
BABEŞ-BOLYAI UNIVERSITY
Faculty of Computer Science and Mathematics


# ARTIFICIAL INTELLIGENCE

## Introduction

# Summary

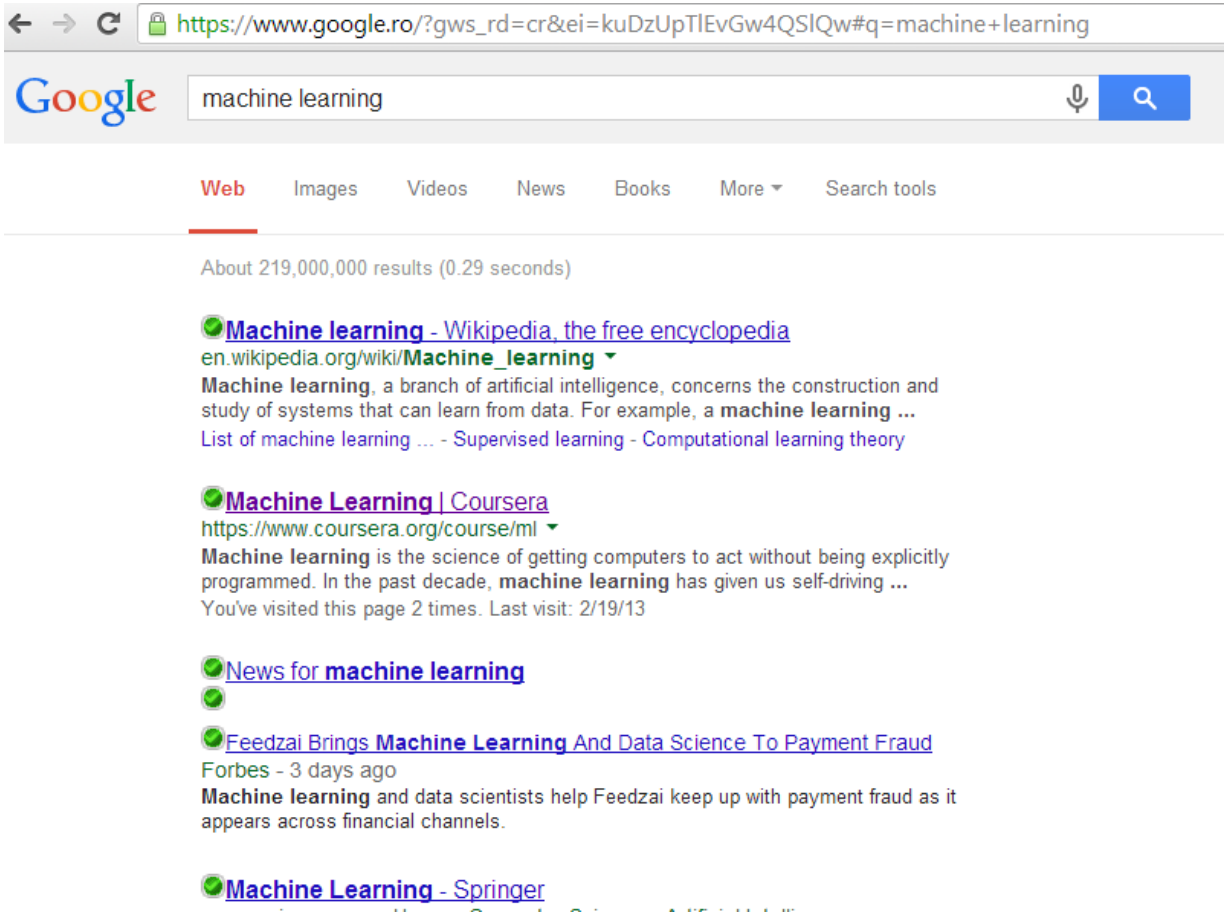
- Short questions about AI
- History of AI
- Applications of AI

# Short questions about AI

- What AI represents?
  - Difficult question (AI is very young)
  - ***AI is a branch of Science which deals with helping machines find solutions to complex problems in a more human-like fashion.***
  - On short: machines that make intelligent things
  - Strong AI
  - Weak AI

# Short questions about AI

- Why we need AI?
  - Web ranking



# Short questions about AI

- Why we need AI?
  - Web ranking
  - Recognition / analyse of
    - Voice
      http://www.indiegogo.com/projects/feed-your-pet-from-your-phone-with-pintofeed
    - Images
    - Handwritten

