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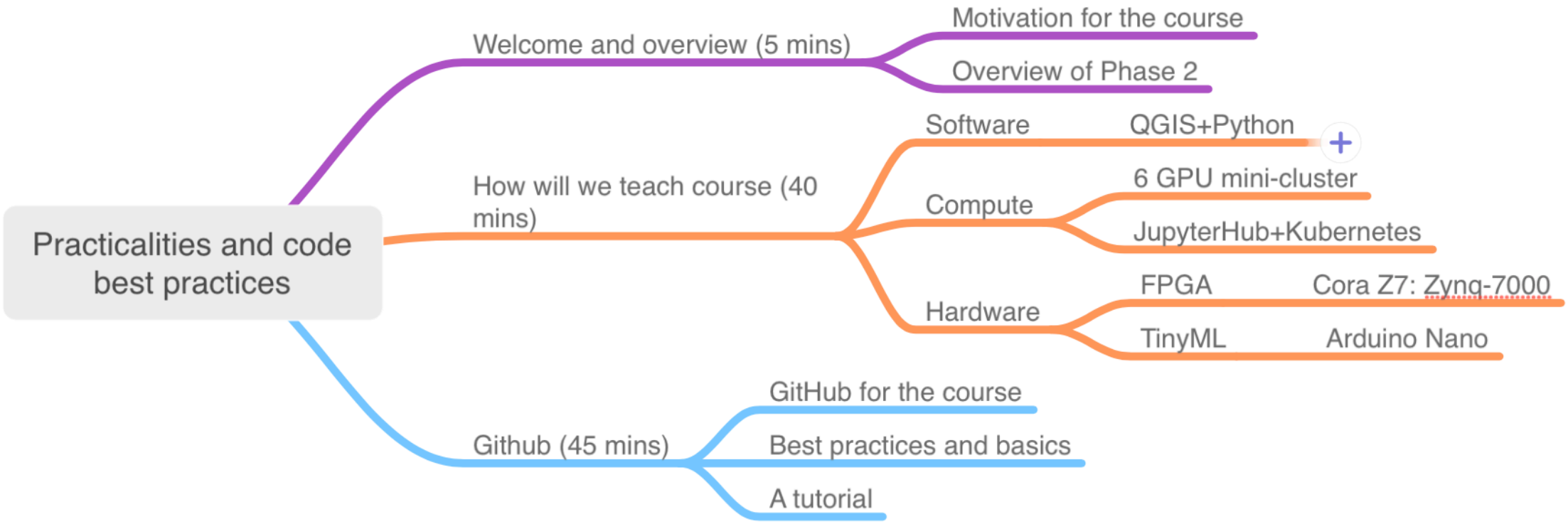
Welcome!

Becky Canning

Institute of Cosmology and Gravitation

Thanks for joining us!



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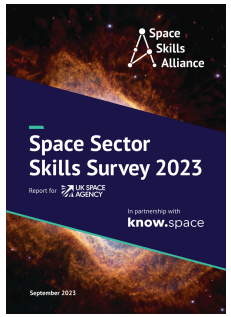
What's all this about…

- A reminder of context of the course and course logistics



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Context of the course

- What is needed?

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- What is needed?

Software & data is identified as the largest skills gap for the sector.

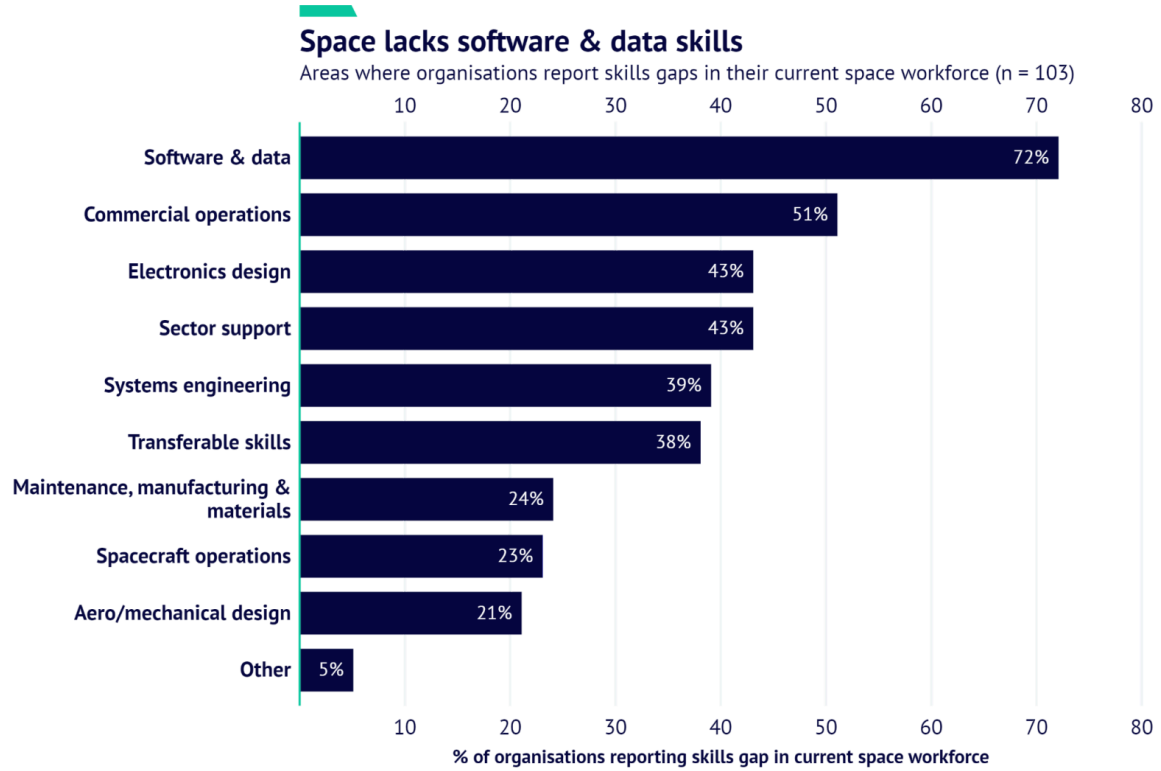

Figure 2: Skills gaps in current workforces grouped by theme, among organisations with a skills gap in their current workforce. Data comes from Q27.

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Context of the course

- What is needed?

There is evidence that these gaps are increasing in severity..

