SCHOOL OF ELECTRICAL AND INFORMATION ENGINEERING
University of the Witwatersrand, Johannesburg
Software Development III

Laboratory 1 — Git Collaboration, Azure Deployment

In this lab we will go over the basics of git usage as well as show how a static website can be deployed to Microsoft's Azure cloud service.

1 Install Git

Go to https://git-scm.com/downloads and follow the instruction for your operating system.

GitKraken: Installation

For Git, an alternative to the command line is GitKraken which is a GUI frontend for the Git tool. Download the installer from https://www.gitkraken.com/download and following the instructions.
Note: For some of the sections in this lab, the GitKraken procedure is shown in a box like this one.

2 Setting up Git

Once you have installed Git, there are a few things to do before you can start working

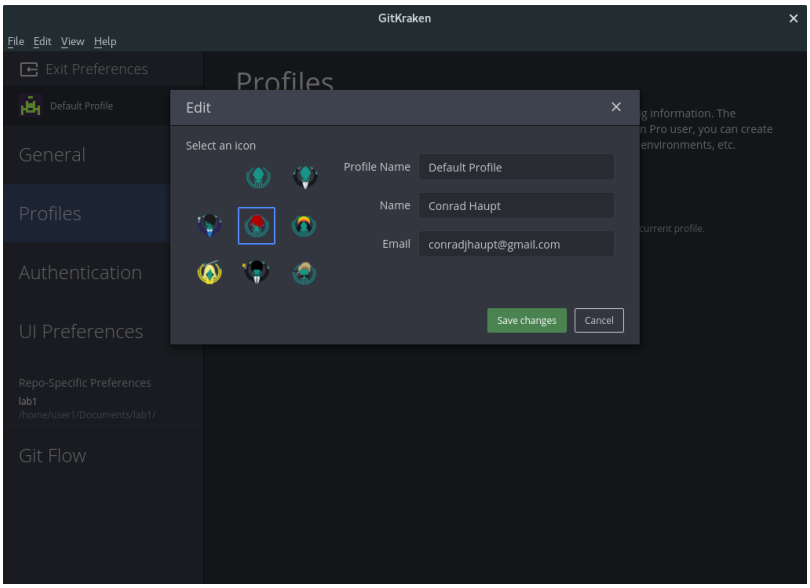
2.1 Setting up your global identity

Whenever you make a change using Git, your name and email address are recorded. These can be set up per-repository or globally (per-installation). We will be configuring a global ID. To do so, open the terminal/git bash and type the following in *mutatis mutandis* (i.e. use what is below as a template, changing that which must be changed):

```
1 git config --global user.name "Micky Duck"
2 git config --global user.email "micky.duck@students.wits.ac.za"
```

GitKraken: Config setup

To setup your Git config, navigate to the GitKraken preferences (hamburger icon on the top-right) and then "Profiles" in the sidebar. A screenshot of this window is given below. You can setup this in GitKraken or the Git command-line tool.



2.2 Setting up your editor

git brings up an editor at several points for you to make comments. The default editor is `vi`, which, while it has its share of devotees, does not have obvious key-strokes. Other command line editors are `emacs`, `nano` and `pico`. Another option is to use the default text editor for your system: `notepad` for Windows, `textedit` for OS X or `gedit` for Ubuntu (and most other linux distros). If you don't know what to use, then your system's editor is a good place to start. To set your editor, type:

```
git config --global core.editor nano #or emacs, notepad, vim, etc...
```

3 Creating and using a local repository

Now we will create a local repository and put some files under version control.

3.1 Initialising the repository

Create a folder where you want your repository to be. Now open the terminal/git bash again and type the following in *mutatis mutandis*:

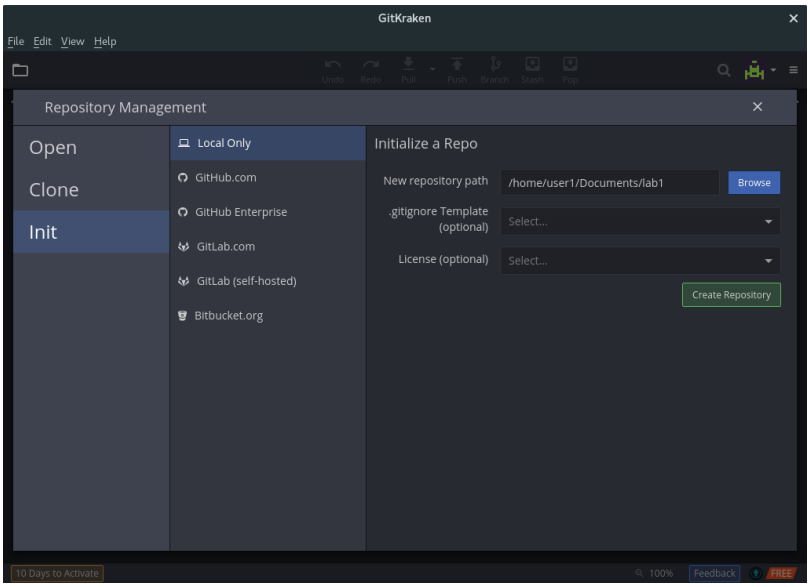
```
cd /path/to/my-git-repo #From now on I'm going to assume you are in the
# repository directory unless directed otherwise

git status              #This line should give you an error
git init
git status              #This line should not give you an error
```

Notice the output of the `git status` commands? (We're going to be using this command a lot)

GitKraken: Init repo

To initialise/clone/open any repo in GitKraken, click on the folder icon on the top left of the window. The repo initialisation window is shown below.



