        ]],
    ];

    $valid->check($input);

    if(empty($valid->errors)){
        $message = "<div class=\"message-success\">Your form has been submitted!</div>";
        //header('Location: thanks.php');
    }else{
        $message = "<div class=\"message-error\">Your form has errors!</div>";
    }
}
?>

<!DOCTYPE html>
<html lang="en">
<head>
    <meta charset="UTF-8">
    <title>Contact Me - YOUR-NAME</title>
    <meta name="viewport" content="width=device-width, initial-scale=1.0">
    <link rel="stylesheet" href="./dist/css/main.css" type="text/css">
</head>
<body>

    <header>
        <span class="logo">My Website</span>
        <a id="toggleMenu">Menu</a>

```



```

<nav>
  <ul>
    <li><a href="index.html">Home</a></li>
    <li><a href="resume.html">Resume</a></li>
    <li><a href="contact.html">Contact</a></li>
  </ul>
</nav>
</header>

<main>
  <h1>Contact Me - YOUR-NAME</h1>

  <?php echo (!empty($message)?$message:null); ?>

  <form action="contact.php" method="POST">

    <input type="hidden" name="subject" value="New submission!">

    <div>
      <label for="name">Name</label>
      <input id="name" type="text" name="name" value="<?php echo $valid->userInput('name'); ?>">
      <div class="text-error"><?php echo $valid->error('name'); ?></div>
    </div>

    <div>
      <label for="email">Email</label>
      <input id="email" type="text" name="email" value="<?php echo $valid->userInput('email'); ?>">
      <div class="text-error"><?php echo $valid->error('email'); ?></div>
    </div>

    <div>
      <label for="message">Message</label>
      <textarea id="message" name="message"><?php echo $valid->userInput('message'); ?></textarea>
      <div class="text-error"><?php echo $valid->error('message'); ?></div>
    </div>

    <div>
      <input type="submit" value="Send">
    </div>

  </form>
</main>

<script>
  var toggleMenu = document.getElementById('toggleMenu');
  var nav = document.querySelector('nav');
  toggleMenu.addEventListener(
    'click',
    function(){
      if(nav.style.display=='block'){
        nav.style.display='none';
      }else{
        nav.style.display='block';
      }
    }
  );
</script>
</body>
</html>

```

Include Files and Namespaces

So far we have a lot of code in the what would typically be considered a *view* (the presentation layer) which should be separated from from data and logic as much as possible. In this lesson we will create include and class files that will help us keep our views clean.

[PHP Fig](#) is a working group aimed at developing interoperability standards for PHP libraries. This will help us build a standardized directory structure.

- [PSR 0](#)
- [PSR 4](#)

Include Files

An include file is a file that contains a snippet of code that is referenced by another file. In PHP include files can be accessed using [include](#), [include_once](#), [require](#) or [require_once](#) functions along with a relative or absolute file path.

```
// relative include
include 'util.php';

// absolute include
include '/var/www/example.com/util.php';
```

Namespace

At the end of the day a name space is simply a way to disambiguate name collisions. Earlier we created a class called `Validate()`. Validation classes are fairly common and let's say you liked specific methods from two different vendors both of who named the class `Validate`, suddenly you have a collision.

Lets say we have two vendors Sally and Bob and I like Sally's email method and Bob's phone method. I want to load this class from both vendors but without a name space the autoloader would not know which class to load into a given object. I might try to include then instantiate but there is no guarantee this will work as classes tend to get cached.

```
include 'vendor/Sally/src/Validation/Validate.php';
$v1 = new Validate();
$v1->Validate->email($email); //This will probably work

include 'vendor/Bob/src/Validate/Validate.php';
$v2 = new Validate();
$v2->Validate->phone($phone); //Sally's version of the class may or may not be cached so the method we want may
or may not be there.
```

With name spaces.

```
// You can probably use an autoloader so you will not have to worry about this.
include 'vendor/Sally/src/Validation/Validate.php';
include 'vendor/Bob/src/Validate/Validate.php';

// The namespace disambiguates class names so $v2's object will have the target class.
$v1 = new \Sally\Validation\Validate();
$v2 = new \Bob\Validate\Validate();

$v1->Validate->email($email);
$v2->Validate->phone($phone);
```

Exercise 4

Create the path `/var/www/example.com/core/About/src/Validation/Validate.php` and copy the `Validates` class into the file. Add a name space declaration as the first line of the file.

`/var/www/example.com/core/About/src/Validation/Validate.php`

```
<?php
```

```
namespace About\Validation;

class Validate{

    public $validation = [];

    public $errors = [];

    private $data = [];

    public function notEmpty($value){

        if(!empty($value)){
            return true;
        }

        return false;
    }

    public function email($value){

        if(filter_var($value, FILTER_VALIDATE_EMAIL)){
            return true;
        }

        return false;
    }

    public function check($data){

        $this->data = $data;

        foreach(array_keys($this->validation) as $fieldName){

            $this->rules($fieldName);
        }
    }

    public function rules($field){
        foreach($this->validation[$field] as $rule){
            if($this->{$rule['rule']}($this->data[$field]) === false){
                $this->errors[$field] = $rule;
            }
        }

        //Make sure the array is empty if no errors are detected.
        if(count($this->errors) == 0){
            $this->errors = [];
        }
    }

    /**
     * Detects and returns an error message for a given field
     * @param string $field
     * @return mixed
     */
    public function error($field){
        if(!empty($this->errors[$field])){
            return $this->errors[$field]['message'];
        }

        return false;
    }
}
```

```

    * Returns the user submitted value for a give key
    * @param string $key
    * @return string
    */
    public function userInput($key){
        return (!empty($this->data[$key])?$this->data[$key]:null);
    }
}

```

Since we have pulled the validation logic into a library all we need to do in the contact form is call the class and process it.

`/var/www/example.com/public/contact.php`

```

<?php
//Include non-vendor files
require '../core/About/src/Validation/Validate.php';

//Declare Namespaces
use About\Validation;

//Validate Declarations
$valid = new About\Validation\Validate();

$args = [
    'first_name' => FILTER_SANITIZE_STRING,
    'last_name' => FILTER_SANITIZE_STRING,
    'email' => FILTER_SANITIZE_EMAIL,
    'subject' => FILTER_SANITIZE_EMAIL,
    'message' => FILTER_SANITIZE_EMAIL,
];
$input = filter_input_array(INPUT_POST, $args);

if(!empty($input)){

    $valid->validation = [
        'first_name'=>[[
            'rule'=>'notEmpty',
            'message'=>'Please enter your first name'
        ]],
        'last_name'=>[[
            'rule'=>'notEmpty',
            'message'=>'Please enter your last name'
        ]],
        'email'=>[[
            'rule'=>'email',
            'message'=>'Please enter a valid email'
        ]],
        [
            'rule'=>'notEmpty',
            'message'=>'Please enter an email'
        ]],
        'subject'=>[[
            'rule'=>'notEmpty',
            'message'=>'Please enter a subject'
        ]],
        'message'=>[[
            'rule'=>'notEmpty',
            'message'=>'Please add a message'
        ]],
    ];

    $valid->check($input);
}

if(empty($valid->errors) && !empty($input)){
    $message = "<div>Success!</div>";
}else{
    $message = "<div>Error!</div>";
}

```

```
}  
  
?>  
  
<!DOCTYPE html>  
...
```

Additional Resources

- [PSR-0: Autoloading Standard](#)
- [PHP filter_input_array\(\)](#)
- [PHP filter_var\(\)](#)
- [Email RegEx Examples](#)
- [RegEx 101](#)
- [HTML Purifier](#)
- [Yahoo's HTML Purify](#)
- [Google Caja](#)
- [Sanitize HTML](#)

Udemy

- [Object Oriented Programming \(OOP\) in PHP - Build An OOP Site](#)

API

An Application Programming Interface (API) is a means of providing programming hooks into a larger system. For example `document.getElementById('e1').style` is a programming hook that allows a JavaScript programmer to work with the browser. Some APIs are open to the public and others are closed and accessible only by those who have been granted special access. Some APIs are accessible over Internet protocols.

JSON

Before we dive into the Mailgun API we should take a moment to talk about JavaScript Object Notation (JSON). This is the notation used by JavaScript for creating objects it is a string of key pairs (similar to an array) and in recent years has become the defacto standard for interacting with API. Since we are using PHP to interact with JSON we will use `json_decode()` and `json_encode()` to convert a JSON string into an array and vice versa.

Curly braces `{}` encapsulates a JSON string (creates an object in JS)

Colons : separate key to value pairs, fields are comma separated (aka CSV or comma separated values).

```
{
  '_id':1234,
  'firstname':'Sally',
  'lastname':'Smith'
}
```

A company with multiple addresses (in this case an array of addresses)

```
{
  '_id':1,
  'company':'MicroTrain Technologies',
  'addresses':[
    {
      'street':'200 W Adams Suite 410',
      'city':'Chicago',
      'state':'IL',
      'zip':60606
    },
    {
      'street':'720 E Butterfield Rd Suite 100',
      'city':'Lombard',
      'state':'IL',
      'zip':60148
    },
  ]
}
```

One JSON string with multiple company objects

```
{
  {
    '_id':1,
    'company':'42 North Group, Inc',
    'addresses':[
      {
        'street':'720 E Butterfield Rd Suite 100',
        'city':'Lombard',
        'state':'IL',
        'zip':60148
      }
    ]
  }
}
```

```
    },
  ],
},
{
  '_id':2,
  'company':'TheProfessional.Me',
  'addresses':[
    {
      'street':'200 W Adams Suite 410',
      'city':'Chicago',
      'state':'IL',
      'zip':60606
    },
    {
      'street':'720 E Butterfield Rd Suite 100',
      'city':'Lombard',
      'state':'IL',
      'zip':60148
    },
  ],
}
]
```

In any case PHP will convert this to an array and you would parse out the array to find your desired value. So the first example would appear as.

```
array(
  '_id' => 1234,
  'firstname' => 'Sally',
  'lastname' => 'Smith'
)
```

Let's this was returned via a fictitious `User->get(1234)` method (in which `User` is a class and `get()` is a member (property/method) of that class) you might access `firstname` as follows.

```
$users = new User();
$user = $users->get(1234);

//Writes Sally to the screen
echo $user['firstname'];
```

The Mailgun SDK abstracts most of the JSON interaction away from us, so we are left working mostly with PHP objects. JSON will come up again so this seems a good time introduce it.

Mailgun API

Exercise - Getting Started with Mailgun.

Go to mailgun.com and create a free account. You may choose not to add a credit card as we will be working with the sandbox. You will need to activate your account via email and SMS, this requires a phone number that receive texts. If you do not have one try creating a Google Voice account.

The landing page will provide you the details you need need to send a test email. Start by creating a shell script and pasting the curl example into the shell.

```
cd ~
vim mailgun.sh
```

```
#!/bin/bash
curl -s --user 'api:YOUR_API_KEY' \
  https://api.mailgun.net/v3/YOUR_DOMAIN_NAME/messages \
  -F from='Excited User <mailgun@YOUR_DOMAIN_NAME>' \
  -F to=YOU@YOUR_DOMAIN_NAME \
  -F subject='Hello' \
  -F text='Testing some Mailgun awesomness!'
```

- Make the file executable.
- Execute the script.

```
chmod +x mailgun.sh
./mailgun.sh
```

```
{
  "id": "<20171009154755.125901.xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx.mailgun.org>",
  "message": "Queued. Thank you."
}
```

The first thing you will want to do is [Mailgun's PHP](#) library to your project. You will do this via Composer.

Let's start by creating a feature branch. This will allow us to keep any changes separate from our production code until we are ready for it.

```
cd /var/www/about
git checkout -B feature/mailgun
```

```
composer require mailgun/mailgun-php php-http/curl-client guzzlehttp/psr7
```

```
Writing lock file
Generating autoload files
```

```
git status
```

```
composer.json
composer.lock
vendor/
```


We do not want to commit the vendor directory to our repo. So we will create a *.gitignore* file. From your Atom sidebar create a file called *.gitignore* under the about project (Do not forget the preceding dot) and add the following line.

```
/vendor
```

Now if you run `git status` you will see the following.

```
.gitignore
composer.json
composer.lock
```

Commit these files and push to the new feature branch.

```
git add .
git commit -m 'Added mailgun lib'
git push origin feature/mailgun
```

Create the file `/var/www/example.com/test.php` and copy and paste the PHP sample code from the Mailgun landing page. Below the pasted code add the line `var_dump($results);`.

```
<?php
# Include the Autoloader (see "Libraries" for install instructions)
require 'vendor/autoload.php';
use Mailgun\Mailgun;

# Instantiate the client.
$msgClient = new Mailgun('key-xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx');
$domain = "sandboxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx.mailgun.org";

# Make the call to the client.
$result = $msgClient->sendMessage("$domain",
    array('from' => 'Mailgun Sandbox <postmaster@sandboxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx.mailgun.org>',
        'to' => 'YOUR-NAME <YOUR-EMAIL-ADDRESS>',
        'subject' => 'Hello YOUR-NAME',
        'text' => 'Congratulations YOUR-NAME, you just sent an email with Mailgun! You are truly awesome! '));

var_dump($results);
```

From a browser window, navigate to <http://localhost/YOUR-PROJECT-NAME/test.php> and you should get a json string similar to:

```
php object(stdClass)#24 (2) { ["http_response_body"]=> object(stdClass)#19 (2) { ["id"]=> string(91) "<20171009164718.79178.xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx.mailgun.org>" ["message"]=> string(18) "Queued. Thank you." } ["http_response_code"]=> int(200) }
```

Then check your email to see if it worked.

****Security Check Point****

Never push a key to a public repository, use a key file that exists outside of the public repo

Exercise - Pass Variables into the API Call

Create a key file

```
`sh
```

```
mkdir -p /var/www/example.com/config
```

```
vim /var/www/example.com/config/keys.php
```

Add the following line to your .gitignore file and commit your changes to the *feature/mailgun* branch.

