Robo-Ethics

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Ethics

- moral principles that govern a person's behavior or the conducting of an activity
- Techno ethics
  - whether it is always, never, or contextually right or wrong to invent and implement a technological innovation.
  - how standard ethical questions are changed by the new powers.

Ethics

- Address the issues of what is 'right', what is 'just', and what is ‘fair'.
- Covers many aspects of technology
  - Access, Accountability, Privacy, Environmental, Existential, Health, Safety, Quality of Life, Security, Transparency, …
- Techno ethics has a long history as people have been worried about technology all along.

PAPA

- In ICT the rules of PAPA have been developed
  - Privacy - what are you required to share?
  - Accuracy - who is responsible for data accuracy?
  - Property - Who owns information?
  - Accessibility - who has access, and is it accessible for everyone?

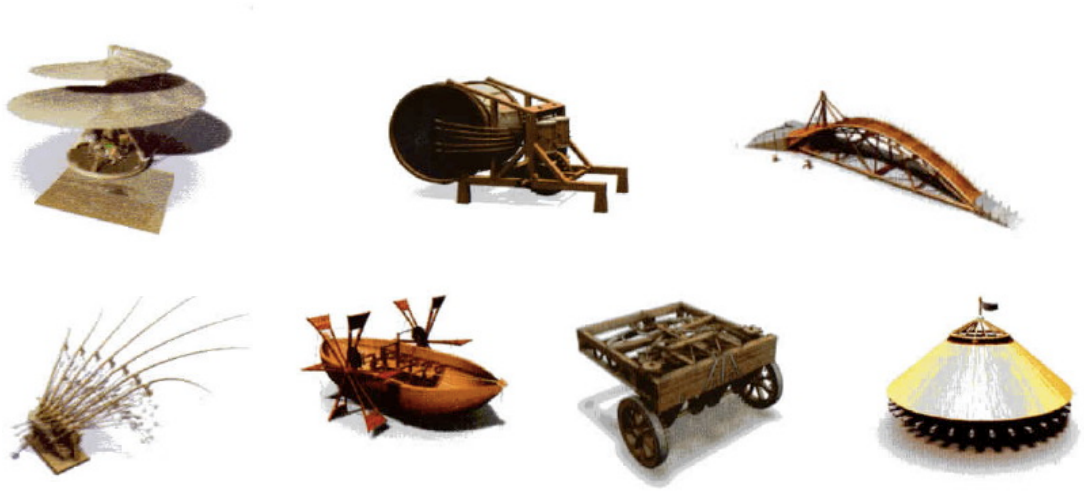
RoboEthics

- Robotics has been “discussed” for 100+ years
- Asimov created the 3-5 laws of robotics
- Safety has been a key factor since robotics became an industry ~60 years ago
- A more formal treatment of RoboEthics gained momentum 2004
- Today IEEE RAS has a RoboEthics Committee, …

Leonardo Da Vinci (1452-1519)

- Considered one of the most accomplished scientists, engineers and artists
- As a “non” nobility he was never educated in mathematics & latin
- Not widely published until late in life and as such largely ignored
- Probably more widely known as an artist/painter than a scientist
- Covered - medicine, flying, engineering, warcraft, civil engineering, …
- Remarkably productive and insightful for his time.
- Some work clearly also popularism in terms of picking up trends
  - Press, Clock Springs.

