

Umetna inteligenca in ekspertni sistemi

Marko Bohanec

Institut Jožef Stefan, Ljubljana

<http://www-ai.ijs.si/MarkoBohanec/mare.html>

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Kazalo

Uvod v umetno inteligenco

- Kaj je umetna inteligenca?
- Zgodovina umetne inteligenca
- Področja umetne inteligenca

Ekspertni sistemi

- Kaj so ekspertni sistemi?
- Zgodovina ekspertnih sistemov
- Področja uporabe ekspertnih sistemov
- Arhitektura ekspertnih sistemov
- Preprosti primeri ekspertnih sistemov

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Kaj je umetna inteligenca? (1/2)

- *AI is the science of making machines do things that require intelligence if done by men*, Minsky, 1968.
- *AI is that part of computer science concerned with designing intelligent computer systems, i.e. systems that exhibit the characteristics which we associate with intelligence in human behaviour - e.g. understanding language, learning, reasoning, solving problems, etc.*, Feigenbaum, 1981.
- *Artificial Intelligence is the study of ideas that enable computers to be intelligent*, Winston, 1984.
- *A field of study that seeks to explain and emulate intelligent behaviour in terms of computational processes*, Schalkoff, 1990.
- *The study of the techniques for solving exponentially hard problems in polynomial time by exploiting knowledge about the problem domain*, Rich & Knight, 1991.
- *The study of the computations that make it possible to perceive, reason, and act*, Winston, 1992.
- *Science and engineering of making intelligent machines, especially intelligent computer programs*, McCarthy, 2004.

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Kaj je umetna inteligenca? (2/2)

- Ability of machines to adequately function in human culture
- AI is getting more out of a computer than the designer could predict
- Attempting to compete with a human being without feeling
- Attempting to find useful solutions to problems we don't know how to solve
- Attempting to reinvent human capabilities on a different technological basis
- Attempting to understand the processes of consciousness
- Construction of machines which behave in a way people describe as intelligent
- Study of general principles underlying mental processes
- The study of the nature of intelligence, independent of (human) hardware
- Trying to do make computer do things that people can do better
- The step just beyond where AI research has gotten to today

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Opredelitev pojma "inteligenca"? (1/2)

Naloga: Izračunaj kvadratni koren iz 1000



Dryden Flight Research Center: E49-0033. Photographed 10/49. Early "computers" at work. NASA photo

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Opredelitev pojma "inteligenca"? (2/2)

Naloga: Premagaj svetovnega šahovskega prvaka!



Maj 1997:
Gari Kasparov : Deep Blue (IBM) 2,5 : 3,5

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Cilji umetne inteligence

- Razumeti principe inteligence
 - ⇒ boljše razumevanje človeka
 - ↔ filozofija, psihologija, lingvistika, izobraževanje
- Inteligentno obnašanje računalnikov
 - ⇒ večja uporabnost računalnikov
 - ↔ računalništvo, informatika, matematika, logika

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Zgodovina umetne inteligence

- do 1950: "Predzgodovina"
računanje, matematika, logika, mehanika, "robot", kibernetika
- 1950: Začetki
Turingov test, John McCarthy, GPS, LISP
- 1960: Obdobje hitrih uspehov
igranje iger, dokazovanje izrekov, analiza slik in jezika, Eliza
- 1970: Streznitev ("srednji vek")
ekspertni sistemi, strojno učenje, teorija naučljivosti, Prolog, ILP
- 1980: Specializacija
praktiki : teoretiki, strong : weak AI, conventional : computational
področja UI, praktični prispevki

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Področja umetne inteligence

- Igranje iger
- Hevristično reševanje problemov
- Inteligentni roboti
- Procesiranje naravnega jezika
- Računalniški vid
- Ekspertni sistemi
- Strojno učenje in sinteza znanja
- Iskanje zakonitosti v podatkih in "rudarjenje" podatkov
- Avtomatsko programiranje
- Nevronske mreže
- Evolucijsko računanje (tudi genetski algoritmi)
- Semantični splet
- ...

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Prispevki umetne inteligence

- Turingov test (*Turing test*)
- prostor stanj (*state space*)
- preiskovalni algoritmi (*search algorithms*)
- heuristično reševanje problemov (*heuristic problem solving*)
- programski jeziki umetne inteligence: LISP, prolog
- ekspertni sistemi (*expert systems*)
- nevronske mreže (*neural nets*)
- genetski algoritmi (*genetic algorithms*)
- evolucijsko računanje (*evolutionary computing*)
- strojno učenje (*machine learning*)
- induktivno logično programiranje (*inductive logic programming*)
- iskanje zakonitosti v podatkih (*knowledge discovery in databases*)
- teorija naučljivosti (*computational learning theory, PAC learning*)
- predstavitve znanja (npr. ontologije)
- semantični splet (*semantic web*)