```
/config/keys.php
```

Add the following (Where YOUR-KEY-HERE is the key provided by Mailgun):

```
<?php
define('MG_KEY', 'dYOUR-KEY-HERE');
define('MG_DOMAIN', 'YOUR-DOMAIN-HERE');
```

Add the following to the top of <http://localhost/YOUR-PROJECT-NAME/test.php>

```
require '../config/keys.php';
```

Change

```
$mgClient = new Mailgun('key-xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx');
$domain = 'sandboxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx.mailgun.org';

$from = 'Mailgun Sandbox <postmaster@xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx.mailgun.org>;
```

to

```
$mgClient = new Mailgun(MG_KEY);
$domain = MG_DOMAIN;

$from = "Mailgun Sandbox <postmaster@{$domain}>;
```

Instead of passing static values into the method pass variables.

- Replace the existing method call with the following.
- Remove the `var_dump($results);`

```
$from = "Mailgun Sandbox <postmaster@{$domain}>";
$to = 'YOUR-NAME <YOUR-EMAIL-ADDRESS>';
$subject = 'Hello YOUR-NAME';
$text = 'Congratulations YOUR-NAME, you just sent an email with Mailgun! You are truly awesome!';

$result = $mgClient->sendMessage(
    $domain,
    array('from' => $from,
          'to' => $to,
          'subject' => $subject,
          'text' => $text
        )
);
```

Update your README file.

Navigation to *README.md* from your ATOM sidebar.

```
# example.com

An about me web site.

## Dependencies
```

```
* PHP 7.0 or higher
* Composer
* An API key for Mailgun

## Installation

Clone this project into a web directory
```sh
cd /var/www
git clone git@github.com:jasonsnider/example.com.git
```

Install composer dependencies

```
cd /var/www/example.com
composer install
```

...

## Additions Resources

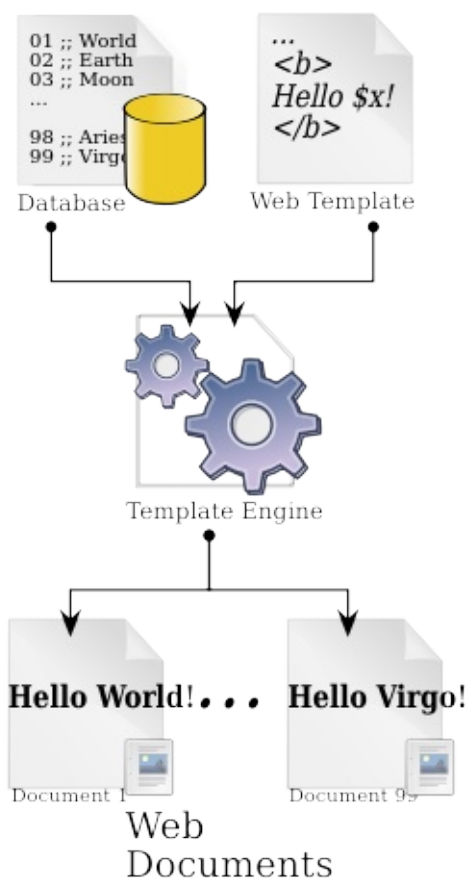
- [JSON](#)
- [MDN](#)

### Udemy

- [JSON and APIs](#)

## Templates

Now that we have all of our styles into a single style sheet, it is time use a single template for managing our layout. This will allow us to store out sites main layout in a single file while the page itself will only hold the content specific to that page. This is a huge win once your site exceeds more that a few pages. HTML does not offer such a system so we will either need to choose a template engine such as [Pug](#) or build a template using a programming language. We will learn about Pug once we get into the section about the MEAN stack. For now we will use PHP.



About: TempEngWeb016.svg

The general flow is as follows.

1. The user asks the server for an endpoint perhaps <https://localhost/example.com/public/contact.php>.
2. The server processes data and business logic as required by that endpoint.
  - i. This may include calls from a database, a flat file, an API, etc.
3. The server generates the content to be presented to the user for that end point.
  - i. This may be from a database, a flat file, an API, etc.
4. The server calls the template for that endpoint.
5. The server passes the content into the template.
6. The endpoint presents the data to the user. This may be in the form of an HTML document, a PDF, XML/JSON file or whatever else may be required.

## Heredoc

A heredoc allows large amount of text to be written as a string without the need of escaping. Heredoc will process any PHP code it encounters, which makes it a subtitle candidate for our simple use case. I should note this a very simple example of a template system and is intended simply as an introduction to the concept. We will discuss more complex examples in later lessons.

In previous lessons we used `echo` to write the value of some variables into an HTML document. This is a good way to view a template system. This is something that allows you to have a single or a select few templates that treat the contents in which the content of a page is being passed as a [variable](#) onto the template.

The basic idea is as follows. We are simply passing the [variable](#) `$content` into an HTML document using PHP's echo statement.

```
<?php $content="<h1>Hello World</h1><p>Welcome to my web page.</p>"; ?>

<html>
 <head></head>
 <body><?php echo $content; ?></body>
</html>
```

The previous example works for simple strings, but what about a page that has tens if not hundreds of lines of HTML? Writing all of that as a PHP string is tedious and prone to error, this is where the heredoc syntax can help.

```
<?php
$who = 'World';
$content = <<<EOT
<h1>Hello {$who}</h1>
<p>Welcome to my web site.</p>
EOT;
?>
<html>
 <head></head>
 <body><?php echo $content; ?></body>
</html>
```

A heredoc string start by declaring a [variable](#) and setting a delimiter. PHP uses `<<<` to declare a delimiter. In our case `<<<EOT` (End of Text) is our delimiter. When a delimiter is encountered followed by a semicolon with no spaces around it the string is terminated.

The previous example passes the content into an HTML string but it still requires the entire document to be embedded in every page. Let's push the HTML document into an include file.

*contact.php*

```
<?php
$who = 'World';
$content = <<<EOT
<h1>Hello {$who}</h1>
<p>Welcome to my web site.</p>
EOT;

require 'layout.php';
```

*layout.php*

```
<html>
 <head></head>
 <body><?php echo $content; ?></body>
</html>
```

Now we only have to include the layout on each page of our site. The advantage is we will only need to change a single file to cascade [Look and Feel](#) changes across the entire website.

## Exercise 1

Create the path `/var/www/example.com/core/layout.php` and add the following lines.

```
<!DOCTYPE html>
<html lang="en">
 <head>
 <meta charset="UTF-8">
 <title>About Jason Snider</title>
 <meta name="viewport" content="width=device-width, initial-scale=1.0">
 <link rel="stylesheet" type="text/css" href="css/dist/main.css">
 </head>
 <body>

 <div id="wrapper">
 <nav class="top-nav">
 Site Logo
 <ul role="navigation">
 Home
 Resume
 Contact

 </nav>

 <div class="row">
 <div id="Content">
 <?php echo $content; ?>
 </div>
 <div id="Sidebar">
 <div id="AboutMe">
 <div class="header">Hello, I am YOUR-NAME</div>

 </div>
 </div>
 </div>

 <div id="Footer" class="clearfix">
 <small>© 2017 - MyAwesomeSite.com</small>
 <ul role="navigation">
 Terms
 Privacy

 </div>
 </div>

 </body>

</html>
```

Change the path `/var/www/example.com/public/contact.php` to the following. Pay special attention to the echo statements, these are now treated as variables being passed into a string such that `<?php echo $valid->userInput('first_name'); ?>` becomes `{ $valid->userInput('first_name') }`.

```
<?php

require 'core/processContactForm.php';

$content = <<<EOT
<form method="post" action="contact.php">
 { $message }
 <div>
 <label for="firstName">First Name</label>

 <input type="text" name="first_name" id="firstName" value="{ $valid->userInput('first_name') }">
 <div class="text-error">{ $valid->error('first_name') }</div>
```

```
</div>

<div>
 <label for="lastName" id="lastName">Last Name</label>

 <input type="text" name="last_name" value="{ $valid->userInput('last_name') }">
 <div class="text-error">{ $valid->error('last_name') }</div>
</div>

<div>
 <label for="email" id="email">Email</label>

 <input type="text" name="email" value="{ $valid->userInput('email') }">
 <div class="text-error">{ $valid->error('email') }</div>
</div>

<div>
 <label for="subject" id="subject">Subject</label>

 <input type="text" name="subject" value="{ $valid->userInput('subject') }">
 <div class="text-error">{ $valid->error('subject') }</div>
</div>

<div>
 <label for="message" id="message">Message</label>

 <textarea name="message">{ $valid->userInput('message') }</textarea>
 <div class="text-error">{ $valid->error('message') }</div>
</div>

<input type="submit">

</form>
EOT;

require 'core/layout.php';
```

Navigate to <https://loc.example.com/public/contact.php> and submit the form. The functionality should not have changed in anyway but the code is now cleaner and easier to maintain this is know as a [refactoring](#).

## Additional Resources

- [Web template system](#)
- [Output Buffering Control](#)

## Udemy

- [The Complete MySQL Developer Course](#)

Since meta tags belong in the document we will want to add them to the template. We will need to be able to set these on a page by page basis so these should be passed as a [variable](#) from the page in question.

```
$meta = [];
$meta['description'] = "The best thing about hello world is the greeting";
$meta['keywords'] = "hello world, hello, world";

<meta name="description" content="<?php echo $meta['description']; ?>">
<meta name="keywords" content="<?php echo $meta['keywords']; ?>">
```

For example *contact.php* might read as follows. Rather than an array, perhaps a heredoc containing any meta tags you want to include would be preferred.

```
<?php

require 'core/processContactForm.php';

//Build the page metadata
$meta = [];
$meta['description'] = "The best thing about hello world is the greeting";
$meta['keywords'] = "hello world, hello, world";

//Build the page content
$content = <<<EOT
<form method="post" action="contact.php">
 {$message} ...
EOT;

require 'core/layout.php';
```





# SQL

Structure Query Language (SQL) is language designed specifically for working with databases. SQL is an open standard maintained by the American National Standards Institute (ANSI). Despite being an actively maintained open standard you'll most likely alot of time working with vendor specific variants. These differences are typically subtle and quick Google search will typically get you around them. For instance if you're used to working with Oracle's `TO_DATE()` and now you're working with MySQL; `TO_DATE()` will not work. Google something like *TO\_DATE in mysql* and one of the first results will liekly point to MySQL's `STR_TO_DATE()` method. Point being, learning any vendor variant of SQL will be enough to allow you to work with just about any vendor variant. The same Google tricks can even be used for NoSQL databases which we will learn about later. Knowledge of SQL is desired in many industries outside of tech as it is considered to be the *English* of the data world. Understanding SQL helps you understand other data paradigms such as *noSQL*.

## Database

Not to be confused with a Database Management System (DBMS) is a container. This may be a file or a set files, it really doesn't matter as you will likely never see the data. You will be working exclusively with the DBMS. The DBMS is the software that works with the database. For example products such as Oracle, MySQL, SQL Server and even MongoDB are all database management systems. The first three are also known as a Relation Database management System (RDBMS) while the latter is a NoSQL DBMS.

## Schema

Schema is defined as *a representation of a plan or theory in the form of an outline or model*. Unfortunately, the terms database and schema are often used interchangeably. For our purposes *schema* will be used to describe a database. This may be a visualization or the actual SQL file that contains the build commands for the database.

## Tables

A table is a structured list of data typically designed to represent a collection like items. These collections may be users, customers, products, etc. Naming your tables, especially in larger project can prove difficult; defining a [style guide](#) and sticking to it can save you some headaches in the long run. Once common rule is for all tables to end in a plural form of the entity it represents.

## Columns

A column is often refereed to as a field. A column has several attributes a name, data type, default value and indices are typically what you'll be concerned with. The data type itself may have additional parameters such a length.

Column names should be short and two the point. While style guides vary typical rules state a column name should differ from that of the table and must not over lap with any [reserved words](#).

[Data types](#) cast restraints on a column. For example a column of type integer (INT) would not allow any non-numeric characters. A `VARCAHR(10)` would allow any combination of characters but will truncate the string after 10 characters.

Default values define what is to be entered if no value is present. This may be null or not null (which will force a value) or any other value compatible with the data type.

[Indices](#) are used to improve performance. These take specific columns from a table or tables and stores them in a way that allows them to be looked up quickly with out needing to reanalyze all of the content of all tables involved in the query. I have seen good indexing literally cut minutes of page load times. While not required all tables should have a primary key.

A primary key is unique index for a row of data. The most common primary key is a simple id. This can be an [auto-incrementing](#) number, a universally unique identifier ([UUID](#)) or any other bit of unique data such an email [address](#).