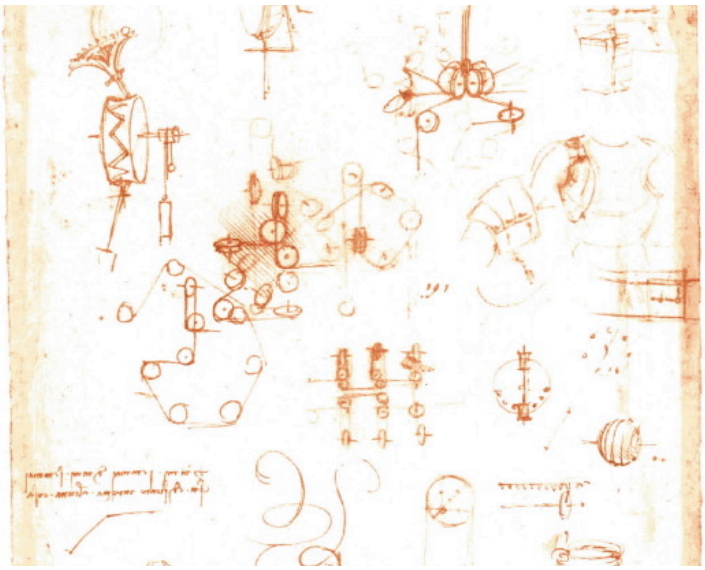
Populating the space of engineering



From: Leonardo's Machines

The Knight

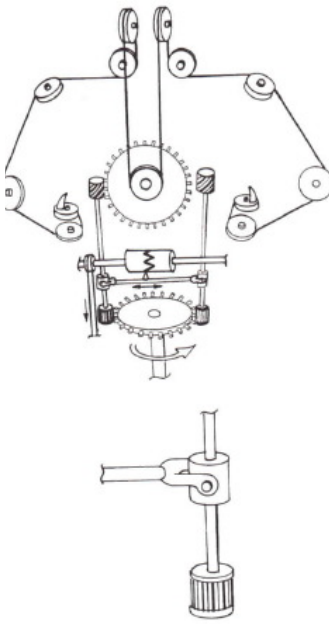
- Design of an "automated" soldier
- Walking & Arm movements to have a real knight
- How can a system be designed for programmed motion of arms and legs?
- Cam wheels? Pulley system?
- Using experience for anatomic atlas to provide a suggested solution



The Knight

Tendon system for actuation

Programmed by a pulleys that can be controlled in terms of direction and speed



The Knight

- Reconstructed on a BBC program by 2001.
- Basic design to consider the pros and cons
- The wire drive is not optimal due to coupled control
- The elasticity of wires poses a challenge to control
- If the tendon is under constant expansion it can be used for efficient low-weight manipulation



Asimov's Three Laws of Robotics

- First Law
  - A robot may not injure a human being or, through inaction, allow a human being to come to harm.
- Second Law
  - A robot must obey the orders given it by human beings except where such orders would conflict with the First Law.
- Third Law
  - A robot must protect its own existence as long as such protection does not conflict with the First or Second Law.

Source: Asimov, Isaac (1950). "Runaround". I, Robot (The Isaac Asimov Collection ed.). New York City: Doubleday. p. 40.

Additional Laws

- Zero'th Law
  - A robot may not harm humanity, or, by inaction, allow humanity to come to harm.
- Fourth Laws
  - A robot must establish its identity as a robot in all cases. (Dilov, 1974)
  - A robot must know it is a robot. (Kesarovski, 1983)
  - All robots endowed with comparable human reason and conscience should act towards one another in a spirit of brotherhood. (Ashrafian, 2014)

Key legal issues in robotics

- Responsibility
  - Who can we attribute responsibility to?
  - What about robots with ML?
- Liability
  - Is the manufacturer liable? What about hackers?
- Privacy
  - Who can have access to information?
  - Can a robot spy on you?

