Logica

Corso di Laurea in Informatica

AA 2025-2026

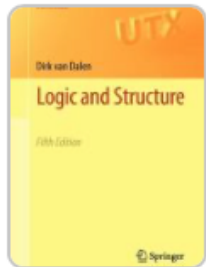## Logica simbolica

Libro   Masini, Andrea (<1958-^^^^>), Milano, McGraw-Hill education, c2023

📚 Disponibile presso Biblioteca centrale "E. Meneghetti" Prestito 20 giorni: BM AB 500 A 159

⌄ Altri riferimenti   (1)

Logic and structure / Dirk van Dalen

Libro   Dalen, Dirk van, 5. ed, Berlin, Springer, c2013

📚 Disponibile presso Biblioteca "Bruno Forte", Dipartimento di Informatica Prestito 20 giorni: INF 511 DAL 2013
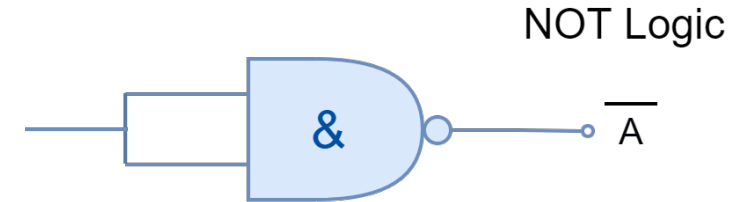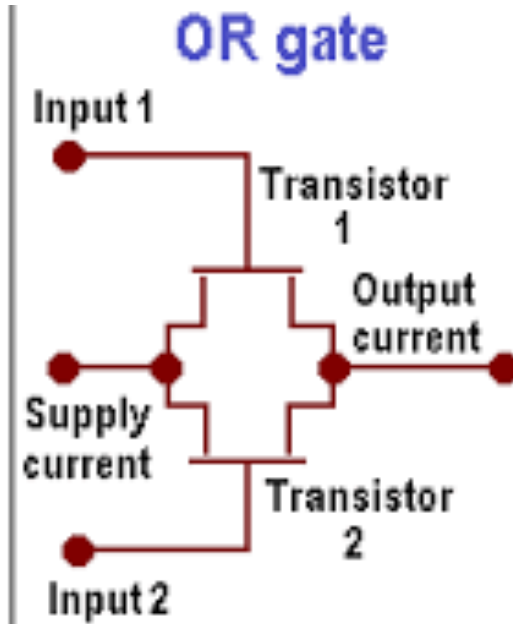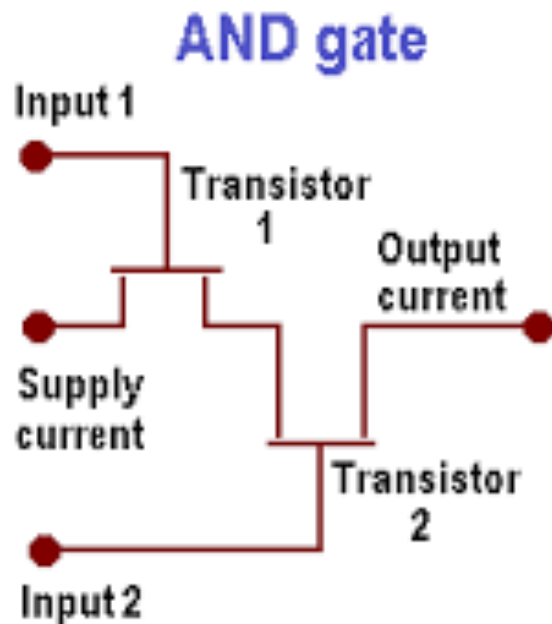
Logica in Informatica

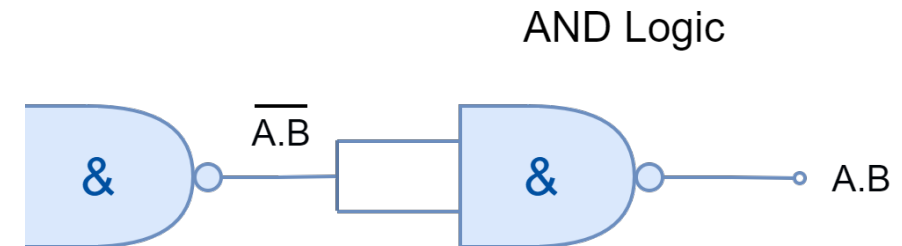**Logic is used in almost every field of computer science**

- the construction of computers, such as computer architecture (digital gates, hardware verification),
- software engineering (specification, verification),
- programming languages (semantics, type theory, abstract data types, object-oriented programming),
- databases (relational algebra),
- artificial intelligence (automated theorem proving, knowledge representation),
- algorithms and theory of computation (complexity, computability), etc.