#### Security Checkpoint

I have seen a number of systems that ask for sensitive data such as social security or employer identification numbers simply because that is the only way they could think of not to risk duplicate data. Think twice before doing this, if your business does not absolutely require this sort of information do not even think about storing it. If it is required, please consult a security professional.

## Additional Resources

- [NoSQL Not Only SQL](#)
- [Naming Conventions: Stack Overflow Discussion](#)
- [Integer Types](#)

## Udemy

- [SQL for Beginners](#)

Next: [MySQL](#)

# MySQL

MySQL is a free and open source [relational database management system](#) (RDBMS) currently under the control of Oracle. An RDBMS will store data in a container called a table. This data is organized by rows and columns similar to a spreadsheet (aka tabular data). Relationships are joined by creating foreign key relationships between rows of data across multiple tables. MySQL uses Structured Query Language (SQL) to retrieve data from tables.

Much like SQL Server, Oracle or PostgreSQL, MySQL is client-server software. This means the database and database management software is running on a server. Even if you're running a local instance of MySQL, you're running a server. The client is the software you interact with. When you interact with the software, the software makes a request to the server on your behalf. Some common clients are the [MySQL CLI](#), [phpMyAdmin](#) and [MySQL Workbench](#). Even programming languages act as clients; for example PHP uses the [PDO library](#) to interact with a DBMS. [ORMs](#) are another type of client package; an example of this would be [Doctrine](#) for PHP.

## Core Concepts of an RDBMS

### Table Structure

A database is made up of tables which are defined by columns, rows, data types and values. Conceptually you can think of a table in the same way you think of a spreadsheet.

My customers table might look like the following.

COLUMNS				
id	firstname	lastname	dob	
1	sally	smith	1977-01-22	R
2	frank	brown	1951-04-01	W
3	bob	gray	2004-08-17	S

### Keys and Indices

#### Index

An index provides a faster means of lookup for an SQL query. A good rule of thumb is to create an index for every column that appears in a WHERE clause. You should not create an index for a column that is not used for looking up data.

#### Primary Key (Unique Index)

A primary key in MySQL is both an index and a unique identifier for a given column. Typically an auto-incrementing integer or a [UUID](#). In the above example the id column would be my primary key.

#### Foreign Key (Index)

This is a column that links one table to another. For example if I have an [address](#) table that I want to link to my customers table I would add a column called `customer_id` and the value of this column would match an id in the customers table. In this case `customer_id` is said to be a `foreign_key`.

## Unique Keys (Unique Index)

This is an indexed column that requires a unique value for every row in the table.

## Composite Keys (Unique Index)

This is an indexed key pair that can uniquely identify a row in the table.

## FullText Index (Unique Index)

This is a special type of index that allows various configurations string searches against rows containing large amounts of text.

## Relationships

### One-to-one

Table A may (or must) have one and only one corresponding rows in table B.

### One-to-many

Table A may (or must) have one or more corresponding rows in table B.

### Many-to-many

Table A may (or must) have one or more corresponding rows in table B and table B may (or must) have one or more corresponding rows in table A. A many-to-many relationship must be resolved by an associative entity. An associative entity is table that links two or more tables together using foreign keys.

## Additional Resources

- [PDO Library](#)
- [MySQL for NodeJS](#)
- [MySQL Client Programs](#)
- [ORM Is an Offensive Anti-Pattern](#)
- [To ORM or Not to ORM](#)
- [ORM Hate](#)

## Udemy

- [The Complete MySQL Developer Course](#)

[Next: Working with MySQL](#)

# Working with MySQL

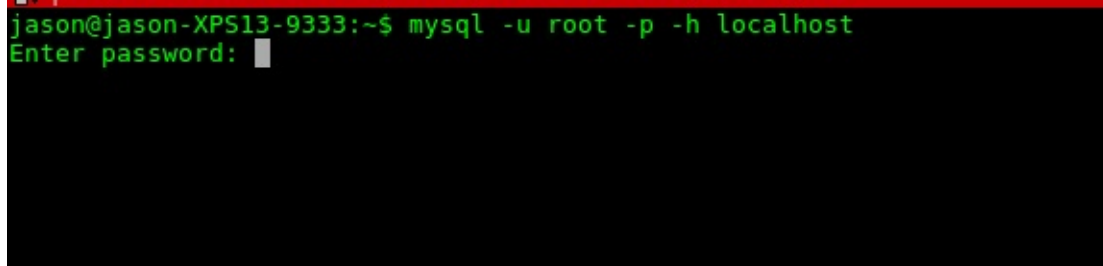
## Making a Connection

Before you can work with MySQL you need to make a connection; we will start with the CLI. If you followed the setup instructions in section 01-04 you should have a local instance of the DBMS running with the credentials of root:password and this will be running on localhost

```
mysql -u root -p -h localhost
```

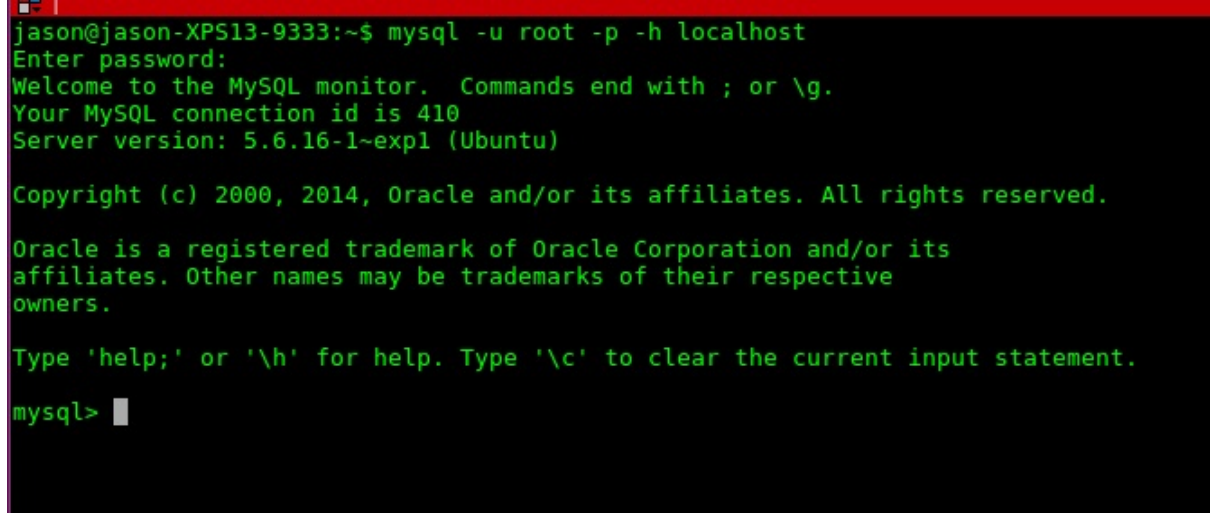
- `mysql` - invokes the MySQL CLI
- `-u root` - `-u` is the user argument `-u root` says login to MySQL as the user root
- `-p` - `-p` is the password argument. You do not want to enter the password here, so this tells the client to prompt you for a password.
- `-h` - `-h` host; locally this will be localhost a remote connection would likely be an IP [address](#) or a URL.

As you may have guessed; by entering the aforementioned command you will be prompted a password.



```
jason@jason-XPS13-9333:~$ mysql -u root -p -h localhost
Enter password: █
```

Upon connection you will be presented with a MySQL prompt.



```
jason@jason-XPS13-9333:~$ mysql -u root -p -h localhost
Enter password:
Welcome to the MySQL monitor. Commands end with ; or \g.
Your MySQL connection id is 410
Server version: 5.6.16-1~exp1 (Ubuntu)

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affiliates. Other names may be trademarks of their respective
owners.

Type 'help;' or '\h' for help. Type '\c' to clear the current input statement.

mysql> █
```

At the prompt the following command to get a list of databases.

```
show databases;
```

You will see something similar to the following. By default MySQL installs a few system databases that it uses for its own purposes. It is unlikely you ever need to access these yourselves. Just be sure not to delete them.

```
+-----+
```

```

| Database |
+-----+
| information_schema |
| mysql |
| performance_schema |
+-----+
3 rows in set (0.03 sec)

```

Now let's create a databases.

```
CREATE DATABASE bootcamp;
```

You should get something similar to the following response. What you are really looking for is an affected row count.

```
Query OK, 1 row affected (0.00 sec)
```

Now verify the database has been created. Run the following command and you will see *bootcamp* in the list of databases.

```
SHOW DATABASES;
```

Now lets use our new database.

```
USE bootcamp;
SHOW TABLES;
```

*show tables;* shows a list of tables from the current database. After running this command the DBMS should respond with *Empty set (0.00 sec)*.

Let's say we were going to build our own blogging software in the form of a web application. We will start by gathering some requirements.

- As a blogger I need to be able to create blog posts.
- As a web site owner I need to assure that only authorized people can post to the blog.

From a data perspective the first item can be achieved with a table named *users* the second with a table named *posts*.

Tables are created using the *CREATE TABLE* command. *CREATE TABLE \_tablename\_()* where *tablename* is the name of the table to be created. The columns in your table are passed into the parentheses as comma separated values.

Add the following table to your bootcamp database.

```

CREATE TABLE users (
 id VARCHAR(36) PRIMARY KEY COMMENT 'Primary Key UUID',
 first_name VARCHAR(40) DEFAULT NULL COMMENT 'The users first name',
 last_name VARCHAR(40) DEFAULT NULL COMMENT 'The users last name',
 email VARCHAR(200) DEFAULT NULL COMMENT 'A unique identifier for a user',
 created DATETIME DEFAULT CURRENT_TIMESTAMP COMMENT 'When the post was created',
 modified DATETIME DEFAULT CURRENT_TIMESTAMP ON UPDATE CURRENT_TIMESTAMP COMMENT 'When the post was last edited'
) ENGINE=INNODB;

```

We already talked about *CREATE TABLE* now lets look at the columns definitions. *id VARCHAR(36) PRIMARY KEY COMMENT 'Primary Key UUID'*

- *id* - This is the name of the column. Most tables will have an *id* column.
- *VARCHAR(36)* - This allows any character on the keyboard but caps the length at 36 characters. This is usually indicative of a UUID or GUID.

- PRIMARY KEY - Every table SHOULD have a primary id. This serves as a unique index for that table.
- COMMENT 'Primary Key UUID' - A short description about the purpose of this column. In practice I wouldn't comment obvious fields.

Lets jump to the modified column *modified DATETIME DEFAULT CURRENT\_TIMESTAMP ON UPDATE CURRENT\_TIMESTAMP*

- modified - The name of the column.
- DATETIME - Sets the datatype to a mysql time stamp *YYYY-MM-DD HH:MM:SS*
- DEFAULT CURRENT\_TIMESTAMP - When a new row is created the modified column will default to the time of creation.
- ON UPDATE CURRENT\_TIMESTAMP - When a new row is created the modified column will change to the time of update.

Now let's create the table for holding our blog posts.

```
CREATE TABLE posts (
 id VARCHAR(36) PRIMARY KEY COMMENT 'Primary Key UUID',
 title VARCHAR(255) COMMENT 'The title of the blog post',
 slug VARCHAR(255) COMMENT 'A human and SEO friendly lookup key',
 keywords VARCHAR(255) COMMENT 'Meta data for SEO',
 description VARCHAR(255) COMMENT 'Meta data for SEO',
 body TEXT COMMENT 'The content of the blog post',
 user_id VARCHAR(36) COMMENT 'The creator of the blog post',
 created DATETIME DEFAULT CURRENT_TIMESTAMP COMMENT 'When the post was created',
 modified DATETIME DEFAULT CURRENT_TIMESTAMP ON UPDATE CURRENT_TIMESTAMP COMMENT 'When the post was last edited',
) ENGINE=INNODB;
```

Now let's take a look at our data structure.

```
USE bootcamp;
SHOW TABLES;

SHOW COLUMNS FROM users;
DESCRIBE posts;
```

Now that we have created a couple of tables. Let's add some data. Run the following command from your bootcamp database replacing xxxx with you information.

```
INSERT INTO users SET id=UUID(), first_name='xxxx', last_name='xxxx', email='xxxx';
```

Now let's look up your user record.

```
SELECT * FROM users WHERE email='xxxx';
```

What if only want a list of names?

*NOTE: As queries get longer this style may be easier to read.*

```
SELECT
 first_name,
 last_name
FROM
 users
WHERE
 email='xxxx';
```

Id rather see the user's name in a single column formatted as *last, first*



```
SELECT
 CONCAT('last_name', ' ', first_name) AS user
FROM
 users
WHERE
 email='xxxx';
```

Add another user.

```
INSERT INTO
 users
SET
 id=UUID(),
 first_name='Bob',
 last_name='Smith',
 email='bsmith@exampl.com'
```

Let's find all users with a .com and sort in ascending order by last name.

```
SELECT
 CONCAT('last_name', ' ', first_name) AS user
FROM
 users
WHERE
 email LIKE '%.com'
ORDER BY last_name ASC
```

```
INSERT INTO
 posts
SET
 id=UUID(),
 slug='hello',
 title='Hello',
 user_id = '1a804677-7953-11e7-8397-180373ae98cc';

SELECT
 posts.title,
 CONCAT(first_name, ' ', last_name) AS author
FROM
 posts,
 users
WHERE
 posts.created_user_id = users.id ;
```

For full authentication you will want to add password and salt columns

- password VARCHAR(60) COMMENT 'A salted hash of the password'
- salt VARCHAR(128) COMMENT 'User specific salt'

```
ALTER TABLE
 ADD
 password VARCHAR(60) COMMENT 'A salted hash of the password',
 salt VARCHAR(128) COMMENT 'User specific salt';
```

### Security Checkpoint

Never store a password in plain text, always store a hashed version of the password. Always create a user specific salt this will protect against [rainbow table attacks](#).

