COMP 472: Artificial Intelligence
Introduction
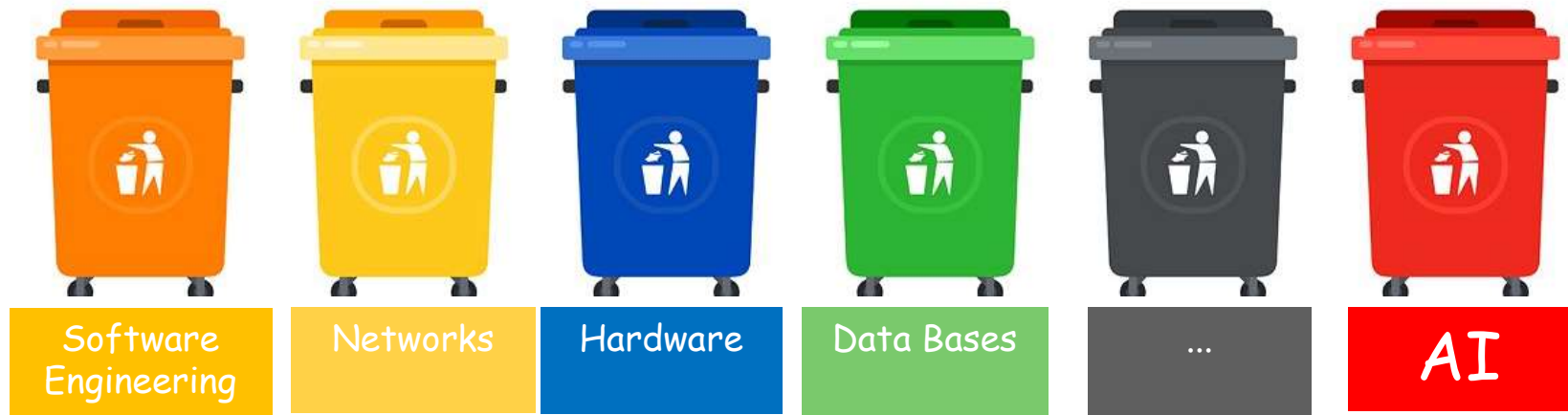## History

- Russell & Norvig, chap. 1 & 27

Today

1. Introduction to AI
2. Intelligence & the Turing Test
   a) What is intelligence?
   b) What is artificial intelligence?
   c) The Turing Test
3. What do we do in AI?   YOU ARE HERE!
4. History of AI

Pragmatic Definition of AI

- AI = the *"I don't know how to solve it"* bucket…

| Software Engineering | Networks | Hardware | Data Bases | … | AI |

- A more pragmatic definition of AI today :

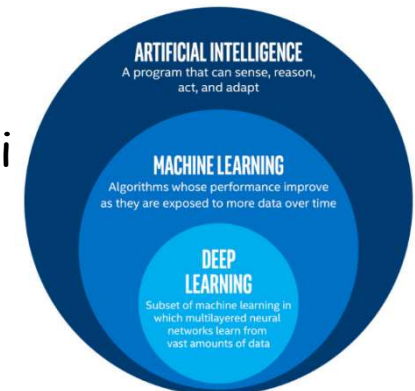   *"AI research is that which computing scientists do not know how to do cost-effectively today."*

Successes of AI...

- A few years ago, all these were considered AI problems... now, no one thinks of them as AI
  - Machine Translation
  - Image Recognition
  - Optical Character Recognition
  - Speech Recognition & Synthesis
  - Information Retrieval
  - Spell checker and Grammar checker
  - Word Prediction
  - ...

