

EECS 348: Introduction to Artificial Intelligence

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aka “willie”

It is not my aim to surprise or shock you—but the simplest way I can summarize is to say that there are now in the world machines that think, that learn and that create. Moreover, their ability to do these things is going to increase rapidly until—in a visible future—the range of problems they can handle will be coextensive with the range to which human mind has been applied.

Herbert Simon

1957

What is Artificial Intelligence?

AI is a HUGE field

Natural language generation Commonsense reasoning
Planning Qualitative reasoning Speech recognition
Image classification Logical inference
Data science Natural language processing Intelligent agents
Problem Solving Interactive agents Hierarchical task networks
Connectionism Automated reasoning Statistical pattern matching
Face recognition Natural language understanding Sentiment analysis
Computer vision Knowledge representation Constraint satisfaction Chatbots
Machine learning Topic modeling Analogical reasoning
Cognitive architectures Robotics Naive Bayes Neural networks
Deep learning And MUCH MUCH More

A few definitions:

Artificial Intelligence is the search for the answer to the fundamental question: Why are computers so stupid? -- Prof. Riesbeck

Systems that perform actions that, if performed by humans, would be considered intelligent -- Prof. Hammond

Artificial intelligence is the study of the computations that make it possible to perceive, reason, and act. -- Patrick Winston

Basic architecture

Sense

Perceive environment with sensors:

- Camera
- Microphone
- Radar
- Tactile

Think

Solve problems using knowledge and reasoning

Learn facts and models of the world

Act

Interact with environment through

- Physical action
- Speech
- Visual displays

Where we have an effect on our environment

Some AI things I have worked on...

Qualitative simulation of military operations

Mining scholarly articles to predict growing trends

Analogy-based model of affect appraisals

Utility-theoretic model of effect of empathy on moral decisions

Learning generalized robot actions from single exemplar

Social robot to assist in medication sorting

Architecture for managing robot's goals and actions

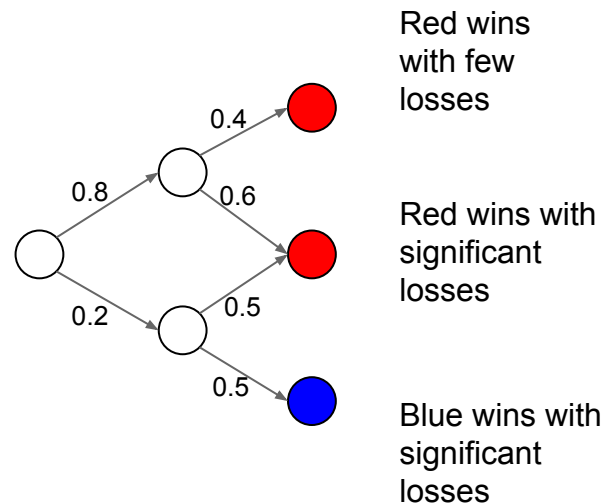
Qualitative simulation of military operations

Qualitative simulations rapidly produce multiple trajectories of possible outcomes of interactions

Uses Qualitative Process Theory to define military actions

Actions are *envisioned* to describe the possible ways an interaction may play out

Stochastic simulation then assigns probabilities to each branch



(Hinrichs et al., 2011)

