

PILOT SETUP AND DEPLOYMENT

D23 (PROTOTYPE)

IDEALVis Consortium

<http://idealvis.inspirecenter.org/>



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**ΙΔΡΥΜΑ
ΕΡΕΥΝΑΣ ΚΑΙ
ΚΑΙΝΟΤΟΜΙΑΣ**

Executive Summary

This deliverable presents the deployment documentation of the IDEALVis platform which demonstrates all the necessary steps required to setup IDEALVis in a secure cloud environment. The provided documentation steps aim to thoroughly explain the process of how to set up the online server environment and required services on the cloud using Microsoft Azure. More specifically, this documentation provides guidance on (i) how to create a Windows Server virtual machine instance on Microsoft Azure, (ii) how to install and setup the web server using IIS (Internet Information Services) and other useful tools for deployment, (iii) how to create an Azure SQL Server and further setup the required platform database, and finally (iv) how to deploy the IDEALVis platform on the virtual machine instance. All setup and security practices demonstrated in this deliverable are, either adopted from Microsoft Azure's Documentation, or are well known best practices followed by Microsoft MVPs (Most Valuable Professionals), and the broader Azure community in general. Note, that the deployment process demonstrated in this deliverable covers the exact deployment steps that were followed for deploying IDEALVis in the context of the pilot study held towards the end of the project's lifecycle. The compiled IDEALVis platform source code and database files which are required for deployment are provided via links later through the deliverable in appropriate sections. Once the deployment process is finished, we also provide a set of test user accounts which the reader can use to access the deployed IDEALVis platform.

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1 Introduction

This deliverable provides detailed instructions on how to set up and deploy the IDEALVis platform on a Windows Server virtual machine instance hosted by Microsoft Azure. More specifically, the deliverable describes the steps to setup the virtual machine server, webserver, and database server on the cloud, and how to configure those servers for optimal performance and security. The information outlined in the following sections should be applied in the exact order provided.

1.1 *Deliverable Structure*

The rest of the deliverable is structured as follows:

- Introduction to essential Microsoft Azure terminologies
- Creating a new Windows Server virtual machine on Microsoft Azure
- Setting up the Webserver with IIS (Internet Information Services)
- Setting up essential deployment tools on the virtual machine
- Creating an Azure SQL Server
- Initializing the application's database
- Deploying the IDEALVis platform on the virtual machine instance

2 Essential Microsoft Azure Terminologies

Deploying an application to the cloud using Microsoft Azure is a multi-step process that requires some prerequisite knowledge. In this section, our aim is to provide the reader with a set of fundamental terminologies that will make it easier to understand the content provided in the following sections. Note that this deliverable is not by any means a complete Microsoft Azure tutorial, instead it provides the set of steps required to deploy the IDEALVis platform. Microsoft Azure is a dynamic in nature platform that constantly receives frequent updates by Microsoft. Consequently, figures or references provided in this deliverable might be slightly different from what you experience in the Azure Portal at time of reading.

Below we provide a list of prerequisite Microsoft Azure related terminologies:

- **Azure Subscription:** An Azure account should have an active subscription prior to using any Azure resources i.e., services such as virtual machines, databases etc. The subscription acts as a single billing unit for the services or resources utilised. For instance, a pay-as-you-go subscription is billed on a monthly basis for settling the payment of different resources used under that subscription.
- **Resource Groups:** Resource groups are essentially logical collections of different Azure resources such as storage accounts, virtual machines, virtual networks, web apps, databases, and database servers. Usually, related resources for a given application are grouped under the same resource group. For instance, given a single application, a development team can use two nearly identical resource groups i.e., one for testing and one for production.

To better illustrate the relationship between subscriptions, resource groups and resources please refer to Figure 1.

