

CSE 415, 22wi: Introduction to AI

MWF at 1:30 in CSE2 G01. Weeks 1 - 4 here online
(</courses/cse415/22wi/uwnetid/zoom.html>).

Recordings in canvas (<https://canvas.uw.edu/courses/1515278>).

Schedule

(subject to change)

Wk.	Dates	Lecture slides (optional slides)	Reading (optional reading)
1	1/3, 5, 7	Intelligence (/courses/cse415/22wi/uwnetid/slides/lec00_intelligence/) ; Introduction (/courses/cse415/22wi/uwnetid/slides/lec01_intro.pdf) ; Agents (/courses/cse415/22wi/uwnetid/slides/lec02_agents.pdf) ; Search (/courses/cse415/22wi/uwnetid/slides/lec03_search.pdf)	R&N, 1,2,3.1
2	1/10, 12, 14	Informed Search (/courses/cse415/22wi/uwnetid/slides/lec04_search_informed.pdf)	R&N 3.2-end, 5.1-5.2; Search tool (http://qiao.github.io/PathFinding.js/visual/)
3	1/19, 21	Adversarial Search (/courses/cse415/22wi/uwnetid/slides/lec05_search_adversarial.pdf) ; Efficient Adversarial Search (/courses/cse415/22wi/uwnetid/slides/lec06_search_efficient.pdf)	R&N 5.3-5.5, (4)
4	1/24, 26, 28	Constraint Satisfaction Problems (CSPs) (/courses/cse415/22wi/uwnetid/slides/lec07_csp.pdf) ; CSP Solvers (/courses/cse415/22wi/uwnetid/slides/lec08_csp_solvers.pdf)	R&N 6.1-6.4, (6.5-end); CSP demo (/courses/cse415/22wi/uwnetid/csp/csp_den)
5	1/31, 2/2, 4	Markov Decision Processes (MDPs) (/courses/cse415/22wi/uwnetid/slides/lec09_mdp.pdf) ; MDP Solvers (/courses/cse415/22wi/uwnetid/slides/lec10_mdp_iteration.pdf)	R&N 17.1-17.3, (S&B 4.3-4.4)
6	2/7, 9, 11	Passive Reinforcement Learning (RL) (/courses/cse415/22wi/uwnetid/slides/lec11_reinforce_intro.pdf) ; Active RL (/courses/cse415/22wi/uwnetid/slides/lec12_reinforce_q.pdf)	R&N 22.1-22.3, (S&B 5.1-5.5)
7	2/14, 16, 18	Probability (/courses/cse415/22wi/uwnetid/slides/lec13_prob_intro.pdf) ; Graphical Models (/courses/cse415/22wi/uwnetid/slides/lec14_prob_graphs.pdf)	R&N 12, 13.1-13.3
8	2/23, 25	Graphical Models ; Independence (/courses/cse415/22wi/uwnetid/slides/lec15_prob_indep.pdf)	R&N 13.4-end
9	2/28, 3/2, 4	Exact Inference (/courses/cse415/22wi/uwnetid/slides/lec16_prob_exact.pdf) ; Markov Models (/courses/cse415/22wi/uwnetid/slides/lec17_prob_markov.pdf)	R&N 14.1-end; (S&B 14, 15)
10	3/7, 9, 11	Bayes' Net Sampling (/courses/cse415/22wi/uwnetid/slides/lec17_prob_sampling.pdf), Dynamic Bayes' Nets and Particle Filters (/courses/cse415/22wi/uwnetid/slides/lec18_prob_hmm_complex.pdf)	Hardt's Note (https://data102.org/sp20/assets/notes/note (B&H&N 1,2); R&N 27

Communication

For fastest response, contact us on Ed (<https://edstem.org/us/courses/16745>). Otherwise contact us over email at cse415-staff@cs.uw.edu.

We try to keep asynchronous course communication brief (namely on this page and in our responses on Ed). Please don't interpret this as cold. If you have any questions please reach out directly, whether in class, office hours, or in a privately scheduled meeting.

Staff and Office Hours

We will try to schedule office hours to accommodate students' schedules and will offer at least 20 percent of office hours virtually. If you're still not able to make this time, please reach out to us on Ed (<https://edstem.org/us/courses/14873/>).

Those of us with a physical location listed will mainly hold our office hours there and generally not in a hybrid fashion.

We will be enforcing room limits in office hours so for those of you unable to fit we may use a queue.

All times are Pacific.

