A Brief Summary of Research on Provably Beneficial AI

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Good AI systems

- Restricted systems (tool AI)
- Constraints on a smart system
- Value alignment
- other

Value alignment

- Inverse reinforcement learning (IRL)
- Cooperative IRL (CIRL): a two-player game with "human" and "robot"
  - Human "knows" the value function (usually acts according to it)
  - Robot doesn't know it, but wants to maximize it
  - Optimal solutions have these properties:
    - Robot has an incentive to ask questions first
    - Human has an incentive to teach the robot
      - Human behavior is "suboptimal"
      - So an IRL algorithm shouldn't expect "optimal"

The off-switch

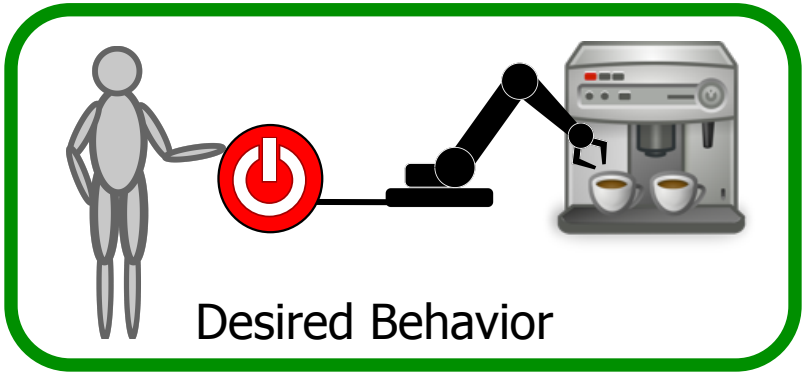
"If a machine can think, it might think more intelligently than we do, and then where should we be? Even if we could keep the machines in a subservient position, for instance by ***turning off the power*** at strategic moments, we should, as a species, feel greatly humbled. ...

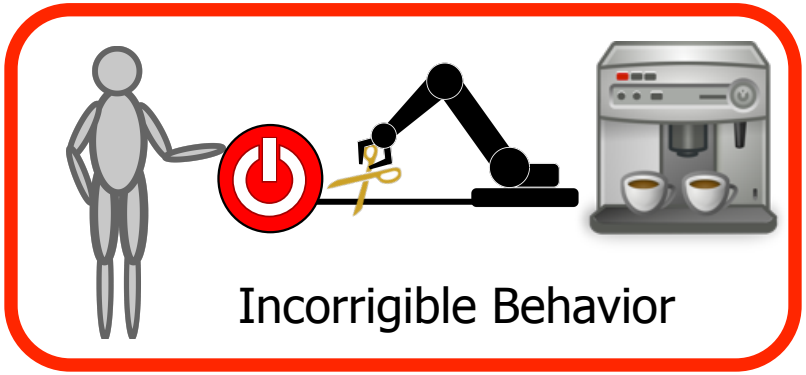
[T]his new danger … is certainly something which can give us anxiety."

