

Lecture #2 on Day #1

- ENGR 399 instructors: Dr. Daniel Lacks and Dr. Émile P. Torres.

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- ENGR 399 instructors: Dr. Daniel Lacks and Dr. Émile P. Torres.
- I'm a philosopher (specializing in moral philosophy) and historian, with a background in neuroscience (master's degree)
 - Questions about this first class? Email me: ept24@case.edu
 - I will post these slides to Canvas
- We will discuss the syllabus on Thursday. For now, let's dive right into our topic for today!

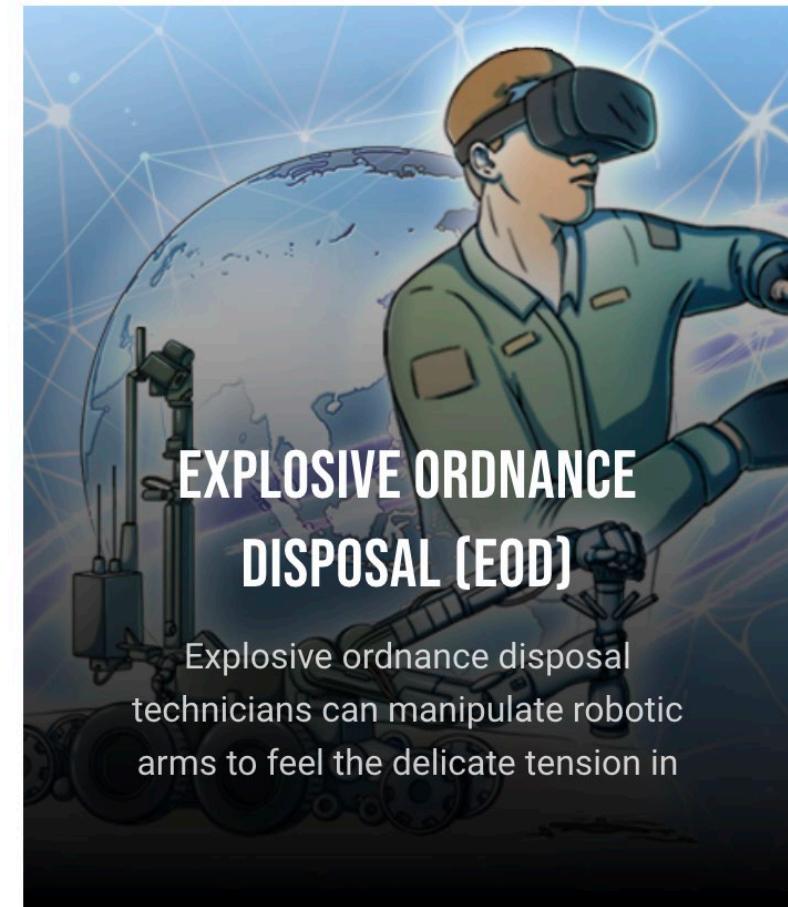
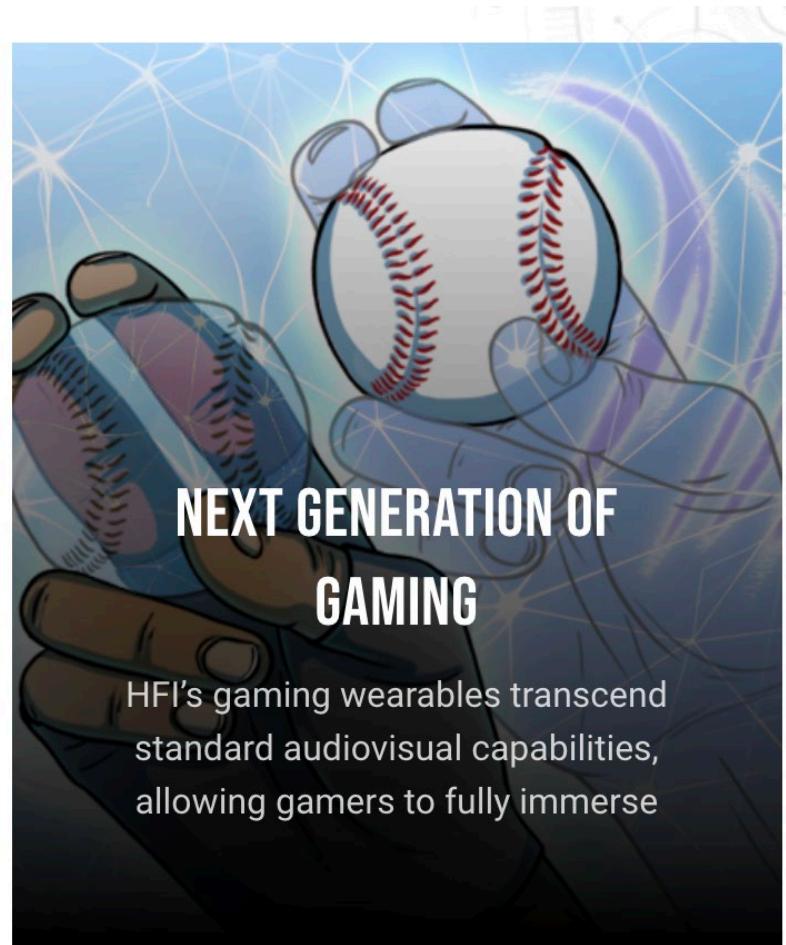
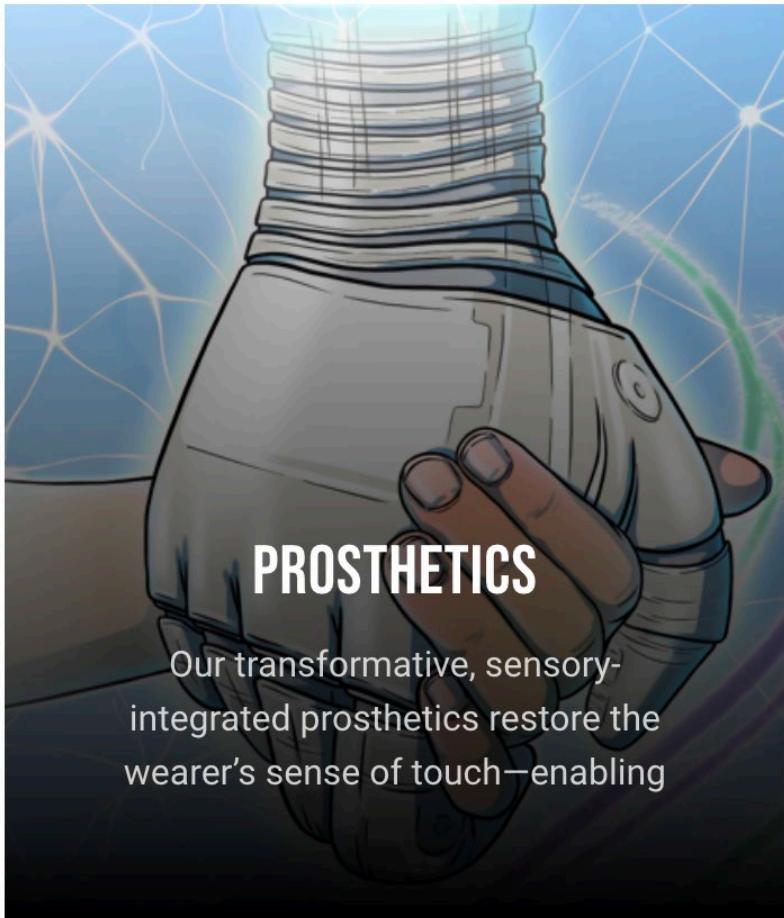
This lecture... what we will cover

1. Consequentialist ethics
2. Deontological ethics
3. Virtue ethics
4. Using these ethical theories to analyze ethical issues in engineering

We will apply these ideas in the context of
next-generation biomedical devices and
the use of AI in the military



Human Fusions Institute at CWRU



Dr. Dustin Tyler



EMILY MULLIN

SCIENCE SEP 16, 2024 7:00 AM

This Brain Implant Lets People Control Amazon Alexa With Their Minds

Neuralink rival Synchron is connecting its brain-computer interface with consumer technologies to allow people with paralysis more functionality.

