# Model Based Systems Quadruped

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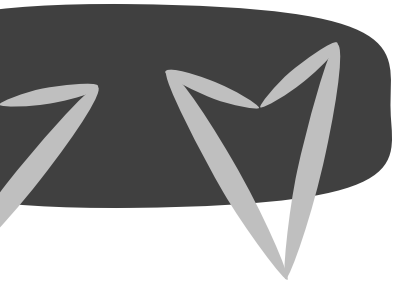

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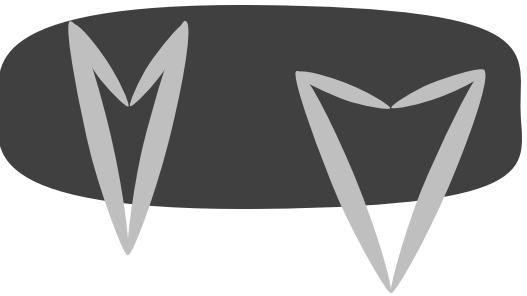

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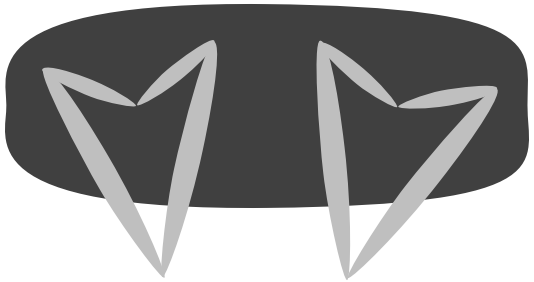

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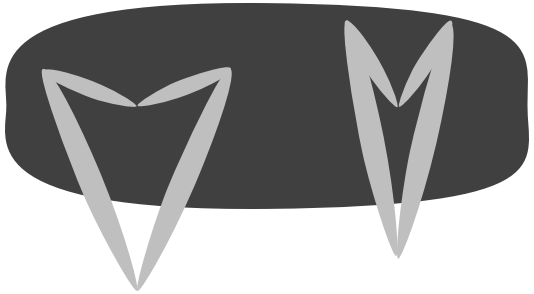

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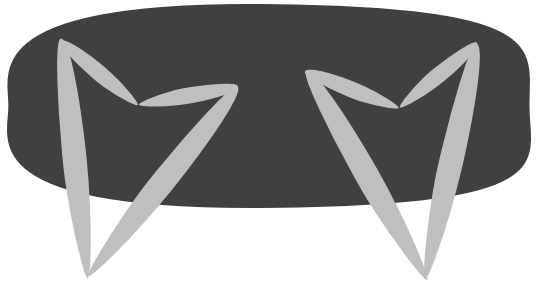

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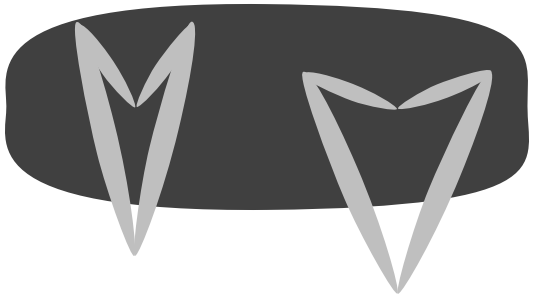

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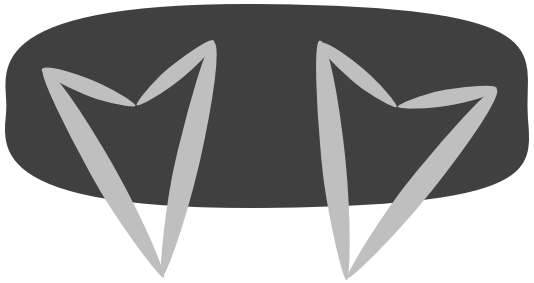

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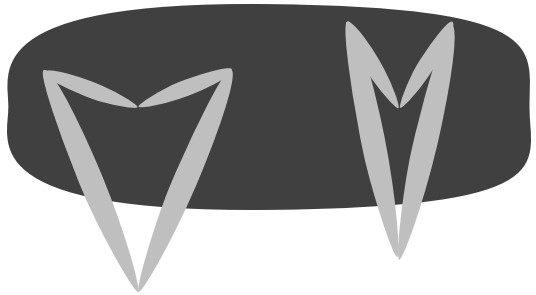

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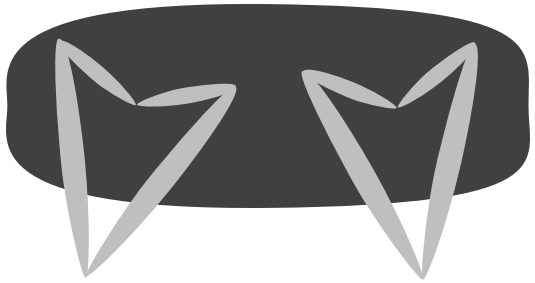

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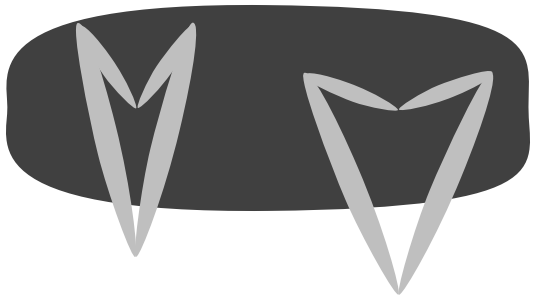

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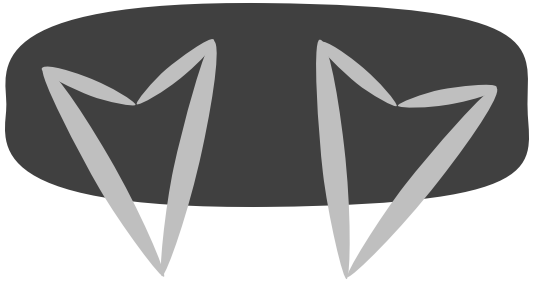

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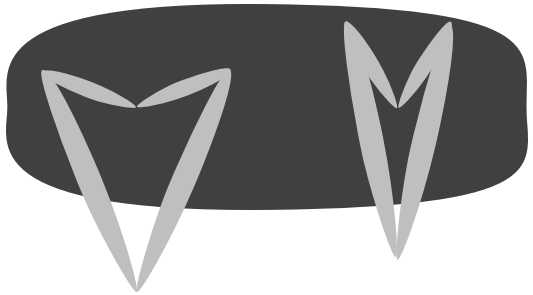

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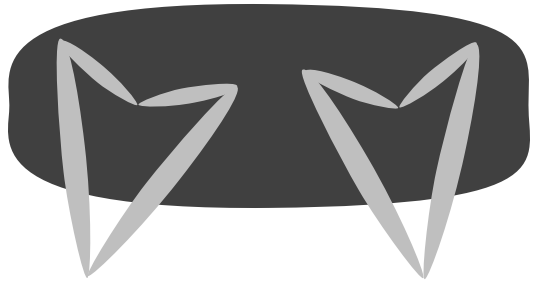

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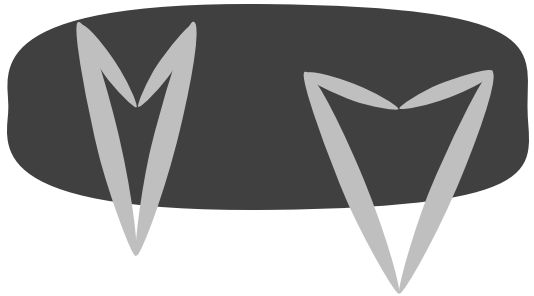

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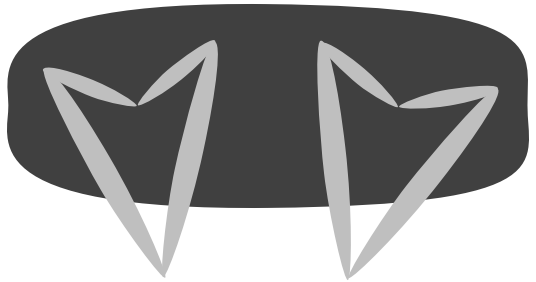

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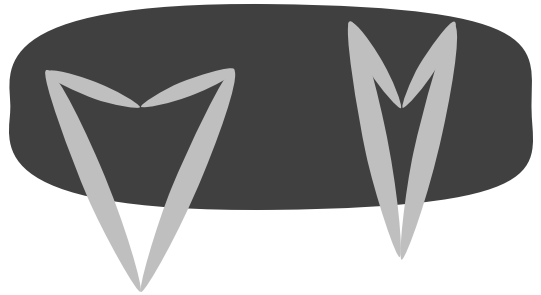

