Can robots play soccer?

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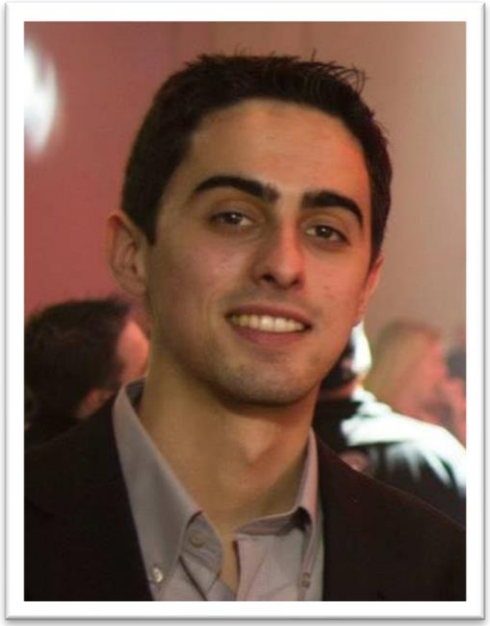
DSPT#18 - “The Big Data Championship“
Altice Labs – 22/Nov/2017

Iris-LAB / IEETA / DETI / UA
University of Aveiro, Portugal

Who am I?

Entroncamento

2014 – Mestrado Integrado
Eng. Electrónica e Telecomunicações (UA)

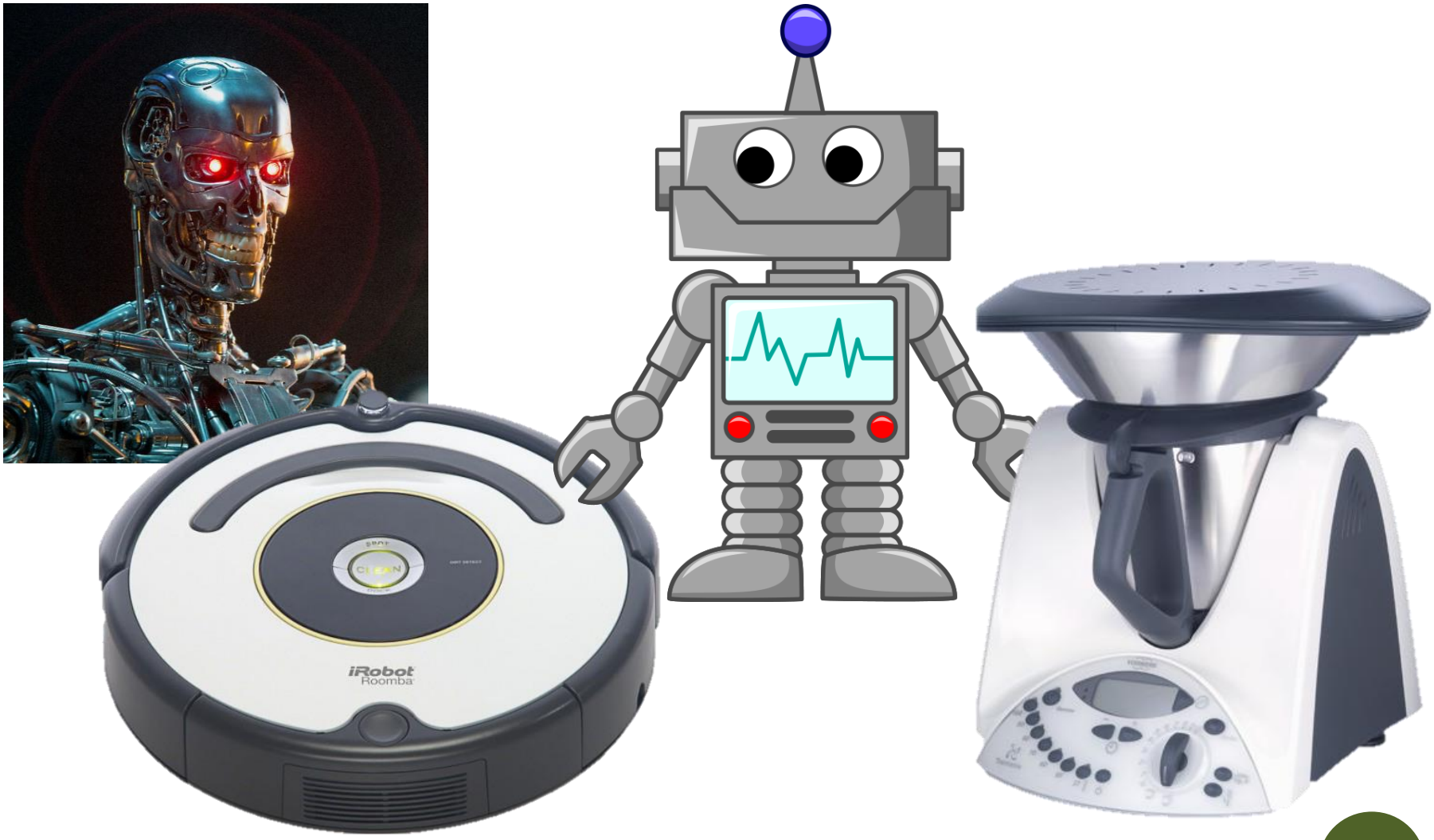


- **2009** – CAMBADA Team Volunteer
- **2013** – Elected Team-Leader

- Worked in the industry in R&D for 1 year (vehicular networks)
- Currently taking a Robotics PhD in University of Aveiro
- Former RoboCup MSL Technical Committee Member
- Current RoboCup MSL Executive Committee Member

What is a robot?

Introduction



Introduction

GOAL

Introduction

GOAL

inputs

Sensors

Introduction

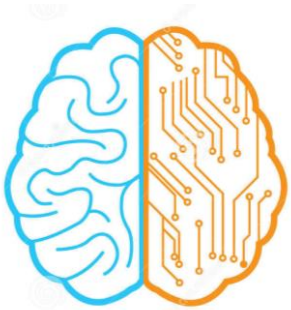
GOAL

inputs

Sensors

“brain”

Artificial Intelligence



Introduction

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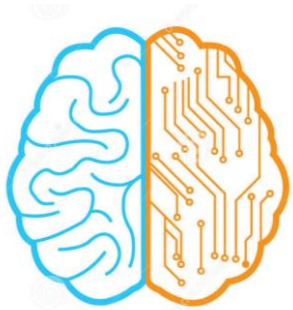
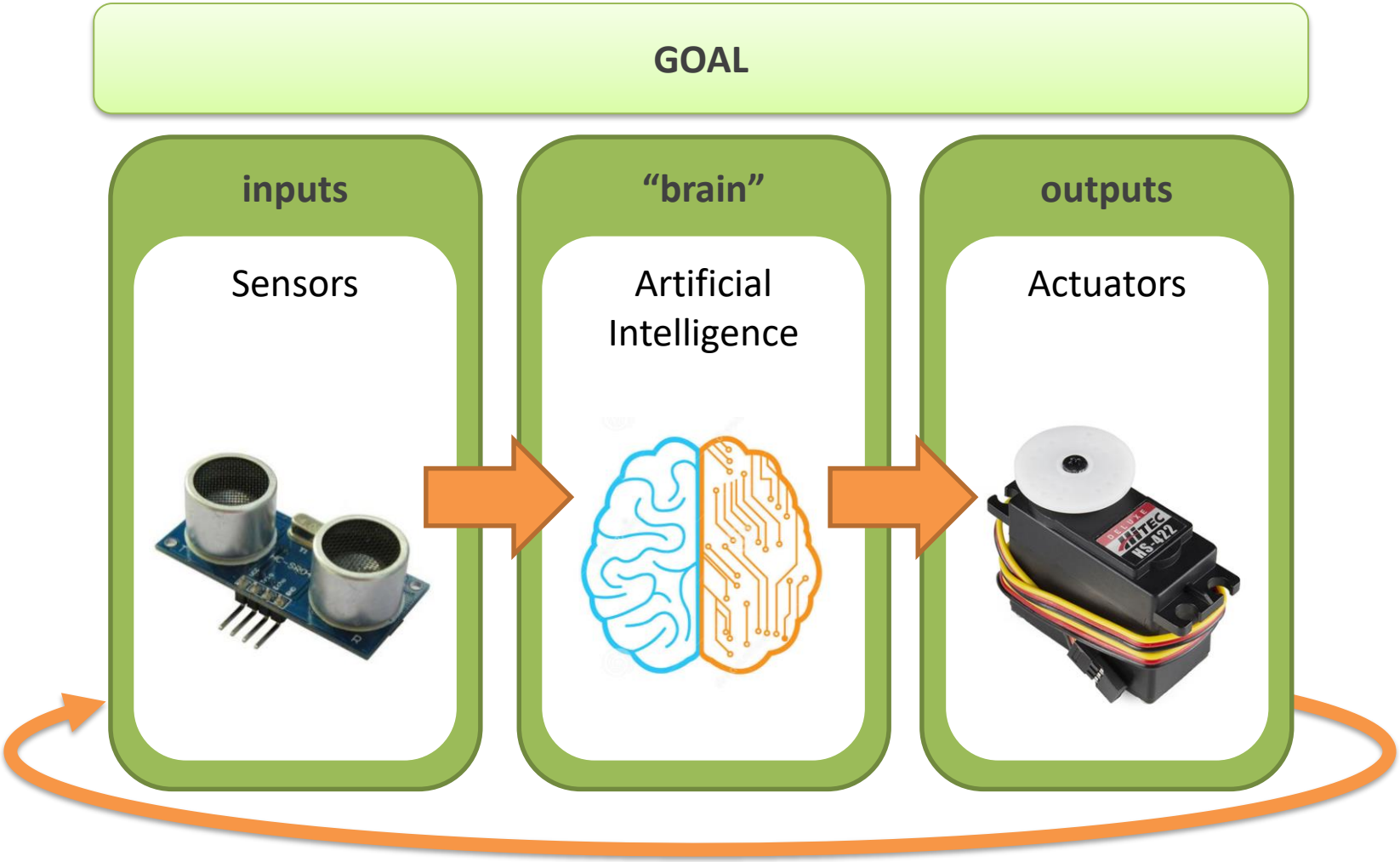


