Windows Server 2022 Virtualization & Network Infrastructure Project
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OPERATING SYSTEM VIRTUALIZATION AND COMPUTER ARCHITECTURE RESEARCH PART 1

Project Introduction

The focus of this project is to create two new virtual machines(Microsoft Windows Server 2022) for Digitech, acting as the assistant of the Network Administrator. One VM will act as a DNS server which handles the name resolution and the other will be purely built to serve as a Web server which hosts a basic one-page website for the network. The report aims to show the fully functional server connection between the two servers through IP configurations, rename of the servers, and the network connectivity testing.

Hypothetical case: I'm the assistant to the Network Administrator of a busy product services company called DigiTech. I'm required to build a fully operational Server that will be running as a DNS Server for the Network and another VM to be the Web Server for the network.

Part 1: Installing the network and setting up the network infrastructure

Installing and setting up virtual machines:

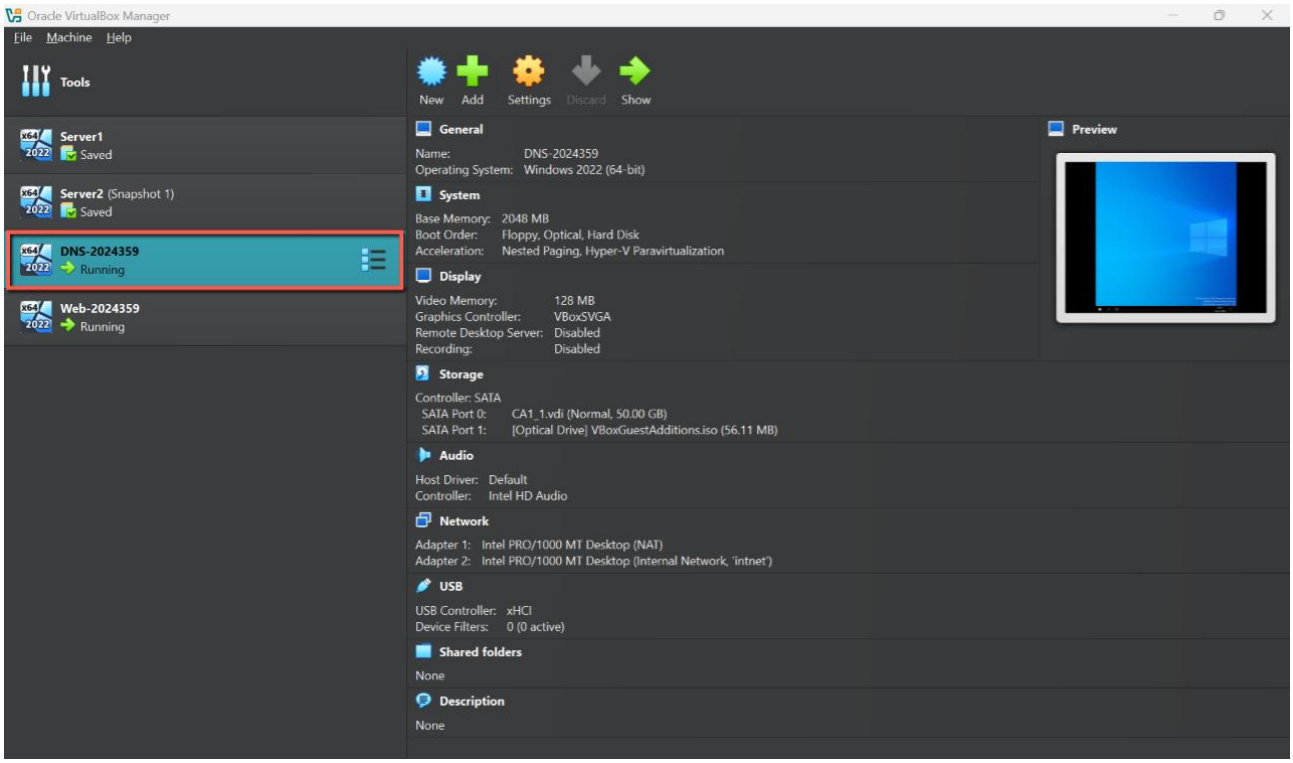

Fig. 2: Installation of DNS Server Virtual Machine

Fig. 3: Running the DNS-2024359 machine

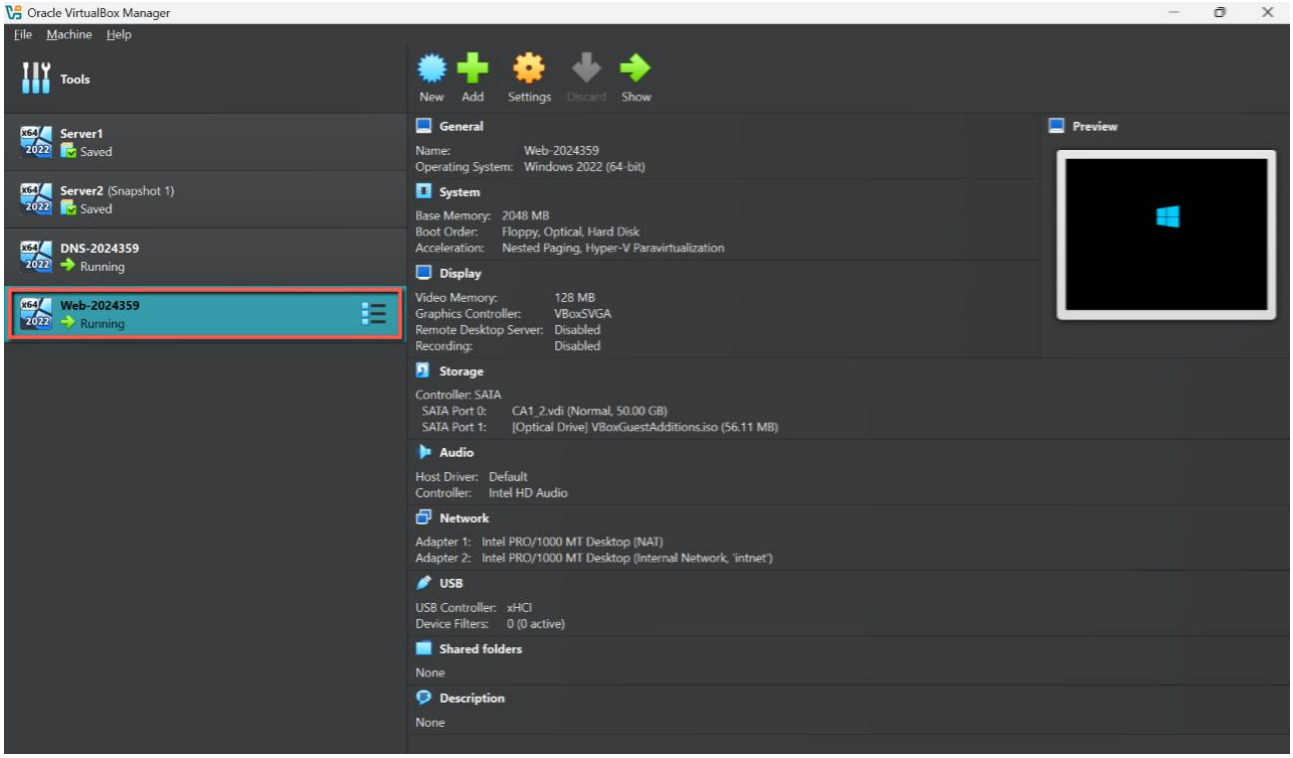

Fig. 4: Installation of Web Server Virtual machine

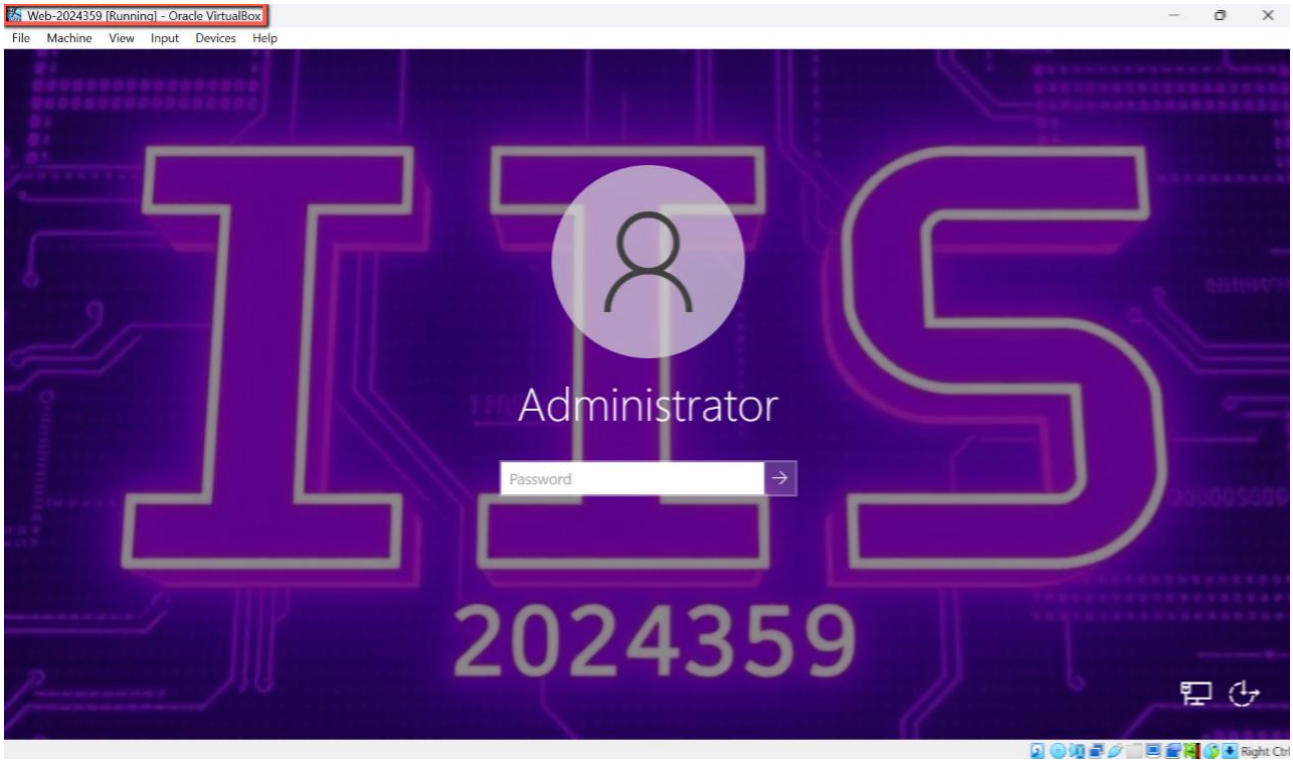

Fig. 5: Running the Web-2024359 Machine

Note: For the first machine, I named the machine DNS-2024359 and for the other machine Web-2024359.For the network settings, I changed the network adapter settings to NAT for the adapter 1 and Internal network for the adapter 2.