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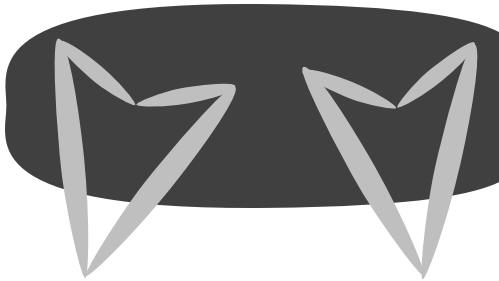

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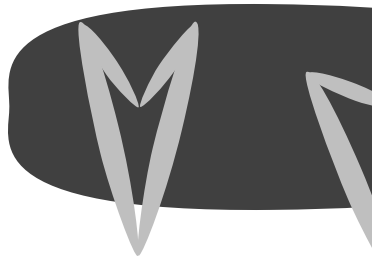

# Model Based Systems Quadruped

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# Team Introductions

Milton Bouchard
*Modeling Engineer*

Michael Dina
*Systems Engineer*

Onoriode Onokpise
*User Interface Engineer*

Jackson Raines
*Testing Engineer*

Zachary Shapiro
*Testing Engineer*

# Sponsors and Advisor

CISCOR

Center for Intelligent Systems, Control, and Robotics

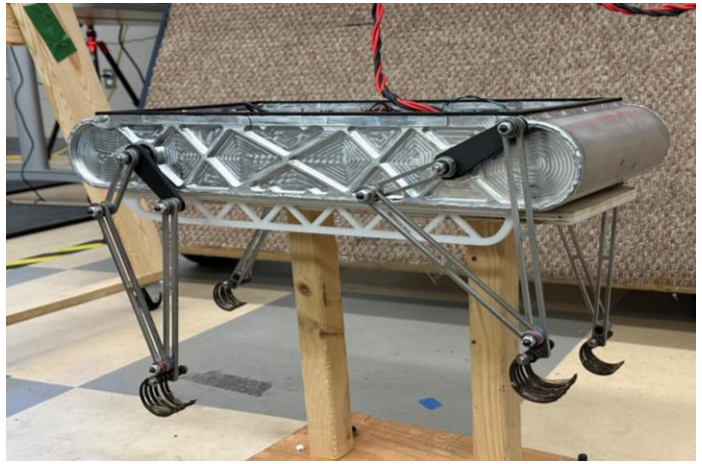
Dr. Jonathon Clark
Sponsor

Dr. Patrick Hollis
Advisor

Dr. Shayne McConomy
Sponsor

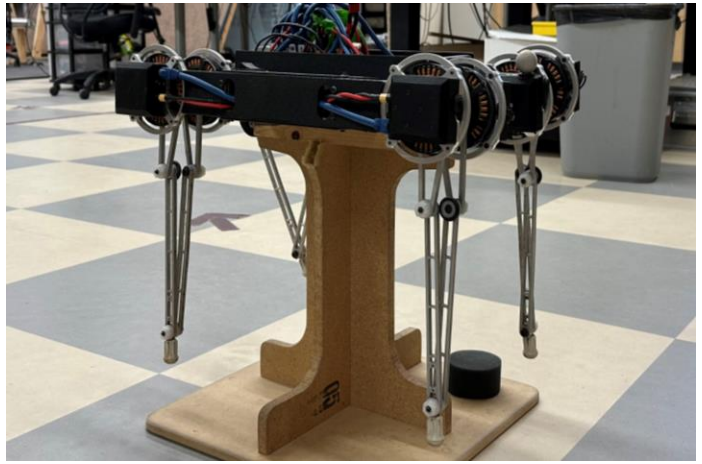
# Objective

The objective of this project is to develop a software tool that expedites the design and construction of quadrupedal robots. The tool will use the knowledge gained from robots previously built at CISCOR.



ET-Quad

RHex



Minitaur

# Primary Market

Professors

Graduate Students

Undergraduate assistants

# Primary Market

Professors

Graduate Students

Undergraduate assistants

# Primary Market

Professors

Graduate Students

Undergraduate assistants

# Primary Market

CENTER FOR INTELLIGENT SYSTEMS, CONTROL, AND ROBOTICS

Professors

Graduate Students

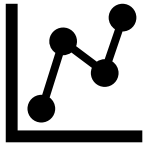
Undergraduate assistants

# Secondary Markets

Oregon State University

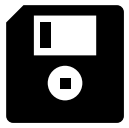
# Key Goals

Develop a tool to assist new quadrupedal robot development



Return critical parameter values

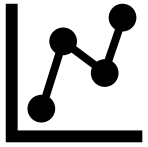
Reduce development time



Act as a database of knowledge for robot development

# Key Goals

Develop a tool to assist new quadrupedal robot development



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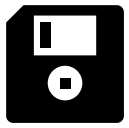

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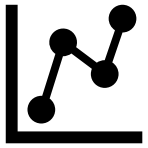

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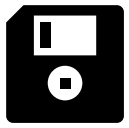
Reduce development time



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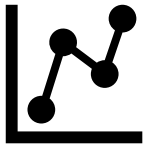

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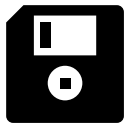

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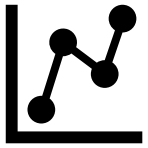
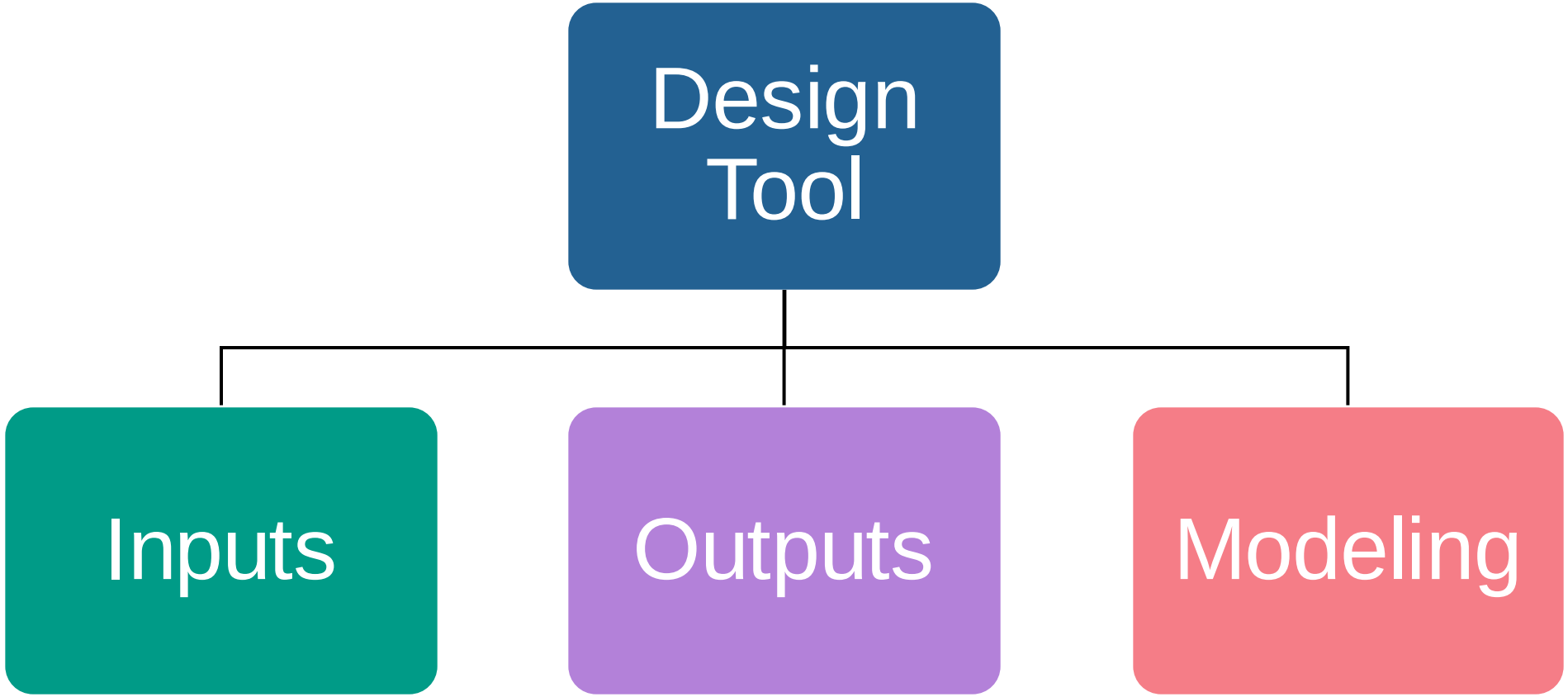


