



BIRZEIT UNIVERSITY

Faculty of Engineering & Technology

Electrical & Computer Engineering Department

COMPUTER NETWORKS - ENCS3320

First Project Report

“Socket Programming”

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1. Abstract:

The main aim of this project is dealing with application-layer protocols such as HTTP and DNS. The first part of the project consists of defining and working with network diagnostic tools or network troubleshooting tools. Where each tool serves a purpose. The command line interface is used to explore these tools by the given test cases. Then Wireshark is used to capture some DNS messages created by doing a certain action on the network and observing the messages.

The second task involves building a simple web server using socket programming. The server delivers English and Arabic webpages with team details, a networking topic, and links to resources. It also supports a form for requesting images or videos, with unavailable requests redirected appropriately. The focus is on organizing files, handling HTTP requests, and ensuring proper server-client communication.

The third part This task involves creating a trivia game using UDP socket programming. The server manages the game by broadcasting questions, collecting answers from clients, and updating scores. Clients join the game, receive questions, and submit their answers within a set time. The task highlights server-client interaction and real-time data exchange.

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2. Task (1):

2.1 Description of the following commands are (ipconfig, ping, tracert, nslookup, telnet)

- **ipconfig:** Displays and manages a system's network configuration, including IP address, gateway, and DNS settings.
- **ping:** A command-line tool used to check if a server can be reached by measuring the round-trip time, packet time to live (TTL), and packet loss statistics.
- **tracert:** A command tool used to trace the route from a source to a destination by sending three packets to each device on the path and computing the round-trip time for each packet.
- **nslookup:** A command-line tool used to query the DNS to obtain domain name or IP address mapping or any other specific DNS record.
- **telnet:** A protocol that lets you connect to and control remote computers or systems over a network. Can access command line interface or virtual terminals. It works for both sending and receiving data in 8-bit format.

2.2 Use an Internet-connected computer to test the above commands on Windows OS

2.2.1 ipconfig a device in the same network

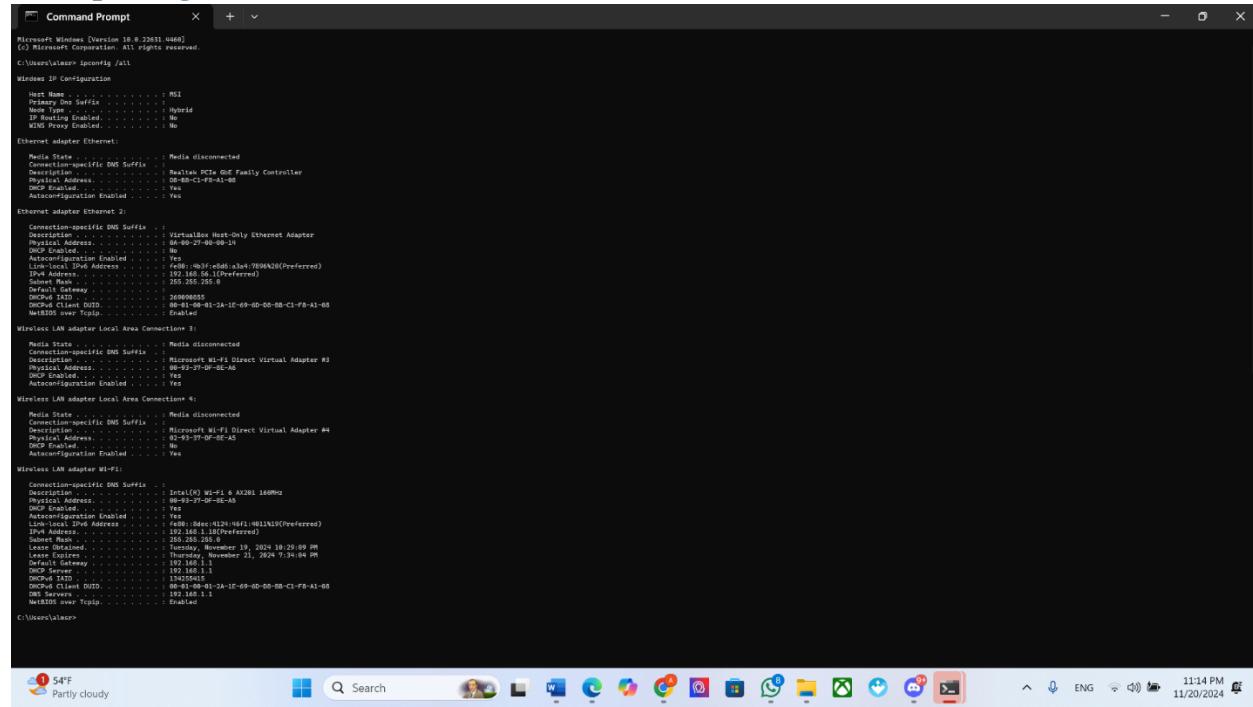


Figure 1: Results of using the command ipconfig

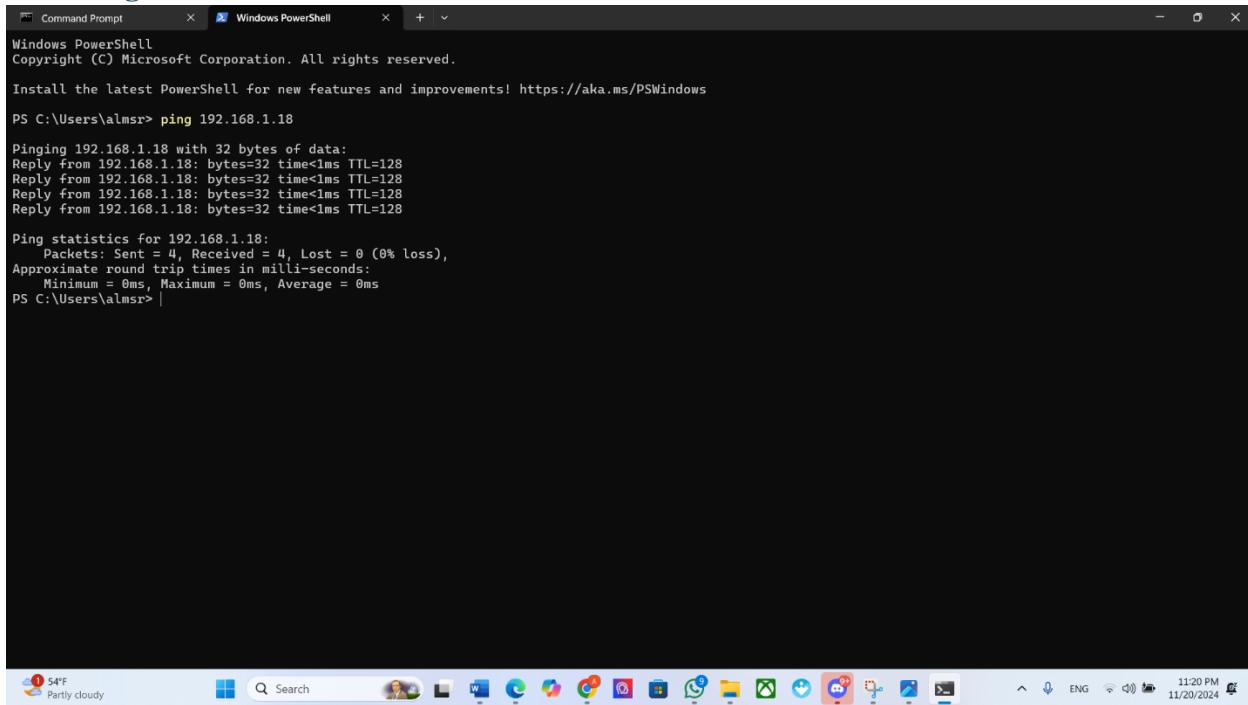
```
Wireless LAN adapter Wi-Fi:  
  
Connection-specific DNS Suffix . :  
Description . . . . . : Intel(R) Wi-Fi 6 AX201 160MHz  
Physical Address. . . . . : 00-93-37-DF-8E-A5  
DHCP Enabled. . . . . : Yes  
Autoconfiguration Enabled . . . . . : Yes  
Link-local IPv6 Address . . . . . : fe80::8dec:4124:46f1:4011%19(PREFERRED)  
IPv4 Address. . . . . : 192.168.1.18(PREFERRED)  
Subnet Mask . . . . . : 255.255.255.0  
Lease Obtained. . . . . : Tuesday, November 19, 2024 10:29:09 PM  
Lease Expires . . . . . : Thursday, November 21, 2024 7:34:04 PM  
Default Gateway . . . . . : 192.168.1.1  
DHCP Server . . . . . : 192.168.1.1  
DHCPv6 IAID . . . . . : 134255415  
DHCPv6 Client DUID. . . . . : 00-01-00-01-2A-1E-69-6D-D8-BB-C1-F8-A1-08  
DNS Servers . . . . . : 192.168.1.1  
NetBIOS over Tcpip. . . . . : Enabled  
  
C:\Users\almsr>
```

Figure 2: ipconfig command

The figure shows the network configuration of a Wi-Fi adapter ("Intel(R) Wi-Fi 6 AX201 160MHz") obtained via the ipconfig command. The adapter has a MAC address of "00-93-37-

DF-8E-A5" and is configured with DHCP enabled, assigning it the IPv4 address "192.168.1.18" (Preferred) with a subnet mask of "255.255.255.0." The default gateway and DNS server are both set to "192.168.1.1," indicating the router's address. The IP lease was obtained on November 19, 2024, at 10:29 PM and expires on November 21, 2024, at 7:34 PM. Additionally, NetBIOS over TCP/IP is enabled, allowing legacy network applications to function, confirming proper connectivity and configuration for network communication.

