

COMPSCI 4C03 Assignment 5

Question 1: Understanding DHCP

#1-A: First, I will add the screenshots:

Discover:

The screenshot shows a Wireshark packet capture titled 'dhcp-ethereal-trace-1'. The packet list pane displays the following packets:

No.	Time	Source	Destination	Protocol	Length	Info
1	0.000000	192.168.1.102	192.168.1.255	BROWSER	250	Domain/Workgroup Announcement
2	7.587185	0.0.0.0	255.255.255.255	DHCP	342	DHCP Discover - Transaction
3	7.588881	LinksysG_da:af:73	Broadcast	ARP	60	Who has 192.168.1.101? Tel
4	8.632950	192.168.1.1	255.255.255.255	DHCP	590	DHCP Offer - Transaction
5	8.633123	0.0.0.0	255.255.255.255	DHCP	342	DHCP Request - Transaction
6	8.635133	192.168.1.1	255.255.255.255	DHCP	590	DHCP ACK - Transaction
7	8.638148	Dell_4f:36:23	Broadcast	ARP	42	ARP Announcement for 192.1
8	9.285757	Dell_4f:36:23	Broadcast	ARP	42	ARP Announcement for 192.1
9	10.285814	Dell_4f:36:23	Broadcast	ARP	42	ARP Announcement for 192.1
10	11.309600	192.168.1.101	224.0.0.22	IGMPv3	54	Membership Report / Join g

The packet details pane for packet 2 (DHCP Discover) shows the following information:

- Frame 2: 342 bytes on wire (2736 bits), 342 bytes captured (2736 bits)
- Ethernet II, Src: Dell_4f:36:23 (00:08:74:4f:36:23), Dst: Broadcast (ff:ff:ff:ff:ff:ff)
- Destination: Broadcast (ff:ff:ff:ff:ff:ff)
- Address: Broadcast (ff:ff:ff:ff:ff:ff)
- Type: IPv4 (0x0800)
- Internet Protocol Version 4, Src: 0.0.0.0, Dst: 255.255.255.255
- User Datagram Protocol, Src Port: 68, Dst Port: 67
- Dynamic Host Configuration Protocol (Discover)

Offer:

The screenshot shows a Wireshark packet capture titled 'dhcp-ethereal-trace-1'. The packet list pane displays the following packets:

No.	Time	Source	Destination	Protocol	Length	Info
1	0.000000	192.168.1.102	192.168.1.255	BROWSER	250	Domain/Workgroup Announcement
2	7.587185	0.0.0.0	255.255.255.255	DHCP	342	DHCP Discover - Transaction
3	7.588881	LinksysG_da:af:73	Broadcast	ARP	60	Who has 192.168.1.101? Tel
4	8.632950	192.168.1.1	255.255.255.255	DHCP	590	DHCP Offer - Transaction
5	8.633123	0.0.0.0	255.255.255.255	DHCP	342	DHCP Request - Transaction
6	8.635133	192.168.1.1	255.255.255.255	DHCP	590	DHCP ACK - Transaction
7	8.638148	Dell_4f:36:23	Broadcast	ARP	42	ARP Announcement for 192.1
8	9.285757	Dell_4f:36:23	Broadcast	ARP	42	ARP Announcement for 192.1
9	10.285814	Dell_4f:36:23	Broadcast	ARP	42	ARP Announcement for 192.1
10	11.309600	192.168.1.101	224.0.0.22	IGMPv3	54	Membership Report / Join g

The packet details pane for packet 4 (DHCP Offer) shows the following information:

- Frame 4: 590 bytes on wire (4720 bits), 590 bytes captured (4720 bits)
- Ethernet II, Src: LinksysG_da:af:73 (00:06:25:da:af:73), Dst: Broadcast (ff:ff:ff:ff:ff:ff)
- Destination: Broadcast (ff:ff:ff:ff:ff:ff)
- Address: Broadcast (ff:ff:ff:ff:ff:ff)
- Type: IPv4 (0x0800)
- Internet Protocol Version 4, Src: 192.168.1.1, Dst: 255.255.255.255
- User Datagram Protocol, Src Port: 67, Dst Port: 68
- Dynamic Host Configuration Protocol (Offer)