outputs

Actuators

Introduction

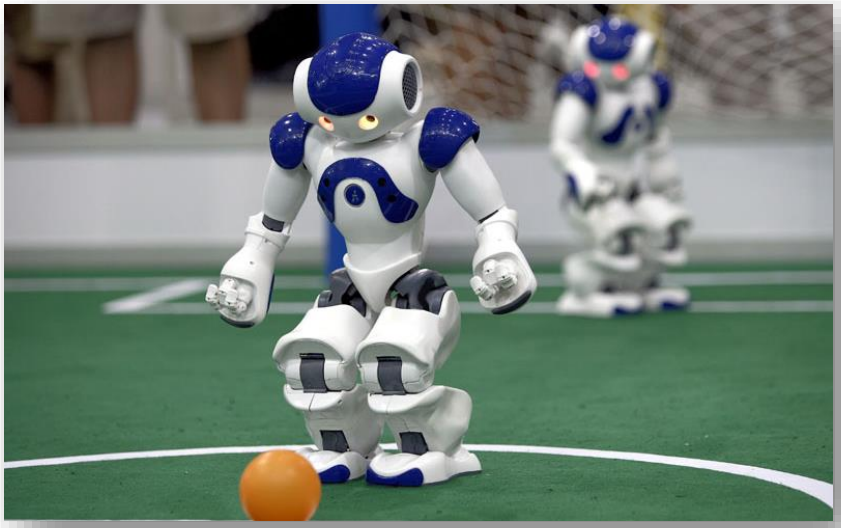


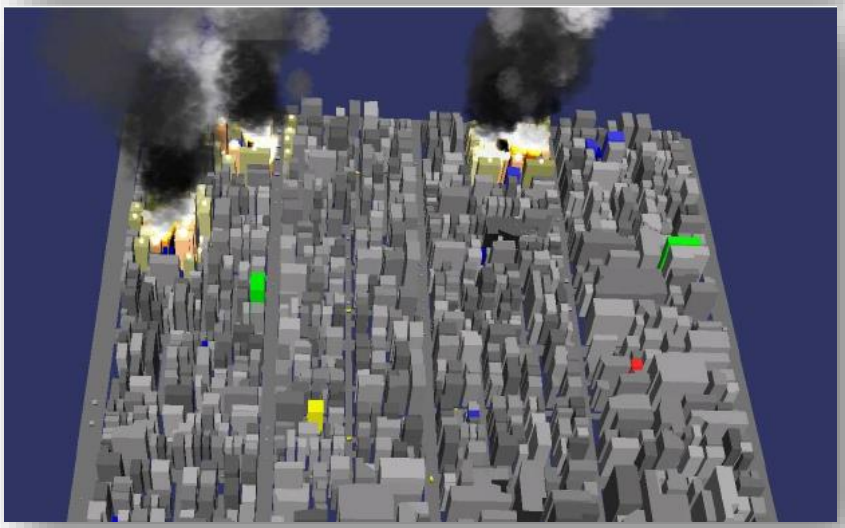
RoboCup

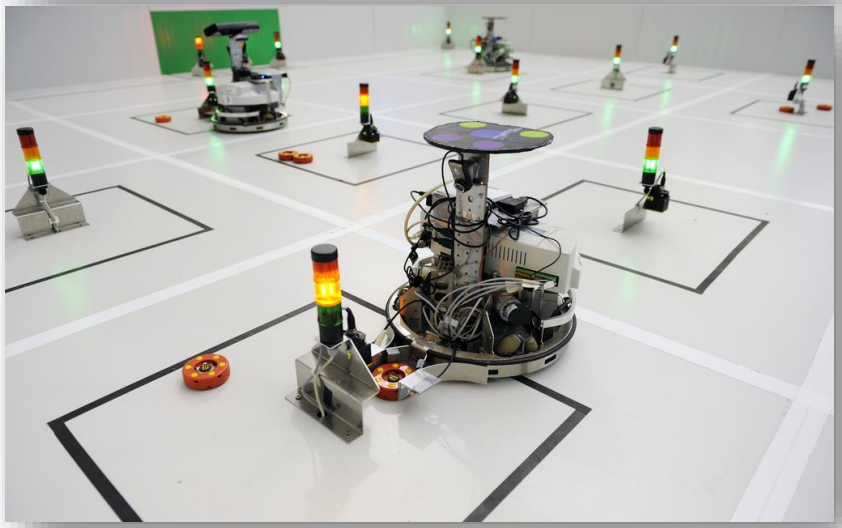

RoboCup

RoboCup – The Big Goal

RoboCup - Leagues







Middle-Size League

Middle-Size League

Cooperative **A**utonomous **M**obile ro**B**ots with **A**dvanced **D**istributed **A**rchitecture

CAMBADA Team

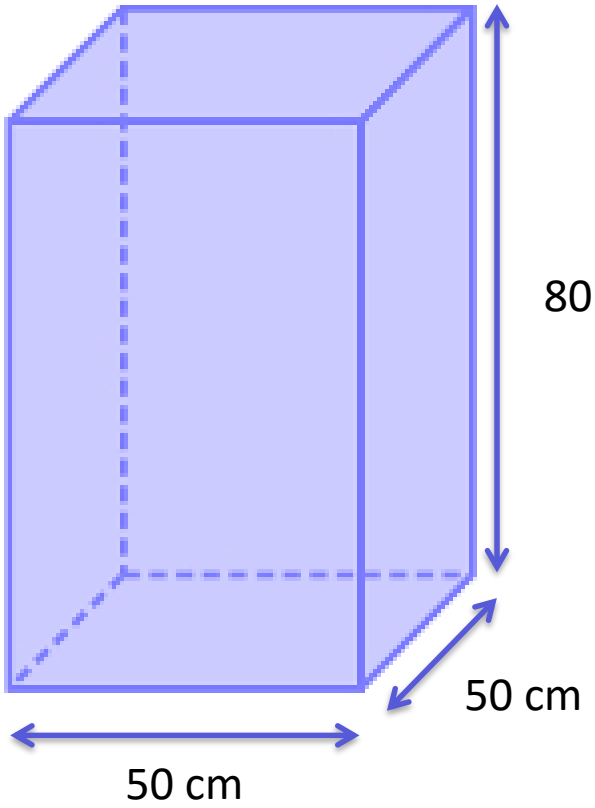
- Project kick-off: 2003
- > 60 total people involved
- Participations
  - **12x** RoboCup
  - **14x** Portuguese Robotics Open
  - **Other 5** local RoboCup events
    - Iran, Germany, Netherlands

CAMBADA Team

- **Achievements**
  - National champion since 2007
  - World Champion in 2008 (podium since then)

  - 3 Technical Challenges and 3 Scientific Challenges

MSL – The Rules



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MSL – The Rules

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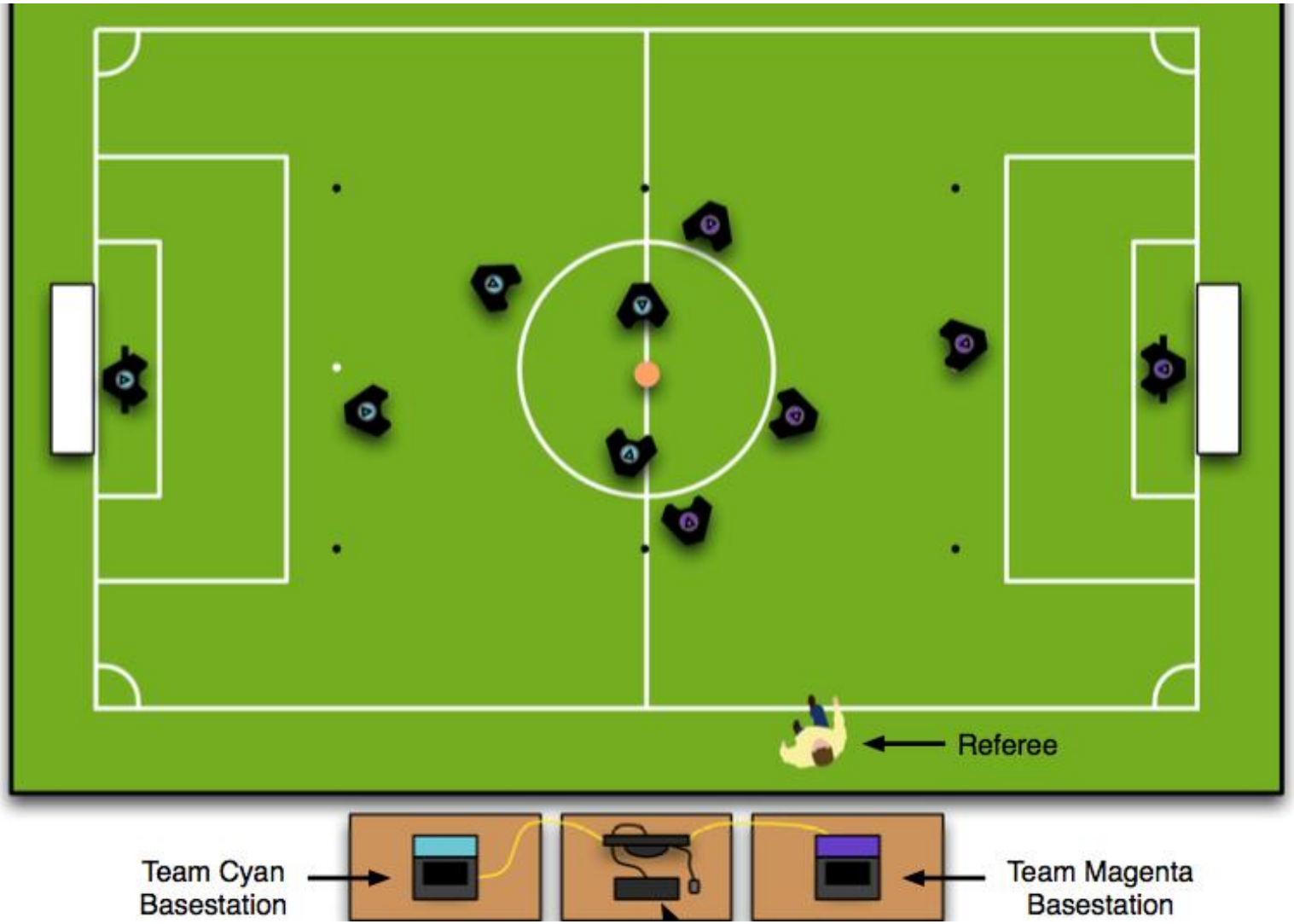
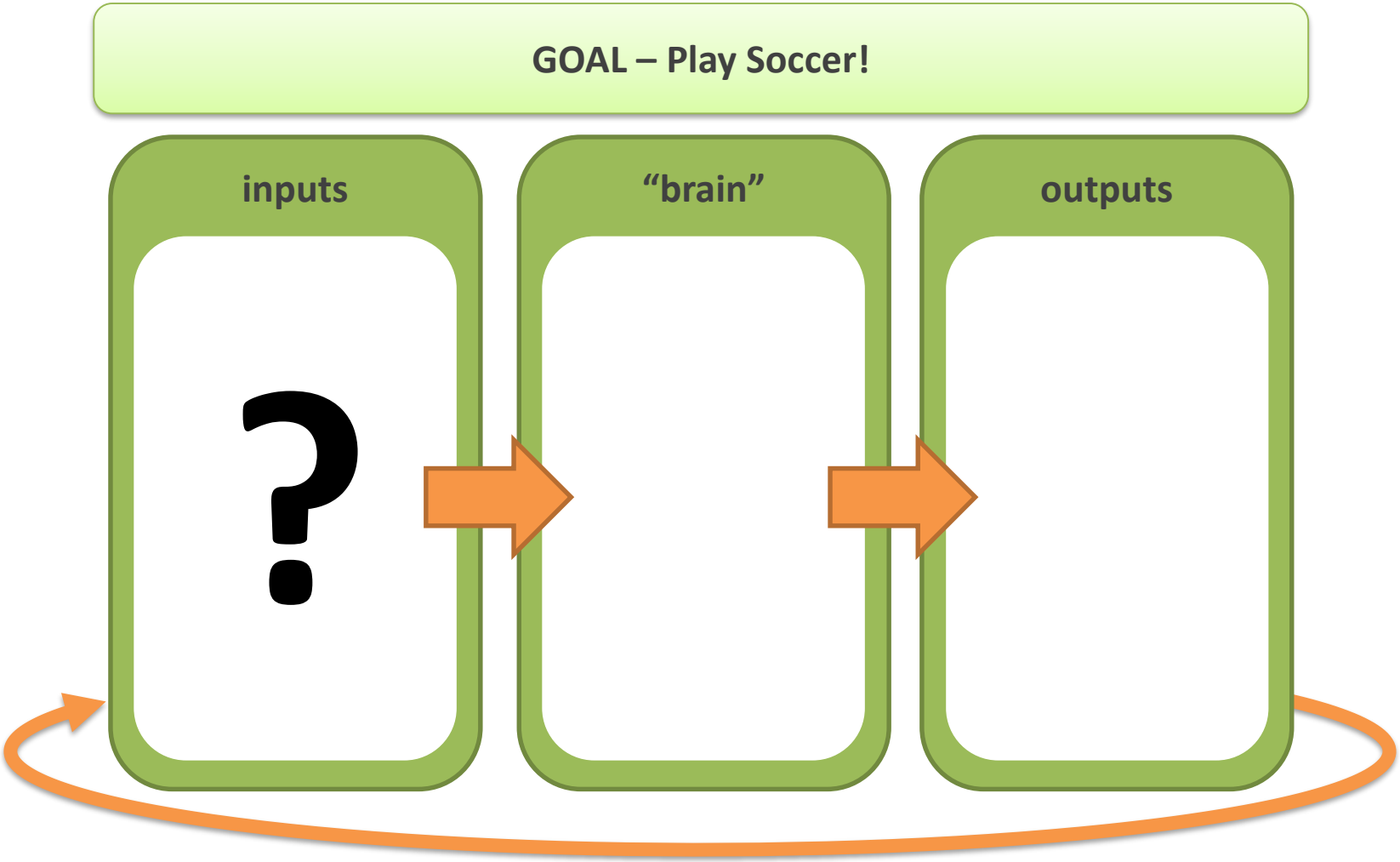


