**Introduction to ROBOTICS**

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## Are robots a good?

- 322 BC – Aristotle, a Greek philosopher, wrote "If every tool, when ordered, or even of its own accord, could do the work that befits it... then there would be no need either of apprentices for the master workers or of slaves for the lords."

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## robot: (*noun*) …

Insert image here

**?**

What is a robot?

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## The Origins of Robots

~1250 — Bishop Albertus Magnus holds banquet at which guests were served by metal attendants. Upon seeing this, Saint Thomas Aquinas smashed the attendants to bits and called the bishop a sorcerer.

1640 — Leonardo DaVinci designed a mechanical device that looked like an armored knight, which moved in human-like motions.

1640 — Descartes builds a female automaton which he calls "Ma fille Francine." She accompanied Descartes on a voyage and was thrown overboard by the captain, who thought she was the work of Satan.

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1738 — Jacques de Vaucanson builds a mechanical duck made of more that 4,000 parts. The duck could quack, bathe, drink water, eat grain, digest it and void it. Whereabouts of the duck are unknown today. He also built a flute, and a flute and drummer.

1770 — Swiss clock makers and inventors Pierre Jaquet-Droz and his son Henri-Louis created three doll automata: one could write, one could play music, and one could draw pictures.

1801 — Joseph Jacquard built an automated loom controlled by punch cards.

1805 — Doll, made by Maillardet, that wrote in either French or English and could draw landscapes.
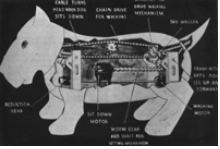
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1898 — Nikola Tesla built and demonstrated a remote controlled robot boat at Madison Square Garden*.

1923 — Karel Capek coins the term *robot* in his play *Rossum's Universal Robots (R.U.R.)*. *Robot* "might come" from the Czech word *robota*, which means "servitude, forced labor."

1940 — Sparko, the Westinghouse dog, uses both mechanical and electrical components.

\* This was MSG II on 26th and Madison

## Slide 1

1950's -1960's

Computer technology advances and control machinery is developed. Questions Arise: Is the computer an immobile robot? 1962, first industrial arm, the Unimate, is introduced

Industrial Robots created. Robotic Industries Association states that an "industrial robot is a re-programmable, multifunctional manipulator designed to move materials, parts, tools, or specialized devices through variable programmed motions to perform a variety of tasks."

## Slide 2

1956

Researchers aim to combine "perceptual and problem-solving capabilities," using computers, cameras, and touch sensors. The idea is to study the types of intelligent actions these robots are capable of. A new discipline is born: A.I. John McCarthy, Marvin Minsky, Nat Rochester, and Claude Shannon organized 'The Dartmouth Summer Research Project on Artificial Intelligence' at Dartmouth College. This was the first use of the term 'artificial intelligence.'
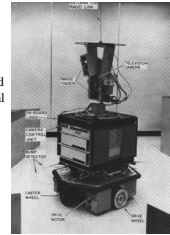
1960

Shakey is made at Stanford Research Institute International. It contained a television camera, range finder, on-board logic, bump sensors, camera control unit, and an antenna for a radio link. Shakey was controlled by a computer in a different room.



Information and pictures from the previous five slides can be found in Isaac Asimov's and Karen A. Frenkel's book "Robots, Machines in Man's Image." © 1985

## Slide 3

# Timeline

- 1966 – Joseph Weizenbaum created an artificial intelligence program named ELIZA at MIT. ELIZA functioned as a computer psychologist that manipulated its users statements to form questions.
- 1969 – Victor Scheinman, a mechanical engineering student in the Stanford Artificial Intelligence Lab, created the Stanford Arm. The arm's design became a standard and is still influencing the design of robot arms today.
- 1970 – Stanford University produced the Stanford Cart. It is designed to be a line follower but can also be controlled from a computer via radio link.
- 1972 – Shigeo Hirose built the first snake robot; this became the first of many great Hirose robots
- 1974 – Victor Scheinman formed his own company and started marketing the Silver Arm, which was capable of assembling small parts together using touch sensors – this leads to Adept Robots forming
- 1977 – Deep space explorers Voyagers 1 and 2 were launched from the Kennedy Space Flight Center.
- 1979 – The Robotics Institute at Carnegie Mellon University was established.
- 1979 – The Stanford Cart was rebuilt by Hans Moravec, who added a more robust vision system allowing greater autonomy. These were some of the first experiments with 3D environment mapping.
- 1980 – Seymour Papert published "Mindstorms: Children, Computers, and Powerful Ideas," where he advocated constructionism, or learning through doing.
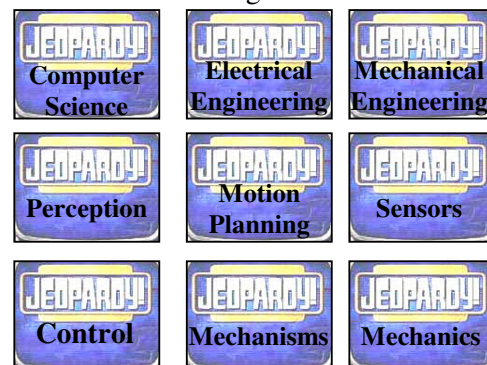- 1981 – Takeo Kanade built the direct drive arm, the first to have motors