3.2 Committing files

Now that we have a repository, let's add some files. Since we're going to be doing web development, let's make a simple website. In your repository folder, create a file called `index.html` and type the following in **exactly as below**:

```
1  <!DOCTYPE html>
2  <html lang="en">
3  <head>
4      <title>Hello World</title>
5      <meta charset="utf-8" />
6  </head>
7  <body>
8      <h1>Hello World</h1>
9      <p>
10     &#127760 - Hello (your name here)!
11     </p>
12 </body>
13 </html>
```

Also create a file called `dummy.html` without any text in it.

Open `index.html` in your web browser. Not pretty, but it works!

Commits: Every time you save changes with git, you need to make a commit. A commit is like a snapshot of the state of your repository when you made the commit. This allows you to see all the previous versions of your files by moving between commits.

Commit this file with git (once again *mutatis mutandis*):

```
git commit -m "My first commit"
```

The output should be ... `nothing to commit`?

Check the status of the repository:

```
git status
```

File tracking: Git doesn't automatically track files because there are often files that we don't want to keep under revision control such as binaries, compilation artifacts, debug logs and any other content that would bloat the repository unnecessarily. To keep a project small and efficient, you should only track *source* files and omit anything that can be generated from those files.

So, our files need to be tracked. This is done by staging them.

Staging: Continuing on the photography metaphor, in order to include something in a snapshot(commit) it needs to be staged. This is done using the `git add <files>` command which tells Git to include the listed files in the next commit. Staging has to be done before every commit, even if the file is tracked.

Stage `index.html` and `dummy.html`:

```
git add index.html dummy.html
git status
```

Try committing the files again:

```
git commit
```

Your chosen text editor should come up. Type the message "My first commit" and save the file. Now close the editor. This signals to Git that you are done entering your message and that it should continue with the commit.

Make sure the commit worked:

```
git status
```

What does the `-m` flag do?

Working Directory: Note that you could have many git repos. Git, by default, assumes you are referring to the repo in the current directory. The contents of the current directory is the working directory. Usually there will be some minor to moderate changes of the contents of the directory compared to the most recent commit. You can restore files from previous commits into your working directory, if you need to.

Staging more efficiently: The `git add` command supports flags to make staging files faster. By giving the relative folder path to the repository folder (`git add .` ← the dot is the file path) git will stage all files that are new or modified as well as files that have been

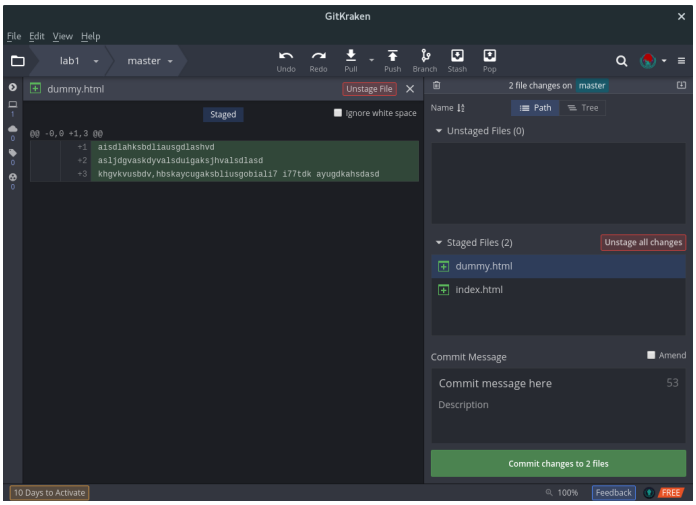
deleted. `git add -u .` will only stage tracked files that have been modified or removed and `git add –ignore-removal .` will ignore deletions, but stage both tracked and untracked files.

Staging and committing as a single command: the `-a` flag can be used when committing to automatically stage changes to and deletions of tracked files. Thus, in most cases where new files have not been created, a commit can be reduced to:

```
git commit -am " <commit message here> "
```

GitKraken: Staging and Commiting

Once a repo is open in GitKraken, the Git history (similar to `git log`) is shown in the middle of the window. The right sidebar shows any modified files (both staged and unstaged). To commit a file/modification stage the file, enter a commit message, and confirm. You can fine-tune each commit by selecting the file and staging specific lines. A preview of a staged commit is shown below.



4 Moving between commits

Edit line 10 of `index.html` to reflect your name rather than the placeholder. Delete `dummy.html`. Stage and commit `index.html` with an appropriate commit message.