Robots are everywhere

Service



Medical





Agriculture



Construction



Space



Manufacturing



Companion Teaching





Security



Mining



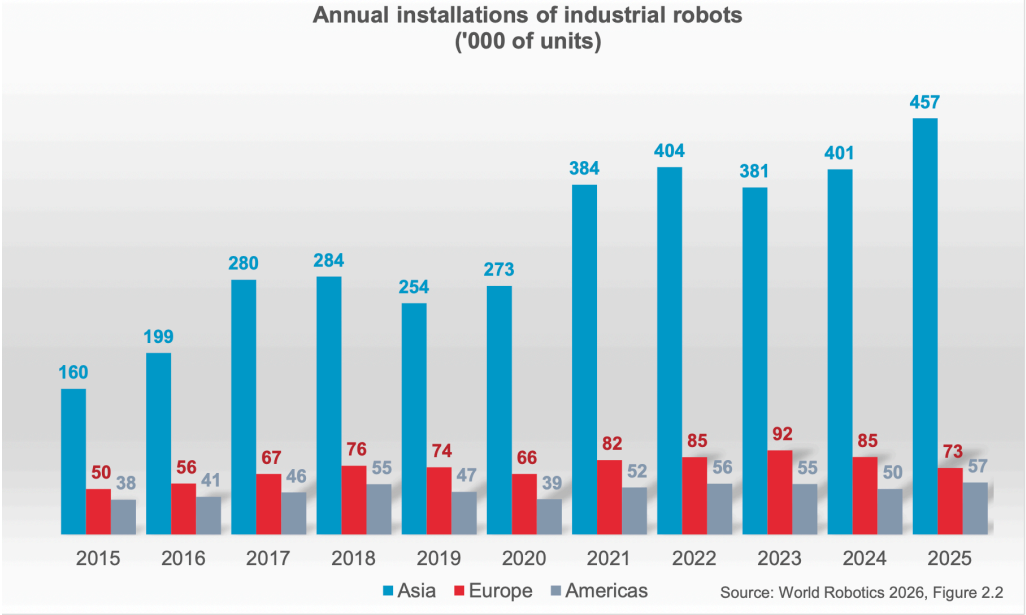
Cars



Industrial Robots

- Robot Arms
- Robot Work Cells
- Assembly Lines

Industrial Robotics is a $30B industry



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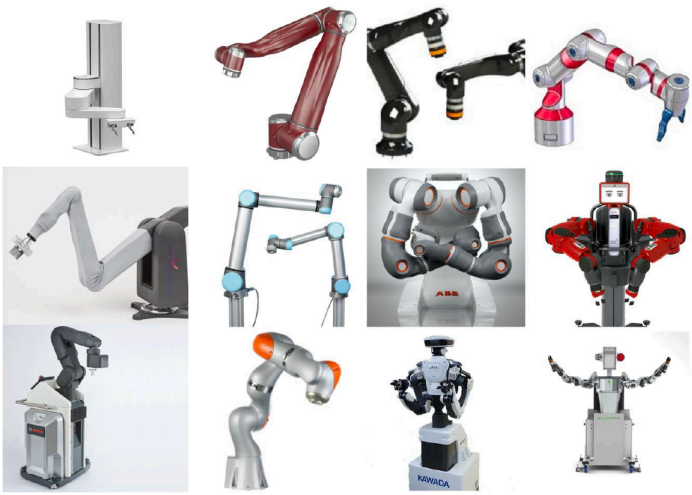
Robot Arms - Safety is a major concern



