

# **XCS229ii: Machine Learning Strategy and Intro to Reinforcement Learning**

## **Syllabus and Course Information**

## Welcome

Welcome to XCS229ii: Machine Learning Strategy and Intro to Reinforcement Learning! This professional course is based on graduate-level material from Stanford's on-campus course, CS229, adapted for a professional certificate format and split into two parts (XCS229i: Machine Learning and XCS229ii: Machine Learning Strategy and Intro to Reinforcement Learning) to make the content and workload more manageable for working professionals. In this course you will:

- Learn from Stanford classroom lecture videos that have been edited and segmented by topic for easier navigation, reference, and review.
- Complete three problem sets enhanced with additional supports and scaffolding.
- Receive support from Stanford-affiliated Course Facilitators.
- Design and complete a final project of your own choosing.
- Connect with a cohort of peers from diverse locations and professional backgrounds.

XCS229ii is an extension of XCS229i Machine Learning. If you'd like to review the materials covered in XCS229i, you can view [this Resource Handout](#).

## Note About Upcoming Changes to Our XCS229 Professional Courses

Beginning in Spring 2022, material from CS229 will be offered as a single course (XCS229), in line with all other courses in the program. The new course will include all topics in XCS229i and XCS229ii, but will not include the final project which is currently part of XCS229ii. This October cohort of XCS229ii is the final opportunity to take the second half of the XCS229i/ii course series, including the final project.

## Course Launch

All lecture videos will be available on the first day of the course (**October 4<sup>th</sup>**) at **12:00pm Pacific Time**. Course problem sets will be released as indicated in the calendar below, without exception. Maintaining this schedule enables Course Facilitators to be most effective in providing support and answering questions on subject matter throughout the course.

## Getting Started

This course will use different tools to distribute content, manage problem sets, and deliver support. They are:

- **SCPD Learning Management System** – accessed via the [mystanfordconnection](#) site which you used to apply to and enroll in this course.
- **GitHub** – to distribute code and data for the problem sets.
- **Slack** – for additional course support and class discussions.

### Joining Slack

In addition to direct small group support from Course Facilitators (more details and guidelines in [Course Facilitators, Support, and Guidelines](#) section below), the cohort will have a Slack workspace to ask additional questions and discuss course topics. An email invitation to the Slack workspace will be sent to your email address on file with SCPD on **October 1<sup>st</sup>**.

If you have previously joined an SCPD/Stanford Slack Workspace for a previous course in the AI Professional Program, Slack does not send a notification when our staff ‘re-invites’ you to this workspace. Instead, you are automatically re-activated, and on **October 1<sup>st</sup>** should proceed directly to <http://xcs229ii-scpd.slack.com/> → I have a guest account → Log in using your credentials.

### Joining GitHub

You will receive an email invitation to a GitHub team called “XCS229ii-Fall-2021” at your address on file with SCPD on **October 1<sup>st</sup>**. If you’d prefer that you receive a GitHub invitation at a different address, just let us know at [xcs229ii-staff@stanford.edu](mailto:xcs229ii-staff@stanford.edu).

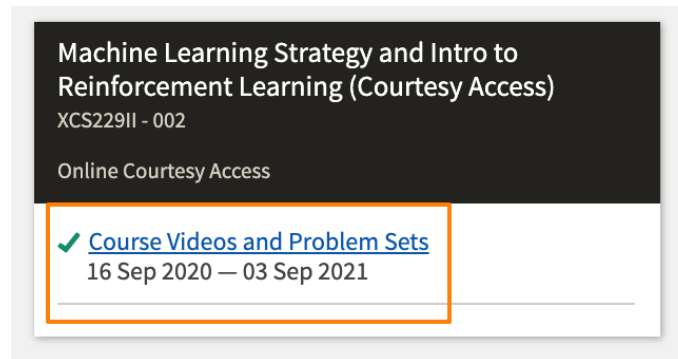
You will need to accept the invitation and be logged into your GitHub account in order to view course problem sets and code.