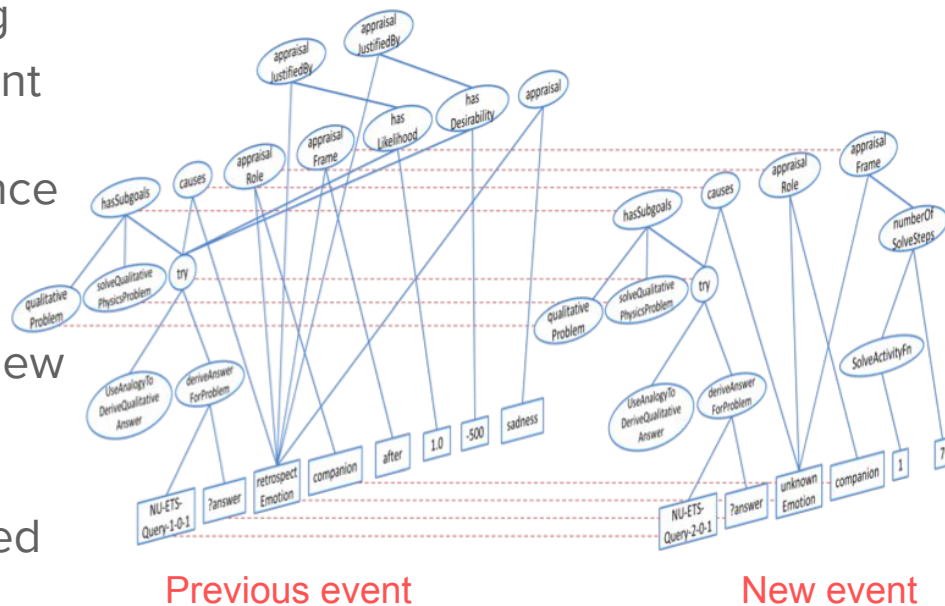
Emotions based on previous experience

Affect appraisal is a process of inferring emotions based on response to an event

Previous emotional experiences influence how we perceive a new event

Use analogical reasoning to compare new event and previous event

If events are similar, emotion is projected onto the new event



(Wilson et al., 2013)

Social and cognitive assistance from a robot

Organizing medications can be a challenging and stressful task for older adults, especially those with chronic disorders

Robot can monitor the person's progress and assist only when necessary, allowing the person to remain in control at all times

Robot uses algorithms to monitor sorting grid, determine what type of assistance to provide, and how much assistance to provide



(Wilson et al., 2016)

Knowledge

Central to how the robot works (and how most AI systems work) is the need to **represent knowledge**

- Know there are 7 days in a week
- Know about each medication
- Know about the events in a person's life
- Encode what it senses (what it see and hears)
- Know what actions it can take, and how those actions relate to what it senses

What are the goals of AI?

Think like a human Cognitive Modeling	Think rationally Logic-based Systems
Act like a human Turing Test	Act rationally Rational Agents

An **intelligent agent** takes the best possible action in a situation.

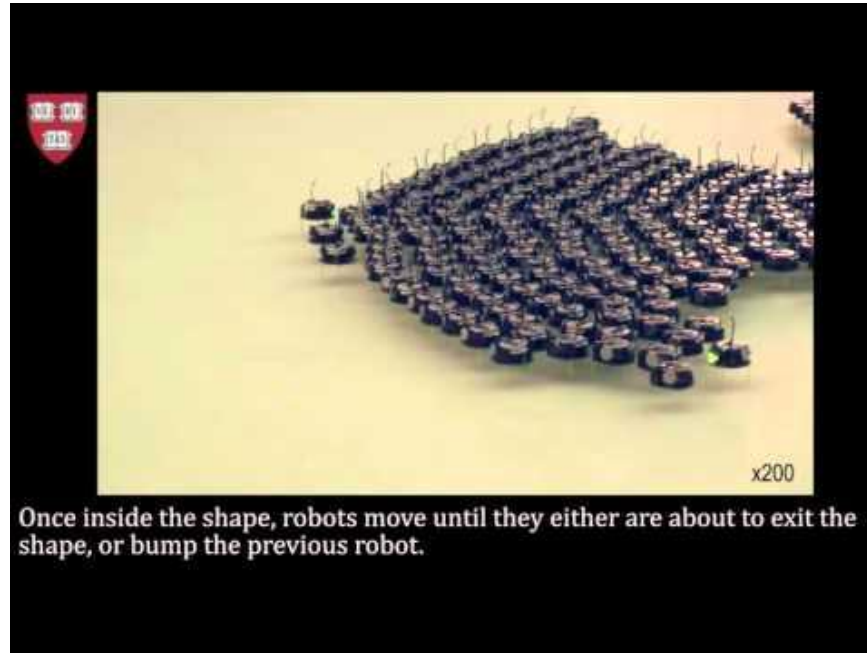
Interactive, Intelligent Agent

In addition to thinking and acting rationally,
an Interactive, Intelligent Agent communicates rationally.



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How do we build AI?

In this class, we

- Implement AI algorithms in Python

- Define knowledge in logical forms

Python

Python 3

Ideally, you should already be familiar with Python

Test yourself...