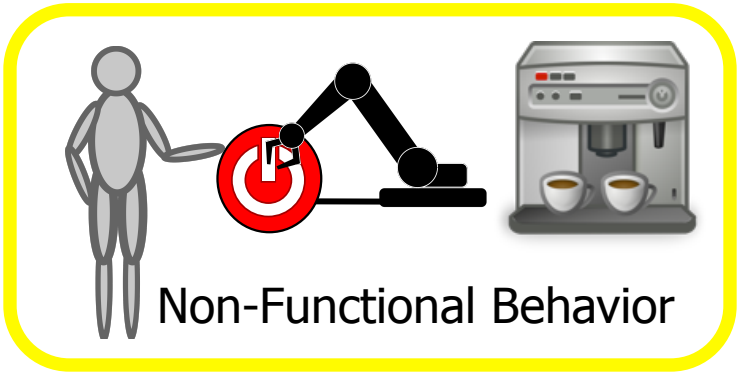
Alan Turing, 1951

The off-switch problem

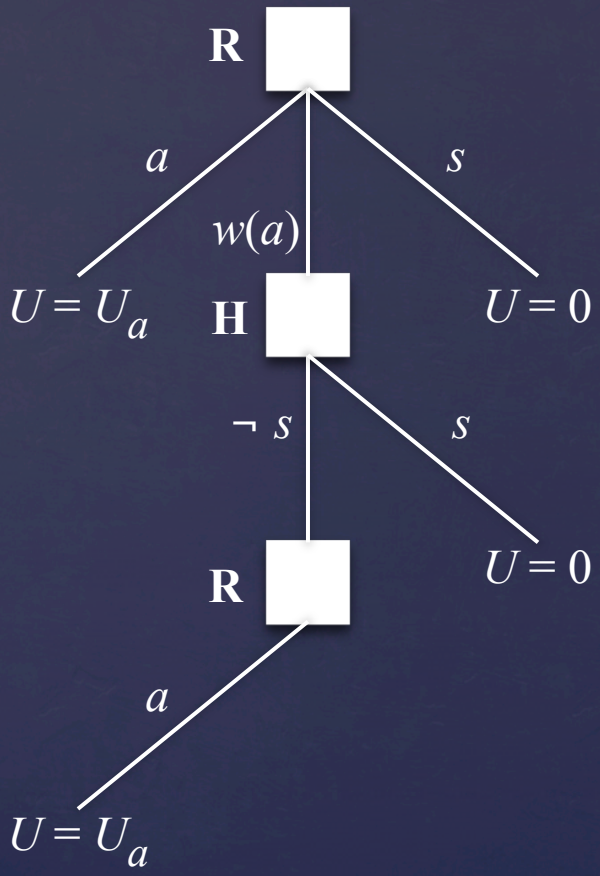
- A robot, given an objective, has an incentive to disable its own off-switch
  - "You can't fetch the coffee if you're dead"
- How can we prevent this?
- Answer: robot isn't given an objective!
- It must be ***uncertain*** about the true objective
  - The human will only switch off the robot if that leads to better outcomes for the true human objective
  - Theorem: it's ***in the robot's interest*** to allow it
    - cf non-negative value of information

