RickLab

About People Works

人工智能原理 5

Ricklab

A little bit of this, A little bit of that

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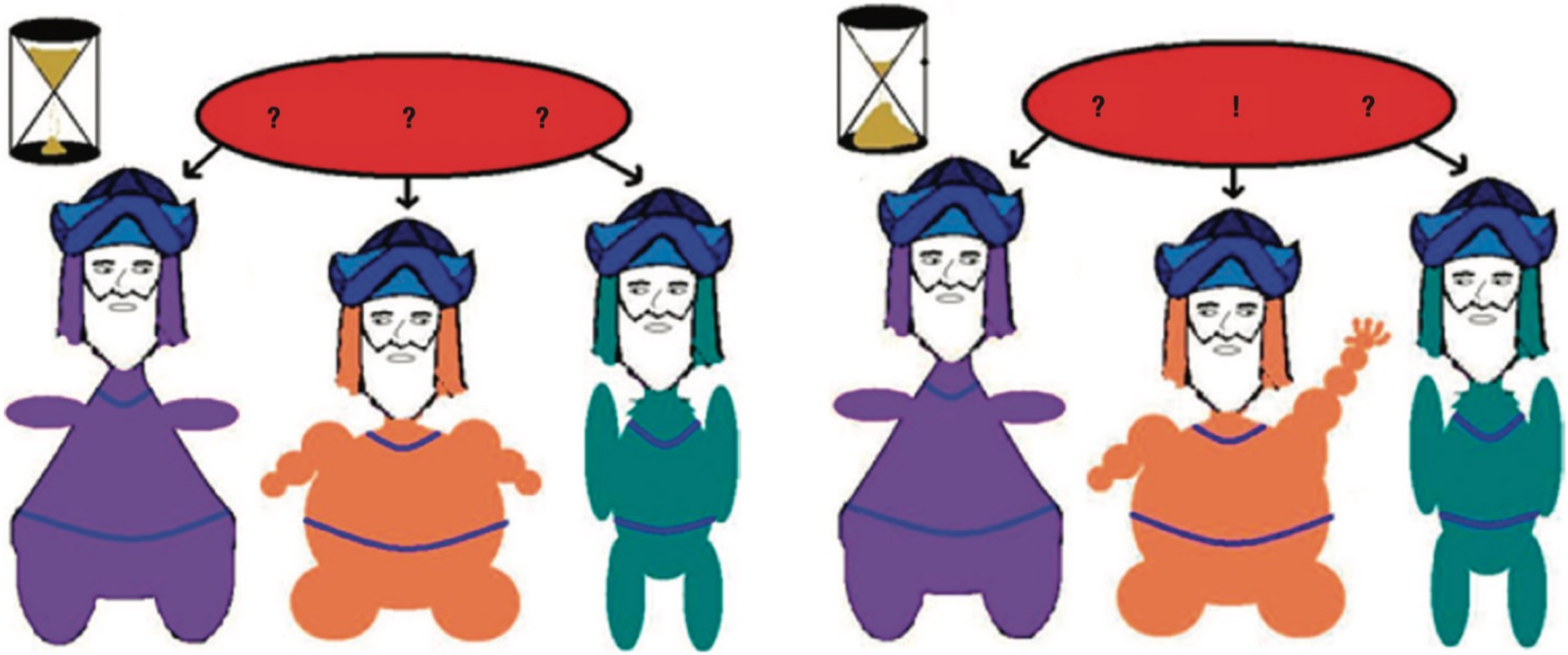
Welcome to Ricklab with some of our works.

Logic in Artificial intelligence


CREWMATE
There are 3 Impostors among us
MUD

Logic is a concise language for

knowledge representation



WM_1( )

$$WM\_1(W) \wedge WM\_2(W) \wedge WM\_3(B)$$

Propositional Logic

1. He is taking the bus home tonight.
2. The music was beautiful.
3. Watch out.

The **atomic sentences** consist of a single proposition symbol.

propositional logic variables: p, q, r……

Complex sentences are constructed from simpler sentences, using parentheses and operators called logical connectives.

Symbol	Name	Example	English Equivalent
$\wedge$	conjunction	$\mathbf{p} \wedge \mathbf{q}$	**p** and **q**
$\vee$	disjunction	$\mathbf{p} \vee \mathbf{q}$	**p** or **q**
$\sim$	negation	$\sim\mathbf{p}$	not **p**
$\Rightarrow$	implication	$\mathbf{p} \Rightarrow \mathbf{q}$	if **p** then **q** *or* **p** implies **q**
$\Leftrightarrow$	biconditional	$\mathbf{p} \Leftrightarrow \mathbf{q}$	**p** if and only if **q** *or* **p** is equivalent to **q**

Truth Table

(a) AND function

p	q	p ∧ q
F	F	F
F	T	F
T	F	F
T	T	T

(b) OR function

p	q	p ∨ q
F	F	F
F	T	T
T	F	T
T	T	T

(c) NOT function

p	~p
F	T
T	F

What is XOR

Exclusive OR = XOR

(b) OR function

p	q	p ∨ q
F	F	F
F	T	T
T	F	T
T	T	T

$\oplus$

p	q	p $\veebar$ q
F	F	F
F	T	T
T	F	T
T	T	F

p(前项、前件、前提) ⇒ q (后项、后件、结论)

p	q	p ⇒ q
F	F	T
F	T	T
T	F	F
T	T	T

There is only one false when the case in which p is true and q is false.

converse、 inverse、 contrapositive

1	2	3	4	5	6
p	q	$p \Rightarrow q$	$q \Rightarrow p$	$\sim p \Rightarrow \sim q$	$\sim q \Rightarrow \sim p$
F	F	T	T	T	T
F	T	T	F	F	T
T	F	F	T	T	F
T	T	T	T	T	T