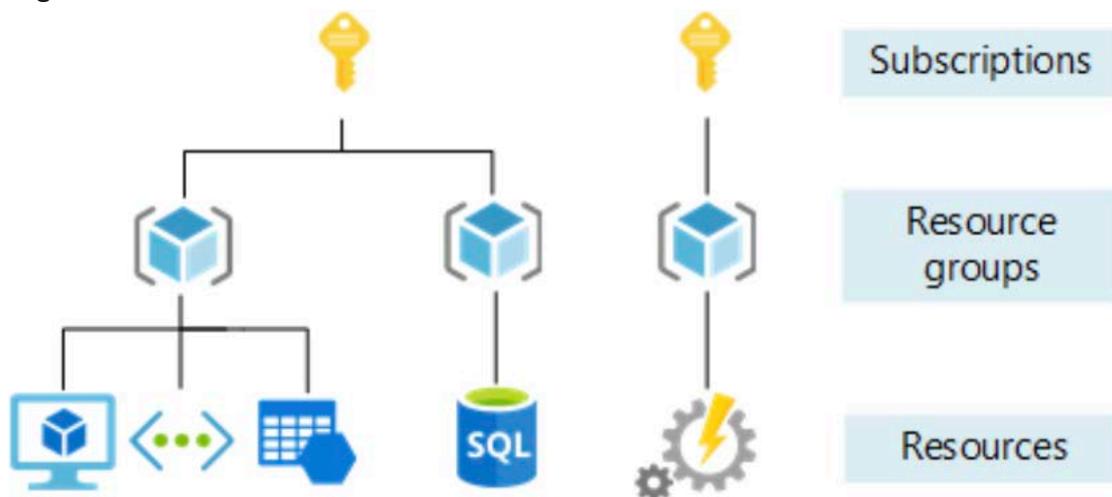


Figure 1 - Azure Subscriptions, Resource Groups and Resources

Below we provide a list of useful abbreviations:

- DTU - Database Transaction Unit
- vCore – Virtual Core (as of CPU core)
- VM – Virtual Machine
- OS – Operating System
- RDP – Remote Desktop Protocol
- IIS – Internet Information Services

3 Creating a Windows Server VM

From this section onwards we assume that the reader has an active Microsoft Account that can be used to access the Azure Portal¹. Moreover, the following steps assume that an active subscription was set up in Azure, required for provisioning resources (i.e., Windows Server VM).

The first step required in deploying an application to the cloud, is the actual server that will host our application. Please follow the steps provided below to provision a Windows Server 2019 instance using the Azure Virtual Machines service.

1. Sign into the Azure Portal at <https://portal.azure.com/>
2. Under Azure Services (Figure 2), click the plus icon labelled as “Create a resource”.

Azure services



Figure 2 - Azure List of Services

3. From the provided list of popular products (Figure 3) click the *Create* link under the product called “Windows Server 2019 Datacenter”. In case that you cannot see the desirable product just search for it using the search bar provided on the top of the list.

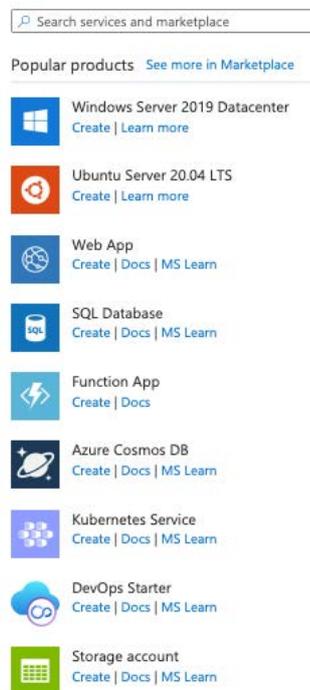


Figure 3 - Azure List of Services to Create

4. This step provides a wizard that will guide us through the process of instantiating a VM. The first wizard step is called “Basics” (Figure 4) and is where we will configure most of the

¹ <https://portal.azure.com/>

properties of the VM. Regarding the Basics Tab, please follow the list of steps provided below:

- a. Select a Subscription.
- b. Create a new Resource Group and select it as the resource group of this virtual machine. An example name could be *IDEALVIS-RG*.
- c. Provide a name for the VM. An example name could be *idealvis-server-vm*.
- d. Select a Region where the VM will be hosted. For the purposes of this project, we suggest *Switzerland North* as it is one of the nearest (with regards to Cyprus where IDEALVis will be used) datacentres.
- e. Set the Security type option to *Standard* and the Availability options to *No infrastructure redundancy required*. VM redundancy is not required, as the VM only holds the application itself and not the data that is collected/maintained by the IDEALVis platform. These data are kept in the database which is a separate Azure Resource discussed in Section 6.
- f. For Image, select *Windows Server 2019 Datacenter – Gen 1*. This refers to the actual installation image that will be used to install the OS.

