



# AAE2004 Introduction to Aviation Systems

## AAE

# Design of Path Planning Algorithm for Aircraft Operation

## First Week

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Dr Li-Ta Hsu and Dr Kam Hung NG  
Assisted by  
Miss Hiu Yi HO (Queenie), Miss Yan Tung LEUNG (Nikki)

# Lecturer's Information

- Instructor: Dr Li-Ta HSU
- Office: QR828
- Phone: 3400-8061
- Email: lt.hsu@polyu.edu.hk
- Office Hour: by appointment
- Expertise: GPS navigation, Autonomous driving, Pedestrian localization using Smartphone, Sensor Integration

# Li-Ta HSU

1985.08 – Born in a fish farmer family in Tainan, Taiwan

2003.06 – Graduated from Kang Ming Senior High School, Taiwan

2007.06 – Bachelor of NCKU Department of Aeronautics and  
Astronautics (DAA), Taiwan

2010.09 – Ph.D. Candidate of NCKU DAA, Taiwan

2012.02 – Visiting Researcher  
in University College London, UK

2012.06 – Part-time Consultant for Spirent, UK

2013.07 – Visiting Researcher  
in Tokyo Marine University, Japan

2013.12 – Ph.D. of NCKU DAA, Taiwan

2014.04 – Postdoctoral Researcher in the  
University of Tokyo , Japan

2017.05 – Assistant Professor  
in AAE of PolyU, Hong Kong

2021.07 – Associate Professor  
in AAE of PolyU, Hong Kong



# Ground Rules

## For students

- Try to speak as much English as possible.
- Participate the class activates assigned.

## For teaching staffs

- Reply your email with 3 working day.
- Open to any question regards to the subject

## For us!

- Keep an open mind—enter the classroom dialogue with the expectation of learning something new. Look forward to learning about—and being challenged by—ideas, questions, and points of view that are different than your own.
- Arrive on time to the class and finish the class on time

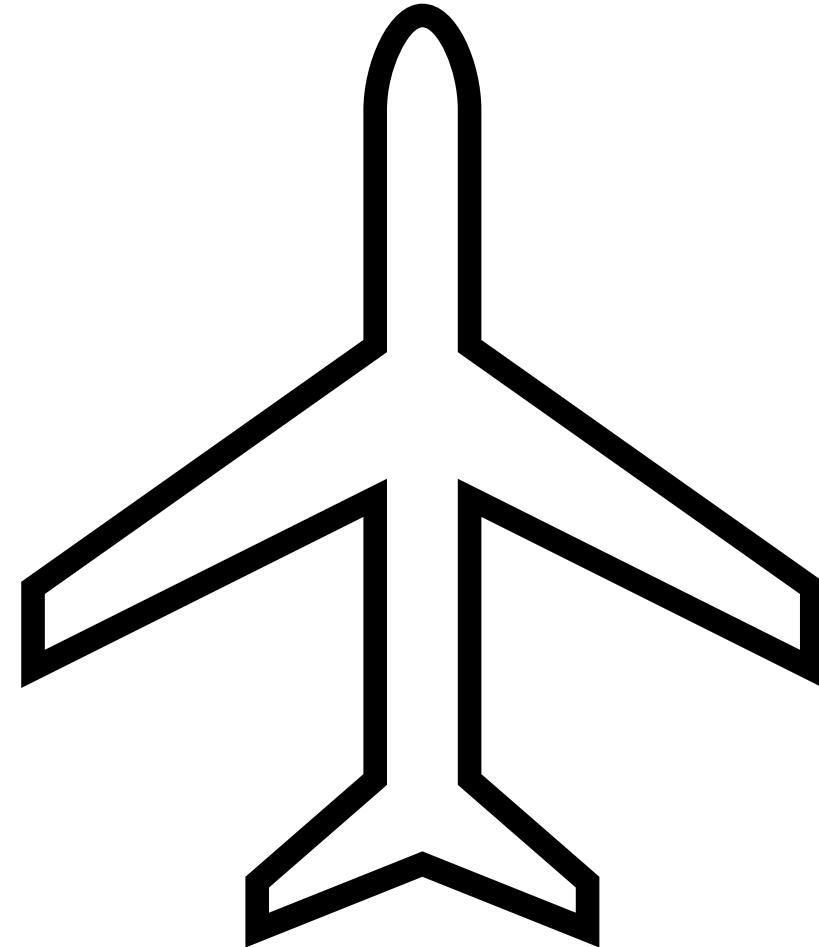
# Necessary Information

- Course Repository link: [https://github.com/IPNL-POLYU/PolyU AAE2004 Github Project](https://github.com/IPNL-POLYU/PolyU_AAE2004_Github_Project)
- TA Information & Contact:
  - Group 1-5: Queenie Ho ([hiu-yi.ho@connect.polyu.hk](mailto:hiu-yi.ho@connect.polyu.hk))
  - Group 6-10: Nikkie Leung ([yan-tung.leung@connect.polyu.hk](mailto:yan-tung.leung@connect.polyu.hk))

# Week 1 Content

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1. Introduction to Path Planning
2. Introduction to GitHub  
(Background)
3. Introduction to GitHub Operations
4. Software Installation and setup  
Guide

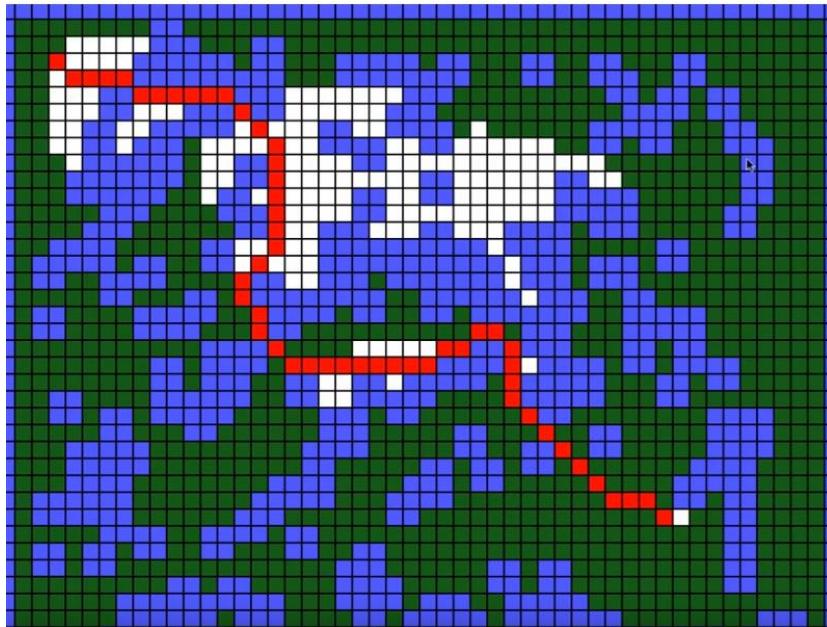


# Introduction to Path Planning

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# What is Path Planning?

- **Path planning** (also known as the **navigation problem**) is computational problem to find a sequence of valid configurations that moves the object from the source to destination. The term is used in **aviation, robotics and computer games**.

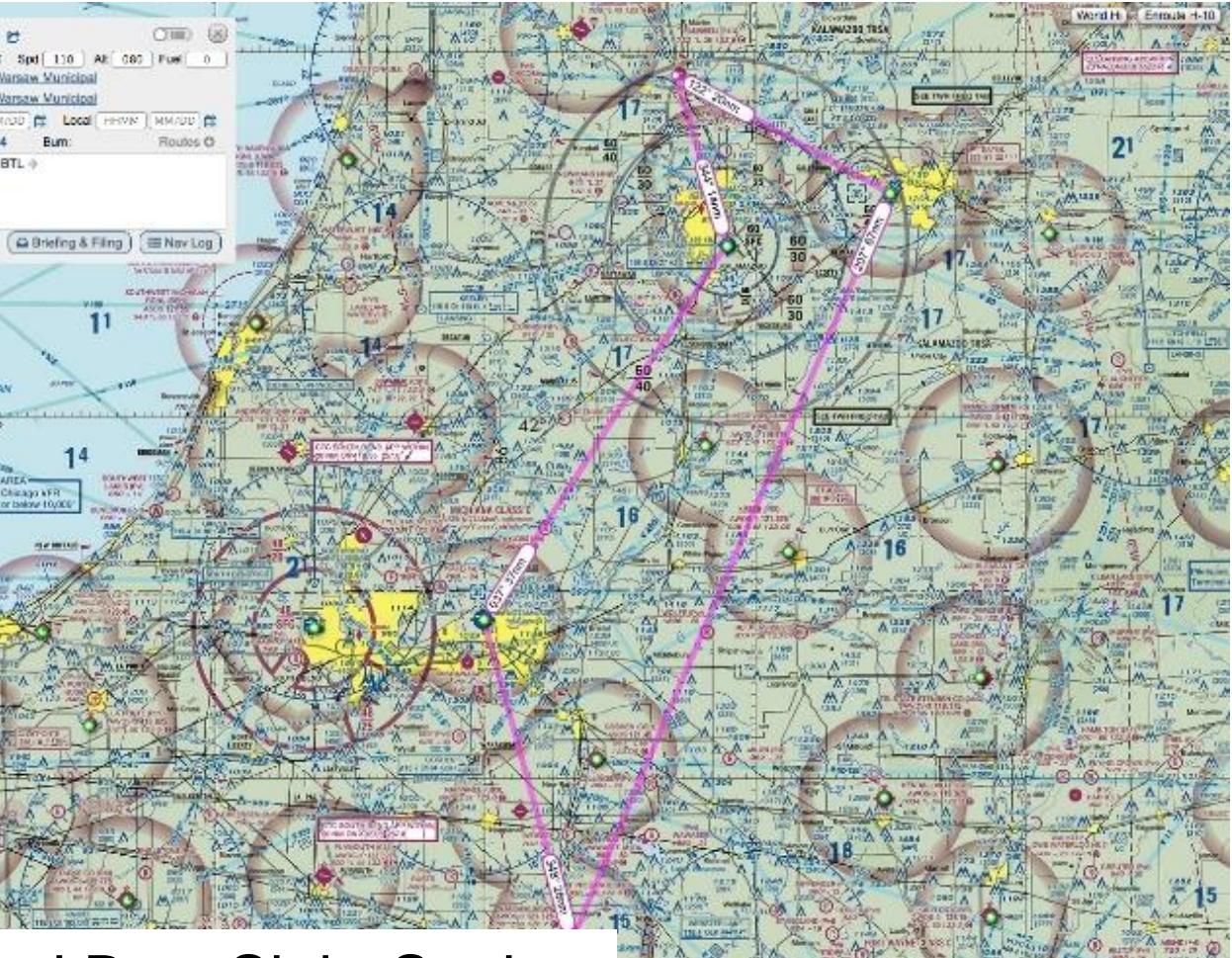
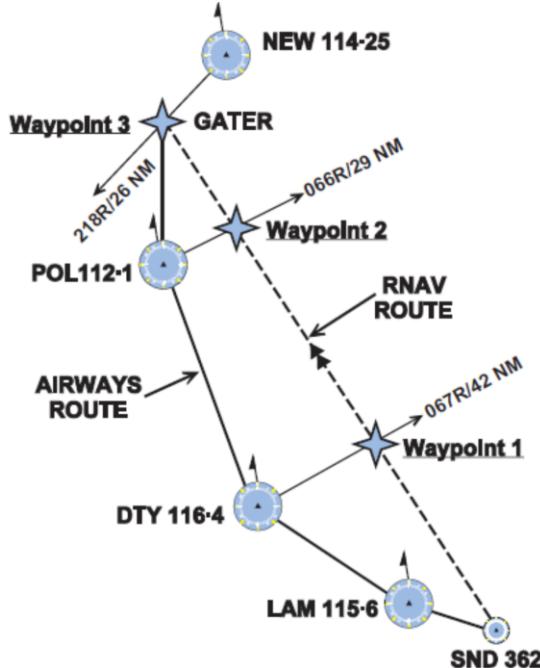


**How to go from A to B considering factors!**



# How is Path Planning important to Aviation Engineering?

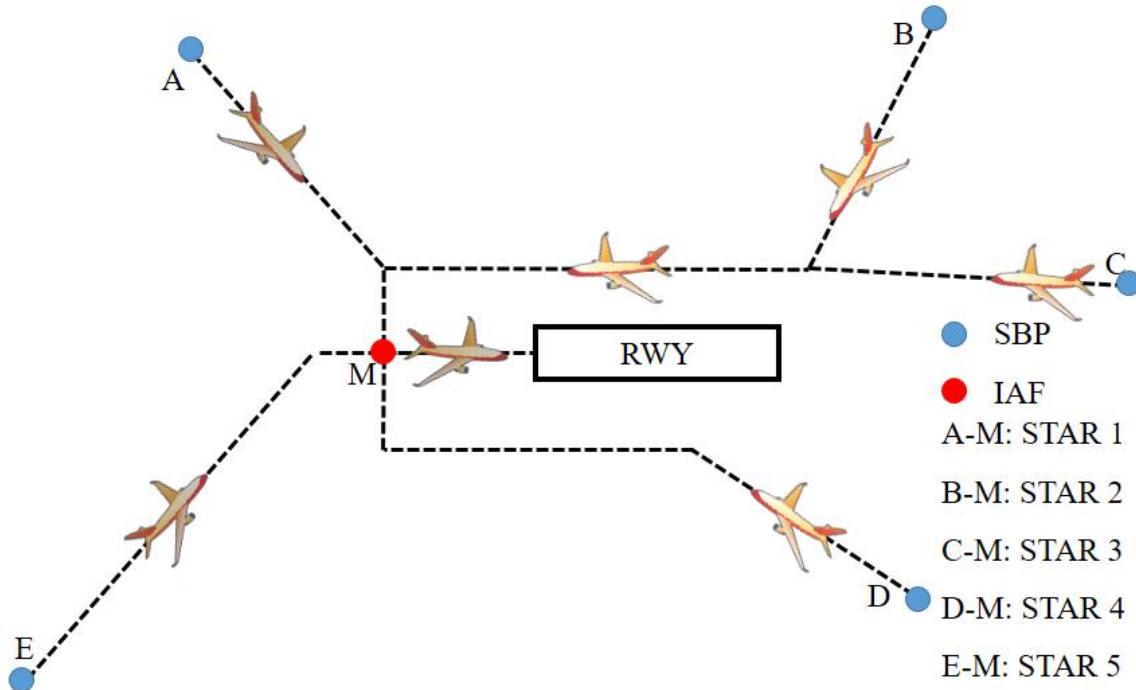
- Private pilots do the path plan before the flight to make sure the navigation aid is available



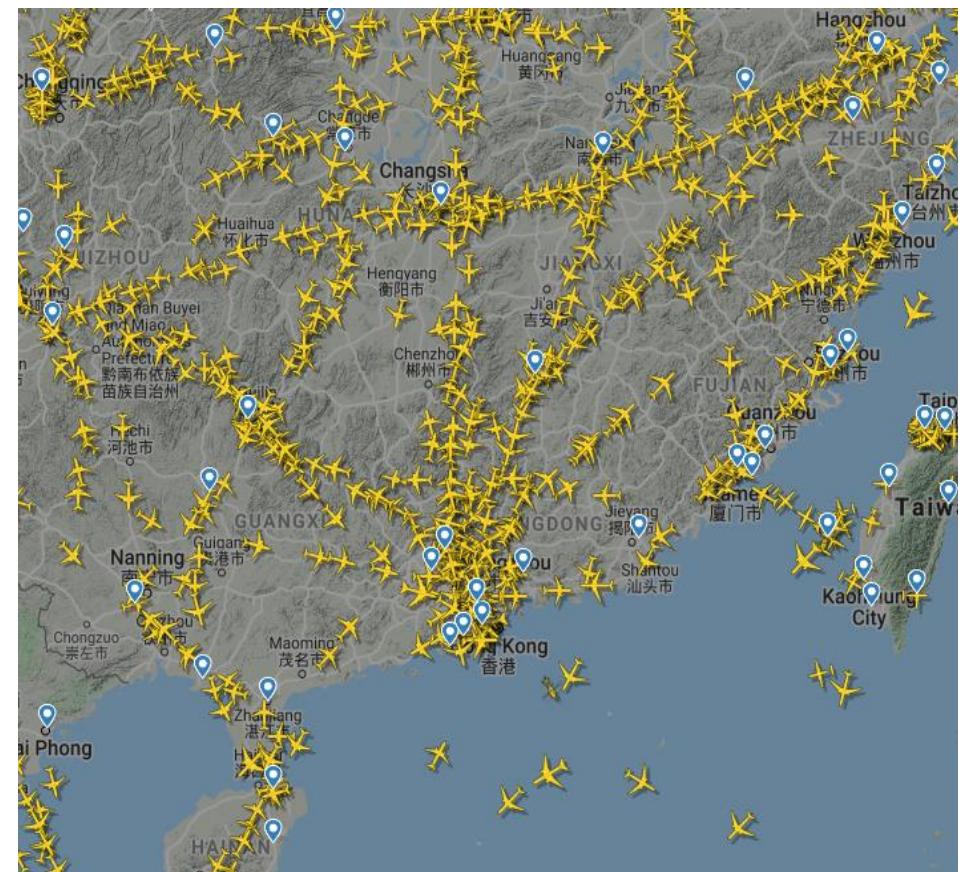
# Objective: Safe and Best Sight Seeing

# How is Path Planning important to Aviation Engineering?

- For ATC near airports, collaborative path planning is required to make the best use of the crowded airspace



Objective: Safe and least delay

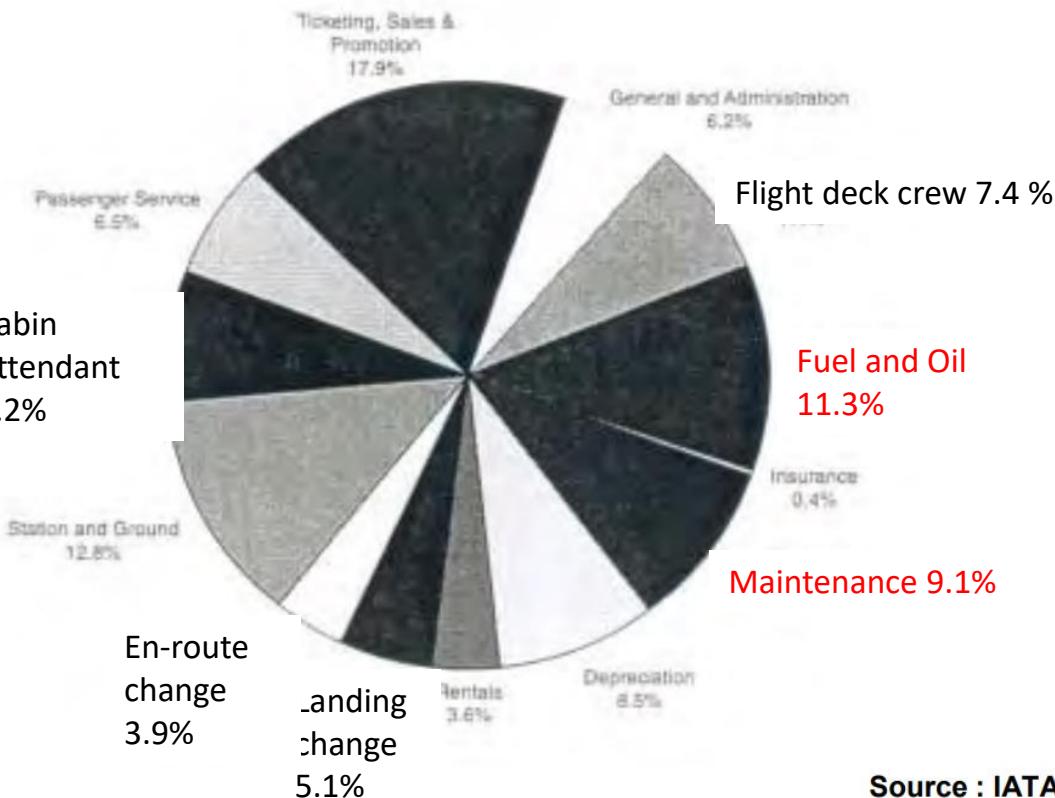


# How is Path Planning important to Aviation Engineering?

- Commercial pilot follow the path that plan based on different cost index designed by airlines.