# Short questions about AI

- Why we need AI?
  - Recognition / analyse of
    - Voice
    - Images
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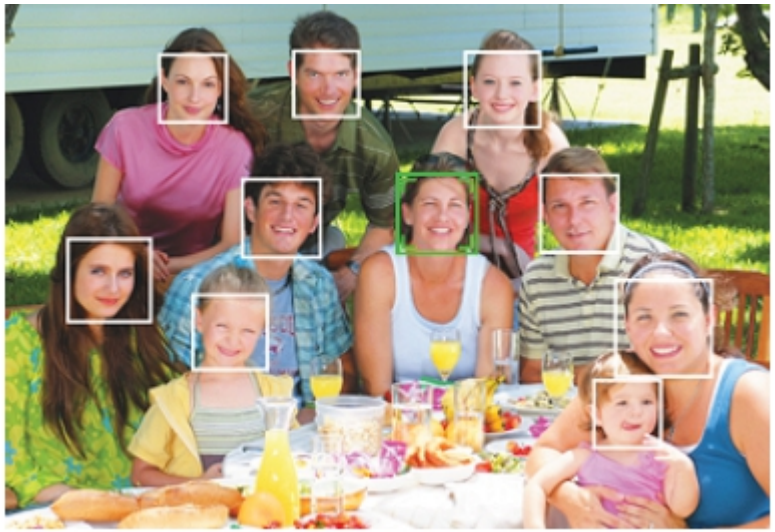


# Short questions about AI

- Why we need AI?
  - Recognition / analyse of
    - Voice – http://www.indiegogo.com/projects/feed-your-pet-from-your-phone-with-pintofeed
    - Images
    - Handwritten




# Short questions about AI

- Why we need AI?
  - Automatic translation

# Short questions about AI

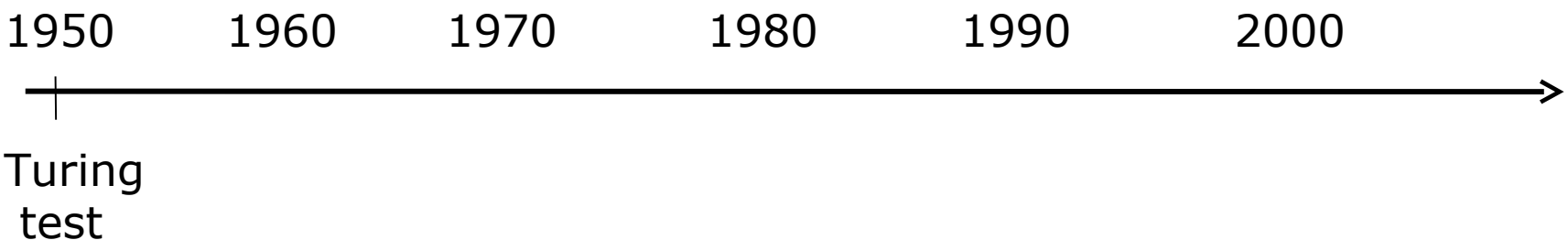
- Why we need AI?
  - Medical diagnosis
  - Task planning
  - Robot manipulation
  - Spam filtering
  - Air-craft avoidance

# History of AI

- Major steps:
  - Born of AI (1943-1956)
  - Golden age (1956-1974)
  - First winter(1974-1980)
  - Boom (1980-1987)
  - Second winter (1987-1993)
  - Meta-modern AI (after 1993)

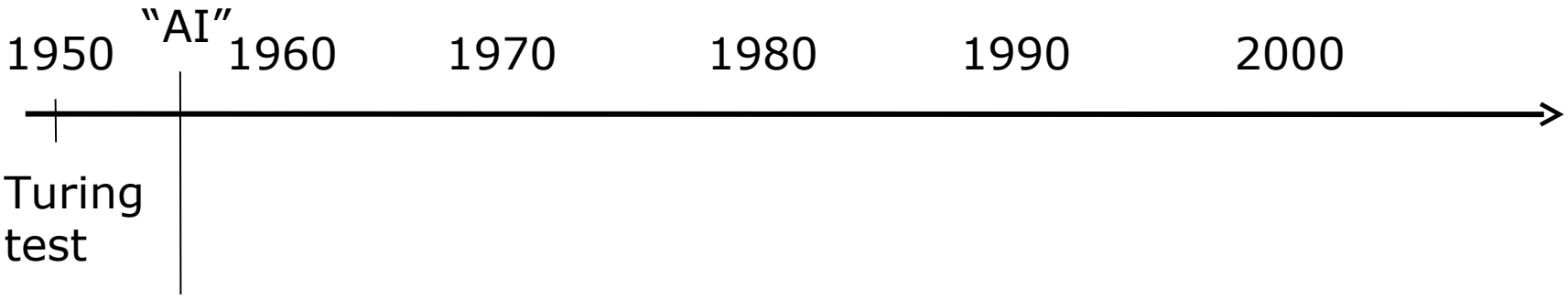
# History of AI – born of AI (1943-1956)