There are safety standards

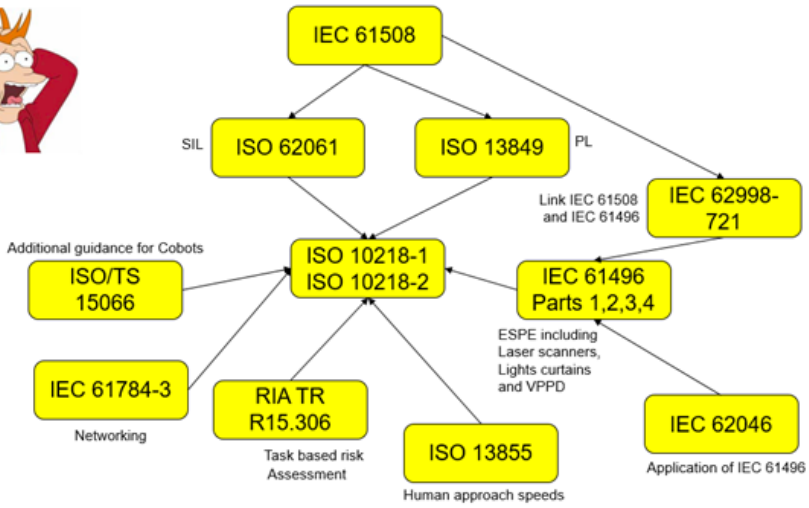
- This should be simple



There are safety standards

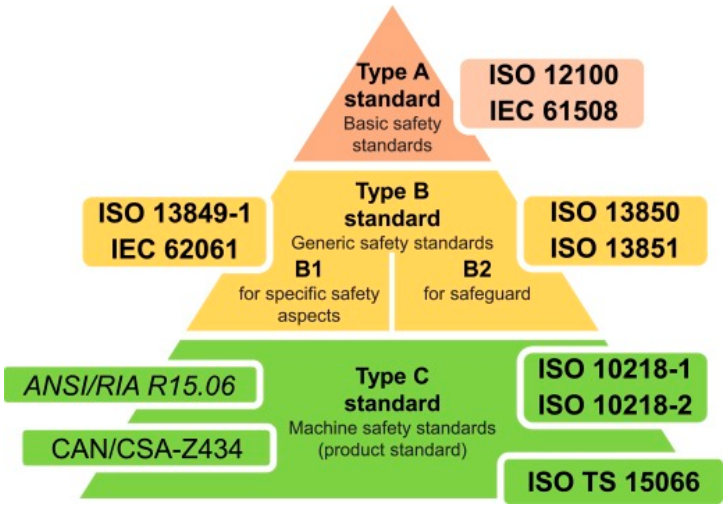
- Maybe not





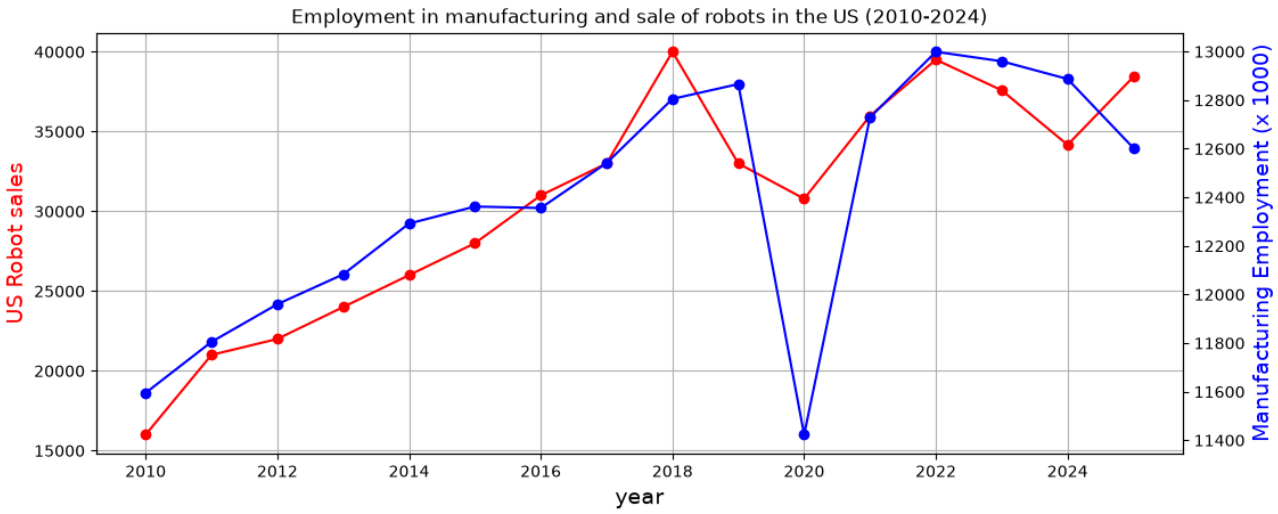
Src: Analog Devices

Standards for collaborative robots



Src: Science Direct

Robots and Jobs



Robots & Stress



SAFETY TECHNOLOGY

How Warehouse Robotics Reduce Worker Injuries

Automation solutions have increased productivity while alleviating employees from performing physically-intensive tasks.

Kayla Matthews
AUG 15, 2019

- Reduced load
- Improved safety
- Reduced # falls
- Managing fatigue
- Src: EHS Today

Service Robots

- Domestic Service Robots

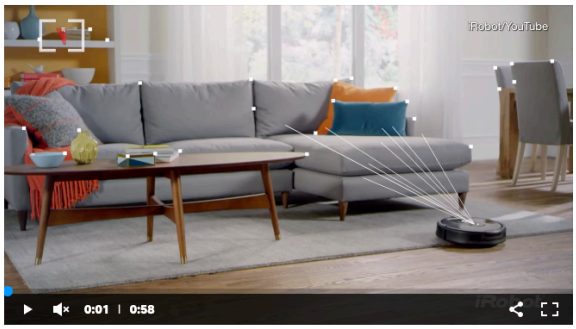
- Professional Service Robot

Privacy and Service Robots?

Your Roomba already maps your home. Now the CEO plans to sell that map.

