

# Engineering & The World

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1. Science, Technology, Engineering, Math
2. Columbia Engineering
3. Sensors & Feedback

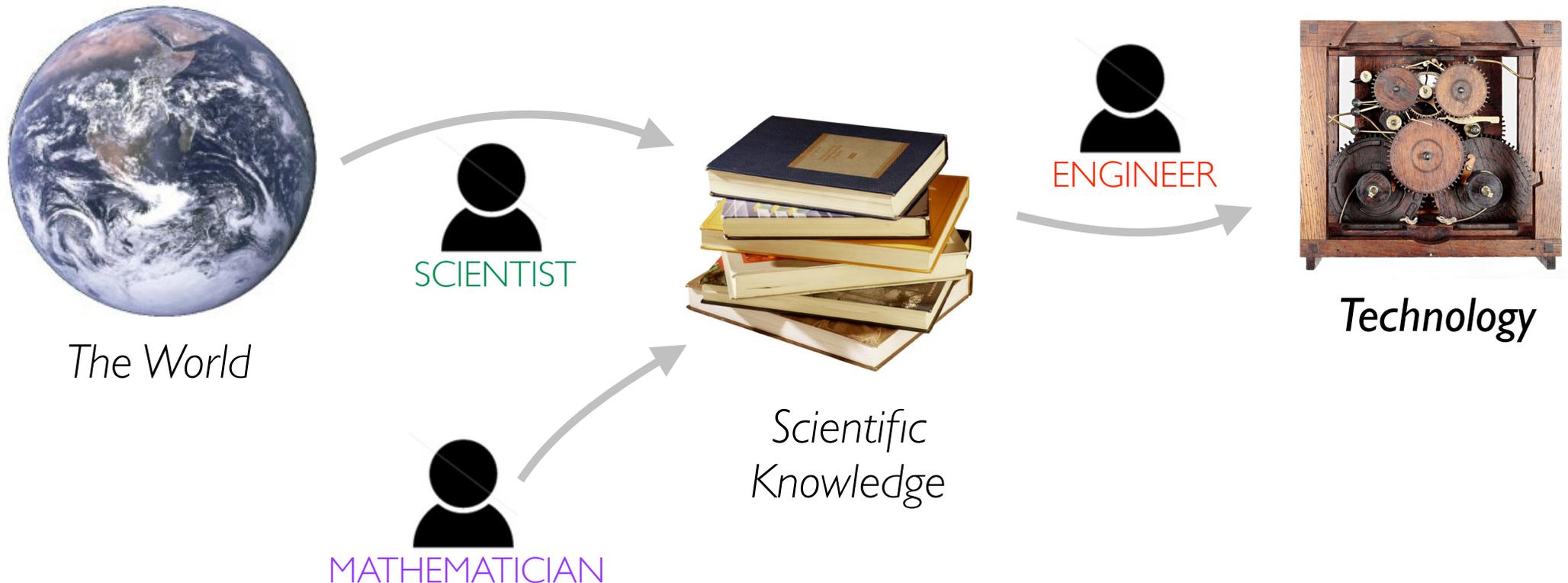


COLUMBIA UNIVERSITY  
IN THE CITY OF NEW YORK

# STEM: Science, Technology, Engineering, Math

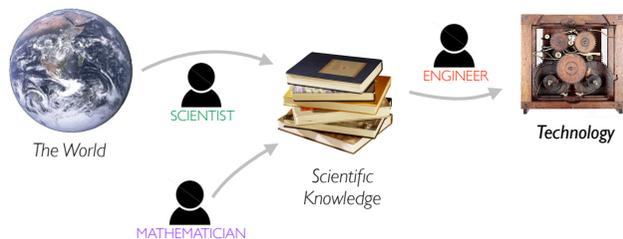
- “Scientists discover the world that exists; Engineers create the world that never was.”

*Theodore von Kármán*



# Famous People

- Scientists
- Mathematicians
- Engineers



# The Astrolabe (c. 600 CE)

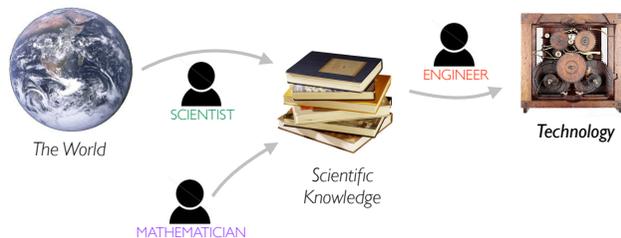
- What time is it?



