Ethical Reasoning and Autonomous Vehicle Technology

Source: Mercedes-Benz

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Emerging technologies will present significant ethical considerations.

Ethical Reasoning and Autonomous Vehicle Technology

Autonomous vehicle technologies include: Driverless cars

Currently legal to road-test in four U.S. States
2020 – Expected introduction in several states in the U.S.
2035 – 75% of passenger cars with driverless capability.

Source: Rinspeed

Source: Wikipedia

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Autonomous vehicle technologies include:
Unmanned aerial vehicles

Source: VT News

Source: Virginia Tech

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Autonomous vehicle technologies include:

Unmanned aquatic vehicles   "Wave Glider"

Source: Liquid Robotics
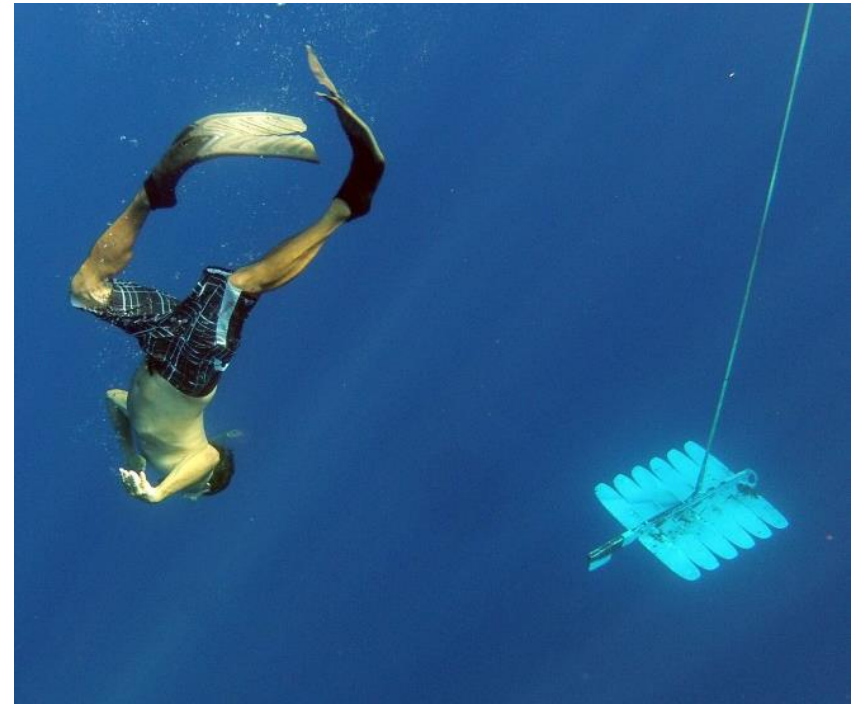
Mission: capture about 2.25 million data points on the ocean's physical characteristics.

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Ethical Reasoning and Autonomous Vehicle Technology

Why:

Autonomous vehicles will soon be pervasive in society. Incorporating ethical thinking into the design and development of this new technology will lead to safer, more sustainable products.

Two ethics questions:

1. What are the ethical consequences of introducing autonomous vehicles?

2. Can we make autonomous vehicles that conform to human ethical standards?

Technological innovations predicted by futurists and science fiction writers will soon be a part of our day-to-day lives.

The Future Is Now!

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Source: FOR

"The best way to predict the future is to invent it."

~ Alan Kay

Humans are accumulating knowledge exponentially:

1900 – Global human knowledge doubling every 100 years.*

1945 – Doubling every 25 years.*

Current – Doubling every 12 to 18 months
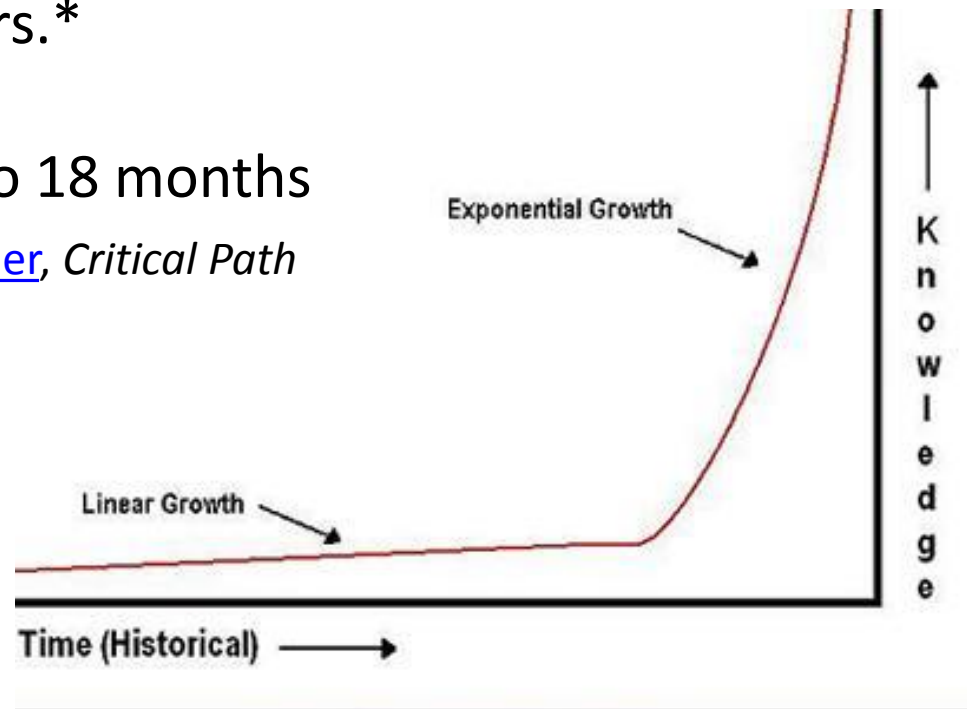
*R. Buckminster Fuller, *Critical Path*

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Exponential Growth

Linear Growth

Knowledge

Time (Historical)

Figure 1 - The Knowledge Doubling Curve

Source: Leo Pia

We are amassing so much data that it exceeds the computational capacity of our brains to make sense of.

However…

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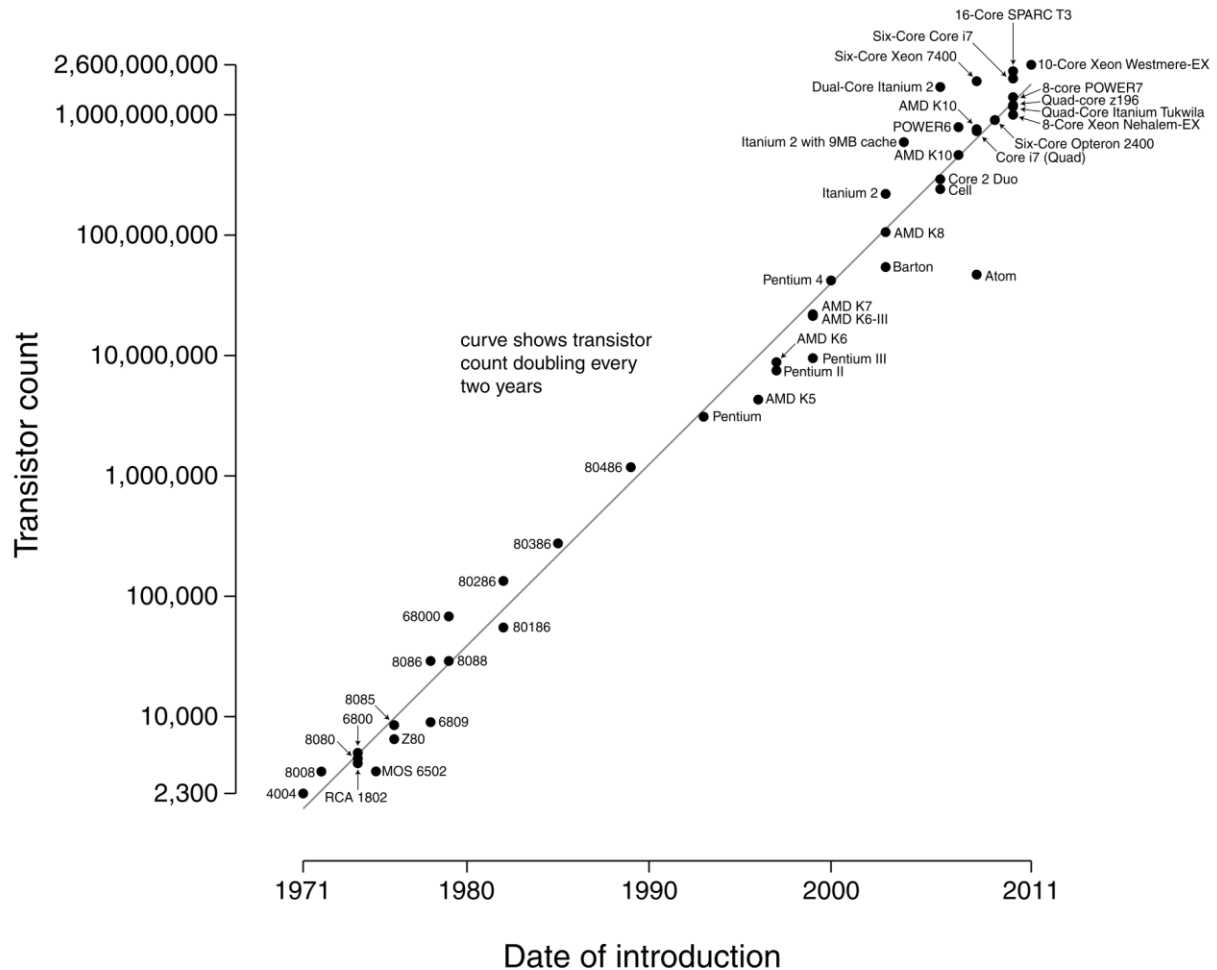*Invent the Future®*

