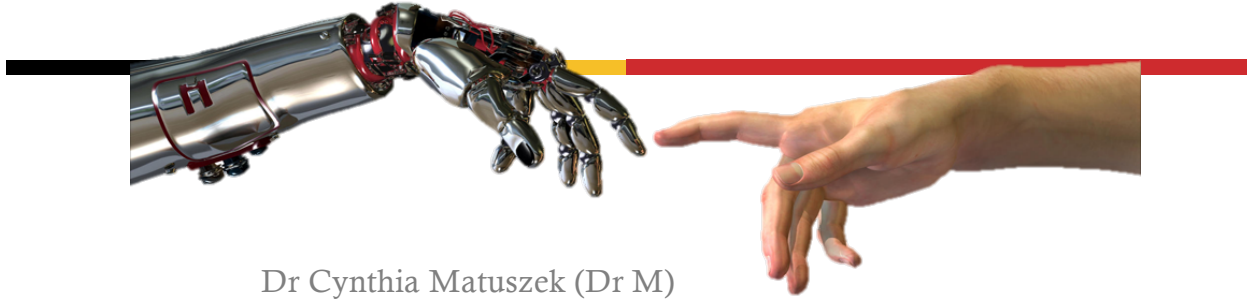


# Artificial Intelligence

## Class 1: Course Overview



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## What we'll cover today (in some order)

- Who am I?
- What is this class all about?
  - Class goals
  - Syllabus stuff
    - Structure and grading
    - Class during COVID
    - Schedule
- Is this a good class for you?



Hi! I'm a  
Softbank  
Pepper robot!

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## My Research

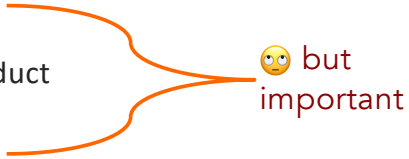
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- Robotics
  - How can we go from industrial robots to useful robots in human environments? (Schools, cars, homes...)
- Natural Language Processing
  - How can computers learn to understand and speak human languages (English)?
- Artificial intelligence
  - How to get computers to behave in ways that we would consider to be “intelligent”
- Human-Robot Interaction (HRI)

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## Today: Intro & Overview

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- Review of syllabus and schedule
    - Academic honesty
    - Expectations and conduct
    - Policies, grading, etc.
  - Brief history of AI
    - What is AI? (and why is it so cool?)
    - What’s the state of AI now?
  - What is ‘intelligence’?
- 

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# Resources

- The syllabus is longish, but important:
  - <http://tiny.cc/ai-class>
- Lecture topics and reading on the schedule:
  - <http://tiny.cc/ai-schedule>
  - You'll want to check this every class
- Academic integrity:
  - <http://tiny.cc/ai-ai>
- Discord:
  - <http://tiny.cc/ai-discord>
- We will only use Blackboard for turnins and CMI

## CMSC 671: Principles of Artificial Intelligence Fall 2022

Syllabus • Schedule • Academic Integrity

[Syllabus](#)

[About This Class](#)

DATE	TOPIC / SLIDES	PRE-READINGS
9/1	Introduction and overview	<a href="#">Class web page</a> <a href="#">Integrity policy</a>
9/6	Agents	2.1, 2.2 intro, 2.2.1-2.2.2 3.1 intro, 3.1.1-3.1.1.1

Syllabus • Schedule • Academic Integrity

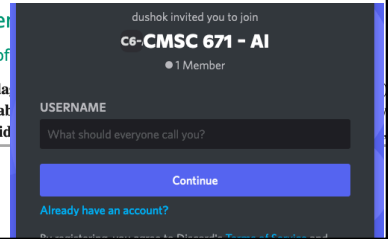
All students must read, understand, and follow the course policy on academic integrity. If you have any questions, please contact me.

Please watch the brief video about integrity.

