FAMU-FSU College of Engineering

NSWC - RoboBoat
Team 521

November 16, 2023 | Virtual Design Review 2

Team Introductions (ME)

Ivanna Caballero
Materials Engineer

Andly Jean
Mechatronic Engineer

Nicholas Norwood
Mechanical Systems Engineer

Makenzie Wiggins
Design Engineer

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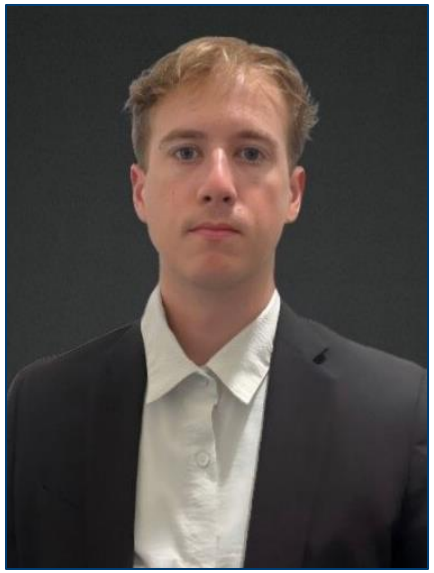
Team Introductions (EE)

Sophia Barron
Electrical Systems Engineer

Michael Fitzsimmons
Electronics Engineer



Lucca Meyer
Test Engineer

Sponsor and Advisor

Engineering Mentor/Sponsor
Dr. Damion Dunlap
Navy Surface Warfare Center

Academic Advisor
Dr. Shayne McConomy
Senior Design Coordinator

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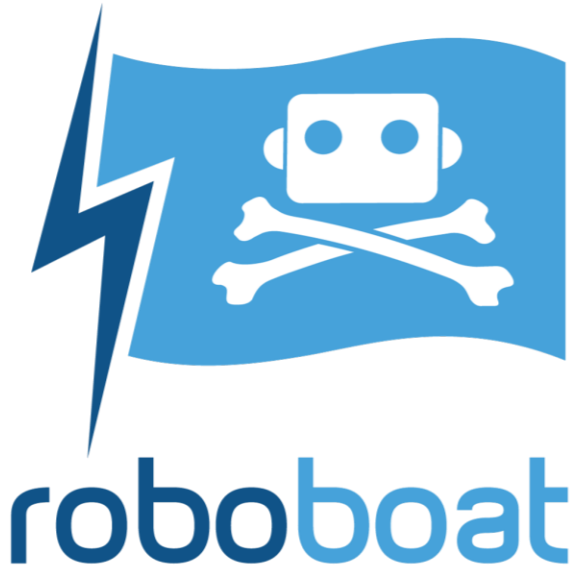
Project Objective

The objective of this project is to design, build and program an autonomous surface vehicle capable of completing several tasks in the following categories:

- Navigation
- Detection
- Object delivery
- Object avoidance
- Station keeping
- Conduct two-step behavior



Markets

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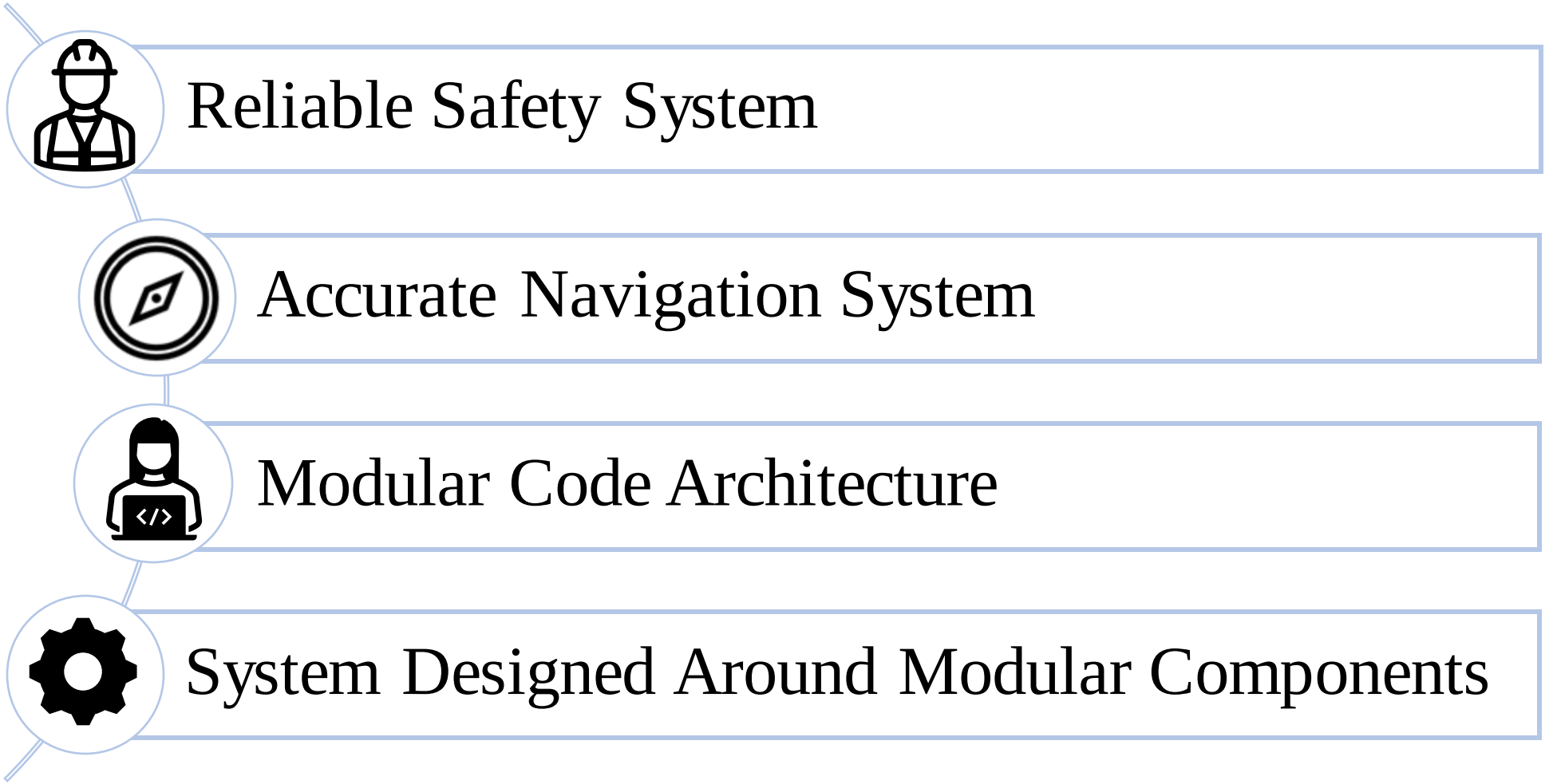
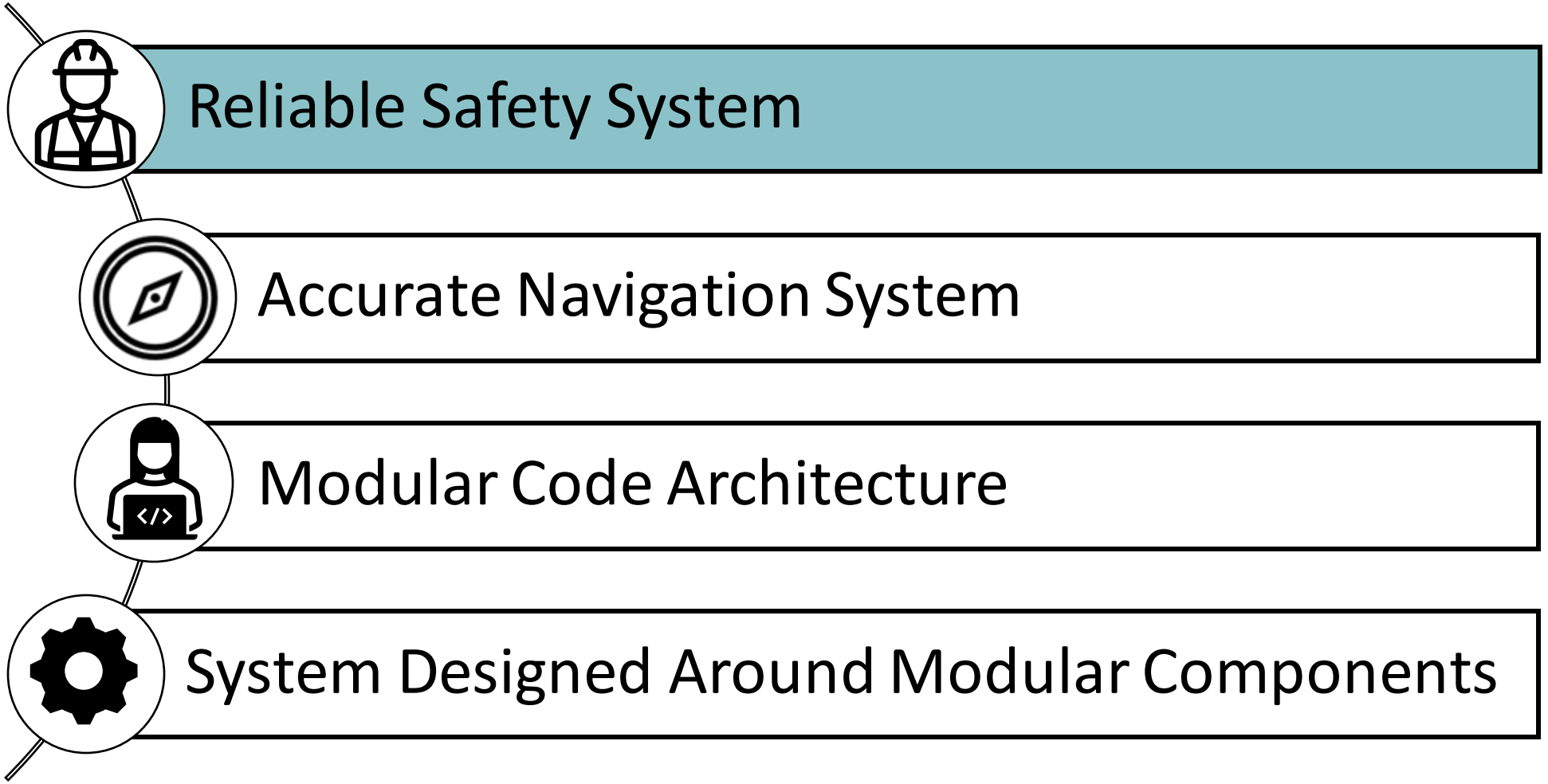
Customer Needs

- Navigation System
- Safety System
- Power/Battery System
- Weight/Size Restraint
- One Major Task

Updated Key Goals



Updated Key Goals



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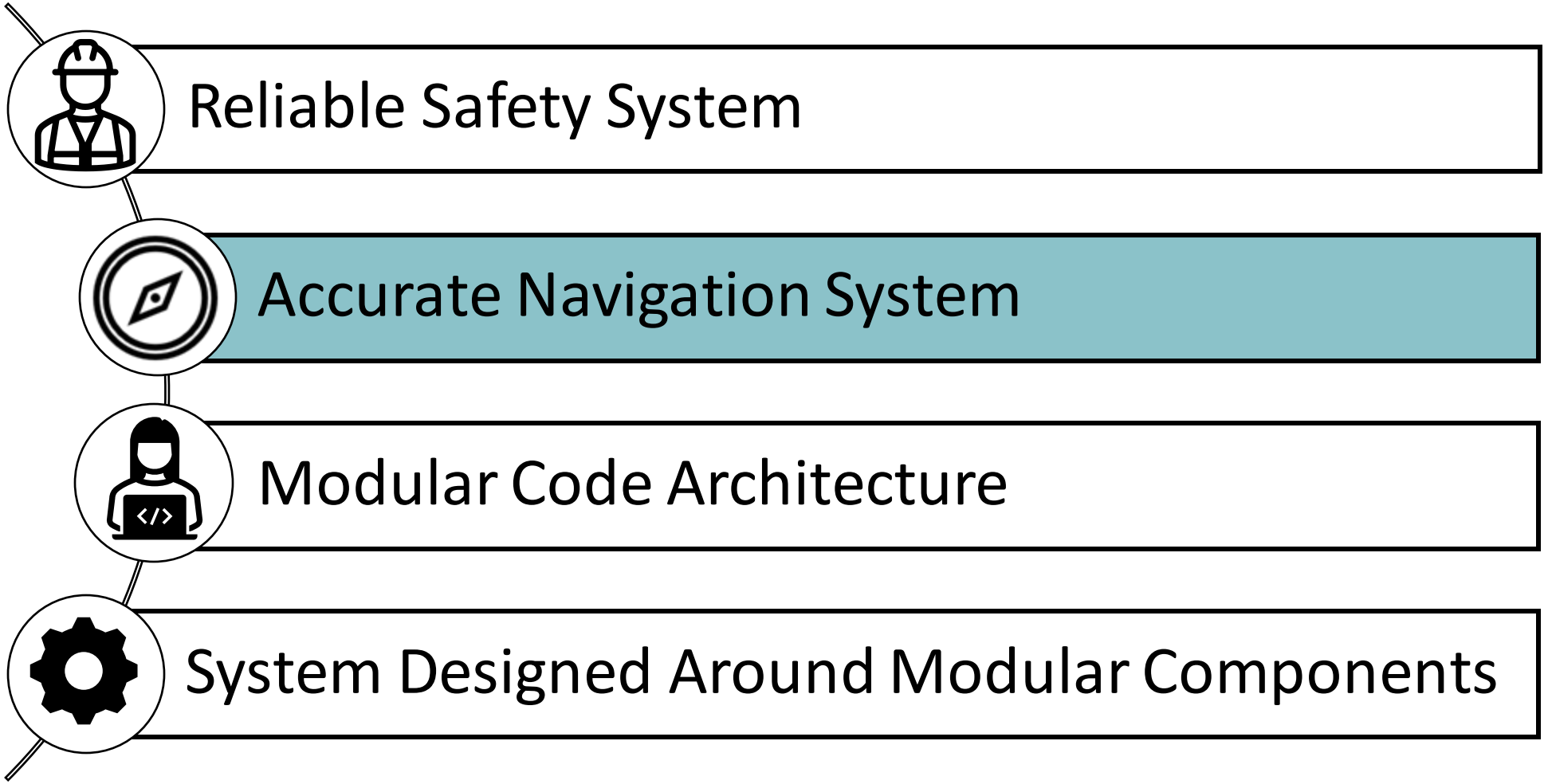

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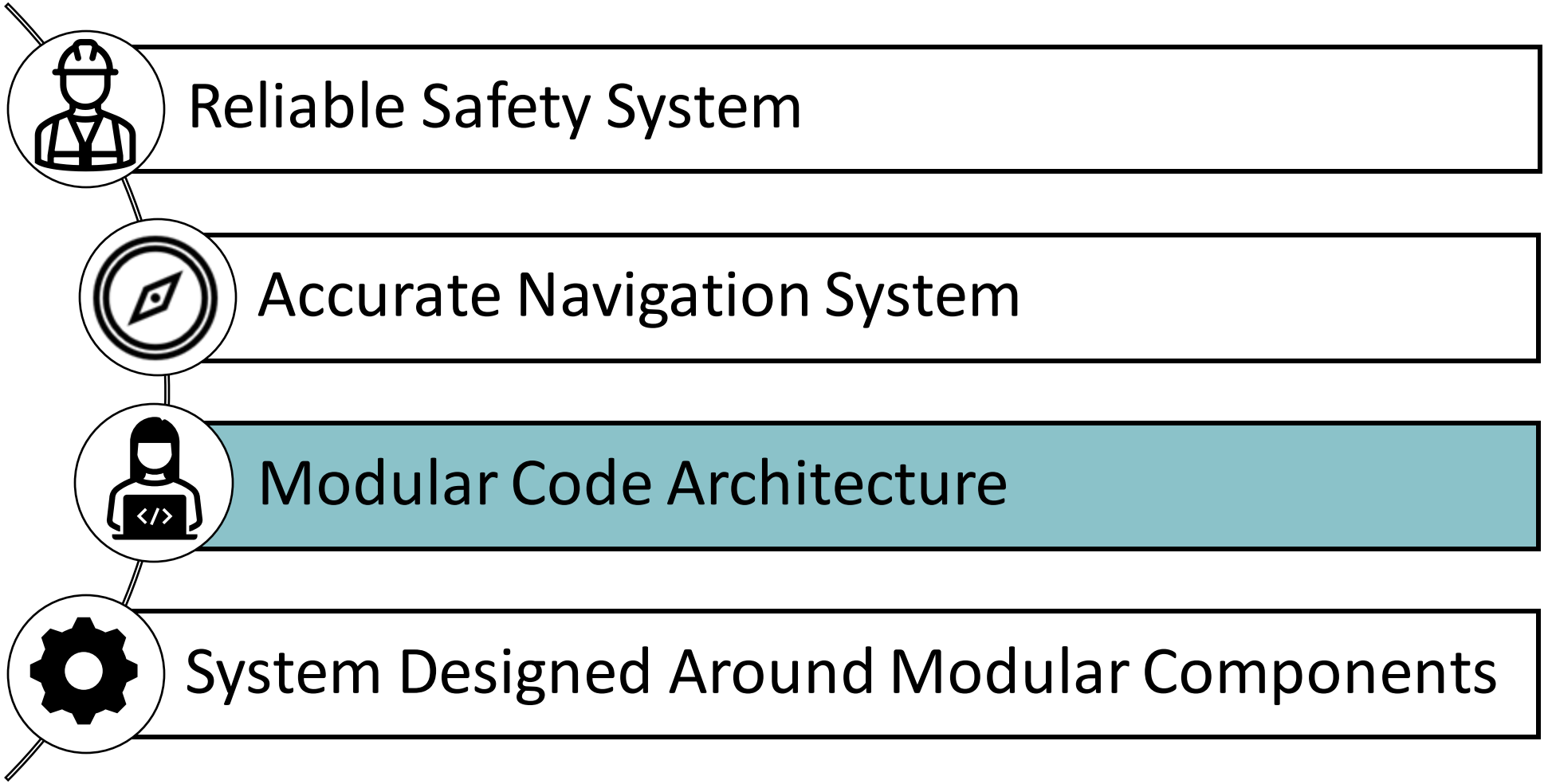

