# Tuning Your Car

Final Presentation - Summer 2025

CS3300

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# Project Concept & Core Ideas

Offer a place for clients to explore and learn more about their cars.

- Can test their planned upgrades in theory before investing money in it.

Clients can see the displayed graphs for their chosen boost upgrades.

- It will show visual representations of the changes they can anticipate.

Clients can input and view the approximate parameters of upgrades.

# Functional Requirements

- Simulated fuel injection adjustment
  - precise adjustment of fuel delivery to match engine load
- Engine parameter logging
  - log engine parameters like RPM, temperature, and pressures
- UI
  - interface for inputting commands, visualizing data, and configuring settings
- Parameter definition
  - define and customize engine parameters
- Performance
  - respond accurately to user inputs and update parameters

# Non-Functional Requirements

- Accuracy
  - precise adjustments
- Reliability
  - code cannot break
- Maintainability
  - well documented and easy to maintain

# Risks

- Program may not run the same on every type of device. Mitigated by including instructions for the best way to run in README file.
- Program has too many requirements for proper data visualization. Mitigated by limiting requirements to Python and related modules (specified in README).
- Program does not provide expected mathematical output to user. Mitigated by taking account of atmospheric pressure for accurate results.
- .png overwrites every time the program is run. Mitigated by explicitly stating in README that the user must rename any output file they wish to save.

# User Story 1

*CUSTOMER PROBLEM*

User is a car enthusiast planning to upgrade their naturally aspirated engine with a turbocharger, and wants to simulate how boost pressure and RPM affect estimated horsepower output, so that they can visualize performance gains before spending money on parts or tuning services.

*SOLUTION*

The user can input their engine's stock horsepower and boost parameters, simulate different engine states (idle, cruise, acceleration with boost), and observe how horsepower would change across RPM and MAP levels — all visualized in a live chart which will be saved.

# User Story 2

*CUSTOMER PROBLEM*

User is a car enthusiast preparing their car for a track day at their local race track, and wants to simulate typical engine behavior under various driving conditions (cruising, hard acceleration, deceleration), so that they can estimate safe RPM and/or boost levels and avoid over-stressing their engine during the real track runs.

*SOLUTION*

By using driving state simulations and by defining thresholds like maximum RPM or peak boost, the user can model expected engine strain, see when boost is active, and determine safe operating zones before taking their car to the track.

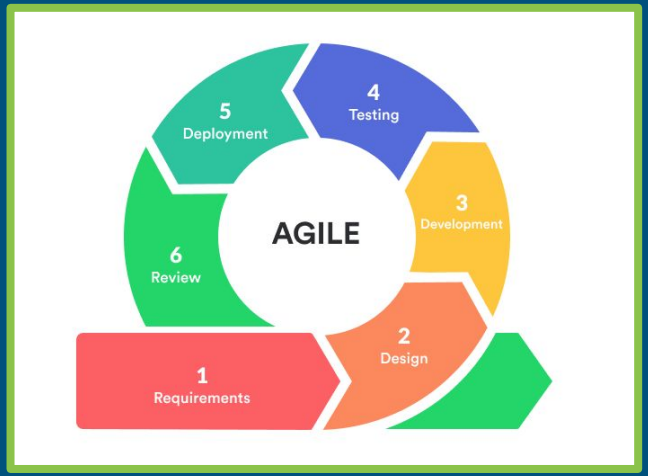
| Task Breakdown | Task Designation | Timeline |
| --- | --- | --- |
| Import Packages, Set-Up Constants, Set-Up Engine Data Simulation and Functions (Atmospheric Pressure, etc.) | Sreya | Week 1 |
| Set-Up Simulation Control Variables, Set-Up Graphing Limits Updating Graphs | Tara | Week 2 - 3 |
| Main Function (User Input, Engine Calculations, Simulation and Graph Output) | Tara, Sreya | Week 2 - 5 |
| Functions for Simulation Data, Graph Updating, and Engine Data Simulations | Tara | Week 1 - 4 |
| Test Cases | Sreya | Week 5 - 6 |
| Presentation Slides | Tara, Sreya | Week 1 - 6 |

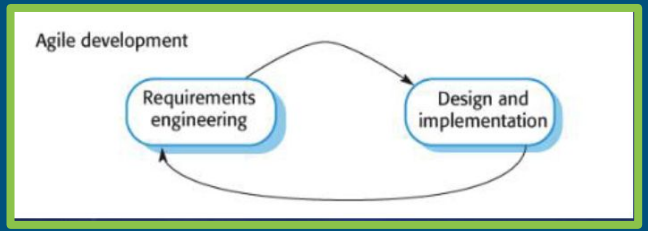
# Why This Project?

- Clients can utilize this for free
  - Check potential improvements to vehicle BEFORE investing.
- Prevent trial and error modification process that many car enthusiasts follow.
- Clients can potentially protect themselves financially and research further into the kind of modification they are looking for (functional/non-functional).

