# Rise of the Robots

**From Mechanical Turtles to Humanoid Superhumans**

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## Rise of the Robots
**Introduction**

- This session explores the evolution of robotics, from ancient automata to intelligent humanoids and beyond.
- This field blends…
  - engineering,
  - AI,
  - biology,
  - and imagination.

## Origins: 1940-1980

## Early years
**Machina speculatrix, 1948**

- Early robotic “tortoise” were the first robots.
- They were built by William Grey Walter.

## Early years
**Machina speculatrix, 1948**

- Tortoises were sensual and mimicked nature.
- It was a *great start* for the fledgling industry.
- They exhibited animal-like behaviors.

## Early years
**Shakey - 1960s**

- Shakey isn’t a reference to the 1960s pop star Shakin' Stevens!
- Rather, it is a reference to the first AI robot with vision.
- Unfortunately, technology in the 1960s was not powerful enough for of AI.
  - It was SLOW!

## Early years
**Shakey - 1960s**

- It could also only operate on flat floors.
- The technology was the first synergy of intelligence and machines.
- However, it was many decades too early

## Industrial Robots
**Starting a revolution**

- The first industrial robot was created and patented in 1954 by George Devol.
- It could even serve coffee!
- It weighed 4000 pounds (1814 kg)
- First installed at a General Motors plant in 1961.

## Industrial Progress
**Automation in the 60s and 70s**

- By the 1960s, non-intelligent robots were starting to become common in factories.
- These were purely mechanical and typically did simple repetitive tasks.
- They unfortunately lacked sensors and were extremely dangerous.

## 1st Killer Robot

**Automation in the 60s and 70s**

- In 1979, Robert Williams, a 25-year-old factory worker, was asked to count parts on a massive shelving unit.
- A robot arm tasked with retrieving parts finds him and kills him instantly.
- The robot continues working, and Williams remains dead for 30 minutes before his body is discovered.

## 1st Killer Robot

**Automation in the 60s and 70s**

- There simply weren't safeguards in place to protect Williams.
- No alarms notified him of the approaching arm.
- In 1979, AI involved wasn't sophisticated enough to do anything to prevent such a death.

## Formative years

**The Cart - 1970s**

- Stanford University had been tasked with developing space robots.
- This led to the development **The Cart** - a robot that pioneered *computer vision navigation*.

## Formative years

**The Cart - 1970s**

- They developed the first system that could follow a line - and gave birth to computer vision
  - deployed in self driving cars today.
- The Cart was upgraded in 1979 by the legendary roboticist Hans Moravec.

## Formative years

**The Cart - 1970s**

- The Cart was made at a time when **technology couldn't enable such complexity**.
- It was a disaster outside!

## Formative years

**The Cart - 1970s**

- This meant while the field of AI was born…
- …robotics research was stalled by striving for intelligence.
- However, this was only in the USA!

## Formative years

**WABOT-1 - 1973**

- At the same time, Japan's Waseda University introduced WABOT-1 (1973).
- This focussed on physical movement and real-time reactions rather than intelligence.
- WABOT-1 was the world's first full-scale humanoid robot.
- It was capable of walking and rudimentary communication

## Formative years

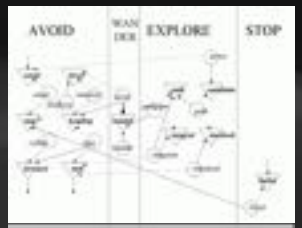
**WABOT-2 - 1984**

- By 1984, Waseda's WABOT-2 could even read musical scores and play a keyboard with its hands..
- .. a remarkable early foray into humanoid dexterity and social interaction

## Animal Instincts

## Behavior-Based Robots
**1980s**

- The next major phase was the beginning of modern robotics.
- They shifted from attempting complex planning to focusing on real-time behaviors.
- In other words, they tried to build robots that **mimic natural animals**.

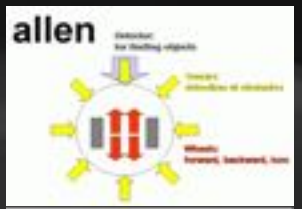



## Behavior-Based Robots
**1980s**

- Rodney Brooks is the inventor of the Roomba and Baxter in recent years.
- Back in 1986, he created Allen - the first Behavior-Based Robot.

## Behavior-Based Robots
**1980s**

- Allen had three layers with different purposes:
  1. Avoid obstacles
  2. Wander
  3. Pursue goals
- Each layer could act in parallel.




## Behavior-Based Robots
**1980s**

- Soon after complete Allen, **Herbert** was created.
- It was a walking trash collector!
- …and the first useful robot.

## Collaborative Robots
**1990s**

- The 1990s saw the arrival of robots that would work with humans.
- These are often dubbed "**Cobots**".

## Collaborative Robots
**1990s**

- Cobots were designed with sensitive sensors that could detect people.
- This was the first time robots and humans work together.

## Artificial Intelligence
**1990s**

- Breakthroughs in *computer vision* allowed the robots to understand their environments.
- They could also adapt and perform complex tasks.

