Candy Grab Game

As you walk in:

1. Grab a pack of game pieces (candy)
2. Form groups of 2 (or 3 with an observer)
3. Play the game!
   A. 11 pieces on the table
   B. Take turns taking either 1 or 2 pieces
   C. Person that takes the last piece wins!
4. Think about how you might implement an Agent to play this in code:
   ```python
   class Agent:
       function getAction(state):
           return action
   ```
Course Staff

Instructors

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Course Information

Website: [https://www.cs.cmu.edu/~15381](https://www.cs.cmu.edu/~15381)

Canvas: [canvas.cmu.edu](https://canvas.cmu.edu)

Gradescope: [gradescope.com](https://gradescope.com)

Communication: [piazza.com](https://piazza.com)
E-mail: [pvirtue@cmu.edu](mailto:pvirtue@cmu.edu)

Prerequisites/Corequisites

Course Scope
Announcements

Recitation starting this Fri 3pm, GHC 4401 (recommended)
No class next Mon 1/21, MLK Holiday

Assignments:

- HW1 (online)
  - Released tomorrow
  - Due Tue 1/22, 10 pm

- P0: Python & Autograder Tutorial
  - Required, but worth zero points
  - Due Thu 1/24, 10 pm
What is artificial intelligence?

A brief history of AI

AI applications and techniques
Designing Rational Agents

An **agent** is an entity that *perceives* and *acts*.

A **rational agent** selects actions that maximize its (expected) *utility*.

Characteristics of the **percepts**, **environment**, and **action space** dictate techniques for selecting rational actions.

**This course** is about:
- General AI techniques for a variety of problem types
- Learning to recognize when and how a new problem can be solved with an existing technique
Pac-Man as an Agent

Pac-Man is a registered trademark of Namco-Bandai Games, used here for educational purposes
Pac-Man as an Agent
Candy Grab Agent

class Agent

    function getAction(state)

        return action
Candy Grab Agent

Agent 001 – Always choose 1

    function getAction()

    return 1
Candy Grab Agent

Agent 002 – Always choose 2

function `getAction` ( numPiecesAvailable )

    return 2
Candy Grab Agent

Agent 004 – Choose the opposite of opponent

```javascript
function getAction( numPiecesAvailable )
    return ?
```
Candy Grab Agent

Agent 007 – Whatever you think is best

```javascript
function getAction(numPiecesAvailable)
    return ?
```

function \texttt{getAction}( \texttt{numPiecesAvailable} )

\begin{verbatim}
    if \texttt{numPiecesAvailable} \% 3 == 2
        return 2
    else
        return 1
\end{verbatim}
Piazza Poll question
Games – Three “Intelligent” Agents
Which agent code is the most “intelligent”?
Games – Three “Intelligent” Agents

A: Search / Recursion

MAX (X)

MIN (O)

MAX (X)

MIN (O)

TERMINAL

Utility

-1
0
+1
Games – Three “Intelligent” Agents

B: Encode the pattern

function getAction( numPiecesAvailable )

    if numPiecesAvailable % 3 == 2
        return 2
    else
        return 1

<table>
<thead>
<tr>
<th>Value</th>
<th>Result</th>
</tr>
</thead>
<tbody>
<tr>
<td>10</td>
<td>Win</td>
</tr>
<tr>
<td>9</td>
<td>Lose</td>
</tr>
<tr>
<td>8</td>
<td>Win</td>
</tr>
<tr>
<td>7</td>
<td>Win</td>
</tr>
<tr>
<td>6</td>
<td>Lose</td>
</tr>
<tr>
<td>5</td>
<td>Win</td>
</tr>
<tr>
<td>4</td>
<td>Win</td>
</tr>
<tr>
<td>3</td>
<td>Lose</td>
</tr>
<tr>
<td>2</td>
<td>Win</td>
</tr>
<tr>
<td>1</td>
<td>Win</td>
</tr>
<tr>
<td>0</td>
<td>Lose</td>
</tr>
</tbody>
</table>
Games – Three “Intelligent” Agents

C: Record statistics of winning positions

<table>
<thead>
<tr>
<th>Pieces Available</th>
<th>Take 1</th>
<th>Take 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>0%</td>
<td>100%</td>
</tr>
<tr>
<td>3</td>
<td>2%</td>
<td>0%</td>
</tr>
<tr>
<td>4</td>
<td>75%</td>
<td>2%</td>
</tr>
<tr>
<td>5</td>
<td>4%</td>
<td>68%</td>
</tr>
<tr>
<td>6</td>
<td>5%</td>
<td>6%</td>
</tr>
<tr>
<td>7</td>
<td>60%</td>
<td>5%</td>
</tr>
</tbody>
</table>
Piazza Poll question

Games – Three “Intelligent” Agents

Which agent code is the most “intelligent”?

