Introduction to Web Science

Institute of Web Science and Technologies

Department of Computer Science

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Assignment 1

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1.1 Write a simple python program that does the following:

1. Generate a random number sequence of 10 values between 0 to 80.

2. Perform sine and cosine operation on numbers generated.

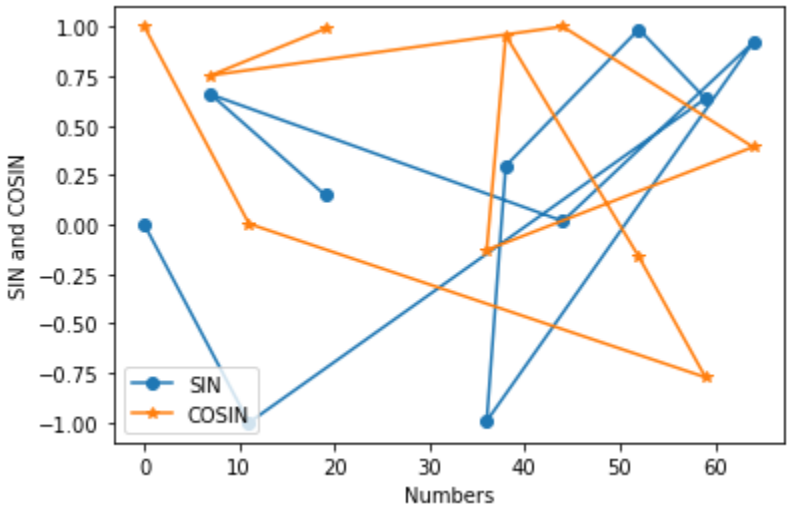
3. Store the values in two different arrays named SIN and COSIN respectively.

4. Plot the values of SIN and COSIN in two different colours.

5. The plot should have labelled axes and legend.

You are allowed to use the following libraries only if required : random, numpy, matplotlib.

Solution
Code attached as python file. **(assignment1-q1_1.py)**



1.2. Write another simple python program that does the following:

1. Read the sample.txt file

2. Count the frequency of each character in the text file. (How many times each

character occurred)

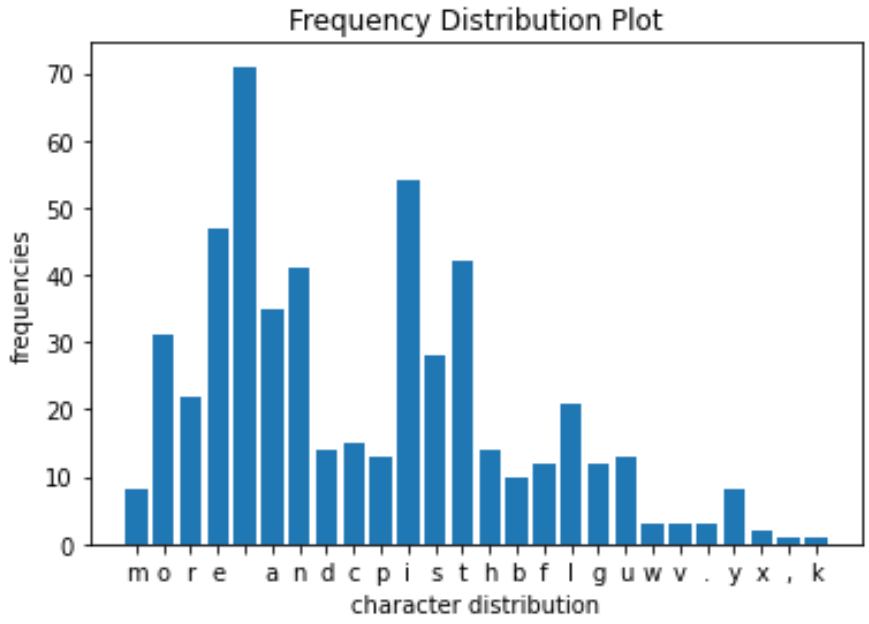
3. Plot the frequency distribution of “sample.txt” (see Figure 1 for an example).

4. The plot should have labelled axes.

You are allowed to use only matplotlib for this question

Solution

Code attached as python file. **(assignment1-q1_2.py)**



2.1 Explain in your own words what the capture effect is and how it impacts the probability of a collision?

Solution

Capture effect is a phenomenon that happens when there are multiple stations/devices of varying strengths and the LAN only grabs the station with the higher strength even though there are other stations waiting for access to transmit their data on the network.

Capture effect lowers the probability of a collision because of its unfairness. This is also referred to as a drawback of the CSMA/CD protocol, because the capture effects enable the stronger station to be able to transmit its frames repeatedly as its collision counter becomes 0 and hence lowering the probability of collisions.