Objective: Safe and Minimum Cost

Figure 2. Distribution of operating costs



## 2.1 Trip cost

Without having to resort to complicated mathematics we can readily appreciate that the total cost of a specific trip is the sum of fixed and variable costs :

$$C = C_F \times \Delta F + C_T \times \Delta T + C_c$$

with   
  $C_F$  = cost of fuel per kg  
 $C_T$  = time-related cost per minute of flight  
 $C_c$  = fixed costs independent of time  
 $\Delta F$  = trip fuel  
 $\Delta T$  = trip time

In order to minimize  $C$  or the total trip cost we therefore need to minimize the variable cost :

$$C_F \times \Delta F + C_T \times \Delta T$$

Source : IATA

<https://ansperformance.eu/library/airbus-cost-index.pdf>

# Cost-Index Published by Aircraft Manufacturer

Flight Operations Support & Line Assistance

getting to grips with the cost index

Issue II - May 1998

Customer Services

AIRBUS



## 3.1 A300/A310 Family

Considering, with good approximation, that the following range of time-related costs cover the maintenance cost difference between A300 and A310 as well as the cabin crew contingent (plus or minus two) difference, the following cost brackets result :

6 < Hourly maintenance cost < 12 (US\$/min)

+ 7 < Crew cost < 14 (US\$/min)

13 < Time-related cost < 26 (US\$/min)

NB : Crew composition = 2 cockpit crews + 8 ( $\pm 2$ ) cabin crews.

In turn, the following cost index tables reflect these cost ranges for the A300 and for the A310.

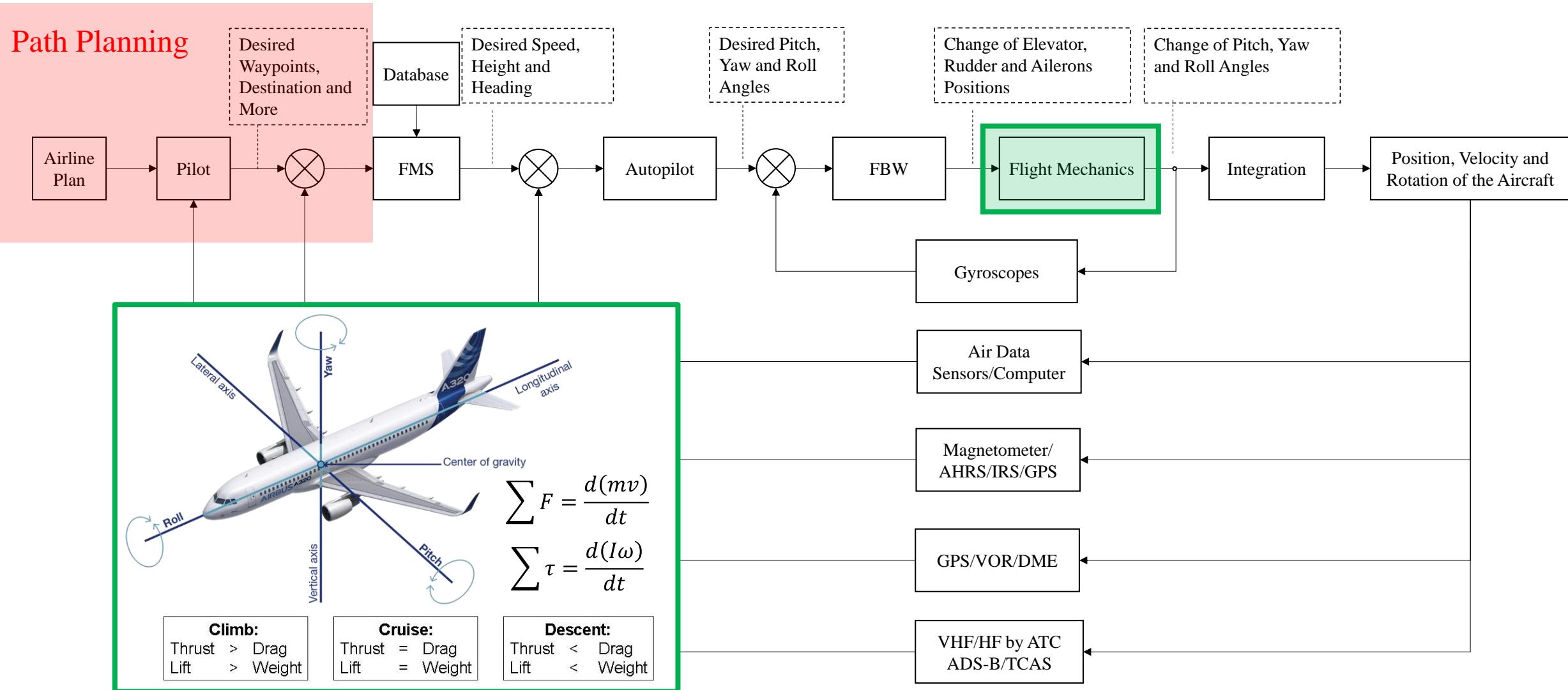
Table 1. A300/A310 cost index

(kg/min)  
(Honeywell FMS)

TIME COST (US\$/min)\ FUEL COST (US\$/USG)	LOW	MEDIUM	HIGH
LOW < 0.7	65	85	100
MEDIUM 0.7 < < 0.9	50	65	80
HIGH > 0.9	40	55	65

<https://ansperformance.eu/library/airbus-cost-index.pdf>

# Aircraft Operation in Flight Control System



# How is the Freshman Project related to the AE programme study?

- Mathematics & Physics
- Computer Science
- Aeronautical and Aviation
- The plan should be planned considering the physical limitation (dynamics) of the aircraft

Year 1 (33 + 4 training credits)					
Semester 1 (15 + 2 training credits)		Semester 2 (18 +2 training credits)			
AAE2001	Introduction to Aircraft and Aviation Systems	AMA1120	Basic Mathematics II		
AMA1110	Basic Mathematics I	AP10006	Physics II		
AP10005	Physics I	APSS1L01	Tomorrow's Leaders		
ENG1003	Freshman Seminar for Engineering	ENG2003	Information Technology		
LCR I (English)		LCR II (English)			
		CAR I ^			
Healthy Lifestyle (non-credit bearing) ^					
IC2105    Engineering Communication and Fundamentals (4 training credits) or IC2133    Aircraft Manufacturing and Maintenance Fundamentals (4 training credits)					
Year 2 (30 + 3 training credits)					
Semester 1 (15 credits)		Semester 2 (15 + 3 training credits)			
AMA2111	Mathematics I	AMA2112	Mathematics II		
ENG2001	Fundamentals of Materials Science and Engineering / Biology / Chemistry	EE2902S	Fundamentals of Electrical and Electronic Engineering		
ENG2002	Computer Programming	ME33001	Mechanics of Materials		
ME23001	Engineering Mechanics	LCR III (Chinese)			
CAR II^		CAR III^			
IC381	Appreciation of Aircraft Manufacturing Processes (3 training credits)				
Year 3 (32 + 3 training credits)					
Semester 1 (17 + 1.5 training credits)		Semester 2 (15 + 1.5 training credits)			
AAE3001	Fundamentals of Aerodynamics	AAE3003	Aircraft Propulsion Systems		
AAE3002	Aircraft Structures and Materials	AAE4006	Flight Mechanics and Control Systems		
AAE3004	Dynamical Systems and Control	AAE4301	Avionics Systems		
ELC3531	Professional Communication In English For Engineering Students (2 credits)	AF3625	Engineering Economics		
CAR IV ^		ISE3009	Aviation Safety and Reliability		
Service Learning ^					
IC388 Aircraft Manufacturing and Maintenance practice (3 training credits)					

# Path Planning

- Optimization Problem:
- To optimize a path that fulfilling all the constrains and by a set of certain criteria.
- Goal of this project, ***to select the best aircraft models with an optimized route that minimized the cost of the aircraft operation under given scenario.***
- ***Design the cost of the aircraft operation***
- ***Design an aircraft model (virtually) with different cost coefficients to fly safe and cheapest.***
- ***Design the path planning algorithm considering 3D, 2D + time, scenarios.***

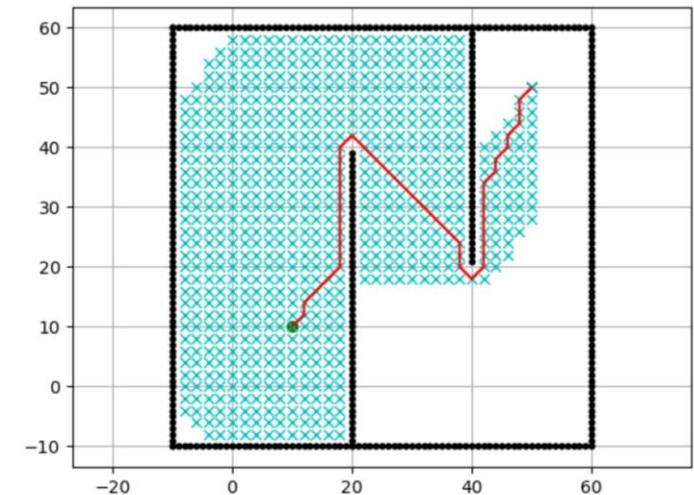
# What you are expected to learn?

Academic level of algorithm designs

- Design of a path planning algorithm and aircraft model cost function
  - 2D path planning for simplicity

Make use of the **open-resource** to work on coding-project **remotely**.

- Programming and coding
  - Python
- Online coding collaboration
  - GitHub



In this project, students will be acted as

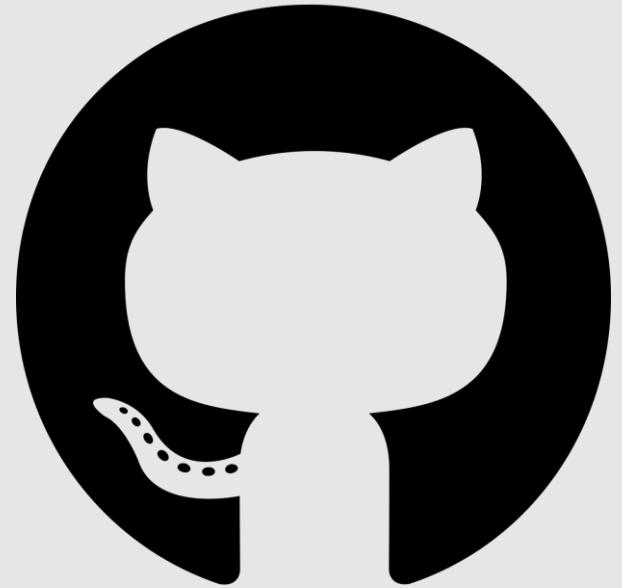
1. Group leader or members to collaborate on an online project,
2. R&D engineers to design and develop path-planning algorithm,
3. Project manager to present the designed code and prepare report.

## Assessments

- (30%) Demonstration and Presentation
- (40%) Report & reflective essay – one report per group, with individual reflective essay
- (20%) Log sheet – one per student after the first week
- (10%) Performance/participation in in-class activities (Confidential peer evaluation)

# Introduction to GitHub (Background)

# What is GitHub?



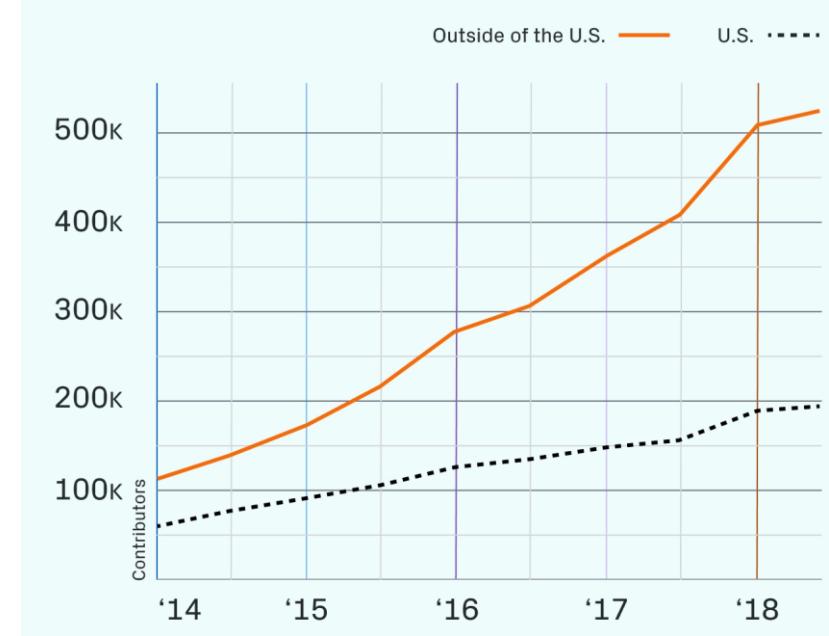
# What is Github?



- A social network and platform for software developers
  - Over 65 million users
  - A place to Share, Communicate, Collaborate with others, especially programmers
-

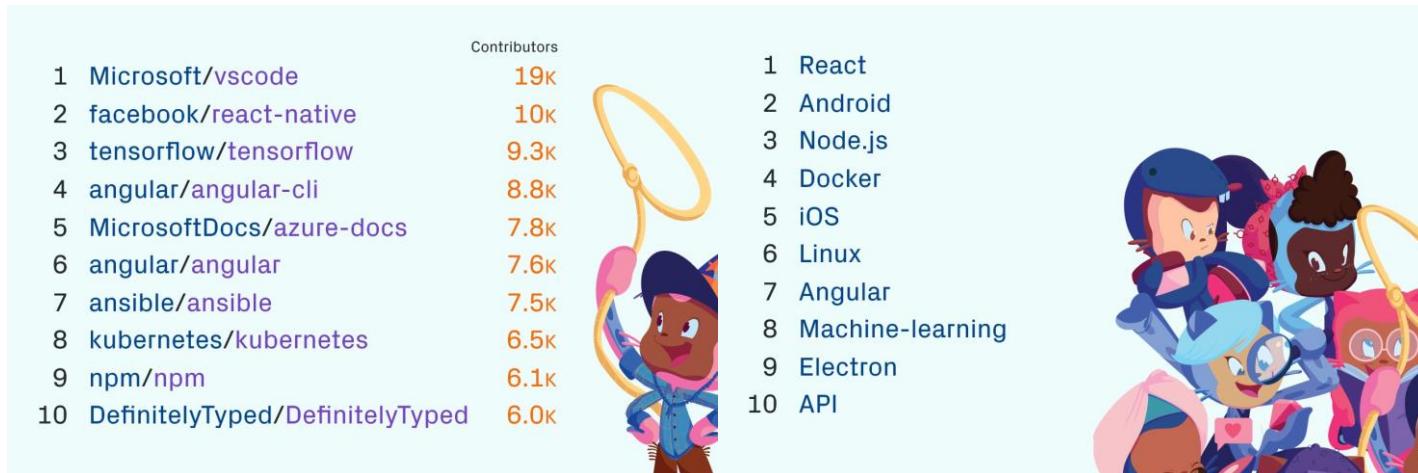
# What's on GitHub

- Over 100 million live Projects
- New projects increasing over the years
- Showing the trend of using GitHub for Software development



# Variety of GitHub

- Countless topics and projects available for the public
- Encompassing most popular topics nowadays



# BIG GitHub Pages

**Tesla, Inc.**  
Open source projects and samples from Microsoft

**Microsoft**  
Open source projects and samples from Microsoft

**Graphomer**  
This is the official implementation for "Do Transformers Really Perform Bad for Graph Representation?"

**calculator**  
Windows Calculator: A simple yet powerful calculator that ships with Windows

**v8-jsi**  
React Native V8 JSI adapter

**ts-gyb**  
Generating native code interfaces from TypeScript

**fixed-containers**  
C++ Fixed Containers

**mongo-go-driver**  
Forked from mongo/mongo-go-driver  
The Go driver for MongoDB

**coreboot**  
Coreboot sources

**linux**  
Linux sources

**ansible puller**

**Google**  
Google ❤️ Open Source

<https://opensource.google/> [@GoogleOSS](#) [opensource@google.com](mailto:opensource@google.com) [Verified](#)

**Repositories** 2.1k **Packages** **People** 1.2k **Projects**

**closure-compiler-npm**  
Package for managing and documenting closure-compiler for use via npm

**it-cert-automation-practice**  
Google IT Automation with Python Professional Certificate - Practice files

**CFU-Playground**  
Want a faster ML processor? Do it yourself! -- A framework for playing with custom opcodes to accelerate TensorFlow Lite for Microcontrollers (TFLM).