Two tautologies in the propositional logic

p	q	$(p \Rightarrow q)$	$(\sim p \vee q)$	$\boxed{(p \Rightarrow q) \equiv (\sim p \vee q)}$	$(\sim p \vee \sim q) \equiv \sim(p \wedge q)$
F	F	T	T	T	T
F	T	T	T	T	T
T	F	F	F	T	T
T	T	T	T	T	T

$$(p \Rightarrow q) \equiv \sim p \vee q$$

Two tautologies in the propositional logic

p	q	(p ⇒ q)	(~p ∨ q)	(p ⇒ q) ≡ (~p ∨ q)	(~p ∨ ~q) ≡ ~(p ∧ q)
F	F	T	T	T	T
F	T	T	T	T	T
T	F	F	F	T	T
T	T	T	T	T	T

$$\neg(\alpha \wedge \beta) \equiv (\neg\alpha \vee \neg\beta) \quad \text{De Morgan}$$
$$\neg(\alpha \vee \beta) \equiv (\neg\alpha \wedge \neg\beta) \quad \text{De Morgan}$$

$$
\begin{aligned}
(\alpha \land \beta) &\equiv (\beta \land \alpha) \quad \text{commutativity of } \land \\
(\alpha \lor \beta) &\equiv (\beta \lor \alpha) \quad \text{commutativity of } \lor \\
((\alpha \land \beta) \land \gamma) &\equiv (\alpha \land (\beta \land \gamma)) \quad \text{associativity of } \land \\
((\alpha \lor \beta) \lor \gamma) &\equiv (\alpha \lor (\beta \lor \gamma)) \quad \text{associativity of } \lor \\
\neg(\neg\alpha) &\equiv \alpha \quad \text{double-negation elimination} \\
(\alpha \Rightarrow \beta) &\equiv (\neg\beta \Rightarrow \neg\alpha) \quad \text{contraposition} \\
(\alpha \Rightarrow \beta) &\equiv (\neg\alpha \lor \beta) \quad \text{implication elimination} \\
(\alpha \Leftrightarrow \beta) &\equiv ((\alpha \Rightarrow \beta) \land (\beta \Rightarrow \alpha)) \quad \text{biconditional elimination} \\
\neg(\alpha \land \beta) &\equiv (\neg\alpha \lor \neg\beta) \quad \text{De Morgan} \\
\neg(\alpha \lor \beta) &\equiv (\neg\alpha \land \neg\beta) \quad \text{De Morgan} \\
(\alpha \land (\beta \lor \gamma)) &\equiv ((\alpha \land \beta) \lor (\alpha \land \gamma)) \quad \text{distributivity of } \land \text{ over } \lor \\
(\alpha \lor (\beta \land \gamma)) &\equiv ((\alpha \lor \beta) \land (\alpha \lor \gamma)) \quad \text{distributivity of } \lor \text{ over } \land
\end{aligned}
$$

证明$[(\sim p \vee q) \wedge \sim q\ ] \Rightarrow \sim p$是一个重言式

An argument in the propositional logic has the form:

A: P_1

P_2

.

.

.

P_r

C // **Conclusion**

$$(P_1 \wedge P_2 \wedge \ldots \wedge P_r) \Rightarrow C \text{ is a tautology.}$$

Let **g** represent: "the moon is made of green cheese" and **r** represent: "I am rich." This argument has the form:

$$\frac{g}{\therefore\ r}$$

1. $\mathbf{p} \Rightarrow \mathbf{q}$
2. $\mathbf{q} \Rightarrow \sim\mathbf{r}$
3. $\sim\mathbf{p} \Rightarrow \sim\mathbf{r}$

$\therefore \sim\mathbf{r}$

1	2	3	4	5	6	7	8
p	q	r	$p \Rightarrow q$	$q \Rightarrow \sim r$	$\sim p \Rightarrow \sim r$	$4 \wedge 5 \wedge 6$	$7 \Rightarrow \sim r$
F	F	F	T	T	T	T	T
F	F	T	T	T	F	F	T
F	T	F	T	T	T	T	T
F	T	T	T	F	F	F	T
T	F	F	F	T	T	F	T
T	F	T	F	T	T	F	T
T	T	F	T	T	T	T	T
T	T	T	T	F	T	F	T

This approach assumes that the **premises are true** and that the **conclusion is false**

There is no:

1. implication
2. conjunction
3. **double negation**

1. $p \Rightarrow q$
2. $q \Rightarrow \sim r$
3. $\sim p \Rightarrow \sim r$

$\therefore \sim r$

1') $\sim p \vee q$
2') $\sim q \vee \sim r$
3') $p \vee \sim r$
4') r

Predicate Logic

A predicate logic expression consists of a **predicate name** followed by **a list (possibly empty) of arguments**.

WM_1( )

Two quantifiers

∃: existential quantifier, read as: “there exists an x”

∀: universal quantifier, reads as: “for all x”

Because **∀ is really a conjunction** over the universe of objects and **∃ is a disjunction**

$$\neg\exists x\ P \equiv \forall x\ \neg P$$
$$\neg\forall x\ P \equiv \exists x\ \neg P$$

Setting (sun) and ~Setting (sun) is a contradiction

Beautiful (Day) and ~Beautiful (Night)

In order to find contradictions, we require a matching procedure that compares two literals to detect whether there exists a set of substitutions that makes them identical. This procedure is called **unification**.

If two literals are to unify, then first, their predicate symbols must match

If the predicate symbols match, then you check the arguments one pair at a time.