CS3640 Written Assignment-4

Due: May 3, 2022 midnight
Submit as a single PDF on ICON

This assignment covers the research topics of SDN and cloud computing. The goal is to help students learn to critique and analyze emerging developments in the field of networking. Please remember that copying answers verbatim from the paper/articles earns no points.

Part-A (Software Defined Networking)

A1. Describe SDN's core abstraction of *match-plus-action* in your own words. How would you use this abstraction to implement a firewall? **20 points**

Match-plus-action is explained in page 353 of our textbook, while firewall is explained page 359. However, any attempt to copy them verbatim will get no points.

A2. Why did Google transition their networks to SDN? Highlight any two (technical) reasons that made this shift necessary. **20 points**

(i) Google's pace of innovation i.e., their need for new networking features and capabilities, was much faster than what networking vendors could support, (ii) in order to manage and administer their global scale networks easily and efficiently, Google had to centralize the control-plane. *Or any other valid technical reason from the CACM paper.*

A3. Imagine you are a maker of high-end networking gear, e.g., Cisco. Give two reasons why you may find it beneficial to embrace the SDN revolution? **20 points**

It is natural for a high-end (implying high profit margin) router maker to detest SDN revolution, whose goal is to make routers a commodity. However, Cisco may find it beneficial to embrace SDN because (i) it helps them stay relevant and keep some market share if the networking world were to eventually become SDN-dominated, (ii) it still allows them to focus on control-plane innovations since SDN tries to commoditize only the data-plane activities (i.e., forwarding).

Part-B (Cloud Computing)

B1. We discussed how cloud computing is revolutionizing data storage and computation. Describe two advantages and two disadvantages of cloud computing. Please keep your answers technical and CS-focused. **20 points**

Advantages: (i) administration and maintenance of physical infrastructure is eliminated, (ii) high-levels reliability and availability, (iii) possibility of global deployment without having physical infrastructure across the globe. *Or any other valid technical reason.*

Disadvantages: (i) potential loss of privacy and security since your data and code reside at the cloud providers, (ii) dependence on cloud providers to introduce new hardware/frameworks since all your solutions are built on their infrastructure. *Or any other valid technical reason.*

B2. Datacenters pose many new challenges for the field of networking. Name and describe two such challenges. You don't have to provide any solutions. **20 points**

Most networking challenges within datacenters stem from the fact that a large number of servers are densely packed. Two such challenges: (i) networking *does not scale well horizontally*, so any attempt to increase the bandwidth results in expensive and complex network topologies, (ii) another problem is *TCP incast* (see this paper for more details: https://www.usenix.org/system/files/login/articles/chen12-06.pdf). This happens when a large number of servers try to communicate with a single server, creating a bottleneck link, which in turn triggers the TCP congestion control, thereby reducing the throughput for everyone.