2.2.2 Ping



```
Command Prompt      Windows PowerShell      + 
Windows PowerShell
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Install the latest PowerShell for new features and improvements! https://aka.ms/PSWindows

PS C:\Users\almsr> ping 192.168.1.18

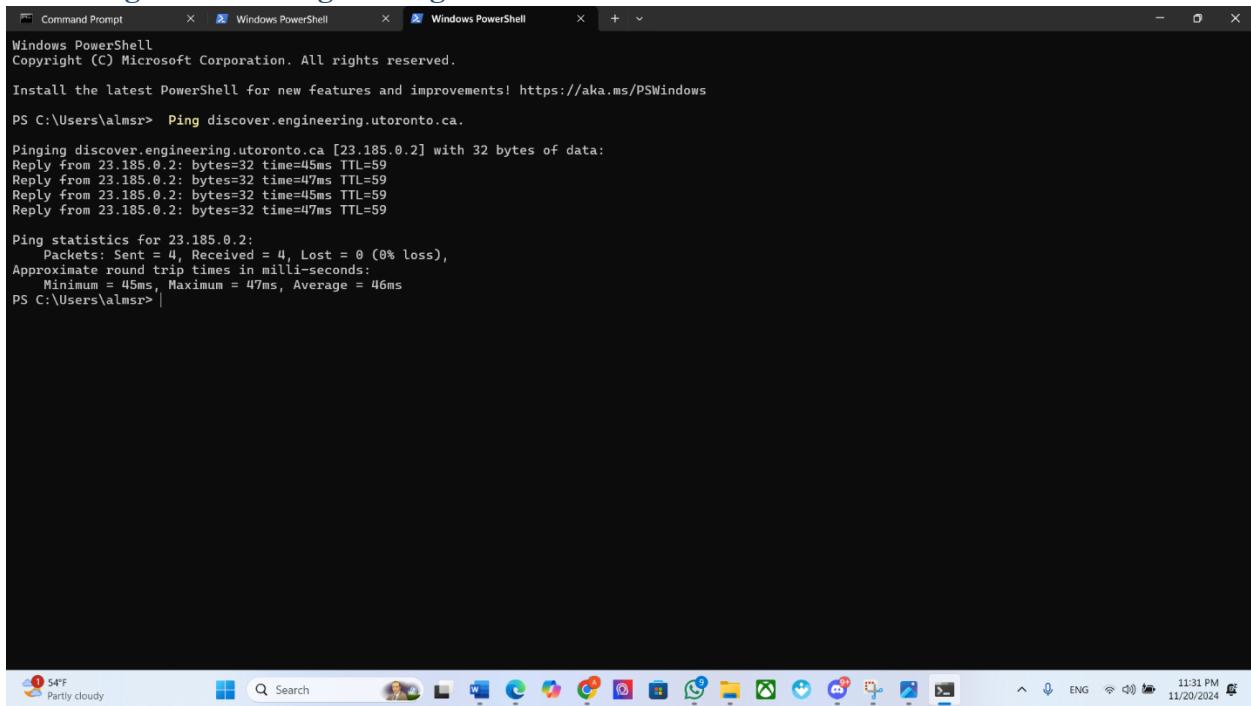
Pinging 192.168.1.18 with 32 bytes of data:
Reply from 192.168.1.18: bytes=32 time<1ms TTL=128

Ping statistics for 192.168.1.18:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
    Approximate round trip times in milli-seconds:
        Minimum = 0ms, Maximum = 0ms, Average = 0ms
PS C:\Users\almsr> |
```

Figure 3: Pinging a smartphone from a laptop which are both connected to the same network

the computer pings the IP address 192.168.1.18, sending 4 packets, each containing 32 bytes of data. All packets are successfully received without any packet loss. The round-trip time (RTT) for these packets is reported as 0 milliseconds for minimum, maximum, and average times, indicating near-instantaneous communication with the device. The TTL (Time To Live) value of 128 implies that packets can traverse up to 128 network devices before being discarded. These results confirm that the target device at 192.168.1.18 is reachable and responds efficiently to requests from the computer.

2.2.3 Ping” discover.engineering.utoronto.ca”



```
PS C:\Users\almsr> Ping discover.engineering.utoronto.ca.

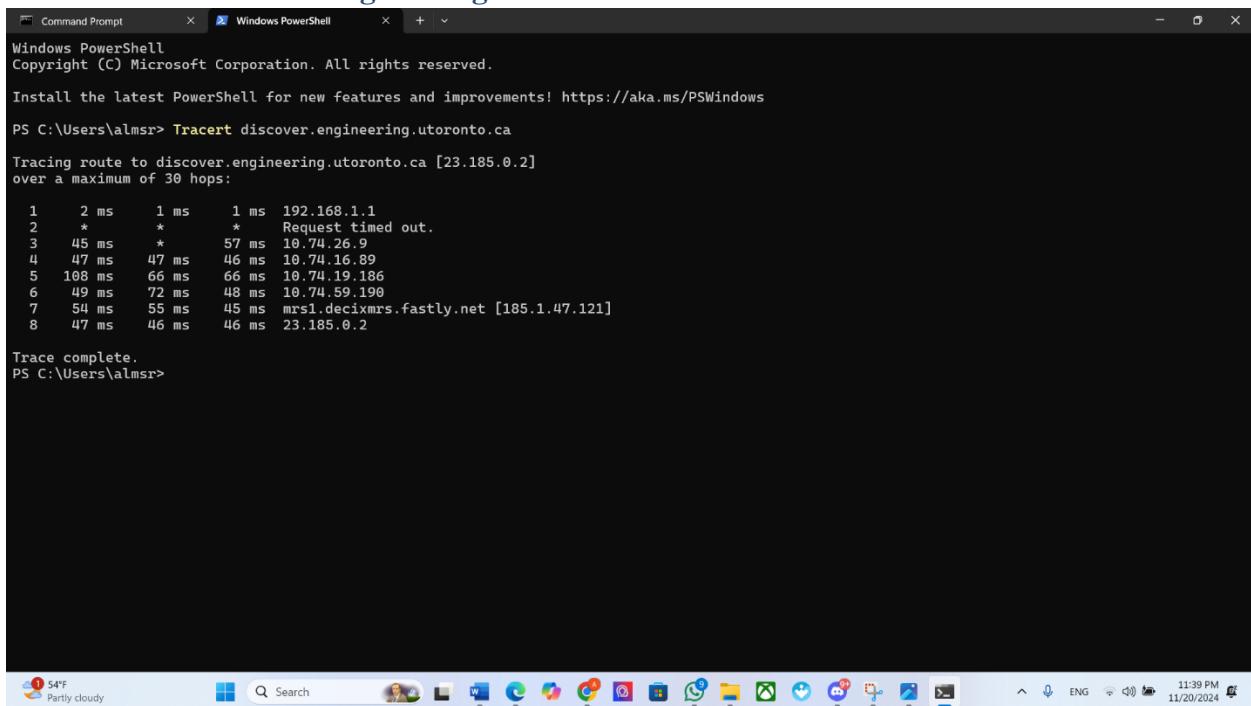
Pinging discover.engineering.utoronto.ca [23.185.0.2] with 32 bytes of data:
Reply from 23.185.0.2: bytes=32 time=45ms TTL=59
Reply from 23.185.0.2: bytes=32 time=47ms TTL=59
Reply from 23.185.0.2: bytes=32 time=45ms TTL=59
Reply from 23.185.0.2: bytes=32 time=47ms TTL=59

Ping statistics for 23.185.0.2:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
    Approximate round trip times in milli-seconds:
        Minimum = 45ms, Maximum = 47ms, Average = 46ms
PS C:\Users\almsr> |
```

Figure 4: Ping result of “discover.engineering.utoronto.ca”

When discover.engineering.utoronto.ca was pinged, 4 packets were sent and successfully received, each with a round-trip time (RTT) averaging 46 ms and a TTL of 59. The higher RTT compared to devices within the same network suggests that the destination is located in a geographically distant network, likely in Canada. The IP address 23.185.0.2 confirms the server's remote nature. The relatively low TTL value indicates that the packets passed through several network devices or hops before reaching the destination.

2.2.4 Tracert “discover.engineering.utoronto.ca”



```
Windows PowerShell
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PS C:\Users\almsr> Tracert discover.engineering.utoronto.ca

Tracing route to discover.engineering.utoronto.ca [23.185.0.2]
over a maximum of 30 hops:

 1    2 ms      1 ms      1 ms  192.168.1.1
 2    *          *          * Request timed out.
 3    45 ms     *          57 ms  10.74.26.9
 4    47 ms     47 ms     46 ms  10.74.16.89
 5    108 ms    66 ms     66 ms  10.74.19.186
 6    49 ms     72 ms     48 ms  10.74.59.190
 7    54 ms     55 ms     45 ms  mrs1.decixmrs.fastly.net [185.1.47.121]
 8    47 ms     46 ms     46 ms  23.185.0.2

Trace complete.

PS C:\Users\almsr>
```

