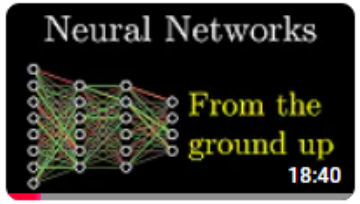
Využití nástrojů AI v psychologii

Vojtěch Formánek, FF a FI MUNI, 20.2.2025

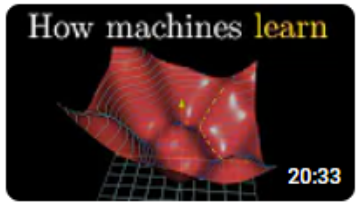
First, recommendations

- AI dětem
- FF:AI001/2/3
- Kreativita a umělá inteligence – KISK blog
- 3Blue1Brown



But what is a neural network? | Deep lea

3Blue1Brown • 18M views • 7 years ago



Gradient descent, how neural networks

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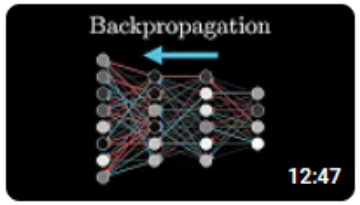

Backpropagation, step-by-step | DL3

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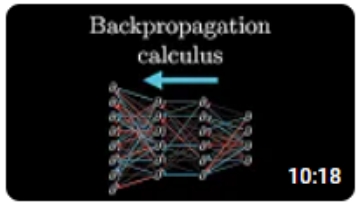

Backpropagation calculus | DL4

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AI dětem

Lídr vzdělávání v oblasti umělé inteligence

Motivation

Closeness of AI and Psychology

Basic principles

How models see problems

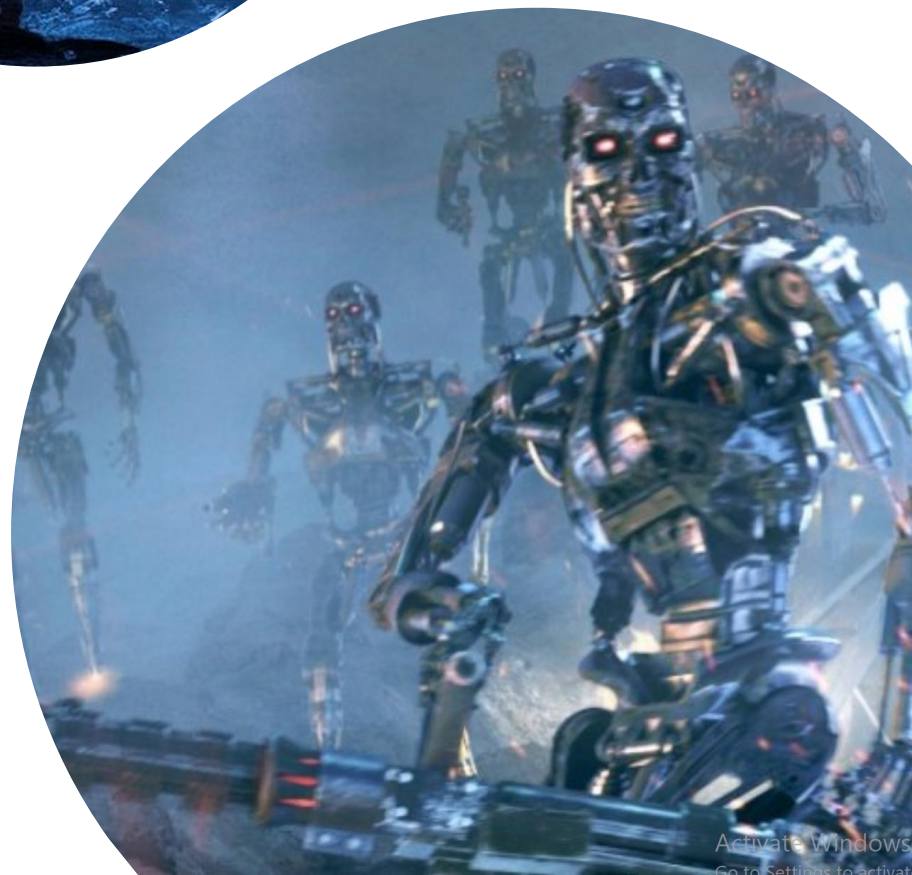
Key algorithms

Explain the I in AI

Parallels with today

Today

- AI, the short version
- Foundations
- Early history (50s)
- AI Boom (80s)
- AI winter + Turing test (2000s)