Create a virtual machine

Basics Disks Networking Management Advanced Tags Review + create

Create a virtual machine that runs Linux or Windows. Select an image from Azure marketplace or use your own customized image. Complete the Basics tab then Review + create to provision a virtual machine with default parameters or review each tab for full customization. [Learn more](#)

Project details

Select the subscription to manage deployed resources and costs. Use resource groups like folders to organize and manage all your resources.

Subscription * ⓘ Azure for Students

Resource group * ⓘ (New) Resource group
[Create new](#)

Instance details

Virtual machine name * ⓘ

Region * ⓘ (Europe) Switzerland North

Availability options ⓘ No infrastructure redundancy required

Security type ⓘ Standard

Image * ⓘ Windows Server 2019 Datacenter - Gen1
[See all images](#) | [Configure VM generation](#)

Size * ⓘ Standard_B2s - 2 vcpus, 4 GiB memory (US\$44.97/month)
[See all sizes](#)

Administrator account

Username * ⓘ

Password * ⓘ

Confirm password * ⓘ

Inbound port rules

Select which virtual machine network ports are accessible from the public internet. You can specify more limited or granular network access on the Networking tab.

Public inbound ports * ⓘ None Allow selected ports

Select inbound ports * ⓘ RDP (3389)

[Review + create](#) < Previous Next: Disks >

Figure 4 - Wizard for Creating a Virtual Machine

- g. Size is where we select the processing power and memory allocated to the VM. Here we select *B2s* which is a VM size under the B Series of VM sizes offered by Azure. Series B is ideal for workloads that do not need continuous full CPU performance. While IDEALVis tends to continually utilize CPU cycles, the utilization is mostly lightweight, needed for handling requests and simple business logic e.g., sending data to the front-end or sending requests to the database. We are confident that for the current sample of IDEALVis users, provisioning of 2 vCores and 4 GB of memory should be enough for the main application running on the VM server, since most of the heavy lifting is performed at the database level i.e., executing analytical queries against large datasets.
- h. Provide a username for the administrator account of the VM. This will be used for logging into the actual VM using a remote desktop connection.
- i. Provide a strong user password for the administrator account and confirm it.

- j. For inbound port rules we only need to have two inbound rules enabled, HTTP (80) port and RDP (3389) port. Other ports are blocked as an extra layer of security to the VM.
5. At this point we are not interested in further configuring the VM so we will skip the other wizard tabs by clicking the *“Review + Create”* button at the bottom left of the screen. This will take us to the last wizard tab (Figure 7) where we can review all VM properties and finally create the VM using the *“Create”* button at the bottom left of the screen.
6. Creating and deploying the VM might take a few seconds to complete. Once the VM is ready Azure will provide a message indicating that the deployment of the VM was completed as seen in Figure 5. From there click the *“Go to resource”* button for accessing the VM’s management page.