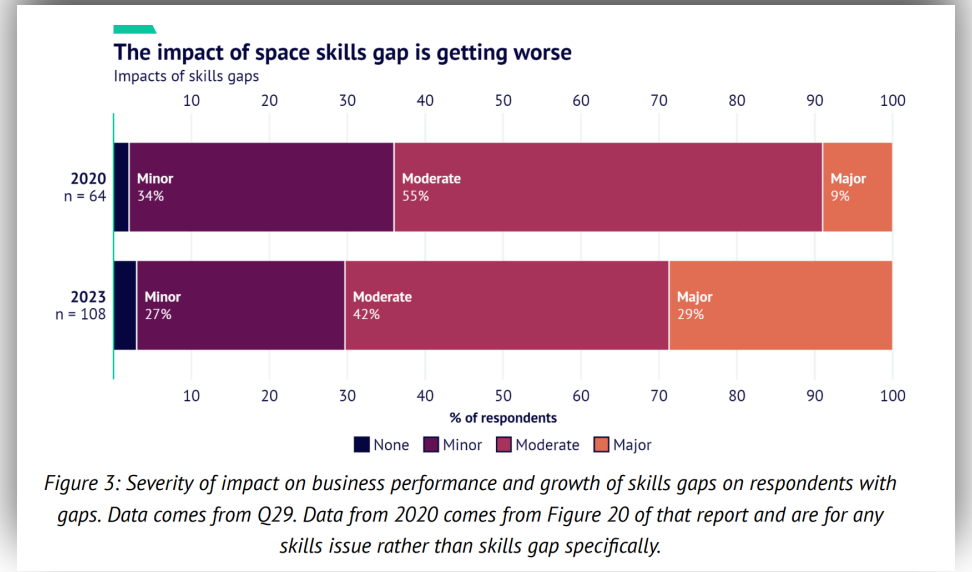

Figure 3: Severity of impact on business performance and growth of skills gaps on respondents with gaps. Data comes from Q29. Data from 2020 comes from Figure 20 of that report and are for any skills issue rather than skills gap specifically.

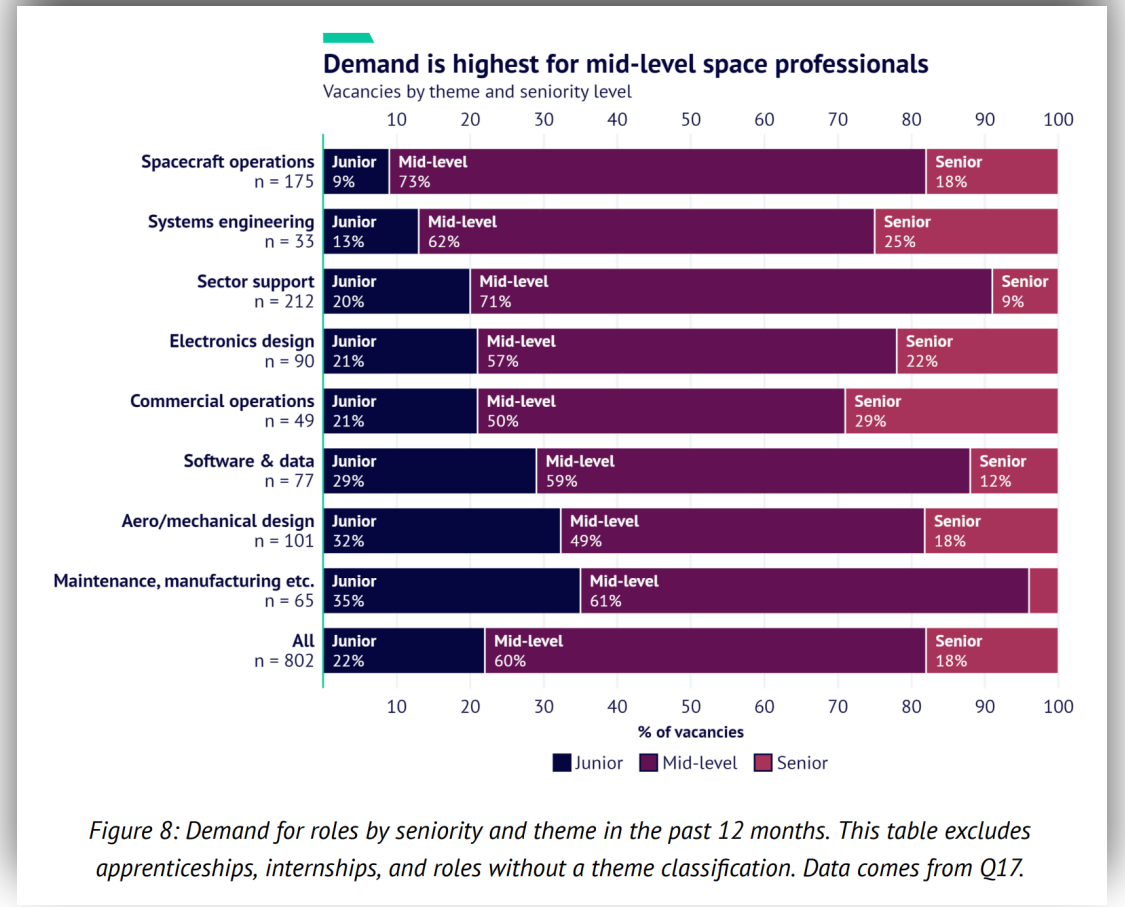

Figure 8: Demand for roles by seniority and theme in the past 12 months. This table excludes apprenticeships, internships, and roles without a theme classification. Data comes from Q17.

..and that mid-career is where the sector experiences its largest squeeze.

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Context of the course

- What is needed?

Skill	% reporting skills gap in current workforce 2020 n = 49	2023 n = 103	Change (pp)
Artificial intelligence and machine learning	33	41	+8
Systems engineering	39	39	0
Data analysis & modelling (2023) / data analytics (2020)	22	36	+14
Strategy & leadership (2023) / Leadership or motivational skills (2020)	18	32	+14
Data processing & manipulation	-	30	-
Software engineering	45	29	-14
Radio frequency & telecoms engineering (2023) / radio frequency engineering (2020)	41	28	-13
Technical leadership	-	25	-
Project management	29	24	-5
Analogue and digital systems	-	23	-
Education and training	-	22	-
Sales & commercial	-	22	-
Regulation	-	19	-
Data visualisation	-	17	-
Assembly, integration, and testing	-	17	-

Table 1: Top 15 skills gaps in the current workforce, full list in Table 27 in Appendix C. Data comes from Q27. Data from 2020 comes from Figures 14 and 15 of that report, scaled to an n of 49.

