

**LECTURER: Nghia Duong-Trung**

# **ARTIFICIAL INTELLIGENCE**

TOPIC OUTLINE

History of Artificial Intelligence

1

Early Systems in Artificial Intelligence

2

Neuroscience and Cognitive Science

3

Modern Artificial Intelligence Systems

4

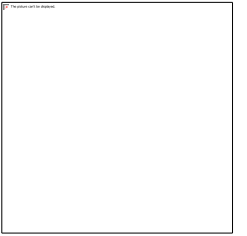
Applications of Artificial Intelligence

5

## UNIT 2

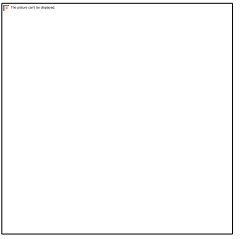
# EARLY SYSTEMS IN ARTIFICIAL INTELLIGENCE

## STUDY GOALS

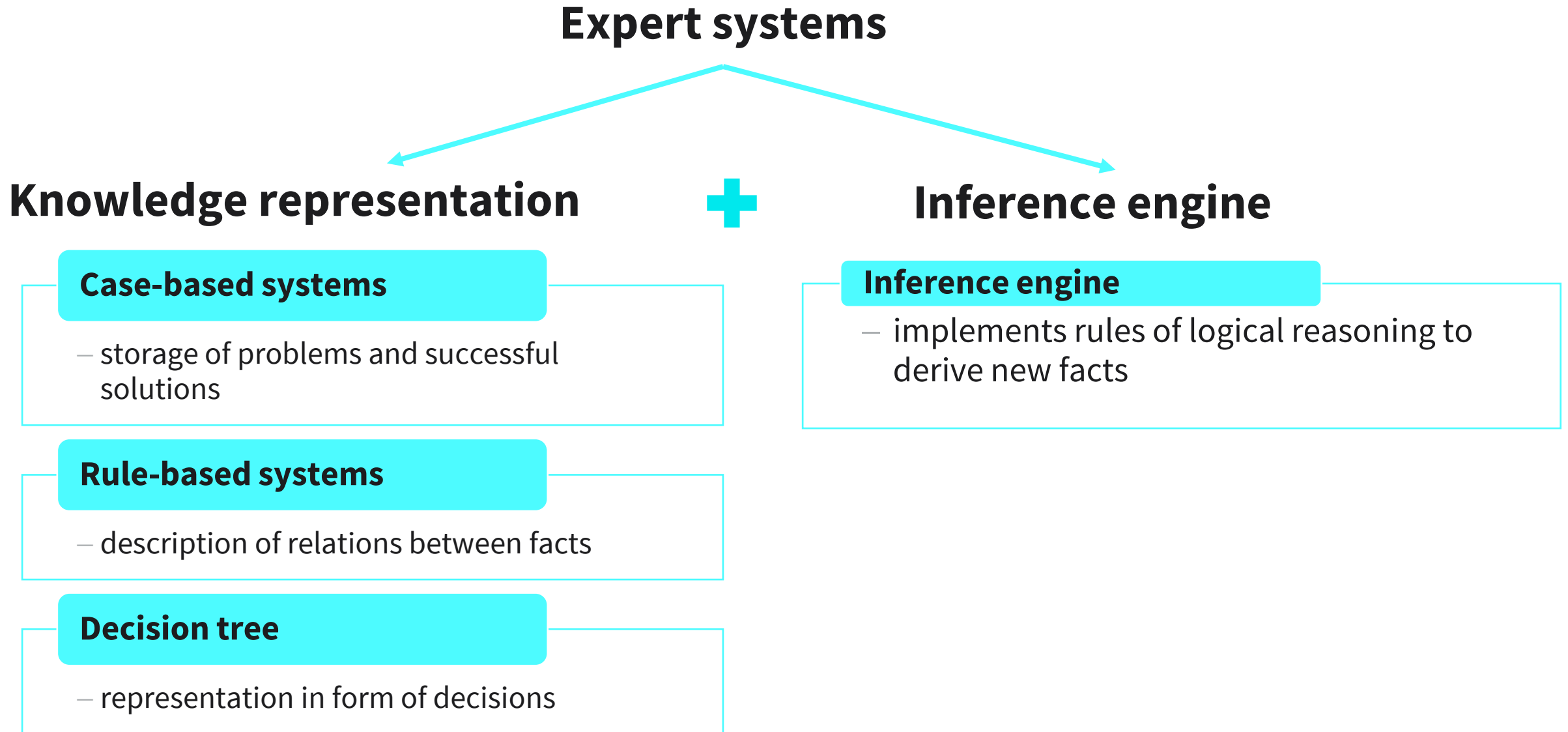


On completion of this unit, you will have learned ...