Now, edit your name in line 10 of `index.html` replacing the first vowel with a "q". Stage and commit this change with the message "A Mistake"

Look at the commit history of the repository using:

```
git log
```

Commit checksums: Note that the log gives a history of all commits. Next to each commit is a checksum that acts as an ID. However, as we will see later, you don't need to use the entire checksum to refer to a commit, just the first part.

4.1 Reverting a commit

That last commit was clearly a mistake, let's undo it.

To do this we are going to call `git revert <commit ID>` with the ID of the last commit. Remember that you don't need to type the whole checksum, just the first few digits. So run the following (*mutatis mutandis*):

```
git log --oneline   # To find out the checksum of the previous commit
                    # Notice that --oneline only shows the first few digits
                    # of the commit checksums
git revert 3eb20e6 # Substitute the first few digits of your commit checksum
```

Notice that instead of deleting the "A Mistake" commit, Git figures out how to undo the changes it contains, then tacks on another commit with the resulting content. So, our fourth commit and our second commit represent the exact same snapshot, as shown below. Again, Git is designed to never lose history. The third snapshot is still accessible, just in case we want to continue developing it.

Let's add an author page to our website. Create a file called `author.html` with the following content:

```
<!DOCTYPE html>
<html lang="en">
<head>
    <title>Authors</title>
    <meta charset="utf-8" />
</head>
<body>
    <h1>This page was made by:</h1>
    <p>
    (your name here)!
    </p>
</body>
</html>
```

Let's make some more mistakes:

Create two new files: `tracked.html` and `untracked.html` with anything in them.

Now run the following:

```
rm index.html
git add tracked.html
```

GitKraken: Reverting a commit

The option to revert a commit is shown in the right-click menu for any specific commit in the main window.

4.2 Undoing changes without committing

Now, we don't want to commit those mistakes. Let's revert them. However, we don't want to use `git revert` this time. We don't want to just commit and revert because we'll lose all our useful work in creating `author.txt`. So we're going to have to remove the incorrect files manually.

Any newly created file that has not been git added can just be deleted. But a file that we have asked git to add, must be unstaged using reset. Finally we can undo a change to a file by doing a checkout from the repo. Here HEAD is a git key word, which refers to the commit we are about to operate on. Usually this refers to the most recent commit (as it does in the example below), but we can change the HEAD.

```
rm untracked.html # untracked files can just be deleted
git status

git reset HEAD tracked.html # tracked files must be unstaged using reset
git status

rm tracked.html
git status

git checkout index.html
git status
```

The `checkout` command we used got the file from the most recent commit. But you can also get a file (or files) from a previous commit. As an example, suppose we realise that it was a mistake to delete the `dummy.html` file. We do a `git log` to remind us of when we had it and find the commit ID. Then we change our status to checkout all the files from that commit into the working directory. Do the following (*mutatis mutandis*) using your commit ID, not mine:

```
git checkout d82778f7b9
```

Now you can do an `ls` and check that this was the commit where you had the `dummy.html` file. If not, you checkout another commit until you find it.

Now you can copy the file into a temporary place:

```
mkdir ../tmp
cp dummy.html ../tmp
```

And we go back to where we came from and restore the file (`master` points to the most recent commit).

```
git checkout master
mv ../tmp/dummy.html .
rm -rf ../tmp
git add dummy.html
git commit -a -m 'Restoring dummy.html'
```

As an aside, if we knew for sure which commit the dummy.html was in, we could have just done

```
git checkout d82778f7b9 dummy.html
```

Note that in this case we don't have to do a git add because, although we deleted the file from the directory, it knows this is the same file we used to track.

5 Branching and merging

Suppose you wanted to try out a new idea without using Git, you might copy all of your project files into another directory and start making changes. If you liked the results, you would copy the affected files back into the original project. Otherwise, you would simply delete the entire folder and forget about it.

This is the functionality offered by Git branches... with some key improvements. First, branches present an error-proof method for incorporating changes back into the main project. Second, they let you store all of your experiments in the same directory, with the same version control as your main project.

Let's see our existing branches:

```
git branch
```

The master branch: The master branch is Git's default branch and is usually used to denote the main branch of a project, with experiments being branched from it.

Notice the * next to master? That means that it is the active branch (i.e. the branch currently reflected in the working directory)

Let's create a branch where we can develop a new feature:

5.1 Creating a branch

To create a branch from the active commit, type the following:

```
git branch <branch name>
```

Create a branch called "newFeature".

```
git branch newFeature
```

To switch to the branch, call `git checkout` with the branch name:

```
git checkout newFeature
```

GitKraken: Creating a branch

To create a branch you can either click on the branch icon on the top of the GitKraken window, which will create a branch at the current commit, or right-click on a commit and select "create branch here". To switch between branches either double-click on the branch name in the log window or double-click on the branch item on the left sidebar.

5.2 Committing to a branch

Lets add the links between our index and author pages in this branch.

in `index.html`, add a line above the body closing tag (</body>) with the following:

```
<p><a href="author.html">Authors</a></p>
```

Similarly, in `author.html`, add:

```
<p><a href="index.html">Return to home page</a></p>
```

Open `index.html` in your web browser and confirm that your new links work. Then stage and commit your changes.