Building a robot to play soccer



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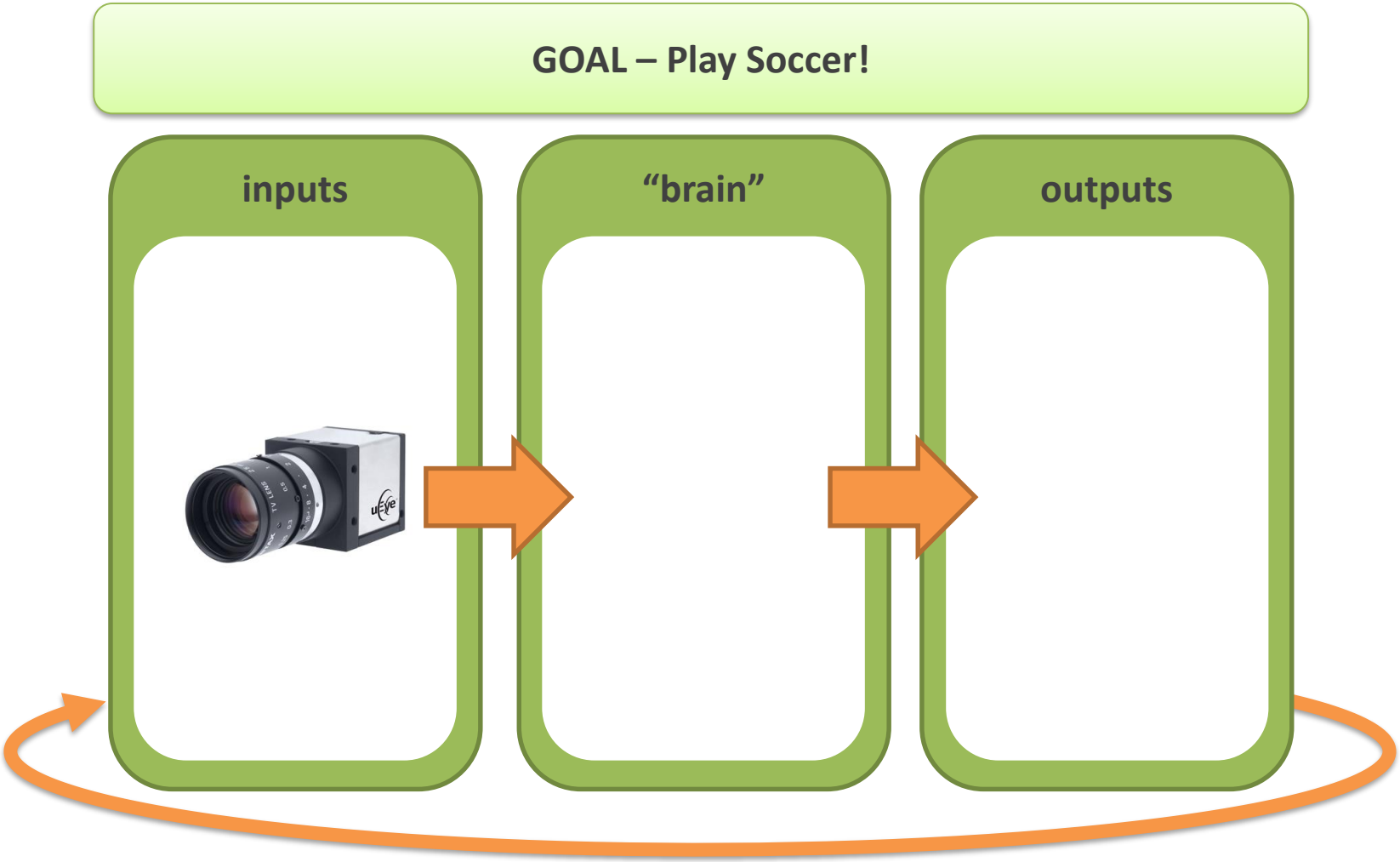

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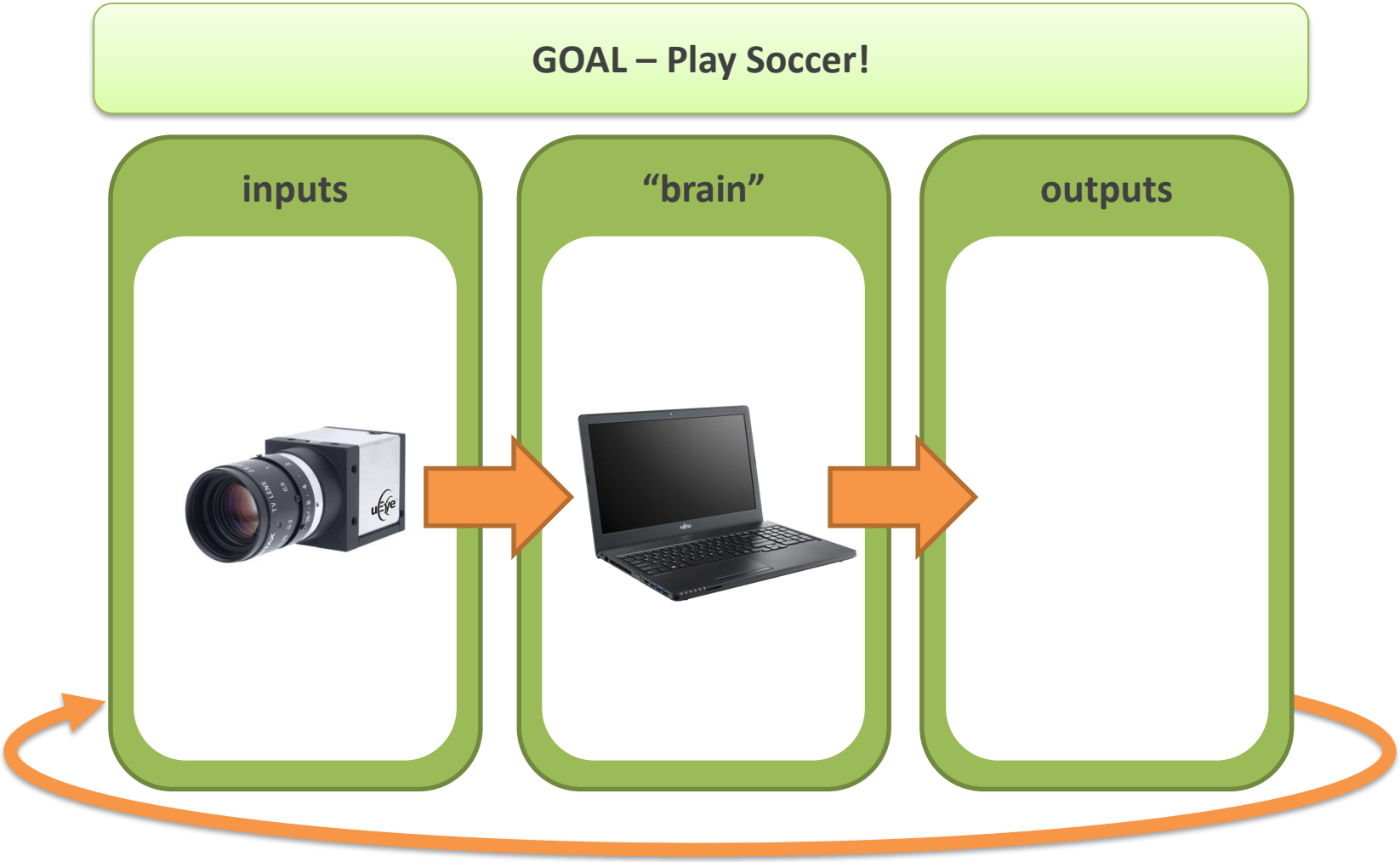

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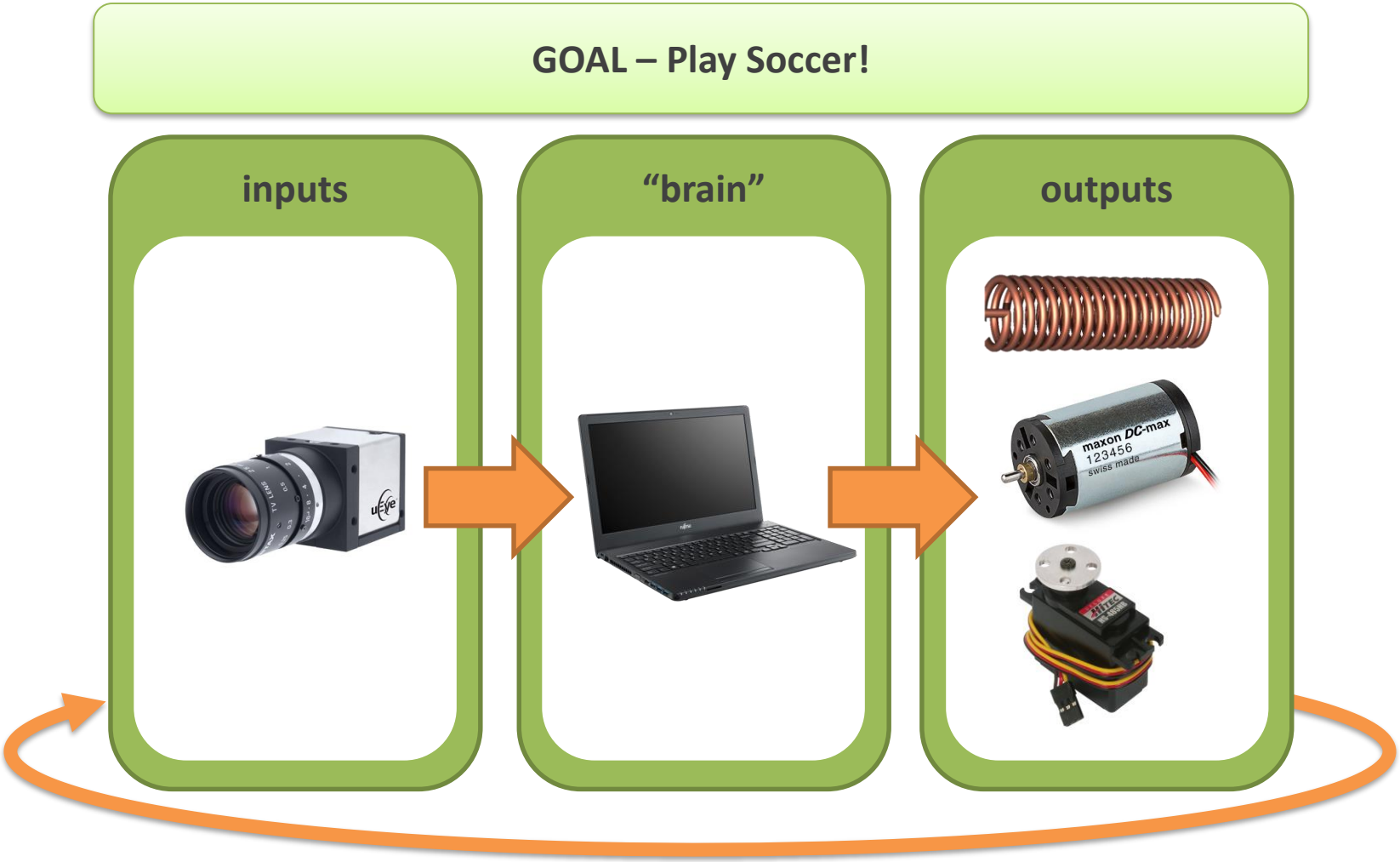

