TEAM ROS

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Agenda

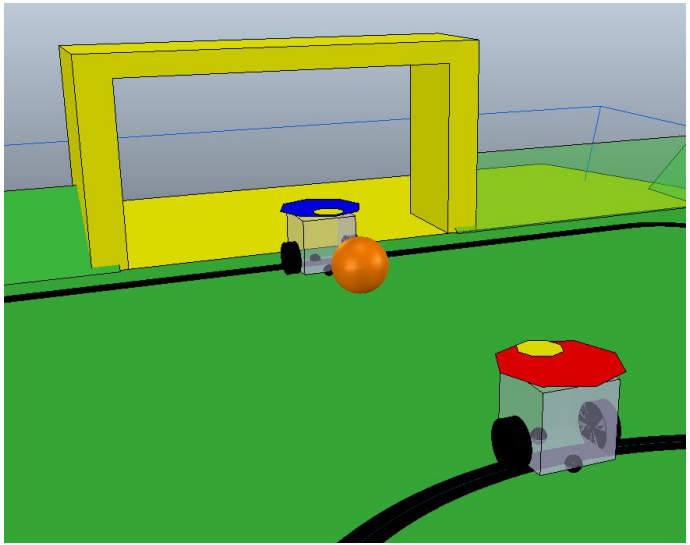
- Teamwork
- Question 1
- Question 2
    a. Dribbling
    b. Passing
- Question 3
- Program Structure

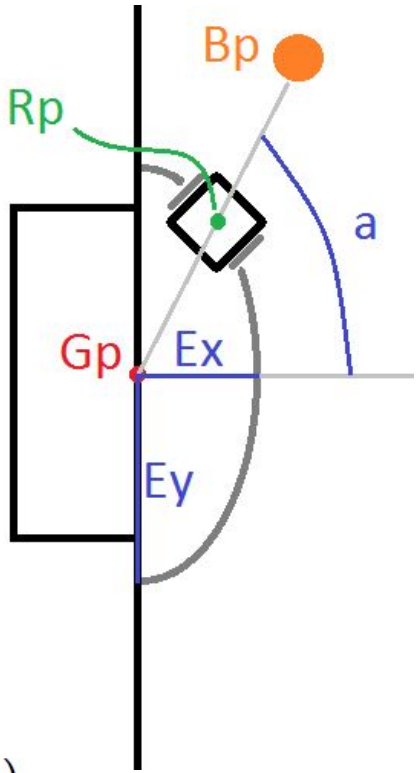
Teamwork

- Weekly meetings
- Collaborative code sharing using GitHub
- GoogleDocs, GoogleDrive
- Milestones
- Divided the workload, ***yet***
- ***Coordinated our code block interfaces***

Question 1 - Goalie Strategy

- Goalie stays on an Elliptic trajectory
- Based on the position of the ball
- Implemented with a P controller





$$\vec{Rp} = \begin{bmatrix} Gp_x + E_x cos(a) \\ E_y sin(a) \end{bmatrix}$$

$$a = atan2(Bp_y, Gp_x - Bp_x)$$

Question 1 - V2PosP

- Compute the velocity to reach the position P
- P controller => the robot will **stop** at the point

Kp: proportional gain

KR: rot gain

Vf: forward velocity

Vt: translational velocity

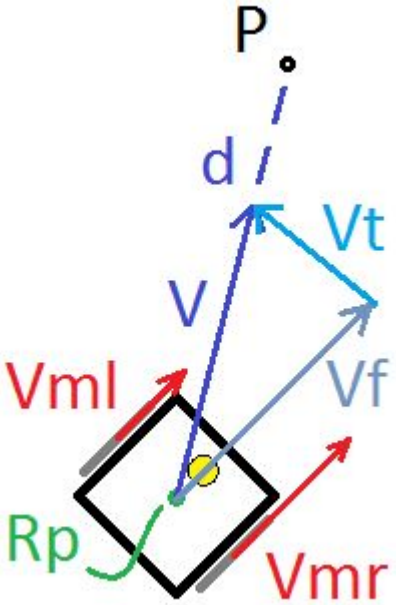
$$\vec{V} = min[K_p\vec{d}, Vmax \cdot \vec{d}/d]$$

$$Vm_L = Vf - K_R Vt$$

$$Vm_R = Vf + K_R Vt$$

The goalie can also go **backward** !