Academic Integrity

Types of Academic Integrity

- Plagiarism
- Fabrication
- Aid



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# Classroom Policies

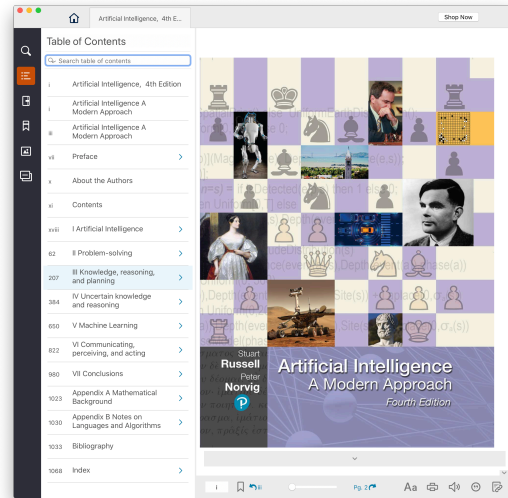
- Be courteous to classmates and instructors.
- No devices in use except when specified.
  - You don't learn as much.
  - People around you don't learn as much.
  - <http://tiny.cc/devices-in-class>
- No food in this classroom.



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## Text, CMI

- 4th edition of AIMA (2020) has lots of new material since the 2009 3rd edition
- UMBC CMI program charges
  - \$35 for a digital version, \$160 on Amazon for hardcopy
- Access on Blackboard or download epub to computer/phone
- Opt-out of CMI via Blackboard



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## COVID-19

- Class during a pandemic comes with additional expectations
- 1. **Be respectful of your own and others' health**
  - **Stay masked** (mouth and nose) during *any* class interaction
    - Class, office hours, *and* lab
  - Be sensible about exposure vectors and don't expose others
    - **When sick, stay home**
    - If home for 2+ classes, get in touch and we'll work out the details

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## COVID-19 university statement on masks

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- UMBC has set clear expectations for masking while on campus that include the requirement that **you must wear a face mask that covers your nose and mouth in all classrooms regardless of your vaccination status**. This is to protect your health and safety as well as the health and safety of your classmates, instructor, and the university community. Anyone attending class without a mask or wearing one improperly will be asked by the instructor to put on a mask or fix their mask in the appropriate position. **Any student that refuses to comply with this directive will be asked to leave the classroom immediately** and failure to do so will result in the instructor requesting the assistance of the University Police.
  - Students who refuse to wear masks may be referred to Student Conduct and Community Standards and may face disciplinary action for violations of the Code of Student Conduct, specifically, Rule 2: Behavior Which Jeopardizes the Health or Safety of Self or Others and Rule 16: Failure to Comply with the Request of a University Official. UMBC's on-campus safety protocols, including masking requirements, are subject to change in response to the evolving situation with Covid-19.

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## Harassment and Inclusivity

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**All students are entitled to a safe, respectful, and inclusive learning environment both inside and outside the classroom.**

- No discrimination, exclusion, or harassment
- Respectful, inclusive discussion
  - Use one another's preferred names, pronouns, etc.
- If there are problems
  - Talk to me, the TA, or someone else
  - There are resources on the syllabus

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## Grading

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- Grades in Blackboard
  - Know your grades
  - Keep track of what's left
- Grade questions:
  - 24-hour "cooling" period before any discussion
- Grade changes/regrades:
  - Requests to professor and TA
  - TA cannot change grades!

Homework	30%
Midterm	20%
Project	30%
Final exam	20%

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## Participation

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- Attend class.
  - The program (and I) expect you to be here for the entire semester.
- Speak up.
  - Ask & answer questions
  - Tell us your thoughts
- Do any take-home quizzes and/or surveys.



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## 4-6 Homework Assignments

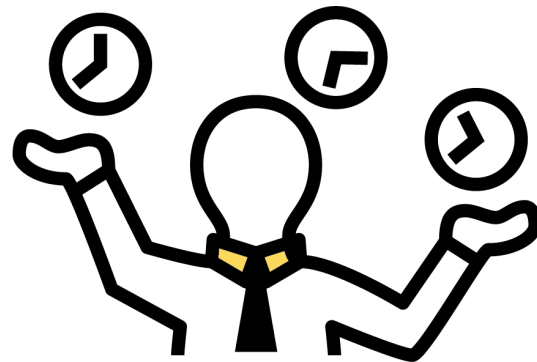
- Written text, problem sets, and programming
  - Due at 11:59 PM the day before class
  - Late: 25% off /day
- Assignments will be turned in **electronically**
  - Assignment will specify Blackboard, forms, or email
  - Sometimes 10% penalty for not following instructions
    - Example: Wrong file type
- Questions? **Discord, then TA**

- Don't ask for exceptions after the fact.
- Don't tell us it's "just a little bit" late.
- You have multiple turnins. Use them!