Skill	Theme	% reporting skills gap in job applicants n = 131
Artificial intelligence and machine learning	Software & data	52
Systems engineering	Systems engineering	42
Strategy & leadership	Commercial operations	40
Software engineering	Software & data	37
Radio frequency & telecoms engineering	Electronics design	34
Project management	Transferable skills	32
Data analysis & modelling	Software & data	31
Technical leadership	Transferable skills	31
Data processing & manipulation	Software & data	29
Analogue and digital systems	Electronics design	26
Assembly, integration, and testing	Maintenance, manufacturing & materials	25
Education and training	Sector support	25
Communication	Transferable skills	24
Funding & incubation	Sector support	22
Problem solving	Transferable skills	21

Table 11: Top 15 skills gaps in job applicants, full list in Table 28 in Appendix C. Data comes from Q27.

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Context of the course

- <u>What is needed?</u>

- Skills gaps in analysis of big data and code is seen as an retention and recruitment issue for companies, and also an innovation issue
- Pace of AI and data hosting and cloud services so quick and jargon so dense - difficult to keep up
- Strategic decisions made by those who are mostly self taught and time poor whilst new employees are coming in with very different background that might not contain enough 'domain' knowledge - can be communication gaps
- Challenge for training mid career: pool of delegates will be very broad, some skills imparted need to be bespoke…

Context of the course

- What is the structure of this course?

Context of the course

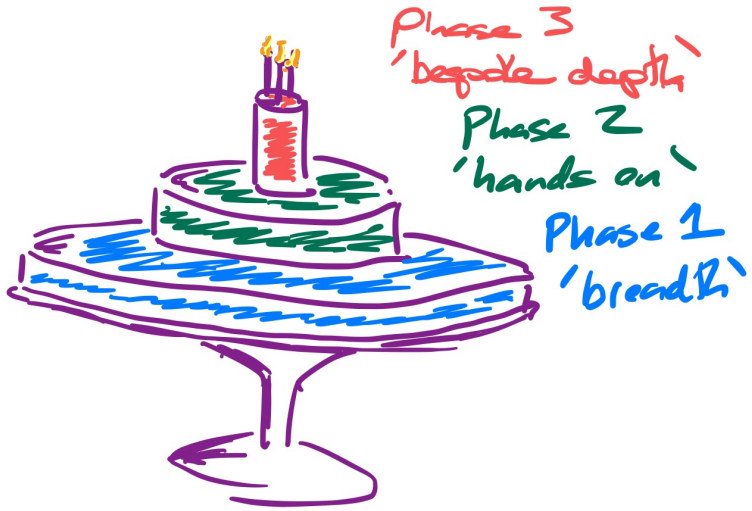
Pressures of mid-career:
- Little time inside and outside work
- Need breadth, strategy and specific depth

Pressures of space sector:
- Project based
- Boom and bust

Dual use sector + commercial:
- Not all companies can be open with computational resources or computational or application needs

Training must be:

- Flexible
  - Time to complete
  - Hours of delivery
- Deliver breadth and depth (necessarily bespoke)
- Deliver professional development



Context of the course

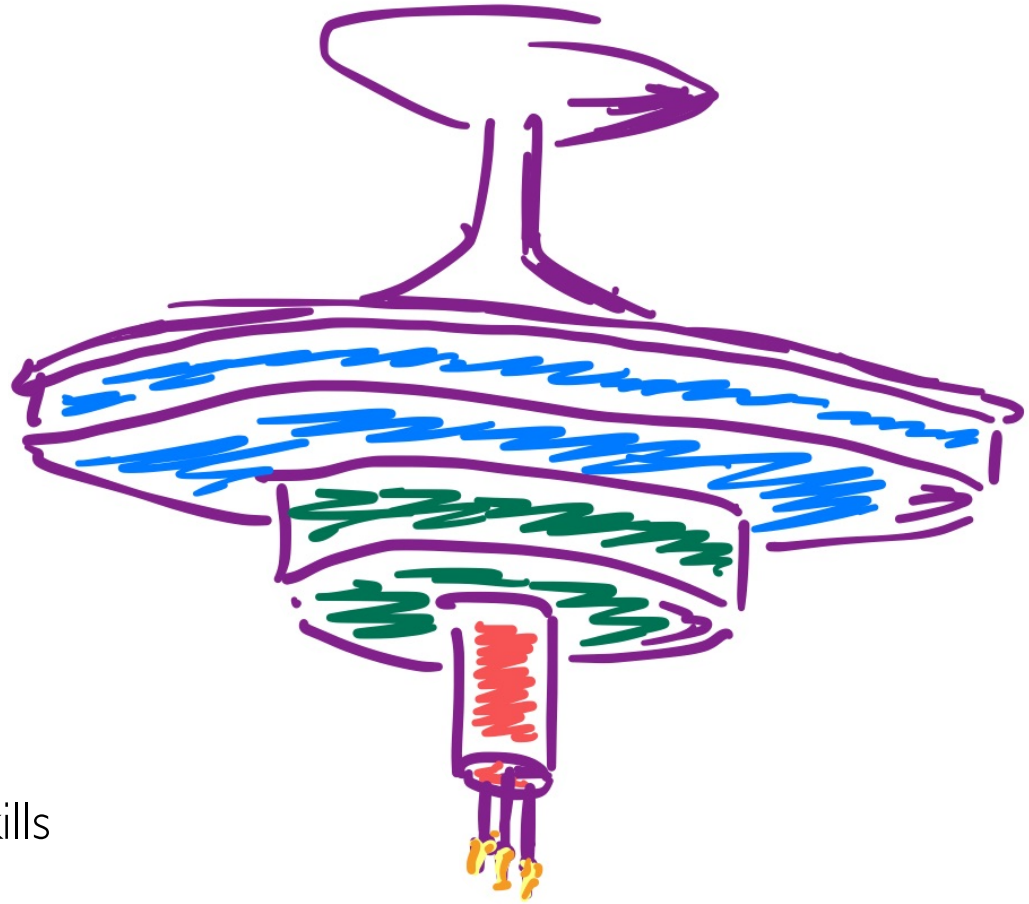
General topics covered:

- Software best practices and standards
- Satellite data access and applications
- Fundamentals of AI/ML and state-of-the-art techniques
- Embedded software and tinyML
- Cyber security in the space sector
- Bid writing in the space sector

Two streams for in-person workshop

- Earth observation data, AI/ML
- Embedded software, and tinyML
- All together for security, trust/ethics, bid writing