if $Vf < 0$: $Vt \cdot (-1)$

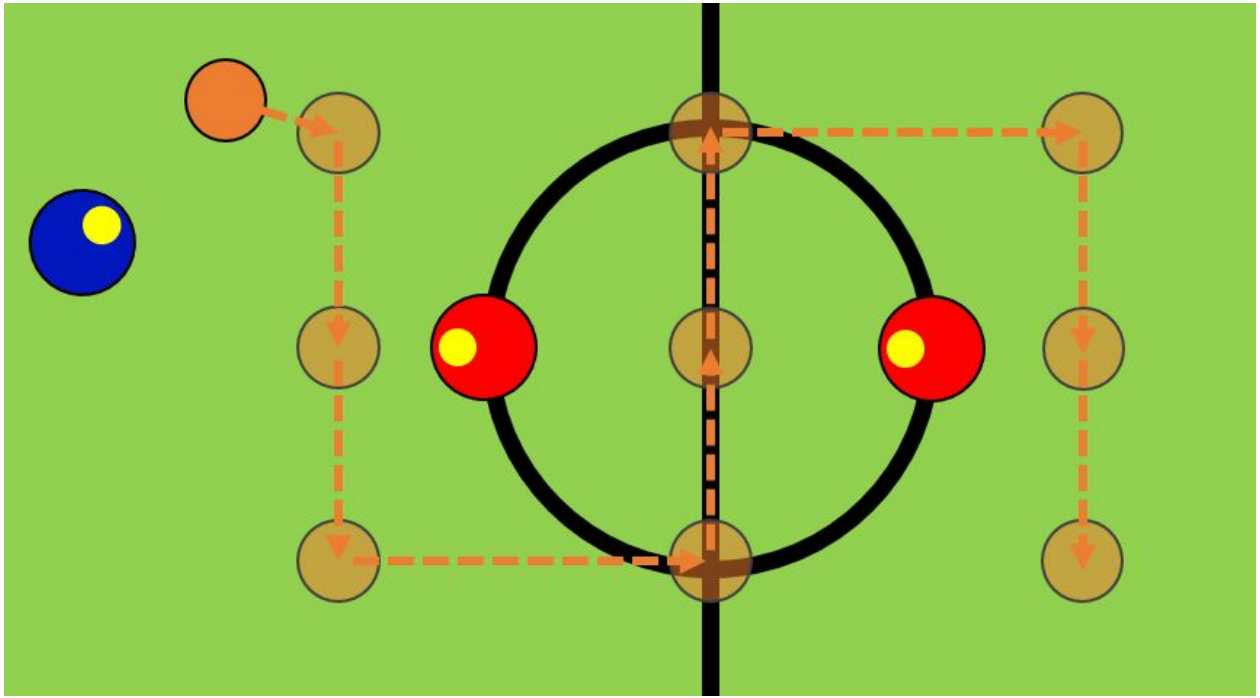


Question 1 - Pros and Cons

+ The robot does not fall in the goal (the ellipse is far from the goal)
+ Reusable for the match
+ Smooth (with the backward implementation)
+ Automatically kick the ball away

- Risk to kick in his own goal
- Get sometimes blocked on the pole

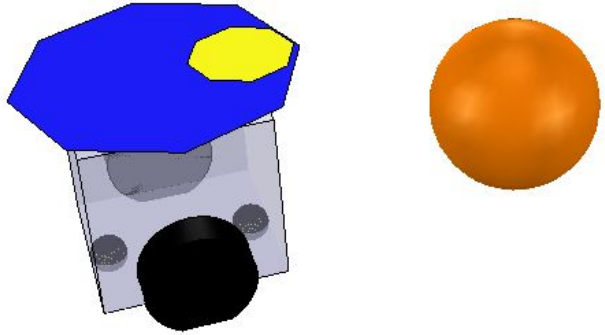
Question 2 a) - Dribbling



Ball model

- Kick the ball at different motor velocity
- Record the ball distance and time
- Rescale the record to have the ball kicked at t=0
- Normalized the curve by the robot velocity

(System assumed linear)