The computational capacity of our machines has been growing exponentially too.

Moore's Law predicts that the number of transistors in integrated circuits doubles about every two years.

Microprocessor Transistor Counts 1971-2011 & Moore's Law

Transistor count vs. Date of introduction

curve shows transistor count doubling every two years

Data points labeled: 16-Core SPARC T3, Six-Core Core i7, Six-Core Xeon 7400, 10-Core Xeon Westmere-EX, Dual-Core Itanium 2, AMD K10, 8-core POWER7, Quad-core z196, Quad-Core Itanium Tukwila, 8-Core Xeon Nehalem-EX, POWER6, Itanium 2 with 9MB cache, Six-Core Opteron 2400, AMD K10, Core i7 (Quad), Core 2 Duo, Cell, Itanium 2, AMD K8, Barton, Atom, Pentium 4, AMD K7, AMD K6-III, AMD K6, Pentium III, Pentium II, AMD K5, Pentium, 80486, 80386, 80286, 68000, 80186, 8086, 8088, 8085, 6800, 6809, 8080, Z80, 8008, MOS 6502, 4004, RCA 1802

Source: Wikipedia

Source: Wikipedia

Source: Apple

Apple II Computer (1977)
64 KB memory

Apple iPhone 6 (2014)
64 GB memory

One million times the memory!

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Concerns about artificial intelligence:

"I don't understand why some people are not concerned."
                                                    ~ Bill Gates

"Once you start to make machines that are rivaling and surpassing humans with intelligence, it's going to be very difficult for us to survive."   ~ Clive Sinclair

"I think the development of full artificial intelligence could spell the end of the human race."   ~ Stephen Hawking

"Computers are going to take over from humans, no question."
                                                    ~ Steve Wozniak

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Bionic Technology – copying nature