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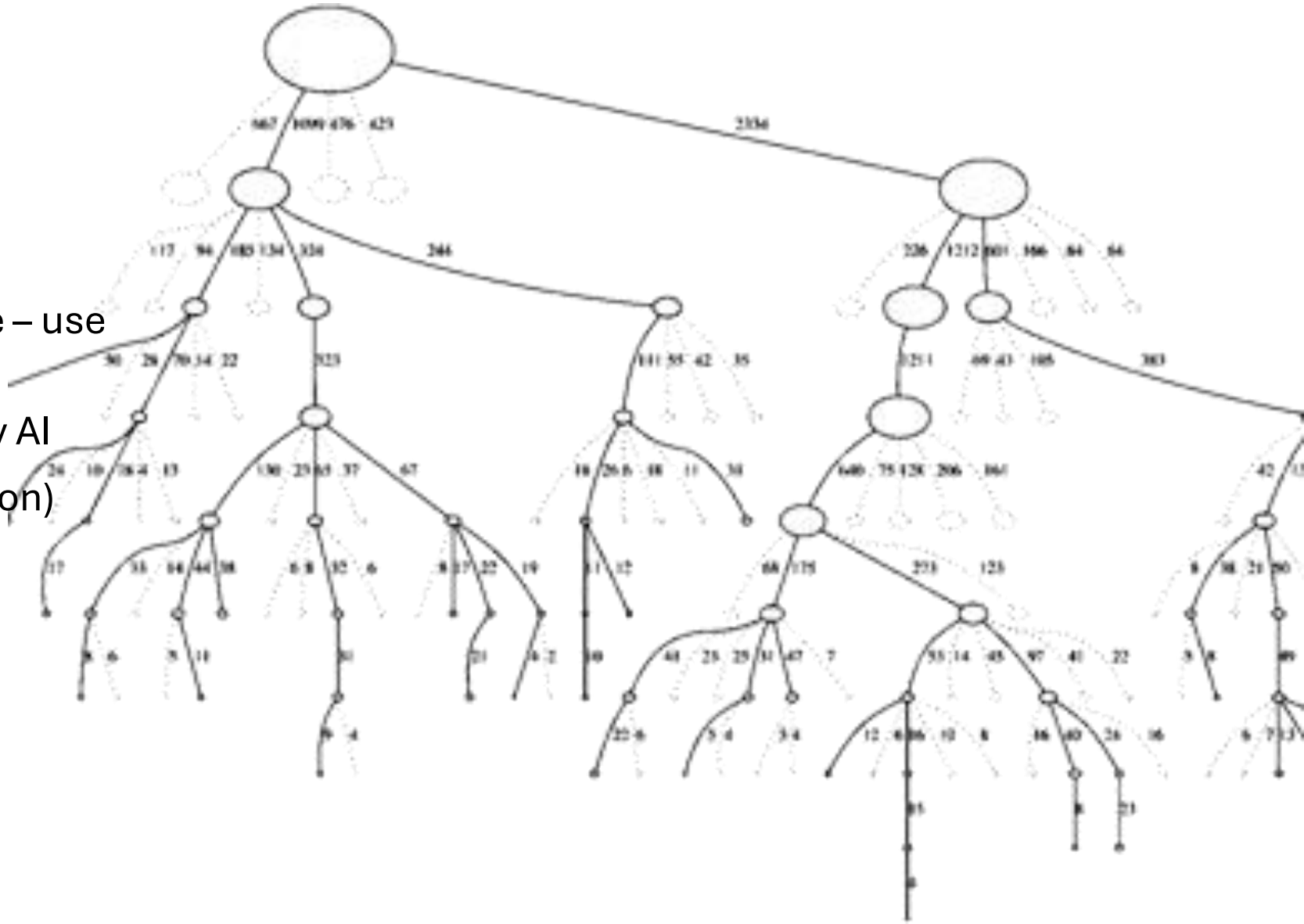
All About the I

- Marketing genius
- … but a nightmare for explaining ;)
- Imprecision inherited from psychology
- Anthropomorphizing is typical (and wrong)

Psychological Primer

- Solutions in reasonable time – use heuristics
- TFaS got (heavily) inspired by AI
- Bounded Rationality (H. Simon)



