Massachusetts Institute of Technology
6.176 Pokerbots Competition

IAP 2021
MWF Jan 4 – Jan 15
1:00–2:30 p.m. EST
Zoom Link: https://pkr.bot/class

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Links

Homepage:	https://pokerbots.org
Live Zoom Lecture:	https://pkr.bot/class
Zoom Office Hours:	https://pkr.bot/oh
Scrimmage Server:	https://pkr.bot/scrimmage
Canvas page:	https://pkr.bot/canvas
Piazza:	https://pkr.bot/piazza
Resources:	https://pkr.bot/resources
Instagram:	https://pkr.bot/instagram

Introduction

This course is an annual month-long programming competition in which students create an autonomous poker-playing algorithm, called a "pokerbot," in teams of one to four members. It emphasizes building computer science, game theory, and data analytics skills through the open-ended pokerbot design project over the course of IAP.

Students will learn how to think about developing their pokerbots by attending six lectures and will have the chance to test their skills in competition against their peers. During the two weeks of lecture, students will learn poker strategy and game theory as well as algorithm design and software architecture. A scrimmage server allowing teams to challenge each other will be run for the first three weeks of IAP with a mini tournament held at the end of each week. In the fourth week, teams may continue to work on their pokerbots separately. During the final competition, teams' finished pokerbots are put to the test in a tournament for larger prizes.

Poker is a complex yet highly accessible challenge: it's easy to learn, but difficult to be competitive in. Building a pokerbot is similar, as anyone can make an elementary bot, but building a competitive bot requires a deep understanding of the strategies adopted by other teams and how to contest them. At the heart of the Pokerbots competition is the challenge of applying the algorithmic and strategic thinking taught in theoretical courses.

Evaluation

To receive a passing grade in 6.176, students are expected to fulfill both of two requirements: participation on the scrimmage server, and completion of a final strategy report.

Participation

Pokerbots is designed to encourage exploration. Students who put more effort into trying new ideas to design a winning pokerbot will have greater learning opportunities and a better chance to win prizes. To earn 6 units of credit for participation in 6.176, students are expected to put sustained effort into developing their pokerbots. This will be judged by three weekly scrimmage server check-ins during which each team's pokerbot will be evaluated for improved performance relative to their previous week's submission and against a bot that implements a random strategy.

Make-up

If a team fails to improve their pokerbot from one week to the next, that team is expected to submit a half-page double-spaced make-up report describing the unsuccessful attempted improvements for the week. This is intended to avoid penalizing students who explore avenues that do not end up resulting in successful strategies. Make-up reports (if necessary) are due the Tuesday following each mini tournament.

Final Report

Each team is expected to submit a three to five page double-spaced strategy report outlining the techniques they used in developing their final pokerbot, due near the end of IAP. These reports are meant to catalog the effectiveness of strategies explored throughout the class, as well as describe the distribution of work. Diagrams are optional, but *highly* recommended. The report should highlight the strategic and/or architectural insights that went into your team's pokerbot.

Grading

All teams who meet the above requirements in good faith will receive a passing grade.

Structure

Over the course of IAP, students have five main touchpoints with the course: the lectures, the scrimmage server, Canvas, Piazza, and the final event.

Lectures

We will be giving 6 lectures, each which will be directly applicable to developing a successful pokerbot. Office hours will be held daily over the first three weeks of IAP. We'll also be holding giveaways during each of the lectures!

Scrimmage Server

The scrimmage server is how you will gauge the performance of your pokerbot relative to reference bots and other teams. On the scrimmage server, you can challenge your opponents and keep track of useful bot statistics. Furthermore, all pokerbot submissions are done via the scrimmage server. We'll be giving out prizes based on your performance on the server as well!

Canvas

Throughout this course we will be posting materials, announcements, and additional resources to Canvas. We will be providing detailed notes (along with slides) and a recording after every lecture as well. Materials will also be posted publicly on Github for the duration of the course.

Piazza

Piazza is an online forum we will be using to answer questions. You can post (publicly or privately to classmates) and a member of the Pokerbots team will respond as soon as possible. You are also encouraged to answer other students' questions, and we will be rewarding students who contribute the most in this manner over the month.

Final Tournament + Event

Pokerbots culminates in a virtual final event on January 29th, 2021. This is where we will announce the winners of the final pokerbots tournament, as well as give out many additional prizes. There will be fun and games, as well as a chance to meet our sponsors directly! More details about the final tournament and event will be posted on the course Piazza as the date approaches.