Let's also make a second page to greet the universe in `dummy.html`. Change the contents of `dummy.html` to:

```
<!DOCTYPE html>
<html lang="en">
<head>
    <title>Hello Universe</title>
    <meta charset="utf-8" />
</head>
<body>
    <h1>Hello Universe</h1>
    <p>
    Hello (your name here)!
    </p>
  <p><a href="index.html">Return to home page</a></p>
</body>
</html>
```

Add a link to your second page into `index.html` and test that all your new pages and links work. Then, stage and commit your changes.

Now that we're happy that our feature is finished, let's switch back to `master`:

```
git checkout master
```

Notice that all your changes have been undone? Let's look at the log:

```
git log --oneline
```

Your new commits are missing, this is because the commits were made on the newFeature branch.

Since we're done with that branch let's merge it back into master. This is like copying your changes back into your main folder:

```
git merge newFeature
git log --oneline
```

Feature Branches: By creating branches for features in development, we can ensure that no incomplete code is on `master`. This allows us to have a master branch that is always ready to be deployed, since it only contains stable, tested code. What are the drawbacks of this approach?

6 Git Collaboration

For the next section pair up with another member of your group. Where instructed work with your partner.

In this course we will be using GitHub to host our repositories.

Create an account and a new repository for you and your partner. You only need to create one repo for the both of you. Add your partner as a collaborator in the repo settings window so that you both have permission to work on the code.

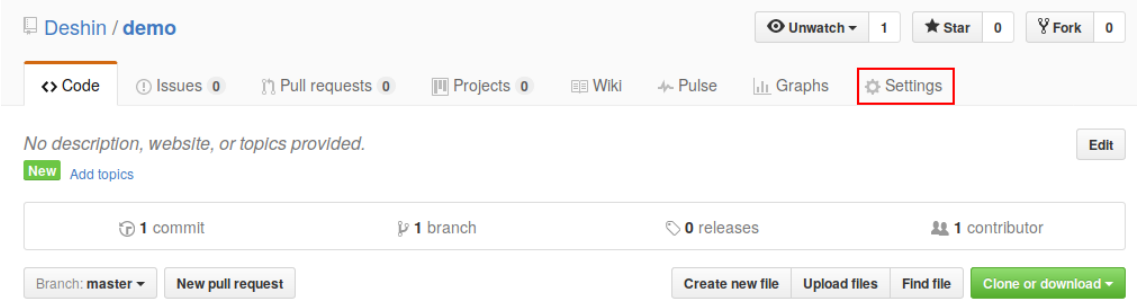


Figure 1: The settings window on Github.

6.1 Local and Remote

In order to work on the code in your new repository, you need to create a local (on your machine) copy of it.

This is achieved by `clone`ing it from your remote repository (GitHub). Get your repository URL from GitHub using the "Clone or Download" button on you repository page. Copy the HTTPS URL.

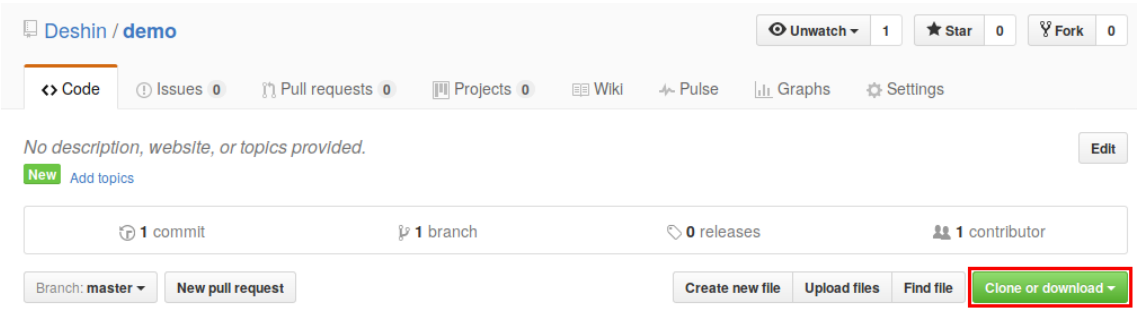


Figure 2: The clone/download button on GitHub.

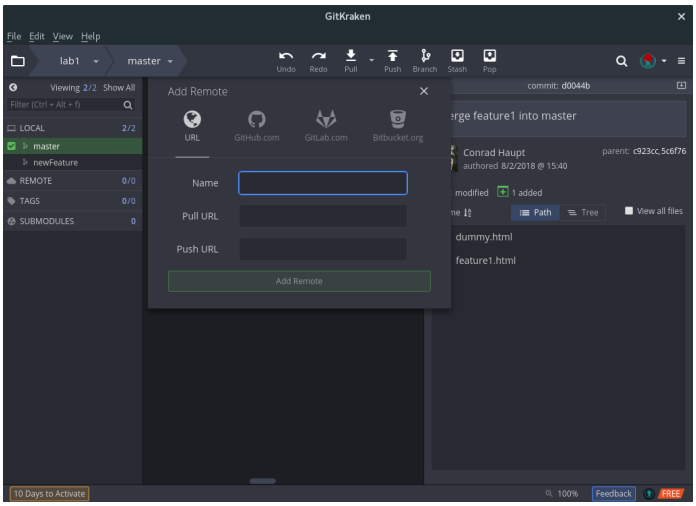
Now, in the folder where you want to clone your repository (it will create a new subfolder) type the following command:

```
git clone <Repository URL> #e.g. git clone https://github.com/Deshin/Lab1-2017.git
```

Git should the create a local copy of your repository.

