UNIT – I: DATA HANDLING USING PANDAS-I

CHAPTER-1

DATA HANDLING USING PANDAS-I

Topic-1 Introduction To Python Libraries

Concepts Covered • *Pandas library,* • *Series*

Revision Notes

- **Pandas**

  The Pandas is a high-performance open source library for data analysis in Python, developed by Wes McKinney in 2008. Over the years, it has become the de-facto standard library for data analysis using Python.

  There are 3 well-established python libraries namely NumPy, Pandas and Matplotlib specially for scientific and analytical use.

  These libraries allow us to manipulate, transform and visualise data easily and efficiently.

  Using the Pandas, we can accomplish five typical steps in the processing and analysis of data, regardless of the origin of data. These steps are- load, prepare, manipulate, model and analyse.

  Some key features of Pandas include the following:

  (i) **It can process a variety of data sets in different formats:** time series, tabular heterogeneous arrays and matrix data.
  (ii) It facilitates loading and importing data from varied sources such as CSV and DB/SQL.
  (iii) **It can handle a myriad of operations on data sets:** sub-setting, slicing, filtering, merging, grouping, re-ordering, and re-shaping.
  (iv) It can deal with missing data according to rules defined by the user and developer.
  (v) It can be used for parsing and managing (conversion) of data as well as modeling and statistical analysis.
  (vi) It integrates well with other Python libraries such as SciPy.
  (vii) It delivers fast performance and can be speeded up even more by making use of Cython (C extensions to Python).

- **Benefits of Pandas**

  The benefits of pandas over using the languages are:

  - **Data representation:** It can easily represent data in a form naturally suited for data analysis through its DataFrame and Series data structures in a concise manner. Doing the equivalent in C/C++ or Java would require many lines of custom code, as these languages were not built for data analysis but rather networking and kernel development.
  - **Clear code:** The clear API of the Pandas allows you to focus on the core part of the code. So, it provides clear code.

- **Matplotlib**

  It is an amazing visualization library in Python that used for 2D plots of arrays. It is a multi-platform data visualization library which build **NumPy** arrays. Matplotlib produces publication-quality figures in a variety of hardcopy formats and interactive environments across platforms. Matplotlib can be used in Python scripts, the Python and IPython shell, web application servers and various graphical user interface toolkits.

  To get matplotlib up and running in our environment, we need to import it.

  import matplotlib.pyplot as plt

- **Data structures in Pandas**

  Data structure is defined as the storage and management of the data for its efficient and easy access in the future where the data is collected, modified and the various types of operations are performed on the data respectively. Pandas provides two data structures for processing the data, which are explained below:

(1) **Series:** It is one dimensional object similar to an array, list or column in a table. It will assign a labelled **index** to each item in the series. By default, each item will receive an **index** label from 0 to N, where N is the length of the series minus one.

(2) **Data Frame:** It is a tabular data structure comprised of rows and columns. DataFrame is defined as a standard way to store data which has two different **indexes** *i.e.*, row **index** and column **index**.

- **Series**

Pandas series is one-dimensional array that is capable of holding various data types such as integer, string, float, object etc. with the the help of series () method, we can easily change the list, dictionary into series. A series does not contain multiple columns and rows. Labels of series are called **index**.

Syntax

pandas.Series (data, **index**, dtype, copy)

Here, data can be list, tuple etc

index value should be unique and hashable

dtype defines data type of series

copy copies the data

Key Words

Index: Index attribute is used to get or set the index labels of the given Series object.

NumPy: NumPy is a Python library used for working with arrays.

- **Creating a series**

(i) Create an empty series

Empty series means it will not have any value.

Syntax

series_Object = pandas.Series ()

(ii) Create a series using Inputs

We can create series by using various inputs as array.

- **Creating series from array:** To create a series from array, we have to import the **numpy** module and then use array () method. If data is an ndarray, then passed index must be of same length. If there is no index passed as an argument, then index will be range (n) by default, where n is array length.
- **Creating series from dict:** A dict can be passed as an input. If there is no index specified, then the dictionary's keys are taken in a sorted order. If **index** is passed, then corresponding values to a particular label in the **index** will be extracted from the dictionary.
- **Creating series from scalar:** If data is a scalar value, an index must be provided. The value will be repeated to match the length of index.

- **Mathematical Operations**

We can perform mathematical operation on series like addition, subtraction, multiplication, division etc.

For this, various methods are used, as follows:

- **add():** This function is used to add series and others, element wise.

  Syntax, Series.add (other, fillValue=None, axis=0)

  Here, other is series or scalar value

  fillValue is None or float value but its default value is None

- **sub():** This function is used to get subtraction of series and others, element wise.

  Syntax, Series.sub (other, fillValue=None, axis=0)

- **mul():** This function is used to get multiplication of series and others, element-wise.

  Syntax, Series.mul (other, fillValue=None, axis=0)

- **div():** This function is used to get floating division of series and others, element-wise.

  Syntax, Series.div (other, fillValue=None, axis=0)

- **pow():** This function is used to get exponential power of series and others, element-wise.

  Syntax, Series.pow (other, fillValue=None, axis=0)

Example 1

Program to show the operation of addition, subtraction, multiplication and division on Series.

Solution:

```
import numpy as np
import pandas as pd
x = pd.Series([2, 1, 2, np.nan], index=['p', 'q', 'r', 's'])
y = pd.Series([1, np.nan, 2, 1], index=['p', 'q', 's', 't'])
print("---Addition---")
print(x.add(y, fill_value=0))
print("---Subtraction---")
print(x.sub(y, fill_value=0))
print("---Multiplication---")
print(x.mul(y, fill_value=0))
print("---Divsion---")
print(x.div(y, fill_value=0))
print("---Power---")
print(x.pow(y, fill_value=0))
```

Output :

	Addition	Subtraction	Multiplication	Division	Power
p	3.0	1.0	2.0	2.0	2.0
q	1.0	1.0	0.0	int	1.0
r	2.0	2.0	0.0	int	1.0
s	2.0	–2.0	0.0	0.0	0.0
t	1.0	1.0	0.0	0.0	0.0

dtype: float 64

Head and Tail functions

- head() function is used to get the first *n* rows.
  Syntax, Series.head(n=5)
  Here, *n* is the selected number of rows. It is int type and has default value 5.
- tail() function returns last *n* rows from the object based on position. It is useful for quickly verifying data, for example, after sorting.
  Syntax, Series.tail(*n* = 5)
  Here, *n* is the selected number of rows whose default value is 5.

Example 2

Program to show the head function.

Solution:

```
import pandas as pd
import numpy as np
  #Create a series with 4 random numbers
  s = pd.Series(np.random.randn(4))
  print ("The original series is:")
  print(s)
  print ("The first two rows of the data series:")
  print(s.head(2))
```

OUTPUT:

```
The original series is:
0  0.720876
1 -0.765898
2  0.479221
3 -0.139547
The first two rows of the data series:
0  0.720876
1 -0.765898
```

Example 3

Program to show the tail function.

Solution:

```
import pandas as pd
import numpy as np
  #Create a series with 4 random numbers
  s = pd.Series(np.random.randn(4))
  print ("The original series is:")
  print(s)
  print ("The last two rows of the data series:")
  print(s.tail(2))
```

OUTPUT:

```
The original series is:
0 -0.655091
1 -0.881407
2 -0.608592
3 -2.341413
The last two rows of the data series:
2 -0.608592
3 -2.341413
```

- **Selection**

In series, Series.select() function is used for selection. This function returns data corresponding to axis labels matching criteria. We pass the name of the function as an argument to this function which is applied on all the index tables. The index labels satisfying the criteria are selected.

Syntax, Series.select (crit, axis=0)

Here,

crit = called on each label

axis = int value

- **Indexing**

The object supports both integers and label based indexing and provides a host of methods for performing operation involving the index.

In Python Pandas, Series.index attribute is used to get or set the index labels of the given series object.

Syntax, Series.index

Pandas supports three types of multi-axes indexing, which are as follows:

(i) **.loc[]:** This attribute is used to access a group of rows and columns by label(s) or a boolean array in the given series object.
Syntax, Series.loc

(ii) **.iloc[]:** This attribute enables purely integer location based indexing for selection by position over the given series object.

(iii) **.ix[]:** This attribute is primarily label location based indexer, with integer position fallback. It takes the label as input and returns the value corresponding to that label.
Syntax, Series.ix

- **Slicing**

Slicing is a powerful approach to retrieve subsets of data from a Pandas object. A slice object is built using a syntax of **start: end: step**, the segments representing the first item, last item and the increment between each item that you would like as the step.

Topic-2 Data Frames

Concepts Covered • *Dataframe* • *CSV file*

Revision Notes

- **Data Frames**
  - Data Frame is a two dimensional data structure *i.e.*, data is aligned in a tabular form as rows and columns. Data frame consists of various properties as iteration, indexing etc.
  - In data frame, columns can be heterogeneous types like integer, boolean etc.
  - It can be seen as a dictionary of series where rows and columns both are indexed.
    Data can be created using following syntax:
    pandas. DataFrame (data, index, columns, dtype, copy)
    Here **data** contains different forms like ndarray, series, map, constants etc.
    index is used for the row label
    columns is used for column label
    dtype refers to the data type of each column
    copy used for copying data
- **Create DataFrame**

We can create DataFrame using various inputs which are discussed below:

- **Creating an empty DataFrame:** It is basic DataFrame that can be created as follows:
  import pandas as pd
  object_Name = pd.DataFrame()
- **Creating a DataFrame From dict of series:** Dictionary of series can be passed to form a DataFrame. The resultant index is the union of all the series indexes passed.
  Syntax:
  pandas.Series(data=None, index=None, dtype = None, name=None, copy=False, fastpath=False)

Key Words

Index: Index or array-like
Index to use for the resulting dataframe. If we don't use this parameter, it will default to RangeIndex.

Columns : Index or array-like
Column labels to use for the resulting dataframe. Again, if we don't use this parameter it will default to RangeIndex (0, 1, 2, …, n).

Dtype : Dtype, default None
If we want data to be of a certain data type, dtype is the parameter to use. Only a single dtype is allowed.

Copy : Boolean, default False
Will make a copy of data from inputs.

Example 1

Program to create Dataframe from dict of series.

Solution:

```
import pandas as pd
    data={'First' : pd.Series (['abc', 'xyz', 'pqr'],
    index = [11, 12, 13]),
      'second' : pd.Series (['The', 'That', 'This',
      'abc'],
            index=[11, 12, 13, 14])}
    value=pd.DataFrame(data)
    print(value)
```

Output

	First	Second
11	abc	The
12	xyz	That
13	pqr	This
14	NaN	abc

- **Creating a DataFrame From list of dictionary:** List of dictionary can be passed to form a DataFrame. Keys of dictionary are taken as column names by default.

Example 2

Program to create dataframe from list of dictionaries.