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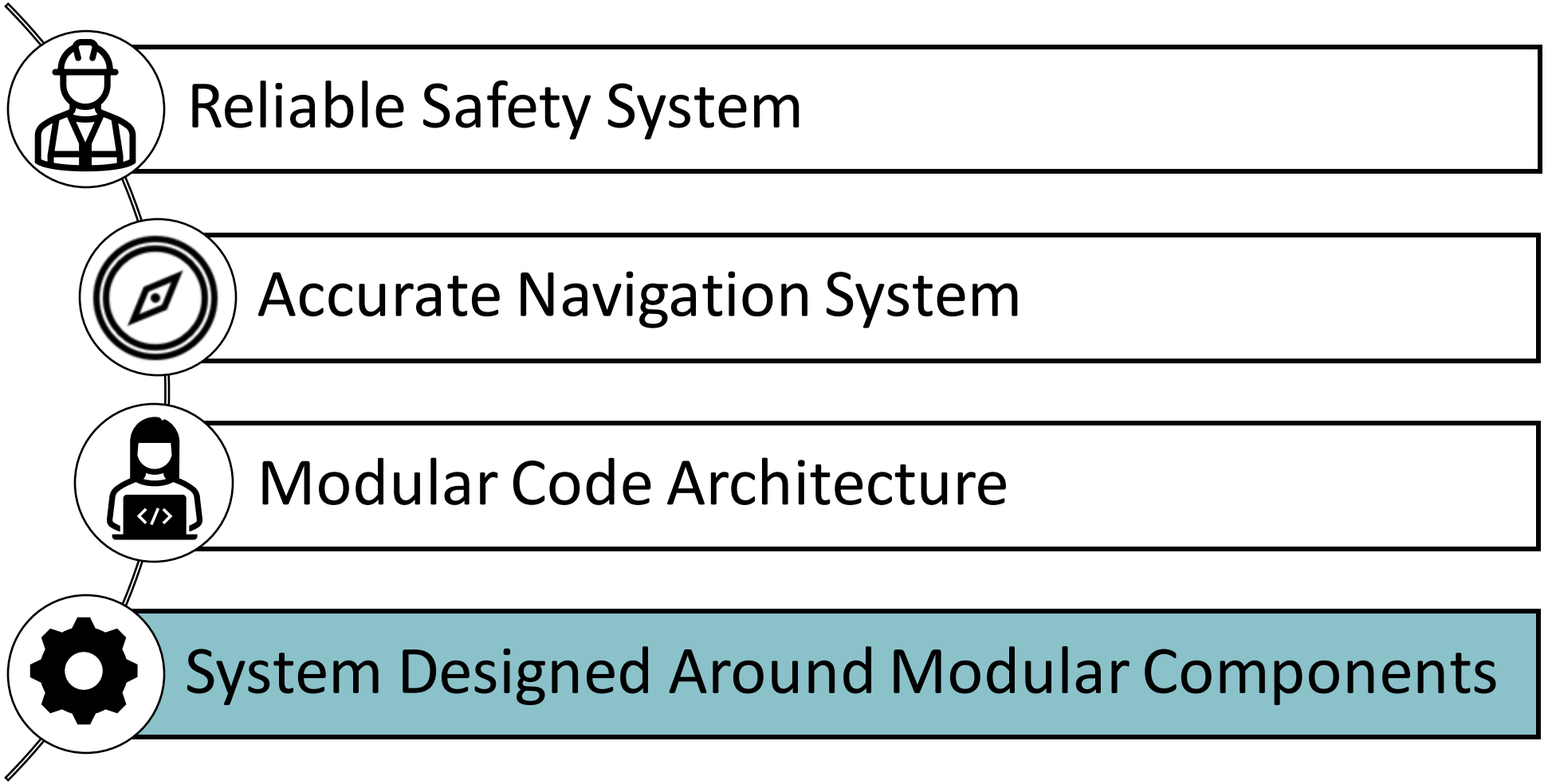
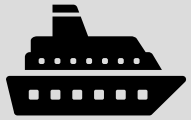


Functional Decomposition

Locomotion

Navigation



Structure

Power Systems

Safety

Object Retrieval

Water Spraying

Object Detection

Functional Decomposition


Locomotion


Navigation


Structure


Power Systems


Safety


Object Retrieval


Water Spraying


Object Detection

Functional Decomposition

Locomotion

Navigation

Structure

Power Systems

Safety

Object Retrieval

Water Spraying

Object Detection

Functional Decomposition

- Locomotion
- Navigation
- Structure
- Power Systems
- Safety
- Object Retrieval
- Water Spraying
- Object Detection

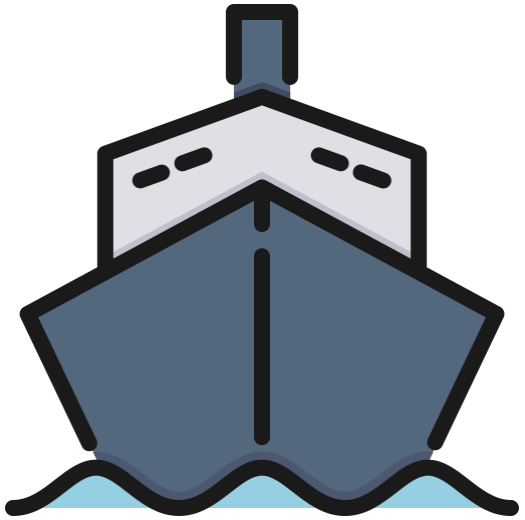
Critical Targets and Metrics

Targets and Metrics:

- **Structure**
- **Locomotion**
- **Safety**
- **Navigation**
- **Power Systems**
- **Object Detection**

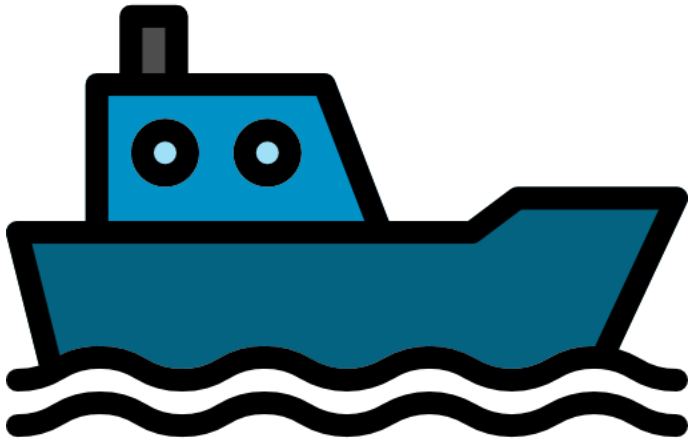
System: Structure

Function	Target	Metric
Length	3.94(ft)	size
Width	2.58(ft)	size
Height	2.445(ft)	size
Weight	63.25(lbs)	weight
Buoyancy	300N	force
Deflection Angle	15 degrees	angle



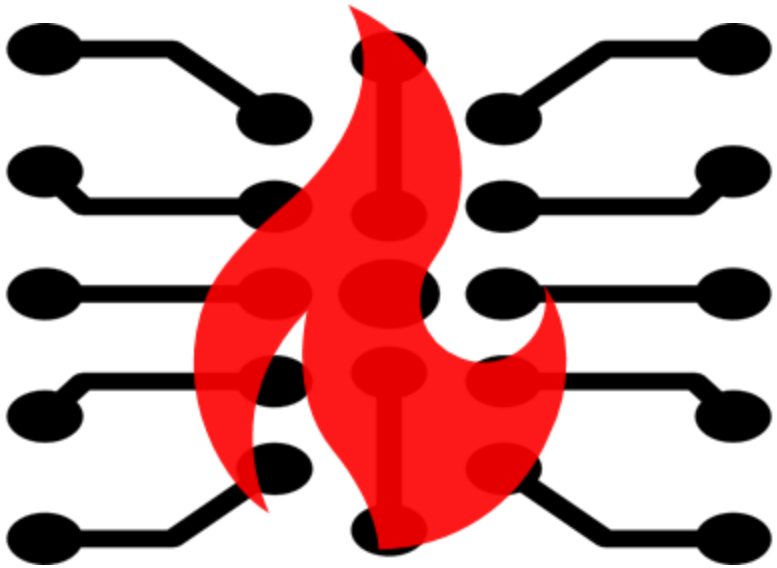
System: Locomotion

Function	Target	Metric
Speed	>=1.515 (m/s)	velocity
Acceleration	0.25 (m/s)	acceleration
Thrust	14.6 (lbs)	force



System: Safety

Function	Target	Metric
Kill switch response time	0.25(s)	time
Manual-Remote kill switch integration	True	Boolean

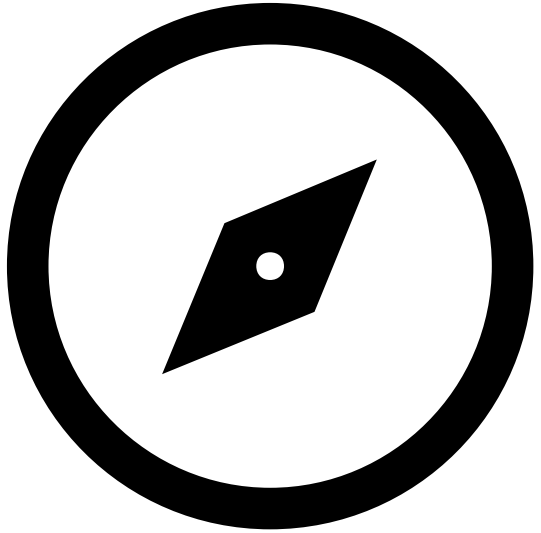


System: Power Systems

Function	Target	Metric
Battery size	13200(mAh)	Charge capacity
Battery life	1 (hr)	Time
Capability of tracking battery life	True	Boolean

System: Navigation

Function	Target	Metric
Cross-track error of navigating to a destination	2(m)	length
Boat localization error	< 5(m)	length



System: Object Detection

Function	Target	Metric
Camera Resolution	1920x1080 (pixels)	Number of Pixels
Range of object detection	25(m)	Length
Accuracy of detecting color	95%	Percent Error
Capability of identifying different objects	Min. Of 6 objects	Number of objects

System: Object Detection

Function	Target	Metric
Camera Resolution	1920x1080 (pixels)	Number of Pixels
Range of object detection	25(m)	Length
Accuracy of detecting color	95%	Percent Error
Capability of identifying different objects	Min. Of 6 objects	Number of objects

Michael Fitzsimmons

Methods used

Biomimicry

Anti-Problem

Crap Shoot

Forced Analogy

Morphological Charts

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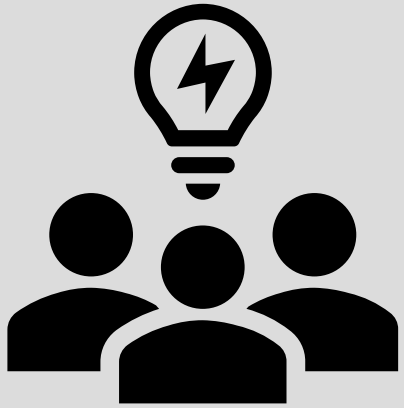
Concept Generation



100 Concepts

5 Medium Fidelity

3 High Fidelity

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Medium Fidelity Concepts

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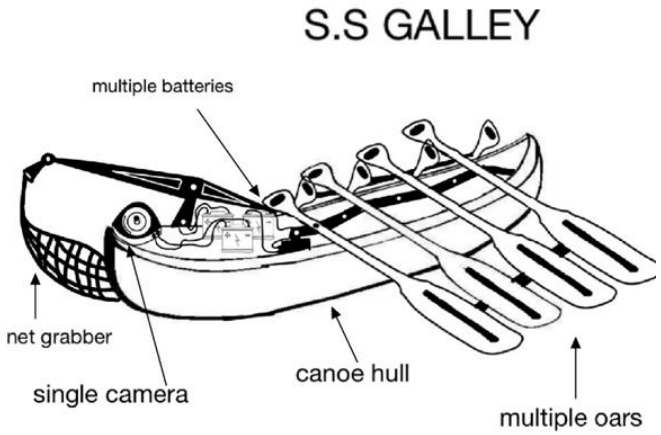
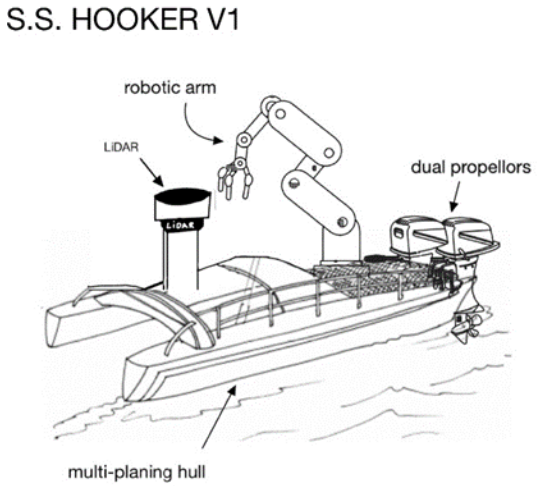
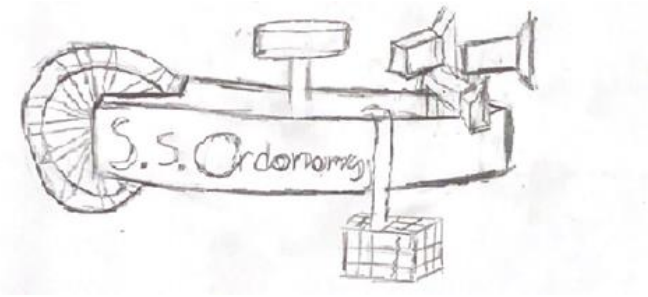
S.S Galley



S.S Hooker V1



S.S Ordonomy



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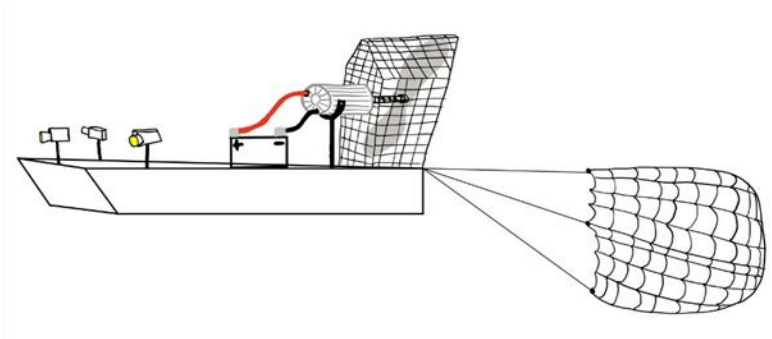
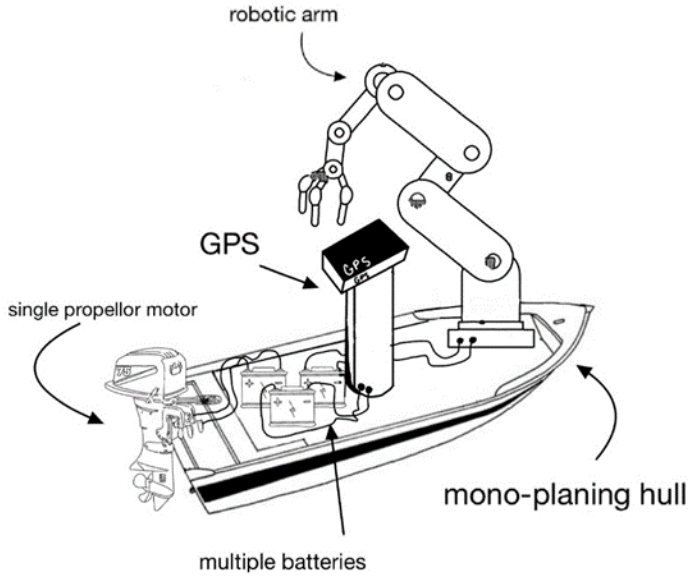
S.S Air Goose



