Artificial Intelligence

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2024-2025

Knowledge

knowledge-based agents

اداه او وکیل

agents that reason by operating on internal representations of knowledge

If it didn't rain, Harry visited Hagrid today.

Harry visited Hagrid or Dumbledore today, but not both.

Harry visited Dumbledore today.

Harry did not visit Hagrid today.

It rained today.

Logic

sentence

an assertion about the world
in a knowledge representation language

Propositional Logic

Proposition Symbols

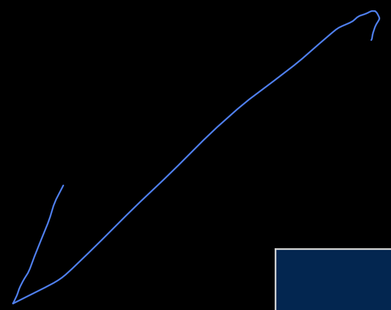
P Q R

Logical Connectives

$\neg$	$\wedge$	$\vee$
not	and	or

$\rightarrow$	$\leftrightarrow$
implication	biconditional
شرطي - إثباتي	ثنائي الأبعاد

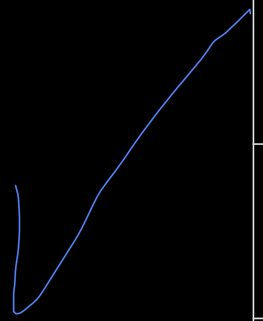
Not (¬)



P	$\neg P$
false	true
true	false

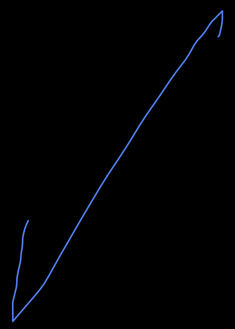
And ($\wedge$)

P	Q	$P \wedge Q$
false	false	false
false	true	false
true	false	false
true	true	true



Or ($\vee$)

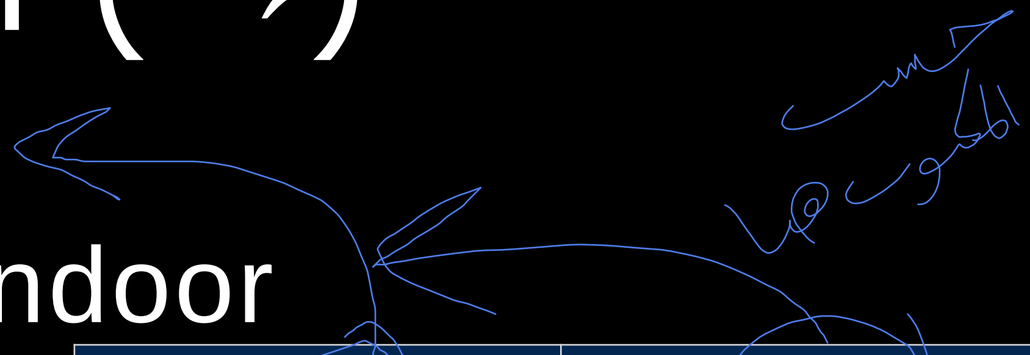
P	Q	$P \vee Q$
false	false	false
false	true	true
true	false	true
true	true	true



Implication ($\rightarrow$)

P: If It is raining

Q: Then I will be indoor



Let p: "you take out the trash"
q: "you will get a dollar"

P	Q	$P \rightarrow Q$
false	false	true
false	true	true
true	false	false
true	true	true

Biconditional ($\leftrightarrow$)

P	Q	$P \leftrightarrow Q$
false	false	true
false	true	false
true	false	false
true	true	true

model

assignment of a truth value to every propositional symbol (a "possible world")

model

P: It is raining.