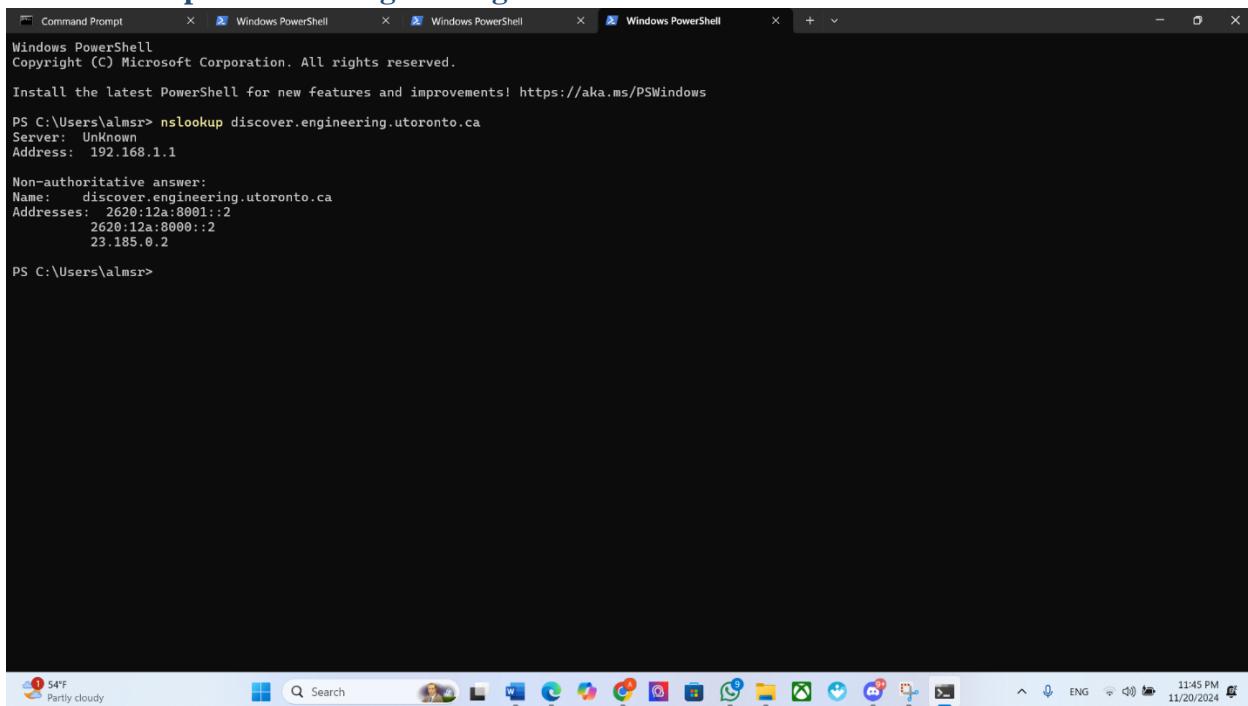
Figure 5: Results of using the command Tracert “discover.engineering.utoronto.ca”

As shown in above figure, the packets were routed through 7 hops to reach the destination, indicating that the three packets had to traverse 7 network devices or systems.

The first column represents the hop number, while the next three columns display the round-trip time (RTT) in milliseconds for each of the three packets transmitted during that hop. The last column specifies the destination IP or hostname of the network device handling the packets at that hop.

Notably, one of the hops is marked with an asterisk (*) and "Request timed out," indicating that the router at this point did not respond with a reply message within the predefined time limit. However, the traceroute successfully completed, reaching the destination host (discover.engineering.utoronto.ca).

2.2.5 nslookup “discover.engineering.utoronto.ca”



```
Windows PowerShell
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PS C:\Users\almsr> nslookup discover.engineering.utoronto.ca
Server: UnKnown
Address: 192.168.1.1

Non-authoritative answer:
Name: discover.engineering.utoronto.ca
Addresses: 2620:12a:8001::2
          2620:12a:8000::2
          23.185.0.2

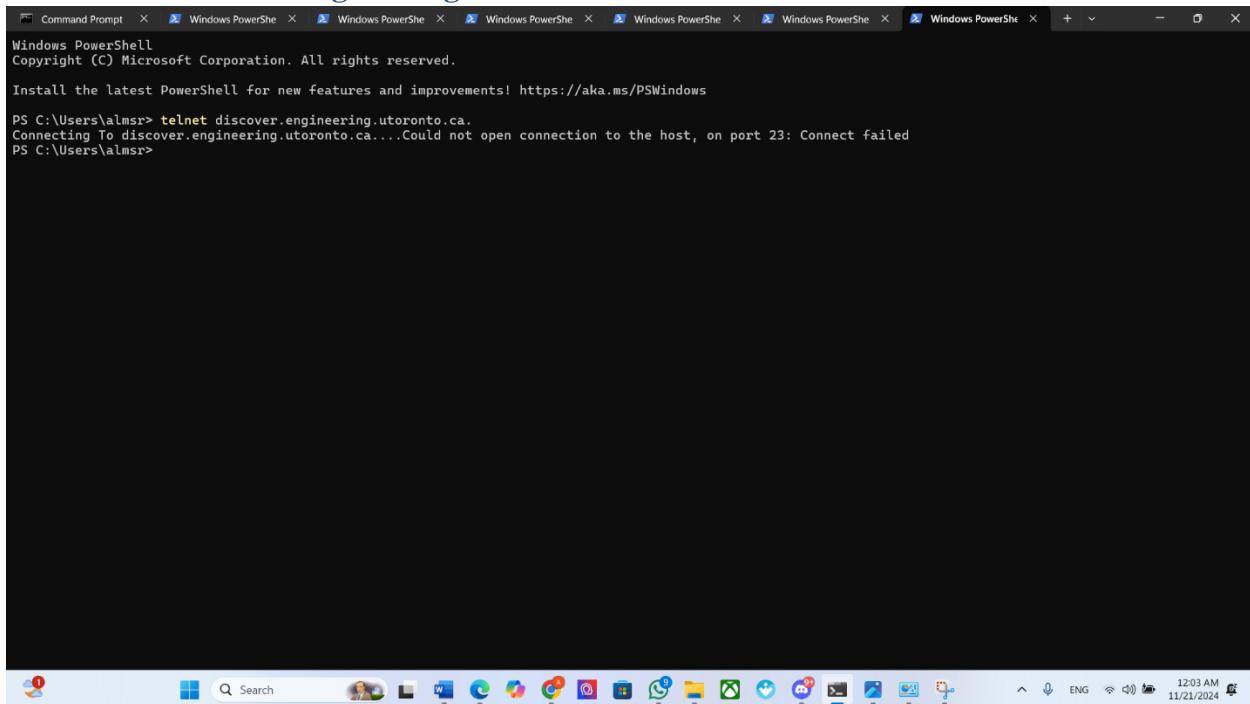
PS C:\Users\almsr>
```

Figure 6: Results of using the command nslookup “discover.engineering.utoronto.ca”

The response includes a "non-authoritative answer," indicating that the DNS server used for this query is not the authoritative DNS server for the domain discover.engineering.utoronto.ca. The output lists the domain name and associated IP addresses: 2620:12a:8001::2 (IPv6), 2620:12a:8000:2 (IPv6), and 23.185.0.2 (IPv4).

These IP addresses can be used to access the resources linked to the domain discover.engineering.utoronto.ca. The inclusion of multiple IP addresses suggests redundancy or support for both IPv4 and IPv6 connectivity.

2.2.6 telnet “discover.engineering.utoronto.ca”



A screenshot of a Windows desktop environment. At the top, there is a taskbar with several icons, including a search bar and pinned application icons. Below the taskbar is a window titled "Windows PowerShell". The window shows the command "telnet discover.engineering.utoronto.ca" being run, followed by an error message: "Connecting To discover.engineering.utoronto.ca...Could not open connection to the host, on port 23: Connect failed". The rest of the window is mostly blank black space.

```
Windows PowerShell
Copyright (C) Microsoft Corporation. All rights reserved.

Install the latest PowerShell for new features and improvements! https://aka.ms/PSWindows

PS C:\Users\almsr> telnet discover.engineering.utoronto.ca.
Connecting To discover.engineering.utoronto.ca...Could not open connection to the host, on port 23: Connect failed
PS C:\Users\almsr>
```

Figure 7: Results of using the command telnet “discover.engineering.utoronto.ca”

The figure shows the result of attempting to connect to `discover.engineering.utoronto.ca` on port 23 using the `telnet` command, which failed with the message: "Could not open connection to the host, on port 23: Connect failed." This indicates that the server is not running a Telnet service on port 23, or the connection is being blocked by a firewall or network restriction. Modern servers often disable Telnet due to security vulnerabilities, as it transmits data in plaintext, favoring secure alternatives like SSH.

2.3 Capture some DNS messages using “Wireshark”

Wireshark is an open- source network protocol analyzer widely used for capturing, analyzing, and troubleshooting network traffic. Developed by the Wireshark community, it provides a detailed and real-time view of data moving across a network, helping users understand the communication patterns between devices. Here we must use the wireshark to capture some DNS messages, we chose Wi-Fi, the network interface that corresponds to the network we want to monitor. To focus on DNS messages, we applied a display filter (DNS).