- ... about important approaches that have defined the field of artificial intelligence in the past and that continue to influence it today.
- ... why expert systems are important and how they have contributed to artificial intelligence and computer science.
- ... about advances brought about in the Prolog programming language.
- ... the definition of machine learning and how it contributes to artificial intelligence.

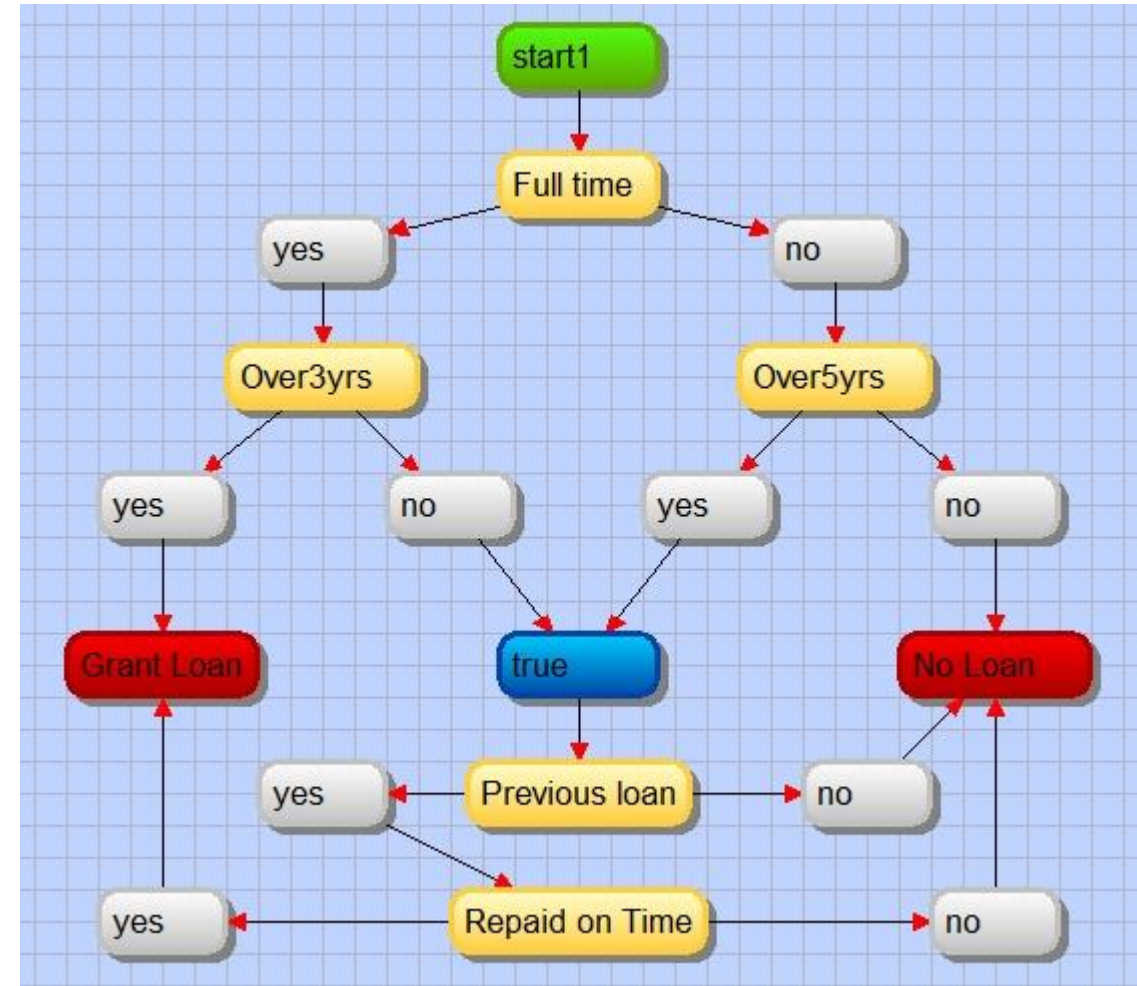


1. List the three types of machine learning and explain them using your own words.
2. What are the main components of expert systems?
3. Explain the declarative programming paradigm.