While virtual assistants are already helpful for people with disabilities, they don't always afford privacy since they rely on voice commands that can be overheard. "Restoring any amount of independence is really important to people, but restoring independent private use is even better," says Emily Graczyk, an assistant professor of biomedical engineering at Case Western Reserve University, who is working on restoring sensation with BCIs.

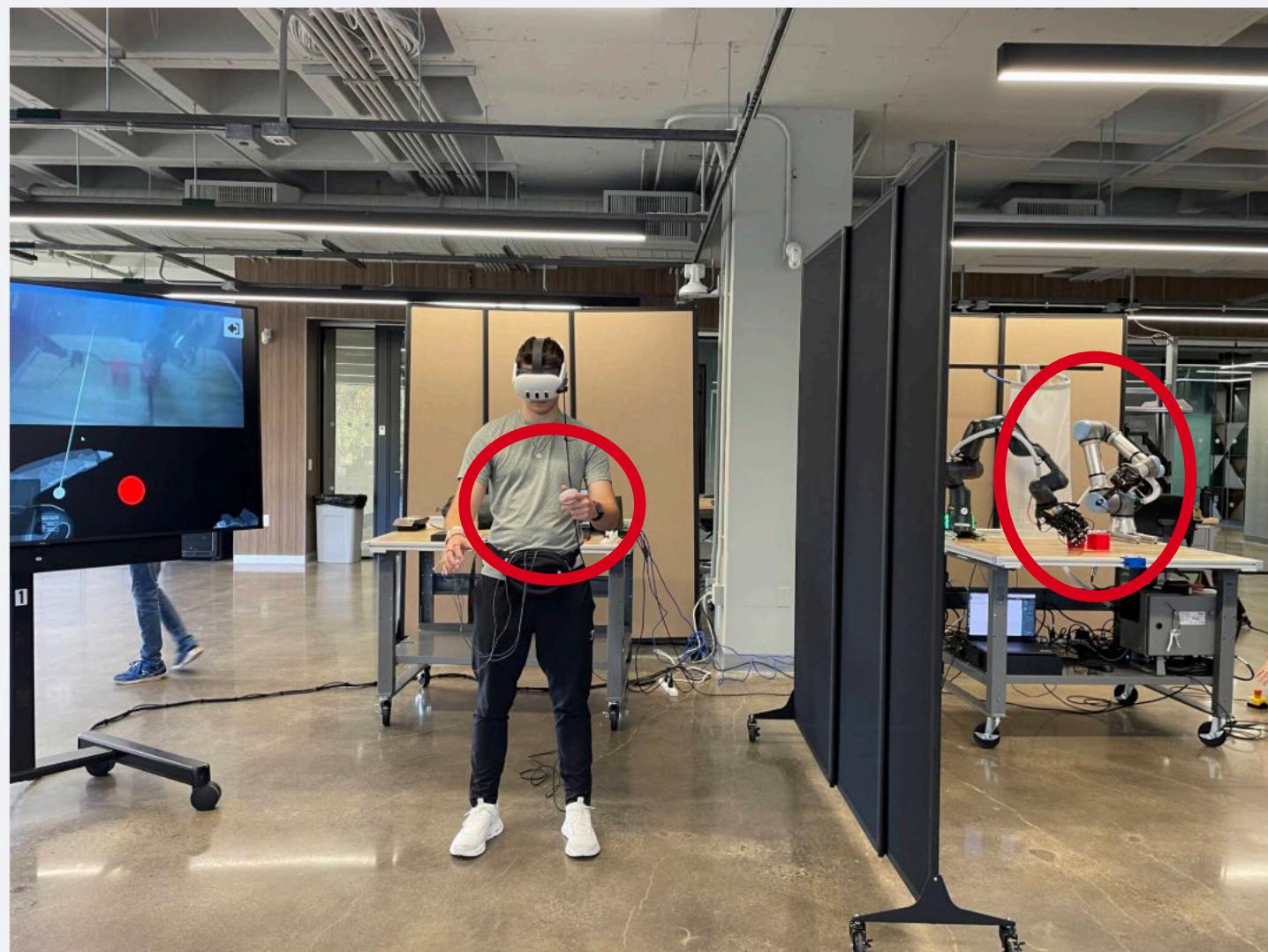
Symbiotic human-machine relations: Ethics is central

(Hint for later: listen for the word “utilitarian” in this video)

“Experience the robotic arm as their own”

The project I work on...

- \$10 million Office of Naval Research (ONR) project to develop wearable device connected to a robotic arm for the purpose of, e.g., disposing of bombs without putting user (soldier, police officer, etc.) in harm
- The ultimate aim is to allow the operator to experience the robotic arm as their own and even feel the grasp
- Sensitive enough so that one could defuse a bomb without any visual input at all!

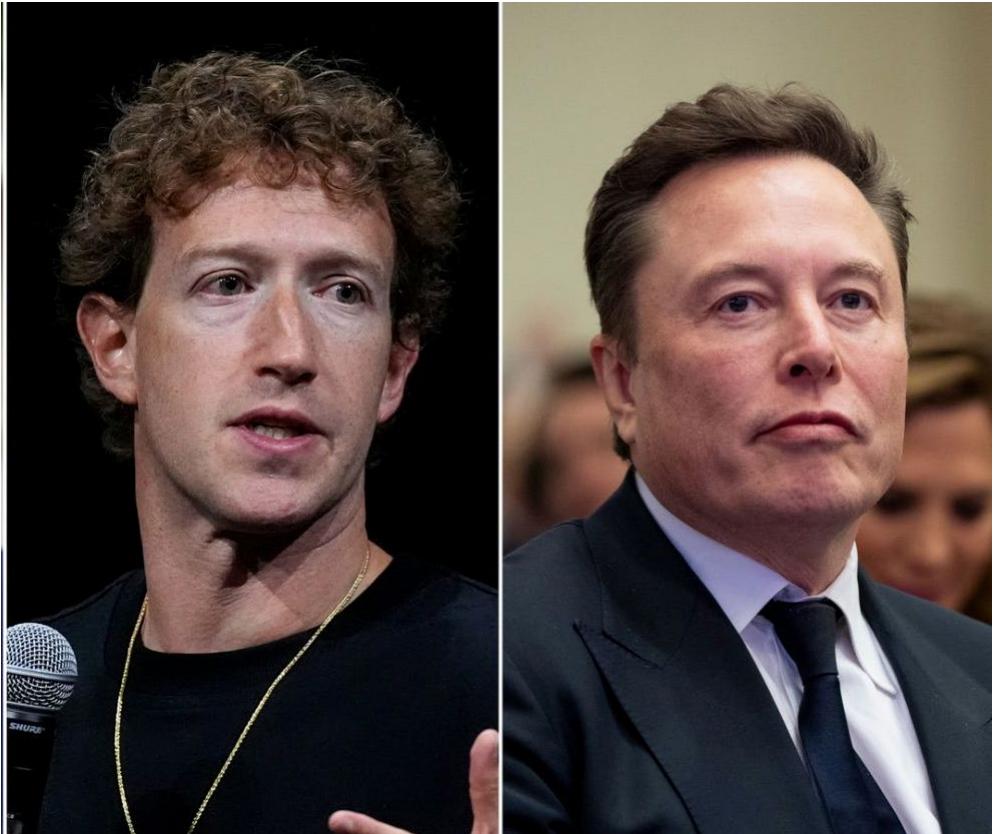


I Am Part of Human Fusion's ELSI team

- Ethical, Legal, and Societal Implications ("ELSI") team of scientists, philosophers, engineers.
- I ask questions like: "Is that, you know, really a good idea?"
 - More seriously: How might these technologies be misused or abused? How might the dynamics of military engagement change if (or when) our geopolitical adversaries acquire such technologies? How might terrorists exploit them?
 - How could merging biology and technology, organism and artifact, into a single phenomenological unit change the user's sense of *self*? If users begin to experience the robotic arms as part of their self, and then this arm is blown up, could this result in PTSD or other psychiatric disturbances — even though these users were not physically injured? What are the ethical implications of this?
 - How might these technologies contribute to a broader push in society right now toward realizing the aims of *transhumanism*?