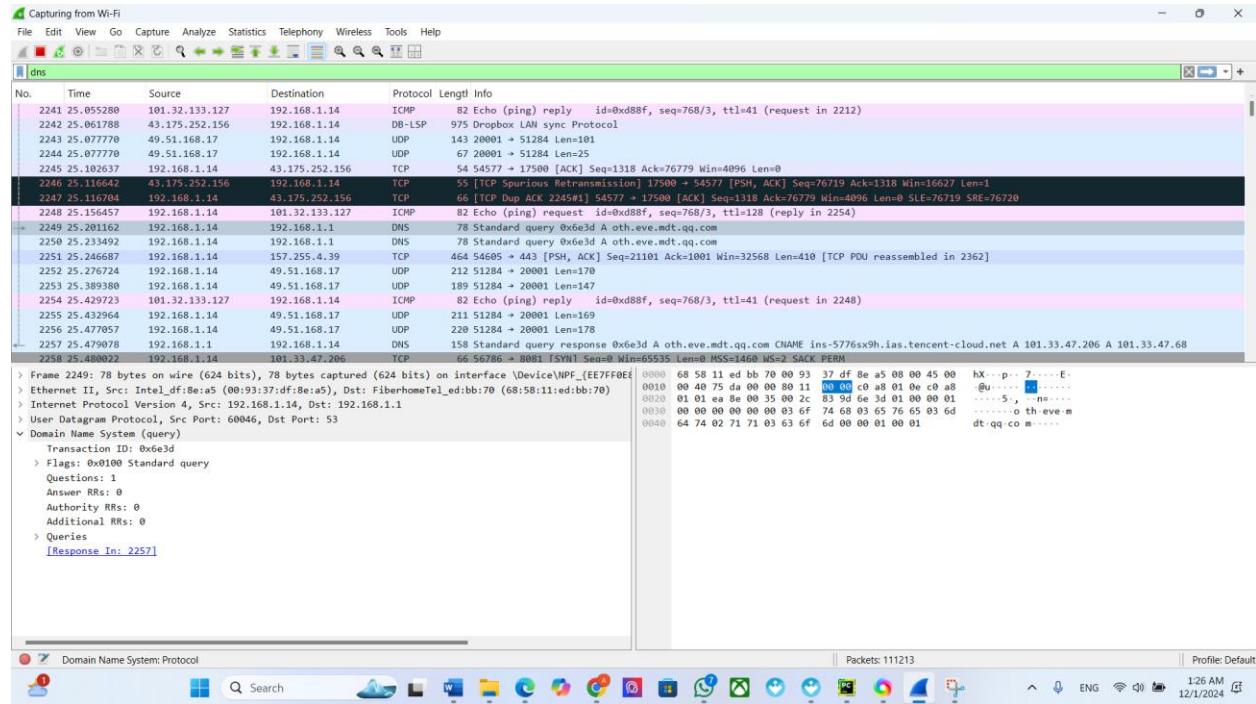


Figure 8: DNS query response message captured by Wireshark

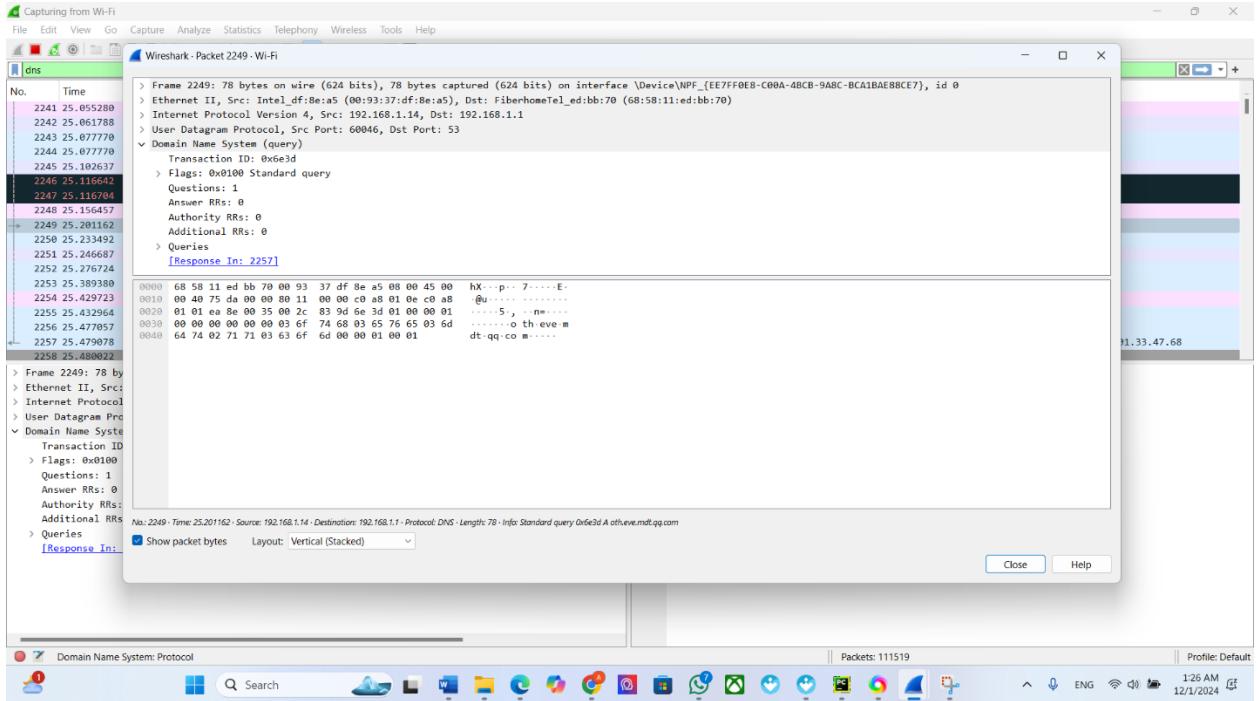


Figure 9: DNS query response message captured by Wireshark

As seen above, we have captured many DNS messages, each one of them has its own frame number that is a unique identifier for each captures packet, also there is a time that it's the time elapsed since the start of the capture, and the source and 6 destination IP addresses (or MAC addresses, depending on the layer) of the communication. The protocol Indicates the protocol used for the communication, such as TCP, UDP, or DNS, in addition the info column provides a summary of the packet content. For example, for DNS packets, you might see information about the DNS query or response.

Task 2 – TCP Theory and Procedure Socket Programming

The task utilizes the core principles of networking, specifically the HTTP protocol, socket programming, and multithreading:

HTTP Protocol: The server communicates with the client using the HTTP protocol. It sends responses such as HTTP/1.1 200 OK for successful requests, HTTP/1.1 307 Temporary Redirect for redirections, and HTTP/1.1 404 Not Found for missing resources.

Socket Programming: The server establishes a socket connection using Python's socket library. It binds to a specific IP address (127.0.0.1, or localhost) and port (5698) to listen for incoming requests.

Multithreading: The server handles multiple client connections simultaneously using the threading module. Each request is processed in a separate thread to ensure concurrent handling.

Initializing the Server, The server creates a socket, binds it to the localhost IP and port, and starts listening for incoming client connections.

```
104     def start_server():
105         if not os.path.exists(FILE_DIR):
106             os.makedirs(FILE_DIR)
107
108         server_socket = socket.socket(socket.AF_INET, socket.SOCK_STREAM)
109         server_socket.bind((HOST, PORT))
110         server_socket.listen(5)
111         print("Server running on " + HOST + ":" + str(PORT))
112
113     while True:
114         client_socket, client_address = server_socket.accept()
115         print("Connected by: " + str(client_address))
116         threading.Thread(target=handleResponse, args=(client_socket, client_address)).start()
117
```

Figure 10: Web Server Startup Log

Handling Requests: When a client connects, the server receives the request and determines the requested file path. The request is parsed to extract the file_name parameter, and the file is retrieved from the files directory.

```
46     def handleResponse(client_socket, client_address):
47         try:
48             request = client_socket.recv(1024).decode('utf-8')
49             print("Request received from " + str(client_address) + ":\n" + request)
50
51             if "GET" in request:
52                 lines = request.splitlines()
53                 request_line = lines[0]
54                 parts = request_line.split(" ")
55
```

Figure 11: Successful HTTP File Request

Responding to File Requests:

The server checks if the requested file exists:

Image or Video Available: If the file exists and is a valid type (e.g., .jpg, .png, .mp4), it constructs an HTML response to display the file using appropriate HTML tags (or <video>).

File Not Found: If the file is unavailable, the server redirects the user to Google Images or YouTube with a 307 Temporary Redirect response.

Request Supporting Material

Enter the name of the file you are looking for:
Select file type:

Figure 12: File Not Found Response

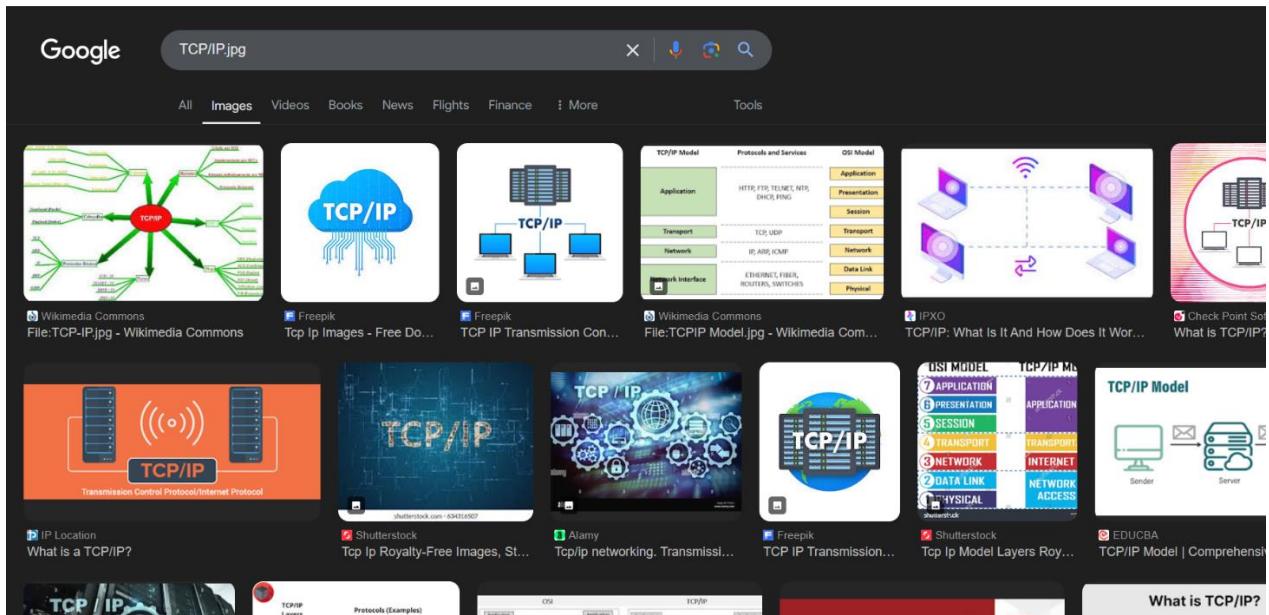


Figure 13: File Not Found Response

Request Supporting Material

Enter the name of the file you are looking for:

Select file type:

Figure 14: HTML Response for Video File

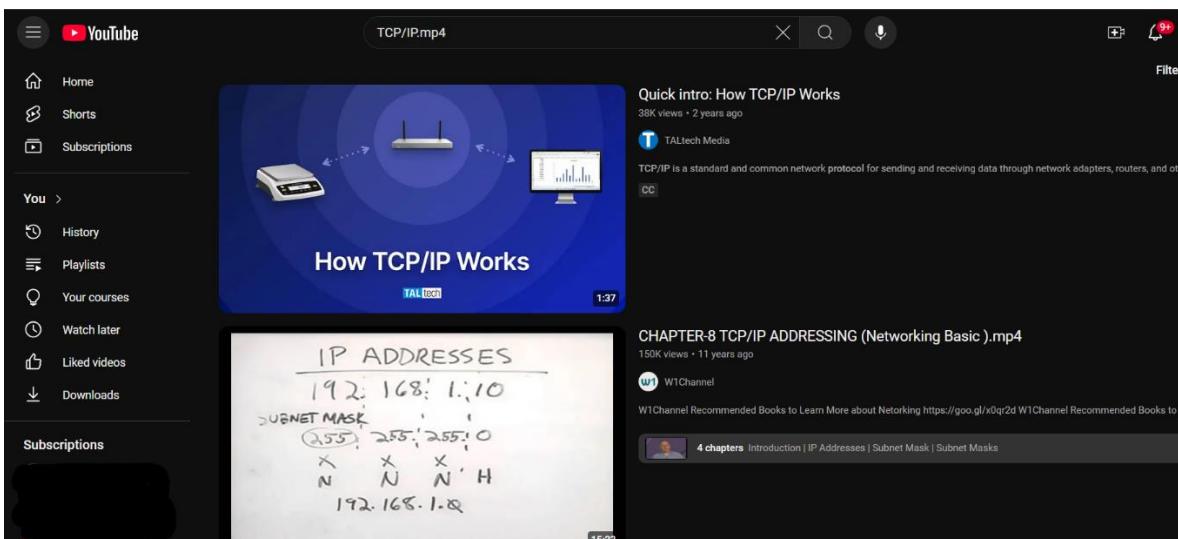


Figure 15: HTML Response for Video File

This URL contains several components,

[https://www.google.com/search: This is the base URL for Google's search engine.](https://www.google.com/search?q=TCP/IP.mp4&tbo=isch)

[?q=file_name: This query parameter specifies the search keyword. The server appends the requested file's name to q=, allowing Google to search for the file.](#)

[&tbo=isch: This parameter tells Google to return image search results \(tbo=isch stands for "Tableaux Mode Image Search"\).](#)

The URL is dynamically constructed based on the file name provided by the user, making the server flexible in handling various search queries.

```

15     if os.path.exists(file_path):
16         if file_name.endswith((".jpg", ".png", ".jpeg")):
17             content = (
18                 "<html lang=\"ar\" dir=\"rtl\">"
19                 if is_arabic
20                 else "<html lang=\"en\">"
21             )
22
23     else:
24         return "HTTP/1.1 400 Bad Request\r\n\r\n" + ("!پیغام غیر معتبر است" if is_arabic else "Unsupported file type!")
25     else:
26         if file_name.endswith((".jpg", ".png", ".jpeg")):
27             return "HTTP/1.1 307 Temporary Redirect\r\nLocation: https://www.google.com/search?q=" + file_name + "&tbo=isch\r\n\r\n"
28         elif file_name.endswith(".mp4"):
29             return "HTTP/1.1 307 Temporary Redirect\r\nLocation: https://www.youtube.com/results?search_query=" + file_name + "\r\n\r\n"
30         else:
31             return "HTTP/1.1 404 Not Found\r\n\r\n" + ("!فایل مورد نظر شما دریافت نشد" if is_arabic else "File not found!")
32
33
34
35
36
37
38
39
40
41
42
43
44
45

```

The server uses two main endpoints to handle file requests:

/request_file: For English responses.

/request_ar_file: For Arabic responses.

When a user requests a file, the server checks whether the file exists in the files directory. If the file is found, it generates an HTML page to display the image or video. If the file is not found, it performs a URL redirection.

One of the main issues encountered was that even when the file existed in the local directory, the server sometimes redirected to Google instead of displaying the file. This issue arises due to errors in handling the path or parsing the file name correctly. Further debugging would be required to address this, such as ensuring proper URL decoding and file existence checks. This is likely due to an error in the file existence check logic (os.path.exists(file_path)).

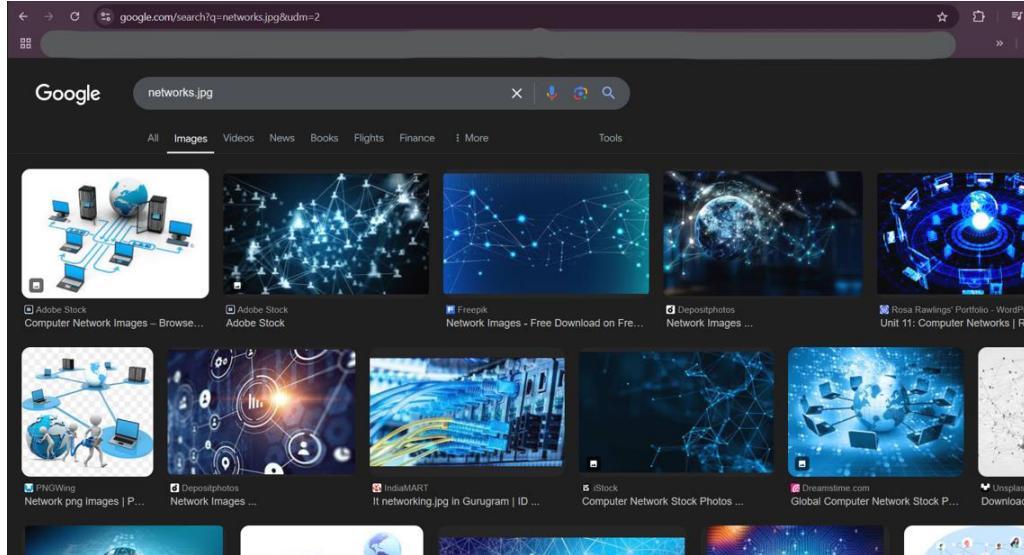


Figure 16: Generated Redirect URL

Components and Their Functions:

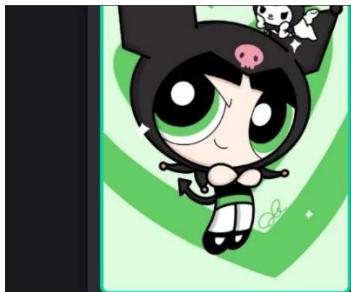
socket: Establishes communication between the server and clients.

threading: Allows the server to handle multiple client connections simultaneously.

os.path: Manages file path operations, checking for file existence.

unquote: Decodes URL-encoded file names.

A screenshot of a web application titled "Welcome to ENCS3320 - Computer Networks Webserver". The main title is displayed in a large, bold, light blue font at the top center. Below the title, there is a section titled "Our Team" in a smaller white font. Underneath this section, there are three separate image boxes, each featuring a different member of the Powerpuff Girls. The first image shows Buttercup, the second shows Blossom, and the third shows Bubbles. Each image is framed by a thin white border and is set against a dark background. The overall layout is clean and modern, with a focus on the team members.



Lina Abufarha 1211968

Hi, I'm Lina from Jenin. I have experience in developing 3D and 2D games on the Unity game engine in C#. I also master other languages such as Java, C, and Python. I have created projects in these languages using object-oriented programming and data structures. I also have skills in drawing and design.



Areen Masri 1210596

Hi, I'm Areen, a driven fourth-year Computer Engineering student at Birzeit University. My academic journey has been an exciting exploration of programming and problem-solving, sparking my passion for mastering languages like C, Java, Python, and beyond.



Raghad Isleem 1211326

I'm Raghed, a fourth-year Computer Engineering student at the Faculty of Engineering, with a deep passion for Artificial Intelligence and Robotics. Beyond my academic pursuits, I engage in a variety of interests such as drawing, crafts, and music, and I have a strong fascination with nature, animals, and astronomy.

Introduction to Computer Networks

Computer networks allow devices to communicate, share resources, and collaborate effectively. Networks can be classified based on their size (LAN, WAN) and architecture (client-server, peer-to-peer).



- Local Area Network (LAN)
 - Wide Area Network (WAN)
 - Metropolitan Area Network (MAN)
1. Understanding TCP/IP
 2. Network Topologies
 3. OSI Model Layers

Useful Links:

- [Textbook Website](#)
- [Ritaj Website](#)
- [Supporting Material](#)

The Links:

[Textbook Website](#)

This link redirects the user to the official website of the textbook used in the course or project.

