Controlling Robots with Non-Invasive Brain-Computer Interfaces

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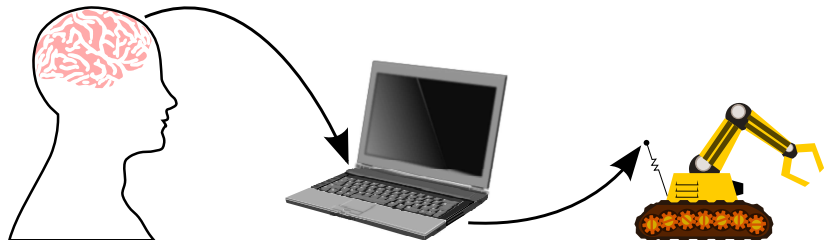
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Brain-Computer Interfaces

- Brain-Computer Interface (BCI)

- Direct channel of between brain and machine

- Voluntary changes in mental state

- Bypasses innate motor-based means of communication

Uses for BCI

- BCI have many potential uses

- Reestablish communication with people who are Locked-in
  - ALS, stroke, traumatic brain injury

- Assistive technology
  - electric wheelchairs, computers, telephones

- Everyday devices
  - video games, monitoring emotional states

- Driving kewl robots around the lab with your mind!

Electroencephalography

- Electroencephalography (EEG) to measure brain activity

- Non-invasive, portable, relatively inexpensive

- Superficial & noisy signals
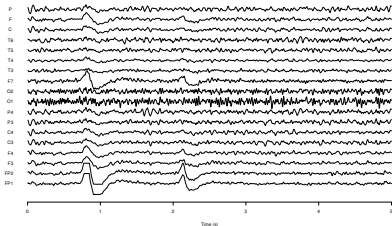
Machine Learning & Pattern Analysis

- Machine Learning algorithms identify patterns in EEG

- This is **extremely** difficult because
  - different for each person
  - change over time
  - noise & artifacts
 - the brain is complex!
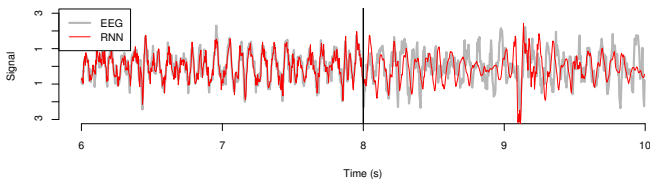
Synchronous BCI

- Some BCI use patterns associated with external stimuli

- P300 speller is an example

- User looks for a specific character in a series or grid of flashing characters
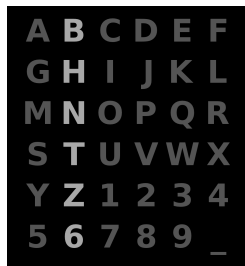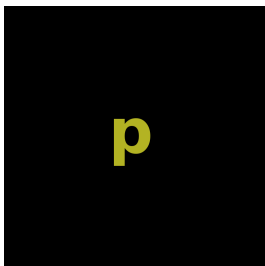
Asynchronous BCI

- Other BCI do not require external stimuli

- Mental Tasks is an example

- Imagine left arm moving moves to the left while silently singing a song moves to the right
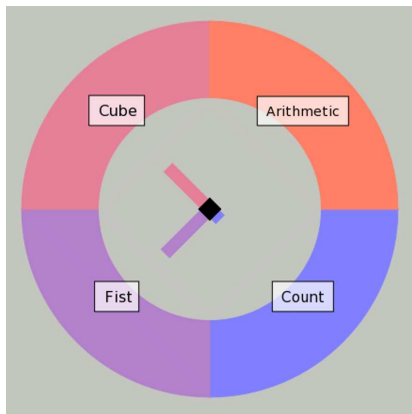
Robots

- Controlling robots is a first step toward real-world applications

- Drive a robot before an electric wheelchair

- Demonstrates that user has control

- Just plain fun!

Ideas for Robot Club, I

- Current robot module is hacked together but better systems to come.

- Some ideas for robot club to start on

- Streaming video through sockets, to python

- Better user interfaces
  - Fluid control
  - How far to move
  - Control gripper

Ideas for Robot Club, II

- Safety systems
  - Don't hit a wall
  - Don't go down stairs

- Hybrid control
  - Turn away from walls
  - Move toward objects

Thanks!