- AI's origin?
  - Mathematic, logique, computer science, philosophy, cognitive science, biology
- First concepts of AI
  - 1943 → Walter Pitts & Warren McCulloch proposed artificial neuron
  - 1950 → Alan Turing → Turing test
    - Can machines think?
    - Demo → ALICE http://www.alicebot.org
  - 1951 → first game programs (chess and checkers)
  - 1955 → Allen Newell & Herbert Simon → first program for automatically theorem proving



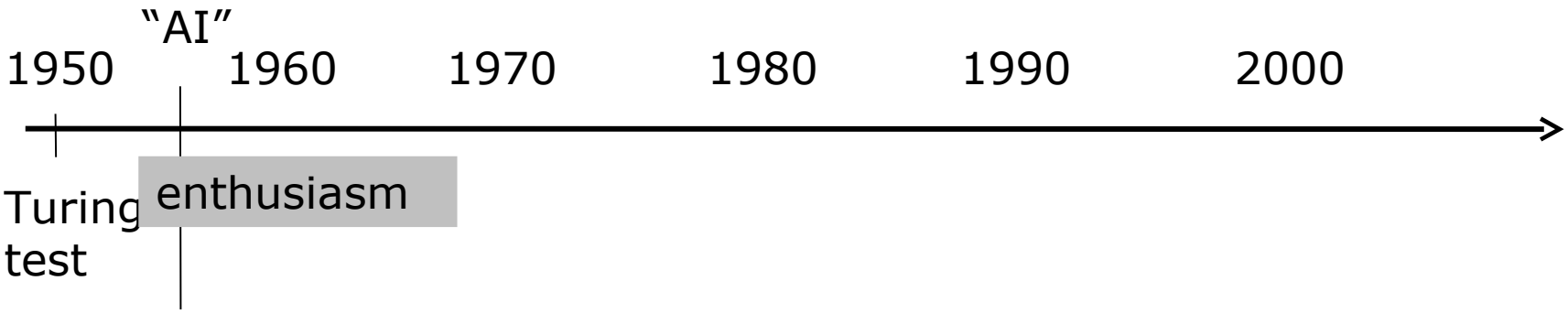
# History of AI – born of AI (1943-1956)

- AI concept
  - 1956 → John McCarthy, summer school, Dartmouth, SUA, has proposed the term AI
  - 1956 → John McCarthy - first demonstration of running an AI program at CMU (Carnegie Mellon University)



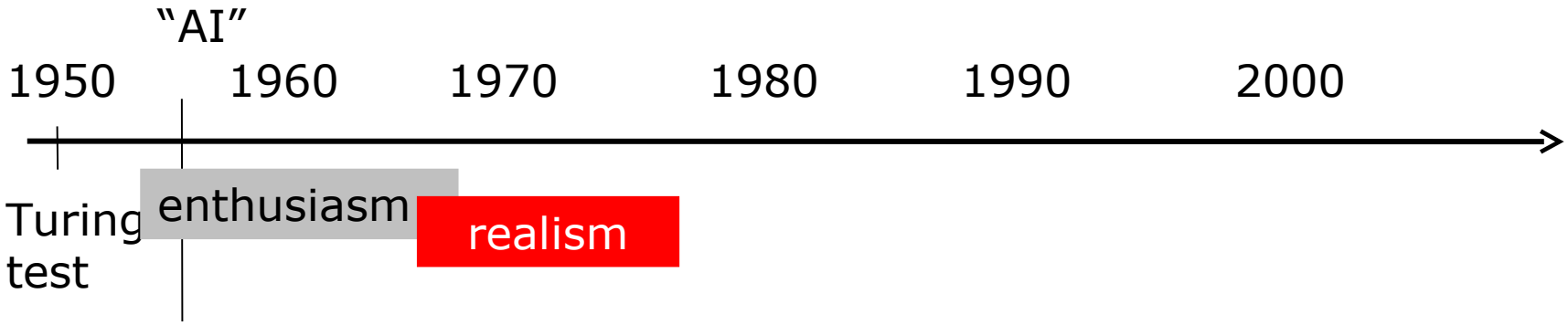
# History of AI – golden age (1956-1974)