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Umetna inteligenca danes

Robotika in inteligentni stroji



HONDA ASIMO



Roomba



Robocup

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Umetna inteligenca danes

Robotika in inteligentni stroji



Mars Rover

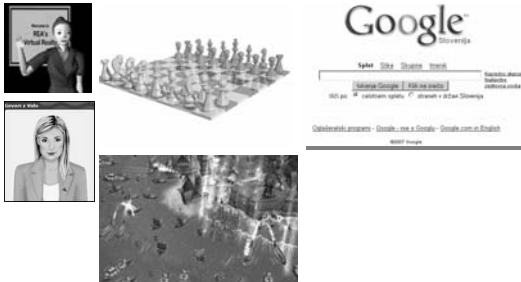


DARPA Grand Challenge

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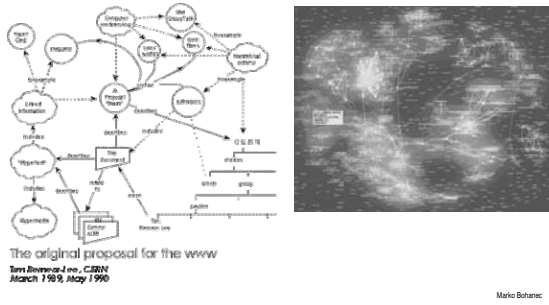
Umetna inteligenca danes

Inteligentni programi



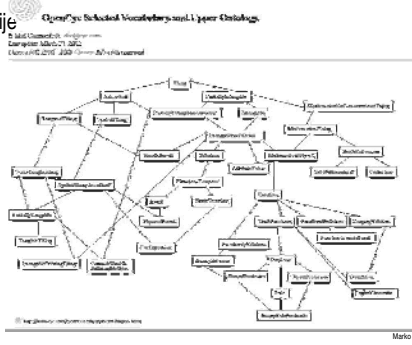
Umetna inteligenca danes

Semantični splet



Umetna inteligenca danes

Ontologije



Umetna inteligenca danes

- Analiza podatkov in odkrivanje znanja
- Procesiranje naravnega jezika
- Razumevanje človeških miselnih procesov
- Umetnost



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Viri



Stuart Russell, Peter Norvig:
Artificial Intelligence: A Modern Approach,
Prentice-Hall, 2002.



Patrick Henry Winston:
Artificial Intelligence,
Addison Wesley, 1992.

Michael Negnevitsky:
Artificial Intelligence: A Guide to Intelligent Systems,
Addison Wesley, 2004.

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Viri

http://en.wikipedia.org/wiki/Artificial_intelligence

- Wikipedia: Artificial Intelligence
- Wikipedia: AI
- AI Education Repository
- AI on the Web
- History of AI
- John McCarthy: What is AI
- US, Department of Knowledge Technologies
- Video Lectures
- En. Gradov: "Umetna inteligenca in teorija algoritmov"
- Rubenag Research (Seo, Custom, Magento, Opus)
- Web 3.0 - Machine Learning Software in Java
- Science



<http://www.cs.berkeley.edu/~russell/ai.html>

AI on the Web

This page links to 868 pages around the web with information on Artificial Intelligence. Some of the links will pop up additional information when you move the mouse over them. Links in **Red**, followed by a star are especially useful and interesting sites. If you have new links to add, [let us know](#). The subtopics are:

Overview of AI	Planning	Philosophy and the Future
Building Recommended Links	Reasoning with Uncertainty	AI Programming (Lisp)
Robotic Agents	Machine Learning	AI Programming (C++ and Java)
Search and Game Playing	Natural Language Processing	AI Programming (Python)
Logic and Knowledge Representation	Perception and Robotics	AI Programming (Prolog)

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Viri http://kt.ijs.si/

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Ekspertni sistemi (ES)

Računalniški sistemi, ki:

- rešujejo probleme
- na (ozkem) strokovnem področju
- podobno kot strokovnjaki (eksperti)

Zahteve:

- sposobnost sklepanja
- sposobnost presoje
- zmožnost delovanja pri nezanesljivih in nepopolnih podatkih
- zmožnost pojasnjevanja:
 - delovanja in sklepanja: vprašanja "Kako?" in "Zakaj?"
 - predlaganih rešitev

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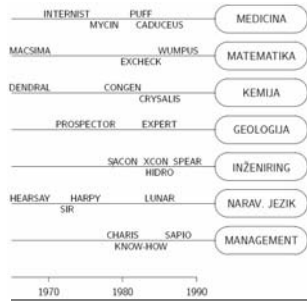
Prvi ekspertni sistemi

Razviti v okviru umetne inteligence

- MYCIN (1976)
diagnosticiranje infekcij in izbor terapije
- AL/X (1980)
odkrivanje okvar v kompleksnih proizvodnih procesih (naftne ploščadi)
- DENDRAL (od 1956)
ugotavljanje kemijskih strukturnih formul iz spektrov
- PROSPECTOR (1980)
geološke raziskave
- PUFF (1980)
diagnoze pljučnih bolezni