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## Time Management

- Some things can be rescheduled
  - E.g., overlapping exams, if enough people have them
- Individual extensions may be given:
  1. With reasonable cause
    - e.g., conference travel
  2. **When requested in advance**
- Talk to me!



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## A Word About This Class

- The biggest complaint people have had:

*I needed an easy class to go with OS and algorithms and this class was supposed to be easy*

- This **is not** an easy class
- We cover a lot of ground – you must keep up
  - Time-consuming** and **theory-heavy**
  - Difficulty** depends on your background

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## Reading

- Pre-readings: Do these before that class
  - Easy to get lost in terminology etc. if you don't pre-read

DATE	TOPIC / SLIDES	PRE-READINGS	READINGS	HOMEWORK	HANDOUTS
9/1	<a href="#">Introduction and overview</a>	<a href="#">Class web page</a> <a href="#">Integrity policy</a>	Ch. 1		
9/6	Agents	2.1, 2.2 intro, 2.2.1; skim 2.3.1-2.3.2	Ch. 2	HW1 out	
9/8	Problem solving as search	3.1 intro, 3.1.1, skim 3.3	Ch. 3.1-3.3		
9/13	Meta-level search	3.4 intro, 3.4.1, 3.4.2	Ch. 3.4		

- Readings: Do these after class
  - More detail on concepts
- Slides posted after class

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## Academic Integrity

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- Instructor's responsibilities:
  - Be respectful
  - Be fair
  - Be available
  - Tell the students what they need to know and how they will be graded
- Students' responsibilities:
  - Be respectful
  - Do not cheat, plagiarize, or lie, or help anyone else do so
  - Do not interfere with other students' academic activities

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## Academic Integrity Policy

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- *“By enrolling in this course, each student assumes the responsibilities of an active participant in UMBC’s scholarly community, in which everyone’s academic work and behavior are held to the highest standards of honesty. **Cheating, fabrication, plagiarism, and helping others to commit these acts are all forms of academic dishonesty, and they are wrong.** Academic misconduct could result in disciplinary action that may include, but is not limited to, suspension or dismissal.”*

*[Statement adopted by UMBC’s Undergraduate Council and Provost’s Office]*

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## Integrity: Plagiarism

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- Representing someone else's work as your own is **plagiarism**
- What 'counts' as plagiarism is cultural
- It may be different now from what you are used to
  - This means you must be very careful!
- We use research and publication standards.
- CS is not fundamentally about reinventing wheels, *but*
- The answer isn't always "out there" – the goal is to learn to do it yourself

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## From the syllabus

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- You are free to use online references like Stack Overflow for questions that are not the primary aspect of the course
  - If, for example, you're having an issue with unicode in Python, or are getting a weird compilation error, then sites like Stack Overflow are a great resource
- You may generally use external libraries (and even parts of standard libraries), **provided what you use does not actually implement what you are directed to implement.**
- However, be sure to properly acknowledge and cite external help, be it from students, third party libraries, Wikipedia, or any other source.

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## Integrity: Plagiarism

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- **What if the reference is in the bibliography?**
  - If you didn't explicitly quote the text you used and cite the source where you used the text, it is plagiarism.
- **What if I only use some of the words?**
  - Scattering some of your own words and rephrasing isn't enough. If the ideas are not restated entirely in your own words, it is plagiarism.

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## Integrity: Plagiarism

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- **The introduction and background material are borrowed; all of the research is original.**
  - If somebody else's words appear in any document that you claim is written by you, it is plagiarism.
- **It was a draft or not an official assignment**
  - If you represented somebody else's words as your own, even in an informal context, it is plagiarism.
- **"But the professor told me to use that source!"**
  - Unless you are explicitly told to copy a quote from a source, you must write your answers in your own words.