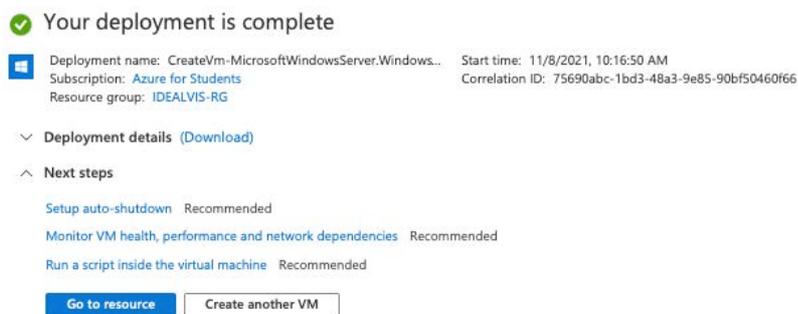


Figure 5 - VM Deployment Completed Screen

7. At this point the VM is up and running and we are now interested in connecting on the VM using a remote desktop connection (enabled at step 4, point j). Remote connection can be achieved by downloading an RDP file from the VM’s management page. From the menu illustrated in Figure 6 click the *“Connect”* tab. Next click the *“Download RDP File”* button for retrieving the RDP file that enables us to connect on the VM using remote desktop tool. The steps provided below further explain how to load the RDP file on a remote desktop tool:
 - a. If your local system on which you are performing these steps runs on Windows, you can directly open the RDP file. A prompt will appear asking for a username and password where you need to provide the VM’s administrator account username and password (created at step 4, points h and i). From there Windows will ask you if you trust the VM’s certificate, by clicking yes (i.e., accepting the certificate) you will be able to remotely connect on the VM.

- b. (Optional Step) In case your local system runs on MacOS you will need to download the Microsoft Remote Desktop tool² from the AppStore that will enable you to open the RDP file and connect on the VM.

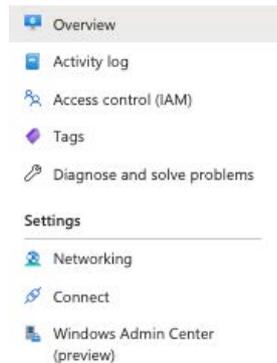


Figure 6 - VM's Management Page Menu

Create a virtual machine ...

Validation passed

Basics Disks Networking Management Advanced Tags **Review + create**

PRODUCT DETAILS

Standard B2s
by Microsoft
[Terms of use](#) | [Privacy policy](#)

Subscription credits apply ⓘ
0.0616 USD/hr
[Pricing for other VM sizes](#)

TERMS

By clicking "Create", I (a) agree to the legal terms and privacy statement(s) associated with the Marketplace offering(s) listed above; (b) authorize Microsoft to bill my current payment method for the fees associated with the offering(s), with the same billing frequency as my Azure subscription; and (c) agree that Microsoft may share my contact, usage and transactional information with the provider(s) of the offering(s) for support, billing and other transactional activities. Microsoft does not provide rights for third-party offerings. See the [Azure Marketplace Terms](#) for additional details.

⚠ You have set RDP port(s) open to the internet. This is only recommended for testing. If you want to change this setting, go back to Basics tab.

Basics

Subscription	Azure for Students
Resource group	(new) IDEALVIS-RG
Virtual machine name	idealvis-server-vm
Region	Switzerland North
Availability options	No infrastructure redundancy required
Security type	Standard
Image	Windows Server 2019 Datacenter - Gen1
Size	Standard B2s (2 vcpus, 4 GiB memory)
Username	idealvisadmin
Public inbound ports	RDP
Already have a Windows license?	No

Disks

OS disk type	Premium SSD LRS
Use managed disks	Yes
Ephemeral OS disk	No

Networking

Virtual network (new) IDEALVIS-RG-vnet

Create < Previous Next > [Download a template for automation](#)

Figure 7 - Final Wizard Tab for VM Creation

² <https://apps.apple.com/us/app/microsoft-remote-desktop/id1295203466?mt=12>

4 Setting up the Web Server

Up to this step of the IDEALVis platform deployment process, we demonstrated how to setup a VM (to be used as the application's server) by creating a VM through Microsoft Azure, and we also explained how a remote connection can be established on the VM using appropriate tools. At this point we assume that the reader is connected on the VM and currently viewing the Server Manager Dashboard, which is the first screen that loads when the VM is started (Figure 8).