Ball model

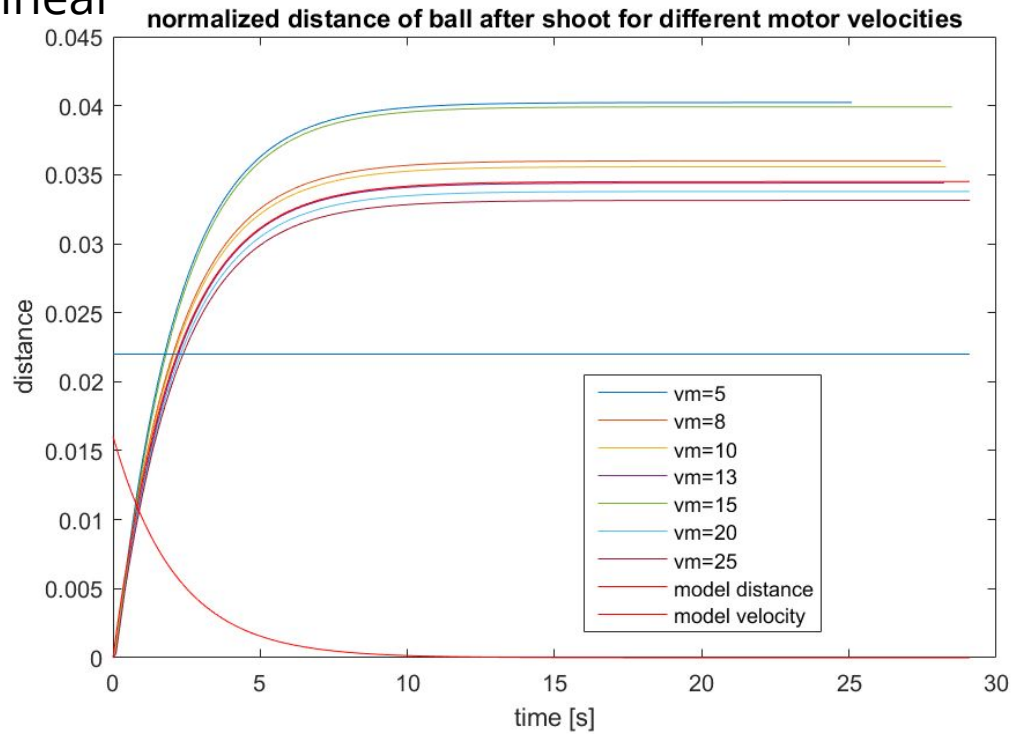
Model obtained: First order linear

$$V_m K\left(1 - e^{-t/T}\right)$$

- Vm: motor velocity
- K=0.0345
- T=2.15 [s]

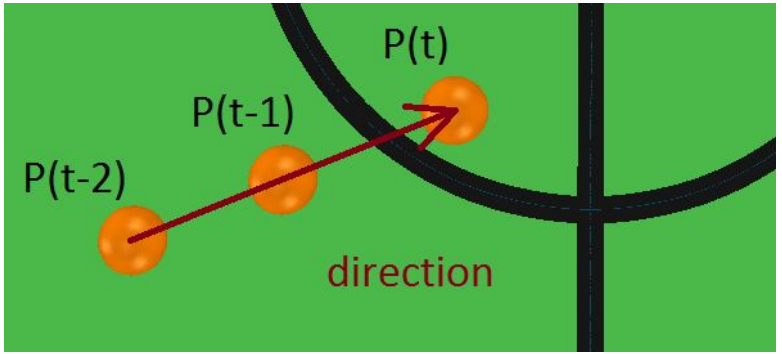
Pass to a distance d:

Vm=d/K ⇐ motor command



Ball Engine

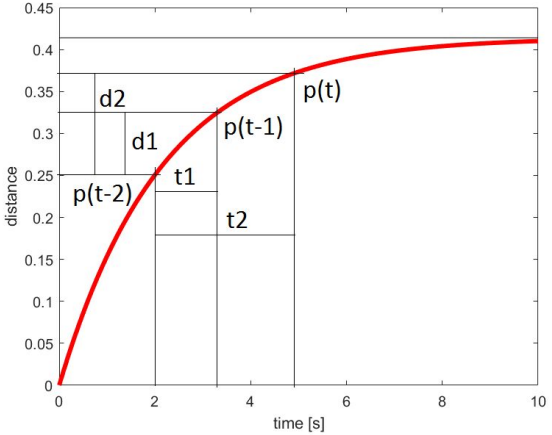
- Updated at each cycle
- Predict where the ball will stop
- Direction given by last two positions:



Unit vector: $\vec{u} = \frac{\vec{P}(t) - \vec{P}(t_{-2})}{||\vec{P}(t) - \vec{P}(t_{-2})||}$

- Final distance given by:

$$\vec{P_f} = \vec{P}(t_{-2}) + k_0 \cdot \vec{u} \qquad k_0 = \frac{d_1 - d_2 e^{\frac{t_2 - t_1}{T}}}{1 - e^{\frac{t_2 - t_1}{T}}}$$

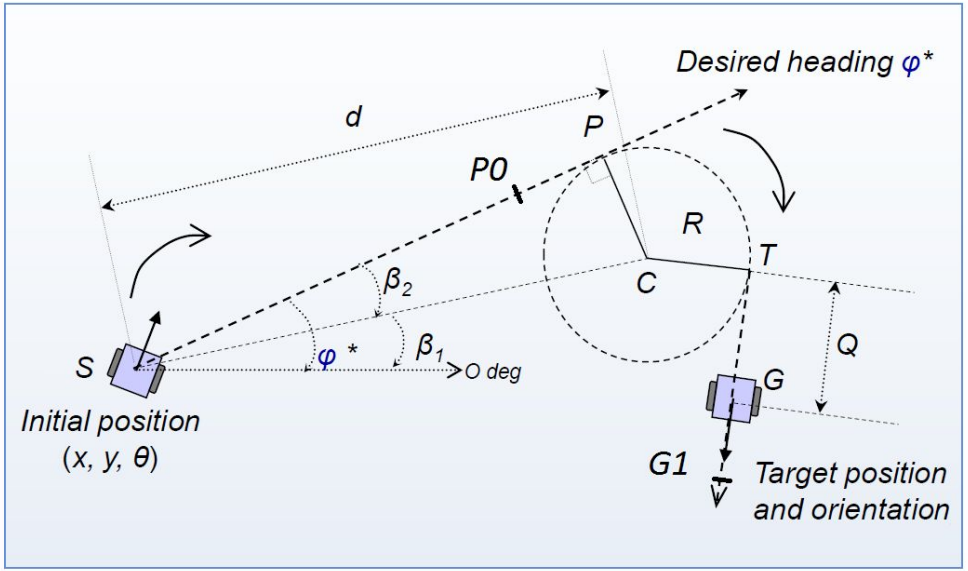


Pass Path

- Smooth path for desired orientation
- Path decomposed in steps
- Each step has a velocity Vm