# Key Project Highlights

- Business-to-Client Model
- Agile Programming
  - Embracing Change, Incremental Delivery, Maintaining Simplicity, People Matter NOT the Process
- Inspiration for This Project:
  - F1 Data Aggregator GitHub: https://github.com/omillspaugh/F1-Semester-Project



# Key Project Highlights

- GitHub Project Versioning
- Open-Source License (Apache 2.0 License - Used Previously)
- **LINK TO SUMMER 2025 TUNING PROJECT GITHUB:**
  - https://github.com/prasadtara/Tune-Semester-Project/tree/main

# Relationship Between Project and Course

- Approach
  - Agile method used due to time constraints and flexible nature
- User stories and tasks implemented
- User and system requirements
- Functional and non-functional requirements
- Incremental development
- Risk management
  - identification, analysis, planning, monitoring

# Disclaimer: AI use

- AI tools were used for project ideation, visualization, and organization.
- No part of any deliverable was copied from AI.
- Tools used:
  - Gemini
  - ChatGPT
  - GitHub Copilot

# Demonstration

Test Vehicle: 2007 TRD FJ Cruiser

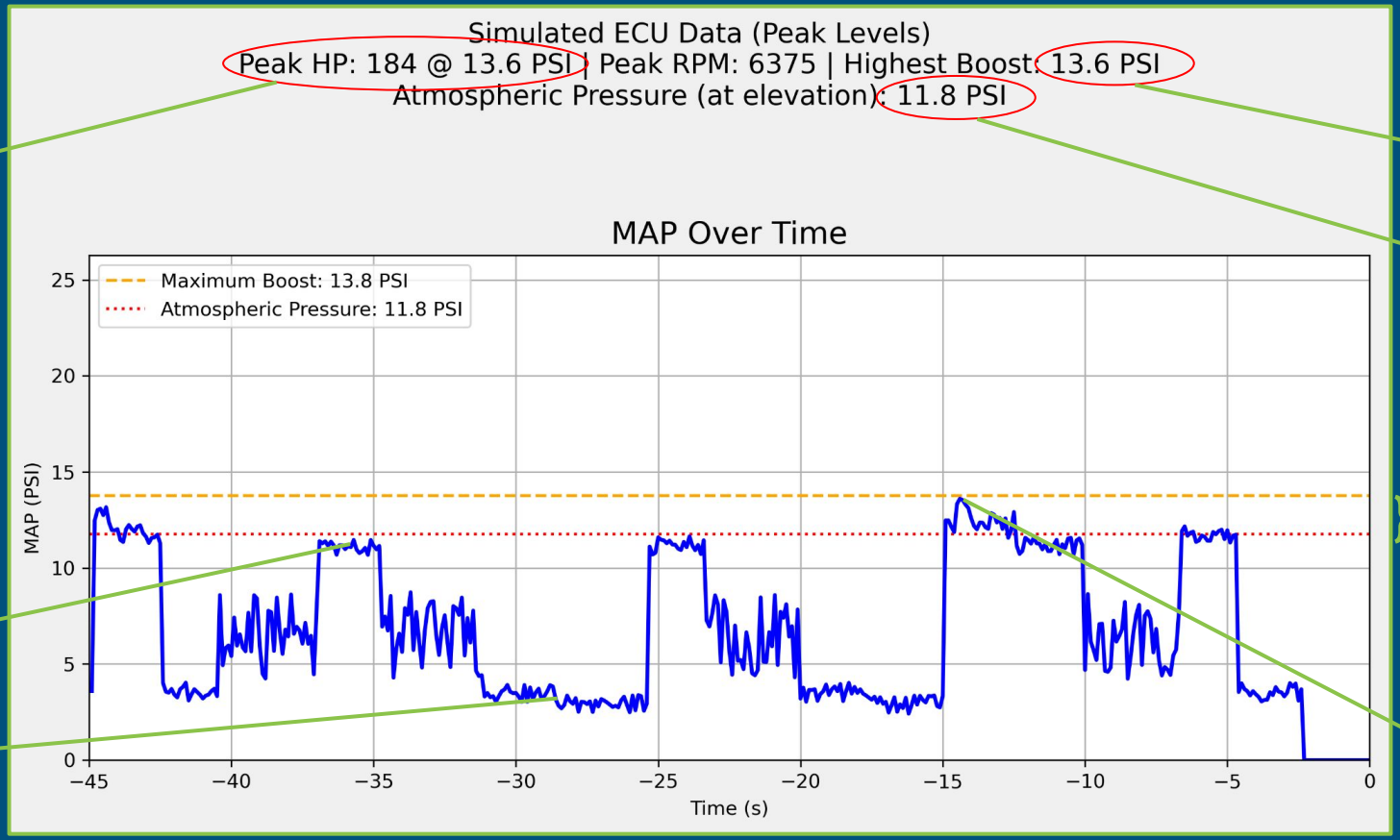
- Stock HP: 239
- Redline: 5500 RPM
- Idle: 900 RPM

Boost: Magnuson Supercharger (6 psi)

Test Elevation: 1839m

**All information taken from personal vehicle and internet sources*

# Example Output Breakdown: 1997 Mazda Miata/Jackson Racing Supercharger




power output at peak boost

peak boost

atmospheric pressure at current elevation

atmospheric pressure vs. boost pressure

acceleration phase

deceleration phase

peak boost reached

# Mathematical Formulas

- **Unit Conversion (Kilopascal to PSI)**:
- **Barometric Formula**
- **Manifold Absolute Pressure (MAP) Components**
  - Idle MAP
  - Cruise MAP Minimum
  - Cruise MAP Maximum
  - Naturally Aspirated WOT MAP
  - Boost Progress
  - Target MAP during Boost
- **Horsepower Estimation**
  - HP Unit Factor
  - Estimated Horsepower

# Sources

Agile Programming Diagram:
https://medium.com/@chathmini96/agile-methodology-30ec4cdf3fc

Agile Development Diagram: CS3300 Summer 2025 Lecture 04 Slides (Slides by Dr. Armin Moin)

ALL Car Images (Dark Horse, FJ Cruiser, GR86, Land Cruiser, Miata, WRX): Photos Taken by Tara & Sreya of Our Personal/Friends'/Family's Vehicles (with permission)

# THANK YOU