

AI Methods for Conversational Agents in Healthcare

Will Kearns, Aakash Sur

Instructors

- Will Kearns
 - 5th Year PhD
 - Knowledge Grounded Dialog Management and Consumer Health Question & Answering
 - kearnsw@uw.edu
- Aakash Sur
 - 5th Year PhD
 - Bioinformatics and Genome Assembly
 - asur@uw.edu
- Trevor Cohen
 - BHI Faculty
 - Semantic Representation and Knowledge Discovery
 - cohenta@uw.edu

Logistics

- Tuesdays from 11:30am - 12:20pm
- HST T478
- [Join on Slack](#)
- Course Readings (optional)
- Interactive Coding (Rasa & Pytorch/Tensorflow)
- Course Website <https://kearnsw.github.io/bime-591/>

Grading

- Pass/Fail
- 80% attendance required
- If you need to miss more, let us know
- Course participation on interactive coding sessions

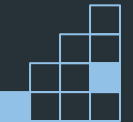
Class Introductions

Introduce yourselves!

1. Name, Program, and Year
2. Interest in AI & NLP

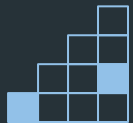
Health Dialog System Applications

- Medical Education
- Clinical Processes
- Mental Health
- Personal Health
- Patient Education





Medical Education



Type questions to Ms. Adler to:

1. Determine what allergies - if any - she might have.
2. Follow up to gather data about reaction type, treatment, and prevention.

When you have covered as many topics as you can think of, click 'Continue' to get feedback.



Do you have any allergies?

Yeah, I'm allergic to peanuts.

What happens when you eat peanuts?

Well, when I've eaten peanuts the inside of my mouth and inside my throat gets pretty itchy. It's weird. But I don't think I've ever had hives or anything like that.

Do you have any environmental aller|

Ask

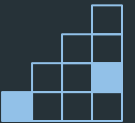
Educate

Empathize

Submit



Clinical Processes



MYCIN

24) Does Jane Doe have any cutaneous lesions or rash on physical examination?

NO

25) Does Jane Doe have evidence of ocular nerve dysfunction?

WHY

[i.e. WHY is it important to determine whether PATIENT-1 has evidence of ocular nerve dysfunction?]

[1.0] This will aid in determining the organisms (other than those seen on cultures or smears) which might be causing the infection.
It has already been established that

[1.1] the infection which requires therapy is meningitis.
Therefore, if

[1.2] Jane Doe has evidence of ocular nerve dysfunction
then

there is weakly suggestive evidence (.2) that *Mycobacterium-tb* is one of the organisms (other than those seen on cultures or smears) which might be causing the infection.

Author: Yu

[RULE366]

[Back to question]