S.S Ol' John



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High Fidelity Concepts

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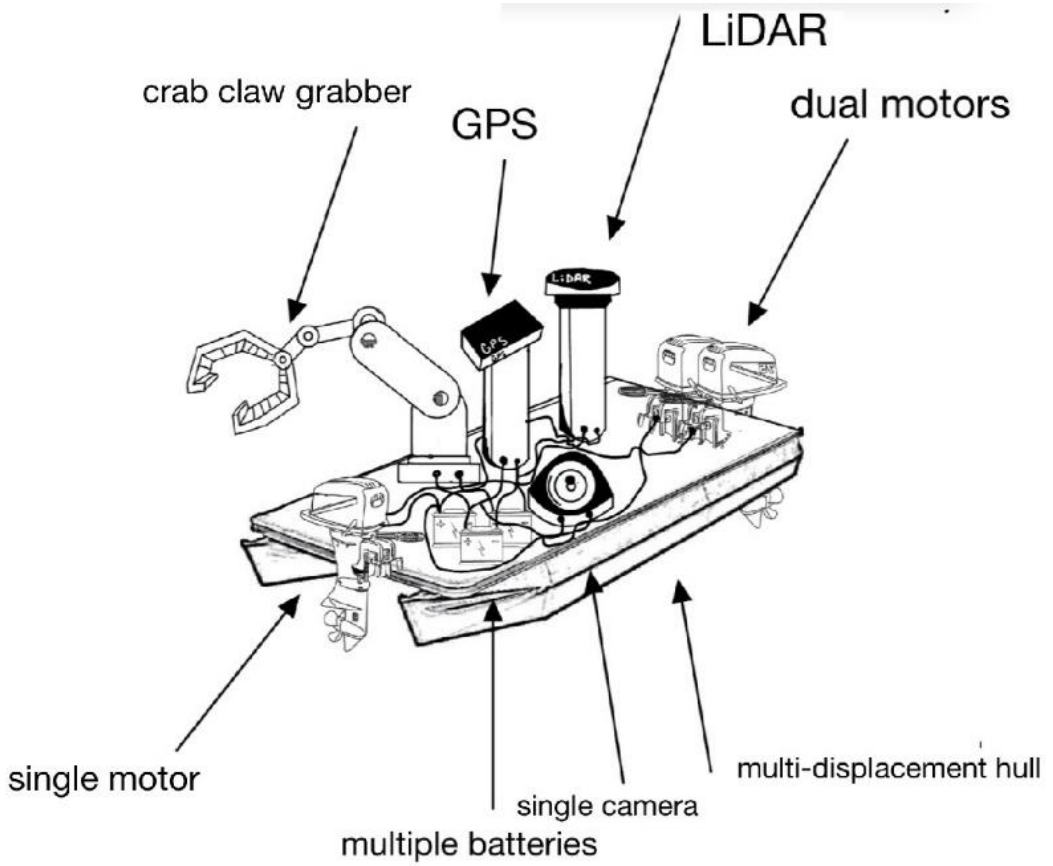
S.S. Shayne 1.0

- Multi-displacement hull
- Dual rear propellers
- Single front propeller
- GPS, camera, and Lidar
- Crab claw grabber
- Multiple batteries



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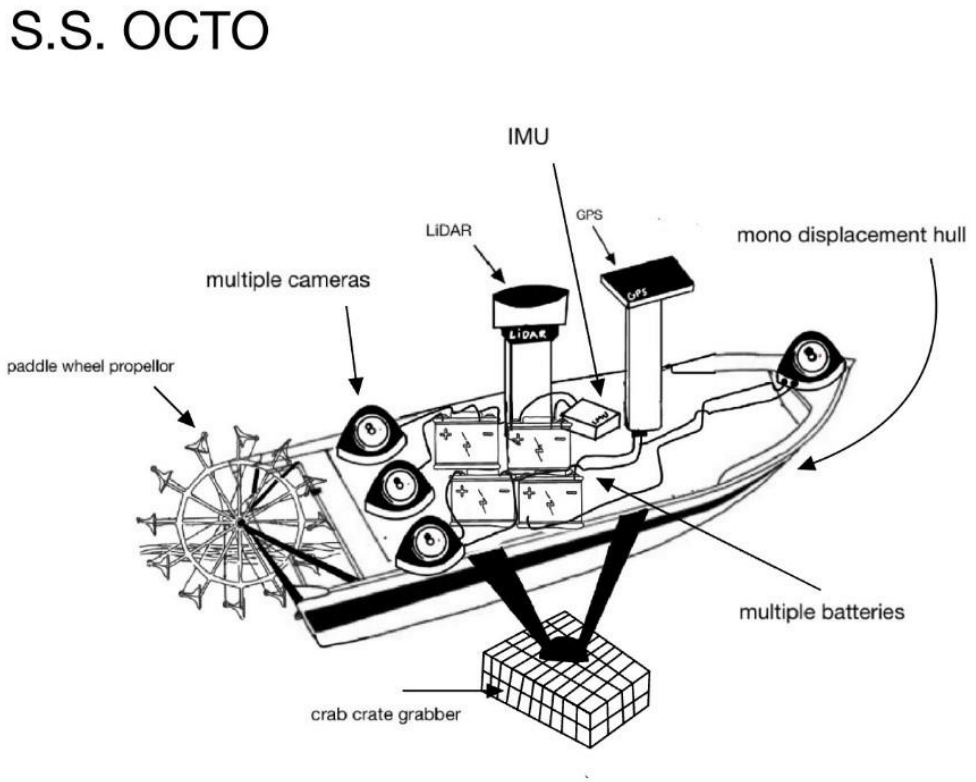
S.S. Octo

- Mono-displacement Hull
- Paddle wheel propeller
- Multiple cameras
- GPS, Lidar, IMU
- Crab crate
- Multiple batteries



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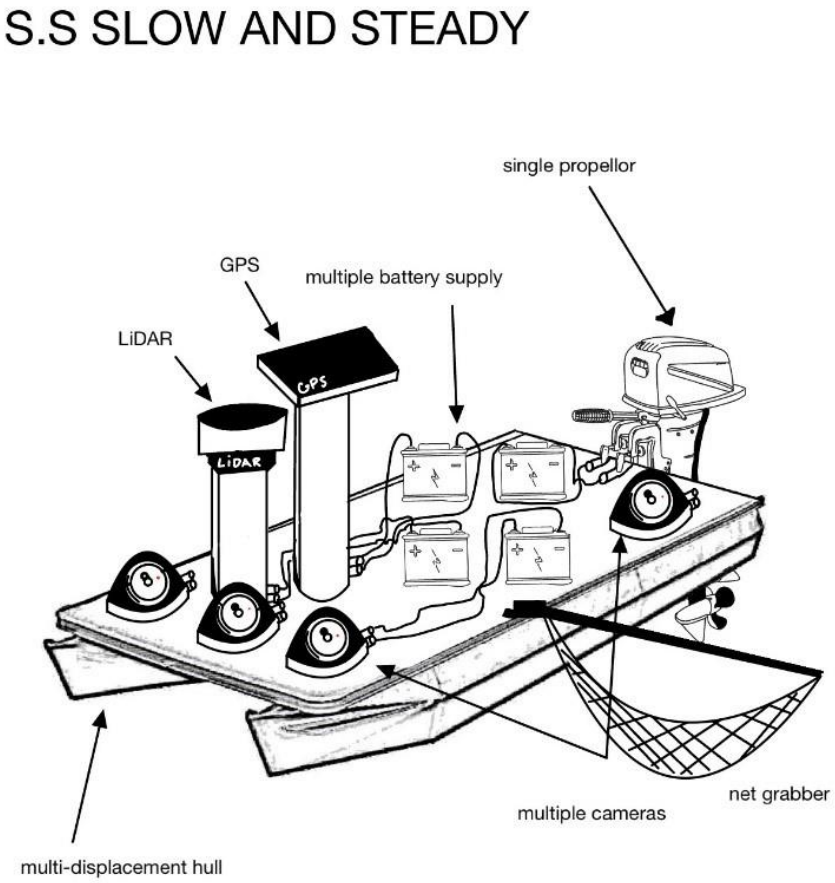
S.S. Slow N' Steady

- Multi-displacement hull
- Single propeller
- GPS & Lidar
- Multiple batteries
- Multiple Cameras
- Net Grabber



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Norwood

Concept Selection

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Concept Selection

Customer Needs	Weight
Stability	9
Cost Stays Within Budget	8
Modular Components	6
Weight	6
Size Within Competition Rules	5
Navigation	5
Run Time	3
Object Detection	2
Autonomy	1
Object Retrieval	0

Target	Priority
Battery Power	1
Buoyancy	2
Sensor Resolution	3
Size	4
Weight	5
Navigation	6
Deflection Angle	7

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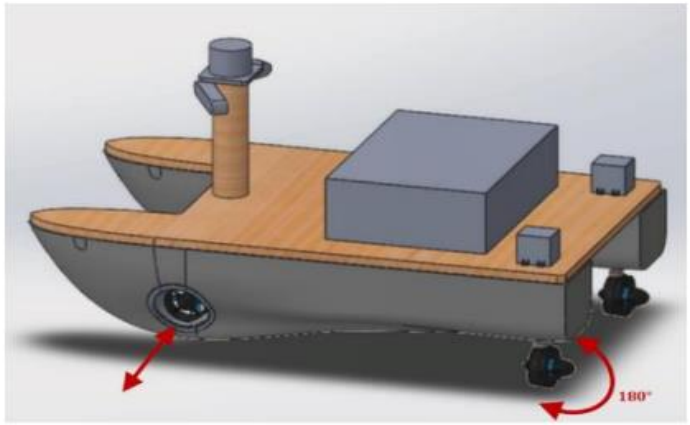
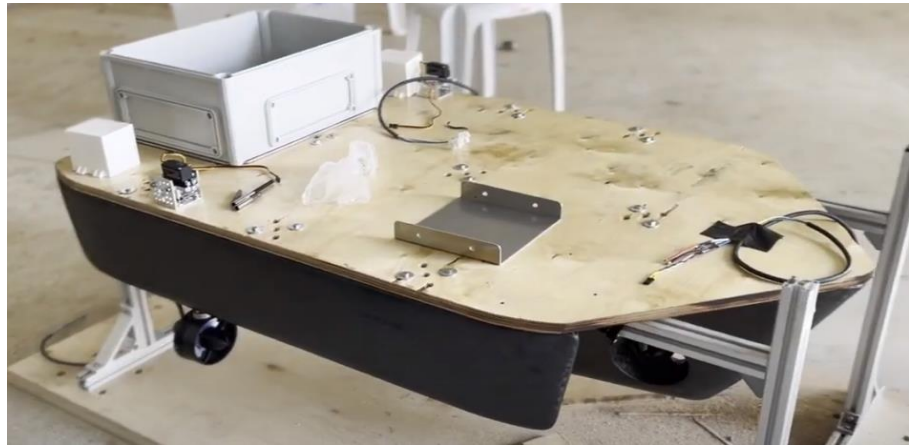
Pugh Charts – Tel Aviv





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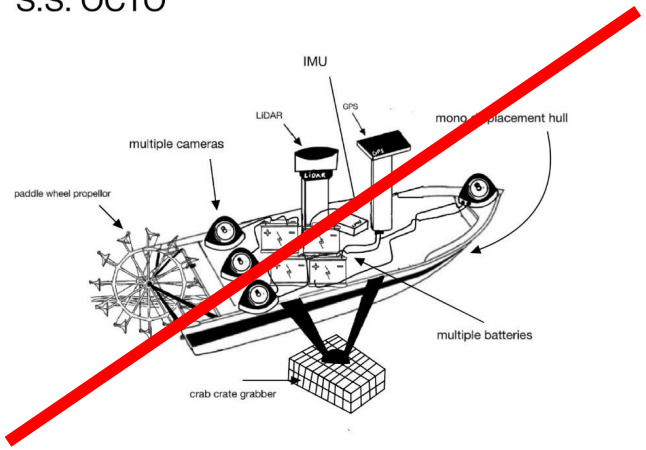
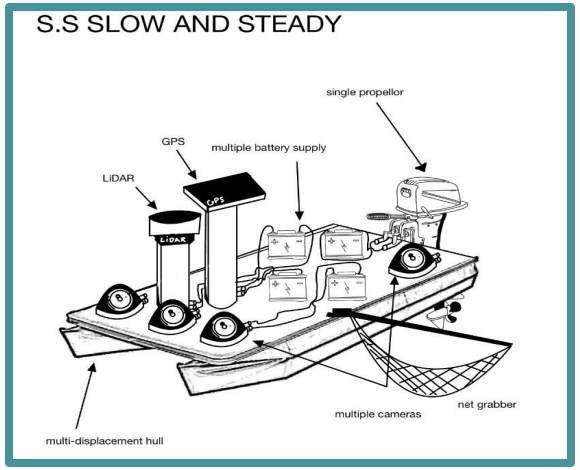
Pugh Charts – 1st Iteration

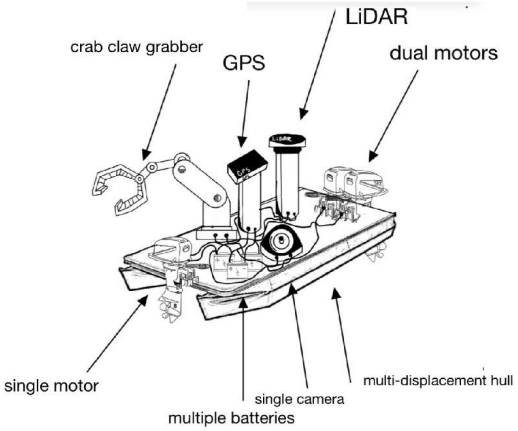
S.S. OCTO



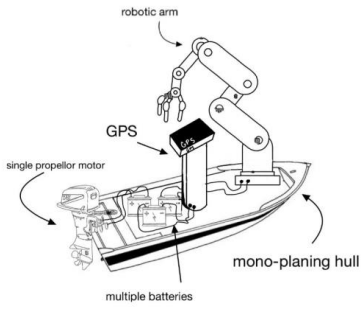
S.S SLOW AND STEADY



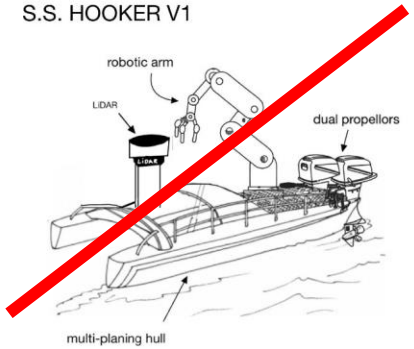
S.S. SHAYNE 1.0



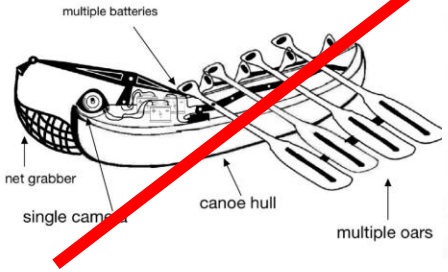
S.S. OL' JOHN



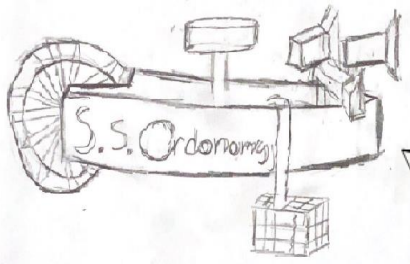
S.S. HOOKER V1



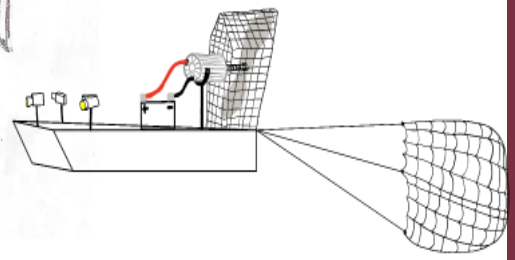
S.S GALLEY



S.S. Ordonomy



S.S. Air Goose



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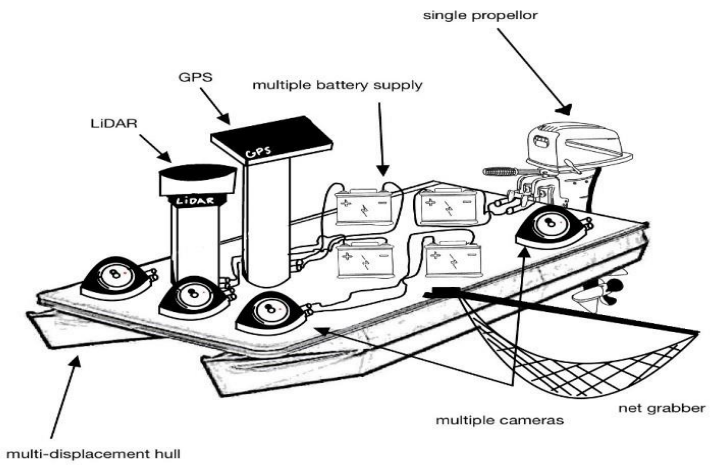
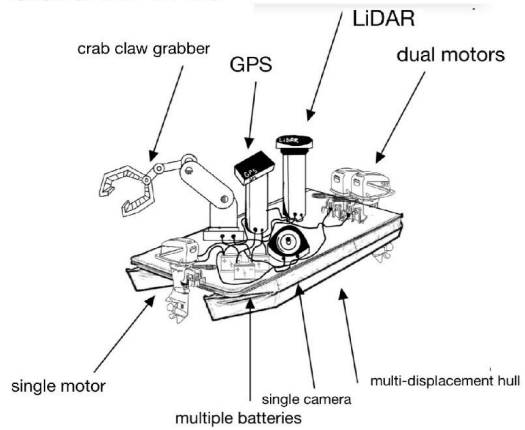
Pugh Charts – 2nd Iteration