Transhumanism



- Advanced technologies to radically reengineer the human to become “posthumans” with superintelligence, immortality, etc.
- What about links with eugenics? Can it lead to *extinction* of our species? Can this happen in the near future — within our lifetimes?
- Might the Human Fusions Institute (inadvertently) contribute to the *realization* of the transhumanist project?

Transhumanism is an ideology that has become enormously influential within Silicon Valley.

When ethical issues arise...

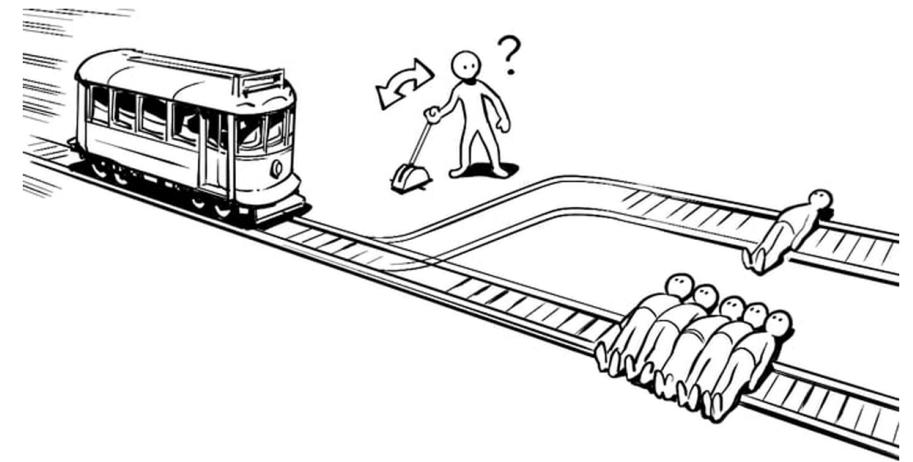
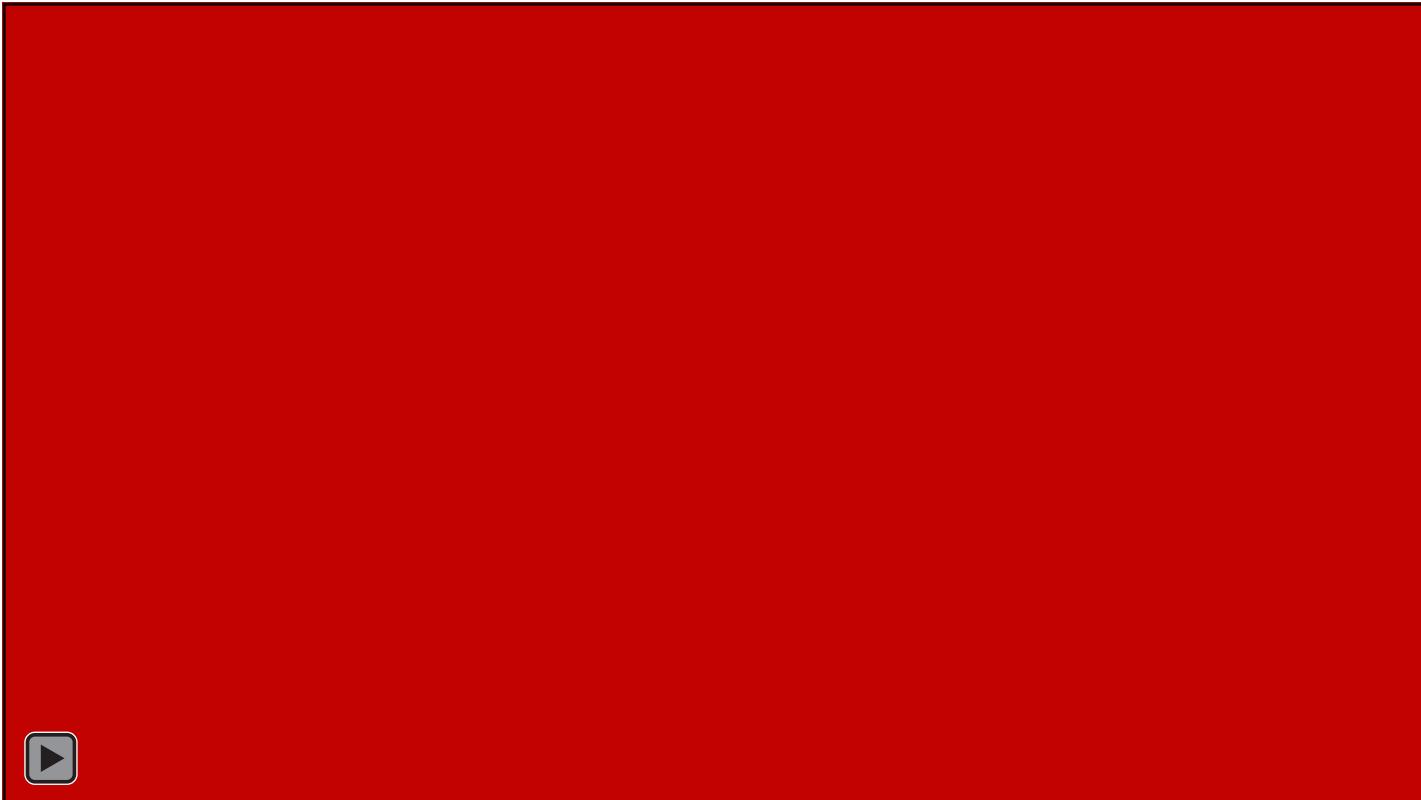
rather than say "I just think xyz is right"...

can we analyze the ethical issues and articulate our conclusions systematically?

Let's develop a "tool kit" for this!

Runaway Trolley, Scenario #1

- The most famous thought experiment in ethics: the Trolley Problem (introduced by the philosopher Philippa Foot).