## Additional Resources

- [Safe Password Hashing](#)
- [Rainbow Tables](#)

## Data Models

[https://en.wikipedia.org/wiki/First\\_normal\\_form](https://en.wikipedia.org/wiki/First_normal_form) Customer data with one or many phone numbers stored in a single row.

customers			
id	first_name	last_name	phone
123	John	Smith	(555) 861-2025, (555) 122-1111
456	Jane	Doe	(555) 403-1659, (555) 929-2929
789	Cindy	Who	(555) 808-9633

```
SELECT phone FROM customers WHERE id = 123
```

1 result (555) 861-2025, (555) 122-1111



# CakePHP

CakePHP is an MVC (Model, View, Controller) based rapid application development (RAD) framework built using PHP. CakePHP has a solid eco-system and is designed around test driven development (TDD).

## MVC

MVC is a software design pattern that splits your application into three distinct layers: data (Model), Business Logic (Controller), and presentation (View).

### Model

A model can be anything that provides data such as a table in a database, a reference to an API, a spreadsheet, etc. For our user a model will reference a table in a database.

### View

Views are the presentation layer. Views will typically be HTML but can be anything a client can read such as .html, .json, .xml, .pdf or even a header that only a machine can access.

### Controller

Business and application logic.

## CRUD

Create, Read, Update, Delete

## Migrations

Rolling snapshots of the database structure. These allow you to migrate your database's structure forward and backwards across snapshots.

## Create a Repository on GitHub

- Create the repository *cake.example.com*.
- **DO NOT** Initialize with a README
- Add the MIT License

`</>` [code](#) Initial Commit

## Installation

First make sure you have installed internationalization functions for PHP.

```
sudo apt-get install php-intl
```

Create a CakePHP project via composer. Sticking with the *example.com* nomenclature we will call this one *cake.example.com*.

```
cd /var/www
composer create-project --prefer-dist cakephp/app cake.example.com
```

Answer yes to the following

```
Set Folder Permissions ? (Default to Y) [Y,n]?
```

## Your First App

Move into the new project folder

```
cd cake.example.com
```

Spin up a development web server.

```
bin/cake server
```

In a browser go to <http://localhost:8765/>. You will be presented a default home page that shows that gives you plenty of resources to help you learn CakePHP and it will return a system status that makes sure you system is set up correctly. Everything should be green except for the database.



Please be aware that this page will not be shown if you turn off debug mode unless you replace src/Template/Pages/home.ctp with your own version.

### Environment

- Your version of PHP is 5.6.0 or higher (detected 7.0.22-0ubuntu0.16.04.1).
- Your version of PHP has the mbstring extension loaded.
- Your version of PHP has the openssl extension loaded.
- Your version of PHP has the intl extension loaded.

### Filesystem

- Your tmp directory is writable.
- Your logs directory is writable.
- The *FileEngine* is being used for core caching. To change the config edit config/app.php

### Database

- CakePHP is NOT able to connect to the database.  
Connection to database could not be established: SQLSTATE[HY000] [1045] Access denied for user 'my\_app'@'localhost' (using password: YES)

### DebugKit

- DebugKit is loaded.

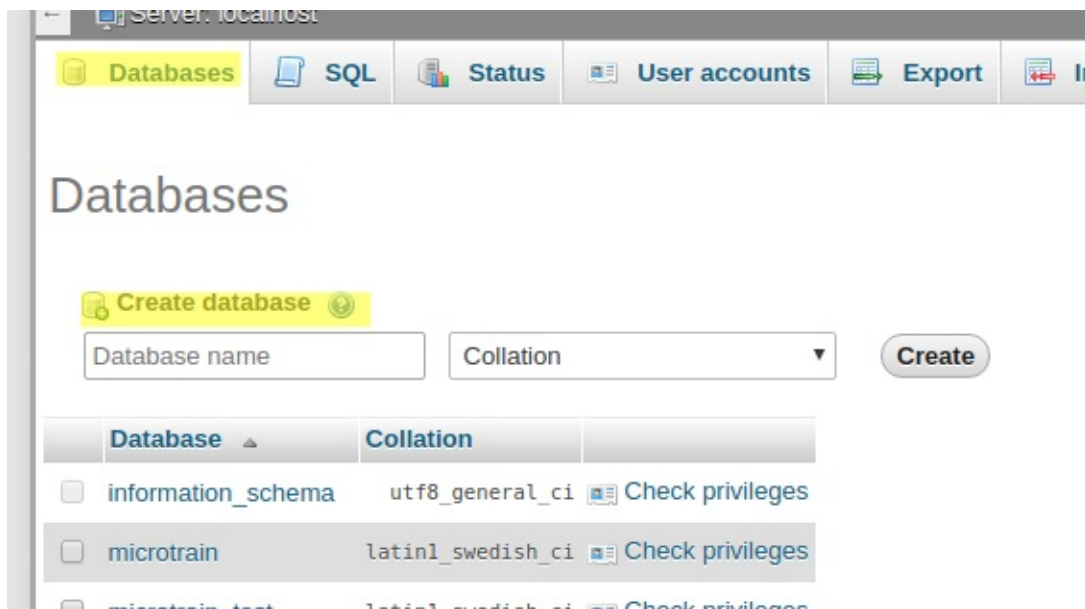
Add *cake.example.com* as a project in Atom. Navigate to *config/app.php* this is the default configuration file for your application. CakePHP stores its configuration as an array, find the *Datasources* attribute somewhere around the line 220 (you can use the shortcut [ctrl] + [g] and enter 220). You will notice two child attributes *default* and *test*. *default* holds the configuration for your application's database while *test* holds the configuration for running unit tests.

## Setup Your Database

We will use PhpMyAdmin to create two databases

- cake\_app
- cake\_test

Go to <http://localhost/phpmyadmin> and login as with *root:password*. Find the Databases tab and under the *Create database* header enter *cake\_app* as your first database. This will now ask you to create a table, skip this step and find your way back to the Databases tab and create another database called *cake\_test* you can now close out of phpMyAdmin and return to the *app.php* file in Atom.



Update the database configurations as follows.

*default*

```
'username' => 'root',
'password' => 'password',
'database' => 'cake_app',
```

*test*

```
'username' => 'root',
'password' => 'password',
'database' => 'cake_test',
```

Return to <http://localhost:8765/>(<http://localhost:8765/>) and refresh the page, all settings should now be green.

## Configure Apache

Let's set up an Apache configuration with a local hosts entry for development purposes.

```
sudo vim /etc/apache2/sites-available/cake.example.com.conf
```

```
<VirtualHost 127.0.0.101:80>

 ServerName loc.cake.example.com

 ServerAdmin webmaster@localhost
 DocumentRoot /var/www/cake.example.com/webroot

 # Allow an .htaccess file to ser site directives.
```

```
<Directory /var/www/cake.example.com/webroot/>
 AllowOverride All
</Directory>

Available loglevels: trace8, ..., trace1, debug, info, notice, warn,
error, crit, alert, emerg.
It is also possible to configure the loglevel for particular
modules, e.g.
#LogLevel info ssl:warn

ErrorLog ${APACHE_LOG_DIR}/error.log
CustomLog ${APACHE_LOG_DIR}/access.log combined

</VirtualHost>
```

Add the following to `/etc/hosts`

```
127.0.0.101 loc.cake.example.com
```

and finally load the new site.

```
sudo a2ensite cake.example.com && sudo service apache2 restart
```

Navigate to <http://loc.cake.example.com/> and you should encounter write permission issues. Resolve this by changing ownership of these files to the Apache process (`www-data`) and Yourself (replace `jason` with your Ubuntu username).

```
sudo chown www-data:jason logs
sudo chown www-data:jason logs/*
sudo chown www-data:jason tmp
sudo chown www-data:jason tmp/*
sudo chown www-data:jason tmp/**
```

Return to <http://loc.cake.example.com/> and all systems should now be a go.

## Merge with the Existing GitHub Project

</> **Code** Run the following commands, be sure to replace `YOUR-GITHUB-USERNAME` with your github username.

```
cd /var/www/cake.example.com
git init
git remote add origin git@github.com:YOUR-GITHUB-USERNAME/cake.example.com.git
git pull origin master
git add .
git commit -am 'Initial build'
```

## Cake File Structure, Callbacks and Routing

@todo navigate to `src`, explain the directory structure Model, Views and Controller @todo callback methods and lifecycles as it pertains a CakePHP and Programming in general.

## Blog Tutorial

We will start by using Composer to install CakeDC's [User Authentication plugin](#). We will then build an Articles CRUD based on CakePHP's [CMS tutorial](#). We will then tie Users to Articles (a blog post). Our lad will apply everything we just learned to building a comment system for our blogging platform. In you console, please navigate to `/var/www/cake.example.com`, this



tutorial assumes `/var/www/cake.example.com` as the base path for all `cd`, file and folder creation commands.

## Users

1. We will install the users plugin developed by CakeDC. The documentation is available [here](#).
2. Install the core by running.

```
composer require cakedc/users
```

1. Add the following line to the end of `config/bootstrap.php`, this bootstraps the plugin to application start up.

```
Plugin::load('CakeDC/Users', ['routes' => true, 'bootstrap' => true]);
```

2. Use [the migrations plugin](#) to install the required tables.

```
bin/cake migrations migrate -p CakeDC/Users
```

1. `</>` code Commit your changes with a message of *Added CakeDC's user plugin*.

1. Remove deprecation warnings from line 168 of `config/app.php`

```
'errorLevel'=>'E_ALL & ~E_USER_DEPRECATED',
```

2. Set the mail transport to debug on line 196 of `config/app.php`

```
'className' => 'Debug',
```

3. Navigate to <http://loc.cake.example.com/users/users/login> and have a look around. Use the navigation links to find the registration page and create an account.
4. Notice you will not be able to login, this is because you have not yet clicked the authorization link out of your email. The local server cannot send emails so you will have manually flip that switch in the database.
5. Login to PhpMyAdmin, find your user record in the `cake_app` database and flip the active and superuser flags to 1.
6. Now return to the login page and try to login. On success you will be redirected to the CakePHP debuggin page.

## Add the Database Tables

- Login to phpMyAdmin <https://localhost/phpmyadmin>
- Click into cake > cake\_app from the side bar
- Click on the SQL tab
- Copy and Paste the following the text area and hit submit
- Repeat this process for cake > cake\_test

```
-- First, create our articles table:
CREATE TABLE articles (
 id CHAR(36) NOT NULL PRIMARY KEY,
 title VARCHAR(255) NOT NULL,
 slug VARCHAR(191) NOT NULL,
 body TEXT,
 published BOOLEAN DEFAULT FALSE,
 created DATETIME DEFAULT CURRENT_TIMESTAMP COMMENT 'When the post was created',
 modified DATETIME DEFAULT CURRENT_TIMESTAMP ON UPDATE CURRENT_TIMESTAMP COMMENT 'When the post was last edi
```

```

ted',
 UNIQUE KEY (slug)
) ENGINE=INNODB;

-- Then insert some articles for testing:
INSERT INTO articles (id,title,slug,body)
VALUES ('6f814dc0-4adb-11e8-842f-0ed5f89f718b', 'The Title', 'the-title', 'This is the article body.');
```

```

INSERT INTO articles (id,title,slug,body)
VALUES ('6f8155ae-4adb-11e8-842f-0ed5f89f718b', 'Hello World', 'hello-world', 'This is the article body again.');
```

```

INSERT INTO articles (id,title,slug,body)
VALUES ('6f815964-4adb-11e8-842f-0ed5f89f718b', 'Hello World Again', 'hello-world-again', 'This is the article body again and again.');
```

</> **Code** Since we have the table in our database we can automate the build by *baking* the model. Run the following command and take note of what files get created. In addition to creating an Entity and a Table classes, fixtures and tests will be created, this will provide a placeholder for building unit tests.

```
bin/cake bake model Articles
```

Navigate to the *src/Model* and check out the files in *Entity* and *Article* folders.

## Unit Test

</> **Code** Start by installing PHP unit

```
composer require --dev phpunit/phpunit:"^5.7|^6.0"
```

Run a unit test for each table

```
vendor/bin/phpunit tests/TestCase/Model/Table/ArticlesTableTest
```

Navigate to the *tests/TestCase/Model/Table* walk through the default test cases.