New Datum

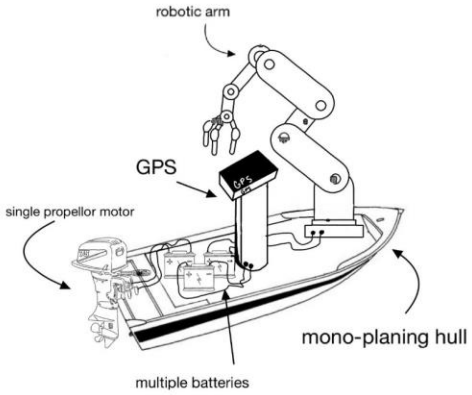
S.S SLOW AND STEADY



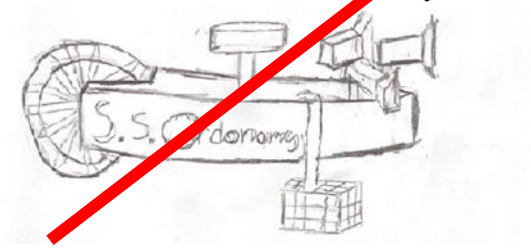
S.S. SHAYNE 1.0



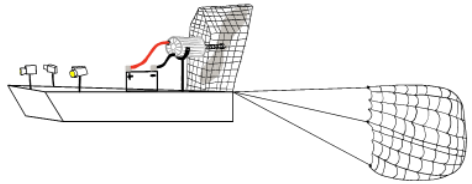
S.S. OL' JOHN



S.S. Ordonamy



S.S. Air Goose



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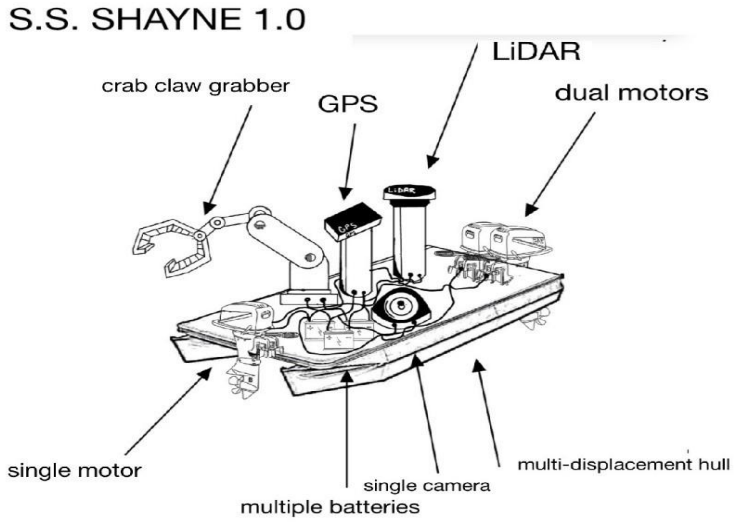
Analytical Hierarchy Process

Final Rating Matrix			
Selection Criteria	S.S. Air Goose	S.S Ol' John	S.S Shayne 1.0
Batter Power	0.091	0.455	0.455
Buoyancy	0.633	0.106	0.260
Sensor Resolution	0.261	0.106	0.633
Size	0.106	0.633	0.260
Velocity	0.261	0.106	0.633
Deflection Angle	0.200	0.200	0.600

Concept	Alternative Value
S.S. Air Goose	0.241
S.S. Ol' John	0.255
S.S. Shayne 1.0	0.504



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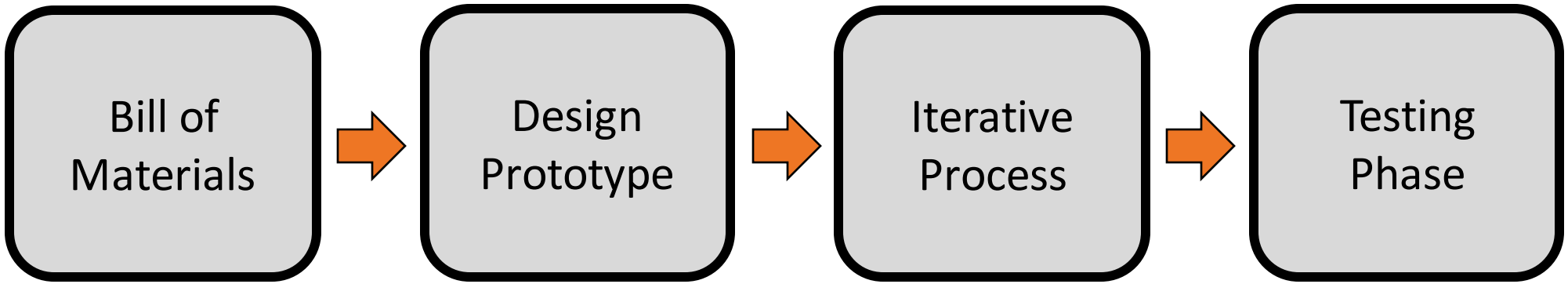
Future Work



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Past programs. RoboBoat. (2019, September 27).
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https://roboboat.org/programs/2024/

Tel Aviv Competition Strategy Video. (2022, May 16).
https://www.youtube.com/watch?v=qss0lyN3KJ8

Nicholas
Norwood

Thank You

Nicholas Norwood

Thank You

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Backup Slides

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Makenzie
Wiggins

Background

RoboBoat

- Program at RoboNation
- An international student competition
- Design autonomous, robotic boats to navigate through a challenge course
- Tackle tasks that mimic real-world challenges

Makenzie
Wiggins

Background

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Makenzie
Wiggins

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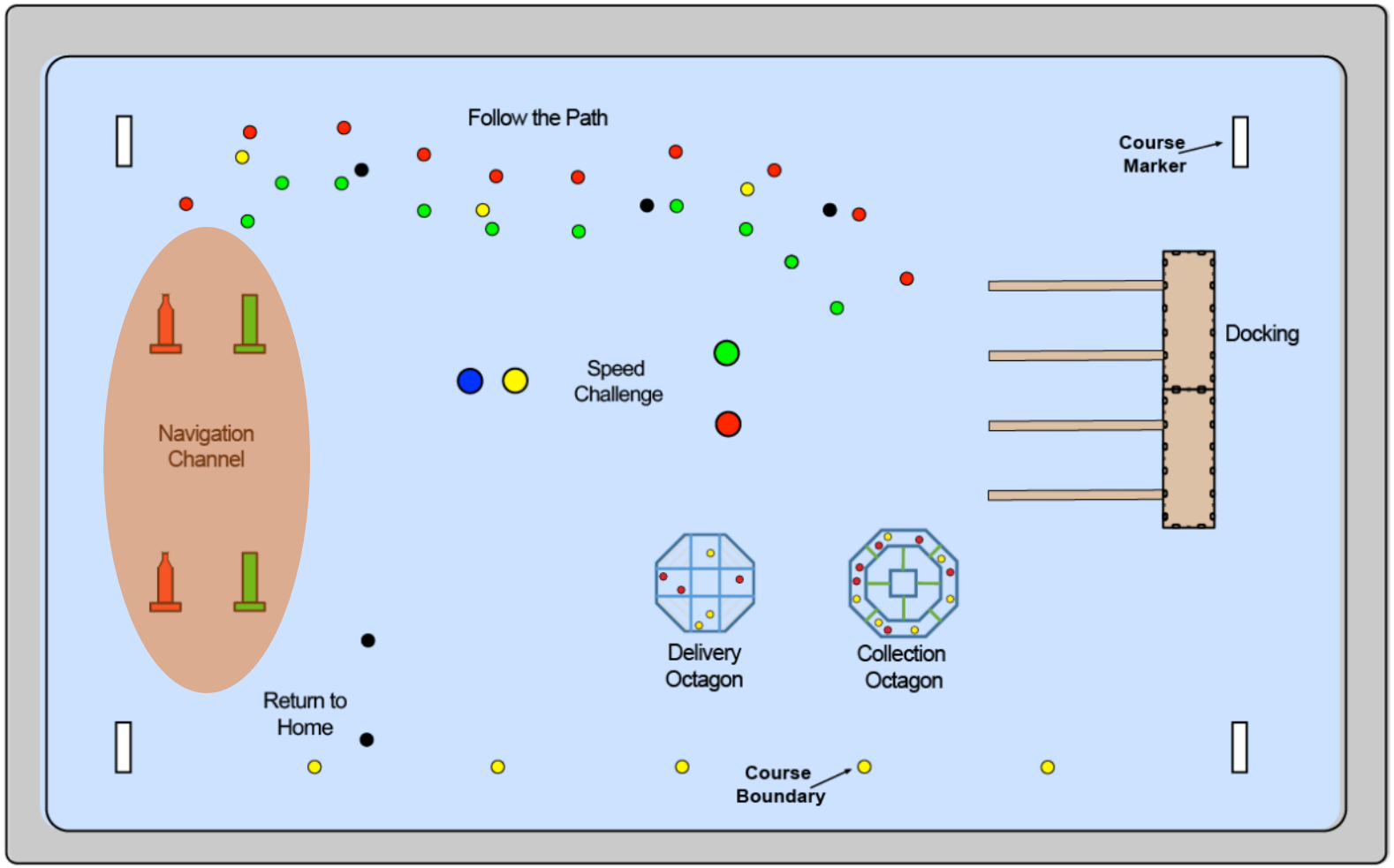

Task 1:
Navigation Channel

Task 2:
Follow the Path

Task 3:
Docking

Task 4:
Duck Wash

Task 5:
Speed Challenge

Task 6:
Collection Octagon

Task 7:
Delivery Octagon

Task 8:
Return to Home

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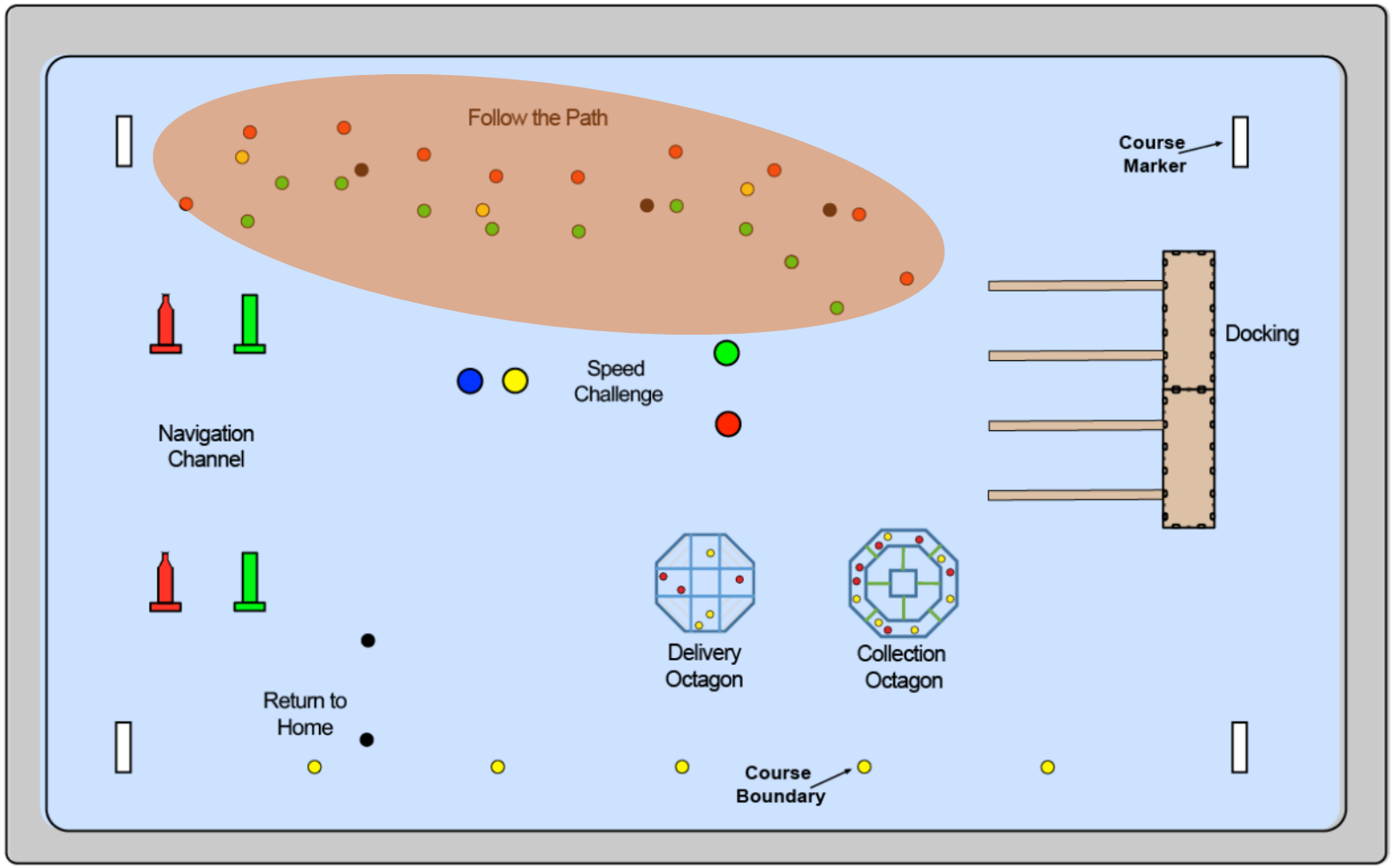
Wiggins

