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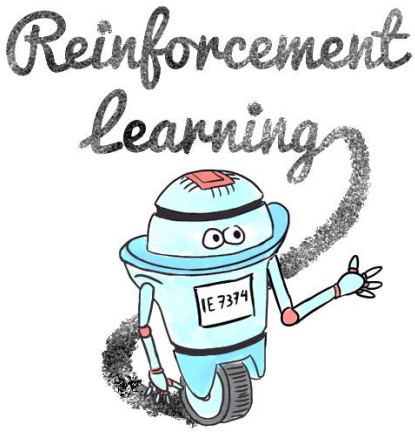

Reinforcement Learning with MATLAB

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Welcome to Reinforcement Learning with MATLAB modules! These guidelines will provide details on how to setup and access the software required for this lab. Along with this, a list of useful resources, documentations, and online MATLAB training is provided to brush-up your MATLAB skills. Please go through this document to understand the Lab structure.

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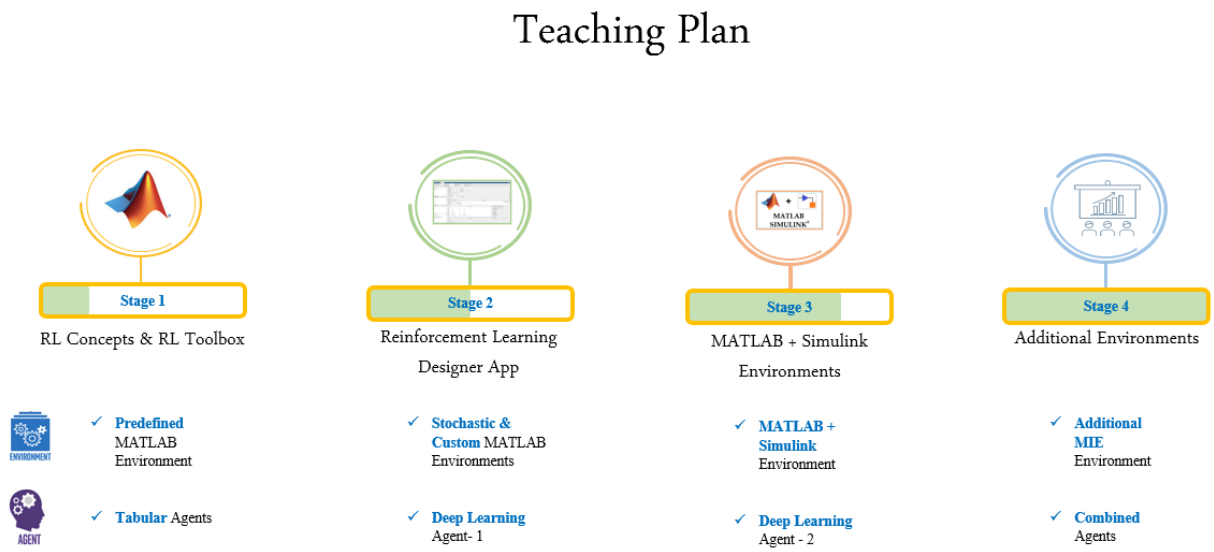
Understanding the Lab structure

This section provides a broad overview of the lab structure. It is divided into 4 stages. Each stage is built on top off the previous one. In stage 1 we start with learning RL concepts by manually coding the RL problem. Later we see how the same thing can be done by using functions available in MathWorks RL toolbox. In stage 2, we deal with complex environments and learn how Deep Learning agents are modelled and trained. Additionally, we see how to custom build an environment in MATLAB. Essentially, we develop a Gym like environment of our problem. Stage 3 introduces us to Simulink. We develop environments using Simulink RL blocks. Stage 4 brings us to **additional** environments of Mechanical and Industrial Engineering problems, that we will build using the concepts taught before.



Modules:

Stage	Module	Type	Comment
1	Simple MDP with manual Qlearning Agent	Class Module	Open the file Template_MDP_MATLAB Environment first
	Simple MDP with MATLAB Q-learning	Class Module	Open the file MDP_Train_MATLAB first
	Gridworld with SARSA	Assignment	
	Formulate MDP for given problems	Assignment	
2	Stochastic Gridworld with DQN	Class Module	Open the file StochasticGridworld
	Limitations of Tabular Agents	Explanation Doc	
	Custom Cart-Pole with DQN	Class Module	Open the file CartPole_DQN
	Assignment - Explore RL Training App Plot reward curves with different epp, gamma and initial q values	Assignment	
3	Controling Thermal Model of a House using a DDPG Agent	Class Module	Open the file ddpg_live(new)
4	Robot Walking	Class Module	Open file rlWalkingBipedRobot
	Portfolio Management	Class Module	Open file Portfolio Management

Documentation

1. Introduction

A brief information on features available in MathWorks RL toolbox can be found by visiting the RL toolbox home page (Link).

2. RL toolbox Documentation

The below mentioned documents would be referenced throughout the modules. Please visit this link to learn more about list of functions in RL toolbox.

Please make sure to download the PDF files as well.

3. Other Available resources

The table below provides you with a list of online training that can accessed on the MathWorks website. The trainings can be accessed once you register for an account using your university credentials. Please visit this link or contact your TA if you have any questions regarding this process.

Course	Description	Link
MATLAB Fundamentals	Introduction to Data Analysis, Visualization, Modeling, and programming *No prior MATLAB experience required.*	Link
Reinforcement Learning Onramp	Introduction to Reinforcement Learning *Prerequisites – MATLAB Fundamentals*	Link
Simulink Onramp	Create, edit, and simulate models in Simulink. *Prerequisites – MATLAB Fundamentals*	Link
Deep Learning Onramp	Interactive introduction to practical deep learning methods for Image Recognition *Prerequisites – MATLAB Fundamentals*	Link
Deep Learning with MATLAB	Theory and practice of building deep neural networks with real-life image and sequence data. *Prerequisites – MATLAB Fundamentals and Deel Learning Onramp*	Link

Lab Series

The Process Flow

Before we begin with the labs, first, let us understand the code structure. The figure below briefly explains the steps that goes into formulating an RL problem in MATLAB. Each step comes with a certain set of tasks. As you go through the lab codes you will find each lab is divided into the section mentioned in the figure.

➢ The structure

Each module follows a problem-based structure. Meaning, each RL problem is taught in the following structure.

Figure1: Process flow to develop an RL problem code

➢ Stage wise teaching modules

- Ensures that students with little or no background of RL or MATLAB can solve basic RL problems.
- Linear increase in the difficulty level in terms of exposure to RL concepts and MATLAB toolbox function.
- This ensures a clear visibility and understanding of how concepts and toolbox functions are built on top of each other.

➢ Covers range of Environments and Agents available in MATLAB and Simulink.

- The module covers Predefined and Custom [MATLAB + Simulink] Environments along with Tabular and Deep RL Agents
- Specifically focuses on Mechanical and Industrial Engineering environments.

➢ Designer Apps

- Along with using RL learning toolbox the modules cover usage of Reinforcement learning designer app and Deep Reinforcement learning designer app.

➢ Additional teaching material

- Along with Live script codes, the modules would be supported by allied teaching material, explaining steps followed, functions used, and assignments.
- Parallelly, we also put up a guide which sheds light on how to prepare RL teaching modules.

To conclude, these module series facilitate a range of students from undergraduate to graduate level, making it more accessible. A comprehensive teaching material which systematically teaches a variety of concepts and functions available in RL toolbox. And most importantly, exposes students to utilize RL for Mechanical and Industrial problems