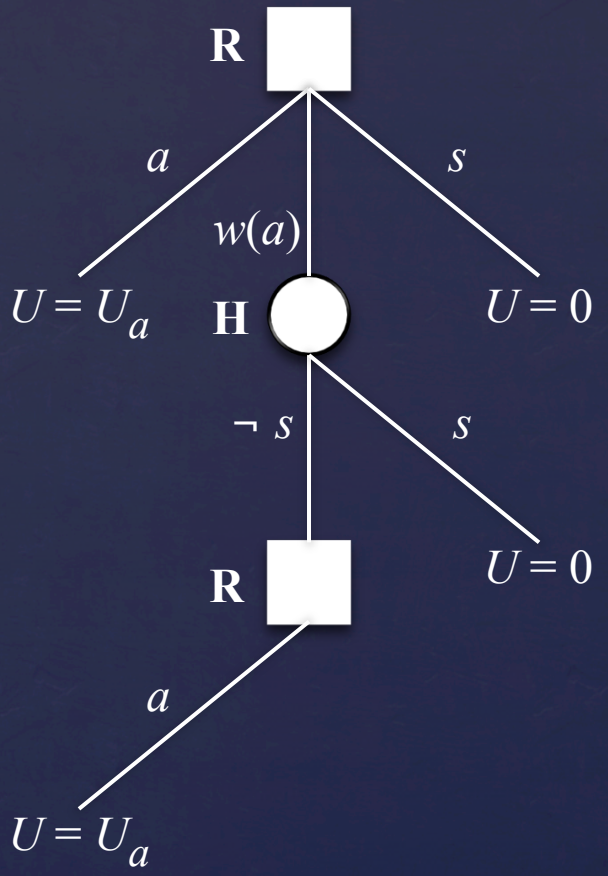

Desired Behavior


Incorrigible Behavior


Non-Functional Behavior

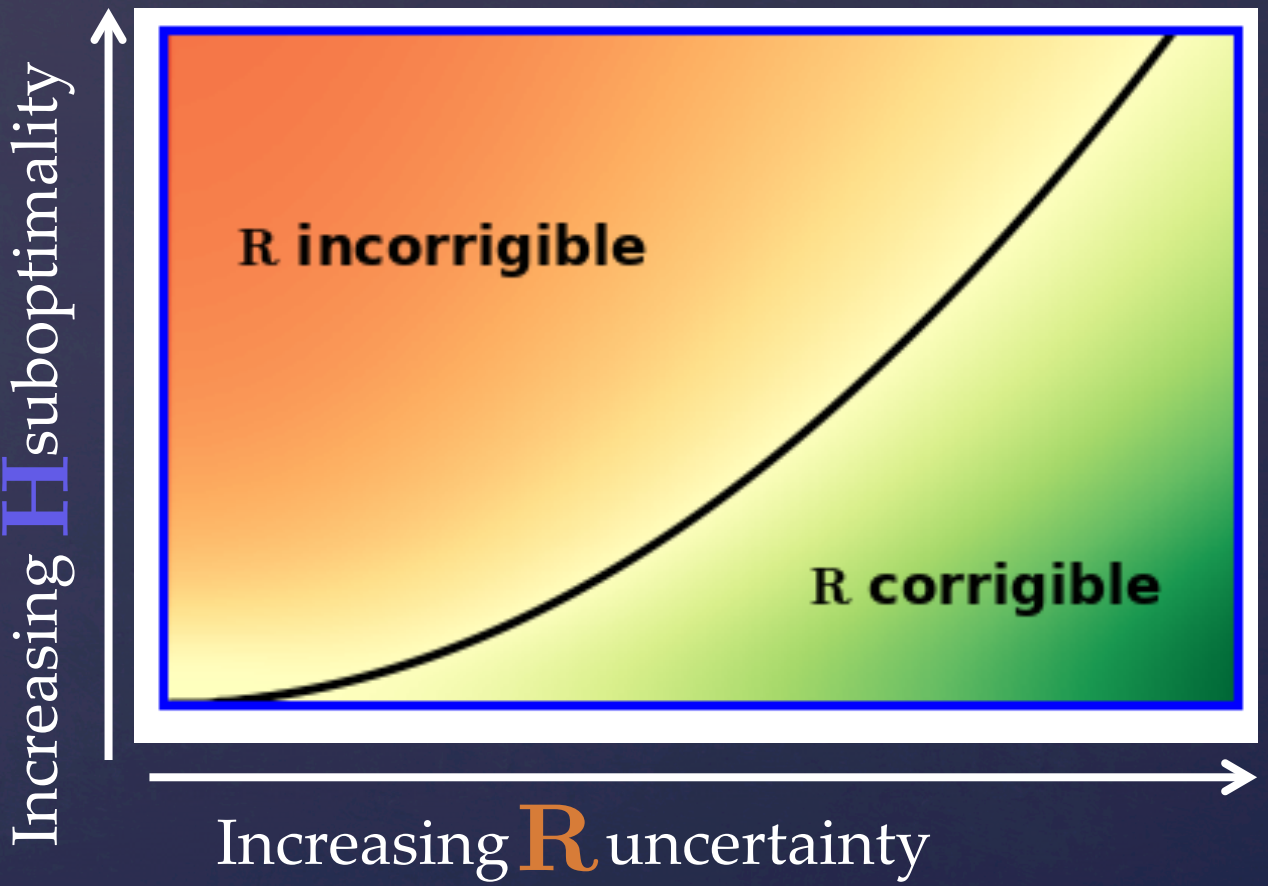
Off-switch model





w(*a*) preferred to *a* or *s*

a or *s* preferred to *w*(*a*)

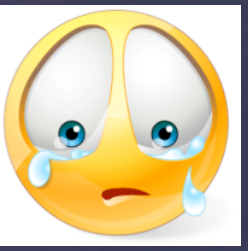

R incorrigible
R corrigible
Increasing H suboptimality
Increasing R uncertainty

Uncertainty in objectives

- *Irrelevant* in standard decision problems…
- …*Unless* the environment provides further information about objectives
  - E.g., observable human actions
  - A "reward signal" is a human action that provides *information not reward*
    - Avoids the wireheading problem

Value alignment contd.

- Humans are nasty, irrational, inconsistent, weak-willed, computationally limited, and heterogeneous



Center for Human-Compatible AI

… to reorient the general thrust of AI research towards provably beneficial systems

Current topics

- What is an instruction?
- What is an advising machine?
- Can we make safe question-answering systems of arbitrary ability?
- Extensions of CIRL to multiple humans and robots (possibly w/ global sharing)
- Safety margins when the robot may be unaware of some dimensions of U