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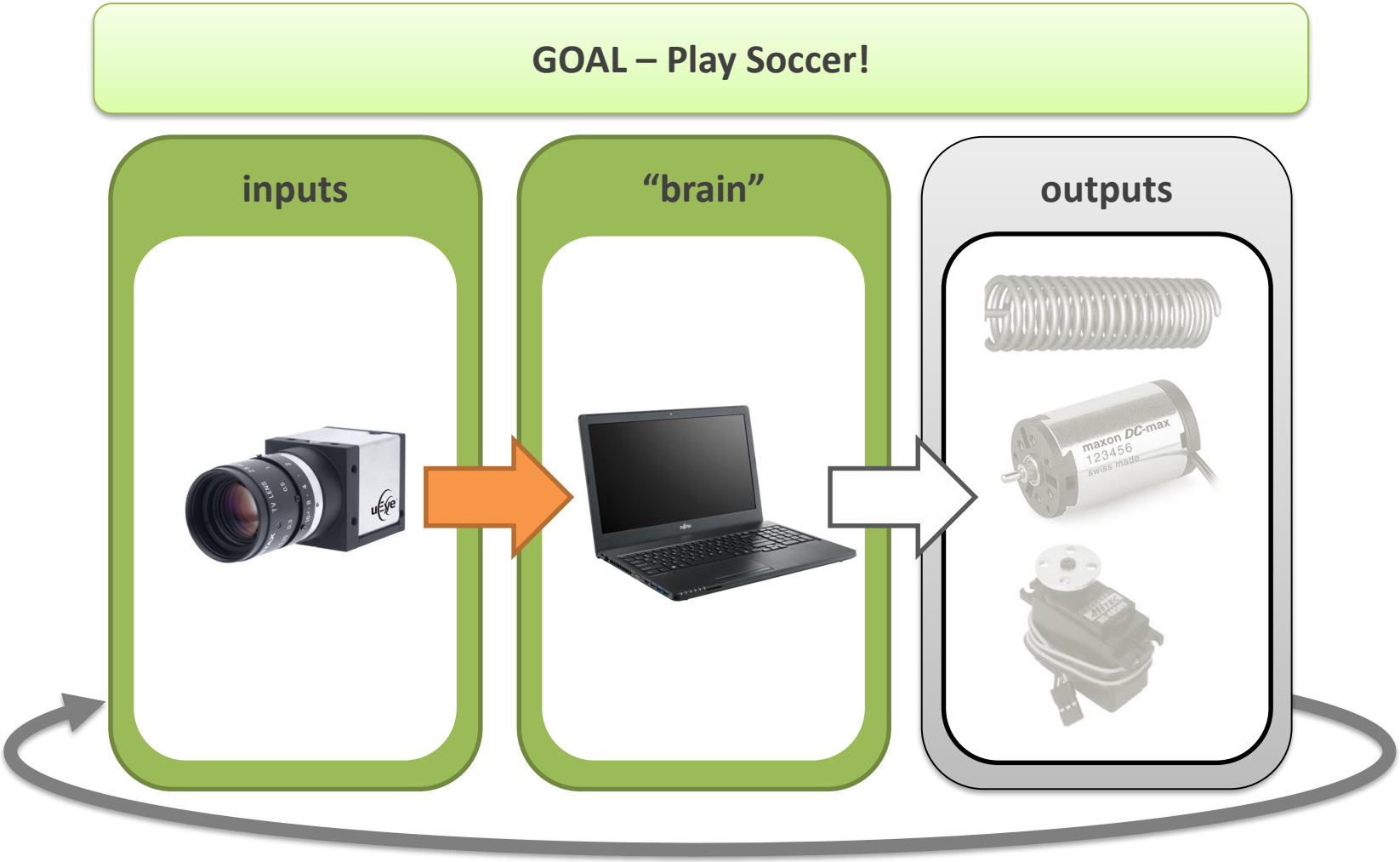
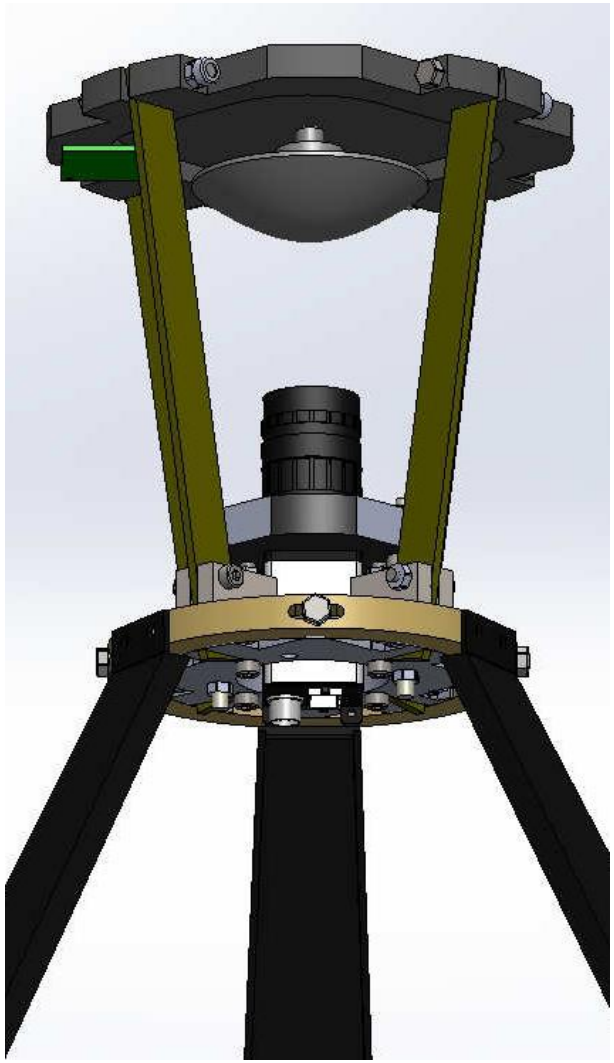


Our Vision System

CAMBADA Vision System



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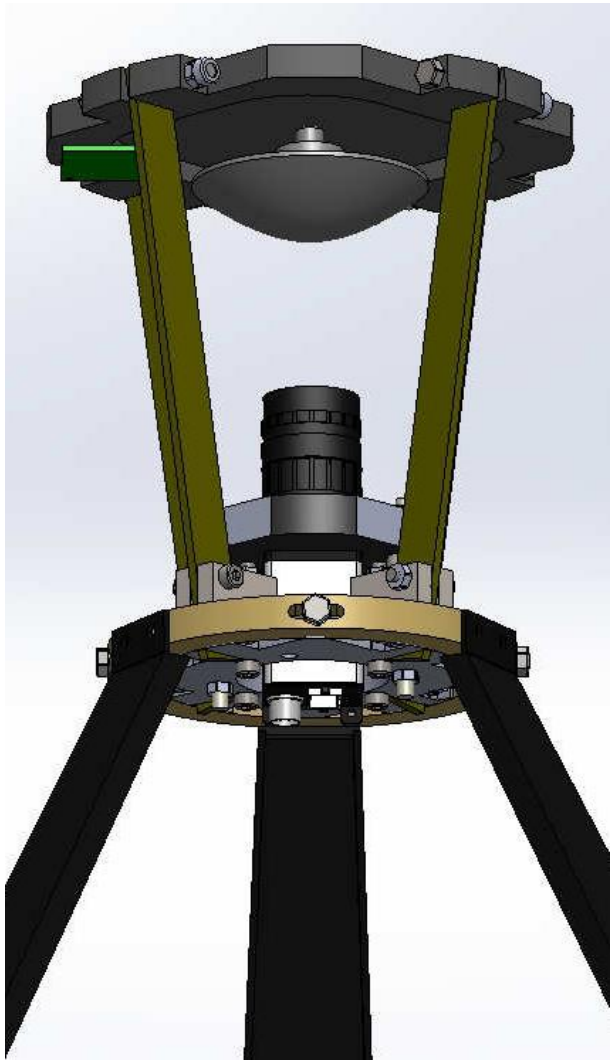