Return critical parameter values

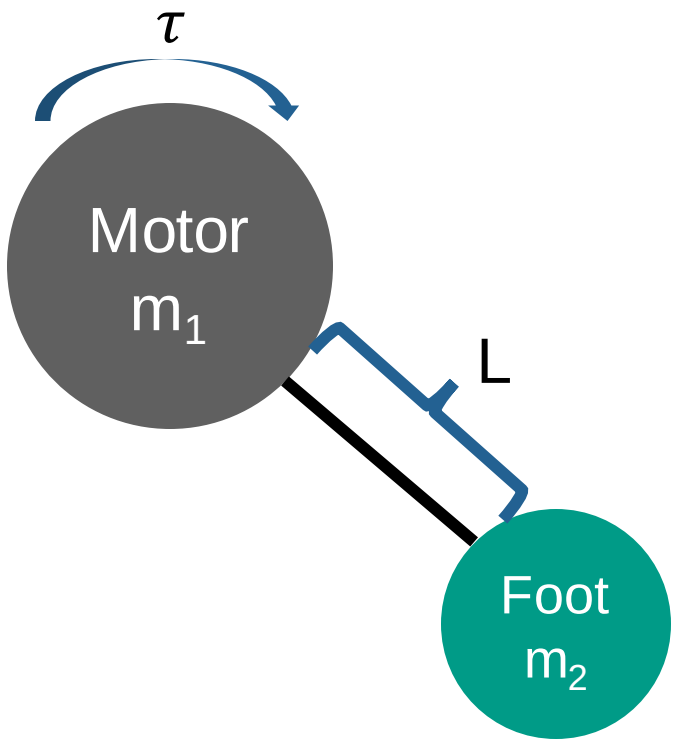
Reduce development time

Act as a database of knowledge for robot development

# Functions Hierarchy Chart

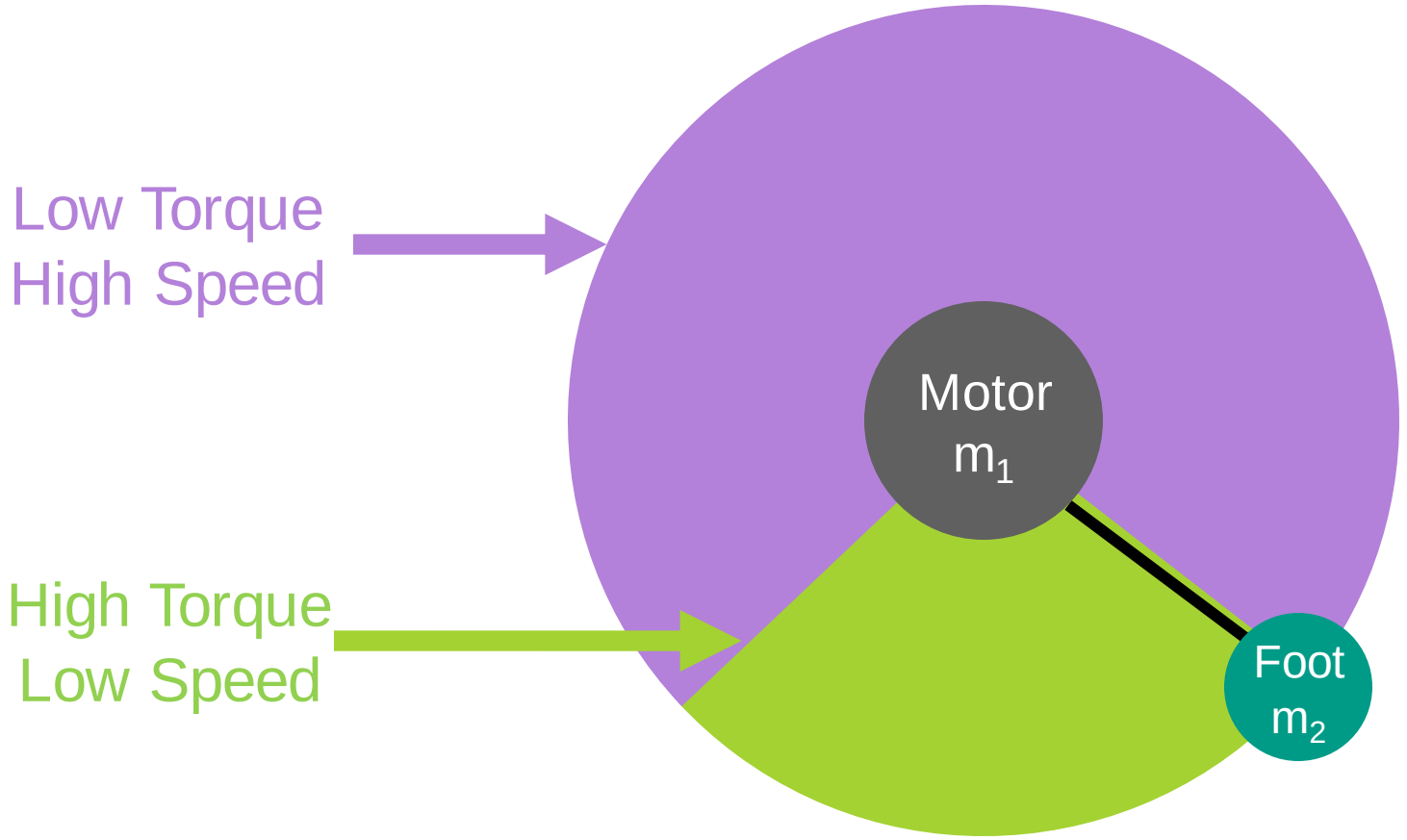


# Starting Motor Model - Simple

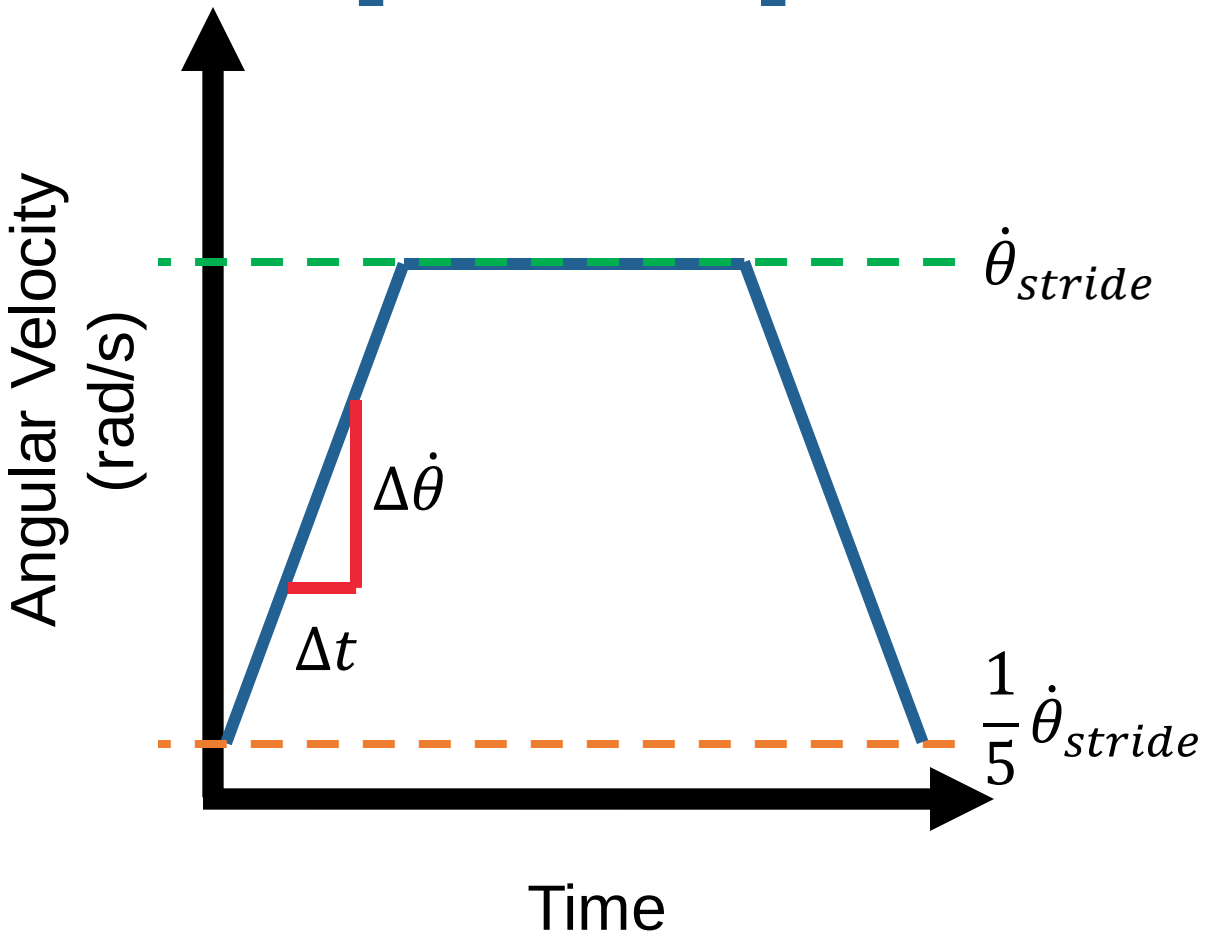


RHex

# Two Phases - Slight

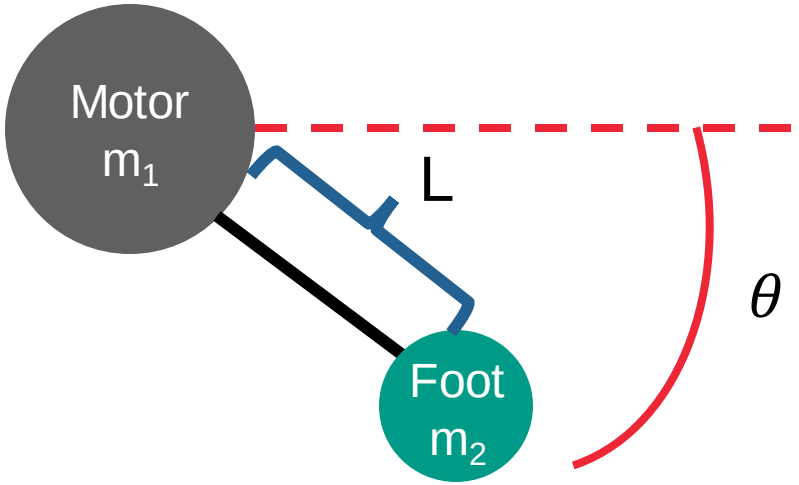