## VisiRule – decision-support system

- Access loan decision
- <https://visiruleexamples.com/vregs.html>



## **New use cases require a larger knowledge base**

- Increased computational complexity during inference
- Challenge of consistency without contradictions
- Lead to development of logical programming to formulate rules and reasoning processes

## **Declarative programming**

- programming style with specified properties of the sought solution but not the algorithm
- sequence of operations that lead to a solution (= logic)



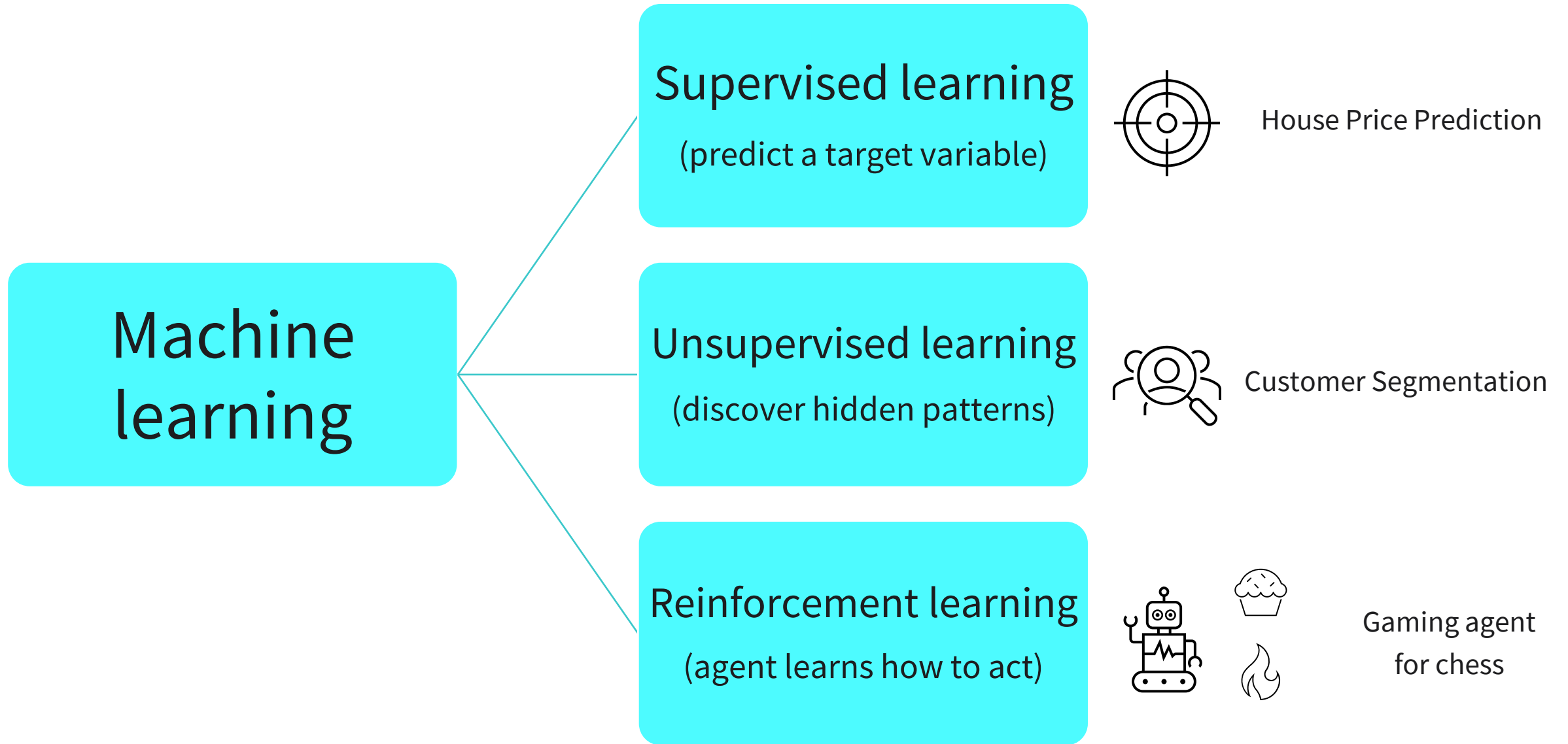
## PROGRAMMING IN LOGIC (PROLOG):