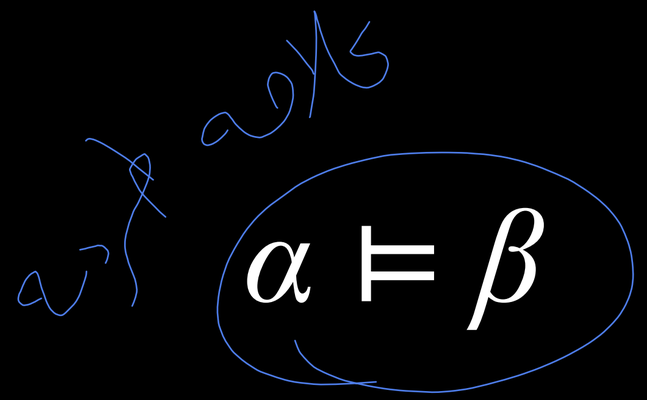
Q: It is a Tuesday.

$\{P = \text{true}, Q = \text{false}\}$

knowledge base

a set of sentences known by a knowledge-based agent

Entailment



In every model in which sentence α is true, sentence β is also true.

If it didn't rain, Harry visited Hagrid today.

Harry visited Hagrid or Dumbledore today, but not both.

Harry visited Dumbledore today.

Harry did not visit Hagrid today.

It rained today.

inference

the process of deriving new sentences from old ones

P: It is a Tuesday.

Q: It is raining.

R: Harry will go for a run.

KB: $(P \wedge \neg Q) \rightarrow R$ P $\neg Q$

Inference: R

Inference Algorithms

Does

$\mathrm{KB} \models \alpha$

?

Model Checking

Model Checking

- To determine if $\text{KB} \models \alpha$:
  - Enumerate all possible models.
  - If in every model where KB is true, α is true, then KB entails α.
  - Otherwise, KB does not entail α.

P: It is a Tuesday. Q: It is raining. R: Harry will go for a run.

KB: $(P \wedge \neg Q) \rightarrow R$ P $\neg Q$

Query: R

P	Q	R	KB
false	false	false	
false	false	true	
false	true	false	
false	true	true	
true	false	false	
true	false	true	
true	true	false	
true	true	true	

P: It is a Tuesday. Q: It is raining. R: Harry will go for a run.

KB: $(P \wedge \neg Q) \rightarrow R$ P $\neg Q$

Query: R

P	Q	R	KB
false	false	false	false
false	false	true	false
false	true	false	false
false	true	true	false
true	false	false	false
true	false	true	true
true	true	false	false
true	true	true	false

P: It is a Tuesday. Q: It is raining. R: Harry will go for a run.