Solution:

```
import pandas as pd
  data = [{'abc' : 10, 'xyz' : 20, 'pqr' : 30},
        {'The' : 10, 'pqr' : 20, 'xyz' : 30, 'abc' : 40}]
    value = pd.DataFrame (data)
    print(value)
```

Output

	The	abc	pqr	xyz
0	NaN	10	30	20
1	10.0	40	20	30

- **Iterating in Pandas DataFrame**

Iteration is a general term for taking each item of something one after another.
In Pandas DataFrame, we can iterate an element in two ways:

(i) Iterating over rows: There are three function to iterate over rows as follows:
- **iterrows():** It returns the iterator yielding each index value along with a series containing the data in each row.
- **iteritems():** It iterates over each column as key, value pair with label as key and column value as series object.
- **itertuples():** In DataFrame, it returns a tuple for each row. The first element of the tuple will be the row's corresponding index value, while the remaining value are the rows values.

(ii) Iterating over columns
In order to iterate over columns, we need to create a list of dataframe columns and then iterating through that list to pull out the dataframe columns.

- **Operations on rows and columns**

As DataFrame is a two dimensional data structure means data is arranged in a tabular format like rows and columns, some basic operations can be perform like adding, deleting, selecting and renaming. These operations are as follows:

(i) Addition

- To add a column in Pandas Dataframe, a new list as a column can be declared and add to an existing DataFrame.
- To add a row in Pandas DataFrame, we can concat the old dataframe with new one.

(ii) Selection

- To select a column in Pandas DataFrame, we can either access the columns by calling them by their column names.
- To retrieve rows from a DataFrame, a special method is used named DataFrame.loc[]. Rows can also be selected by passing integer location to iloc[] method.

(iii) Deletion

- To delete a column from Pandas DataFrame, drop() method is used. Columns are deleted by dropping columns with column names.
- To delete a row from Pandas DataFrame, drop() method is used. Rows are deleted by dropping rows by index label.

(iv) Renaming

We can change the labels of rows and columns in a DataFrame using the DataFrame.rename() method.

► **Head and Tail functions**

head() and tail() methods or functions are used to view a small sample of a DataFrame object. These functions are described below

(i) head(): This function returns the first *n* rows for the object based on position. It is useful for quick testing if your object has the right type of data in it.

Syntax, DataFrame.head (*n*=5)

Parameters: n-is an integer value, number of rows to be returned where default value is 5. Return DataFrame with top *n* rows

(ii) tail(): This function returns last *n* rows from the object based on position. It is useful for quickly verifying data. *e.g.* after sorting

Syntax, DataFrame.tail (*n*=5). If the parameter n is not specified by default it gives the last 5 rows of the DataFrame.

Example 3

Write a program that illustrate the head() function using dataFrame.

Solution:

```
import pandas as pd
import numpy as np
#Create a Dictionary of series
d = {'Name':pd.Series(['Tom','James','Ricky','Vin','Steve','Smith','Jack']),
'Age':pd.Series([25,26,25,23,30,29,23]),
'Rating':pd.Series([4.23,3.24,3.98,2.56,3.20,4.6,3.8])}
#Create a DataFrame
df = pd.DataFrame(d)
print ("Our data frame is:")
print(df)
print ("The first two rows of the data frame is:")
print(df.head(2))
```

Output:

Our data frame is:

	Age	Name	Rating
0	25	Tom	4.23
1	26	James	3.24
2	25	Ricky	3.98
3	23	Vin	2.56
4	30	Steve	3.20
5	29	Smith	4.60
6	23	Jack	3.80

The first two rows of the data frame is:

	Age	Name	Rating
0	25	Tom	4.23
1	26	James	3.24

Example 4

Write a program that illustrate the tail() function using dataFrame.

Solution:

```
import pandas as pd
 import numpy as np
 #Create a Dictionary of series
 d = {'Name':pd.Series(['Tom','James','Ricky','Vin','
     Steve','Smith','Jack']),
 'Age':pd.Series([25,26,25,23,30,29,23]),
 'Rating':pd.Series([4.23,3.24,3.98,2.56,3.20,4.6,3.8])}
 #Create a DataFrame
 df = pd.DataFrame(d)
 print ("Our data frame is:")
 print(df)
 print ("The last two rows of the data frame is:")
 print(df.tail(2))
```

Output:

Our data frame is:

	Age	Name	Rating
0	25	Tom	4.23
1	26	James	3.24
2	25	Ricky	3.98
3	23	Vin	2.56
4	30	Steve	3.20
5	29	Smith	4.60
6	23	Jack	3.80

The last two rows of the data frame is:

	Age	Name	Rating
5	29	Smith	4.6
6	23	Jack	3.8

- **Indexing using Labels**

Indexing in Pandas means simply selecting particular rows and columns of a DataFrame. Indexing can also be known as subset selection.

It is common operation to pick out one of the DataFrame's columns to work on. To select a column by its label, we use the .loc[] function.

Pandas DataFrame.loc attribute access a group of rows and columns by label(s) or a boolean array in the given DataFrame.

Syntax: DataFrame.loc

loc takes two single/list/range operator separated by ','. The first one indicates the row and the second one indicates columns.

- **Boolean Indexing:**

It helps us to select the data from the DataFrames using a boolean vector. We need a DataFrame with a boolean index to use the boolean indexing.

In boolean indexing, we can filter a data in four ways

- Accessing a DataFrame with a boolean index
- Applying a boolean mask to a dataFrame
- Masking data based on column value
- Masking data based on index value

Example 5

Program to show the boolean indexing in DataFrame.

Solution:

```
import pandas as pd
    dict={'Name' : ["Rahul", "Kiyaan", "Shreya",
    "Riya"],
        "Salary" : ["28000", "38000", "34000",
        "3600"]}
    info=pd.DataFrame(dict, index=[True, False,
    False, True])
    print (info)
```

Output

	Name	Salary
True	Rahul	28000
False	Kiyaan	38000
False	Shreya	34000
True	Riya	36000

- **CSV File**

  CSV files are the **comma separated values.** This type of file can be view as an excel file and separated by commas. CSV file is nothing more than a simple text file. However, it is the most common, simple and easiest method to store tabular data. This particular format arranges tables by a specific structure divided into rows and columns.

  Once we have the DataFrame, we can persist it in CSV on the local disk. Let's first create CSV file using data that is currently present in the DataFrame, we can store the data of this DataFrame in CSV format using API called to_CSV (…) of Pandas

- **Importing/Exporting Data between CSV files and DataFrames**
  - Pandas **read_csv()** function is used to import a CSV file to DataFrame format.
    Syntax, df.read_csv('file_name.CSV', header=None)
    Here,
    Header allows you to specify which row will be used as column names for your DataFrame. Expected int value or a list of int values. If your file does not have a header, then simply set header=None
  - To export a Pandas DataFrame to a CSV file, use **to_csv** function. This saves a DataFrame as a CSV file.
    Syntax, to_csv(parameters)

```
import pandas as pd
df = pd.read_csv('data.csv')
print(df)
```

CHAPTER-2

DATA VISUALIZATION

Revision Notes

- Data visualization is the presentation of data in graphical format. It helps people understand the significance of data by summarizing and presenting a huge amount of data in a simple and easy to understand format and helps communicate information clearly and effectively.
- **Plotting using Matplotlib**
  - The matplotlib Python library developed by John Hunter and many other contributors, is used to create high quality graphs, charts and figures.
  - Matplotlib produces publication quality figures in a variety of hardcopy format and interactive environments across platforms. It can be used in Python scripts, the Python and IPython shell, web application servers and various graphical user interface toolkits.
  - For installation of matplotlib in various operating system such as Windows, Linux, MacOS, etc., use following command at command prompt :

```
Python -m pip install -U matplotlib
```

  - Importing matplotlib

```
from matplotlib import pyplot as plt
```

    OR

```
import matplotlib.pyplot as plt
```

  - Plotting using Matplotlib provides a brief introduction for plotting in Pandas using matplotlib. The Matplotlib API is imported using the standard convention.
  - pyplot is a module in the Matplotlib package. This module provides an interface that allows you to implicitly and automatically create figures and **axes** to achieve the desired **plot**.

Key Words

plot(): The plot() function is used to draw points (markers) in a diagram.
axes.plot(): This is the basic method of axes class that plots values of one array versus another as lines or markers.

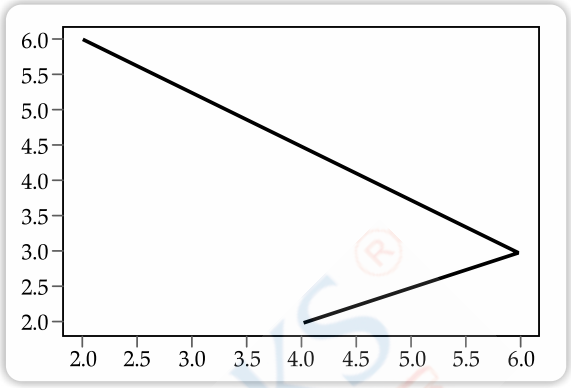
Example 1

Code to show the simple line chart

Solution:

```
from matplotlib import pyplot as plt
    plt.plot ([4, 6, 2], [2, 3, 6])
    plt.show()
```

OUTPUT:



Line Plot

For all matplotlib **plots**, we start by creating a figure and an **axes**.

The figure (an instance of the class plt. figure) can be thought of as a single container that contains all the objects represented **axes**, graphics, text and labels.

The **axes** (an instance of the class plt. axes) is a bounding box with ticks and labels, which will eventually contain the **plot** elements that make up our visualization. If we want to create a single figure with multiple lines, we can simple call the **plot** function multiple times :

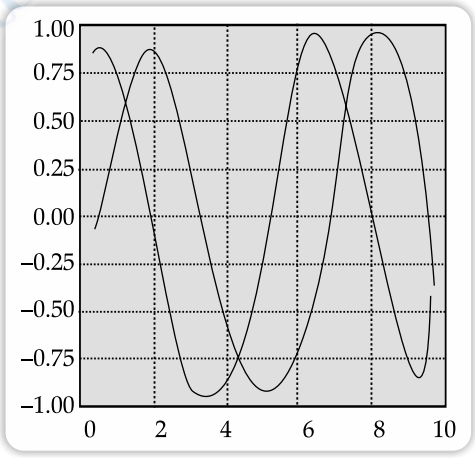
Example 2

Code to show the line chart with two lines.

Solution:

```
import matplotlib.pyplot as plt
import numpy as np
fig = plt.figure()
ax = plt.axes()
x = np.linspace(0, 10,1000)
ax.plot(x, np.sin(x))
plt.plot(x, np.sin(x))
plt.plot(x, np.cos(x))
```

OUTPUT:



Plotting Bar Graph

Categorical data can be represented in rectangular blocks with different heights or lengths proportional to the values. Such a type or representation is called a bar chart. The bar chart can be plotted vertically or horizontally.

A bar graph uses bars to compare data among different categories.