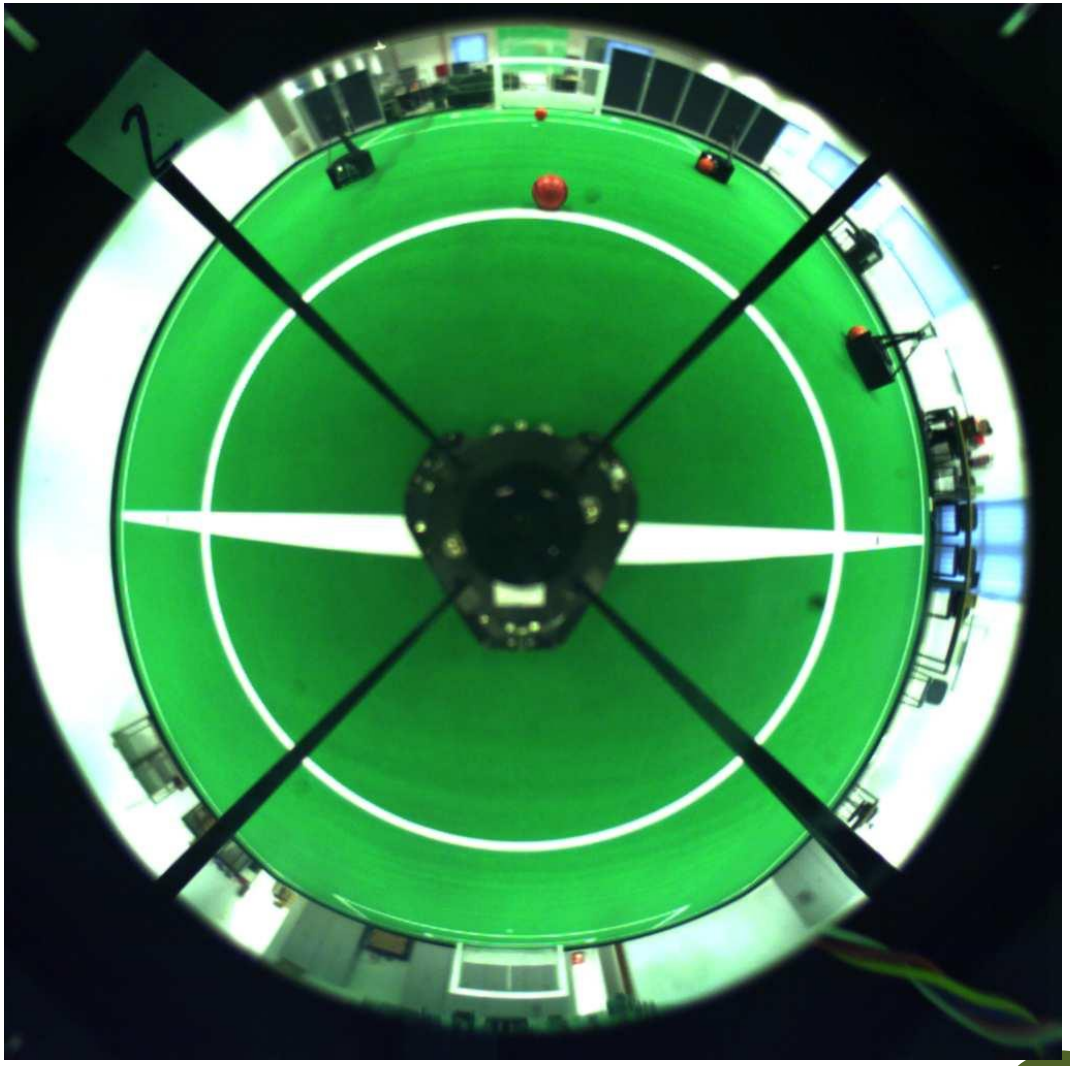

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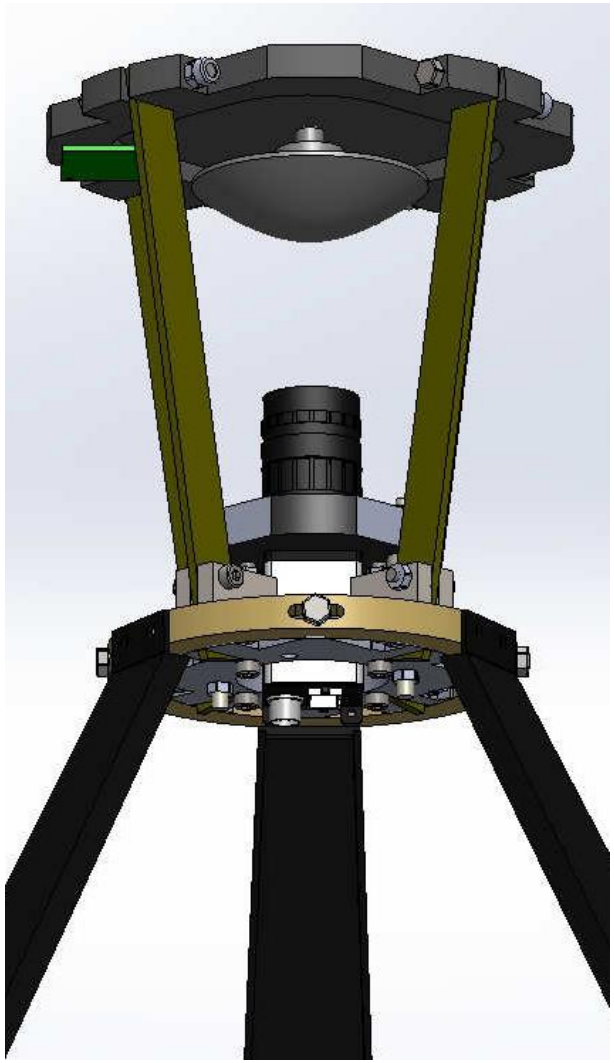

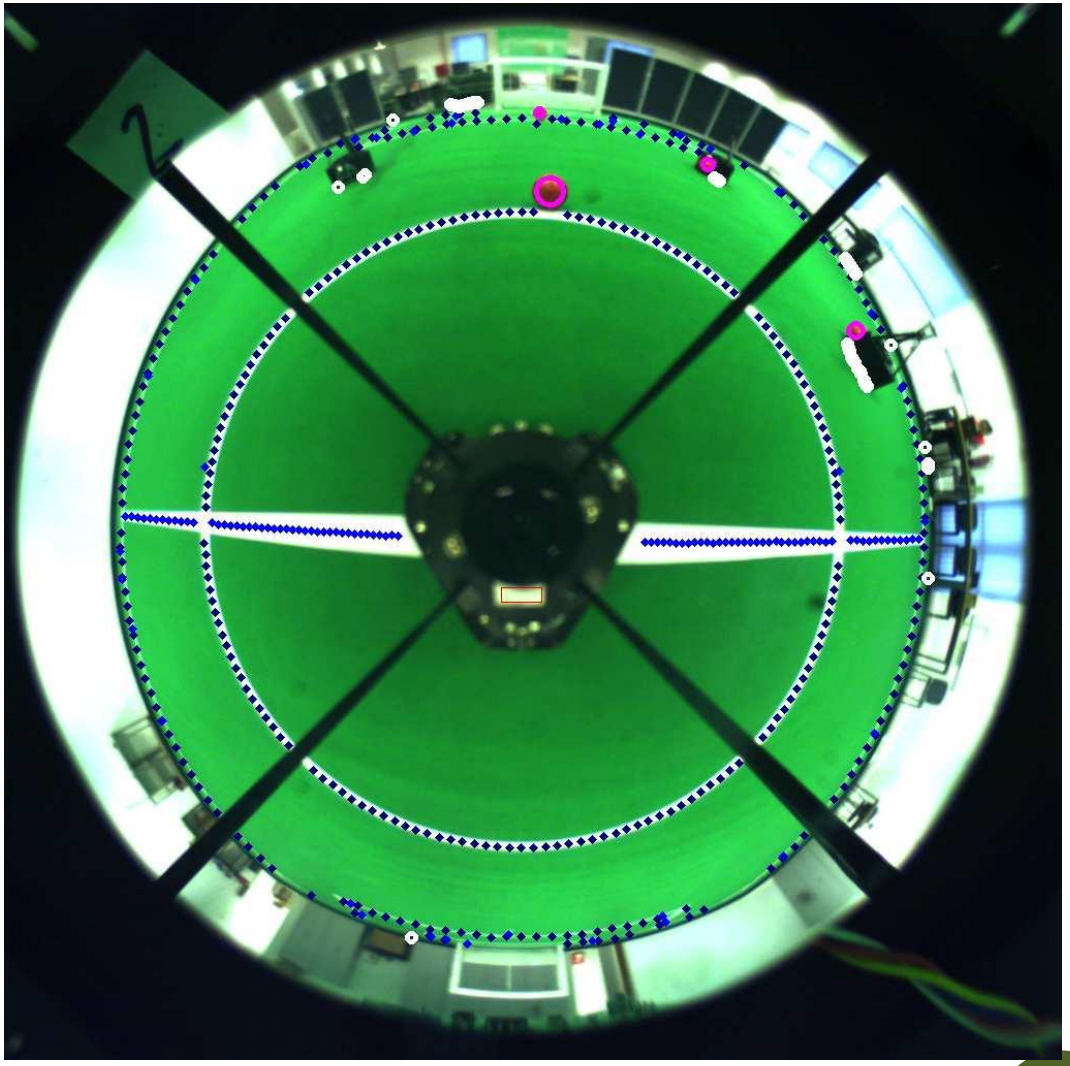

Ball Detection

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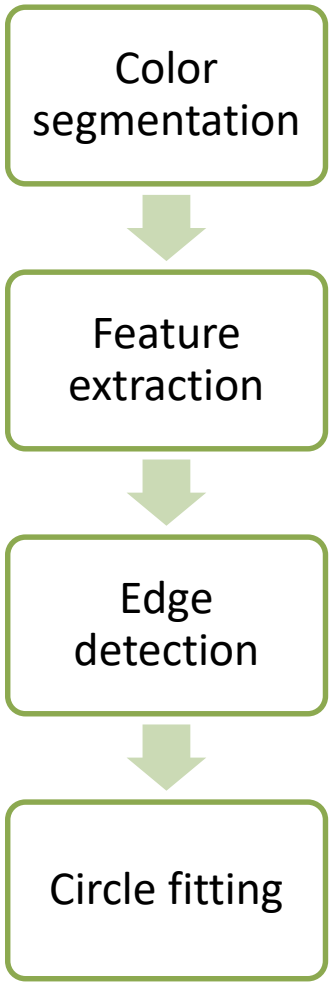