**pytype**  
A static type analyzer for Python code

**trax**  
Trax — Deep Learning with Clear Code and Speed

**pigweed**

# BIG GitHub Pages

## Boeing

Overview Repositories 5 Packages People Projects

### Popular repositories

<a href="#">modular_navigation</a> C++ ⭐ 6 📈 6	<a href="#">modular_cartographer</a> C++ ⭐ 5 📈 5
<a href="#">cartographer</a> C++ ⭐ 5 📈 3	<a href="#">math6d</a> Python ⭐ 2 📈 1
<a href="#">image_tran</a> C++	

## Airbus Group

We design, manufacture and deliver industry-leading commercial aircraft, helicopters, military transports, satellites and launch vehicles  
Toulouse <https://www.airbus.com> Verified

Overview Repositories 2 Packages People Projects

### Popular repositories

<a href="#">scikit-decide</a> AI framework for Reinforcement Learning, Automated Planning and Scheduling Python ⭐ 14 📈 10	<a href="#">ED247_LIBRARY</a> Example of ED-247 standard implementation C++ ⭐ 13 📈 7
<a href="#">Repositories</a> Find a repository... Type Language Sort	
<a href="#">ED247_LIBRARY</a> Example of ED-247 standard implementation C++ ⭐ 13 📈 7 ⚡ 3 🔍 1	
<a href="#">scikit-decide</a> AI framework for Reinforcement Learning, Automated Planning and Scheduling Python ⭐ 14 📈 MIT 📈 10 ⚡ 2 🔍 0	

[View all repositories](#)

## NASA

Read about NASA's Open Data initiative here: <https://www.nasa.gov/open/> & Members Find Instructions here: <http://nasa.github.io/>  
United States of America <https://github.com/nasa/nasa.github.io...> [nasa-data@lists.arc.nasa.gov](mailto:nasa-data@lists.arc.nasa.gov)

Repositories 359 Packages People 42 Projects 1

### Pinned repositories

[nasa.github.io](#)  
<https://github.com/nasa/nasa.github.io/blob/master/docs/INSTRUCTIONS.md>

HTML ⭐ 238 📈 52

Find a repository... Type Language Sort

#### fprime

F - A flight software and embedded systems framework

raspberry-pi components real-time framework embedded cpp  
nasa

C++ Apache-2.0 📈 981 ⚡ 8,370 ⚡ 68 (1 issue needs help) 🔍 7 Updated 34 minutes ago

#### cumulus-orca

Python 📈 7 ⚡ 7 ⚡ 0 🔍 1 Updated 1 hour ago

#### ow\_autonomy

C++ 📈 4 ⚡ 13 ⚡ 0 🔍 0 Updated 2 hours ago

#### LHASA

R 📈 7 ⚡ 8 ⚡ 0 🔍 0 Updated 2 hours ago

#### earthdata-search

Earthdata Search is a web application developed by NASA EOSDIS to enable data discovery, search, comparison, visualization, and access across EOSDIS' Earth Science data holdings.

data-discovery hacktoberfest eosdis earthdata-search  
JavaScript 📈 202 ⚡ 618 ⚡ 14 🔍 1 Updated 3 hours ago

### Top languages

Python C C++ JavaScript  
Jupyter Notebook

### Most used topics

nasa cumulus nasa-cumulus  
eosdis satellite

### People

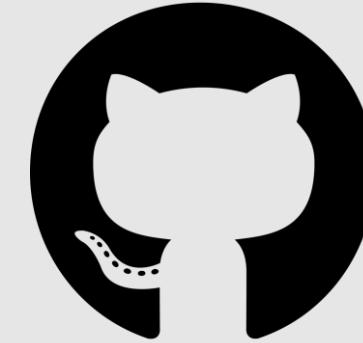
42 >



Developer Program Member

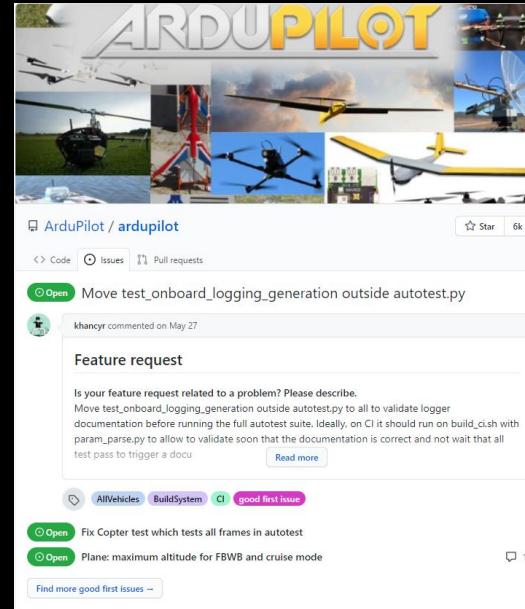
Report abuse

# What's on GitHub? How is it related to AAE?



# Flight control softwares for UAV

Ardupilot, PX4 and more



The screenshot shows the PX4 GitHub repository page. At the top is a banner with the PX4 logo and several small images of different UAVs. Below the banner, the repository name 'PX4 / PX4-Autopilot' is displayed along with a star icon and '4.7k' stars. A green button labeled 'Open' and the title 'Feature request' are visible. Below the title is a detailed description of the feature request. A 'Read more' link is also present. A 'Find more good first issues' button is located below the description. A 'Code', 'Issues', and 'Pull requests' navigation bar is at the top. Below the navigation bar, the text 'PX4 Autopilot Software' is displayed. A tag cloud below the text includes: uav, drone, ros, px4, pixhawk, uas, dronecode, autopilot, mavlink, autonomous, drones, dds, hacktoberfest, ugv, mavros, multicopter, qgroundcontrol, fixed-wing, fast-rtps, avoidance. A note 'Updated 19 minutes ago' and 'C++' are shown at the bottom.

The screenshot shows the mavlink/qgroundcontrol GitHub repository page. At the top is a banner with the qgroundcontrol logo and several small images of different UAVs. Below the banner, the repository name 'mavlink / qgroundcontrol' is displayed along with a star icon and '1.9k' stars. A green button labeled 'Open' and the title 'Cross-platform ground control station for drones (Android, iOS, Mac OS, Linux, Windows)' are visible. Below the title is a detailed description of the repository's purpose. A 'Read more' link is also present. A 'Code', 'Issues', and 'Pull requests' navigation bar is at the top. Below the navigation bar, the text 'Cross-platform ground control station for drones (Android, iOS, Mac OS, Linux, Windows)' is displayed. A tag cloud below the text includes: qt, uav, drone, px4, pixhawk, uas, mavlink, ardupilot. A note 'Updated 23 hours ago' and 'C++' are shown at the bottom.

# About These Softwares

Ardupilot:

- Open source software suite
- Quadcopters, VTOL and more
- Cross platform
- Over 10 years of development and improvement



PX4:

- Also open source
- Works with QGC and MAVLink (Also available in GitHub)

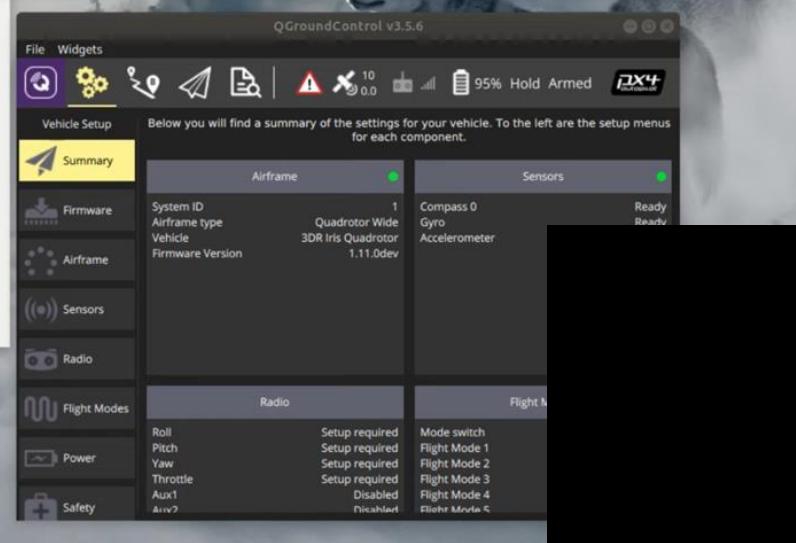
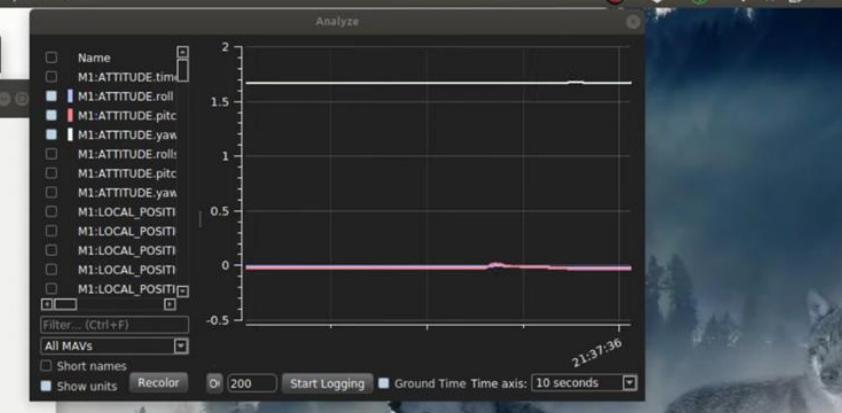
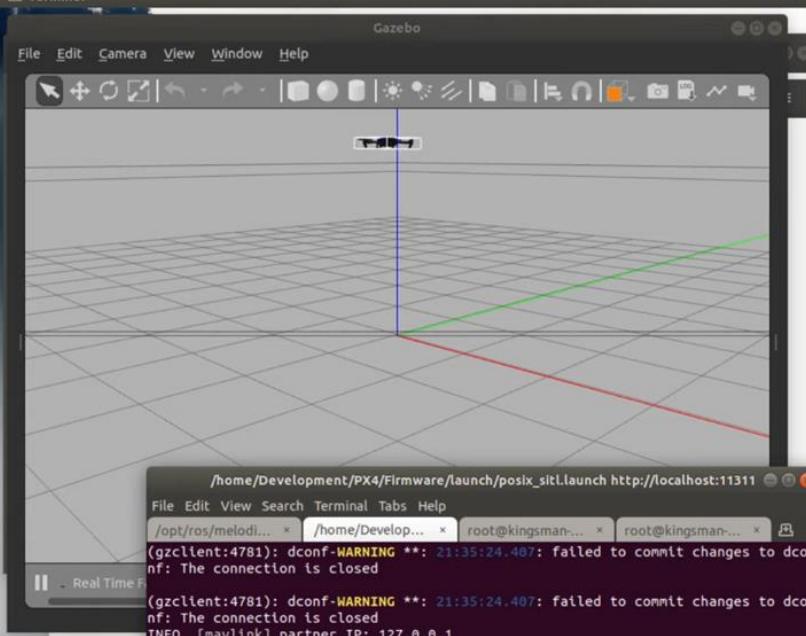


Activities

Terminal

Sun Feb 9, 21:37:36

95 %



# Aviation Services Engineering

Logistics and Facility Management  
and more

# airport

Here are 148 public repositories matching this topic...

Language: All ▾

Sort: Best match ▾

Ysurac / FlightAirMap

Star 388

Code Issues Pull requests

Open source project displaying live aircrafts, ships or trackers on 2D/3D map. Browse through the data based on a particular aircraft, airline, airport, tracker or vessel to search through the database or see extensive statistics. Can use ADS-B in SBS1 format (dump1090, Radarcap...), VRS, VA (VATSIM, IVAO whazzup.txt, phpvms,...), ACARS (acarsdec, acarsdeco2), APRS, AIS as datasource.

tracker cesium crash metar airport airline flight ship vatsim aircraft iavo acars  
glidernet phpvms notam modes ads-b sbs vessel 3d-map

Updated on Nov 25, 2020 TSQL

felix-dumit / FSDAirportFlipLabel

Star 83

Code Issues Pull requests

UILabel like old Airport flipping labels

ios label ios-animation airport

Updated on Mar 9, 2018 Objective-C

Ivysauro / CNRT

Star 74

Code Issues Pull requests Discussions

中国轨道交通数据库 (非技术类) - 另一角度看地铁/ Data base of China Rail Transit (Non-tech) - Another view of Rail Transit

bus metro payment railway china airport subway rail-transit

Updated 3 days ago SCSS

gravity-EDDS / EDDS-freeware-releases

Star 57

Code Issues Pull requests

# Logistics and Facility Management

- Data analysis resources
- System modelling and simulations
- Logistical models

## Machine learning for data analysis

- Faster analysis
- Potential extra self-learning for students
- Extremely beneficial to their careers

The screenshot shows a GitHub repository page for 'LogisticsPipes'. At the top, it displays '4 branches' and '11 tags'. Below the repository name, there's a list of commits from 'Michał-MK' with details like date, file changes, and descriptions. To the right, there are sections for 'Releases' (17), 'Packages' (No packages published), 'Contributors' (60), and 'Languages' (Java 84.4%, Kotlin 15.6%).

The screenshot shows a GitHub search results page for 'Machine Learning'. It includes a sidebar with repository statistics (339K repositories, 8M code, 271K commits, etc.) and a language section (Jupyter Notebook 132,549, Python 72,791, etc.). The main area shows search results for 'Machine Learning' with details like repository name, description, language, and update date.

# Aeronautical Engineering

## Material, aircraft designs, CFD and more

# computational-fluid-dynamics

Here are 198 public repositories matching this topic...

Language: All ▾

Sort: Best match ▾

doyubkim / fluid-engine-dev

Star 1.1k

Code Issues Pull requests

Fluid simulation engine for computer graphics applications

c-plus-plus visual-studio sdk animation computer-graphics physics-engine computational-physics fluid-simulation-engine computational-fluid-dynamics

Updated on Apr 25 C++

CubbyFlow / CubbyFlow

Star 175

Code Issues Pull requests

Voxel-based fluid simulation engine for computer games

cplusplus cpp computer-graphics physics-engine computational-physics cpp17 fluid-simulation-engine computational-fluid-dynamics

Updated 6 days ago C++

AvtechScientific / ASL

Star 153

Code Issues Pull requests

Advanced Simulation Library - hardware accelerated multiphysics simulation platform.

crystallography gpgpu scientific-computing high-performance-computing design-space-exploration computational-fluid-dynamics virtual-sensing image-guided-surgery computer-aided-engineering

Updated on Dec 21, 2018 C++

loliverhennigh / Steady-State-Flow-With-Neural-Nets

Star 119

Code Issues Pull requests

A Tensorflow re-implementation of the paper Convolutional Neural Networks for Steady Flow Approximation

# aircraft-design

Here are 21 public repositories matching this topic...

Language: All ▾

Sort: Best match ▾

JSBSim-Team / jsbsim

Star 394

Code Issues Pull requests Discussions

Open XML validation

14

bcoconni commented on Jan 12, 2019

JSBSim provides schemas for XML validation ( JSBSim.xsd for flight models, JSBSimScript.xsd for script files and JSBSimSystem.xsd for system files) but they have not been updated for a while so they might reject perfectly valid XML files.

XML files can be tested with xmllint

> xmllint --noout --schema JSBSim.xsd file.xml [Read more](#)

bug help-wanted good-first-issue

Aero Sandbox

by Peter Sharpe



peterdsharpere / AeroSandbox

Sponsor Star 236

Code Issues Pull requests

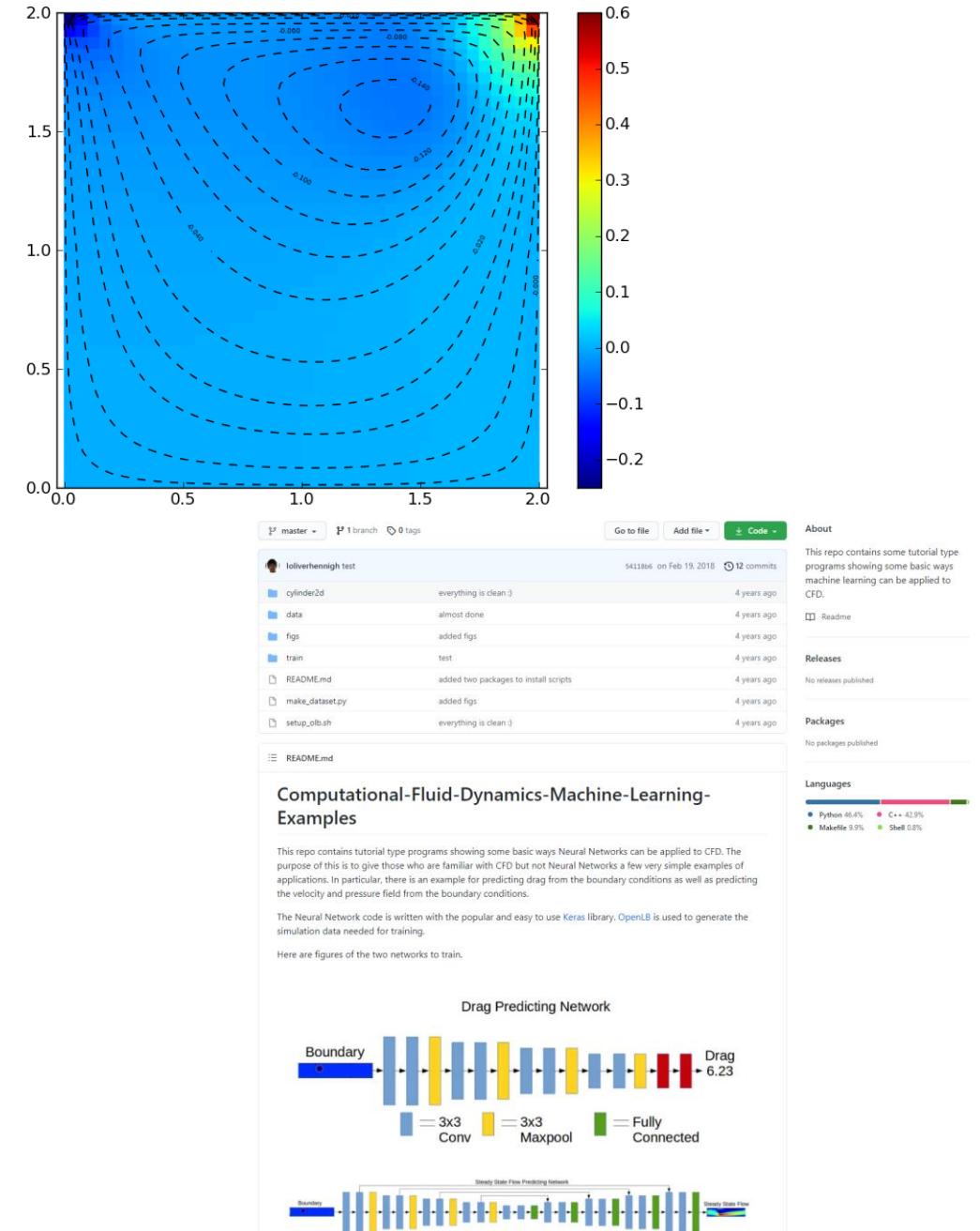
Aircraft design optimization made fast through modern automatic differentiation. Plug-and-play analysis tools for aerodynamics, propulsion, structures, trajectory design, and much, much more.

python analysis optimization aerospace automatic-differentiation airplane cfd aircraft aerodynamics vlm xfoil aircraft-design indra mdao aerodynamic-analysis 3d-panel

Updated 4 days ago Jupyter Notebook

# CFD Python

- Full course for CFD Python
- Course Materials (Lectures and video)
- Software resources



# Aircraft Maintenance

## Propulsion, NDT and more

NASA Jet Propulsion Laboratory  
A world leader in the robotic exploration of space  
Pasadena, California, US <http://www.jpl.nasa.gov> [github@jpl.nasa.gov](mailto:github@jpl.nasa.gov)

Overview Repositories 26 Packages 6 People 6 Projects

Pinned

**open-source-rover**  
A build-it-yourself, 6-wheel rover based on the rovers on Mars!  
Gnuplot 6.8k 1.1k

**osr-rover-code**  
Code that runs on the Open Source Rover  
Python 267 96

**COVID-19-respirators**  
JPL designed 3D and tested printed respirators to help with the COVID-19 pandemic response.  
G-code 104 18

