

AAE2004 Introduction to Aviation Systems

AAE

Design of Path Planning Algorithm for Aircraft Operation

Week 10 (Project Additional Tasks)

Dr Li-Ta Hsu, Dr **Guohao Zhang**, and Dr Weisong Wen

Assisted by

Miss Hiu Yi HO (Queenie), Miss Yan Tung LEUNG (Nikki),

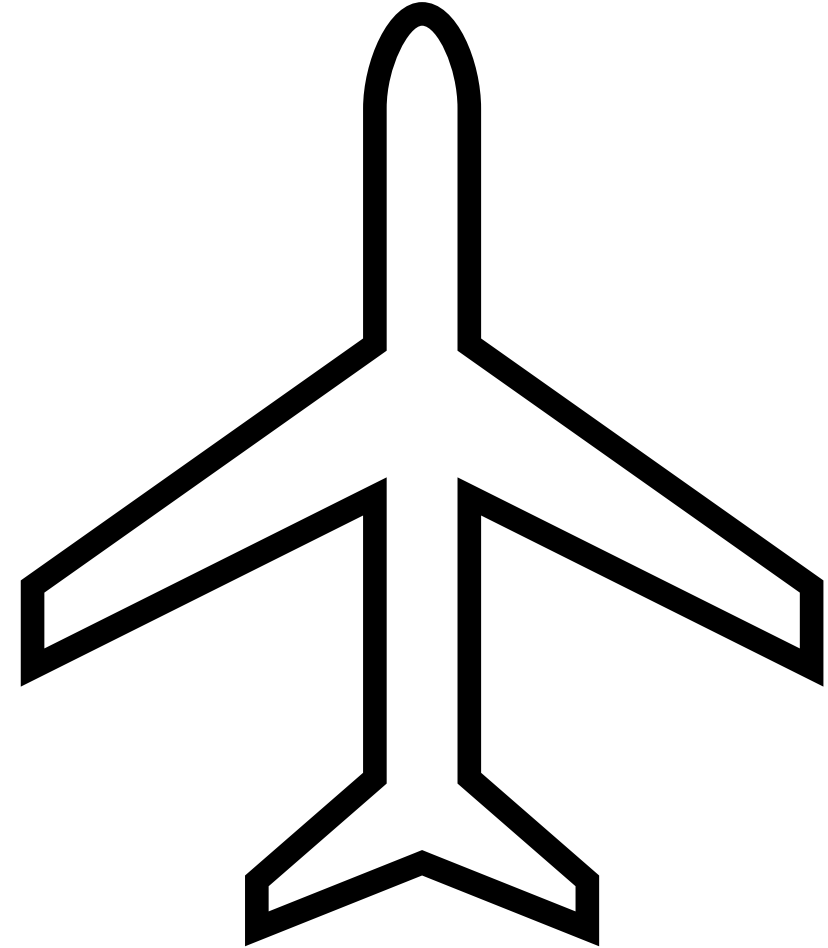
Mr Hoi Fung NG (Ivan) and Mr Feng HUANG (Darren)

Necessary Information

- Course Repository (project download) link:
- https://github.com/IPNL-POLYU/PolyU_AAE2004_Github_Project
- TA Information & Contact:
 - Group 1-3: Queenie Ho queenie-hy.ho@connect.polyu.hk
 - Group 4-6: Nikkie Leung nikkie-yt.leung@connect.polyu.hk
 - Group 7-9: Ivan Ng hf-ivan.ng@connect.polyu.hk
 - Group 10-12: Darren Huang darren-f.huang@connect.polyu.hk

Week 10 Content

1. Project Additional Tasks (Optional)
2. GitHub Readme Tutorial



Project Additional Tasks (Optional)

Additional Tasks

- 1. Adding Checkpoints**
- 2. Changing Environment**
- 3. Compare Different Algorithms**

*Start working on the following Tasks after you finish the previous ones
(Create separate.py files so these tasks don't affect each other)