##

TCR 00:17:09.23

PLAY

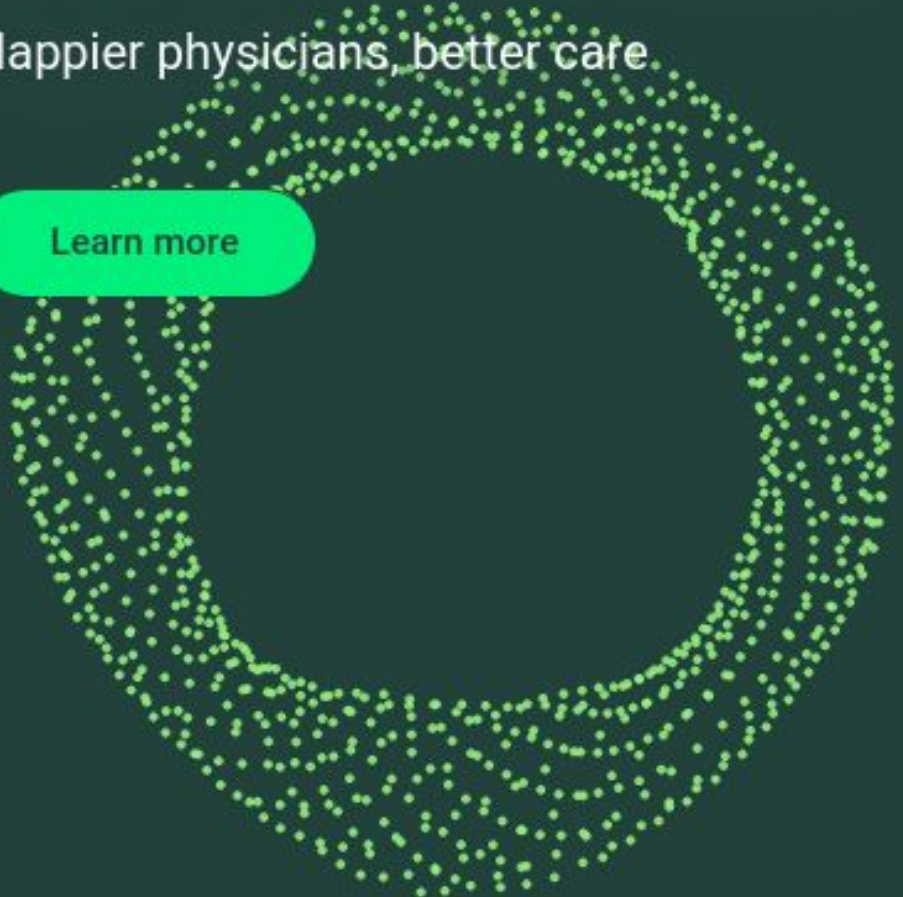
LOCK

Clinical Documentation

The AI-Powered Scribe

Happier physicians, better care

Learn more

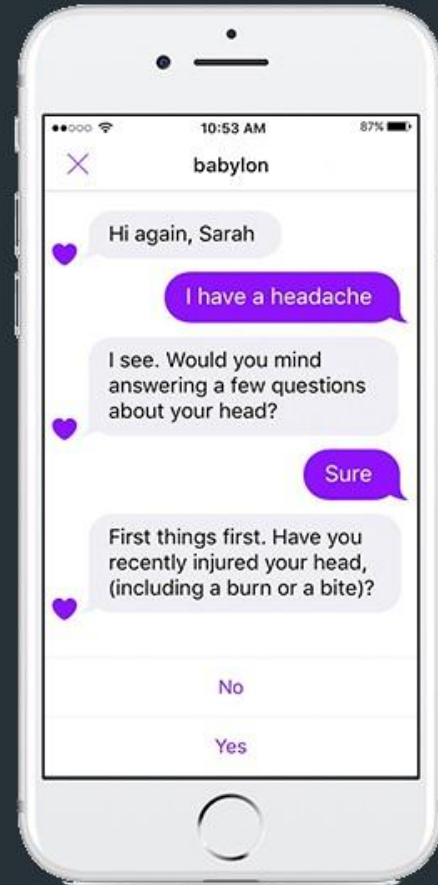


<http://www.saykara.com/>

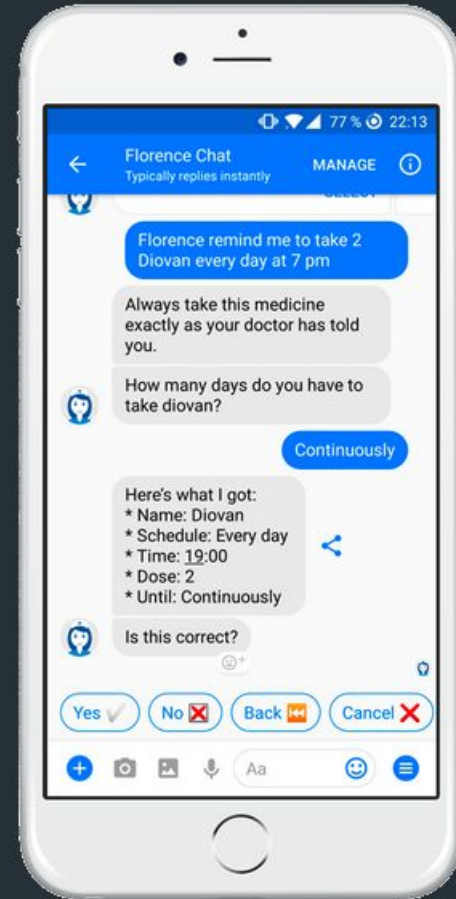


History Taking and Screening

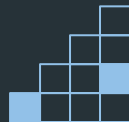
Symptom Checkers



Treatment Adherence



Mental Health



Welcome to

```
EEEEEE LL      IIII ZZZZZZZZ AAAAA
EE      LL      II     ZZ     AA  AA
EEEEEE LL      II     ZZZ     AAAAAA
EE      LL      II     ZZ     AA  AA
EEEEEE LLLLLL IIII ZZZZZZZZ AA  AA
```

Eliza is a mock Rogerian psychotherapist.

The original program was described by Joseph Weizenbaum in 1966.

This implementation by Norbert Landsteiner 2005.

ELIZA: Is something troubling you ?

YOU: Men are all alike.

ELIZA: What is the connection, do you suppose ?

YOU: They're always bugging us about something or other.

ELIZA: Can you think of a specific example ?

YOU: Well, my boyfriend made me come here.

ELIZA: Is it important to you that your boyfriend made you come here ?

YOU: He says I'm depressed much of the time.

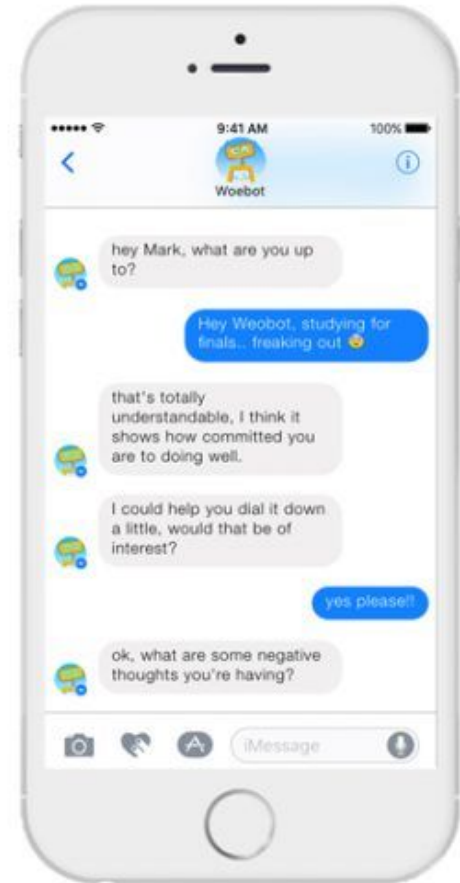
ELIZA: I am sorry to hear that you are depressed.

YOU: It's true. I am unhappy.

ELIZA: Can you explain what made you unhappy ?

YOU: █

Cognitive Behavioral Therapy



