

COLLOQUIUM IN HONOR OF VALERIJ BOČVARSKI

Belgrade 13th – 14th October, 2017

EXPERT SYSTEMS:
METHODOLOGY AND

REALIZATION

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Introduction

- computer programs that use human knowledge and practical experience to solve a specific problem in the given area
- solve problem by simulating the expert's activities
- can be divided into three categories: scientific, technological and commercial

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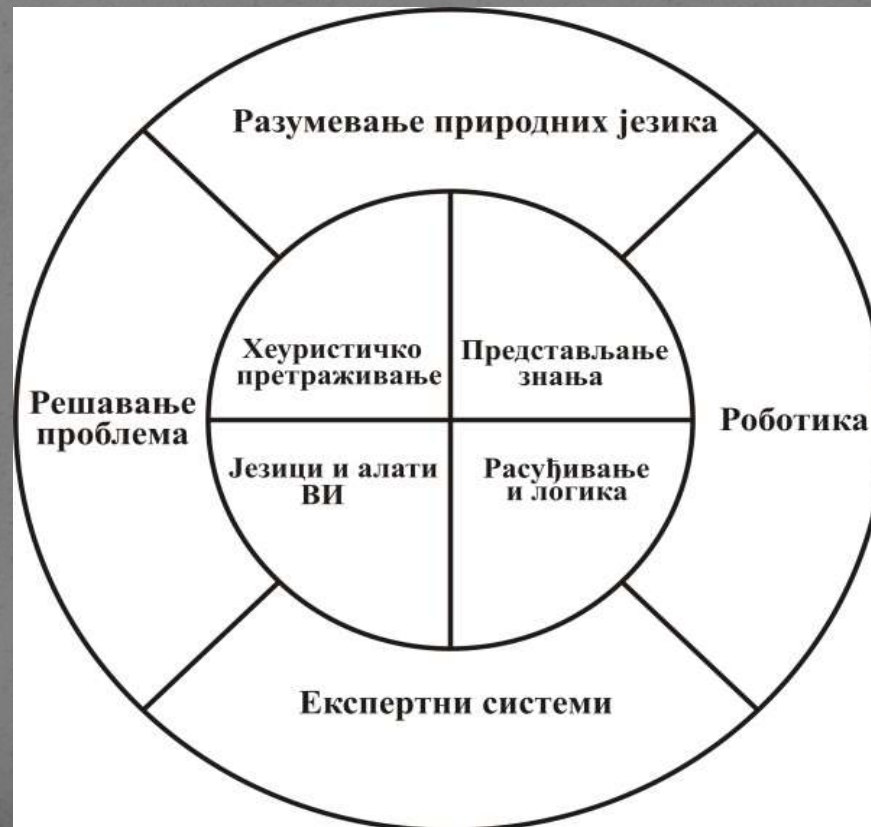
Artificial intelligence

- the phrase artificial intelligence
- conference *The Dartmouth Summer Research Conference on Artificial Intelligence* in 1952, Dartmouth College in New Hampshire
- "every aspect of learning or any other feature of intelligence can be so precisely described that a machine can be made to simulate it".
- Human intelligence- fact or an artefact?

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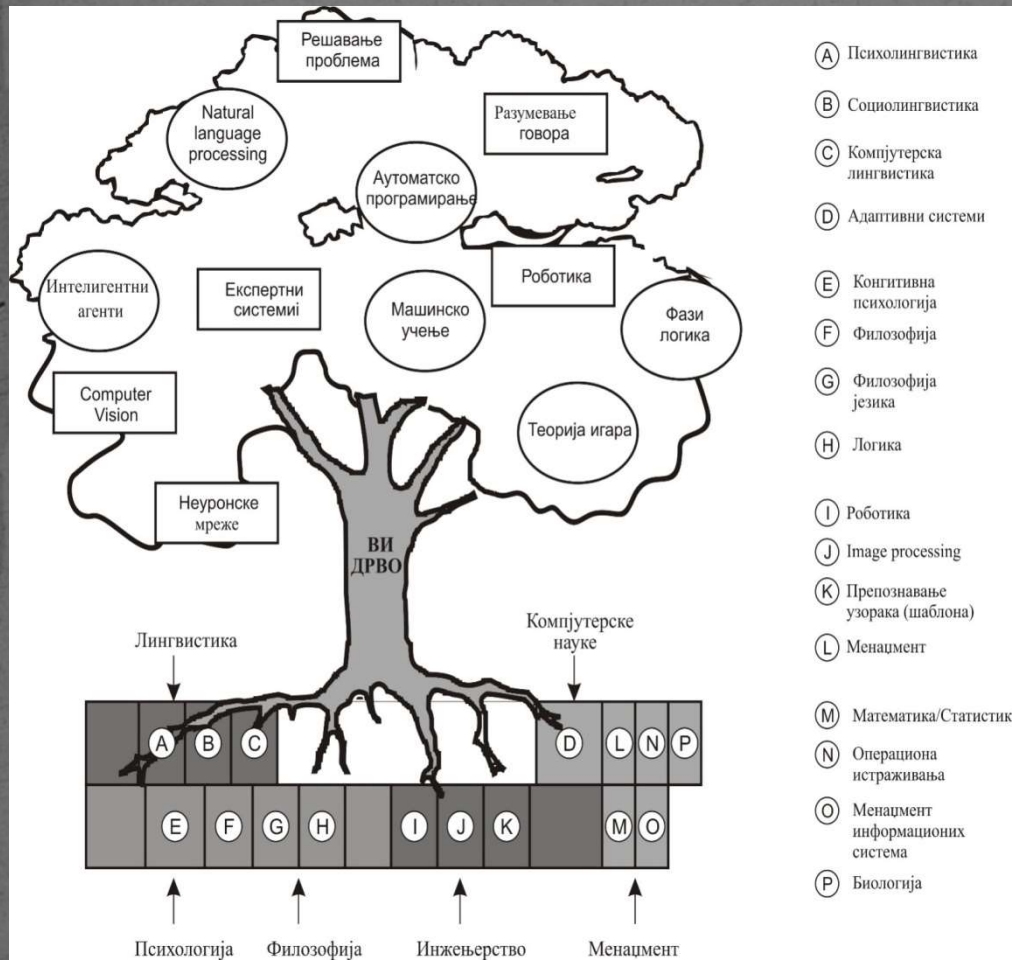
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- Alan Turing “*Computing Machinery and Intelligence*” (1950)
- From the field of AI, many domains originated:



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Knowledge-based systems

- Considered to be a major branch of AI.

Expert systems

- An expert system is a system that employs human knowledge captured in a computer to solve problems that ordinarily require human expertise.
- A computer program that emulates the behaviour of human experts who are solving real-world problems associated with a particular domain of knowledge.

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Some of the characteristics of expert systems are:

- Modularity and possibility to change the implemented knowledge
- Prevailing processing of symbolic data
- Imitation of the intelligent human behavior.
- Can operate with incomplete or uncertain information
- Possibility to explain the reasoning

DENDRAL, 1965, Stanford University (developed by J. Lederberg, E.A. Feigenbaum and B.G. Buchanan)

MYCIN, 1972 , Stanford University (E.H. Shortliffe)

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Advantages and limitations of an expert system

- Advantages:

- can work in dangerous hazardous or environments
- “work” is independent from the time, environment, or emotions.
- possibility to combine the knowledge of many experts
- explaining the conclusion process in detailed.

Limitations:

- It can be difficult to extract expertise from humans.
- difficulty to differentiate between the relevant and irrelevant
- narrow domain of knowledge
- vocabulary is often limited and difficult to understand.
- help from knowledge engineers is difficult to obtain and costly

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Production rules

Any rules consist of two parts:

- The IF part (premise or condition),
- The THEN part (conclusion or action).
- Additionally, the rule can contain an alternative, the ELSE part

Chaining of rules

- Forward chaining,
- Backward chaining

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Methodology of expert systems

- Aristotle, 4th “The Organon“.
- logic is *the study of the principles of correct reasoning.*
- *the reflection*

- *”A deduction (syllogism) is a discourse in which, certain things having been supposed, something different from the things supposed of necessity because these things are so”.*

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Example 1:

Premise 1: “A teacher teaches the others”

Premise 2: “Socrates teaches the others”

Conclusion: “**Socrates is a teacher**”

- **Conclusion is a union of its premises.**
- *Syllogism is always true.*

Example 2:

Premise 1: “Cat is a mammal”

Premise 2: “Socrates is a mammal”

Conclusion: “Socrates is a mammal”.

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- Collecting facts
- Expert knowledge – an analysis
- “For accidental observations, made according to no preconceived plan, cannot be united under a necessary law. But it is this that reason seeks for and requires.” Kant
- 1. The facts exist!! The theory must be organized so that it corresponds to facts as much as possible.

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- Following contradiction, we can say that: Knowledge must have processes i.e. relations as its content, while facts appear as a potential confirmation of those processes.
- An expert in its, now we can say knowledge system, must behave on the following way: he starts from a process (theory) and by decomposition over series of syllogisms he comes to elements which can be measured (observed) and which he can use for a “checking”.
- 2. The theory exists!! Facts must be organized to correspond to the theory as much as possible.

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Realization

- instructions from Apollo temple in Delphi:

KNOW THYSELF (γνωθι σεαυτόν)

- In which cases an automatic reaction of an expert can be transformed in an automatic reaction of computer?
- For example in the case (“fact-conclusion-action”),
pressure $P = 4.5 \times 10^{-7}$ Torr \rightarrow “vacuum is good” “I start to record a spectrum”

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- A nature of facts (physical facts)
- The two groups of facts are:
 - quantities which determine required conditions for realization of given experiment
 - from facts which are directly or indirectly involved in a process of result's analysis.

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- Is it possible and how to “automate” analytical process of an expert when even he hasn’t an automatic reaction in a working phase?
- This is “a key point” in a process of realization of an expert system.
- The answer is positive i.e. it is possible. This is direct consequence of the fact that there aren’t any accidental observations but only those performed by determined plan.