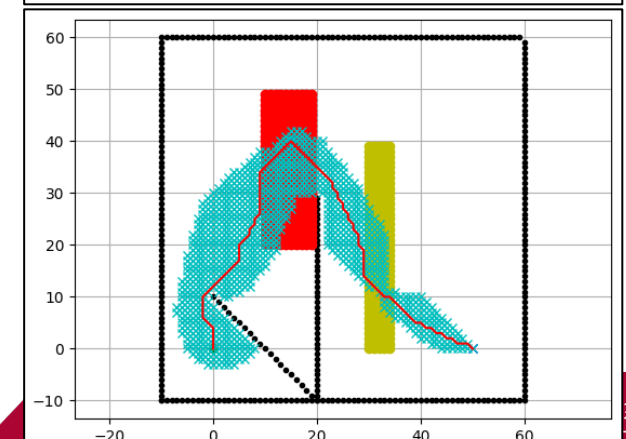
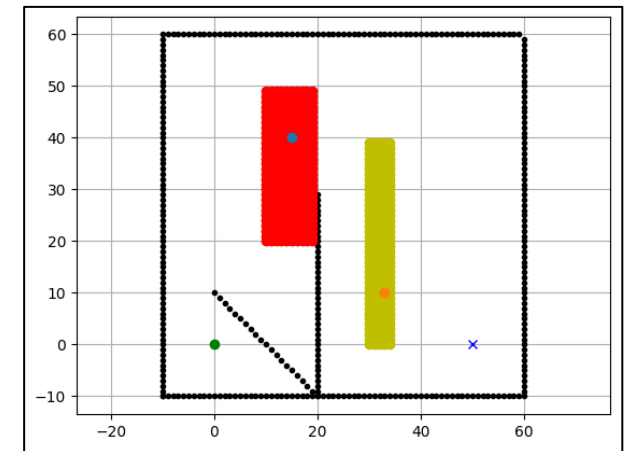
Task A1 - Adding a Checkpoint

Assume the aircraft is a supply craft that must reach 2 drop-off points to drop supplies before heading to base.

- Add one checkpoint for each cost intensive area (2 in total)
- Reach all checkpoints before arriving at the destination

Requirements:

1. This is an add-on for the code you are currently working on
2. Checkpoints should be generated inside the cost intensive areas
3. Plot the checkpoints together with your planned path with appropriate visualization

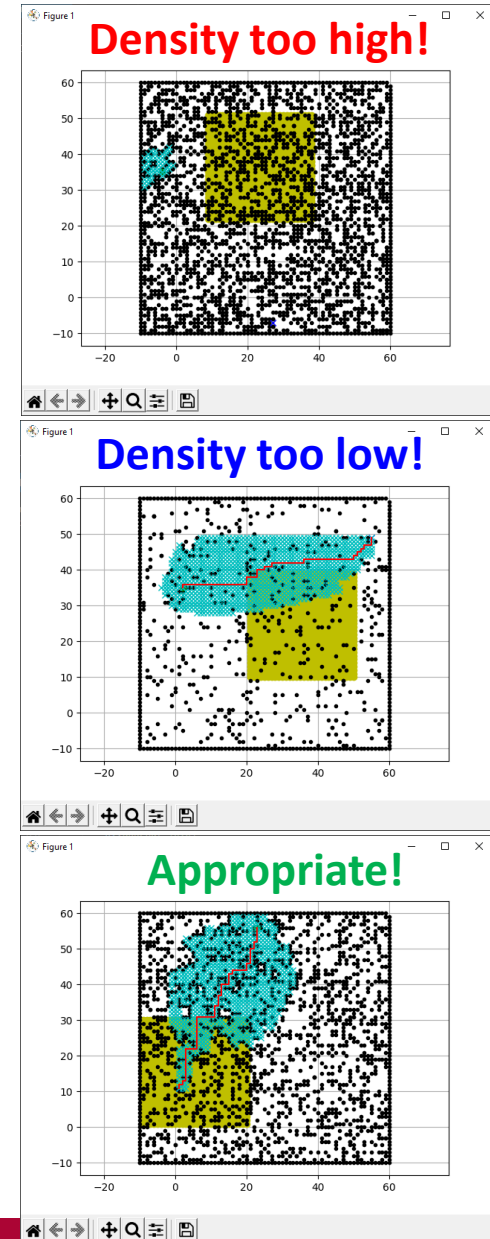


Task A2 - Changing Environment

Assume the mission and the environment keep changing for each operation.