The screenshot shows a web browser with the URL gaia.cs.umass.edu/kurose_ross/index.php. The page has a red header bar with navigation links: HOME, ABOUT, RESOURCES (FOR EVERYONE) ▾, INSTRUCTOR RESOURCES, and MORE ▾. Below the header, there's a book cover thumbnail for 'Computer Networking: A Top-Down Approach, 8th edition' by Jim Kurose, Keith Ross, with a link to 'Authors' website'. The main content area features a welcome message from the authors, information about the 8th edition publication, and details about where to buy or rent the book. It also includes a note of thanks to John Broderick and copyright information.

Welcome to the authors' website for the textbook, Computer Networking: A Top Down Approach (Pearson). The 8th edition of our textbook has been published in the spring of 2020 - find out [what's new in the 8th edition](#). From this page here (check out the menu at the top of the page), you can find resources and information of interest to students, teachers, and readers alike.

Since the publication of the first edition 21 years ago, the book has been adopted at many hundreds of colleges and universities, translated into 14 languages, and used by literally millions students and practitioners worldwide. We've been overwhelmed by the positive response.

This textbook is for a first course on computer networking. It has been used in computer science and electrical engineering departments, information systems and informatics departments, in business schools, and elsewhere - at both the undergraduate and graduate levels. It should also be of interest to practitioners in industry as well. Find out more about the textbook [here](#).

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We gratefully acknowledge the programming and problem design work of John Broderick (UMass '21), which has really helped to substantially improve this site.

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Comments welcome and appreciated: kurose@cs.umass.edu

Ritaj Website

This link leads to the "Ritaj" platform, used by students to access university resources, course materials, and academic information.

The screenshot shows a web browser with the URL ritaj.birzeit.edu/register/. The page has a green header with the 'Ritaj' logo and 'Birzeit University Academic and Administrative Portal'. The main content area shows a login form with fields for 'اسم المستخدم' (username) and 'كلمة المرور' (password), and a 'تسجيل الدخول' (log in) button. Below the form is a link 'Forgot your password? - [找回密码](#)'. The right side of the page features a large photo of two female students walking outdoors. The bottom of the page is divided into three sections: 'معلومات' (Information) on the left, 'المدونات' (Blogs) in the center, and 'روابط' (Links) on the right. The 'Information' section contains links like 'لائحة الشرف', 'مواعيد درام واسنادحة الدوائر', 'احداث الشفقة الجامعية', 'أسعار ال碧عب في المكتريات الجامعية', 'قوافل ضرورية', and 'نشرات ارشادية - قسم المساحة العامة'. The 'Blogs' section lists posts for the academic year 2024/2025, such as 'التفوييم الأكاديمي للعام الدراسي 2024/2025', 'دليل درجة البكالوريوس', 'دليل الراسات العليا', 'الأاضنة والطالبات', 'لوحة الإعلانات الرسمية', 'أسلة شامة - دائرة التسجيل والقبول', 'تحليمات بفع الروس المنهجية', 'علشون بريد الكتروني ضروري', and 'تحليمات التأمين الصحي طلبة الجامعة'. The 'Links' section lists various university services like 'تصديق الاقرارات والتكنولوجيا', 'مرصد العدالة الاجتماعية في جامعة بيرزيت', 'مكتبات الجامعة', 'وحدة الرخص الطلبية - وزارة التربية والتعليم العالي', 'البريد الإلكتروني', 'خطوات', 'طلبات التوظيف', 'مسارح المسالك', and 'صفحة itcollege'.

البوابة الأكademية والإدارية لجامعة بيرزيت
Birzeit University Academic and Administrative Portal

اسم المستخدم
كلمة المرور
تسجيل الدخول
找回密码

Forgot your password? - [找回密码](#)

معلومات

المدونات

روابط

تصديق الاقرارات والتكنولوجيا
مرصد العدالة الاجتماعية في جامعة بيرزيت
مكتبات الجامعة
وحدة الرخص الطلبية - وزارة التربية والتعليم العالي
البريد الإلكتروني
خطوات
طلبات التوظيف
مسارح المسالك
صفحة itcollege

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عنوان البريد الإلكتروني للراسل مع الجامعة: 0599281200_0599282919@birzeit.edu | +970-2-2982000 | www.birzeit.edu

<https://ritaj.birzeit.edu/users/recover-pwd/>

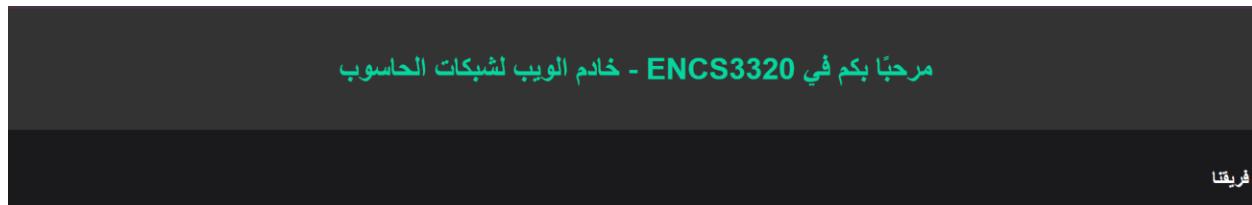
Supporting Materials (Image Search)

This link redirects the user to a page to search for supporting materials on the server.

A similar version of the webpage was created with support for the Arabic language. This version ensures that users who prefer Arabic can easily navigate and access all the provided resources in their native language.

Key adjustments made to support Arabic include:

- Text Direction:** The text is aligned from right to left (RTL) using the `dir="rtl"` attribute.
- Language Declaration:** The `lang="ar"` attribute is added to specify the document's language as Arabic.
- Content Translation:** All text, labels, and links have been translated to Arabic to provide a seamless experience for Arabic-speaking users.



 ردد	 أرين المصري	 لينا أبو فرجة
أنا ردد، طالب في السنة الرابعة في كلية الكمبيوتر بكلية الهندسة، ولدي شغف صحي ب مجالات التكاء الأكاديمى والروبوتات، يعنى عن دراسى الأكاديمية، استمعت بمجموعة من الأنشطة مثل الرسم والحرف والموسيقى، ولدي اهتمام هو بالطبيعة والحيوانات والفن..	مرحبا، أنا هرين، طالبة طموحة في السنة الرابعة في هندسة الماسنجر بجامعة بيرزيت، كنت رطيني الأكاديمية تجربة مثيرة في علم البرمجة وحل المشكلات، مما أشعل شهي، يتقن لغات مثل C و Java و Python وغيرها..	مرحباً إلينا من جينز لدى خبرة في تطوير العاب ثنائية وبعد وثائقية الاعداد على محرك الالعاب Unity بلغة C# كما اتقن لغات اخرى مثل Java و C و Python وافت بالشروع بهذه الغاية باستخدام البرمجة الشبيهة OOP وهياكل البيانات كما الذي مهارات في الرسم والتصميم.

مقدمة عن شبكات الحاسوب

تتيح شبكات الحاسوب للأجهزة التوصيل، مشاركة الموارد، والتعاون بفعالية. يمكن تصنيف الشبكات بناء على حجمها (الشبكة المحلية LAN، الشبكة الواسعة WAN) أو بنيتها (صيغ ساخام، النظير للنظير).



- الشبكة المحلية (LAN)
 - الشبكة الواسعة (WAN)
 - شبكة منطقة المدينة (MAN)

- ١. فهم بروتوكول TCP/IP
- ٢. طبیعت و مفهوم شبکات
- ٣. طبقات نمودج OSI

The server is running successfully, processing requests for image and video files, and displaying them in the browser. It redirects users to external search engines if the file is not found.

Task 3 – UDP Client-Server Trivia Game Using Socket Programming

- 1) We started the server script (server.py) on a machine with the IP address 192.168.1.19 and port 5689 and the server waits for at least two clients to join the game before it begins.
 - 2) Three client instances (client.py) were started, each connecting to the server using the same IP address (192.168.1.19) and port (5689) and Each client provided a username to join the game:
 - **Client 1: Username raged**
 - **Client 2: Username areen**
 - **Client 3: Username lina**
 - 3) Each client successfully connected to the server, and the server acknowledged their participation.
 - 4) Once there is more than two clients the server began the trivia game after a 30-second scountdown.
 - 5) we designed this trivia game to run for two rounds, but we made it flexible so that the number of rounds can easily be changed.

```
C:\Users\SS\Desktop\4\py>python server.py
Server started on 172.19.1.22:5689
2024-12-01 13:03:08,961 - Waiting for at least 2 clients to join the game...
2024-12-01 13:03:13,962 - Waiting for at least 2 clients to join the game...
2024-12-01 13:03:18,963 - Waiting for at least 2 clients to join the game...
2024-12-01 13:03:23,964 - Waiting for at least 2 clients to join the game...
raghed joined the game from ('172.19.1.22', 60084)
2024-12-01 13:03:28,965 - Waiting for at least 2 clients to join the game...
2024-12-01 13:03:33,966 - Waiting for at least 2 clients to join the game...
2024-12-01 13:03:38,967 - Waiting for at least 2 clients to join the game...
areen joined the game from ('172.19.1.22', 57858)
lina joined the game from ('172.19.1.22', 57859)
2024-12-01 13:04:13,970 - Round 1, Question 1: What is the square root of 25?
```

```
C:\Users\SS\Desktop\4\py>python client.py
Enter the server IP address: 172.19.1.22
Enter the server port number: 5689
Enter your name: raghed
Successfully connected to server at 172.19.1.22:5689
raghed has joined the game!
Your answer (or type 'exit' to quit):
areen has joined the game!
Starting the Trivia Game in 30 seconds! Get ready!
lina has joined the game!
Starting Round 1!
Question 1: What is the square root of 25?
5
```

```
Command Prompt - python c × + ▾
C:\Users\SS\Desktop\4\py>python client.py
Enter the server IP address: 172.19.1.22
Enter the server port number: 5689
Enter your name: areen
Successfully connected to server at 172.19.1.22:5689
areen has joined the game!
Your answer (or type 'exit' to quit):
Starting the Trivia Game in 30 seconds! Get ready!
lina has joined the game!
Starting Round 1!
```

```
Command Prompt - python c × + ▾
C:\Users\SS\Desktop\4\py>python client.py
Enter the server IP address: 172.19.1.22
Enter the server port number: 5689
Enter your name: lina
Successfully connected to server at 172.19.1.22:5689
lina has joined the game!
Your answer (or type 'exit' to quit):
Starting Round 1!
Question 1: What is the square root of 25?
5
```

- And now the game has officially started!