- Computers are able of executing a task X
  - X = puzzle solving, automatic theorem proving, checkers playing
    - Toy problems
  - 1958 → John McCarthy has proposed LISP language at MIT (Massachusetts Institute of Technology)
  - 1965 → ELIZA
  - 1969 → robot Shakey has combined locomotion, perception and problem solving (Stanford Research Institute)
  - 1970 → "born" of evolutionary algorithms



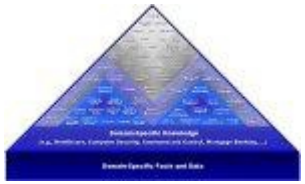
# History of AI – golden age (1956-1974)

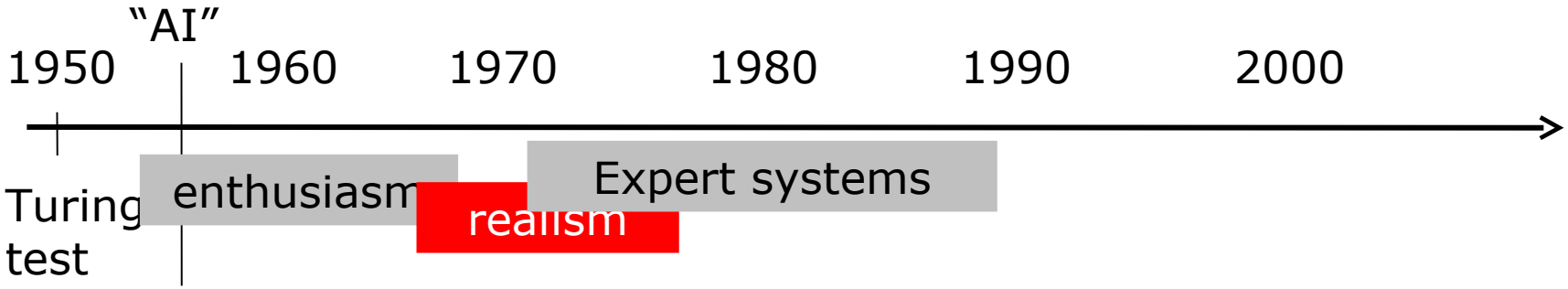
- 1966 – 1973 → a dose of realism
  - Problem specific knowledge is required
    - Syntactic approach is not sufficient → automatic translation Russian - English (US has suspended the funding)
  - Difficult control → exponential complexity
    - Britannic government has suspended AI funds → Lighhill report → pessimism about AI research
  - Theoretical limits → perceptron can not solve XOR problem
    - Neural network research is stopped



# History of AI – golden age (1956-1974)

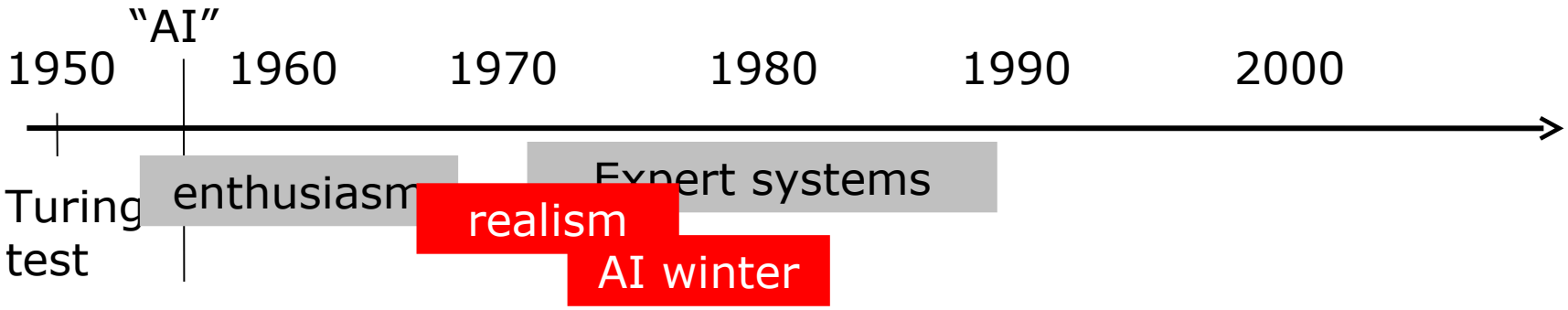
- 1969 – 1988 → knowledge-based systems
  - Guided search based on specific knowledge of the problem domain
    - Cyc → a knowledge database → http://cyc.com
    - Numerous companies have developed expert systems