# Torque Required

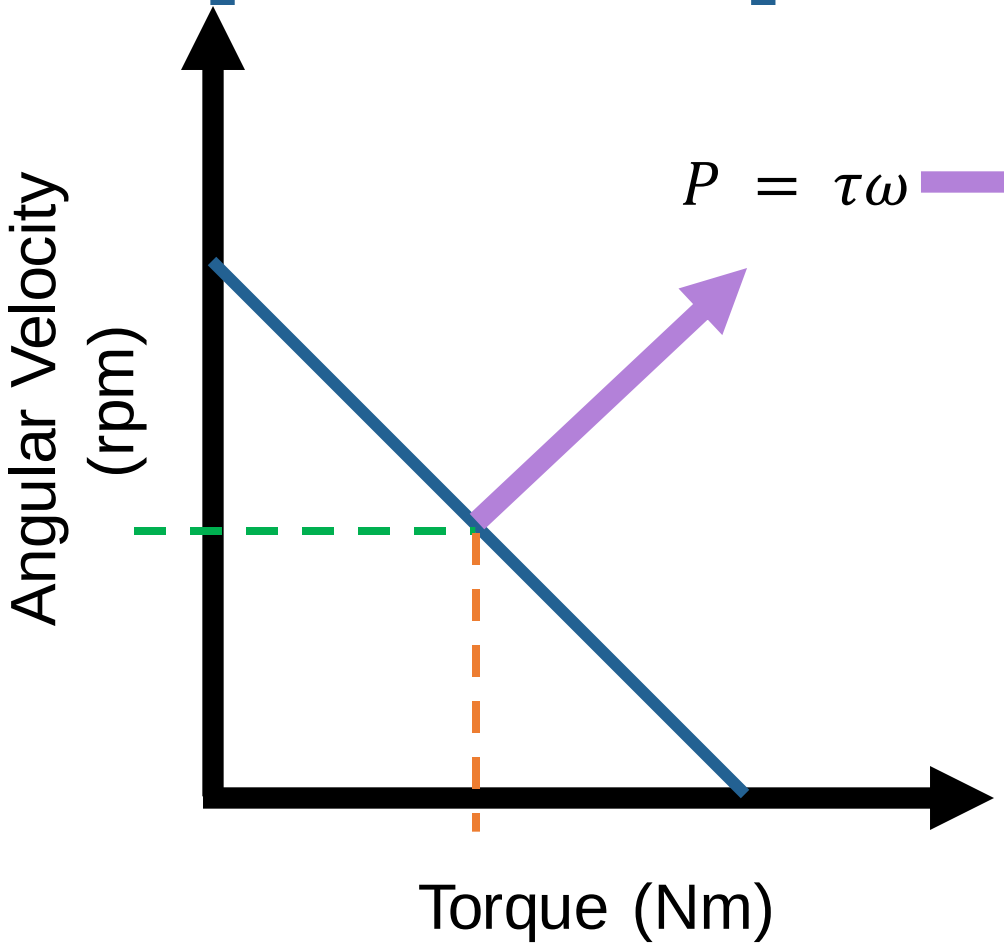



$$\tau_{stance} = m_1 L g \cos\theta$$

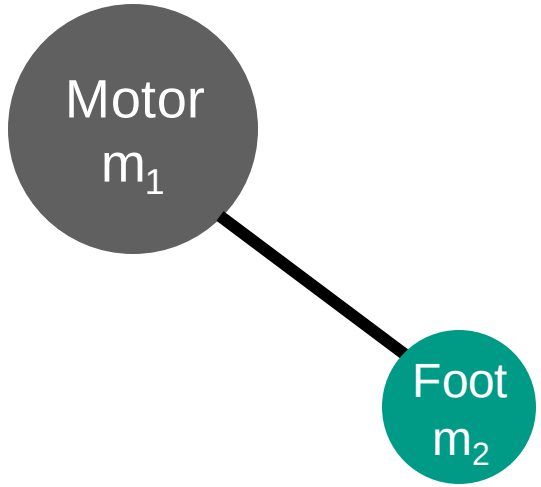
$$\tau_{stance} = m_2\left(\frac{8\pi f_{stride}}{5\Delta t}\frac{8\pi f_{stride}}{5\Delta t}L^2 + g\cos\theta\right)$$



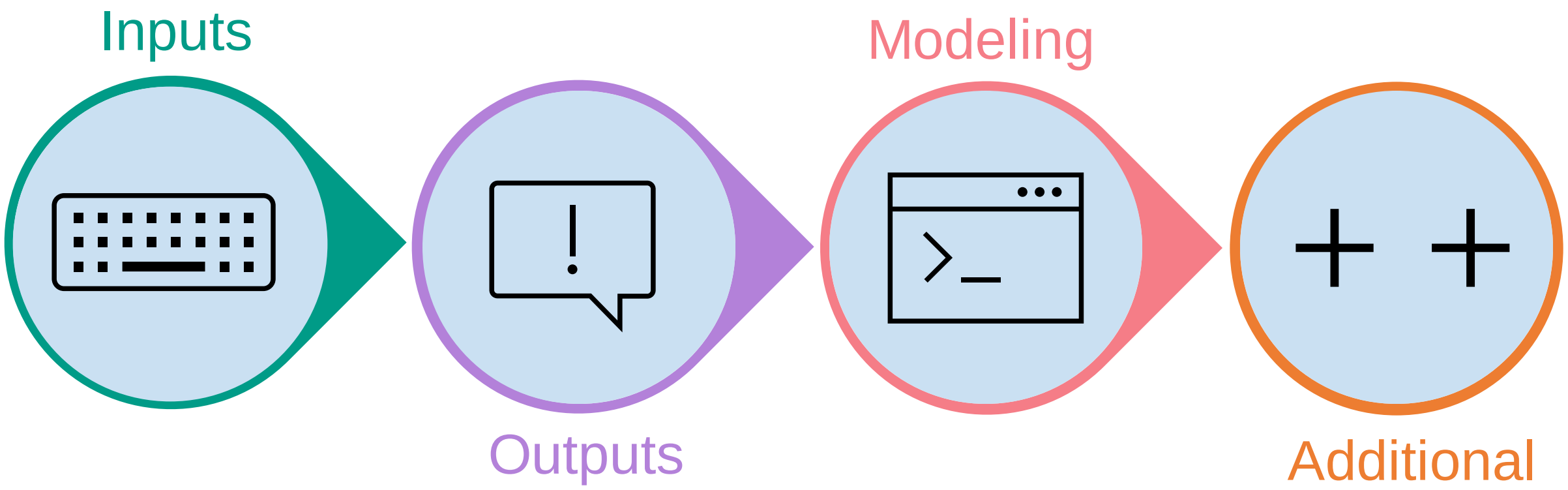
# Speed-Torque Curve




$$P = \tau\omega \rightarrow P \propto m \rightarrow m_{motor} \cong 0.2m_{total}$$