What is AI, the Short Version

- Wide (and deep) family of algorithmic approaches
- Gives up perfect solutions for quickly* reachable ones
- Works well in practice
- Underpins many systems

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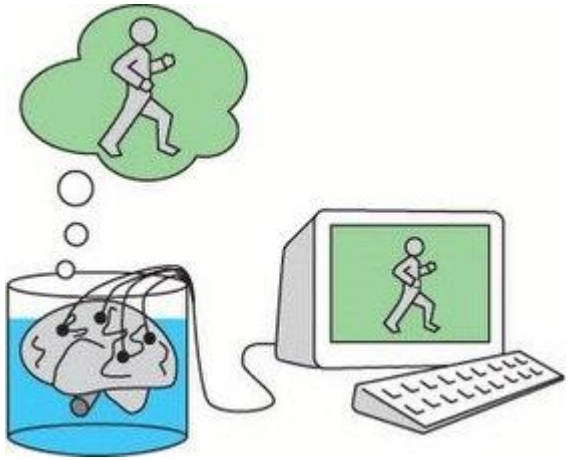
Philosophy

- Mind and Brain (Descartes)
- Consciousness
- Language, meaning
- Ethics
- Reasoning formalization – logic (Aristotle)



Mathematics

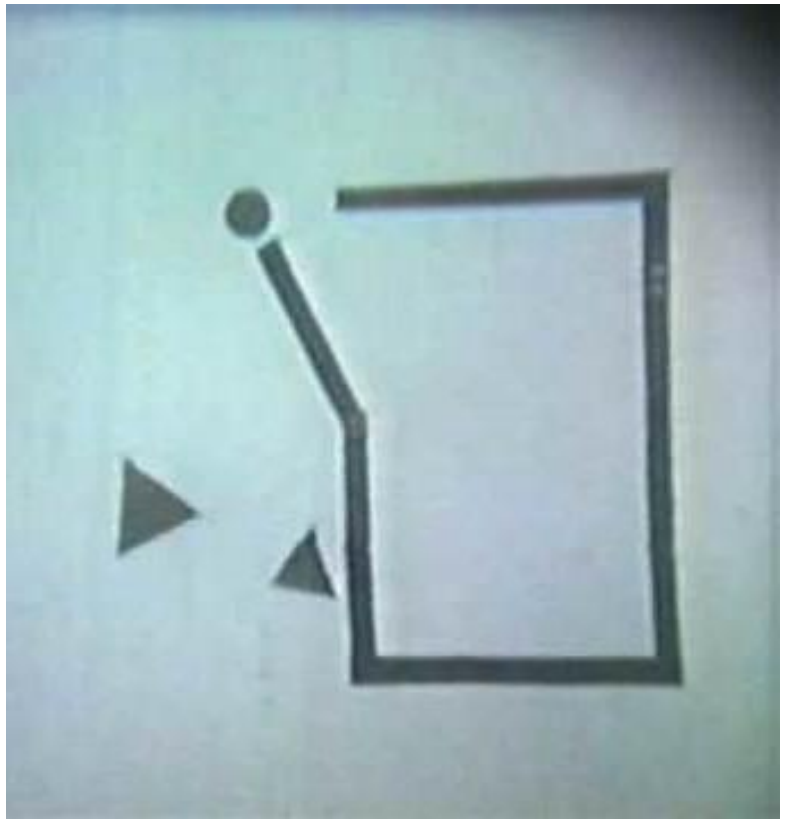
- Probability, statistics
- Incompleteness (Gödel)
- Complexity – computation time
- Theoretical representations
- Computational frameworks

Economics

- Decisions under uncertainty
- Probability + Utility theory
- Games, multi-agent systems
- Satisficing – good-enough decisions work better (Simon)

Psychology

- Rewards + SR
- Systems
- Stimuli translation into symbols
- Heuristics, biases
- Constructs – intelligence, empathy …



Neuroscience

- Processing external stimuli
- Cognition can be localized (Broca)
- Cognition has subsystems
- Neural networks

And others…

- Linguistics – Syntactic structures (Chomsky)
- Computer engineering – Moore’s law
- Cybernetics – Control theory

