| **NOME** | **DEFINITION** | **WHAT IT NEEDS** | **RESULTS** | **WHAT TO CHECK** | **EXAMPLE** |
| --- | --- | --- | --- | --- | --- |
| Constant | Every term is a constant |  |  | If arity = 0 | c,d…. |
| Predicate | Can be unary binary, predicates, intransitive verbs  Predicate = boolean |  | Boolean result | Check arity | *dog(fuffi), man(Bob), sleep(Joe)*  (unary)  *Love(Angie,20)*(binary)  *Give(Angie,venti, roses)*(ternary)  P,R,Q… |
| Term | Denote individuals (objects). Can be repeated |  |  | Ground (without variables)  Not ground (with variables) | t,u,u… |
| Variables | Can not be repeated |  |  | Is not repeated. Free (no quantifiers) and bounded (located inside of a subformula of the kind ∀xB or ∃xB ) | x, x1, x2, y, z…  ∀x(x,y) → Q(x)  Bounded  Free |
| Formula | Denote booleans (truth values) | Boolean | Boolean | Open: without quantifies (∀, ∃)  Not open: with quantifies (∀, ∃) | A,B,C… |
| Function | If arity = 0 is a term | Term | Term |  | f,g,h… |
| Sentence | Formula where no terms occurs free (are all bounded) | Boolean | Boolean |  | ∀ xR(x,f(x))  ∀xR(x,y) NOT SENTENCE |
| Universal closure/formula | Is a formula with quantifiers  With ∀ |  |  |  | ∀xR(x,y) |
| Existential closure/formula | Is a formula with ∃ quantifiers  With ∃ |  |  |  | ∃xR(x,y) |
| Atomic | Predicate letter applied to the right number of terms |  |  | Check arity | P(x)  If α (x) = 1 |
| Literal | Atom or negated atom |  |  |  | t, ¬ t… |
| Clause | Disjunction of literals |  |  |  | t v u, t v ¬ u… |
| CNF | Conjunction of clauses |  |  |  | (t v u) ^ ( t ^ ¬ u) |

grammatically correct?

which ones are sentences?

which ones are open?

which ones are ground?

which ones are universal?

| **Grammarly correct** | Check the arity of predicates and of the function |  |
| --- | --- | --- |
| **Sentence** | formula in which no variable is free | If it is not a sentence then there is at least one variable that is not free |
| **Open** | At least one free variable | If it is not open then there is no free variable |
| **Ground** | without using variables | If it is not ground than there is at least one variable |
| **Universal** | Only universal quantifiers | If it is not universal that there are no quantifiers or there is at least one existential quantifiers ( ∃ ) |

| **Free** | A variable without ∃ or ∀ | A variable is not free (bounded) if it has ∃ or ∀ |
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OPEN has opposite NOT OPEN (is wrong CLOSE) has meaning:

*Without quantifiers* (so without ∃ and ∀ )

CLOSE has opposite NOT CLOSE (is wrong OPEN) is the same as saying SENTENCE and has meaning:

*No free variables*

∃x (B(x) v Q(x) ) is NOT OPEN AND CLOSED(sentence)

∀x (B(y) v Q(x)) is NOT OPEN and NOT CLOSE(not sentence)

B(c) v Q(c) is ground