Pass to a distance d

Vm(T⇒ G1) = d/K



PassPath - V2Pos

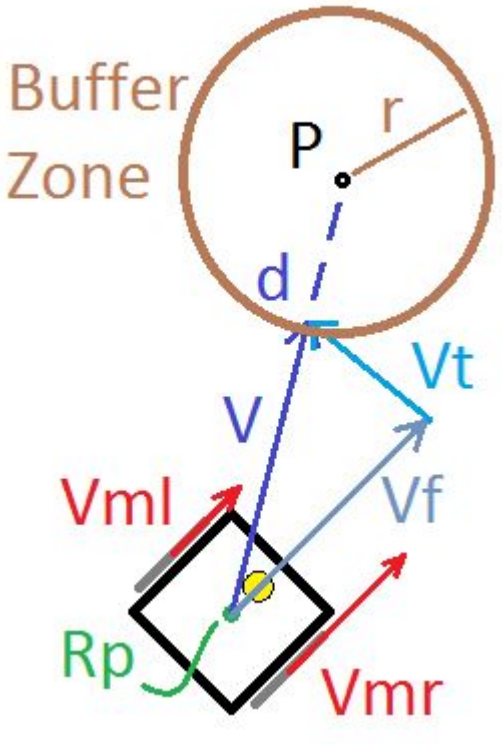
- Compute the velocity to reach the position P
- the robot will reach the point with a velocity

