**Computer Networks – Fall 2019**

**Assignment 1**

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**Part 1** The screenshots of the hand-written solution are in a separate folder titled ‘Part 1’.

**Part 2** Find and read the OSI model on this link. Write up the summary on a single page according to your best understanding. You may use other resources to provide an effective answer.

**Ans.** OSI or Open Systems Interconnection model is a conceptual networking model which divides characteristic functions of a network between two end systems into seven layers. Each layer offers functionalities to support the layers above it and offers services to the layers below it. The three lowest layers focus on passing traffic through the network to an end system. The top four layers come into play in the end system to complete the process.

The first layer is the “physical” layer, in this layer the actual transfer of data (bits) takes place from one node in the network to the next node. In this layer, the protocols of the medium are defined. The second layer is “data link” layer which provides the mechanism for a device to send or receive messages (known as frames) on a network. It offers a physical address or a MAC address which is used by switches to filter and forward data traffic. The third layer is “network” layer which is responsible for moving data (known as datagrams) from one host to another using either TCP or UDP. This layer provides the IP address to the datagram. The fourth layer is “transport” layer which provides two transport protocols TCP and UDP, both of which can transport application-layer messages. In the transport layer, a packet is known as segment. The fifth layer is “session” layer which synchronizes the data shared between each end of the network, it also provides acknowledgement of data received in a session and retransmission of data if not received or lost during transfer (recovery scheme). The sixth layer is “presentation” layer which is responsible for how the application formats the data which is to be sent over the network. It provides encryption and decryption of data (security), compression for efficiency, graphics and content formatting and system-specific translation. The last layer is “application” layer which provides an interface to the end-user to connect to a network, it shows the data received through the network to the end-user. There are many protocols at work in this layer e.g. HTTP (web), SMTP (email) etc. The data is known as messages in this layer.

**Part 2** Explain how the bittorrent protocol works. Discuss briefly the following terms:

* What is a tracker?
* Who are seeders, leechers?
* What is choking, free-riders?
* What is the number of neighbors a new node tries to find?
* What does the .torrent file contain?
* What is bartering?

**Ans.** It is a communication protocol for P2P file sharing. A user uses a BitTorrent client (a program which implements the BitTorrent protocol) on an internet-connected computer. They download a .torrent file which contain the metadata about the files to be shared and the “trackers” which keep track of seeds and peers which are ready to share the file with the user.

* Tracker:

A server which assists in the communication between peers using the BitTorrent protocol. It keeps track of seeds and peers in the swarm and provides this list to the client so they can connect to these seeds and peers and download the file.

* Seeders:

A seeder is a downloader who has completed downloading and is ready to share, when he starts sharing/uploading to other peers so they can download; he becomes a seeder.

* Leechers:

A downloader who downloads more than they upload is a leecher, this can be achieved by using a modified client or excessively limiting upload speed.

* Choking:

When a client refuses to send file pieces to another peer in the swarm, due to the following reasons:

* The peer is a seeder (already has downloaded all the pieces)
* The client is already uploading at its full capacity
* The peer is blacklisted due to abusive behavior or is using a blacklisted BitTorrent client
* Free-riding:

A free rider is a user who downloads the file but does not upload.

* Number of neighbours:

According to [this](https://wiki.theory.org/index.php/BitTorrentSpecification#Tracker_Response), the number is 50 by default.

* .torrent file:

It contains the metadata about all the files it makes downloadable, including their names, sizes and checksums of all pieces in the torrent. It contains the address of the tracker that coordinates communication between the peers in the swarm.

* Bartering:

Bartering is the sharing of pieces among peers e.g. peer A has the second piece but not the fourth piece while peer B has the fourth piece and wants the second piece of a torrent, they will barter the pieces amongst them so each of them have both pieces.