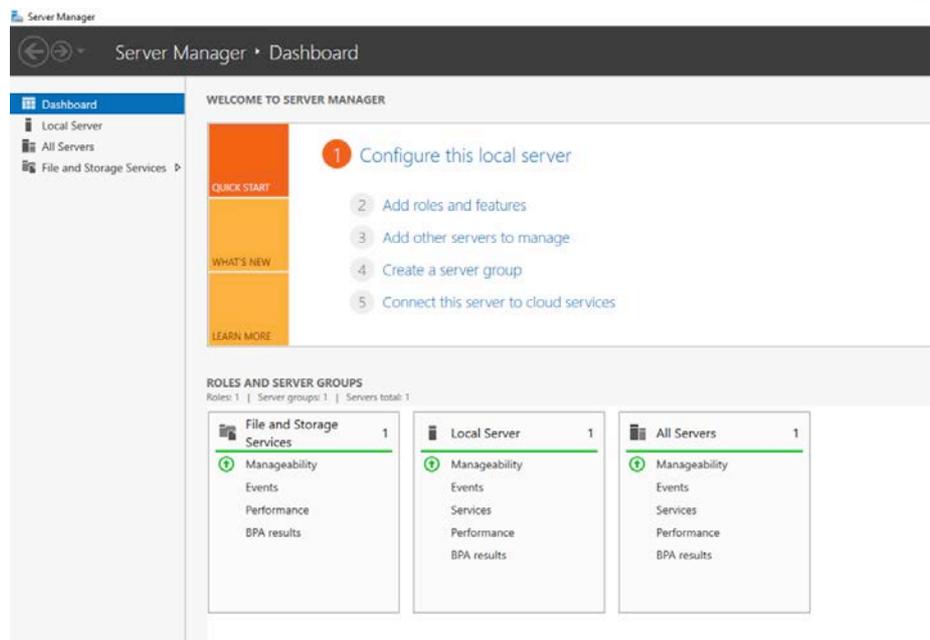


Figure 8 - Server Manager Dashboard

At this point of the process, we have an online server that is not able to serve any type of content (e.g., websites or static files etc.) and this is because we need to install and configure an appropriate webserver service on our VM. For the purposes of the IDEALVis project and since we are using a Windows Server OS, the webserver of choice is IIS³.

4.1 Setting up IIS

Please follow the steps provided below to setup IIS.

1. From the Server Manager Dashboard (Figure 8) click *“Add roles and features”* under *“Configure this local server”*. This will provide a wizard that will enable us to set up IIS.
2. Skip the first page by clicking Next.
3. At wizard step (**Installation Type**) make sure to have the *“Role-based or feature-based installation”* option selected. Then click Next.
4. At wizard step (**Server Selection**) keep the default selections and click Next.
5. At wizard step (**Server Roles**) make sure to check the box for *“Web Server (IIS)”* then click the *“Add Features”* button in the popup window and finally click Next.
6. At wizard step (**Features**) keep the default selections and click Next.

³ <https://www.iis.net>

7. At wizard step (**Web Server Role (IIS)**) keep the default selections and click Next.
8. At wizard step (**Role Services**) keep the default selections and click Next.
9. At wizard step (**Confirmation**) click Install. This installation may take a few minutes to complete. Once the installation is completed click Close to exit the wizard.

At this point IIS is successfully installed on our server VM. Moreover, by default IIS hosts a static website that we can access for making sure that everything was setup correctly. Since our server has port 80 open for public access (this was setup in Section 3), we can access the website hosted by IIS by visiting the public IP address of our VM. The address can be retrieved from the Azure Portal by going to the VM's management page under the "Overview" tab, located to the right of the page as illustrated by the red star indicator in Figure 9. Copy this IP address and paste it into your browser's URL search bar and hit Enter. The default IIS website should load up as seen in Figure 10.