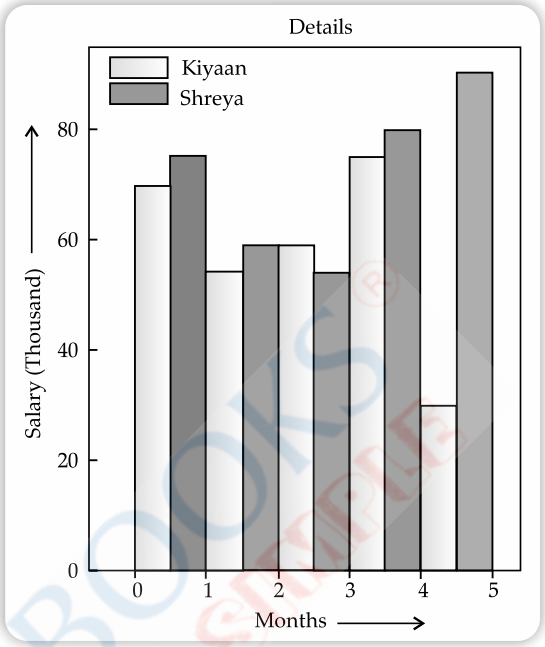
Example 3

Code to show the bar chart

Solution:

```
from matplotlib import pyplot as plt
import numpy as np
plt.bar([0.25, 1.25, 2.25, 3.25, 4.25], [70, 50, 60, 75, 30],
label="Kiyaan",width=.5)
plt.bar([.75, 1.75,2.75,3.75,4.75],[75, 60, 50, 80, 93],
label ="Shreya",color='r',width=.5)
plt.legend()
plt.xlabel('Month')
plt.ylabel('Salary (Thousand)')
plt.title('Details')
```

OUTPUT:



Plotting Histogram

A histogram is an accurate representation of the distribution of numerical data. It uses rectangle to represent data. Histograms are used to show a distribution. A probability distribution can be estimated using a histogram **plot**.

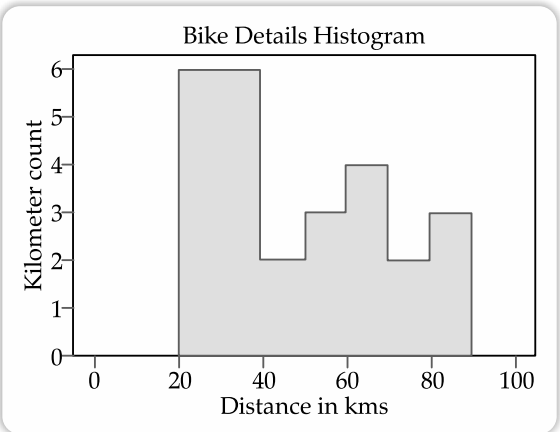
Example 4

Code to show the bar chart

Solution:

```
import matplotlib.pyplot as plt
days = [50, 80, 70, 80, 40, 20, 20, 20, 70, 20, 60, 20, 80,
50, 40, 50, 20, 60, 60, 60]
bins = [0,10,20,40,50,60,70,80,90,100]
plt.hist(days, bins, histtype='stepfilled',
rwidth=0.88)
plt.xlabel('Distance in kms')
plt.ylabel('Kilometer count')
plt.title('Bike Details Histogram')
```

OUTPUT:



Customizing Plots

You can customise the charts or graphs with proper details. The graph or **plot** should have a proper title, labels, legends, etc.

- **Adding a title :** To add a tittle in chart or graph title () function is used.

  Syntax

  <matplotlib.pyplot>.title(title_string)

- **Adding Labels :** To set the labels for X-axis and Y-axis, xlabel() and ylabel() are used respectively.

- **Adding Legends :** When we plot multiple ranges on a single **plot**, it becomes necessary that legends are specified. To add legend to the **plot**, legend( ) function is used.

  Syntax

  <matplotlib.pyplot>.legend(loc = <string or position no>)

- **Save a Plot to a File Using Matplotlib**

Matplotlib is a widely used python library to plot graphs, plots, charts, etc. show() method is used to display graphs as output, but don't save it in any file. To save generated graphs in a file on storage disk, savefig() method is used.

Key Words

- **Pyplot :** It is a collection of methods within matplotlib library which allows user to construct 2D plots easily and interactively.
- **MATLAB :** It is a high performance language for technical computing. It integrates computation, visualization, and programming in an easy to use environment where problems and solutions are expressed in familiar mathematical notations.
- **Title :** This is the text that appears on the top of the plot. It defines what the chart is about. The legend of a graph reflects the data displayed in the graph's Y-axis, also called the graph series.

UNIT – II: DATABASE QUERY USING SQL

CHAPTER-3

DATABASE QUERY USING SQL

Revision Notes

Built-In Functions

- SQL provides many built-in Functions to perform operations on data. These functions are useful while performing mathematical calculations, string concatenations, sub-strings, etc.
- According to the processing on the value of column SQL functions can be classified as below.

  Two types of SQL Functions

  - **Group Functions**
    - "Functions act on set of values are known as group functions".
    - SUM, AVG, MIN, MAX (Aggregate Functions)
  - **Scalar Functions**
    - "Functions act on only one value at a time are known as Scalar functions".
    - Length ASCII.

Key Word

Data type: It is an attribute that specifies the type of data that the object can hold.

- According to the SQL **Data Type** functions can be classified as below.
  - **Numeric Functions:**
    - For processing Number **Data type.**
  - **String Functions:**
    - For processing on String **Data type.**

- **Conversion Functions:**
  - For Convert **Data type** from one data type to another.
- **Date Functions:**
  - For processing on Date **Data Type.**

Mathematical Functions

There are various built-in functions available in MySQL for mathematical calculations. These mathematical functions accept numeric value, perform pre-defined specific operations on it and also return numeric value in result.

Some mathematical functions used in MySQL are as follows:

(i) POWER( ): This function is used to get the power of the given values.

Syntax:

POWER (m, n)

- **Parameter:**

m: It is a base value in the calculation

n: It is exponent value in the calculation

This function returns m raised to the n^{th} power.

e.g.,

SELECT POWER (4, 3);

Output

POWER(4, 3)
64

(ii) ROUND( ): This function is used to round up the number to the upwards or downwards whichever the nearest whole number.

Syntax:

ROUND (number)

If you want to get number with certain number of decimal places, you can also pass that number, and use following syntax.

ROUND (number, decimal place);

e.g.,

mysql>SELECT ROUND (56.567);

Output

ROUND (56.567)
57.0

e.g.,

mysql>SELECT ROUND (56.567, 2);

Output

ROUND (56.567, 2)
56.57

Key Word

Expression: It is a combination of one or more values, operators and SQL functions that evaluate to a value.

(iii) MOD( ): This function is used to return the remainder of one number or **expression** by dividing it to another number or **expression**.

Syntax:

MOD(n, m)

Parameter:

n: number to be divided by m

m: number that will divide n

e.g.,

mysql > SELECT MOD(17, 3);

MOD(17, 3)
2

Text/String Functions

MySQL text functions manipulate the character string data effectively. Some text functions used in MySQL are as follows:

(i) UCASE/UPPER function: UCASE () or UPPER () function is used to convert the string argument into upper case characters.

Syntax:

UCASE(str)

OR

UPPER(str)

e.g.,

mysql > SELECT UPPER ('Hello');

Output

UPPER ('Hello')
HELLO

mysql > SELECT UCASE ('Program');

Output

UCASE('Program')
PROGRAM

(ii) LCASE( )/LOWER(): This function is used to convert the characters of an argument string to the lowercase characters:

Syntax:

LCASE(str)

OR

LOWER (Str)

e.g.,

mysql>SELECT LOWER('HELLO');

Output

LOWER('HELLO')
hello

(iii) MID( ): This function extracts a substring from a string and returns a string with given length and position.

Syntax:

MID (str, pos, len)

e.g.,

SELECT MID('Python program', 3, 5);

Output

MID('Python program',3,5)
thon

(iv) SUBSTRING( )/SUBSTR( ): These functions are same as MID( ) function.

(v) LENGTH( ): This function is used to return the length of the specified string. It returns the length in bytes. This function also includes all the blank spaces which are include in string.

Syntax:

LENGTH(str)

e.g.,

mysql > SELECT LENGTH('program');

Output

LENGTH('program')
7

(vi) LEFT( ): This function is used to return a specified number of characters from the left of the string. The number of characters returned is determined by the second argument.

Syntax:

LEFT(str, len)

e.g.,
mysql > SELECT LEFT ('Program', 4);
Output

LEFT('Program', 4)
Prog

(vii) RIGHT( ): This function is just opposite of LEFT( ) function. It is used to return a specified number of characters from the right of the string. The number of characters returned is determined by the second argument.
Syntax:
RIGHT (str, len)
e.g.,
mysql > SELECT RIGHT ('Program', 4);
Output

RIGHT ('Program', 4)
gram

(viii) INSTR( ): This function takes two arguments as str (string) and sub_str (sub string) and returns the position of the first occurrence of a specified sub_str from a given str.
Syntax:
INSTR(str, sub_str)
e.g., mysql>SELECT INSTR('Python Program', 'thon') as Result;
Output

Result
3

(ix) LTRIM( ): This function takes a string argument and returns a new string with all the leading space characters removed. Spaces in the middle or trailing spaces are not removed.
Syntax:
LTRIM(str)
e.g., mysql > SELECT LTRIM (' Python Program') as Result;
Output

Result
Python Program

(x) RTRIM( ): This function takes a string argument and returns a new string with all the trailing space characters removed. Spaces in the middle or leading space are not removed.
Syntax:
RTRIM (str)
e.g., mysql > SELECT RTRIM (' Python Program ') as Result;
Output

Result
Python Program

(xi) TRIM( ): This functions enables you to remove leading and trailing white space from string.
Syntax:
TRIM (str);
e.g.,
mysql > SELECT TRIM (' Python Program ') as Result;
Output

Result
Python Program

- **Date Functions:** The date functions are used to perform some operations on date that is stored in the database. Some common date functions are as follows:

(i) NOW( ): This function returns the current date and time in the configured time zone as a string, or a number in the 'YYYY-MM-DD HH: MM: SS' or 'YYYYMMDDHHMMSS' format.

Syntax:

NOW( )

e.g.,

mysql > SELECT NOW( );

Output

NOW( )
2020-07-30 14:15:38

(ii) DATE( ): This function extracts the date value from a date.

Syntax:

DATE (date)

e.g.,

mysql > SELECT DATE ('2020-07-25 03:16:43');

Output

DATE ('2020-07-25 03:16:43')
2020-07-25

(iii) MONTH( ): This function returns the month for date, in the range 1 to 12 for January to December. If it returns 0 then month part of the given date contains NULL.

Syntax:

MONTH (date)

e.g.,

mysql >SELECT MONTH ('2020-07-28');

Output

MONTH ('2020-07-28')
7

(iv) MONTHNAME( ): This function returns the full name of the month for given date.

Syntax:

MONTHNAME (date)

e.g., mysql > SELECT MONTHNAME ('2020-07-28');

Output

MONTHNAME ('2020-07-28')
July

(v) YEAR( ): This function returns the year of the given date. It returns a year value in the range 1000 to 9999. If the date is zero, it returns 0.

Syntax:

YEAR(date)

e.g.,

mysql > SELECT YEAR ('2020-07-28');

Output

YEAR ('2020-07-28')
2020

(vi) DAY( ): This function returns the day of the month of a given date. If the date argument is zero, it returns 0. In case, the date in NULL, this function returns NULL.

Syntax:

DAY(date)

e.g., mysql> SELECT DAY("2003-03-24");

Output

DAY ('2003-03-24')
24

(vii) DAYNAME date: It returns the name of the day from the date.

