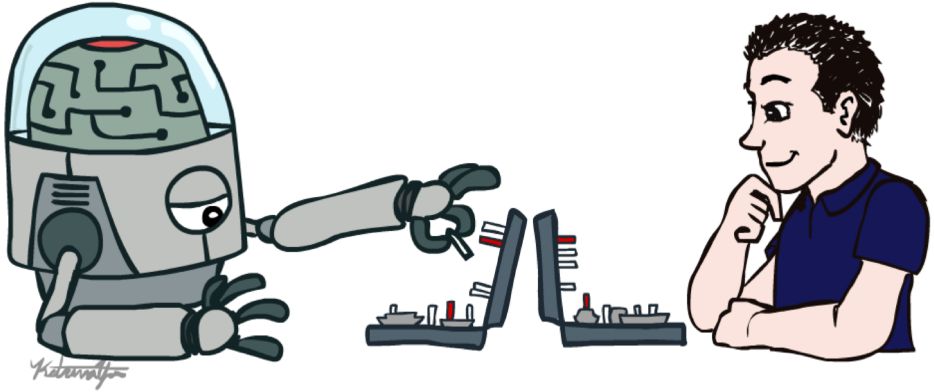
CS 188: Artificial Intelligence

Introduction



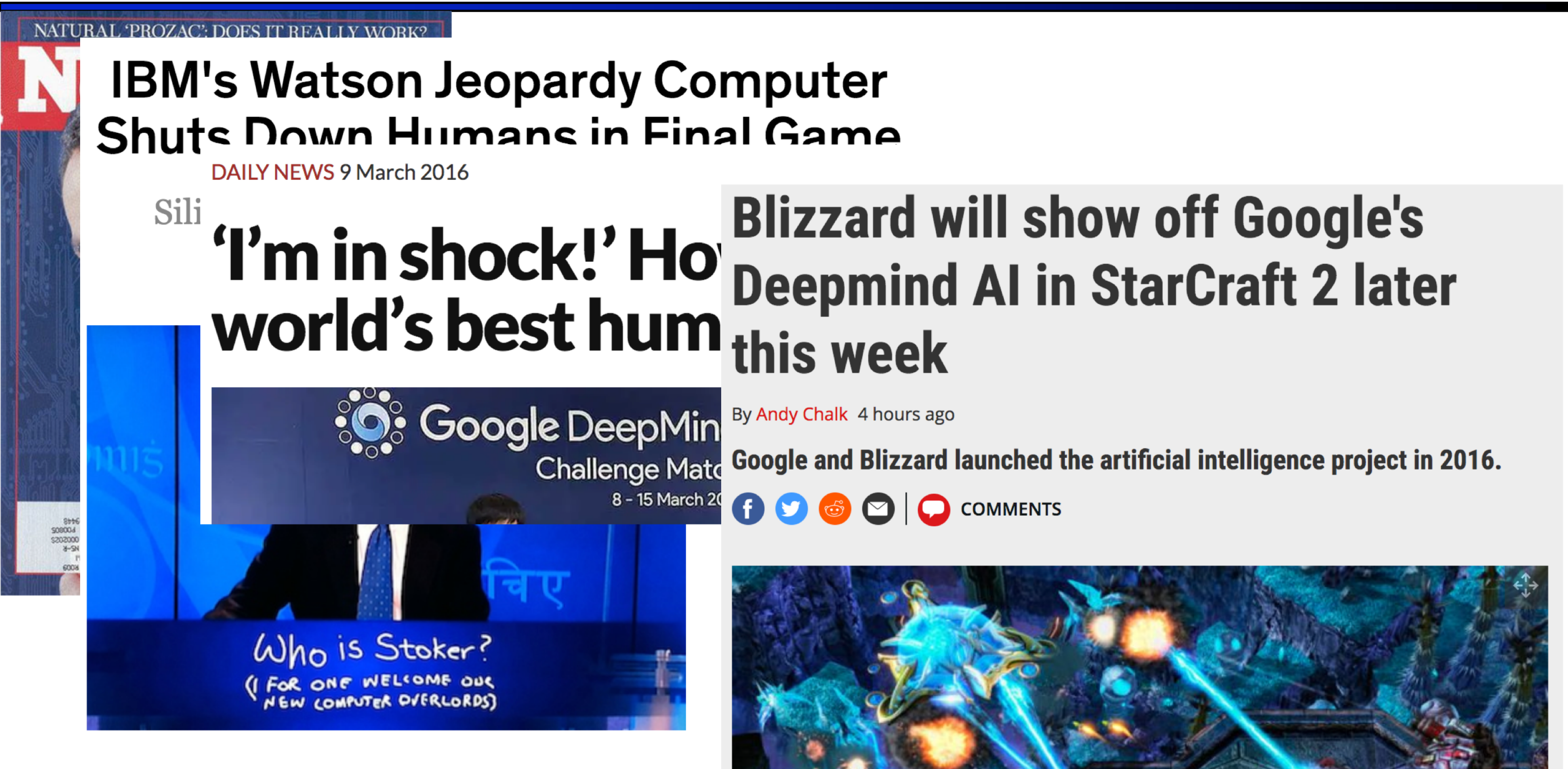
Instructor: Angela Liu, Yanlai Yang

University of California, Berkeley

(slides adapted from Dan Klein, Pieter Abbeel, Stuart Russell, Anca Dragan, et al)

Sci-Fi AI?

News AI



NATURAL 'PROZAC': DOES IT REALLY WORK?

IBM's Watson Jeopardy Computer Shuts Down Humans in Final Game

DAILY NEWS 9 March 2016

Sili

'I'm in shock!' Ho
world's best hum

Blizzard will show off Google's Deepmind AI in StarCraft 2 later this week

By Andy Chalk 4 hours ago

Google and Blizzard launched the artificial intelligence project in 2016.

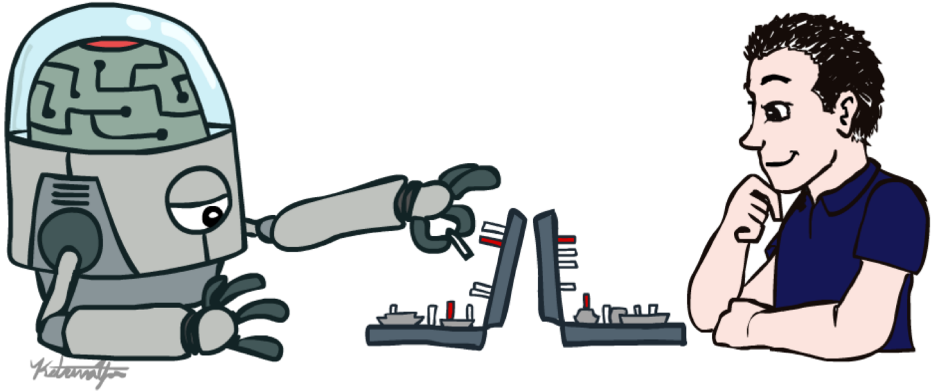
COMMENTS

TUG
CAUTION
MAY CONTAIN
CHEMOTHERAPY DRUG
CAUTION
MAY CONTAIN
CHEMOTHERAPY DRUG
TUG

WAYMO

CS 188: Artificial Intelligence

Logistics



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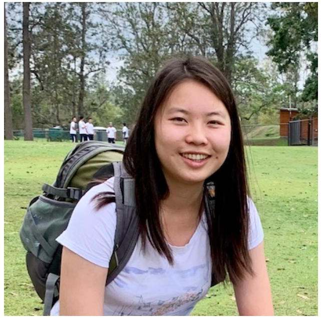
Course Staff