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## Integrity: Plagiarism

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- Any time you find yourself copy-pasting—**even a sentence**—you are plagiarizing.
- Copying code from any source without citations is plagiarizing.
- The first time:
  - 0 on the (entire) assignment
  - 1 letter-grade reduction in the class
- You may also:
  - Fail the class without possibility of dropping it
  - Be suspended or expelled from university

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## Integrity: Abetting

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- This includes putting someone's name on something when they didn't work on it.
  - "This is just everyone on our team" is wrong.
- Know what your project partners are doing.
  - Their cheating can hurt you.
- Helping another student to cheat, falsify, or plagiarize will result in you receiving the **same penalty**.

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## Integrity: What To Do

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- You can **always** bring it to me.
- Cheating by others / in your group / etc.:
  - You **may** talk to them about it first
    - Unless it's too late (it's been turned in, the test is over)
      - Then you are abetting unless you report
    - This is not the preferred option
- You **do not have to** talk to anyone but me
- If you think *you* made a mistake, bring it to me.

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## About Groupwork

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- Study groups are **encouraged!**
  - Talking about the homework is completely acceptable
  - Just don't share code
- Programming must be done **individually**
  - Programs must be written entirely by you
  - Copying another person's code is never acceptable
  - You can discuss conceptually; never look at code
- Some homework is for 2-3 students working together
  - The assignment will say so; otherwise, it's individual.

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## Availability & Communication

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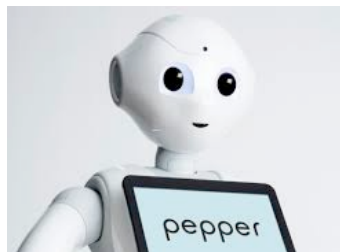
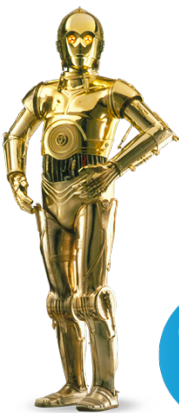
- Leave lead time for all questions
  - Email takes 24-48 hours
  - Discord is often faster
- Always send email to TA or professor *and TA*
- Office hours
  - Available on syllabus
  - Available by appointment



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## All right! What is AI?

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Google



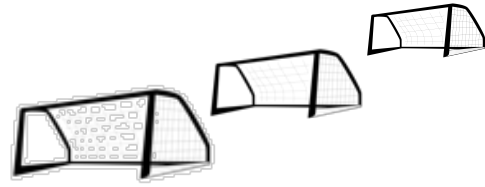
DeepMind



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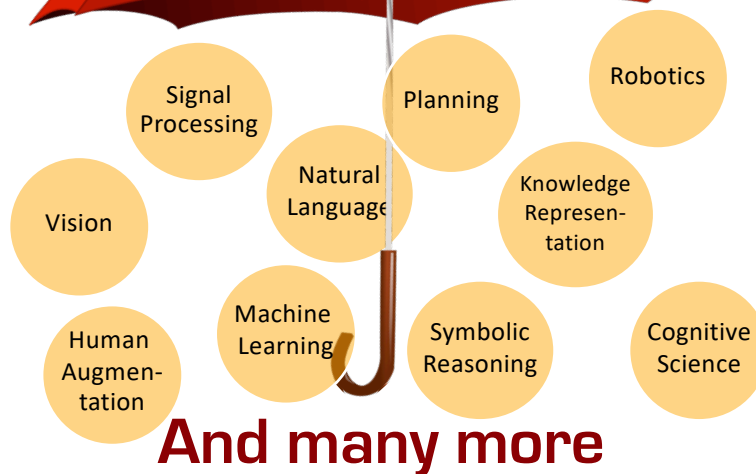
## “Intelligence” is Problematic

- How do we measure it?
- What’s an ‘intelligent action’?
  - In practice, ‘previously human only’
- Is there something ineffable missing?
  - What?
- How do we test?