RoboBoat 2024 Course



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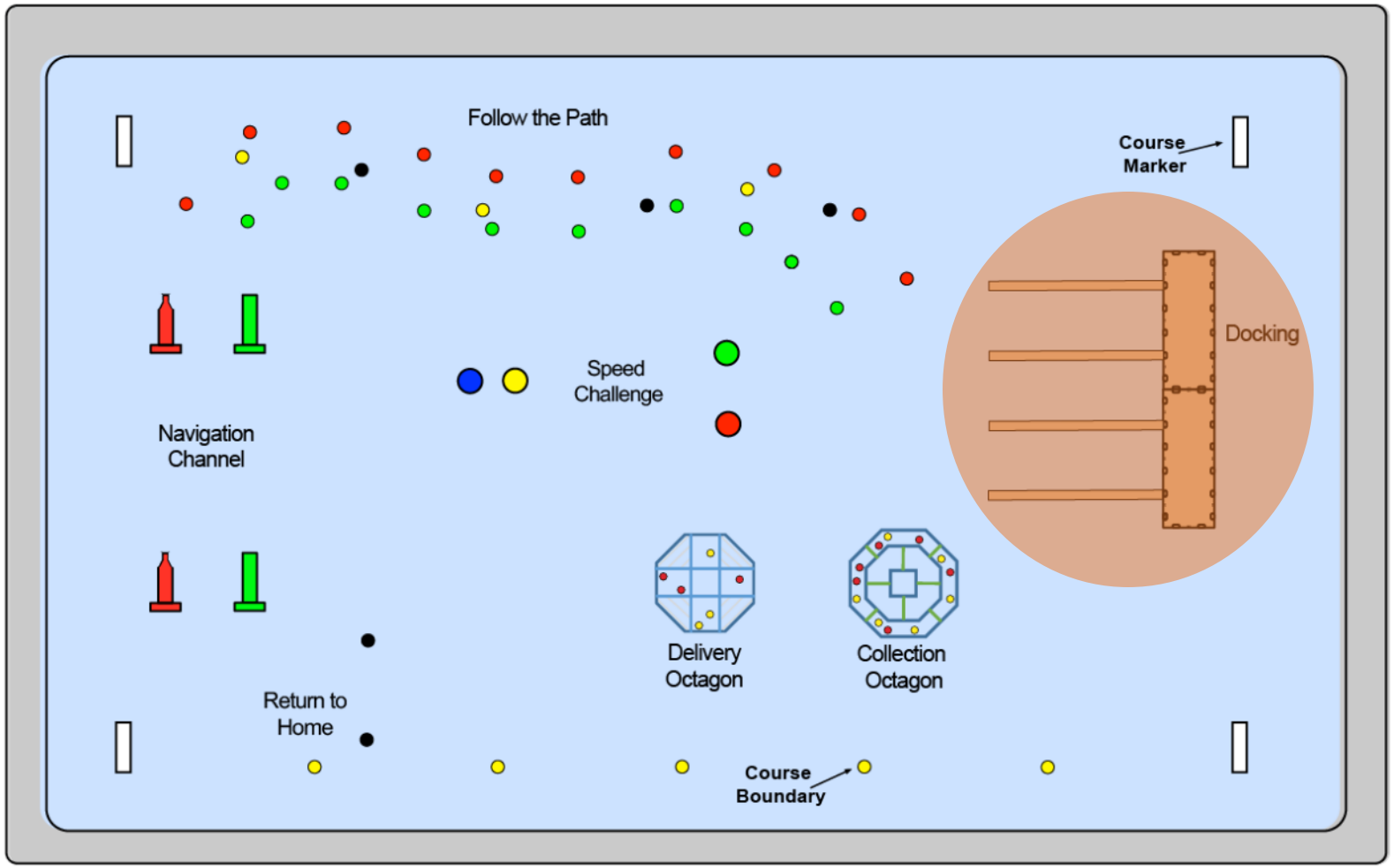

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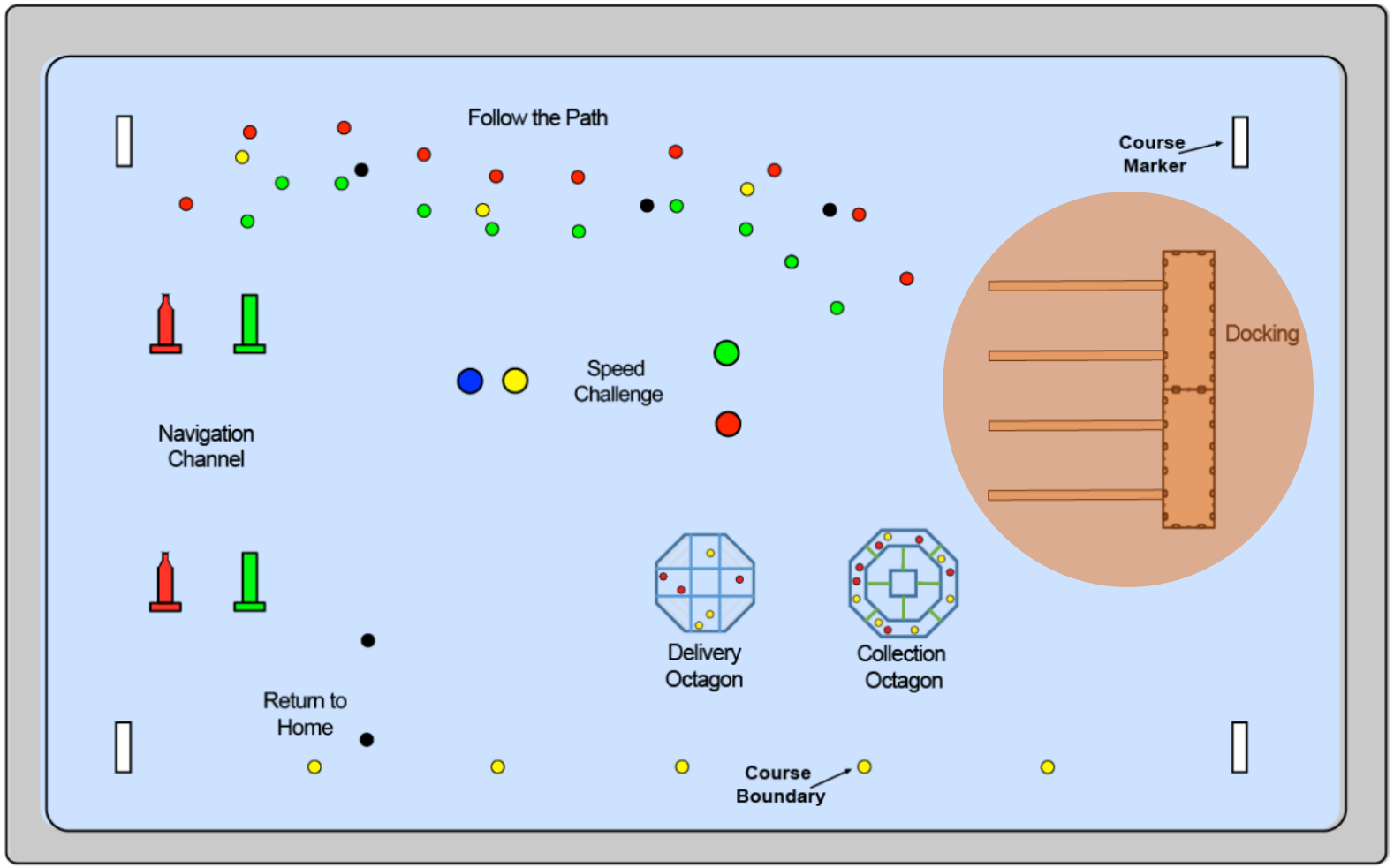

Task 1:
Navigation Channel
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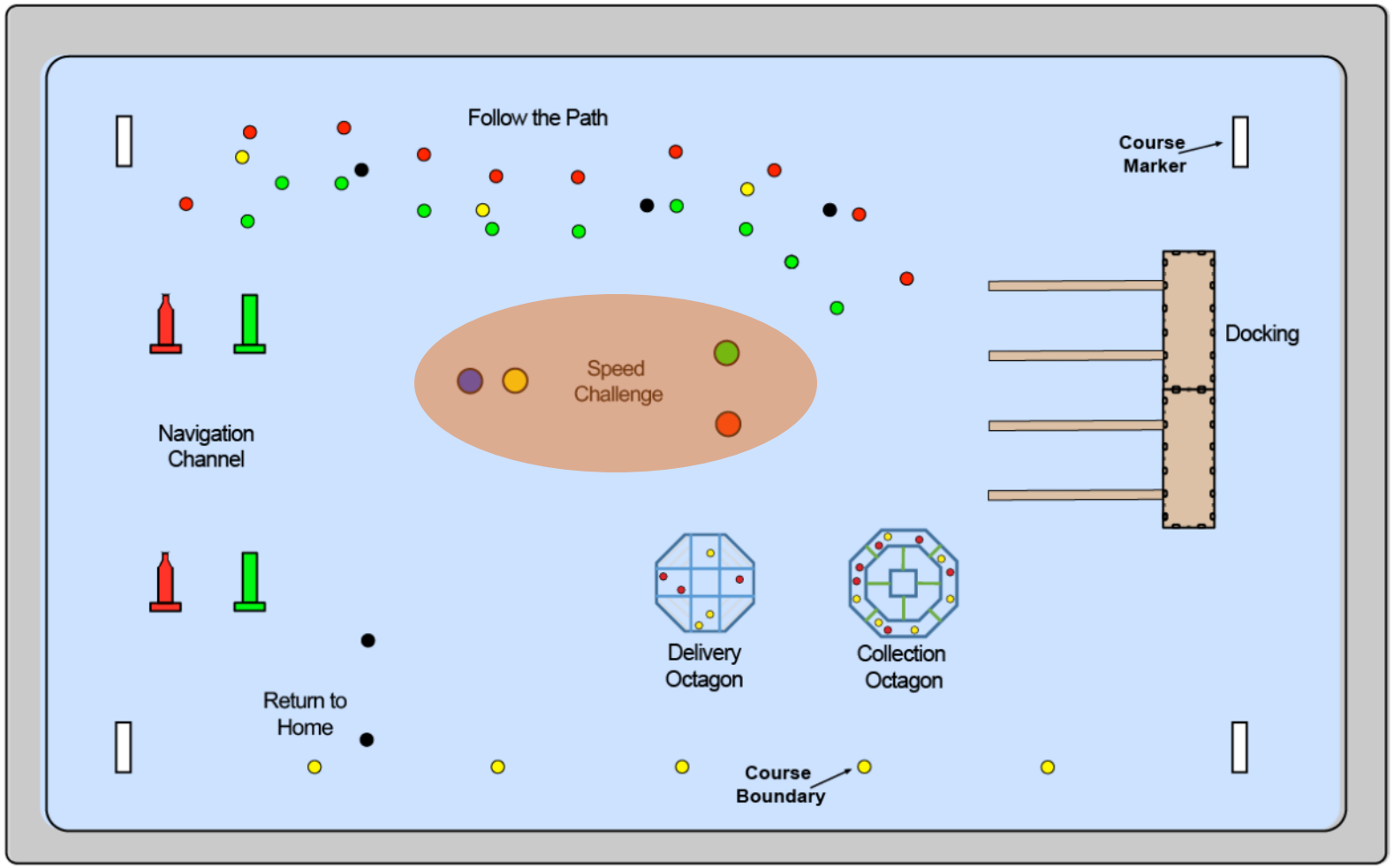
FAMU-FSU
College of
Engineering

Makenzie
Wiggins

RoboBoat 2024 Course



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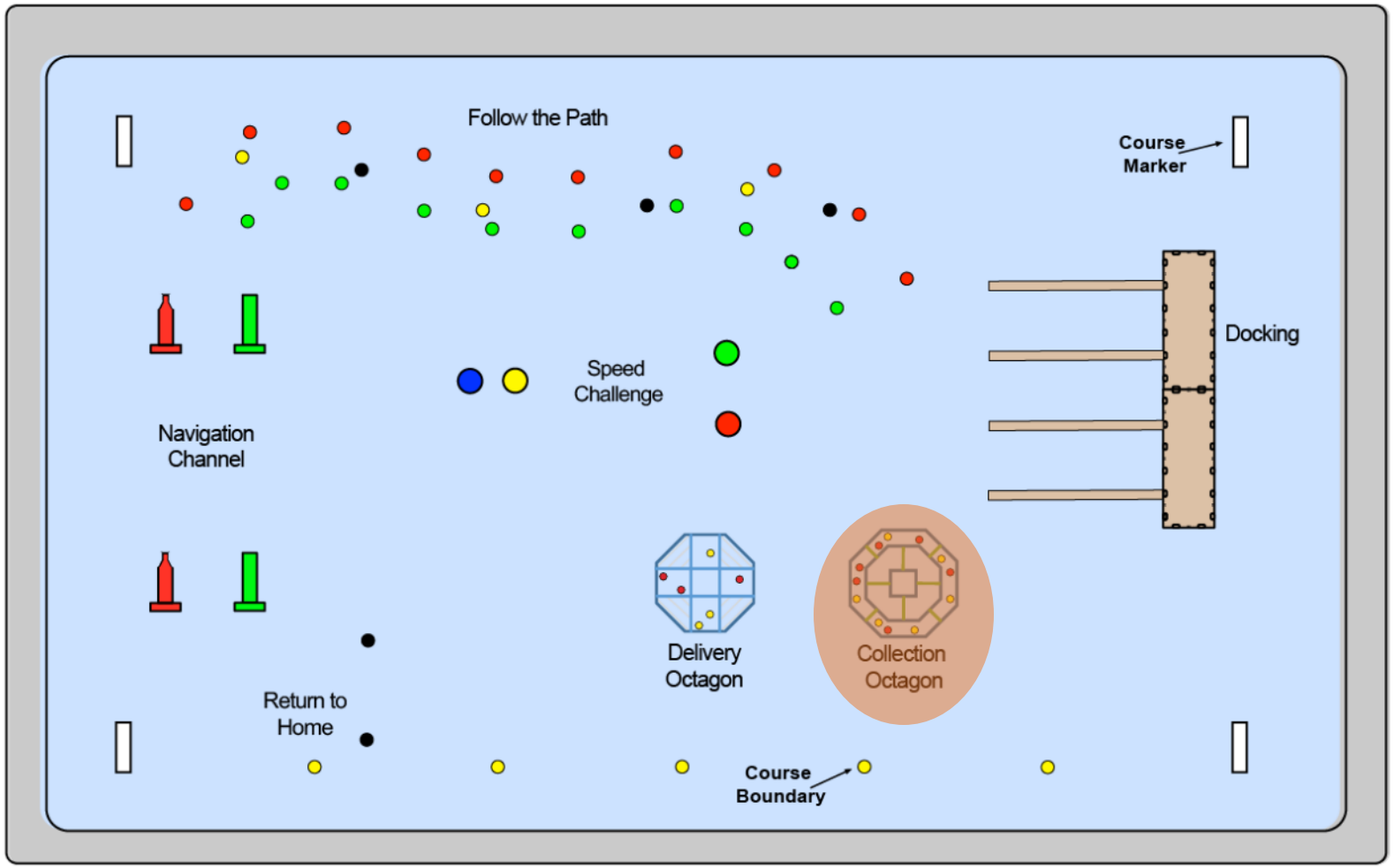

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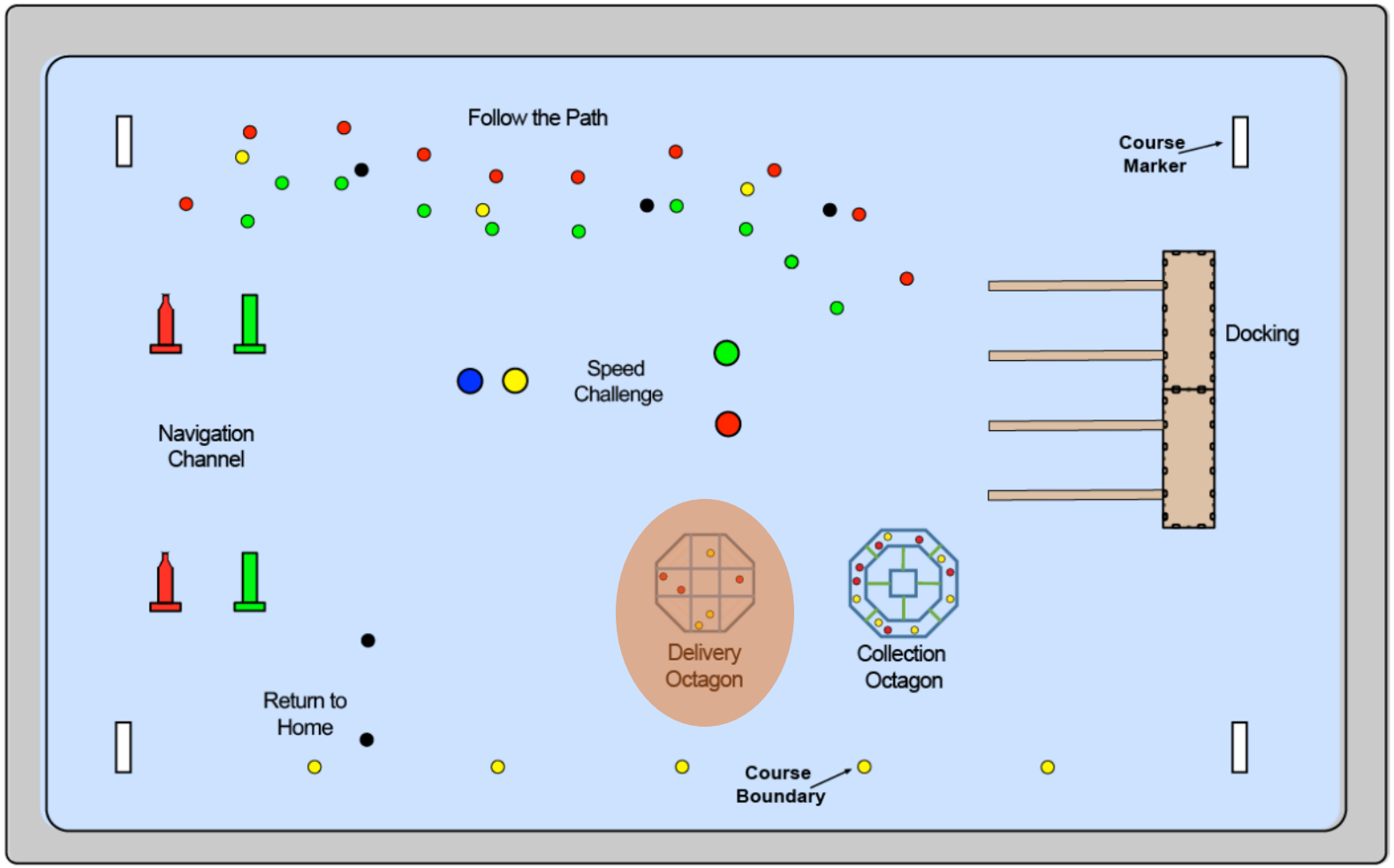