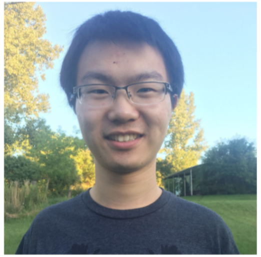
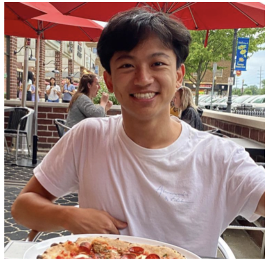
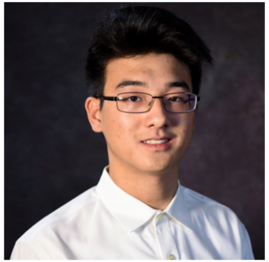
Instructors



Angela Liu

Yanlai Yang

GSIs

 Arvind Rajaraman	 Zhuang Liu	 Neil Thomas	 Sid Ijju	 Joy Liu
 Cham Yao	 Andrew Wang	 Perry Dong	 Weijia Zeng	 Xiangwei Kong

Course Information

- Website: http://inst.eecs.berkeley.edu/~cs188/su22/
  - Tentative schedule, lecture slides and notes, course policies, etc.
- Piazza: https://piazza.com/berkeley/summer2022/cs188
  - Announcements, Q&A for any course-related questions
  - Private posts: personal questions
- Gradescope: https://www.gradescope.com/courses/399015, entry code **DJ55BE**
  - All assignment submissions and grades
- Staff email: cs188@berkeley.edu
  - Personal questions for the head TAs and Instructors
  - Individual staff emails can also be found on the website

Prerequisites

- Programming experience - CS 61A and CS 61B
  - Coding/debugging Python, data structures, search strategies (BFS/DFS/A*)
  - Project 0 – Python setup + short coding diagnostic
- Math – CS 70
  - Discrete probability, counting, derivatives
  - Homework 0 – probability diagnostic questions

Project 0 and Homework 0 are **not graded**. Due dates are a recommendation and you will not be penalized for submitting late (or not at all).

However, we do **highly recommend** that you complete them!

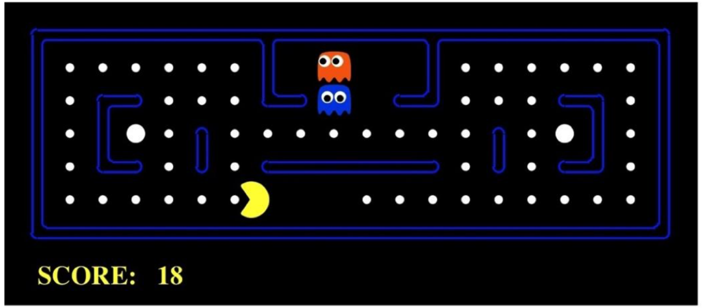
Course Format – Direct Instructions

- Lectures
  - Live lecture in Lewis 100; lecture recording will be posted afterwards
- Discussion Sections
  - Twice a week: either M+W (regular) or T+Th (exam prep)
  - Discussion recordings and solutions will be posted after the last section
- Office Hours
  - 1-2 TAs helping with course-related conceptual, hw, or proj questions
  - Hybrid but *in-person students will be prioritized on the queue*
- Homework/Project Parties
  - Work with other students and TAs on the current hw or proj!

Course Format - Grade Breakdown

Assignments:

- Electronic Homework (10%)
- Written Homework (10%)
- Projects (25%)



Exams:

- Midterm (20%)
- Final (35%)

This course is not curved, grade bins on the website.

Course Format - Assessments

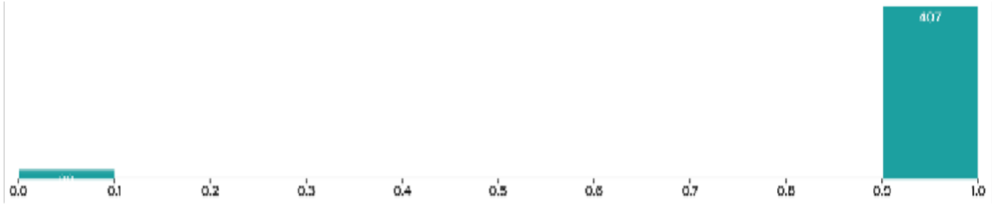
- Midterm: 20%, Final 35%
- Times
  - **Midterm: Friday 07/15, 7-9 PM Pacific Time**
  - **Final: Friday 08/12, 7-10 PM Pacific Time**

No alternative times will be provided.

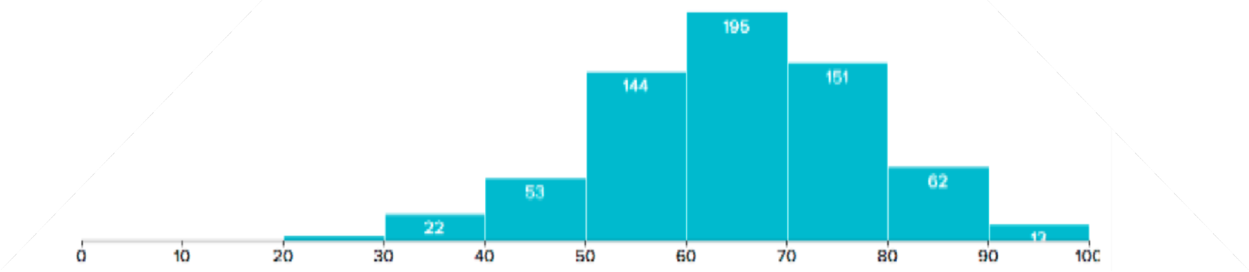
- In-person by default. Remote exam requests will be approved on a case-by-case basis for extraneous situations. (More info provided a week before the exam.)

Some Historical Statistics

- Homework and projects: work alone/together, iterate/learn till you nailed it



- Exams: assessment



Course Principles

- Diversity Statement
- A Note on Student Wellness
- Academic Integrity

Course Principles

- Diversity Statement
  - We believe in the crucial importance of creating a learning environment that is welcoming and respectful to students of all backgrounds.
  - We expect all students to understand that not everyone comes from the same background, and no one should make unwarranted assumptions about anyone based on stereotypes. Mutual understanding and respect is extremely important towards building an inclusive atmosphere.

Course Principles – Student Wellness

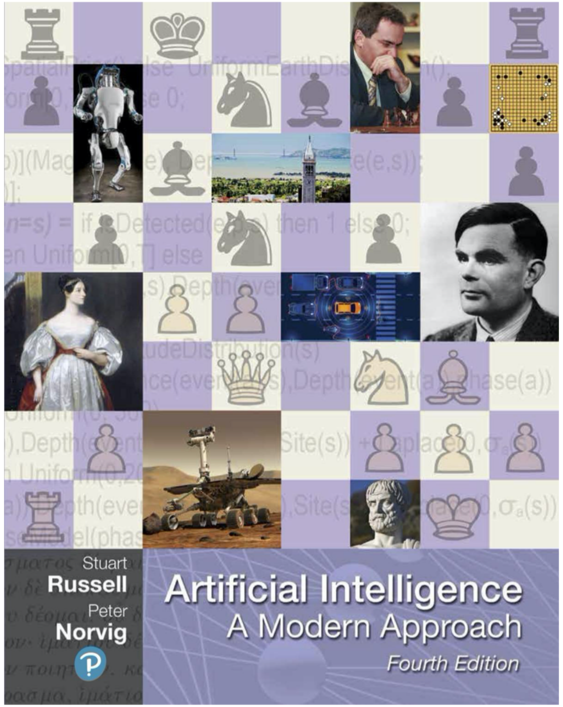
- A Note on Student Wellness
  - We understand that computer science courses at UC Berkeley are rigorous and mentally demanding, and CS 188 is no exception.
  - If you ever feel overwhelmed by the course, please email the instructors directly, and we will set up a one-on-one meeting with you to identify your options.
  - If you would like to seek professional help, you may find a list of resources here: https://sa.berkeley.edu/conduct/resources/wellness
- Extensions Policy
  - **All <= 3 day extension requests for any assignment will be automatically granted, no questions asked.**
  - For extensions of > 3 days, please email cs188@berkeley.edu