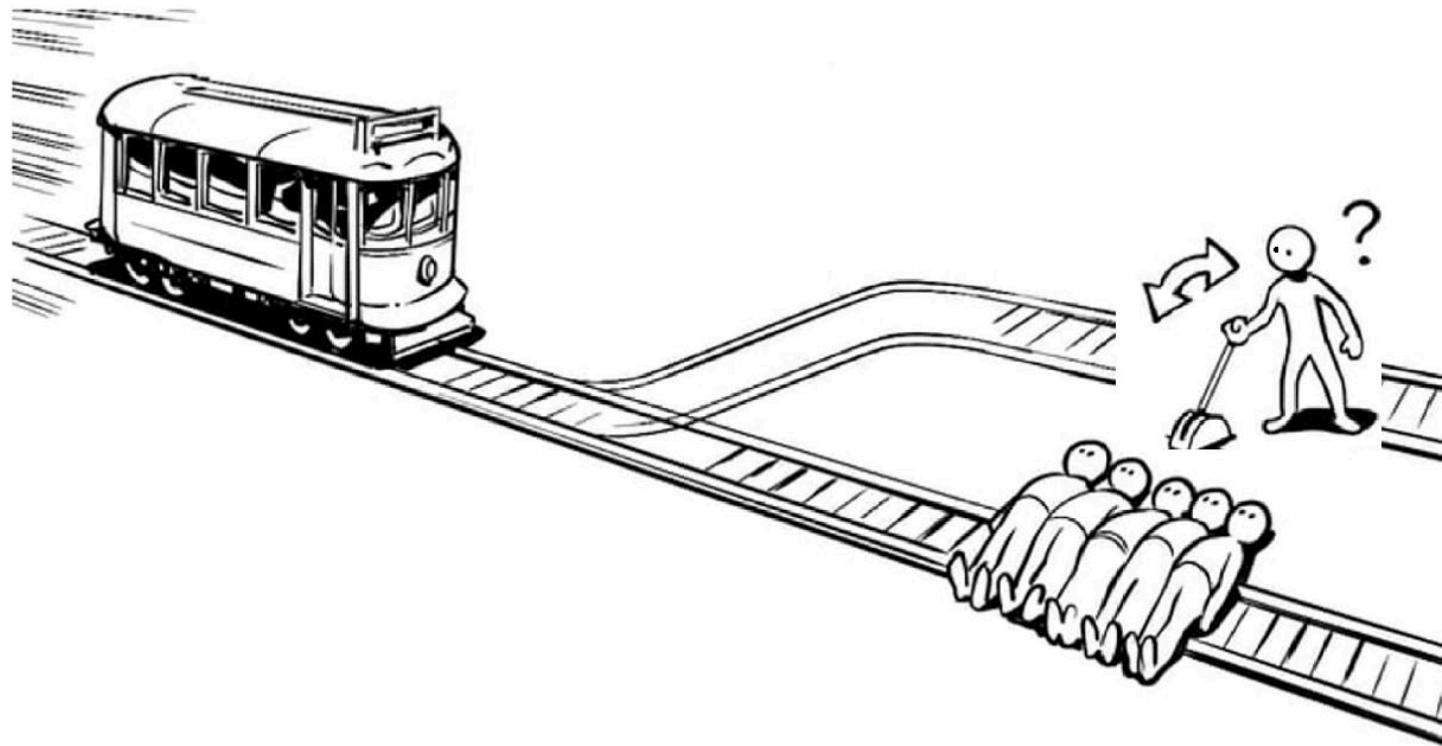
Runaway Trolley, Scenario #2

The footbridge dilemma

The person on the bridge can choose to push the large person onto the track, thereby killing that person but potentially stopping the tram and saving the five people further down the track.



Runaway Trolley, Scenario #3



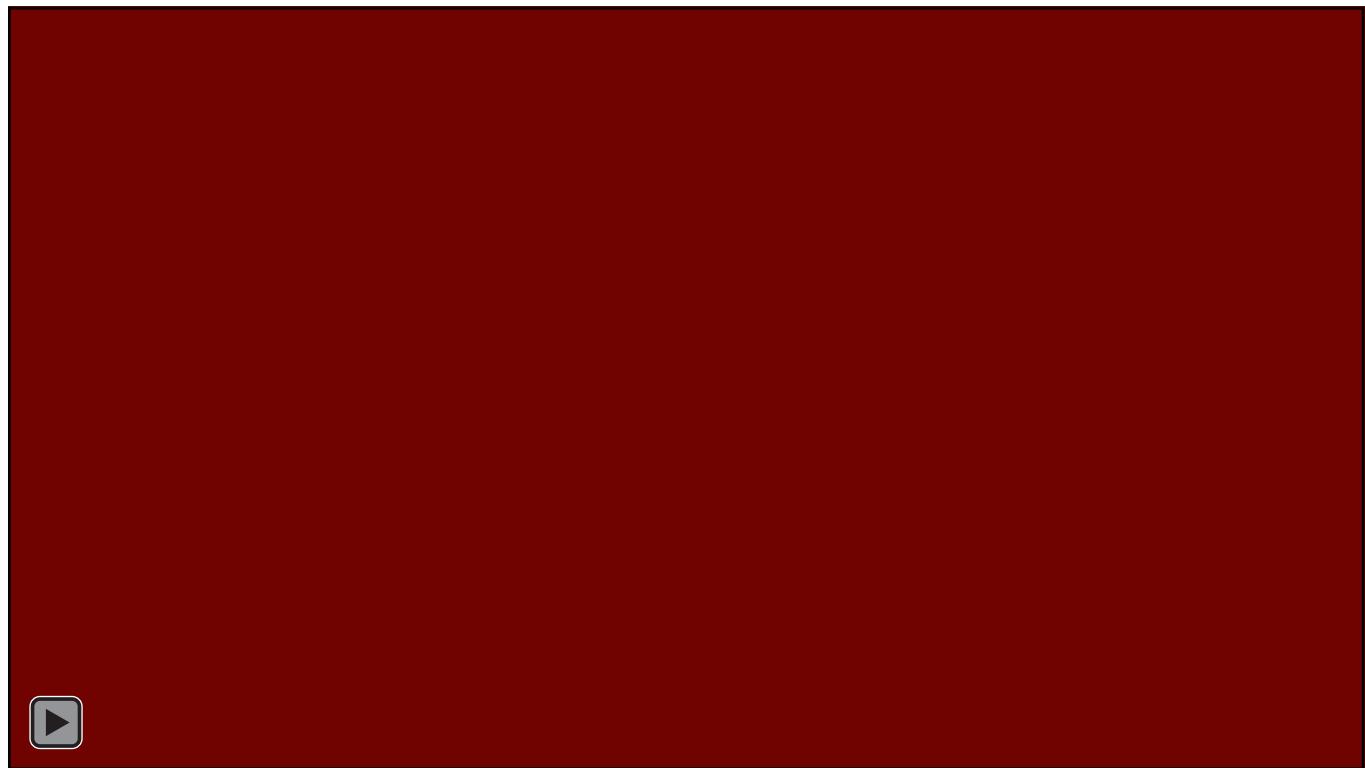
The Trolley Problem

The usefulness of these Trolley Problem scenarios is that they foreground different moral intuitions — which differ from person to person, and (among individuals) from scenario to scenario:

Consequentialism

The morally right action is that which leads to the best consequences

In Scenario #1 of the Trolley Problem, many of us have moral intuitions that align with consequentialism: it seems right to pull the railway switch and have one person die rather than five

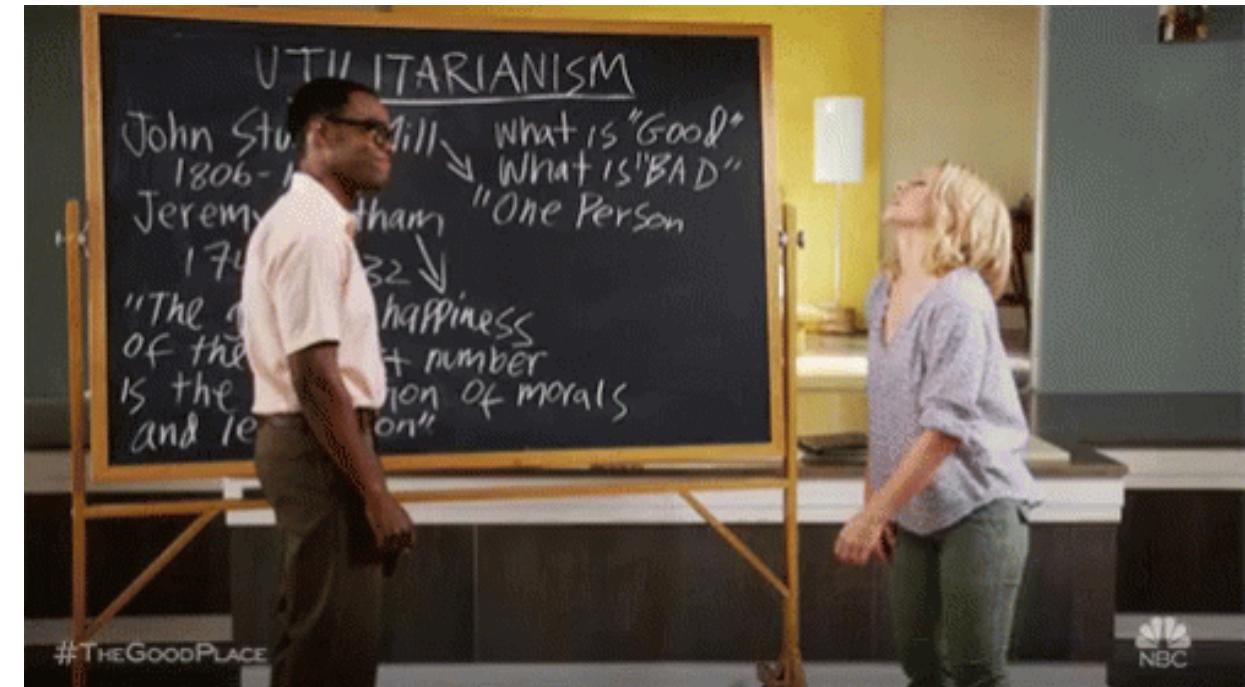


Consequentialism: Utilitarianism

(Recall Dr. Tyler mentioned the word “utilitarian” in an earlier video about Human Fusion research)