…

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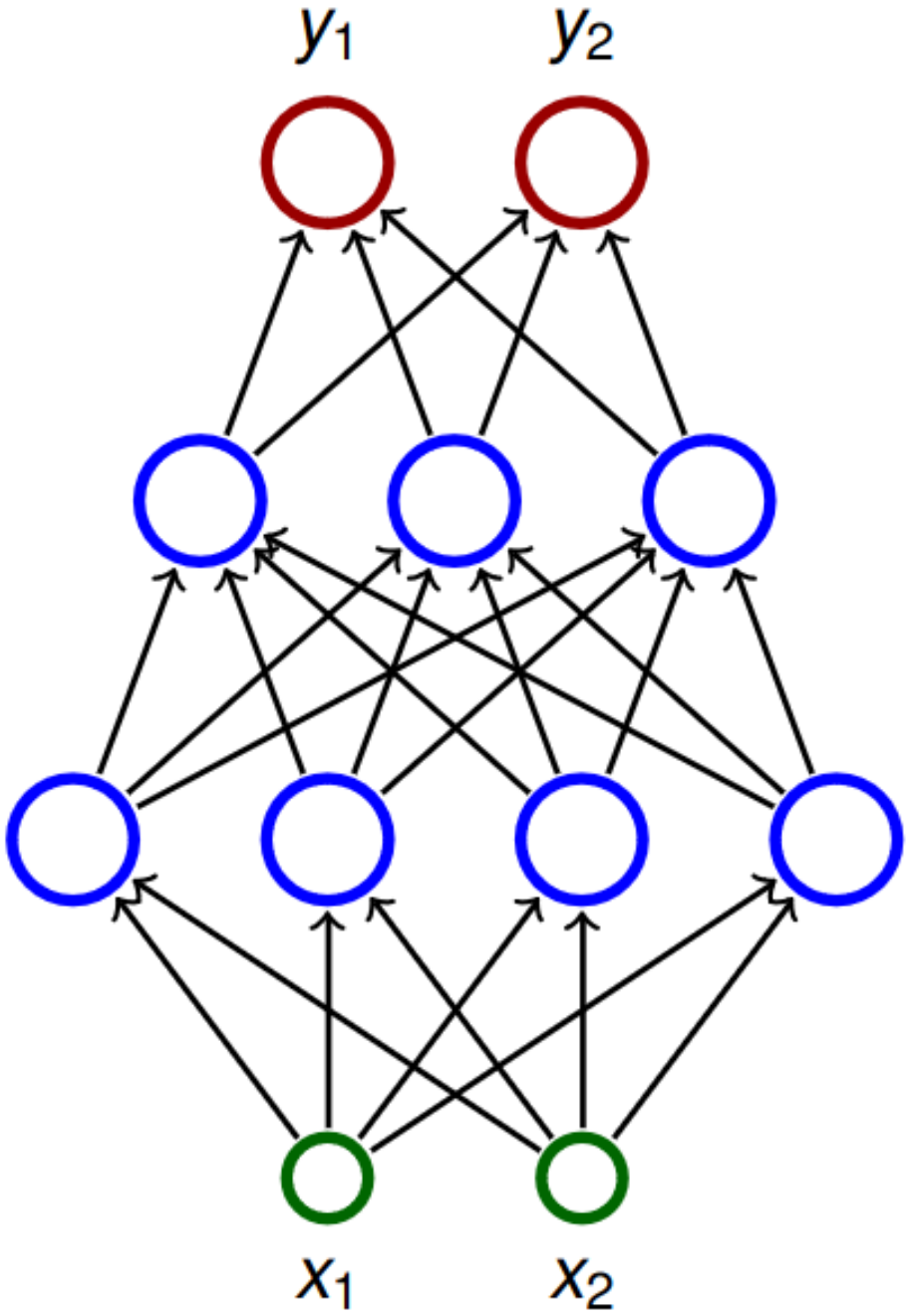
The First and Latest? AI

- Neural Networks (McCulloch & Pitts, 19
- Neurons as switches
- “On” = n neighboring neurons activate
- Learns using Hebbian Learning



Start of the Field

- Dartmouth workshop

Goal: … *every aspect of learning or any other feature of intelligence can in principle be so precisely described that a machine can be made to simulate it*.