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## Artificial Intelligence

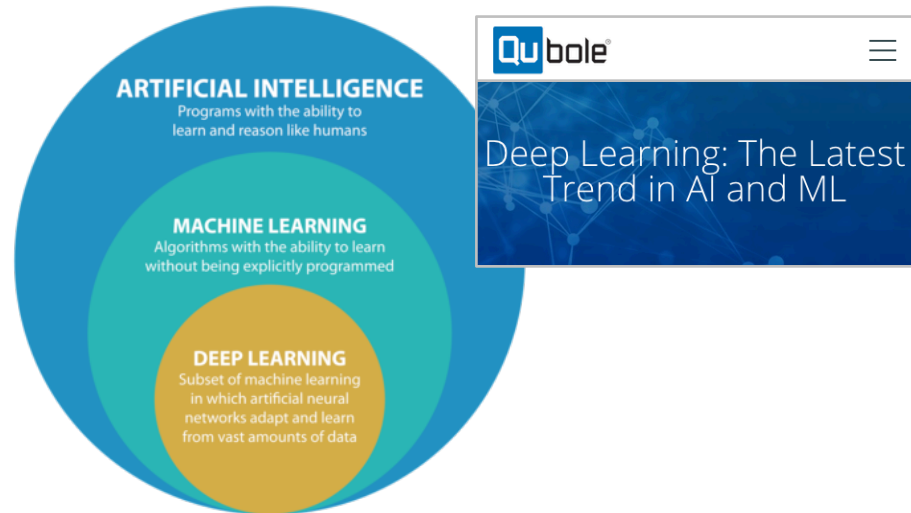


[en.wikipedia.org/wiki/File:Umbrella-159361.svg](https://en.wikipedia.org/wiki/File:Umbrella-159361.svg)

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## But Deep Learniiiiinnng

- We will learn some ML
- But also many, many other things



[www.qubole.com/blog/deep-learning-the-latest-trend-in-ai-and-ml](http://www.qubole.com/blog/deep-learning-the-latest-trend-in-ai-and-ml)

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## Artificial Intelligence

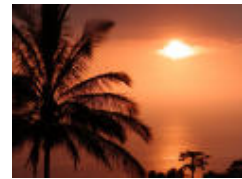
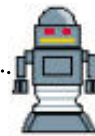
- Key types
  - Strong AI: mental/thought capabilities equal to (or better than) human
  - Weak (bounded) AI: intelligent actions or reasoning in some limited situations
- Also: scruffy/neat, symbolic/statistical, ...
- “Human-level” intelligence
  - In what situation?
  - Internally?
- Self-awareness / Consciousness

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## AI: A Vision

- Could an intelligent agent living on your home computer...
  - Manage your email?
  - Coordinate your work and social activities?
  - Help plan your vacations?
  - Drive you to that vacation?
  - Do your laundry while you are away?



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## Main Goals of AI

- **Represent** and **store** knowledge
- **Retrieve** and **reason** about knowledge
- **Behave intelligently** in complex environments
- **Learn** from environment and interactions
- **Develop** interesting and useful applications
- **Interact** with people, agents, and environment

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## Why AI?

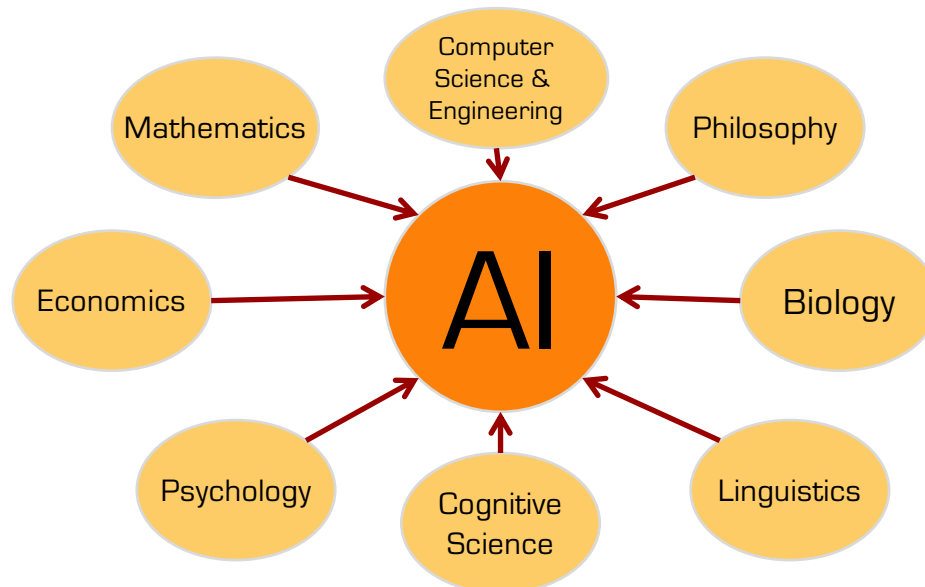
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- Engineering
  - To get machines to do a wider variety of useful things
    - Understand spoken natural language
    - Recognize individual people in visual scenes
    - Find the best travel plan for your vacation
- Cognitive Science
  - Help understand how natural minds work
    - Visual perception, memory, learning, language, etc.
- Philosophy
  - As a way to explore interesting (and important) philosophical questions