Request:

dhcp-ethereal-trace-1

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No.	Time	Source	Destination	Protocol	Length	Info
1	0.000000	192.168.1.102	192.168.1.255	BROWSER	250	Domain/Workgroup Announcement
2	7.587185	0.0.0.0	255.255.255.255	DHCP	342	DHCP Discover - Transaction
3	7.588881	LinksysG_da:af:73	Broadcast	ARP	60	Who has 192.168.1.101? Tel
4	8.632950	192.168.1.1	255.255.255.255	DHCP	590	DHCP Offer - Transaction
5	8.633123	0.0.0.0	255.255.255.255	DHCP	342	DHCP Request - Transaction
6	8.635133	192.168.1.1	255.255.255.255	DHCP	590	DHCP ACK - Transaction
7	8.638148	Dell_4f:36:23	Broadcast	ARP	42	ARP Announcement for 192.1
8	9.285757	Dell_4f:36:23	Broadcast	ARP	42	ARP Announcement for 192.1
9	10.285814	Dell_4f:36:23	Broadcast	ARP	42	ARP Announcement for 192.1
10	11.309600	192.168.1.101	224.0.0.22	IGMPv3	54	Membership Report / Join g

> Frame 5: 342 bytes on wire (2736 bits), 342 bytes captured (2736 bits)

> Ethernet II, Src: Dell_4f:36:23 (00:08:74:4f:36:23), Dst: Broadcast (ff:ff:ff:ff:ff:ff)

- > Destination: Broadcast (ff:ff:ff:ff:ff:ff)
Address: Broadcast (ff:ff:ff:ff:ff:ff)
... ..1. = LG bit: Locally administered address (this is NOT the factory default)
... ..1. = IG bit: Group address (multicast/broadcast)
- > Source: Dell_4f:36:23 (00:08:74:4f:36:23)
Address: Dell_4f:36:23 (00:08:74:4f:36:23)
... ..0. = LG bit: Globally unique address (factory default)
... ..0. = IG bit: Individual address (unicast)
Type: IPv4 (0x0800)
- > Internet Protocol Version 4, Src: 0.0.0.0, Dst: 255.255.255.255
- > User Datagram Protocol, Src Port: 68, Dst Port: 67
- > Dynamic Host Configuration Protocol (Request)

ACK:

dhcp-ethereal-trace-1

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Apply a display filter ... <Ctrl-/>

No.	Time	Source	Destination	Protocol	Length	Info
1	0.000000	192.168.1.102	192.168.1.255	BROWSER	250	Domain/Workgroup Announcement
2	7.587185	0.0.0.0	255.255.255.255	DHCP	342	DHCP Discover - Transaction
3	7.588881	LinksysG_da:af:73	Broadcast	ARP	60	Who has 192.168.1.101? Tel
4	8.632950	192.168.1.1	255.255.255.255	DHCP	590	DHCP Offer - Transaction
5	8.633123	0.0.0.0	255.255.255.255	DHCP	342	DHCP Request - Transaction
6	8.635133	192.168.1.1	255.255.255.255	DHCP	590	DHCP ACK - Transaction
7	8.638148	Dell_4f:36:23	Broadcast	ARP	42	ARP Announcement for 192.1
8	9.285757	Dell_4f:36:23	Broadcast	ARP	42	ARP Announcement for 192.1
9	10.285814	Dell_4f:36:23	Broadcast	ARP	42	ARP Announcement for 192.1
10	11.309600	192.168.1.101	224.0.0.22	IGMPv3	54	Membership Report / Join g

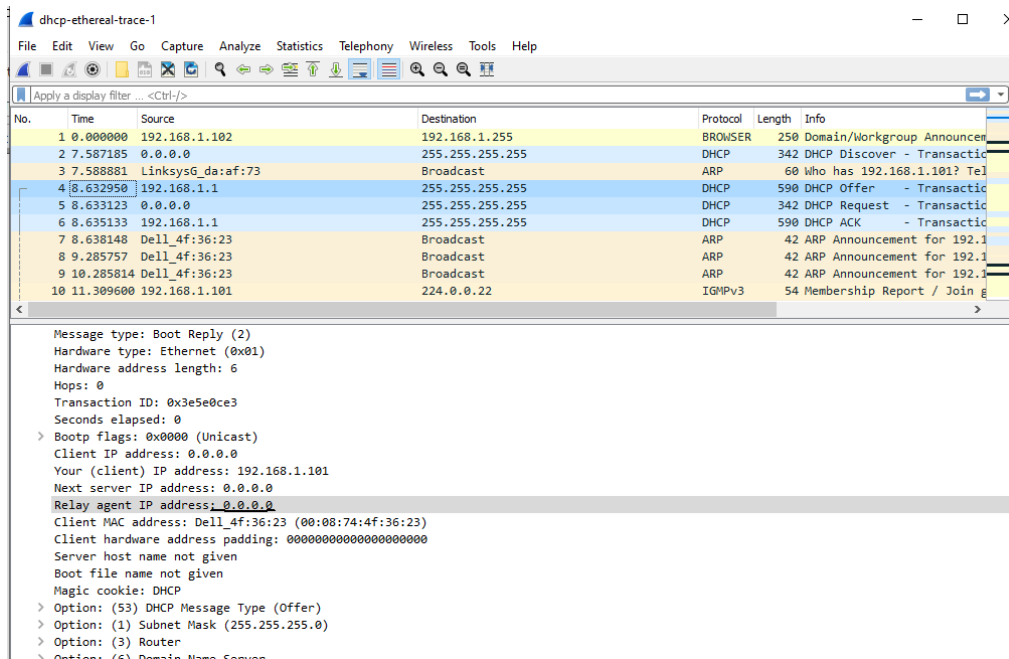
> Frame 6: 590 bytes on wire (4720 bits), 590 bytes captured (4720 bits)