Bespoke project to develop and practice more specific skills



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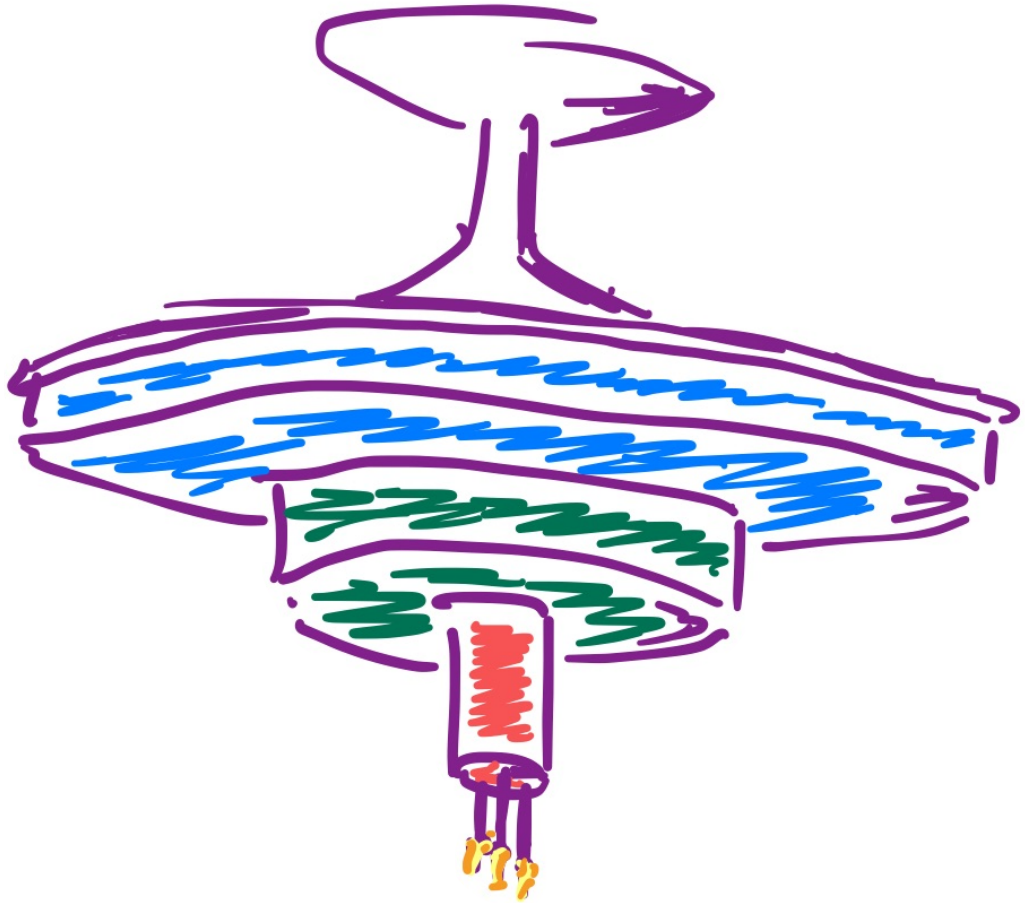
Context of the course

In person couse:

Only have 2.5 days…



Context of the course

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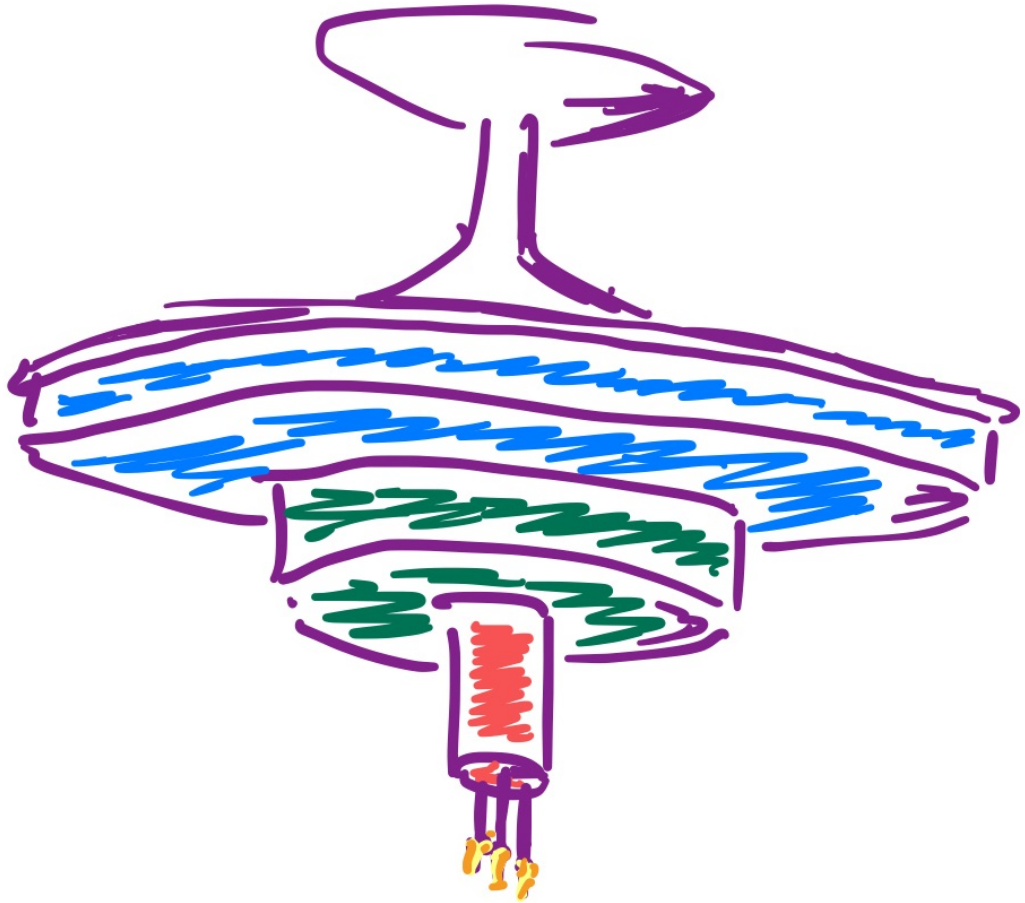
For context - on 1,024 A100 GPUs ChatGPT took 34 days to train…

Running on a single high spec but more affordable GPU it has been estimated to take 355 years!