Fitzpatrick KK, Darcy A, Vierhile M. Delivering Cognitive Behavior Therapy to Young Adults With Symptoms of Depression and Anxiety Using a Fully Automated Conversational Agent (Woebot): A Randomized Controlled Trial. *JMIR Ment Heal*. 2017;4(2):e19.



Hi there, my name's William Ford. You can call me Bill. Pleased to meet you.

Now the suits want me to explain that I'm a virtual human, which means that I'm based on the real experiences and personalities of actual warfighters and their families. But I'm not affiliated with the military in any fashion. I'm here to listen, and I'm here to help, make sense?

Now the suits want me to explain that I'm a virtual human, which means that I'm based on the real experiences and personalities of actual warfighters and their families. But I'm not affiliated with the military in any fashion. I'm here to listen, and I'm here to help, make sense?

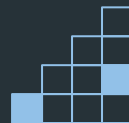
Send

Download

Stop

Veterans and their Families

Personal Health





During breakfast

C1: Do you have anything arranged for today?

U1: I'm playing Squash

C2: Is that before dinner?

U2: Yes

C3: Okay. Are you going to take the train to work?

U3: Yes

C4: Right. You could take in a packed lunch to work?

U4: Yes, that would be fine

Later on in the evening

C5: Welcome back! How did your game of Squash go?

U5: The game was cancelled, so I went to the gym

C6: Okay. Did you take the train to work?