Istanbul, 1577



Hipparchos, 190-120 BCE

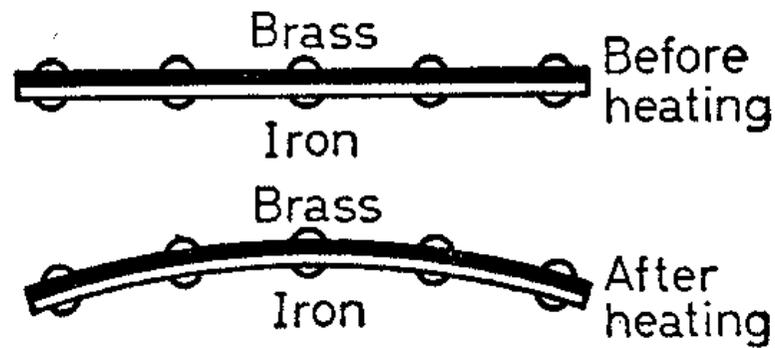


# The Sea Clock (1759)

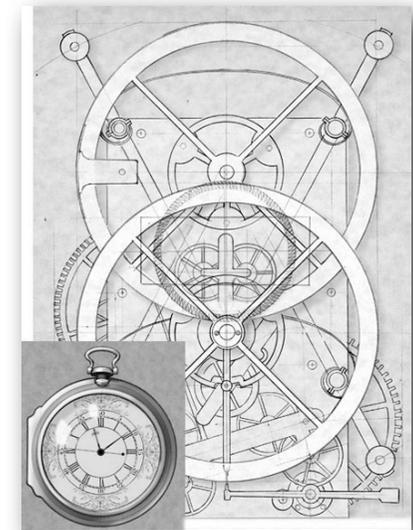
- But *what time is it?*
- “When longitude at sea is lost, it cannot be found again by any watch.” *Isaac Newton*



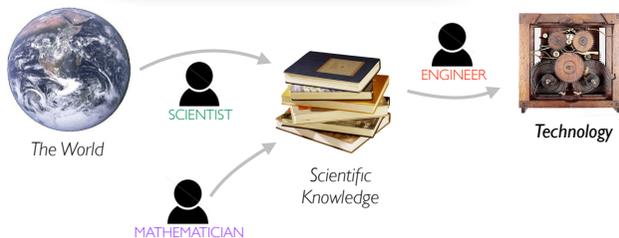
John Harrison, 1693-1776



Bimetallic strip



The cost of the first sea clocks was  $\sim \frac{1}{3}$  of the ship

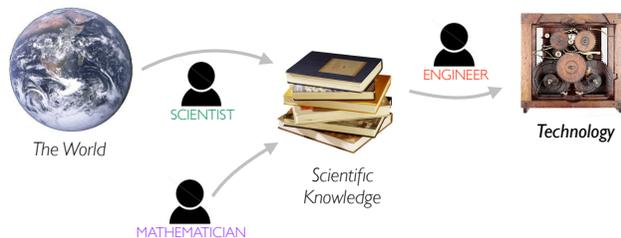


# The Brooklyn Bridge (1883)

- Bridge building was the “hot technology” of the 1860s



Emily Roebling, 1843-1903



# The Engineering Process

- **Analyze** the problem

- What principles can be used to solve it?



- **Design** a solution

- faster, better, cheaper



- **Test** it out

- Does it behave as expected?  
Why not?



- **Refine & repeat**

- again and again and ...



# Teamwork

- There's only so much **one person** can do
  - Large projects require collaboration
  - How can teams work together efficiently?



- **Communication** is critical to Engineering
  - John Harrison had to wait until he was 80 to receive his prize
- **Documentation** of what you've done
  - for the team...
  - for the future...