- The server waits for **30 seconds** to give players enough time to respond to each question.

```
2024-12-01 13:04:13,970 - Round 1, Question 1: What is the square root of 25?
Timeout waiting for new clients to join.
2024-12-01 13:04:24,703 - Received answer from ('172.19.1.22', 60084): 5
2024-12-01 13:04:24,703 - First answer recorded for ('172.19.1.22', 60084): 5
2024-12-01 13:04:30,163 - Received answer from ('172.19.1.22', 57859): 5
2024-12-01 13:04:30,164 - First answer recorded for ('172.19.1.22', 57859): 5
2024-12-01 13:05:00,162 - Timeout waiting for answers.
2024-12-01 13:05:00,163 - raghed got it right (+1.000 points)!
2024-12-01 13:05:00,164 - lina got it right (+0.500 points)!
2024-12-01 13:05:00,165 - areen did not answer.
2024-12-01 13:05:00,166 - raghed: 1.00 points
2024-12-01 13:05:00,166 - areen: 0.00 points
2024-12-01 13:05:00,167 - lina: 0.50 points
Timeout waiting for new clients to join.
```

```
Starting Round 1!
Question 1: What is the square root of 25?
5
Your answer (or type 'exit' to quit):
5
Your answer (or type 'exit' to quit):
Time's up! The correct answer was: 5
raghed got it right (+1.000 points)!
lina got it right (+0.500 points)!
areen did not answer.
Current Scores:
raghed: 1.00 points
areen: 0.00 points
lina: 0.50 points
```

```
Command Prompt - python c:\Users\SS\Desktop\4\py
Microsoft Windows [Version 10.0.26100.2314]
(c) Microsoft Corporation. All rights reserved.

C:\Users\SS>cd C:\Users\SS\Desktop\4\py

C:\Users\SS\Desktop\4\py>python client.py
Enter the server IP address: 172.19.1.22
Enter the server port number: 5689
Enter your name: areen
Successfully connected to server at 172.19.1.22:5689
areen has joined the game!
Your answer (or type 'exit' to quit):
Starting the Trivia Game in 30 seconds! Get ready!
lina has joined the game!
Starting Round 1!
Question 1: What is the square root of 25?
```

```
Command Prompt - python c:\Users\SS\Desktop\4\py
Successfully connected to server at 172.19.1.22:5689
lina has joined the game!
Your answer (or type 'exit' to quit):
Starting Round 1!
Question 1: What is the square root of 25?
5
Your answer (or type 'exit' to quit):
Time's up! The correct answer was: 5
raghed got it right (+1.000 points)!
lina got it right (+0.500 points)!
areen did not answer.
Current Scores:
raghed: 1.00 points
areen: 0.00 points
lina: 0.50 points
Question 2: What is the capital of Palestine?
```

```
2024-12-01 13:05:30,168 - Round 1, Question 2: What is the capital of Palestine?
Timeout waiting for new clients to join.
2024-12-01 13:05:47,686 - Received answer from ('172.19.1.22', 60084): jerusalem
2024-12-01 13:05:47,686 - First answer recorded for ('172.19.1.22', 60084): jerusalem
2024-12-01 13:05:50,288 - Received answer from ('172.19.1.22', 57858): jerusalem
2024-12-01 13:05:50,288 - First answer recorded for ('172.19.1.22', 57858): jerusalem
2024-12-01 13:05:52,986 - Received answer from ('172.19.1.22', 57859): jerusalem
2024-12-01 13:05:52,986 - First answer recorded for ('172.19.1.22', 57859): jerusalem
Timeout waiting for new clients to join.
2024-12-01 13:06:23,001 - Timeout waiting for answers.
2024-12-01 13:06:23,002 - raghed got it right (+1.000 points)!
2024-12-01 13:06:23,003 - areen got it right (+0.667 points)!
2024-12-01 13:06:23,004 - lina got it right (+0.333 points)!
2024-12-01 13:06:23,005 - raghed: 2.00 points
```

```
Question 2: What is the capital of Palestine?
jerusalem
Your answer (or type 'exit' to quit):
jerusalem
Your answer (or type 'exit' to quit):
Time's up! The correct answer was: Jerusalem
raghed got it right (+1.000 points)!
areen got it right (+0.667 points)!
lina got it right (+0.333 points)!
Current Scores:
raghed: 2.00 points
areen: 0.67 points
lina: 0.83 points
Question 3: What is 5 * (4 + 2)?
```

```
Command Prompt - python c:\Users\SS\Desktop\4\py
Question 2: What is the capital of Palestine?
Jerusalem
Your answer (or type 'exit' to quit):
Time's up! The correct answer was: Jerusalem
raghed got it right (+1.000 points)!
areen got it right (+0.667 points)!
lina got it right (+0.333 points)!
Current Scores:
raghed: 2.00 points
areen: 0.67 points
lina: 0.83 points
```

```
Command Prompt - python c:\Users\SS\Desktop\4\py
Question 2: What is the capital of Palestine?
Jerusalem
Your answer (or type 'exit' to quit):
Time's up! The correct answer was: Jerusalem
raghed got it right (+1.000 points)!
areen got it right (+0.667 points)!
lina got it right (+0.333 points)!
Current Scores:
raghed: 2.00 points
areen: 0.67 points
lina: 0.83 points
```

```

2024-12-01 13:06:53,007 - Round 1, Question 3: What is 5 * (4 + 2)?
2024-12-01 13:06:58,846 - Received answer from ('172.19.1.22', 57859): 30
2024-12-01 13:06:58,846 - First answer recorded for ('172.19.1.22', 57859): 30
2024-12-01 13:07:01,816 - Received answer from ('172.19.1.22', 60084): 30
2024-12-01 13:07:01,816 - First answer recorded for ('172.19.1.22', 60084): 30
2024-12-01 13:07:06,877 - Received answer from ('172.19.1.22', 57858): 30
2024-12-01 13:07:06,877 - First answer recorded for ('172.19.1.22', 57858): 30
Timeout waiting for new clients to join.
2024-12-01 13:07:36,883 - Timeout waiting for answers.
2024-12-01 13:07:36,884 - lina got it right (+1.000 points)!
2024-12-01 13:07:36,885 - raghed got it right (+0.667 points)!
2024-12-01 13:07:36,885 - areen got it right (+0.333 points)!
2024-12-01 13:07:36,887 - raghed: 2.67 points
2024-12-01 13:07:36,887 - areen: 1.00 points

```

```

Question 3: What is 5 * (4 + 2)?
30
Your answer (or type 'exit' to quit):
Time's up! The correct answer was: 30
lina got it right (+1.000 points)!
raghed got it right (+0.667 points)!
areen got it right (+0.333 points)!
Current Scores:
raghed: 2.67 points
areen: 1.00 points
lina: 1.83 points
Round 1 Winner: raghed with 2.67 points!
Next round starts in 30 seconds. Be ready!
Starting Round 2!

```

```

Command Prompt - python c × + ▾
Question 3: What is 5 * (4 + 2)?
30
Your answer (or type 'exit' to quit):
Time's up! The correct answer was: 30
lina got it right (+1.000 points)!
raghed got it right (+0.667 points)!
areen got it right (+0.333 points)!
Current Scores:
raghed: 2.67 points
areen: 1.00 points
lina: 1.83 points
Round 1 Winner: raghed with 2.67 points!
Next round starts in 30 seconds. Be ready!

```

```

Command Prompt - python c × + ▾
Question 3: What is 5 * (4 + 2)?
30
Your answer (or type 'exit' to quit):
Time's up! The correct answer was: 30
lina got it right (+1.000 points)!
raghed got it right (+0.667 points)!
areen got it right (+0.333 points)!
Current Scores:
raghed: 2.67 points
areen: 1.00 points
lina: 1.83 points
Round 1 Winner: raghed with 2.67 points!
Next round starts in 30 seconds. Be ready!