U6: Yes, I did

C7: Right. Did you take in a packed lunch?

U7: No. I was in a rush so I went to the cafeteria

A physical exercise with the Mobile Companion

C8: Hello, what kind of exercise would you like to do?

U8: I would like to do some running

C9: Ok, running it is. Select start when you are ready.

After 12 minutes

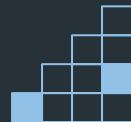
C10: You have been running for 12 minutes. The distance is 2.5 kilometres; the current pace is 5 minutes per kilometre.

U9: Okay, please play some relaxing music

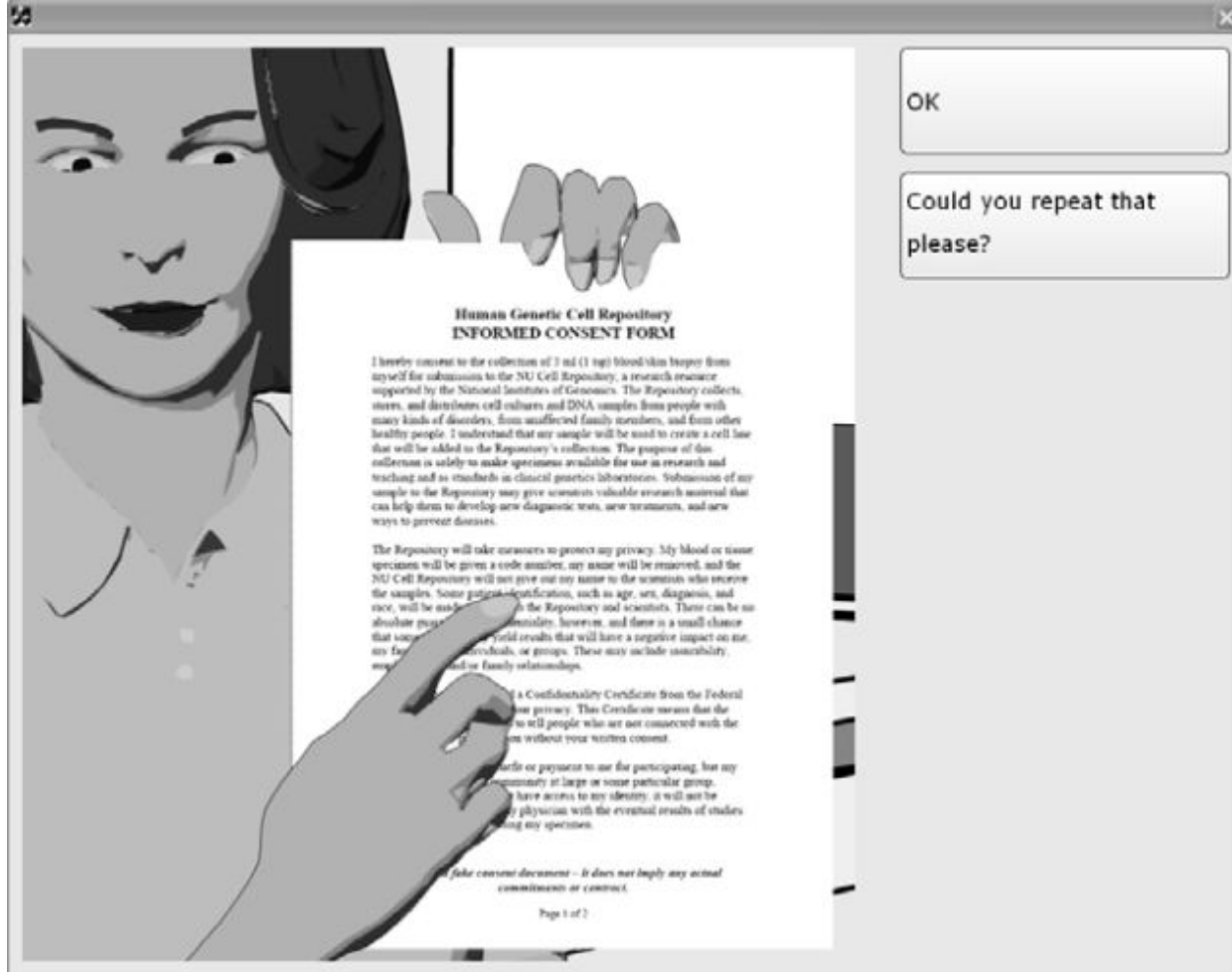
SNL



Patient Education

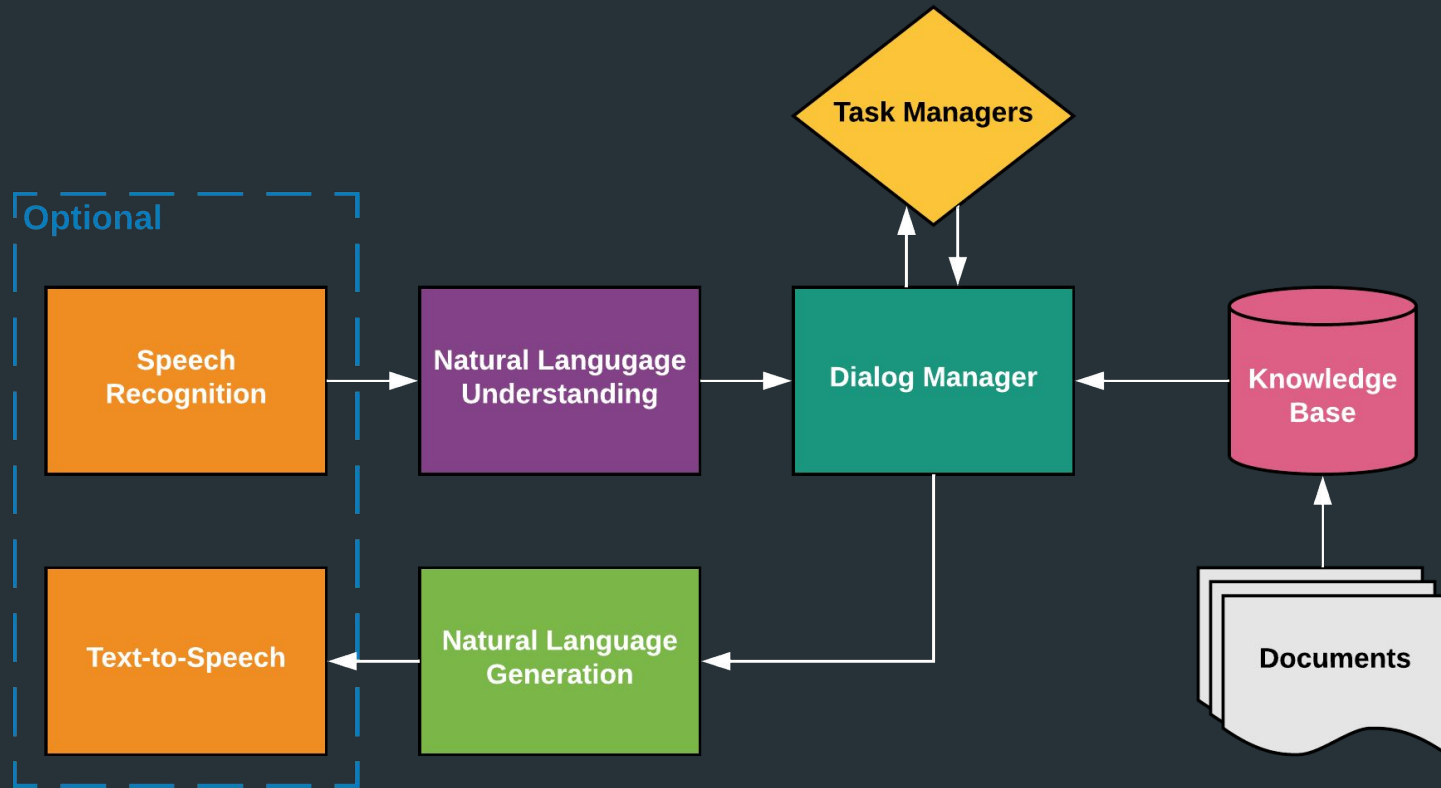


Patient Education



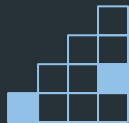
Bickmore, T. W., Pfeifer, L. M., & Paasche-Orlow, M. K. (2009). Using computer agents to explain medical documents to patients with low health literacy. *Patient Education and Counseling*, 75(3), 315–320.