Syntax:

DAYNAME(date)

mysql>SELECT DAYNAME ('2020-07-28');

Output

DAYNAME ('2020-07-28')
Tuesday

Functions

- Depending on their application in one or multiple rows, SQL functions are categorised as:
  - **(i) Single Row functions:** These are also known as **Scalar functions.** Single row functions are the one the work on single row and return one output per row. For example, length and case conversion functions are single row functions.
  - **(ii) Multiple Row functions:** Multiple row functions are also called **Aggregate functions.** Multiple row functions work upon group of rows and return one result for the complete set of rows. They are also known as Group Functions.
- **Aggregate Functions**
  - An aggregate function performs a calculation on one or more values and returns a single value. We often use aggregate functions with the GROUP By and HAVING clauses of the SELECT statement.
  - Except for count (*), aggregate functions totally ignore NULL values and considers all values in the present in a column.

Some aggregate functions are as follows:

(i) MAX(): This function returns the maximum value in selected columns. MAX() function ignores NULL values and considers all values in the calculation.

Syntax:

SELECT MAX(Column_Name) FROM Table_Name ;

(ii) MIN(): This function returns the minimum value in selected columns. MIN() function ignores NULL values.

Syntax:

SELECT MIN(Column_Name) FROM Table_Name;

(iii) AVG(): This function calculates the average of specified column(s). It ignores NULL values.

Syntax:

SELECT AVG(Column_Name) FROM Table_Name;

(iv) SUM(): This function calculates the sum of all values in the specified columns. It accepts only the **expression** that evaluates to numeric values.

Syntax:

SELECT SUM(Column_Name) FROM Table_Name;

(v) COUNT(): This function returns the number of rows found in a set.

COUNT(*) function returns a number of rows in a specified table or view that includes the number of duplicates and NULL values.

Syntax:

SELECT COUNT(*) FROM Table_Name;

- **GROUP BY Clause**

GROUP BY clause is used to group rows returned by SELECT statement into a specified rows or groups.

Syntax:

SELECT column 1, column 2, ..., Aggregate_function (exp)
FROM Table_Name
WHERE condition
GROUP BY Column_Name;

- **ORDER BY clause**

ORDER BY clause is used to sort a result set returned by a SELECT statement.

To sort a result set in ascending order, use ASC Keyword and in descending order, use DESC Keyword.

The ORDER BY clause sorts the result set in ascending order by default.

Syntax:

SELECT column 1, column 2, ...
FROM Table_Name
ORDER BY Column_Name <ASC/DESC>;

➢ **Having Clause**

HAVING clause is oftenly used with the GROUP BY rows based on a specified condition.

Syntax:

SELECT column 1, column 2, ..., Aggregate_function (Exp)
FROM Table_Name
GROUP BY Column_Name
HAVING condition;

Key Word

- **DISTINCT** Keyword help us in removing the duplicates values from the result.
- **COUNT(*)** includes all the null and duplicate values.
- **ALL** keyword includes even duplicates. If nothing is specified the ALL is assumed as the default.
- **SUM** and **AVG** functions only work on numeric data.

UNIT – III: INTRODUCTION TO COMPUTER NETWORKS

CHAPTER-4

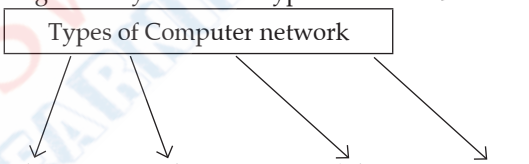
INTRODUCTION TO COMPUTER NETWORKS

Revision Notes

Computer Networks

- A computer network is an interconnected collection of computers that allows sharing of resources and information. Computers may connect to each other by either wired or wireless media.
- Computer network uses distributed processing in which task is divided among several computers.
- **Types of Network**

A computer network can be categorised by their size. Types of network are as follows:



e.g., Ethernet e.g., MTNL e.g., Internet e.g., WiFi

(i) **Local Area Network (LAN):** It is a network where two or more computers are connected within 1 km. LAN exists within a campus. It is owned by a single organisation. Many expensive resources are shared through LAN. There is a limit on the number of computers that can be attached to a single LAN.

(ii) **Metropolitan Area Network (MAN):** It covers up to 50 km area. MAN is larger than a LAN but smaller than WAN. MANs are usually characterised by high speed connections. They are usually operated by a single entity such as a government body or larger corporation. It expands throughout a city such as cable TV network.

(iii) **Wide Area Network (WAN):** It spans a large geographical area often a country or a continent. Internet is the largest WAN. Wide area networks are widely used in the field of business, government, education etc.

(iv) **Personal Area Network (PAN):** Personal Area Network refers to the network created by persons or individuals. Let's understand with this example. If you are sending files from your smartphone to another smartphone using Bluetooth or any other app is considered as Personal Area Network. Mostly people use their own devices like PDAs, Smartphones, Tablets etc. to share the data using Bluetooth or Wi-Fi.

- **Network Devices**

(i) **Hub:** It connects multiple computer networking devices together. A hub also acts as a repeater as it amplifies signals that deteriorate after travelling long distances over connecting cables. A hub can be used with both digital and analog data, provided its settings have been configure to prepare for the formatting of the incoming data.

(ii) **Switch:** Switches generally have a more intelligent role than hubs. It maintains limited routing information about **nodes** in the internal network, and it allows connections to systems like hubs or routers. Generally, switches can read the hardware addresses of incoming packets to transmit them to the appropriate destination.

(iii) **Router:** Routers help transmit packets to their destinations by charting a path through the sea of inter-connected networking devices using different network topologies. Routers are also used to divide internal network into two or more sub networks. It contains information about the systems connected to it and where to send requests if the destination is unknown.

(iv) **Bridge:** Bridges are used to connect two or more hosts or network segments together. The basic role of a bridge network architecture is storing and forwarding frames between the different segments that the bridge connects.

(v) **Gateway:** It is a network device that is used to connect two or more dissimilar networks. e.g. A computer with multiple Mics connected to different networks.

(vi) **Modem:** Modems (modulators-demodulators) are used to transmit digital signals over analog telephone lines. Digital signals are converted by the modem into analog signals of different frequencies and transmitted to a modem at the receiving location.

(vii) **Repeater:** A repeater is an electronic device that receives a signal and retransmits it. Repeaters are used to extend transmissions so that the signal can cover longer distances or be received on the other side of an obstruction.

- **Network Topology**

Topology refers to the way in which the workstations attached to the network are interconnected.

Some common network topologies are as follows:

(i) **Bus Topology:** It uses a common single cable to connect all the workstations. Each computer reforms its task of sending messages without the help of the central server.

However, only one workstation can transmit a message at a particular time in the bus topology.

Advantage:

- Easy to connect and install.
- Involves a low cost of installation time.
- Can be easily extended.

Disadvantages:

- The entire network shuts down if there is a failure in the central cable.
- Only a single message can travel at a particular time.
- Difficult to troubleshoot an error.

Key Words

Node: It is a device or application that works as a connection point for a network connection.
Communication: It is the exchange of information between two or more things, such as people, devices, governments, organizations, or businesses.

(ii) **Star Topology:** It is based on a central connection which acts as a hub. A star topology is common in home networks where all the computers connect to the single central computer using a hub.

Advantages:

- Easy to troubleshoot.
- A single **node** failure does not affect the entire network.
- Fault detection and removal of faulty parts is easier.
- In case a workstation fails, the network is not affected.

Disadvantages:

- Difficult to expand.
- Longer cable is required.
- The cost of the hub and longer cable makes it expensive over other topologies.
- In case hub fails, the entire network fails.

(iii) **Tree Topology:** It combines the characteristics of the linear bus and star topologies. It consists of groups of star configured connected to a bus backbone cable.

Advantages:

- Eliminates network congestion.
- The network can be easily extended.

- Faulty **nodes** can be easily isolated from the rest of the network.

Disadvantages:

- Uses large cable length.
- Requires a large amount of hardware components and hence is expensive.
- Installation and reconfiguration is very difficult.

(iv) **Mesh Topology:** In this topology, each device is connected to every other device on the network through a dedicated point-to-point link. When we say dedicated, it means that the link only carries data for the two connected devices only.

Advantages:

- It is secure because there is a point to point link thus unauthorized access is not possible.
- No data traffic issues as there is a dedicated link between two devices which means the link is only available for those two devices.

Disadvantages:

- Amount of wires required to connect each system is tedious.
- Since each device needs to be connected with other devices, number of I/O ports required must be huge.
- Scalability issues because a device cannot be connected with large number of devices with a dedicated point to point link.

Internet

- The Internet is world wide system of computer networks i.e., network of networks. Through Internet, computers become able to exchange information with each other and find diverse perspective on issues from a global audience.
- All computer on the Internet, communicate with one another using TCP/IP, which is a basic protocol of the Internet.
- Internet has been the most useful technology of the modern time, which helps us not only in our daily lives, but also in our personal and professional lives developments. Internet is not governed by any single organisation. A volunteer group W3C has been formed to help, coordinate and wrist with the development of the Internet.
- **URL**
  - URL stands for Uniform Resource Locator. It is a unique identifier used to locate a resource on the Internet. It is also referred to as web address.
  - URL protocols include HTTP (Hypertext Transfer Protocol) and HTTPs (HTTP secure) for web resources, mail for email addresses, FTP for files on a file transfer protocol server and telnet for session to access remote computers.

    The URL contains three parts which are as follows:

    (i) The name of the protocol to be used to access the file resource.

    (ii) A domain name that identifies a specific computer on the Internet.

    (iii) A path name with hierarchical description that specifies the location of a file on that computer.

    e.g.,

  - You can open a URL by clicking on a or by typing the URL in the browser address bar.
- **World Wide Web (WWW)**
  - The world wide web is a way of exchanging information, between computers on the Internet, tying them together into a vast collection of interactive multimedia resources.
  - The development of the world wide web began in 1989 by Tim Berners-Lee and his colleagues at CERN, an international scientific organisation based in Geneva, Switzerland.
  - World wide web had several differences from other hypertext systems available at that time. The web required only unidirectional links rather than bidirectional ones, making it possible for someone to link to another resource without action by the owner of that resource.
  - The terms Internet and world wide web are often used without much distinction. However, the two terms do not mean the same thing.
  - The basic idea of the www was to merge the evolving technologies of computers, data networks and hypertext into a powerful and easy to use global information system.

Advantages of world wide web are as:

(i) Availability of information i.e., you are able to access information from anywhere and also make friends from across the globe.

(ii) Rapid interaction **communication** which can be used for different services.

(iii) Facilitates access of different sources of information which is continuously updated.

(iv) Exchange of huge volumes of data as well as establishment of professional contact.

- **Applications of WWW:**
  - E-Mail
  - Chat
  - VoIP
  - Publishing, Marketing and advertising
  - Research and Development
  - **Communication**
  - Collaboration
  - Industrial classification of the sample companies etc.
- **Web**

The web is the common name for the World Wide Web, a subset of the Internet consisting of the pages that can be accessed by a web browser.

Many people assume that the web is the same as the Internet and use these terms interchangeably. However, the term Internet refers to the global network of servers that makes the information sharing, over the web possible.

