

**Predicate logic symbols**  $\rightarrow$   $\neg$   $\wedge$   $\vee$   $\forall$   $\exists$

**Why predicate logic ?** It permits representation of things that can not be represented in propositional logic. The structure of representation reflects the structure of the knowledge itself

**Problems in predicate logic:** It is not decidable. it is semi-decidable.

☺ **Example : represent the following sentences in wff's**

1. *Marcus* was a man.
2. *Marcus* was a Pompeian.
3. **All** Pompeians were Romans.
4. *Caesar* was a ruler.
5. **All** Romans were either loyal to Caesar OR hated him .
6. **Everyone** is loyal to someone.
7. **People** only try to kill rulers they are NOT loyal to.
8. *Marcus* tried to kill *Caesar*

**Answer >>>**

1. man (Marcus)
2. Pompeian (Marcus)
3.  $\forall x : \text{Pompeian}(x) \rightarrow \text{Roman}(x)$
4. ruler (Caesar)
5.  $\forall x : \text{Roman}(x) \rightarrow \text{loyalTo}(x, \text{Caesar}) \vee \text{hated}(x, \text{Caesar})$
6.  $\forall x : \exists y: \text{loyalTo}(x, y)$
7.  $\forall x : \forall y: \text{person}(x) \wedge \text{ruler}(y) \wedge \text{tryToKill}(x, y) \rightarrow \neg \text{loyalTo}(x, y)$
8. tryToKill (Marcus, Caesar)

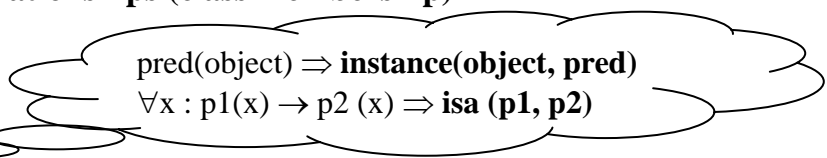
**Was Marcus loyal to Caesar ?  $\rightarrow$  Prove  $\neg \text{loyalTo}(\text{Marcus}, \text{Caesar})$**

First we need to add fact :  $\forall x : \text{man}(x) \rightarrow \text{person}(x)$

$\neg \text{loyalTo}(\text{Marcus}, \text{Caesar})$   
 $\uparrow$  ( 7, substitution)  
 **$\text{person}(\text{Marcus}) \wedge \text{ruler}(\text{Caesar}) \wedge \text{tryToKill}(\text{Marcus}, \text{Caesar})$**   
 $\uparrow$  ( 4 )  
 **$\text{person}(\text{Marcus}) \wedge \text{tryToKill}(\text{Marcus}, \text{Caesar})$**   
 $\uparrow$  ( 8 )  
 **$\text{person}(\text{Marcus})$**

**(X) Representing instance & isa relationships (class membership)**

1. instance( Marcus, man)
2. instance ( Marcus, Pompeian)
3. isa( Pompeian , Roman )
4. instance (Caesar, ruler)
5.  $\forall x : \text{instance}(x, \text{Roman}) \rightarrow \text{loyalTo}(x, \text{Caesar}) \vee \text{hated}(x, \text{Caesar})$
6.  $\forall x : \exists y: \text{loyalTo}(x, y)$
7.  $\forall x : \forall y: \text{instance}(x, \text{person}) \wedge \text{instance}(y, \text{ruler}) \wedge \text{tryToKill}(x, y) \rightarrow \neg \text{loyalTo}(x, y)$
8. tryToKill (Marcus, Caesar)
9.  $\forall x : \forall y: \forall z: \text{instance}(x, y) \wedge \text{isa}(y, z) \rightarrow \text{instance}(x, z)$



## Hintats

Any, all, every, each, نوع, جمع, ----->  $\forall x$

- all Egyptians are smart ----->  $\forall x: \text{Egyptian}(x) \rightarrow \text{smart}(x)$
- Canadian girls are beautiful ----->  $\forall x: \text{girl}(x) \wedge \text{Canadian}(x) \rightarrow \text{beautiful}(x)$
- a bird (نوع) can fly ----->  $\forall x: \text{bird}(x) \rightarrow \text{fly}(x)$

A, an, one, some, there is, there was, there exists ----->  $\exists x$

$\forall x: (... \rightarrow ...)$

$\exists x: (... \wedge ...)$

$\forall x: \text{die}(x)$  ، تبقى ، every one will die : (كلنا لها) مثل حذفه، يمكن حذفه، everyone ، زي آدمين ، عن البنى آدمين ، لو المبتدأ عن البنى آدمين ، زي everyone ، يمكن حذفه، مثل (كلنا لها) : every one will die ، تبقى ،  $\text{die}(x)$

$\forall x$	$... \wedge ... \wedge ...$	اسم موصول that, which, who, what, where, when وممكن يكون محذوف، خذ بالك	$\rightarrow$	باقي الجملة
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مثال: الجملة السابعة في المثال الأول