Josh Hafner and Edward C. Baig USA TODAY

Published 12:36 p.m. ET Jul. 25, 2017 | **Updated 9:06 p.m. ET Jul. 25, 2017**



Here's why the makers of Roomba want to sell your home's floor plan

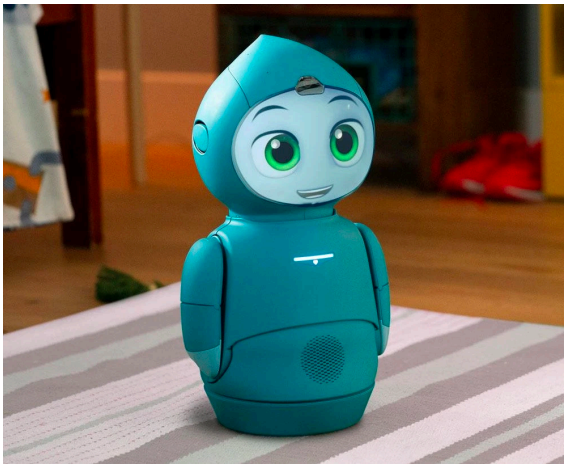
The makers of the Roomba are looking to sell consumers' home floor plans. *Buzz60*

Where is it OK to have cameras?



Src: Nick Wilkes Photography

New Breed of Home Robots

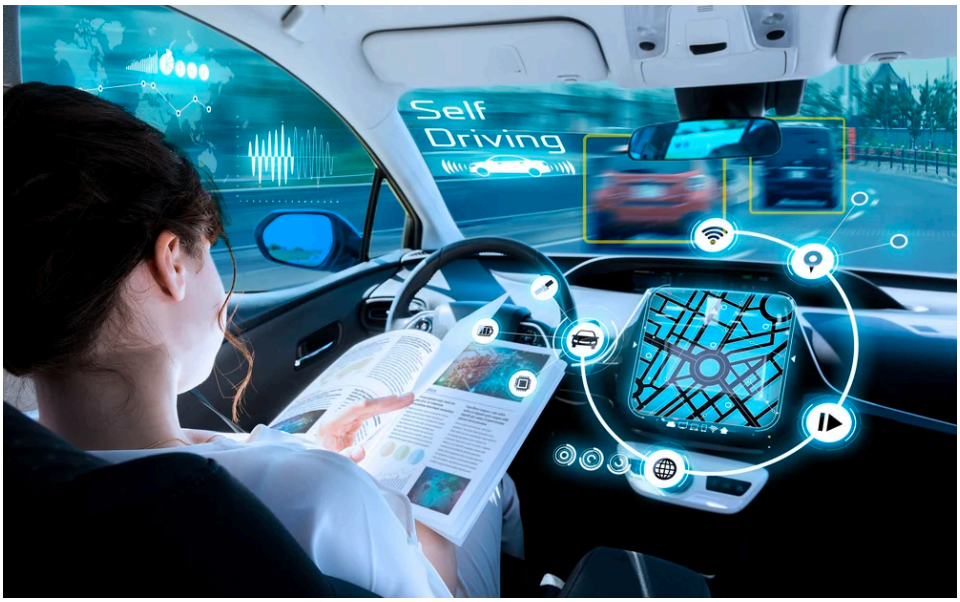


Src: Embodied, 2020

- Moxie
- Jibo
- Roomba
- …

- What about privacy?

Autonomous Cars



Autonomous Cars

- Poses a number of questions from an ethical point of view
  - Who is responsible?
    - Rules vary by state
  - When/if OK to violate the law?
    - We do it all the time
  - “Who should I collide with?”

