What is going on in the robot economy?

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The Royal Institute of Technology - KTH

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Outline

- Impact of robotics
- History of robotics
- Autonomous or Teleoperated
- Robotics Today and Tomorrow
  - Threat or Possibility

Robot Impact? (the tech optimist)

- 1:st industrial revolution (mechanics)
- 2:nd industrial revolution (IT)
- 3:rd industrial revolution (IT+mechanics)

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Robot impact? (the economist)

Trends
- Industrial robots
  - 170% growth in sales 2009-11
  - Baxter costs 25% less than typical robot
- Autonomous Driving
  - 7 miles, 2004
  - 1540 miles, 2005
  - 300 000+ miles, today

Impact
- 12% of jobs in manufacturing (worldwide)
- 1000 milj. Vehicles today
- 1.5 milj traffic deaths by 2025

Källa: McKinsey Global Institute

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Robot impact? (sci-fi-enthusiast)

- Robots are awesome...
  - But research is so slow!
  - Why?
    - Robotics is difficult
    - Biological system are **amazing**
- Amaras Law: "*We tend to overestimate the effect of a technology in the short run and underestimate the effect in the long run.*" (Roy Amara)

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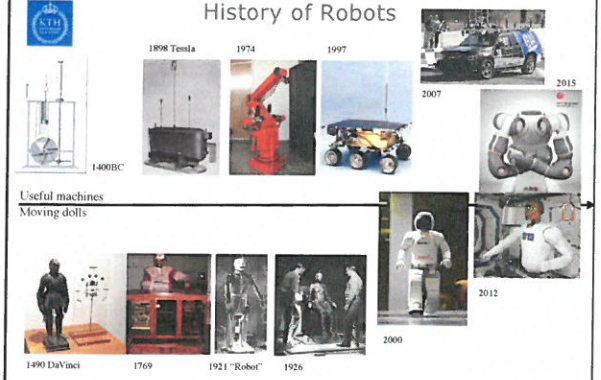
History of Robots



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Artificial Intelligence

3 Extreme achievements

- Chess, 1997: "Deep blue" wins vs Kasparov
- Driving, 2007: 100km in urban traffic
- Jeopardy, 2011: "Watson" wins vs human champion

All 3 extremely specialized, far from *General Intelligence*

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Autonomy vs Operator Support

- Paradox of Autonomy:
  - "human factor" in operator
    - Autonomy needed
  - "human factor" in engineer/programmer
    - Operator needed
- Combination of Autonomy and Operator
  - Who does what?
  - Advantages?
  - Operator looses focus/skill
  - Automation surprise

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Robotics today and tomorrow

- Autonomous Driving
- Service robots
- Health care robots
- Logistics
- Agriculture
- Industrial robots

- Will the robots take over?...

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Autonomous driving

- Darpa Grand Challenge
  - 2004: tot. 7 miles
  - 2005: tot. 1540 miles
- Darpa Urban Challenge
  - 2007: urban traffic

- Now "towards production"
- Nissan: 2020 product ready!

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Autonomous driving (coming soon)

Automated Driving – Overview

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Service Robots: Electrolux Trilobite

Service Robots: Husqvarna

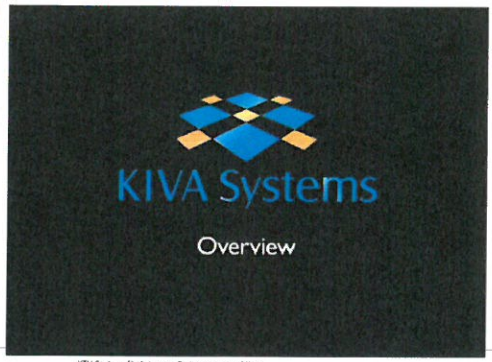
Service Robots

- This is teleoperation...
- Huge challenge to achieve this autonomously

Surgical robots: Da Vinci

- Not that autonomous...

