Contents

❖ Sets:

Describing sets is just a matter of making a formal description of what is included and what is not included. Thus, I think we do this daily when communicating with other people about various ideas, actions, objects. “Hey, I found this cool playlist on Spotify! Here are the songs: Heaven is a Place on Earth, What’s Up, What I Need, Same Love, Born This Way, Firework, We Can’t Stop.”

- Spotify is a set containing all songs.

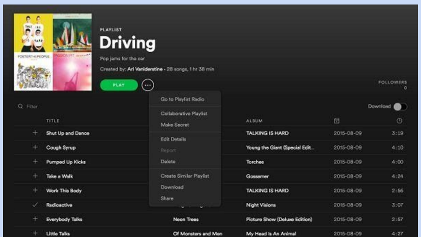
Some people think there is a use of sets in programming. They use set theory the most when they are dealing with large sets of data in Python and MySQL as there are commands that are just making sets for natural join which is identified as an intersection. Programmers can use many commands to create sets and subsets. As to Python, some experts worked with the sets function in it just to identify the data and what is to be included in a subset.

Application:

1. Universe:

As we all know that there are millions of galaxies present in our world which are separated from each other by some distance. Here, the universe acts as a set.

2. Play Lists:



Most of us have a different kind of playlists of songs present in our smartphones and computers. Rock songs are often separated from classical or any other genre. Hence, playlists also form the example of sets.

❖ Functions:

A mathematical function can be expressed as: **f(x)=y**
we say that it is a function if the value of the variable depends on the value of the other variable. In this case we are presenting **x** as the independent variable and
y as the dependent.

Application:

1. Imagine that you are running at a certain speed and you want to know what the total distance is covered. How do you determine what is the total distance? Well, you can notice that the total distance depends on the time spent running.
   - **f(time)=Distance**

2. Another example can be when you are at the gym and you try to bench press. The amount of bench presses that you can do depends on the strength.
   - **f(strength)=bench press**

❖ Relations:

Whenever sets are being discussed, the **relationship** between the elements of the sets is the next thing that comes up. **Relations** may exist between these elements.
Relations are sets of ordered pairs.

Applications:

1. (Sister A shares room with Sister B) - Equivalence Relation.

2. **A relation over geographic regions:**
Manhattan is within the bounds of New York City.
Manhattan is within the bounds of Manhattan, where else would it be? Because it is within New York City, it must be within the bounds of New York State, and therefore also within the bounds of the United States.

❖ Number Theory:

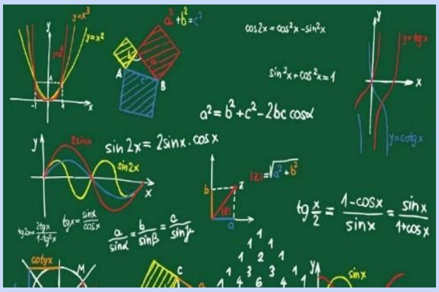
Number theory was labelled the "Queen of Mathematics" by Gauss. For many years it was thought to be without many practical applications. That situation has changed significantly in the twentieth century with the rise of computers.

Application:

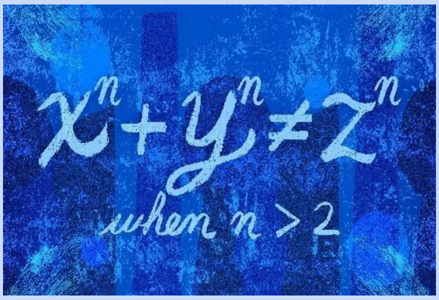
1. The best-known application of number theory is public key cryptography, such as the RSA algorithm. Public key cryptography in turn enables many technologies we take for granted, such as the ability to make secure online transactions.

2. The whole of encryption works due to number theory. As a result, security of transactions is ensured. If it were not for number theory, your money

will not be safe in your bank, information about you could be accessed by anyone.



3. Other formulas of number theory allow computer programs to find out many years in advance what days of the week will fall on what dates of the month, so that people can find out well in advance what day of the week Christmas or the Fourth of July will occur. Many computers have pre-installed internal programs that tell users when they last modified a file down to the second, minute, hour, day of the week, and date of the month. These programs work thanks to the formulas of number theorists.



4. Using Fermat's theorem, a computer can quickly compute if a number-even a large number-is prime. However, once a computer finds out that a number is not prime, it then takes a long time to find out what its factors are, especially if the number is a large composite (say 120 digits long). It can take years on a supercomputer to find the prime factors of large composite numbers.

❖ Propositional Logic:

Propositional Logic is concerned with statements to which the truth values, “true” and “false”, can be assigned. The purpose is to analyse these statements either individually or in a composite manner.

Applications:

1. Translating English Sentences:

Decompose each part of the statement into individual propositional variables and write as a compound proposition:
You drink coffee only if you put the ground coffee into the maker and don't forget to press brew.
Answering the coffee question, we let:

- d: You can drink coffee.
- g: You put ground coffee into the maker
- f You forgot to press brew.

Then the statement is $d \to (g \land \neg f)$

2. Boolean Searches:

Search engines using Boolean searches use logical connectives.

- AND requires records match both terms
- OR returns records that match one or both terms
- NOT (or sometimes AND NOT) excludes a term

❖ Predicate and Quantifiers:

Predicate:

A predicate is a statement that contains variables (predicate variables) and that may be true or false depending on the values of these variables.

• $P(x)$ is a predicate.

Example:

Let $P(x, y)$ = "$x > y$".

Domain: integers, i.e. both x and y are integers.

• $P(4, 3)$ means "$4 > 3$", so $P(4, 3)$ is TRUE;

• $P(1, 2)$ means "$1>2$" , so $P(1, 2)$ is FALSE;

• $P(3,4)$ is false (in general, $P(x,y)$ and $P(y,x)$ not equal)

Quantifier:

Quantifiers are words that refer to quantities such as "some" or "all" and tell for how many elements a given predicate is true.

Examples:

• Statements like

- Some birds are angry.

D={birds}, P(x)="x is angry".

- "All rabbits are faster than all tortoises."
  Domains: R={rabbits}, T={tortoises}
  Predicate $C(x, y)$: Rabbit x is faster than tortoise y