$$\vec{V} = Vm \cdot \vec{d}/d$$

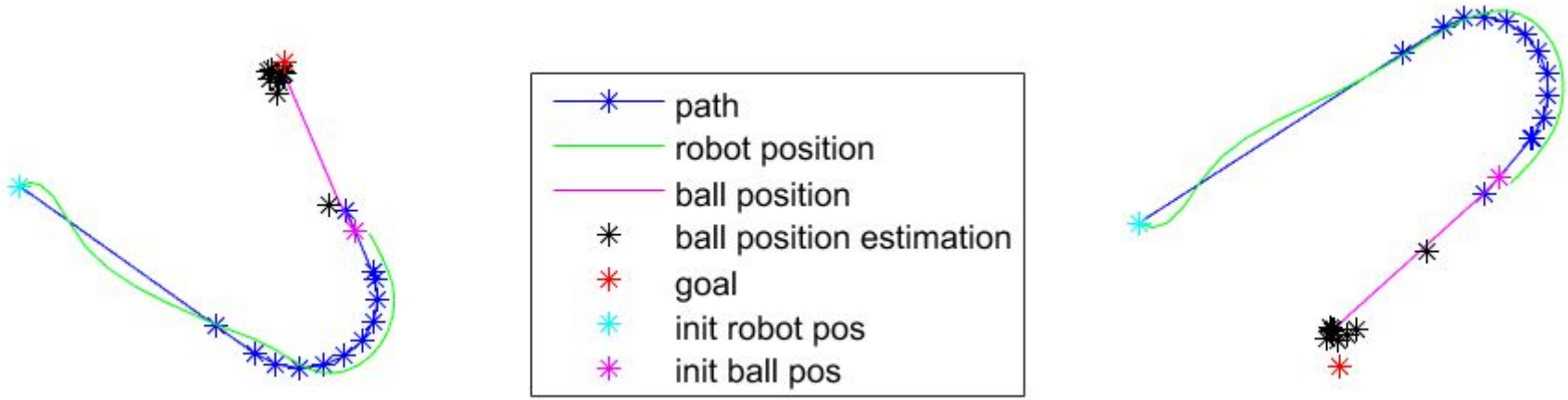
Vml, Vmr: same as before

We consider the next step (next point P) when

the robot is inside the buffer zone

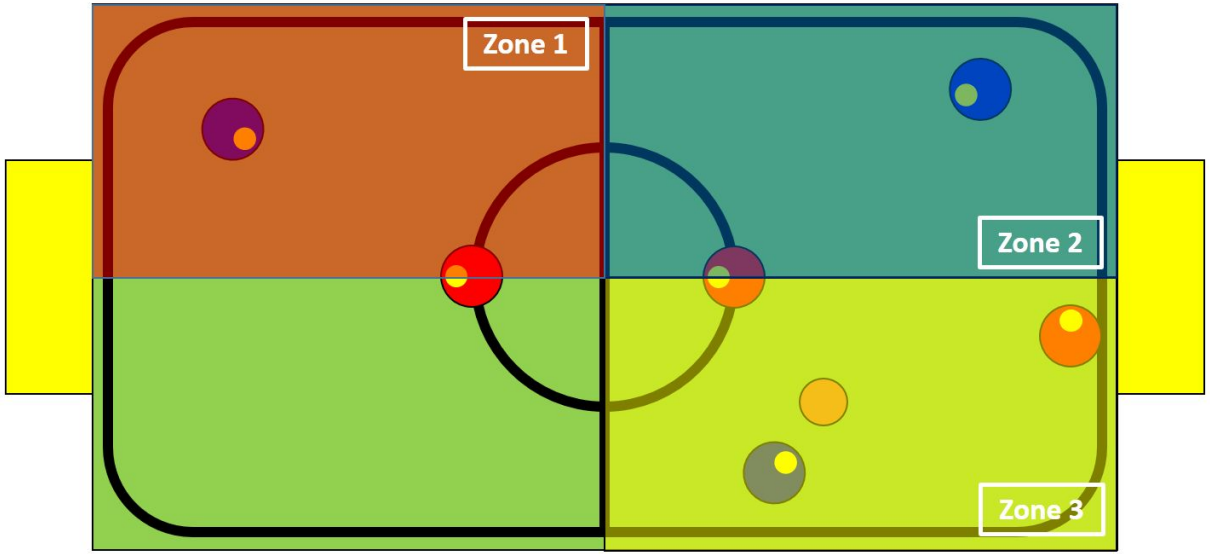


Trajectory obtained example

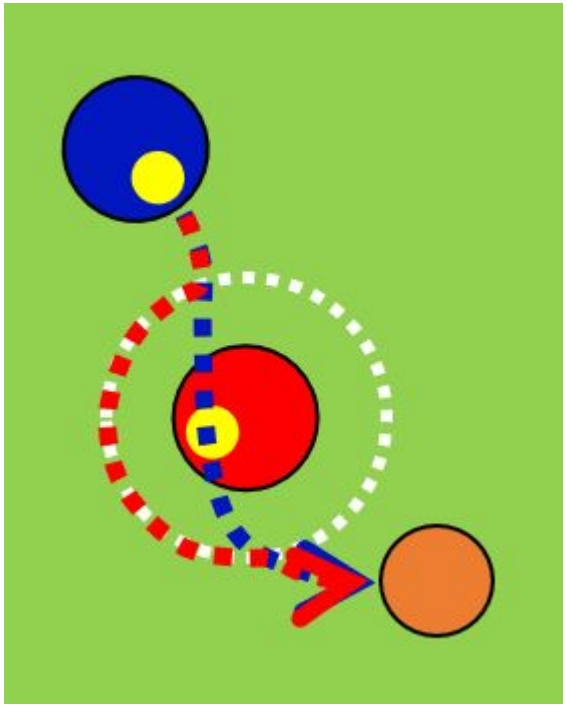


Question 2 b) - Passing

- Passing order and roles fixed
- Wait for ball rest
- If ball progressed to next zone, increment next active player and zone



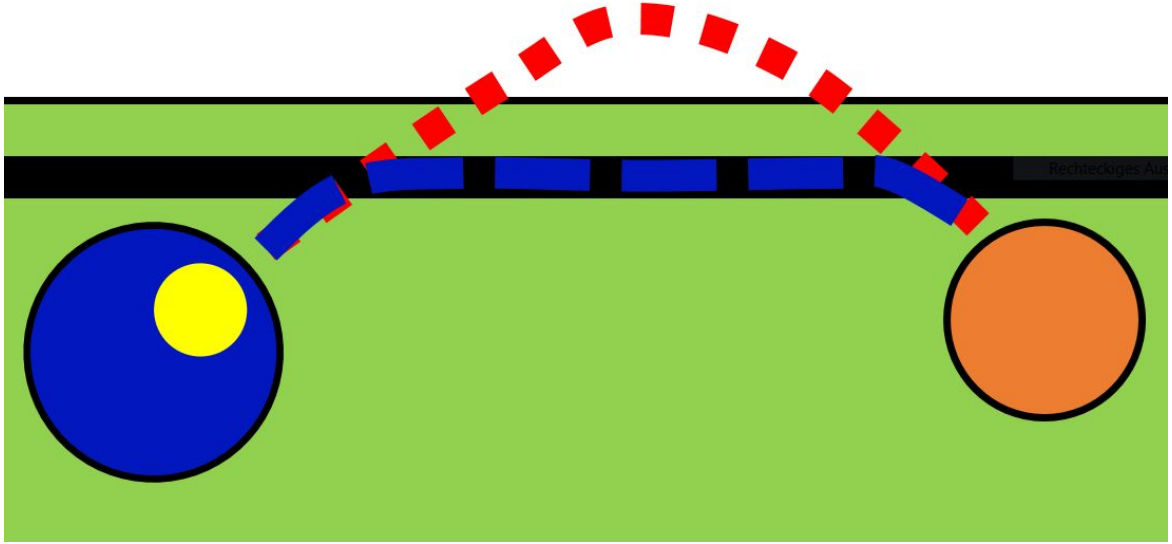
Question 2 b) - Obstacle Avoidance



- Check if planned path passes through the bounding bubble of other objects
- If yes: Move path points to the outside of the box
- Multiple obstacle aware path generated by calling obstacle avoidance for all obstacles