**osr-android-app**  
Android application used to control the Open Source Rover  
Java 59 30

**SPOC**  
A website showcasing SPOC (Soil Property and Object Classification), a deep learning-based terrain classifier for Mars rovers  
HTML 6 1

**spoc\_lite**  
A light-weight, experimental terrain classifier for Mars rovers  
C++ 7 4

Repositories

Find a repository... Type Language Sort

**itslive**  
A NASA MEaSUREs project to provide automated, low latency, global glacier flow and elevation change datasets  
Jupyter Notebook 4 MIT 0 3 0

**LiveViewLegacy**  
Real-time tools for Imaging Spectroscopy Data  
C++ 18 7 0 0 0

**open-source-rover**  
A build-it-yourself, 6-wheel rover based on the rovers on Mars!  
Gnuplot 6,785 Apache-2.0 1,104 34 (1 issue needs help) 8

**itslive-projects**  
Jupyter Notebook 0 MIT 0 0 0

**sstmp**  
Solar System Treks Mosaic Pipeline  
Python 4 Apache-2.0 0 21 0

**jsd**  
Just SOEM Drivers

# Example on NDT

- Resources on the whole conference
  - 20th World Conference on Non-Destructive Testing
- Documentation and software resources
- Applying LSTM to NDT

master 3 branches 0 tags Go to file Add file Code

vewald Merge branch 'master' of https://github.com/xaviergoby/LSTMforSHM 0f00291 on Oct 21, 2020 67 commits

File	Description	Time Ago
configs_and_settings	recent work	10 months ago
literature	non-code commit	13 months ago
results	Merge branch 'master' of https://github.com/xaviergoby/LSTMforSHM	10 months ago
src	recent work	10 months ago
.gitignore	recent work	10 months ago
LICENSE	Initial commit	2 years ago
README.md	Revert "Results Update"	13 months ago
__init__.py	1st commit of og Vicent lstm & my data_loading script w/ data and labels	2 years ago
call_mainscript.py	Update results	10 months ago
main.py	recent work	10 months ago
main_v2.py	Merge branch 'master' of https://github.com/xaviergoby/LSTMforSHM	10 months ago
main_v3_xav.py	recent work	10 months ago
p2atR.jpg	non-code commit	13 months ago
settings.py	recent work	10 months ago

Readme MIT License

Releases No releases published

Packages No packages published

Contributors 2 xaviergoby Alexander Xavier O'Rour... vewald

Environments 1 github-pages Active

Languages Python 100.0%

About Application of LSTM network for Structural Health Monitoring & Non-Destructive Testing

xaviergoby.github.io/convlstm-compu...

computer-vision timeseries tensorflow keras cnn waves lstm supervised-learning classification shm ultrasonic-sensor ndt structural-engineering structural-analysis convlstm structural-health-monitoring lambwaves pzt aircraft-inspection non-destructive-testing

Sequential Modelling in Data-Driven Approach for Structural Health Monitoring by Recurrent Convolutional Neural Networks

Conference: 20th World Conference on Non-Destructive Testing  
Location & Date: South Korea, Seoul - June 2020  
Co-authors: Ewald V., Goby X., Groves R.M. & Benedictus R.  
Labarotory: TU Delft Aerospace NDT Lab

Usage Instruction

In order to make use of this project all you need mainly be concerned with is the main.py Python script. In it you shall (hopefully) find yourself a more than sufficient amount of documentation in order to understand and be able to make use of it!

Dev Progress Log-Journal, Data Characteristics & Background Information

Notes:

# Navigation and Positioning

RTKLIB, VINS, ORB\_SLAM3, ROS and more

The image displays three GitHub repository pages side-by-side:

- UZ-SLAMLab / ORB\_SLAM3**: This page shows the repository's code history. The master branch has 49 commits from richard-elvira. Recent commits include "V0.4: Beta version, 21 April 2021" for Examples, Thirdparty, Vocabulary, evaluation, include, src, .gitignore, CMakeLists.txt, Changelog.md, Dependencies.md, LICENSE, README.md, build.sh, and build\_ros.sh. The repository has 165 issues, 27 pull requests, and 1k forks.
- tomojitakasu / RTKLIB**: This page shows the repository's code history. The master branch has 69 commits from tomojitakasu. Recent commits include "rtklib 2.4.2 p13" for app, bin, brd, data, doc, lib, and src. The repository has 303 issues, 39 pull requests, and 290 forks.
- HKUST-Aerial-Robotics / VINS-Mono**: This page shows the repository's code history. The master branch has 76 commits from shaozu. Recent commits include "fix ar\_demo image interface" for ar\_demo, "another warning" for benchmark\_publisher, "add Eigen3 cmake" for camera\_model, "Merge branch 'master' of github.com:HKUST-Aerial-Robotics/VINS-Mono" for config, "update docker" for docker, "add realSense config: avoid imu disorder; fix relocalization visualiza..." for feature\_tracker, "add docker" for pose\_graph, "modify readme" for support\_files, "user-friendly updates" for vins\_estimator, and "user-friendly updates" for .gitignore, LICENSE, and README.md. The repository has 231 issues, 4 pull requests, and 217 forks.

# Aviation

Powered By GitHub

# aviation

Here are 368 public repositories matching this topic...

Language: All Sort: Best match



**Generalized Aviation™**

[generalized-intelligence / GAAS](#) Star 1.6k

Code Issues Pull requests

GAAS is an open-source program designed for fully autonomous VTOL(a.k.a flying cars) and drones. GAAS stands for Generalized Autonomy Aviation System.

aviation uav drone flight-controller flight lidar autonomous drones autonomous-quadcopter autonomous-driving autonomous-vehicles vtol flying-car evtol hd-map e-vtol

Updated on Oct 25, 2021 C++

[cyoung / stratus](#) Star 842

Code Issues Pull requests

Aviation weather and traffic receiver based on RTL-SDR.

aviation weather traffic rtl-sdr stratus

Updated 6 days ago C

[szpaider / RTLSDR-Airband](#) Star 469

# Variety of resources

All free on GitHub

# aircraft

Here are 287 public repositories matching this topic...

Language: All ▾ Sort: Best match ▾

wiedehopf / [tar1090](#) ★ Star 582

Provides an improved webinterface for use with ADS-B decoders readsb / dump1090-fa

sdr rtl-sdr webinterface aircraft ads-b adsb rtl-sdr 1090 readsb 1090mhz

Updated 3 days ago JavaScript

JSBSim-Team / [jsbsim](#) ★ Star 504

Open XML validation 16

bcoconni commented on Jan 12, 2019

JSBSim provides schemas for XML validation (`JSBSim.xsd` for flight models, `JSBSimScript.xsd` for script files and `JSBSimSystem.xsd` for system files) but they have not been updated for a while so they might reject perfectly valid XML files.

XML files can be tested with `xmllint`

```
> xmllint --noout --schema JSBSim.xsd file.xml
```

Read more

bug help wanted good first issue

robin-shaun / [XTDrone](#) ★ Star 418

Code Issues Pull requests

UAV Simulation Platform based on PX4, ROS and Gazebo

px4 ros px4 gazebo aircraft self-driving



# What Will You will Learn and Experience?

- Pull Request (Basic Features)
  - Allowing leaders to **double check** modifications done by teammates
- Code Synchronization (Version Control on Web, VS, MATLAB etc)
  - Ensuring everyone is working on the **latest** code version
- Self-learning using GitHub resources
- Look for interesting issues on GitHub

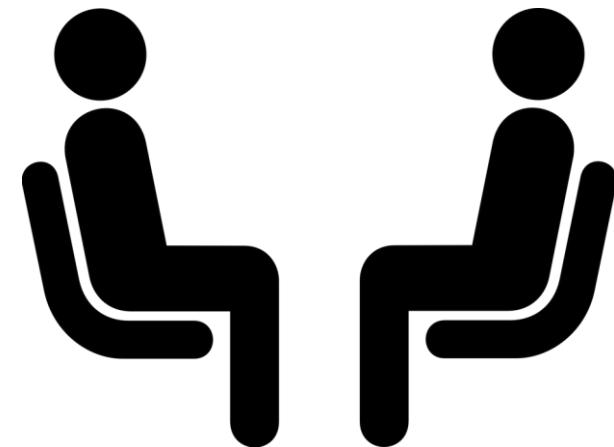


For Your Career

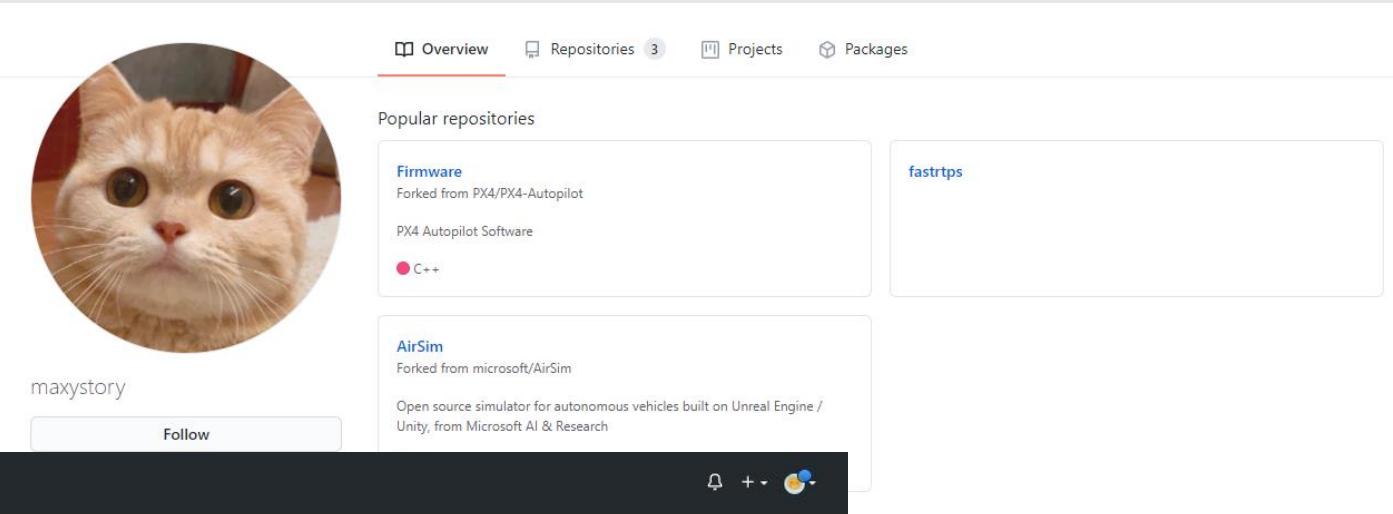


# GitHub Facilitated Job Hunting

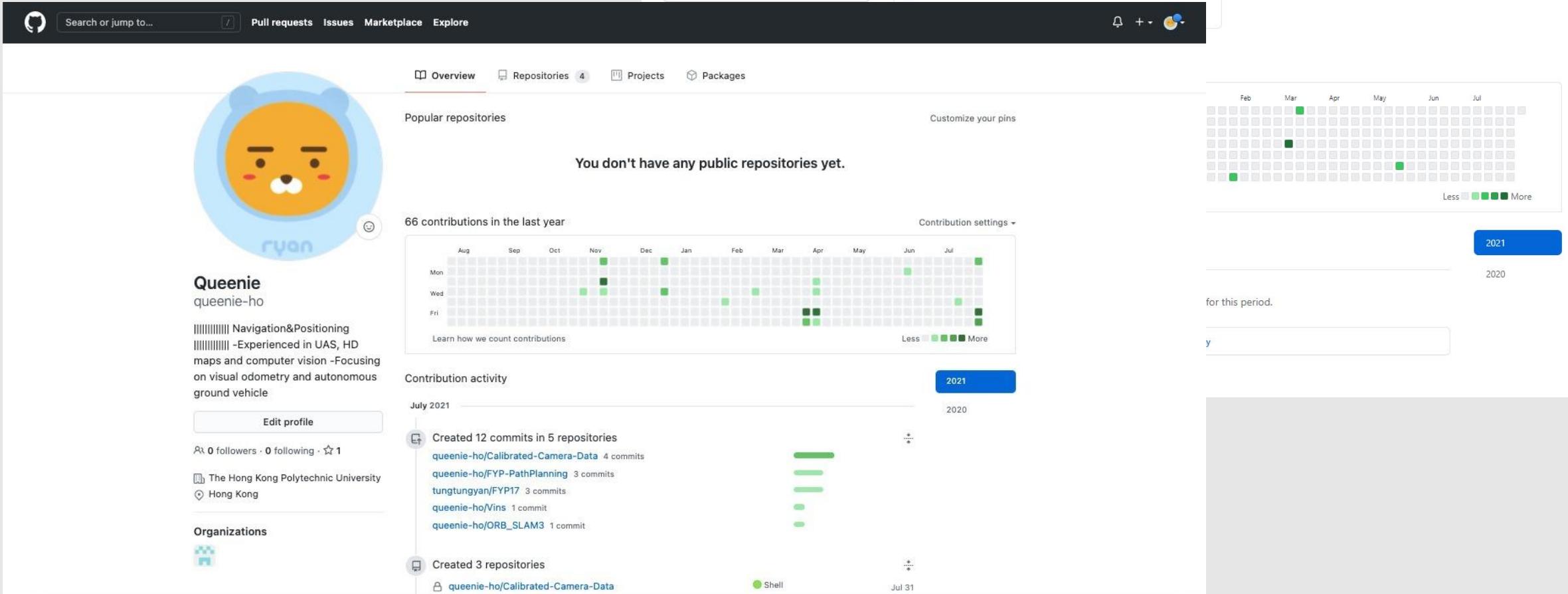
- A online digital profile for students
  - Indicating interests
  - Show past work
  - Roadmap of students' development career
- Let people know that you are looking for a job
- During job hunting
  - Better first impression
  - Better understanding
  - Appears more enthusiastic



# Develop Personal Profiles Starting from AAE UG



The screenshot shows a GitHub profile for the user 'maxystory'. The profile picture is a close-up of an orange cat's face. Below the picture, the username 'maxystory' is displayed, along with a 'Follow' button. The top navigation bar includes links for Overview, Repositories (3), Projects, and Packages. The 'Popular repositories' section lists 'Firmware' (forked from PX4/PX4-Autopilot) and 'AirSim' (forked from microsoft/AirSim). The 'Firmware' repository is described as 'PX4 Autopilot Software' in C++.



The screenshot shows a GitHub profile for the user 'queenie-ho'. The profile picture is a cartoon character with a yellow face and blue body. Below the picture, the username 'queenie-ho' is displayed, along with a link to 'Edit profile'. The user has 0 followers, 0 following, and 1 starred repository. The bio mentions experience in UAS, HD maps, and computer vision, focusing on visual odometry and autonomous ground vehicle. The 'Popular repositories' section indicates 'You don't have any public repositories yet.' The 'Contribution activity' section shows a heatmap of contributions over the last year, with 66 contributions in total. The timeline shows contributions from August 2020 to July 2021. The 'Contribution settings' dropdown allows selecting 'Less' or 'More' contributions per square. The 'Contribution activity' section also lists repositories where the user has created commits: 'queenie-ho/Calibrated-Camera-Data' (4 commits), 'queenie-ho/FYP-PathPlanning' (3 commits), 'tungtungyan/FYP17' (3 commits), 'queenie-ho/Vins' (1 commit), and 'queenie-ho/ORB\_SLAM3' (1 commit). The 'Created 3 repositories' section lists 'queenie-ho/Calibrated-Camera-Data' (Shell, Jul 31).



B.X.W  
baaixw

Follow

Visual SLAM GNSS

At 8 followers · 15 following · ⭐ 42

Intelligent Positioning and Navigation L...  
Hong Kong

Achievements



Block or Report

Overview Repositories 33 Projects Packages

Popular repositories

remoteSensing2020

Improved VINS based on the adaptive covariance and adaptive M-estimator

C++ ⭐ 4 2

ios\_logger

Forked from Vanvarilos\_ios\_logger

Application for camera and sensor data logging (IOS)

Objective-C++ ⭐ 1

vins-application

Forked from engcang/vins-application

VINS-Mono and Fusion application of different sets of cameras and imu on different board including desktop and jetson xavier

C++ ⭐ 1

catkin

Original vins-fusion for validation some data. The related path has been revised to ourself path.

C++ ⭐ 1 1

CV\_GNSS

Forked from weisongwen/CV\_GNSS

CV Aided GNSS

C++

tutorials

128 contributions in 2020



2021  
2020  
2019  
2018

Activity overview

Contributed to weisongwen/researchTools.

Code review

# Up to Phd Studies

The image shows two GitHub profiles side-by-side for comparison. The left profile is for B.X.W (baaixw) and the right is for Darren Wong. Both profiles feature a circular profile picture, a summary section with pinned repositories, a contributions calendar, and achievement sections. The right profile (Darren Wong) includes additional sections for organizations and a code review chart.

**B.X.W Profile (Left):**

- Popular repositories:** remoteSensing2020, ios\_logger, vins-application, catkin, CV\_GNSS, tutorials.
- Achievements:** 128 contributions in 2020.
- Activity overview:** Contributed to weisongwen/researchTools.

**Darren Wong Profile (Right):**

- Pinned:** e3372-web-management, protobuf-over-nanomsg-example.
- Contributions:** 98 contributions in the last year.
- Organizations:** IPNL @IPNL-POLYU, @HKUST-Aerial-Robotics.
- Code review:** 100% Commit, 0 Issues.



### Seph Soliman

scarlac

[Follow](#)

Tattoodo, Bitbucket, Konstellation. Software entrepreneur, developer and true full stack developer.