Modify the code so that:

1. Only the fuel-consuming area remains and generate it randomly **with a fixed area (30x30)**
2. Diagonal movement is **disabled**, change parameter(s) so that the object could travel **within one grid size**
3. Obstacles are generated randomly with **reasonable density**
4. Destination and starting points are generated randomly with **at least a 50-unit distance in-between**
5. Diagonal movements are **disabled**
6. Plotting of the fuel-consuming area would not cover the obstacles, and obstacles **should not generate** at/near the start and end point



Task A3 - Comparing Algorithms

A-star is one of the many path planning algorithms

Different Algorithms:

- Different theories
- Different performance
- Difference limitations and strengths

Requirements:

1. Choose 2 more algorithms from GitHub repositories
2. Modify the code so all 3 algorithms are working with the same obstacle set
3. Try and compare the algorithms and conduct a discussion

AStar	fix unittest animation bugs (#429)
BSplinePath	mypy fix test
BatchInformedRRTStar	fix scanning error (#339)
BezierPath	Replaced $\sqrt{x^2+y^2}$ with hypot in PathPlanning/BezierPath/bezier...
BidirectionalAStar	fix scanning error (#339)
BidirectionalBreadthFirstSearch	fix scanning error (#339)
BreadthFirstSearch	Update breadth_first_search.py (#374)
BugPlanning	fix docstring error
ClosedLoopRRTStar	Fix No module error in GridBasedSweepCPP and ClosedLoopRRTStart (#516)
CubicSpline	improve test coverage (#352)
DStar	change DStar animation
DStarLite	Add D* Lite. (#511)
DepthFirstSearch	Update breadth_first_search.py (#374)
Dijkstra	Update breadth_first_search.py (#374)
DubinsPath	fix dubins path length bug and clean up codes. (#527)
DynamicWindowApproach	dwa pr (#390)
Eta3SplinePath	use pytest for test runner (#452)
Eta3SplineTrajectory	use pytest for test runner (#452)
FlowField	fix unittest animation bugs (#429)
FrenetOptimalTrajectory	mypy fix test
GreedyBestFirstSearch	Update greedy_best_first_search - calc_final_path method (#477)
GridBasedSweepCPP	Fix No module error in GridBasedSweepCPP and ClosedLoopRRTStart (#516)
HybridAStar	Test code clean up (#456)
InformedRRTStar	Using scipy.spatial.rotation matrix (#335)
LQRPlanner	add comment for stopping the simulation
LQRRRTStar	add comment for stopping the simulation
ModelPredictiveTrajectoryGenerator	Merge pull request #222 from zhkmax9302013/master
PotentialFieldPlanning	Potential field - potential range and occlusions (#345)

Readme in GitHub Repository

What is a README.md?

A file for your repository front page

Contains:

- Information about your repository
- Directory
- Contribution
- And more...

Important? ... Yes!



☰ README.md

UrbanNav

An Open-Sourcing Localization Dataset Collected in Asian Urban Canyons, including Tokyo and Hong Kong

This repository is the usage page of the UrbanNav dataset. Positioning and localization in deep urban canyons using low-cost sensors is still a challenging problem. The accuracy of GNSS can be severely challenged in urban canyons due to the high-rising buildings, leading to numerous Non-line-of-sight (NLOS) receptions and multipath effects. Moreover, the excessive dynamic objects can also distort the performance of LiDAR, and camera. The UrbanNav dataset wishes to provide a challenging data source to the community to further accelerate the study of accurate and robust positioning in challenging urban canyons. The dataset includes sensor measurements from GNSS receiver, LiDAR, camera and IMU, together with accurate ground truth from SPAN-CPT system. Different from the existing dataset, such as Waymo, KITTI, UrbanNav provide raw GNSS RINEX data. In this case, users can improve the performance of GNSS positioning via raw data. In short, the UrbanNav dataset pose a special focus on improving GNSS positioning in urban canyons, but also provide sensor measurements from LiDAR, camera and IMU. If you got any problems when using the dataset and cannot find a satisfactory solution in the issue list, please open a new issue and we will reply ASAP.

