Funded by
the European Union

ASSISTANT

Course on Artificial Intelligence

José Coelho, 2024

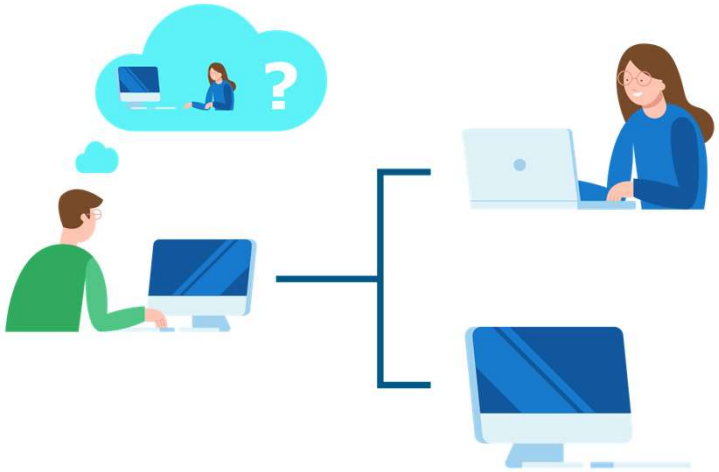
Lesson 1: Overview of Artificial Intelligence

Table of contents

Introduction

What is Artificial Intelligence?

- Building intelligent entities;
- Definition of intelligence
- Turing test



360° view of AI [1/6]

Major areas of Artificial Intelligence:

- Problem Solving
- Knowledge Representation, Reasoning and Planning
- Uncertain Knowledge and Reasoning
- Learning
- Communication, Perception and Action

360° view of AI [2/6]

Problem Solving:

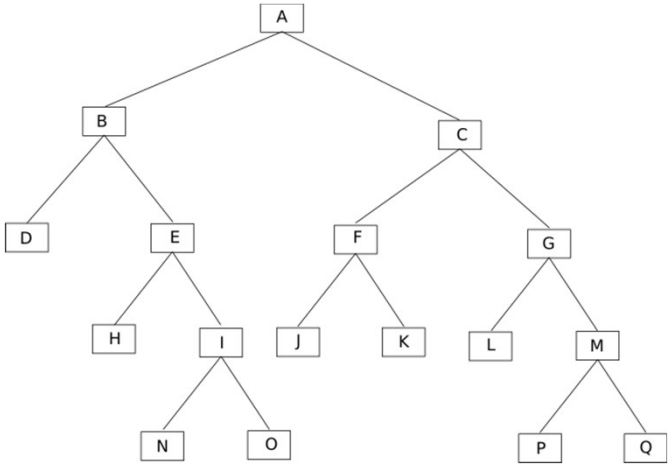
- Decision Problems
- Search Problems
- Optimization Problems
- Adverse Search

How to use existing techniques:

- Implement a technique in a programming language for the specific problem
- Define the problem in a generic solver

State of the art:

- Optimal solutions are found for specific problems
- Good solutions are found for other problems



360° view of AI [3/6]

Suppose you have the following knowledge base:
$(P \land Q) \Rightarrow (R \lor S), P, \neg R$
Show, using the Modus Ponens and/or AND-elimination inference rule, that one can conclude:
$\neg Q \lor S$

Knowledge representation, reasoning and planning:

- Propositional logic
- First-order logic
- Inference
- Planning
- Ontologies

Action(Flight(p,from,to),
precondition: In(p,from) and Airplane(p) and Airport(from) and Airport(to)
effect: remove In(p,from), add In(p,to)

1. $(P \land Q) \Rightarrow (R \lor S)$
2. P
3. $\neg R$
4. $\neg P \lor \neg Q \lor R \lor S$ (1)
5. $(\neg P \lor \neg\neg R) \lor \neg Q \lor S$(4)
6. $(P \land \neg R) \Rightarrow (\neg Q \lor S)$ (5)
7. $P \land \neg R$ (2,3)
8. $\neg Q \lor S$ (6,7)

Suppose you have the following knowledge base:
- Everyone likes to eat some type of food;
- There is no type of food that is enjoyed by all people;
- There are those who like all types of food;
- Fernando doesn't like cod.