- **E-mail**

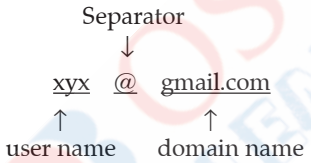
E-mail stands for Electronic Mail. It is a paperless method of sending messages, notes, pictures and even sound files from one place to another using the Internet as a medium.

e-mail address is an individual name which is used to send and receive e-mail on the Internet. It is used to specify the source or destination of an e-mail message.

The format of an mail address is username@domain_name.

Where

- username identifies a unique user name.
- @ separates the user name from the domain name.
- domain_name identifies the mail server.



Some sites which provide the e-mail services are Gmail, Yahoo, Rediff mail etc.

- **Some components of e-mail messages are:**
  - **To** field is where the e-mail address of the person receiving the e-mail is placed.
  - **From** field displays the address of the sender.
  - **Subject** field indicates the purpose of e-mail.
  - **Cc** stands for carbon copy. It specifies recipients who are not direct addresses. This filed is optional.
  - **Bcc** stands for Blind carbon copy. It is similar to Cc, except that the recipients do not get to know who the other recipients are. This field is optional.
  - **Message Body** is the area where you type your main message.
- **The most commonly used Email protocols on the internet –**
  - **POP3:** Post Office Protocol version 3 (POP3) is a standard mail protocol used to receive emails from a remote server to a local email client. POP3 allows you to download email messages on your local computer and read them even when you are offline.
  - **IMAP:** The Internet Message Access Protocol (IMAP) is a mail protocol used for accessing email on a remote web server from a local client.
  - **SMTP:** Simple Mail Transfer Protocol (SMTP) is the standard protocol for sending emails across the Internet.

- **Chat**
  - Chat refers to the process of communicating, interacting and/or exchanging message over the Internet. It involves two or more individuals that communicate through a chat enabled service or software.
  - In addition, there are many browser based services that do not require downloaded chat program.

    There are two basic modes for chatting on the Internet as follows:
    1. **Text-based chat:** Enables **communication** through sending and receiving text messages.
    2. **Multimedia chat:** Enables **communication** through audio and video transmission.
  - A chat room is the hub of Internet chatting. Chat rooms are actually chat servers that allow several users to login to them simultaneously. After joining a room, you can read the message of other users and send your own messages to them or to anyone else.

    Some chat etiquette are as follows:

    (i) Do not write in all capital as it symbolisies yelling.

    (ii) Try your best to spell all words correctly and use proper punctuation and use polite language.

    (iii) Behave the same way you would when talking to someone in real life.

    (iv) Avoid chat slang.
- **VoIP**
  - VoIP stands for Voice over Internet Protocol. It is a technology that allows you to make voice calls using a broadband internet connection instead of a regular phone line.
  - If you are calling a regular phone number, the signal is converted to a regular telephone signal before it calls directly from a computer, a special VoIP phone or a traditional phone connected to a special adapter.
  - A voice over IP solution provides significant cost savings over a traditional phone system. Users can take advantage of free calls and low rates for international calls and long distance.
- **Website**
  - Basically, a website is a collection of publicly accessible, interlinked web pages that share a single domain name. Websites can be created and maintained by an individual, group, business or organisation to serve a variety of purposes.
  - A site or website is a central location of web pages that are related and accessed by visiting the home page of the website using a browser.
  - Website come in a nearly endless variety, including educational sites, news sites, forums, social media sites, e-commerce sites and so on. The page within a website are usually a mix of text and other media.

    Together, all publicly accessible websites constitute the world wide web.
  - The first website was built at CERN by Tim Berners-Lee and launched on August 6, 1991.
  - Website programming is the main method of defining the structure of a website and managing its behaviour as visitors browse through its pages. With the help of web design techniques, the well structured information is given a user friendly look and feel.
- **Web page**
  - A web page is a document for the world wide web that is identified by a unique Uniform Resource Locator (URL). These pages are written in HTML, that is viewed in an Internet browser. A webpage may contain text, graphics and hyperlinks to other web pages and files.
  - A webpage is often used to show private information to viewers, including pictures or videos to help illustrate important topics. A web page may also be used as a method to sell products or services to viewers.
  - The first or main page of a website is known as **home page**. It helps viewers to find out what they can find on that particular site.
- **Types of webpages**

  There are two types of web pages as follows:

  (i) **Static Webpage:** Static Webpage contains content that remains same always. They may only change if the actual HTML file is manually edited. They are generally available to users without restriction.

  (ii) **Dynamic Webpage:** A website is a collection of dynamic webpages. These webpages are temporary pages that are created on-demand. This means that dynamic pages or parts of it do not exist and are only created

when there is a request. Content in dynamic pages may be restricted to some users and will only be displayed once identification has been established.

Differences between website and webpage are as follows:

Website	Webpage
• It is a cluster of related webpages addressed to a typical URL.	• Webpage is a part of website which comprises links to other web pages.
• There is no extension used in the URL of a website.	• The webpage URL has an extension.

- **Web Server**
  - A web server is a computer that runs websites. It is a computer program that distributes web pages as they are requested. The basic objective of the web server is to store, process and deliver web pages to the users.
  - The main job of a web server is to display the website content. If a web server is not exposed to the public and is used internally, then it is called Internet server.
- **Web Hosting**

A web hosting is a type of Internet hosting service that allows individuals and organisations to make their website accessible via world wide web. Web hosts are companies that provide space on a server. Owned and leased for use by clients as well as providing Internet connectivity, typically in a data center.

- **Web Browser**

A web browser or simply browser is a special software that enables the users to read/view web- page and jump from one webpage to another. It displays a webpage and interprets its HTML codes. It is the software that is needed to find, retrieve, view and send information over the Internet.

Browsers are of two types:

1. **Text Based Web Browsers** are the web browsers that support text only, *i.e.*, these browsers do not support graphics.
   e.g., Lynx.
2. **Graphical web browsers** Graphical browser display text, images, and other web applications including video and audio files (as compared with text only browsers). *e.g.*, Chrome, Internet Explorer, Mozilla firefox etc.

- **Commonly used browsers**
  - **Google Chrome:** This web browser is developed by Google, and its beta version was first released in september 2008 for Microsoft windows.
  - **Mozilla Firefox:** Firefox is a new browser derived from Mozilla. It was released in 2004 and has grown to be the second most popular browser on the Internet.
  - **Internet Explorer (IE):** It is a product of Microsoft. This was introduced in 1995 along with windows 95 launch and it has passed Net scape popularity in 1998.
  - **Safari:** It is a web browser developed by Apple Inc. and launched with Max OS X Panther. It was first released as a public beta in January 2003. Safari has very good support for latest technologies like XHTML, CSS2 etc.
  - **Opera:** It is smaller and faster than most other browsers, yet it is full-featured, Fast, user friendly, with keyboard interface, multiple windows zoom functions and more.
  - **Lynx:** It is a fully featured world wide web browser for users on UNIX, VMS and other platforms running cursor-addressable, character cell terminals or emulators.
- **Browser Setting:**
  - Open the Settings page.
  - Locate the Privacy section and choose Content settings.
  - In the ''Content Settings'' overlay ensure that the following options are set:
    - **(i) Cookies:** Allow local data to be set
    - **(ii) Javascript:** Allow all sites to run Java scripts
    - **(iii) Pop-ups:** Allow all sites to show popups
- **Add-ons**

Add-ons are tools which integrate into your browser. They are similar to regular apps or programs, but only run when the browser runs. Add-ons can allow the viewing of certain types of web content, such as Adobe Flash player for youtube videos etc.

Add-ons can work within the framework of the browser provided or they can provide separate functions, such adding a status bar.

Examples of add-ons for a computer include card for sound, graphic acceleration, modem capability and memory. Software add-ons are common for games, word-processing and accounting programs.

- **Plug-ins**

Plug-ins are software additions that allow for the customization of computer programs, apps and web browser as well as the customization of the content offered by websites. While plug-ins continue to be used by add-ons to customise programs and apps, their use in web browser has decreased somewhat, in favour of using browser extensions instead.

Here are a few good plugins to help customize your user experience with web browsing, content creation, and with your favorite apps and programs:

- **Adobe Acrobat Reader:** We're all expected to view PDFs these days. This plugin allows you to access and view those important documents.
- **Adobe Flash Player:** Sometimes, in order to view videos online, a plugin called Adobe Flash Player has to be enabled.
- **Bukkit Plugins:** For those into Minecraft, Bukkit plugins are a type of plugin that provide countless ways to customize how the sandbox video game can be played.
- **HP Print Service:** Allows you to send print jobs from an Android device to an HP printer. This plugin can be downloaded like an app from the Google Play Store.

- **Cookies**

Cookies are messages that web servers pass to your web browser when you visit Internet sites. Your browser stores each message in a small fill, called cookie.txt. When you request another page from the server, your browser sends the cookies back to the server. These files typically contain information about your visit to the web page as well as any information you have volunteered. Such as your name and interests.

Key Words

- **Ring Topology:** In this topology, each **node** is exactly connected to two other nodes, forward and backward.
- **NIC (Network Interface Card):** It is a hardware component used to connect a computer with another computer onto a network.
- **Server:** It is a computer or system that provides resources, data, services or programs to other computers known as clients over a network.
- **CC** ("Carbon Copy") field allows you to specify recipients who are not direct addressees (listed in the "To" field).
- **BCC** Each BCC recipient will receive the e-mail, but will not see who else received a copy.
- **Home Page-**Home page is the "front door" of the site.

UNIT – IV: SOCIETAL IMPACTS

CHAPTER-5

SOCIETAL IMPACTS

Topic-1 Cyber Safety

Concepts Covered • *Digital footprint* • *Net and communication etiquettes* • *Data protection*

Revision Notes

- Cyber safety is the act all about the responsible and safe use of Internet services by dealing with the risk which is associated using the Internet. This behaviour helps us to protect our personal information and minimize the danger online.
- When we use Internet we need to be careful about sharing our personal information. Share your personal information only with the trustworthy sources. If someone succeeds in stealing your personal information it could create great danger.

Key Words

Surfing: It is popularly known means to go from one page to another on the Internet, browsing for topics of interest.
Website: It is a collection of publicly accessible, interlinked Web pages that share a single domain name.

- **Digital Footprint**
  - Whatever a person does online , creates a trail or shadow. this trail or shadow can be traced back to know more about that person. these trails or traces are termed as digital footprint.
  - Digital footprint includes e-mail you sent, information you shared, **websites** you visited and the activities you took part online.
  - Digital footprint is used for several reason for example marketers use your digital footprint to find out what kind of product you have interested in and a interviewer what kind of activities the candidates perform online, it gives better idea about the candidate's personality.
    Digital footprint is of two types:
    1. **Active Digital Footprint:** When a user knowingly share the personal data in order to share information about the user by means of social networking digital platform.
       e.g. when user makes a comment or post something on social media.
    2. **Passive Digital Footprint:** When the personal data of the user is collected without letting him know or collection of personal data of user without the permission of him is known as passive digital footprint.
       e.g. when user visits any **website** traces his physical location using user's device IP address.
- **How can you make your digital footprint positive?**

You can make your digital footprint positive by being little careful when you are **surfing**. You can do following things:

- Always check the content you post on web. If you are not careful about what you do online then there is the possibility of your negative digital footprint.
- Don't keep the attitude that you can do anything online and no one will come to know. This information can be fetched even without your permission. All the information stored in the form of cookies which can be accessed by the one who wants to get information about your digital footprint.
- You should always know what you exactly want because the confusion can create wrong footprint and can mislead the one who is looking for your digital footprint.

