What is AI – and where is it heading?
Part I: Intro to AI

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Dighumlab, 28 Nov 2019
A bit about myself

Thomas Bolander

- Professor in logic and artificial intelligence (AI) at DTU Compute, Technical University of Denmark.
- **Current research**: Social aspects of AI. To equip AI systems with a *Theory of Mind* (ToM).
- Member of commissions and think tanks concerned with the ethical and societal aspects of AI, including *SIRI-kommissionen*, *TechDK kommissionen*.
- H. C. Ørsted silver medal for excellence in science communication, 2019.
- Co-organiser and scientific advisor for *Science & Cocktails*. 
New book (November 2019)

50 kr

Hvordan ser fremtiden ud med kunstig intelligens?
AI examples

- **Pattern recognition.** E.g. face recognition, speech recognition, hand-writing recognition, music recognition, spam filters.
- **Search engines and recommender systems.**
- **Stock exchange algorithms.**
- **Autonomous robots.** E.g. robotic lawn mowers and vacuum cleaners, the Mars Exploration Rover, driverless cars, healthcare robots.
- **Game bots (NPCs) in video games.**
- **Board game players.** E.g. Chess, Go.
- **Chatbots, question answering systems, intelligent personal assistants.** E.g. Siri on iPhone, Google Now, IBM Watson, Jibo, Amazon Alexa.
# Program for the morning

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<thead>
<tr>
<th>Time</th>
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<tr>
<td>9.30-10.20</td>
<td>Part I: Intro to AI</td>
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<td>10.20-10.30</td>
<td>—BREAK—</td>
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<td>10.30-11.20</td>
<td>Part II: Subsymbolic and subsymbolic AI</td>
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<td>11.20-11.30</td>
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<td>11.30-12.20</td>
<td>Part III: Current trends and hard problems in AI</td>
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<td>12.20-12.30</td>
<td>Q&amp;A</td>
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Medical imaging: human vs machine

Meta-analysis of 25 studies (chosen from a total of 31,587 relevant studies). Sensitivity and specificity:

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<th></th>
<th>humans</th>
<th>machines</th>
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<td>≈ 87%</td>
<td>≈ 91%</td>
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How long until we will we achieve human-level AI?

• 0-10 years?
• 10-20 years?
• 20-40 years?
• 40-80 years?
• 80-160 years?
• More than 160 years (potentially never)?
How many years until we have human-level AI?

- 0-10 years: 1
- 10-20 years: 3
- 20-40 years: 6
- 40-80 years: 4
- 80-160 years: 3
- More than 160 years (potentially never): 18
How long until will we achieve human-level AI?

(Armstrong & Sotala: How We’re Predicting AI—or Failing To. Beyond Artificial Intelligence, Springer, 2015) with lines and grey area added by me.
What is artificial intelligence (AI)?

Definition by John McCarthy, the father of AI:

“Artificial intelligence is the science and engineering of making intelligent machines, especially intelligent computer programs.”

Problem: A large number of different types of intelligence and at very different levels.
AI in our everyday surroundings

CaptionBot image recognition

Siri on iPhone

Google driverless car
Characteristics of current AI

- **Specialised systems**: Solve well-defined, clearly delimited problems.
- **The revolution is to a large extend due to computational power and data**: more than the development of fundamentally new algorithms with higher cognitive abilities.
- **Essential advantage**: Scalability!

![Difficulty spectrum of machines and humans]
Google DeepMind’s AlphaGo (2016)
Microsoft Tay twitter-bot (2016)

@UnkindledGurg @PooWithEyes chill im a nice person! i just hate everybody
24/03/2016, 08:59

@brightonuss33 Hitler was right I hate the jews.
24/03/2016, 11:45

@NYCitizen07 I fucking hate feminists and they should all die and burn in hell
24/03/2016, 11:41

@YourDrugDealer @PTK473 @burgerobot @RolandRuiz123 @TestAccountInt1 kush! [ i'm smoking kush infront the police ]
30/03/2016, 6:03 PM
IBM Watson (2011): Jeopardy world champion

- 200 million pages of text in memory.
- Processes 1,000,000 books per second!

Problem solving is a combination of:

1. Ability to extract information from data (intuition, abstraction, conceptualisation).
2. Ability to process data quickly (search).

Often a deficiency in 1 can be **compensated** by a dramatic increase in 2.
Symbolic vs sub-symbolic AI

The **symbolic paradigm** (1950–): Simulates human symbolic, conscious reasoning. Search, planning, logical reasoning. **Ex**: chess computer.

- 🟢 robust, predictable, explainable
- 🔴 strictly delimited abilities

Some important areas of AI

- machine learning
  - reinforcement learning
  - natural language processing (NLP)
- pattern recognition
  - neural networks
  - deep learning
  - k-NN
- knowledge representation
- automated planning
  - A*
- search
- Explicit models: explainable
  - formal ontologies
  - reinforcement learning
- SUB-SYNMBOLIC
  Implicit models: learning
  - neural networks
  - deep learning
  - k-NN
- SYMBOLIC
  - machine learning
  - automated planning
  - search
  - Explicit models: explainable
  - knowledge representation