# Discrete Math --- Class 12 --- Feb. 24, 2004

**Predicates:**

Predicate is a proposition with a variable. Once the value of the variable is known then the value of the proposition can be determined.

Specifics of a predicate:

Has built-in ambiguity
Proposition has true or false value

Ex: *x* is a multiple of 3.

We can't make determination for that statement, yet as soon as we know the value of x we can make a conclusion about that predicate. We denote predicates in a sort of "propositional" notation.

P(x): *x* is a multiple of 3.

Ex: in C++:

```
bool mult_of_3 (x) {
   if ( x is a multiple of 3)
     return true;
   else
     return false;
}
```

When predicate is given possible set of variables has to be provided.

Ex: $R(x; y)\ x > y$
*x* and *y* are variables

In order for us to continue discussion on the topic of predicates Dr. Hochberg defined for us and gave examples of the numerical groups that we will be using when we will be working with predicates.

**Natural Numbers**
{0,1,2,3,4,………} Infinite set of numbers

**Integers**
{…….-2,-1,0,1,2……..}

**Rational numbers**
Rational numbers are numbers of the form a/b where a are integers and b is greater than zero.

**Real numbers**
Real numbers, every number on the number line, all the rational $\pi$, $e$, $\sqrt{2}$, and etc.
to make a predicate a proposition we have to for each variable ether give it a value or quantify it. We quantify a variable by ether assert the predicate is true, or some value of the variable is existential ($\exists$, "there exists"). Assert the predicate becomes true for all values of the variable (universal, $\forall$ "for all").

Ex:
Let R($x$, $y$) be the assertion that $x > y$
R (7, 13) is False

$\forall x$ R ($x$, 9) False

$\exists$ $x$ R ($x$, 9) True

$T(x, y)$ $x^2 = y$
$x$ and y are integers

$\forall x \exists y T(x; y)$ True

Give any value x, I square it and that's my y, for example x = 17; y = 289.

$\exists y \forall x T(x; y)$ False
Asserts that there is a value for x that no matter what my y is $x^2 = y$

Later on in class we were given a quiz:

| | | | |
|---|---|---|---|
| $\forall x R(x;0)$ False | $\forall x R(1; x)$ False | $\forall x \forall y R(x; y)$ False | $\forall y \forall x R(x; y)$ False |
| $\forall x R(0; x)$ False | $\forall x R(x;1)$ False | $\forall x \exists y R(x; y)$ False | $\forall y \exists x R(x; y)$ True |
| $\exists x R(x;0)$ True | $\exists x R(1; x)$ True | $\exists x \forall y R(x; y)$ False | $\exists y \forall x R(x; y)$ False |
| $\forall x R(0; x)$ False | $\exists x R(x;1)$ True | $\exists x \exists y R(x; y)$ True | $\exists y \exists x R(x; y)$ True |

**Note:**
In the beginning of the class we were asked by doctor Hochberg if we have any questions regarding the material that was covered during previous lecture. There were some questions asked regarding the logics as well as the validity of arguments. We were given an answer with the examples that clarified more the nature of arguments.

Argument is a technical term.

Ex:
P: Your name is Bill.
Q: Your name starts with B.

P implies Q is true

But true only to these values of P and Q.

We can’t say that P implies Q is a valid arguments, because “P implies Q” is not true in general.

There is a distinction between the structure of an argument (or any logical expression) and any specific instance of it. Example above is a specific instance “P implies Q” is a general structure.

For argument to be valid the statement has to be true, regardless of an order.