Insect Ocelli inspire onboard vision sensor in robotic fly

Source: Wikipedia
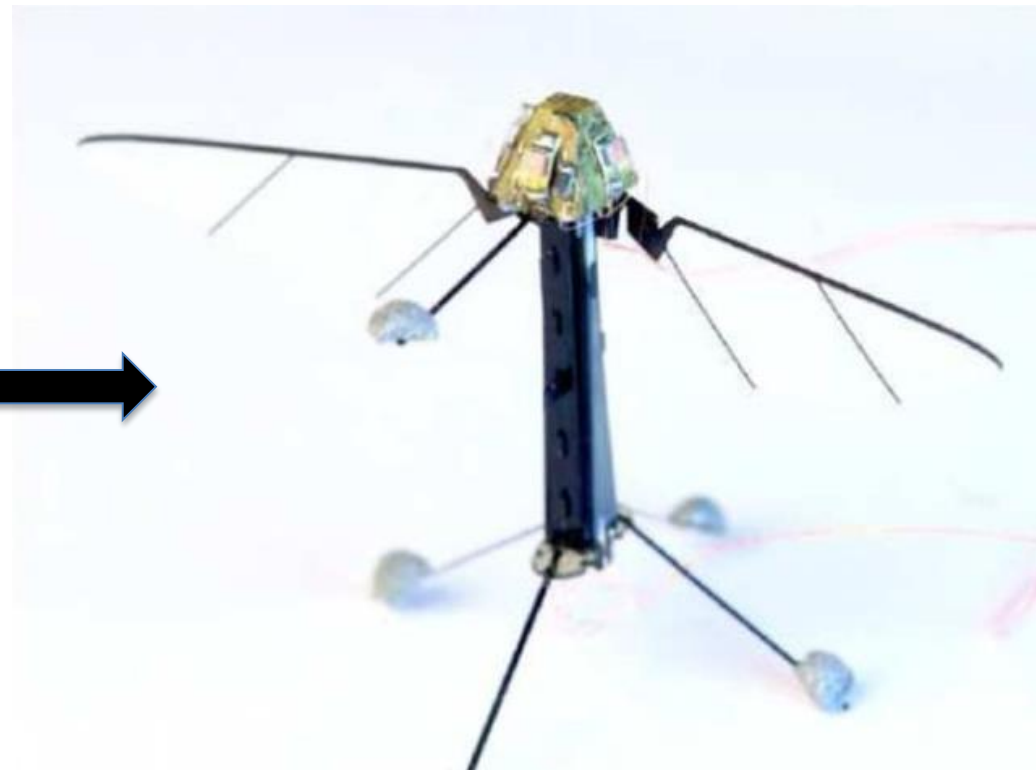
Source: Wyss Institute