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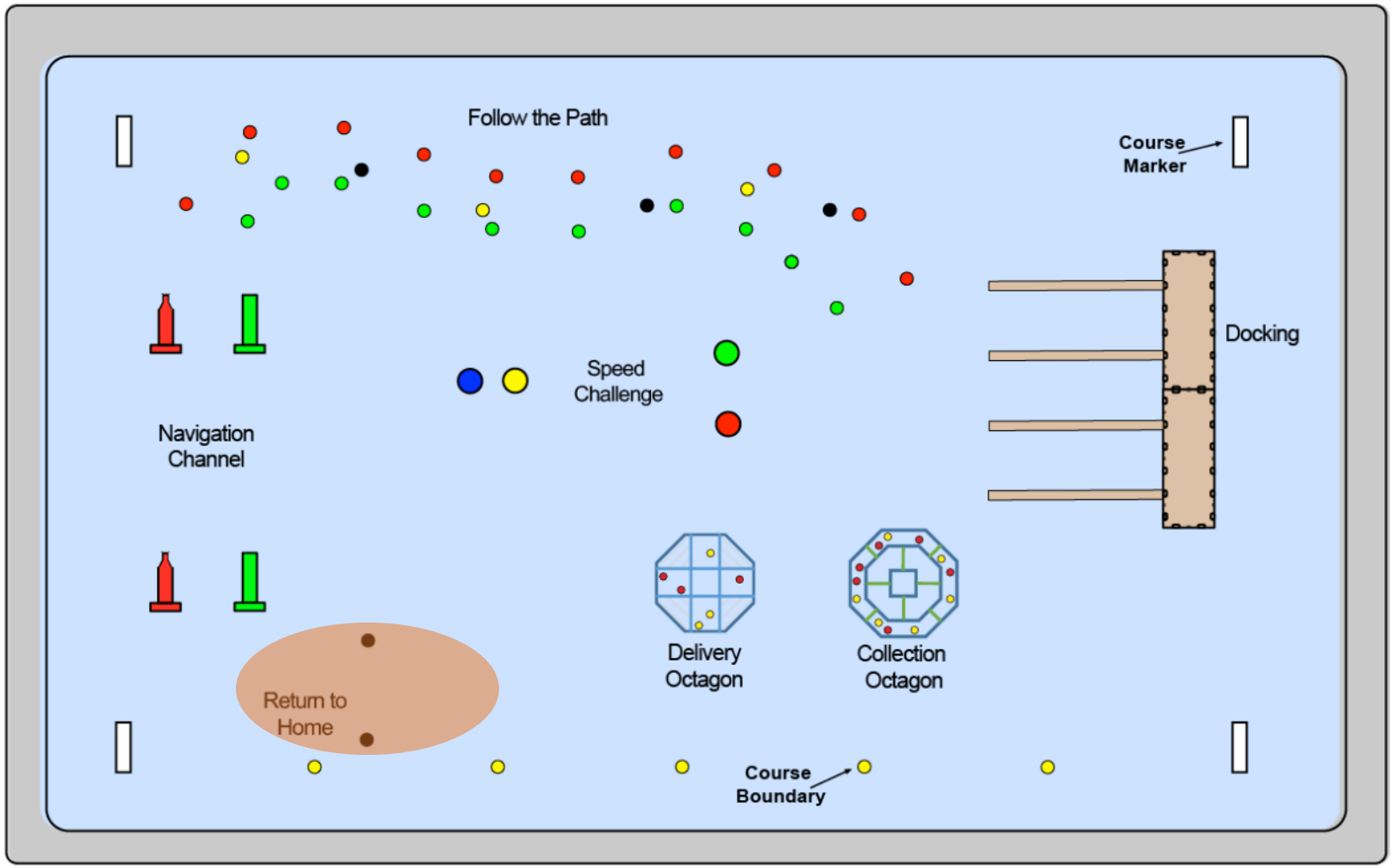

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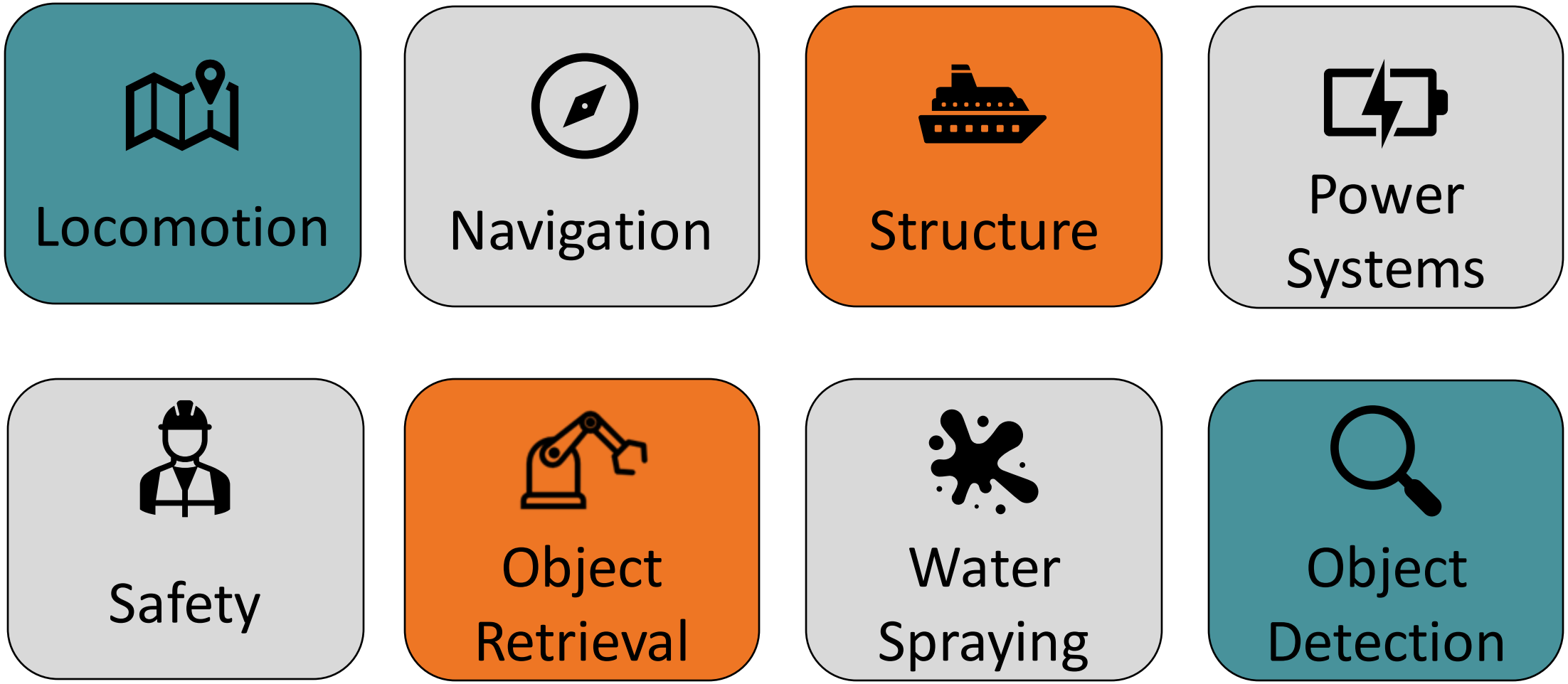
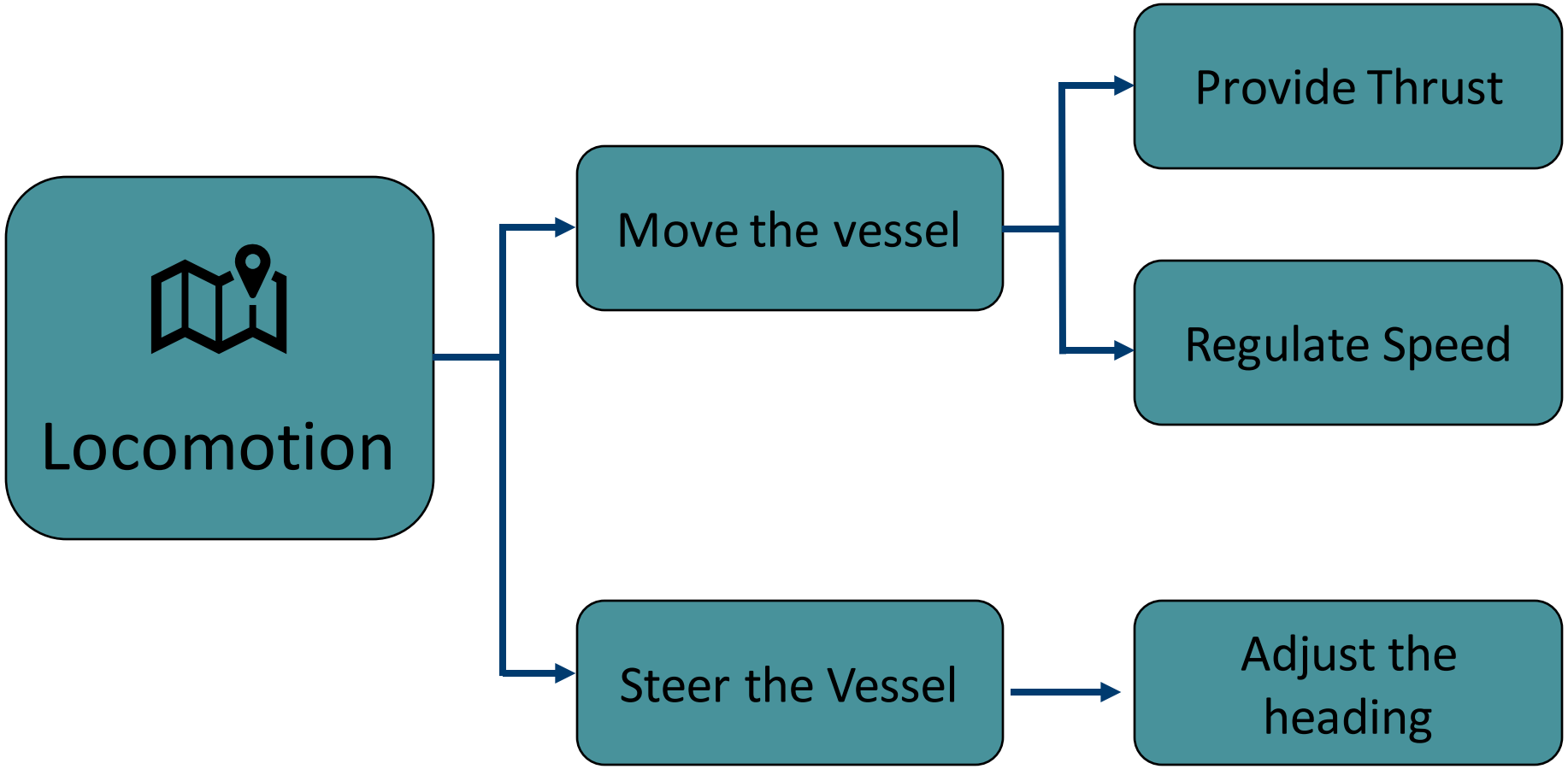
Functional Decomposition



Functional Decomposition



Sophia Barron

Sophia
Barron

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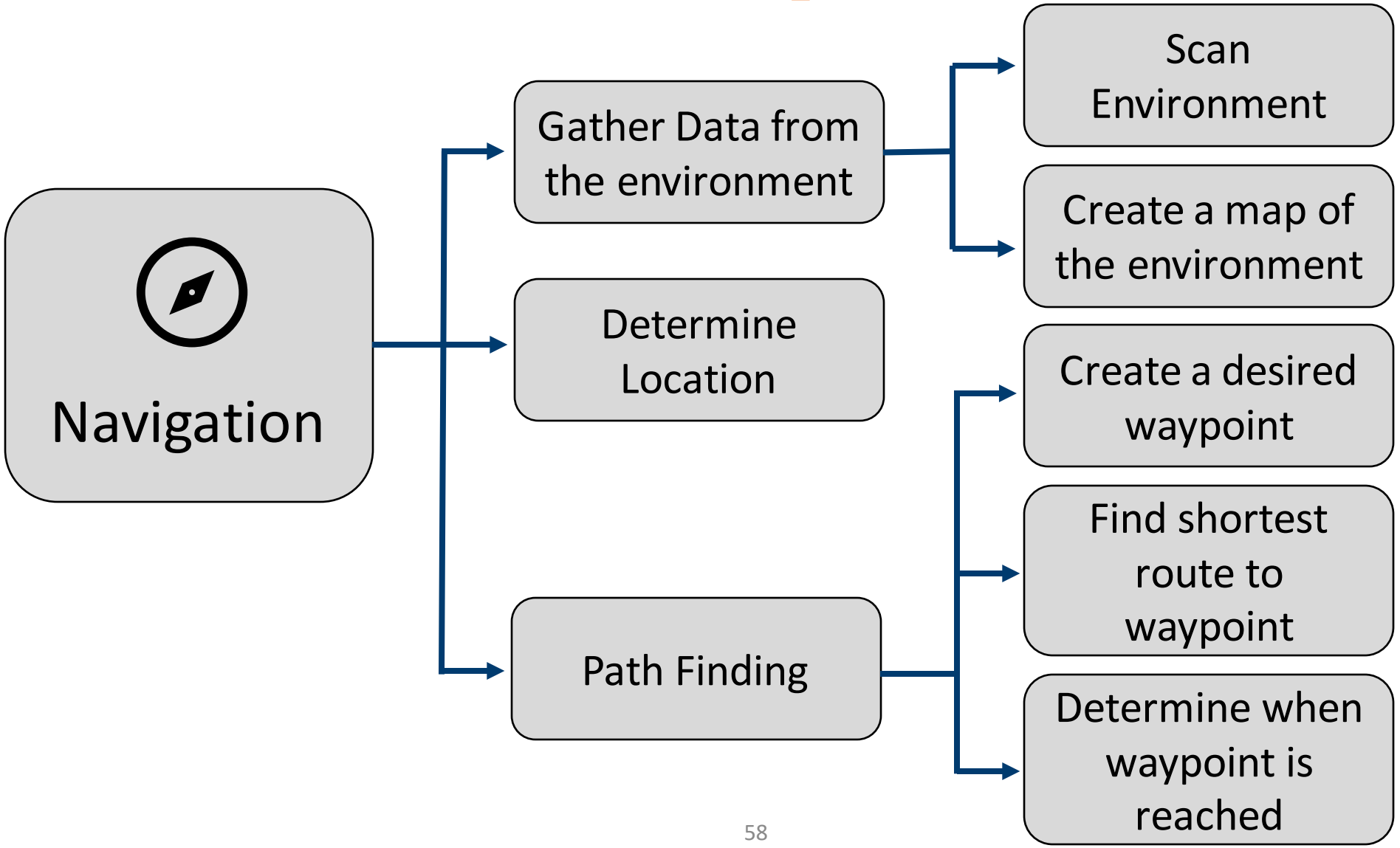