# Are You an Engineer?

- There are many **different kinds** of engineer...
  - a successful team needs a range of talents
  - But I believe I was **born to be an engineer**
- **Top signs:**
  - You are curious about **how things work**
  - You like to **take things apart** (and put them back together)
  - You really enjoy having an idea about **something that might work**, trying it out, and finding it does



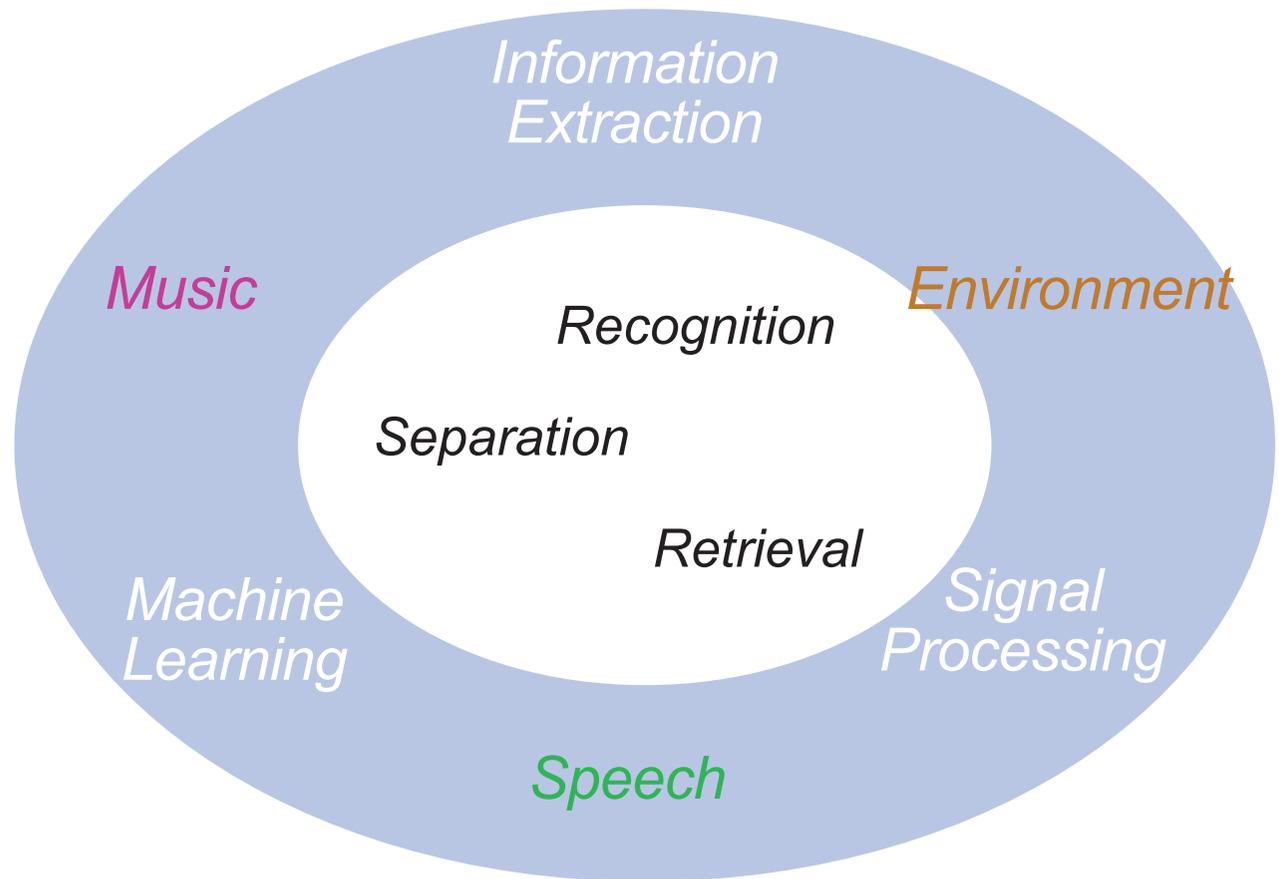
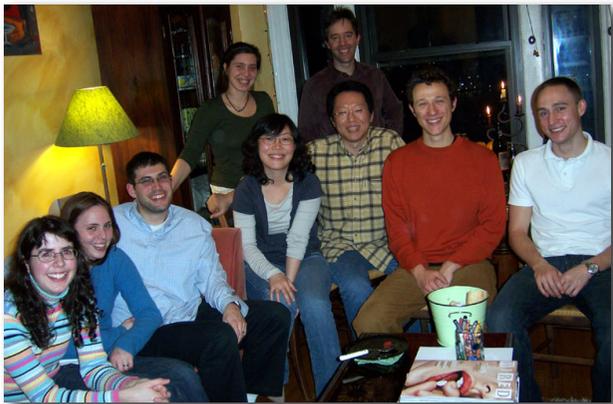
# Columbia Engineering