Timeline

Date	Day	Class	Deadline
Jan 4	Mon	Lecture 1: Intro to Pokerbots	
Jan 6	Wed	Lecture 2: Poker Theory	
Jan 8	Fri	Lecture 3: Game Theory	11:59 PM, Upload and select week 1 bot
Jan 9	**Sat**	**Mini Tournament #1**	
Jan 11	Mon	Lecture 4: Performance & Engineering	
Jan 13	Wed	Lecture 5: Advanced Topics	
Jan 15	Fri	Lecture 6: Guest Lecture: Noam Brown	11:59 PM, Upload and select week 2 bot
Jan 16	**Sat**	**Mini Tournament #2**	
TBA	**TBA**	**Poker Night Study Break** (with prizes!)	
Jan 22	Fri	No class	11:59 PM, Upload and select week 3 bot
Jan 23	**Sat**	**Mini Tournament #3**	
Jan 26	Tue	No class	11:59 PM, Strategy report due
Jan 27	Wed		11:59 PM, Upload and select final bot
Jan 29	**Fri**	**Pokerbots Final Event**	

Prizes

The prize pool for Pokerbots 2021 is over **$30,000.** Here's the breakdown:

Final Tournament Prizes	
First place	$5,000
Second place	$4,000
Third place	$3,000
First place in language (Python, Java, or C++)	$1,000 x 3
Second place in language (Python, Java, or C++)	$500 x 3
Third place in language (Python, Java, or C++)	$250 x 3
Best freshman-majority (>51%) team	$1,500
Most improved	$1,000

Scrimmage Server Weekly Tournament Prizes	
Weekly tournament winner	$1,000 x 3
Biggest upset	$500 x 3
Most improved	$750 x 2

Miscellaneous Prizes	
Most helpful piazza students	$250 x 3
Secret, unannounced prizes	$5,000

We'll also be holding raffles during each of the classes for great tech prizes!

Class Objectives

Monday 1/4/21: Introduction to Pokerbots	♠ Introduce rules of poker variant for Pokerbots 2021 ♠ Game engine overview ♠ Upload to scrimmage server ♡ Prepare students to start working by the end of class
Wednesday 1/6/21: Poker Strategy	♠ Understand hand types w/ example driven approach ♠ Learn betting strategy ♡ Pot odds ♡ Position ♡ Playstyle ♠ Live coding demo implementing strategy concepts - code available for download
Friday 1/8/21: Game Theory	♠ Normal- and extensive-form games ♠ Imperfect information ♠ Nash equilibria ♡ Deviating from Nash ♠ Adverse selection
Monday 1/11/21: Engineering & Performance	♠ Computational Complexity ♠ Algorithms and Data Structures ♠ Systems and Memory ♠ Code Optimizations
Wednesday 1/13/21: Advanced Topics	♠ Reinforcement learning ♡ Q-learning ♡ Counterfactual regret minimization ♠ Recent successes in algorithmic poker playing ♠ Neural Network and Deep Learning Techniques
Friday 1/15/21: Guest Lecture: Noam Brown	♠ Renowned computational poker researcher ♠ Creator of the Libratus and Pluribus poker algorithms ♠ Facebook AI researcher

Sponsors

Gold

Belvedere Trading is a leading proprietary trading firm proudly headquartered in downtown Chicago. Our traders work hard to provide liquidity to the market through their market-making activities and are the masters of a diverse set of commodity, interest rate, exchange-traded fund (ETF), and equity index options. This wouldn't be possible without the dedicated efforts of our technology teams who utilize and perfect our innovative technology solutions.

Citadel is a leading investor in the world's financial market and Citadel Securities is an award-winning global market maker that helps meet the liquidity needs of asset managers, banks, broker dealers and many more. We are two organizations with locations all across the globe.

DRW is a diversified trading firm with decades of experience bringing sophisticated technology and exceptional people together to operate in markets around the world and across many asset classes. We value autonomy and the ability to quickly pivot to capture opportunities, and so we operate using our own capital and trading at our own risk.

Headquartered in Chicago with over 10 offices around the world, we trade everything you'd expect from a leading firm, including Fixed Income, Equities, FX, Commodities and Energy. We also have leveraged our expertise and technology to expand into three non-traditional strategies: real estate, venture capital and cryptoassets.

We operate with respect, curiosity and an open mind, and the people who thrive here share our belief that it's not just what we do that matters but also how we do it. It's a place of high expectations, integrity, innovation and a willingness to challenge consensus.

Learn about our full-time and internship opportunities at drw.com/oncampus.