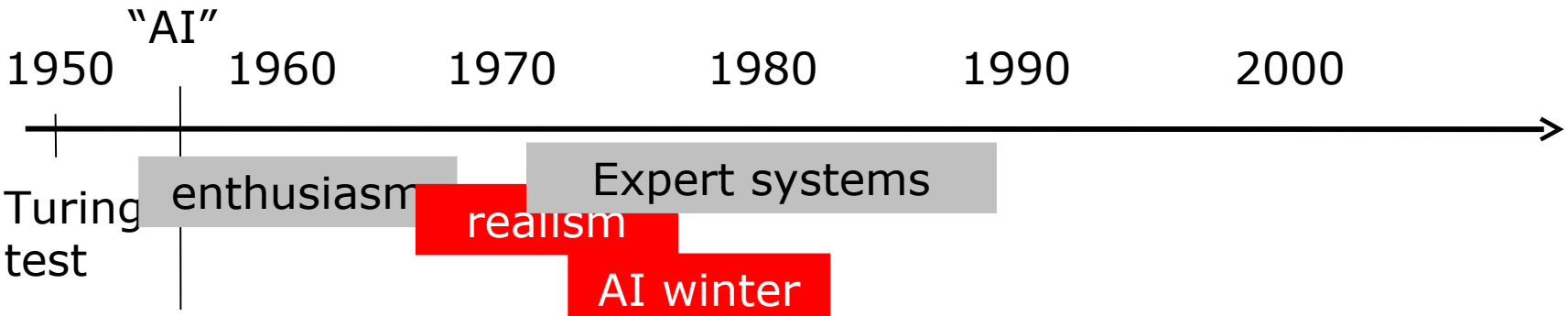
# History of AI – first winter (1974 – 1980)

- Problems
  - Limited power of computers
  - AI techniques require exponential time for problem solving
  - Knowledge database requirement
  - Funding is stopped



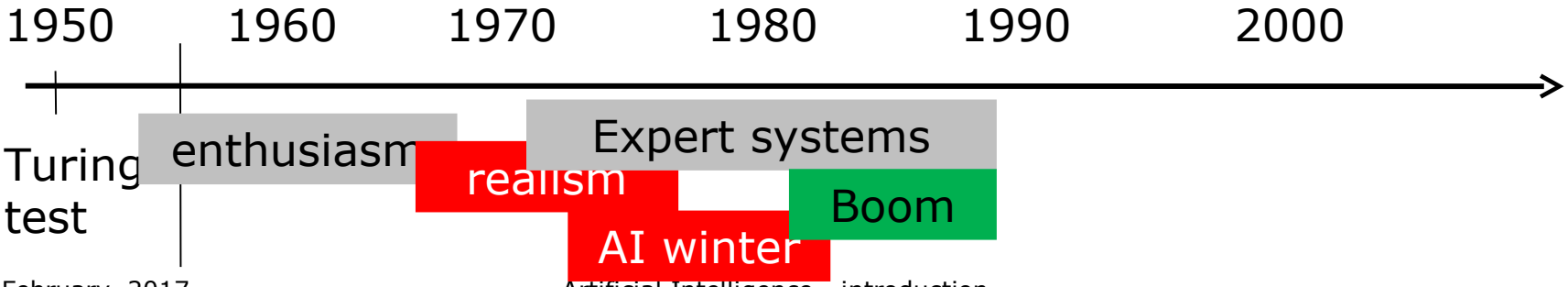
# History of AI – first winter (1974 – 1980)

- Expert systems
  - Massive investments
  - Extravagant promises
- Financial Crah
  - AI funding is limited
- 1979 – first autonomic vehicle controlled by computer (the Stanford Cart)



