Q1. Do ping and traceroute to google.com

PING

Ping is a network diagnostic tool used to test the reachability of a host (in this case, `google.com`) on an IP network. It also measures the round-trip time for messages sent from the originating host to the destination and back.

When you run a **ping** command to `google.com`, your computer sends a small packet (called an "ICMP Echo Request") to Google's server, and if that server is reachable, it replies with an **ICMP Echo Reply**.

What happens during a Ping:

1. Your computer sends a small data packet to `google.com`.
2. If Google's server is available and responsive, it sends the packet back (reply).
3. The time it takes for the round trip (from sending the packet to receiving the reply) is measured, and you see that as the "ping time" or "latency."

```
PS C:\Users\291201> ping google.com

Pinging google.com [142.250.206.174] with 32 bytes of data:
Reply from 142.250.206.174: bytes=32 time=168ms TTL=58
Reply from 142.250.206.174: bytes=32 time=216ms TTL=58
Reply from 142.250.206.174: bytes=32 time=185ms TTL=58
Reply from 142.250.206.174: bytes=32 time=168ms TTL=58

Ping statistics for 142.250.206.174:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 168ms, Maximum = 216ms, Average = 184ms
PS C:\Users\291201>
```

Key Elements:

- **IP Address**: The target's IP address (e.g., `142.250.190.78`).
- **Time**: The time it took for the round trip in milliseconds (ms).
- **TTL (Time-To-Live)**: This indicates how many hops the packet can make before being discarded. A high TTL suggests fewer network hops.

Use Cases for Ping:

- **Network Connectivity**: To check if a device or server is online.
- **Latency Testing**: To measure the time it takes for data to travel to and from a destination.
- **Packet Loss Detection**: To identify if there are any issues in the network where packets are being lost.

TRACEROUTE

Steps to Run Traceroute

1. Open **Command Prompt**:
   - Press `Win + R`, type `cmd`, and press Enter.
2. Type the following command:

   ```
   bash
   Copy code
   tracert google.com
   ```

3. Press **Enter**. You will see a series of hops that the data packets pass through on their way to `google.com`.

```
PS C:\Users\291201> tracert google.com

Tracing route to google.com [142.250.77.238]
over a maximum of 30 hops:

  1     *        *        *     Request timed out.
  2   132 ms   200 ms   199 ms  167.103.22.101
  3   177 ms     *      180 ms  167.103.22.3
  4   136 ms   119 ms   107 ms  1.7.212.29
  5   248 ms   202 ms   200 ms  142.250.77.238

Trace complete.
PS C:\Users\291201>
```

Explanation of the Output:

1. **Hop Number**: The first column shows the hop number (1, 2, 3, etc.) representing each device/router your packet passes through.
2. **Round-Trip Time (RTT)**: For each hop, you will see 3 times in milliseconds (ms). These are the round-trip times for the packets from your computer to the router and back.
   - If the values are low (like 1ms, 5ms), it means the hop is close to you, usually within your local network or nearby.
   - Higher values (like 35ms, 45ms) indicate that the hop is further away, possibly in a different region or on the internet.
3. **IP Address or Hostname**: The output shows either the IP address or, if available, the hostname of each router along the path.
   - For example: `192.168.1.1`, `10.0.0.1`, or `172.217.6.46`.

4. **Asterisks ("*")**: If a hop does not respond within the timeout period, you will see an asterisk (`*`) instead of the round-trip time. This typically happens due to routers not sending ICMP responses, which can be intentional (as a security measure) or due to network issues.
5. **Trace Complete**: When the traceroute finishes, it will show a message like "Trace complete," indicating that all hops were completed or a timeout occurred.

Common Outputs and What They Mean:

- **Request Timed Out (`* * *`)**: This usually happens if a router is configured to ignore traceroute requests or if there's a network issue. It doesn't always mean there's a problem.
- **Successful Completion**: If you see the destination IP (like `142.250.190.78` in the example), it means the traceroute successfully reached the destination.
- **Multiple Time Values**: The 3 values per hop indicate the round-trip time for three different attempts to reach that hop. This helps measure consistency and network performance.

Use Cases:

- **Network Troubleshooting**: Traceroute is useful to determine where packet loss or delays are happening between your system and a remote destination.
- **Performance Monitoring**: Helps identify if there are any slow network segments or hops.
- **Understanding Routing**: You can see the path your data takes through the network, including routers and ISPs involved in reaching a website like `google.com`.