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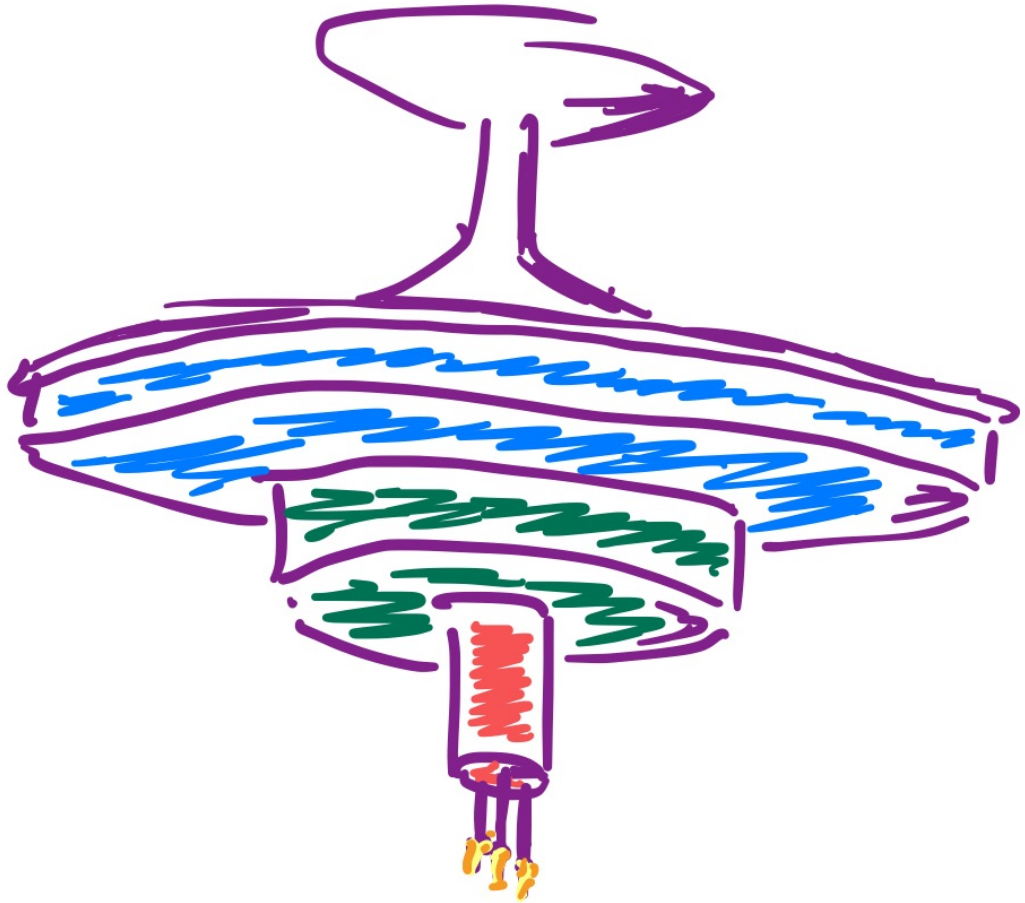
For context - on 1,024 A100 GPUs ChatGPT took 34 days to train…

Running on a single high spec but more affordable GPU it has been estimated to take 355 years!

The in person part aims to be the **project accelerator** - it should **set delegates up for the bespoke part of the course.**
Some lecture format but much practical - **go at your own pace and ask lots of questions!**



How will the course run?

- Course logistics

Please contact Dan at daniel.smith@port.ac.uk for any queries on logistics.

For this pilot year UKSA will fund:

- Course fees incl. accommodation, breakfast and lunch. A light dinner and welcome reception will be provided on Tuesday 1st October and the course dinner will occur on Thursday 3rd October.
- Accommodation will be booked and details sent to delegates individually.

UKSA will not fund:

- Travel to/from Portsmouth
- ~~Dinner on Wednesday evening (2nd October)~~ Canapés at Mary Rose Museum

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With huge thanks to:

- **Lecturers, demonstrators, supervisors:** Ben, Chris Br, Chris P, Coleman, Basel, Becky, Ehsan, Gbenga, Hanna, Hugh, Ioana, John, Keith, Lorenza, Mojtaba, Obinna, Pete, Richard, Scott, Victoria, Vincent, Xan
- **Technical team:** Alexandra, Barrie, Becky, Chris Be, John, Michael, Toby, **Xan**
- **Project management, administration and comms: Dan and Pam**, Amanda, Ben, Chris B, Emma, Finnoula, Glenn, Hugh, Louise B, Louise P, Phil, Priya, Scott, Sharon, Vicky, Victoria
- All of you and many of your colleagues

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The next few days…

- Broad course - many lecturers (sometimes a couple or few at once)
- Some involved in the course but not teaching this part, but you may still see them around these few days - pleased do chat and ask them any stored up questions!
- **FTC 4th floor (here!)** is our base - **all food and caffeine will be here** during the day
- Breakfast is at hotel and there are dinner events
- Some lectures will make use of facilities in other locations specifically:
  - Mission Incubator - Dennis Sciama Building rm 1.12 (up main stairs and go to glass box in the corner)
  - Anglesea A0.07 - Lab - for FPGA development

The next few days…

Phase	Duration	Delivery	Schedule							
1	4-week	Online (16 hrs)	Introduction lecture course to software and data usage in the space sector							
	3-day		9-10.30	10.30-11.00	11-12.30	12.30-13.30	13.30-15.00	15.00-15.30	15.30-17.00	18.30-21.00
		Tuesday 1st Oct								Welcome reception (Portland atrium)
		Wednesday 2nd Oct	Welcome **(BC)** Getting started with Git **(Future Technology Center, FTC)**	Coffee/Tea **(FTC)**	EO data & processing **(RT + EK) (MIssion Incubator, MI)** Embedded software - FPGA 101 **(MG) (Anglesea 0.07, A0.07)**	Lunch **(FTC)**	EO data analysis **(RT + EK) (MI)** Embedded software FPGA 101 **(MG) (A0.07)**	Coffee/Tea **(FTC)**	AI 101: syntax, data prep and training **(BC) (MI)** Embedded software FPGA 101 **(MG) (A0.07)**	Mary Rose event
		Thursday 3rd Oct	AI 101 continued: ML v's deep learning **(BC) (MI)**	Coffee/Tea **(FTC)**	Deep learning case study **(BC) (MI)** Real time processing **(CB) (FTC)**	Lunch **(FTC)**	Project kick-off **(FTC)** / Coffee / Tea **(FTC)**	3-5pm - Cyber security - Threat Modelling **(BH + IB) (FTC)**		Course Dinner - Queens
2		Friday 4th Oct	Trust and ethics: AI/Automation in safety critical sectors **(PL) (FTC)**	Coffee / Tea **(FTC)**	Bid writing for the space sector **(VC) (FTC)** **Bus**	Lunch and tour (Metaverse) Tour 13.00-14.30 (arrive 12.45)				
3	8-week	Online (32 hrs)	1 hour mentorship per week, participant to spend total of 4-hours per week on project incl. mentorship							

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How will we teach the course

- EO data processing and analysis - QGIS
- AI/ML models - Python packages (SciKit-Learn, PyTorch)
- AI/ML models on device (Tensorflowlite/micro, C and Arduino Nano)
- FPGA programming (VHDL with Vivado on Xilinx Cora Z7: Zynq-7000)
- Web based activities

How will we teach the course

Mission incubator computers (windows)

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Laptops (windows)

How will we teach the course

Mission incubator computers (windows)

6 GPU mini-cluster (linux, accessed through JupyterHub + Kubernetes)

Laptops (windows)

- All accessed via your 'staff' account - who will have this from now throughout Phase 3
- VPN is required to access the cluster
- Data for AI examples is already on the cluster, unless 'getting the data' is the part being taught!
- Data for projects can be stored on the cluster.

