



Software Design & Architecture

LAB 01

(lect01: principles of good programming)

Today's lab

- Many topics covered in the lecture
- ==> many small exercises in this lab
- Whatever you don't complete today, you are *expected* to complete in your private study time as part of this unit
- Where appropriate, solutions will be made available
- Sometimes we will do group work, peer reviews etc

Refer to lectures, reading materials and any further hints in each lab

Version Control (15 – 45 minutes)

1. If not done so already, complete LAB 5
"Introduction to Git" from Full-Stack Web
Development course
 - Snapshot/copy is available also from SDA moodle
2. Use your knowledge of 'git' to create your own
github repository for this course containing files
needed for lab01
 - See next slides...

Git

1. In a new directory on your lab machine, initialise a new local git repo
2. Pull from the SDA github repo
<https://github.com/mkbane/mmu-sda.git>
You now have a copy of the files (to date)

Git

1. Create yourself a github account and create a new, *empty*, **private** repository for your work on this SDA unit
2. When you hit the green "Create repository" button, you will see something like image on right
 - If you not using previously set ssh keys then **ensure you have HTTPS selected** (so you have an https URI)

Create a new repository

A repository contains all project files, including the revision history. Already have a project repository elsewhere? [Import a repository.](#)

Owner *

 highendcompute


Repository name *

test-mmu-sda2 

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

Description (optional)

 highendcompute / test-mmu-sda2 Private

 Unwatch 1

[Code](#) [Issues](#) [Pull requests](#) [Actions](#) [Projects](#) [Security](#) [Insights](#) [Settings](#)

Quick setup — if you've done this kind of thing before

 Set up in Desktop or [HTTPS](#) [SSH](#) <https://github.com/highendcompute/test-mmu-sda2.git>

Get started by [creating a new file](#) or [uploading an existing file](#). We recommend every repository include a [README](#), [LICENSE](#), and [.gitignore](#).

...or create a new repository on the command line

```
echo "# test-mmu-sda2" >> README.md
git init
git add README.md
git commit -m "first commit"
git branch -M main
git remote add origin https://github.com/highendcompute/test-mmu-sda2.git
git push -u origin main
```

...or push an existing repository from the command line

```
git remote add origin https://github.com/highendcompute/test-mmu-sda2.git
git branch -M main
git push -u origin main
```

...or import code from another repository

You can initialize this repository with code from a Subversion, Mercurial, or TFS project.

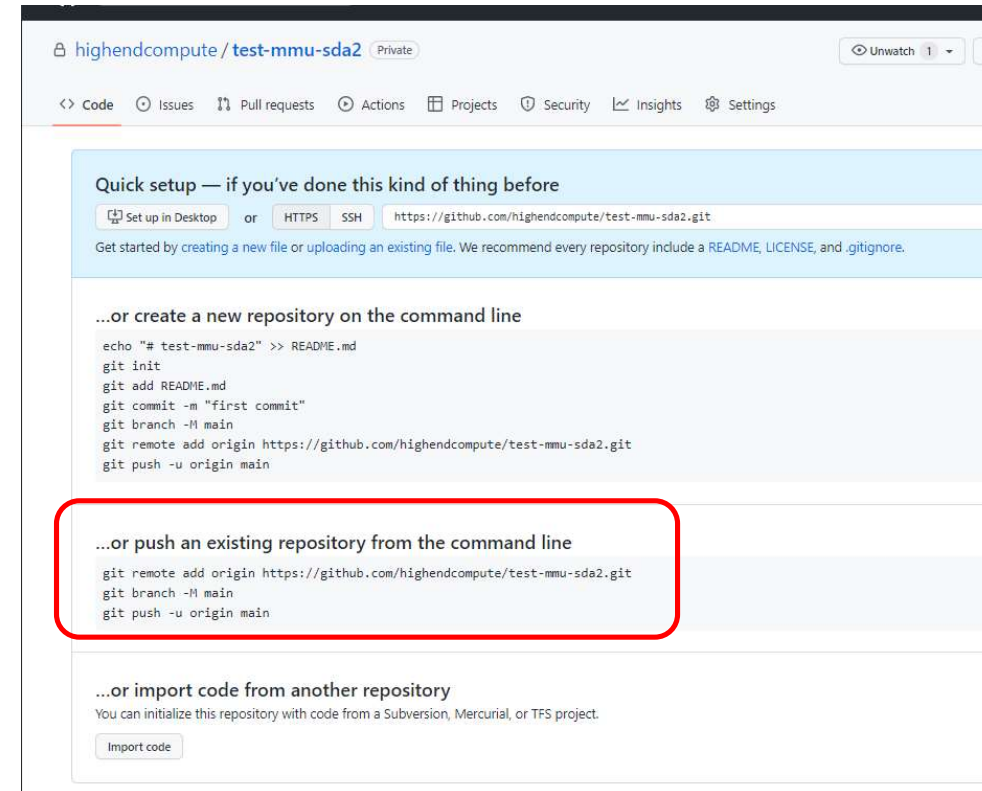
[Import code](#)

Git

1. Using the URI of *your* remote repo follow the highlighted (red box) instruction on your lab machine (& use name of *your* github repo you just created), using your username and **Personal Access Token**

2. When successful then

- You have now pushed a copy of the files to your own remote git repository and can work on these files and commit to your own github repository
- Check you have the files in the remote repository!