A. Search / Recursion

B. Encode multiple of 3 pattern

C. Keep stats on winning positions
Games – Three “Intelligent” Agents

C: Record statistics of winning positions

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AI in the News

https://www.youtube.com/watch?v=EfGD2qveGdQ

FEBRUARY 25, 2015

ARTIFICIAL INTELLIGENCE GOES TO THE ARCADE
BY NICOLA TWILLEY

A shaky video, recorded with a mobile phone and smuggled out of the inaugural First Day of Tomorrow technology conference, in April, 2014, shows an artificially intelligent computer program in its first encounter with Breakout, the classic Atari
Sci-Fi AI?
What is AI?

The science of making machines that:

- Think like people
- Act like people
- Think rationally
- Act rationally
Turing Test

In 1950, Turing defined a test of whether a machine could “think”
“A human judge engages in a natural language conversation with one human and one machine, each of which tries to appear human. If judge can’t tell, machine passes the Turing test”

en.wikipedia.org/wiki/Turing_test
What is AI?

The science of making machines that:

Think like people

Act like people
AI Definition by John McCarthy

What is artificial intelligence

- It is the science and engineering of making intelligent machines, especially intelligent computer programs

What is intelligence

- Intelligence is the computational part of the ability to achieve goals in the world

http://www-formal.stanford.edu/jmc/whatisai/whatisai.html
Rational Decisions

We’ll use the term **rational** in a very specific, technical way:

- Rational: maximally achieving pre-defined goals
- Rationality only concerns what decisions are made (not the thought process behind them)
- Goals are expressed in terms of the **utility** of outcomes
- Being rational means **maximizing your expected utility**

A better title for this course would be:

**Computational Rationality**
Maximize Your Expected Utility
What About the Brain?

- Brains (human minds) are very good at making rational decisions, but not perfect
- Brains aren’t as modular as software, so hard to reverse engineer!
- “Brains are to intelligence as wings are to flight”
- Lessons learned from the brain: memory and simulation are key to decision making
A Brief History of AI
A Brief History of AI

AI
Excitement!
1950-1970

Knowledge Based Systems
1970-1990

https://books.google.com/ngrams
What went wrong?

Dog
- Barks
- Has Fur
- Has four legs

Buster
- Barks ✓
- Has Fur ✓
- Has four legs ✗
A Brief History of AI

AI Excitement! 1950-1970

Knowledge Based Systems 1970-1990

Statistical Approaches 1990--

https://books.google.com/ngrams

artificial intelligence
machine learning
formal logic
big data
A Brief History of AI

1940-1950: Early days
- 1943: McCulloch & Pitts: Boolean circuit model of brain
- 1950: Turing’s “Computing Machinery and Intelligence”

1950—70: Excitement: Look, Ma, no hands!
- 1950s: Early AI programs, including Samuel's checkers program, Newell & Simon's Logic Theorist, Gelernter's Geometry Engine
- 1956: Dartmouth meeting: “Artificial Intelligence” adopted
- 1965: Robinson's complete algorithm for logical reasoning

1970—90: Knowledge-based approaches
- 1969—79: Early development of knowledge-based systems
- 1980—88: Expert systems industry booms

1990—: Statistical approaches
- Resurgence of probability, focus on uncertainty
- General increase in technical depth
- Agents and learning systems... “AI Spring”?

2012—: Where are we now?
What Can AI Do?

Quiz: Which of the following can be done at present?

✓ ▪ Play a decent game of table tennis?
✓ ▪ Play a decent game of Jeopardy?
✓ ▪ Drive safely along a curving mountain road?
✓ ▪ Drive safely across Pittsburgh?
✓ ▪ Buy a week's worth of groceries on the web?
✓ ▪ Buy a week's worth of groceries at Giant Eagle?
✓ ▪ Discover and prove a new mathematical theorem?
✓ ▪ Converse successfully with another person for an hour?
✓ ▪ Perform a surgical operation?
✓ ▪ Put away the dishes and fold the laundry?
✓ ▪ Translate spoken Chinese into spoken English in real time?
✗ ▪ Write an intentionally funny story?