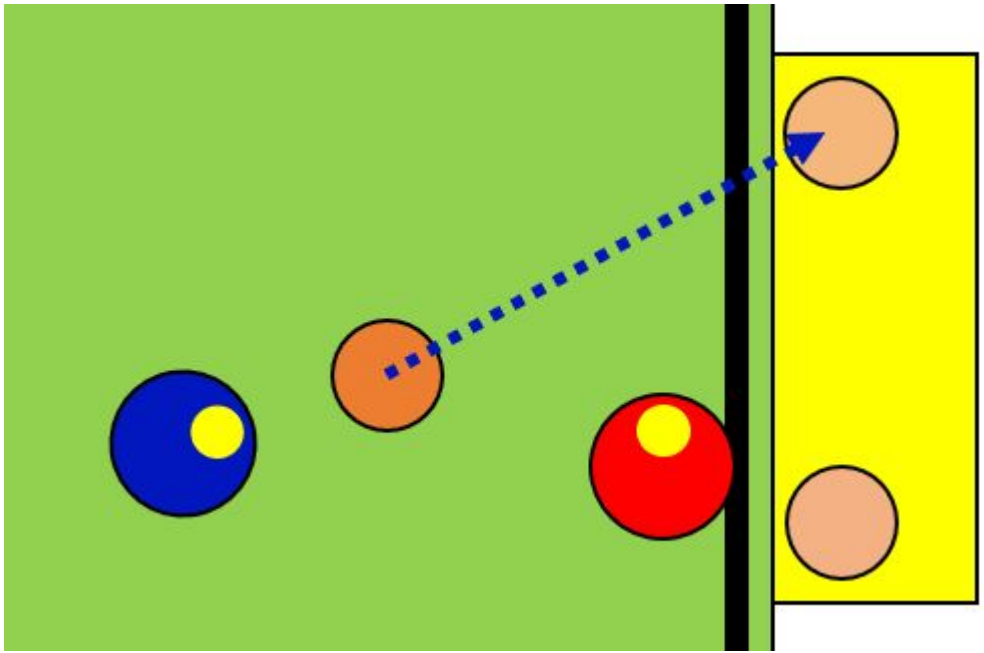
Question 2 b) - Prune Path

- Check if planned path has points outside of the playing field
- If yes: Move these points back into the playing field with an offset to the field boundary

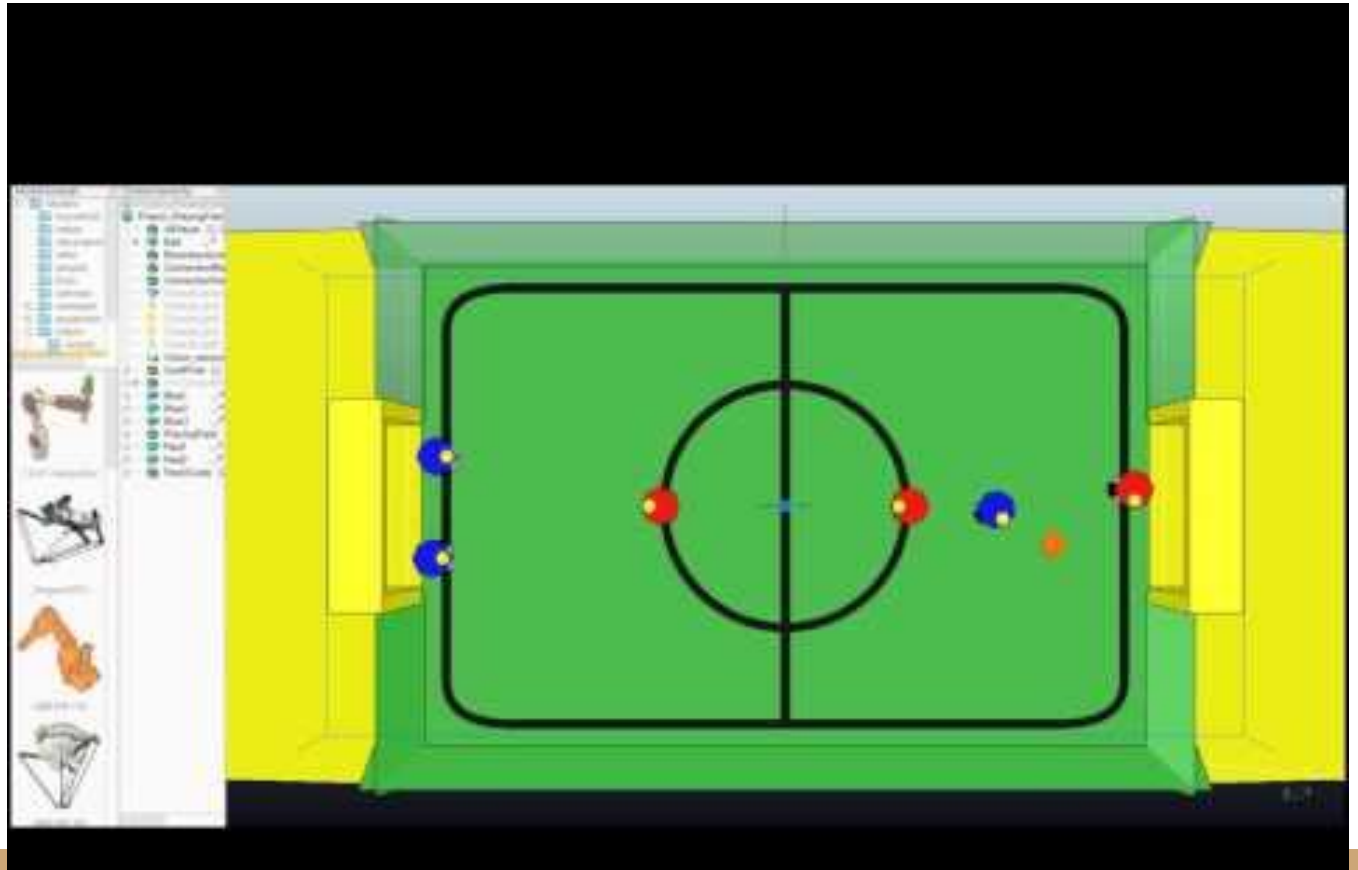


Question 2 b) - Shooting and Aiming

- Keeping track of (estimated) goalie Position
- Two aiming positions depending on that position
- Kicking the ball with high velocity using passPath