GitKraken: Adding a remote

To add a remote to your local Git repo using GitKraken hover over the remote label in the left sidebar until a plus icon appears. Click the plus icon and fill in the details of your remote into the window that appears. If you have logged into GitKraken with your Github account, you should see your Github repos listed in the window. This process is shown in the screenshot below.



6.2 Pushing and Pulling

When working with this repository, most interactions are the same as previously with the local-only repository. However, in order to synchronize the remote repository with your local copy, two new concepts are defined, `push`ing and `pull`ing.

Let's make some changes and see how to sync them to the remote.

Open `index.html` and edit it so that the placeholders in brackets are replaced with their correct values. Confirm that your changes are correct using a browser, stage and commit your changes.

Confirm that your commit has worked.

```
git log --oneline
```

Browse to your repository in GitHub and look at the commits to the repository. Notice that your new commit isn't there? It's because your changes to your local repository haven't been synced with the remote yet.

Before we sync the repository, in a different folder, clone your partner's repository (your repository and your partner's will have the same name).

Now we can sync your repository. Switch back to your local repository.

Before we can sync, lets find out what our remote is called:

```
git remote -v
```

Now we can see that our remote is called `origin`

So let's tell Git to push the changes to our local repository up to the remote:

```
git push -u origin
```

The `-u` argument tells git to set the remote as the upstream (default remote) repository so that we can just call `git push` next time.

Make sure your partner has reached this point as well and switch to your partner's repository. Let's get the changes they made to their repository:

```
git pull -u origin
```

Open `index.html` in your browser to confirm that the pull worked.

Order: In order to ensure that you are always committing changes to the newest version of the repository, you should always `pull` before you `push`. This ensures you receive any new commits that have happened to the remote repository before you push your commits.

Now that we have seen that we can synchronise our repositories, let's look at what happens when two people edit the same file.

GitKraken: Pushing and Pulling

To push and pull in GitKraken, use the Pull and Push icons on the top of the window. The pull option has a dropdown menu with more specific types of pull actions. If you have not yet pushed your current branch to your remote, GitKraken will verify that you would like to create a remote branch with the same name. To pull a remote branch you do not have locally, you should instead select the branch in the left sidebar.

6.3 Merge Conflicts

Switch back to your repository and edit your `index.html`, add a group bio to your home page describing the group. To do this, add another paragraph (`<p>`) below the existing one and type your bio in there.

Open `index.html` in your web browser to confirm your changes, stage and commit them.

Do the same for the `index.html` in your partner's repository. In your partner's repository, `pull` and then `push` your changes up to GitHub.

Once your partner has done the same, switch to your repository and `pull` their changes from GitHub. Your output should tell you that a merge conflict occured and it failed to automatically merge the files, instructing you to fix conflicts.

Merge Conflicts When two people attempt to commit changes to the same section of a file, Git is unable to decide which change to use (or whether to keep both and in what

order). This is called a merge conflict. To fix the conflict, it delegates the decision over what to keep to the developer who attempts to commit their changes second. (This is why you must pull before you push)

Okay, let's resolve this merge conflict. Open `index.html` and look at the section where you added your code. Notice that git has added both versions of the line with big delimiters ("«««< HEAD", etc...) between them? To fix the conflict, make the file valid again by removing the delimiters (you can keep both paragraphs). Now call:

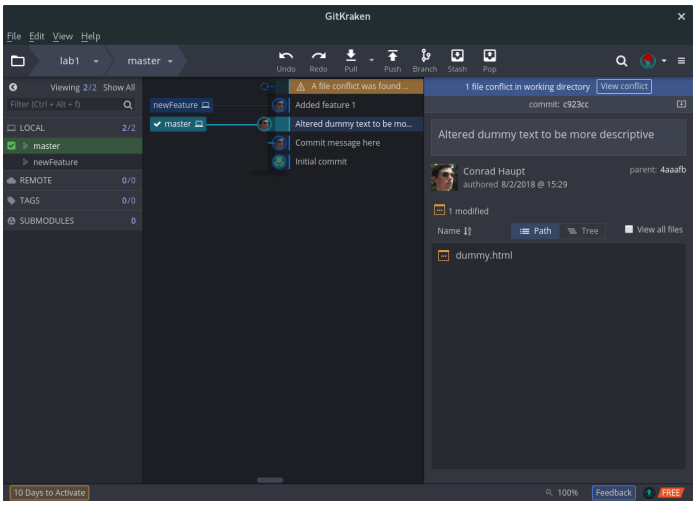
```
git commit
```

Notice that Git has already filled your message in for you?