Ball Detection

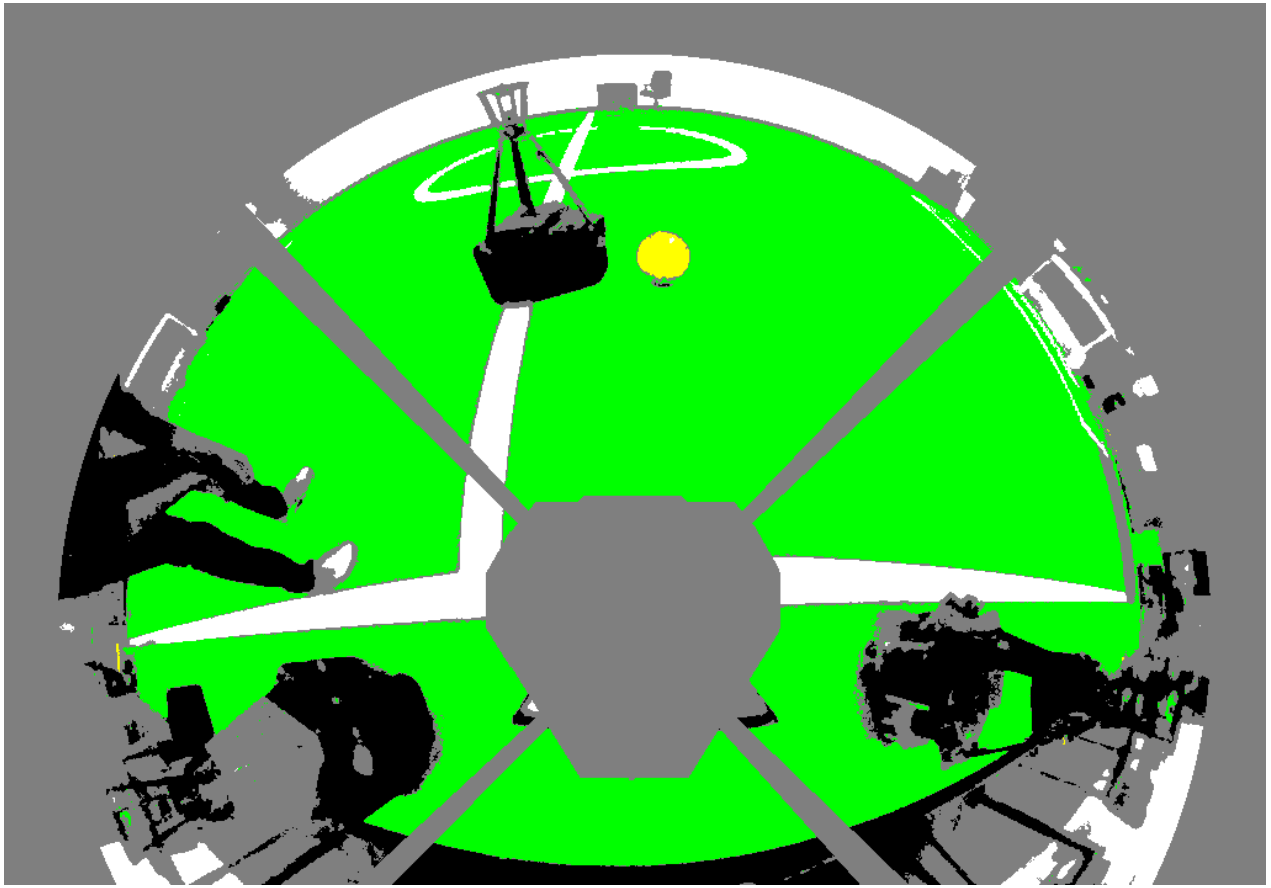
Color segmentation

Feature extraction

Edge detection

Circle fitting

- Hue/Saturation/Value ranges



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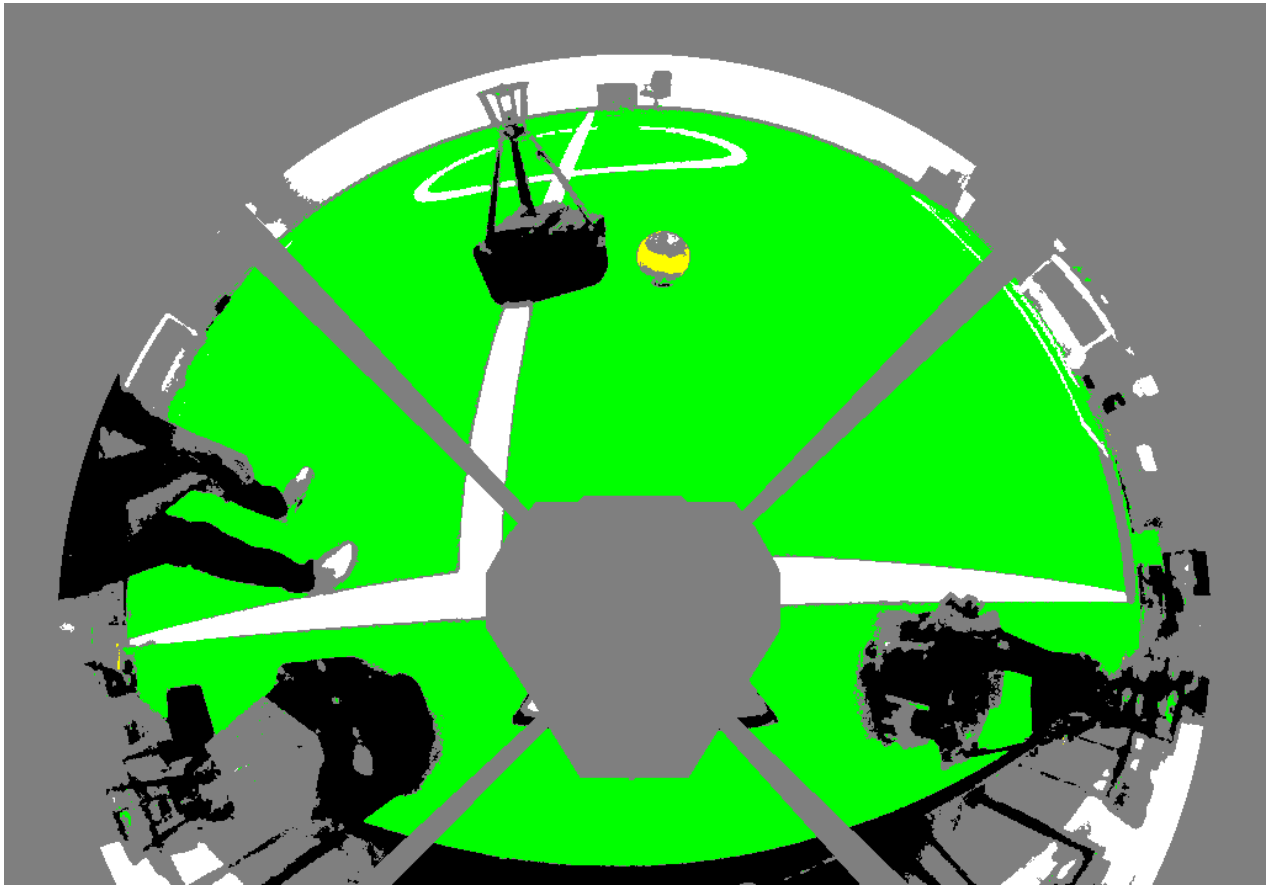

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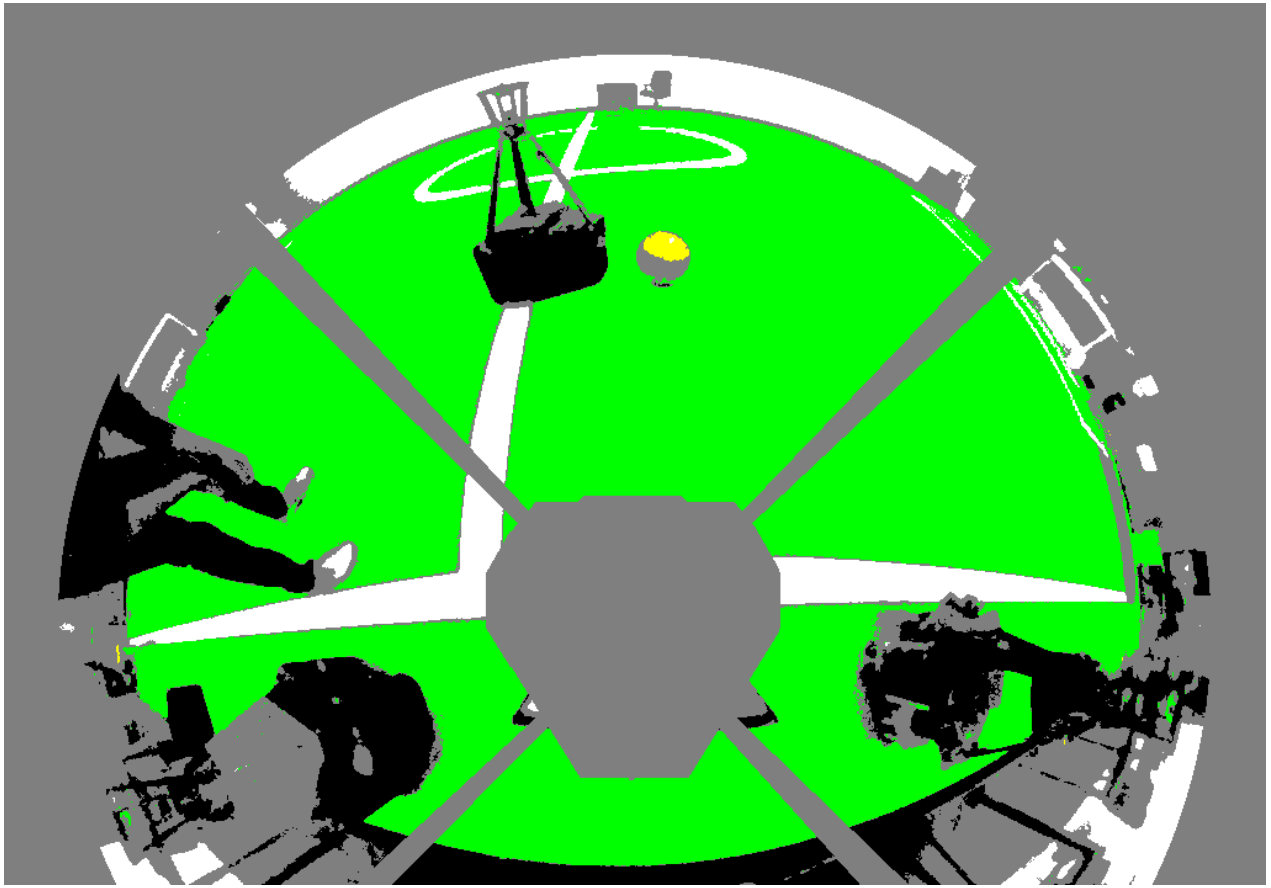

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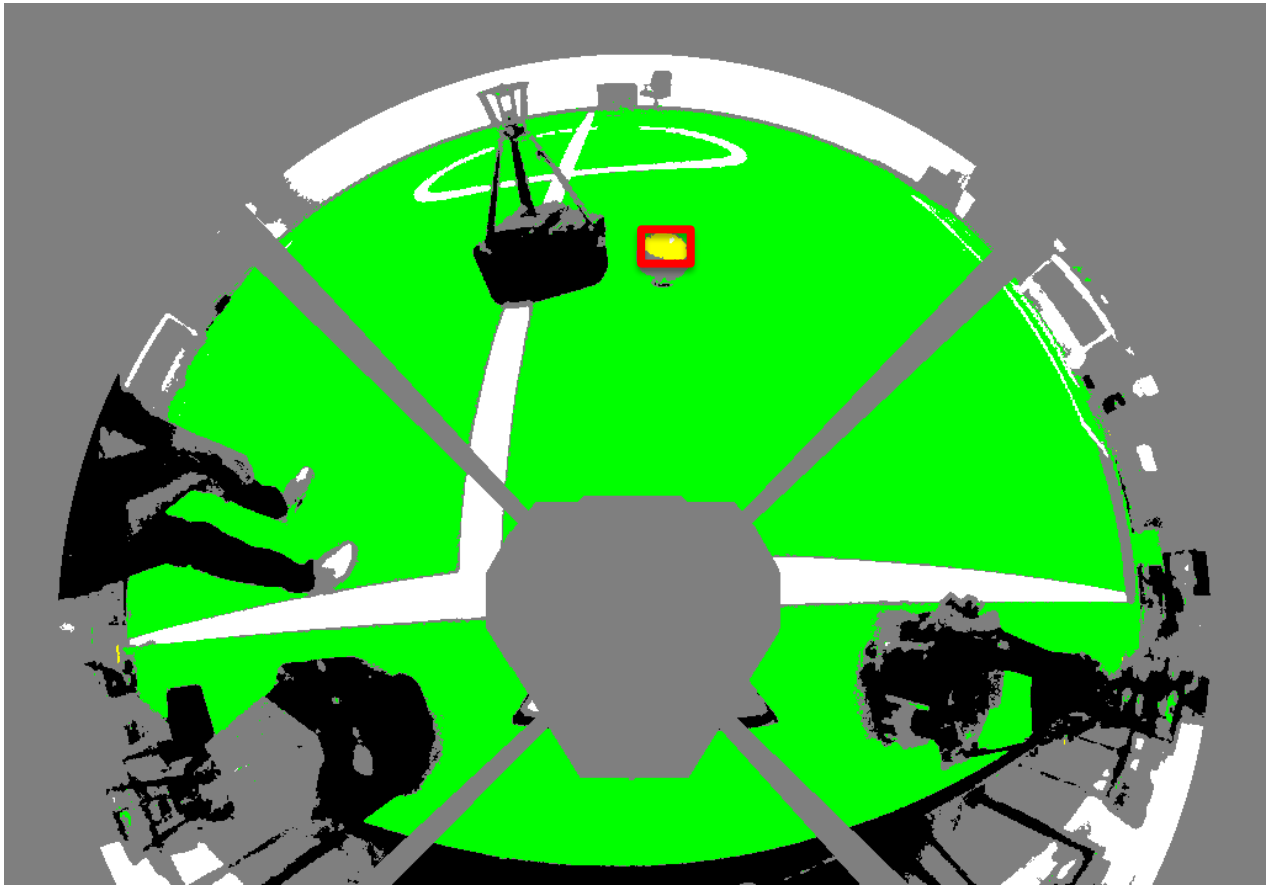
- Blobs of “ball color” (e.g. yellow)



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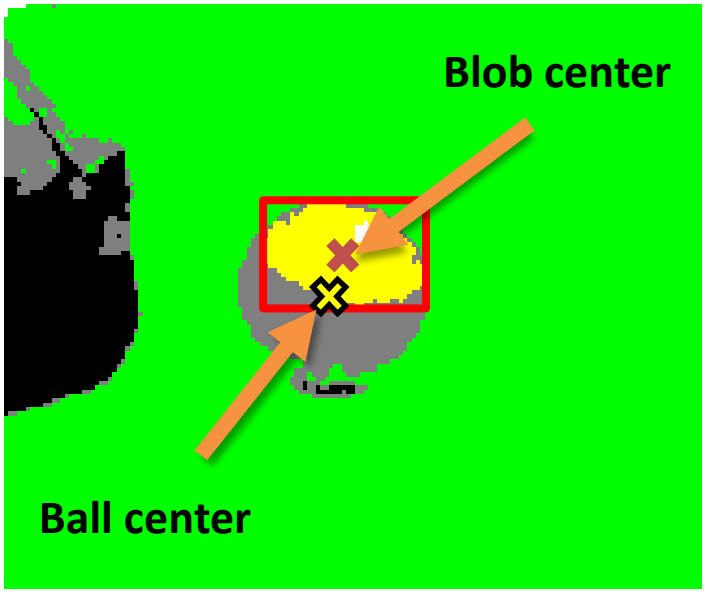