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## Foundations of AI

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## Big Questions

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- Can machines think?
- If so, how?
- If not, why not?
- What does this say about human beings?
- What does this say about the mind?
- Many of these can only be answered philosophically
  - And we are engineers

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## What's Easy and What's Hard?

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- It's easi(er) to mechanize high-level tasks
  - Symbolic integration
  - Proving theorems
  - Playing chess
  - Medical diagnosis
- It's hard to mechanize tasks that lots of animals can do
  - Walking around without running into things
  - Catching prey and avoiding predators
  - Interpreting complex sensory information (e.g., visual, aural, ...)
  - Modeling the internal states of other animals from their behavior
  - Working as a team (e.g., with pack animals)
- Is there a fundamental difference?

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## Turing Test

- Three rooms:
- 1 person, 1 computer, and 1 interrogator
  - The interrogator can communicate with the other two
  - The interrogator tries to decide which is the person
  - Both try to convince the interrogator they are the person
- If the machine succeeds, the machine can think
- ...Right?

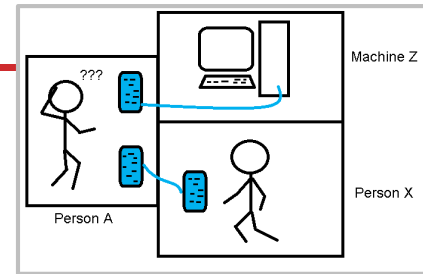


Image: [filipinofreethinkers.org/2012/06/23/turings-tremendous-talent-and-trenchant-test/turing-test](http://filipinofreethinkers.org/2012/06/23/turings-tremendous-talent-and-trenchant-test/turing-test)

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## What Can AI Systems Do Now?

- **Computer vision:** face recognition from a large set
- **Natural language processing:** machine translation
- **Expert systems:** medical diagnosis in a narrow domain
- **Spoken language systems:** continuous speech
- **Planning and scheduling:** Hubble Telescope experiments
- **Robotics:** autonomous (mostly) automobiles
- **User modeling:** Bayesian reasoning in Windows help
- **Games:** Grand Master level in chess (world champion), perfect play in checkers, Go
- **Search:** You've used Google
- **Learning:** So much learning

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## What Can't AI Systems Do Yet?

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- Understand natural language robustly
- Learn a natural language
- Surf the web
- Interpret an arbitrary visual scene
- ~~Play Go as well as the best human players~~
- Construct plans in dynamic real-time domains
- Refocus attention in complex environments
- Perform life-long learning