Key words: Positioning, Localization, GNSS Positioning, Urban Canyons, GNSS Raw Data, Dynamic Objects, GNSS/INS/LiDAR/Camera, Ground Truth



Hong Kong Dataset
Hong Kong Team lead by:
Prof Wu Chen, Hong Kong Polytechnic University, Hong Kong,
Dr. Zhizhao Liu, Hong Kong Polytechnic University, Hong Kong,
Dr. Li-Ta Hsu, Hong Kong Polytechnic University, Hong Kong.



Tokyo Dataset
Tokyo Team lead by:
Prof Nobuaki Kubo, Tokyo University of Marine Science and
Technology, Japan
Prof Junichi Meguro, Meijo University, Japan
Dr. Taro Suzuki, Chiba Institute of Technology, Japan

Important Notes:

- **About access to GNSS RINEX file:** The GNSS measurements is provided as GNSS RINEX data. We will recently open-source a package, the GraphGNSSLib, which provide easy access to the GNSS RINEX file and publish the data as customized ROS message. Meanwhile, we GraphGNSSLib also provide the capabilities of GNSS positioning and real-time kinematic (RTK) using factor graph optimization (FGO). If you wish to use the GraphGNSSLib, keep an eye on the update of this repo.
- **Dataset contribution:** Researches who wish to contribute their dataset as part of the UrbanNav dataset, please feel free to contact us via email darren-f.huang@connect.polyu.hk, welson.wen@polyu.edu.hk, and lt.hsu@polyu.edu.hk. We wish the UrbanNav can be a platform for navigation solution development, validation and sharing.
- **Algorithm validation and contribution:** Researches are welcomed to share their navigation solution results, source code to the UrbanNav dataset after a code review process, e.g, code for GNSS/INS integration or LiDAR SLAM, etc.

Overview

- Objective
- Hong Kong Dataset
- Tokyo Dataset
- Getting Started
- Acknowledgements
- License
- Related Publications