Finally, `pull` and then `push` your changes up to GitHub

GitKraken: Merge conflicts

If a merge conflict occurs, GitKraken will illustrate this with a yellow commit log message in the main window. Select it to show the conflicting files in the right sidebar. You can either edit the files manually or request GitKraken to open a merge tool. The screenshot below shows how a merge conflict will appear when it cannot be automatically resolved by GitKraken and Git.



6.4 Using a Merge Tool

Doing a merge using a text editor can become tedious and difficult in complex situations where conflicts happen in many parts of many files.

To make it more manageable, we can use a specialised tool to do the actual merge. In this course, we will use Meld. Install it from http://meldmerge.org/.

Now configure git to use Meld as your merge tool:

```
git config --global merge.tool meld
```

To try it out, induce a merge conflict with your partner by adding another paragraph to your and their `index.html`.

This time though, once you get a merge conflict, type:

```
git mergetool
```

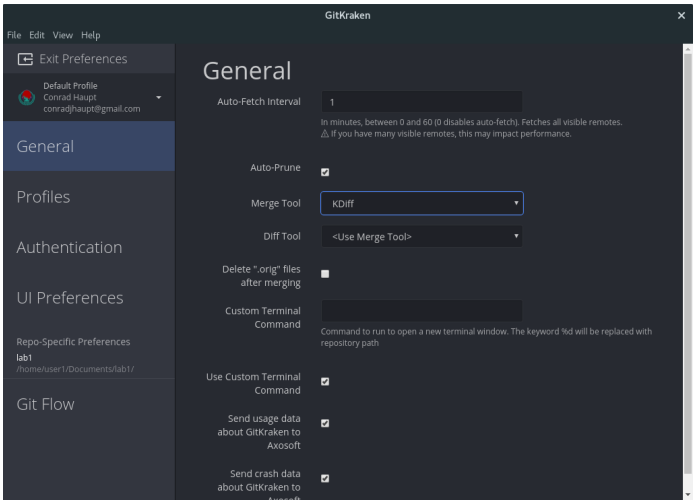
Meld should open. Use Meld to do your merge to the file in the center pane. When you're done, save the file in the center and close Meld. Then commit the fix as usual, `pull` and `push`.

Continue practicing merging with your partner by creating profile pages for yourself and them using `profile.html` as a template. Remember to correct the links in the sidebars of all 3 pages as well.

An alternative to Meld is KDiff3, which can be found at http://kdiff3.sourceforge.net/. To use KDiff3, set it up the same way you would Meld.

GitKraken: Setting default merge and diff tools

To set the default merge and diff tools for GitKraken, navigate to preferences and then "General". If you have installed some of the popular tools, GitKraken should identify them automatically and list them in the dropdown menus. See the screenshot below for how this is meant to look.



7 Git Workflow

There are many workflows for git to standardise how teams submit their code. We discussed the feature branch workflow above where a new branch in created for every new feature and merged once the feature is complete.

In this course, we will be using a simplified form of this workflow. Since we can assume that each developer will be working on only one feature at a time, instead of creating new branches each time, each developer can have a single development branch and submit a pull request every time a feature is completed.

8 Hosting Static Web Pages in Azure

This section of the lab will show you how to simply host the static web pages that you created earlier in the cloud using the PHP technology stack. In subsequent labs, we will

introduce Node as well as *continuous integration* and how to run tests etc. before deploying your code. Additionally, the group laboratory web application will need to be developed using Node.js.

Firstly, sign up for a Microsoft student account here: `https://azure.microsoft.com/en-us/free/students/`. You will need a Microsoft account to complete the Azure Student Account registration.

Go to the GUI interface for Azure at `https://portal.azure.com/` and select *App Service* from the side panel followed by *Add* on the top left. Select *WebApp* as the service type you would like to create. Fill in the details as shown in Figure 3 but change the *app name* to be something unique.

