The module I SEE on Artificial Intelligence

I SEE
It's your time to imagine the futures

MEETING THE FOCAL THEME

Overview on artificial intelligence today

(Prof. Nico Lanconelli, Physician)

Overview on artificial intelligence in the history and the culture

(Prof. Paola Mello, computer engineer

Prof. Gianni Zanarini, Physician)

I SEE
It's your time to imagine the futures

AI today

(Lanconelli)

- The artificial intelligence is not a novelty, but it has been used and funded and then ignored in different periods
- Definition of intelligent behavior
- AI is nowadays applied to every field, also in Physics research (specific example in Applied Physics)

Activity CO: Application of AI in several fields (examples)

AI in the History ….. and in the culture

(Mello)

- Approaches to AI and paradigms for problem solving: imperative programming, logic programming and machine learning
- How to teach a robot to exit a room?
- Introduction of crucial AI terms and concepts: intelligence, learning, base of knowledge, rules, algorithm, symbolic and subsymbolic; emulation vs simulation

(Zanarini)

- Nature as a machine
- Complexity as new paradigm in Science and also in AI
- From determinism to complexity, from "certainty" to probability
- Different rationalities: from linear to circular causality, from models to emerging properties of systems
- Introduction of crucial concepts : uncertainty, probability, behaviour

Paradigmi e parole chiave

1) IMPERATIVE-PROCEDURAL

Executing, step by step

2) LOGIC-DEDUCTIVE

Reasoning , decision trees T/F

3) MACHINE LEARNING

Learning, examples

Reflections on different human approaches to problem solving

APPROACHES: A COMPARISON

Determinism (1,2) vs Complexity (3)

Algorithm (1,2,3)

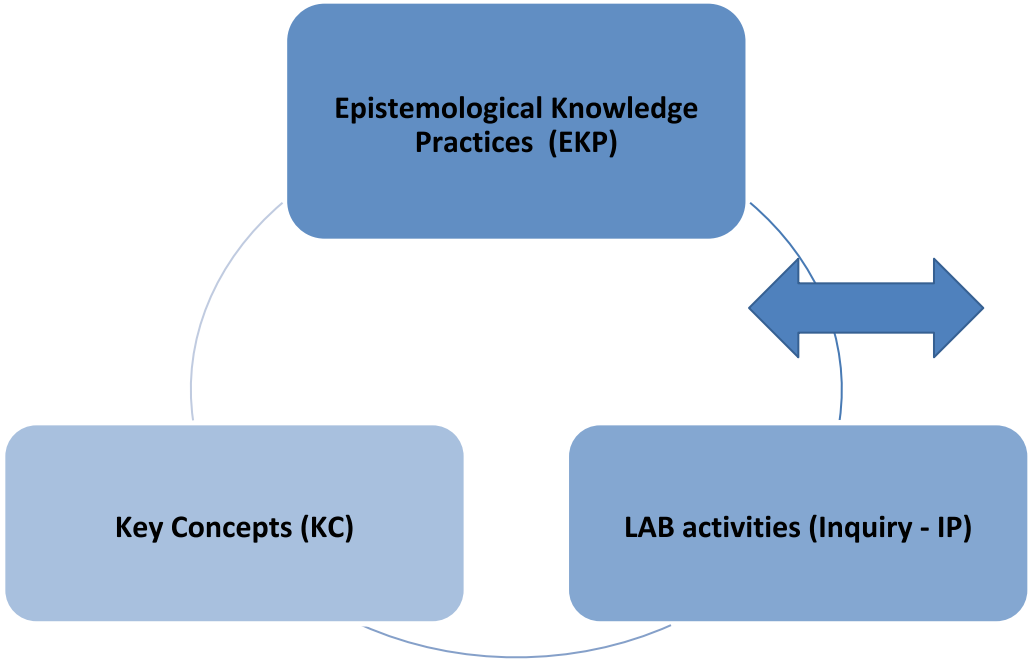
Symbolic (2) vs Subsymbolic (3)