- Instructor, Jared, time: **Mondays 2:30-3:30pm**, location: CSE 204 or online (</courses/cse415/22wi/uwnetid/jared.html>).
- Vivek, time: **Tuesdays 5:00-6:00pm**, location: online (</courses/cse415/22wi/uwnetid/vivek.html>).
- Will, time: **Wednesdays 2:30-3:30pm**, location: online (</courses/cse415/22wi/uwnetid/will.html>).
- Vinitha, time: **Wednesdays 3:00-4:00pm**, location: online (</courses/cse415/22wi/uwnetid/vinitha.html>).
- Phuong, time: **Thursdays from 2:00-3:00pm**, location: online (</courses/cse415/22wi/uwnetid/phuong.html>).
- Jeffrey, time: **Fridays 2:30-3:30pm**, location: CSE 153 or online (</courses/cse415/22wi/uwnetid/jeffrey.html>).

In addition to these regular hours, we will offer one additional virtual hour on the due date of each assignment which we will post about on Ed and list next to the relevant assignment in the preceding tables.

Assignments

Homework (written)

Individual assignments graded on correctness and due by 10pm on the day listed. Worth 50% of grade total. Make sure your answers are selected and visible when you submit them.

- You may handwrite and scan the homework if you would like, but the answers must be clearly visible (i.e. pencil may not work).
- Unless the question asks you to justify your answers, please do not add any explanations.
- When a question does ask you to justify your answer, it is enough to just provide justification for just the answer you chose.
- Please make sure to add the corresponding question tag to your solution to make grading easier. This may be cumbersome but will allow us to get you your homework grades more quickly.

Homework (HW)

Total Due Hours spent?
Points

1: Search (/courses/cse415/22wi/uwnetid/homework/hw1.pdf)	27	1/28	feedback (https://docs.google.com/forms/d/e/1FAIpQLSc48L6G5BPN88BHxwPU4U5FwYpsnk7G_N15EfzQ/viewform ;
2: CSPs (/courses/cse415/22wi/uwnetid/homework/hw2.pdf)	25	2/4	feedback (https://docs.google.com/forms/d/e/1FAIpQLSfr7iV_Voyw/viewform?usp=sf_link)
3: MDPs (/courses/cse415/22wi/uwnetid/homework/hw3.pdf)	25	2/11	feedback (https://docs.google.com/forms/d/e/1FAIpQLSfc8tA/viewform?usp=sf_link)
4: Q-Learning (/courses/cse415/22wi/uwnetid/homework/hw4.pdf)	26	2/25	feedback (https://docs.google.com/forms/d/e/1FAIpQLSeCscqkcF_nPusp=sf_link)
5: Uncertainty (/courses/cse415/22wi/uwnetid/homework/hw5.pdf)	26	3/4	feedback (https://docs.google.com/forms/d/e/1FAIpQLSfwbcxKDYVvusp=sf_link)
6: HMMs (/courses/cse415/22wi/uwnetid/homework/hw6.pdf)	30	3/11	feedback (https://docs.google.com/forms/d/e/1FAIpQLSf_blecMXPswQ/viewform?usp=sf_link)

Projects (programming)

Individual assignments graded on correctness and due by 10pm on the day listed. Worth 50% of grade total.

Projects (PR)	Total Points	Due	Hours spent?
0: Warm-up (/courses/cse415/22wi/uwnetid/project/0/)	3	1/7	feedback (https://docs.google.com/forms/d/e/1FAIpQLSdefYqz1vFeRVLS2dyloSOgb3NA/viewform?usp=sf_link)
1: Search (/courses/cse415/22wi/uwnetid/project/1/)	15	1/21	feedback (https://docs.google.com/forms/d/e/1FAIpQLScjXPYJAeb4njYusp=sf_link)
2: Multi-agent (/courses/cse415/22wi/uwnetid/project/2/)	19	1/31	feedback (https://docs.google.com/forms/d/e/1FAIpQLSeqn3W_OZKVmlnMda7usp=sf_link)
3: Q-learning (/courses/cse415/22wi/uwnetid/project/3/)	18	2/18	feedback (https://docs.google.com/forms/d/e/1FAIpQLSc1OUOTLrMKVNjOvT9gQ/viewform?usp=sf_link)

Practice Problems

Optional, graded on completion, open for collaboration, and due at 10pm on the day of the subsequent lecture (no late days accepted). (Because we have 30 days of class and only 20 lectures we'll release the due dates as the lectures are completed.) Review the correct answers on gradescope or below after the submission date.

Each completed problem adds: (number of completed practice problems) * (10 / total number of practice problems) to your grade, which will then be renormalized. (E.g. completing all of them is worth 10% of grade, in which case written and programming assignments are worth 45% each.)

Links posted on Gradescope (<https://www.gradescope.com/courses/345646>).