64 followers · 7 following · 71 contributions

[Tesla](#)  
[San Francisco](#)  
<https://www.seph.dk>

**Achievements**



**Organizations**

  
[Block or Report](#)

**Pinned**

- js-stopwatch**  
JavaScript Stopwatch class. Output can be controlled using a simple callback.  
JavaScript ⭐ 24 ⚡ 7
- drag-check-js**  
Library for checking multiple checkboxes by click-and-dragging over them. Paint your selection!  
JavaScript ⭐ 21 ⚡ 9
- ClamshellOpen**  
App to allow running your laptop in clamshell mode with an open lid for Lion (10.7) and Mountain Lion (10.8)  
Objective-C ⭐ 5
- chargenow**  
See DriveNow EVs in your area that needs charging. First react project.  
JavaScript ⭐ 1
- d3d-strategy**  
Exam assignment to write a C# program. I chose to write a Direct 3D Strategy game. Graphics for this game was borrowed from C&C: Red Alert. For legal reasons, they are not included in the repository.  
C# ⭐ 1
- lолpause**  
MacOS utility app to pause League of Legends GUI Flash client while game is active to lower CPU consumption  
Objective-C ⭐ 1

**44 contributions in 2021**





### Jonathan Hall

flimzy

You can also find me on GitLab: <https://gitlab.com/flimzy>

[Follow](#)

139 followers · 32 following · 45 contributions

[Amsterdam, NL](#)  
<https://jhall.io/>  
[@DevOpsHabits](#)

**Highlights**

\* Arctic Code Vault Contributor

**Organizations**


**Popular repositories**

- anki**  
Go library to read Anki \*.apk files  
Go ⭐ 18 ⚡ 3
- go-pouchdb**  
GopherJS bindings for PouchDB ⚠ NOTICE ⚡ this package has been superseded by https://github.com/go-kivik/kivik  
Go ⭐ 13 ⚡ 1
- onload**  
Onload handler for GopherJS without the bloat of jQuery  
Go ⭐ 10 ⚡ 1
- go-sql.js**  
GopherJS bindings for SQL.js  
Go ⭐ 9
- minimal-pairs**  
Tool for finding minimal pairs given a corpus of words  
HTML ⭐ 5 ⚡ 1
- jsblob**  
GopherJS bindings for JavaScript Blob objects  
Go ⭐ 3

**977 contributions in the last year**





### Jonathan Hall

flimzy

You can also find me on GitLab: <https://gitlab.com/flimzy>

[Follow](#)

139 followers · 32 following · 45 contributions

[Amsterdam, NL](#)  
<https://jhall.io/>  
[@DevOpsHabits](#)

**Highlights**

\* Arctic Code Vault Contributor

**Organizations**


**Popular repositories**

- anki**  
Go library to read Anki \*.apk files  
Go ⭐ 18 ⚡ 3
- go-pouchdb**  
GopherJS bindings for PouchDB ⚠ NOTICE ⚡ this package has been superseded by https://github.com/go-kivik/kivik  
Go ⭐ 13 ⚡ 1
- onload**  
Onload handler for GopherJS without the bloat of jQuery  
Go ⭐ 10 ⚡ 1
- go-sql.js**  
GopherJS bindings for SQL.js  
Go ⭐ 9
- minimal-pairs**  
Tool for finding minimal pairs given a corpus of words  
HTML ⭐ 5 ⚡ 1
- jsblob**  
GopherJS bindings for JavaScript Blob objects  
Go ⭐ 3

**977 contributions in the last year**



## Making GitHub Part of your Work

Now you have an empty GitHub profile. How do you make it shine?

The following tips are roughly organized according to effort. Practically anyone can implement at least some of them. The later suggestions will be more discretionary, depending on your interests and time.

### Star interesting projects

Whenever you run across a GitHub project that piques your interest, "star" it. Your starred projects appear on your public profile, and if nothing else, they provide recruiters and hiring managers an indication of what sorts of projects you find interesting.

### Follow interesting people

GitHub also allows you to follow interesting people, and these people will appear on your public profile, as well. In addition to signaling to the world whom you find interesting, when people you follow make contributions to their projects, you will



# Introduction to GitHub Operations

# Mutual editing on a document with collaborators remotely?

acceptance	26/3/2021 11:58 AM	File folder	
final submission	2/8/2021 11:38 AM	File folder	
ieee_taes_novatel_heatmap	29/7/2020 2:44 PM	File folder	
My EndNote Library.Data	20/7/2020 9:17 PM	File folder	
My EndNote Library.enl.unzipped	14/7/2020 9:26 AM	File folder	
revision 1	28/12/2020 5:31 PM	File folder	
Artical file (single column).docx	24/8/2020 3:55 PM	Microsoft Word D...	4,036 KB
Article Processing Charges.pdf	19/4/2021 9:33 AM	Adobe Acrobat D...	118 KB
cover letter.docx	28/7/2020 12:26 PM	Microsoft Word D...	17 KB
figure.pptx	22/6/2020 11:11 AM	Microsoft PowerP...	7,122 KB
ieee_taes_3dma_rtk (20200612 Ivan).docx	22/6/2020 10:12 AM	Microsoft Word D...	4,103 KB
ieee_taes_3dma_rtk (20200622 GH).docx	22/6/2020 2:52 PM	Microsoft Word D...	4,112 KB
ieee_taes_3dma_rtk (20200709 WS).docx	9/7/2020 3:38 PM	Microsoft Word D...	4,294 KB
ieee_taes_3dma_rtk (20200714 LT).docx	15/7/2020 5:47 PM	Microsoft Word D...	4,306 KB
ieee_taes_3dma_rtk (20200722 lucy).docx	23/7/2020 4:49 PM	Microsoft Word D...	7,319 KB
ieee_taes_novatel_heatmap.rar	29/7/2020 2:42 PM	WinRAR archive	13,851 KB
Manuscript_two_columns.docx	13/10/2020 1:45 PM	Microsoft Word D...	4,030 KB
My EndNote Library.enl	8/1/2021 10:42 AM	EndNote Library	141 KB
References.docx	14/7/2020 9:16 AM	Microsoft Word D...	18 KB

Download files from various channels, such as mail, whatsapp, etc?

Can we edit the documents online ? Google, Microsoft has the solutions!

Can we edit the “code” online? **Github**

# Archive your coding online (in the cloud)

Pull

Pull: *To update local branch with remote, update all remote tracking branches*

Video: **VSC-Git Basic Operations**

Cloud repository (project)

Clone : *To download a repository to your local machine*

Clone/  
Fetch

Local repository (project)

Fetch : *To pull a branch to your local machine*

Push

Push: *To upload the commit made on a local branch to GitHub*

Check out to: *Switch to a specific branch*

Open file and  
Check out to

Code and Debugger

Commit

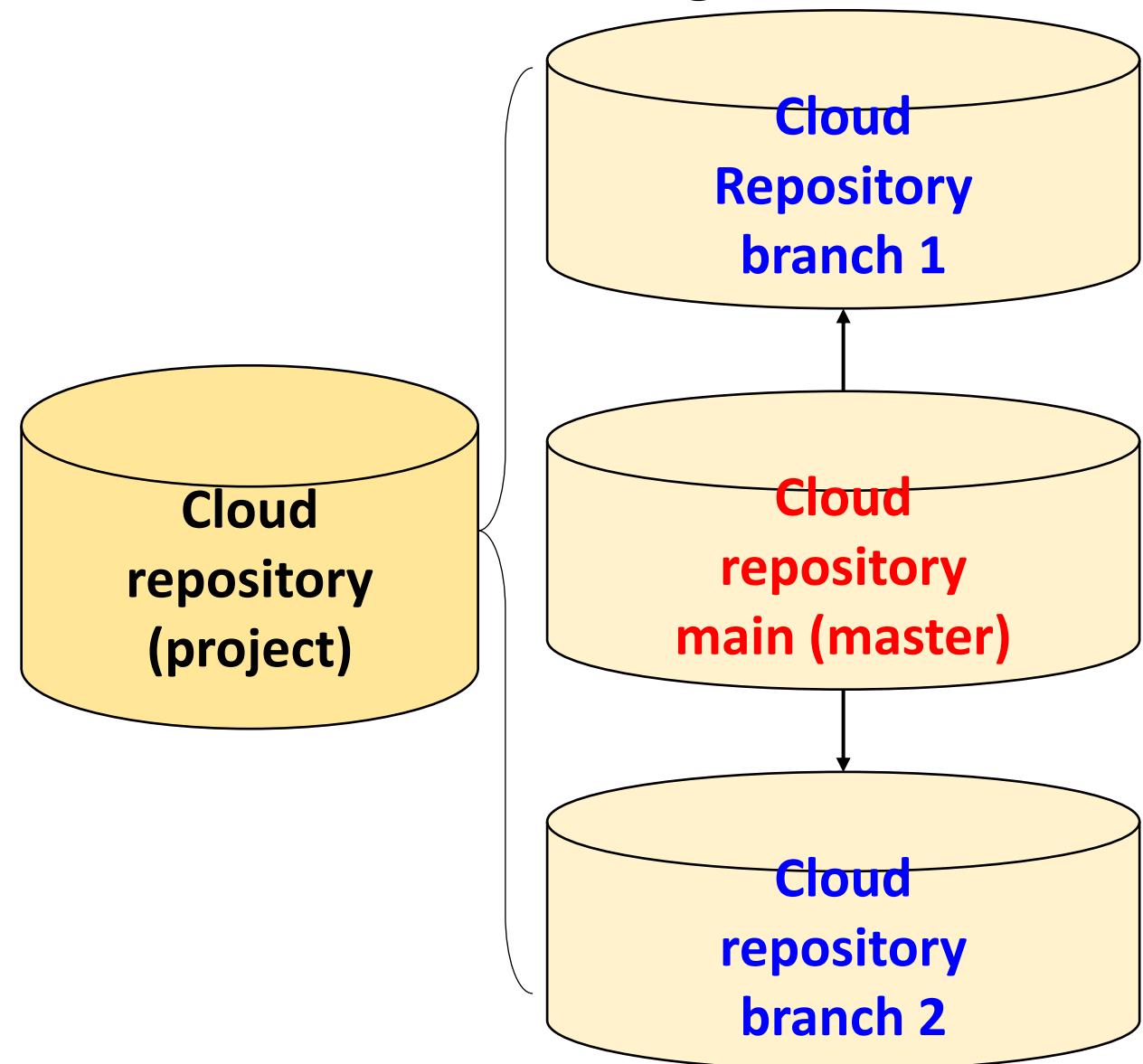
New Version

Add (Stage)

Commit: *To create a snapshot of the repository*

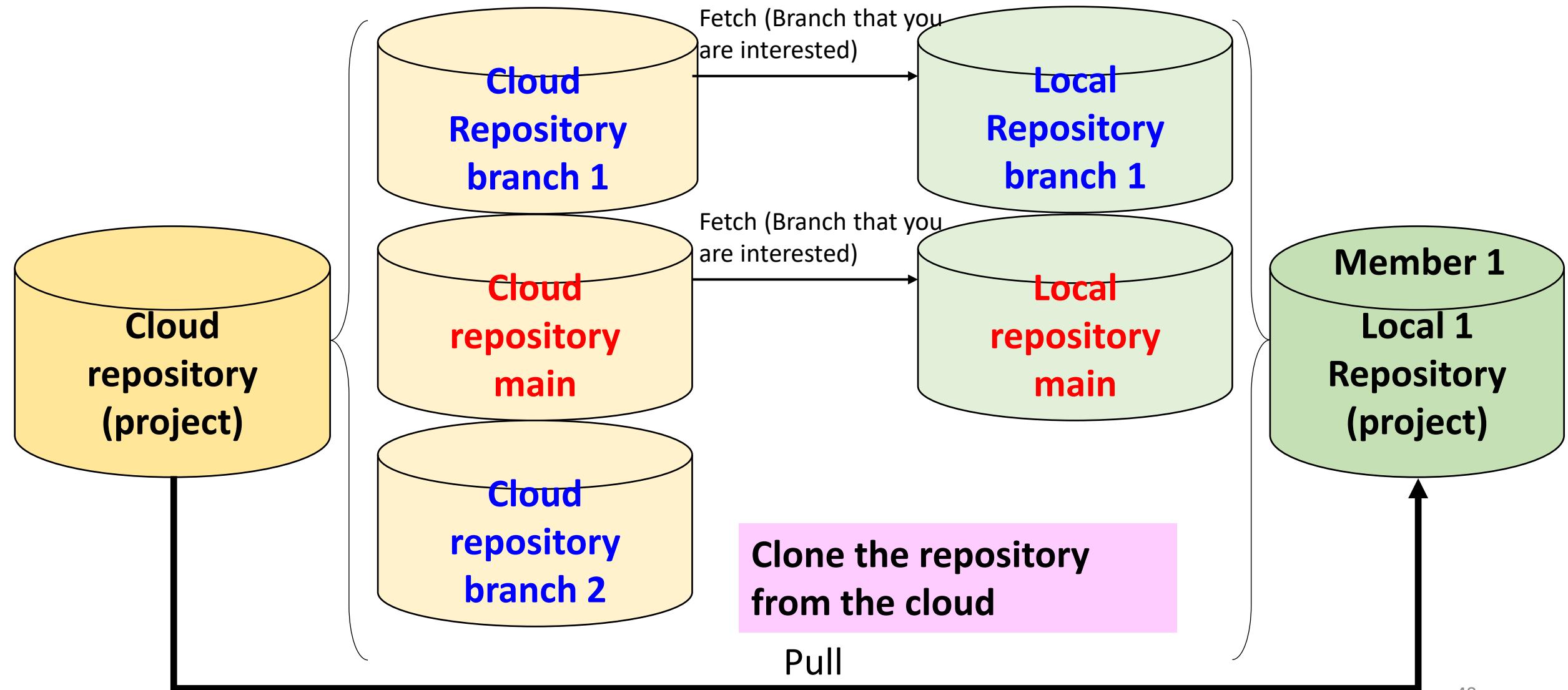
Add (Stage): *To add files or segments in the next commit*

## Collaborative coding online – Generate Branch (Member)

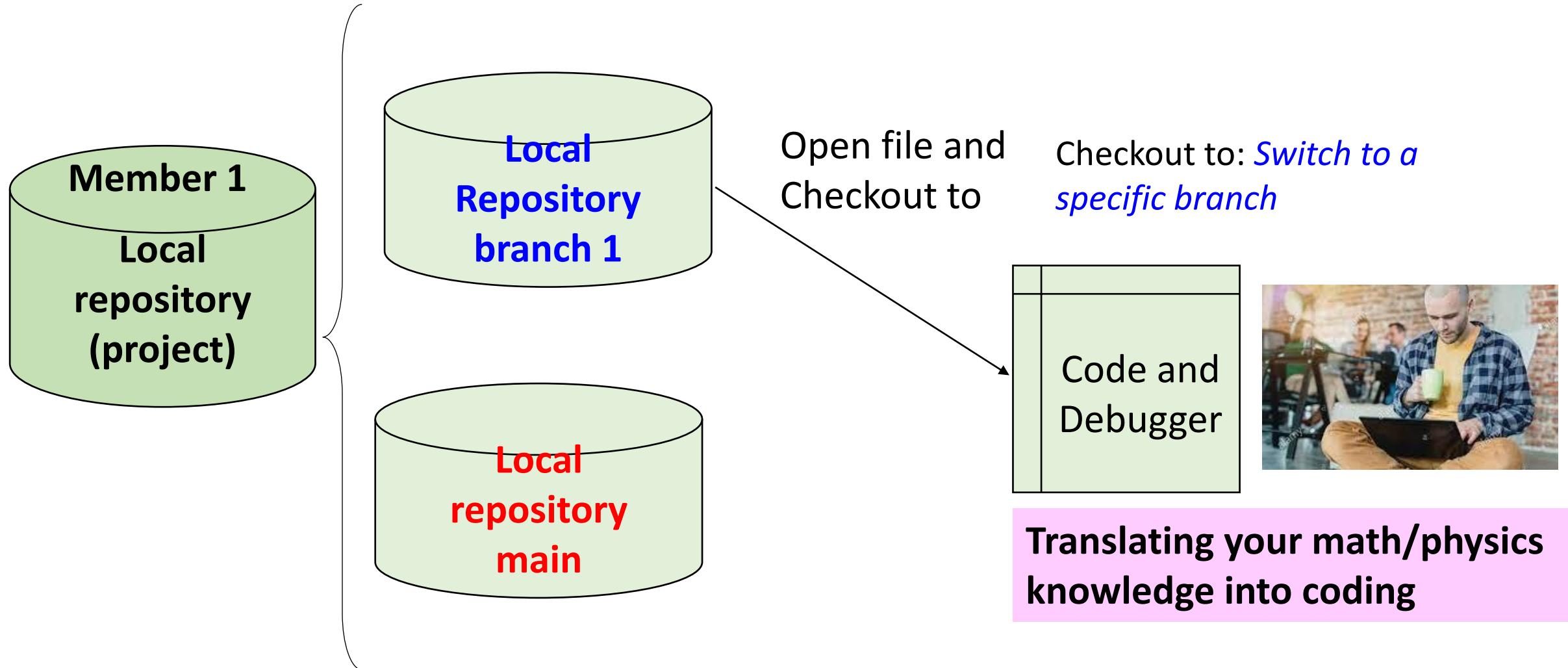


To generate a branch for different member that participant the project, creating a contained area of your repository to develop features, fix bugs and more.

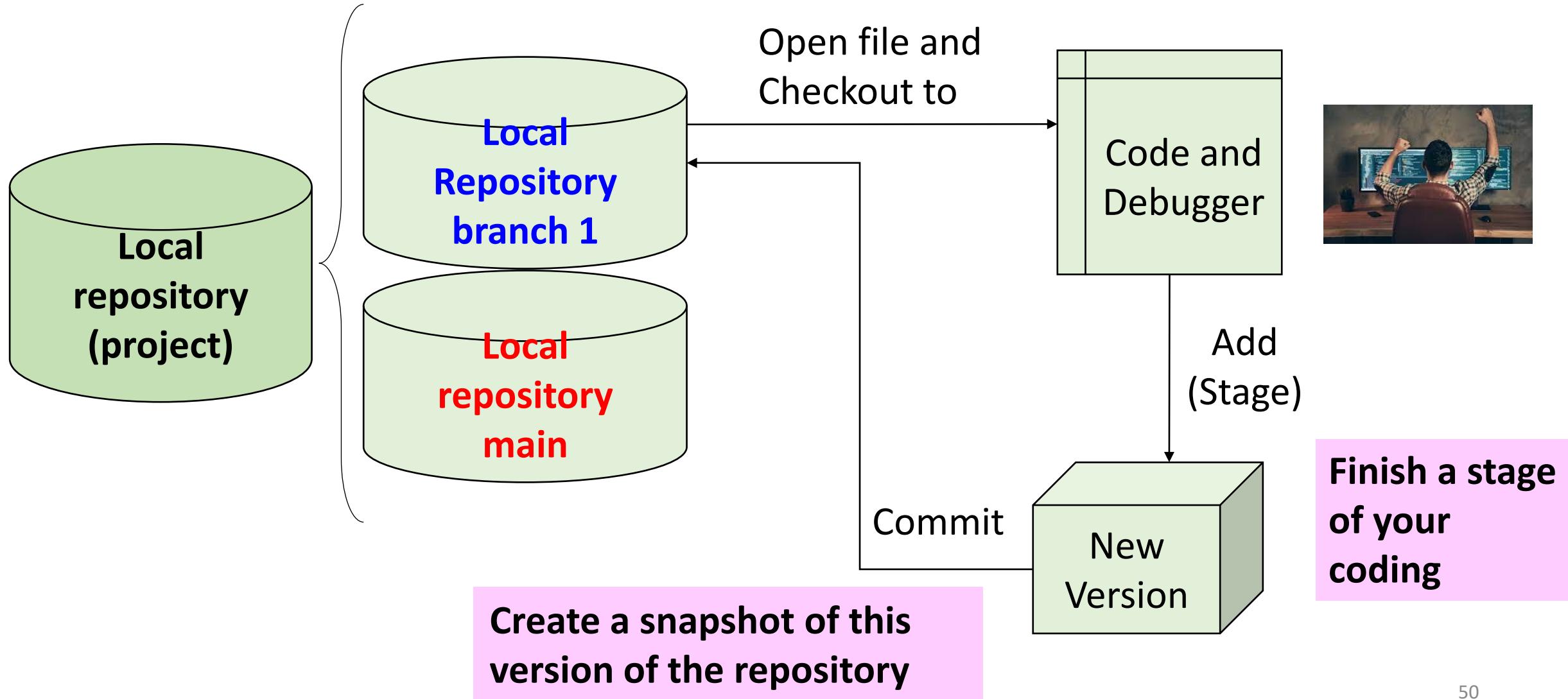
# Collaborative coding online – Fetch/Pull Branch from Cloud