- **Advantage of digital footprint:**

Although when we hear the name digital footprint a negative image comes in our mind because it keeps the record of each and every activity of us, we do online. But digital footprint has so many advantages.

- Digital footprint makes our online experience friendly. Digital footprint decreases the complexity of the online world. Without digital footprint, our net **surfing** may not be easy as it is today.
- Digital footprint helps Google Ad Sense to serve as best. Using our digital footprint, Google Ad Sense provides us appropriate advertisement. If they haven't used our digital footprint it may happen that when we are searching for job information and our search is fed with with railway booking information.
- These days most of the devices are GPS enabled with digital footprint, online maps provide you best root possible.

- **Net and communication etiquettes (Netiquettes)**
  - Netiquette is a way to communicate over Internet. In real world, we use a manner to talk so that the exact meaning could successfully be conveyed to the listener. On Internet, this manner is known as Netiquettes which help the user to get exact idea of what is said.

    Good netiquette are:
    (i) Don't send same message again and again, it creates negative effect and irritate other people, no matter how good this message is.
    (ii) Always take permission of other person before sharing their personal information, photos etc. If you don't take permission before sharing the information, it is bad netiquette.
    (iii) Never make bad comments about anyone on social media, it will degrade your reputation and don't catch into fight on social media even try to avoid such situation.

(iv) Never post abusive content on social media, it will create difficulty for you. Even your account can be terminated.

Do's	Don'ts
Keep messages and posts brief.	Post inflammatory/offensive comments.
Reread your posts or emails to make sure they say what you intend.	Write in ALL CAPS. It is considered as SHOUTING on the net.
Remember that you leave a digital footprint. So, be careful what you write.	Respond to internet trollers/personal attacks.
Use discretion.	Post private or embarrassing images/comments.
Include a subject line in an email.	Use sarcasm. It might be misinterpreted.
Protect personal information.	Violet copyright laws, Make sure your work is your own or properly cited.
Obey copyright laws.	Exclude people or talk behind their backs.
Stay focused and stick to the topic.	Spam others by sending large number of unsolicited e-mails.

- **e-mail Etiquettes**
  - Write a clear, concise subject line that reflects the body of the e-mail. Avoid subject lines with general works like, ''Hi'', ''Hello'' and do not leave the subject line blank.
  - Always use an appropriate greeting. Begin your e-mail with phrases such as Good Morning, Good Afternoon etc.
  - Be aware that funny sayings or colloquialisms may be completely misconstrued by your colleagues in overseas offices.
  - Always state if your e-mail needs an action and by when. Open-ended e-mails can be confusing. Having an action or even letting the recipient know that no further action is required.
  - Don't hit reply all. It can be annoying to be copied into every email or to see every response in a chain if it is not relevant to your recipient.
  - Never use inappropriate language in an e-mail. The reality is that your e-mail will remain on the server long after you have deleted it.
- **Data protection**
  - It is the process of safeguarding important information from corruption, compromise or loss. In short, you should be able to decide whether or not you want to share some information, who has access to it, for how long, for what reason and be able to modify some of this information and more.
  - A large part of a data protection strategy is ensuring that data can be restored quickly after any corruption or loss. Protecting data from compromise and ensuring data privacy are other key components of data protection. There are two key areas of data management used in data protection as.
    (i) **Data life cycle management** is the process of automating the movement of critical data to online and offline storage.
    (ii) **Information life cycle management** is a comprehensive strategy for valuing, cataloguing and protecting information assets from application and user errors, malware and virus attacks, machine failure or facility outage and disruptions.

Purpose of data protection

Storage technologies that can be used to protect data include a disk or tape backup that copies designated information to a disk based storage array or a tape cartridge device so it can be safely stored. Mirroring can be used to create an exact replica of a **website** or files so they are available from more than one place. Storage snapshots can automatically generate a set of pictures to information stored on tape or disk, enabling faster data recovery while continuous data protection backs up all the data in an enterprise whenever a change is made.

Key Words

- Cybersafety addresses the ability to act in a safe and responsible manner on the Internet and other connected environments.
- Digital footprint is data that is left behind when users have been online.
- **Digital Tattoos:** Digital footprints are also termed as Digital Tattoos.

Topic-2 Ethical Issues

Concepts Covered • *Intellectual Property Rights* • *Licensing* • *Free and open source software*

Revision Notes

- **Intellectual Property**
  - When someone owns a house or a motorcycle, we say that the person owns that property. Similarly, if someone comes out with a new idea, this original idea is that person's intellectual property.
  - Intellectual property refers to the inventions, literary and artistic expressions, designs and symbols, names and logos. The ownership of such concepts lies with the creator or the holder of the intellectual property.
  - This enables the creator or copyright owner to earn recognition or financial benefit by using their creations or inventions.

    Intellectual property is legally protected through copyright patents, trademarks etc.

    (i) Copyright: It grants legal rights to creators for their original works like writing, photograph, audio recordings, video, sculptures, architectural works, computer software, and other creative works like literary and artistic work.

    Copyrights are automatically granted to creators and authors. Copyright law gives the copyright holder a set of rights, that they alone can avail legally. The rights include right to copy (reproduce) a work, right to create derivative works based upon it, right to distribute copies of the work to the public and right to publicly display or perform the work. It prevents others from copying, using or selling the work. For example, any writer holds the copyright to his book. It would be an infringement of the writer's copyright if someone used parts of his book without permission. To use other's copyrighted material, one needs to obtain a license from them.

    (ii) Patent: It is usually granted for inventions. Unlike copyright, the inventor needs to file for patenting the invention. When a patent is granted, the owner gets an exclusive right to prevent others from using selling or distributing the protected invention.

    Patent gives full control to the patentee to decide whether or how the invention can be used by others. Thus it encourages inventors to share their scientific or technological findings with others. A patent protects an invention for 20 years, after which it can be freely used. Recognition and financial benefits right the environment and provide motivation for more creativity and innovation.

    (iii) Trademark: It includes any visual symbol, word, name, design, slogan, label etc., that distinguishes the brand or commercial enterprise, from other brands or commercial enterprise.

    For example, no company other than ABC can use the ABC brand to sell shoes or clothes. It also prevents others from using a confusingly similar mark, including words or phrases.

- **Intellectual Property Rights (IPR)**

Intellectual Property Rights are the exclusive rights given to the person over his/her creation for specific time period. These rights allow the patents or owner to buy, sell, exchange their licensed goods to different people or organisations. Intellectual property rights are largely covered by laws governing to patents. Copyrights, industrial design rights, trademarks, plant variety rights, trade dress, geographical indications, circuit design rights and supplementary protection certificates for pharmaceutical products and database rights etc.

- **Objectives of IPR**

The policy is a comprehensive document that lays down seven objectives which have been elaborated with actionable steps to be undertaken by the identified nodal ministry or department towards achieving objectives.

(i) IPR Awareness: Outreach and Promotion — To create public awareness about the economic, social and cultural benefits of IPRs among all sections of society.

(ii) Generation of IPRs: To stimulate the generation of IPRs.

(iii) Legal and Legislative Framework: To have strong and effective IPR laws, which balance the interests of owners rights with larger public interest.

(iv) Administration and Management: To modernize and strengthen service oriented IPR administration.

(v) Commercialization of IPRs: Get value for IPRs through commercialization.

(vi) Enforcement and Adjudication: To strengthen the enforcement and adjudicatory mechanisms for combating IPR infringements.

(viii) Human Capital Development: To strengthen and expand human resources, institutions and capacities for teaching, training, research and skill building in IPRs.

- Intellectual Property laws and enforcement vary widely from jurisdiction to jurisdiction. Term 'open source' governmental efforts to harmonize them through international treaties such as 1994 World Trade Organisation (WTO) Agreement on Trade Related aspects of Intellectual Property Rights (TRIPs), while other treaties may facilitate registration in more than one jurisdiction at a time.
- With companies, institutions and individuals constantly forging ahead in newer fields and geographical territories and with path breaking inventions becoming the norm, the field of Intellectual Property rights has assumed primordial importance, especially in emerging economics like India.
- **Violation of IPR**

Violation of IPR may happen in one of the following ways:

(i) Plagiarism: With the availability of Internet, we can instantly copy or share text, pictures and videos. Presenting someone else's idea or works as one's own idea or work is called plagiarism. If we copy some contents from Internet, but do not mention the source or the original creator, then it is considered as an act of plagiarism. Further, if someone derives an idea or a product from an already existing idea or product, but instead presents it as a new idea then also it is plagiarism. It is a serious ethical offense and sometimes considered as an act of fraud. Even if we take contents that are open for public use, we should cite the author or sources to avoid plagiarism.

Types of Plagiarism:

1. Direct Plagiarism is the word to word transcription of a section of someone elses work without attribution and without quotation marks.
2. Self Plagiarism occurs when a student submits his or her own previous work or mixes parts of previous work.
3. Mosaic Plagiarism occurs when a student borrows phrases from a source without using quotation marks.
4. Accidental Plagiarism occurs when a person neglects to cite their sources or misquotes their sources.

Apart from these, other categories of plagiarism are as follows:

- **CLONE:** Cloning is the most problematic and common form of plagiarism.
- **Ctrl + C:** In this type of plagiarism, a particular portion of the text is copied from a single source without any alteration.
- **FIND-REPLACE:** Most common keywords of the copied content are changed.
- **REMIX:** Information from various sources are collected and mixed.

(ii) Copyright Infringement: Copyright infringement is when we use other person's copyrighted work without obtaining their permission to use or we have not paid for it, if it is being sold. Suppose we download an image from the Internet and use it in our project. But if the owner of the copyright of the image does not permit its free usage, then using such image even after giving reference of the image in our project is a violation of copyright. Just because it is on the Internet, does not mean that it is free for use. Hence, check the copyright status of writer's work before using it to avoid plagiarism.

(iii) Trademark Infringement: Trademark infringement means unauthorised use of other's trademark on products and services. An owner of a trademark may commence legal proceedings against someone who infringes its registered trademark.

- **Software License**

It is a document that provides legally binding guidelines for the use and distribution of software. Software licenses typically provide end users with the right to one or more copies of the software without violating copyrights.

Types of Software License:

(i) Proprietary license is a license where the copyright stays with the produces and the user is granted the right to use the software.

(ii) GNU General Public License (GPL) which are agreements under which open source are usually licensed.

(iii) End User License Agreement (EULA) indicates the terms under which the end user may use the software.

(iv) Creative commons (CC) license is a public copyright license that enables free distribution of a copyrighted work.

Apache is the most popular web server software that enables a computer to host one or more websites. It is open source and free to use hence enabling web hosting companies to offer web hosting solutions at minimal costs.