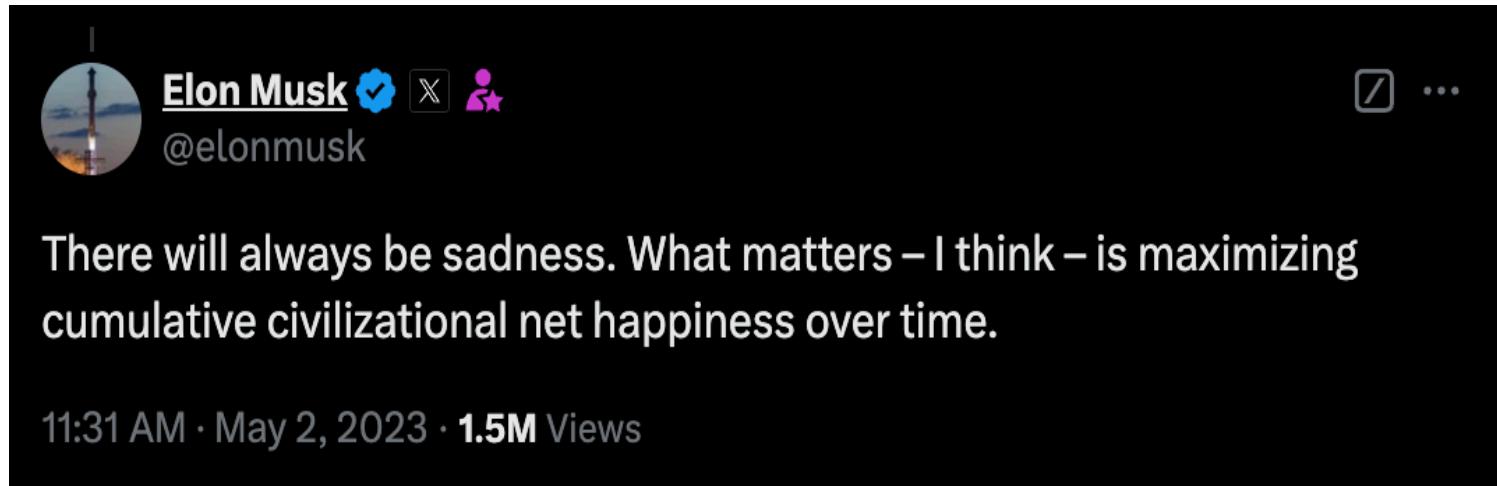
Utilitarianism: the most influential version of consequentialism

- Our *sole moral obligation* is to *maximize the total amount of wellbeing*
- What is “wellbeing”? It could be interpreted in different ways, but a common interpretation is *happiness*
- Developed by Jeremy Bentham, John Stuart Mill



Consequentialism: Utilitarianism

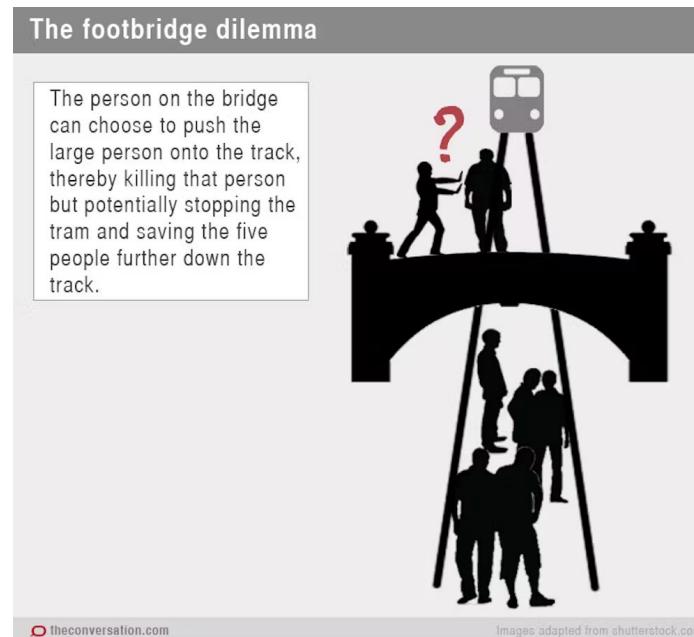
Utilitarianism is very influential among the transhumanists that we mentioned earlier. For example:



Deontology

Morally right actions follow duties and/or respect rights of others ... *regardless of the consequences (to some degree or another)*

In Scenario #2 of the Trolley Problem, many of us have moral intuitions that align with deontology: While pushing one person onto the tracks to stop the trolley would save five people, many people feel *very uncomfortable* with the thought of looking into the eyes of the other person on the bridge and saying — as they throw this person to their death — “I’m sorry I have to do this, but it’s for the greater good!”

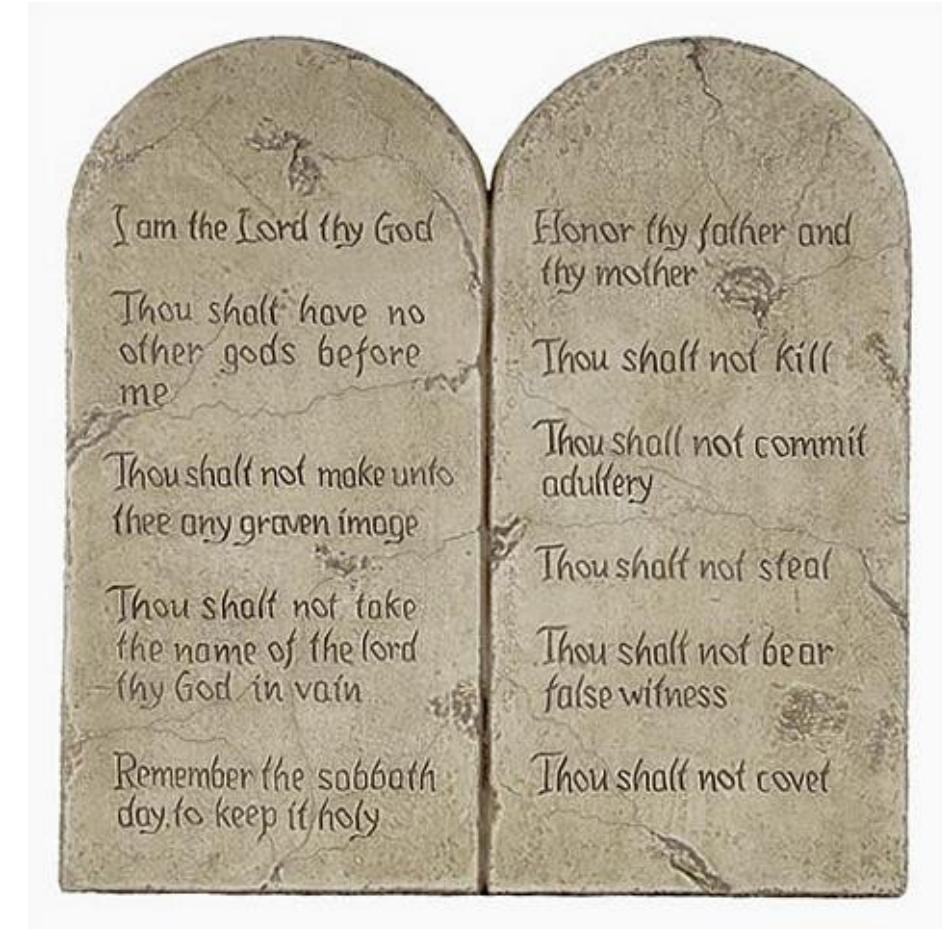


Deontology: The Ten Commandments

A list of rules — such as “Thou shalt not steal” — that one must always follow.

