Lecture 4 - Technological implications

Applied computer science, and the implications of technology

- Implementations don't allow for infinite state, so does not fit the traditional theoretical definition of a computer
- What are the ethical boundaries associated with technology?
- Is it ethical to create some technology?

These are not even computers

- Going back to our very abstract definition of a computer, it's clear that if our *M* function is only defined over a finite set without i/o from the real world, then our machine is not subject to the Halting Problem
- This is generally a benefit, even from a theoretical standpoint; the Halting Problem is a limitation on human knowledge introduced by the concept of infinite state. If you don't impose considerations of such an obvious impossibility on a technological implementation, then you don't have to deal with its consequences.

"Eppur si muove!"

- Galileo's famous formulation of respect for reality: "And yet it moves!"
- So, too, computer scientists, when implementing technology, are constrained to interact with the real world.
- Our ideal computer no longer is so idealized since our input and output from the real world is not necessarily coherent.

Other constraints

- It turns out that many times if we want to use technology in the real world that we have to solve a different problem, that of "hard real-time computation"
- Hard real-time computation is a notoriously difficult problem. Analog devices can have much better response times than digital ones based on von Neumann-style computations; the delay induced by having a sequence of simple computer instructions modifying digital state is usually quite different

Other constraints

- Many of our great challenges coming up will be with hard real-time systems. These systems often involve great amounts of energy: potential energy, chemical energy, electrical, and kinetic.
- Not having the Halting Problem being applicable to this work is a happy circumstance.

Is it ethical to create some technology?

- Like the physical, biological, and medical sciences, computer scientists sometimes ask themselves if it is even "right" to create some technology.
- Chemists and physicists have long asked themselves this because of the obvious applications of their technologies to war-making: Alfred Nobel, the Einstein letter

Is it ethical to create some technology?

- ▶ The medical and biological sciences spend a great deal of time on thinking about the ethical implications of their work since it deals so directly with the human condition
- ▶ Everything from stem cell research to geriatric research to analgesics to palliative care

DNA digital data storage

- And, now, DNA storage.DNA could store all of the world's data in one room, DNA data storage gets random access, DNA data storage
- Can we store this information in living organisms? Cas encoding of a digital movie into the genomes of a population of living bacteria, Complex cellular logic computation using ribocomputing devices

From the movies

- What are the ethical issues in creating a "Skynet"
- Is it ethical to even risk creating a "Matrix" world?

Multi-use tools

- Even if we don't intentionally create tools to do harm, what about creating tools that can still be used to do so? An axe is useful for chopping wood, but it can also be used as a deadly weapon

Multi-use tools

▶ What about creating a set of libraries to do elementary physics? What about creating a physics engine to simulate the motion of an automobile? What about creating glueware to incorporate access to the physics engine live to an autonomous vehicle? What about incorporating the physics engine in the software? What about using this incorporated physics engine for a new control structure using an experimental and non-deterministic "differential analysis" for handling unexpected situations?

Badly made tools

- What about badly made tools? By giving more responsibility to technology, the risks from buggy — or even just ill-match — software software grow. Who takes responsibility in such a situation? The integrator? The author? Whoever has the worst lawyer?

Design practices

- What about using "rapid release" models of software design rather than "waterfall models"? Is it ethical not to take due diligence when designing technology that can have very large effects on individual humans, or even groups of humans? Many design practices currently in use intentionally turn out shoddy code in a rapid fashion, hoping to fix problems on the fly rather than eliminate those before release.

- Is front-end development having an identity crisis

Maintenance practices

- Toyota recalls all Mirais for software bug
- What about failure to do regular maintenance, such as failure to install software updates?
- Or failure to test software updates before installing undesirable updates?

The obsolence of work?

▶ Throughout the industrial age, there have been concerns about technology displacing human workers. From the Luddites and the Swing Riots through articles like the 2015 World without work, it seems obvious that as automation replaces the need for humans for some jobs that concerns will be engendered as to what activities will replace those jobs.