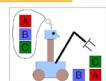


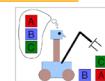
## AI: Thinking rationally



- The logicist approach.
  - Logic: notation and rules of derivation for thoughts
- Problems:
  - Not all intelligent behavior is mediated by logical deliberation
  - What is the purpose of thinking? What thoughts should I (bother to) have?

16

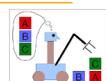
## AI: Acting Rationally



- “A field of study that seeks to explain and emulate intelligent behavior in terms of computation processes” Schalkoff, 1990
- “The branch of computer science that is concerned with the automation of intelligent behavior” Luger and Stubblefield
- Rational behavior: *doing the right thing*
  - The “right thing” is that which is expected to maximize goal given the available information.
- Our focus: rational agents, and how to construct them.

17

## What is AI?



Definitions of artificial intelligence:

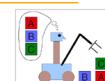
Systems that <b>think like humans</b>	Systems that <b>think rationally</b>
Systems that <b>act like humans</b>	Systems that <b>act rationally</b>

- The definitions vary by:
  - Thought processes vs. action
  - Judged according to human standards vs. success according to an ideal concept of intelligence: rationality.

18

## What is Artificial Intelligence?

### A Day in a Life



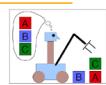
1. Wake up, get dressed, eat breakfast [power optimization]
2. Check email [spam filter, security agent]
3. Read news [personalized presentation, information agent]
4. Drive to work [traffic light control, collision avoidance, route planning, GPS network maintenance]
5. Teach and/or do service [search engine]
6. Work on research projects [search engine]
7. Meet with collaborators [scheduling]
8. Go grocery shopping [market basket analysis, fraud detection]
9. Have dinner [search engine]
10. Watch video [collaborative filtering]
11. Read

## AI Systems: Some Milestones

- Deep Space 1: AI planner controls space probe - NASA 1999.
- Deep Blue: Defeats Kasparov, Chess Grand Master - IBM 1997
- DARPA grand challenge 2005: 130 mile race of driverless cars in the desert.
- Curiosity Mars rover 2012



20



## AI Technologies: Computer Vision

Introducing Kinect for Xbox 360

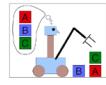
You are the controller! No goggles, no gloves, just you!

Kinect lets games and entertainment be in a revolutionary new way—without controllers. And it's the first time you can play with your body without being self-conscious about it. With Kinect, technology moves, letting the natural motion of all of us move.

Getting started with Kinect is easy. Click here to learn more about how Kinect works and how easy it is to get up.

## AI Technologies: Genetic Algorithms

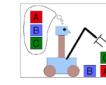
"A genetic algorithm is any population-based model that uses selection, recombination and mutation operators to generate new sample points in a search space." D. Whitley



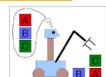
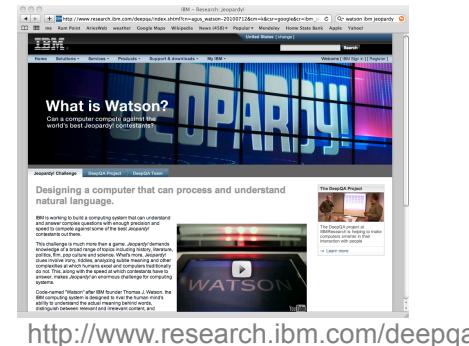
## AI Technologies: Natural Language Understanding

Siri. Sports. Restaurants. Movies.  
Now ask even more of Siri.

With iOS 6, Siri understands more languages and works in more countries. So you can get more things done in more places around the world. Want to know the latest scores and stats for your favorite teams and players? Thanks to iOS 6, Siri knows the answers. Or maybe it's movie night. Siri can show you the latest reviews and showtimes for theaters near you. And if you're a fan of Angry Birds, Siri can even have Siri open your apps for you—no tapping required. Say "Launch Flight Tracker" or "Open Angry Birds" and Siri does just that. You can also use Siri to post Facebook updates and tweet for you. Learn more about Siri.



## AI Technologies: NLP/Question answering, Game Players



## AI Technologies: Robotics

Boston Dynamics  
DARPA challenge



Texas A&M

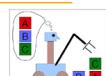
Search and rescue



MBARI Fish tracking

## AI in Medicine

The first screenshot is from a news article on 'Robotics Zeitgeist' titled 'The first-ever all-robotic surgery OCT 25TH'. It shows a surgeon in blue scrubs sitting at a control console, with two robotic arms performing surgery on a patient. The second screenshot is from the 'Oncotype DX Breast Cancer Assay' website, which provides a step-by-step guide for healthcare professionals on how to use the assay.



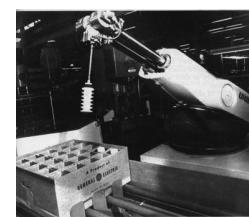
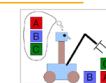
## Mundane Versus Expert Tasks

### Mundane

- ❑ Identifying objects in an image
- ❑ Answering a question
- ❑ Picking up an arbitrary object

### Expert

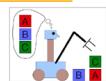
- ❑ Chess
- ❑ Medical diagnosis
- ❑ Configuring computer hardware (circuit layout)
- ❑ Special purpose robots



Armed for duty. A Unimate robot—nearly just as arm—picks up and puts down parts in a General Electric factory.

27

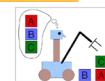
## Foundations of AI



- Philosophy: Logic, reasoning, rationality.
- Mathematics: Logic, computability, tractability
- Psychology: understanding how humans think and act.
- Neuroscience: how do brains process information?
- Economics: theory of rational decisions, game theory.
- Computer Engineering: building the hardware and software that make AI
- Linguistics: how to deal with language
- ...

28

## Beware of combinatorics!

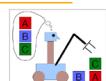


- “Solvable in Principle”: little help in practice
- Beware of intractability...
  - Considering all possibilities often leads to correct, but intractable, algorithms.
  - Intractable means exponential time to solution.
- NP-Complete Problems
  - Class of intractable problems

One View: *AI proposes imperfect, but practical, algorithms to solve NP-Complete problems.*

29

## Foundations of AI: Neuroscience

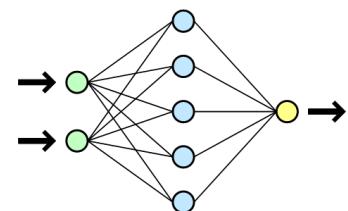


Use ideas from neuroscience to design computer architectures that “learn”.



Artist's depiction of a neural network

<http://www.bitspin.net/images/neuron.jpg>



Abstraction as an artificial neural network

[http://en.wikipedia.org/wiki/Neural\\_network](http://en.wikipedia.org/wiki/Neural_network)

30