Figure 9 - VM's Public IP Address

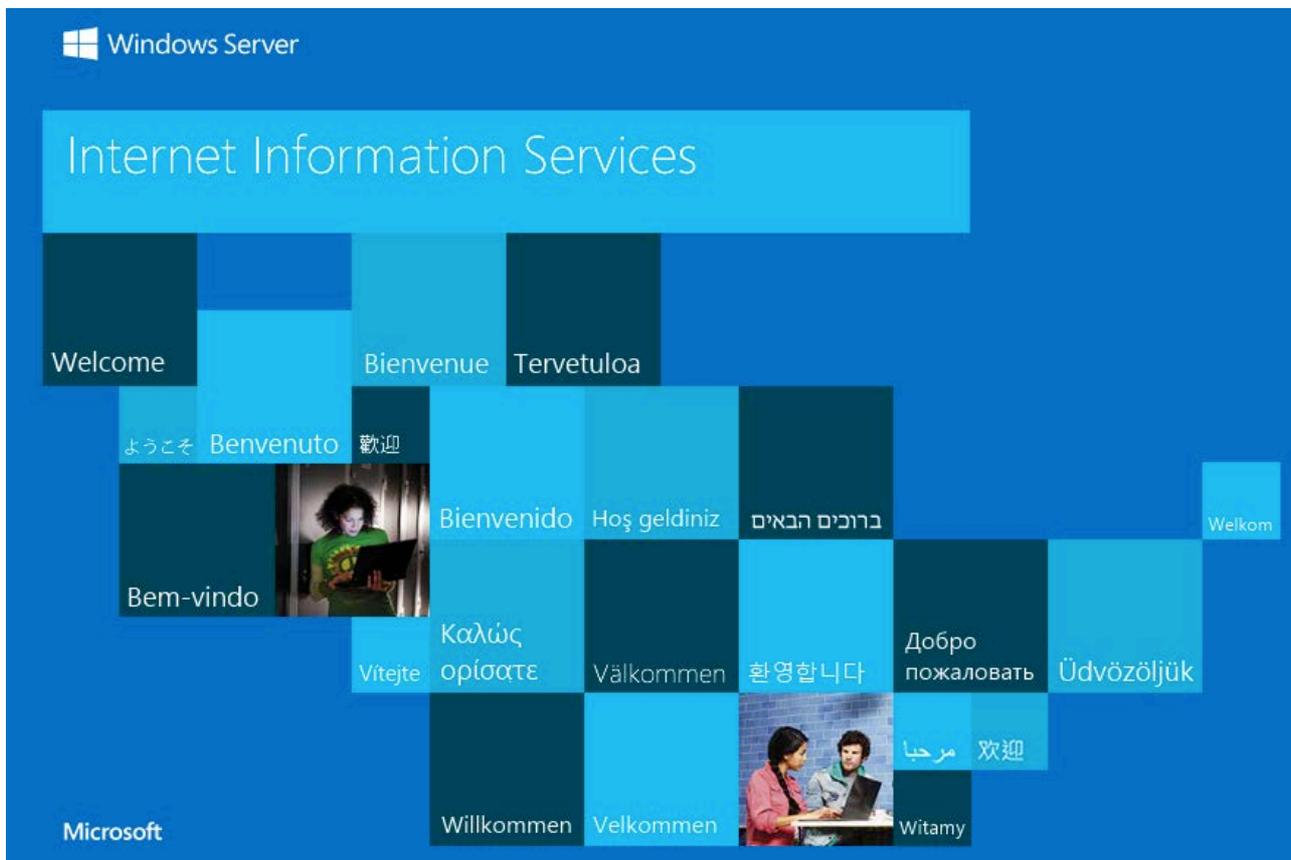


Figure 10 - Default IIS Website

5 Setting up Deployment Tools

Up to this step of the IDEALVis platform deployment process, we have demonstrated how to setup the webserver on the server VM. In this section we take a step further and we demonstrate a set of tools that need to be installed, for facilitating the upcoming deployment steps presented in this deliverable. Specifically, the goal is to install the following tools:

- Visual Studio Code:
 - **Link:** <https://code.visualstudio.com/Download>
 - **Purpose:** Visual Studio Code is a code / text editor that we can use to modify configuration files regarding the web-application.
- SQL Server Management Studio (SSMS):
 - **Link:** <https://docs.microsoft.com/en-us/sql/ssms/download-sql-server-management-studio-ssms?view=sql-server-ver15>
 - **Purpose:** SQL Server Management Studio will enable us to connect on the web-application's database and ensure that the database is configured appropriately.
- .NET Core Hosting Bundle:
 - **Link:** <https://dotnet.microsoft.com/download/dotnet/thank-you/runtime-aspnetcore-5.0.3-windows-hosting-bundle-installer>
 - **Purpose:** The .NET Core Hosting Bundle is required as an extension to IIS. This essentially makes up the ASP.NET Core runtime and tools required for the webserver to be able to run our web-application (i.e., the IDEALVis platform).
- Python Version 3.9:
 - **Link:** <https://www.python.org/ftp/python/3.9.12/python-3.9.12-amd64.exe>
 - **Purpose:** Python is required on the VM server since IDEALVis uses an external Python service that was developed for handling advanced analytics (e.g., Forecasting).