If you do not
already have a PAT
see next 2 slides

Git PAT (1 of 2)

- User icon -> settings -> developer settings -> Personal access tokens -> Tokens (classic)
- Select "Generate a personal access token"
- Next screen: add Note, **select repo**, & then click green "Generate token" button at bottom

Settings / Developer settings

GitHub Apps
OAuth Apps
Personal access tokens
Fine-grained tokens (Beta)
Tokens (classic)

Personal access tokens (classic) [Generate new token](#)

Need an API token for scripts or testing? [Generate a personal access token](#) for quick access to the GitHub API.

Personal access tokens (classic) function like ordinary OAuth access tokens. They can be used instead of a password for Git over HTTPS, or can be used to [authenticate to the API over Basic Authentication](#).

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New personal access token (classic)

Personal access tokens (classic) function like ordinary OAuth access tokens. They can be used instead of a password for Git over HTTPS, or can be used to [authenticate to the API over Basic Authentication](#).

Note
sda pat

What's this token for?

Expiration *
Custom... 26/05/2023

Select scopes
Scopes define the access for personal tokens. [Read more about OAuth scopes.](#)

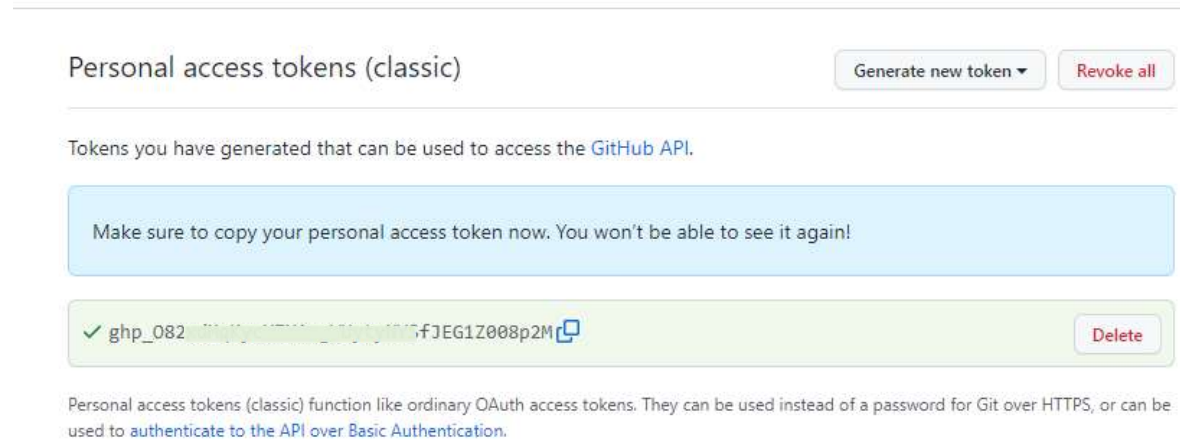
<input checked="" type="checkbox"/> repo	Full control of private repositories
<input type="checkbox"/> repostatus	Access commit status
<input type="checkbox"/> repo_deployment	Access deployment status
<input type="checkbox"/> public_repo	Access public repositories
<input type="checkbox"/> repo_invite	Access repository invitations
<input type="checkbox"/> security_events	Read and write security events
<input type="checkbox"/> workflow	Update GitHub Action workflows
<input type="checkbox"/> write_packages	Upload packages to GitHub Package Registry
<input type="checkbox"/> read_packages	Download packages from GitHub Package Registry

<input type="checkbox"/> admin_gpg_key	Full control of public user GPG keys
<input type="checkbox"/> write_gpg_key	Write public user GPG keys
<input type="checkbox"/> read_gpg_key	Read public user GPG keys
<input type="checkbox"/> admin_ssh_signing_key	Full control of public user SSH signing keys
<input type="checkbox"/> write_ssh_signing_key	Write public user SSH signing keys
<input type="checkbox"/> read_ssh_signing_key	Read public user SSH signing keys

[Generate token](#) [Cancel](#)

Git PAT (2 of 2)

- Next screen: **copy the PAT token somewhere safe** (but treat like a password)
- When you asked for "password" (when accessing github via CLI) then it means your PAT
- You only use actual password when logging in to web interface



Documentations

IN PAIRS:

- Examine the C code entitled "t1.c" in directory "lab01" (from the git repository)
 1. Discuss what you think it is doing?
 2. What could be improved?