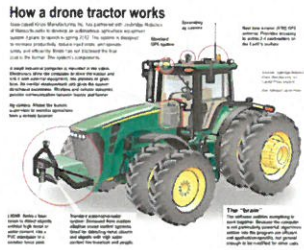
Logistics and Warehouses



KTH team in Amazon Picking Challenge

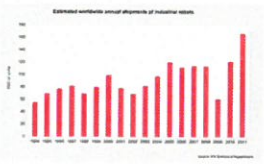
Hospital Logistics: RobCab

Agriculture



Industrial robots

- 40 years of development
- Car industry still main client



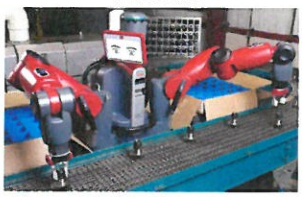
Industrial robots

5 Trends in Industrial robotics

- Pricereduction:
  - 1/3 of price from Gen1→Gen3
- Reliability
  - 5-times MTBF from Gen 1 → Gen 3
- Motion control
  - Position
  - Speed
- Human-Robot collaboration
- Intelligence

New concepts: Baxter

- Safe (but weak)
- Learning by doing (pull wrist and show)
- Pick here, drop there, learn to recognize this
- Eye feedback: next move, internal state
- 22000 USD



New concepts: Opiflex (Västerås)

- Autonomous movement between docking stations
- Gives
  - Flexibility
  - Robustness
- (Easy to program)

New concepts: ABB YuMi (released 2015)

- Safety
- Human-robot collaboration
- Focus in
  - Easy to program
  - Robust (smart) assembly

Industrial robot needs

- Short integration time
- Safe
- Collaborate with humans
- Easy to program
  - By demonstration (visual)
  - By demonstration (physical)
  - By learning (AI)
  - By planning (AI)

Will the robots take over?

- Will the robots take over jobs?
  - Yes
- Will the robots take over the planet?
  - No,
  - ... probably not...

Will the robots take over jobs?

Difficult:
- Dexterity
- Originality
- Social skills

Andel jobb som försvinner
- -machine operators: 90%
- -**assembly workers** (montör): 90%
- -**train operators**: 90%
- -butchers, chefs, food workers: 87%
- -**construction workers**: 85%
- -**vehicle operators**: 85%
- -**warehouse workers**, mailmen: 78%
- -painters: 75%
- -security staff, cleaners: 65%
- -industrial robot operators: 35%
- -pilots: 32%
- -professional athletes: 22%
- -teachers: 13%
- -politicians: 1.2%

Will the robots take over the planet?

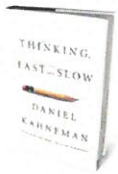
- "The singularity"
  - Robots get smarter than humans
  - Starts developing themselves
  - Compete for resources
  - Eradicate man...
- Proponents
  - Stephen Hawkin etc. (writers, philosophers, Elon Musk)
- Critics
  - AI-researchers
  - (a conspiracy?...)

Why do we overestimate AI?

- The public
  - Watches movies (Terminator)
  - Inherently looks for "intelligence and intent"
- Researchers
  - Oversells results (wants appreciation)
  - Oversells future results (needs funding)
  - Invents Names for methods that are design to be misunderstood:
    - Artificial Intelligence • (algorithms that act rational)
    - Reinforcement Learning • (parameter optimization)
    - Artificial Neural Networks • (functions with many parameters)
    - Deep Learning • (... even more parameters)
    - Machine Learning • (parameter optimization)

Human brain looks for "Intelligence and Intent"

- Example (clip from 1944)
- **"Your mind is ready and eager to identify agents assign them personality traits and specific intetions"**
- Effect even stronger in robots...



Singularity Critics

- Russel & Norwig: (AI textbook, Berkeley)
  - "Even with a computer of virtually **unlimited** capacity, we **still would not know how** to achieve the brain's level of intelligence"
- Rodney Brooks:
  - "people who **fear** a runaway AI **misunderstand** what computers are doing **when we say** they're thinking or getting smart"
- Koen Hindrick
  - You would **have to be insane**... I do **not know any** researcher in AI who thinks this is a problem

Artificial Intelligence

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***But**: General Intelligence exists (humans), and one day we might understand how to create it...*

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Tackar...