- Logic theorist, otherwise, no results
- *2 months later start of cognitive science

Logical Theorist

- Solves logical expressions
- Uses methods (heuristics) to alter equations
- Iteratively reduces expression
- Solves by exploring a search tree

$$Q(A, N) \wedge Q(B, N)$$

$$(P \wedge (\neg Q)) \Rightarrow ((\neg R) \vee ((\neg P) \wedge Q))$$

Expert systems

Cíl: zjistit jestli je místnosti hluk

Vstup: T a B je na přednášce o AI

Rule 1

T a B nesedí vedle sebe, pak je v místnosti klid

Rule 2

T a B sedí spolu, pak T zlobí B

Rule 3

T a B jsou na C, pak T a B sedí vedle sebe.

Rule 4

T zlobí B, pak B zlobí T

Rule 5

T zlobí B a B zlobí T, pak je v místnosti hluk

Use cases

- Earliest experimental
- Medical
- Cognitive Psychology
- Great early promise

RULE037

IF: 1) *The identity of the organism is not known with* certainty, and
2) The stain of the organism is gramneg, and
3) The morphology of the organism is rod, and
4) The aerobicity of the organism is aerobic

THEN: There is strongly suggestive evidence (.8) that the class of the organism is enterobacteriaceae

RULE145

IF: 1) The therapy under consideration is one of: cephalothin clindamycin erythromycin lincomycin vancomycin, and
2) Meningitis is an infectious disease diagnosis *for the patient*

THEN: It is definite (1) the therapy under consideration is not a potential therapy for use against the organism

RULE060

IF: The identity of the organism is bacteroides

THEN: I recommend therapy chosen from among the following drugs:

1 - clindamycin	(.99)
2 - chloramphenicol	(.99)
3 - erythromycin	(.57)
4 - tetracycline	(.28)
5 - carbenicillin	(.27)

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AI Boom I. (80s)

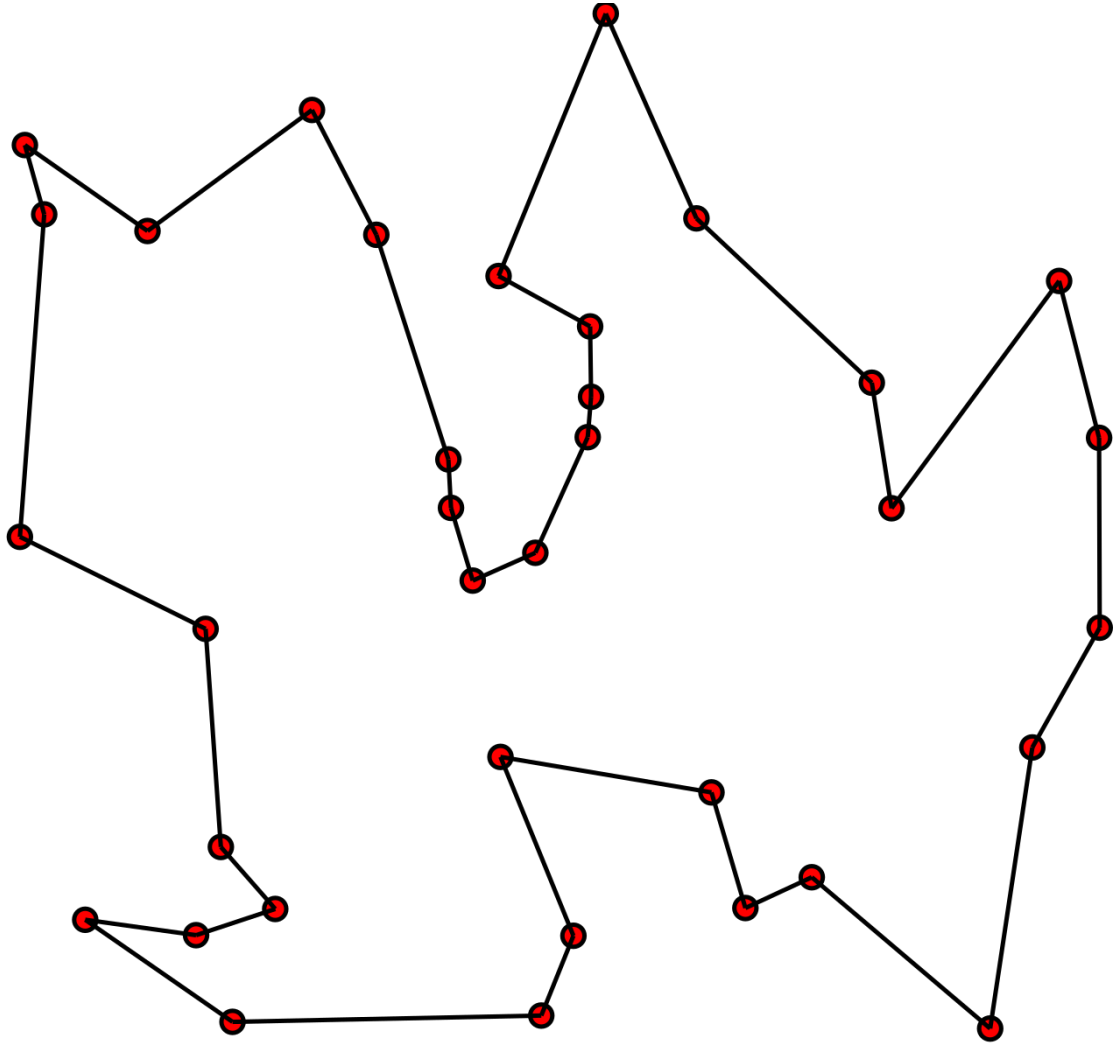
- Planning
- Huge investment into AI
- Medicine, banking, responsive databases
- Companies building 100s of systems