## Slide 4

# Fill out paper

- Name
- Email
- Major
- Acting Major
- Enrolled/Waitlist
- Favorite robot movie
- Why are you taking this class
- Draw a robot
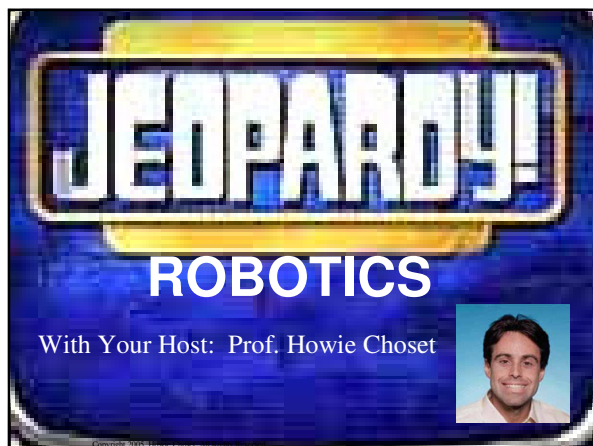
## Slide 5



## Slide 6

The Categories Are…..

Combining these fields we can create a system that can

# SENSE

↓

# PLAN

↓

# ACT

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Combining these fields we can create a system that can

# Mechanical Engineering

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# Electrical Engineering

↓

# Computer Science

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So What IS a Robot?

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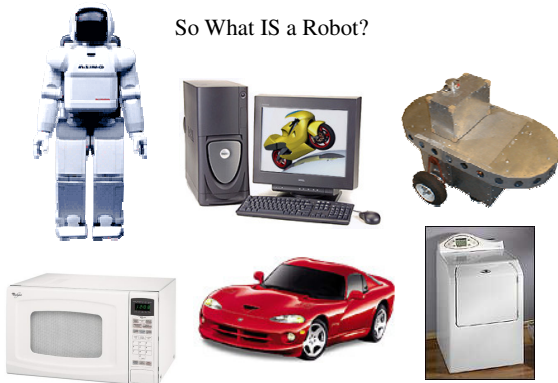
There is no widely
accepted definition of
what a robot is.

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This semester we will study many aspects of robotics.

**Vision**

**Artificial Intelligence**

**Motion Planning**

**Sensors and Sensor Planning**

**Mobile Robot Platforms**

**Forward Kinematics**

**Inverse Kinematics**

**Non-Holonomic constraints**

**http://generalrobotics.org**

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# High Workload

- Lots of homework
- First HW assignment handed out today
- Second HW assignment handed out Tues
- Work responsibly
- Time consuming design experience
- Lots of work assigned around Carnival times
- Another design experience
- Programming
- Exams

## Some strict rules

- Attendance not mandatory, punctuality is
- No late HW assignments accepted, your printer or dog eating your HW is not an excuse…
- Demos start on-time (early), your responsibility to make it work (memory stick, etc)
- Absence from a demo receives a zero
- Lowest HW grade dropped, if you get all the HW's in at the end of semester, except HW 1 and 2
- Exams: 8.5 x 11 sheet of paper, both sides, in your hand
- Cannot take this class if it overlaps with another
- Miscommunications must be cleared up before demo day

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### Undergraduate Robotics Minor at Carnegie Mellon: http://www.ri.cmu.edu

**Overview**

**16-311 Introduction to Robotics**

**Controls**

One of the following courses:
**06-205 Chemical Engineering Process Control**
**18-370 Fundamentals of Control**
**24-451 Feedback Control Systems**
**16-299 Introduction to Feedback Control Systems**

**Manipulation, Dynamics, Mechanisms**

One of the following courses:
**15-384/18-384 Manipulation**
**24-353 Intermediate Dynamics ????**
**24-355 Kinematics and Dynamics of Mechanisms ??????**

**Electives (this list is getting bigger)**

Two of the following courses:
**15-381 Artificial Intelligence: Representation and Problem solving**
**15-385 Computer Vision**
**15-462 Computer Graphics I**
**15-463 Computer Graphics II**
**15-681 Machine Learning**
**15-881/15-499 Introduction to Geometry**
**16-362/16-862 Introduction to Mobile Robot Programming**
**16-721 Advanced Perception**
**16-879/18-879/24-700 Mechatronic Design**
**24-384 Special Topics in Design: Computational Geometry**
**24-700/16-735 Robotic Sensor Based Motion Planning**
**24-779 Human Systems and Control**
**60-422 Advanced ETB: Robotic Art Studio**
**85-213 Information Processing and Artificial Intelligence**
**85-370 Perception**
**One Independent study course**
**An upper level RI course**

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## Meet the TA's

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## Waitlist people

- Motivated students usually get in