- Prolog is based on a declarative programming paradigm
  - The sequence of operations that lead to a solution
  - A Prolog program consists of a collection of facts and rules that relate the facts to one another
  - Program execution is then initiated by formulating a query using the aforementioned knowledge base.


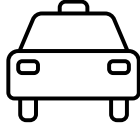


# Prolog consists of predicates and clauses

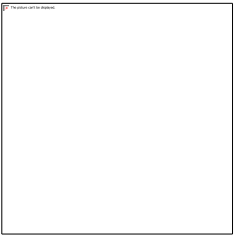
Example of the Prolog Language		
Prolog language construct	Prolog syntax	Meaning and output
Fact	lectures (Smith, DLMAIAI01)	Establishes the fact that Dr. Smith teaches the course DLMAIAI01. It is an exmple of a Prolog clause.
Predicate	professor/1 professor(Smith). professor(Jones). professor(Meyer).	Defines the one argument predicate professor by three facts. Drs. Smith, Jones, and Meyer are professors.
Rule	technicalCourse(X) :- engineeringCourse(X)	All engineering courses are technical courses. Note the use of variable X!
Query	? – lectures(Smith, DLMAIAI01)	Does Dr. Smith teach DLMAIAI01?
Goal	? – lectures(Smith, X)	What courses does Dr. Smith teach? Note the use of the variable X!

## TYPES OF MACHINE LEARNING



## USE CASE EXAMPLES IN DIFFERENT INDUSTRIES

- Healthcare: wearables 
- Automobile: autonomous driving 
- Banking: fraud detection 
- Retail: personalized product recommendations 



You have learned ...

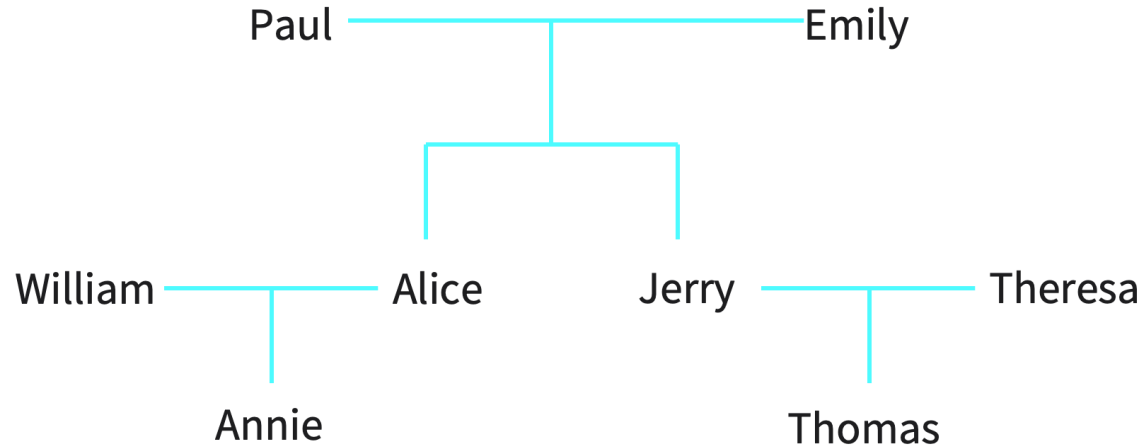
- ... about important approaches that have defined the field of artificial intelligence in the past and that continue to influence it today.
- ... why expert systems are important and how they have contributed to artificial intelligence and computer science.
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**SESSION 2**

# **TRANSFER TASK**

## TRANSFER TASK

Use Prolog to develop rules for the following family relations:



Write the following queries:

- *Does Annie have an uncle? Who?*
- *Who are the grandparents of Thomas?*

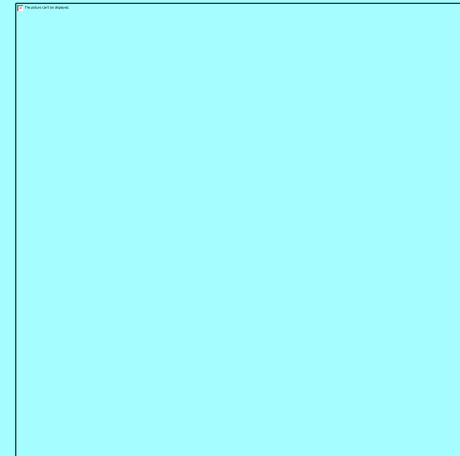
→ Use this virtual environment: [SWI Prolog](http://www.macs.hw.ac.uk/~rpp6/teaching/F29AI/prolog/)

Tutorial: <http://www.macs.hw.ac.uk/~rpp6/teaching/F29AI/prolog/>

**TRANSFER TASK**  
**PRESENTATION OF THE RESULTS**

Please present your  
results.

The results will be  
discussed in plenary.





## TRANSFER TASK SAMPLE SOLUTION

female(annie).  
female(theresa).  
female(alice).  
female(emily).

male(thomas).  
male(jerry).  
male(william).  
male(paul).

parent\_of(paul,alice).  
parent\_of(emily,alice).  
parent\_of(paul,jerry).  
parent\_of(emily,jerry).  
parent\_of(alice,annie).  
parent\_of(william,annie).  
parent\_of(jerry,thomas).  
parent\_of(theresa,thomas).

father\_of(X,Y) :- male(X),  
                  parent\_of(X,Y).  
mother\_of(X,Y) :- female(X),  
                  parent\_of(X,Y).

grandfather\_of(X,Y) :- father\_of(X,Z),  
                          parent\_of(Z,Y).  
grandmother\_of(X,Y) :- mother\_of(X,Z),  
                          parent\_of(Z,Y).

sister\_of(X,Y) :- female(X),  
                  parent\_of(Z,X),  
                  parent\_of(Z,Y).  
brother\_of(X,Y) :- male(X),  
                  parent\_of(Z,X),  
                  parent\_of(Z,Y).

aunt\_of(X,Y) :- sister\_of(X,Z),  
                  parent\_of(Z,Y).  
uncle\_of(X,Y) :- brother\_of(X,Z),  
                  parent\_of(Z,Y).

Does Annie have an uncle?

➤ *uncle\_of(\_,annie).*

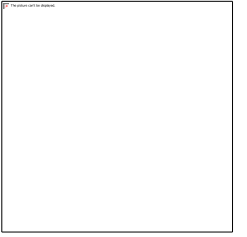
Who?

➤ *uncle\_of(X,annie).*

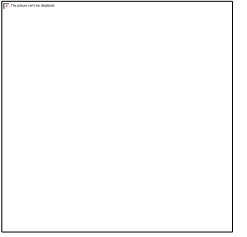
Who are the grandparents of Thomas?

➤ *grandmother\_of(X,thomas).*

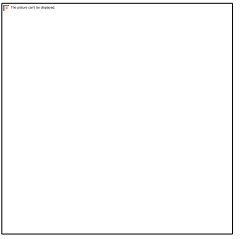
➤ *grandfather\_of(X,thomas).*



1. In Prolog, the sequence of concrete steps to arrive at a desired program outcome is:
  - a) specified by the program user.
  - b) generated by the Prolog system.
  - c) specified by the programmer.
  - d) not determined at all



2. Supervised learning, unsupervised learning, and reinforcement learning
- a) define the full range of the field of artificial intelligence.
  - b) are concepts still being tested in laboratories. They are not yet being applied.
  - c) have no relation to machine learning or artificial intelligence.
  - d) are subfields of machine learning.



3. The main lasting contribution of expert systems to artificial intelligence and/or computer science were
- a) explicit formal representation of knowledge, declarative programming style, and rapid prototyping.
  - b) the popularization of imperative programming and probabilistic reasoning.
  - c) list processing and procedural programming.
  - d) object-oriented programming and the implementation of systems without prototyping.

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