Gold (continued)

Five Rings is a proprietary trading firm founded with a vision of combining strategy, innovation and technology to succeed in today's global markets. Five Rings trades in various domestic and international markets, both established and esoteric.

Our team constantly seeks new opportunities, analyzes their risks and rewards, and creates strategies and tools to capitalize on them. We have an open culture and encourage the flow of knowledge and ideas between all areas of the firm. New hires work both independently and with others to develop ideas and analyses, and integrate them into our trading strategies and systems.

Our firm is a meritocracy and progress in both responsibility and compensation is rapid for those capable of demonstrating excellence in their particular field.

Five Rings does not depend on clients or outside investors. The strength of our firm comes from the talent of our people. Our highly competitive compensation package reflects this belief.

Hudson River Trading (HRT) brings a scientific approach to trading financial products. We have built one of the world's most sophisticated computing environments for research and development. Our researchers are at the forefront of innovation in the world of algorithmic trading.

At HRT we come from all sorts of backgrounds: mathematics, computer science, statistics, physics, and engineering. We're a community of self-starters who are motivated by the excitement of being at the cutting edge of automated trading. Our culture celebrates great ideas whether they come from HRT veterans or new hires. At HRT we're friends and colleagues, whether we are sharing a meal, playing the latest board game, or writing elegant code. We embrace a culture of togetherness that extends far beyond the walls of our office.

Seem like something you might be interested in? Our goal is to find the best people and bring them together to do great work in a place where everyone is valued. HRT is proud of our diverse staff; we have offices all over the globe and benefit from our varied and unique perspectives. HRT is an equal opportunity employer; so whoever you are we'd love to get to know you.

Gold (continued)

IMC is a leading global market maker buying and selling securities in all major asset classes on dozens of trading venues worldwide. Our cutting-edge systems and advanced trading strategies reduce transaction costs for market participants by ensuring tighter spreads between bid and offer prices. Pioneering the combination of advanced technology and trading expertise, IMC draws on three decades of industry experience to provide liquidity to financial markets globally. Founded in 1989 in Amsterdam, IMC is an ambitious, innovative company built on an open, collaborative culture where great ideas thrive. Today, IMC employs more than 700 traders, technologists and support staff across offices in Europe, the US and Asia Pacific.

SEVEN EIGHT CAPITAL, LP

At Seven Eight Capital, we take a scientific approach to applying the latest research, made possible with top-notch technology and years of market experience, to produce superior returns.

We are a hedge fund built on technology; over 90% of our employees write code on a daily basis. Producing cutting-edge trading infrastructure and algorithms requires a tightly integrated team where researchers need to understand code, and software engineers need to understand the models.

Our research process is built on hiring the best researchers and engineers and enabling the team to reach their full potential. We continually renew and refine our processes based on the latest academic research. We leverage the latest developments in massive scale computing, machine learning, and leverage the newest open-source technology. Our employees work with senior mentors to gain exposure to the different parts of the business and understand the broader picture - something we strongly believe leads to better results.

Silver

The D. E. Shaw group is a global investment and technology development firm. Founded in 1988 over a small bookstore in downtown New York City, we began with six employees and quickly became a pioneer in computational finance. Since then, we've built a reputation for successful investing based on persistent innovation, analytical rigor, careful risk management, and uniquely talented employees.

We're focused on collaboration, not internal competition—teams work together to share trade ideas, identify and address risks, build tools, and explore new opportunities. Our staff includes world-class mathematicians, economists, physicists, computer scientists, analysts, business-builders, and system architects relying on specialized trading, operational, and compliance expertise developed over 30+ years.

SIG is a global quantitative trading firm founded with a growth mindset and an analytical approach to decision making. We bring together the brightest minds, the best tech, and the most expansive library of data in the industry. Only by tapping into our diverse perspectives, can we truly reach our potential. At the end of the day, by thinking together we achieve winning results. Committing our own capital, we trade financial products around the globe. We improve the financial markets by providing liquidity and ensuring competitive prices for buyers and sellers. Working collaboratively and leveraging each other's strengths, we build virtually all of our own trading technology from scratch to implement our quantitative trading strategies that make us leaders in high performance, low latency trading.

At Two Sigma, our community of scientists, technologists and academics collaborate to solve some of the most challenging economic problems. We rely on the scientific method, rooted in hypothesis, analysis, and experimentation, to drive data-driven decisions, to manage risk, and to expand into new areas of focus. In this way, we create systematic tools and technologies to forecast the future of global markets.