Course Principles

- Academic Integrity Policy
  - No consultation or collaboration for Exams
  - You should acknowledge all collaborators and sources on Written HW and projects
    - Accessing or viewing homework/project solutions online before they are officially released is strictly prohibited.
    - Posting solutions online (ex. public github project repo) is also considered cheating and a copyright violation
  - We have a **zero-tolerance** policy towards academic misconduct
    - We will forward all suspicious cases to the Center of Student Conduct, and recommend **immediate failure (F)** if the involved individuals are found guilty.

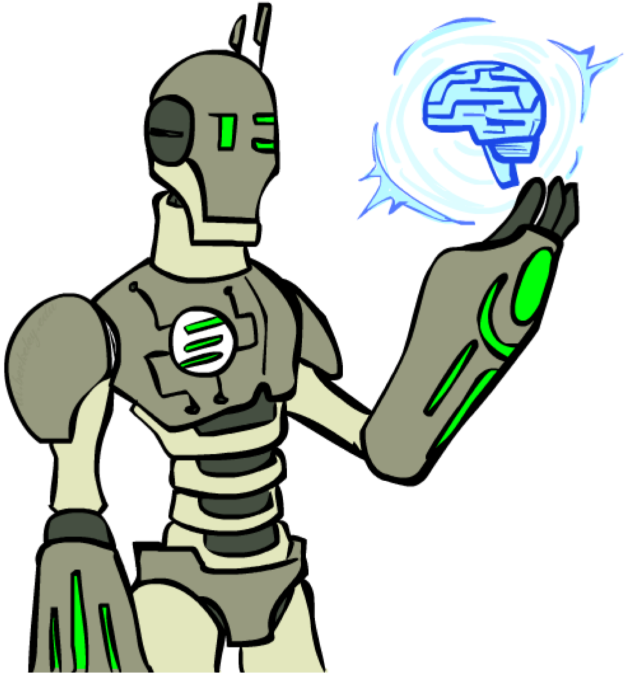
Textbook

Russell & Norvig, AI: A Modern Approach, 4th Ed.

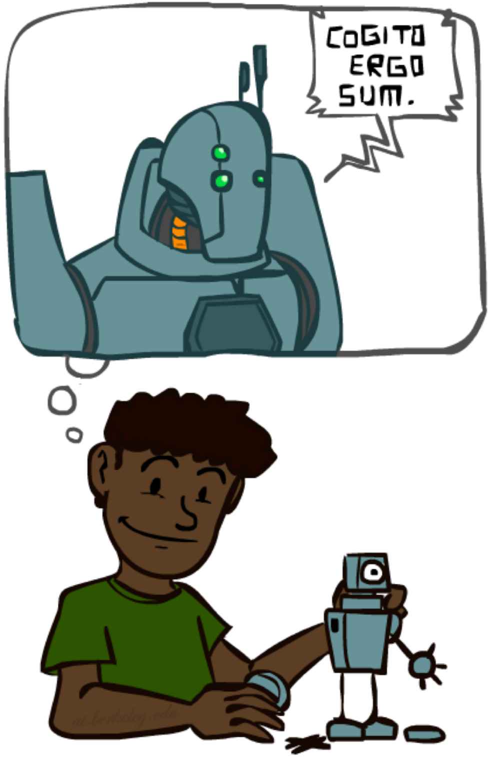


Today

- What is artificial intelligence?
- Where are we and how did we get here?
- How do we think about the design of AI systems?



A (Short) History of AI



Demo: HISTORY – MT1950.wmv

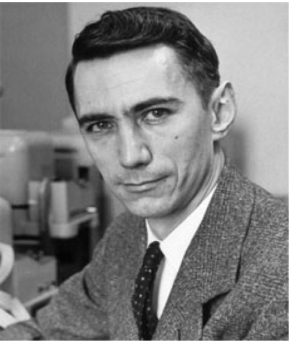
A short prehistory of AI

- Prehistory:
  - **Philosophy** (reasoning, planning, learning, science, automation)

> Aristotle: For if every instrument could accomplish its own work, obeying or anticipating the will of others . . . if, in like manner, the shuttle would weave and the plectrum touch the lyre without a hand to guide them, chief workmen would not want servants, nor masters slaves

  - **Psychology** (learning, cognitive models)
  - **Linguistics** (grammars, formal representation of meaning)
- Near miss (1842):
  - Babbage design for universal machine
  - Lovelace: “a thinking machine” for “all subjects in the universe.”

AI’s official birth: Dartmouth, 1956

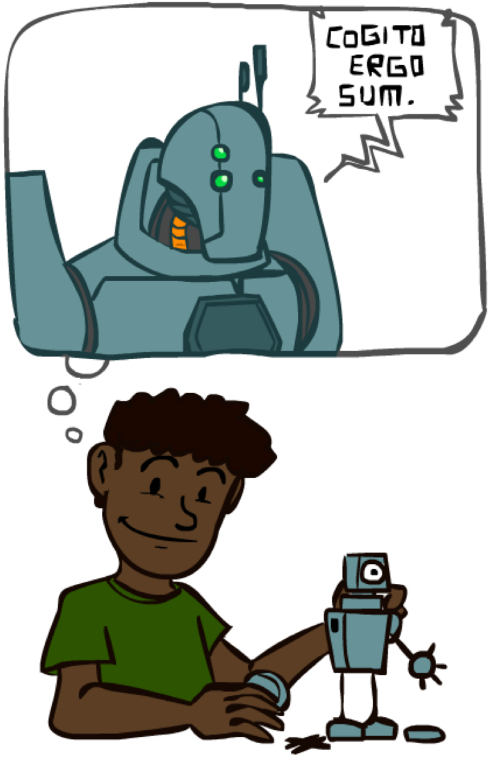


“An attempt will be made to find how to make machines use language, form abstractions and concepts, solve kinds of problems now reserved for humans, and improve themselves. ***We think that a significant advance can be made if we work on it together for a summer.”***