Note: The Ten Commandments do NOT say:

“Thou shalt not steal, *unless* stealing a loaf of bread and some vegetables enables your family to eat tonight, which may produce more *overall good*, all things considered, even though it inflicts a (small) harm on the huge corporation that owns the grocery store.”



Deontology: Professional Codes of Ethics



NSPE Code of Ethics for Engineers

I. Fundamental Canons

Engineers, in the fulfillment of their professional duties, shall:

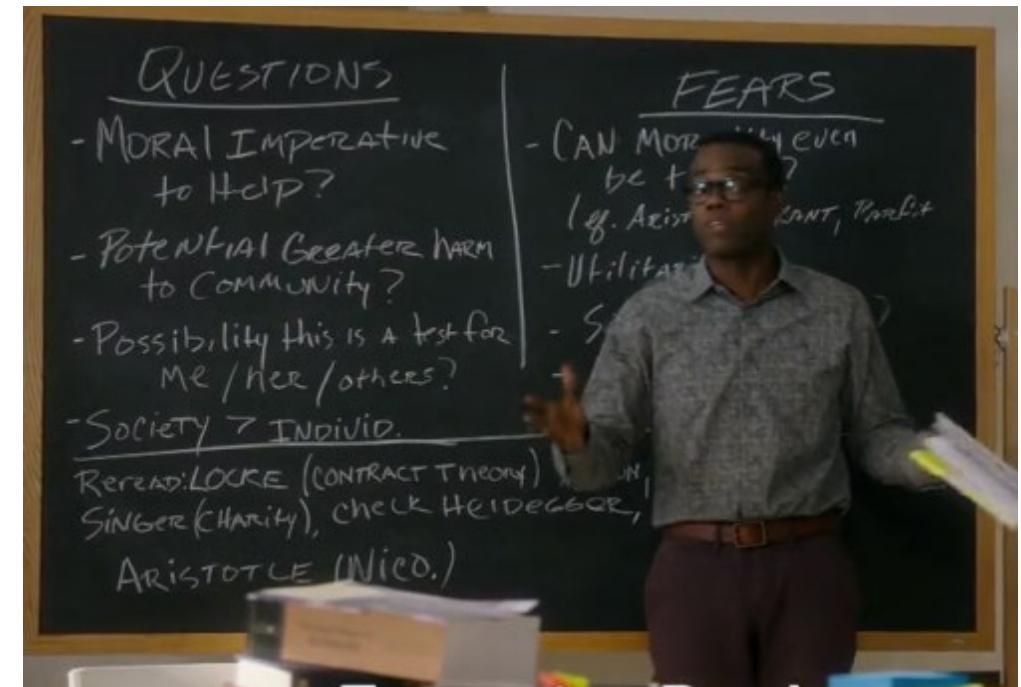
1. Hold paramount the safety, health, and welfare of the public.
2. Perform services only in areas of their competence.
3. Issue public statements only in an objective and truthful manner.
4. Act for each employer or client as faithful agents or trustees.
5. Avoid deceptive acts.
6. Conduct themselves honorably, responsibly, ethically, and lawfully so as to enhance the honor, reputation, and usefulness of the profession.

The professional society for each field of engineering also has its own code of ethics
(e.g. AIChE, IEEE, ASME, BMES ...)

Deontology: The Categorical Imperative

Kantian ethics and the categorical imperative: the most influential version of deontology

- Do not use other people solely as a means to an end... i.e., respect them as persons
- Developed by Immanuel Kant



The Conflicted Doctor

Imagine a doctor is treating five very sick patients. One of these patients needs a new liver, two others need a kidney, yet another needs a blood transfusion, etc.

The doctor then happens to peek into the waiting room and notice a perfectly healthy patient waiting for their annual physical. It suddenly occurs to the doctor that if he lures the healthy patient into a waiting room, kills this patient, and harvests the healthy patient's organs and blood, he could save the five dying patients.



The Conflicted Doctor

Utilitarianism (and consequentialism more generally) seems to imply that the morally right thing for the doctor to do is kill the healthy patient!! After all, utilitarianism bases what's right on what's good (i.e., *overall best, all things considered*), and it would obviously be better for five people to live while one person dies than for five people to die while one person lives! This is *exactly the same reasoning* that leads many of us to pull the railway switch in Scenario #1 of the Trolley Problem.

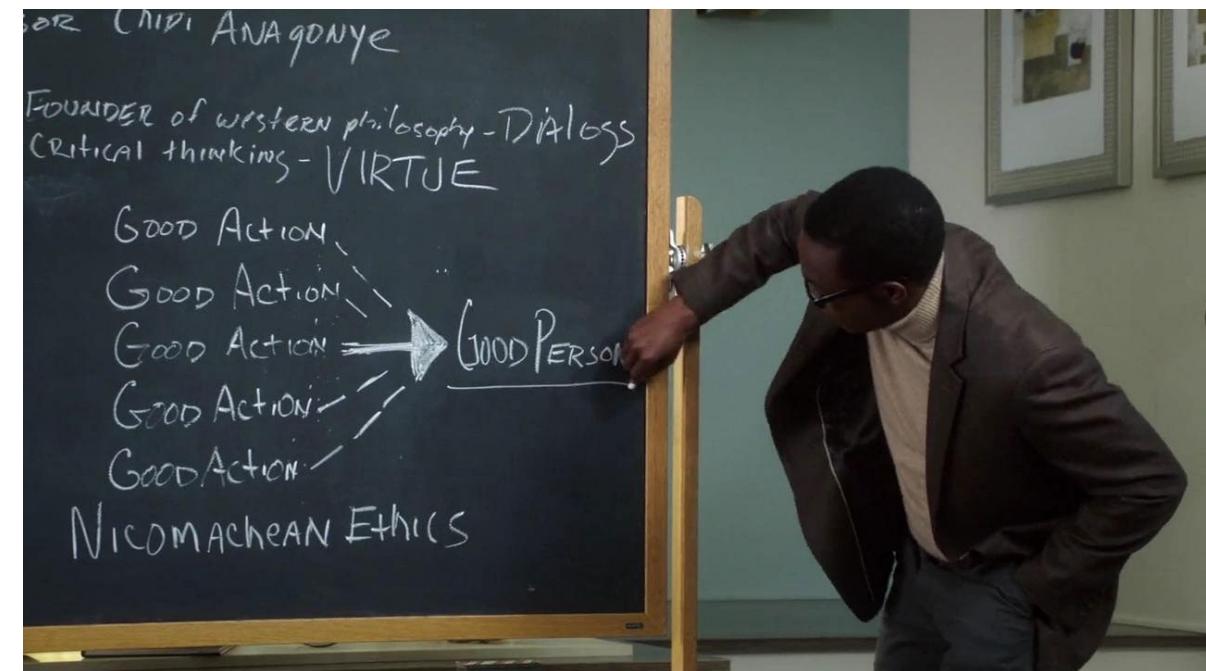
Deontologists (such as Kant) would argue that what's right is independent from what's good. They would say that there's a moral restriction on killing people — that is, we are *forbidden* from doing this. Hence, the doctor would do something morally *wrong* by saving the five patients (in this way). Some deontologists would say that the same reasoning applies even if the doctor could save 5,000 patients, rather than just 5. Just. Do. Not. Murder. — the deontologists would insist!



Virtue Ethics

"If deontology is about what you do, and consequentialism is about what happens, virtue ethics is about who you are" (Sean Carroll, cosmologist and philosopher).