Renaming the servers:

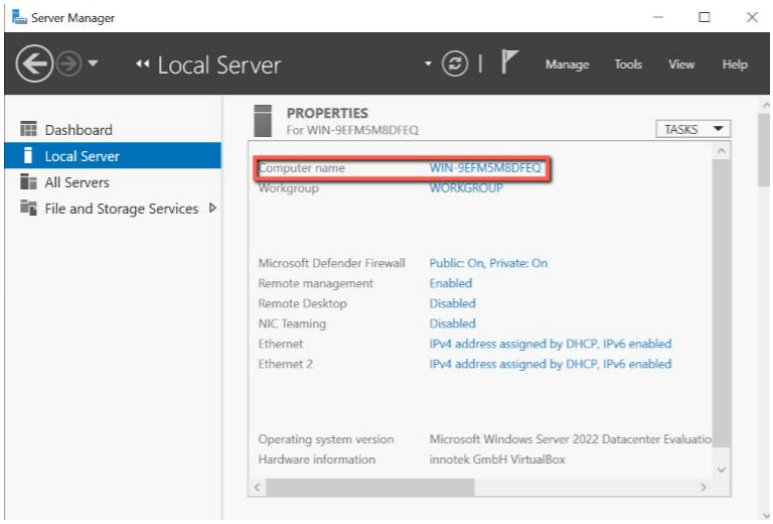

Fig. 6: DNS server before renaming on Windows Server Manager

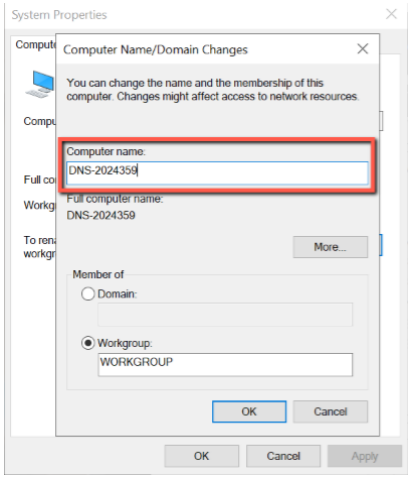

Fig. 7: Renaming the first server DNS-2024359 using Windows Server Manager

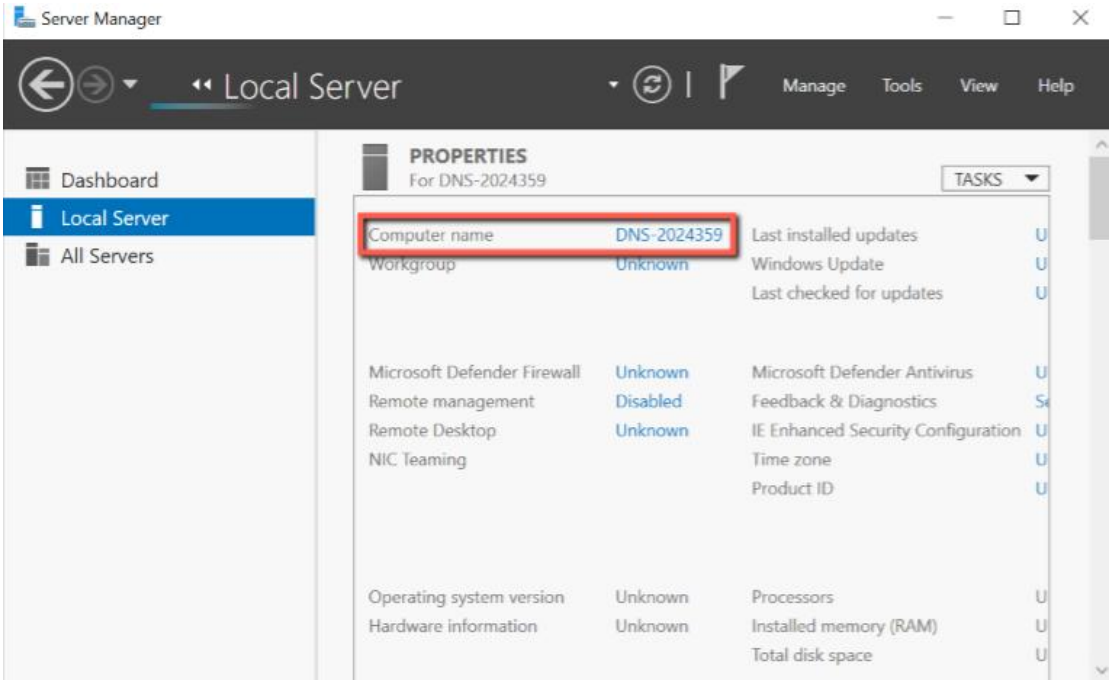

Fig. 8: After the renaming the first server on Windows Server Manager

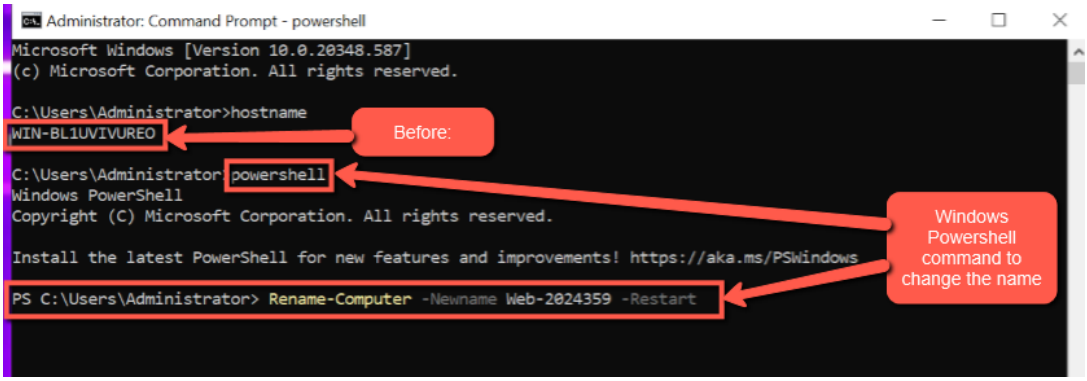

Fig. 9: Renaming the second server on Windows PowerShell

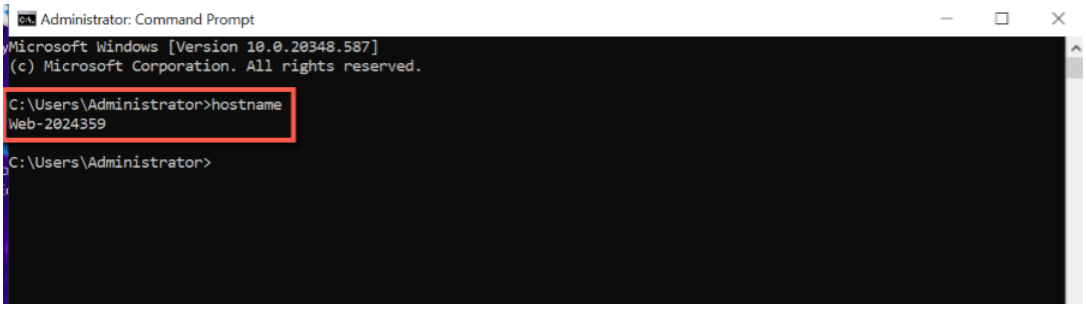

Fig. 10: After renaming the second server on Windows PowerShell

Assigning the server static IP address:

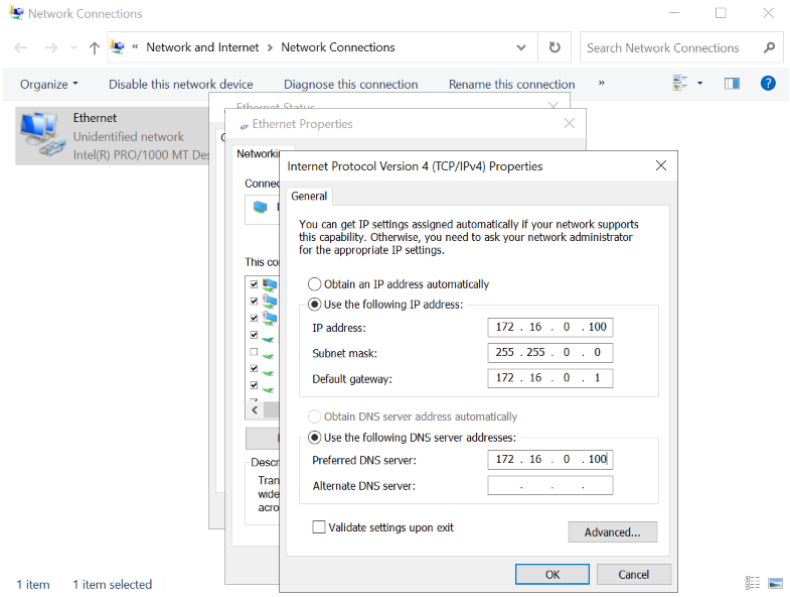

Fig. 11: Assigning the given IP address for the DNS server

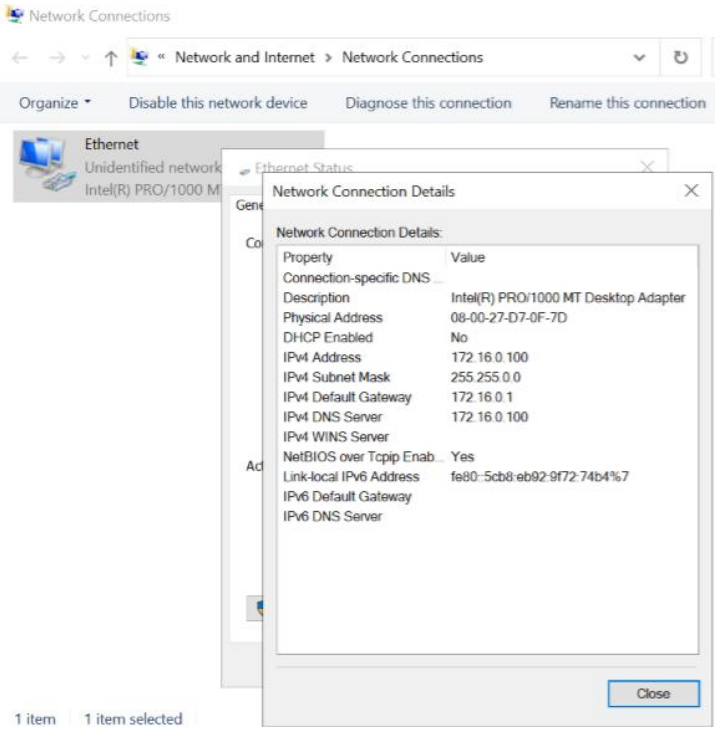

Fig. 12: After assigning the IP address for the DNS server

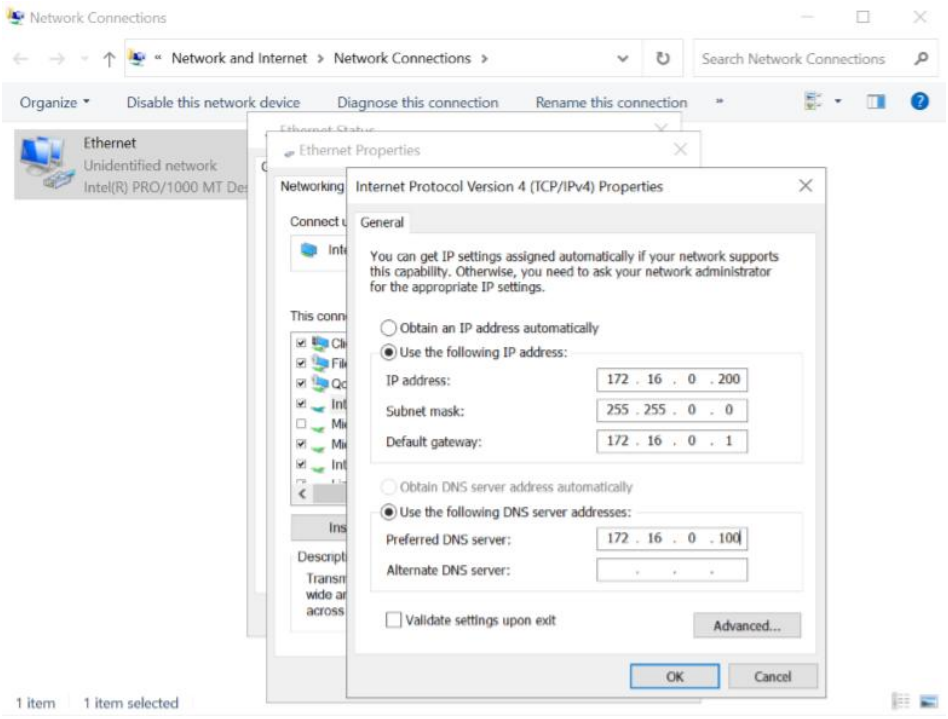

Fig. 13: Assigning the given IP address for the Web server

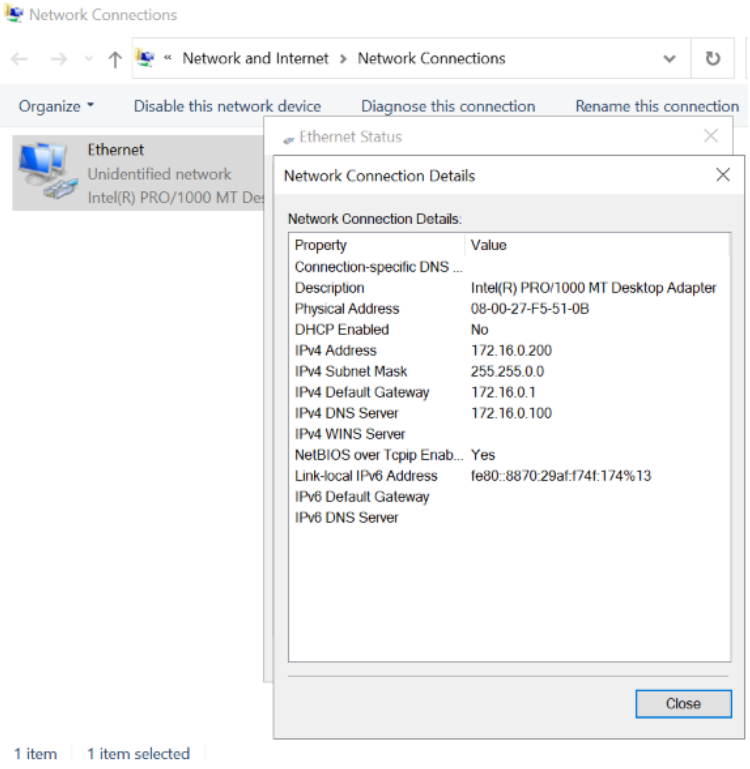

Fig. 14: After assigning the IP address for the Web server

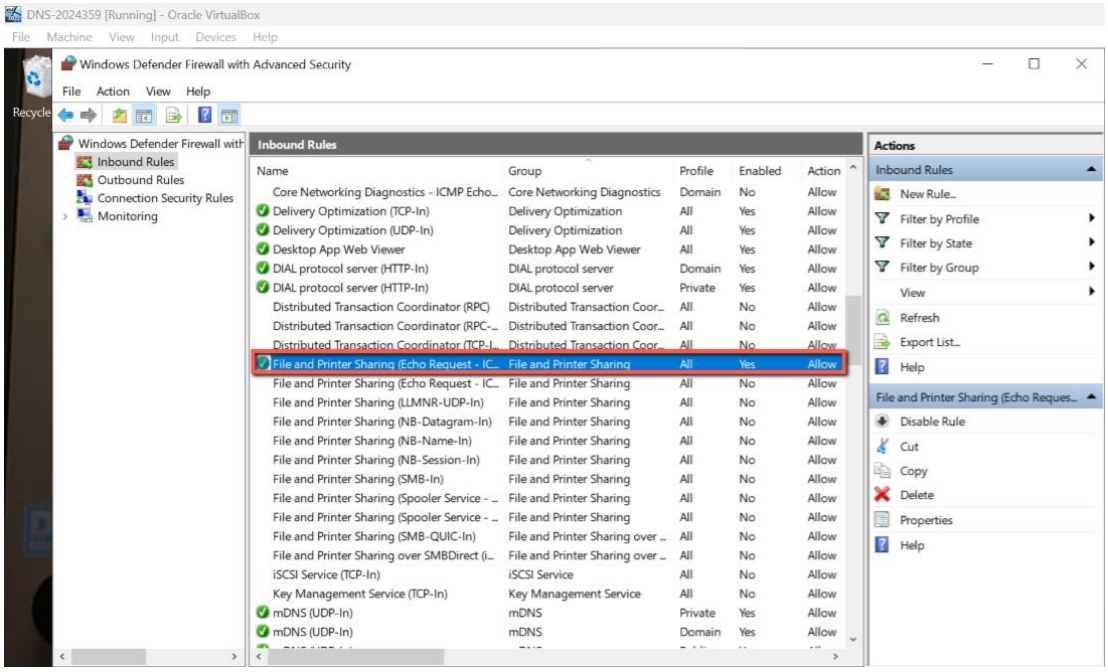

Fig. 15: Enabling the File and Printer Sharing(Echo Request – ICMPv4-In) on Firewall for the DNS server

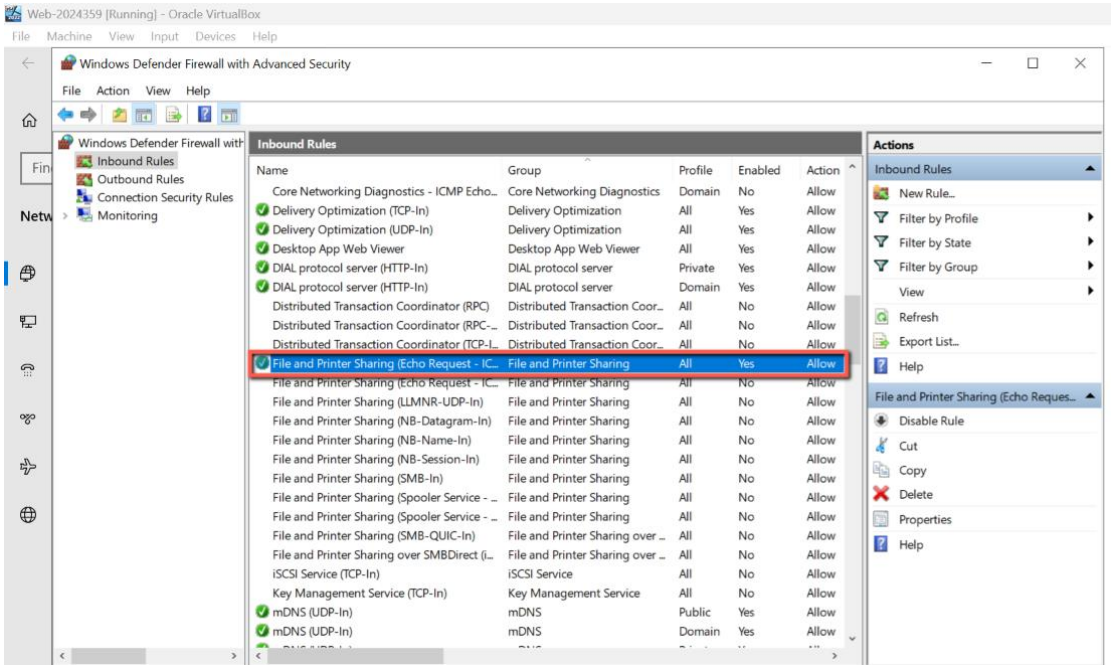

Fig. 16: Enabling the File and Printer Sharing(Echo Request – ICMPv4-In) on Firewall for the Web server

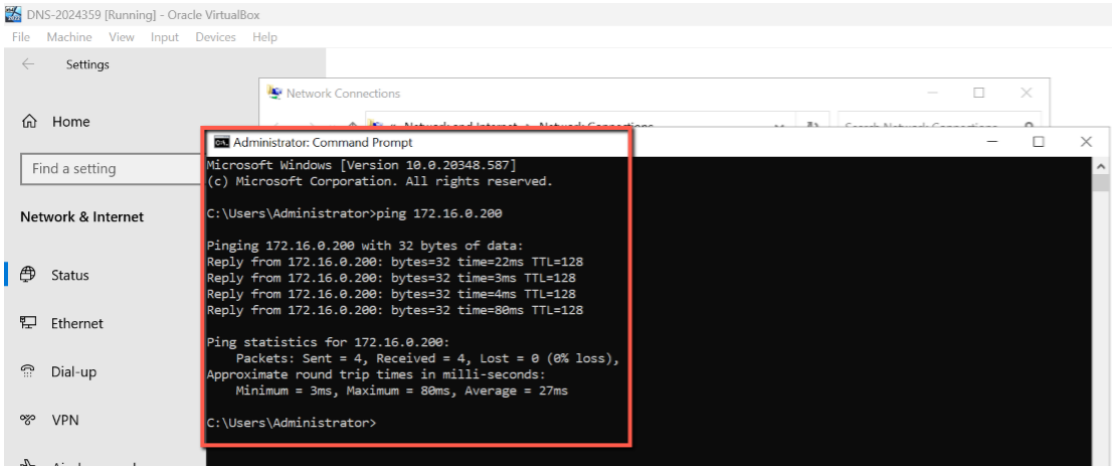

Fig. 17: Pinging Web server(172.16.0.200) on DNS server

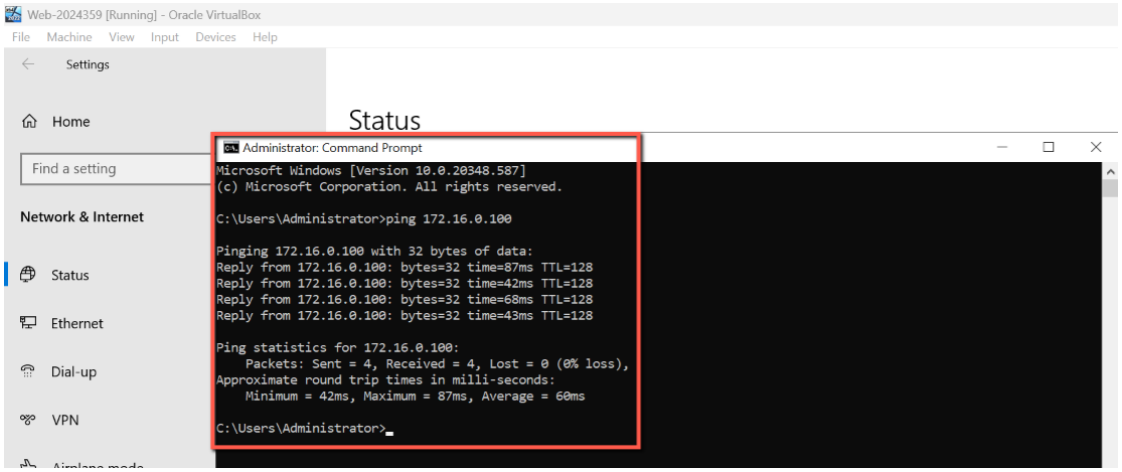

Fig. 18: Pinging DNS server(172.16.0.100) on Web server

Part 2: Setting up and testing a simple web site

Installation of 2 servers:

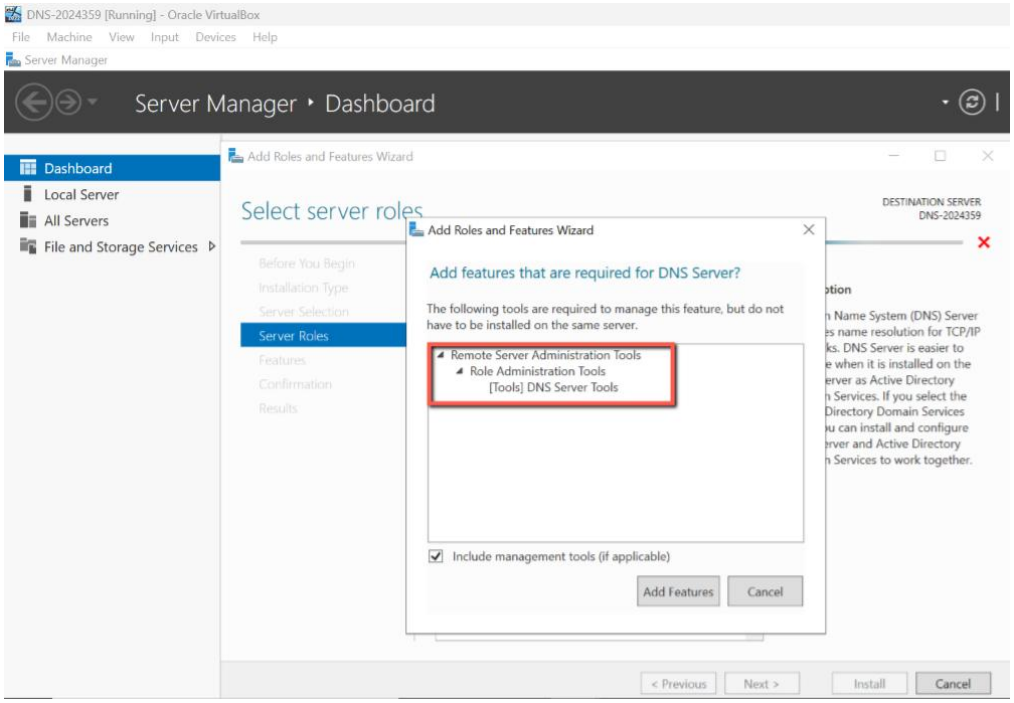

Fig. 19: Adding roles and features of DNS server on Server Manager

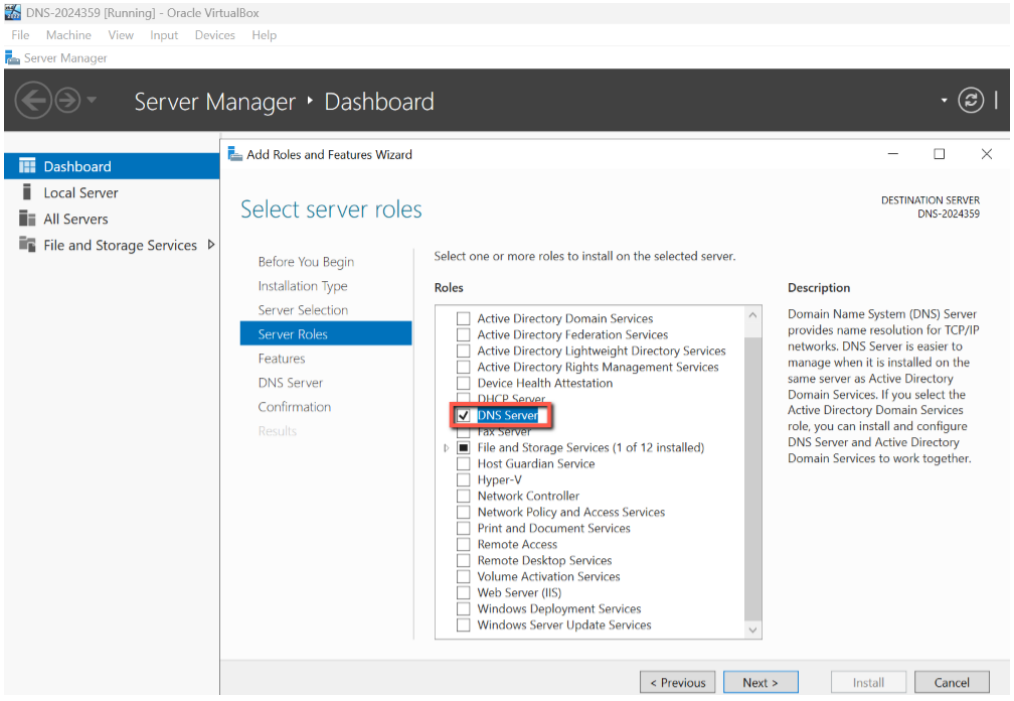

Fig. 20: Installing DNS server on Server Manager for DNS-2024359

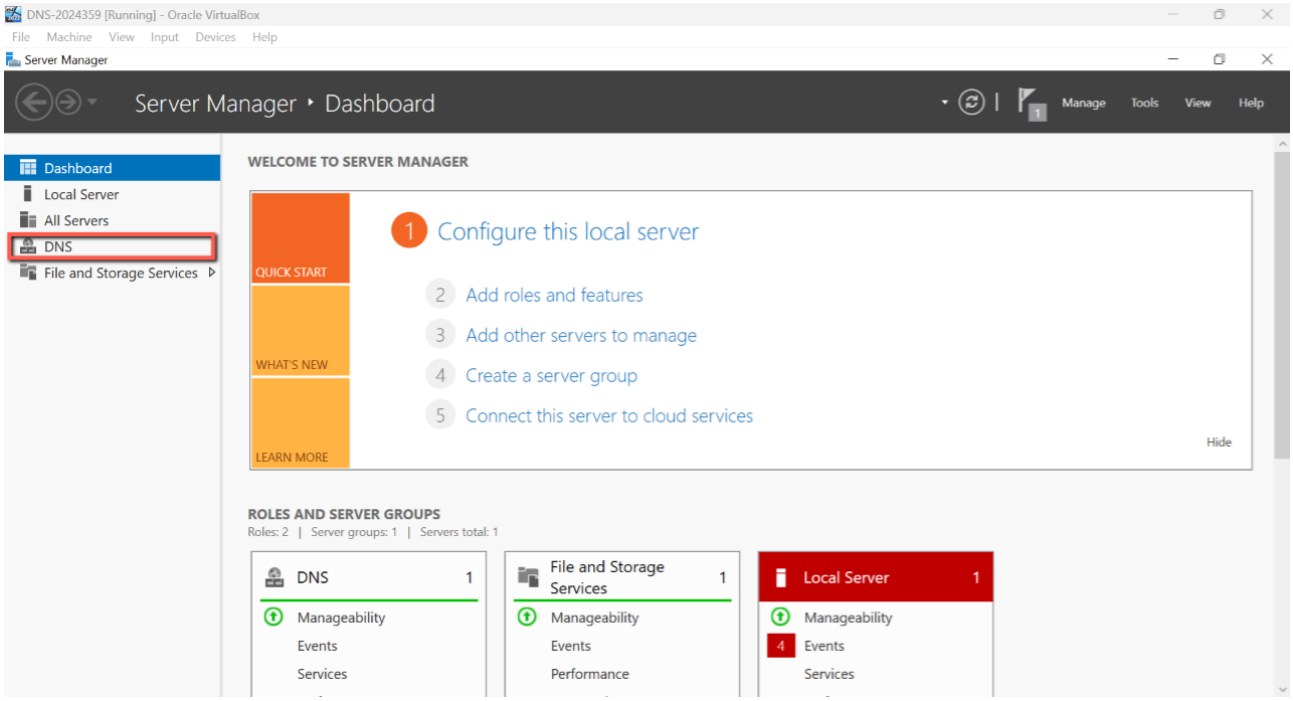

Fig. 21: The installed DNS server on DNS-2024359

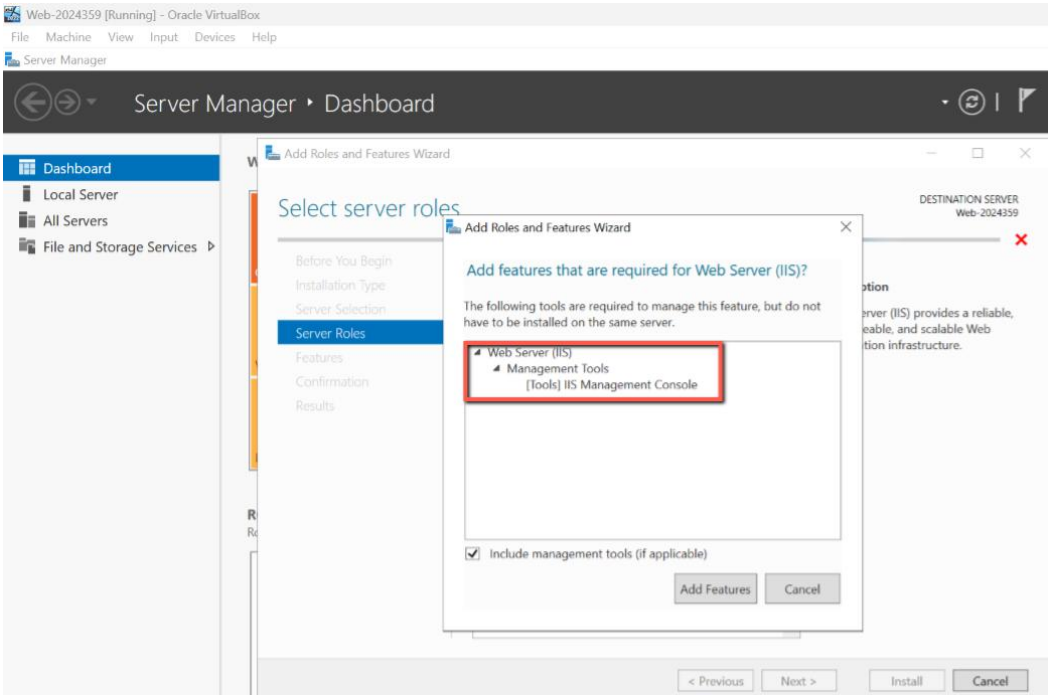

Fig. 22: Adding roles and features of Web server on Server Manager

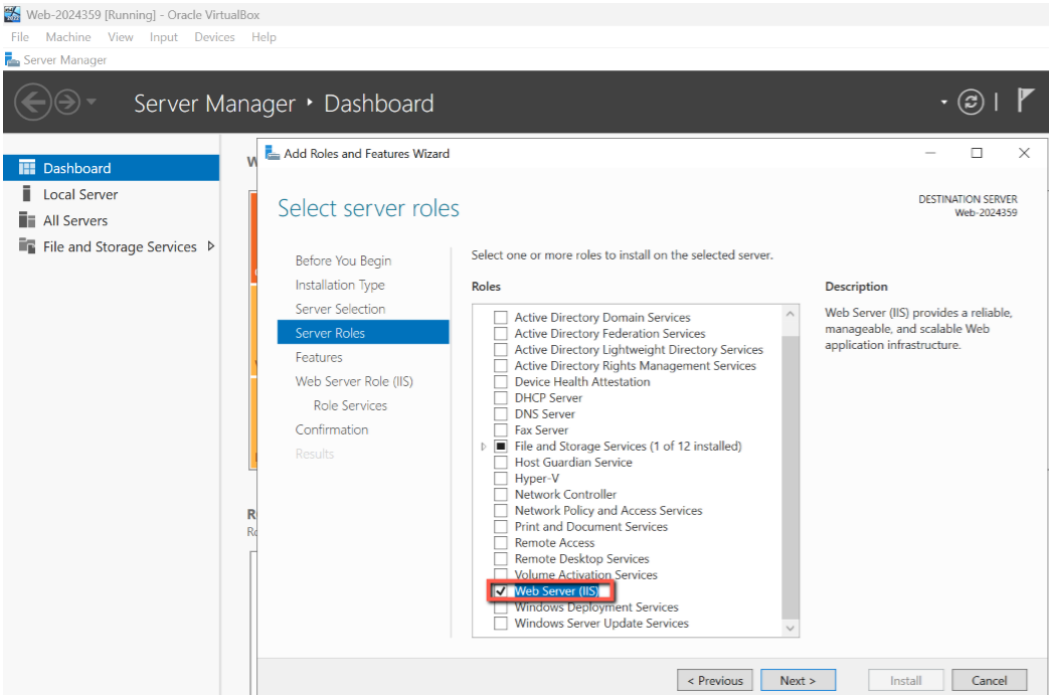

Fig. 23: Installing IIS Web server on Server manager for Web-2024359

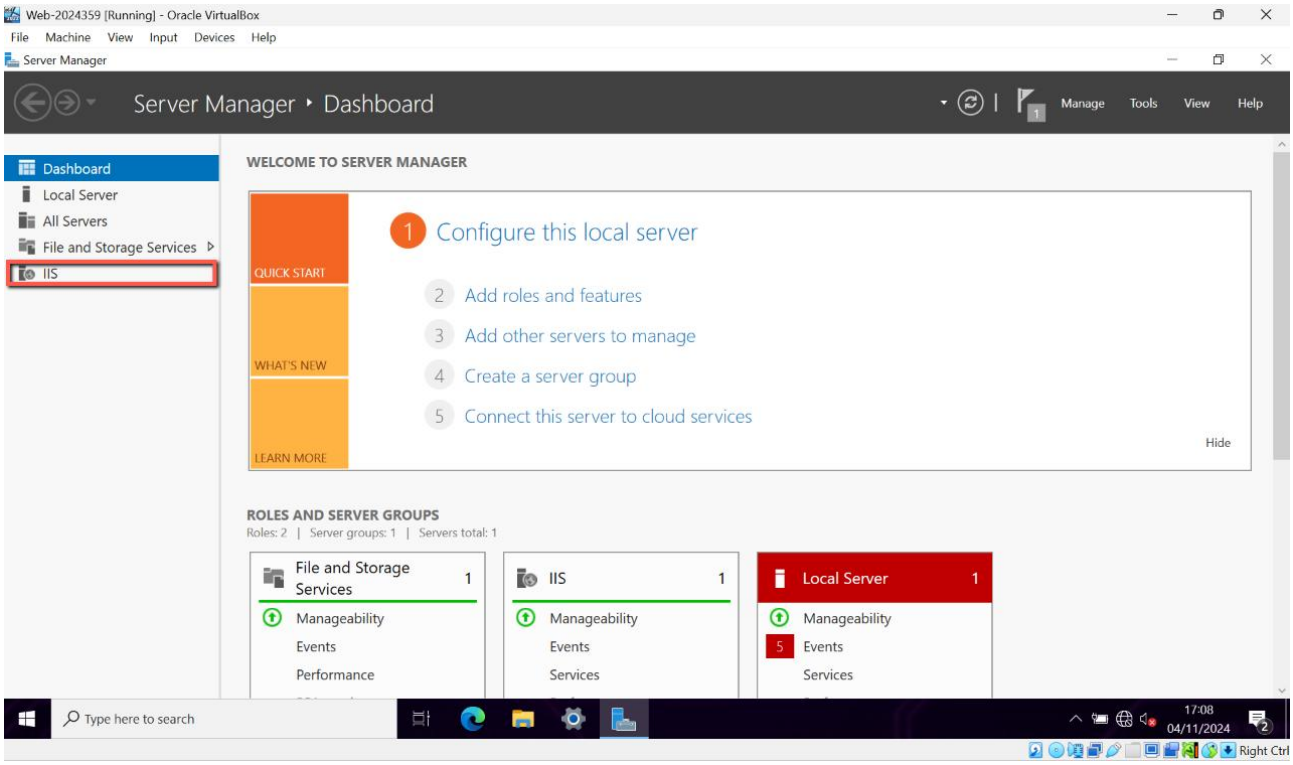

Fig. 24: The installed DNS server on Web-2024359

Creating a landing page Website for Digitech.abc company:

index - Notepad

File Edit Format View Help

```
        #Construction img {
            max-width: 70%; /* Adjust this value for size */
            border-radius: 5px;
        }

        /* Hover Effect for Neon Glow */
        #Digitech:hover, #Construction:hover {