John McCarthy and Claude Shannon
Dartmouth Workshop Proposal

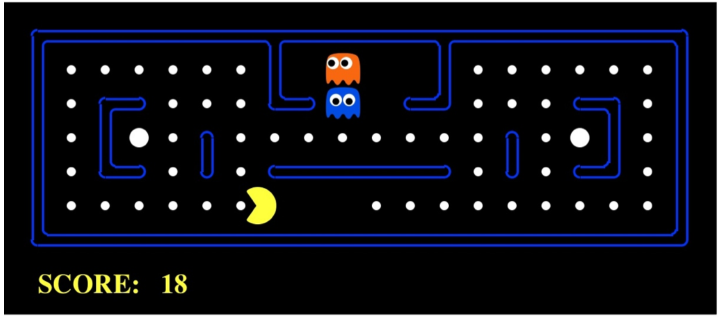
A (Short) History of AI

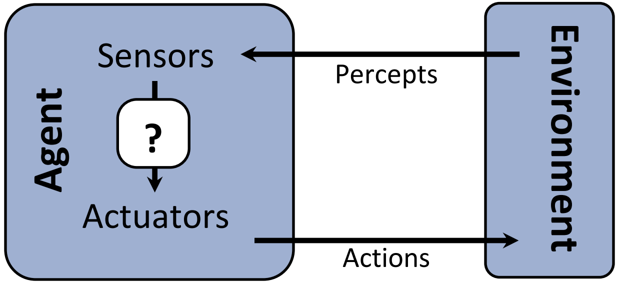
- 1940-1950: Early days
  - 1943: McCulloch & Pitts: Boolean circuit model of brain
  - 1950: Turing's “Computing Machinery and Intelligence”
- 1950—70: Excitement: Look, Ma, no hands!
  - 1950s: Early AI programs: chess, checkers (RL), theorem proving
  - 1956: Dartmouth meeting: “Artificial Intelligence” 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
  - 1988—93: Expert systems industry busts: “AI Winter”
- 1990— 2012: Statistical approaches + subfield expertise
  - Resurgence of probability, focus on uncertainty
  - General increase in technical depth
  - Agents and learning systems… “AI Spring”?
- 2012— ___: Excitement: Look, Ma, no hands again?
  - Big data, big compute, deep learning
  - AI used in many industries



AI as Designing Rational Agents

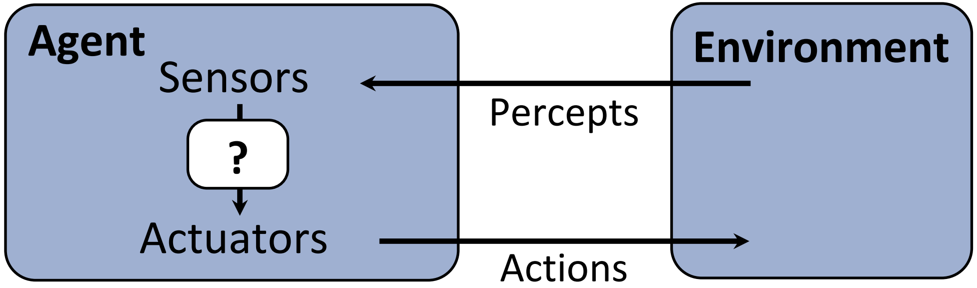
- An **agent** is an entity that *perceives* and *acts*.
- A **rational agent** selects actions that maximize its expected **utility**.
- Characteristics of the **sensors, actuators, and environment** dictate techniques for selecting rational actions
- **This course** is about:
  - General AI techniques for many problem types
  - Learning to choose and apply the technique appropriate for each problem





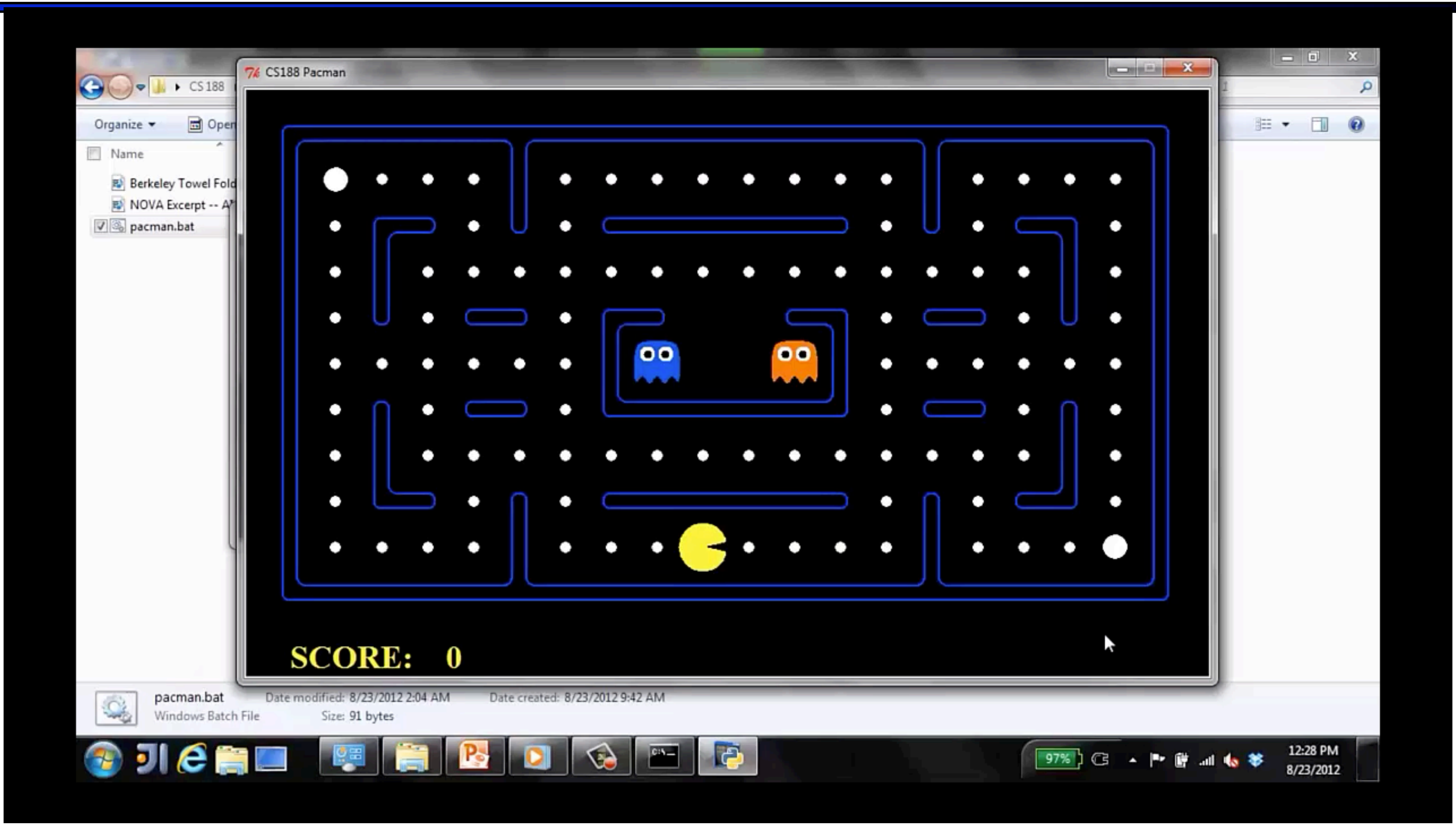
Pac-Man is a registered trademark of Namco-Bandai Games, used here for educational purposes

Agents and environments



- An agent ***perceives*** its environment through ***sensors*** and ***acts*** upon it through ***actuators*** (or *effectors*, depending on whom you ask)
- The ***agent function*** maps percept sequences to actions
- It is generated by an ***agent program*** running on a ***machine***