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Pause to test staff account details and VPN access

- To set up staff account please see your e-mails
- For VPN install see this site: https://myport.port.ac.uk/guidance-and-support/staff-it-support/staff-vpn-global-protect

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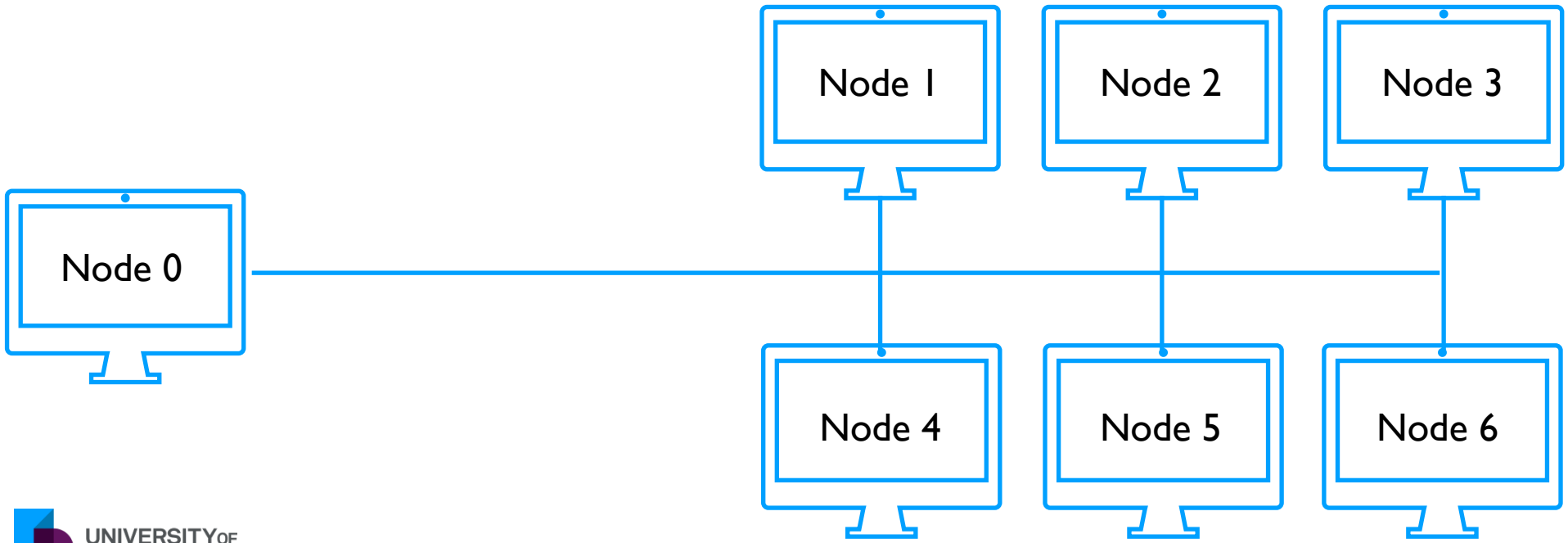
Introducing the mini-cluster

A huge thanks to:
Xan Morice-Atkinson, Toby Maule, Chris Beakes, John Randell, Alexandra Packer, Barrie Miles, Michael Reid

- Not a full scale HPC but plenty good enough for moderate deep learning (not going to retrain ChatGPT but it will be pretty good for object detection in imaging)
- 1-6: Nvidia RTX 4000, 20GB, 16 core Threadripper, 64GB, 512GB SSD, 8TB HD
- 0: Intel Integrated Graphics, 10 core Intel, 16GB, 2TB - **Keep for login**



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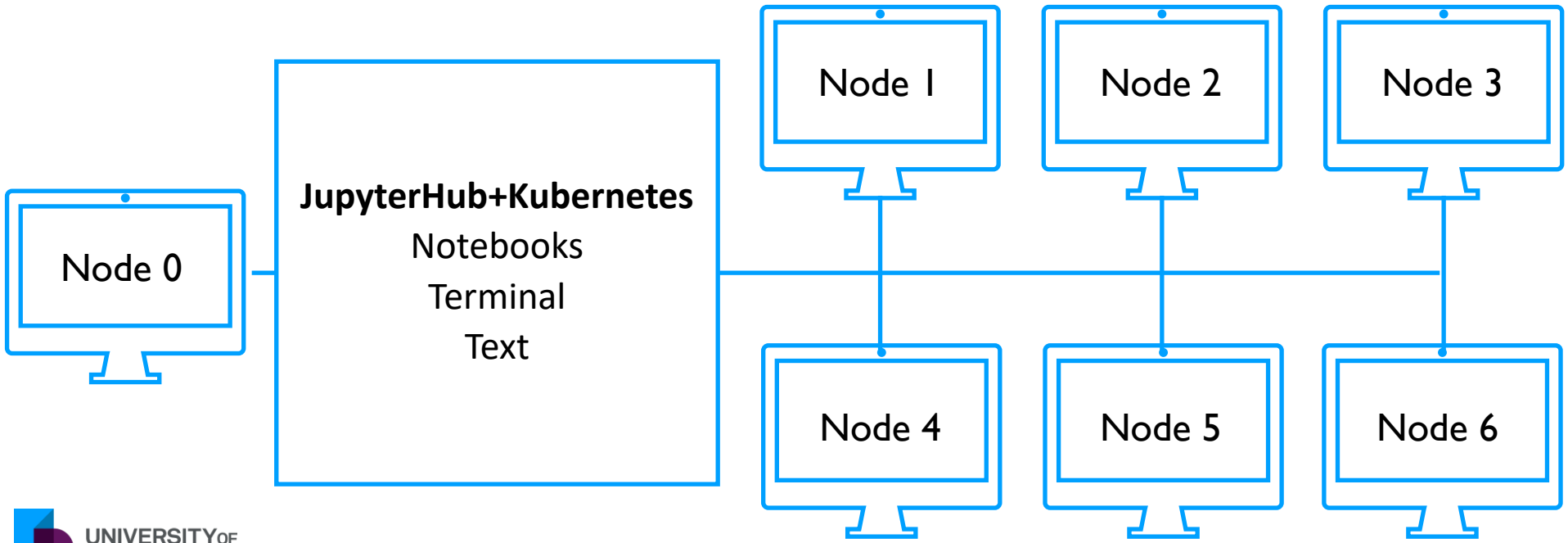