Notable accidents

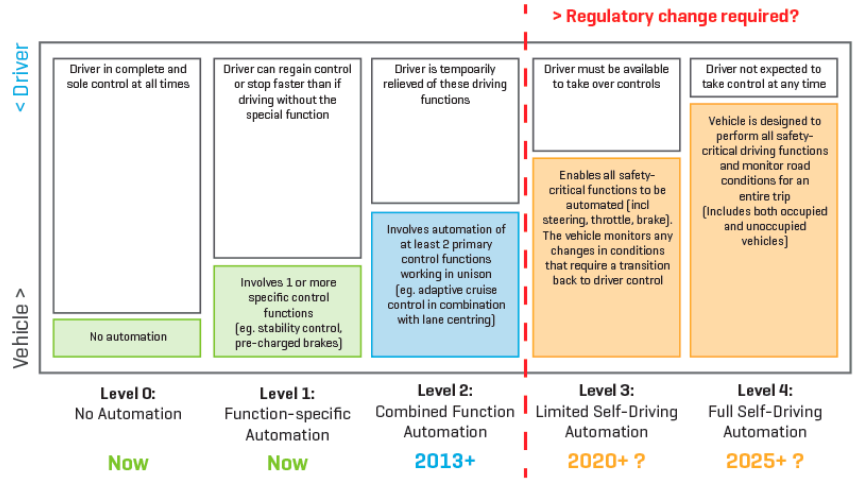


Notable accidents



Autonomy Levels

Levels of driving automation (NHTSA)



Source: NHTSA (Modified)

Merging into traffic



Unmanned Aerial Vehicles?

- FAA rules for UAVs
  - Line of sight
  - Need registration of the vehicle
  - Need a UAV pilot license
  - …

UAVs and Privacy

- Privacy by Design?
  - Proactive not reactive - Preventive not remedial
  - Privacy embedded into design
  - Full Functionality - Positive Sum
  - End-to-end security
  - Visibility and transparency
  - Respect for User Privacy - Keep it user centric

UAV deployment slowly relaxed

JANUARY 15, 2019

The Chula Vista Police Department Defines How Drones Can Be Used as First Responders

by Jeremiah Karpowicz in Public Safety & Emergency Services

SHARE



UAV issues

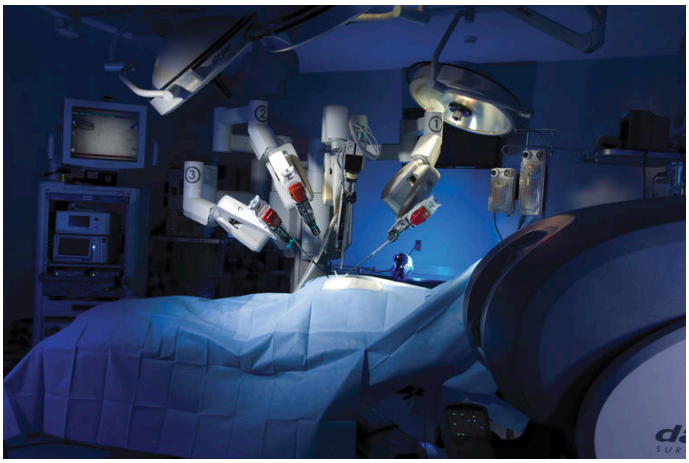
Trust

Human in the loop?