Emulation (1,2) vs simulation (3)

Known Procedures (1,2) vs Known Solution (3)

Control step by step (1,2) vs Training (3)

“ENGAGEMENT WITH”

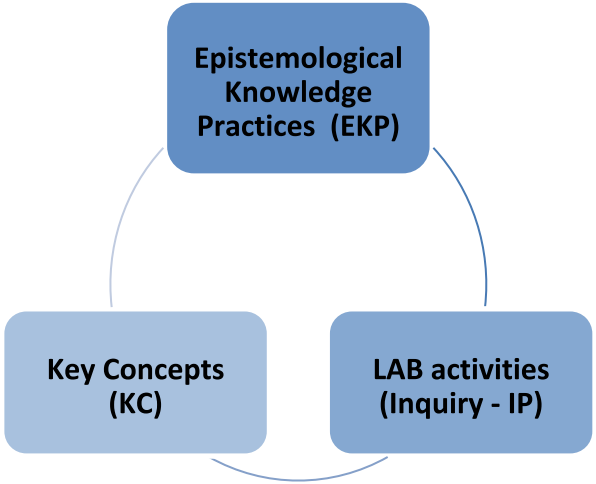


Future oriented activities

- exposure activities to widen the imagination of possible future carriers in STEM;
- activity to highlight and recognize different rationalities elaborated within Science to pass from determinism to complexity, implying a new relation present-future;
- activities inspired by *futures studies*;
- *action competence* activities

i) **Concepts:** Methods and programming to solve a problem according to different approaches to AI and using different languages.
"Critical details" :

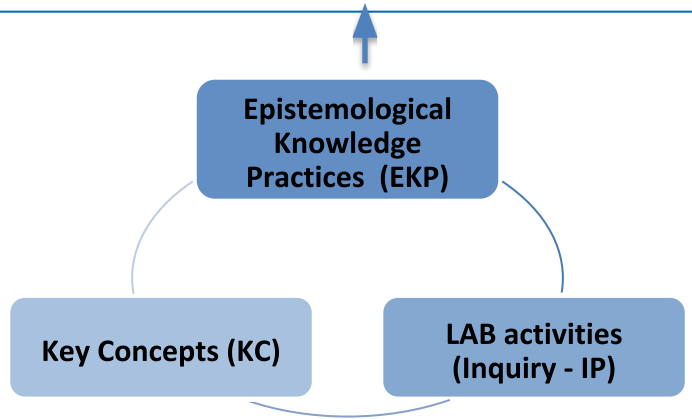
- role of the **base of knowledge**, **rules, algorithms** and **check procedures**;
- **symbolic/subsymbolic** approach;
- **interaction programmer-machine**: what the machine does "on its own", what we ask it to do, how we express instructions, problems and knowledge (pseudo-language)
- **logic/deduction** (true/false tables, modus ponens, material implication, inference);
- **physical/mathematical models** at the basis of the complex system of neural networks (neuron, minimization of error functions, weights, probability, efficiency)

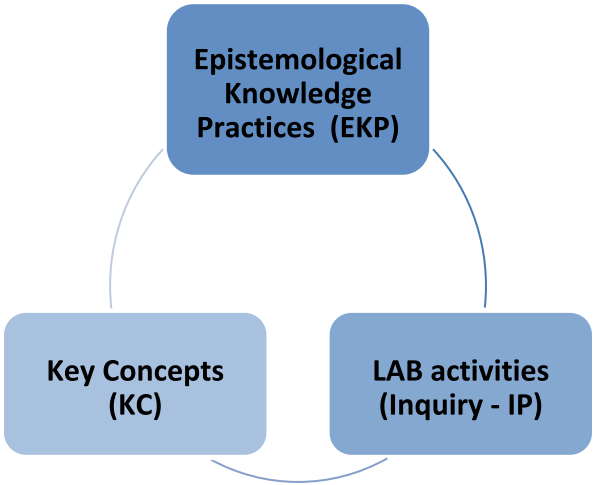


I SEE
It's your time to imagine the futures

ii) Epistemological practices: **problem-posing & solving**, **argumentation** & **explanation** to <u>show the passage from the deterministic paradigm to the complex systems perspective,</u> highlighting:

- **deterministic/sequential reasoning** and **probabilistic reasoning/emerging properties**
- **rationalities behind different approaches to problem solving** and the choice of keeping under control/fixing the procedure or the results
- relationship between **epistemology and methods of different disciplines** and **approaches to problem solving** (Computer Science, Mathematics, Physics)
- **argumentation** to decide whether and when to use AI instead of/supporting human beings





iii) *Inquiry based activities*: *peer-to-peer interaction* to find out strategies to:

1. program a robot to win playing Tic-Tac-Toe
2. identify different rationalities behind the solutions we proposed with different approaches to the same problem in Python and Prolog or with a neural network.

Activity: TRIS (Tic Tac Toe)

Goals:

1. To show AI "in action" following the 3 approaches by following different AI playing Tic Tac Toe vs Humans or vs another AI in Python, Prolog and with a neural network
2. To reflect on the impact of the rationalities on the approach to programming in the mentioned cases and on the kind of problems the rationalities suggests to face with each approach, also considering the concepts of efficiency, probability, model.

Description:

- Students **look for and write down strategies to win** and ways to make a robot win
- Experts from the disciplinary fields involved in our project introduce **key concepts**, **different rationalities** behind the choice of a strategy and of a particular kind of programming method, paying attention to the **resonance between these choices and the STEM disciplines**
- Experts interacting with students show **a description in pseudo-language of the code** that makes the AI playing and a **simulation of the code working** and **playing against humans**
- Experts show statistics of AI vs AI, making statistics and providing interpretations of them

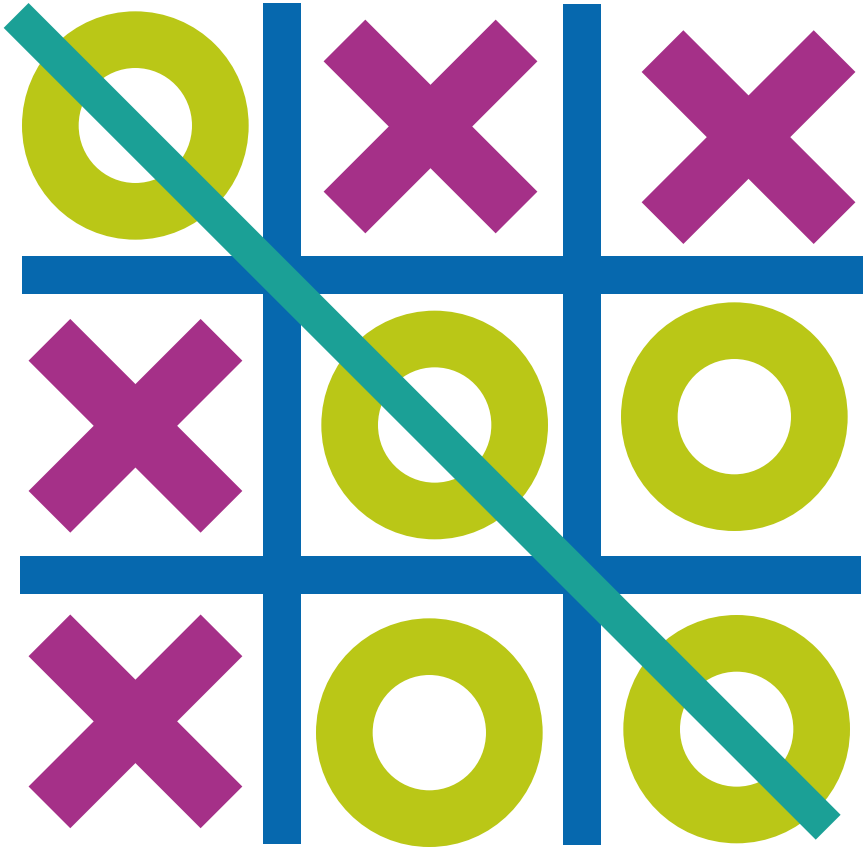
Examples of activities proposed to students (excerpts from the experts' presentations)

Programming machine for learning:

are they really intelligent?