```

- After the first round, the winner is **raghed** with the highest score so far!
- The server pauses for **30 seconds** between rounds, giving players time to review the leaderboard and prepare for the next round and print “Next round starts in 30 seconds. Be ready!”
- Round 2

```

2024-12-01 13:08:36,892 - Round 2, Question 1: What is the square root of 25?
2024-12-01 13:08:42,859 - Received answer from ('172.19.1.22', 57858): 5
2024-12-01 13:08:42,859 - First answer recorded for ('172.19.1.22', 57858): 5
Timeout waiting for new clients to join.
2024-12-01 13:08:49,202 - Received answer from ('172.19.1.22', 57859): 55
2024-12-01 13:08:49,202 - First answer recorded for ('172.19.1.22', 57859): 55
2024-12-01 13:08:50,176 - Received answer from ('172.19.1.22', 57859): 5
2024-12-01 13:08:52,385 - Received answer from ('172.19.1.22', 60084): 5
2024-12-01 13:08:52,385 - First answer recorded for ('172.19.1.22', 60084): 5
Timeout waiting for new clients to join.
2024-12-01 13:09:22,387 - Timeout waiting for answers.
2024-12-01 13:09:22,389 - areen got it right (+1.000 points)!
2024-12-01 13:09:22,390 - raghed got it right (+0.500 points)!
2024-12-01 13:09:22,390 - lina answered: 55 (Incorrect)

```

```

Starting Round 2!
Question 1: What is the square root of 25?
5
Your answer (or type 'exit' to quit):
Time's up! The correct answer was: 5
areen got it right (+1.000 points)!
raghed got it right (+0.500 points)!
lina answered: 55 (Incorrect)
Current Scores:
raghed: 0.50 points
areen: 1.00 points
lina: 0.00 points
Question 2: In which year did World War II end?
1945

```

```

Command Prompt - python c × + ▾
Starting Round 2!
Question 1: What is the square root of 25?
5
Your answer (or type 'exit' to quit):
Time's up! The correct answer was: 5
areen got it right (+1.000 points)!
raghed got it right (+0.500 points)!
lina answered: 55 (Incorrect)
Current Scores:
raghed: 0.50 points
areen: 1.00 points
lina: 0.00 points
Question 2: In which year did World War II end?
1998
Your answer (or type 'exit' to quit):
Time's up! The correct answer was: 1945
raghed got it right (+1.000 points)!

```

```

Command Prompt - python c × + ▾
Starting Round 2!
Question 1: What is the square root of 25?
5
Your answer (or type 'exit' to quit):
55
Your answer (or type 'exit' to quit):
55
Your answer (or type 'exit' to quit):
5
Your answer (or type 'exit' to quit):
Time's up! The correct answer was: 5
areen got it right (+1.000 points)!
raghed got it right (+0.500 points)!
lina answered: 55 (Incorrect)
Current Scores:
raghed: 0.50 points
areen: 1.00 points
lina: 0.00 points
Question 2: In which year did World War II end?

```

- Lina initially submitted an incorrect answer (55) and then changed it to the correct answer (5). However, the server ignored the second answer because it had already logged her first answer.

```

2024-12-01 13:09:52,394 - Round 2, Question 2: In which year did World War II end?
2024-12-01 13:09:58,235 - Received answer from ('172.19.1.22', 60084): 1945
2024-12-01 13:09:58,235 - First answer recorded for ('172.19.1.22', 60084): 1945
2024-12-01 13:10:02,548 - Received answer from ('172.19.1.22', 57858): 1998
2024-12-01 13:10:02,548 - First answer recorded for ('172.19.1.22', 57858): 1998
2024-12-01 13:10:06,617 - Received answer from ('172.19.1.22', 57859): 1945
2024-12-01 13:10:06,617 - First answer recorded for ('172.19.1.22', 57859): 1945
Timeout waiting for new clients to join.
2024-12-01 13:10:36,616 - Timeout waiting for answers.
2024-12-01 13:10:36,617 - raghed got it right (+1.000 points)!
2024-12-01 13:10:36,618 - lina got it right (+0.500 points)!
2024-12-01 13:10:36,619 - areen answered: 1998 (Incorrect)
2024-12-01 13:10:36,620 - raghed: 1.50 points
2024-12-01 13:10:36,621 - areen: 1.00 points
2024-12-01 13:10:36,622 - lina: 0.50 points
Timeout waiting for new clients to join.

Question 2: In which year did World War II end?
1998
Your answer (or type 'exit' to quit):
Time's up! The correct answer was: 1945
raghed got it right (+1.000 points)!
lina got it right (+0.500 points)!
areen answered: 1998 (Incorrect)
Current Scores:
raghed: 1.50 points
areen: 1.00 points
lina: 0.50 points

```



```

Question 2: In which year did World War II end?
1945
Your answer (or type 'exit' to quit):
Time's up! The correct answer was: 1945
raghed got it right (+1.000 points)!
lina got it right (+0.500 points)!
areen answered: 1998 (Incorrect)
Current Scores:
raghed: 1.50 points
areen: 1.00 points
lina: 0.50 points
Question 3: What is the capital of Japan?
tokyo
Your answer (or type 'exit' to quit):
tokyo
Your answer (or type 'exit' to quit):

Question 2: In which year did World War II end?
1945
Your answer (or type 'exit' to quit):
Time's up! The correct answer was: 1945
raghed got it right (+1.000 points)!
lina got it right (+0.500 points)!
areen answered: 1998 (Incorrect)
Current Scores:
raghed: 1.50 points
areen: 1.00 points
lina: 0.50 points

```



```

2024-12-01 13:11:06,623 - Round 2, Question 3: What is the capital of Japan?
Timeout waiting for new clients to join.
2024-12-01 13:11:24,551 - Received answer from ('172.19.1.22', 60084): tokyo
2024-12-01 13:11:24,551 - First answer recorded for ('172.19.1.22', 60084): tokyo
2024-12-01 13:11:27,643 - Received answer from ('172.19.1.22', 57859): toky
2024-12-01 13:11:27,643 - First answer recorded for ('172.19.1.22', 57859): toky
2024-12-01 13:11:35,063 - Received answer from ('172.19.1.22', 57858): tokyo
2024-12-01 13:11:35,064 - First answer recorded for ('172.19.1.22', 57858): tokyo
Timeout waiting for new clients to join.
2024-12-01 13:12:05,069 - Timeout waiting for answers.
2024-12-01 13:12:05,070 - raghed got it right (+1.000 points)!
2024-12-01 13:12:05,070 - areen got it right (+0.500 points)!
2024-12-01 13:12:05,070 - lina answered: toky (Incorrect)
2024-12-01 13:12:05,071 - raghed: 2.50 points
2024-12-01 13:12:05,071 - areen: 1.50 points
2024-12-01 13:12:05,071 - lina: 0.50 points
Timeout waiting for new clients to join.
2024-12-01 13:12:35,072 - Round 2 Winner: raghed with 2.50 points!
Timeout waiting for new clients to join.

Question 3: What is the capital of Japan?
tokyo
Your answer (or type 'exit' to quit):
Time's up! The correct answer was: tokyo
raghed got it right (+1.000 points)!
areen got it right (+0.500 points)!
lina answered: toky (Incorrect)
Current Scores:
raghed: 2.50 points
areen: 1.50 points
lina: 0.50 points
Round 2 Winner: raghed with 2.50 points!

Question 3: What is the capital of Japan?
tokyo
Your answer (or type 'exit' to quit):
Time's up! The correct answer was: tokyo
raghed got it right (+1.000 points)!
areen got it right (+0.500 points)!
lina answered: toky (Incorrect)
Current Scores:
raghed: 2.50 points
areen: 1.50 points
lina: 0.50 points
Round 2 Winner: raghed with 2.50 points!

```

- The winner in this round is **raghed** with the highest score so far!

- So The winner of the game is **raghed** because she won in both rounds!

<pre>Timeout waiting for new clients to join. Server is shutting down. Goodbye!</pre>	<pre>Game Winner: raghed with 2 round wins! Server is shutting down. Thanks for playing! exit Exiting the game. Goodbye!</pre>
<pre>Command Prompt Game Winner: raghed with 2 round wins! Server is shutting down. Thanks for playing! exit Exiting the game. Goodbye!</pre>	<pre>Command Prompt Game Winner: raghed with 2 round wins! Server is shutting down. Thanks for playing! exit Exiting the game. Goodbye!</pre>

- The server implements a controlled shutdown mechanism. A KeyboardInterrupt (generated by pressing Ctrl+C) triggers a graceful shutdown sequence. The server broadcasts a termination message to all connected clients before closing the network connection. Clients can also initiate a disconnect by entering the command 'exit', which closes their connection to the server.

- Here's an example of what happens if a client enters an incorrect IP address:

<pre>C:\Users\SS\Desktop\4\py>python server.py Server started on 172.19.1.22:5689 2024-12-01 13:43:02,964 - Waiting for at least 2 clients to join the game... 2024-12-01 13:43:07,965 - Waiting for at least 2 clients to join the game... 2024-12-01 13:43:12,966 - Waiting for at least 2 clients to join the game... raghed joined the game from ('172.19.1.22', 57198) 2024-12-01 13:43:17,966 - Waiting for at least 2 clients to join the game... 2024-12-01 13:43:22,967 - Waiting for at least 2 clients to join the game... 2024-12-01 13:43:27,968 - Waiting for at least 2 clients to join the game... 2024-12-01 13:43:32,970 - Waiting for at least 2 clients to join the game...</pre>	<pre>C:\Users\SS\Desktop\4\py>python client.py Enter the server IP address: 456 Enter the server port number: 66 Enter your name: raghed Could not connect to server: [Errno 11001] getaddrinfo failed Enter the server IP address: 172.19.1.22 Enter the server port number: 5689 Enter your name: raghed Successfully connected to server at 172.19.1.22:5689 raghed has joined the game! Your answer (or type 'exit' to quit):</pre>
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4.Conclusion:

This project provided hands-on experience with key concepts in computer networking, focusing on protocols, troubleshooting tools, and socket programming.

In the first task, we used network tools like ping, tracert, and nslookup to explore how networks operate and diagnose issues. Wireshark allowed us to capture and analyze DNS traffic, giving us insight into real-world data exchange.

The second task involved building a simple TCP-based web server. This task taught us how to handle HTTP requests, manage files, and respond to client actions, including challenges like debugging file paths.

The third task focused on creating a UDP-based trivia game, where we applied real-time communication and multi-client interactions. This task highlighted the importance of clear protocols and teamwork.

"الرحمة والخلود للشهداء لمن هم أكرم منا جميما ، والشفاء العاجل لكل الجرحي"