# Collaborative coding online – Edit the code in the local computer



# Collaborative coding online – Edit the code in the local computer

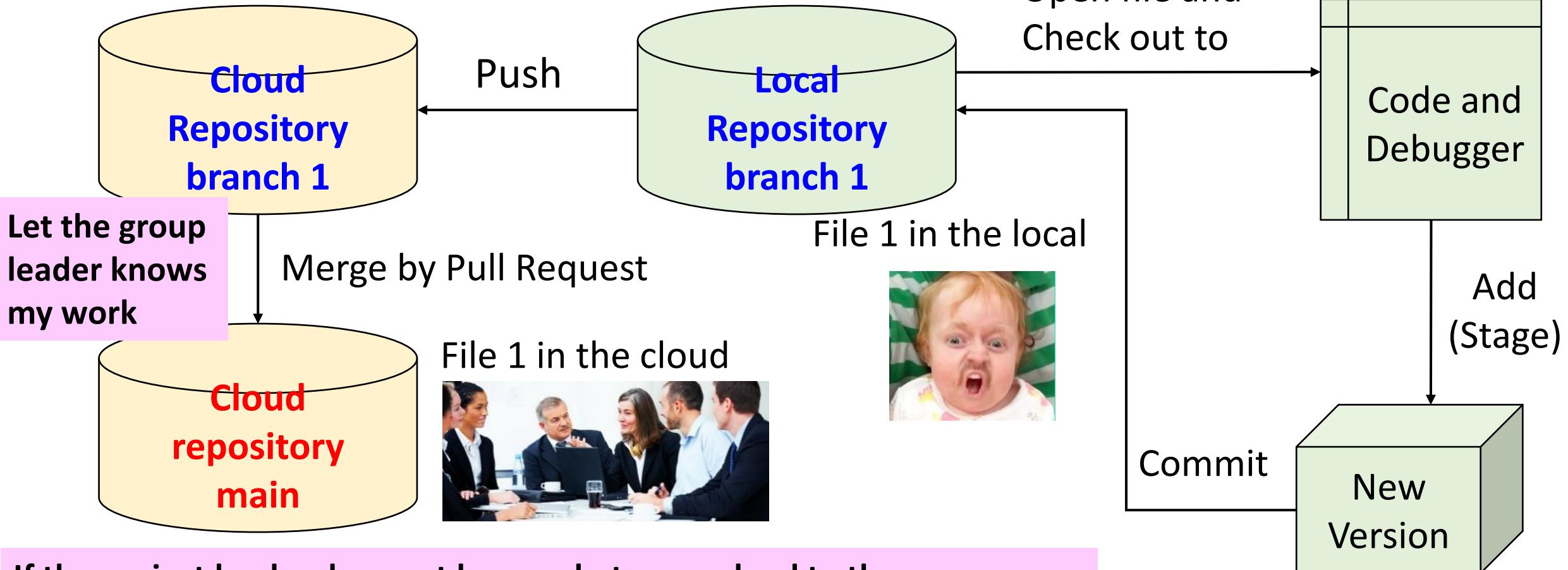


# Concept of collaborative coding online

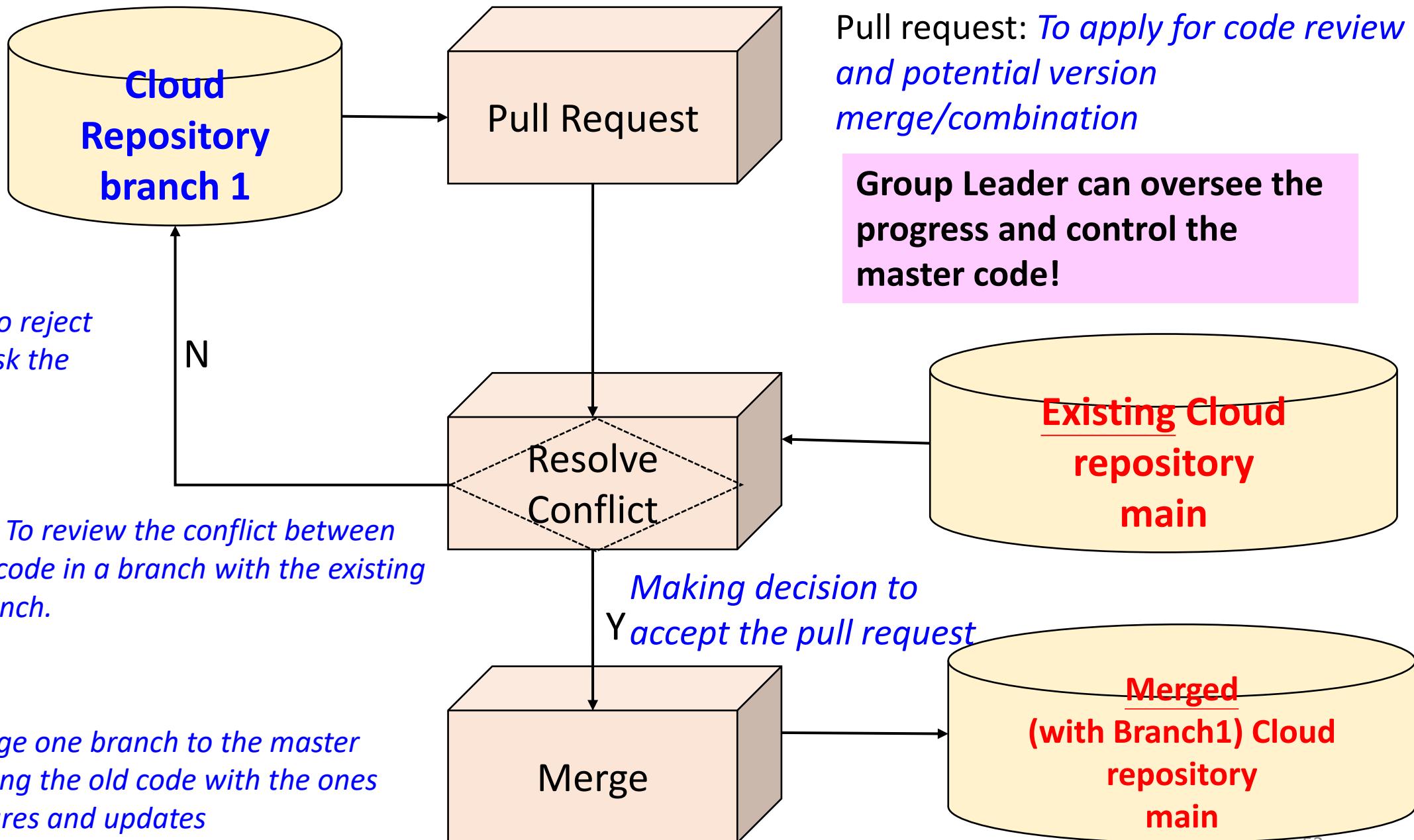
Web based

Video: [VSC-Git  
Branches](#)

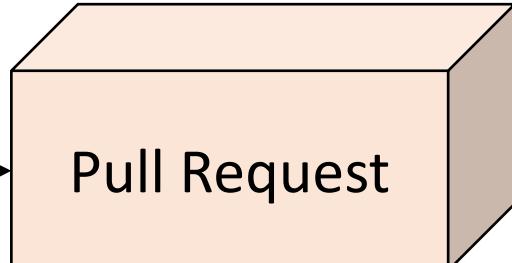
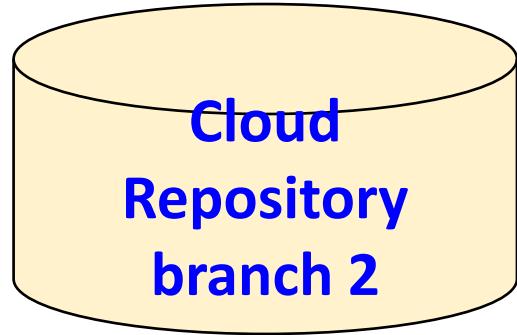
Ready to update to the cloud branch!



Web based



Web based

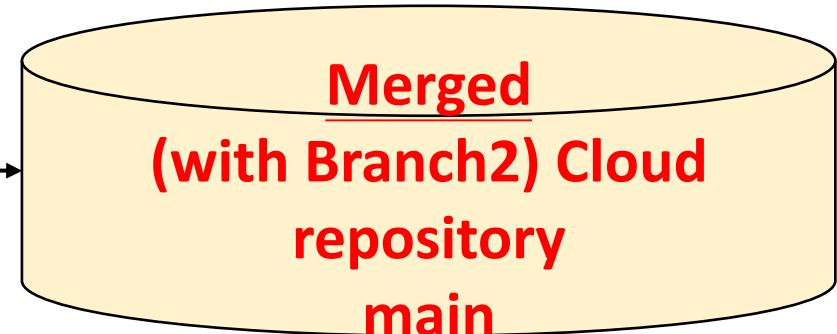
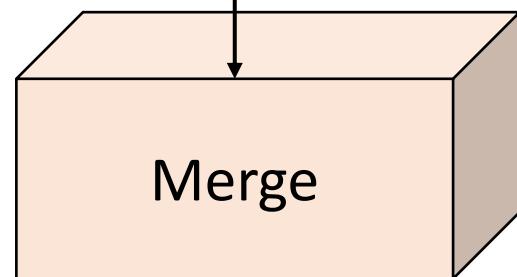
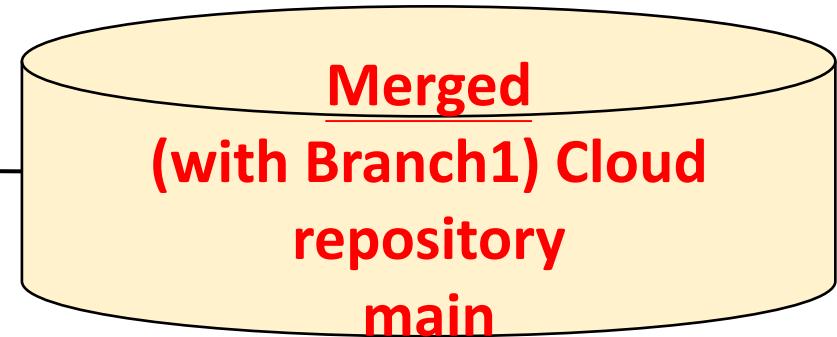
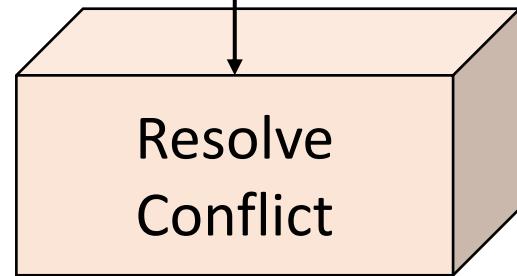


Group Leader can oversee the progress and control the master code!

Resolve Conflict: *To review the conflict between the new version code in a branch with the existing code in main branch.*

[More conflict!](#)

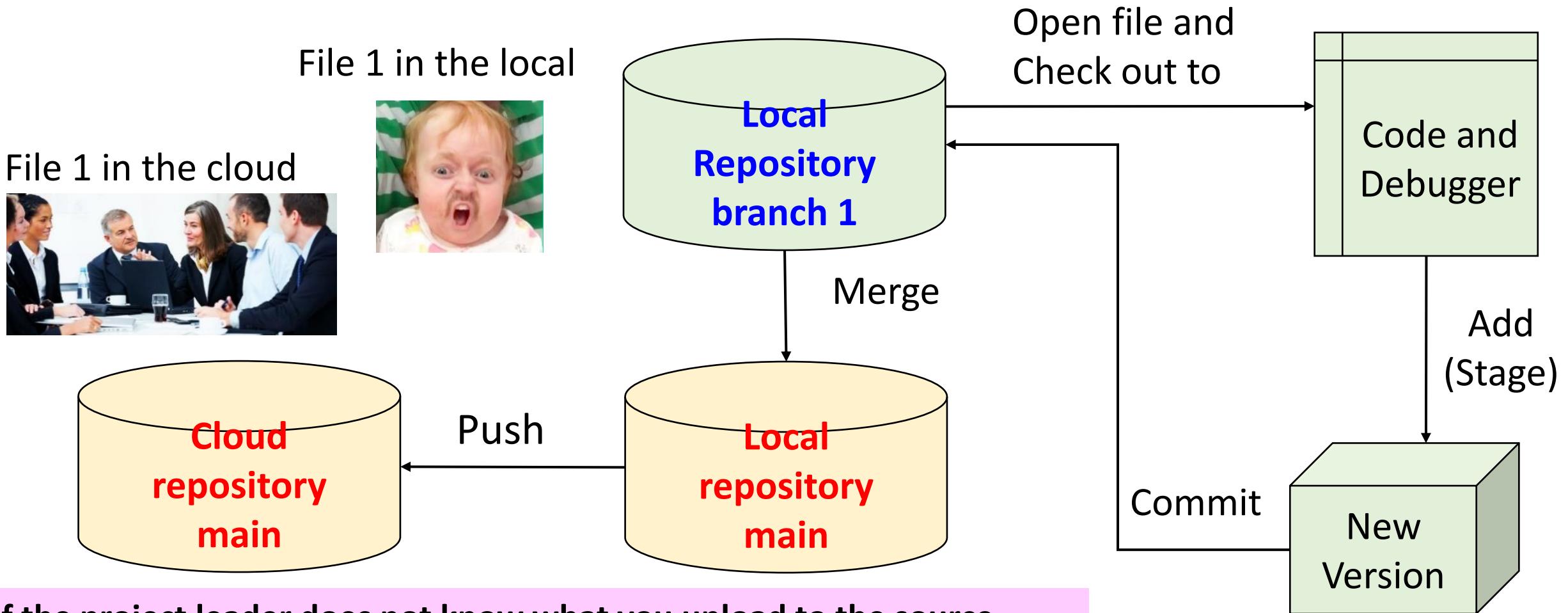
*After reviewing, making decision to change or reject the pull request.*



# Concept of collaborative coding online

VS code based

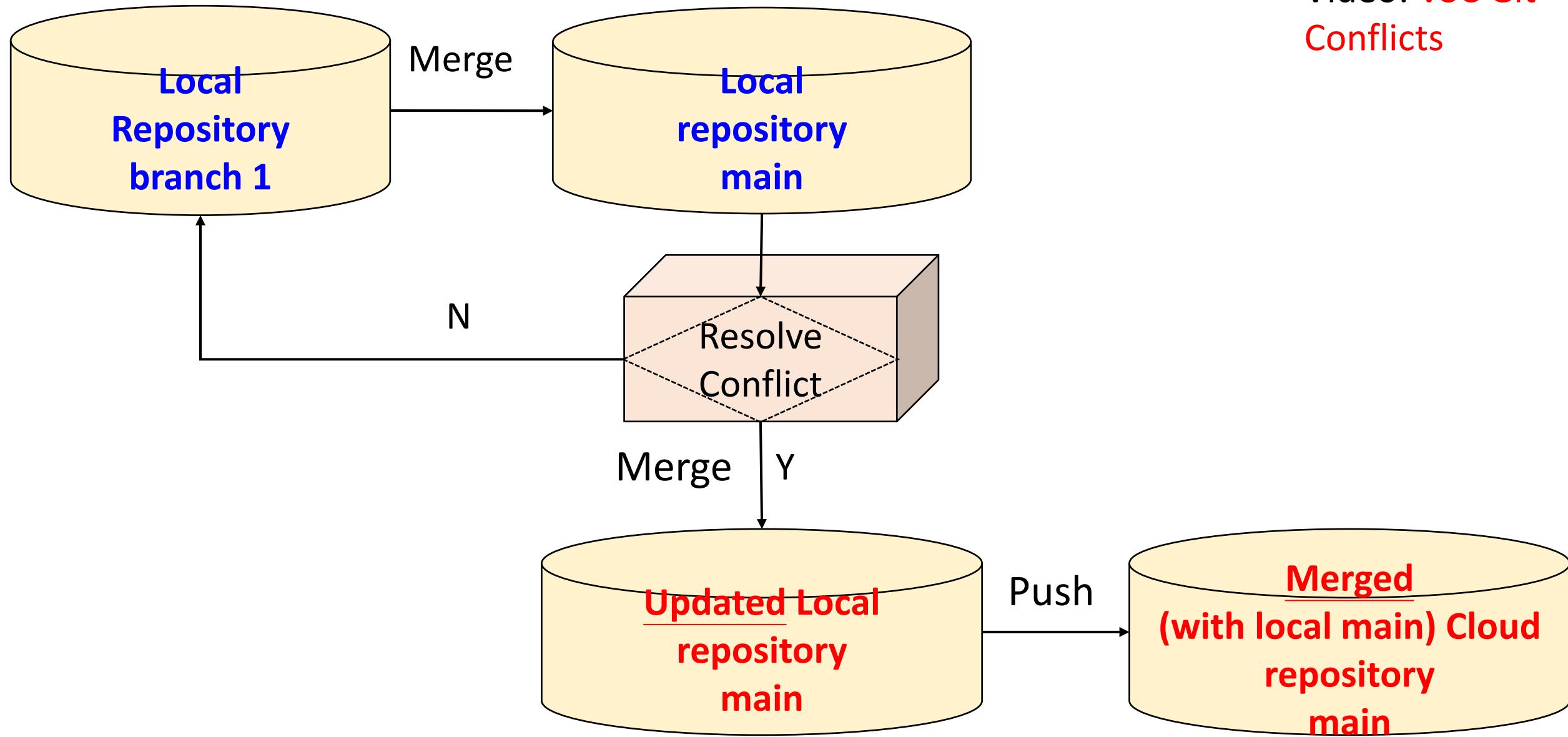
Video: [VSC Git Conflicts](#)



If the project leader does not know what you upload to the source code, you will create a lot of confusions!