Planning, scheduling

- Often overlooked outside of AI
- Factory assembly, schedules, navigations
- A mix of algos (usually combined)
- Find a solution (an order) for a given problem (quickest path) for a specific instance (a “sightseeing” tour of Brno)

Traveling Salesman Problem (TSP)

- Planning problem
- Shortest route starting and ending in the same place
- Brno-venkov – 187 villages → 187! ~10^{345} solutions
- Observable universe ~ 10^{82} atoms



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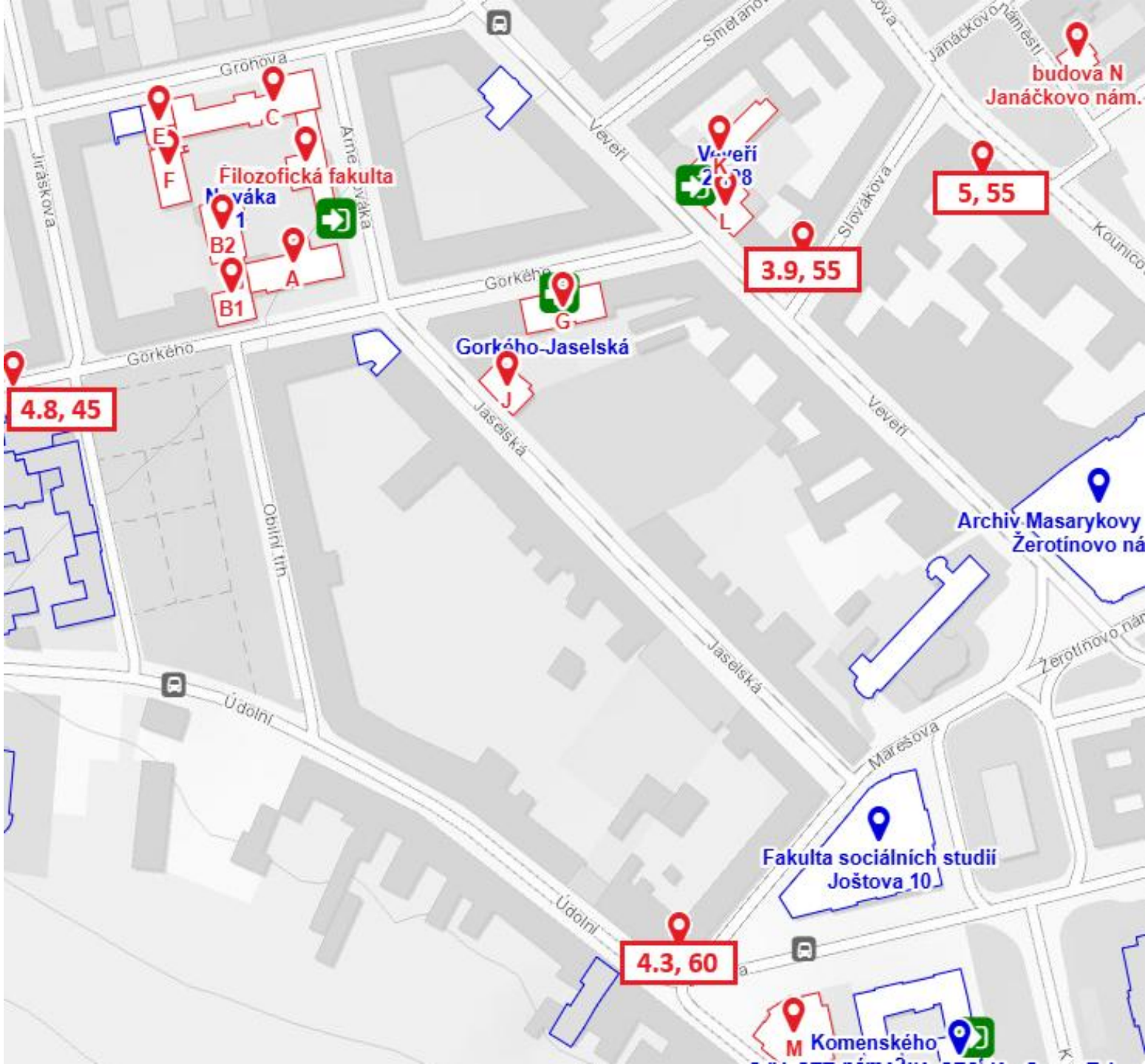
Trable Studenta Psychologie (T$Ψ)