## IT Demand
**1990s**

- The rise of the **personal computer** dramatically increased demand for semiconductors.
- The brought the invention of the cleanroom industrial robots.

## Blasting to the stars
**1997**

- NASA's Mars Pathfinder mission in 1997 featured the Sojourner rover.
- This demonstrated autonomous navigation capabilities on another planet.

# Rise of the Humanoids

## Humanoid Robots
**2000s**

- Humanoid robots have been a dream for many years.
- That future wasn't so near as we thought in the late 20th century.

## ASIMO
**2000**

- In 2000, Honda unveiled ASIMO, a child-sized humanoid robot.
- It is famous for its smooth bipedal walking.
- ASIMO could climb stairs and respond to voice commands, though it was largely **remote-operated** in early years

## ASIMO
**2010s**

- By the 2010s, humanoid robotics exploded globally.
- Robots with human-like features became common.
- For example, MIT's **Kismet** (right) in 2000 showed emotional expression and face tracking.

# Robots Around Us Today

## Robots Today
**State of the Art**

- Tesla announced it's robots in 2021.
  - Elon Musk has been tasked with selling one million robots to get his $1 trillion bonus!
- Today, there are now more than four million robots in factories.

## Robots Today
**State of the Art**

- On assembly lines, articulated robot arms weld, paint, and assemble with high precision.
  - These robots have grown smarter and safer.
- They computer vision to inspect quality and adjust to new tasks.

## Robots Today
**State of the Art**

- Machine learning is ubiquitous in modern industrial robots.
- Industrial robots continue to spread as **costs drop** and **capabilities rise**.

## Homes & Daily Life
**State of the Art**

- Robots are parts of many family households today.
  - **21 million floor cleaners** were sold in 2024!
- The next revolution is personal assistants.
  - Essentially voice activated smart speakers on wheels!

## Homes & Daily Life
**State of the Art**

- Household robots hint at a future where everyday errands…
  - (cleaning, deliveries, even cooking)
- …could be delegated to a machine helper.

## AI Integration
**State of the Art**

- The integration of machine learning means home robots are becoming more adept at:
  - understanding voice commands,
  - recognizing objects,
  - and navigating unpredictability (pets, kids' toys on the floor, etc.).

## Homes & Daily Life
**State of the Art**

- Robotics has also become fun.
- Sony's AIBO robotic dog and other robot pets provide play and companionship:
  - These use sensors and AI to react in cute, animal-like ways.
  - Although the $3000 price tag is often seen as crazy!

## Fun & Companions
**State of the Art**

- Social robots like Pepper entertain assist customers in stores.
  - They can chat, tell jokes, or dance - and engage people.
- These technology *less intimidating*.

## Fun & Companions
**State of the Art**

- In education, programmable robots entertain…
- …while teaching coding and engineering concepts to students.

## Healthcare
**State of the Art**

- Robots are making a lifesaving impact in hospitals and clinics.
- The **da Vinci** surgical robot (right) allows surgeons to perform delicate surgeries.
- Over 1.5 million robotic-assisted procedures have occurred.

## Healthcare
**State of the Art**

- Exoskeletons help patients learn to walk again.
- They are more effective than any previous physiotherapists.

## Healthcare
**State of the Art**

- Therapy robots comfort seniors in nursing homes…
  - …responding to touch and sound to provide psychological benefit.
  - And allowing monitoring and communication.

## Robotaxis
**State of the Art**

- Robotaxis were allowed on freeways for the first time this year.
  - In San Francisco, LA and Phoenix.
- Tesla launches their Cybercab in the USA in 2026.
- London has announced they will have robot taxis running in Spring 2026.

## Robotaxis
**State of the Art**

- Robotaxis will likely not be to own!
  - They will be for hire.
- Cars drive from the factory to customers and will self-charge.
- This will bring the cost of transport down, "*to be cheaper than a bus*" according to Musk.

## Weaponization
Military Robots

## Humanoids & Beyond
**State of the Art**

- Humanoid robots are beginning to live up to the goofy movie expectations!
- They will open a new frontier in AI research..
  - ..becoming the eyes and ears of AI
  - Allowing it to learn directly and have a presence in the world.

## Humanoids & Beyond
**State of the Art**

- Boston Dynamics' Atlas..
  - walks on two legs
  - carries objects
  - sprints on uneven terrain
  - does backflips!
- Check them out…

## Humanoids & Beyond
**State of the Art**

- Agility Robotics is building robots for factories.
  - They can lift and stack boxes
  - They can also use AI to handle complex manipulation tasks

## Humanoids & Beyond
**State of the Art**

- Humanoid robots today are extremely limited
- But, they are pushing the boundaries of robotics
- They are becoming more human-like every day, as they become more dexterous.