Source Code vs Preview of README.md

Source Code

```
1 <!-- TABLE OF CONTENTS -->
2 <details open="open">
3   <summary><h2 style="display: inline-block">Table of Contents</h2></summary>
4   <li><a href="#Background-of-Path-Planning-to-Aviation-Engineering">Background of Path Planning to Aviation Engineering</a></li>
5   <li><a href="#Theory-of-Path-Planning-Algorithm">Theory of Path Planning Algorithm</a></li>
6   <li><a href="#Introduction-of-the-Engineering-Tools">Introduction of the Engineering Tools </a></li>
7 </ol>
8 </details>
9
10
11
12 <!-- ABOUT THE PROJECT -->
13 # Background of Path Planning to Aviation Engineering
14
15 "Lorem ipsum dolor sit amet, consectetur adipiscing elit, sed do eiusmod tempor incididunt ut labore et dolore magna aliqua. Ut enim ad minim veniam, quis nostrud exercitation ullamco laboris nisi ut aliquip ex ea commodo consequat. Duis aute irure dolor in reprehenderit in voluptate velit esse cillum dolore eu fugiat nulla pariatur. Excepteur sint occaecat cupidatat non proident, sunt in culpa qui officia deserunt mollit anim id est laborum."
16
17 ![This is an image](https://www.researchgate.net/profile/Jan-Bieser/publication/333867743/figure/fig2/AS:771428257374208@1560934237674/Bar-chart-showing-the-number-of-observations-value-attribute-for-each-age-group-key.png)
18
19 "At vero eos et accusamus et iusto odio dignissimos ducimus qui blanditiis praesentium voluptatum deleniti atque corrupti quos dolores et quas molestias excepturi sint occaecat cupiditate non provident, similique sunt in culpa qui officia deserunt mollitia animi, id est laborum et dolorum fuga. Et harum quidem rerum facilis est et expedita distinctio. Nam libero tempore, cum soluta nobis est eligendi optio cumque nihil impedit quo minus id quod maxime placeat facere possimus, omnis voluptas assumenda est, omnis dolor repellendus. Temporibus autem quibusdam et aut officiis debitis aut rerum necessitatibus saepe eveniet ut et voluptates repudiandae sint et molestiae non recusandae. Itaque earum rerum hic tenetur a sapiente delectus, ut aut reiciendis voluptatibus maiores alias consequatur aut perferendis doloribus asperiores repellat."
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21 "On the other hand, we denounce with righteous indignation and dislike men who are so beguiled and demoralized by the charms of pleasure of the moment, so blinded by desire, that they cannot foresee the pain and trouble that are bound to ensue; and equal blame belongs to those who fail in their duty through weakness of will, which is the same as saying through shrinking from toil and pain. These cases are perfectly simple and easy to distinguish. In a free hour, when our power of choice is untrammelled and when nothing prevents our being able to do what we like best, every pleasure is to be welcomed and every pain avoided. But in certain circumstances and owing to the claims of duty or the obligations of business it will frequently occur that pleasures have to be repudiated and annoyances accepted. The wise man therefore always holds in these matters to this principle of selection: he rejects pleasures to secure other greater pleasures, or else he endures pains to avoid worse pains."
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```

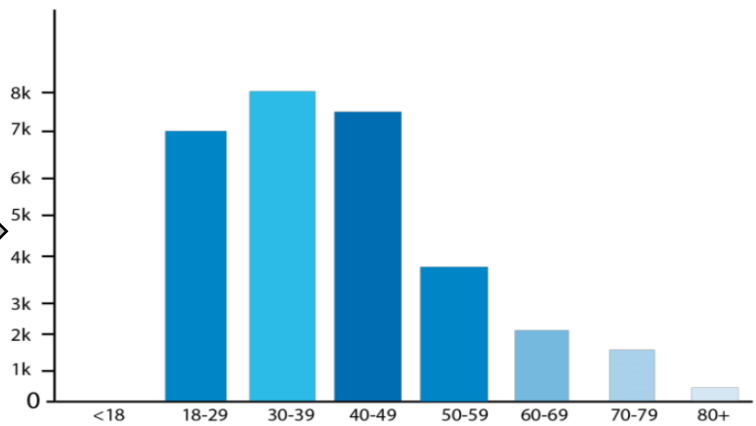
Preview

Table of Contents

- Background of Path Planning to Aviation Engineering
- Theory of Path Planning Algorithm
- Introduction of the Engineering Tools

Background of Path Planning to Aviation Engineering

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Age Group	Observations (approx.)
<18	0
18-29	7000
30-39	8000
40-49	7500
50-59	3800
60-69	2200
70-79	1800
80+	500

Age Group

"At vero eos et accusamus et iusto odio dignissimos ducimus qui blanditiis praesentium voluptatum deleniti atque corrupti quos dolores et quas molestias excepturi sint occaecati cupiditate non provident, similique sunt in culpa qui officia deserunt mollitia animi, id est laborum et dolorum fuga. Et harum quidem rerum facilis est et expedita distinctio. Nam libero tempore, cum soluta nobis est eligendi optio cumque nihil impedit quo minus id quod maxime placeat facere possimus, omnis voluptas assumenda est, omnis dolor repellendus. Temporibus autem quibusdam et aut officiis debitis aut rerum necessitatibus saepe eveniet ut et voluptates repudiandae sint et molestiae non recusandae. Itaque earum rerum hic tenetur a sapiente delectus, ut aut reiciendis voluptatibus maiores alias consequatur aut perferendis doloribus asperiores repellat."

How to Create a README.md?





- ☒  **Public**
Anyone on the internet can see this repository. You choose who can commit.
- ☐  **Private**
You choose who can see and commit to this repository.

Initialize this repository with:

Skip this step if you're importing an existing repository.

- ☒ **Add a README file**
This is where you can write a long description for your project. [Learn more.](#)
- ☐ **Add .gitignore**
Choose which files not to track from a list of templates. [Learn more.](#)
- ☐ **Choose a license**
A license tells others what they can and can't do with your code. [Learn more.](#)

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

 Set up in Desktop or  HTTPS  SSH `https://github.com/melvincheng0830/xd.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 "# xd" >> README.md
git init
git add README.md
git commit -m "first commit"
git branch -M main
git remote add origin https://github.com/melvincheng0830/xd.git
git push -u origin main
```



Basic Features of README.md?