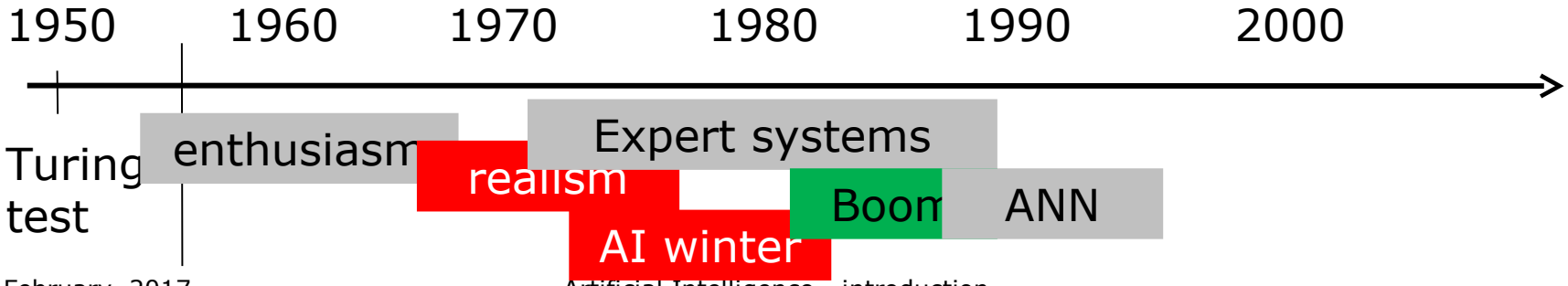
# History of AI – Boom (1980 – 1987)

- Expert systems have exploded
  - MYCIN – Standford University
    - Diagnosis of blood infections
  - XCON (e**X**pert **CON**figurer) - Carnegie Mellon University
    - Select the components of a computer based on user options



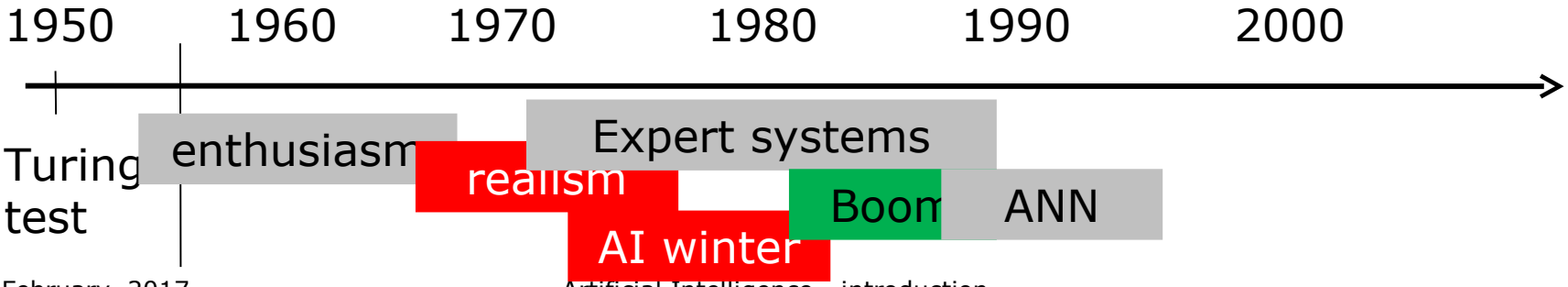
# History of AI – Boom (1980 – 1987)

- 1986 – artificial neural network
  - Multilayer perceptron
  - Backpropagation learning algorithm
  - New development
    - Symbolic models (Newell, Simon)
    - Logistic models (McMarthy)
  - Born of statistical automatic learning



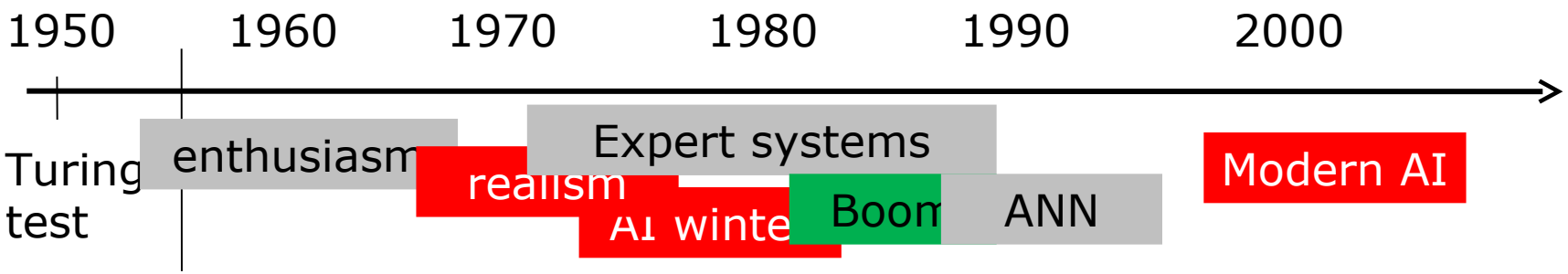
# History of AI – second winter (1987-1993)