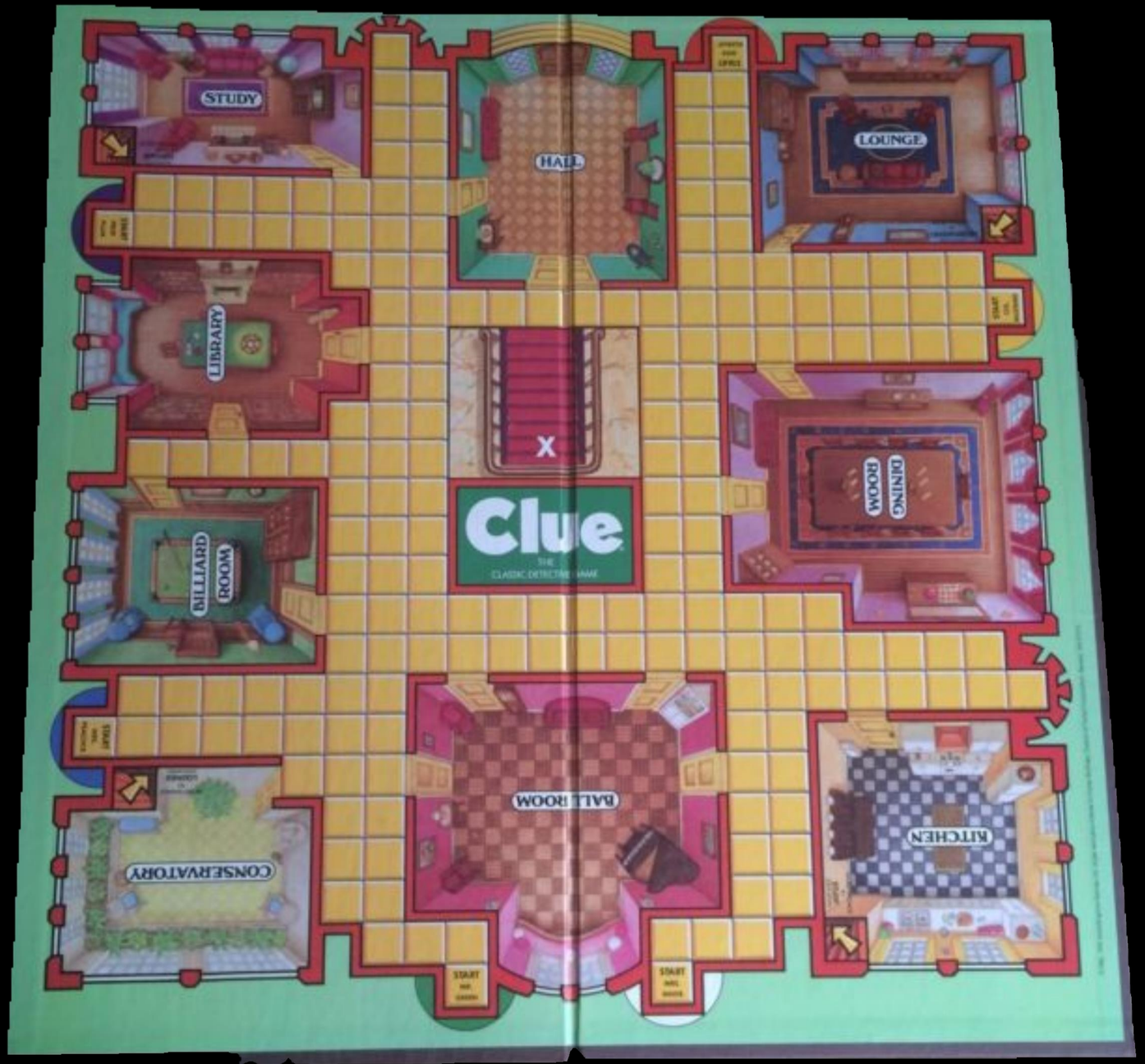
KB: $(P \wedge \neg Q) \rightarrow R$ P $\neg Q$

Query: R

P	Q	R	KB
false	false	false	false
false	false	true	false
false	true	false	false
false	true	true	false
true	false	false	false
true	false	true	true
true	true	false	false
true	true	true	false

Knowledge Engineering

Clue


STUDY
HALL
LOUNGE
LIBRARY
X
Clue
DINING ROOM
BILLIARD ROOM
BALL ROOM
CONSERVATORY
KITCHEN
START
START
START

Clue

نداء العبودية

هل انت محرر؟

People	Rooms	Weapons
Col. Mustard	Ballroom	Knife
Prof. Plum	Kitchen	Revolver
Ms. Scarlet	Library	Wrench

