TON DUC THANG UNIVERSITY
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DISCRETE STRUCTURES
Lab 3
The Logic of Compound Statements

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Abstract

In this Laboratory, we will practice printing and converting logic statements while using Python. For theory parts, read Week_3_4_FirstOrderLogic.pdf on Elit

1 Exercises

1. Determine and print domain D, predicate P of the following expression then write the statement in formal form:

    (a) For all fishes, they need water to survive.

    (b) Exist a person, who is left handed

    (c) Exist an employee in the company, who is late to work everyday.

    (d) For all fishes in this pond, they are Koi fish.

    (e) There is at least one creature in the ocean, it can live on land

    (f) Every students in class A did not pass the test

    Example: "For all students, they need to attend classes and do homework." The answer is:
    D is "students"
    P is "need to attend classes and do homework"
    Formal form: For all x in D, P(x)
    The answer can be obtain with the following code:

```python
print("D is 'students'")
print("P is 'need to attend classes and do homework'")
print("Formal form: For all x in D, P(x)")
```

2. Write a function [D,P,F]=formalConvert(S) to extract D and P then convert the statement S from **Exercise 1.** excluded (f) to formal form F.
   Hint: D contains the words between For all/ Exist/ There is at least one and a comma (,);
   P contains the words after the first word from the comma (,).

3. Determine and print domain D, predicate P and Q of the following expression then write the statement in formal form:
   For example: with (a) D is "people", P is "is blond", Q is "is westerner". formal statement: for all x in D, P(x) then Q(x). You can print them like in **Exercise 1.**

   (a) For all people, if they are blond then they are westerners.
   (b) Exist a person, whose hair is black but is a westerner.
   (c) For all students, if they study correctly then they have high score.
   (d) For every mammal, if they live in the sea, they are either dolphins or whales.
   (e) For every bird, if they don't have wings and can swim then they are penguins.
   (f) Exist a bird, who have wing but can't fly.

4. Write a function [D,P,Q,F]=formalConvertPQ(S) to extract D, P and Q then convert the statement S from 3. to formal form F.

5. Write a function N=nega(A) to calculate and print the negation of statement from **Exercise 1.** excluded (f)
   For example: output of 1.(a) is: Exist fish, they not need water to lives.

6. Print Negation, Contra-positive, Converse, Inverse of all the above statements from in informal statement from **Exercise 3.**;
   Hint: Most statements in **Exercise 3.** has the form $\forall x \in D, P(x) \to Q(x)$
   Negation: $\exists x \in D, P(x) \land \neg Q(x)$
   Contrapositive: $\forall X \in D, \neg Q(x) \to \neg P(x)$
   Converse: $\forall X \in D, Q(x) \to P(x)$
   Inverse: $\forall X \in D, \neg P(x) \to \neg Q(x)$
   For example: For all planets, if they have human, they have life. The answer is as follow:

```python
print("Negation: There is a planet, it has human but doesn't
                      have life")
print("Contrapositive: For all planets, if they don't have
                        life then they don't have
                        human")
print("Converse: For all planets, if they have life, they have
                  human")
print("Invert: For all planets, if they don't have life, they
                don't have human")
```