2.2. Assume there are two computers A and B which have a set of frames to transfer. They attempt to transmit a frame via a quiet link and collide. During the first backoff session, computer A selects a lower backoff number and wins. After A's successful transmission, A and B try to transmit and collide again. What is the probability that B wins the second backoff session (selects a lower backoff number)?

Solution

In the second collision, A was transmitting its second packet and B is yet to transfer its first packet.

Waiting time = back–off time

Let n = collision number or re-transmission serial number.

Then,

Waiting time = K * T(slot) , where K = [0, 2n – 1]

Now collision no. n becomes 1 for packet 2 of A and becomes 2 for packet 1 of B.

For packet 2 of A, K = {0, 1}

For packet 1 of B, K = {0, 1, 2, 3}

Value of K

A	B	Winner/Collision
0	0	Collision
0	1	A
0	2	A
0	3	A
1	0	B
1	1	Collision
1	2	A
1	3	A

Probability that A wins = 5/8 = 0.625 = 62.5%

Probability that B wins = 1/8 = 0.12 = 12.5%

Probability of collision = 2/8 = 0.25 = 25%

3.1 How conflicts (overlapping) in the routing tables are resolved?

Solution

- Overlapping will occur when two organizations have the same IP addresses and try to communicate with each other.
- When two duplicate IP addresses try to communicate with each other then the router will not be able to find the correct path.
- To Overcome this problem, Network Address Translation (NAT) plays a role in it. It will assign a unique public address to a computer/host inside the private network of an organization. It will create a firewall between the two hosts.

3.2. Routing table is of the given structure:

Destination	Gateway
default	default gateway
192.168.0.0/16	10.0.0.1
192.168.1.0/24	10.0.0.4
192.168.0.0/24	10.0.0.3
193.0.0.0/16	10.0.0.2

Table 1: Routing table

Consult Classless Inter-Domain Routing (CIDR) Network References if needed.
Given the table, specify gateways to which the router forwards a packet addressed to:

Solution

192.168.1.20 - 10.0.0.4

192.168.0.20 - 10.0.0.1 and 10.0.0.3

192.168.30.10 - 10.0.0.1

192.168.218.251 - 10.0.0.1

193.168.218.251 - 10.0.0.2

4.1 In case of a collision, how data transfer is resumed and why is it so?

Solution

- For the data transfer resume, we will use the CSMA/CD mechanism which is known as carrier sense multiple access (collision detection).
- Each carrier will first sense the state of the medium before sending any information on the ethernet.
- Each host will wait for a certain amount of time after collision when they try to send a packet on LAN. It is known as Exponential Back off time.
- Exponential back off time will help to reduce the collision on the network.

4.2. Explain in your own words, why IP address is required for a packet transfer and MAC address alone is not enough.

Solution

- The purpose of IP addresses is to be used in overlay networks while MAC addresses are more suitable and useful in local networks.
- IP addresses can change in different networks, for the same device. MAC address is a combination of vendor id and device unique identifier and so is static in nature. This means that it is difficult to maintain and impossible to use across the globe.
- IP addresses can be used to create hierarchical structures which are beneficial for routing information dynamically. With MAC addresses we generally don't have hierarchical structures.

4.3 What is Network Address Translation (NAT) and why is it used?

Solution

- The network address translation is a technique to preserve IP addresses.
- It is a router function where IP addresses are replaced at the boundary of a private network.
- It is method that allows hosts on private networks to communicate with host on the public network/internet
- It has an address translation table which contains the private and public addresses, which can be used to route packet/data.
- It is a short-term solution to resolve the shortage of public IP addresses.
- It was initially used to avoid the need of assigning a new IP address to every host.
- In IPv4, we have a very limited number of public IP addresses to assign on a host. Therefore, NAT comes to play a role in it. It will manage a cluster of public IP addresses at the edge between the private and public network. When a host from the private network sends an IP datagram to a host in a public network, then the NAT device picks a

public IP address from the cluster of an address and links that address to the private address.

4.4. Which fields in IP header (IPv4) get changed during routing assuming that fragmentation is not used? Explain your answer.

Solution

Considering fragmentation is not used, we can expect the following changes to IP header:

- Packet length is subject to change in case the message transferred in IP header is changed.
- Time to live (TTL) is reduced by 1 when a message is passed on to the next device in the network.
- In Flags, Don't Fragment (DF) will be set to 1.
- The Header Checksum field can be modified based on other values in the header.

References

1. https://packetpushers.net/ip-fragmentation-in-detail/
2. https://www.geeksforgeeks.org/back-off-algorithm-csmacd/
3. https://en.wikipedia.org/wiki/Network_address_translation#Applications