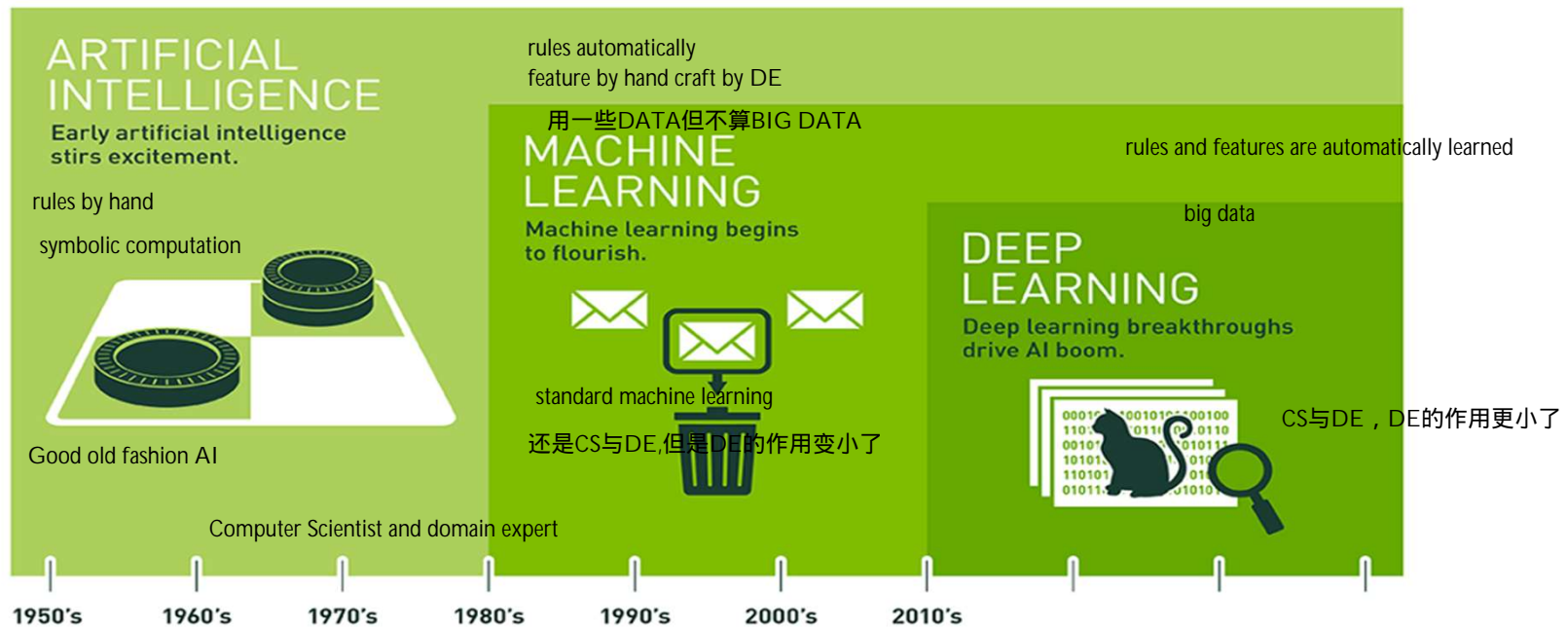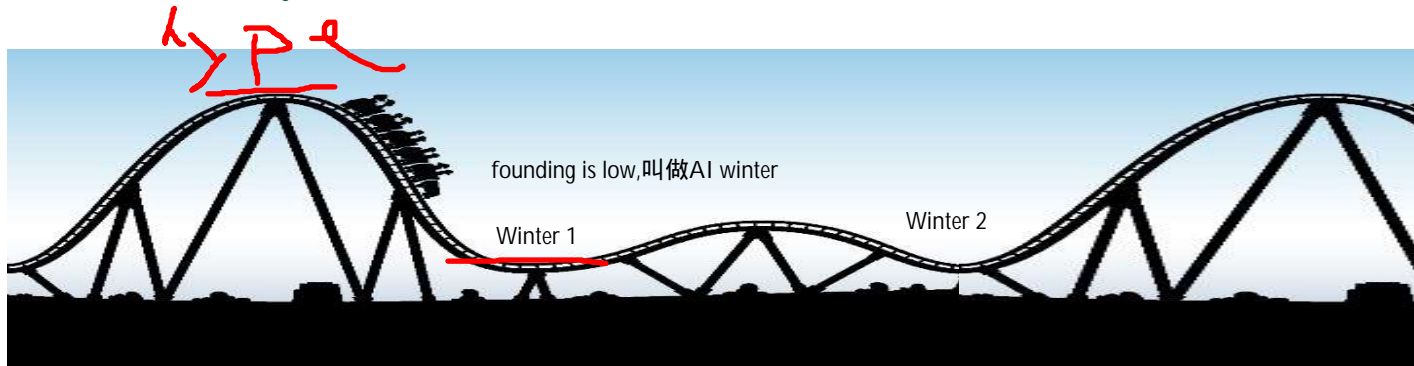# What do we do in AI?