Documentations (15 mins)

IN PAIRS:

- Examine the C code entitled "t1.c"

1. Discuss what you think it is doing?

2. What could be improved?

3. Create a stylesheet and apply to the code

4. Compare your stylesheet to another group's

1. What differs? Discuss

2. What is similar

Optimising Compilers (30 mins)

1. Also in directory "lab01"...
2. You should see aerosol.c and get_wtime.c files
 - Compare aerosol.c to your rewritten t1.c
3. There is a gcc compiler available on lab machines
4. Compile with default optimisation, naming executable default.exe:
gcc aerosol.c get_wtime.c -o default.exe
5. We can then run this simulation. Let's say 25K aerosol particles for 5 timesteps, check the output and see how long it takes

See next slide on how to
tell simulation how
many particles etc

Optimising Compilers

- Example output

```
C:\Users\55142816\OneDrive - MMU\@teaching\L5 sw design & arch\labs\lab01>gcc aerosol.c get_wtime.c -o default.exe
C:\Users\55142816\OneDrive - MMU\@teaching\L5 sw design & arch\labs\lab01>default.exe 25000 5
Initializing for 25000 particles in x,y,z space... (malloc-ed)    INIT COMPLETE
Time 0. System energy=899944
Now to integrate for 5 timesteps
At end of timestep 1 with temp 300.000000 the system energy=893429 and total aerosol mass=18851.7
At end of timestep 2 with temp 299.997000 the system energy=889388 and total aerosol mass=19564.7
At end of timestep 3 with temp 299.994000 the system energy=886955 and total aerosol mass=20257.4
At end of timestep 4 with temp 299.991000 the system energy=885608 and total aerosol mass=20930.2
At end of timestep 5 with temp 299.988000 the system energy=885019 and total aerosol mass=21584
Time to init+solve 25000 molecules for 5 timesteps is 86.7572 seconds
Centre of mass = (0.072349,-0.294246,50.0574)
C:\Users\55142816\OneDrive - MMU\@teaching\L5 sw design & arch\labs\lab01>
```

- NB your time may vary if there any CPU/GPU consuming processes also running on the machine

Optimising Compilers

- Referring back to lecture notes if needed, now compile various levels of optimisation.
- Which do you expect to run the fastest?
- What do you also need to check?

UML

(Unified Modelling Language)

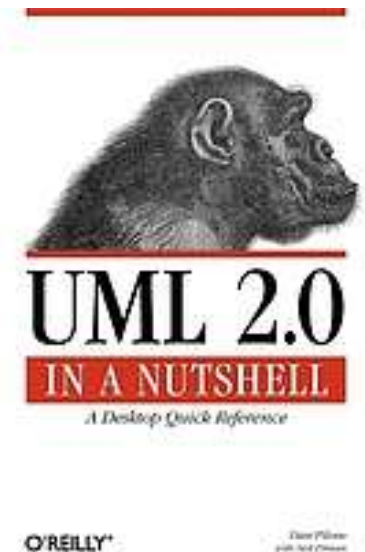
30 MINUTES

UML (30 – 90 mins)

- Unified Modelling Language
- We do not cover in this unit how to do UML, but will be used a lot during rest of unit
- NOW is good time to revise your knowledge

UML training

- If you unsure how to do a Class Diagram or the difference between, say, Sequence Diagram and a Use Case diagram then spend 30 minutes reading:
 - <https://w3cschool.com/tutorial/uml-tutorial>
- UML 2.0 in a Nutshell (Pitman)
 - Available as eBook from MMU library
 - See course unit reading list
- UML 2 for Dummies (Schardt)
 - (requested that MMU library stocks this)



Aerosol Code as OO (30 mins)

- Consider the aerosol code from the "Optimising Compiler" exercise above
 - Currently written in C (without OO)
 - Fairly easy to understand the flow
- Draft (i.e. design!) how you would implement this in an OO language (Java) by constructing the relevant UML diagram/s.
 - What are the objects?
- Pair up with a neighbour and compare your designs
 - What differs? Discuss
 - What is in common?

Linux (30 mins – 1 hour)

- We will use the Linux OS later in the course
- UNIX & Linux are good skills to have for research & for industry
- If you have not used Linux before, reboot your lab machine and at the BIOS prompt select "Debian" option. Your username is adNNNNNNNN where NNNNNNNN is your MMU ID. Password is your MMU password.
- Read and try out the commands in these references
 - <http://www.ee.surrey.ac.uk/Teaching/Unix/>
 - <https://ubuntu.com/tutorials/command-line-for-beginners>

Linux (advanced)

- Open a Terminal window and
 1. follow the 'git' exercise from above
 2. Follow the 'optimising compiler' exercise from above
(15 mins)