Overview



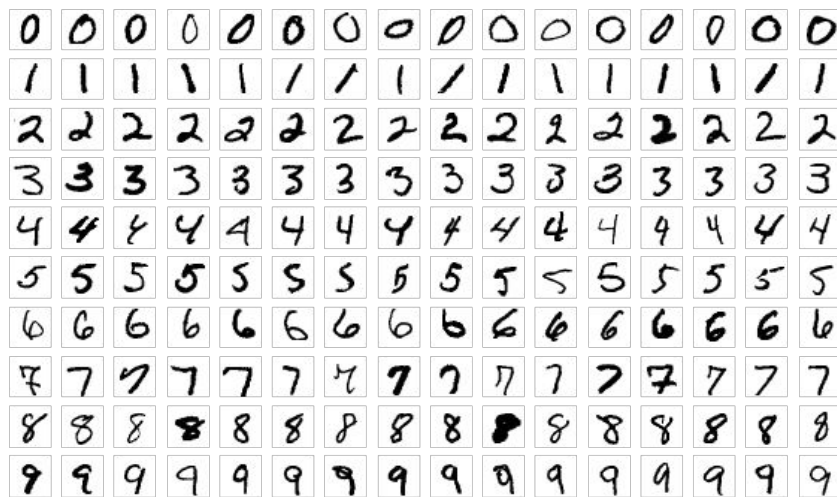


Training Dialog Systems

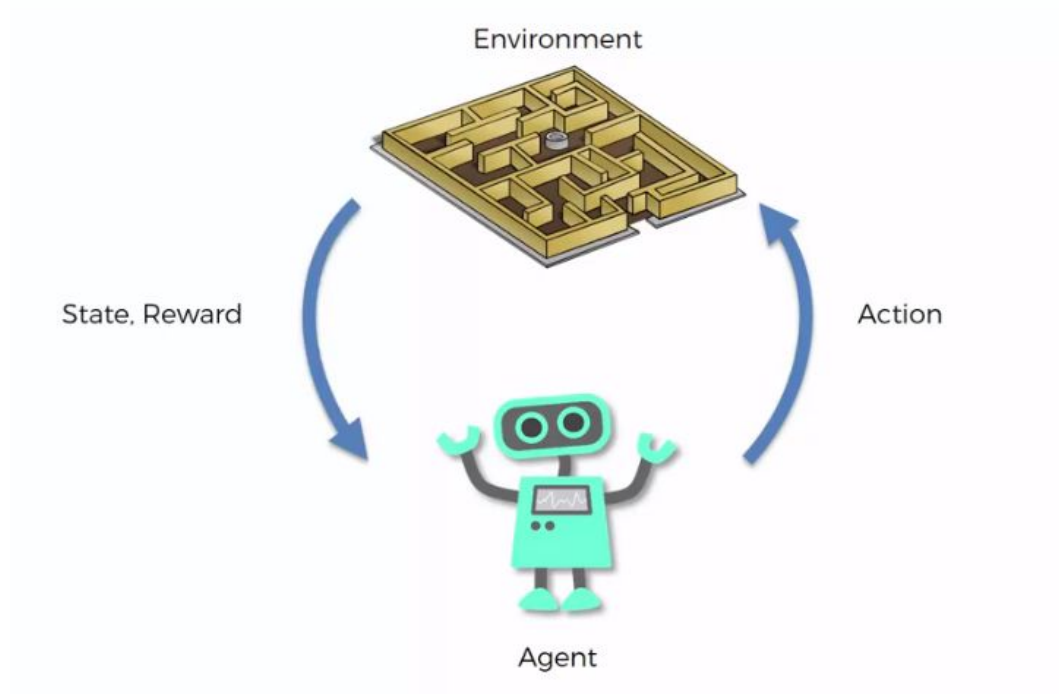


A Supervised Learning Approach

- What is supervised learning?
- Setting up conversations as supervised learning?
- Problems?