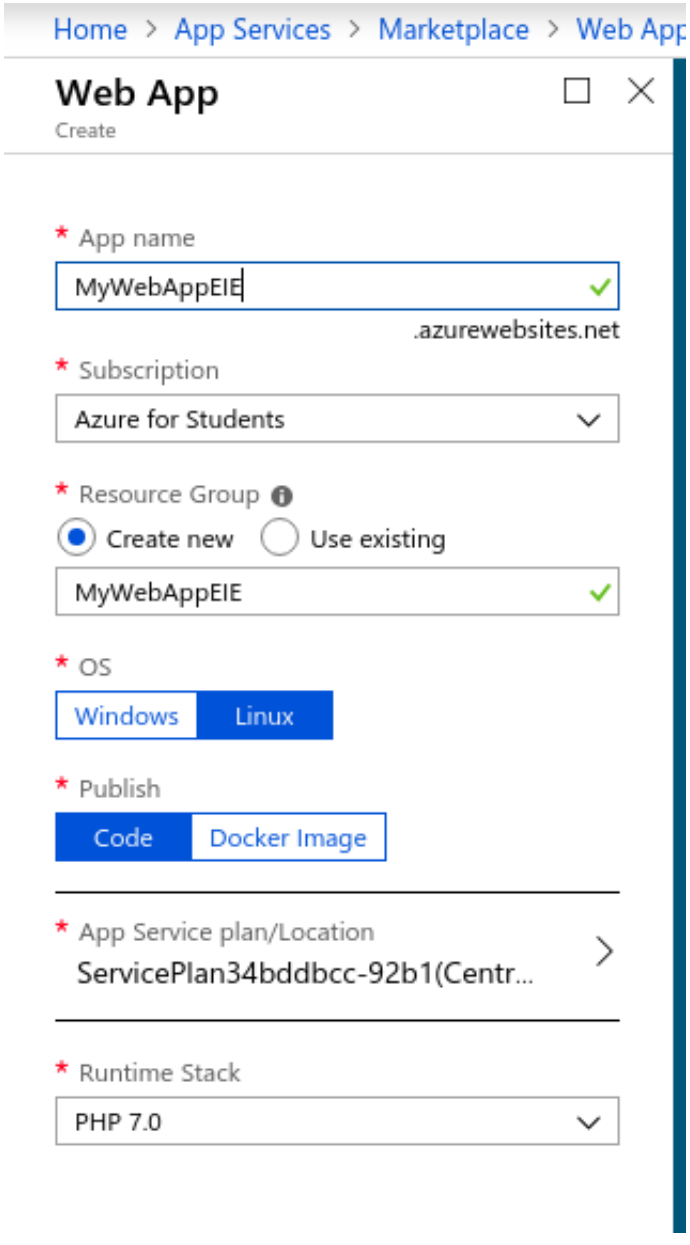


Figure 3: WebApp AppService Settings. Change the service name so it is unique.

Click on *Deployment Centre*. Link your app to your *Github Account* then click *continue*.

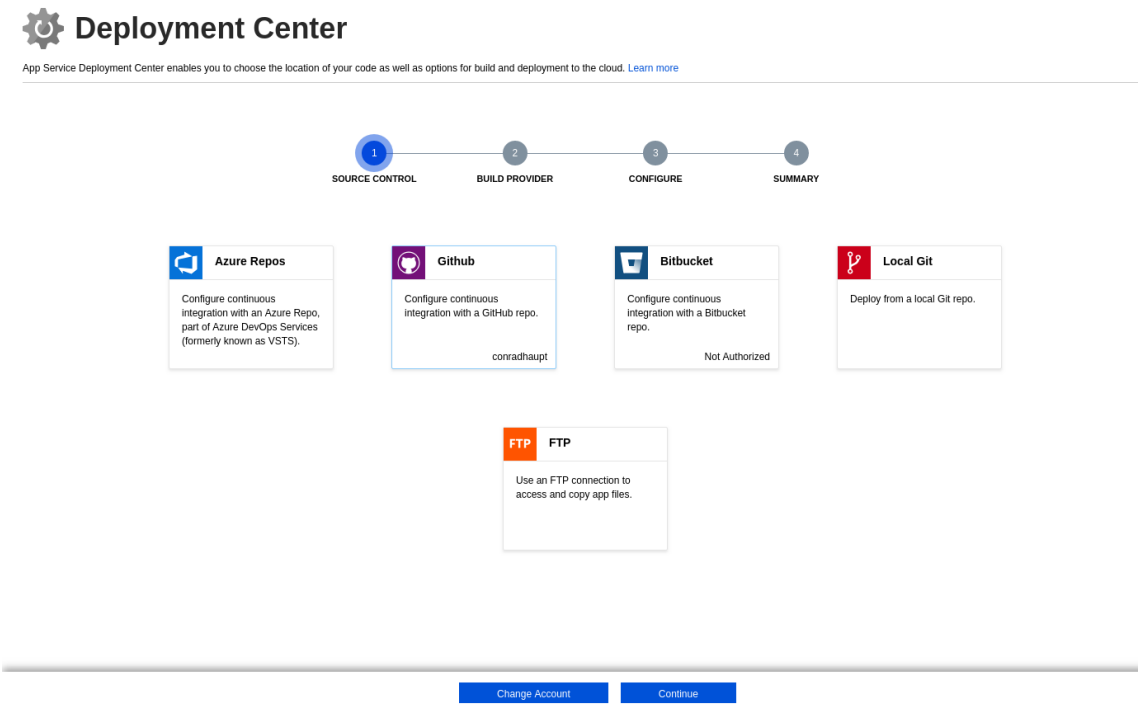


Figure 4: Linking Github and Azure accounts

Select *App Service Kudu build server* as your build provider then continue.