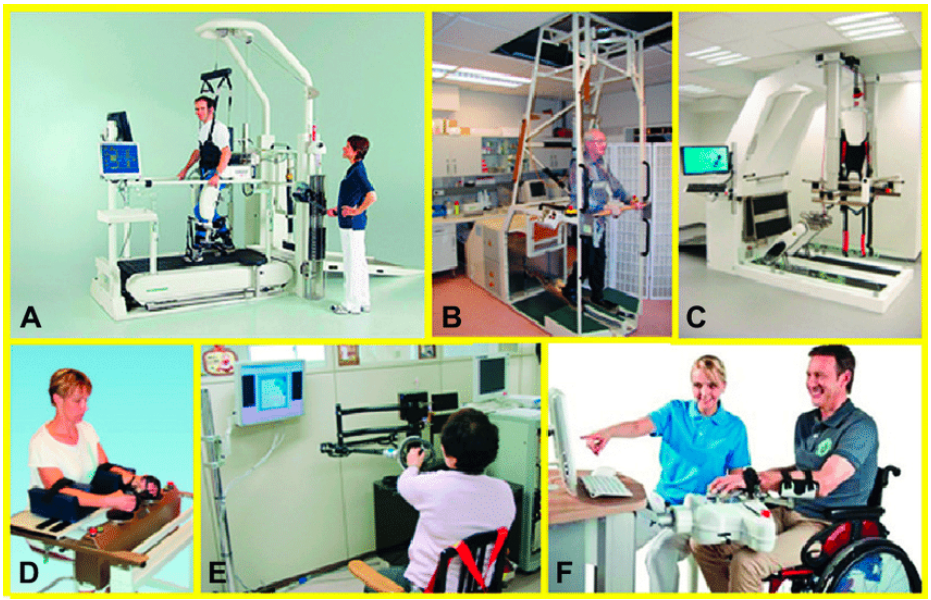


Surgical Robots

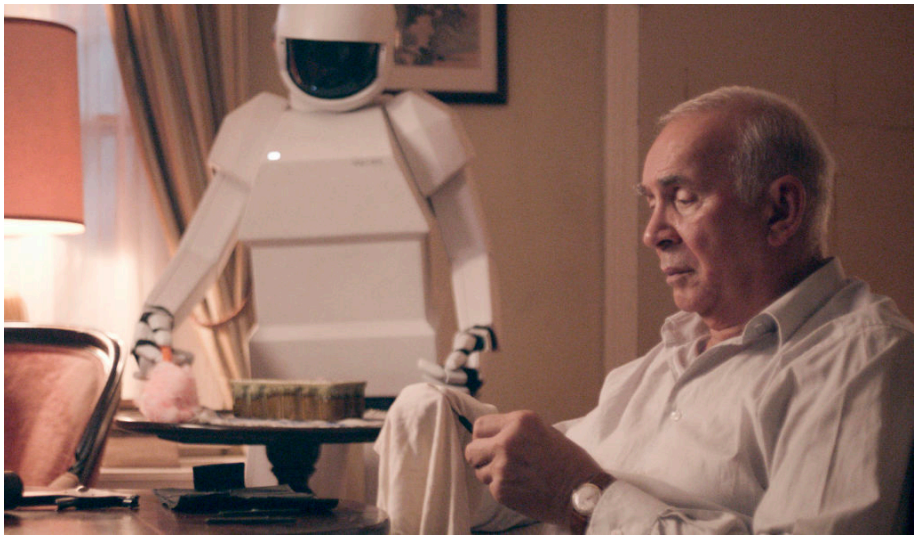
- Training
- Recording
- Setting standards



Rehabilitation Robots



Home care robots



Home care robot



Src: IEEE Spectrum

Paro Home Robot



Exoskeleton Systems

- 291,000 people in US have spinal cord injury
- Who is in control?
- What is a good level of control?



Empowering workers



Empowering workers



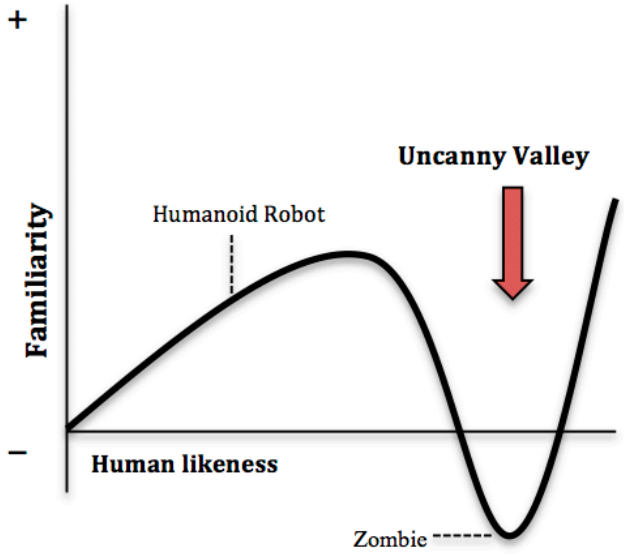
Empowering workers?





When is it getting too close to humans?

Uncanny Valley



Android Robots





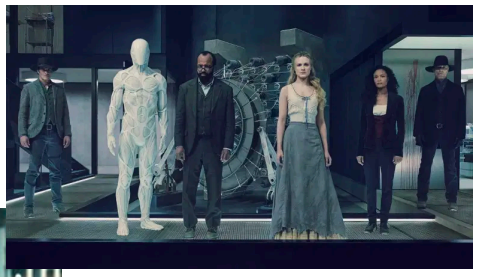
There is a new industry out there



Westworld







Getting it right is hard



SUMMARY

- Robot ethics is in many respects still in its infancy
- We have basic safety standard
- Need to consider the engagement with people across many areas
- An example is cars where the rules are still basic
- UxV rules will pose a challenge
- Complicated considerations about jobs & automation