The project is co-funded by the Erasmus+ Programme of the European Union. Grant Agreement n° 2016-1-IT02-KA201-024373.

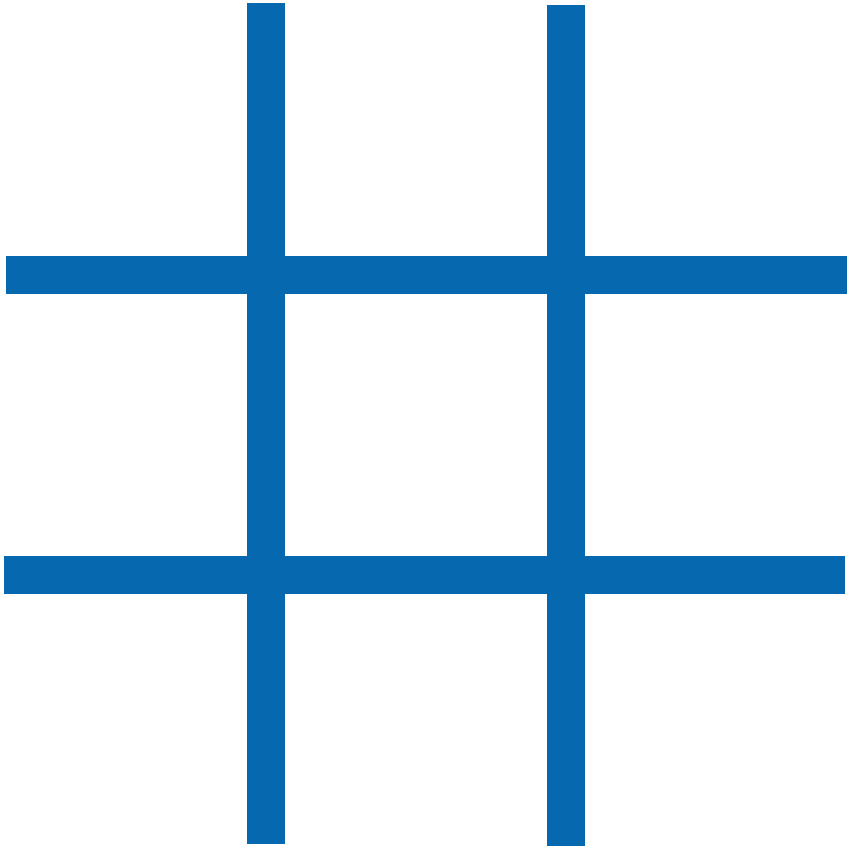
It's your time to imagine the futures

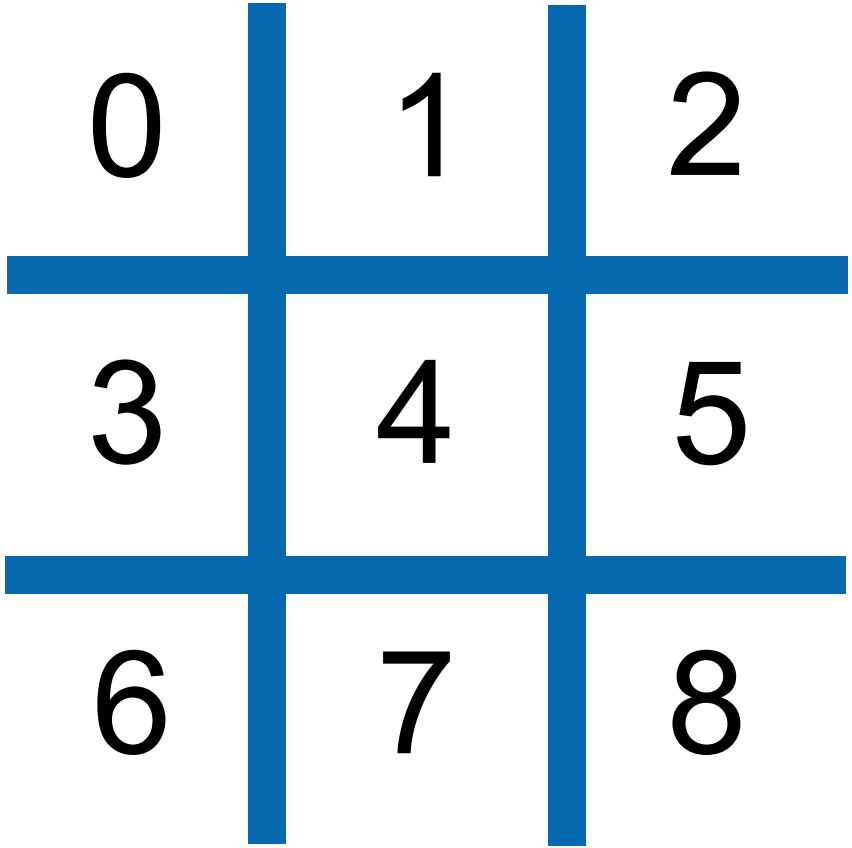


Tic Tac Toe

Human starts first

Computer plays after




0
1
2
3
4
5
6
7
8

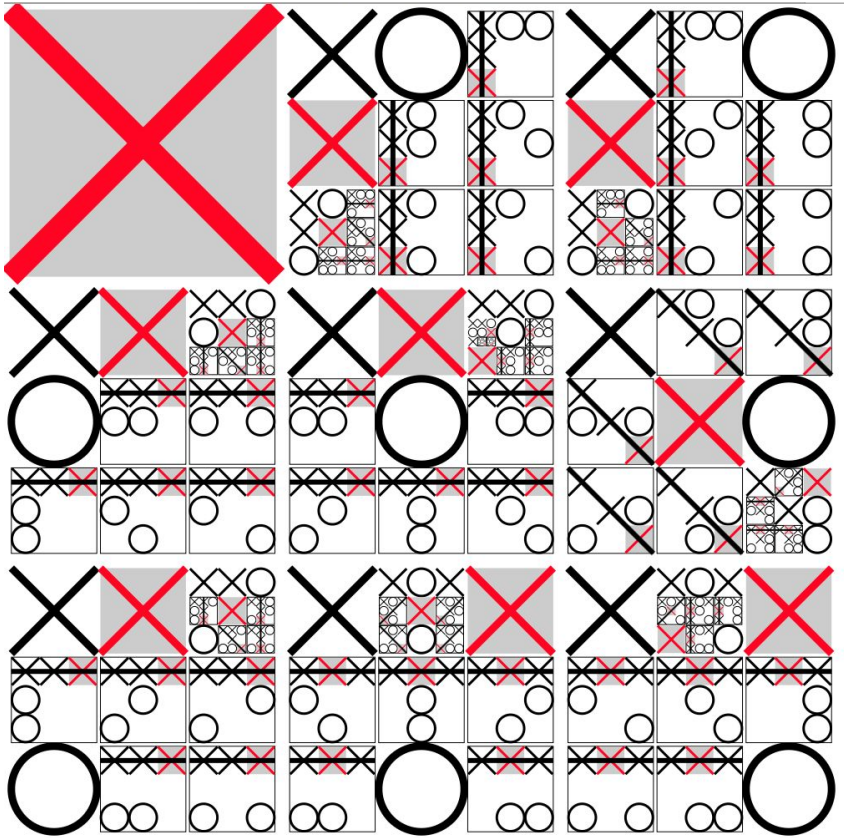
Some plays

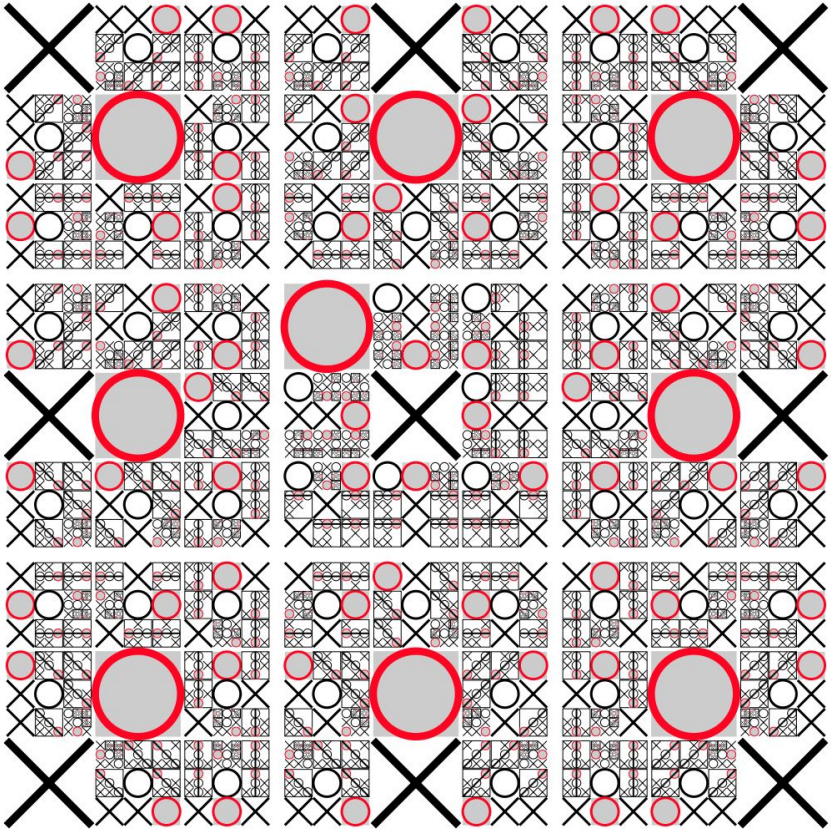
Play Tic Tac Toe in couples thinking about the strategies you are using to win.

Think then to a way to teach Lucy, a robot, how to play and win.