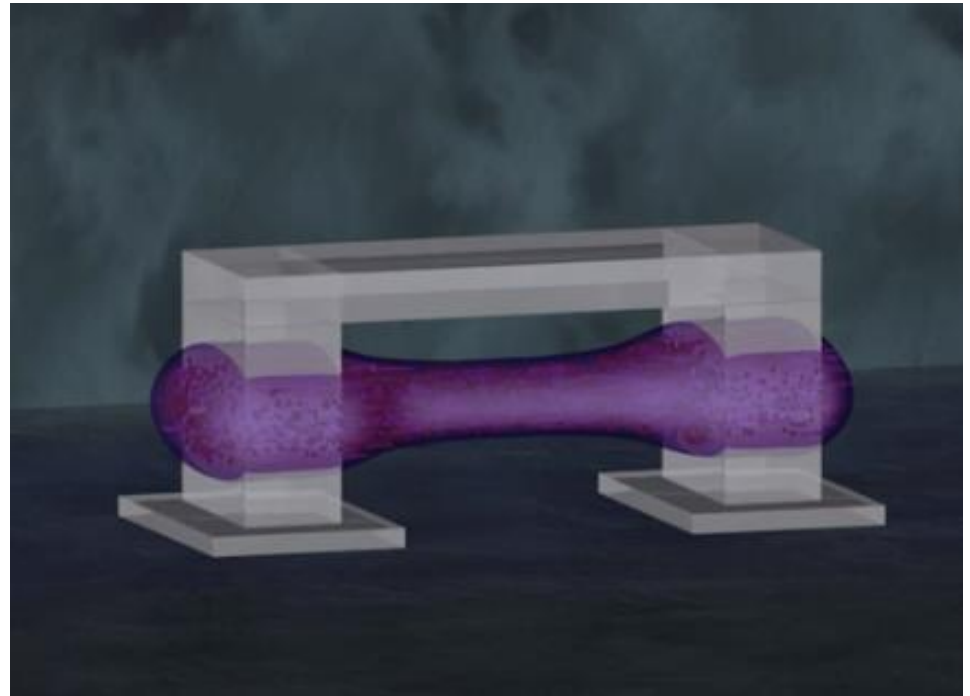## Bionic Technology
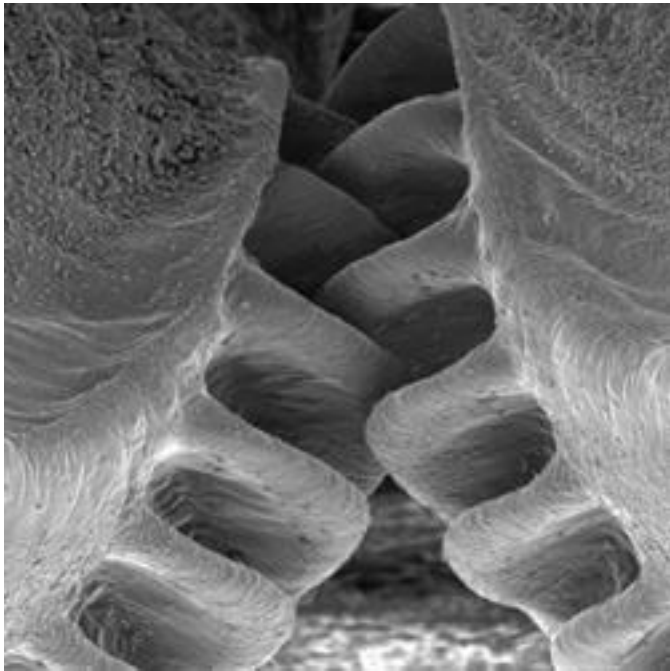
Source: whyfiles

Source: PNAS

Issus Leafhopper "gears"