## Managing Articles

</> **code** Create the file */src/Controller/ArticlesController.php* and add the following.

```

<?php
namespace App\Controller;

class ArticlesController extends AppController
{
}

```

## Add an Index Method

</> **code** The index method will return a paginated list articles and send them a the view.

```

public function index()
{
 $this->loadComponent('Paginator');
 $articles = $this->Paginator->paginate($this->Articles->find());
 $this->set(compact('articles'));
}

```

```
}
```

## Add the View

Create the file `/src/Template/Articles/index.ctp`

```
<h1>Articles</h1>
<table>
 <tr>
 <th>Title</th>
 <th>Created</th>
 </tr>

 <?php foreach ($Articles as $Article): ?>
 <tr>
 <td>
 <?php echo $this->Html->link($Article->title, ['action' => 'view', $Article->id]); ?>
 </td>
 <td>
 <?php echo $Article->created; ?>
 </td>
 </tr>
 <?php endforeach; ?>
</table>
```

## Add a View Method

`</>` code

```
public function view($slug = null)
{
 $Article = $this->Articles->findBySlug($slug)->firstOrFail();
 $this->set(compact('article'));
}
```

## Add the View

Create the file `/src/Template/Articles/view.ctp`

```
<h1><?php echo $Article->title; ?></h1>
<div>Created: <?php echo $Article->created; ?></div>
<div><?php echo $Article->body; ?></div>
<div><?php echo $this->Html->link('Edit', ['action' => 'edit', $Article->slug]); ?></div>
```

## Add an Initialize Method

`</>` code Since the Flash Component will be reused elsewhere we will add an initialization method and add load our components there.

```
public function initialize()
{
 parent::initialize();

 $this->loadComponent('Flash');
 $this->loadComponent('Paginator');
}
```

## Add an Create Method

`</> code`

```
public function create()
{
 $article = $this->Articles->newEntity();
 if ($this->request->is('post')) {
 $article = $this->Articles->patchEntity($article, $this->request->getData());

 $article->slug = Text::slug(
 strtolower(
 substr($article->title, 0, 191)
)
);

 if ($this->Articles->save($article)) {
 $this->Flash->success('Your article has been created.');
```

`return $this->redirect(['action' => 'index']);`

```
 }

 $this->Flash->error('An error has occurred.');
```

`}`

```
 $this->set('article', $article);
}
```

## Add the View

Create the file `/src/Template/Articles/create.ctp`

```
<h1>Create an Article</h1>
<?php
 echo $this->Form->create($article);

 echo $this->Form->control('title');
 echo $this->Form->control('body', ['rows' => '5']);
 echo $this->Form->button('Save Article');
 echo $this->Form->end();
```

## Add an Edit Method

`</>code`

```
public function edit($id = null)
{
 $article = $this->Articles->findById($id)->firstOrFail();
 if ($this->request->is(['post', 'put'])) {
 $this->Articles->patchEntity($article, $this->request->getData());

 $article->slug = Text::slug(
 strtolower(
 substr($article->title, 0, 191)
)
);

 if ($this->Articles->save($article)) {
 $this->Flash->success('Your article has been updated.');
```

`return $this->redirect(['action' => 'index']);`

```
 }
 $this->Flash->error('An error has occurred.');
```

`}`

```
 $this->set('article', $article);
```

```
}
```

## Add the View

Create the file `/src/Template/Articles/edit.ctp`

```
<h1>Edit: <?php echo $article->title; ?></h1>
<?php
echo $this->Form->create($article);
echo $this->Form->control('id', ['type'=>'hidden']);
echo $this->Form->control('title');
echo $this->Form->control('body', ['rows' => '5']);
echo $this->Form->button('Update Article');
echo $this->Form->end();
```

## Add a Delete Method

[code](#)

```
public function delete($id = null)
{
 $this->request->allowMethod(['post', 'delete']);

 $article = $this->Articles->findById($id)->firstOrFail();
 if ($this->Articles->delete($article)) {
 $this->Flash->success("The article: {$article->title} has been deleted.");
 return $this->redirect(['action' => 'index']);
 }
}
```

## Add a delete link to view.ctp

Add a delete link to the view template `/src/Template/Articles/view.ctp`

```
<div>
 <?php
 echo $this->Html->link(
 'Edit',
 ['action' => 'edit', $article->id]
);
 echo ' ';
 echo $this->Form->postLink(
 'Delete',
 ['action' => 'delete', $article->id],
 ['confirm' => __('Are you sure, you want to delete {0}?', $article->title)]
);
 ?>
</div>
```

## A Create, Edit and Delete Links to the Index View

[code](#)

## Create Slugs in the Background

[code](#) We will move our slug creation logic from the Articles controller to the Articles table. Here we will use a callback to create slugs in the background. We will create a unit test to verify our slug creation logic.

Call the namespace for the Utility class. *src/Model/Table/ArticlesTable.php*

```
// the Text class
use Cake\Utility\Text;
```

Create the method for creating a slug. *src/Model/Table/ArticlesTable.php*

```
public function createSlug($title)
{
 return Text::slug(
 strtolower(
 substr($title, 0, 191)
)
);
}
```

Add and run a unit test for the create slug method. *tests/TestCase/Model/Table/ArticlesTableTest.php*

```
public function testCreateSlug()
{
 $result = $this->Articles->createSlug('Hello World');
 $this->assertEquals('hello-world', $result);
 $result = $this->Articles->createSlug('Hello! World');
 $this->assertEquals('hello-world', $result);
 $result = $this->Articles->createSlug('Hello World*');
 $this->assertEquals('hello-world', $result);
 $result = $this->Articles->createSlug('Hello- World-');
 $this->assertEquals('hello-world', $result);
}
```

Rerun the unit test

```
vendor/bin/phpunit tests/TestCase/Model/Table/ArticlesTableTest
```

Call `createSlug()` from the `beforeMarshal()` callback. *src/Model/Table/ArticlesTable.php*

```
public function beforeMarshal($event, $data)
{
 if (!isset($data['slug']) && !empty($data['title'])) {
 $data['slug'] = $this->createSlug($data['title']);
 }
}
```

Test before marshal by creating a new record *tests/TestCase/Model/Table/ArticlesTableTest.php*

```
public function testBeforeMarshal()
{
 $article = $this->Articles->newEntity();
 $article = $this->Articles->patchEntity($article, ['title'=>'Hello World, It's a fine day']);
 $this->Articles->save($article);

 $result = $this->Articles->find()->first();
 $this->assertEquals('hello-world-it-s-a-fine-day', $result['slug']);
}
```

Rerun the unit test

```
vendor/bin/phpunit tests/TestCase/Model/Table/ArticlesTableTest
```

## Add User Authentication

`</>` code Add an instance variable to hold the session object, set this variable during initialization. The following reads as set this instance of `$session` to the session object from this instance of the request object. This will provide a short hand for accessing the session data in controllers.

*src/Controller/AppController.php*

```
protected $session;

public function initialize()
{
 ...
 $this->session = $this->getRequest()->getSession();
}
```

## Deny Access by Default

`</>` code *src/Controller/AppController.php*

```
public function initialize()
{
 parent::initialize();

 // Load the AUTH component
 $this->loadComponent('Auth');

 $this->loadComponent('RequestHandler');
 $this->loadComponent('Flash');
 $this->session = $this->getRequest()->getSession();

 // Deny unauthorized access by default
 $this->Auth->deny();
}
```

At this point when you try to access <http://loc.cake.example.com> the application will try to redirect you to *users/login*. This will error out due to us (a) not having a UsersController at the top level and (b) not having a route that directs us to the CakeDC plugin. We will resolve this by adding a route.

`</>` code Add the following at line 80 of *src/config/routes.php*

```
Router::connect(
 '/users/login',
 [
 'plugin' => 'CakeDC/Users',
 'controller' => 'Users',
 'action' => 'login'
]
);
```

Now accessing <http://loc.cake.example.com> will redirect you to a login page.

## Tie Users to Articles

Add a column called `user_id` to the articles table.

```
-- Add the user_id column
ALTER TABLE articles ADD user_id CHAR(36) AFTER id NOT NULL DEFAULT 0;
```

```
-- Swap out the user_id with YOUR user id from the database
UPDATE articles SET user_id='xxx'
```

## Configuration

Navigate to <http://loc.cake.example.com/users/users> and create a user account.

# Labs

## Lab 1 - Composer

Using the documentation for the users plugin add the ability to login using a social media platform of your choice.

## Lab 2 - Comment System

1. Create a table
  - id - the primary key of the comment system
  - article\_id - the id of the article for which the comment is being made
  - first\_name - the first name of the reader making a comment
  - last\_name - the last name of the reader making a comment
  - email - the email of the reader making a comment
  - comment - the readers comment
  - created - current time stamp at the time of submission
2. At the bottom of each article provide a form that will collect the above data and on submit
  - Save the data to the comments table
  - Use the MailGun API to send your self an email telling you someone has commented on your article.

## Lab 3 - Contact Form

1. Create a contact form.
2. When a user submits the form, save the contents to a database.
3. When the user submits the form, use the MailGun API to send your self an email every time someone submits the contact form.

## Additional Resources

- [CakePHP](#)



## Introduction

MongoDB is a distributed noSQL noSchema document database designed for scalability, high availability, and high performance.

# MongoDB

MongoDB is a distributed noSQL noSchema document database designed for scalability, high availability, and high performance.

## Install MongoDB

### Install MongoDB on Ubuntu 16.04

By default the Ubuntu package manager does not know about the MongoDB repository so you'll need to add it to your system. First add MongoDB's private key to the package manager. Then, update the repository list. Finally, reload the package database.

```
sudo apt-key adv --keyserver hkp://keyserver.ubuntu.com:80 --recv 2930ADAE8CAF5059EE73BB4B58712A2291FA4AD5

echo "deb [arch=amd64,arm64] https://repo.mongodb.org/apt/ubuntu xenial/mongodb-org/3.6 multiverse" | sudo tee /etc/apt/sources.list.d/mongodb-org-3.6.list

sudo apt-get update
```

Now you can install the latest stable release of MongoDB.

```
sudo apt-get install -y mongodb-org
```

## Working with MongoDB

Start the database.

```
sudo service mongod start
```

Access the database by typing `mongo` at the command line.

```
mongo
```

Create a database called cms.

```
use cms
```

Show a list of all databases.

```
show Databases
```

You will not see your new database listed until you insert at least one document into it. This will create a collection called users.

```
db.users.insert({"email":"youremail@example.com","firstname":"YourFirstName","lastname":"YourLastName"})
```

Let's break that last command down.

*db* this calls the database object.

`insert()` is a method of the collection object, this inserts a record into a target collection. The JSON string contains the key/value pairs that will be inserted into the document. Documents in MongoDB are JSON strings.

`users` this is the collection upon which collection methods are called. If a collection does not exist, calling `insert` against the collection will create the collection.

Now if you run `sh show databases` you will see `cms` in the list. Next, you will want to look up your list of collections.

```
show collections
```

Now we will create some new documents in the `users` collection.

```
db.users.insert({"email":"sally@example.com", "firstname":"Sally", "lastname":"Smith"})
db.users.insert({"email":"bob@example.com", "firstname":"Bob", "lastname":"Smith"})
```

Now we will return all of the documents in the database by calling the `find` method (will no arguments) against the `users` collection of the database.

```
db.users.find()
```

We can look up specific documents by building a JSON string.

```
db.users.find({"email":"sally@example.com"})
```

RegEx allows you to search partial strings like every user who's last name ends in *th*.

```
db.users.find({"lastname": /. *th/})
```

Update a document by calling `update()` with the update modifier `$set` against a target collection and passing in the `_id` object. Passing the same JSON string into the `save` method of a collection would completely replace the document.

Update only, using the update modifier.

```
db.users.update({ "_id" : ObjectId(PASTE TARGET ID HERE)}, {$set:{"email":"new@email.com"}})
```

Full document replacement by omitting the update modifier

```
db.users.update({ "_id" : ObjectId(PASTE TARGET ID HERE)}, {"email":"new@email.com"})
```

The same JSON string you build for looking up documents can be used for deletion by passing that string into the `remove` method of collection.

```
db.users.find()
db.users.remove({"email":"bob@example.com"})
db.users.find()
```

Use `drop()` to remove an entire collection;

```
show collections
use cms
db.users.drop()
show collections
```

You can drop the entire database by running *dropDatabase()* directly against the *db* object.

```
use cms
db.dropDatabase()
```

## Atlas

1. Create an Atlas Account
2. Explain the IP Addresses

## Compass

1. Install Compass

## Additional Resources

- [Why You Should Never Use MongoDB](#) - Read the article then dig into the comments.

Express is a web application framework for NodeJS.

# Express

Express is a web application framework for NodeJS.

[Getting Started with Express](#)

## Create an ExpressJS based Project

Go to GitHub and create a new project *mean.example.com*. You can change this to your own domain name if you have one *mean.YOUR-DOMAIN*.

Install the Express Generator

```
sudo npm install express-generator -g
```

## Create the repository

mean.example.com

A MEAN Stack build for my personal website. Provides a CMS and user management via a REST API.

[x] Public

[x] Initialize this repository with a README

Add gitignore: None Add a license: MIT License

Clone the project into your home directory. Replace YOUR-GITHUB-ACCOUNT with the actual account details (for the sale of this lesson we will refer to this as *mean.exxample.com*).

```
cd ~/
git clone git@github.com:YOUR-GITHUB-ACCOUNT/mean.example.com.git
```

Create an Express based website, we will use PUG as our template engine.