Topics at Canadian AI conference 2020

1. Automated Reasoning
2. Bioinformatics and BioNLP
3. Case-based Reasoning
4. Cognitive Models
5. Constraint Satisfaction
6. Data Mining   cover
7. E-Commerce
8. Evolutionary Computation
9. Games
10. Information Retrieval and Search
11. Information and Knowledge Management
13. Knowledge Representation
14. Machine Learning
15. Multimedia Processing
16. Natural Language Processing
17. Neural Nets and Deep Learning
18. Planning
19. Privacy-preservi
20. Robotics
21. Uncertainty
22. User Modeling
23. Web Mining and Applications

ARTIFICIAL INTELLIGENCE
A program that can sense, reason, act, and adapt

MACHINE LEARNING
Algorithms whose performance improve as they are exposed to more data over time

DEEP LEARNING
Subset of machine learning in which multilayered neural networks learn from vast amounts of data

https://towardsdatascience.com/cousins-of-artificial-intelligence-dda4edc27b55

Today

1. Recent Breakthroughs
2. Important Questions
   a) What is artificial intelligence?
   b) What is intelligence?
   c) Is there a test for intelligence?
3. What do we do in AI?
4. History of AI **YOU ARE HERE!**

History of AI

Type

founding is low,   AI winter

Winter 1   Winter 2

ARTIFICIAL INTELLIGENCE
Early artificial intelligence stirs excitement.

rules by hand

symbolic computation

Good old fashion AI

Computer Scientist and domain expert

rules automatically
feature by hand craft by DE

DATA   BIG DATA

MACHINE LEARNING
Machine learning begins to flourish.

standard machine learning

CS   DE,   DE

DEEP LEARNING
Deep learning breakthroughs drive AI boom.

rules and features are automatically learned

big data

CS   DE   DE

1950's   1960's   1970's   1980's   1990's   2000's   2010's

7

History of AI

- **1940-1956**
  - 1943: early work in neural networks... but just a theory, no real implementation

    early individual work AI

  - 1950: Alan Turing describes the Turing test

  - 1956: The Darmouth workshop
    - get-together of the big guys: McCarthy, Minsky, Shannon & others
    - the term "Artificial Intelligence" is first adopted
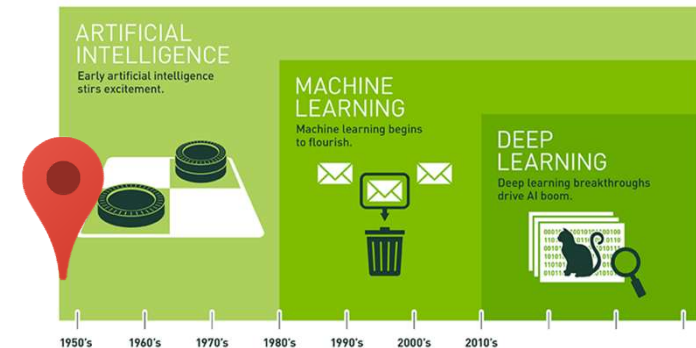
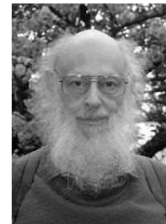**Dartmouth Conference: The Founding Fathers of AI**

