Homework 2

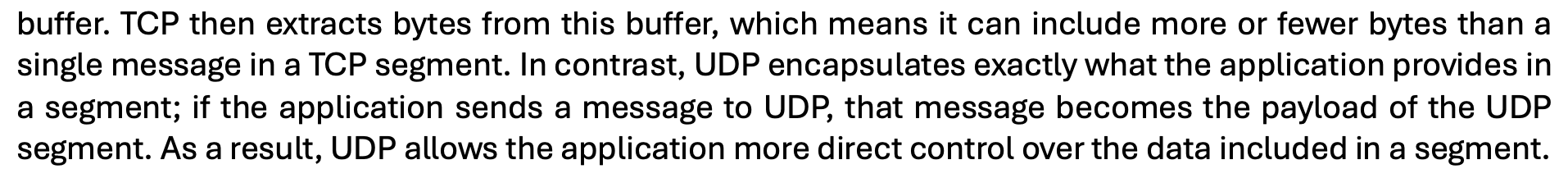
CSCE5580 Computer Network (Fall 2024)

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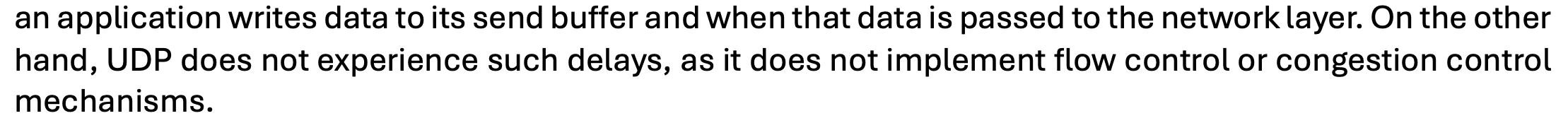
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**1Ans:**

**a)**

When sending an application message using TCP, the application writes data to the connection's send 

**b)**

With TCP, the presence of flow control and congestion control can lead to notable delays between when 

**2Ans:**

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**SYN Cookies as a Defense**

SYN cookies provide an effective defense against SYN flood attacks. When a server receives a SYN

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**3Ans:**  
  
**Issues with Not Using Sequence Numbers in TCP/IP Protocol**

1. **Data Integrity and Ordering**: Without sequence numbers, packets may arrive out of order, making it difficult for the receiving application to reconstruct messages correctly. For example, if packets 1, 3, and 2 are received, the application cannot process them in the intended sequence.
2. **Duplicate Packet Handling**: Sequence numbers help identify and discard duplicate packets. If a packet is resent due to a timeout and lacks a sequence number, the receiver may process it multiple times, leading to inconsistent application states.
3. **Connection Management Vulnerabilities**: Mechanisms like SYN cookies, used to defend against SYN flood attacks, rely on sequence numbers to verify incoming ACKs. Without them, the server cannot distinguish between legitimate and malicious connection attempts, risking resource exhaustion.

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**4Ans:**  
**Step 1: Determine New Subnet Mask**

1. The original subnet mask is /19, which means the first 19 bits are for the network portion.
2. To create four equally sized subnets, we need to borrow 2 bits from the host portion (since 22=4).
3. This gives us a new subnet mask of /21 (19 + 2).

**Step 2: Calculate Subnets**

With a new subnet mask of /21, the subnets will be:

1. **First Subnet**: 138.90.160.0/21
2. **Second Subnet**: 138.90.168.0/21
3. **Third Subnet**: 138.90.176.0/21
4. **Fourth Subnet**: 138.90.184.0/21

**Step 3: Calculate Hosts per Subnet**

With a /21 subnet mask:

* Total addresses per subnet: 211=2048
* Usable addresses:  2048−2=2046 (subtracting 1 for the network address and 1 for the broadcast address).