            box-shadow: 0 0 20px rgba(255, 255, 255, 0.5), 0 0 60px rgba(0, 224, 255, 0.5);
        }
    </style>
</head>

<body>
    <div class="container">
        <!-- Digitech Box -->
        <div id="Digitech">
            <h1>Welcome to Digitech!</h1>
            <h3>Bringing Digital Technologies to an Analog World</h3>
            <h3>Student Name: Egshiglen Enkhbayar</h3>
            <h3>Student Number: 2024359</h3>
            <img src="images/digitech_create.jpg" alt="Digitech Logo">
        </div>

        <!-- Under Construction Box -->
        <div id="Construction">
            <img src="images/underconstruction.jpg" alt="Under Construction Image">
        </div>
    </div>
</body>
</html>
```

Fig. 25: Modifying the sample webpage on notepad (html)

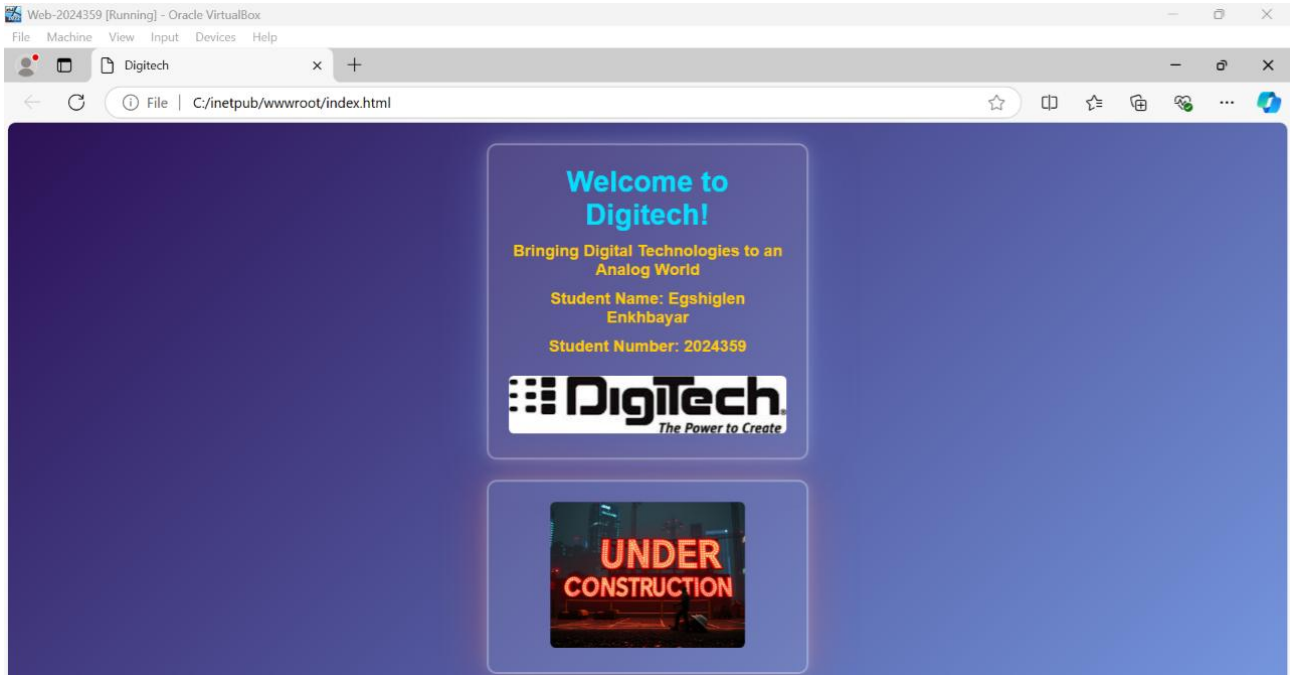

Fig. 26: Creating a webpage for Digitech with my name and student number

Displaying the DigiTech website:

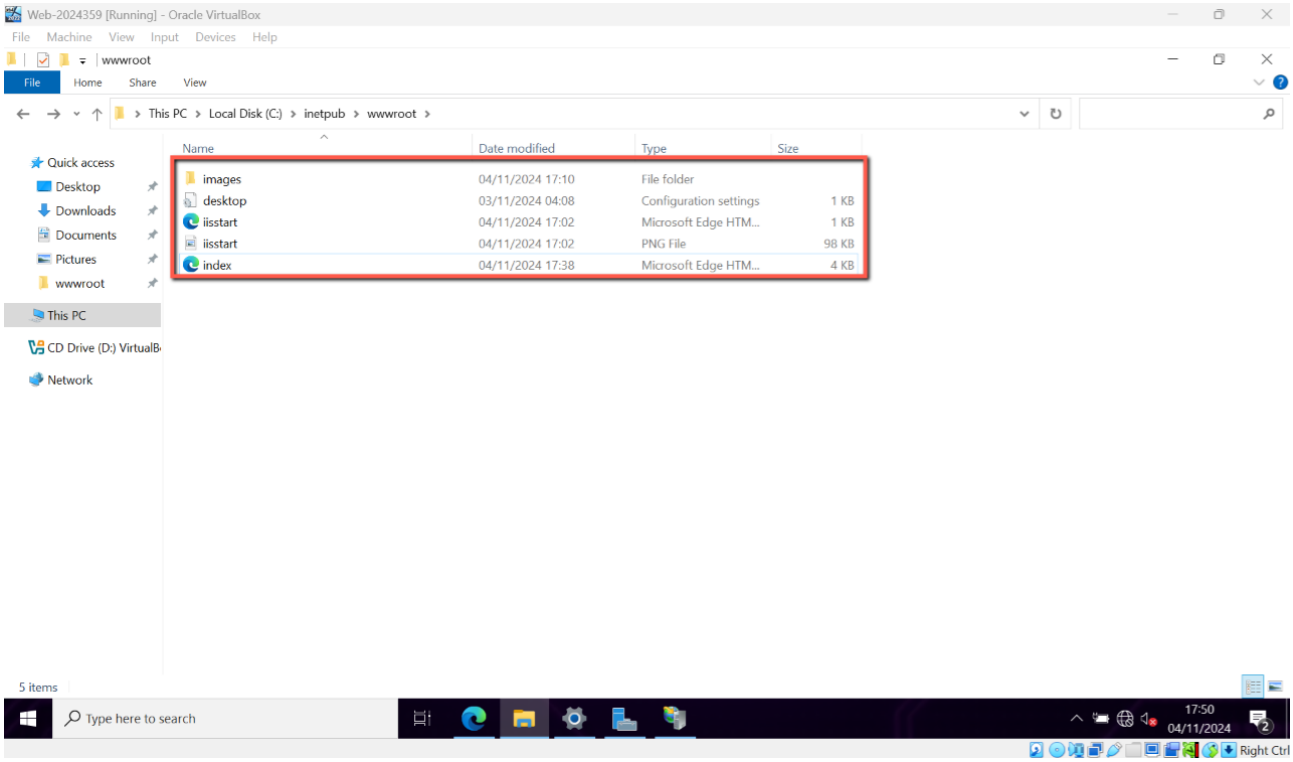

Fig. 27: Copying the modified webpage files to wwwroot on inetpub

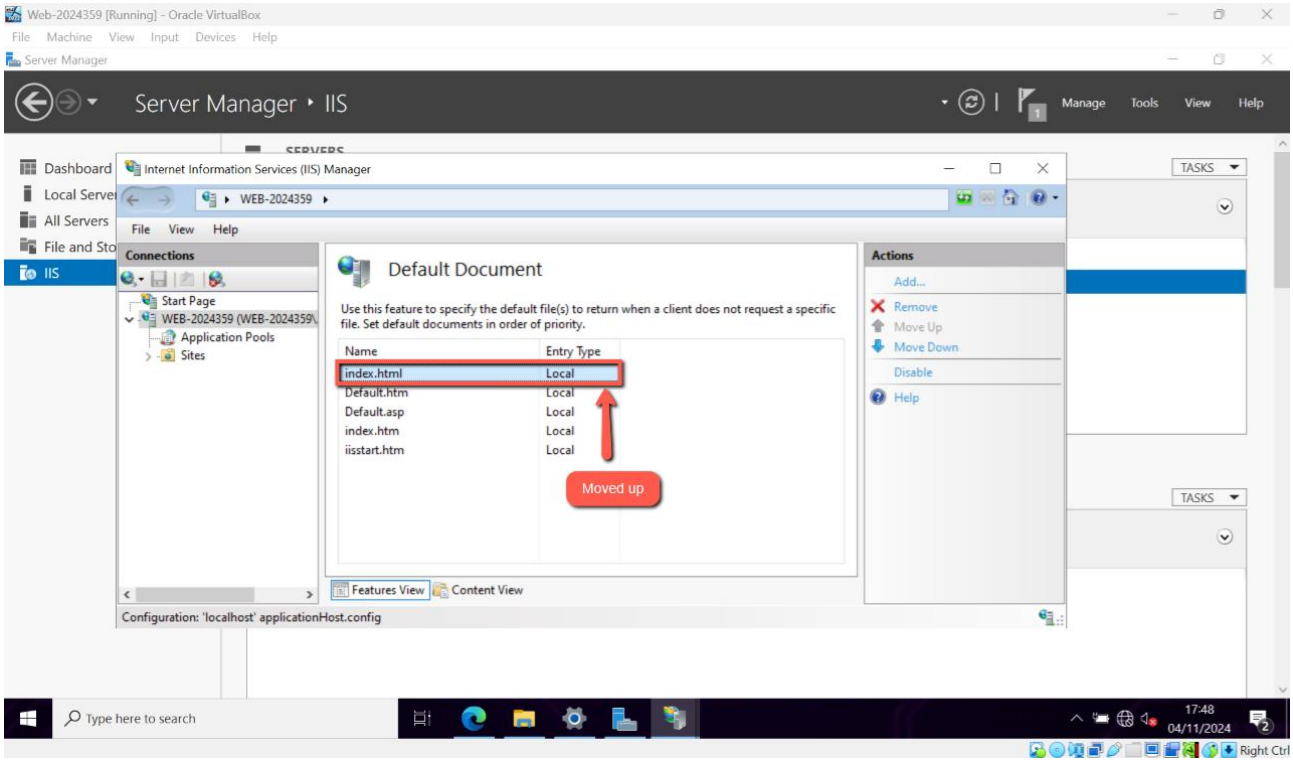

Fig. 28: Moving up index.html on Server Manager, IIS tools, and Default document

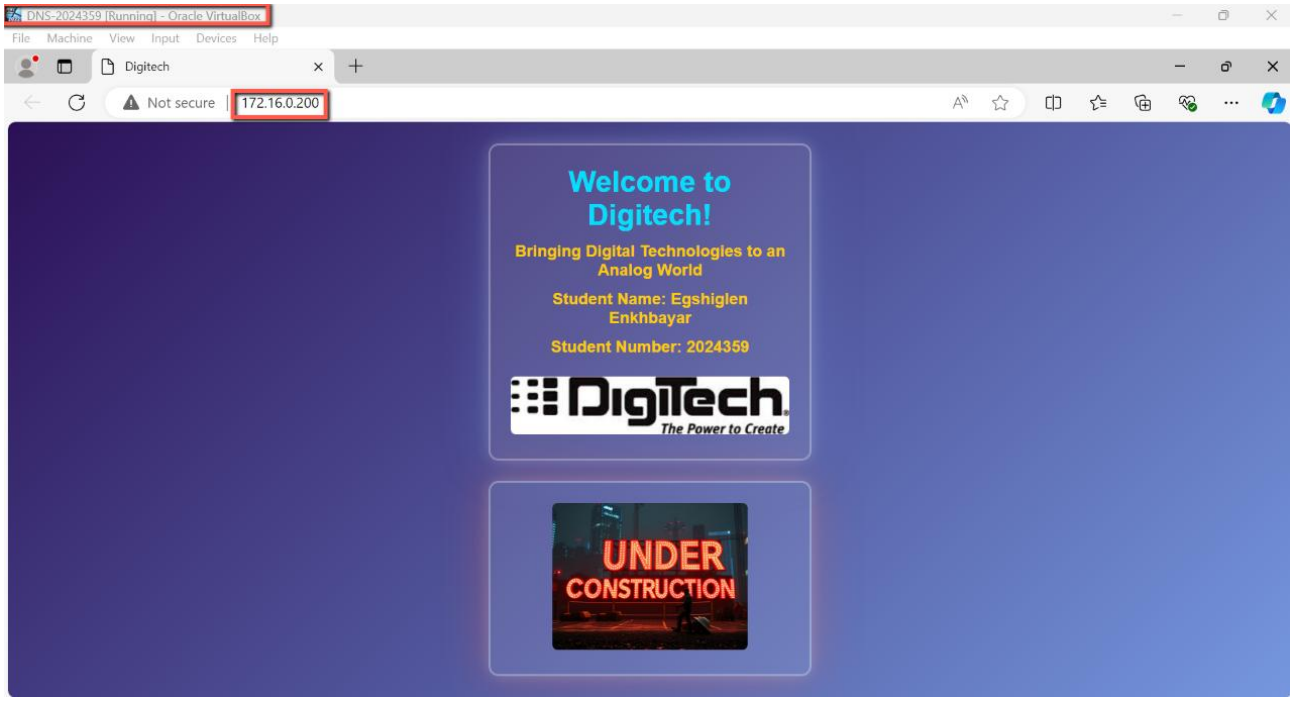

Fig. 29: Testing if the website works on DNS server by IP address (172.16.0.200)

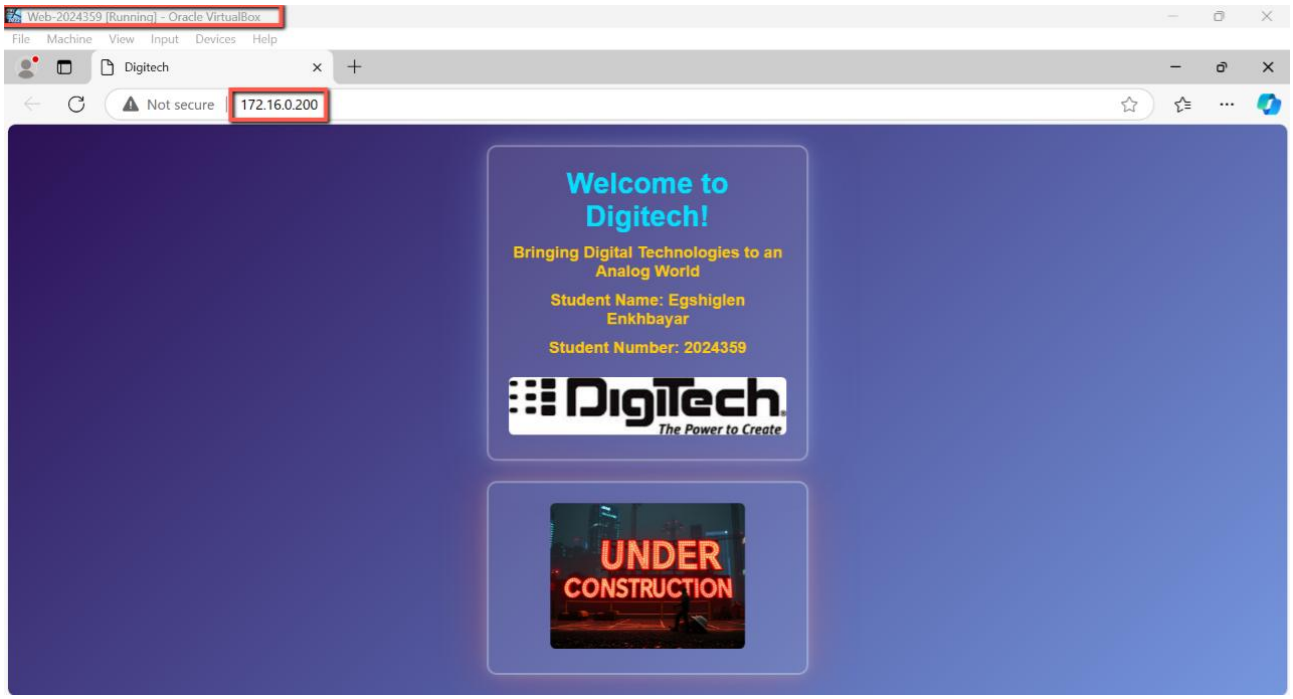

Fig. 30: Testing if the website works on Web server by IP address (172.16.0.200)

Setting up a domain name for the website on DNS server:

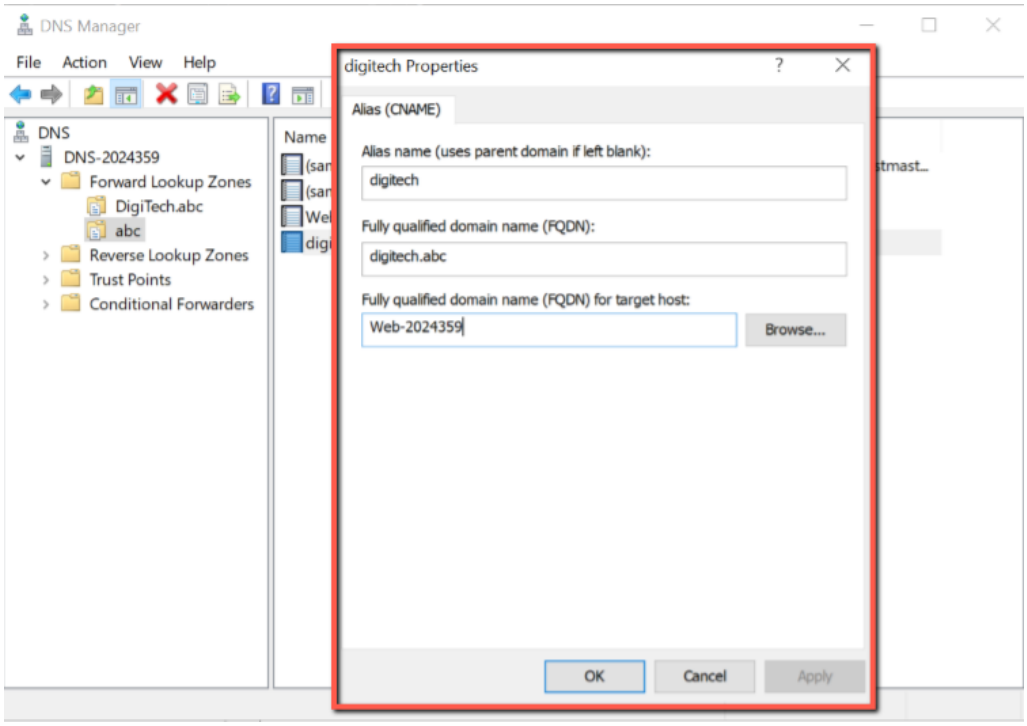

Fig. 31: Adding and setting up an Alias(CNAME) as digitech for Web-2024359 host

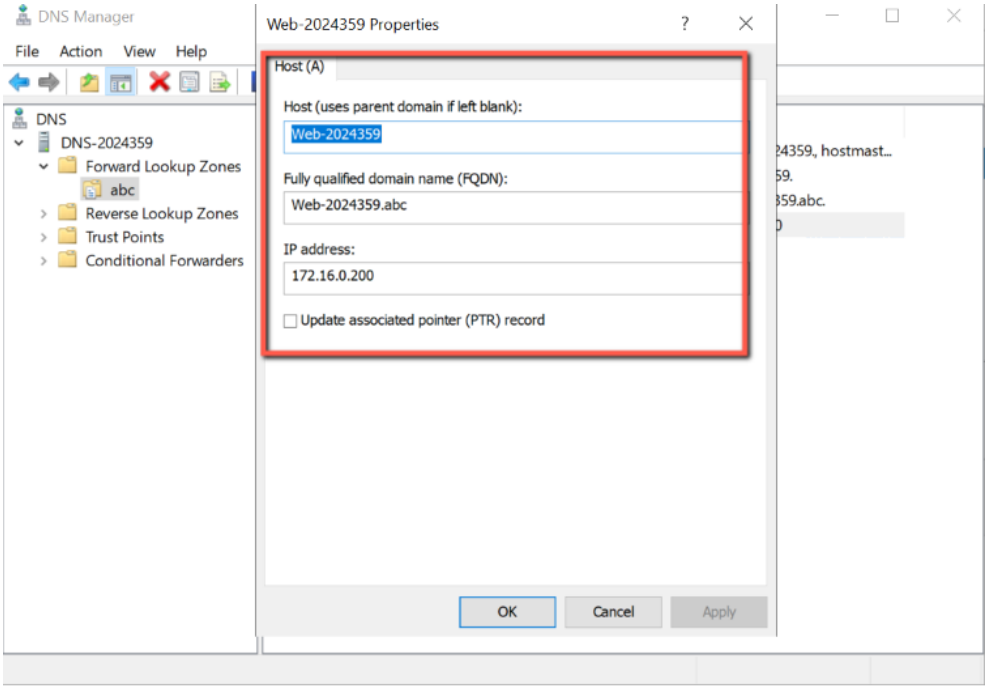

Fig. 32: Adding and setting up a new Host(A) name (Web-2024359) for Web server IP address on DNS Server Manager