John McCarthy   Marvin Minsky   Claude Shannon   Ray Solomonoff

Alan Newell   Herbert Simon   Arthur Samuel

And three others...
Oliver Selfridge (Pandemonium theory)
Nathaniel Rochester (IBM, designed 701)
Trenchard More (Natural Deduction)

https://www.linkedin.com/pulse/goedels-incompleteness-theorem-emergence-ai-eberhard-schoeneburg/

History of AI

- The rise of AI (~1956 - 70s)
  - The era of GOFAI: <mark>Good Old Fashioned AI</mark>
  - Symbolic computation rather then numeric computation
    - `cold`, `hot` rather than `25.5°C`
    - `onTop(red)` rather than `position[1,0,0] = 50cm`

  - Development of AI-specific programming languages:
    - 1958: John McCarthy develops LISP
    - 1972: Colmeraurer develops Prolog

    rule:based system
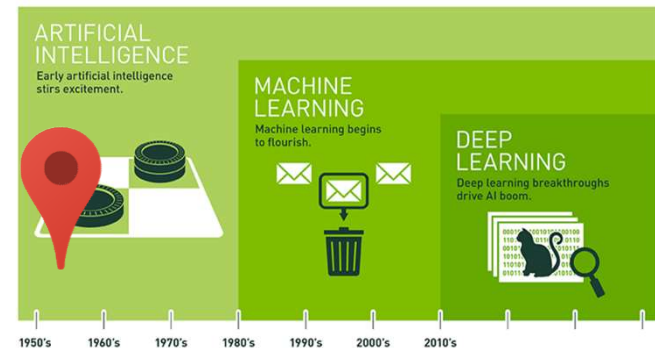
predicate logic on top   red

Unrealistic predictions

50

toy application,   application

- In 1950, Turing predicted that 50 years later (in 2000)
  - it will be possible to program a computer with ~100 Mb memory to pass the Turing Test 30% of the time, with 5 minute conversations.
  - It will be natural to speak of computers 'thinking'.
  - --> we still can't do that

- Machine Translation:
  - In the 1950s, after World War II, we could translate automatically a few sentences from Russian to English.
  - Prediction: "Within three to five years, machine translation will be a solved problem."
 - --> we still can't do that

- All this, lead to the First AI Winter…

History of AI

- **First major *AI Winter...***
- late 60s - early 70s

  - 1966: the ALPAC report kills work in machine translation

    US:alpac

  - 1969: Minsky & Papert's book on the limits of perceptrons kills work in neural networks

    MinsKy   symblic computation

  - 1973: following the Lighthill report, the British government stops funding research in AI due to no significant results

US

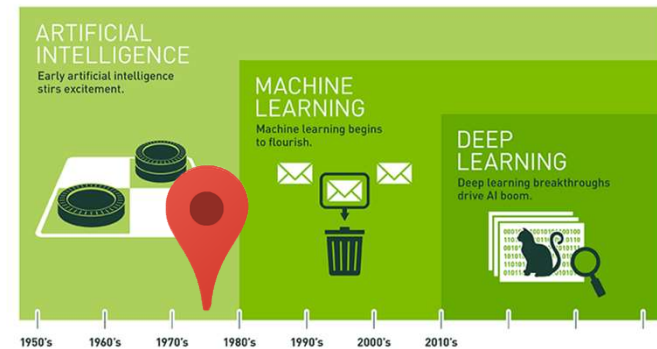uk
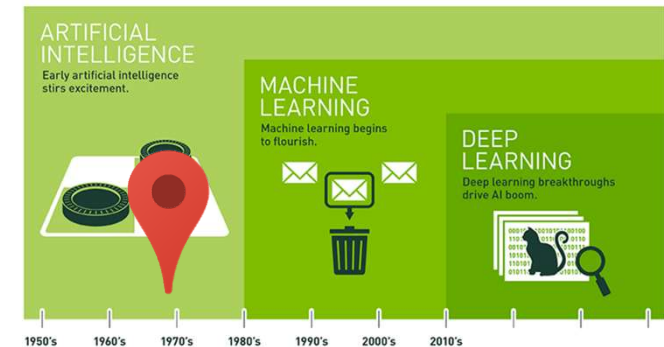
Briefing of Gerald Ford on an MT system