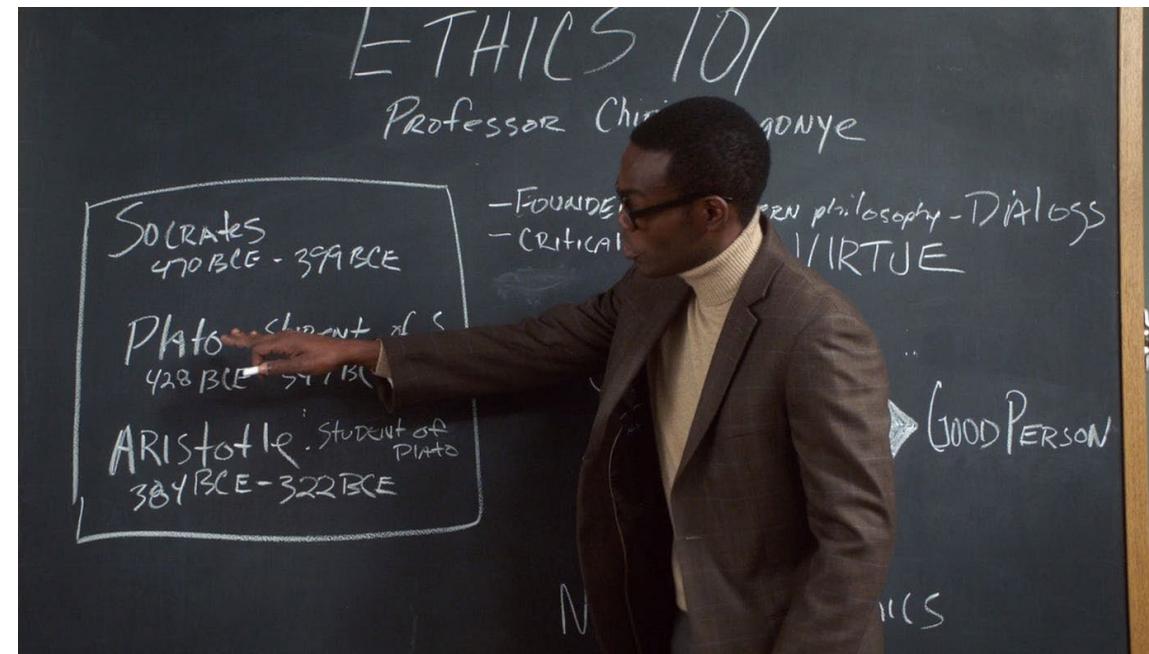
- The oldest ethical theory: Plato and Aristotle in the West; Mencius and Confucius in the East
- In Christianity, "What would Jesus do?"
- Okay, but what makes someone morally virtuous??
- Developing good *moral character* by embodying—through practice—moral virtues such as truthfulness, generosity, courage, etc.



Virtue Ethics: Aristotle's Golden Mean

The Golden mean: the most influential version of virtue ethics

- Virtues lie on a golden mean in between two extremes which are vices
- Examples:
 - Courage: between cowardice and recklessness
 - Generosity: between stinginess and extravagance
- Developed by Aristotle



Some physics problems are easy...
like predicting the trajectory of a dropped baseball

But other physics problems are so hard that we can't know the answer...
like predicting the trajectory of a falling leaf

Real-world ethics problems are often like the falling
leaf!

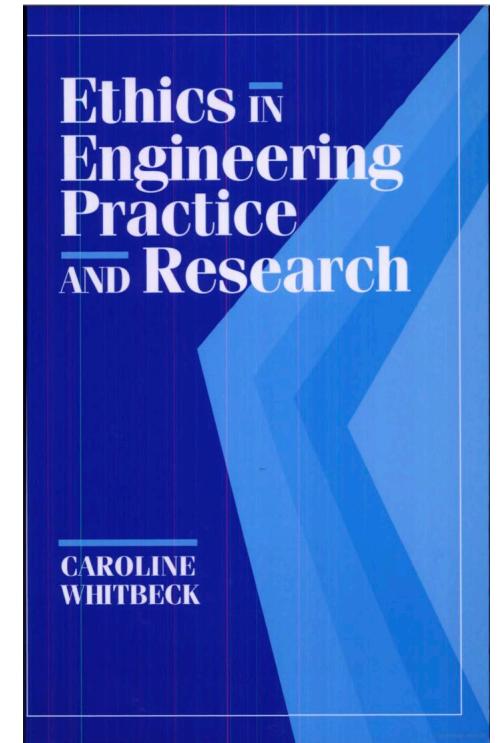
In this class — and in your life and career as an engineer
— you will encounter predicaments with ***no obviously
correct*** moral answer. It's ***just not clear*** what the morally
right thing to do is.



What, Then, Is the Point?

Here's what Caroline Whitbeck, who was a professor right here at Case Western, had to say about this issue in her book *Ethics in Engineering Practice and Research*:

Understanding the ethical significance of problems is the first step in responding well to them, so preparing you to both recognize and understand the ethical significance of problems that commonly face engineers is one purpose of this book. Clear concepts and distinctions will aid your understanding and are necessary for the reflective examination of the ethical validity and soundness of conduct, practices, and customs. *The ability to withstand such examination is what distinguishes a rationally based ethical conviction from a mere opinion*, an opinion that has no rational basis. Such opinions with no rational basis may be firmly established in popular culture or a particular subculture even if they are not well supported with reasons and evidence.

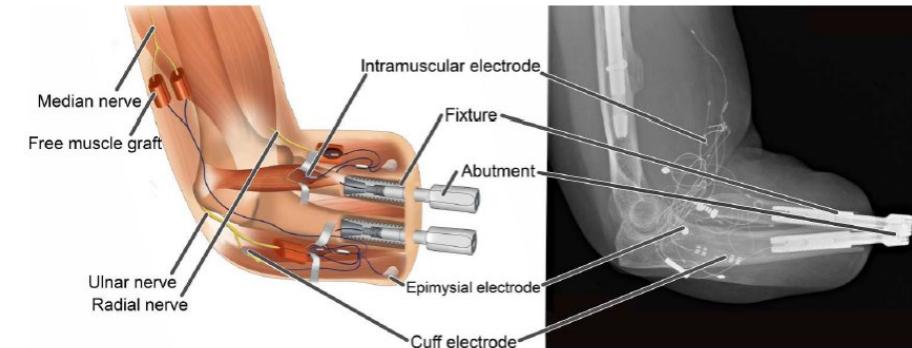


PROSTHETICS

A highly integrated bionic hand with neural control and feedback for use in daily life

Max Ortiz-Catalan^{1,2,3,4*}, Jan Zbinden^{1,3}, Jason Millenaar⁵, Daniele D'Accolti^{6,7}, Marco Controzzi^{6,7}, Francesco Clemente⁸, Leonardo Cappello^{6,7}, Eric J. Earley^{1,3,9}, Enzo Mastinu^{1,3,6,7}, Justyna Kolankowska⁵, Maria Munoz-Novoa^{1,10}, Stewe Jönsson¹¹, Christian Cipriani^{6,7}, Paolo Sasso^{1,12,13}, Rickard Bränemark^{5,14,15}

Restoration of sensorimotor function after amputation has remained challenging because of the lack of human-machine interfaces that provide reliable control, feedback, and attachment. Here, we present the clinical implementation of a transradial neuromusculoskeletal prosthesis—a bionic hand connected directly to the user's nervous and skeletal systems. In one person with unilateral below-elbow amputation, titanium implants were placed intramedullary in the radius and ulna bones, and electromuscular constructs were created surgically by transferring the severed nerves to free muscle grafts. The native muscles, free muscle grafts, and ulnar nerve were implanted with electrodes. Percutaneous extensions from the titanium implants provided direct skeletal attachment and bidirectional communication between the implanted electrodes and a prosthetic hand.



"Human-machine interfaces requiring surgical interventions carry additional risks over noninvasive solutions. Risks associated with the surgery itself and the long-term potential risk of infections must be factored. Failed osseointegration in one implant was observed in this case and was resolved with a larger-diameter implant. The other implant required a change of the e-abutment screw after this broke in June 2022 (>4 years after implantation), potentially because of the fatigue experienced when the patient only used one implant to load the prosthesis. Compromised soft tissue and skeletal structures can complicate reconstruction procedures and the selection of suitable implants. All of these aspects should be weighed against the functional and psychosocial benefits of patients"

Human-machine interfaces requiring surgical interventions carry safety risks. When is it ok to test such devices on people who can live fine without them?