Please make sure to download this software on your local machine and then transfer all setup files to the VM using the remote desktop tool. We do not suggest downloading this software directly on the VM (i.e., using the VM's browser) as Azure has set some download restrictions that we do not want to modify. Once the software is downloaded on your local machine you can copy those files and then simply paste them in the Downloads folder of the VM. This simple copy paste operation will transfer the files from your local machine to the VM on the cloud.

5.1 Installing the Tools

Once all the setup files are successfully transferred on the VM, the installation process can begin. In this sub-section we only demonstrate how to install the .NET Core Hosting Bundle and Python

3.9 since the installation of the other tools should be a straightforward process, as guided by the installation wizard of each tool.

5.1.1 INSTALLING THE HOSTING BUNDLE

Please navigate to the folder where you placed the hosting bundle setup file. In that folder use the File Explorer search bar and type *powershell* (Figure 11), then hit Enter. This action will spawn a new PowerShell window that is active at the current directory, where you have placed the hosting bundle.

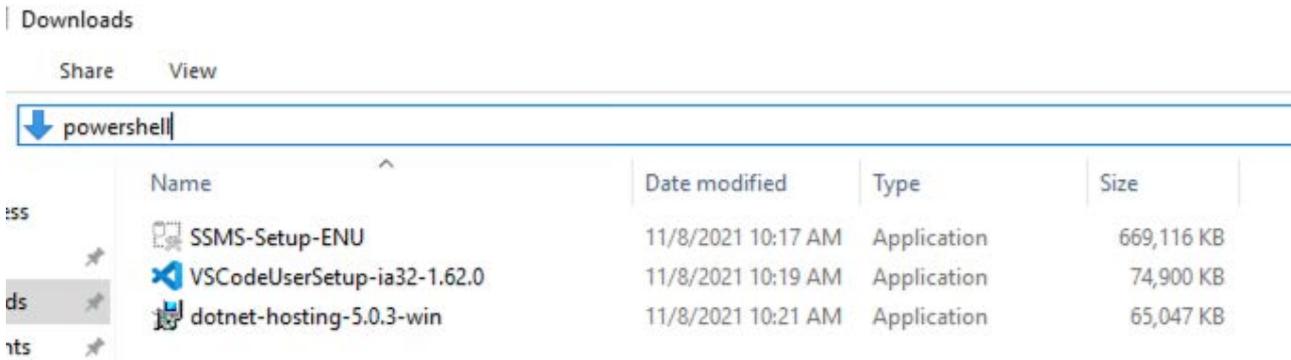


Figure 11 - Starting PowerShell in the Hosting Bundle Directory

In this case we are using PowerShell to start the installation wizard of the hosting bundle since we want to provide a parameter *OPT_NO_RUNTIME=1* to the installer, that makes the installer skip the installation of the .NET Core Runtime. The runtime is not needed in our case since it is bundled within the IDEALVis application build (Self Contained Application). Please refer to Figure 12 for the PowerShell command required to start the hosting bundle installation wizard. Once you copy this command in PowerShell hit Enter. Note that by the time of reading this document the hosting bundle setup file might have a different name, make sure to adjust the PowerShell command accordingly to accommodate for the exact hosting bundle setup filename. Once the installation wizard is started, complete the installation by clicking Install. Once installation is complete, please open a new Command Prompt window and paste this command (*net stop was /y && net start w3svc*) and hit Enter. This command will restart IIS so it can receive all the changes made. You can now close the Command Prompt and PowerShell windows.

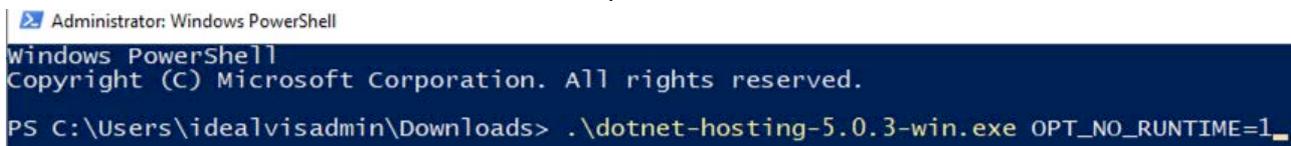


Figure 12 - PowerShell Command for Starting the Hosting Bundle Installation Wizard

5.1.2 INSTALLING PYTHON

Once you start up the installer executable for Python, please make sure to tick the checkbox labelled "Add Python 3.9 to PATH" (Figure 13) and then simply click "Install Now". Adding Python to the PATH essentially will later allow us to run our Python advanced analytics library using the Command Prompt.



