

**PROBLEM SET 2: Predicate Logic****EDyL 2019-2020**

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[**Solutions (in class):** 2019/10/15]

**NOTE:** Make sure to include explanations in your answers. An exercise whose solution is correct but does not include an explanation can be considered incomplete and not receive full credit.

**EXERCISE 1.** Consider the ontology:

Constants: *Thelma, Louise* (people)

Variables: *p* (people), *x* (objects)

<u>Predicates</u>	Name	Arity	Description (including the type of arguments)
	Likes	2	Likes( <i>p</i> , <i>x</i> ) evaluates to "True" if and only if <i>p</i> likes the type of food <i>x</i>
	Cooked	1	Cooked( <i>x</i> ) evaluates to "True" if and only if <i>x</i> is cooked (not raw)
	Food	1	Food( <i>x</i> ) evaluates to "True" if and only if <i>x</i> is a type of food
	Fish	1	Fish( <i>x</i> ) evaluates to "True" if and only if <i>x</i> is a type of fish

Write WFFs in predicate logic that formalize as literally as possible the statements:

- I. "There are some types of food that Thelma dislikes but Louise likes"

- II. "Louise dislikes all types of food that Thelma likes (and possibly others)"

- III. "Thelma likes all types of food except raw fish (which she dislikes)"

## EXERCISE 2.

Build an ontology to formulate statements about operations on integers.

	Symbol	Interpretation
Constant	0	Integer of value 0
Variables	$n, m, r, s, \dots$	Integers
Predicates		
Functions		

Formulate the following statements as WFFs in predicate logic

- a)** The result of subtracting two integers is zero if and only if these integers are equal

- b)** An integer number is the neutral element with respect to the sum if and only if when subtracted from any integer the result is equal to this second integer

- c)** For any integer there is another integer such that the result of subtracting the second integer from the first one yields the neutral element.

- d)** The neutral element with respect to the sum is unique and equal to zero

**EXERCISE 3.** Let us consider a series of elections in which only three voters can cast votes according to their preferences

Variables:  $x, y, z, \dots$  (candidates)  
 $p, q, r, \dots$  (voters)

Predicates:  $P^3$  "Prefers":  $P(p, x, y)$  evaluates to *True* if voter  $p$  prefers candidate  $x$  to candidate  $y$ , *False* otherwise.  
 $B^2$  "Beats":  $B(x, y)$  evaluates to *True* if candidate  $x$  beats candidate  $y$  in a two-candidate election, *False* otherwise.

Translate the following knowledge base into well-formed formulas in predicate logic. The predicate "Equal" ( $E^2$ ) can be used if needed.

- a. Predicate "Beats" is antisymmetric: If a candidate beats another one, the second one does not beat the first one

- b. Predicate "Prefers" is transitive: If a voter prefers a candidate to another one, and also prefers this second candidate to a third one, she prefers the first candidate to the third one.

- c. In a two-candidate election, if at least two different voters prefer one candidate to another one, the first one beats the second one.

- d. Predicate "Beats" is not transitive