- The Fu Foundation School of Engineering and Applied Science



# LabROSA

- The **L**aboratory for **R**ecognition and **O**rganization of **S**peech and **A**udio



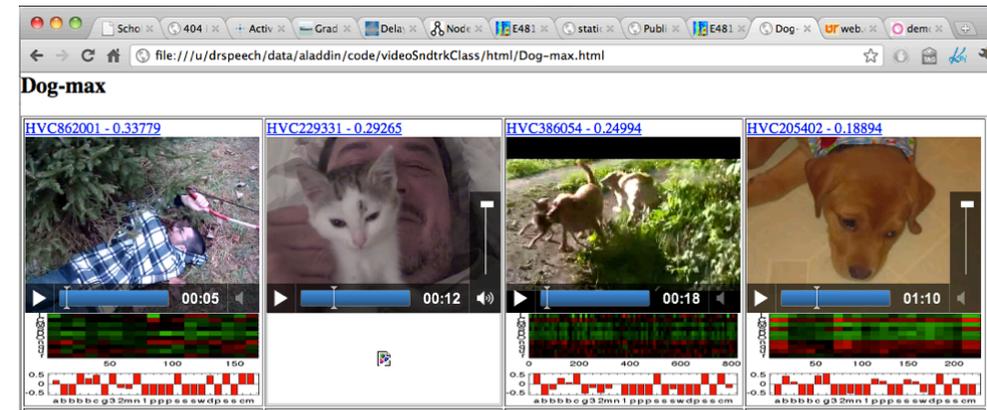
# Environmental Sound Recognition

- Computer **learns** sounds from examples

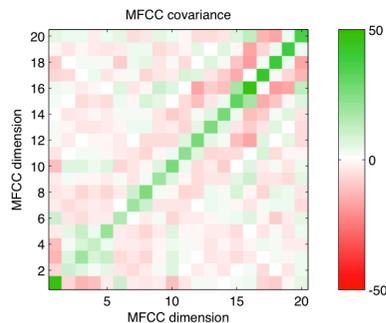
Example Recordings



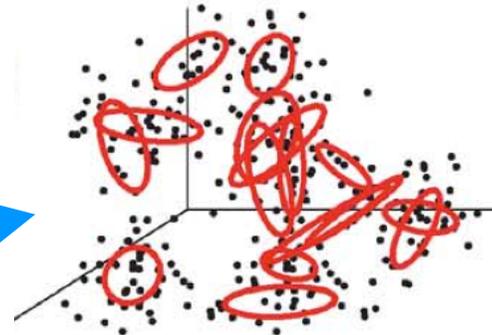