- **Platforms supported by Apache:** Linux, Windows and Macintosh operating systems.
- Apache web server software is also known as Apache HTTP server.

- **Free and Open Source Software (FOSS)**
  - FOSS has a large community of users and developer who are contributing continuously towards adding new features or improving the existing features.
  - The term free indicates that the software does not have constraints on copyrights. The term 'open source' refers software development from expert developers collaborating worldwide without any need for reverse engineering. Free and open source software may also be referred to us Free/libre open source software (FLOSS) or free open source software (FOSS).
  - One major reason for the growth and use of FOSS technology is because users have access to the source so it is much easier to fix faults and improve the applications. In combination with the open license, this simplifies the development process for many enterprises and gives them flexibility that simply is not available with the confiner of a proprietary or commercial product.
  - For example, Linux Kernel based operating systems like Ubuntu and Fedora come under FOSS. Some of the popular FOSS tools are office packages, like Libre office, browser like Mozilla Firefox etc.

Key Words

- **Open Source:** The term open source refers to something people can modify and share because its design is publicly accessible.
- **OSS:** An OSS (open source software) refers to freedom to use, share and/or modify the source code and allow copyrights to other users.
- **Shareware:** Shareware are copyrighted software that can be shared for a limited period for free on a trial basis with the understanding that if the user decides to use it, he will pay for it.
- **Copyleft Licenses:** It allows modification and distribution of software with source code.
- Proprietary software (sometimes referred to as closed source software) is software that legally remains the property of the organisation, group, or individual who created it.

Topic-3 Cyber Crime and IT Act

Concepts Covered • *Cybercrime and cyber laws* • *Hacking* • *Phishing* • *Cyber bullying* • *Overview of Indian IT Act*

Revision Notes

- **Cyber Crime**
  - Criminal activities or offences carried out in a digital environment can be considered as a cyber crime. In such crimes, either the computer itself is the target or the computer is used as a tool to commit a crime.
  - Cyber crimes are carried out against either an individual or a group or an organisation or even against a country, with the intent to directly or indirectly cause physical harm, financial loss or mental harassment. A cyber criminal attacks a computer or a network to reach other computers in order to disable or damage data or services.
  - Apart from this, a cyber criminal may spread viruses and other malwares in order to steal private and confidential data for blackmailing and extortion. A Computer virus is a type of malicious code that can copy itself and can have detrimental effect on the computers, by destroying data or corrupting the system.
  - Similarly, malware is a software designed to specifically again unauthorised access to computer systems. The nature of criminal activities are alarmingly increasing day by day, with frequent reports of hacking, ransomware attacks, denial of services, phishing, e-mail fraud, banking fraud and identity theft.

1. **Hacking**

   Hacking is the act of unauthorised access to a computer, computer network or any digital system. Hackers usually have technical expertise of the hardware and software.

   They look for bugs to exploit and break into the system.

   Hacking, when done with a positive intent is called ethical hacking. Such ethical hackers are known as white hat hackers. They are specialists in exploring any vulnerability or loophole during testing of the software. Thus, they help in improving the security of a software. An ethical hacker may exploit a website in order to discover its security loopholes or vulnerabilities. He then reports his findings to the website owner. Thus, ethical hacking is actually preparing the owner against any cyber attack.

   A non-ethical hacker is the one who tries to gain unauthorised access to computers or networks in order to steal sensitive data with the intent to damage or bring down systems. They are called black hat hackers,

or crackers. Their primary focus is on security cracking and data stealing. They use their skills for illegal or malicious purposes. Such hackers try to break through system securities for identity theft, monetary gain, to bring a competitor or rival site down, to leak sensitive information etc.

2. **Phishing and Fraud e-Mails**

Phishing is an unlawful activity where fake websites or e-mails that look original or authentic are presented to the user to fraudulently collect sensitive and personal details, particularly user names, passwords, banking and credit card details. The most common phishing method is through e-mail spoofing where a fake or forged e-mail address is used and the user presumes it to be from an authentic source. So you might get an e-mail from an address that looks similar to your bank or educational institution, asking for your information, but if you look carefully you will see their URL address is fake. They will often use logos of the original website, making them difficult to recognise if it is real or fake. Fraud phone calls or text messages are also common these days.

(i) **Identity Theft:** Identity thieves increasingly use personal information stolen from computers or computer networks, to commit fraud by using the data gained unlawfully. A user's identifiable personal data like demographic details, e-mail Id, banking credentials, passport, PAN, Aadhaar number and various such personal data are stolen and misused by the hacker on behalf of the victim. This is one type of phishing attack where the intention is largely for monetary gain. There can be many ways in which the criminal takes advantage of an individual's stolen identity. Given below are a few examples:

- **Financial identity theft:** When the stolen identity is used for financial gain.
- **Criminal identity theft:** Criminals use a victim's stolen identity to avoid detection of their true identity.
- **Medical identity theft:** Criminals can seek medical drugs or treatment using a stolen identity.

3. **Ransomware**

This is another kind of cyber crime where the attacker gains access to the computer and blocks the user from accessing, usually by encrypting the data. The attacker blackmails the victim to pay for getting access to the data or sometimes threaten to publish personal and sensitive information or photographs unless a ransom is paid.

Ransomware can get downloaded when the user visit any malicious or unsecure websites or download software from doubtful repositories. Some ransomware are sent as an e-mail attachments in spam mails. It can also reach our system when we click on a malicious advertisement on the Internet.

Combatting and Preventing Cyber Crime

The challenges of cyber crime can be mitigated with the twin approach of being alert and taking legal help. Following points can be considered as safety measures to reduce the risk of cyber crime:

- Take regular backup of important data
- Use an antivirus software and keep it updated always
- Avoid installing pirated software. Always download software from known and secure (HTTPs) sites.
- Always update the system software which include the Internet browser and other application software.
- Do not visit or download anything from untrusted websites.
- Usually the browser alerts users about doubtful websites whose security certificate could not be verified, avoid visiting such sites.
- Use strong password for web login, and change it periodically. Do not use same password for all the websites. Use different combinations of alphanumeric characters including special characters. Ignore common words or names in password.
- While using someone else's computer, don't allow browser to save password or auto fill data and try to browse in your private browser window.
- For an unknown site, do not agree to use cookies when asked for, through a Yes/No option.
- Perform online transaction like shopping, ticketing, and other such services only through well known and secure sites.
- Always secure wireless network at home with strong password and regularly change it.

Cyber Bullying

- Cyberbullying or bullying that takes place over digital devices like cell phones, computers and tablets. Cyberbullying can occur through SMS, text and apps or online in social media, forums or gaming where people can view, participate or share content.

- Cyberbullying includes sending, posting or sharing negative, harmful, false or mean content about someone else. It can include sharing personal or private information about someone else causing embarrassment or humiliation. Some cyberbullying crosses the line into unlawful or criminal behaviour.

The most common places where cyberbullying occurs are:

- Social media such as Facebook Instagram, Snapchat.
- Text messaging and messaging apps on mobile or tablet devices.
- Instant messaging, direct messaging and online chatting over the Internet.
- Online forums, chat rooms and message boards such as Reddit
- e-Mail
- Online gaming communities eg. MUDS (Multi-User Dungeons)

Cyber Law

These are the laws that apply to the Internet and Internet related technologies. Cyber law is one of the newest areas of the legal system. This is because Internet technology develops at a rapid pace.

Cyber law provides legal protections to people using the Internet. This includes both businesses and everyday citizens. Understanding cyber law is of the utmost importance to anyone who uses the Internet. Cyber law has also been referred to as the "law of the Internet".

Importance of Cyber law

- It covers all transactions over Internet.
- It keeps eyes on all activities over Internet.
- It touches every action and every reaction in cyberspace.

Evolution of Cyber law in India

With an increase in the dependency on the use of technology, the need for cyber law was necessary. Much like every coin has two sides, therefore, the dependency on technology has its pros and cons. The rise of the 21st century marked the evolution of cyberlaw in India with the **Information Technology Act, 2000** (popularly known as IT Act).

India Information Technology Act (IT Act)

With the growth of Internet, many cases of cyber crimes, frauds, cyber attacks and cyber bullying are reported. The nature of fraudulent activities and crimes keeps changing. To deal with such menace, many countries have come up with legal measures for protection of sensitive personal data and to safeguard the rights of Internet users.

The Parliament of India passed its first Cyber law the Information Technology (IT) Act, 2000, on the 17th October 2000, which provides the legal infrastructure for e-commerce in India. The purpose of the IT Act, 2000, as mentioned in the language of the Act is:

to provide legal recognition for transaction carried out by means of electronic data interchange and other means of electronic communication, commonly referred to as " electronic commerce", which involves the use of alternative to paper based methods of communication and storage of information, to facilitate electronic filling of document with the Government agencies and further to amend the Indian Penal Code, the Indian Evidence Act,1872, the Banker's Book Evidence Act, 1891 and The Reserve Bank of India Act, 1934 and for matters connected therewith or incidental thereto.

The General Assembly of the United Nations, by its resolution A/RES/51/162 dated 30th January 1997, adopted the Model Law on Electronic Commerce adopted by the United Nations Commission on International Trade Law. The same resolution recommends among other things that all states give favourable consideration to the Model Law when they enact or revise their law, keeping in mind the need for uniformity of law pertaining to alternatives to paper-based methods of communication and storage of information. The Indian Information Technology Act,2000, accordingly draws upon the Model Law.

The implementation of this Act has kick-started a new era of e-governance and will have a lot of impact on the way people do business in India and will also open up new opportunities for E-business as people would be less apprehensive about the legal hassles and issues not under the jurisdiction of law, *e.g.* authenticity of legal document , hacking, digital signatures and so on.

Therefore, it is essential for us to understand what the IT Act offers and what are its various perspectives.

The Government of India's Information Technology Act, 2000 amended in 2008, provides guidelines to the user for the processing, storage and transmission of sensitive information. In many Indian states, there are cyber cells in police stations where one can report any cyber crime. The act provides legal framework for electronic governance by giving recognition to electronic records and digital signatures.

➢ **Highlights of IT Act, 2000**

For a basic understanding of the IT Act by the layman, the salient features of the Act and its relevant portion of an e-business are enumerated below:

- Electronic contracts are legally valid – EDI accorded legal recognition.
- Legal recognition according to digital signature.
- Digital signature to be affected by use of asymmetric crypto system and hash function.
- Security procedure for electronic records and digital signature.
- Appointment of Certifying Authorities (CAs) and the Controller of Certifying Authorities (CCA) including recognition of foreign Certifying Authorities.
- Controller to be appointed, who will act as repository of all digital signature certificates.
- Certifying Authorities require to get license to issue digital signature certificates.
- Various types of computer crimes defined and stringent penalties provided under the Act.
- Appointment of Adjudicating Officer for holding enquiries under the Act.
- Establishment of Cyber Appellate Tribunal under the Act.
- Appeal from order of Adjudicating Officer to Cyber Appellate Tribunal and not to any civil court.
- Appeal from order of Cyber Appellate Tribunal to High Court.
- Act to apply for offences or contraventions committed outside India.
- Network Service providers not to be liable in certain cases.
- Power to Police officers and other officers to enter into any public place and search and arrest without warrant.
- Constitution of Cyber Regulations Advisory Committee to advise the Central Government and Controller.
- Amendments effected in:
  (A) Indian Penal Code
  (B) Indian Evidence Act
  (C) Banker's Books Evidence Act
  (D) Reserve Bank of India Act

➢ **Some of the important concepts introduced in the IT Act, 2000 are:**

- Electronic record
- Secure electronic record
- Digital signature
- Secure digital signature
- Certifying authority
- Digital signature certificate.