The team’s repository will be blank to begin with – code files will be added gradually as each problem set is released (see schedule below).

## Getting Started (On October 4<sup>th</sup>)

### Accessing Your Course

1. On **October 4<sup>th</sup> after 12pm Pacific Time**, log in to the [mystanfordconnection](#) account you used when applying for the XCS229ii course.
2. XCS229ii: Machine Learning Strategy and Intro to Reinforcement Learning will be visible as a live course. Click the link titled “Course Videos and Problem Sets” to enter our learning management system.



## Course Schedule

Week	Suggested Videos	Optional Live Sessions (will also be recorded)	Assignments
Weeks 1 & 2 (Oct 4 - 17)	<b>Module 4: Learning Theory</b> <i>Bias-Variance, Regularization, Train-Dev-Test Splits, Model Selection and Cross Validation, Approximation and Estimation Errors, Empirical Risk Minimizer and VC Dimension, Debugging ML Algorithms, Debugging RL Algorithms, Error Analysis</i>	<b>2 Project Team/Idea Mixers</b> Zoom - Times/Dates TBD	PS1 Released – Mon. Oct 4 PS2 Released – Mon. Oct 4
			PS1 Due – Fri. Oct 15
Weeks 3 & 4 (Oct 18 - 31)	<b>Module 5: Reinforcement Learning</b> <i>RL Introduction, Value Function, Value Iteration and Policy Iteration, Learning a Model for an MDP, Models and Simulation</i>	<b>Project Overview</b> Zoom - Time/Dates TBD	PS3 Released – Fri. Oct 22
			PS2 Due – Sun. Oct 24 Milestone 1 (Proposal) Due – Sun. Oct 31
Weeks 5 & 6 (Nov 1 - 14)	<b>Module 5: Reinforcement Learning</b> <i>Fitted Value Iteration, Finite Horizon MDPs, Linear Dynamical Systems, More Debugging, Policy Search and POMDPs</i>	<b>Project Check-In</b> Zoom - Time/Dates TBD	PS3 Due – Sun. Nov 7 Milestone 2 (Lit. Review) Due – Sun. Nov 14
Weeks 7-10 (Nov 15 - Dec 12)		<b>Optional Project Draft Presentation</b> Zoom - Time/Dates TBD	Milestone 3 (Exp. Protocol) Due – Sun. Nov 28 Milestone 4 (Final Paper) Due – Sun. Dec 12

## Problem Sets

Problem sets will be released via the SCPD course platform on the dates noted above in the course calendar. Below is a brief summary of what each problem set will entail:

### **Problem Set 1**

This problem set contains a series of multiple-choice questions focusing on Machine Learning theory. It includes a short, fictitious case study, some statistical theory revolving around the bias-variance tradeoff, and a look into interesting new Machine Learning research.

### **Problem Set 2**

In this problem set, you will apply reinforcement learning to automatically design a policy for a difficult control task, without ever using any explicit knowledge of the dynamics of the underlying system.

### **Problem Set 3**

In this problem set, you will implement the REINFORCE policy gradient algorithm to converge on a stochastic policy that solves a simple gridded environment.

## Project

The second half of the course is devoted to completion of a final project. Projects are required to be related in a substantive way to at least one of the topics of the course. The project is divided into five parts:

- Project Proposal
- Literature Review
- Experimental Protocol
- Final Paper
- (Optional) Project Draft Presentation or Video

Further details about each project component will be provided in a separate handout.

Along with the individual support of course facilitators, there will be a few optional (recorded) live sessions: Project Team/Idea Mixers and Project Overview that will guide students through the project process.

## Honor Code

Students will be asked to review and maintain the standards set forth by the [Stanford Honor Code](#) when completing problem sets in this course. You can review the section labeled *Violations of the Honor Code* for representative examples relevant to this course.