CPU Architecture Logic Gates

NOT Logic

A	Q
0	1
1	0

AND Logic

$\overline{A.B}$ A.B

A	B	$\overline{A}$
0	0	
0	1	
1	0	
1	1	

OR Logic

$\overline{A}$

$\overline{B}$

A+B

A	B	
0	0	
0	1	
1	0	
1	1	

Prolog: Programming in Logic
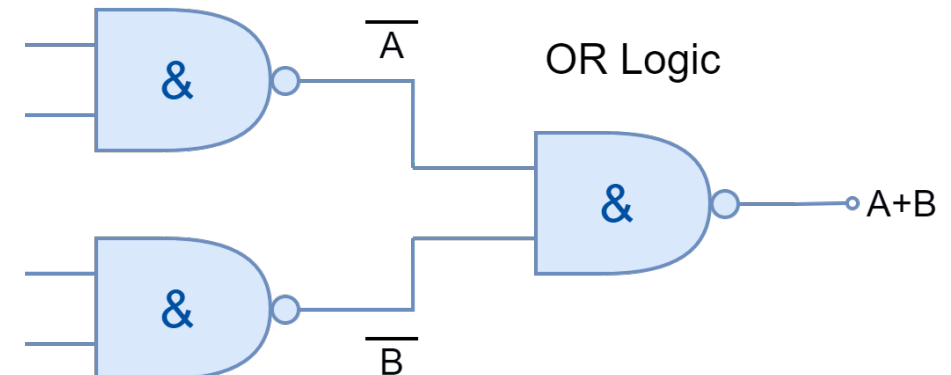

```
D:\VP\_Vip6\demo\pie\Exe\FILE0.PRO
arent(person("Bill","male"),person("John","male")).
arent(person("Pam","female"),person("Bill","male")).
arent(person("Pam","female"),person("Jane","female")).
arent(person("Jane","female"),person("Joe","male")).

randFather(Person, TheGrandFather) :-
    parent(Person, ParentOfPerson),
    father(ParentOfPerson, TheGrandFather).

ather(P, person(Name, "male")) :-
    parent(P, person(Name, "male")).
```
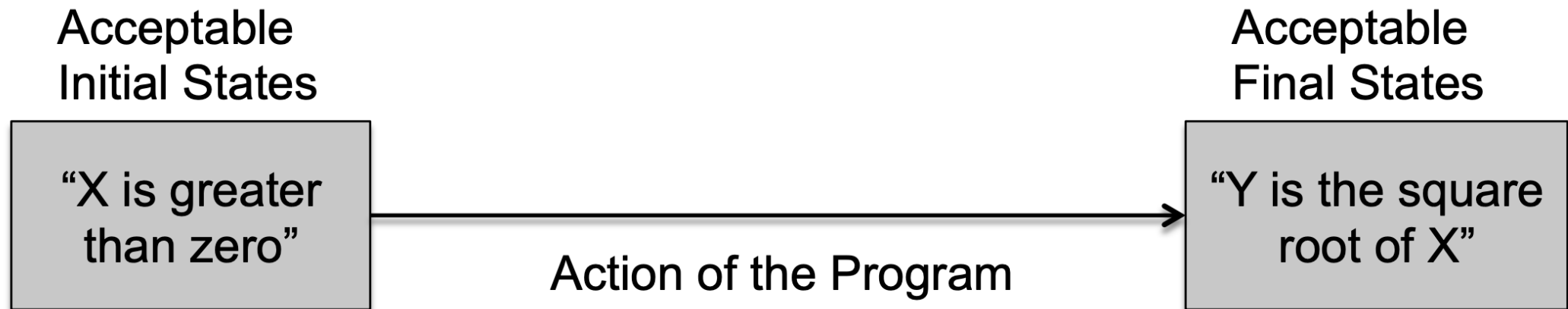
- *Programs are expressed in terms of relations, represented as facts and rules.*

- *A computation is initiated by running a query over these relations.*

- *Relations and queries are constructed by Horn clauses (special first-order formulas)*

Axiomatic Semantics

Hoare Logic: deductive system for proving program correctness

Acceptable Initial States

"X is greater than zero"

Action of the Program

Acceptable Final States

"Y is the square root of X"

Logic in AI

Artificial Intelligence (AI) is about building machines and systems that can reason, learn, and solve problems, similar to how humans do.