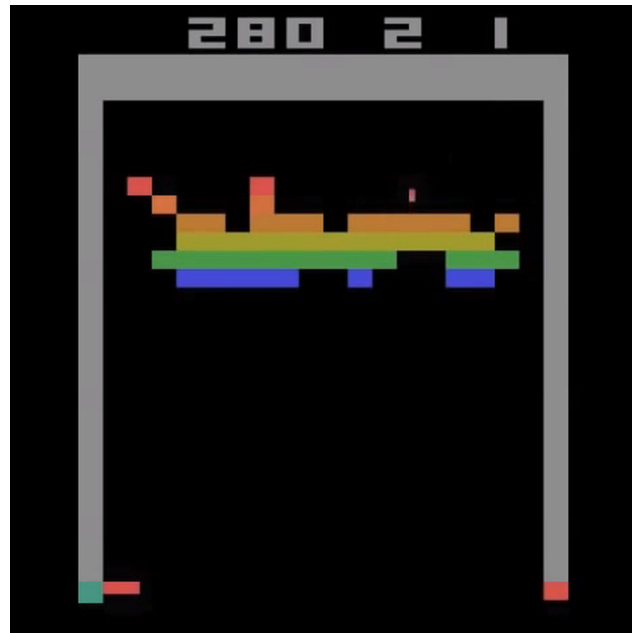
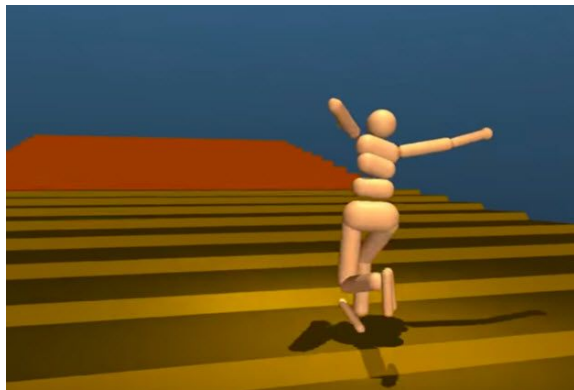
What is Reinforcement Learning?