We strongly encourage students to form study groups. Students may discuss and work on homework problem sets in groups. However, each student must write down the solutions independently, and without referring to written notes from the joint session. **In other words, each student must understand the solution well enough in order to reconstruct it by him/herself.** In addition, each student should write on the problem set the set of people with whom s/he collaborated. Further, because we occasionally reuse problem set questions from previous years, we expect students not to copy, refer to, or look at the solutions in preparing their answers. It is an honor code violation to intentionally refer to a previous year's solutions.

## Grading

**Coding Questions** are graded automatically upon upload and will show your score. You can continue to re-submit up until the due date. To view an example of what this process looks like, you can view this video - [https://youtu.be/8T8RFwl\\_dZ0](https://youtu.be/8T8RFwl_dZ0)

**Written Questions** will be manually graded by Course Facilitators no later than one week after a problem set's 'on-time' due date. Problem sets turned in late may be graded slightly later. To view an example of what the written submission process looks like, you can view this video - <https://youtu.be/eEn826KNUqw> .

## Late Problem Sets and One-time Penalty Waiver

Late problem sets are assessed a penalty of **one point per day late, up to a maximum of five days late at which point the submission link will close.**

We understand that personal or professional events may cause you to miss a deadline on a problem set. Each student is able to use a **one-time, five-day penalty waiver on a problem set, which will not be assessed a scoring penalty.** The waiver cannot be split into smaller parts (e.g. you cannot use two days on Problem Set 1 and three days on Problem Set 3.). In order to use your waiver, contact your Course Facilitator or SCPD staff.

## Passing the Course and Earning the Certificate

In order to earn the Certificate of Achievement associated with this course, you must complete problem sets and project components with a total cumulative score of 70% or higher. Once you have successfully completed the course and the post-class survey, a digital Record of Completion will be emailed to you and the Certificate of Achievement will be mailed in a Stanford holder in approximately four weeks. If you are interested in calculating your progress along the way, it may be helpful to know:

- There are a total of 200 base points in the course (meaning 140 to achieve 70%)
- 8 extra points are available

## Videos and Slides

As noted, this course utilizes content originally delivered in the CS229 graduate course. A few things you will notice about this adaptation process:

- At times you will hear instructors make reference to the final project poster session. As noted above this has been removed from the current version of XCS229ii and you need not worry about the reference.
- Instructors may make reference to “Week 1”, “Week 2”, “Week n” of the course – these references can be ignored.
- In a few specific cases you may see names and/or faces blurred. In general, this is usually due to guidelines regarding student privacy.



## Course Facilitators, Support, and Guidelines

You have a wide range of support available to you throughout the course. You will be assigned and receive contact information for an individual Course Facilitator (CF) who will act as your primary point of contact. Below is a summary of the available resources and course support:

### Office Hours

Your CF will be in touch with availability and scheduling logistics for video conference office hours. Office hours may be conducted using the Zoom conference service or via Slack video (more information below on the course Slack workspace). Your CF will provide further information on how they will schedule and run office hour sessions.