# Targets and Metrics

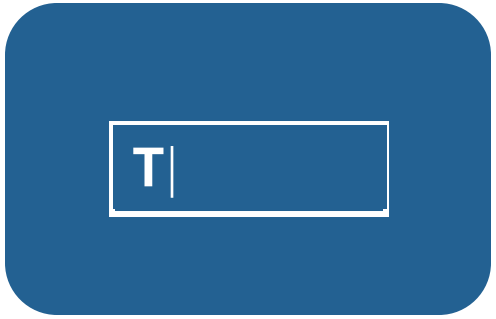


# Concept Generation

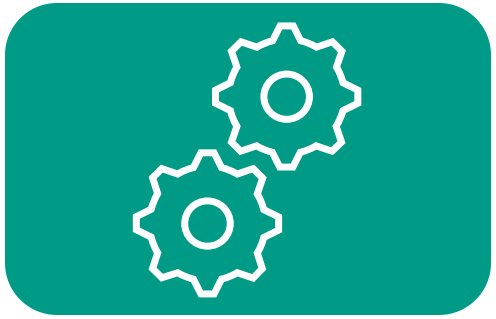
Brainstorming

Forced Analogy

# Medium Fidelity



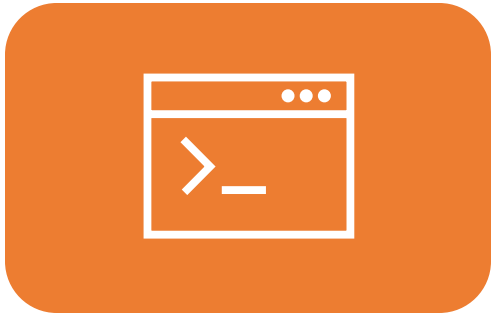

MATLAB Textbox



Simscape Model

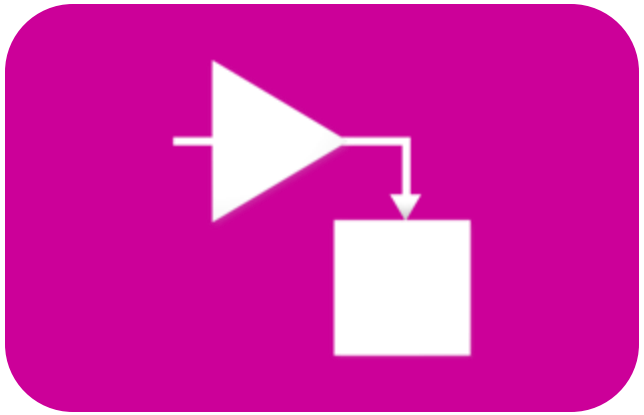
MATLAB GUI with information Dashboard

Racing Car Game Selection



MATLAB command line

# High Fidelity



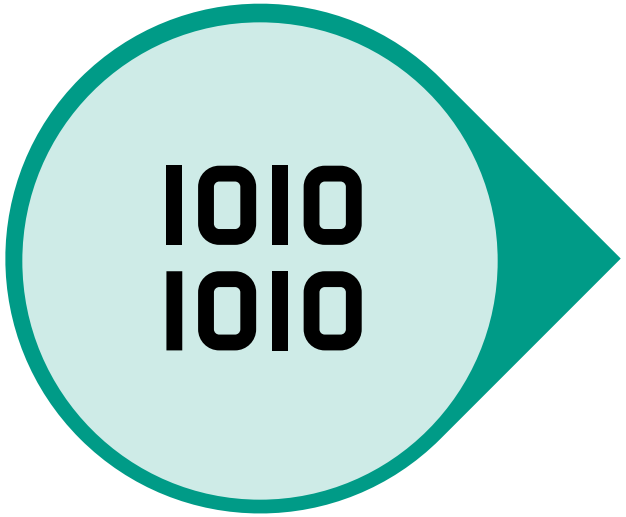
MATLAB to Simulink