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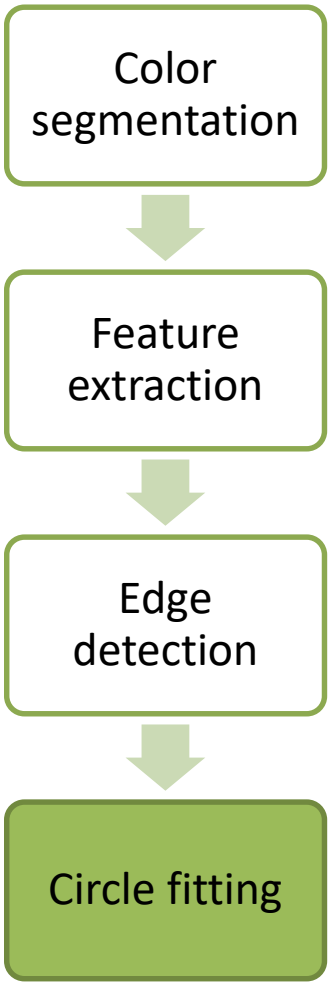
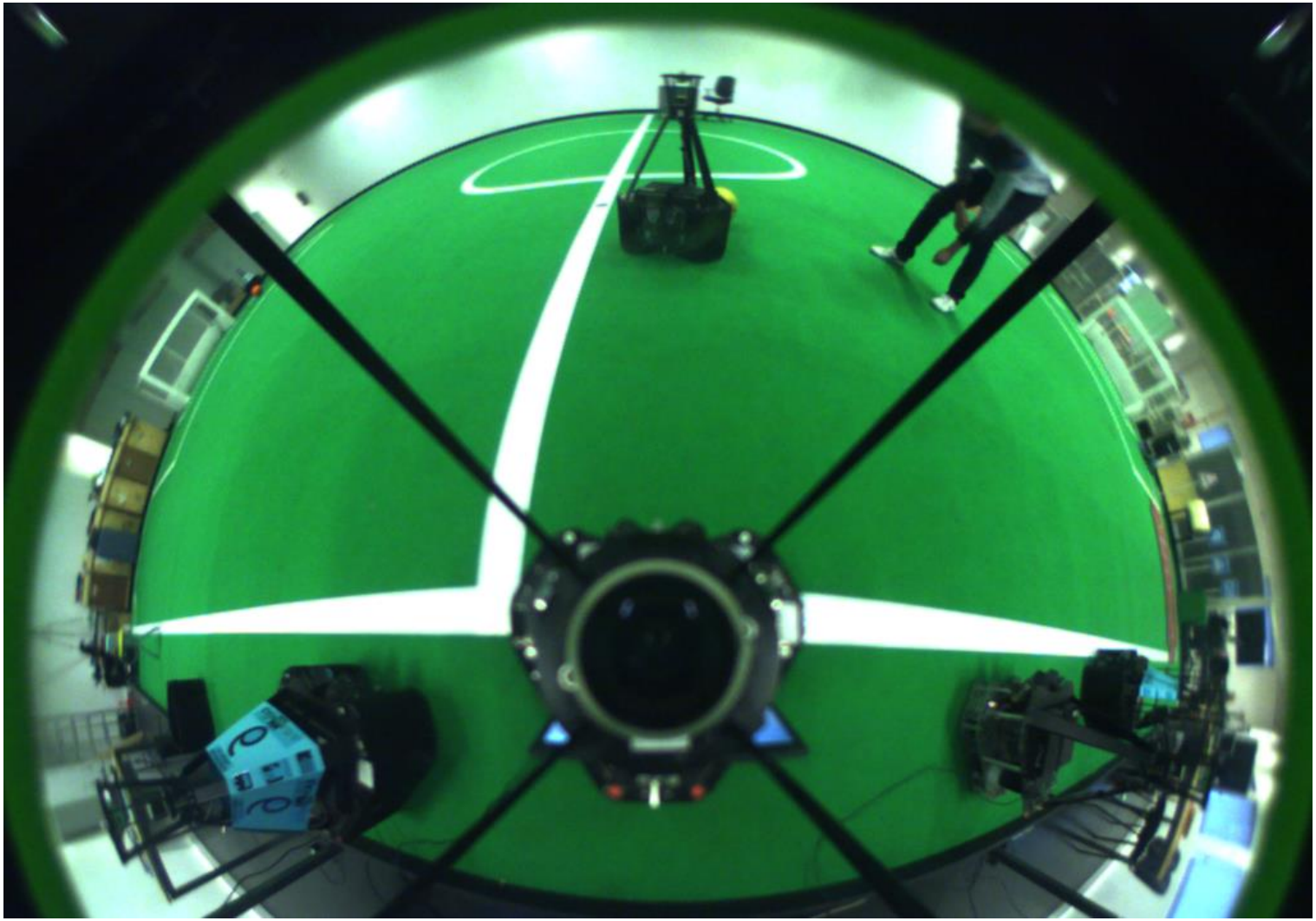


- RANSAC Circle Fit
  - 80 iterations
    - Sample 3 points
    - Fit a circle
    - Measure the “error”/score
  - Weighted average

Ball Detection



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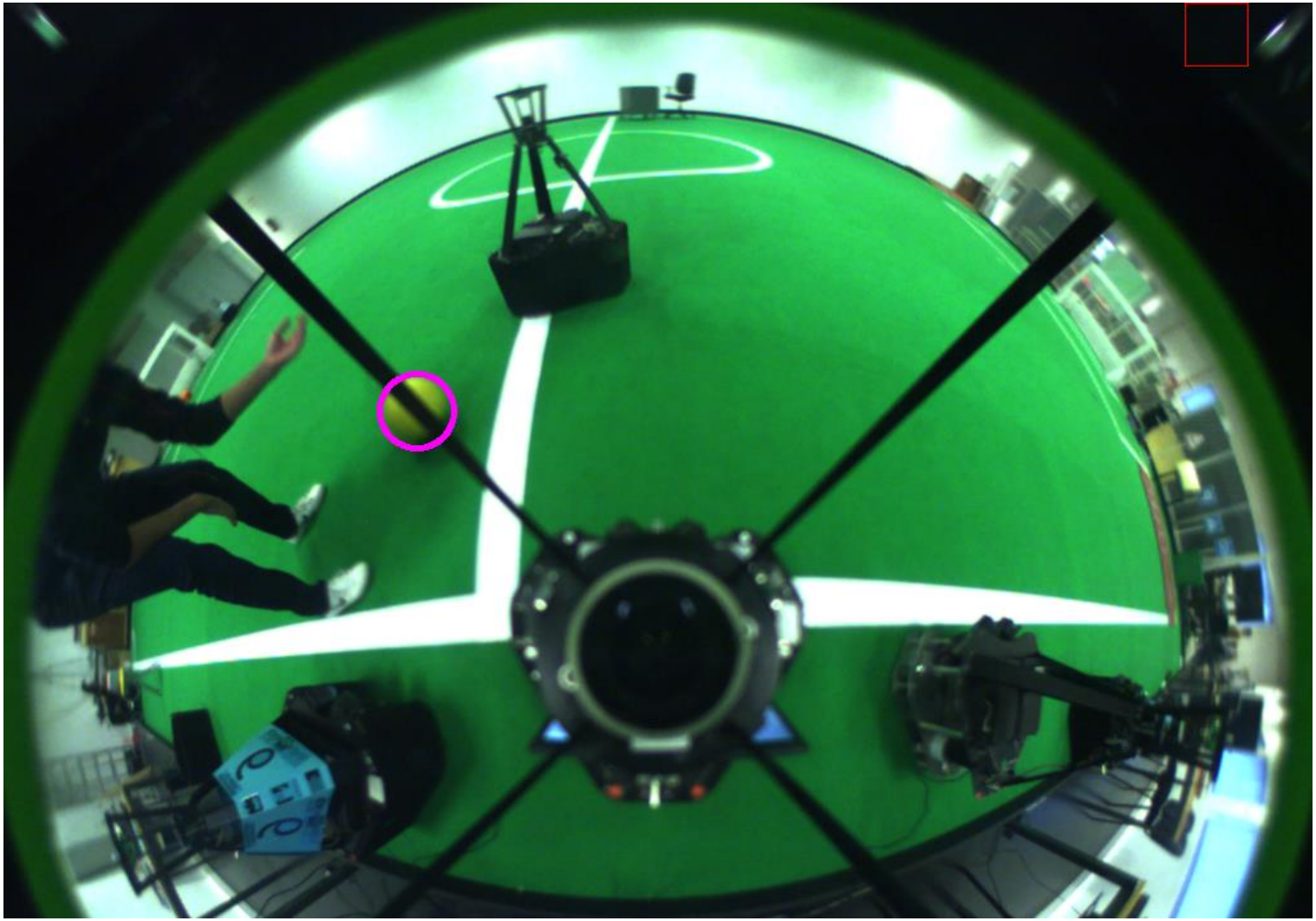
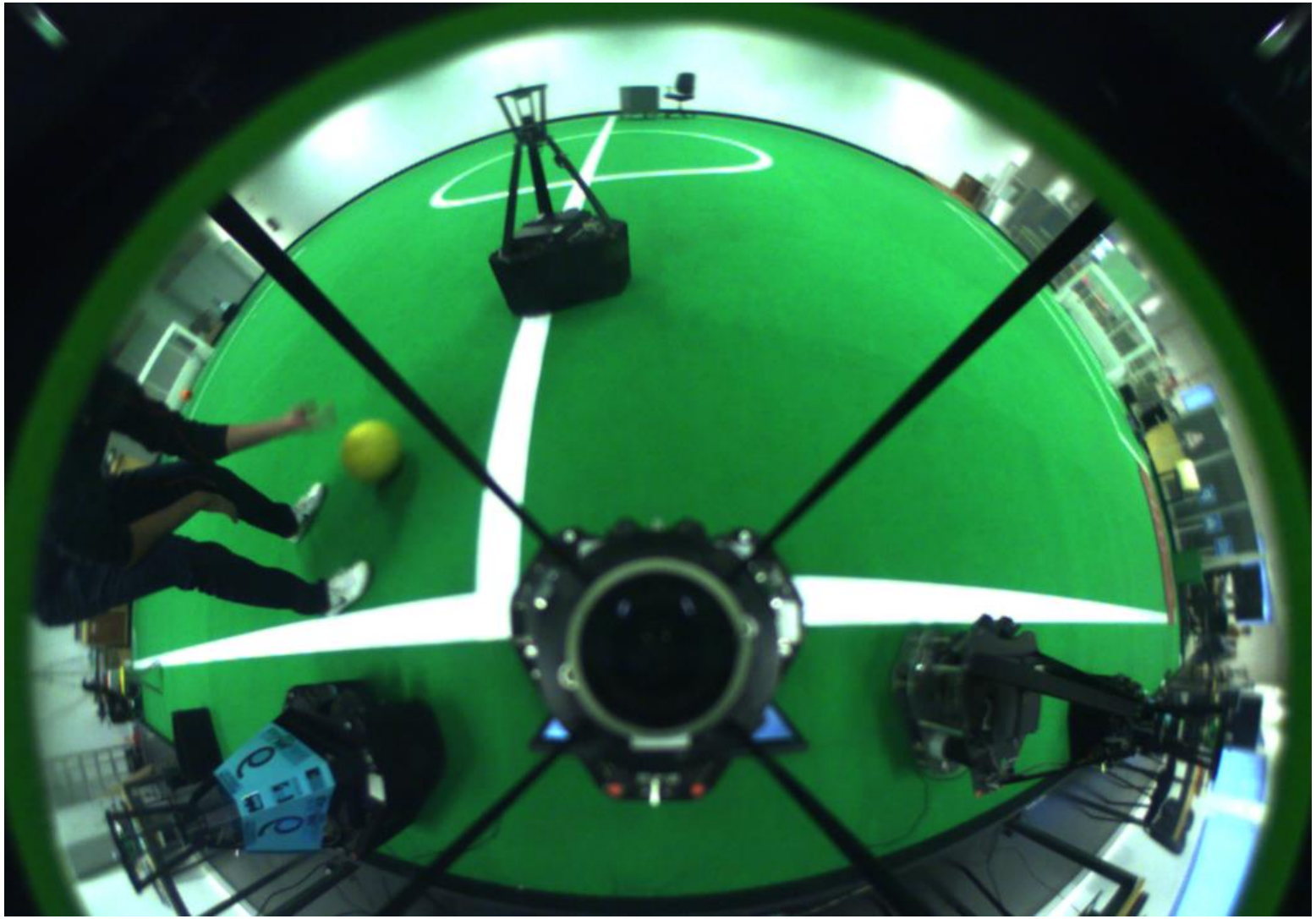