Convert this information to 1st order logic

$\forall_x \exists_y Person(x) \Rightarrow Food(y) \land Like(x,y)$
$\forall_x \exists_y Food(y) \Rightarrow Person(x) \land \neg Like(x,y)$
$\exists_x \forall_y Person(x) \land (Food(y) \Rightarrow Like(x,y))$
$\neg Like(Fernando, Cod)$

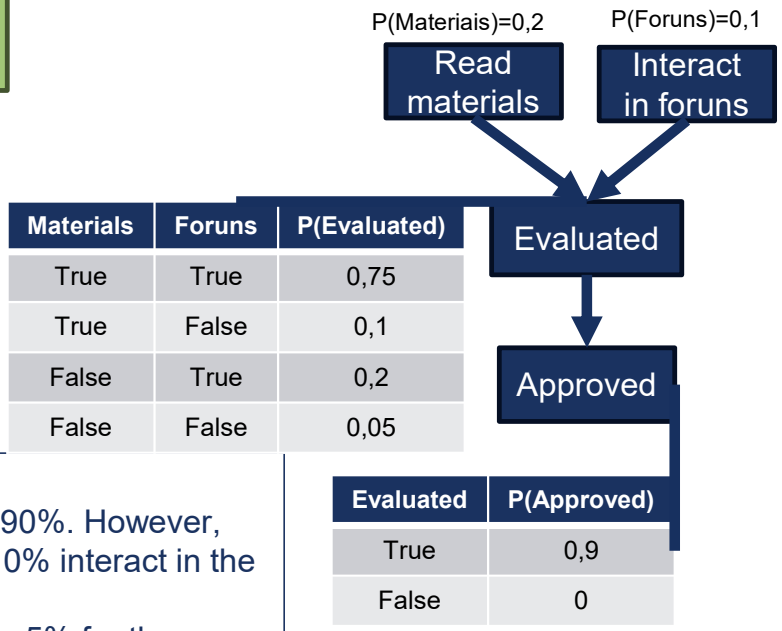
360° view of AI [4/6]

$$P(chest\ pains|cold) = 0{,}45$$
$$P(cold) = 0{,}1$$
$$P(chest\ pains) = 0{,}5$$
We want to know:
$$P(cold|chest\ pains)$$
$$P(A|B) = \frac{P(B|A)P(A)}{P(B)} = \frac{0{,}45 \times 0{,}1}{0{,}5} = 0{,}09$$

Manuel has chest pains. Knowing that if you have a cold the probability of having chest pain is 45%, and that 10% of people have a cold, and 50% of people have chest pain, calculate the probability that Manuel has a cold.

Uncertain Knowledge and Reasoning:

- Uncertainty
- Representation of uncertain knowledge
- Inference
- Utility theory



Materials	Foruns	P(Evaluated)
True	True	0,75
True	False	0,1
False	True	0,2
False	False	0,05

Evaluated	P(Approved)
True	0,9
False	0

Consider the following knowledge:

- In one curricular unit, the students' approval rate is 90%. However, only 20% of students read the materials, and only 10% interact in the forums.
- The probability of carrying out evaluation activities is 5% for those who do not read the materials or interact in the forums, 10% for those who read the materials, 20% for those who only interact but do not read the materials, and 75% for those who read the materials and interact in the forums.

Build a Bayes network that represents this knowledge.
Calculate the approval rate of registered students

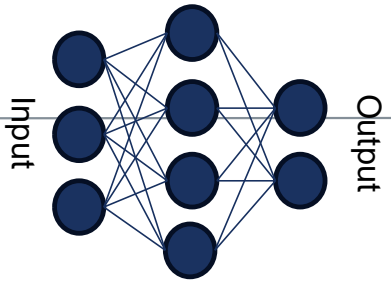
360° view of AI [5/6]

Learning:

- Learning from examples

Methods:

- Decision trees
- K nearest neighbors
- Neural networks

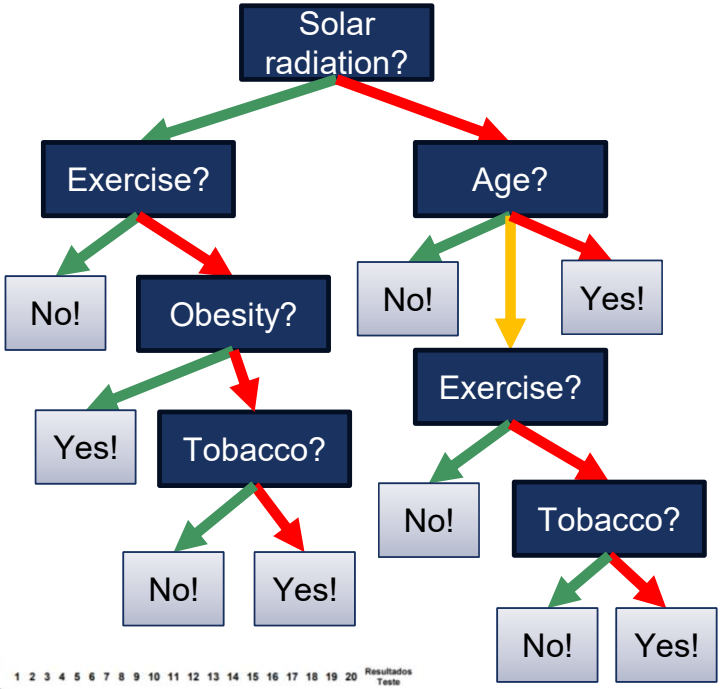


As part of a study on the causes of cancer, information was collected on a group of people with and without cancer, who were classified as being or not in each situation (binary), except age with three levels. The aim is to determine the main causes that are responsible for cancer.

Causes:

1. Excess **tobacco** and/or alcohol;
2. **Obesity** and/or Diet (high in fat);
3. Exposure to **Solar radiation**;
4. **Age** (young, adult, elderly);
5. Lack of Physical **Exercise**.

Build a decision tree for the next training set, using the Decision-Tree-Learning algorithm, indicating all the steps. Choose the variable that allows you to solve more cases in each step.

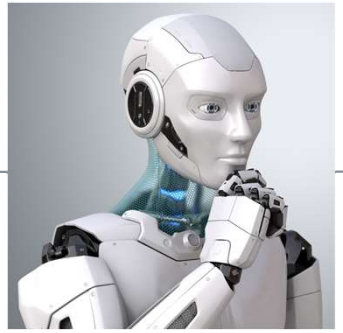


Treino / Teste	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	Resultados Teste
1	3	2	2	3	3	2	3	4	4	3	4	2	3	2	4	2	2	3	2	3	1
2	3	0	2	3	3	2	3	2	2	5	2	4	1	2	2	2	0	1	4	1	0
3	2	5	3	2	3	3	3	4	4	0	4	1	5	3	3	4	5	4	2	4	1
4	1	2	0	3	5	2	3	2	2	3	2	2	3	2	2	2	2	3	4	1	0
5	3	0	2	3	3	2	3	2	2	5	2	4	1	2	2	2	0	1	4	1	0
6	3	2	2	5	3	1	3	2	2	4	2	4	1	2	4	0	2	3	2	3	0
7	4	3	5	2	0	4	2	3	3	3	3	3	2	3	3	3	3	2	1	4	0
8	4	3	3	2	2	4	0	1	1	3	1	3	2	5	3	3	3	4	3	2	0
9	4	1	3	4	2	2	2	1	1	5	1	5	0	3	3	1	1	2	3	2	0
10	0	3	1	2	4	3	4	3	3	2	3	1	4	1	1	3	3	2	3	2	1
Resultados Treino	1	0	0	1	0	1	0	0	0	1	0	1	0	0	0	0	0	0	1	0	0

360° view of AI [6/6]

Communication, Perception and Action:

- Natural Language Processing
- Communicating in Natural Language
- Perception
- Robotics



What to do?

Provocative question about Artificial Intelligence

Essay submission

Thank you for attention

Resources:

- Microsoft Power Point / Clipchamp / DeepL

- Russell, S. J. & Norvig, P. (2010). Artificial intelligence: A modern approach (3rd ed). Prentice Hall.

Funded by the European Union

ASSISTANT - CHALLENGE BASED LEARNING IN AI ENHANCED DIGITAL TRANSFORMATION CURRICULAR NO. 2022-1-LT01-KA220-HED-000086555