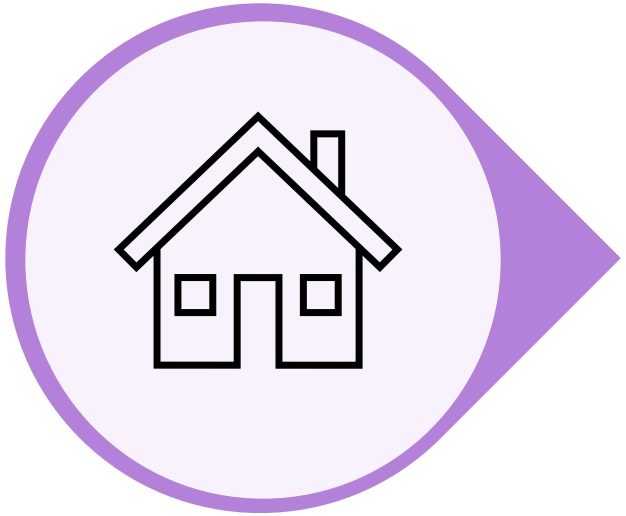
MATLAB GUI with Dropdowns

System Composer GUI

# Concept Selection

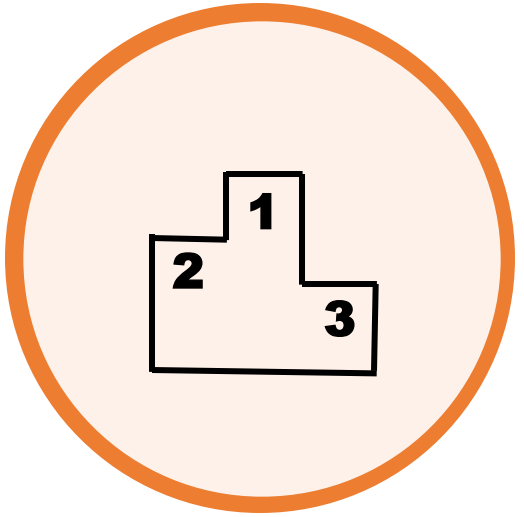
Pairwise Comparison



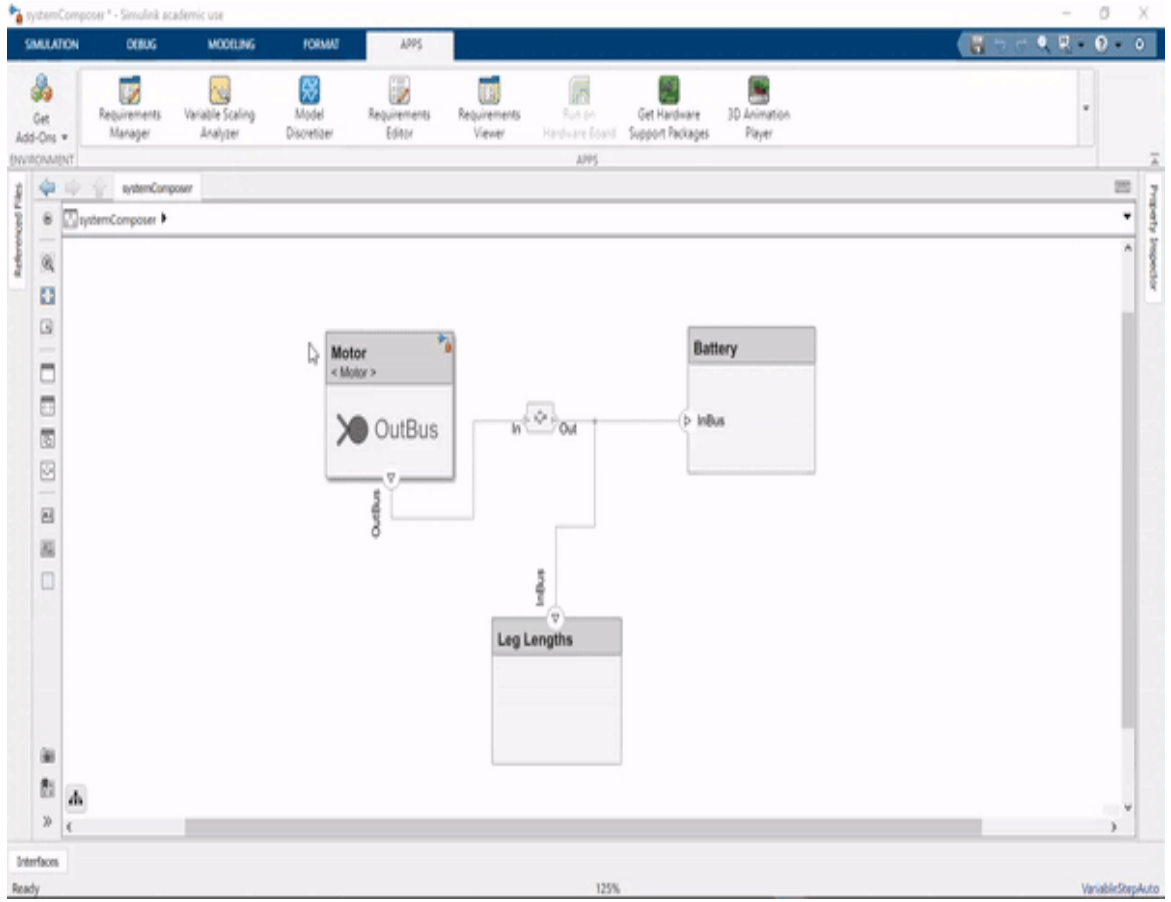
House of Quality

Pugh Chart




Analytical Hierarchy

# Final Selection

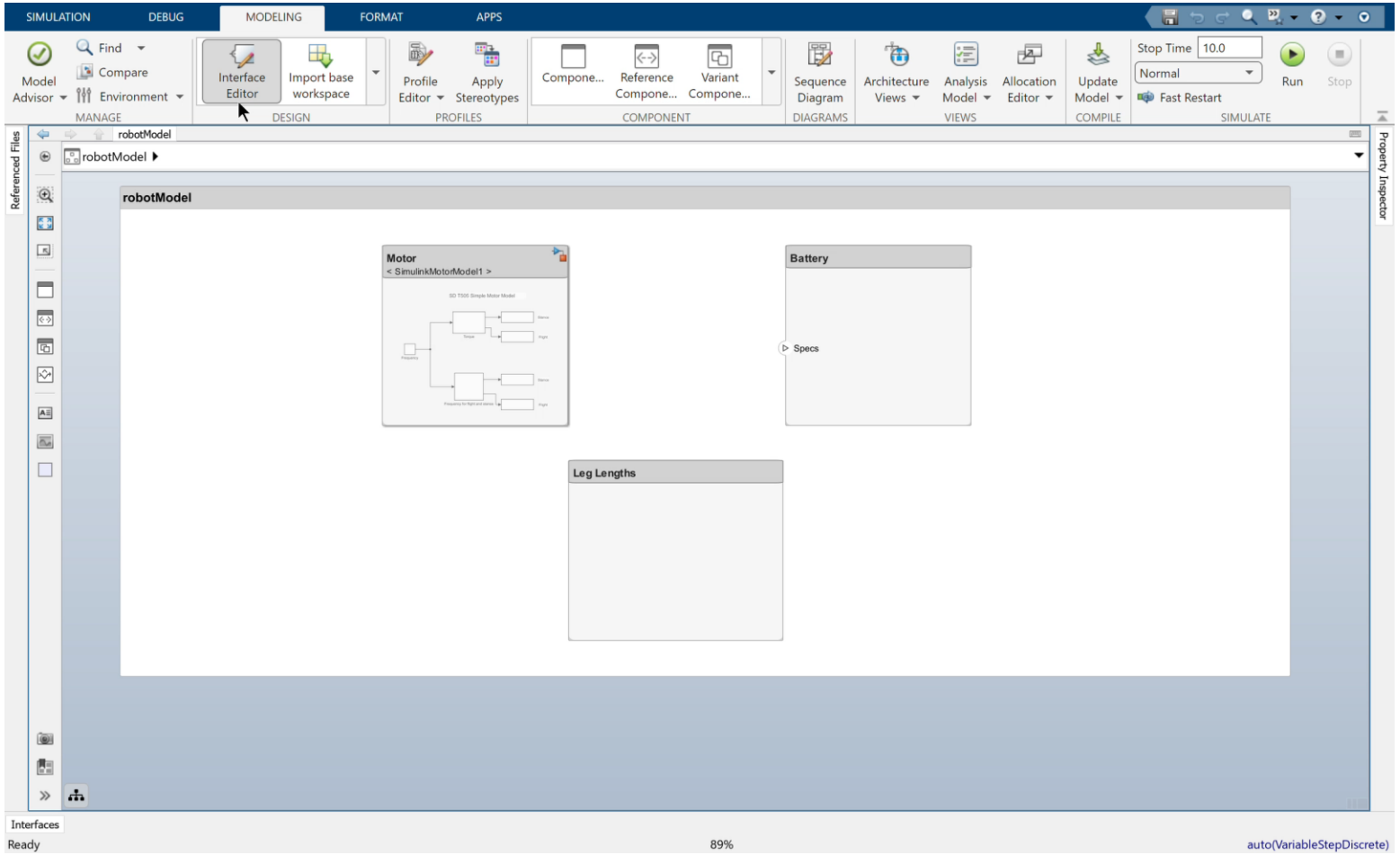



System Composer GUI

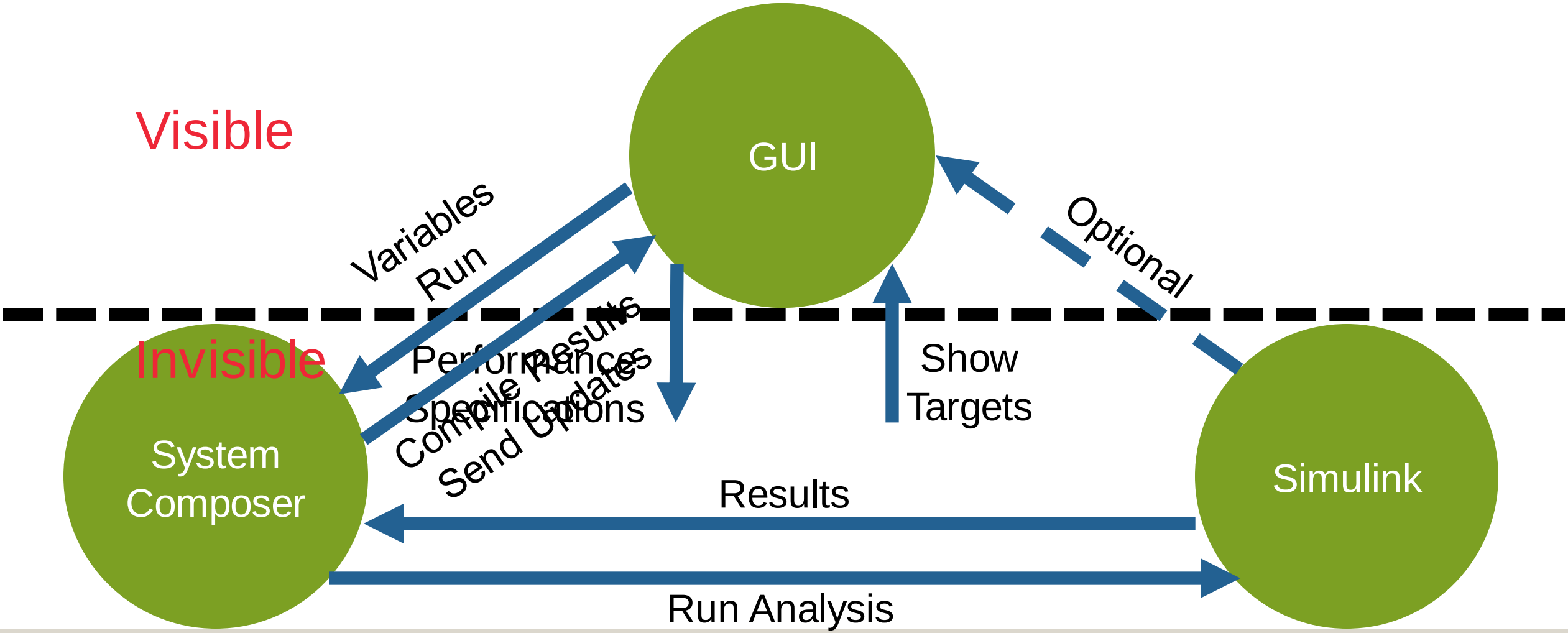
Accepts constraints from user in the form of performance characteristics