Obstacle Detection

Obstacle Detection



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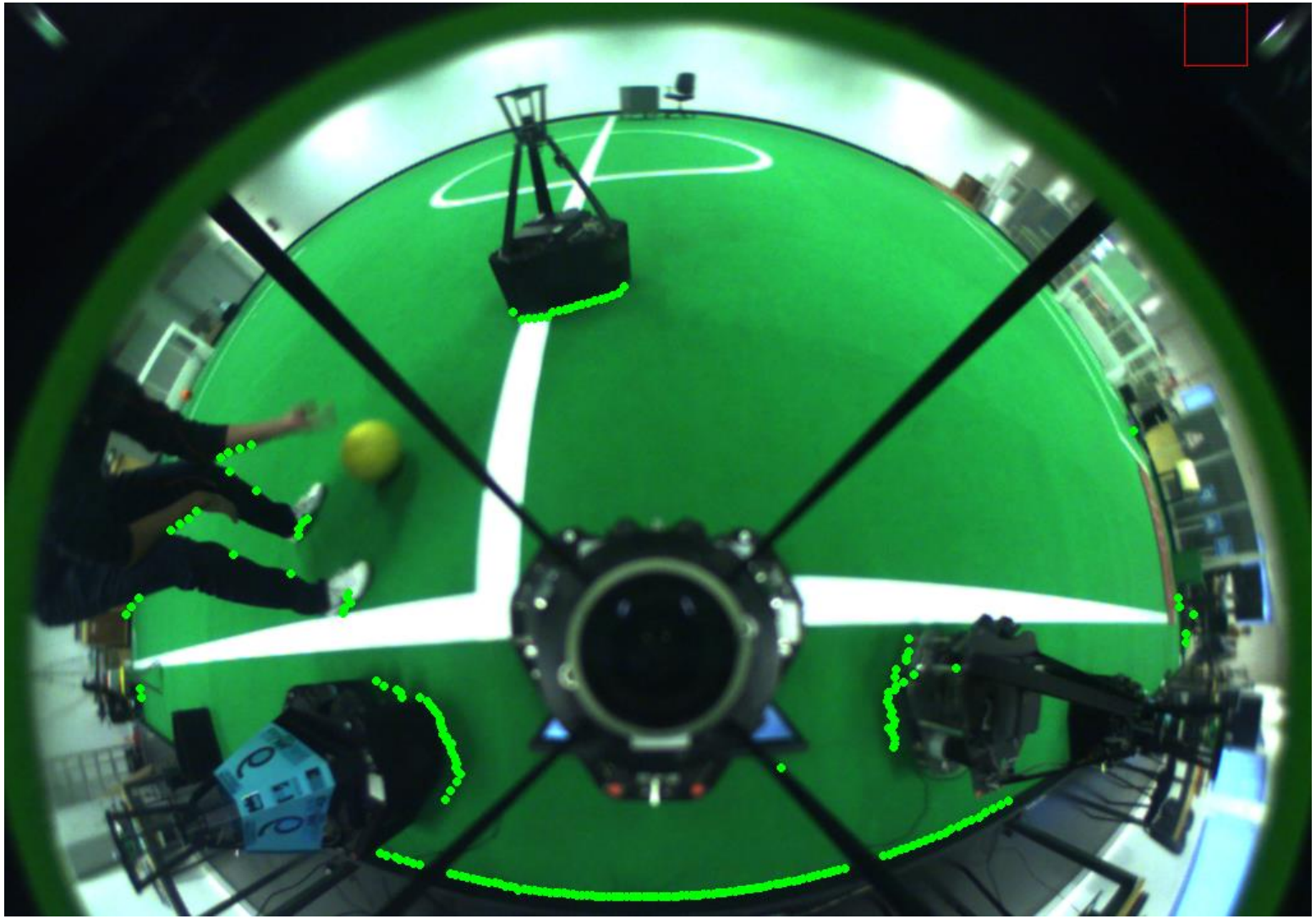

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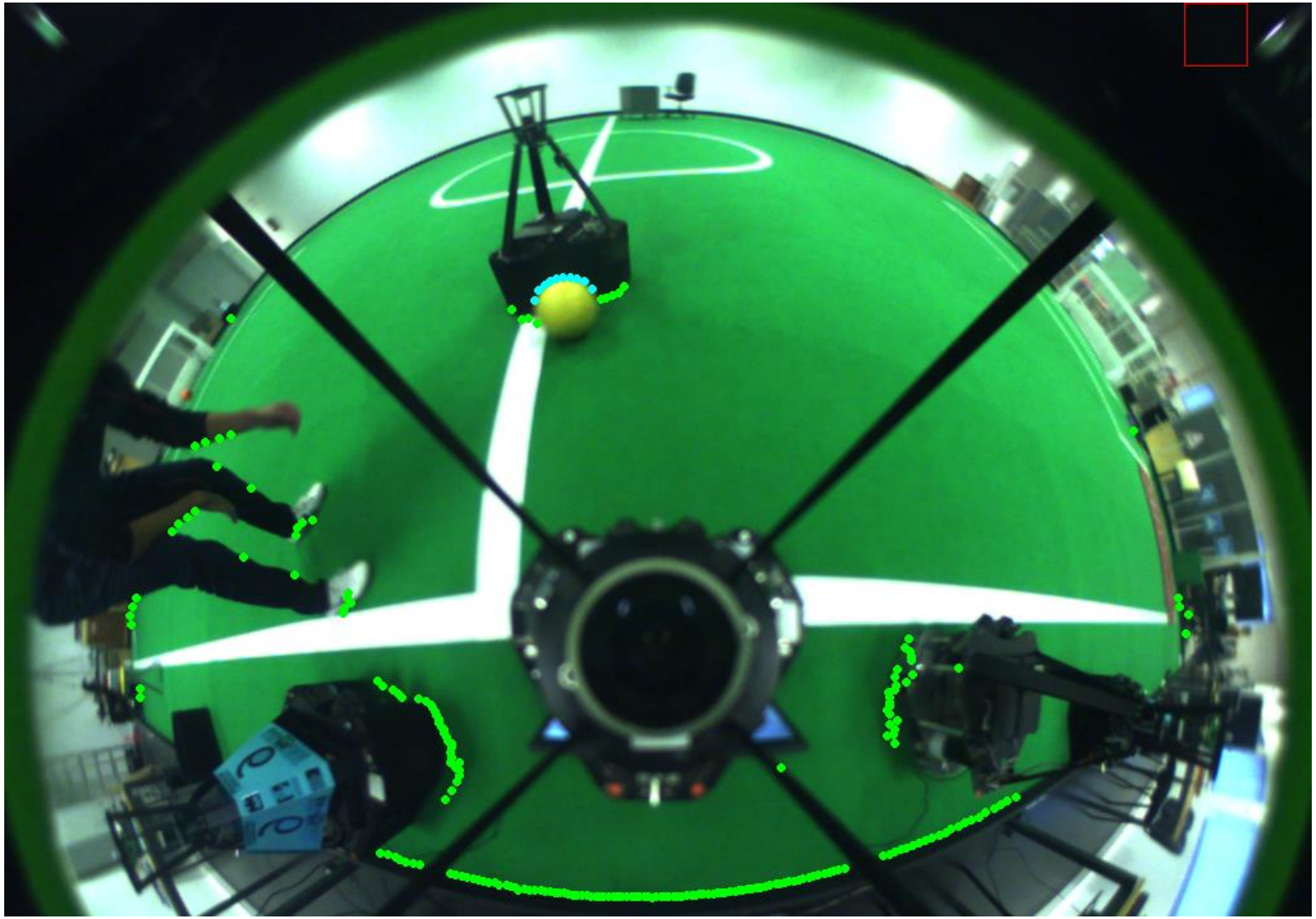


Obstacle Detection

Obstacle Detection

More Data!

Data Mining and Machine Learning Oportunities

More Data!

- Vision
  - Manual to Autonomous Calibration of HSV ranges

- Robots communicate through WiFi
  - Merge shared information to get a global understanding of the environment

More Data!

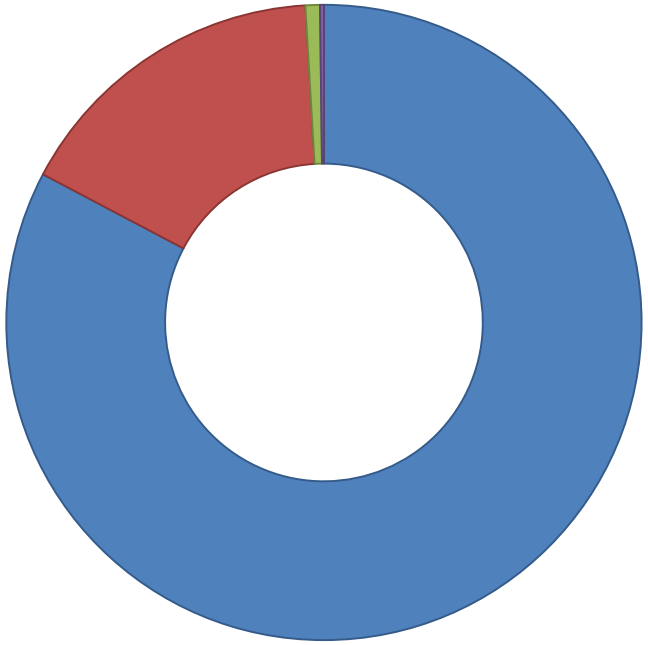
- Behaviours
  - Using RL, train the robot to efficiently dribble the ball without colliding with other robots
  - Train the robot to kick efficiently

- We log our data during matches
  - Lots of data that we can use to train offline all sorts of classifiers that we can use online (ball possession, opponent aggressiveness, …)

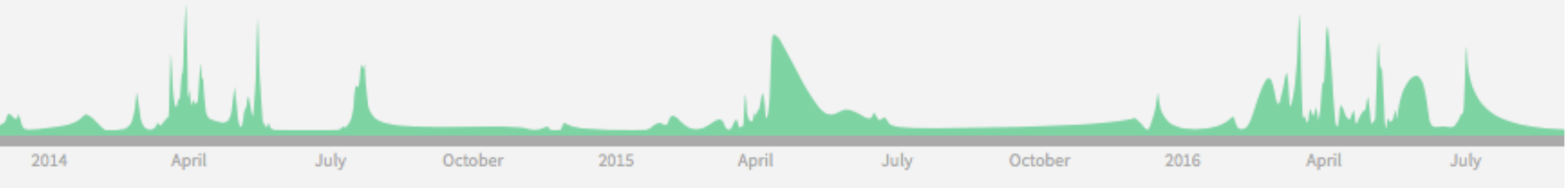
More Data!

- We have access to opponent world state data after the match
  - This includes their robots position and velocity, their perceived ball position and velocity
  - We can use (offline) machine learning techniques to train a model of the behavior of each opponent
  - Use this model in realtime to
    - Predict opponent behavior
    - Perform a coercive attack

CAMBADA Agent



github.com/cambada

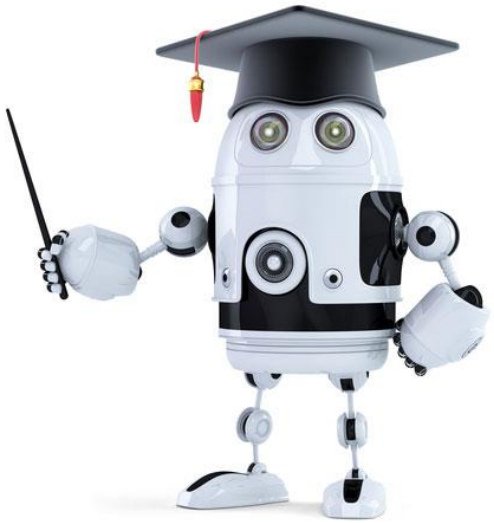


Video

CAMBADA RoboCup 2017 Qualification Video
https://youtu.be/qt1qZp1EmVM

Conclusion

in 5-10 years



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Conclusion


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Thanks for your attention!

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