*In many AI applications, **logical reasoning** plays a crucial role, allowing systems to make decisions based on given conditions and facts.*

By using propositional logic, AI systems can reason effectively and perform tasks like automated decision-making, knowledge representation, and game playing.
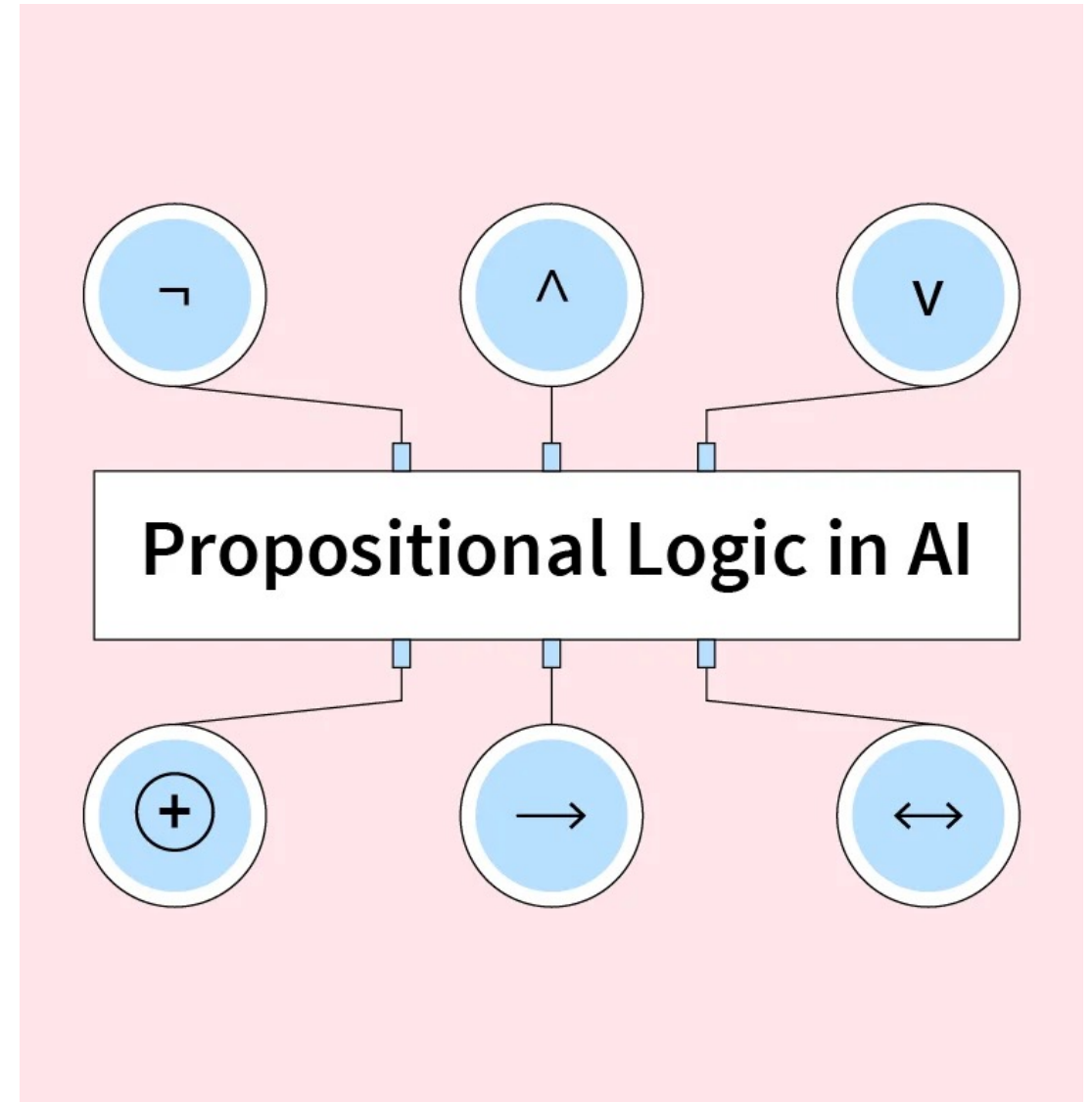
Types of Logics

- Formal Logic
  - **Symbolic logic**
  - Mathematical logic (Computability Theory)
- Philosophical logic

Philosophical logic deal with arguments in the natural language used by humans.

Example

Given the premises that (a) "all men are mortal" and (b)

"Socrates is a man", we may draw the conclusion that (c) "Socrates is mortal", by the inference rule of Modus Ponens.

Logical Paradoxes

• *A paradox is generally a puzzling conclusion we seem to be driven towards by our reasoning, but which is highly counterintuitive, nevertheless.*

• *There are, among these, a large variety of paradoxes of a logical nature which have teased even professional logicians, in some cases for several millennia.*

• *They are a group of antinomies centered on the notion of* **self-reference***, some of which were known in Classical times, but most of which became particularly prominent in the early decades of last century.*