Attach Simulink models to specific functions

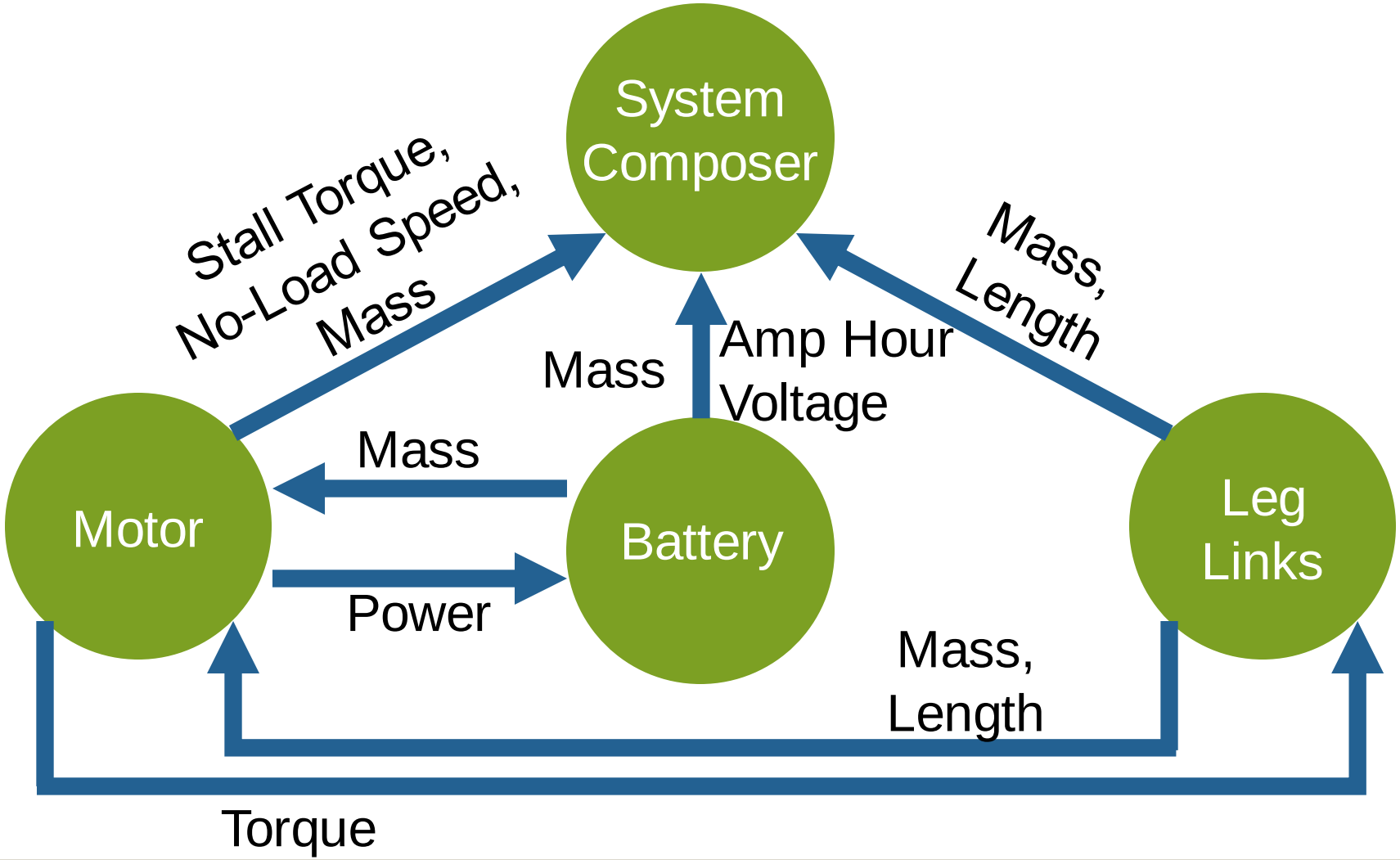
# VDR 3 Prototype



# Software Architecture

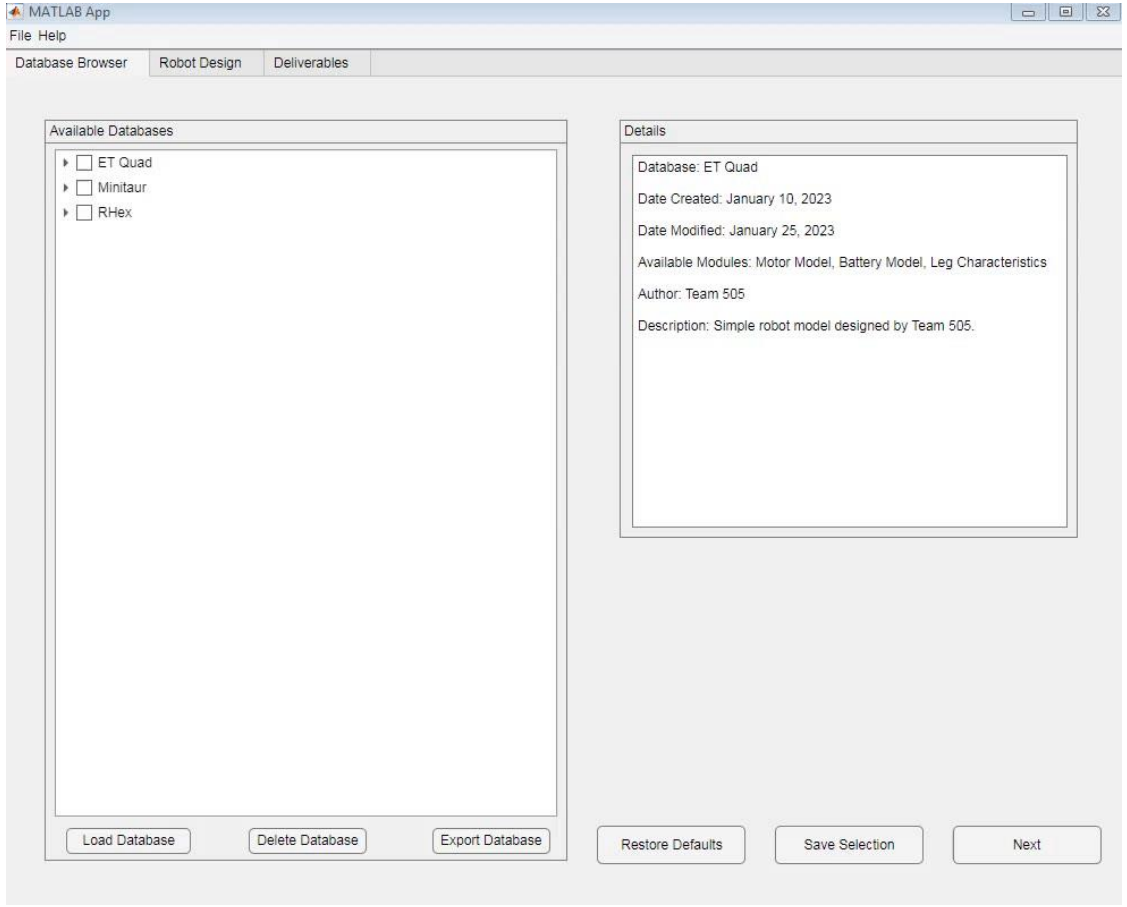


# System Composer Architecture



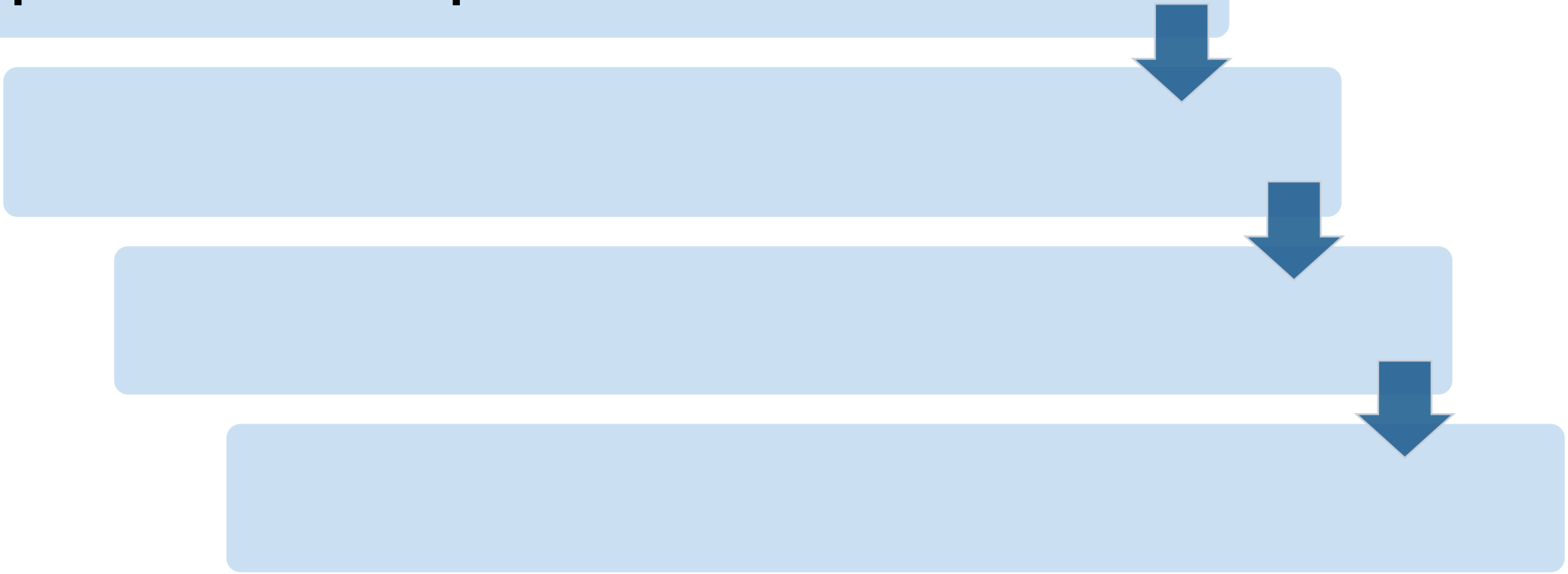
# Software Demo

# Prototype UI



# Future Work

Improve and Update Models



# Future Work

Improve and Update Models

Enhance User Interface

# Future Work

Improve and Update Models

Enhance User Interface

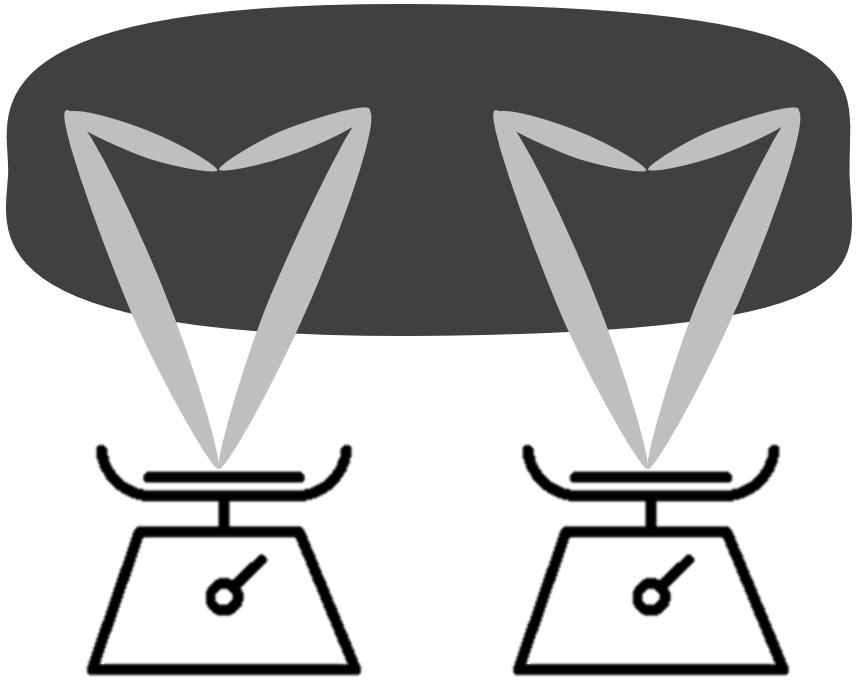
Begin Building Database

# Future Work

- Improve and Update Models