## Humanoids & Beyond
**State of the Art**

- In the coming years, we will see remarkable advances
- The main areas that will improve are:
  - Agility
  - Coordination
  - Decision making (in unstructured settings)

## Humanoids & Beyond
**State of the Art**

- Soon, robots will be assisting in:
  - disaster responses
  - construction
  - caregiving
  - adapting to human environments
  - guarding prisons
  - fighting fires
  - policing dangerous streets

## Tesla
### The next generation

- General-Purpose Humanoid 5'8" robot designed for repetitive, dangerous, and everyday tasks in factories and homes
- AI-Powered Intelligence Leverages Tesla's Full Self-Driving neural networks for navigation, object manipulation, and learning
- Massive Production Ambitions Targeting **1 million units/year** at Fremont, with Gen 3 already demonstrating advanced dexterity
- Consumer Price Target Expected retail price of $20,000-$30,000 - less than the cost of a new car


# The Future

## Looking Ahead
### The Future of Robotics

- Integrated robotic homes are the future!
  - Imagine a world free from:
    - Vacuuming
    - Laundry
    - Cooking
    - Cleaning

## Looking Ahead
### The Future of Robotics

- The LG CLOiD robot
  - Can fold and process laundry
  - Linked to LG kitchen appliances
  - Can do everyday tasks like:
    - retrieving milk from a refrigerator
    - placing a croissant into an oven to prepare breakfast

## Looking Ahead
### The Future of Robotics

- Imagine a smart fridge that can…
  - Tell you what can be made with its contents
  - Can call on other robots to prepare food with ingredients inside
- Imagine a security drone…
  - That can check if you closed windows and locked doors

## Looking Ahead
### The Future of Robotics

- Imagine a smart vacuum that can climb stairs..
  - ..that is now a reality
- Roborock Savos Rover has a pair of legs with wheels to manage stairs.

## Looking Ahead
### The Future of Robotics

- We could also see more general purpose robots…
  - A robot butler that can…
    - Make coffee
    - Fetch beer
    - Set the table
    - Answer the door


## Looking Ahead
### The Future of Robotics

- The ultimate vision is…
  - *an autonomous home where mundane tasks are offloaded to ever-present robotic help*
- Freeing humans for more meaningful activities
- The home won't be the only place transformed by robotics…

## Looking Ahead
### The Future of Robotics

- Chatbots will be embedded in robotics
- This will enable:
  - Fluid conversations
  - For robots to understand complex instructions

## Looking Ahead
### The Future of Robotics

- Computer vision will be embedded in robotics
- This will enable recognition of:
  - Objects
  - Faces
  - Emotions
  - Physical activities

## Looking Ahead
### The Future of Robotics

- This will mean robots can **proactively assist** us
  - E.g. if you look tired it will offer to brew a cup of tea!
- The line between the digital AI brain and the physical robot will blur
- We will have adaptive, strong, precise but intelligent helpers
- https://youtu.be/eCNVet_wXGA?si=am-oR0MdcpnB27iW

## Looking Ahead
### The Future of Robotics

- These robots will be able to self-improve and learn on the fly
- Behaviors will be personalized for each user
- Robots will learn from us and the environment around
  - Allowing the development of ethical and moral artificial creatures

## Looking Ahead
### The Future of Robotics

- Robots will be able to learn in virtual simulations of environments
  - E.g. by playing a game where they clean a house they can train to clean real environments

## Looking Ahead
### The Future of Robotics

- Robots will become in **education** and **care giving**
  - Especially where humans cannot be afforded
- They could be used to:
  - remind seniors to take medicine
  - or for conversation

## Looking Ahead
### The Future of Robotics

- People form attachments to social robots and they can be effective treatments
  - E.g. autistic patients can be trained on social cues

## Looking Ahead
### The Future of Robotics

- Biotech is the blending of biology and robotics
- "Biohybrid" robots are becoming common
  - These incorporate living cells and tissues
  - New robots are powered by muscle cells and controlled using neural signals

## Looking Ahead
### The Future of Robotics

- In the near future, soft robotic limbs will be interfaced with the human nervous system
  - Allowing us to control robot limbs with our brains
- For example, the Luke robotic arm (pictured) can be controlled by thought

## Looking Ahead
### The Future of Robotics

- Implantable robots (nanorobots) could roam our bloodstream in the future
- Imagine them protecting against:
  - Heart attack
  - Cancer
  - Delivering drugs
  - Unclogging arteries

## Looking Ahead
### The Future of Robotics

- Cyborgs could become a common reality!
- Enhanced humans with robotic augmentation.
  - Cochlear implants make the deaf hear.
  - Exoskeletons allow wheelchair users to walk.

## Looking Ahead
### The Future of Robotics

- We could also see the evolution of the super human!
  - Exoskeletons could give superhuman strength
  - We could walk for unlimited distances
  - Lab-grown organs could merge with electromechanical systems for replacement body parts!

## Looking Ahead
### The Future of Robotics

- Eventually we may “grow” robots using genetic algorithms
  - We will blur the line between “engineered” and “organic”
  - It will also make us face profound questions about **what it means to be human**!
- **Blade Runner** could become reality!

## Looking Ahead
### The Future of Robotics

- We need to ensure that as robots rise, human values adapt.
- Robots should take over the dull, dirty and dangerous tasks.
  - …under the supervision of humans to ensure they are for human benefit
- Robot goals must align with human goals

## The rise of the robots will be mind blowing in the coming years!

# Thank-you

**Q&A**