1. Basic text, titles and subtitles
2. Table of contents
3. Inserting figures / photos



Basic Text, Titles and Subtitles

- To create normal texts, simply type them in to the source code
- To create a main title, add a ‘#’ at the beginning
 - *# This is the Main Title*
 - *##### More # makes smaller titles*

Background of Path Planning to Aviation Engineering

Smaller Title

Even smaller title

```
# Background of Path Planning to Aviation Engineering
### Smaller Title
##### Even smaller title
```


Table of Contents

- You need to have titles before creating a table of Contents
- Format of a table of contents
- Everything like fonts, text sizes and more can be altered!

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</details>
```

Text to be
shown

Titles to be
directed to

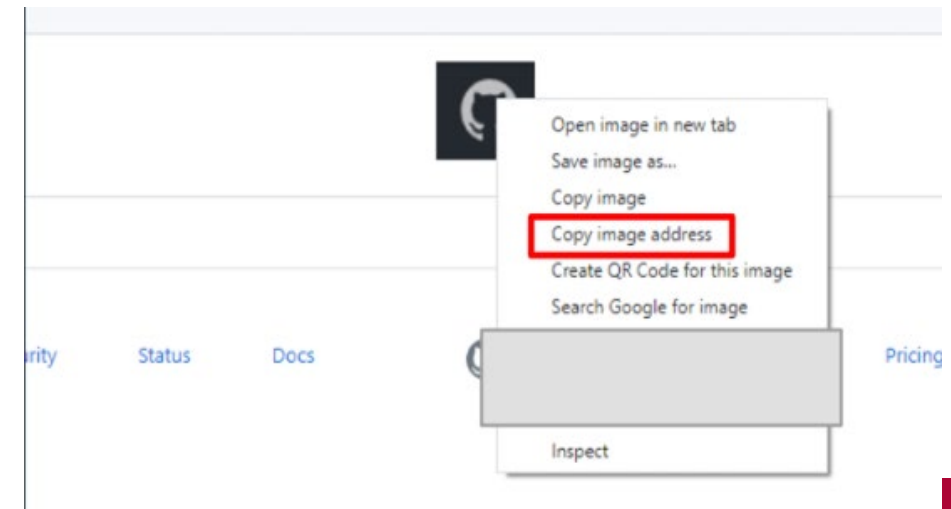
Inserting Figures / Photos

- You need to provide a link of the photo for this to work
- For screenshots you make, you can upload them to your repository and do the same thing by copying the image address!
- Example:

![[This is an image]](<https://www.researchgate.net/profile/Jan-Bieser/publication/333867743/figure/fig2/AS:771428257374208@1560934237674/Bar-chart-showing-the-number-of-observations-value-attribute-for-each-age-group-key.png>)

Message shown
when picture
cannot load

You can get the link for a
photo by right clicking on
it and select 'Copy link
address'



Example

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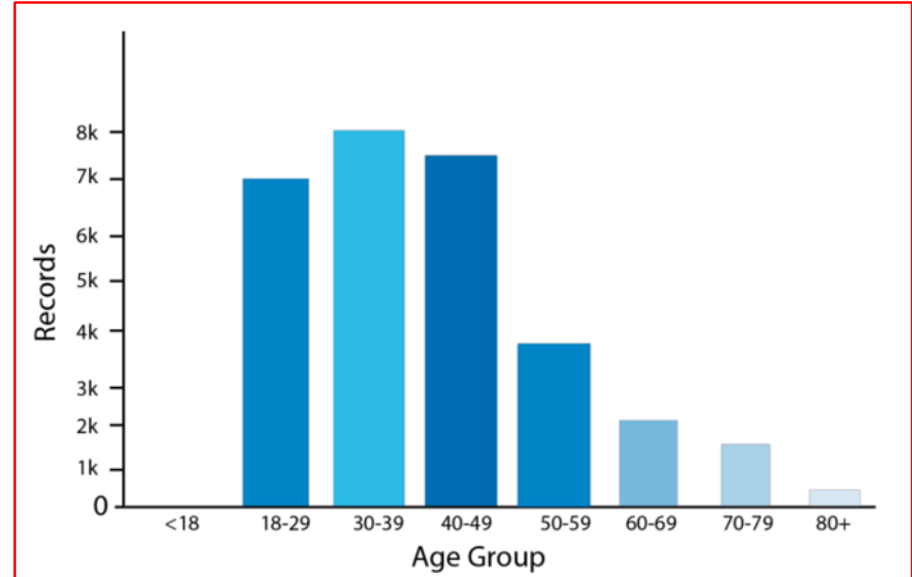