- Enhance User Interface
- Begin Building Database
- Testing for Validation

# Future Work: Testing

- Measuring Foot Forces
- Model Validation
- Margin of Error Validation



# Future Work: Testing

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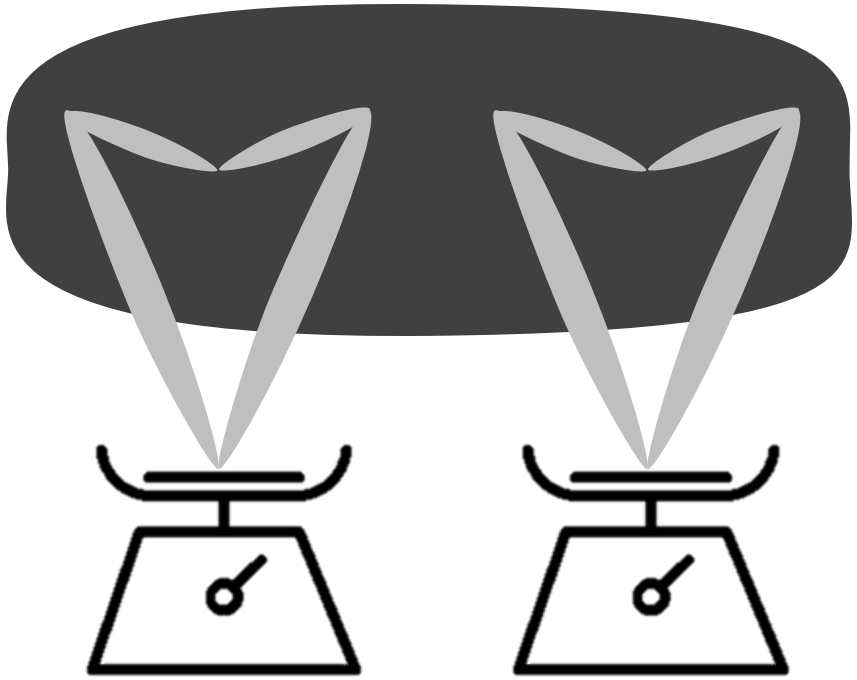
- Model Validation
- Margin of Error Validation



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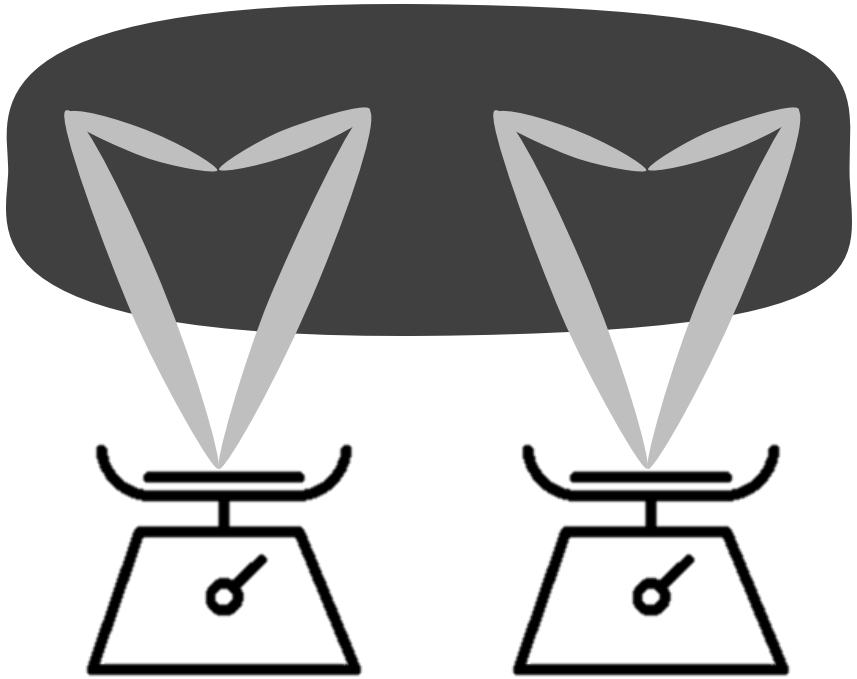

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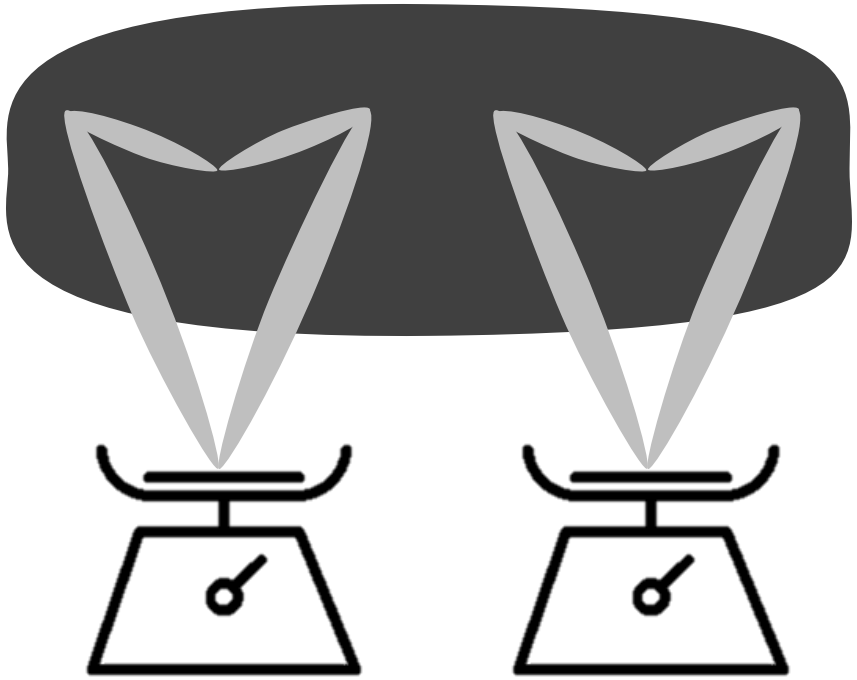

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