**Step 4: Range of Host IP Addresses for the First Subnet**

For the first subnet 138.90.160.0/21:

* **Network Address**: 138.90.160.0
* **Broadcast Address**: 138.90.167.255
* **Range of Usable Host IP Addresses**:

From First usable IP: 138.90.160.1 – To Last usable IP: 138.90.167.254

**5Ans:**

**5.1)**

**Work/Table:**

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**A diagram of a network

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**A table with writing on it

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**5.2)**

Bellman-Ford Algorithm:

1. Initialize:

- Source node A = 0

- All other nodes = ∞

- Each node only knows costs to immediate neighbors

Initial State (Distance to A):

|  |
| --- |
| A = 0 |
| B = ∞ |
| C = ∞ |
| D = ∞ |
| E = ∞ |
| F = ∞ |
| G = ∞ |
| H = ∞ |
| I = ∞ |

Solving it iteratively:

**Iteration 1:**

* A tells neighbors: "I'm 0 from A"
  + B updates: min(∞, 0+3) = 3
  + C updates: min(∞, 0+4) = 4
  + E updates: min(∞, 0+6) = 6

After Iteration 1:

|  |
| --- |
| A = 0 |
| B = 3 |
| C = 4 |
| D = ∞ |
| E = 6 |
| F = ∞ |
| G = ∞ |
| H = ∞ |
| I = ∞ |

**Iteration 2:**

* B tells neighbors: "I'm 3 from A"
  + E updates: min(6, 3+2) = 5
* C tells neighbors: "I'm 4 from A"
  + D updates: min(∞, 4+4) = 8
  + F updates: min(∞, 4+2) = 6
* E tells neighbors: "I'm 5 from A"
  + D updates: min(8, 5+6) = 8
  + G updates: min(∞, 5+6) = 11
  + H updates: min(∞, 5+3) = 8

After Iteration 2:

|  |
| --- |
| A = 0 |
| B = 3 |
| C = 4 |
| D = 8 |
| E = 5 |
| F = 6 |
| G = 11 |
| H = 8 |
| I = ∞ |

**Iteration 3:**

* F tells neighbors: "I'm 6 from A"
  + D updates: min(8, 6+1) = 7
* G tells neighbors: "I'm 11 from A"
  + I updates: min(∞, 11+1) = 12
  + H updates: min(8, 11+2) = 8
* H tells neighbors: "I'm 8 from A"
  + G updates: min(11, 8+2) = 10

After Iteration 3:

|  |
| --- |
| A = 0 |
| B = 3 |
| C = 4 |
| D = 7 |
| E = 5 |
| F = 6 |
| G = 10 |
| H = 8 |
| I = 12 |

**Iteration 4:**

* G tells neighbors: "I'm 10 from A"
  + I updates: min(12, 10+1) = 11

Final distances to A:

|  |
| --- |
| A = 0 |
| B = 3 |
| C = 4 |
| D = 7 |
| E = 5 |
| F = 6 |
| G = 10 |
| H = 8 |
| I = 11 |

**Final Next-Hop Routing Table:**

|  |  |  |
| --- | --- | --- |
| Node | Next Hop | Distance to A |
| A | - | 0 |
| B | A | 3 |
| C | A | 4 |
| D | F | 7 |
| E | B | 5 |
| F | C | 6 |
| G | H | 10 |
| H | E | 8 |
| I | G | 11 |

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The algorithm converges because:

1. Each node updates its distance when it finds a better path

2. Updates continue until no better paths can be found

3. The process stops when no changes occur in an iteration

**6Ans:**

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Therefore, the three network addresses that satisfy these constraints are:

* Subnet 2: 211.1.16.0/25
* Subnet 1: 211.1.16.128/26
* Subnet 3: 211.1.16.192/27

**7Ans:**

No, Dijkstra's algorithm cannot be directly modified to find the longest path in a graph. Here's why:

1. **Fundamental Issue**:

* Dijkstra's algorithm works for shortest paths because it relies on the principle that sub-paths of shortest paths are also shortest paths
* This principle doesn't hold for longest paths
* If the graph contains cycles, the longest path could become infinite by repeatedly traversing the cycle

1. **Alternative Solutions**:

* For acyclic graphs (DAGs): You can negate all edge weights and use Dijkstra's to find shortest path
* For general graphs: Must use different algorithms like:
  + Dynamic programming with path length constraints
  + Branch and bound methods
  + Depth-first search with cycle detection

The longest path problem is actually NP-hard in general graphs, unlike the shortest path problem which can be solved efficiently with Dijkstra's algorithm.

**8Ans:**  
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**9Ans:**

1. **DHCP Server in Router**
   1. The wireless router includes a built-in DHCP (Dynamic Host Configuration Protocol) server
   2. This DHCP server automatically handles IP address management for your internal network
   3. When a PC connects to the wireless network, it sends a DHCP request

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