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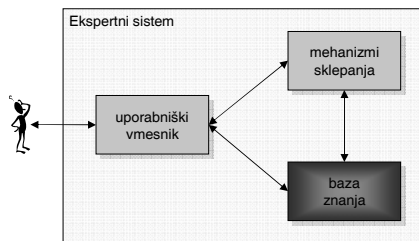
Uporaba ES



- Novejša področja uporabe:
- inteligentni sistemi in agenti
 - poslovno odločanje (poslovna logika in pravila)
 - vodenje procesov
 - zahtevno inženirsko odločanje
 - medicinska diagnostika
 - računalniški vmesniki, "čarovniki"
 - računalniške igre
 - robotika
 - ...

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Splošna arhitektura ES



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Ključni koncepti ES

- Predstavitve znanja ("knowledge representation"):
 - semantične mreže, taksonomije, ontologije
 - okviri, predmeti
 - pravila
 - formalna logika
- Mehanizmi sklepanja ("inference"):
 - sklepanje naprej
 - sklepanje nazaj
- Upoštevanje negotovosti ("uncertainty propagation")
 - verjetnost ("probability")
 - mehka logika ("fuzzy logic", "possibility")

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Primeri predstavitve znanja v ES (1)

Produkcijska ("če-potem") pravila

MYCIN (diagnostika infekcij)

IF (1) infection = primary-bacteremia, and
(2) site of culture is one of the sterilities, and
(3) suspected portal of entry = gastrointestinal tract
THEN there is suggestive evidence (0.7)
that organism is **bacteroides**.

OPTRANS (dodeljevanje posojil)

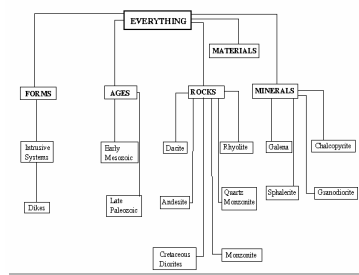
ČE mesečni obrok > ½ maks. obroka
POTEM je možno dodeliti kredit, vendar
PREVERITI garancijo, družino in starost.

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Primeri predstavitve znanja v ES (2)

Taksonomija: hierarhija pojmov in konceptov

PROSPECTOR (geološke raziskave)



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Primeri predstavitve znanja v ES (3)

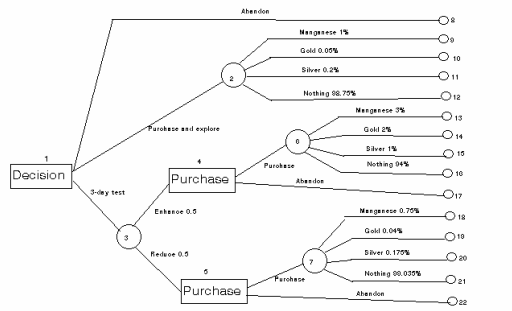
Ontologija: množica konceptov in relacij

CYC



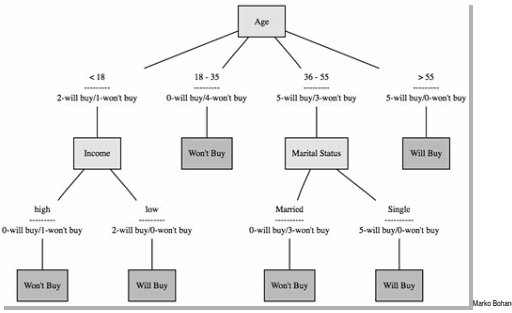
Primeri predstavitve znanja v ES (4)

Odločitveno drevo



Primeri predstavitve znanja v ES (5)

Odločitveno drevo



Primeri ES

- Expertise 2GO
<http://www.expertise2go.com/webesie/>
- Wine Selection:
<http://www.expertise2go.com/webesie/e2gdoc/winepg.htm>
- Choosing Data Analysis Technique:
<http://expertise2go.com/webesie/StatTech/>
- Loan Decision:
<http://expertise2go.com/webesie/loan/>
- Medical Diagnosis:
<http://easydiagnosis.com/>
- ECOGEN Soil Quality Index:
<http://ai.ijs.si/MarkoBohanec/ESQ/ESQL.php>

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Prednosti in slabosti ES

PREDNOSTI

- eksplicitno izražena baza znanja
- simbolično (kvalitativno) sklepanje
- razlaga odločitev
- delovanje z nenatančnimi in nezanesljivimi podatki
- dostopnost
- prilagodljivost

POMANJKLJIVOSTI

- ozka problemska področja
- relativno zahteven razvoj
 - znanje, kadri
 - "Figenbaumovo ozko grlo" -> potreba po strojnem učenju

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