VS code based

Video: [VSC Git Conflicts](#)



# Software Installation and setup Guide

# Install Python in Windows 10

Step 1: Download Python 3.6.4

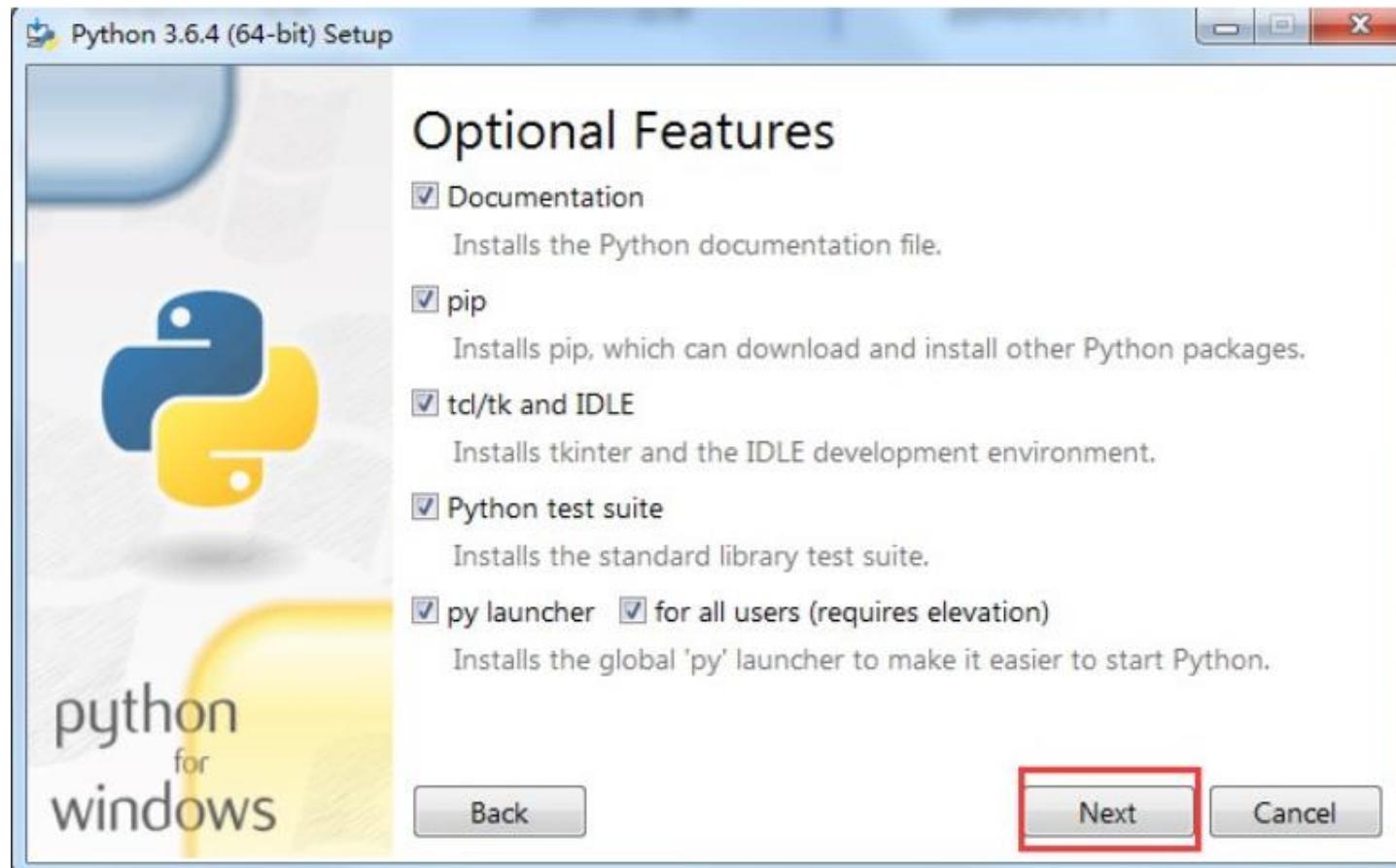
<https://www.python.org/ftp/python/3.6.4/python-3.6.4-amd64.exe>

Step 2: Install Python 3.6.4 in Windows 10



Python is an interpreted, high-level, general-purpose programming language. Created by Guido van Rossum and first released in 1991, Python's design philosophy emphasizes code readability with its notable use of significant whitespace.

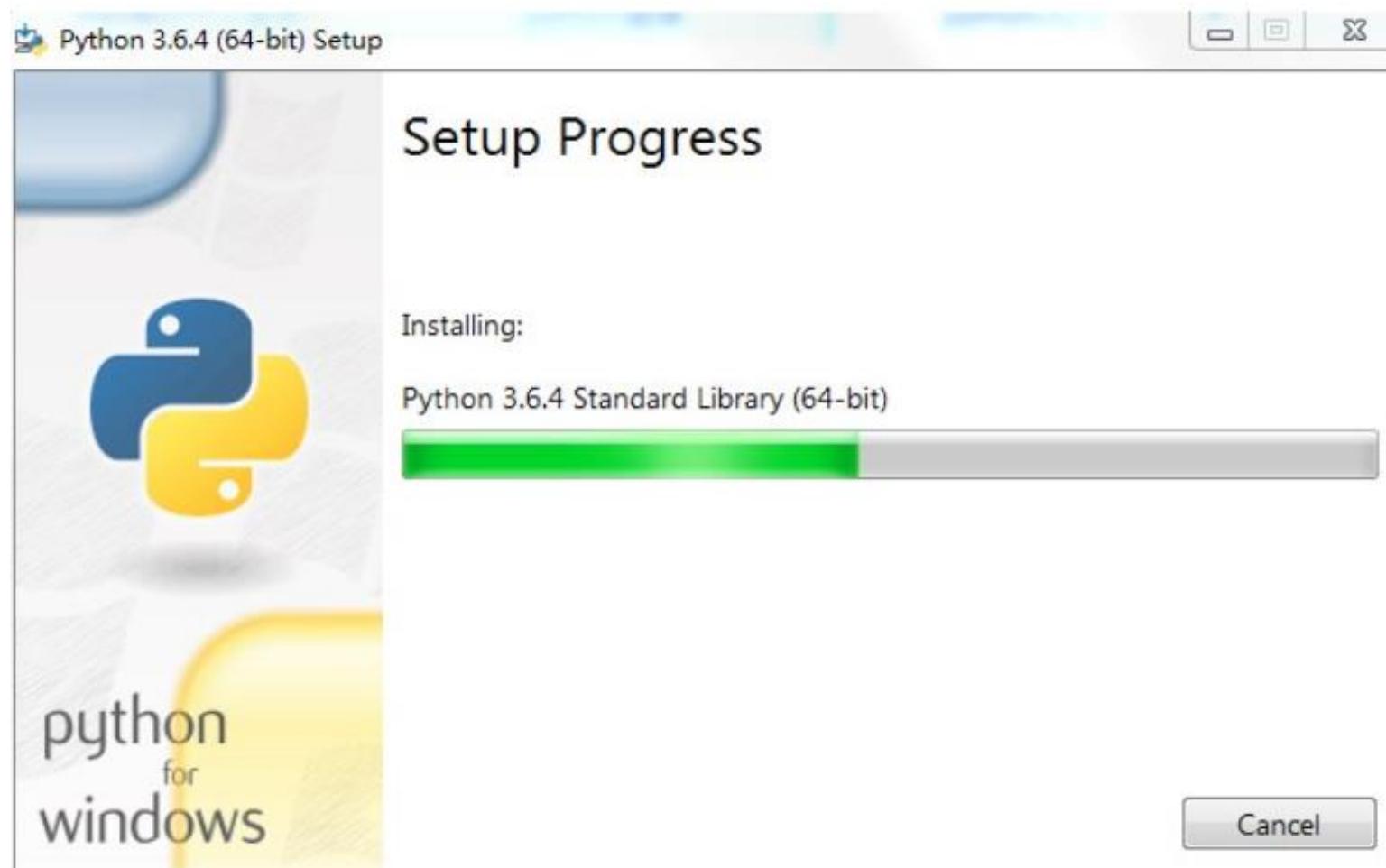
# Install Python in Windows 10



# Install Python in Windows 10



# Install Python in Windows 10



# Install Python in Windows 10

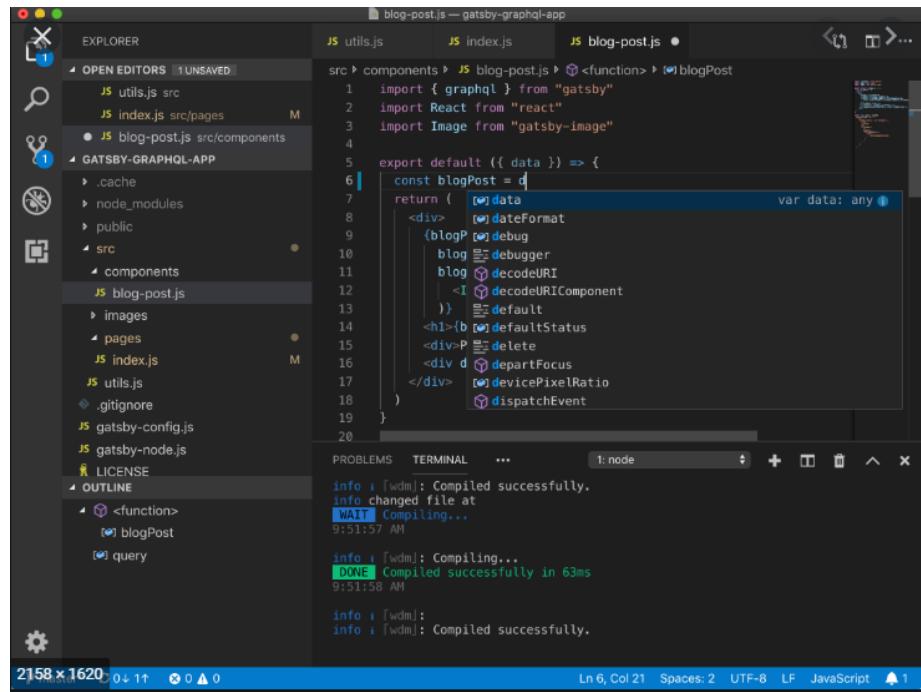


# Install VS code in Windows 10

Step 1: Download the latest VS code

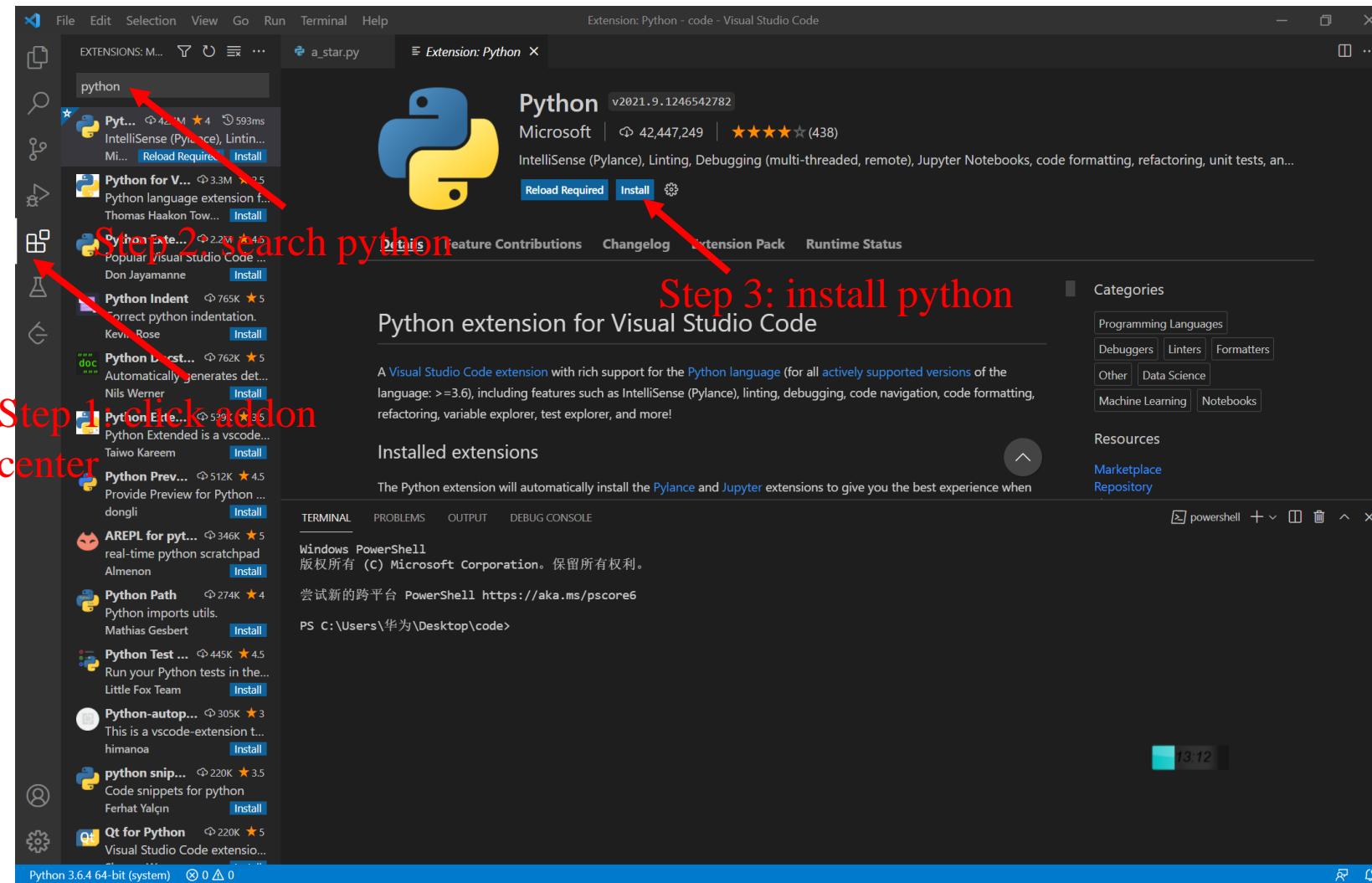
<https://code.visualstudio.com/download>

Step 2: Install latest VS code in Windows 10

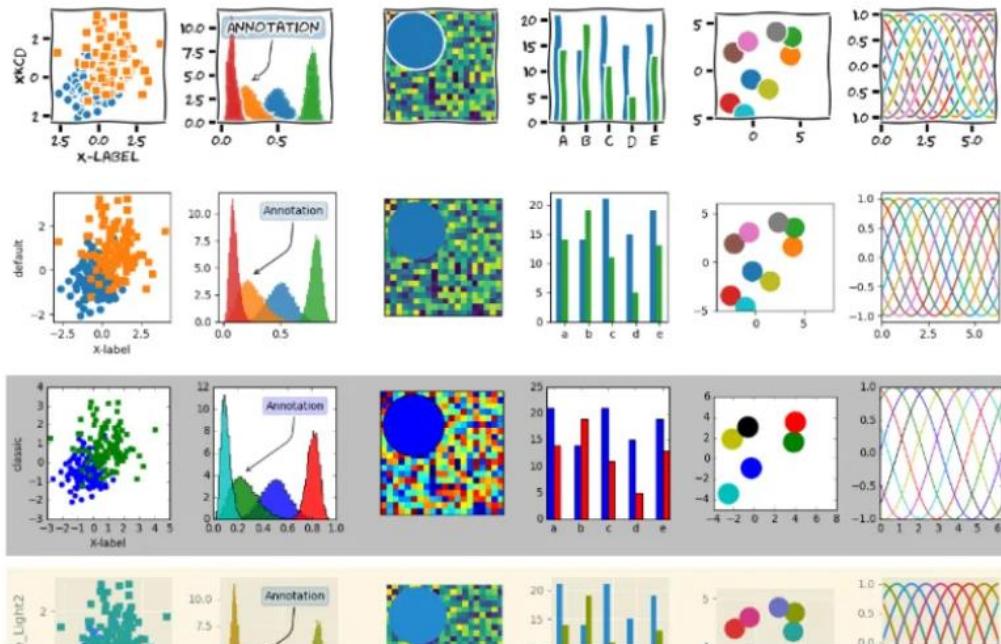


Visual Studio Code is a free source-code editor made by Microsoft for Windows, Linux and macOS. Features include support for debugging, syntax highlighting, intelligent code completion, snippets, code refactoring, and embedded Git.

# Install Python addon in VS code in Windows 10



# Install matplotlib



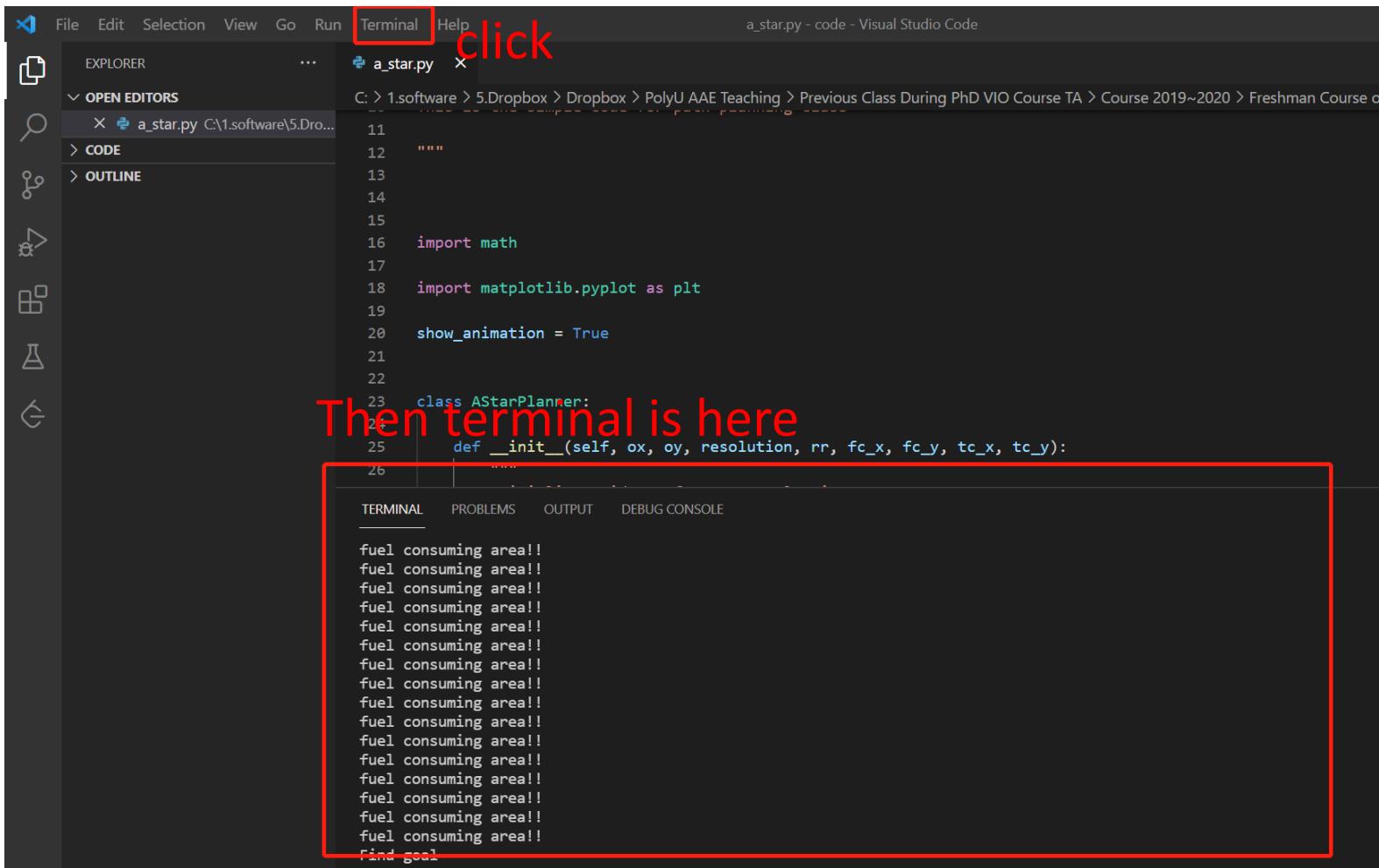
Source:

<https://www.gnuband.org/2017/12/29/gallery-of-xkcd-and-other-python-matplotlib-styles/>

Matplotlib is a plotting library for the Python programming language and its numerical mathematics extension NumPy. It provides an object-oriented API for embedding plots into applications using general-purpose GUI toolkits like Tkinter, wxPython, Qt, or GTK+.

