The Cyborg You Are
and
The Cyborg You Will Be

Brain Machine INTERFACE

Sabrina Reguyal '22 & Rahul Saha '22
If you could have a neural prosthetic, what level of risk are you willing to tolerate?

Consider:
1. Biological risks
2. Ethical concerns
3. Privacy
What is a cyborg?

Biological brains that are enhanced with technology. But enhanced in what aspect? Does using a calculator make you a cyborg?

What about using a boomerang? What about a cochlear implant?

How about electrodes implanted into your brain?

Ask yourself what you think of when you imagine a cyborg.

Fun questions to think about - but are they important?
Ways to Become A Cyborg

- 1. Education and Training
  0. Using a Smartphone
  1. Brain Machine Interfaces (BMI)
  2. Exoskeletons and Prosthetic Limbs
  3. Wearable computing devices
  4. Vision Implants
  5. Auditory Implants
Turing Test

The Imitation Game

"I propose to consider the question, 'Can machines think?'"
Artificial body parts that can substitute or enhance a brain function

Brain function = motor, sensory or cognitive.
Brain–Machine Interfaces (BMI/BCI)

- Record Neuronal signals (such as CNS signals)
- Translate these signals
- Output the translated signal to a device
Vision

Summary - we're really bad at it.

Glasses are cool though!

- Jerry
  - Blinded in adulthood
  - BCI designed by William Dobelle
  - Phosphenes
  - Can now do some tasks unassisted
Scientific Basis
Induced Hallucinations

Cell
Controlling Visually Guided Behavior by Holographic Recalling of Cortical Ensembles

Graphical Abstract

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In Brief
The activation of a small set of pattern completion neurons via two-photon holographic optogenetics triggers neuronal ensembles that appear to be necessary and sufficient for behavior.
Deep Brain Stimulation

- Very promising technology, approved by the FDA
- Neurostimulator - a pacemaker for the brain
- Sends electrical impulses
- Partial treatment for essential tremor, Parkinson's
- Complications include hemorrhage and infection
Companies
Neurable – Neuralink but better?

Mission: create everyday Brain-Computer Interfaces (BCIs)

- founded in 2015, headquartered in Boston
  - roots in UMich Direct-Brain Interface laboratory
- 2017: demonstrates the world's first mind-controlled VR game
  - Awakening, escape room-based game
- 2019: $6 million Series A, moving on to more general applications
  - headphones that measure brain activity to generate insights
Neuralink – Musky

Mission: "If you can't beat 'em, join 'em" - Elon Musk re Artificial Intelligence.

- Founded by Elon Musk and "Others"
  - Who's "others"
  - Flip Sabes - UCSF Prof on BCI
  - Ben Rapport - Neurosurgeon
  - DJ Seo - UCB
  - Paul Merolla - Brain inspired chips!
  - Vanessa Tolosa - Biocompatibility
  - Max Hodak - Duke
  - Tim Hanson - Berkeley Sensor and Actuator Center
  - Tim Gardner - Assoc. Prof at Boston Uni
Neuralink - Musky

- The science behind it, as explained by Neuralink
- Approach
  - Micron-scale threads are inserted into areas of the brain that control movement.
  - Each thread contains many electrodes and connects them to an implant, called the Link.
  - Wireless charger
- How to get a neural implant? What are the risks?
- So...what's new about Neuralink?
Neuralink – Musky

- The App!
  - Bluetooth to control mouse, keyboard
  - Will teach you to use the device
- Transfer information to and from brain
- Large number of electrodes
- Smaller
- >1024 channels of information from the brain

Neuralink trains to pick up increasingly accurate signals.
Nectome – preserve your brain and upload it!

- Y Combinator backed, has raised $1 million in funding
  - used to have a partnership with the MIT Media Lab
- Sam Altman has joined a "waiting list" for having Nectome digitize your brain
  - for the low price of a (refundable) $10k deposit
- the procedure is 100% fatal!
  - embalming + cryogenics
- Alcor Life Extension Foundation
- ethical issues with brain preservation
Zoolingua - Communicate with Doggos

Mission - allow dogs and humans to communicate in both directions

Thoughts

- Why stop at doggos
- Hooman interface

https://zoolingua.com/
Some other uses

- tremor suppression
- communication for those with paralysis
- productivity software
Neurosecurity & Neuroethics

- Preserve neuronal information about you
- Neuromarketing
- Ransomware
- Doping for intellectual sports?

Do you trust a private corporation or a government with access to your neuronal data? What happens in authoritarian regimes?
The NeuroRights Initiative

Five Neuro-rights:
1. Mental privacy
2. Identity (self)
3. Agency (free will)
4. Fair Access (to cognitive augmentation)
5. Protection (from Bias and Discrimination)

13 April 2021: Chilean Congress approves a constitutional amendment that acknowledges and protects mental integrity in light of current advances in neurotech.
Challenges

1. Size *does* matter
2. Power consumption
3. Biocompatibility
4. Surgical precision
5. Mathematical modelling
How are cognitive enhancements different from education and training?

Why would they pose ethical questions that are not already caused by education?
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