Question 2 - Presentation

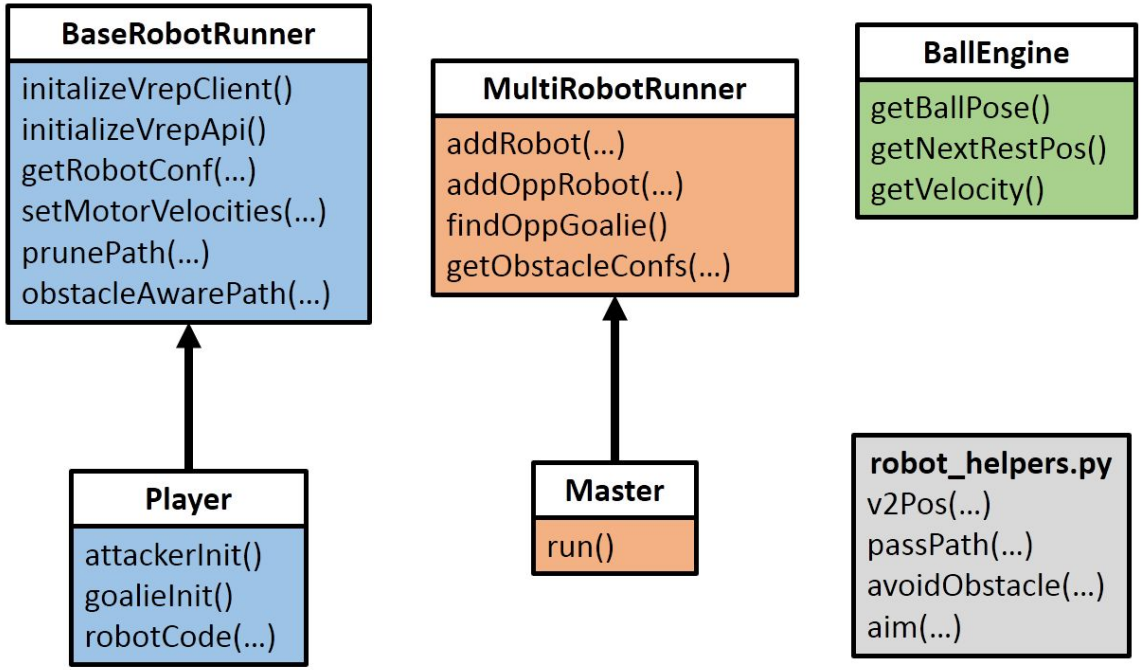


Question 2 - Pros and Cons

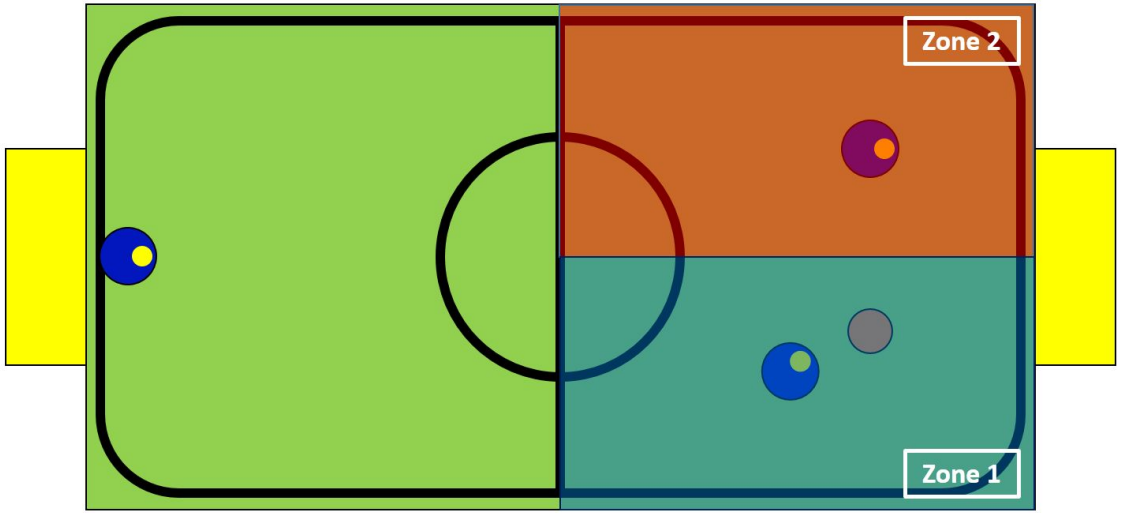
+ Ball Model ensures steady and reliable dribbling and passes
+ Pruned path is dead simple
+ Obstacle Avoidance is beautiful when plotted