> Ethernet II, Src: LinksysG_da:af:73 (00:06:25:da:af:73), Dst: Broadcast (ff:ff:ff:ff:ff:ff)

- > Destination: Broadcast (ff:ff:ff:ff:ff:ff)
Address: Broadcast (ff:ff:ff:ff:ff:ff)
... ..1. = LG bit: Locally administered address (this is NOT the factory default)
... ..1. = IG bit: Group address (multicast/broadcast)
- > Source: LinksysG_da:af:73 (00:06:25:da:af:73)
Address: LinksysG_da:af:73 (00:06:25:da:af:73)
... ..0. = LG bit: Globally unique address (factory default)
... ..0. = IG bit: Individual address (unicast)
Type: IPv4 (0x0800)
- > Internet Protocol Version 4, Src: 192.168.1.1, Dst: 255.255.255.255
- > User Datagram Protocol, Src Port: 67, Dst Port: 68
- > Dynamic Host Configuration Protocol (ACK)

DHCP Message Type	Source IP	Source MAC	Destination IP	Destination MAC
Discover	0.0.0.0	00:08:74:4f:36:23	255.255.255.255	ff:ff:ff:ff:ff:ff
Offer	192.168.1.1	00:06:25:da:af:73	255.255.255.255	ff:ff:ff:ff:ff:ff
Request	0.0.0.0		255.255.255.255	ff:ff:ff:ff:ff:ff
Ack	192.168.1.1		255.255.255.255	ff:ff:ff:ff:ff:ff

#1-B:



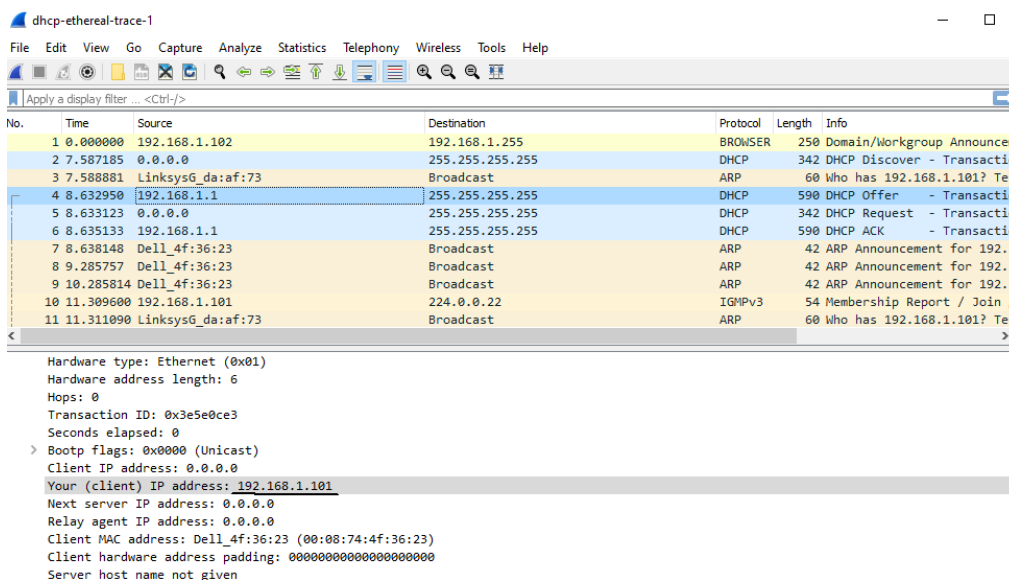
The screenshot shows a Wireshark capture of a DHCP trace. The packet list pane displays several packets, including a DHCP Offer (packet 4) from source IP 192.168.1.1 to destination IP 255.255.255.255. The packet details pane for the selected DHCP Offer shows the following fields:

- Message type: Boot Reply (2)
- Hardware type: Ethernet (0x01)
- Hardware address length: 6
- Hops: 0
- Transaction ID: 0x3e5e0ce3
- Seconds elapsed: 0
- Bootp flags: 0x0000 (Unicast)
- Client IP address: 0.0.0.0
- Your (client) IP address: 192.168.1.101
- Next server IP address: 0.0.0.0
- Relay agent IP address: 0.0.0.0
- Client MAC address: Dell_4f:36:23 (00:08:74:4f:36:23)
- Client hardware address padding: 00000000000000000000
- Server host name not given
- Boot file name not given
- Magic cookie: DHCP
- Option: (53) DHCP Message Type (Offer)
- Option: (1) Subnet Mask (255.255.255.0)
- Option: (3) Router

As seen in the screenshot above, the “Relay agent IP adress” is 0.0.0.0. This indicates that there is no DHCP relay used, and thus we can conclude that there was no relay agent used in this experiment.

#1-C:

Screenshot off OFFER DHCP packet:



The screenshot shows a Wireshark capture of a DHCP trace. The packet list pane displays several packets, including a DHCP Offer (packet 4) from source IP 192.168.1.1 to destination IP 255.255.255.255. The packet details pane for the selected DHCP Offer shows the following fields:

- Hardware type: Ethernet (0x01)
- Hardware address length: 6
- Hops: 0
- Transaction ID: 0x3e5e0ce3
- Seconds elapsed: 0
- Bootp flags: 0x0000 (Unicast)
- Client IP address: 0.0.0.0
- Your (client) IP address: 192.168.1.101
- Next server IP address: 0.0.0.0
- Relay agent IP address: 0.0.0.0
- Client MAC address: Dell_4f:36:23 (00:08:74:4f:36:23)
- Client hardware address padding: 00000000000000000000
- Server host name not given

Screenshot of REQUEST DHCP packet:

The screenshot shows a Wireshark capture of a DHCP Request packet (No. 5) at time 8.633123. The packet is sent from 192.168.1.1 to 255.255.255.255. The details pane shows the following information:

- Transaction ID: 0x3e5e0ce3
- Seconds elapsed: 0
- Bootp flags: 0x0000 (Unicast)
- Client IP address: 0.0.0.0
- Your (client) IP address: 0.0.0.0
- Next server IP address: 0.0.0.0
- Relay agent IP address: 0.0.0.0
- Client MAC address: Dell_4f:36:23 (00:08:74:4f:36:23)
- Client hardware address padding: 000000000000000000
- Server host name not given
- Boot file name not given
- Magic cookie: DHCP
- Option: (53) DHCP Message Type (Request)
- Option: (61) Client identifier
- Option: (50) Requested IP Address (192.168.1.101)
 - Length: 4
 - Requested IP Address: 192.168.1.101
- Option: (54) DHCP Server Identifier (192.168.1.1)
- Option: (12) Host Name
- Option: (60) Vendor class identifier
- Option: (55) Parameter Request List

The packet bytes pane shows the raw data for the Requested IP Address option (Option 50) starting at offset 0110.

The clients requested address can be found in Option: (50) header field of the Request DHCP packet. This matches the clients IP address in the Offer DHCP packet, and thus, in this experiment the client accepts this IP address.

#1-D:

The screenshot shows the details of the Requested IP Address option (Option 50) in the DHCP Request packet. The details pane shows the following information:

- Frame 3: 60 bytes on wire (480 bits), 60 bytes captured (480 bits)
- Ethernet II, Src: LinksysG_da:af:73 (00:06:25:da:af:73), Dst: Broadcast (ff:ff:ff:ff:ff:ff)
- Address Resolution Protocol (request)
 - Hardware type: Ethernet (1)
 - Protocol type: IPv4 (0x0000)
 - Hardware size: 6
 - Protocol size: 4
 - Opcode: request (1)
 - Sender MAC address: LinksysG_da:af:73 (00:06:25:da:af:73)
 - Sender IP address: 192.168.1.1
 - Target MAC address: 00:00:00_00:00:00 (00:00:00:00:00:00)
 - Target IP address: 192.168.1.101

As seen in the screenshot above of an ARP packet, there are ARP requests made by the DHCP server. Before the DHCP server offers an address to the client, it issues an ARP request for the fofered IP to make sure that it is not occupied by another device in the network.

Question 2: Routing

#2-A:

For djikstra's algorithm, we need a dictionary object to represent each link states: cost, router1, and router2, where routers 1 and 2 are the two routers connected by a given link. For example, this dictionary for the link u-v (cost 2) could look like:

```
Link1 = {'r1': 'u', 'r2': 'v', 'cost': 2}
```

#2-B:

See the attached text file for my python implementation