Setup ExpressJS with Pug

```
cd mean.example.com
npm install express --save
express --view=pug
npm install
npm start
```

Split your Terminator window and run `git status`

Running `git status` at this point will show the following.

```
$ git status
app.js
bin/
node_modules/
package-lock.json
package.json
public/
routes/
views/
```

@todo - Explain routing and the express file structure.

- app.js
- bin/
- node\_modules/
- package.json
- package-lock.json
  - [package.json vs package-lock.json](#)
  - [Everything You Wanted To Know About package-lock.json But Were Too Afraid To Ask](#)
- public/
- routes/
- views/

The `node_modules` directory contains third party software that should not be a part of our repository. Npm will handle these dependencies so we do not need them in our repo. Open Atom and add `mean.example.com` as a project folder.

`</code>` Add a `.gitignore` file to exclude `node_modules` from future commits.

Commit the `.gitignore` file.

```
git add .gitignore
git commit -m 'Ignore node_modules from future commits' .gitignore
```

Commit the remaining files created during setup and push both commits to the master branch.

```
git add .
git commit -am 'Setup ExpressJS with Pug'
git push origin master
```

Navigate to Then <http://localhost:3000/> to access your new app.

## Exercise - Express Basics

In this exercise we will make a few basic changes to familiarize ourselves with the basics of ExpressJS. If something breaks don't worry; our last commit created a rollback point. At the end of this exercise we will stash out changes and roll back to our last commit. From Atom open `mean.example.com/routes/index.js` and change the following

```
//change
{ title: 'Express' }
//to
{ title: 'Express', name: 'YOUR-NAME' }
```

From Atom navigate to `mean.example.com/views/index.pug` and change the following. Please note the indentation, indentation matters when it comes to Pug.

```
//change
extends layout

block content
 h1= title
 p Welcome to #{title}
//to
extends layout

block content
```

```
h1= title
p Welcome to #{title}

p My name is #{name}
```

From the same terminal in which your NodeJS server is running press [ctrl+c] then type `sh npm start` this will restart the server. Navigate to <http://localhost:3000/> and refresh the page. You will now see a tag line which states "My name is *YOUR-NAME*"

Let's break this down a bit. In the routing file `mean.example.com/routes/index.js` you define your application's end points (aka actions) by calling an HTTP request request type (typically get or post) in the form of a router method against the router object. The first argument of this method names the end point, the second argument is a call back function that defines the server side functionality for the action.

```
router.get('/', function(req, res, next) {
 res.render('index', { title: 'Express', name: 'YOUR-NAME' });
});
```

So far we have been dealing with the sites home page. This is handled as a get request via `router.get()`. The first argument denotes the desired end point and the last argument is a call back function. The callback function tells the server how to deal with the request. The call back will always have three arguments `req`, `res`, and `next`.

- `req` - shorthand for *request*, this is the request object. This represents the request the user is making of the server. This will contain user supplied data in the form of `req.params` and `req.body` and provides a number of other useful properties.
- `res` - shorthand for *response*, this is the response object. This represents the response the server is building for the user. This will tell the server which views to render, the type of response headers to include and provides a number of other useful properties.
- `next` - `next()` tells the current request to move to the next piece of middle ware.

Take note of the line `res.render('index', { title: 'Express', name: 'YOUR-NAME' });`. The `render()` method is a member of the response object. As its name suggests, `render()` renders a view and serves it to the user. The first argument is a view directory path. In our project the views directory is located at `mean.example.com/views` making the path to index `mean.example.com/views/index`; express knows where to find the views directory so all we need to call is the path relative to views. For example, `render('users/index')` would have the path `mean.example.com/views/users/index`. The second argument is a json object. This object holds a list of key to value pairs that get passed into the view.

The view is a `.pug` file. Pug is a template engine designed for NodeJS. Pug files are processed server side and the resulting HTML is sent to the user. Calling `res.render('index', { title: 'Express', name: 'YOUR-NAME' });` pass two variables `title` and `name` into the view files `mean.example.com/views/index.pug` and build the HTML document that will be served to the user. A pug can handle variables in one of two ways.

```
//An element in which the innerHTML consists of only the variable
h1= title

//An element in which the variable is injected into a string
p Welcome to #{title} how do you do?
```

*index.pug*

```
//The layout into which this page will be injected
extends layout

//creates a content variable, every thing below this will be injected into the layout
block content
 // Pug flavored markup
 h1= title
 p Welcome to #{title}
```



*layout.pug*

```
//standard markup
doctype html
html
 head
 title= title
 link(rel='stylesheet', href='/stylesheets/style.css')
 body
 //the content block of index.pug will be injected here.
 block content
```

Open a browser and navigate to <http://localhost:3000/>. You'll see an unstyled web page that says "respond with a resource". This is because this endpoint is not calling `res.render()` rather it is calling `res.send()`. The `send()` method makes no attempt to render a view, this method simply prints any text passed into it to the screen. This is similar to `res.json()` in that no view is rendered.

```
router.get('/', function(req, res) {
 res.send('respond with a resource');
});
```

Now that we have a general feel for our ExpressJS application. Let's stash our changes and start building our application.

```
git add .
git stash
git stash clear
```

## Create a Data API

An API end point (in this case a data API) is a server response that does not render an HTML view. Rather, the end point would return json, jsonp, xml, soap or the like. Typically, the point of an API is to either accept a data request or return a server response in the form of unformatted data. The intent is to create an end point that can interact with other software rather than a human. For example, `/api/users/create` could allow a user to be created from a web app, desktop app, mobile app, console app, etc. The point is having a single end point that can serve data between to any medium. Our applications will use HTTP verbs (GET, PUT, POST, DELETE) to create a CRUD based REST API that interacts with JSON data.

- Relevant HTTP Verbs - POST, GET, PUT, DELETE
- CRUD - Create, Read, Update, Delete
- REST - REpresentational State Transfer

### Translate HTTP Verbs to CRUD

- Create - POST
- Read - GET
- Update - PUT
- Delete - DELETE

## Create a Data Model

We will start with a JSON based users API. This will provide end points for creating and managing users. This is also known as a data API, since this deals with data; the data model is a logical place to start.

## Create the Database

## Open MongoDB

```
sudo service mongod start
mongo
```

From the MongoDB shell (be sure you see a `>` ) create a database called *mean-cms*. Then create a test document by inserting running an insert against the *users* collection.

```
use mean-cms
db.users.insert({email: 'test@example.com', username: 'testuser'})
```

## Add a Config File

`</>` `code` A config file is a good practice for storing and managing API keys and other configuration variables from a central location. I often create two files, one for production and one for development.

- Create the configuration file *config.dev.js*

*config.dev.js*

```
var config = {};
config.mongodb = 'mongodb://localhost/mean-cms';
module.exports = config;
```

- Call the configuration file from *app.js*

*app.js*

```
var config = require('./config.dev');

//Test the file
console.log(config);
```

## Define the Schema

Next we will create a *models* directory in the root of our project and in it a file named *user.js* resulting is *mean.example.com/models/user.js*.

```
npm install mongoose
git commit -am 'Install Mongoose'
git push origin master
```

Validation is a key feature of Mongoose. Executes before making a save to MongoDB. This allows us to define rules at the model level. We will want to make sure usernames and email addresses are unique. Mongoose does not have a built in validator for this but the community does. We will install the [mongoose-unique-validator](#) plugin and set uniqueness as needed.

```
npm install mongoose-unique-validator
git commit -am 'Install mongoose-unique-validator'
git push origin master
```

```
var mongoose = require('mongoose'),
 Schema = mongoose.Schema,
 uniqueValidator = require('mongoose-unique-validator');

//Create a schema
```

```
var User = new Schema({
 email: {
 type: String,
 required: [true, 'Please enter an email'],
 unique: [true, 'Email must be unique']
 },
 username: {
 type: String,
 required: [true, 'Please enter a username'],
 unique: [true, 'Usernames must be unique']
 },
 first_name: String,
 last_name: String,
 admin: {
 type: Boolean,
 default: false
 }
});

User.plugin(uniqueValidator);

module.exports = mongoose.model('User', User);
```

## Implement the REST/CRUD Functionality

- create - A POST request that creates a user
- read - A GET request that returns either a single user record
- read - A GET request that returns a list of user records
- update - A PUT request that updates an existing record
- delete - A delete request that removes an existing user

### GET/Read All

[code](#) GET/Read all users

```
curl -H "Content-Type: application/json" -X GET http://localhost:3000/api/users/
```

### GET/Read One

[code](#) GET/Read a single user

```
curl -H "Content-Type: application/json" -X GET http://localhost:3000/api/users/5a763b67a5d70c115d81536a
```

### POST/Create

[code](#) CREATE/Create a user

Test with a simple curl request

```
curl -d '{"email":"test2@example.com", "username":"testuser2", "first_name": "Bob", "last_name": "smith"}' -H "Content-Type: application/json" -X POST http://localhost:3000/api/users

curl -d '{"email":"test3@example.com", "username":"testuser3", "first_name": "Sally", "last_name": "Smith"}' -H "Content-Type: application/json" -X POST http://localhost:3000/api/users
```

### PUT/Update

[code](#) PUT/Update a user

```
curl -d '{"_id":"5a77536ad7e4c37d6f792716", "first_name":"Robert"}' -H "Content-Type: application/json" -X PUT http://localhost:3000/api/users
```

### DELETE/Delete

`</code>` DELETE/Delete a user

```
curl -H "Content-Type: application/json" -X DELETE http://localhost:3000/api/users/5a766d52cbe495128293baef
```

## Add Created and Modified Dates

`</code>` Add and auto-populate created and modified dates on document creation.

### Auto Update the Modified Date When a Document is Saved

`</code>` Auto update the modified timestamp prior to saving the document.

# User Authentication with Passport

## Passport Local Strategy

`</>` `code` Install all the packages needed for building a passport session and storing it in the database. The commit points to the package.json files, you can install these packages over the commandline or

```
npm install passport
npm install passport-local
npm install passport-local-mongoose
npm install express-session
npm install connect-mongo
```

`</>` `code` Require session packages *app.js*

```
var session = require('express-session');

//Add this after the Mongo connection
var MongoStore = require('connect-mongo')(session);
```

`</>` `code` Add configuration objects for sessions and cookies *config.dev.js*

```
//Session configuration object
config.session = {};

//Cookie configuration object
config.cookie = {};

//Create a random string to sign the session data
//Bigger is better, more entropy is better
//The is OK for dev, change for production
config.session.secret = '7j&1tH!cr4F*1U';

//Define the domain for which this cookie is to be set
config.cookie.domain = 'localhost:3000';
```

`</code>` Configure the [express session](#)

```
var passport = require('passport');
```

```
...

app.use(require('express-session')({
 //Define the session store
 store: new MongoStore({
 mongooseConnection: mongoose.connection
 }),
 //Set the secret
 secret: config.session.secret,
 resave: false,
 saveUninitialized: false,
 cookie: {
 path: '/',
 domain: config.cookie.domain,
 //httpOnly: true,
 //secure: true,
 maxAge: 1000 * 60 * 24 // 24 hours
 }
}));
app.use(passport.initialize());
app.use(passport.session());
```

`</>` codeSerialize the session data

```
passport.serializeUser(function(user, done){
 done(null,{
 id: user._id,
 username: user.username,
 email: user.email,
 first_name: user.first_name,
 last_name: user.last_name
 });
});

passport.deserializeUser(function(user, done){
 done(null, user);
});
```

## User Registration

### Passport Local Mongoose

`</>` code Update the user model to require hash and salt as strings.

*models/user.js*

```
hash: {
 type: String,
 required: [
 true,
 'There was a problem creating your password'
]
},
salt: {
 type: String,
 required: [
 true,
 'There was a problem creating your password'
]
},
```

`</>` code Add passport-local-mongoose

*models/user.js*

```
var passportLocalMongoose = require('passport-local-mongoose');

...

User.plugin(passportLocalMongoose);
```

</>code Require and use Passport Local Strategy as defined in the user model

```
var LocalStrategy = require('passport-local').Strategy;

//Require models
var User = require('./models/user');

...

//Use LocalStrategy as defined in the user model
passport.use(User.createStrategy());
```

### Clean Up

- </>code Improve Comments
- </>code Improve Variable Names

### Registration Endpoint

</>code Add a users route with an end point for registering a user.

Create the file *routes/users.js*. This will need access to express, passport and the user model.

```
var express = require('express');
var router = express.Router();
var passport = require('passport');
var User = require('../models/user');

router.get('/register', function(req, res, next) {
 res.render('users/register', {
 title: 'Create an Account'
 });
});

module.exports = router;
```

</>code Add the new user route to *app.js*

```
var usersRouter = require('./routes/users');

...

app.use('/users', usersRouter);
```

### Registration View

</>code Create a users view directory with a registration view.