- Dribbling is not continuous
- Hard coded: Active passing robot is persistent, even if pass is valid but not in the predefined zone
- Pruned path does not usually achieve intended ball trajectory

Question 3 - Program Structure

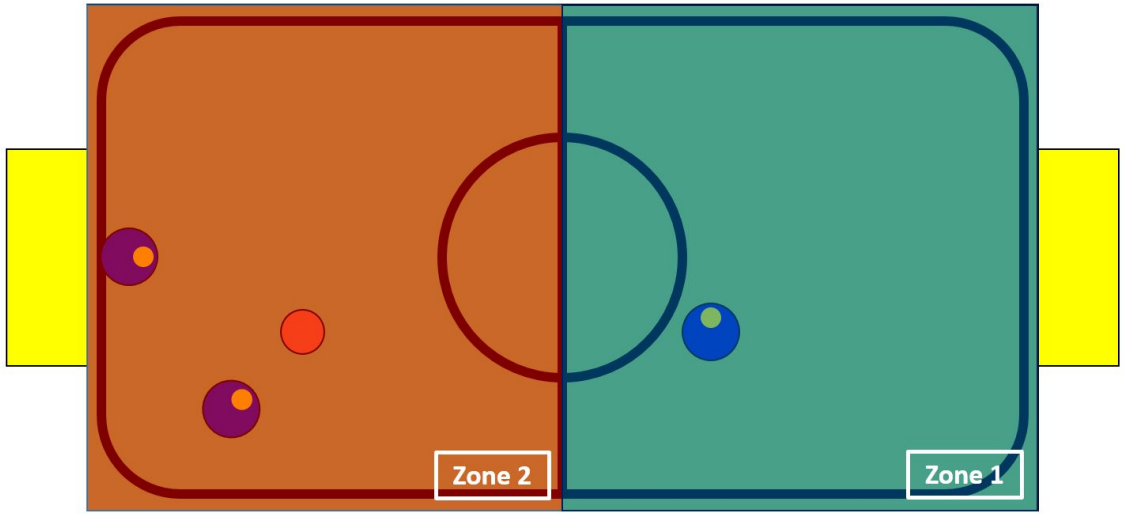


Question 3 - Offense



- Two attackers
- Closest player grabs the ball and tries to score
- Second attacker is ready to take over

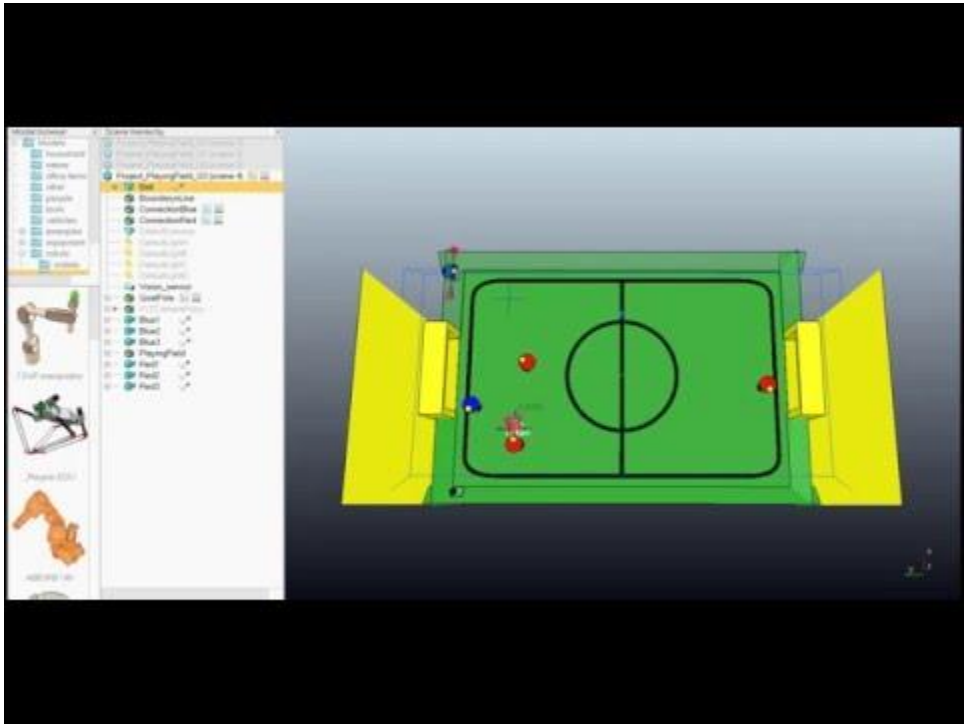
Question 3 - Defense



- One attacker stays up front to prevent the punishment
- Midfielder drops back and acts as a defender

Question 3 - Pros and Cons

+ Utilizing full offensive force, collaboratively!
+ Allows attacker persistence if ball is still in their possession
- No explicit communication to one another limits sophistication
- No awareness of opponent players aside from obstacle avoidance



Questions?