Clue

People

Rooms

Weapons

Clue

People

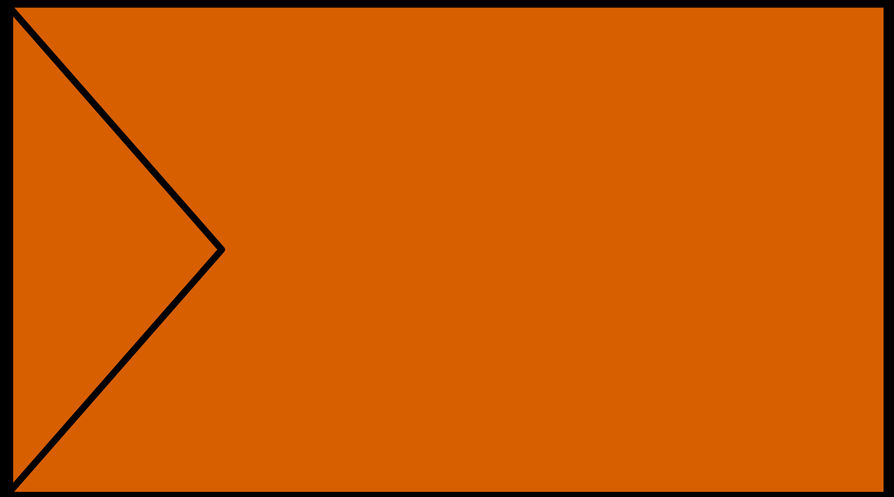
Rooms

Weapons

People

Rooms

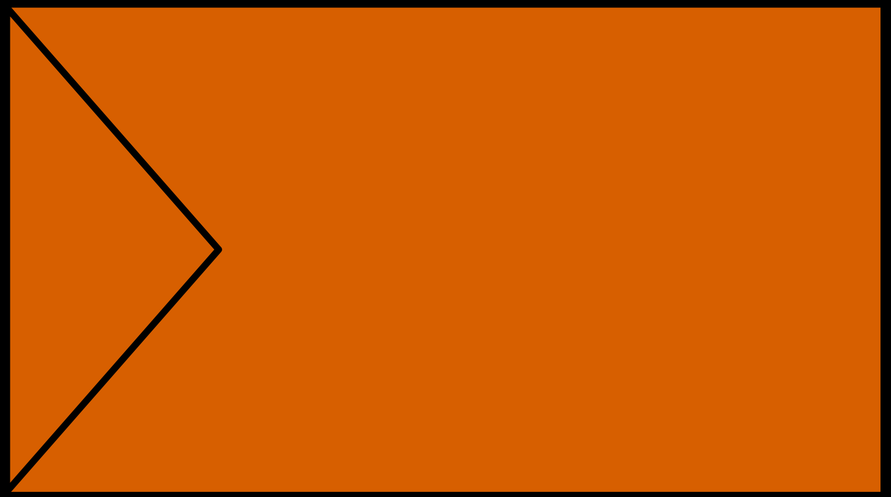
Weapons



People

Rooms

Weapons



Clue

Propositional Symbols

mustard	*ballroom*	*knife*
plum	*kitchen*	*revolver*
scarlet	*library*	*wrench*

Clue

$$(mustard \vee plum \vee scarlet)$$

$$(ballroom \vee kitchen \vee library)$$

$$(knife \vee revolver \vee wrench)$$

$$\neg plum$$

$$\neg mustard \vee \neg library \vee \neg revolver$$

Logic Puzzles

- Gilderoy, Minerva, Pomona and Horace each belong to a different one of the four houses: Gryffindor, Hufflepuff, Ravenclaw, and Slytherin House.
- Gilderoy belongs to Gryffindor or Ravenclaw.
- Pomona does not belong in Slytherin.
- Minerva belongs to Gryffindor.