Try to instruct it to make it never lose against a human (write carefully what you said in your discussion and your decision).

How many possibilities?





Example in Prolog:
Is Andrea grandfather of Anna?

BASE OF KNOWLEDGE: “Giovanni is father of Anna”, “Carlo is father of Antonio”, “Andrea is father of Carlo”, “Andrea is father of Giovanni”.

RULE: *If “X is father of Y” and “Y is father of Z”, so: “X is grandfather of Z”.*

QUESTION TO AI: Is Andrea grandfather of Anna?

EsempioNonni

```
1  padre('Andrea', 'Carlo').
2  padre('Andrea', 'Giovanni').
3  padre('Giovanni', 'Anna').
4  padre('Carlo', 'Antonio').
5
6  nonno(X, Z) :- padre(X,Y), padre(Y,Z).
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
```

trace, *nonno*('Andrea', 'Anna')

```
Call: nonno('Andrea', 'Anna')
Call: padre('Andrea', _4114)
Exit: padre('Andrea', 'Carlo')
Call: padre('Carlo', 'Anna')
Fail: padre('Carlo', 'Anna')
Redo: padre('Andrea', _4118)
Exit: padre('Andrea', 'Giovanni')
Call: padre('Giovanni', 'Anna')
Exit: padre('Giovanni', 'Anna')
Exit: nonno('Andrea', 'Anna')
true                                  1
```

```
?- trace, nonno('Andrea', 'Anna')
```

Examples▲ History▲ Solutions▲ table results Run!

I SEE
It's your time to imagine the futures