A human agent in Pacman

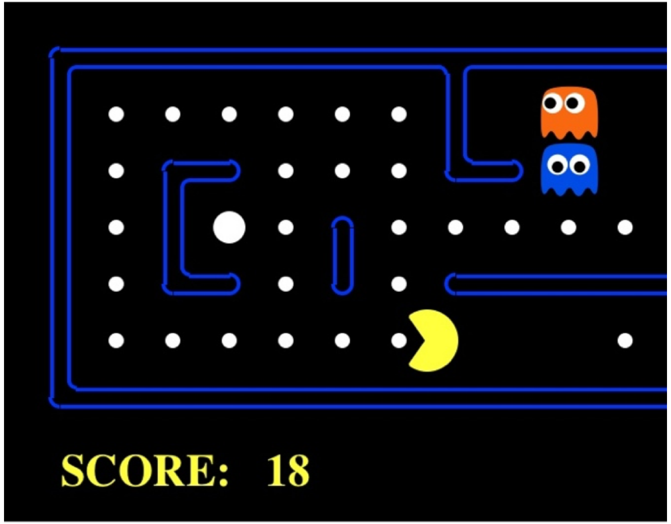


SCORE: 0

pacman.bat
Windows Batch File
Date modified: 8/23/2012 2:04 AM
Date created: 8/23/2012 9:42 AM
Size: 91 bytes

The task environment - PEAS

- Performance measure
  - -1 per step; + 10 food; +500 win; -500 die; +200 hit scared ghost
- Environment
  - Pacman dynamics (incl ghost behavior)
- Actuators
  - Left Right Up Down or NSEW
- Sensors
  - Entire state is visible (except power pellet duration)



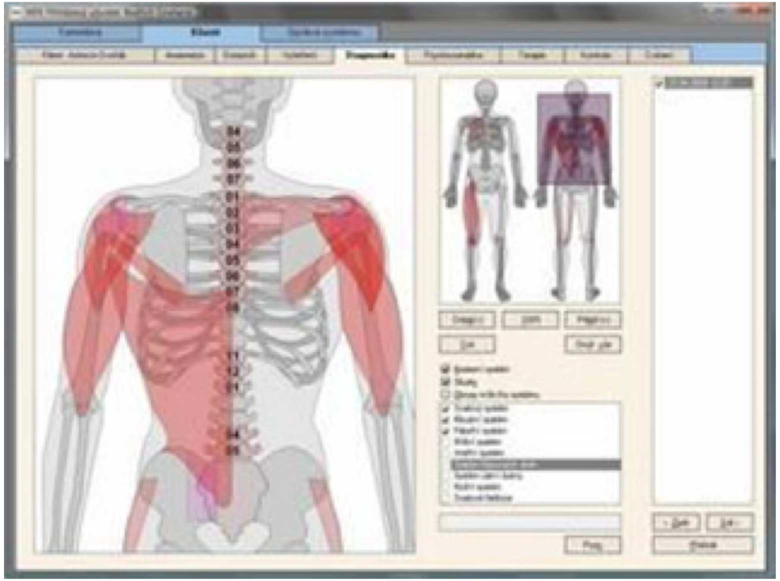
PEAS: Automated taxi

- Performance measure
  - Income, happy customer, vehicle costs, fines, insurance premiums
- Environment
  - US streets, other drivers, customers, weather, police…
- Actuators
  - Steering, brake, gas, display/speaker
- Sensors
  - Camera, radar, accelerometer, engine sensors, microphone, GPS

Image: http://nypost.com/2014/06/21/how-google-might-put-taxi-drivers-out-of-business/

PEAS: Medical diagnosis system

- Performance measure
  - Patient health, cost, reputation
- Environment
  - Patients, medical staff, insurers, courts
- Actuators
  - Screen display, email
- Sensors
  - Keyboard/mouse



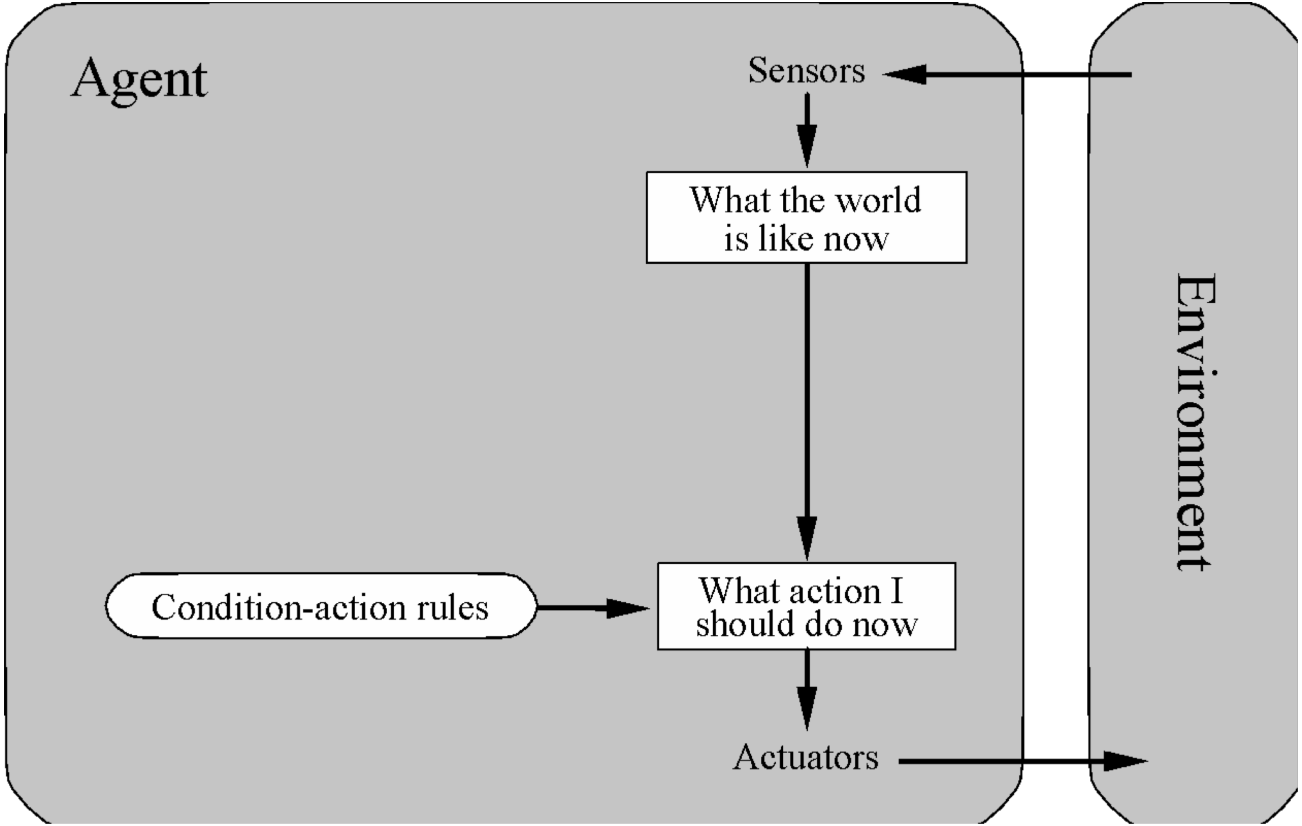
Environment types

	Pacman	Backgammon	Diagnosis	Taxi
Fully or partially observable				
Single-agent or multiagent				
Deterministic or stochastic				
Static or dynamic				
Discrete or continuous				
Known physics?				
Known perf. measure?				