*views/users/register.pug*

```
extends ../layout

block content
```

```

h1 Create an Account
form(method='post' action='/api/users/register')
 div
 label(for='username') Username
 input(type='text' name='username' id='username')
 div
 label(for='email') Email
 input(type='text' name='email' id='email')
 div
 label(for='first_name') First Name
 input(type='text' name='first_name' id='first_name')
 div
 label(for='last_name') Last Name
 input(type='text' name='last_name' id='last_name')
 div
 label(for='password') Password
 input(type='password' name='password' id='password')
 div
 input(type='submit' value='submit')

```

`</>` `code` Add some simple fomr style to *public/stylesheets/style.css*

```

label {
 display: block;
 font-weight: bold;
}

input[type="text"],
input[type="password"],
textarea{
 font: 24px monospace;
 padding: .75rem 1.25rem;
 margin: .5rem 0 1rem;
 display: inline-block;
 border: 1px solid #ddd;
 box-sizing: border-box;
 width: 100%;
 border-radius: 2px;
}

input[type="submit"],
button,
a.button{
 padding: .75rem 1.25rem;
 font: 24px monospace;
 text-decoration: none;
 appearance: button;
 color: #fff;
 border: 1px solid #0055ee;
 background: #fff;
 cursor: pointer;
 background: #0099ee;
 border-radius: 2px;
}

```

## Post the Registration Form to the Users API

`</>` `code` Add a registration end point the the users API. */users/register* is a GET request that will load a registration form. */api/users/register* is a POST request that creates a user record complete with salt and has values. For now, registartion will end with duping a JSON string onto the screen. Later we can convert this to an AJAX application.

Add the following to *routes/api/users*

```

//Register a new user
router.post('/register', function(req,res,next){

```

```
var data = req.body;

User.register(new User({
 username: data.username,
 email: data.email,
 first_name: data.first_name,
 last_name: data.last_name
}),
data.password,
function(err, user){

 if(err){

 return res.json({
 success: false,
 user: req.body,
 errors: err
 });

 }

 return res.json({
 success: true,
 user: user
 });

});

});
```

## User Login/Logout

[code](#) Create a GET and POST end points for login

*routes/users.js*

```
router.get('/login', function(req, res){
 res.render('users/login');
});

router.post('/login', passport.authenticate('local'), function(req, res){
 res.redirect('/users');
});
```

[code](#) Create a login form

*views/users/login.pug*

```
extends ../layout

block content
 form(method='post' action='/users/login')
 div
 label(for='username') Username
 input(type='text' name='username' id='username')
 div
 label(for='password') Password
 input(type='password' name='password' id='password')
 div
 input(type='submit' value='Login')
```

[code](#) Add an index end point for users

*routes/users.js*



```
router.get('/', function(req, res){
 res.render('users/index');
});
```

`</>` [code](#) Add a view for the users index.

*views/users/index.pug*

```
extends ../layout

block content
 h1 Users Management
```

`</>` [code](#) Create a GET end point for logout

*routes/users.js*

```
router.get('/logout', function(req, res){
 req.logout();
 res.redirect('/users/login');
});
```

## Authenticated Whitelist

```
//Session based access control
app.use(function(req,res,next){
 //return next();

 var whitelist = [
 '/',
 '/favicon.ico',
 '/users/login'
];

 if(whitelist.indexOf(req.url) !== -1){
 return next();
 }

 //Allow access to dynamic end points
 var subs = [
 '/stylesheets/'
];

 for(var sub of subs){
 if(req.url.substring(0, sub.length)===sub){
 return next();
 }
 }

 if(req.isAuthenticated()){
 return next();
 }

 return res.redirect('/users/login');
});
```

## Create an AJAX Appliction to for Managing Users

### CORS Cross-Origin Resource Sharing

```
//Set up CORS
app.use(function(req, res, next) {
 res.header('Access-Control-Allow-Credentials', true);
 res.header("Access-Control-Allow-Origin", "");
 res.header('Access-Control-Allow-Methods', 'GET,PUT,POST,DELETE');
 res.header('Access-Control-Allow-Headers', 'Origin, X-Requested-With, X-HTTP-Method-Override, Content-Type, Accept');
 if ('OPTIONS' == req.method) {
 res.send(200);
 } else {
 next();
 }
});
```

## AJAX

Create a method called viewIndex. This method will make an API call to the users index end point aka /.

```
function viewIndex(){
 //Define the target url
 var url = 'http://localhost:3000/api/users';

 //Create a new AJAX request
 var xhr = new XMLHttpRequest();
 xhr.open('GET', url);
 xhr.send();

 xhr.onload = function(){
 console.log(JSON.parse(xhr.response));
 }
}
```

```
function viewIndex(){
 var url = 'http://localhost:3000/api/users';

 var xhr = new XMLHttpRequest();
 xhr.open('GET', url);
 xhr.send();

 xhr.onload = function(){
 let data = JSON.parse(xhr.response);
 var rows = '';

 for(var i=0; i<data['users'].length; i++){
 let x = data['users'][i];
 let name = `${x.first_name} ${x.last_name}`;
 rows = rows + `<tr>
 <td>
 <a href="#edit-${x._id}"
 onclick="viewUser('${x._id}')">
 ${name}

 </td>
 <td>${x.username}</td>
 <td>${x.email}</td>
 </tr>`;
 }

 var app = document.getElementById('app');
 app.innerHTML = `<table class="table">
 <thead>
 <tr>
 <th>Name</th>
 <th>Username</th>
 <th>Email</th>
 </tr>
 </thead>
 <tbody>
 ${rows}
 </tbody>
 </table>`;
 }
}
```

```

 <th>Email</th>
 </tr>
 </thead>
 <tbody>${rows}</tbody>
 </table>`;
}
}

function viewUser(id){
 var url = 'http://localhost:3000/api/users/' + id;

 var xhr = new XMLHttpRequest();
 xhr.open('GET', url);
 xhr.send();

 xhr.onload = function(){
 var data = JSON.parse(xhr.response);
 var user = data.user;
 var app = document.getElementById('app');

 app.innerHTML = `
 <h2>${user.last_name}, ${user.first_name}</h2>
 <table class="table">
 <tbody>
 <tr><th>ID</th><td>${user._id}</td></tr>
 <tr><th>First Name</th><td>${user.first_name}</td></tr>
 <tr><th>Last Name</th><td>${user.last_name}</td></tr>
 <tr><th>Username</th><td>${user.username}</td></tr>
 <tr><th>Email</th><td>${user.email}</td></tr>
 </tbody>
 </table>

 <h3>Edit the User Record</h3>
 <form id="editUser" action="/api/users" method="put">
 <input type="hidden" name="_id" value="${user._id}">
 <div>
 <label for="username">Username</label>
 <input
 type="text"
 name="username"
 id="username"
 value="${user.username}">
 </div>

 <div>
 <label for="email">Email</label>
 <input
 type="text"
 name="email"
 id="email"
 value="${user.email}">
 </div>

 <div>
 <label for="first_name">First Name</label>
 <input
 type="text"
 name="first_name"
 id="first_name"
 value="${user.first_name}">
 </div>

 <div>
 <label for="last_name">Last Name</label>
 <input
 type="text"
 name="last_name"
 id="last_name"

```

```

 value="{user.last_name}">
 </div>

 <input type="submit" value="Submit">
 </form>

 <div class="actions">
 <a href="#deleteUser-{$user._id}"
 onclick="deleteUser('{$user._id}');"
 class="text-danger"
 >Delete
 </div>
 `;

var editUser = document.getElementById('editUser');
editUser.addEventListener('submit', function(e){
 e.preventDefault();
 var formData = new FormData(editUser);
 var url = 'http://localhost:3000/api/users';
 var xhr = new XMLHttpRequest();
 xhr.open('PUT', url);
 xhr.setRequestHeader(
 'Content-Type',
 'application/json; charset=UTF-8');

 var object={};
 formData.forEach(function(value, key){
 object[key] = value;
 });
 xhr.send(JSON.stringify(object));

 xhr.onload = function(){
 let data = JSON.parse(xhr.response);
 if(data.success===true){
 viewIndex();
 }
 }
});
}

function createUser(){
 var app = document.getElementById('app');
 app.innerHTML = `<h2>Create a New User</h2>
 <form id="createUser" action="/api/users" method="post">
 <div>
 <label for="username">Username</label>
 <input type="text" name="username" id="username">
 </div>

 <div>
 <label for="email">Email</label>
 <input type="text" name="email" id="email">
 </div>

 <div>
 <label for="first_name">First Name</label>
 <input type="text" name="first_name" id="first_name">
 </div>

 <div>
 <label for="last_name">Last Name</label>
 <input type="text" name="last_name" id="last_name">
 </div>

 <input type="submit" value="Submit">
 </form>`;

```

```
var createUser = document.getElementById('createUser');
createUser.addEventListener('submit', function(e){
 e.preventDefault();

 var formData = new FormData(createUser);
 var url = 'http://localhost:3000/api/users';
 var xhr = new XMLHttpRequest();
 xhr.open('POST', url);

 xhr.setRequestHeader(
 'Content-Type',
 'application/json; charset=UTF-8'
);

 var object = {};
 formData.forEach(function(value, key){
 object[key]=value;
 });

 xhr.send(JSON.stringify(object));
 xhr.onload = function(){
 let data = JSON.parse(xhr.response);
 if(data.success===true){
 viewIndex();
 }
 }
});

function deleteUser(id){
 if(confirm('Are you sure?')){

 var url = 'http://localhost:3000/api/users/' + id;

 var xhr = new XMLHttpRequest();
 xhr.open('DELETE', url);
 xhr.send();

 xhr.onload = function(){
 let data = JSON.parse(xhr.response);
 if(data.success===true){
 viewIndex();
 }
 }
 }
}

var hash = window.location.hash.substr(1);
if(hash){
 let chunks = hash.split('-');

 switch(chunks[0]){

 case 'edit':
 viewUser(chunks[1]);
 break;

 case 'createUser':
 createUser();
 break;

 default:
 viewIndex();
 break;

 }
}else{
 viewIndex();
}
```

```
}
```

## Lab

1. Create an articles model
  - i. The schema **MUST** contain the following fields
    - title - String
    - slug - String
    - keywords - String
    - description - String
    - body - String
    - published - Date
    - created - Date
    - modified - Date
  - ii. Created and modified dates **MUST** default to now
  - iii. Published date **MUST** be required
  - iv. Published date **SHOULD** default to now
  - v. The modified date **MUST** auto-set on update (pre save) 1. The slug **MUST** auto-set from the title (pre validation)
2. Create a full CRUD REST API for articles

## Walkthrough

### Create a New Feature Branch

A feature branch gives us a place to develop a new feature. Here, we can commit changes specific to a given feature. Once that feature is complete we can merge our changes into the master branch.

```
git checkout -B articles
```

`</>code` Create the Article Model

`</>code` Auto gen a slug prior to validation

`</>code` Add routes

## UI

1. Build a CMS
  - Build a JS app that allows us to work with the API.
  - Build a static view page that is not Ajax.
2. Add an additional Passport strategy of your choosing (GitHub, Facebook, Twitter, etc)
3. Add the ability to reset passwords
4. Create a SPA (single page application) called auth, this will provide
  - user registration
  - user login
  - the ability to change a password
5. Build a layout for website and style the app.
6. Gulp Task
  - Add *src* and *dist* folders to the public directory.
  - Create a Gulp task that will automate the front end packaging

## Additional Resources

- [Express](#)
- [Pug](#)
- [NodeJS Security Checklist](#)

## ReverseProxy

A reverse proxy allows another web server such Apache, IIS, Nginx, etc to stand in front of ExpressJS and is recommended as a [production best practice](#) by the ExpressJS team. In this example ExpressJS will run on localhost:3000 and Apache will field the requests to <http://loc.mean.example.com> (over port 80) and direct those to <http://localhost:3000>

Install the required Apache mods.

```
sudo a2enmod proxy
sudo a2enmod proxy_http
```

Create a VHOST

```
<VirtualHost 127.0.0.102:80>

 ServerName loc.mean.example.com
 ServerAdmin webmaster@localhost

 <Proxy *>
 Order deny,allow
 Allow from all
 </Proxy>

 ProxyRequests Off
 ProxyPreserveHost On

 ProxyPass / http://localhost:3000/
 ProxyPassReverse / http://localhost:3000/

 ErrorLog ${APACHE_LOG_DIR}/error.log
 CustomLog ${APACHE_LOG_DIR}/access.log combined

</VirtualHost>
```

Update your hosts file

```
sudo vim /etc/hosts
```

and add the entry

```
127.0.0.102 loc.mean.example.com
```

Open a browser and navigate to [loc.mean.example.com](http://loc.mean.example.com)

## Additional Resources

- [Advantages of a reverse proxy in front of Node.JS](#)
- [Production best practices: performance and reliability](#)
- (Using nginx as a reverse proxy in front of your Node.js application)[<http://www.nikola-breznjak.com/blog/javascript/nodejs/using-nginx-as-a-reverse-proxy-in-front-of-your-node-js-application/>]
- [Expose Node.js on an IIS Server by Reverse Proxying With ARR](#)





# WebSockets

"[The WebSocket Protocol](#) enables two-way communication between a client running untrusted code in a controlled environment to a remote host that has opted-in to communications from that code.<sup>1</sup>"

## Simple Chat App

## Additional Resources

- [The WebSocket Protocol](#)
- [sokcet](#)

## Footnotes

<sup>1</sup> [RFC 6455 - The WebSocket Protocol](#).

# PM2

## Introduction

PM2 is one of many process managers for NodeJS. We use it primarily to allow the server to auto-recover from errors and managing the number of processes running per machine.