- Computation power is limited
- Companies' suspicions
  - Money were allocated for other research domains



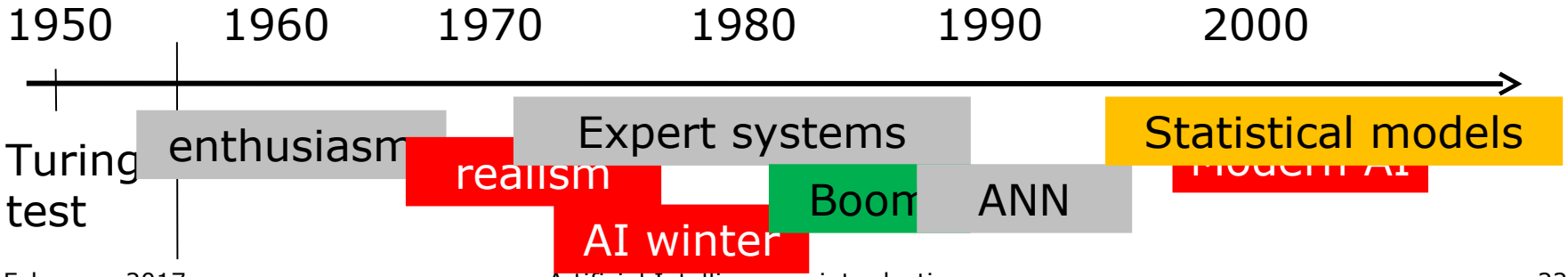
# History of AI – modern AI (1993 – present)

- 1997 – Deep Blue
- 1998 – genetic programming
- 2000 – robots as pets



# History of AI – modern AI (1993 – present)

- Statistical models
  - Machine learning
    - Hidden Markov models (HMM)
    - Support vector machines (SVM)
    - Gaussien processes
    - Graphical models (Bayesien networks, conditional random fields)
    - Nature-inspired models (evolutionary computation, PSO, ACO, quantum computing)
  - Data mining



# AI perception

- Artificial Intelligence AI (2001) – Steven Spielberg

# Applications of AI

- 2005: DARPA grand challenge
  - http://www.youtube.com/watch?v=jSnw6UHBREA
  - Defense Advanced Research Projects Agency → http://www.darpa.mil
- 2011: Google self-driving cars
  - View 1 (http://www.smartplanet.com/blog/thinking-tech/googles-self-driving-car/5445)
  - View 2 (http://www.youtube.com/watch?v=eXeUu_Y6WOw)

# Applications of AI

- Turing test
  - ALICE
    - http://www.pandorabots.com/pandora/talk?botid=f5d922d97e345aa1
  - Laura: My name is Laura
    ALICE: Glad to know you, Laura.
    Laura: Which film do you like?
    ALICE: My favorite movie is Imagine. Have you seen it?
    Laura: No.
    ALICE: I would recommend you check it out.
    Laura: What is it about?
    ALICE: Science fiction.
    Laura: Do you remember my name?
    ALICE: You said your name is Laura?
    Laura: Yes, I said.
    ALICE: Give me a break.
    Laura: Do you know Turing?
    ALICE: A brilliant and tragic figure in the history of computer science.
    Laura: Who else do you know?
    ALICE: No I don't know. I am chatting with several other people at once.
    Laura: But Loebner?
    ALICE: The Loebner Prize is an annual Turing Test sponsored by New York philanthropist Hugh Loebner. Dr. Wallace and ALICE won it in 2000. The ALICE program was ranked "most human computer" by the panel of judges.

# Applications of AI
# natural language processing - *chatbot*

- Valerie: CMU Robot Receptionist in Newell-Simon hall.
- ALICE: 2004 Loebner Prize winner
- ELIZA: psychotherapist
- Jeopady (2011)
  - IBM's Watson – view

# Applications of AI
# natural language processing

- Tone (spoken or by contact) for card number
  - A small vocabulary, an increased accuracy requirement
- Message sending
  - A large vocabulary, an increased accuracy requirement
- Dictation
  - Very large vocabulary, an increased accuracy requirement
  - Eg.
    - IBM Via Voice
    - Dragon Naturally Speaking
- From a theoretical point of view
  - Hidden Markov models,
  - A* search