Agent design

- **The environment type largely determines the agent design**
  - ***Partially observable*** => agent requires ***memory*** (internal state)
  - ***Stochastic*** => agent may have to prepare for ***contingencies***
  - ***Multi-agent*** => agent may need to behave ***randomly***
  - ***Static*** => agent has time to compute a rational decision
  - ***Continuous time*** => continuously operating ***controller***
  - ***Unknown physics*** => need for ***exploration***
  - ***Unknown perf. measure*** => observe/interact with ***human principal***

Simple reflex agents

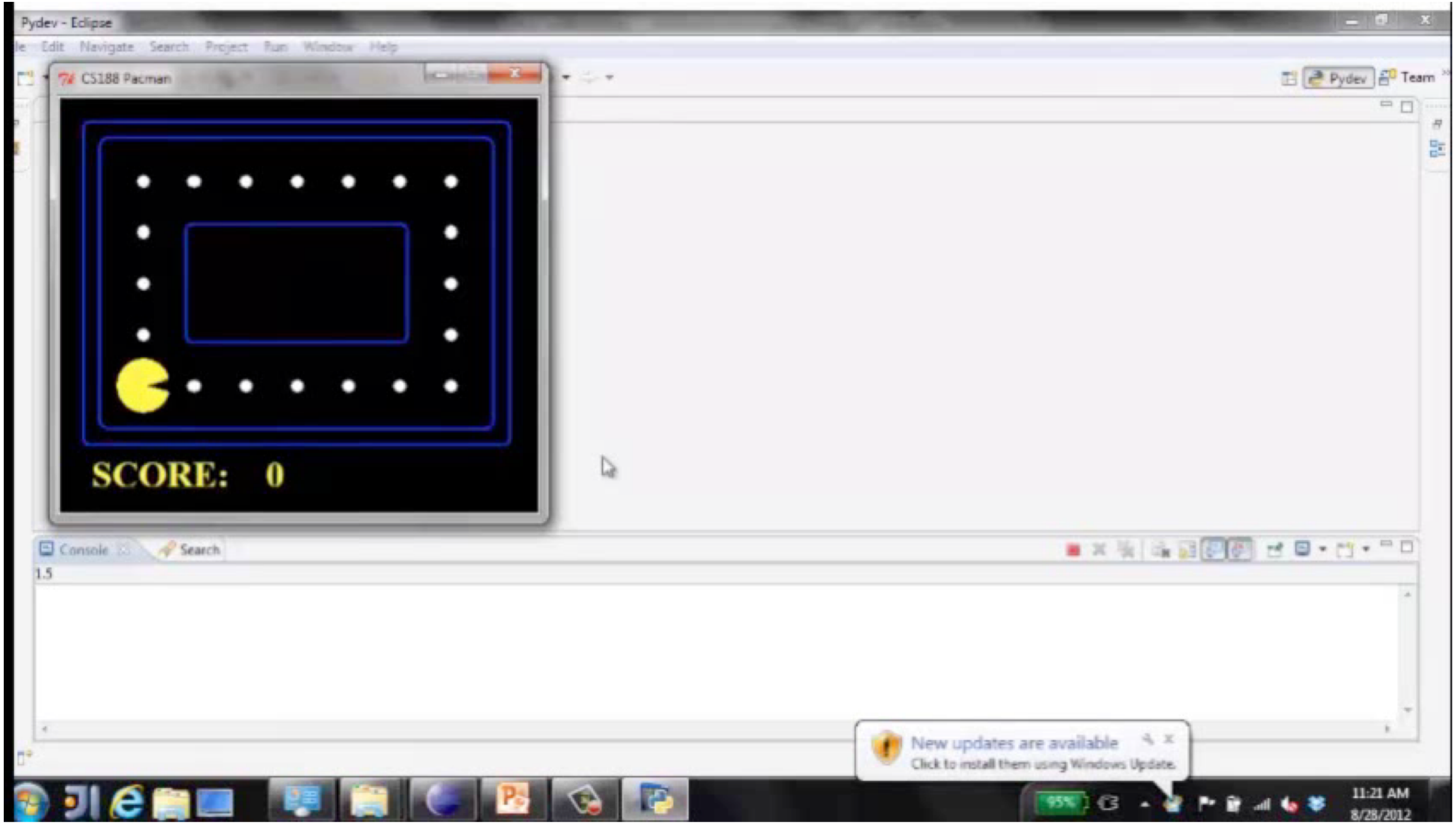


Pacman ***agent program*** in Python

```
class GoWestAgent(Agent):

  def getAction(self, percept):
    if Directions.WEST in percept.getLegalPacmanActions():
      return Directions.WEST
    else:
      return Directions.STOP
```

Eat adjacent dot, if any


Pydev - Eclipse
File Edit Navigate Search Project Run Window Help
CS188 Pacman
Pydev
Team
SCORE: 0
Console
Search
New updates are available
Click to install them using Windows Update.
11:21 AM
8/28/2012

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1.5
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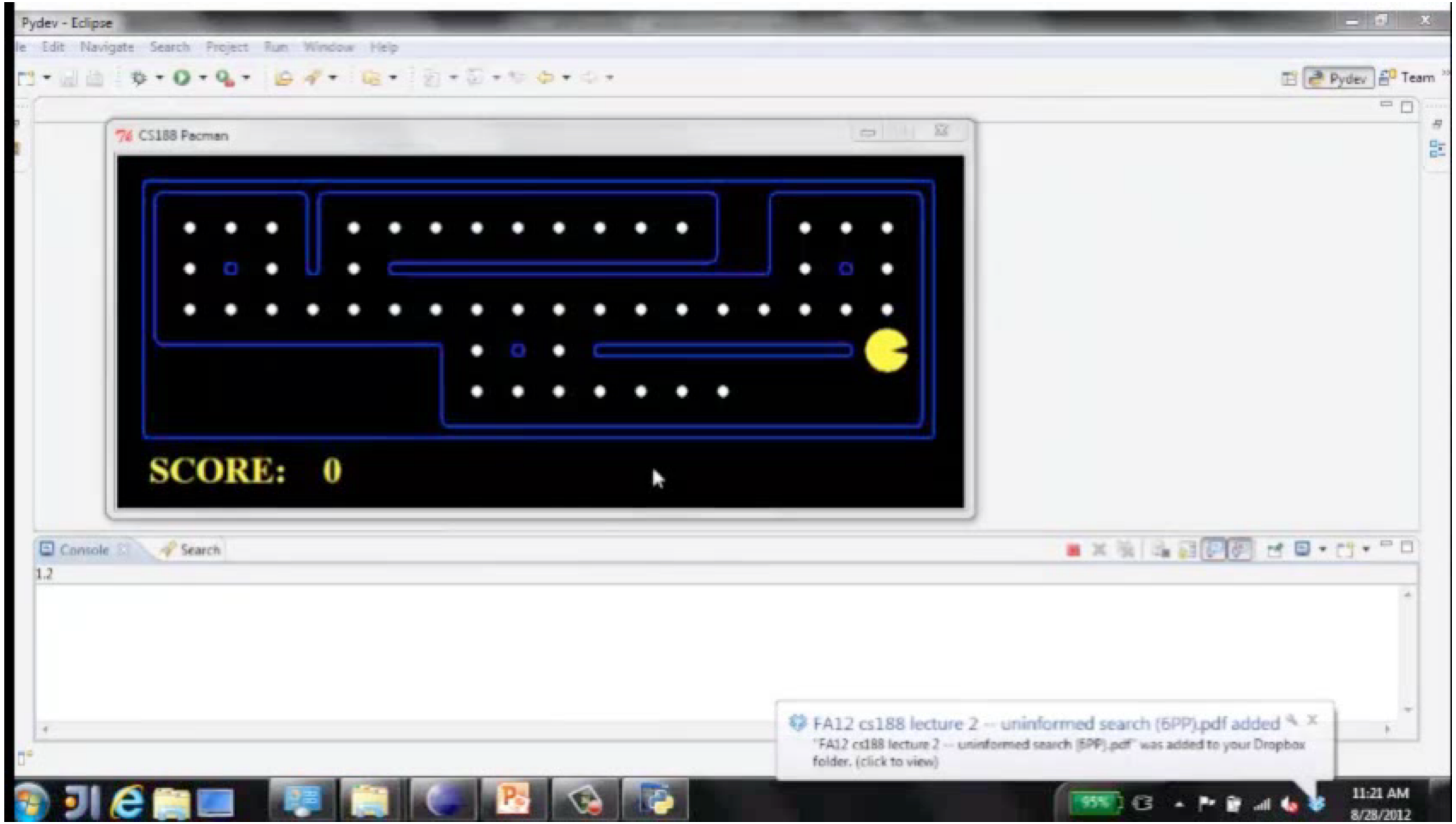
Eat adjacent dot, if any