**Exhibit true autonomy  
and intelligence?**

\ (ツ) /

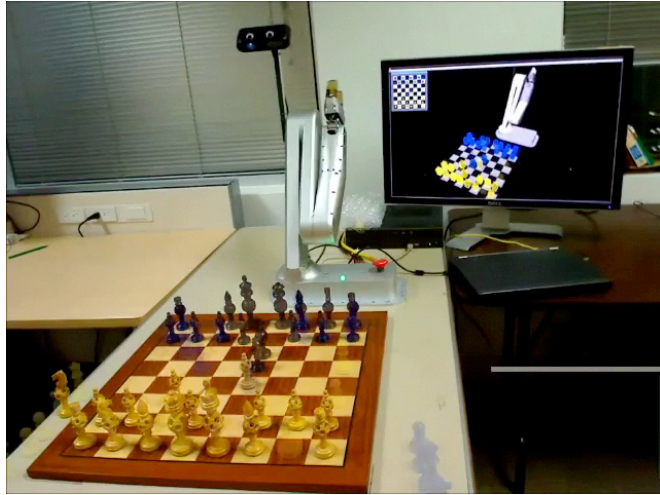
49

## Applications

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## Game Playing



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## Text/Sketch Recognition

steamboat train, from New  
 this **morning** ran off the track  
 New-London. Four cars plunged!



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Image: [play.google.com/store/apps/details?id=com.duolingo&hl=en\\_IN&gl=US](https://play.google.com/store/apps/details?id=com.duolingo&hl=en_IN&gl=US)

# User Modeling & NLP

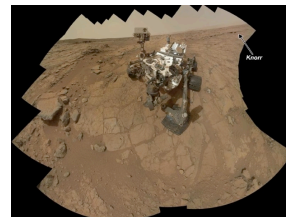
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# Robotics

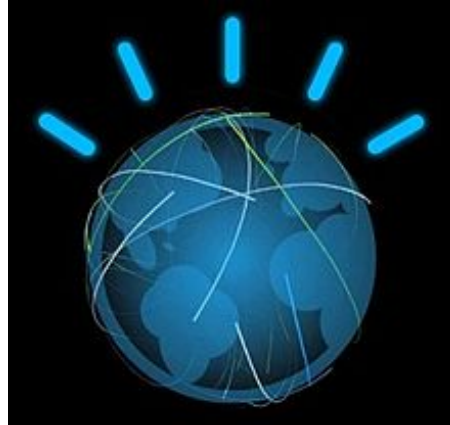
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# Knowledge Representation

- IBM Watson



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# Art



AI model drawing images from any prompt!

craiyon.com

electric sheep



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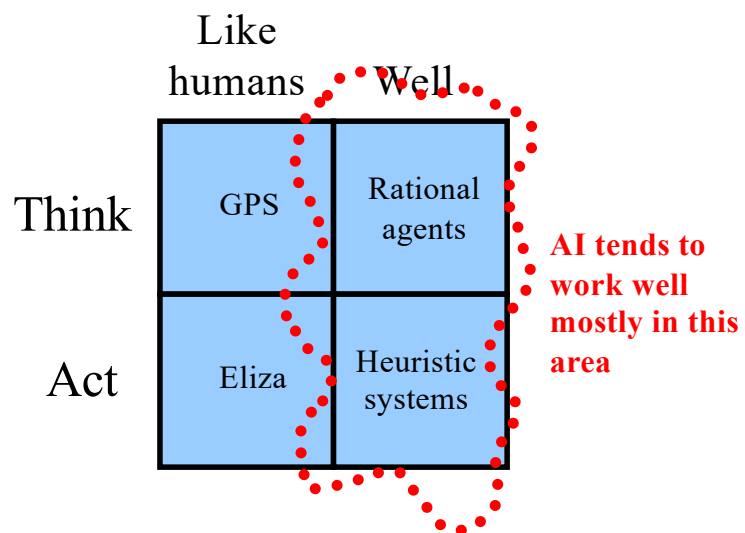


## Computer Vision



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## Possible Approaches



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## Thinking Well

- Develop formal models of knowledge representation, reasoning, learning, memory, and problem solving, that can be rendered in algorithms.
- There is often an emphasis on systems that are provably correct, and guarantee finding an optimal solution.

