Final Exam

⊕ *Do not forget to write your name on the first page. Initial each subsequent page.*
⊕ *Be* **neat** *and* **precise**. **I will not grade answers I cannot read.**
⊕ *You should draw simple figures if you think it will make your answers clearer.*
⊕ *Good luck and remember, brevity is the soul of wit*

- All problems are mandatory

- I cannot stress this point enough: **Be precise**. If you have written something incorrect along with the correct answer, you should **not** expect to get all the points. I will grade based upon what you **wrote**, not what you **meant**.

- Maximum possible points: 50.

Name: _____

Problem	Points
1	
2	
3	
4	
5	
Total	

1. Nomenclature

   (a) Describe the following: (2 points each)
      - Multiple Access Protocol

      - Name Server

      - Consistent Hashing

      - URGENT flag in TCP

      - Error polynomial in CRC

2. Network and Naming

   (a) How does BGP ensure loop-free AS paths? (2 points)

   (b) Assume that a /10 network accesses the Internet via single NAT device. What is the maximum number of simultaneous open TCP connections the device can maintain? (Show your work.) (2 points)

   (c) Why does Mobile-IP specify that packets to- and from the mobile host traverse the Home Agent? (3 points)

   (d) (How) does IP routing change with the introduction of CIDR? (3 points)

3. Transport and Naming

    (a) Does the TCP stack on a host need to know the IP address of the host? Why? (1 points)

    (b) How are three-duplicate ACKs used in TCP? (2 points)

    (c) FINs in TCP consume a sequence number. Show with a example why this is required.(2 points)

    (d) Consider a link with large bandwidth-delay product. List fields in the TCP and IP headers that may limit the number of packets you have in-flight. Which using options, which field limits you the most? (4 points)

4. Applications and Naming

   (a) List two problems with how the original HTTP protocol interacted with TCP/IP. (2 points)

   (b) What is the TURN command in SMTP used for? (2 points)

   (c) Suppose your HTTP request is served by a CDN. What information about your client does the CDN DNS server receive? (3 points)

   (d) Does DNS provide a mechanism for root DNS servers to change their IP addresses? Describe the procedure or state what the primary difficulty is. (3 points)

5. General

(a) The CRC-32 polynomial $x^{32}+x^{26}+x^{23}+x^{22}+x^{16}+x^{12}+x^{11}+x^{10}+x^8+x^7+x^5+x^4+x^2+x+1$ is used in Ethernet. How would you show that this CRC-polynomial can detect all odd number of bit errors? (2 points)

(b) The *Hamming Distance* between two bit strings A and B is the number of bits that have to be changed in A to obtain B. Prove the following statement or disprove it with a counter example: "The minimum Hamming distance between two valid messages using the CRC-32 polynomial above is 16". (3 points)

(c) How are BitCoin peers notified of new transactions? (2 points)

(d) How would BitTorrent be affected if all the SHA-1 hashes in the protocol were replaced by CRCs? (3 points)