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Background of Path Planning to Aviation Engineering

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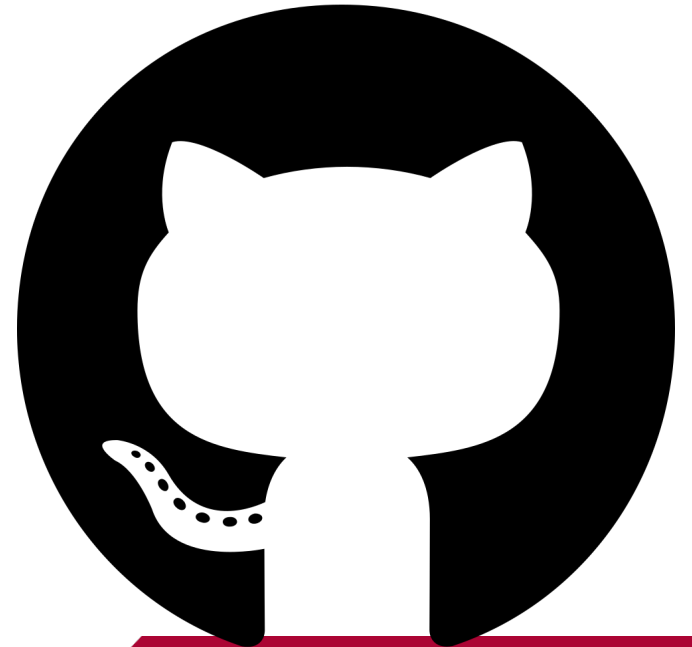


"At vero eos et accusamus et iusto odio dignissimos ducimus qui blanditiis praesentium voluptatum deleniti atque corrupti quos dolores et quas molestias excepturi sint occaecati cupiditate non provident, similique sunt in culpa qui officia deserunt mollitia animi, id est laborum et dolorum fuga. Et harum quidem rerum facilis est et expedita distinctio. Nam libero tempore, cum soluta nobis est eligendi optio cumque nihil impedit quo minus id quod maxime placeat facere possimus, omnis voluptas assumenda est, omnis dolor repellendus. Temporibus autem quibusdam et aut officiis debitis aut rerum necessitatibus saepe eveniet ut et voluptates repudiandae sint et molestiae non recusandae. Itaque earum rerum hic tenetur a sapiente delectus, ut aut reiciendis voluptatibus maiores alias consequatur aut perferendis doloribus asperiores repellat."

- Just like writing an HTML page
- Different formatting syntax creates corresponding visual formatting for the README page

Your README.md Report

- You are required to include the basic features mentioned in this PPT
 - Table of content, image, titling
- For bonus marks:
 - Search for more features on the web and include them appropriately to your README file!
 - What to add?
 - A gif showing your path planning plot
 - Other potential materials you find useful
- Useful links:
 - [GitHub official tutorial](#)



Try them all on your project!