- Visit all FF buildings and a few pubs
- Find shortest path

- Task: create a heuristic that finds a path between two places
- Odkaz



The Long (AI) Winter (until cca 2014)

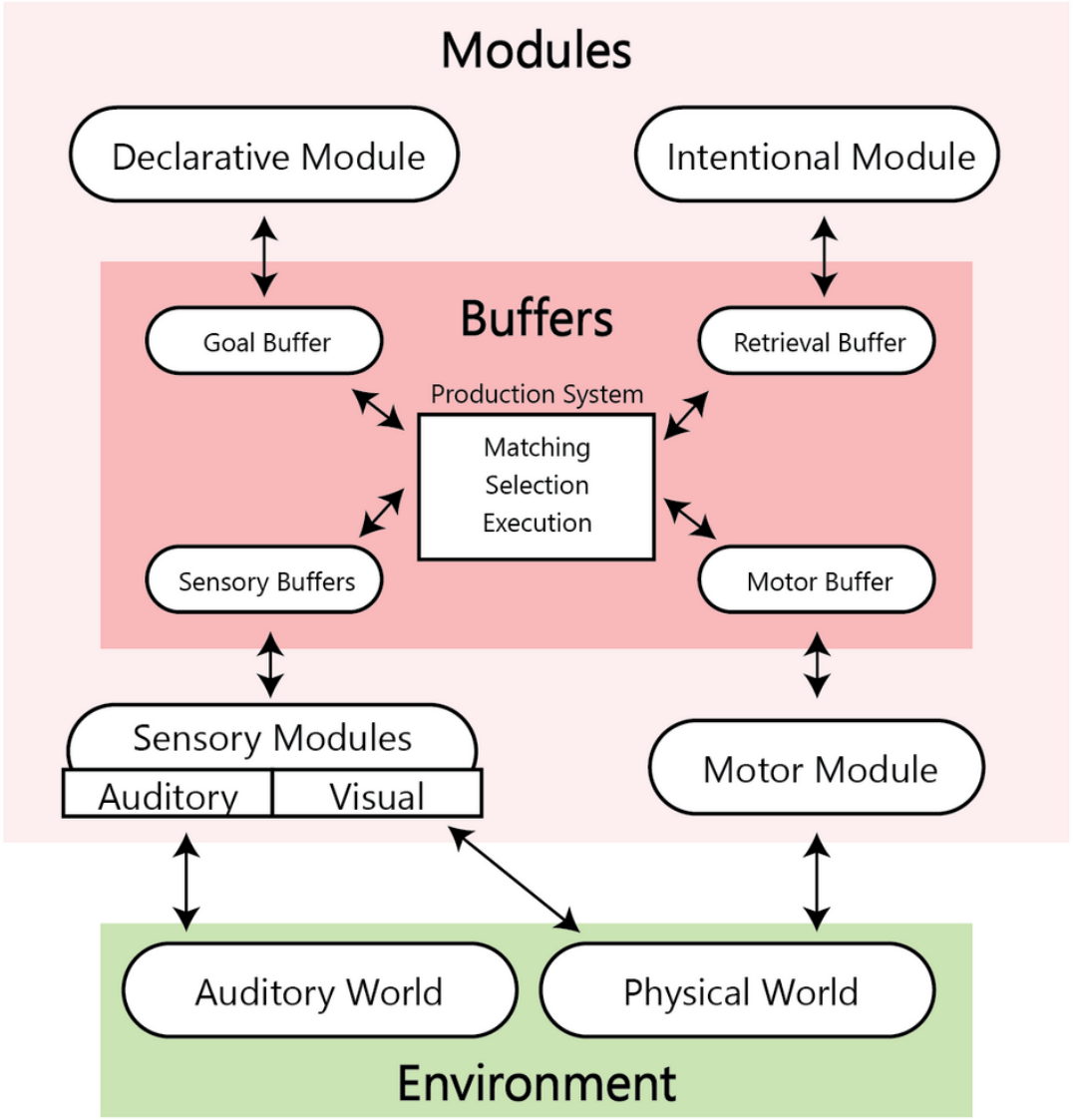
- Issues with Expert Systems
- Ultimately failed to deliver
- Funding froze
- AI was inactive for 30 years