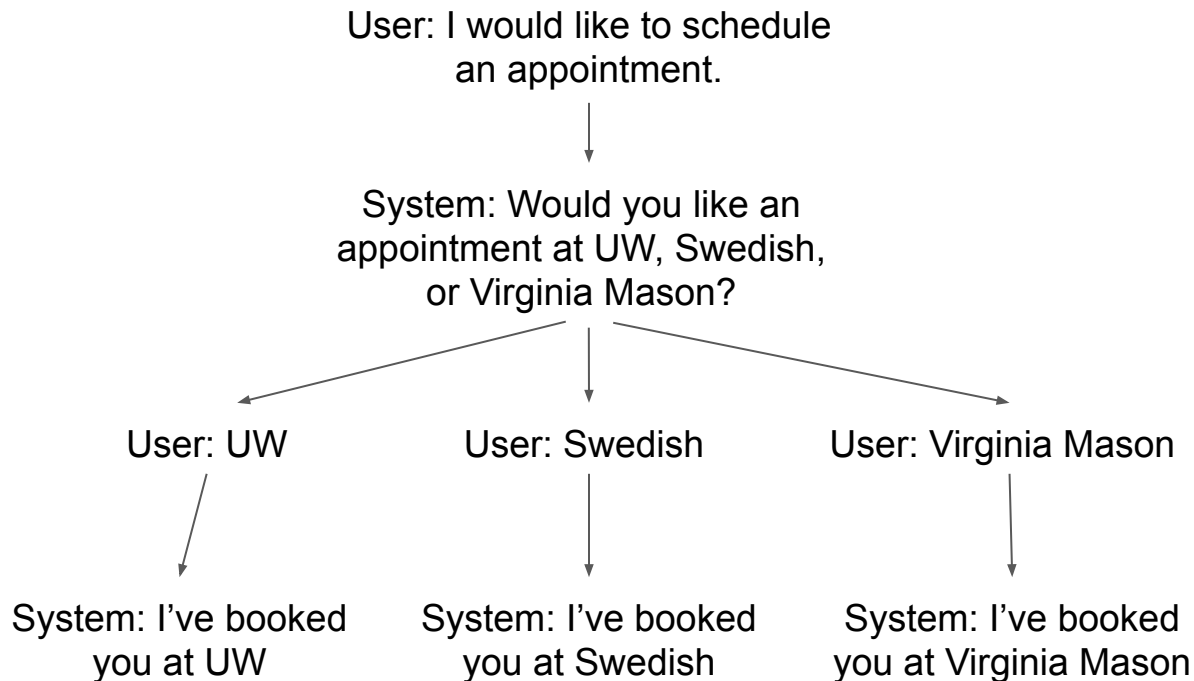
A Reinforcement Learning Approach

- Train an Agent
 - Perceive Environment
 - Choose Best Action
- Comparison to Supervised Learning
 - Develop a Policy
 - Labels are Delayed
 - Learns Optimal Strategy (vs Imitation)
- Applications
 - Robotics
 - Games
 - Dialogue Systems

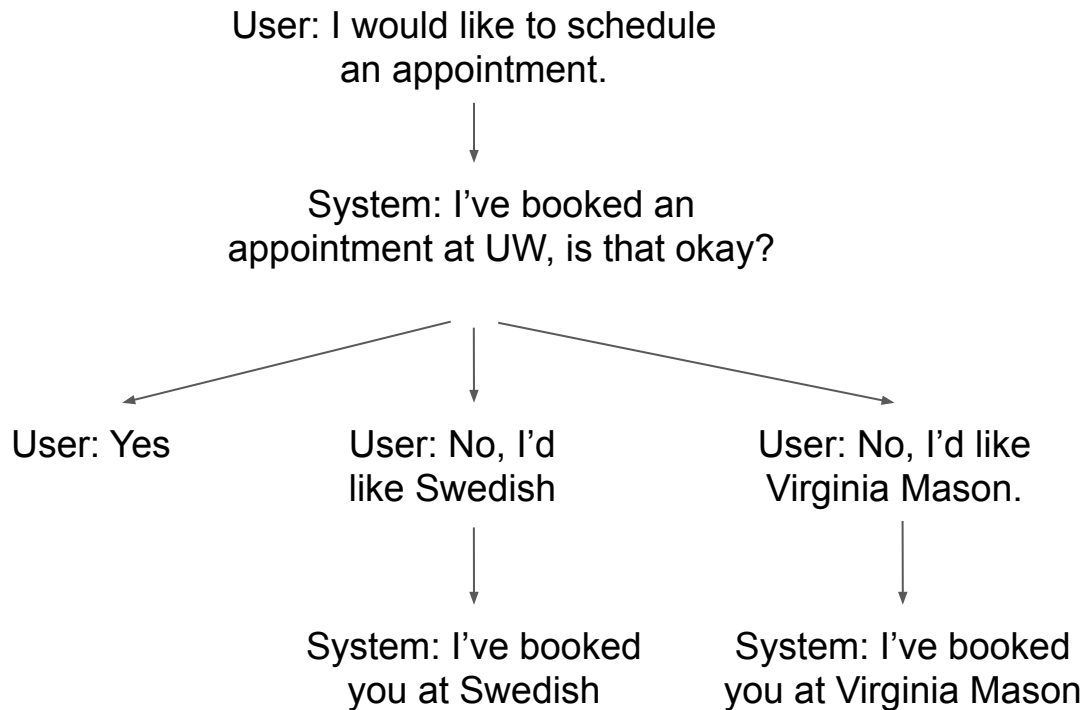
Where has RL been applied?



Example A



Example B



RL and Games

Game 1:

Guess the dice roll, and you win.

RL and Games

Game 2:

Guess the sum of two dice rolls, and you win.

Methods to Reach RL

- Decision Trees
- Markov Decision Processes
- Q-Learning
- Deep Q-Networks