https://en.wikipedia.org/wiki/AI_winter#Early_episodes

History of AI

- 1970s - 1980s
- A big "hype" ... Expert Systems
  - knowledge-intensive, rule-based techniques _if then_
  - Commercial expert systems
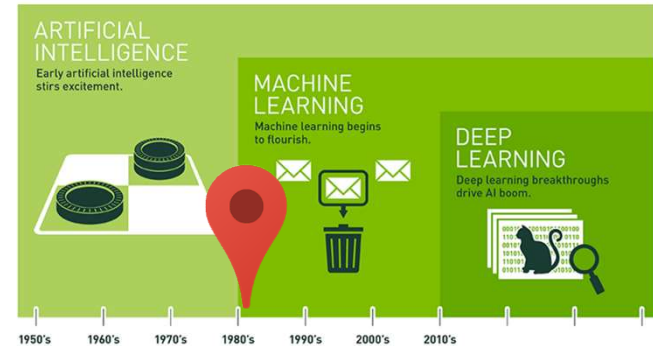 - Decision-support systems

  🙁 HUMANS need to write the rules by hand...

1972: MYCIN diagnoses blood infections as well as doctors.

History of AI

- mid 80s – mid 90s
- Another AI Winter
  - The end of Expert Systems
    - Too tedious to write rules by hand
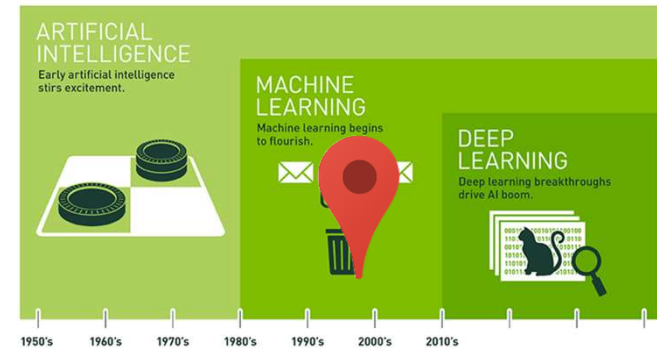   - Too expensive to maintain

History of AI

- 1980s-2010
- The rise of Machine Learning
  - More powerful CPUs-> usable implementation of neural networks
  - Big data -> Huge data sets are available
    - document repositories for NLP (e.g. emails)
    - billions on images for image retrieval
    - billions of genomic sequences
    - ...

😀 Rules are now learned automatically !

but the features are hand craft

2011: Watson wins at Jeapardy!

History of AI

- 2010-today
- Deep Learning

  data hungry
  rules and features are found automatically

  - Development of "deep neural networks"
  - Trained on massive data sets
  - Use of GPU for computations
  - Use of "generic networks" for many applications
    - Image recognition
    - Self driving cars
    - Machine translation
    - Speech recognition & synthesis
    - Chatbots
    - Game playing
    - ...
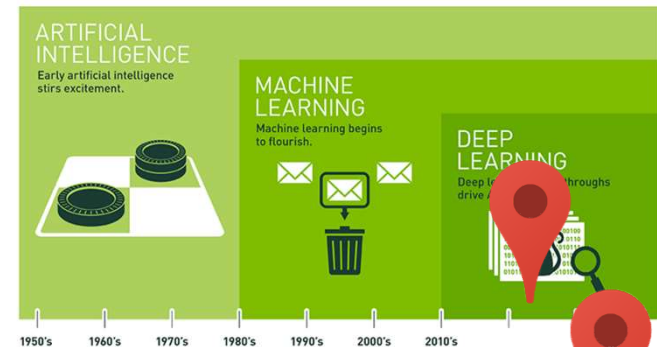
http://www.kdnuggets.com/wp-content/uploads/photo.jpg

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Up Next

- Introduction to Machine Learning