We will start by forcing MongoDB to start up on boot. *rc.local* executes as the system boots.

```
vim /etc/rc.local
```

Add the line `service mongod start` right before `exit 0`. */etc/rc.local* should now read as follows, if it does reboot your system (DO NOT delete anything that was there before, we are only adding to the file).

```
#!/bin/sh -e
#
rc.local
#
This script is executed at the end of each multiuser runlevel.
Make sure that the script will "exit 0" on success or any other
value on error.
#
In order to enable or disable this script just change the execution
bits.
#
By default this script does nothing.

start MongoDB on boot
service mongod start

exit 0
```

When the system boots up type the command `mongo` into a terminal window, if MongoDB starts up you ready for the next step.

```
sudo npm -g install pm2
```

In Atom navigate to *mean.example.com* and add the file *process.yml* and add the following.

```
...

.bashrc executes when a given user account is loaded.

```sh
cd ~
vim .bashrc
```

Add the following line.

```
cd /var/www/mean.example.com && pm2 start process.yml && cd ~
```

Then restart your bash script.

```
. .bashrc
```

Navigate to *loc.mean.example.com*

Additional Resources

- [PM2](#)

Introduction

Angular is a toolkit that makes it easy to build web, mobile, or the desktop applications with using web technology. Angular combines TypeScript, design patterns and auto bundling (think automated gulp) to compile, transpile and package front end assets in realtime. Angular is a CLI based application that runs a dev server on port 4200. Once your satisfied with your project it can be packaged into a distribution package consisting of HTML, CSS and JavaScript.

In this unit we will

- Learn the basics of TypeScript.
- Complete Angular's Tour of Heroes (TOH) tutorial.
- Add a TOH API to an existing stack.
- Modify the TOH app to work with our API.
- Apply Angular to our existing ExpressJS app by adding
 - An authentication app
 - An app for managing blog posts (aka a CMS)
 - A app for managing users

Install Cordova

- Convert the Nasa App to mobile.
- Install Ionic
- Build the users App

Apache Cordova

[Apache Cordova](#) is a free and open source environment that allows us to use web technologies to target multiple platforms with a single code base. This is used primarily for mobile development. While we are able to write the code using web technologies, we still need access to that platform's build environment. Cordova provides a mechanism to compile technology into native application code but it still needs the native environment to build and test that package. If you want to compile your application into an iOS app you will still need access to a MAC running the latest version of xCode. Android on the other hand can build on Windows, MAC or Linux as a result we will focus our build on Android. For the most part, anything you build in Cordova for Android should run on iOS save for the occasional tweaks.

[Android Studio](#) is the official IDE (Integrated Dev Environment) for building Android applications, this provides everything you will need to build Android applications. There are however a few dependencies.

In this lesson we will install

- Apache Cordova
- Java
- Gradle
- Android studio
- A few 32 bit binaries.

Install Apache Cordova

Cordova is built on top of Node; we will use npm to do a global install.

```
sudo npm install -g cordova
```

Install the Java SDK

Android runs on top of Java (and Java compatible APIs) we will need to install Java so we can compile our web based build into Java. We will use Oracle's JDK for this (there are rumors that Google will switch future build to Open-JDK).

Start by adding Oracle's PPA.

```
sudo add-apt-repository ppa:webupd8team/java
```

Update your apt repos list

```
sudo apt-get update
```

Install the JDK

```
sudo apt-get install oracle-java8-installer
```

Choose the desired installation Run the command `sudo update-alternatives --config java` and chose from the resulting menu, which should be similar to the following. In this case, I selected option 0 *auto mode*

Selection	Path	Priority	Status

```
0          /usr/lib/jvm/java-8-oracle/jre/bin/java  1081    auto mode
* 1        /usr/lib/jvm/java-8-oracle/jre/bin/java  1081    manual mode
```

You will need to set your `JAVA_HOME` Environment [Variable](#) (so that running programs can find Java). To do this you will need to find your Java path; do this with the following command (the result of which will contain your Java path).

```
sudo update-alternatives --config java
```

Now set the path using your favorite editor. In my case the path is at `/usr/lib/jvm/java-8-oracle/jre/bin/java` so I will add this line `JAVA_HOME="/usr/lib/jvm/java-8-oracle/jre/bin/java"` to the environment file.

```
sudo vim /etc/environment
```

Once you have added the that line, you will want to reload the file.

```
source /etc/environment
```

```
java -version
```

Install Gradle

In short Gradle is a the build system used by Android. Stack Overflow has a [more detailed answer](#). You can install this using Apt, but the Ubuntu repos are a little behind on this one, so it's better to install it manually.

Download and Unpack Gradle

```
cd ~/Downloads
wget https://services.gradle.org/distributions/gradle-4.7-bin.zip
sudo mkdir /opt/gradle
sudo unzip -d /opt/gradle gradle-4.7-bin.zip
```

Add an Environmental Variable on Startup

Open the *environment* file

```
sudo vim /etc/environment
```

add the following lines, the first is for Gradle, the others you will need later so add them now. Replace `YOUR_USER_NAME` with the user name you use to login to your system.

```
export PATH=$PATH:/opt/gradle/gradle-4.5/bin
export ANDROID_HOME=/home/YOUR_USER_NAME/Android/Sdk
export PATH=${PATH}:${ANDROID_HOME}/tools:${ANDROID_HOME}/platform-tools
```

Restart environment

```
source /etc/environment
```

Install additional 32 bit libraries


```
sudo apt-get install libc6:i386 libncurses5:i386 libstdc++6:i386 lib32z1 libbz2-1.0:i386
```

Install the Android SDK

If you were to build an Android application from scratch, this is what you would use. Cordova needs access to the SDK for it's builds and we need access to the emulators. You will use Cordova to write the code, Cordova will use the Android SDK to build your applications and you will use Android Studio to build your emulators.

Download Android Studio

```
cd ~/Downloads
sudo unzip android-studio-ide-*.linux.zip -d /usr/local
cd /usr/local/android-studio/bin
./studio.sh
```

Follow the prompts and keep choosing next.

_ At some point you will be asked to create or import a new project. This is required but we will not use it. When prompted to do so, go ahead and create a project. Create a new project called Hello World

- Choose create with no activity _

You should now have a running instance of Android Studio. Add a desktop entry *Tools > Create desktop entry...* and lock Android Studio to your launcher.

Now it's time to create an (AVD (Android Virtual Device))(<https://developer.android.com/studio/run/managing-avds.html>)

Tools > Android > AVD Manager Click the *Create Virtual Device* button Choose Nexus 5x Click on the *x86 images* tab and choose *Nougat 25 x86_64* (Download if required) Choose the default options from the AVD screen and click *Finish* From the *Your Virtual Devices* dialog click the green arrow beside our new device.

Hello World

Now let's get started with Cordova. We will start with the classic Hello World example. We will create our Hello World application is a package called hello. This will create a starter package with a few lines of source code to get your started.

```
cd ~
cordova create hello com.example.hello HelloWorld

cd hello
```

Check your list of platforms

```
cordova platform ls
```

Add the Android platform to your project.

```
cordova platform add android
```

Build and Android package from source code.

```
cordova build android
```

Start the emulator

```
cordova emulate android
```

Close the emulator.

Debugging with Logcat.

[Logcat](#) is the default android debugger, we can use this for tracking down issues in our web code. To do this we will want to add the [console plugin](#) to our Cordova app.

```
cordova plugin add cordova-plugin-console
```

Start your emulator and in another terminal start logcat

```
cordova emulate android  
  
adb logcat
```

Everything that happens in the emulator is logged. Logcat `adb` is installed with android studio and lets us read the logs in real time. In a new console, run the logcat command.

```
adb logcat
```

You'll notice straight away that this is far too verbose to be useful, so you will want to run it with filters. We will use the regex filter to only return messages that have contain the string `INFO:CONSOLE`. This will limit Logcat's output primarily to `console.log()` calls. Making it far less verbose and allowing us focus on messages that matter.

```
adb logcat ActivityManager:I Cam:V -e INFO:CONSOLE*
```

Camera Plugin <https://cordova.apache.org/docs/en/latest/reference/cordova-plugin-camera/>

Additional Resources

[Use SQLite In Ionic 2 Instead Of Local Storage](#)

Appendix

Security

This appendix contains information and resources pertinent to information security. While InfoSec is a field in and of itself; it is a cross-functional field. An understanding of security principles and best practices is crucial for long term success in any technical field. I highly recommend for anyone serious about development to delve deeper into this topic.

Additional Resources

- The [Security Now](#) podcast.
- [Sans NewsBites](#)
- [Sans Webcasts](#)

Templates

- [HTML5 Template](#)

A Basic HTML Template

```
<!DOCTYPE html>
<html lang="en">
  <head>
    <meta charset="UTF-8">
    <title>Contact</title>
    <meta name="viewport" content="width=device-width, initial-scale=1.0">
  </head>
  <body>
    <h1>Contact</h1>
  </body>
</html>
```

Search Engine Optimization

This appendix contains information and resources pertinent to information search engine optimization (SEO).

Samples

Downloadable resources and code files [available here](#)

Syllabus (8/13/18 - 10/15/2018)

- Class Hours: Monday-Friday, 9am-5pm
- First Day: Monday, August 13, 2018
- Last Day: Monday, October 15, 2018
- Class will **NOT** meet on
 - Monday September, 3, 2018

Contact

- Join the [Slack Channel](#)
- Email bootcamp@microtrain.net

Description

The class is 40 hours a week for 10 weeks. It is comprised of a series of units. A unit is comprised of working lectures, exercises, labs and additional resources. The goal of this class is to provide a working knowledge of web and mobile application development. This course is not a deep dive on any one topic, rather it is intended to provide a working foundation that will allow you to hit the ground running and give you the knowledge base upon which to build a career. In most cases you will get a light introduction to a topic; typically within a specific context. We will build on these topics as we progress through the course. The syllabus is tentative and may be adjusted to the pace of the class as a whole. The last two to three weeks of class are open and are intended for to allow each student to complete a single or multiple projects to add to their portfolio.

Expectation

- Class starts promptly at 9am, you are expected to have your systems booted up and to be ready to go by 9am.
- Please limit cell phone use during lecture.

Unit Composition

A Lecture

An overview of the topic(s) at hand.

Exercises

Guided application of the topic(s) at hand.

Coding Challenges

Planned and impromptu inclass assignments that will present new and old concepts as challenges to be solved in code.

Labs

The work you are expected to do on your own. Lectures and exercises should take roughly 40% - 50% of the class time with the rest of the time being spent in labs. If you get ahead it is expected that

Additional Resources

This section provides links to additional reading, conversation, ebooks, videos online courses ect. While not required it is encouraged and expected that you will spend some time reviewing this material.

Udemy

We use Udemy as supplemental material. While it is not required it is encouraged to at least review the courses provided in the Additional Resources section. You will have access to Udemy for one year from today so event after this course is finished you can continue to learn in a structured environment.

Khan Academy

This provides free online learning for various topics. This is mostly included as a review of Algebra, Geometry, etc. We do not get to heavy with these topics but any one wanting a review can do so through the links provided.

TENTATIVE SCHEDULE

Week 1 (Dev, Bash, HTML, CSS)

Build and Understand a Development Environment ~1 Day

- Install Ubuntu Linux
- Linux basics
- Install dev tools
- Install the LAMP stack
- Configure the Apache Web Server
- NPM
- Git

Programming Basics ~1 day

- Shell Scripting with Bash

Introduction to Web ~3-5 days

- The Anatomy of a URL
- HTML
 - Intorduction to HTML
 - GitHub Pages (Basic Website)
 - Web Forms
 - HTML Resume
- CSS/Preprocessors
 - CSS and Basic Styles
 - SASS/SCSS and Gulp Processes
 - CSS Layouts (floating grids, CSS grids, flexbox)
 - Responsive CSS

Weeks 2-3 (Server Scripting, PHP, JavaScript)

Server Scripting with PHP ~1-3 days

- Introduction to Templates
 - Build a template in PHP
 - PHP Web Site
 - Form Processing in PHP

JavaScript, jQuery, AJAX and Bootstrap ~5-7 days

- Programming Basics with JavaScript
- Walking the DOM
- Catch Events
- Programming the Canvas
- jQuery Basics
- Ajax
- Introduction to Bootstrap

Weeks 3-4 (SQL, NoSQL, Web Frameworks)

MySQL and CakePHP ~3 days

- MySQL
- CakePHP
- Unit Testing
- Automated Code Review with Code Climate.

MongoDB, Express ~5 days

- MongoDB
- Express
- REST API
- Web Sockets

Introduction to the Cloud 1-2 days

- Launch a production site to Digital Ocean on your preferred tech stack (MEAN or LAMP).

Output Your personal production site on Digital Ocean on your preferred tech stack (MEAN or LAMP).

Week 5 (Angular)

Angular ~5 days

- Tour of Heroes Tutorial
- Interact with your REST API

Week 6-7 (Hybrid Mobile)

Apache Cordova and Ionic ~10 days

- Learn how to build mobile device emulators.
- Learn how to emulate mobile devices using the Chrome browser and Dev Tools.

- Run existing web code as a mobile app
- Ionic Applications

Weeks 8-10

If applicable week 8 may serve as catchup, review or overflow time for any topics of which there are issues.

Projects

Whatever you want to build. Start thinking of a project sooner than later