➢ **Some of section under IT Act, 2000 are given below:**

Section	Offence	Penalty
67A	Publishing images containing sexual acts.	Imprisonment up to seven years,or/and with fine up to ₹ 1,000,000
67B	Publishing child porn or predating children online.	Imprisonment up to five years, or/and with fine up to ₹ 1,000,000 on first conviction. Imprisonment up to seven years, or/and with fine up to ₹ 1,000,000 on second conviction.
67C	Failure to maintain records.	Imprisonment up to three years, or/an with fine.
68	Failure/refusal to comply with orders.	Imprisonment up to three years, or/and with fine up to ₹ 200,000
69	Failure/refusal to decrypt data	Imprisonment up to seven years and possible line.
70	Securing access or attempting to secure access to a protected system	Imprisonment up to ten years, or/an with fine.
71	Misrepresentation	Imprisonment up to two years, or/an with fine up to ₹ 100,000

Topic-4 Technology and Society

Concepts Covered • *E-waste* • *Awareness about health concerns related to the usage of technology*

Revision Notes

e-Waste Management

- In most parts of the world, underground water is not drinkable directly. Long ago, people simply used to draw up water from wells and drink it. But now, you have to use some sort of filter to purify the water and make it drinkable. Why? It is just one of the many problems and hazards of e-waste. The electronic devices, dead cells and batteries you throw away with other garbage contains lead that easily mixes with underground water, making it unfit for direct consumption. That is just the tip of the iceberg – the problems of e-waste disposal.
- This word has caught up in the recent past only when someone studying the subject noted that our environment will be 3x more congested with e-waste by 2017. E-waste is growing in huge volumes. The reason why e-waste is increasing is that technology is growing fast and in an attempt to get better devices, we casually get rid of old electronics – the best examples being that of smart-phones.
- One may ask the relationship between old electronics and e-waste. e-waste is actually the old electronic goods that people simply give away to garbage trucks that are then dumped into landfill or similar sites. Electronics have a number of harmful elements that react with air and water to create problems of e-waste such as water, air and soil pollution as well as problems that affect human beings in the form of diseases.
- In the above example, we used old cells and batteries as an example. Most of the cheaper batteries are lead based and easily react with water (rain or moisture) to seep and mix with underground water along with polluting the soil and air where it was disposed by the garbage department.
- Thus, everything that falls into electronics category, that you intend to throw away, is e-waste (electronic waste). This includes computers, laptops, tablets, smart-phones and so on. There are proper methods to dispose off electronic items. They should be handled differently, but unfortunately, even the developed countries do not have strong policies to take care of such harmful, toxic garbage.
- The solder present on the motherboard of computers and TV contain high levels of lead. Even the glass panels of computer monitors and of course, the lead batteries contaminate air, water, and soil. In addition, they distort the process of brain development, while posing danger to central nervous system and kidneys. This (lead poisoning) is among the most dangerous hazards of e-waste.
- Other than lead, motherboards also have high levels of Mercury. Improper disposal may create skin and respiratory disorders. Mercury poisoning also causes acute brain damages.
- The cables and PVC panels as well as glass, when reacts with moisture and oxygen, creates hazardous soil that may not be suitable for even building a home as the people breathing that air will suffer from reproduction problems and improper development of body parts, including the brain. It also spoils the immune system. Stress, anxiety, and other mental problems that can arise out of breathing air polluted with glass, PVC and other forms of plastic remains found in electronic items.
- The motherboard circuits can cause lung cancer when you breathe air polluted by the fumes released when the motherboard elements react and create Beryllium. It is also responsible for skin diseases, including warts and certain forms of dangerous allergies.

Treating e-Waste

- As of now, there are no proper methods being implemented even in the first world to eliminate the problem of e-waste. The two methods that have been found interesting for proper treatment of e-waste are recycling and refurbishing.
- For recycling, there may be products that cannot be recycled completely. PVC layers, for example, stay as such for ages and cannot be recycled. It would be better if the manufacturers use recyclable material so that the e-waste is converted into something that can be used again without harming the planet and its inhabitants. Thus, one of the major factors in treating e-waste is to compel manufacturers to use green elements.
- If electronics are refurbished, they can be sold again at a lower price. Thus, both the society and environment will be benefited. Instead of simply dumping your old TV into the garbage bin, you might want to think about calling the vendor and ask him where to present the item for refurbishing. If you cannot find, consider donating the item to some charity that can either use it as such or get it repaired and use it. It is not a practice well implemented, but it would be nice if all vendors provide a refurbishing facility.

➢ **Proper disposal of used electronics gadgets**

- Following are the proper steps to dispose e-waste.
  1. Some companies will offer free take back services. Nokia and Lenovo in China are on the forefront of free take back services.
  2. The minamata Convention is a worldwide effort to discontinue the use of mercury in health care by the year 2020. Thermometers and sphygmomanometer are being replaced by newer and safer health care apparatuses. However old school physicians still like the classical mercury sphygmomanometer which is why they still remain on the market. Health care facilities will have to make sure about the exact life span of medical equipment prior to purchase and how to dispose when they expire. Minamata Convention is able to trace mercury substances from the beginning of its production till its disposal.
  3. There is a movement to prohibit the export of second hand electronics to Africa. This will have a major impact on the ability of developing countries of reaching the goals of the United Nations Millennium Development. Even though technically the problem is not with the equipment it is with the lack of e waste regulation.

     There is also a new company called, East African Compliant Recycling. It is a full scale e waste recycling plant that will be launched in Nairobi, Kenya. This plant will be the model that will eventually be used throughout Africa. Not only will it prevent unsafe waste disposal for the environment and the people, but it will create jobs and recover valuable materials that can be sold and reused.
  4. It is also crucial for America to learn from Japan. This country has been in the forefront of e waste management. Already in the 1990's, Japan was the first country to enact e waste laws. The Japanese model has been admired by Russia as well. Japan recycles more than 2 million tons of e waste each year. As opposed to America with only 679,000 tons annually. In 2000, Japan introduced , the Manifest System. This procedure beings tracking e waste form the time it leaves the facility where it was produced initially until it reaches the final e waste facility. No other country has this cradle to grave system yet.

     According to the Department of Japanese Studies, Japan is the most environmentally aware country in the world. Chris McMoran stated that the reason that Japan is one on the cutting edge of this e waste management is due largely to its tragic history with industrial waste as well as pollution during the decades immediately post war.

     Reusable metals in Japan are being recycled in very practical ways. Instead of spending money importing these rare metals why not retrieve them and send them back to a factory in Japan to be used productively again ? The bottom line is money talks. Even though Japan is being praised for being at the forefront of the worldwide ''green'' campaign, it is more the profit motive than the love of nature that is the catalyst.

     It is compulsory to recycle items such as automobiles, computers and other electronic equipments in Japan. It impels recycling by imposing strict laws on both the consumers themselves and the manufacturers of electronic components.

     Not only is e waste recycling a green conscious effort, it is also motivated by profit. The revenue is expected to bring in one trillion yen by the year 2020.
  5. We must help developing countries improve the working conditions for all e waste workers so that they are properly protected. One hundred percent elimination of child labour in this industry paramount.
- Instead of automatically buying a new PC, consider upgrading software or hardware on your present computer. Search for charity organizations in your vicinity that may want your old electronics. There are local electronic donations centres in most towns.

➢ **e-Waste management Rules in India**

The Environment, Forest, and Climate Change Ministry (MoEF&CC) have announced the E-Waste Management Rules 2016. These new rules replaced the earlier E-Waste (Management and Handling) Rules of 2011.

The New Rules make for stricter norms and are a part of the government's increased commitment towards environmental governance.

Highlight of the new e-Waste Management Rules 2016:

1. It includes CFLs or Compact Fluorescent Lamps as well as other lamps with mercury, and similar equipment.
2. The Rules for the first time, bring producers under the ambit to the Extended Producer Responsibility or EPR together with the targets.
3. Producers have been made accountable for e-waste collection and e-waste exchange as well.
4. Additional stakeholder included are:
   (A) Manufacturers
   (B) Dealers

5. Compact Fluorescent Lamp (CFL) and other mercury-containing lamps have been brought under the purview of the rules.

   India's Environment Ministry has notified rules targeting the wide range of groups like hotels, residential colonies, bulk producers of consumer goods, ports, railway stations, airports and pilgrimage spots. This is to ensure that the solid waste generated in their facilities is treated and recycled.

➢ **Awareness about health concerns related to the usage of technology**

As digital technologies have penetrated into different fields, we are spending more time in front of screens, be it mobile, laptop, desktop, television, gaming console, music or sound device. But interacting in an improper posture can be bad for us-both physically and mentally. Besides, spending too much time on the Internet can be addictive and can have a negative impact on our physical and psychological well being.

Here are a few key considerations around technology use and how it affects our health:

(i) **Eyes strain:** When we gaze at a screen for long periods of time, we often forget to blink. In fact, research has shown that digital eye strain reduces our blink rate by half, which means the tears that protect our eyes evaporate without being replaced. Additionally, reading the smaller fonts on a smartphone or other portable device can intensify the strain.

(ii) **Sleep Disorders:** We love our devices so much that many of us even sleep with them. One study found that 72% of smartphone owners keep their phone next to their bed at night to ensure they do not miss a thing. It might seem like a harmless habit but late night technology use can interfere with your ability to sleep.

To avoid sleep disruption, try replacing late night technology use with sleep conducive activities such as taking a bath or reading in bed. Resisting the urge to keep your phone on your nightstand can also help minimize nighttime interruptions.

(iii) **Physical Inactivity:** When we are using technology like computers, video games or TVs, we generally are not exercising. That's why there's an increasing body of research linking the overuse of digital devices to decreasing exercise and fitness levels.

Logically, spending more time on watching TV or playing video games reduces the time you spend staying active.

(iv) **Mental Health:** More than three billion people interact with each other over social media every day. While many of our exchanges are generally harmless, over-using these services can impact our well being. Social media addiction is linked to a rise in mental health disorders like depression, suicidal ideation, particularly in teenagers. Researchers make that correlation by highlighting how platforms like Facebook, Instagram and Twitter place higher social pressures on young people and adults that can lead to instances of cyberbullying, increased need for approval and general feelings of discontent.

Key Words

- **E:** E- is a prefix used to describe anything electronic, that is any data or information transmitted over a network or the Internet.
- PCB – Pollution Control Board
- EPA – Environmental Protection Agency
- UNDP – United Nations Development Program
- CFC – Chloro Fluoro Carbon
- TFT – Thin Film Transistors
- ICT – Information and Communication Technology
- PVC – Polyvinyl Chloride
- GHE – Green House Effect
- CRT – Cathode Ray Tube
- LED – Light Emitting Diode

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