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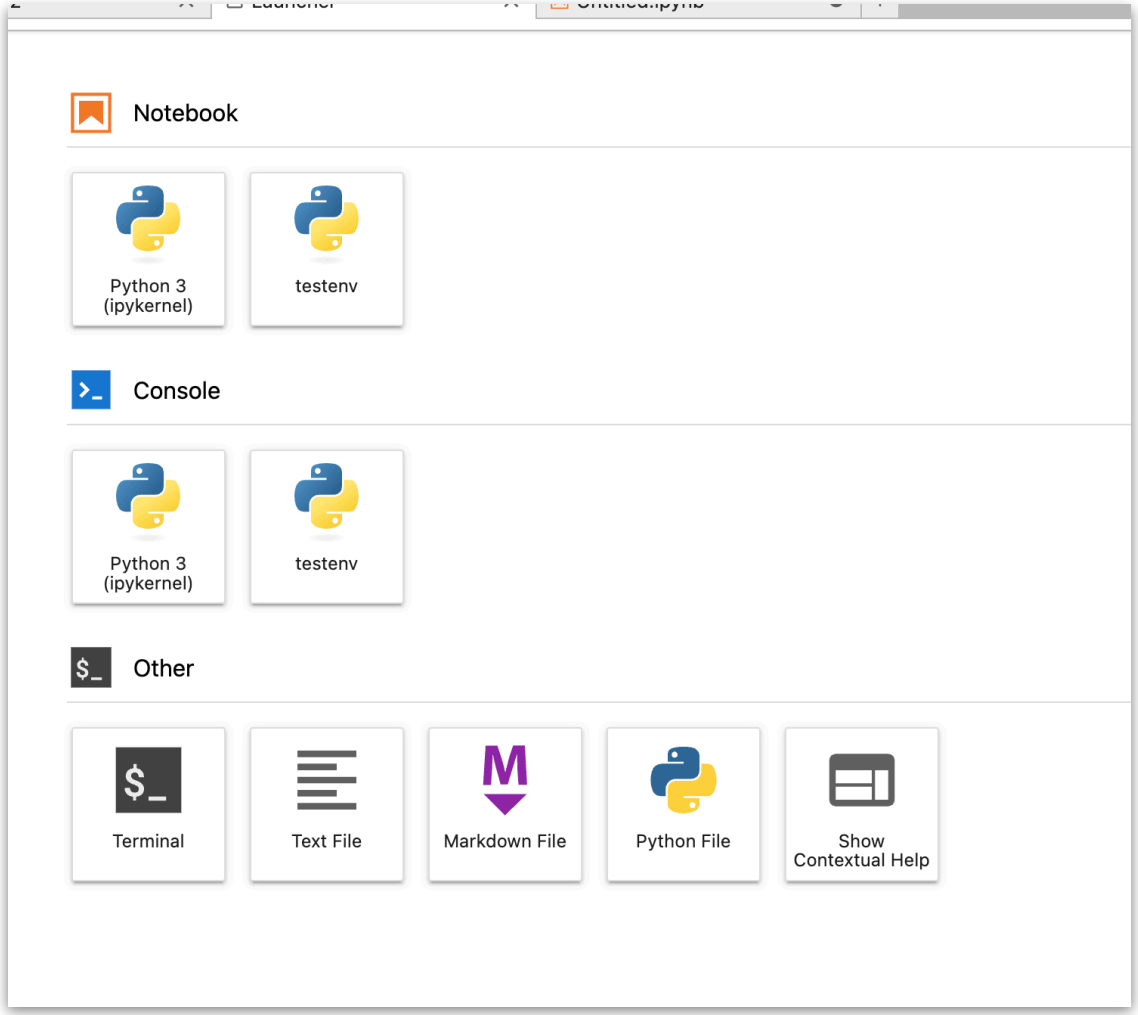
Pause to test cluster access through vpn - end of session

- Open a terminal
- Change nodes
- Create a notebook
- Create a text file



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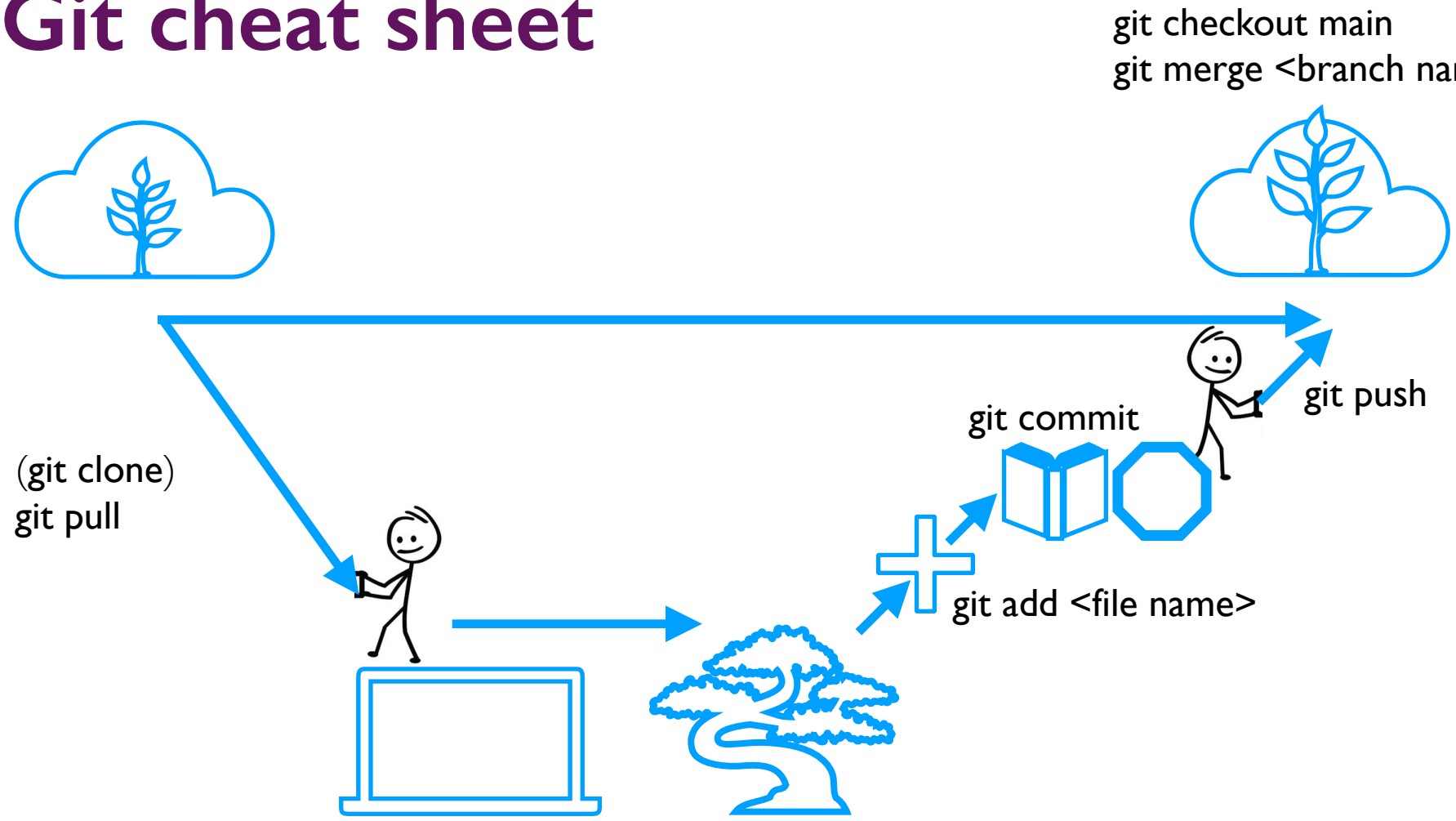
Software versioning and best practice