Logic Puzzles

Propositional Symbols

GilderoyGryffindor
GilderoyHufflepuff
GilderoyRavenclaw
GilderoySlytherin

MinervaGryffindor
MinervaHufflepuff
MinervaRavenclaw
MinervaSlytherin

PomonaGryffindor
PomonaHufflepuff
PomonaRavenclaw
PomonaSlytherin

HoraceGryffindor
HoraceHufflepuff
HoraceRavenclaw
HoraceSlytherin

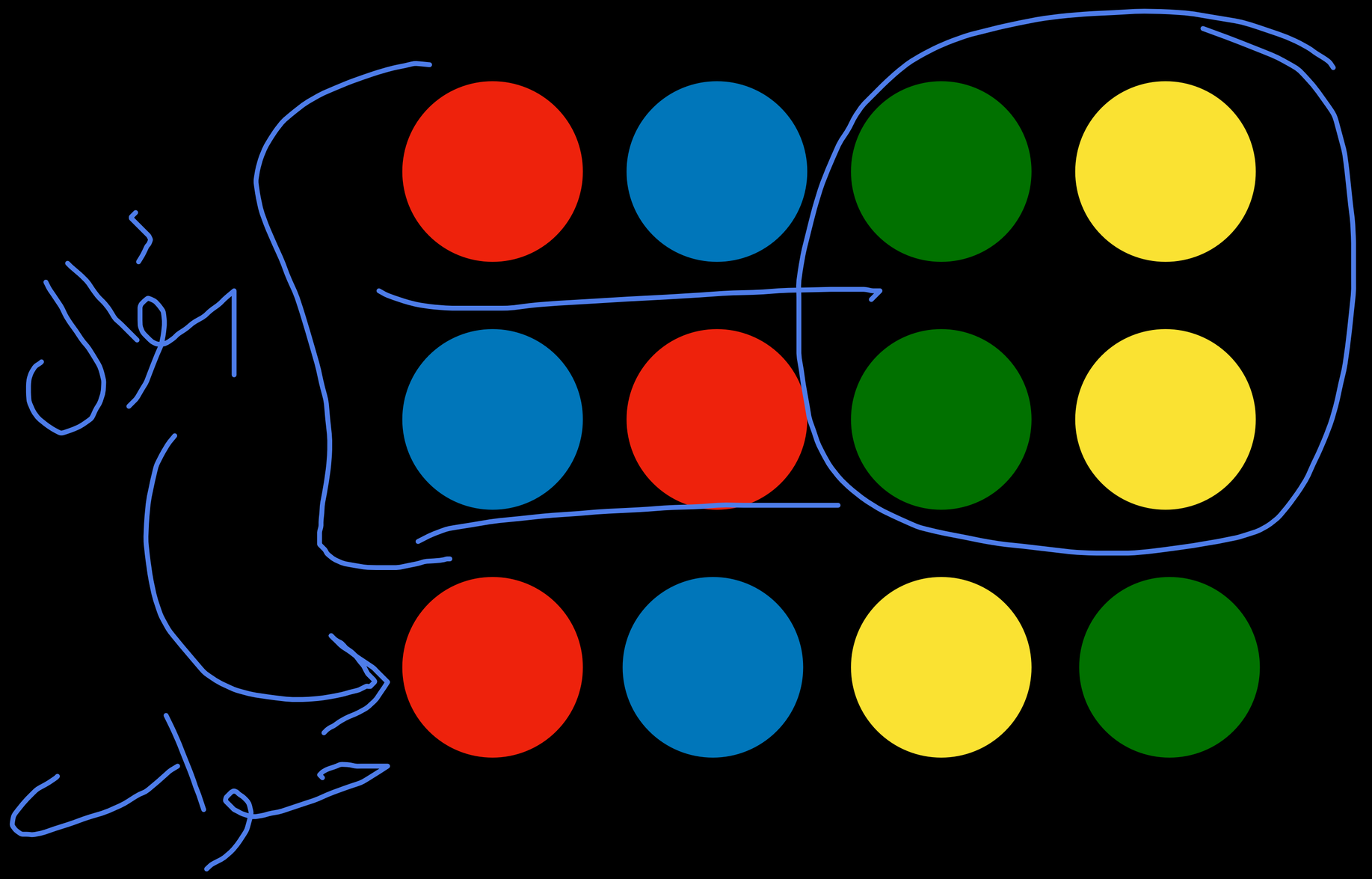
Logic Puzzles

$$(PomonaSlytherin \rightarrow \neg PomonaHufflepuff)$$

$$(MinervaRavenclaw \rightarrow \neg GilderoyRavenclaw)$$

$$(GilderoyGryffindor \vee GilderoyRavenclaw)$$

Mastermind



Thanks