Search Results



Sound Features

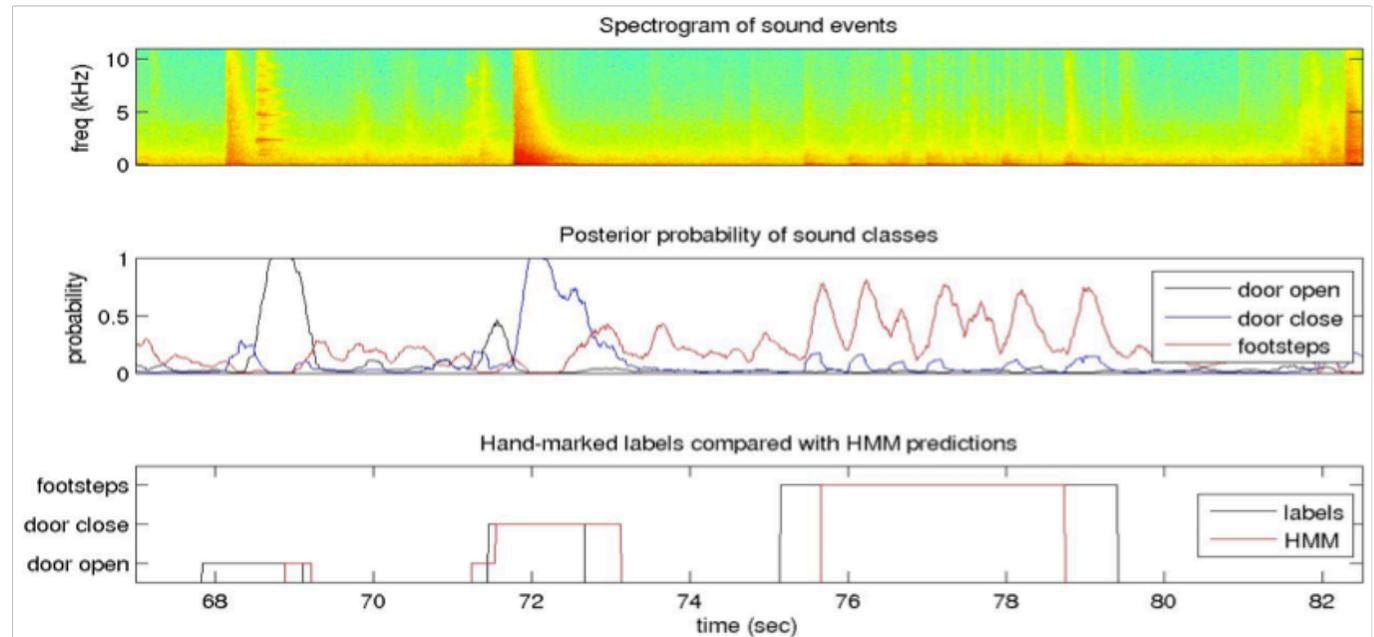


Clusters



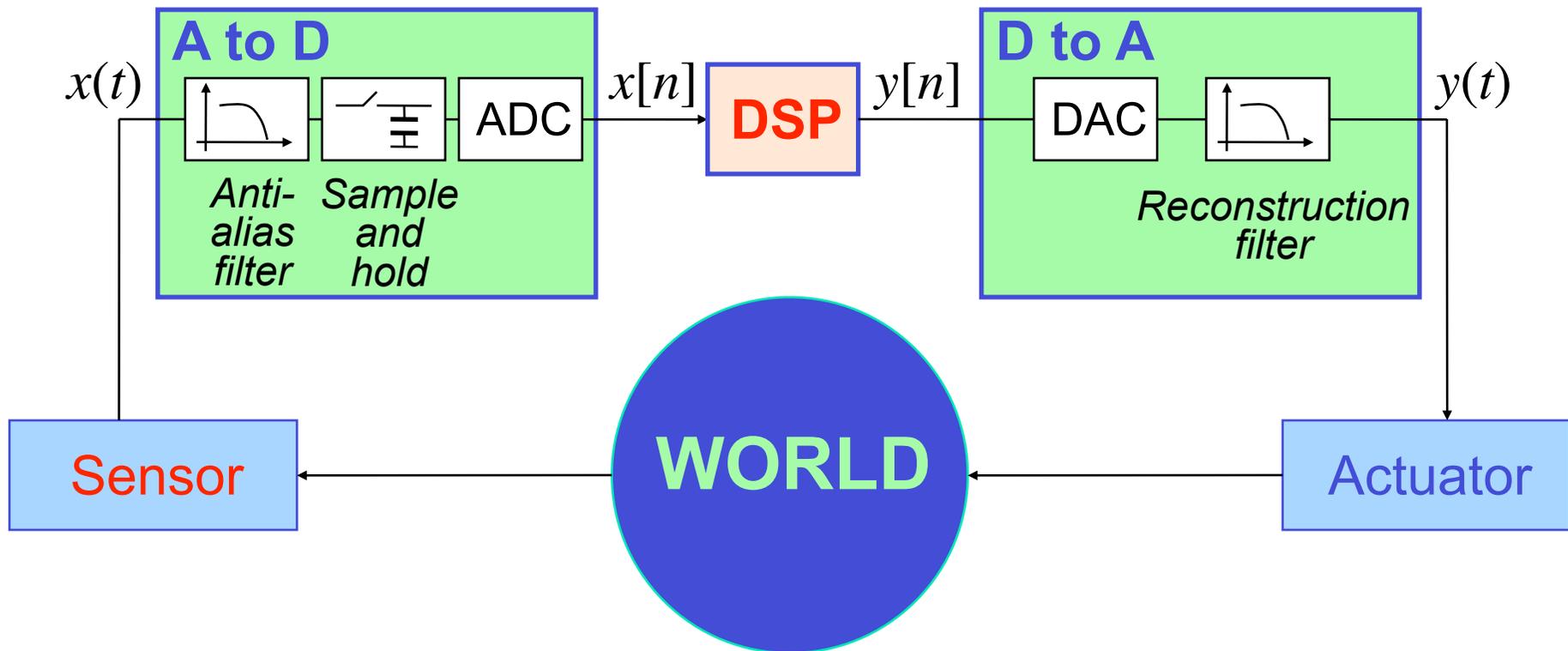
# Mobile Audio Awareness

- Recognize important sounds in **real time**
  - as an aid for the hearing impaired



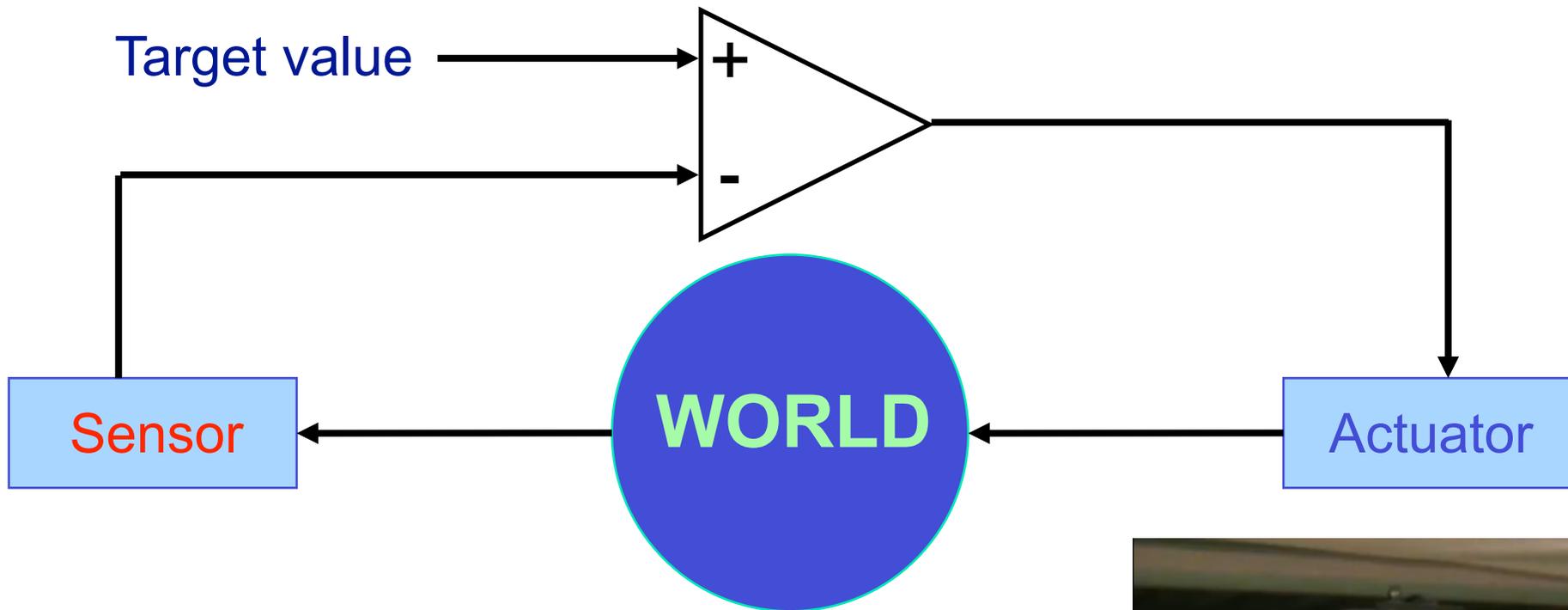
# Sensors

- Technology is interesting only if it interacts with **the world**



# Feedback control

- A system that “acts” to **correct errors**



- Challenge is in getting it **damped** “just right”

<http://www.youtube.com/watch?v=EAvtBQFQJw8>



# Summary

- Science, Technology, Engineering, Mathematics (STEM)
- The Engineering Process
- The Laboratory for Recognition and Organization of Speech and Audio (LabROSA)
- Feedback control