Muscle-powered Bio-bots

Biomechatronics: Integrating with our machines
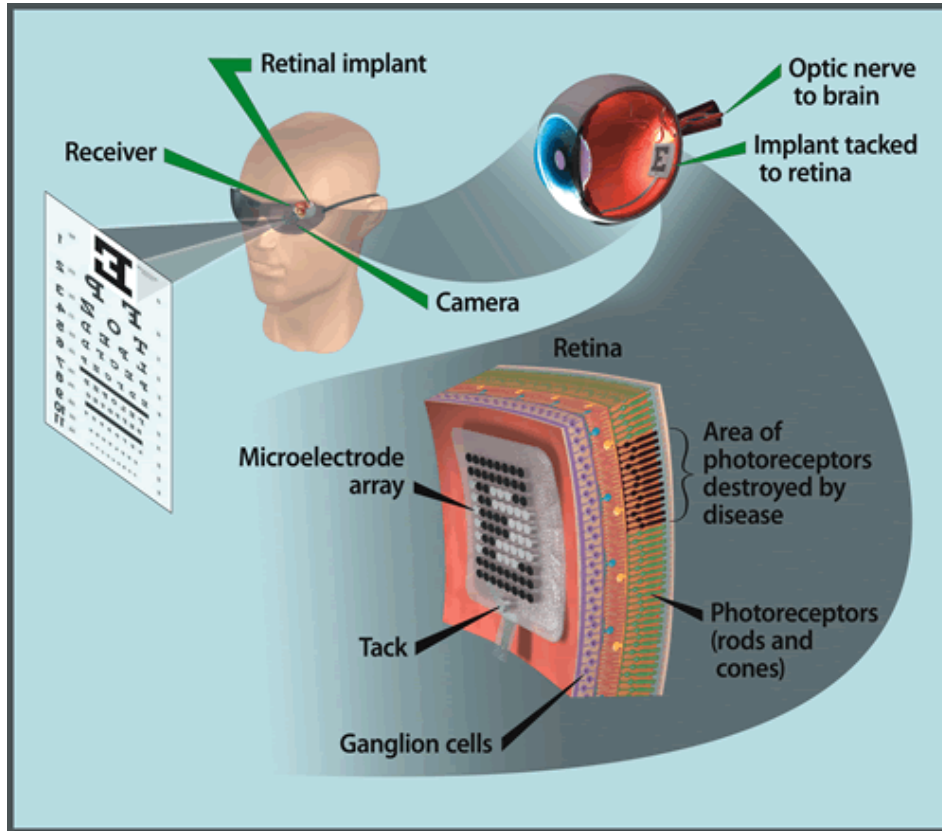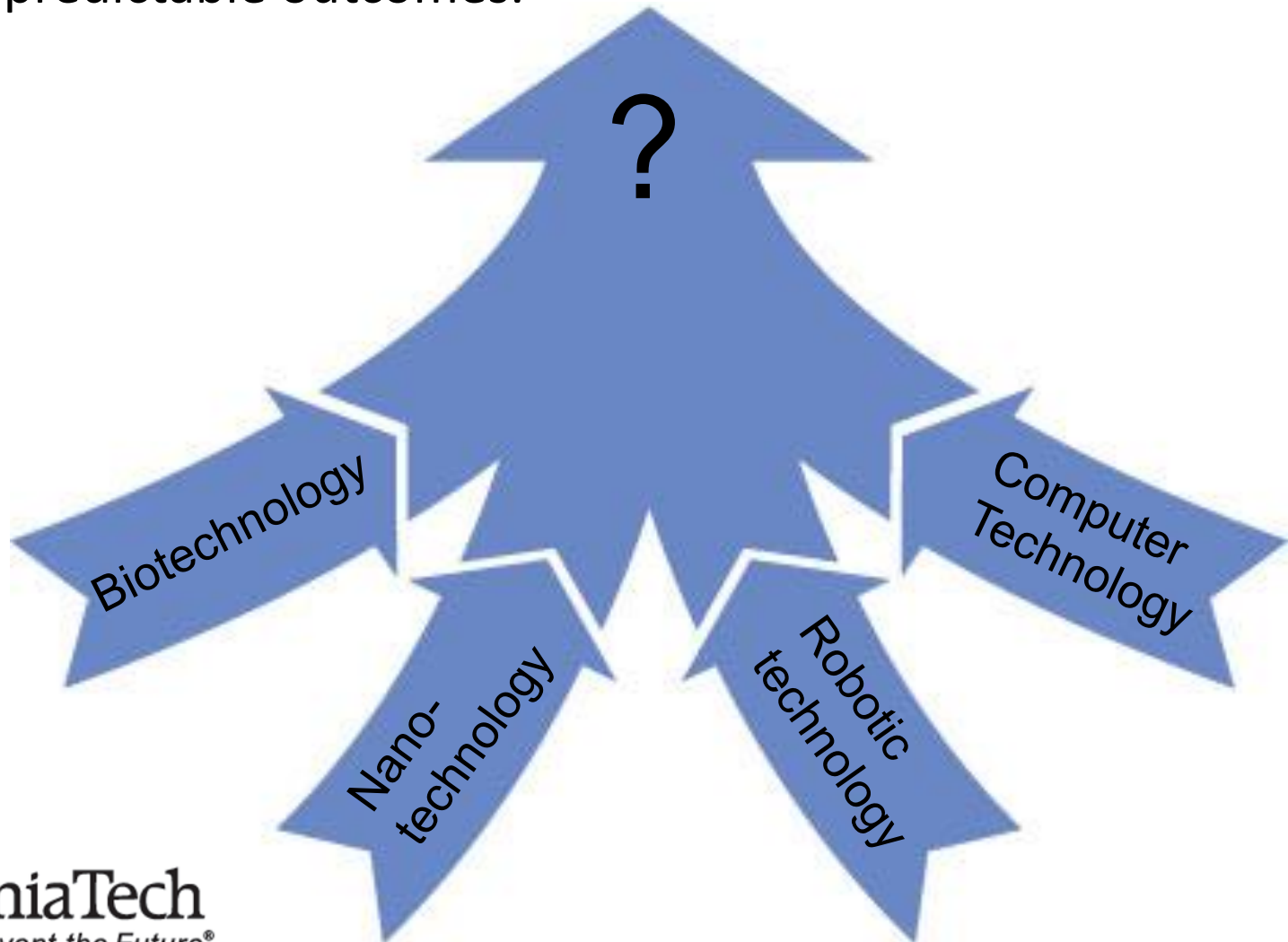
Artificial retina:

Cochlear implant:

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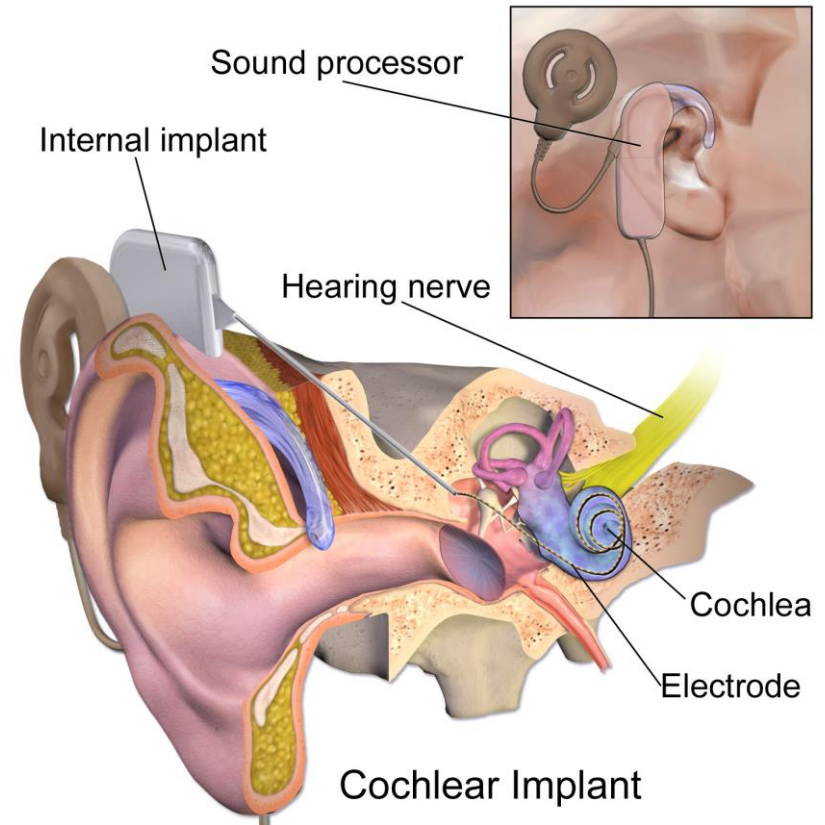
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We are in the midst of a convergence of transformative technologies, with unpredictable outcomes.

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"In times of change learners inherit the earth; while the learned find themselves beautifully equipped to deal with a world that no longer exists.

~ Eric Hoffer

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What is ethical reasoning?

"The proper role of ethical reasoning is to highlight acts of two kinds: those which enhance the well-being of others— that warrant our praise—and those that harm or diminish the well-being of others—and thus warrant our criticism."

~ Understanding the Foundations of Ethical Reasoning

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Two types of ethical questions: Simple and Complex

Simple ethical questions virtually answer themselves. Some examples:

- Is it cruel to subject an innocent creature to unnecessary suffering?
- Is it unjust to deny someone a basic human right?
- Is it ethically wrong to torture animals for fun?

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Complex ethical questions are questions that can be argued in more than one way – they require multiple viewpoints. Some ex

- Under what conditions, if any, should animal experimentation be allowed?
- Is it ethically wrong to kill animals for food?
- Under what conditions should people be kept artificially alive?

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Two guidelines for class discussions involving ethical issues:

1. There are no "right" answers or expected answers to the questions we will be asking.

2. Respect each other's viewpoints even if you disagree with them.

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