Practice (PP)

Lecture 02: Agents [Solutions

[\(/courses/cse415/22wi/uwnetid/practice/lec02_solutions.pdf\)](/courses/cse415/22wi/uwnetid/practice/lec02_solutions.pdf)

Lecture 03: Search [Solutions

[\(/courses/cse415/22wi/uwnetid/practice/lec03_solutions.pdf\)](/courses/cse415/22wi/uwnetid/practice/lec03_solutions.pdf)

Lecture 04: Informed Search [Solutions

[\(/courses/cse415/22wi/uwnetid/practice/lec04_solutions.pdf\)](/courses/cse415/22wi/uwnetid/practice/lec04_solutions.pdf)

Lecture 05: Adversarial Search [Solutions

[\(/courses/cse415/22wi/uwnetid/practice/lec05_solutions.pdf\)](/courses/cse415/22wi/uwnetid/practice/lec05_solutions.pdf)

Lecture 06: Expected Search [Solutions

[\(/courses/cse415/22wi/uwnetid/practice/lec06_solutions.pdf\)](/courses/cse415/22wi/uwnetid/practice/lec06_solutions.pdf)

Lecture 07: Constraint Satisfaction Problems (CSPs) [Solutions

[\(/courses/cse415/22wi/uwnetid/practice/lec07_solutions.pdf\)](/courses/cse415/22wi/uwnetid/practice/lec07_solutions.pdf)

Lecture 08: CSP Solvers [Solutions

[\(/courses/cse415/22wi/uwnetid/practice/lec08_solutions.pdf\)](/courses/cse415/22wi/uwnetid/practice/lec08_solutions.pdf)

Lecture 09: Markov Decision Processes (MDPs) [Solutions

[\(/courses/cse415/22wi/uwnetid/practice/lec09_solutions.pdf\)](/courses/cse415/22wi/uwnetid/practice/lec09_solutions.pdf)

Lecture 10: MDP Solvers [Solutions

[\(/courses/cse415/22wi/uwnetid/practice/lec10_solutions.pdf\)](/courses/cse415/22wi/uwnetid/practice/lec10_solutions.pdf)

Lecture 11: Passive Reinforcement Learning (RL) [Solutions

[\(/courses/cse415/22wi/uwnetid/practice/lec11_solutions.pdf\)](/courses/cse415/22wi/uwnetid/practice/lec11_solutions.pdf)

Lecture 12: Active RL [Solutions

[\(/courses/cse415/22wi/uwnetid/practice/lec12_solutions.pdf\)](/courses/cse415/22wi/uwnetid/practice/lec12_solutions.pdf)

Lecture 13: Uncertainty [Solutions

[\(/courses/cse415/22wi/uwnetid/practice/lec13_solutions.pdf\)](/courses/cse415/22wi/uwnetid/practice/lec13_solutions.pdf)

Lecture 14: Graphical Models [Solutions

[\(/courses/cse415/22wi/uwnetid/practice/lec14_solutions.pdf\)](/courses/cse415/22wi/uwnetid/practice/lec14_solutions.pdf)

Lecture 15: Bayes' Nets [Solutions

[\(/courses/cse415/22wi/uwnetid/practice/lec15_solutions.pdf\)](/courses/cse415/22wi/uwnetid/practice/lec15_solutions.pdf)

Lecture 16: d-separation [Solutions

[\(/courses/cse415/22wi/uwnetid/practice/lec16_solutions.pdf\)](/courses/cse415/22wi/uwnetid/practice/lec16_solutions.pdf)

Lecture 17: Markov Models [Solutions

[\(/courses/cse415/22wi/uwnetid/practice/lec17_solutions.pdf\)](/courses/cse415/22wi/uwnetid/practice/lec17_solutions.pdf)

Lecture 17.2: Markov Models [Solutions

[\(/courses/cse415/22wi/uwnetid/practice/lec17_2_solutions.pdf\)](/courses/cse415/22wi/uwnetid/practice/lec17_2_solutions.pdf)

Lecture 18: Sampling

Lecture 18.2: Particle Filtering

Lecture 19: Fairness and Causality

Policies

Submitting

- All work will be turned in electronically.
- Assignments should be done individually unless otherwise specified. You may discuss the subject matter with other students in the class, but all final answers must be your own work. You are expected to maintain the utmost level of academic integrity in the course, pertinent to the Allen School's policy (<https://www.cs.washington.edu/academics/misconduct>) on academic misconduct.
- Each student has six penalty-free late day for the whole quarter. Consecutive days off (weekends or holidays) count as one late day. Other than that, any late submission will be penalized at 20 percent of the submitted grade per day (weekends count as one day). (This should incentive you to attempt the assignments even if you submit them quite late).
- If seventy percent of you complete the end-of-quarter evaluations everyone will get an additional late day.
- The maximum late days that can be used per assignment is four.
- You must link pages to questions for written assignments submitted to gradescope. You will lose 0.25 point off the assignment if you do not do so. (For guidance watch this video (<https://youtu.be/u-pK4GzpldO>) on how to do this.)

COVID

Please stay home if you're ill. Lectures are recorded and most office hours are held remotely. If one of the course staff becomes ill we will move the appropriate events online. Consult the UW policies (<https://www.washington.edu/coronavirus/>) for more information.