- Unless you write perfect code every time then you will want some sort of version control system for your software.
- If you are working collaboratively or expecting others to use a product of your software this is a must.
- SVN and Git popular
  - Apache subversion - centralised enabling granular access control, single point failure
  - Git - distributed (work offline and redundancy), lacks granular access control

Git terminology

- Repository: A folder that has Git version control set up
  - Local repository: A Git repository that is on your development computer
  - Remote repository: A Git repository that is on the internet
- Pull from remote - "Pulling" the changes from the remote to you local repository
- Push to remote: - "Pushing" changes from the local to the remote repository
- Git add <file name>
- Commit: - Creating a checkpoint you can return back to
- Branch: - A working space that does not effect other branches
- Merge: - Merging two branches together
- Tag: - Naming a commit to make it easier to find in the future (typically new code release versions are tagged)

Git cheat sheet



make a new branch: **git checkout -b <new branch name>**
move to an existing branch: **git checkout <branch name>**
list all (local) branches: **git branch**

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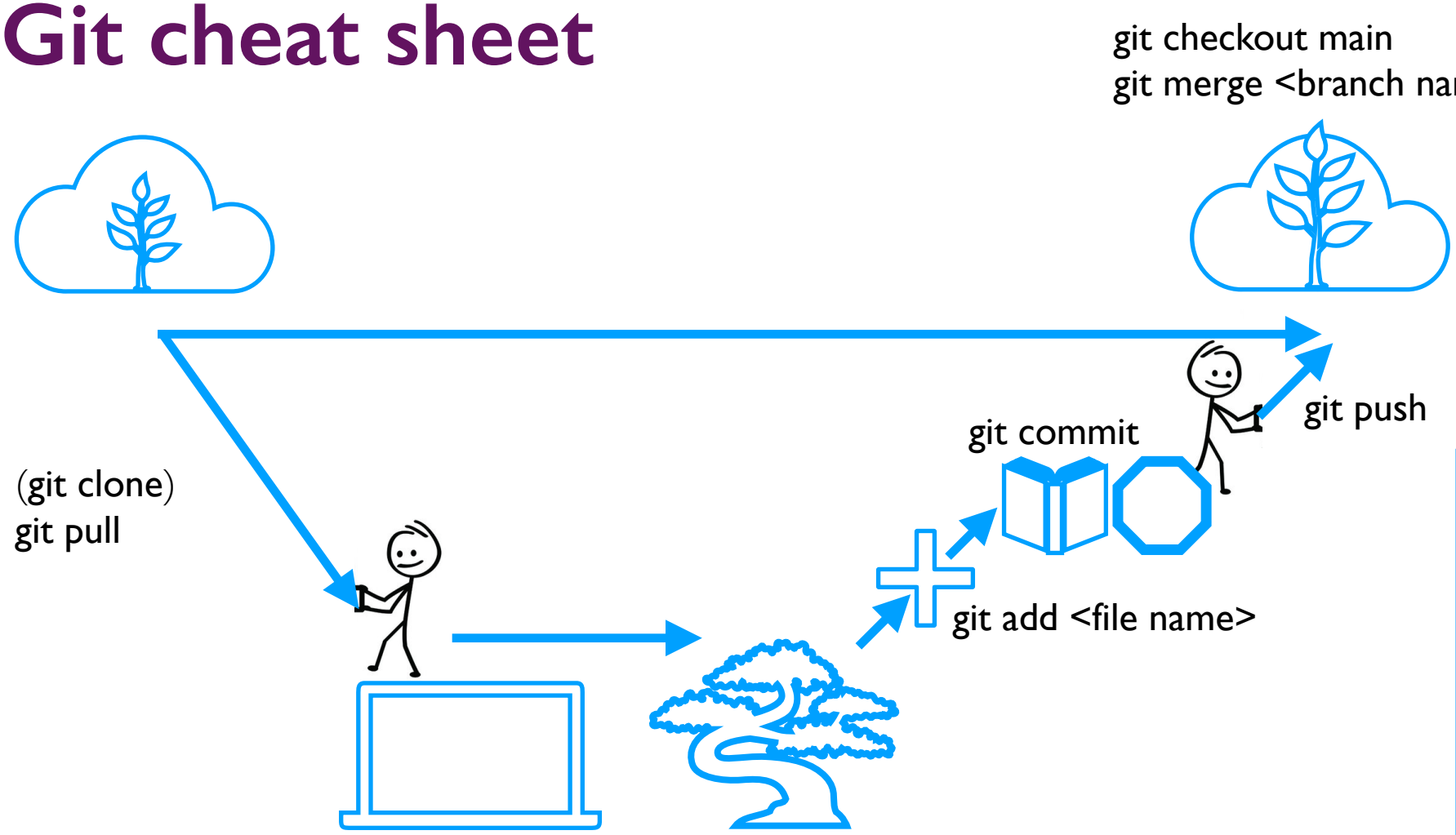
Git cheat sheet



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Also a minimal git workflow.

No reviewers, no feedback, …
No continuous integration or continuous delivery…

Exercise Git.ipynb (written by Coleman)

- Install git (and desktop version if you want it)
- Create a GitHub account
- e-mail Dan your username (for Phase 3)
- Set up ssh key
- Set up two-factor authentication
- Practice Git basics

- If pretty happy with git.ipynb please go on to:
- github_with_collaborators.md, good_coding_practices.md (written by Coleman)

- Coleman will provide a supervision lecture on versioning and best practices inching CI / CD early in Phase 3 to start you off on the right foot!
- **We will now come round and discuss any Phase 3 access issues company-per-company**

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