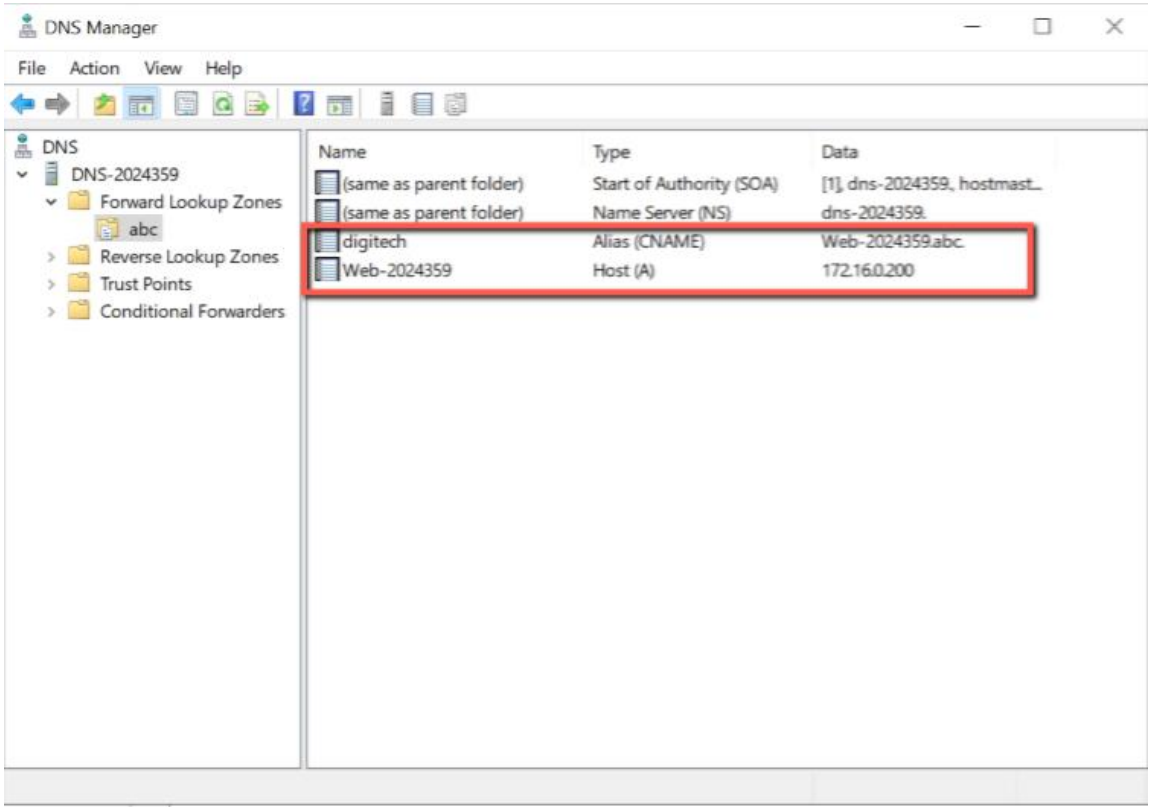

Fig. 33: DNS domain name set up

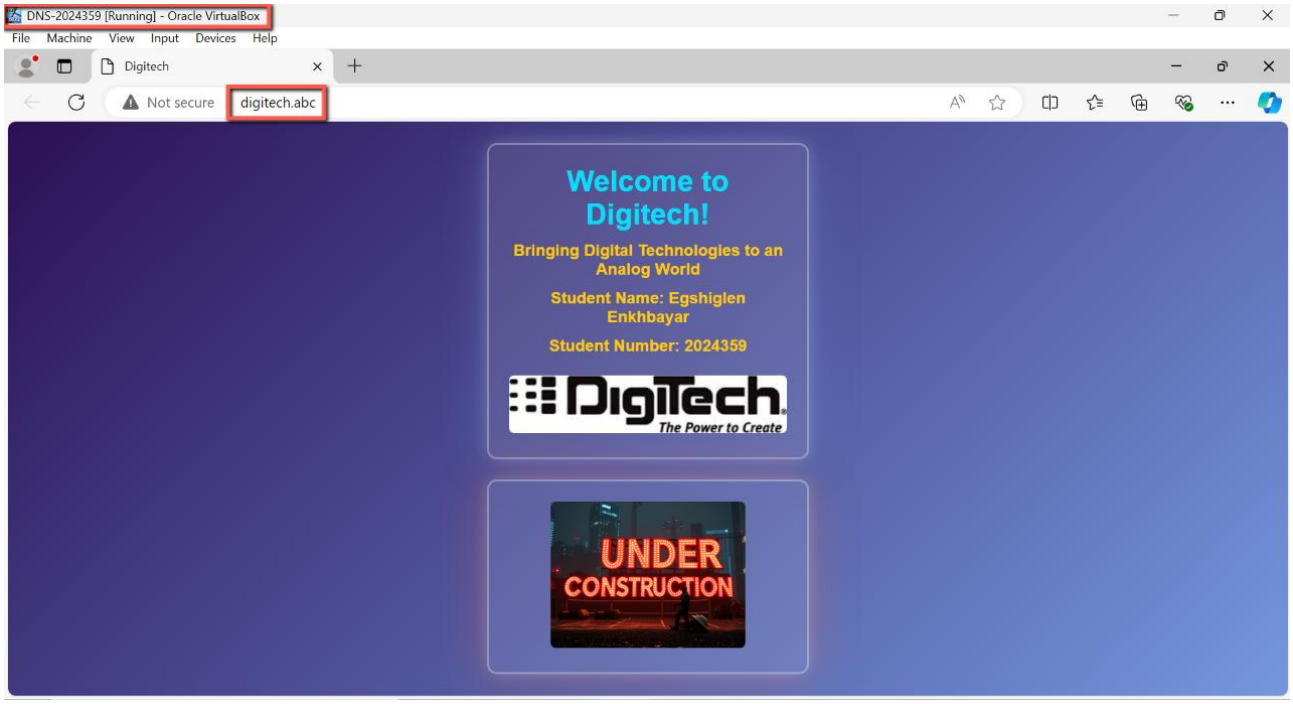

Fig. 34: Testing digitech.abc website on DNS server web browser

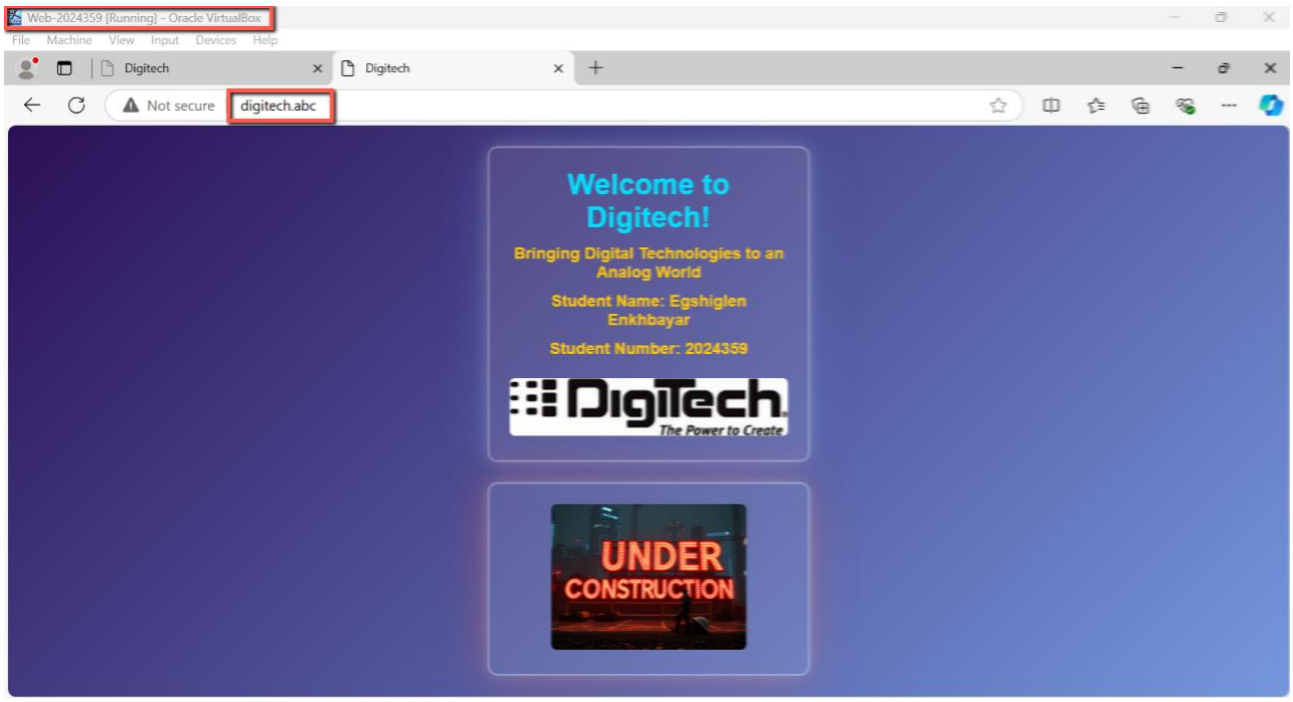

Fig. 35: Testing digitech.abc website on Web server web browser

Part 3: Research topics: Describe a wide range of key micro and macro computer architectures.

Introduction and overview:

In our OS and architecture class, we've been extending our knowledge from small computer architectures to large-scale computing devices such as Mainframes or supercomputers. This report aims to explore the more detailed and academic discoveries based on literature researches.

1. The Evolution of Modern Computers and the invention of transistor

Introduction: Evolution of modern computers

The evolution of modern computers has been on an outstanding journey throughout these last 75 years. It affected us in every way possible. When we go to work, or school, and even interact with each other, this progression has transformed our entire world into much better and advanced version. From a simple mechanical calculator to the powerful computers that we use now, we have undergone through a great developments over the years and yet to explore greater advancements in the future (Kakad et al., 2023).

Pre-Computer Era: The foundation of Computation

In the early age, humans had been dependent on various methods for calculation and information management and it all starts with Abacus which was invented in ancient Mesopotamia or Egypt around 2000 BCE. It's mostly used in China, Greece, Rome, and India. Abacus has such a simple operation of counting for arithmetic calculations. It was one of the earliest computational invention and consisted of a frame with beads strung on wires. In addition, other tools such as slide rule for mathematical computations or astrolabe for astronomical calculations had significant roles. Other examples such as Napier's bones which are a set of manually-operated calculation devices, Pascaline or Stepped Reckoner which are the earliest mechanical calculators had played an important roles on the development of computation (Singh and Singh, 2024).

First Generation Computers (1940 – 1956): Electronic Computation

First Generation Computers replaced human computation with electronic processing. Early computers in this era heavily depended on vacuum tubes as their primary electronic components. The common disadvantages were that vacuum tubes were slow and easily overheated, yet it helped to perform complex calculations at remarkably exceptional speed. According to Chen et al (2024), vacuum tubes has the ability to enhance signals without any distortion and it helped to make it possible for radios or televisions to receive or transmit electronic signal. After that first electronic general-purpose computer called "ENIAC" or "the Electronic Numerical Integrator and Computer" had been introduced and it could perform 400 multiplications or 5000 additions per second solely depending on 18000 vacuum tubes. Additionally the computing speed of ENIAC was 1000 times faster than the mechanical computers. On the other hand, traditional tubes rely on thermal cathodes for thermionic emission that can cause high power usage, large volume, short lifespan, and difficulty in integration. Originally, ENIAC was designed for military reasons but later adjusted to scientific and engineering purposes. The first commercial computer was called The Universal Automatic Computer (UNIVAC) and served for business data processing.

Second Generation Computers (1956 0 1963): The Transistor Era

The invention of transistors initiated a new era of computing. Basically, it was a replacement for vacuum tubes and the benefits were that transistor was faster, smaller, and more reliable. As mentioned in Harvard Technology Review by Balderas (2024), a transistor is a tiny electronic switch which can be turned on and off and it's the fundamental building blocks of modern computers and controls the flow of electricity. It's

recognized as the most impactful invention of human history. Since the invention in 1947, it's calculated that 13 sextillion transistors have been created. These transistors were used in computer chips to execute a variety of functions. However, Moore's law states that on integrated circuit the transistors' number will double about every two years. Transistors exponentially reduced the size and power usage of computers that led to more efficient and compact systems. Second-generation computers had improved speed, reliability, and efficiency compared to first-generation computers and they would perform calculations with fewer errors and much faster speed. We also can't leave FORTRAN and COBOL for their contribution to the development of programming languages. They made computers more accessible and easy to use because of the English-like statements.

Third Generation Computers (1964 - 1971): The Integrated Circuit

The Integrated Circuit Era transformed the computer hardware and they're tiny chips which are capable of holding multiple transistors. ICs decreased the size and power usage in computer and increased the processing speed and reliability even more. The invention of ICs led to the development of Operating system which is the bridge between hardware and users. Early operating system such as IBM's OS/360 had memory management capabilities, efficient system, and multitasking ability. Minicomputers were affordable, smaller, and more flexible compared to mainframe computers. Minicomputers were for more personal use and mainframes were helping large organizations to manage their data processing on much bigger scale which turned into the foundation of modern enterprise computing.

Fourth Generation Computers (1971 - 1980) : The Microprocessor Revolution

In 1971, the microprocessor was invented by Intel and it shocked the computing industry by its low power consumption, faster processing speed, and compact size which all of these painted the way to the development of personal computers and embedded systems. PC or modern solid-state computers typically use solid-state drives (SSDs) that stores data on flash memory tiny chips. Even though early PCs had its limitations, pioneers like Apple II or Altair 8800 paved the way for the PC revolution. PC enabled every individual to have the access to communication tools, information, and entertainment which in the end led to boost human creativity and innovation.

2. The architecture and usage of the Raspberry Pi and Arduino computing platforms

Raspberry Pi computing platform

Raspberry Pi (low-cost, credit-card-sized computer) was created by Eben Upton, Rob Mullins, Jack Lang, and Alan Mycroft in 2009 in the United Kingdom, which is also called the Raspberry Pi foundation (Martinez-Gonzalez et al., 2017).The purpose of this creation was to promote computer science teachings into elementary school students. It's a Broadcom system-on-chip device which consists of a 700 MHz processor, 512 megabytes of RAM and a graphics processor unit. It's a computer-based development board that usually runs on Linux alluded to Raspbian Linux. However, it has various OS support including Linux, Windows, and Android. It's programmable by using languages like Python, C++, and Java. It has the ability to work and be connected to a keyboard, mouse, and screen perform computing functions. For the architectural part, Raspberry Pi contains four USB ports, Ethernet port, 32-bit processor, CSI camera connector, HDMI port, Audio port,, micro SD card slot, and 40 general-purpose I/O (Ooko, 2019). It has different models like Model 2 falls short of embedded Wi-Fi but has to use Wi-Fi adapter via the USB port to get connected through internet. However, the newer models such as Raspberry Pi 3 hold Wi-Fi module making it easier to use internet. Latest models hold a feature like 64-bit quad-core processor that offers improved performance. The main usage is that it supports hardware add-ons, such as cameras, sensors, and displays and other gadgets to browse, host applications, gaming and other PC-like tasks (Oliynyk, 2024).

Arduino computing platform

Arduino (open-source hardware and software platform) started its journey on 2005 as a project for students at the Interaction Design Institute Ivrea (Martinez-Gonzalez et al., 2017). Arduino is based on a simple microcontroller board and a development environment for writing software on board. It has 8-bit microcontroller development board that consists of a USB programming interface for connection to computer and additional connection sockets to external electronics such as sensors, motor speakers, and diodes. The board design of Arduino is open-source and additionally has an open-source IDE that has a debugger, a cross-compiler, and a serial monitor for controlling the I/O. It can either be powered by USB from computer, 9V battery, or a power supply. The input pins are exclusively digital from 0 to 13 or analogue from A0 to A5, as outputs are solely digital from 0 to 13 (Ooko, 2019). As I've introduced that Arduino has 8-bit microcontrollers, there are other ones which use 32-bit Atmel ARM processors. Arduino board is now used for mainly interactive electronic projects and suitable for prototyping and DIY electronics projects (Oliynyk, 2024).

Feature	Arduino	Raspberry Pi
Developer	Arduino Foundation	Raspberry Pi foundation
Type	Microcontroller	Mini computer
Operating System	None	Linux
CPU	Atmel, ARM, Intel	ARM Cortex – A72
Clock speed	16 MHz	1.2 GHz
Memory	32KN	1GB – 4 GB
Storage	1KB	MicroSDHC slot
Power	USB, Battery, Power supply	USB, Power supply
Operating voltage	5V	5V
I/O connectivity	SPI, I2C, UART, GPIO	GPIO, SPI, I2C, UART

3. Seymour Cray is known as the ‘father of the supercomputer’. Perform research and discuss Seymour Cray’s contribution to computer science. You will find that Mainframe computers were the first computers that we had before there were microcomputers such as PCs and Laptops and today they are the most powerful computers that people use. Research and discuss what contributions Seymour Cray made to development of Mainframe computers. Be sure to list at least three different things that Mr Cray developed that contributed to advancing computer technology. In other words, three major innovations that he developed to make computers faster and more efficient. In your discussion be sure to explain what parallel processing is and get examples of how parallel processing is used to enhance the performance of modern computing systems. Provide examples with all your explanations.

4. Perform Research and explore the architectures and uses of modern Mainframe computers: Discuss how modern mainframes and supercomputers are being used in modern society today. Be sure to include a discussion of which Operating Systems that they use. Also provide at least three examples of different applications and uses of these very powerful computers. Finally, complete this discussion by exploring if Ireland has any mainframe computers and where they are located.

Final Task: Your final task for this assignment is to provide a Student Reflection. A Student Reflection is the part of the assignment where you tell me what you learned while researching this assignment. Express what you learned from this assignment. Finally, how do you think this new knowledge would help you when you graduate from the college and are applying for jobs in the IT workforce?

Singh, A.J. and Singh, A.P., 2024. *Evolution of Information Technology: A Comprehensive Review*. Asian Journal of Current Research, 9(4), pp.78-90. Article no. AJOCR.12303.

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Balderas, A., 2024. *Transistors on the Edge: The Quest for Energy-Efficient Computing*. Harvard Technology Review, 22 April. Information and Media.

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