# Applications of AI
# natural language processing – automatic translation

- From
  - Georgetown-IBM experiment
- To
  - Yahoo! Babel Fish → Systran – view (http://www.systranet.com/translate)
  - Free translation → SDL Language Weaver
  - Google translate → Google

- From a theoretical point of view
  - Rule-based systems
  - Statistical translation models (IBM)
  - Example-based systems

# Applications of AI
# Games - chess

- IBM Deep Blue vs. Kasparov, may 1995
- 6 games: K, DB, draw, draw, draw, DB
- IBM → 18 billions of dollars

- From a theoretical point of view
  - Game with
    - 2 players
    - Zero sum
    - Discrete states
    - Perfect information
    - Finite end

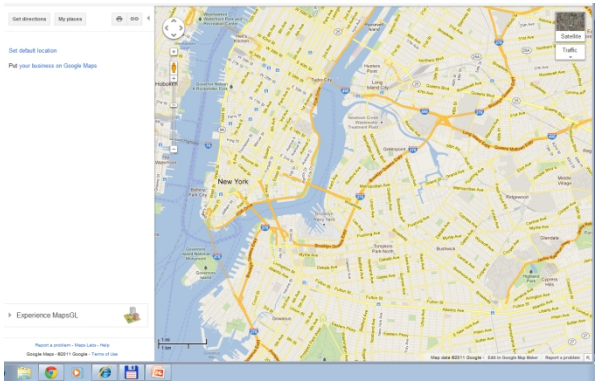
# Applications of AI
# www – web searching

- Automatic selection/order of news
  - Vs.
- Manual organisation of news → CNN

- From a theoretical point of view
  - Unsupervised learning (clustering)

# Applications of AI
# www – map orientation/navigation

- From UBB → streets of New York




- From a theoretical point of view
  - Search strategies

# Applications of AI
# www – information retrieval

- Information retrieval about a job
  - Flipdog → http://www.flipdog.com/
- From a theoretical point of view
  - Supervised learning (classification)

# Applications of AI
# www – collaborative filtering

- User experience
  - Amazon → view (http://www.amazon.com/Intelligent-Systems-Approach-Reference-Library/dp/3642210031)
- From a theoretical point of view
  - Unsupervised learning (clustering)

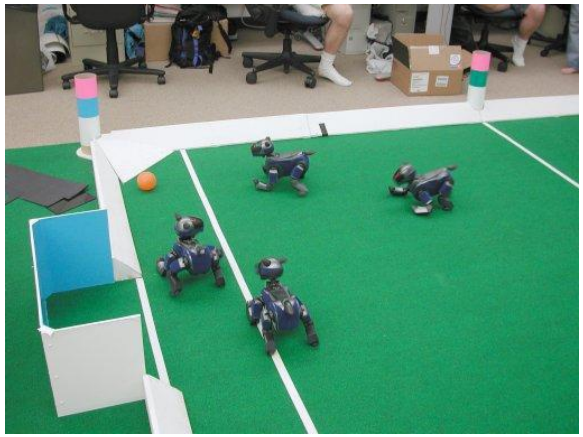
# Applications of AI
# robots – intelligent shoes

- Adapting cushion to speed, road surface, etc.

- From a theoretical point of view
  - Regression modeling

# Applications of AI
# robots – football

- Robocup → http://www.robocup.org/



  - View the movie
  - http://www.youtube.com/watch?v=-Y4H3Sox_4I

- From a theoretical point of view
  - Reinforcement learning

# Applications of AI
# robots – humanoid robots

- Humanoid robots
  - Asimo (Honda) → view
  - QRIO (Sony)


# Applications of AI
# robots – Hubble telescope

- planning: who and when go to see something?
  - 30000 observations/year
  - Many constraints

- From a theoretical point of view
  - Constraint satisfaction problem

# Applications of AI
# robots – vehicles on Mars

- Automatic driving on Mars

- From a theoretical point of view
  - Planning of robot's moves

# Applications of AI
# art

- AARON
  - view

- From a theoretical point of view
  - Automatic learning

# Applications of AI mobile devices

- Text-to-Picture
  - Applications that generates phrases based on observed gestures
    - Help people
- From a theoretical point of view
  - Supervised and unsupervised learning

# AI today

- Summary
  - Do not know how to make 98% of intelligent things
  - But 2% of them can be done very well
  - AI is not magic. All is about:
    - Optimisation
    - Probabilities and statistics
    - Logic
    - Algorithms