# Install matplotlib

- step 1: Open VS code, and then click Terminal



# Install matplotlib

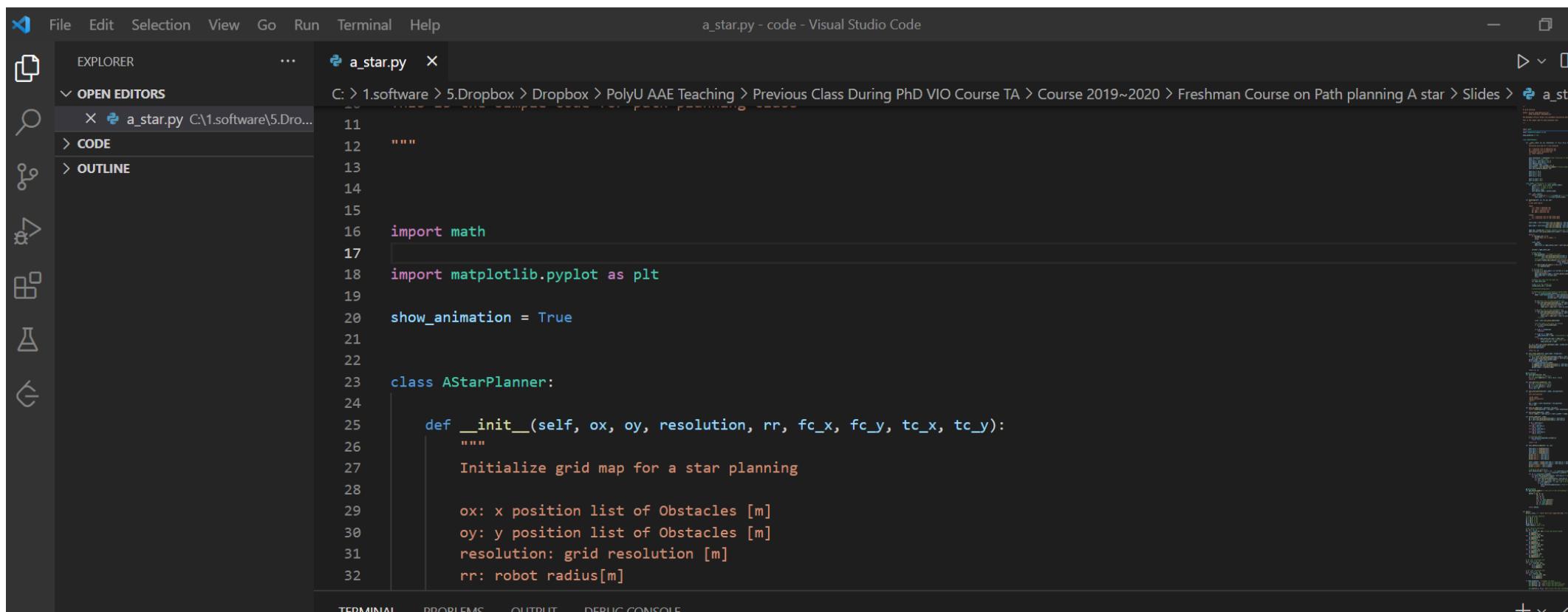
- step 2: Print following command into terminal>

The screenshot shows a Visual Studio Code interface with the following details:

- File Explorer:** Shows a file named "a\_star.py" in the "C:\1.software\5.Dropbox" directory.
- Code Editor:** Displays the Python code for an A\* Planner. The code includes imports for math and matplotlib.pyplot, defines a class AStarPlanner, and implements the \_\_init\_\_ method with parameters ox, oy, resolution, rr, fc\_x, fc\_y, tc\_x, and tc\_y.
- Terminal:** Shows a Windows PowerShell window with the following text:
  - Windows PowerShell
  - 版权所有 (C) Microsoft Corporation。保留所有权利。
  - 尝试新的跨平台 PowerShell <https://aka.ms/pscore6>
- Bottom Status Bar:** Shows the command PS C:\Users\华为\Desktop\code> and the text "pip install matplotlib==3.0.3" in red.

# Test matplotlib

- step 3: Open the code sample by VS code



The screenshot shows the Visual Studio Code interface with the following details:

- File Bar:** File, Edit, Selection, View, Go, Run, Terminal, Help.
- Title Bar:** a\_star.py - code - Visual Studio Code.
- Left Sidebar (Icon Bar):** EXPLORER, OPEN EDITORS, CODE, OUTLINE.
- Central Area:** Code editor showing the 'a\_star.py' file content.
- Code Content:**

```
11
12
13
14
15
16 import math
17
18 import matplotlib.pyplot as plt
19
20 show_animation = True
21
22
23 class AStarPlanner:
24
25     def __init__(self, ox, oy, resolution, rr, fc_x, fc_y, tc_x, tc_y):
26         """
27             Initialize grid map for a star planning
28
29             ox: x position list of Obstacles [m]
30             oy: y position list of Obstacles [m]
31             resolution: grid resolution [m]
32             rr: robot radius[m]
```
- Right Sidebar:** Includes a search bar, a tree view labeled 'File Explorer', and several small preview windows for files like 'grid\_map.png', 'map.png', and 'path.png'.
- Bottom Navigation:** TERMINAL, PROBLEMS, OUTPUT, DEBUG CONSOLE.

# Test matplotlib

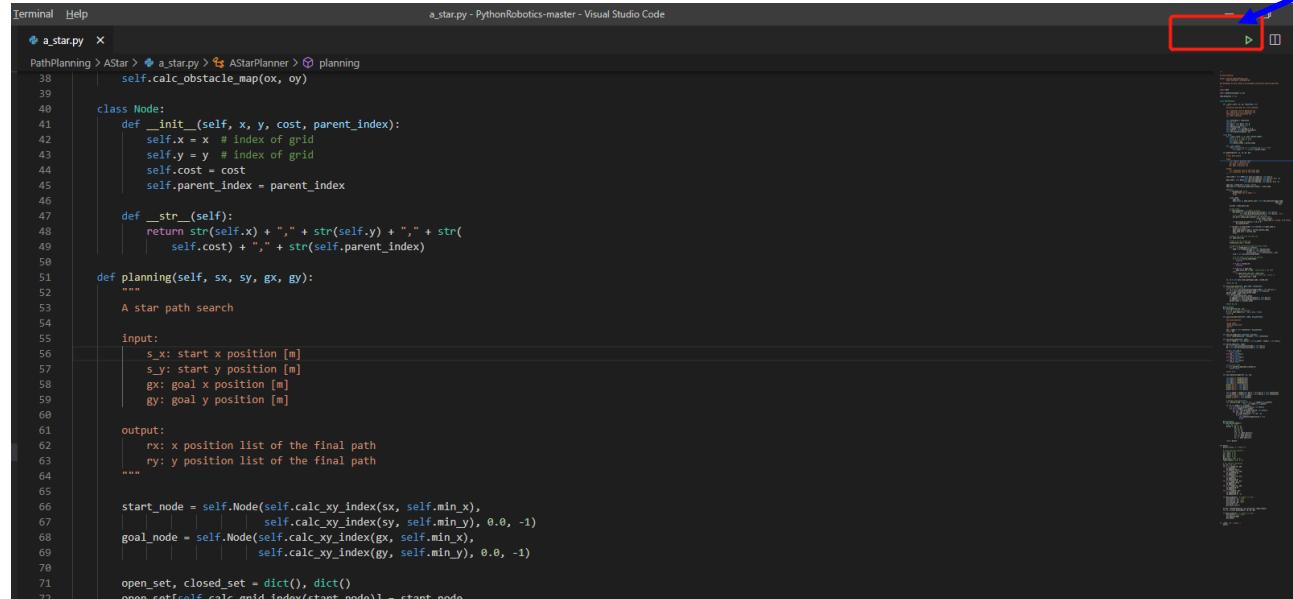
- step 4: Run the demo

The screenshot shows a Visual Studio Code interface with the following components:

- File Explorer:** Shows the file `a_star.py` is open.
- Code Editor:** Displays the Python code for an A\* path planning algorithm. The code imports `math` and `matplotlib.pyplot`, sets `show_animation = True`, and defines the `AStarPlanner` class with its constructor method.
- Terminal:** Prints multiple instances of the string "fuel consuming area!!".
- Output:** Prints the message "Find goal".
- Figure View:** A plot titled "Figure 1" showing a 2D grid map. The grid ranges from -10 to 60 on both axes. The map contains several obstacles: a red rectangular wall from (15, 15) to (25, 30), a vertical green rectangle from (35, 10) to (35, 40), and a vertical blue rectangle from (45, 10) to (45, 50). A red line with circular markers traces a path starting from the bottom-left, moving right, then up, then right again, avoiding the obstacles.
- Activity Bar:** Includes icons for home, back, forward, search, and refresh.
- Status Bar:** Shows the time "05:48".
- Right Sidebar:** Contains sections for "powershell", "Python", and "powershell".

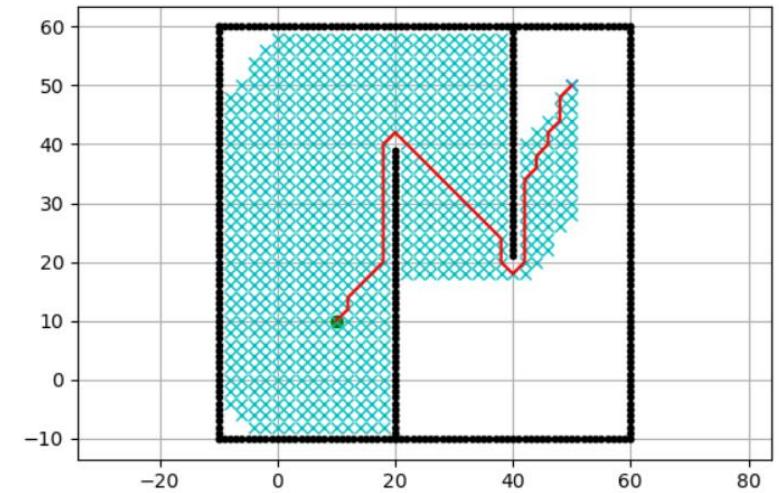
# Run A Star in VS code

Run the code



```
a_star.py - PythonRobotics-master - Visual Studio Code
Terminal Help
a_star.py > AStar > a_star.py > AStarPlanner > planning
38     self.calc_obstacle_map(ox, oy)
39
40 class Node:
41     def __init__(self, x, y, cost, parent_index):
42         self.x = x # index of grid
43         self.y = y # index of grid
44         self.cost = cost
45         self.parent_index = parent_index
46
47     def __str__(self):
48         return str(self.x) + "," + str(self.y) + "," + str(
49             self.cost) + "," + str(self.parent_index)
50
51 def planning(self, sx, sy, gx, gy):
52     """
53     A star path search
54
55     input:
56         sx: start x position [m]
57         sy: start y position [m]
58         gx: goal x position [m]
59         gy: goal y position [m]
56
57     output:
58         rx: x position list of the final path
59         ry: y position list of the final path
56
57     """
58
59     start_node = self.Node(self.calc_xy_index(sx, self.min_x),
60                           self.calc_xy_index(sy, self.min_y), 0.0, -1)
61     goal_node = self.Node(self.calc_xy_index(gx, self.min_x),
62                           self.calc_xy_index(gy, self.min_y), 0.0, -1)
63
64     open_set, closed_set = dict(), dict()
65     open_set[self.calc_grid_index(start_node)] = start_node
66
67     while True:
68         cur_node = None
69         for node in open_set:
70             if cur_node == None or open_set[node].f < open_set[cur_node].f:
71                 cur_node = node
72
73         if cur_node == None:
74             print("A* failed to find a path")
75             break
76
77         if cur_node.x == gx and cur_node.y == gy:
78             print("A* found a path")
79             rx, ry = self.reconstruct_path(cur_node)
80             break
81
82         for i, j in self.get_neighboor_index(cur_node.x, cur_node.y):
83             if i == None or j == None:
84                 continue
85
86             n = self.Node(self.calc_xy_index(i, self.min_x),
87                           self.calc_xy_index(j, self.min_y), cur_node.cost + self.sr,
88                           cur_node.index)
89
90             if i == gx and j == gy:
91                 print("A* found a path")
92                 rx, ry = self.reconstruct_path(n)
93                 break
94
95             if n not in closed_set:
96                 if (i, j) in closed_set:
97                     closed_set.pop((i, j))
98
99                 open_set[n.index] = n
100
101             else:
102                 if closed_set[(i, j)].f > n.f:
103                     closed_set.pop((i, j))
104
105                     open_set[n.index] = n
106
107             if n not in open_set:
108                 open_set[n.index] = n
109
110         closed_set[(cur_node.x, cur_node.y)] = cur_node
111
112         self.show_grid(ox, oy, cur_node)
113
114     return rx, ry
115
116
117 def reconstruct_path(self, cur_node):
118     rx, ry = [], []
119
120     while cur_node.parent_index != -1:
121         rx.append(cur_node.x)
122         ry.append(cur_node.y)
123
124         cur_node = self.nodes[cur_node.parent_index]
125
126     rx.append(self.start_x)
127     ry.append(self.start_y)
128
129     return rx, ry
130
131
132 def show_grid(self, ox, oy, cur_node):
133     if len(ox) == 0 and len(oy) == 0:
134         return
135
136     min_x, min_y, max_x, max_y = self.get_min_max(ox, oy)
137
138     dx = max_x - min_x
139     dy = max_y - min_y
140
141     grid = np.zeros([dy, dx], dtype=np.int32)
142
143     for i in range(min_x, max_x + 1):
144         for j in range(min_y, max_y + 1):
145             grid[j - min_y][i - min_x] = 1
146
147     for i, j in self.get_neighboor_index(cur_node.x, cur_node.y):
148         if i == None or j == None:
149             continue
150
151         if (i, j) in self.obstacles:
152             grid[j - min_y][i - min_x] = 1
153
154     plt.imshow(grid.T, origin='lower')
155
156     plt.plot(ox, oy, "k")
157
158     plt.plot([self.start_x, cur_node.x], [self.start_y, cur_node.y], "r")
159
160     plt.show()
```

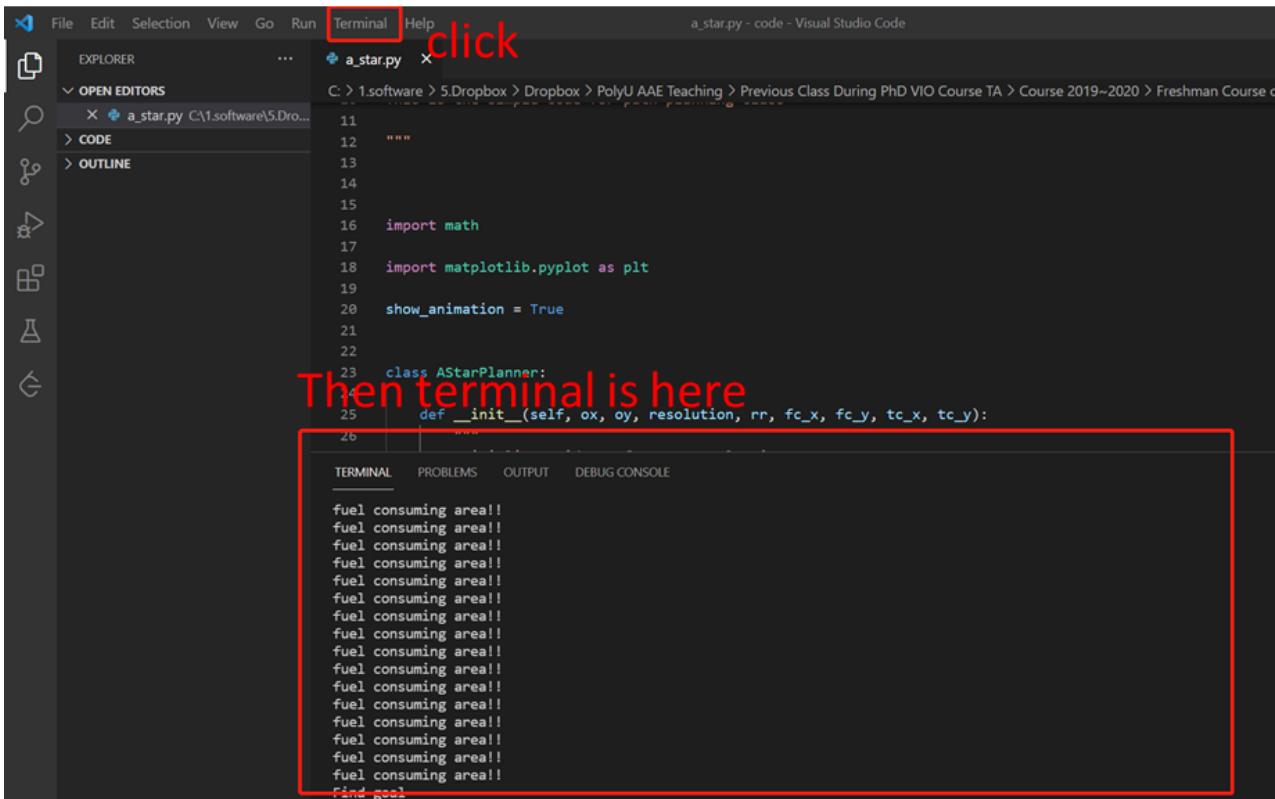
Figure 1



A\* is a graph traversal and path search algorithm, which is often used in many fields of computer science due to its completeness, optimality, and optimal efficiency. One major practical drawback is its space complexity, as it stores all generated nodes in memory.

# Troubleshoot: Connect Github page via command in VS Code

- Input the command below to the terminal (change the blue to your info)
  - *git config --global user.name weisongwen*
  - *git config --global user.email wenwsrobo@gmail.com*



The screenshot shows the Visual Studio Code interface with the following details:

- Terminal Tab:** The "Terminal" tab is highlighted with a red box.
- Code Editor:** An editor window titled "a\_star.py" is open, showing Python code for an A\* pathfinding algorithm.
- Terminal Content:** The terminal window displays repeated output: "fuel consuming area!!" followed by "Find goal".
- UI Elements:** The Explorer, Search, and Outline panels are visible on the left side of the interface.