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Sophia
Barron

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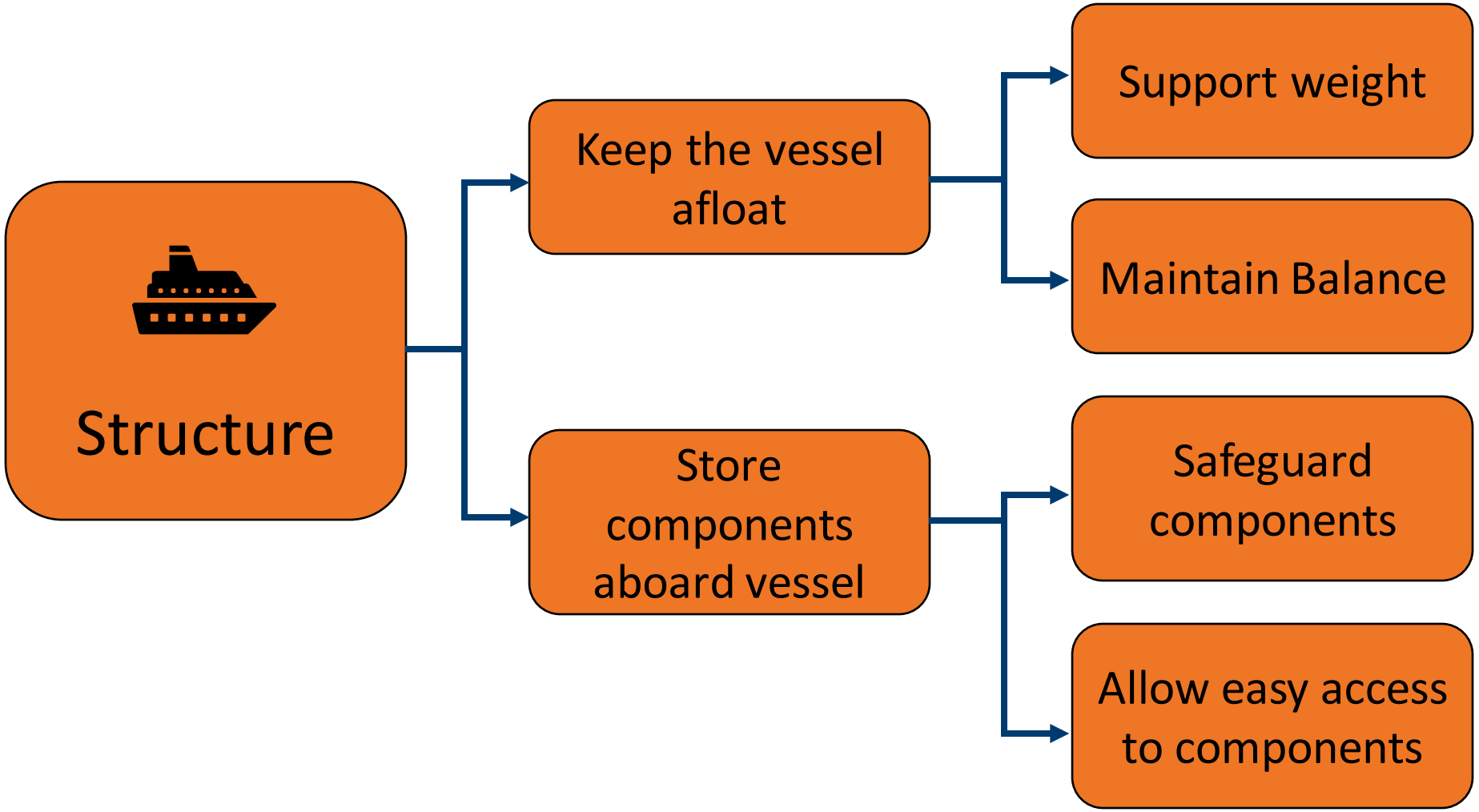

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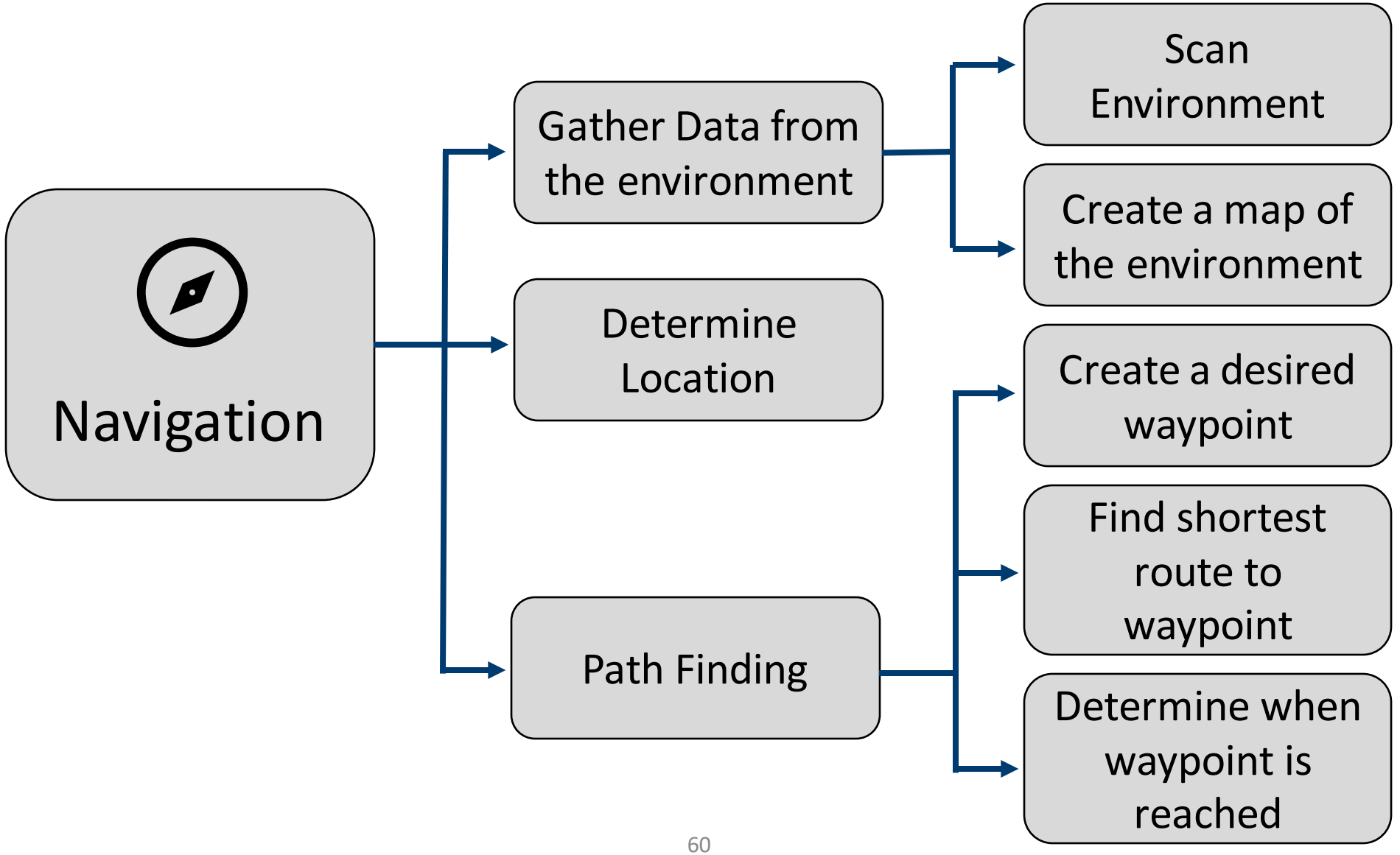

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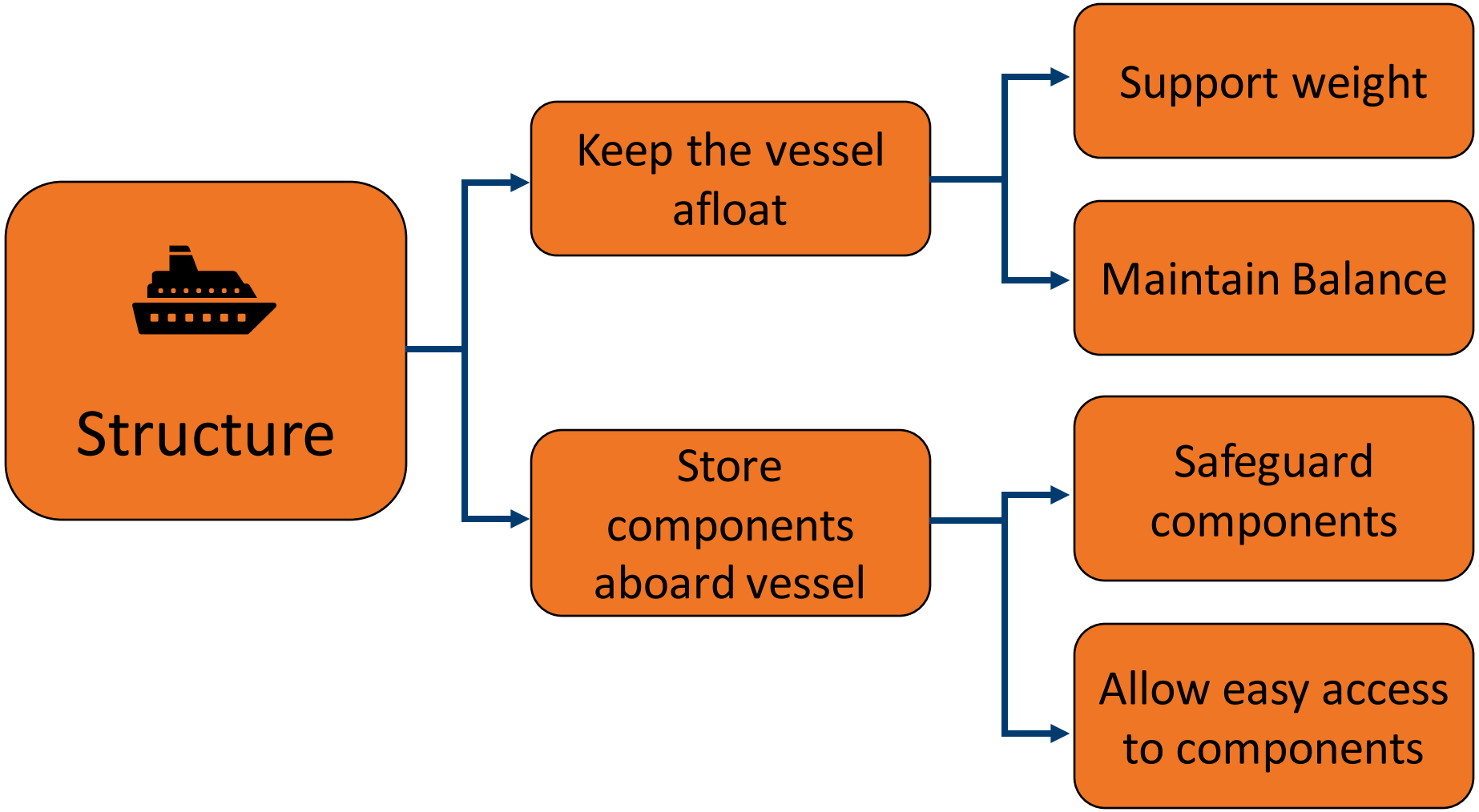

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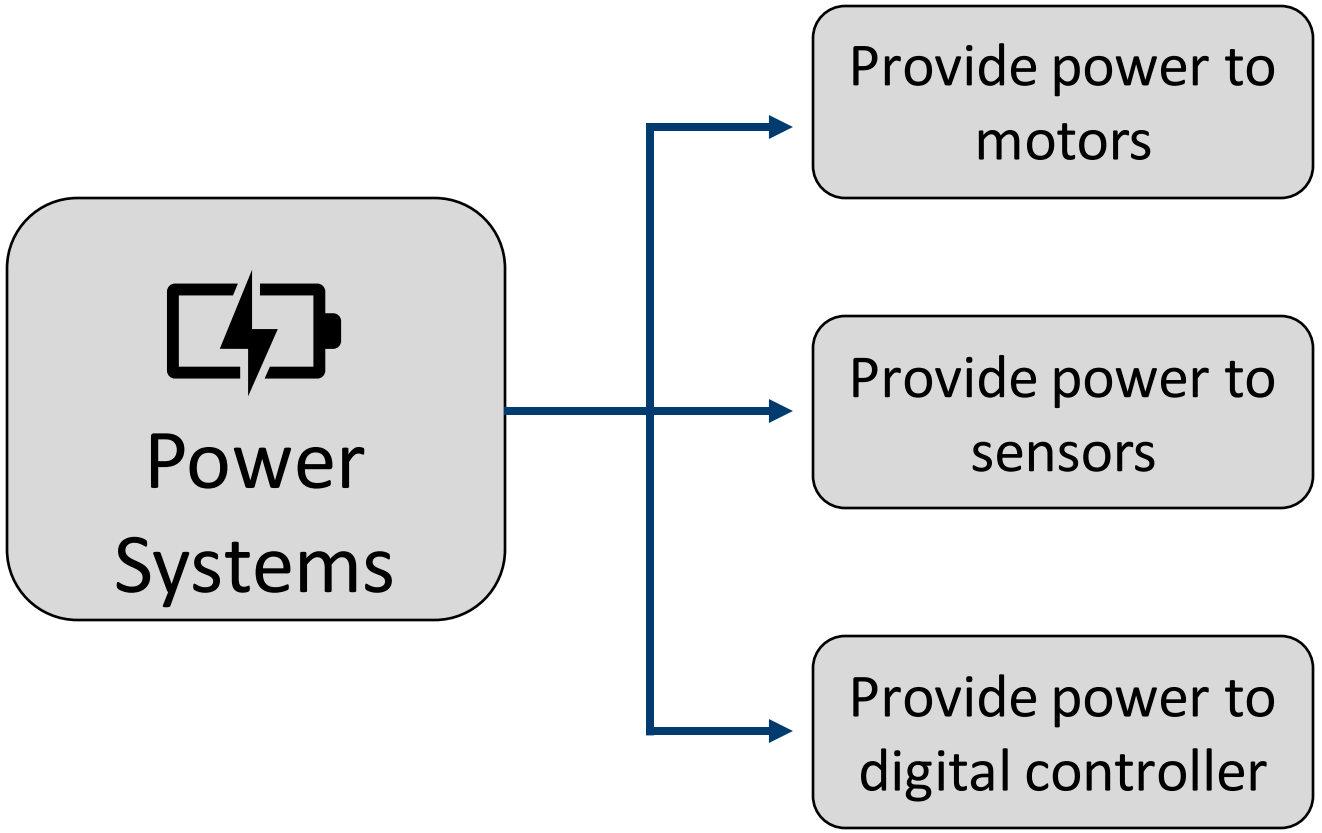
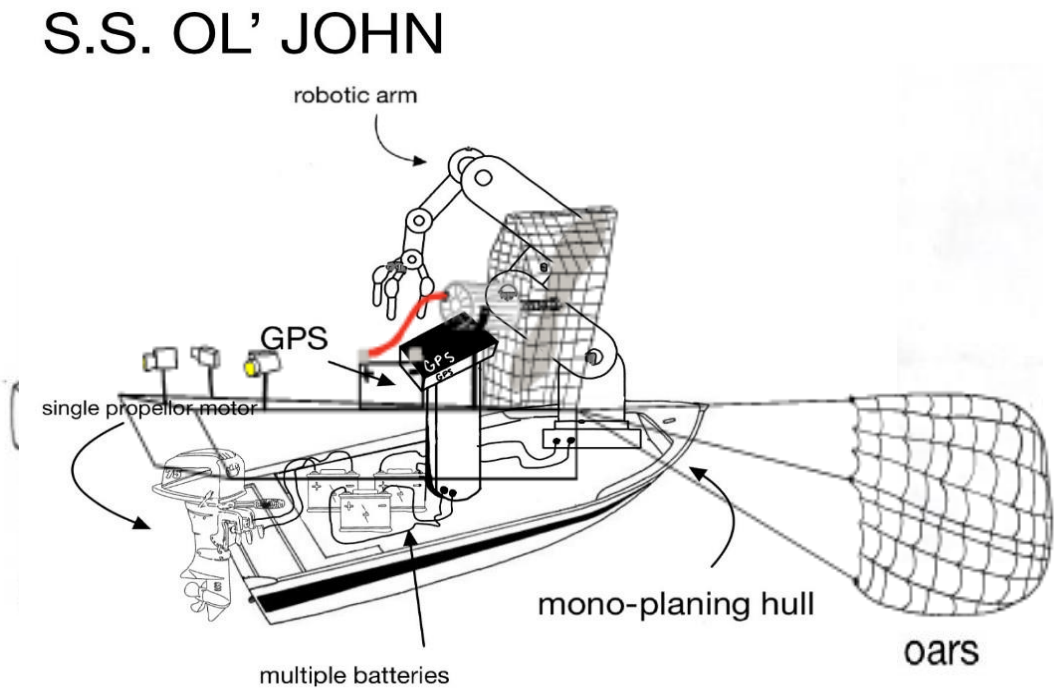