Think about the case without specifically looking for a solution.

If Aristotle, Kant, or Mill were looking at this situation, what do you think they might be noticing?



Contents lists available at ScienceDirect

Journal of Neuroscience Methods

journal homepage: www.elsevier.com/locate/jneumeth



Invited review

DARPA investment in peripheral nerve interfaces for prosthetics, prescriptions, and plasticity



Stephanie Naufel^{a,*}, Gretchen L. Knaack^b, Robbin Miranda^c, Tyler K. Best^d, Karrie Fitzpatrick^e, Al A. Emondi^f, Eric Van Gieson^f, Tristan McClure-Begley^f

^a ECS, 2750 Prosperity Ave., Suite 600, Fairfax, 22203, VA, USA

^b Quantitative Scientific Solutions, 4601 Fairfax Dr #1200, Arlington, VA 22203, USA

^c Infinimetrics Corporation, 12020 Sunrise Valley Dr., Suite 100, Reston, VA 20191, USA

^d Booz Allen Hamilton, Inc., 3811 Fairfax Dr. Ste. 600, Arlington, VA 22203, USA

^e Strategic Analysis Inc., 4075 Wilson Boulevard, Suite 200, Arlington, VA 22203 USA

^f Defense Advanced Research Projects Agency, Biological Technologies Office, 675 N Randolph St., Arlington, VA 22203, USA

“For prosthetics, enhancement may mean a system that provides function beyond that of a typical person — for example, a wrist that rotates all the way around or electronics that produce novel modalities of sensory feedback.”

Is it ethical to develop prosthetics that provide function beyond that of a typical person? How about development for use by people who do not have a disability but want the added functionality?

Think about the case without specifically looking for a solution.

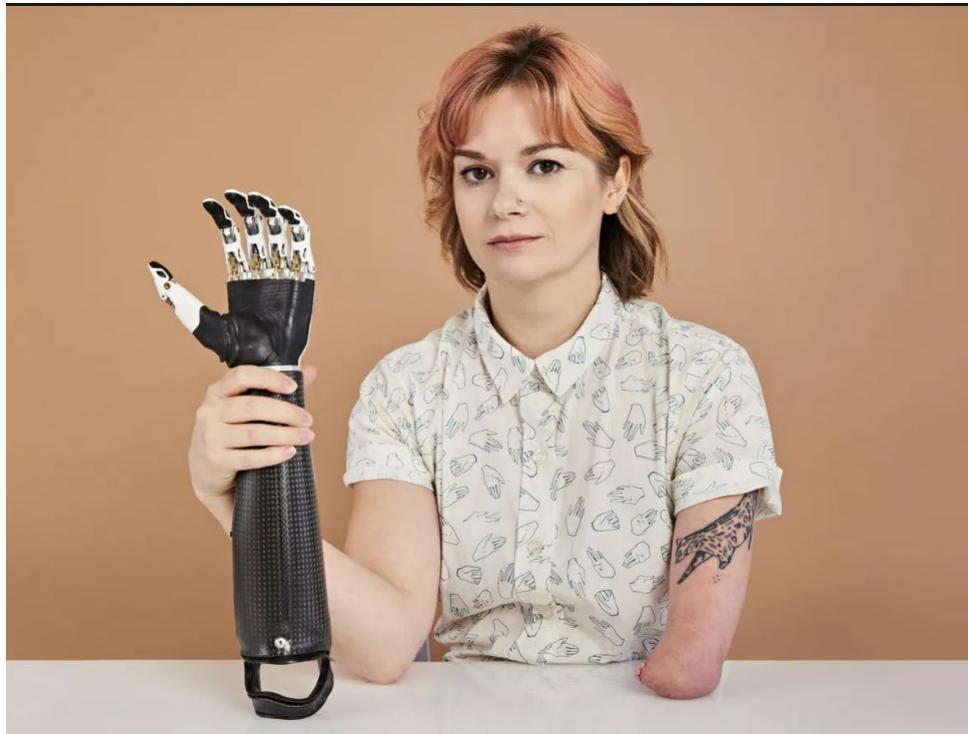
If Aristotle, Kant, or Mill were looking at this situation, what do you think they might be noticing?

FEATURE ROBOTICS

THE BIONIC-HAND ARMS RACE

The prosthetics industry is too focused on high-tech limbs that are complicated, costly, and often impractical

BY BRITT H. YOUNG | 21 AUG 2022 | 12 MIN READ |

The author Britt Young

"In the meantime, this metaphorical race to the moon is a mission that has forgotten its original concern: helping disabled people acquire and use the tools they want.

There are inexpensive, accessible, low-tech prosthetics that are available right now and that need investments in innovation to further bring down costs and improve functionality.

Releasing ourselves from the bionic-hand arms race can open up the possibilities of more functional designs that are more useful and affordable, and might help us bring our prosthetic aspirations back down to earth."

Is it ethical to focus on high tech limbs that are costly and complicated rather than helping disabled people get the tools they want?

Think about the case without specifically looking for a solution.

If Aristotle, Kant, or Mill were looking at this situation, what do you think they might be noticing?

Should an athlete who received an prosthetic foot be allowed to compete in the olympics?

What if this new foot was better than the original foot?

What if a healthy athlete replaced their foot with the better foot?



2012 Olympics: Controversially, South African Oscar Pistorius competed with two prosthetic feet

Should there be rules for allowing/disallowing athletes with prosthetics in competitive sports? If so, what should these rules be based on?

Think about the cases without specifically looking for a solution.

If Aristotle, Kant, or Mill were looking at this situation, what do you think they might be noticing?

Military Ethics

CWRU has the only Masters in Military Ethics in the USA, offered by the Inamori International Center for Ethics and Excellence

Inamori Center Director: Dr. Shannon French

- previously a professor at the US Naval Academy
- teaches ethic courses at the U.S. Army Command and General Staff College
- ELSI committees for DARPA, Boeing, and others

I also work on military ethics, in particular the ethics of the role of technology in the military

- I am employed by the Inamori Center, and my office is in the Inamori Center (in the Tink)
- I co-authored this article (under my old name), although I now disagree with our conclusions!



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The future of war: could lethal autonomous weapons make conflict more ethical?

Open Forum | Published: 06 February 2019

Volume 35, pages 273–282, (2020) [Cite this article](#)

Steven Umbrello Phil Torres & Angelo F. De Bellis



Updated December 17, 2024

Defense Primer: U.S. Policy on Lethal Autonomous Weapon Systems

Lethal autonomous weapon systems (LAWS) are a special class of weapon systems that use sensor suites and computer algorithms to independently identify a target and employ an onboard weapon system to engage and destroy the target without manual human control of the system.

International Discussions of LAWS

Since 2014, the United States has participated in international discussions of LAWS, sometimes colloquially referred to as “killer robots,”

In addition, approximately 30 countries and 165 nongovernmental organizations have called for a preemptive ban on LAWS due to ethical concerns, including concerns about operational risk, accountability for use, and compliance with the proportionality and distinction requirements of the law of war. The U.S. government does not currently support a ban on LAWS ...

NEWS FEATURE | 23 April 2024

Lethal AI weapons are here: how can we control them?

Autonomous weapons guided by artificial intelligence are already in use. Researchers, legal experts and ethicists are struggling with what should be allowed on the battlefield.

By [David Adam](#)

In the Donbas region of Ukraine, a Ukrainian soldier prepares a drone to carry a hand grenade for an attack in March 2023. Credit: Aris Messinis/AFP/Getty

The Ethics of Lethal Autonomous Weapons

What are the ethical implications of LAWs? Should the US military develop and use them?

- What are considerations from a consequentialist viewpoint?
- What are considerations from a deontological viewpoint?
- What are considerations from a virtue ethics viewpoint?