Deep Blue

- Beat Kasparov in a rematch in 1997
- expert system, 200 mil. positions/sec
- evaluation function of 8000 parts encoding positions, piece priorities ..

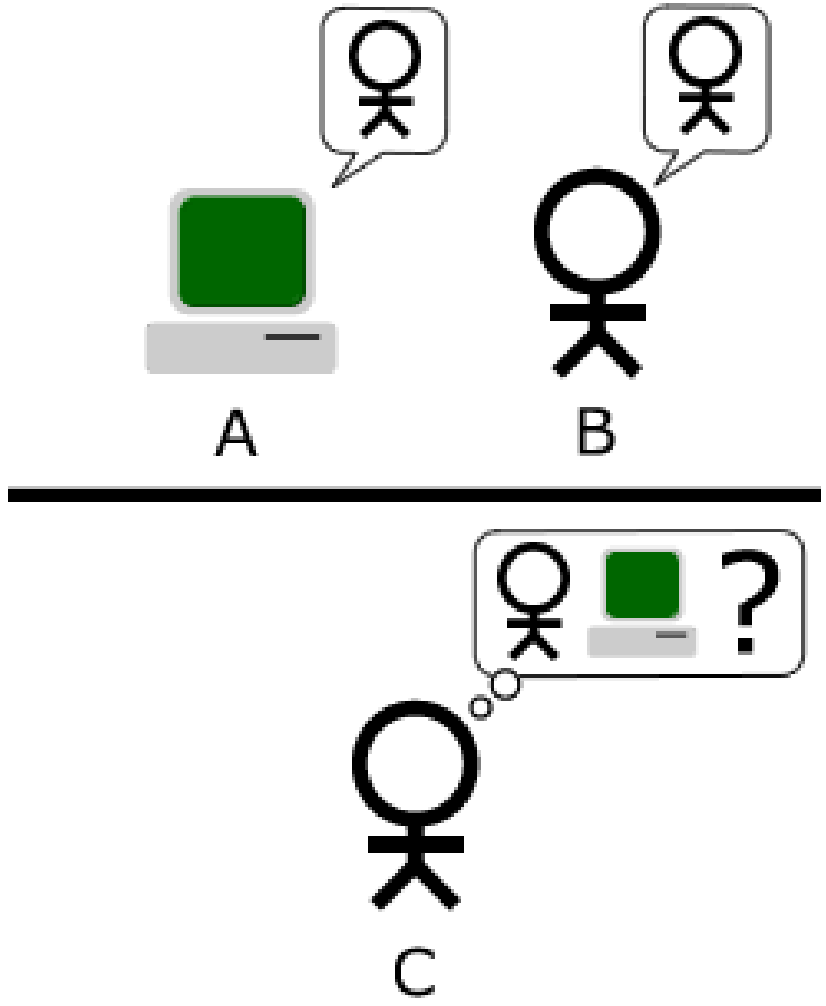
ACT-R

- J.R. Anderson (1973 onward)
- Cognitive architecture
- Symbolic model of cognition
- Later refinement to imitate brain localization



Turing test

- From the 50s
- An intelligence test
- Single (1.5?) blind study
- Low validity and reliability



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