Grade

- Your grade will be the proportion of points you achieve for the projects and the homework, each set weighted by one half.
- Additionally, completing practice problems will decrease the weight of the projects and homework, at a maximum of ten percent of the total.
 - Practice problems are not extra credit. Your grade will be renormalized (set to the range of $[0, 1]$) based on how many you complete.
 - That is, their effect will be exponentially discounted as you approach a perfect score.
- There will be no curve. Rather, your grade will be rounded to the highest decimal point out of four.
 - (The one possible exception to this is that no student gets a 4.0 in which case we would then increase every student's grade by the difference between the highest scoring student and 4.0. We do not expect this to happen but will alert you if there is an assignment for which the max score is greater than the maximum achieved score which would be a proxy for such an event.)
- If you're interested in specifics, we will use the following formula to calculate your grade:
 - $$\text{total}_{hw} = \frac{1}{2} \times \sum_{i \in HW} \max_{hw_i} \sum_{i \in HW} (\text{points}_{hw_i} \times \frac{1}{5} \text{late}_{hw_i})$$
 - $$\text{total}_{pr} = \frac{1}{2} \times \sum_{i \in PR} \max_{pr_i} \sum_{i \in PR} (\text{points}_{pr_i} \times \frac{1}{5} \text{late}_{pr_i})$$
 - $$\text{grade} = \text{bigg} \lceil \frac{\text{total}_{hw} + \text{total}_{pr} + \frac{\sum_{i=1}^{PP} pp_i}{10|PP|}}{1 + \frac{\sum_{i=1}^{PP} pp_i}{10|PP|}} \rceil \times 40 \text{bigg} \lceil / 10.0 \rceil$$
 - where the homework and project scores are $(\text{points}_{hw,pr} \in \mathbb{N})$, the maximum achievable scores are $(\max_{hw,pr} \in \mathbb{N})$, each practice problem is $(pp \in \{0,1\})$, and each day late for an assignment $(\text{late}_{hw,pr} \in \{0, 1, 2, 3, 4\})$, counting contiguous days off (holidays and weekends) as one and late days only applied to the first (and all subsequent) assignments after your total late days number greater than six.

Textbooks

- **Strongly Recommended:** Stuart Russell & Peter Norvig, *Artificial Intelligence: A Modern Approach* (<http://aima.cs.berkeley.edu/>), Prentice-Hall, Fourth Edition (2020) [R&N].
 - (Given how fast the field of AI is moving, the third edition from 2010 will likely suffice, but will not be much of a resource for further investigation.)
- Useful:
 - Melanie Mitchell, *Artificial Intelligence: A Guide for Thinking Humans* (

primo.hosted.exlibrisgroup.com/permalink/f/kjtuig/CP71310569700001451), Farrar, Straus, and Giroux. 2019.

- (This is a lay-oriented overview of AI which explains many of the intuitions and implications of the concepts we cover in this course.)
- Richard Sutton & Andrew Barto, *Reinforcement Learning: An Introduction Second Edition* (<http://incompleteideas.net/book/the-book.html>), MIT Press. 2018 (limited chapters freely available online) [S&B]
- Potentially useful:
 - Barocas, Hardt, and Narayanan. *Fairness and Machine Learning* (<http://www.fairmlbook.org>). 2019. [B&H&N]
 - Murphy, Kevin P. *Probabilistic Machine Learning: An introduction* (<https://probml.ai>), MIT Press. 2012, 2022. [M]
 - Mausam, Andrey Kolobov. *Planning with Markov Decision Processes: An AI Perspective* (<http://www.morganclaypool.com/doi/pdf/10.2200/S00426ED1V01Y201206AIM017>) Synthesis Lectures on Artificial Intelligence and Machine Learning. Morgan and Claypool Publishers. June 2012. (free online version if accessed from UW) (<https://courses.cs.washington.edu/courses/cse573/16wi/uwnetid/mk-text.pdf>) [M&K]

Discussion Board

Please use Ed (<https://edstem.org/us/courses/16745>) for course related questions.

Lectures

Lecture slides will be posted on this site before the relevant day. These are subject to revision of types typographic, syntactic, and semantic. We will alert the class if any major changes are made.

Lecture videos should upload to canvas automatically.

Inclusion

We welcome students from all backgrounds and adhere to the Allen School's Inclusiveness Statement (<https://www.cs.washington.edu/diversity>). If anything related to the course makes you feel unwelcome in any way, let the instructor know.

Accommodation

We are eager to provide necessary accommodations.

For disability accommodations, please see the UW resources. (<http://depts.washington.edu/uwdrs/current-students/accommodations/>.)

For religious accommodations, please see the UW resources. (<https://registrar.washington.edu/staffandfaculty/religious-accommodations-policy/>.)