Pydev - Eclipse
File Edit Navigate Search Project Run Window Help
Pydev
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Console
Search
1.2
FA12 cs188 lecture 2 -- uninformed search (6PP).pdf added
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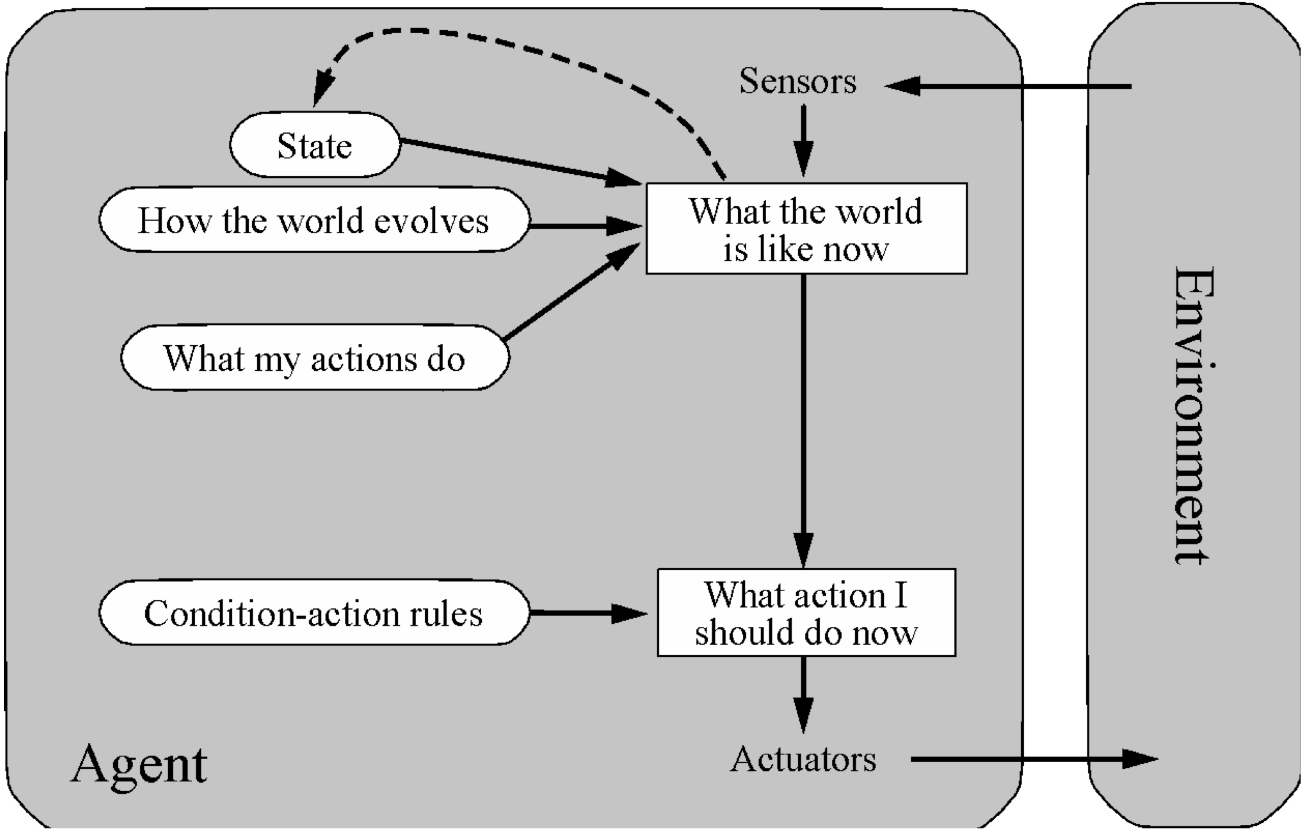
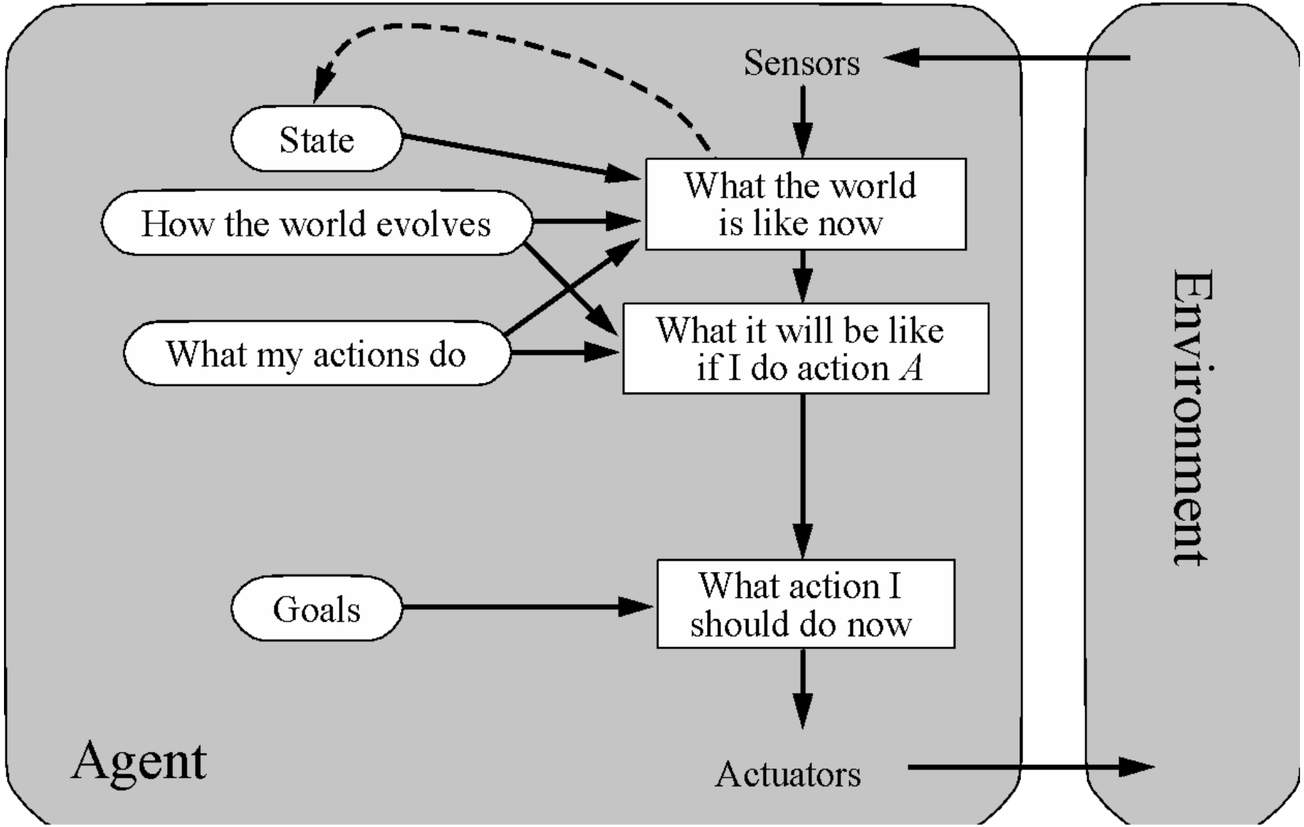
Pacman agent contd.