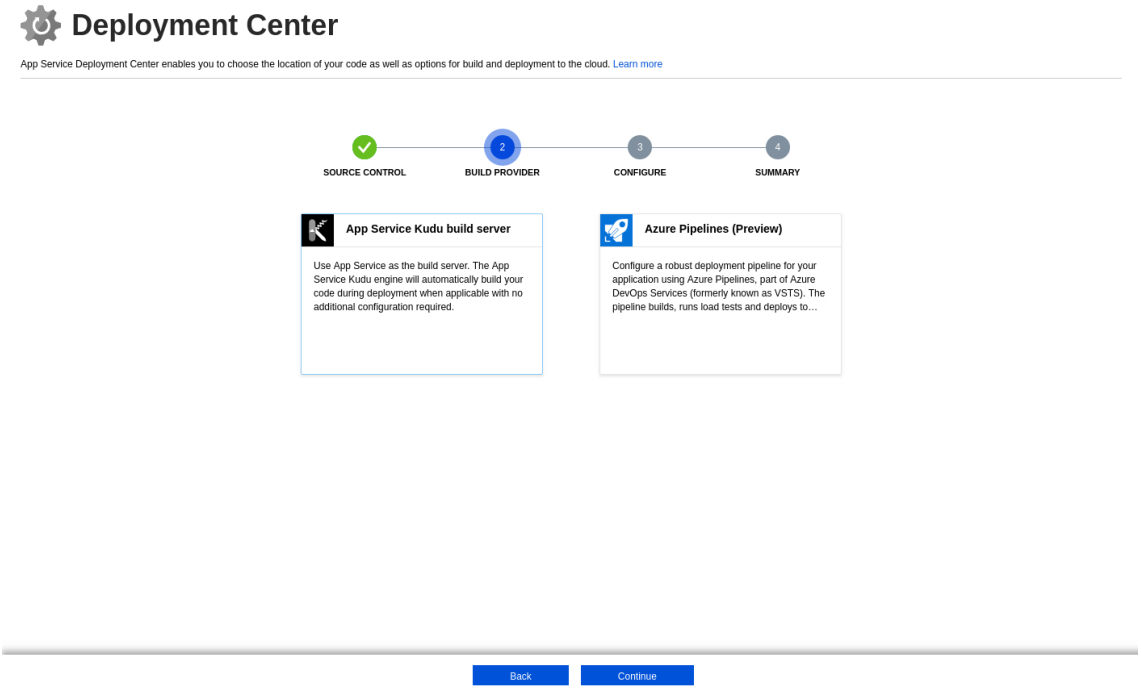


Figure 5: Selecting a build provider for Azure WebApps

Select your details for the repo you created earlier in the lab. Your details should look similar to those in Figure 6. Click *continue and then finish*.

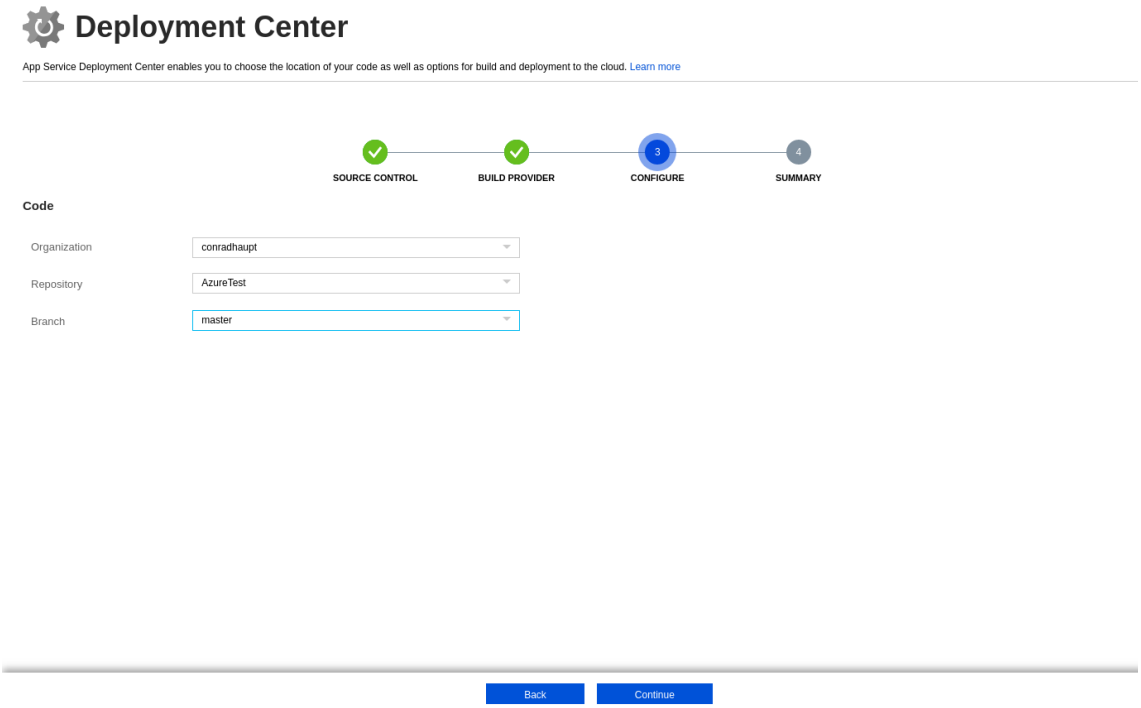


Figure 6: Azure WebApp Deployment Settings

Your website will be hosted at: `http://<app_name>.azurewebsites.net` and whenever you push updates to your GitHub repo, your website will be updated automatically.