Python

```
def eightball(answers):  
    if answers == 1:  
        return "It is certain"  
    elif answers == 2:  
        return "Outlook good"  
    elif answers == 3:  
        return "You may rely on it"  
    elif answers == 4:  
        return "Ask again later"  
    elif answers == 5:  
        return "Concentrate and ask again"  
    elif answers == 6:  
        return "Reply hazy, try again"  
    elif answers == 7:  
        return "My reply is no"  
    elif answers == 8:  
        return "My sources say no"
```

What does this function return in each of these cases:

eightball(2)

eightball('foo')

eightball('1')

eightball(())

More Python

```
>>> friends = ['Allison', 'Buck', 'Carlos', 'Deepak', 'Esma', 'Fahad', 'Geshna']
>>> for i, name in enumerate(friends):
    print "Friend {f}: {n}".format(f=i, n=name)
```

What does this code print out?

```
Friend 0: Allison
Friend 1: Buck
Friend 2: Carlos
Friend 3: Deepak
Friend 4: Esma
Friend 5: Fahad
Friend 6: Geshna
```

```
>>> prices = {'apple': 0.19, 'banana': 0.49, 'mango': 0.99}
>>> my_purchase = {'apple': 4, 'banana': 5}
>>> grocery_bill = sum(prices[fruit] * my_purchase[fruit]
    for fruit in my_purchase)
>>> print 'I owe the grocer $%.2f' % grocery_bill
```

More more Python

```
>>> numbers = [1, 11, 14, 22, 31, 54, 55, 58, 80, 90, 94, 102, 103, 109]
>>> def do_something_with_list(big_long_list, num):
    return _process_list(big_long_list, 0, len(big_long_list)-1, num)

>>> def _process_list(big_long_list, start, end, num):
    if start==end:
        if big_long_list[start] == num:
            return start
        else:
            return None
    middle = int((end-start) / 2) + start
    if big_long_list[middle] < num:
        return _process_list(big_long_list, middle+1, end, num)
    else:
        return _process_list(big_long_list, start, middle, num)

>>> do_something_with_list(numbers, 14)
```

Logic

Not assumed you know the following, though it will be useful if you already do

$$p \wedge q$$

p	q	$p \wedge q$
T	F	?

$$p \wedge q \Rightarrow r$$

p	q	r	$p \wedge q \rightarrow r$
T	?	F	T

Logic 2

$\text{mother_of}(X, Y), \text{mother_of}(X, Z) \rightarrow \text{siblings}(Y, Z)$

$\text{mother_of}(\text{Mary}, \text{John})$

$\text{mother_of}(\text{Mary}, \text{Jane})$

$\text{siblings}(Y, Z)?$

$Y=\text{John}, Z=\text{Jane};$

$Y=\text{Jane}, Z=\text{John}$

Syllabus

Syllabus is posted on Canvas.
Please read in its entirety.

Goals

Structure

Staff

Assistance

Assumption

Grading and assignments

Integrity

Course goals

Gain knowledge and experience in fundamental AI topics

Develop skills in building AI technologies

Learn how to apply AI to real-world problems

Understand some of the social/ethical issues of intelligent systems

Staff

Instructor

Willie Wilson
jrw@northwestern.edu

Best way to contact us is piazza

Teaching Assistants

Ethan Robinson
yikes.gov@u.northwestern.edu
Zuohao She
zuohao@u.northwestern.edu

If privacy is necessary, you may email me directly

For questions about the material, please use piazza

Peer Mentors

Alex Morikado
Matt Paras
William Wang
Richard Huang
Sherwin Shen
Haishan Gao
Shankar Sawan
Joe Cummings

We all have office hours, lots of them

Student assistance

Textbook

- Artificial Intelligence: A Modern Approach
- Not required, but **highly** recommended

Office hours

- Over 30 hours most weeks
- Help with material
- Not for learning Python
- Be able to demonstrate what you have learned/done/tried so far before receiving assistance
- Hours posted on [Google calendar](#)

Piazza

- Post questions on the material
- Help peers answer questions
- TAs or PMs should respond to questions within 24 hours
- Use Northwestern email address to register
- Course material only
- Do not post any code!
- No discussion of grading or policies, no re-grading requests
- Violators will be removed from Piazza

Course structure

Lectures

MWF 4:00-4:50

Fridays may be a little different

Assignments

8 assignments, roughly 1/week

Lots of coding!