- Can we (in principle) extend this reflex agent to behave well in all standard Pacman environments?
  - No – Pacman is not quite fully observable (power pellet duration)
  - Otherwise, yes – we can (*in principle*) make a lookup table…..
  - *How large would it be?*

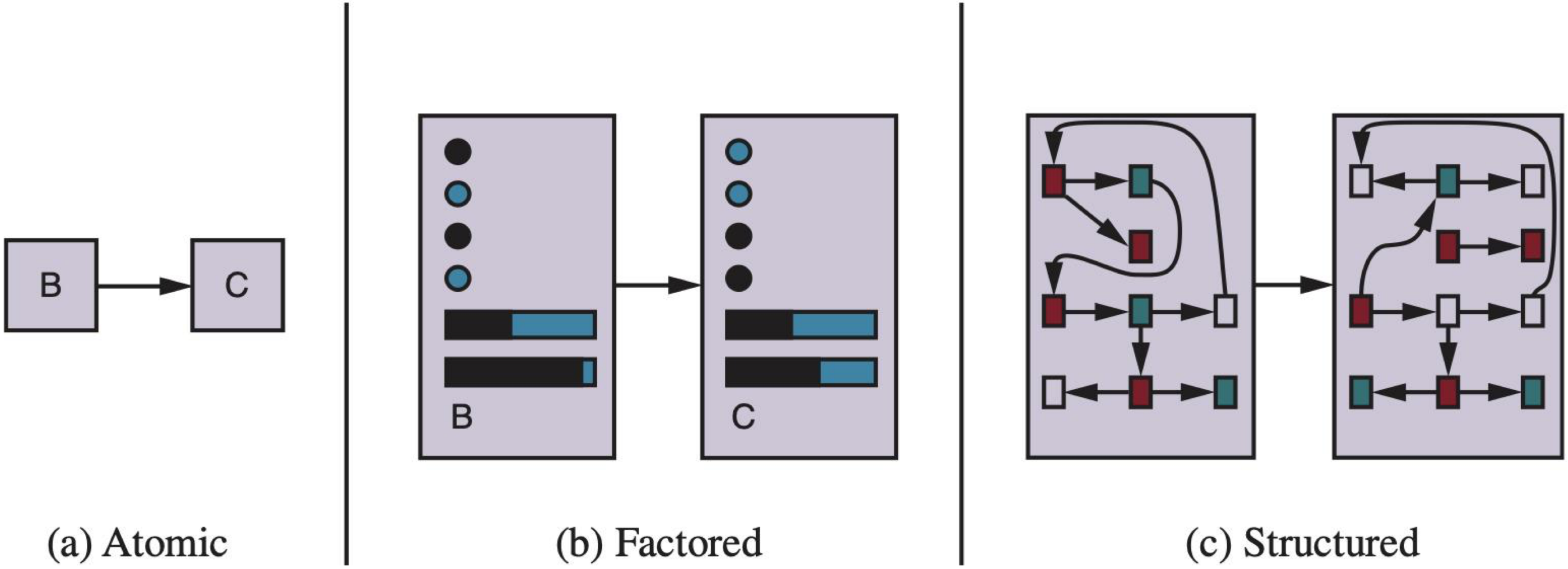
Model-based agents



Goal-based agents


Sensors
State
How the world evolves
What my actions do
What the world is like now
What it will be like if I do action *A*
Goals
What action I should do now
Agent
Actuators
Environment

Spectrum of representations

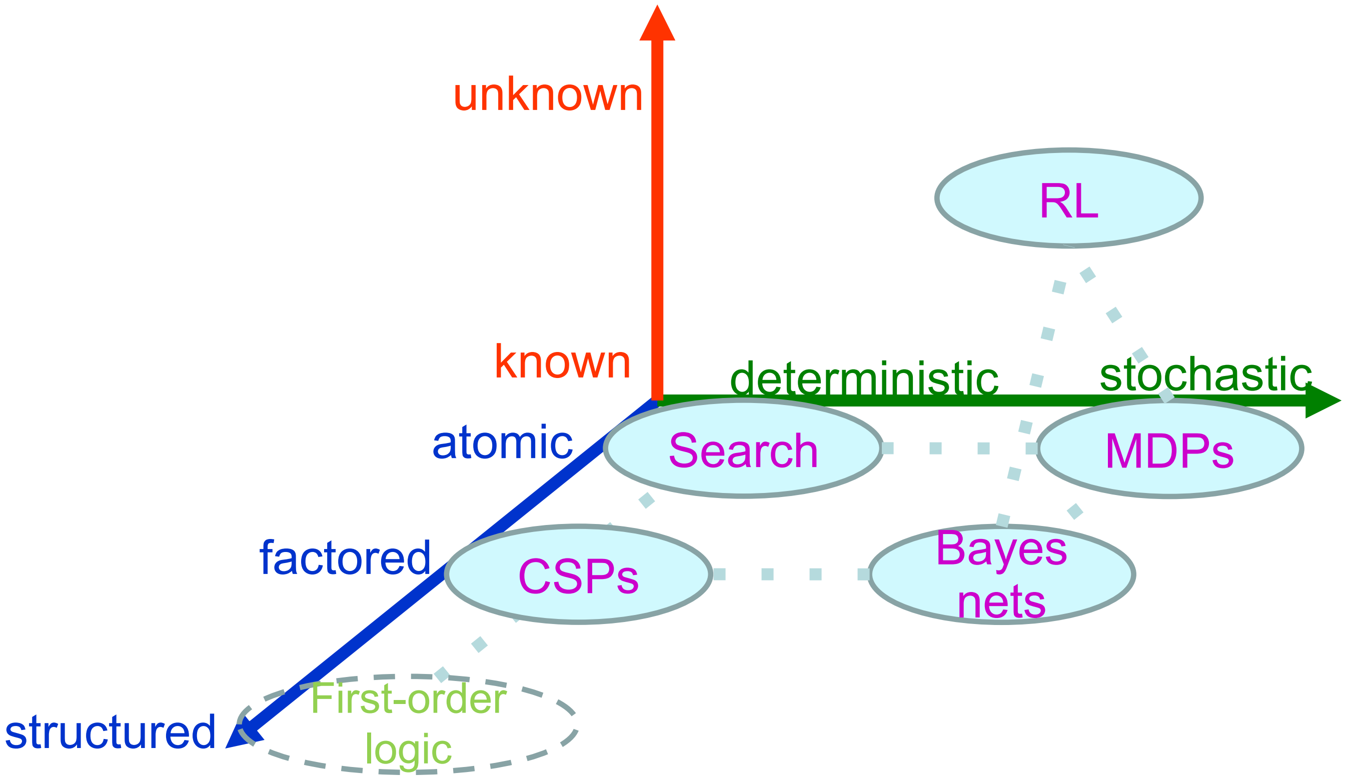


(a) Atomic

(b) Factored

(c) Structured

Outline of the course


unknown
known
deterministic
stochastic
atomic
factored
structured
RL
Search
MDPs
CSPs
Bayes nets
First-order logic