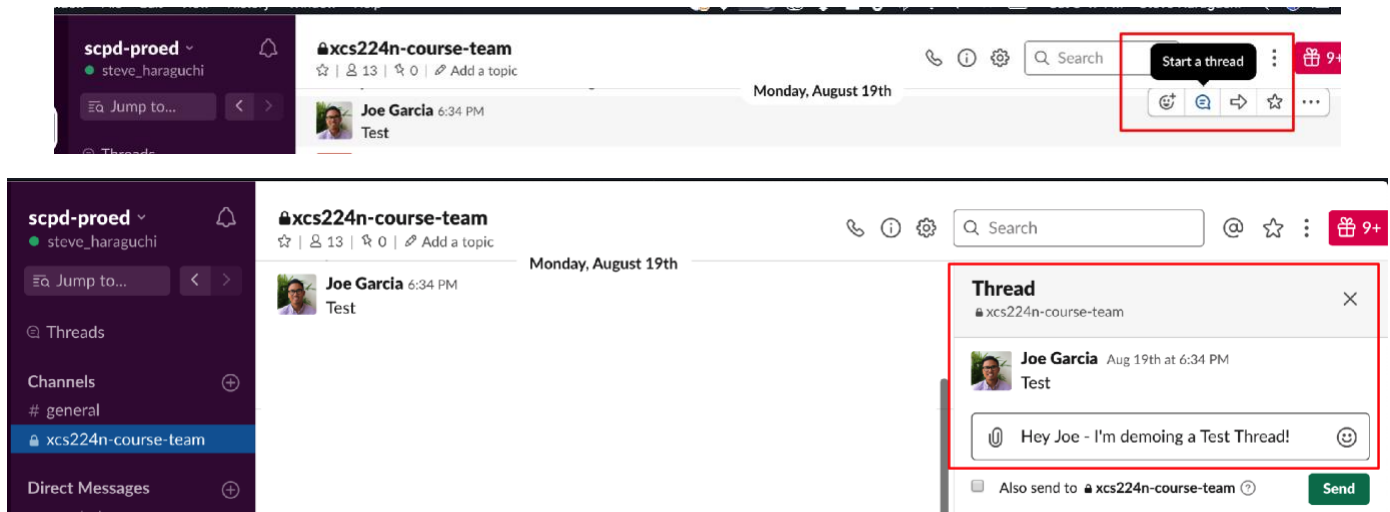
### Email

Your CF will also be available to answer questions via email – a Stanford contact address will be provided when you are first connected to your CF.

### Slack Workspace – Usage and Guidelines

In addition to the individual and small group support provided by CFs, Slack will be a place where questions may be posed to the entire community (this is the fastest way to get an answer!). **In order to keep the Slack workspace readable, searchable, and useful to all, please follow the following guidelines:**

**Reply in Threads to Keep Conversation Organized** – When you are replying to a post or joining a conversation, respond by starting or joining a threaded conversation, rather than responding in the full flow of the standard timeline. See below for an example of how to respond in a threaded conversation to Joe's test message:



**Use Multi-line Messages** – Even if messages are threaded, you will soon see that Slack becomes unmanageable unless people use **single, multi-line messages instead of multiple, single-line messages**. Especially for mobile Slack users, it gets out of control!

**Rather than the following:**

"Hey all I have a question" [RETURN] ← Creates new message

"I am a little confused about the quiz" [RETURN] ← Creates new message

"I'm getting F for Question 40, but it seems like T is better" [RETURN] ← Creates new message

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**Instead, try this!**

"Hey all I have a question" [SHIFT+RETURN] ← Creates new line in SAME message

"I am a little confused about the quiz" [SHIFT+RETURN] ← Creates new line in SAME message

"I'm getting F for Question 40, but it seems like T is better" [SHIFT+RETURN] ← Creates new line in SAME message

[RETURN] ← Posts message

## Note on Code Questions and Debugging

While the course team is here to help and support your experience, it is ultimately your responsibility to write, test, and de-bug your own code. CFs may view and provide guidance on your work, however they will not send you exact answers on what to insert into your problem sets. Additionally, before reaching out to a CF or Slack for help, it's expected that you have taken the reasonable steps of reading and performing an analysis yourself. This policy is meant to ensure that you leave the course having mastered the material and enable CFs to focus attention on questions where their guidance is most impactful.

## Drop/Transfer Policy

You may drop this course for a full refund up until October 4<sup>th</sup>, 2021 – the day the course starts. Once the course has begun, if you request to drop the course by Friday at 5:00pm PST on the third week of the cohort (**October 22<sup>nd</sup>, 2021**) you will be reimbursed 100% of your tuition minus a drop fee of \$100. Beyond the third week of the course, tuition refunds are not granted. Before **October 22<sup>nd</sup>, 2021** you may also request a transfer to a different course in the AI Professional Program, also for a \$100 transfer fee. To request a drop or transfer, send an email to [xcs229ii-staff@stanford.edu](mailto:xcs229ii-staff@stanford.edu)

## Questions

For course-specific questions or concerns (content, assignments, CF support), please contact your designated Course Facilitator.

For other course related questions, email [xcs229ii-staff@stanford.edu](mailto:xcs229ii-staff@stanford.edu)