Exams

Midterm and final

Topics

Knowledge

Logic

Heuristic Search

Adversarial Search

Planning

Natural Language

Probabilistic Inference

Classification

Integrated Systems

Assumption

Class time is a great opportunity to learn new material

I assume that by attending class, you are here to learn

If you are here to browse the web, look at social media, chat with friends, read the news, etc. please sit in the back

Your activities affect those around you and may impede on other people's learning

Grading and assignments

Exams: 20%

Midterm exam (11/5, in class)

Final exam (12/13, 7pm)

Lab assignments: 80%

8 graded assignments

Assignments

8 assignments

Python programming assignments

Done **individually**

Due (almost) every Monday at 11:55 PM

Late submissions are penalized 4.17%/hour late

Last code submitted will be the one graded

Grading assignments

All grading for assignments will be done automatically

There will be no subjective component to the grades

We will not change assignment grades

Make sure submitted code runs, code that does not run will receive a 0

Academic honesty

Plagiarism is unacceptable

Code you submit must be your own

- No copying, adapting, or submitting code you did not create
- Working together and presenting variants of the same file is not acceptable
- Do not exchange code with others in any form (piazza, email, etc.)
- Do not copy solutions from any source, including web or previous quarters' students

Plagiarism detection will be applied to your code

All violations of the academic honesty policies will be immediately reported to the Dean's office

Assignments framework

GitHub Classroom

All code is distributed and submitted
via GitHub

You will need a GitHub account

You will need to know git

GitHub

If you don't already have an account,
create one now

In Canvas, find the **GitHub setup**
assignment

Complete assignment-0 by end of
Monday, October 1st


GitHub setup

Due Monday by 11:59pm **Points** 0 **Submitting** a text entry box

We will be using GitHub Classroom to manage all the code in this course. This includes distributing the starter code and committing your assignment.

You will need to create a GitHub account. If you don't already have one, create one now.

To link your NetID to your GitHub username, you will need to provide your GitHub username here. In the field below just enter your GitHub username.


Then proceed to assignment-0. Step-by-step instructions are here: [GitHubClassroomSetup.pdf](#) 

If you are new to Git, please take some online tutorials.










If you have any questions, we are available for help on piazza, find us there.

Text Entry

Copy and paste or type your submission right here.

 HTML Editor

B *I* U A A I ≡ ≡ ≡ ≡ ≡ x² x₂ ≡ ≡

        12pt Paragraph 

myGitHubName1

Assignment 0

Go to Assignment 0 in Canvas

In the description, there is a link to the code for the assignment

After clicking the link you should get a list of NetIDs, select yours

Clone the repository, edit your code, push it back to the repository

Detailed steps found in
GitHubClassroomSetup.pdf on Canvas

```
$ python main.py
.
-----
Ran 1 test in 0.000s

OK
$ git add student_code.py
$ git commit -m "Assignment complete, I hope"
[master 5541be] Assignment complete, I hope
 1 file changed, 1 insertion(+)
   Create mode 100644 student_code.py
$ git push origin master
Counting objects: 1, done.
Delta compression using up to 4 threads.
Compressing objects: 100% (1/1), done.
Writing objects: 100% (1/1), 115 bytes | 0 bytes/s,
done.
Total 1 (delta 0), reused 0 (delta 0)
To https://github.com/348-Fall-2018-xyz123/setup.git
   3b124e..5541be master -> master
```

Git tools

Command line tools, available on all platforms

GitHub Desktop, for Windows and Mac

Git tutorials:

<http://git.huit.harvard.edu/guide/>

http://kbroman.org/github_tutorial/

<https://try.github.io>

Assignment due dates

Assignment 0 is due Monday night (10/1)

Assignment 1 will be announced on Monday (10/1) and will be due 10/8

In general, an assignment will be almost every Monday

Exception being Midterm Monday

New assignments will be announced on the same day the previous assignment was due

Questions on the assignments?

A Brief History