	Like humans	Well
Think	GPS	Rational agents
Act	Eliza	Heuristic systems

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## Acting Well

- For a set of inputs, generate an appropriate output that is not necessarily correct but gets the job done.
- “Heuristics do not guarantee optimal solutions; in fact, they do not guarantee any solution at all: all that can be said for a useful heuristic is that it offers solutions which are good enough most of the time.” – Feigenbaum and Feldman, 1963, p. 6

	Like humans	Well
Think	GPS	Rational agents
Act	Eliza	Heuristic systems

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## Thinking Like Humans

- Cognitive science approach
- Focus not just on behavior and I/O; also look at reasoning process
- Computational model reflects “how” results were obtained
- Provide a new language for expressing cognitive theories and new mechanisms for evaluating them
- GPS (General Problem Solver):
  - Produce a sequence of steps of the reasoning process similar to the steps followed by a person

	Like humans	Well
Think	GPS	Rational agents
Act	Eliza	Heuristic systems

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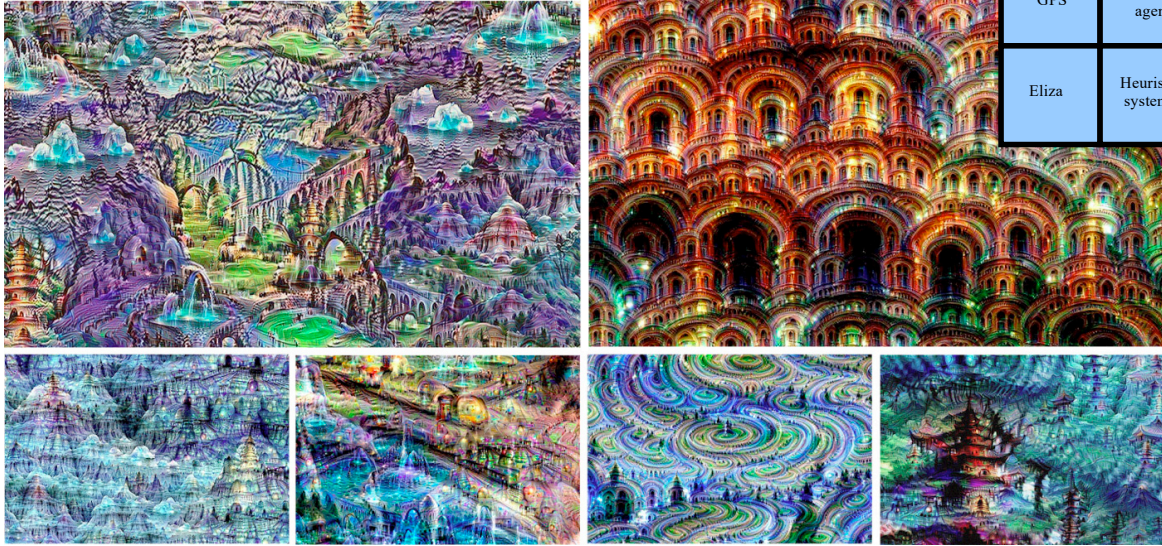
## Acting Like Humans

- Behaviorist approach.
- Not about how you get results, just the similarity to what human results are.
- Exemplified by the Turing Test

	Like humans	Well
Think	GPS	Rational agents
Act	Eliza	Heuristic systems

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## What about Statistical Methods?



Like humans Well

GPS	Rational agents
Eliza	Heuristic systems

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## What we'll cover in this class

- AI as search
- Constraint Satisfaction
- Game playing
- Probabilistic reasoning
- Decision making
- Multi-agent systems
- Machine learning concepts
- Knowledge-based agents
- Propositional logic
- Logical inference
- Knowledge representation
- Planning
- Reinforcement learning
- Applications:
  - Robotics
  - Natural language processing
  - Computer vision
- Some statistical methods

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## For Next Time

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- Before next class:
  - Read academic integrity statement
  - Read syllabus
  - Do reading for this class and pre-reading for next time
- Look at the reading lists

DATE	TOPIC / SLIDES	PRE-READINGS	READINGS	HOMEWORK	HANDOUTS / NOTES
9/1	Introduction and overview	<a href="#">Class web page</a> <a href="#">Integrity policy</a>	Ch. 1		
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9/8	Problem solving as search	3.1 intro, 3.1.1, skim 3.3	Ch. 3.1-3.3		
9/13	Uninformed search	3.4 intro, 3.4.1-3.4.3	Ch. 3.4		
9/15	Informed search	3.5 intro, 3.5.1, skim	Ch. 3.5-3.7		