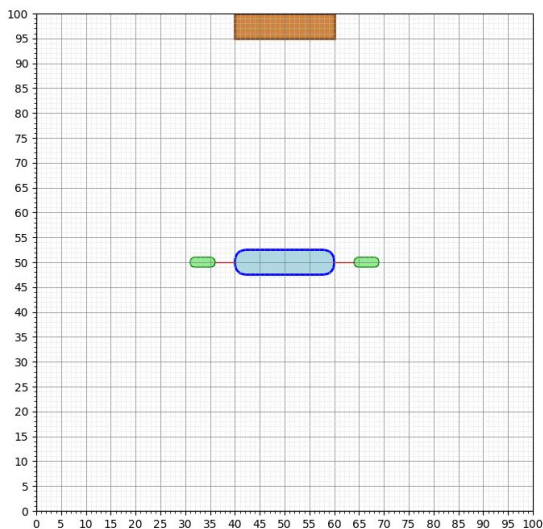
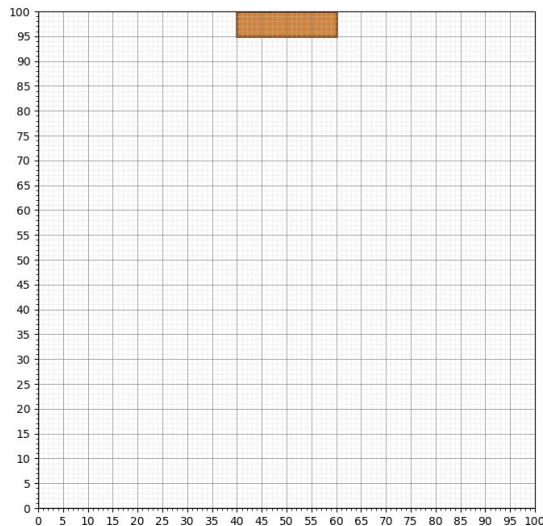


# ECS 427/627: Multi-agent Reinforcement Learning

Project Evaluation 1

# Project Title: Ship Towing and Berthing



The task of the agents is to align the **ship** (blue colored) attached to tugboats with red-colored **ropes** with the dock.

Environment: 100x100 grid.  
Brown box represent a dock.  
*Further obstacles can be added.*

Agents: green-colored **tugboats** and blue-colored **ship**.

- The length of the rope can vary (has max and min values)

**State space:** The continuous state space consists of:

- Ship's position  $(x_s, y_s) \in (0, 100]$  and heading  $\theta_s \in [0, 2\pi]$
- Both tugboats' position,  $(x_{t1}, y_{t1}) \in (0, 100]$ ,  $(x_{t2}, y_{t2}) \in (0, 100]$  and heading,  $\theta_{t1} \in [0, 2\pi]$ ,  $\theta_{t2} \in [0, 2\pi]$
- Distance of the ship from dock,  $d_s$ .
- Length of rope,  $l$ .

**Action space:** The continuous action space consists of:

- Forces exerted by each tugboat,  $F_{t1}$  and  $F_{t2}$
- Steering angle of tugboats  $\alpha_{t1}$  and  $\alpha_{t2}$ .
- Rotational force on ship,  $\tau_s$ .

**Reward:** Different reward functions needs to be tested.

- High positive reward for docking in right alignment
- Very low negative reward for collision (if obstacles present).
- Reward for reducing the distance from the dock.

# Approaches:

- Training of each agent independently to learn a policy using DQN, PPO, etc. without considering other agents.
- Learning joint policies for all agents.
- Communication between agent to improve coordination and so on...