Michael
Fitzsimmons

Medium Fidelity Concepts

- S.S. Galley
- S.S. Ordonomy
- S.S. Hooker V1
- S.S. Air Goose
- S.S. Ol’ John



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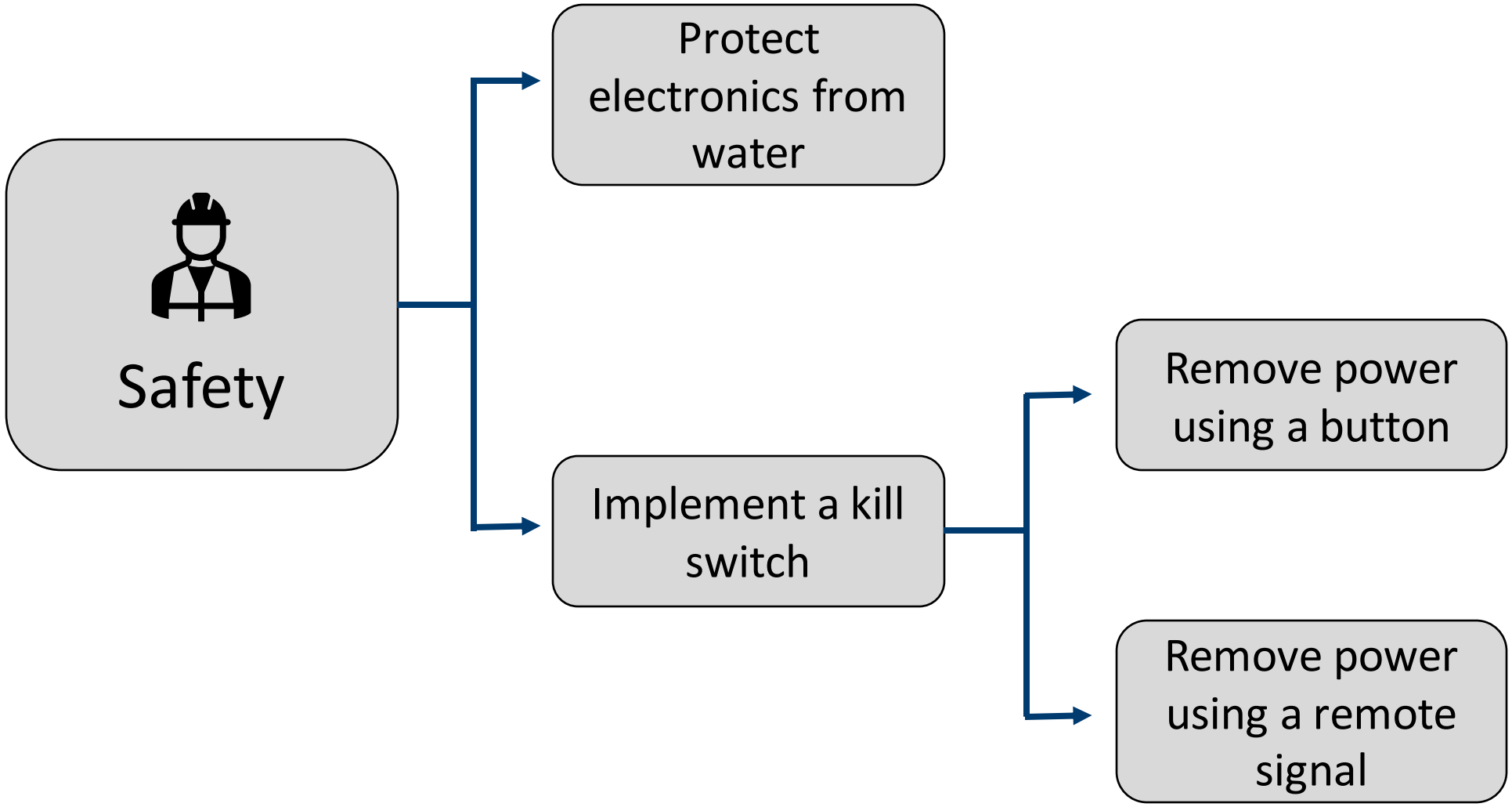

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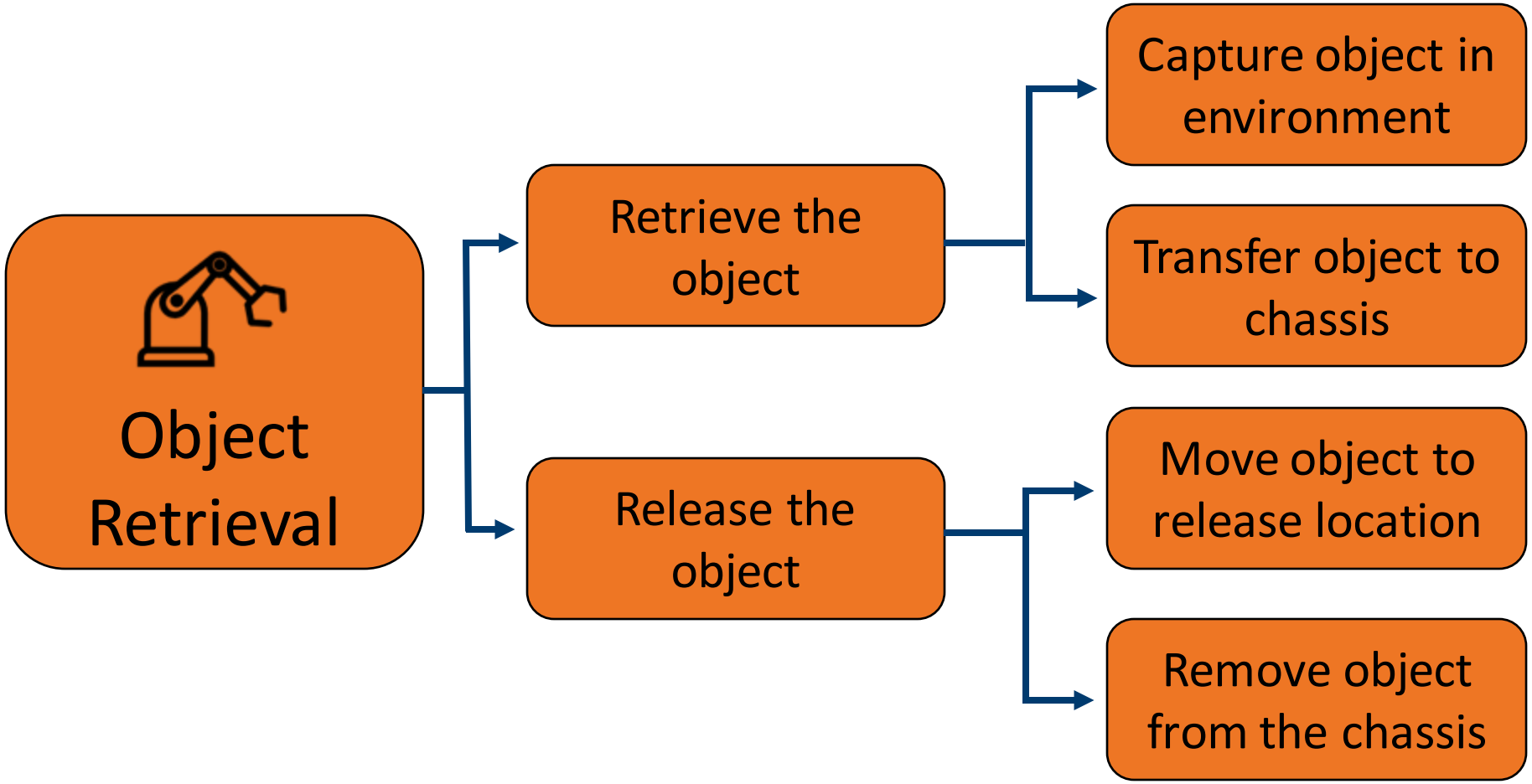

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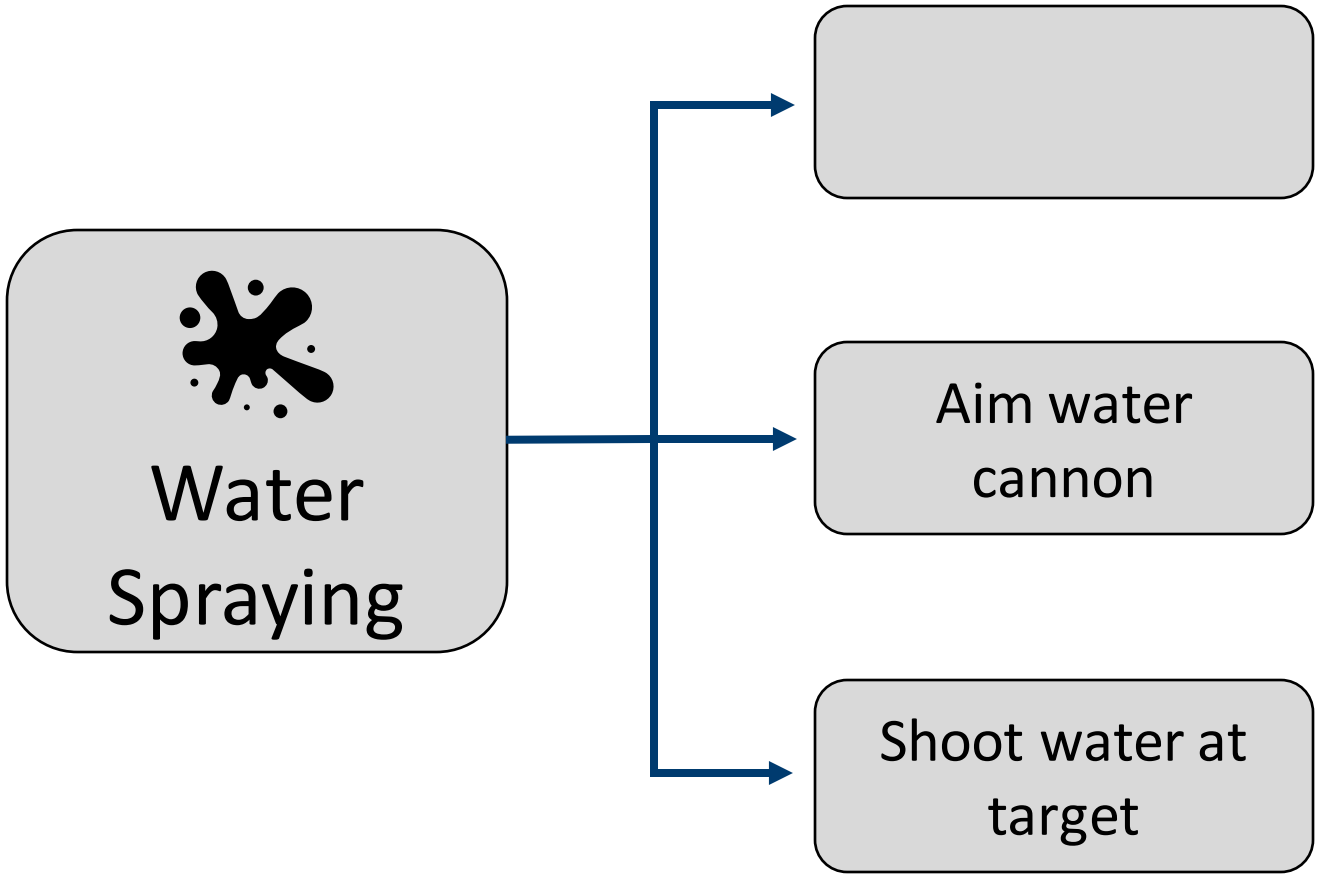

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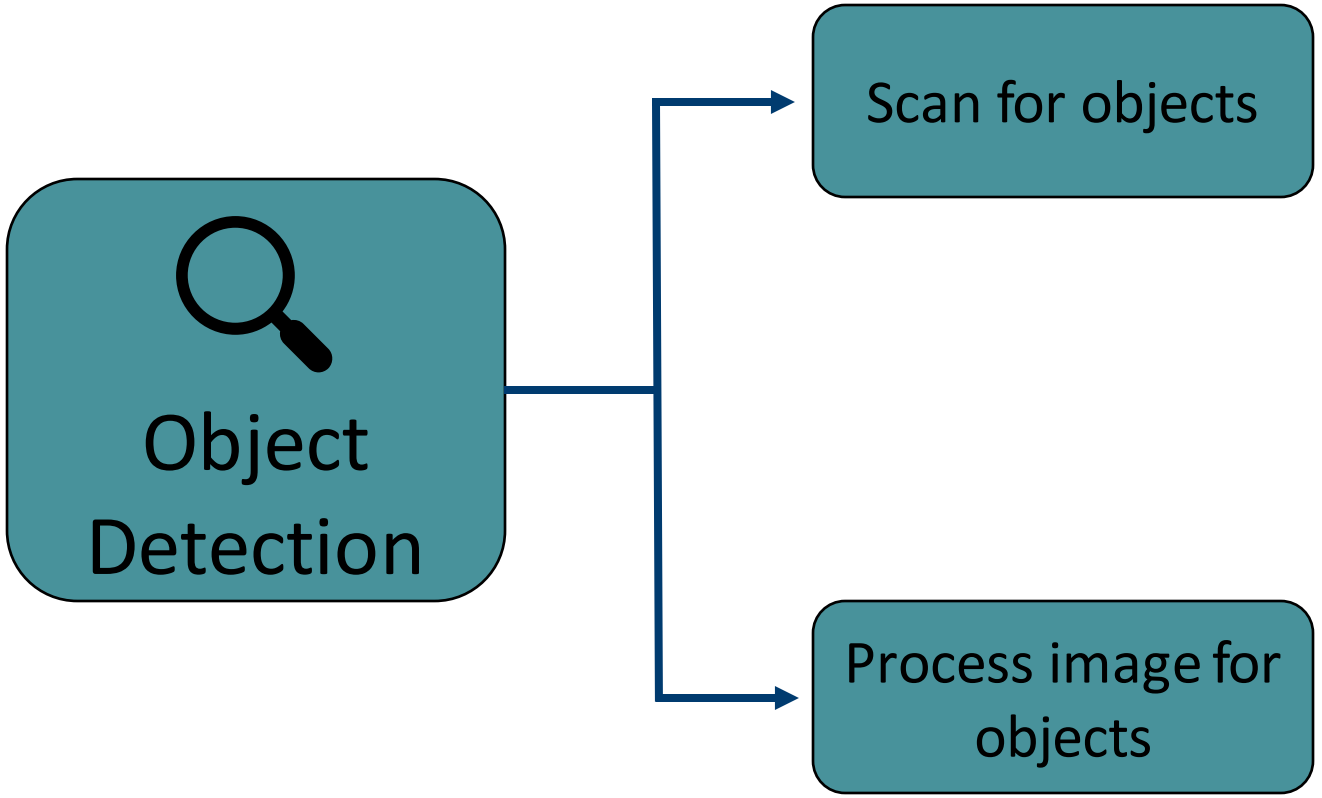
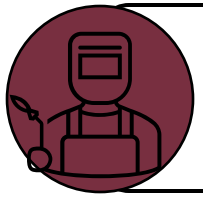
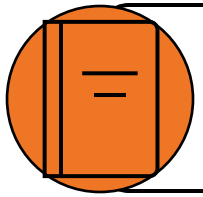
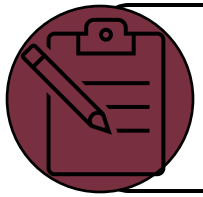


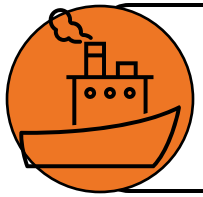
Ivanna
Caballero

Assumptions


Access to Senior Design Lab/Machine Shop


ASV will comply with RoboBoat Rulebook


Access to previous Technical Reports


Competition will be in February 2024

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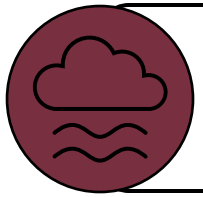
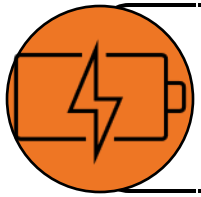
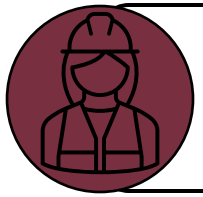
Assumptions



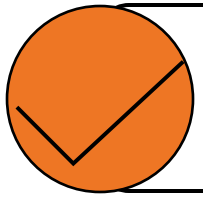
Weather is beyond our control



Battery will have full charge prior to start



Safety Inspection



One task required to Compete

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Near Future Work

- Start working on robot localization
  - Test different GPS module (found in Senior design room)
  - Draft navigation code diagram
  - Test different obstacle aversion methods on prototype
- Test given thrusters (PCB Campus)
- Start drafting and testing kill switches
  - Remote with RC transmitter
  - Physical with push button

Future Work

- Start working on materializing chosen structural design
- Start working on camera object detection
  - Geometric segmentation: Recognizing shapes
  - Semantic segmentation: Object class (Ducks, buoy, etc)
- Integrate different functional systems
  - I.e navigation w/ locomotion and object detection
- Preliminary electrical calculations/schematics
  - Power supply calculations
  - Overall block diagrams
- Finalize first draft of test code for the Autonomous navigation portion of ASV

Ivanna
Caballero

Primary Markets

NAVSEA
NAVAL SEA SYSTEMS COMMAND

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Secondary Markets

INSANE BOATS

BOSTON WHALER®

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Stakeholders

NAVSEA
NAVAL SEA SYSTEMS COMMAND

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- This is 10-point
- This is 15–point Times
- This is 20–point
- This is 25–point
- This is 30–point
- This is 35–point
- This is 40–point
- This is 50–point
- This is 60–point