Figure 13 - Adding Python to PATH

6 Creating an Azure SQL Server

At this point of the deliverable the server VM was configured and created, and all required tools and software were installed. This section will provide all the required information on how to create and setup the platform's database server. Please follow the steps provided below to provision an SQL Server using the Azure.

1. Sign into the Azure Portal at <https://portal.azure.com/>
2. On the very top of the Azure interface there is a global search bar. From there search for *SQL Servers*. SQL Servers will appear under the services category of search results. From there click on SQL Servers. Since we have not yet created an SQL Server, we will be presented with a button to do so. Click on the "Create SQL Server" button.
3. This step provides a wizard that will guide us through the process of creating an SQL Server instance. The first wizard step is called "Basics" (Figure 14) and this is where we will configure most of the properties of the new SQL Server. Regarding the *Basics* Tab, please follow the list of steps provided below:

Home > SQL servers >

Create SQL Database Server

Microsoft

Basics Networking Additional settings Tags Review + create

SQL database server is a logical container for managing databases and elastic pools. Complete the Basic tab, then go to Review + Create to provision with smart defaults, or visit each tab to customize. [Learn more](#)

Project details

Select the subscription to manage deployed resources and costs. Use resource groups like folders to organize and manage all your resources.

Subscription * Azure for Students

Resource group * IDEALVIS-RG [Create new](#)

Server details

Enter required settings for this server, including providing a name and location.

Server name * Enter server name .database.windows.net

Location * (US) East US

Authentication

Select your preferred authentication methods for accessing this server. Create a server admin login and password to access your server with SQL authentication, select only Azure AD authentication [Learn more](#) using an existing Azure AD user, group, or application as Azure AD admin [Learn more](#), or select both SQL and Azure AD authentication.

Authentication method

Use SQL authentication

Use only Azure Active Directory (Azure AD) authentication

Use both SQL and Azure AD authentication

Server admin login * Enter server admin login

Password *

Confirm password *

[Review + create](#) [Next: Networking >](#)

Figure 14 - Wizard for Creating an SQL Database Server

- a. Select a Subscription.

- b. Select the existing Resource Group created previously for the VM (i.e., *IDEALVIS-RG*).
 - c. Provide a name for the database server. An example name could be *idealvis-db-server*.
 - d. Please make sure to set the server's *Location* to the same region used when creating the VM instance (this favours performance). Moreover, for SQL Server make sure to use *SQL Authentication* and provide a server admin login (i.e., *idealvis-db-server-admin*) and a strong password.
4. In the *Networking* tab under "*Firewall rules*" make sure to enable the "*Allow Azure services and resources to access this server*" option by selecting "*Yes*" (Figure 15).

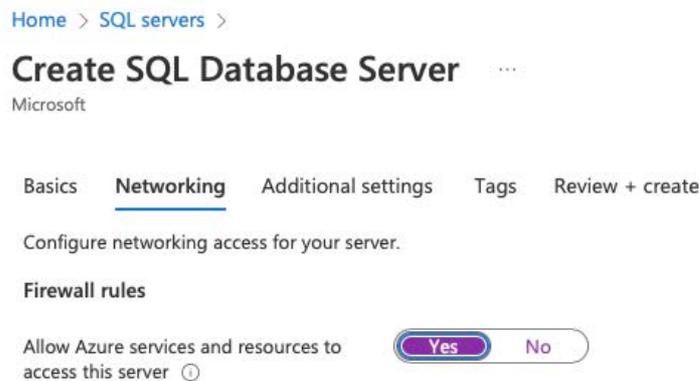


Figure 15 - SQL Database Server Networking Setup

5. At this point we are not interested in further configuring the SQL Server so we will skip the other wizard tabs by clicking the "*Review + Create*" button at the bottom left of the screen. This will take us to the last wizard tab (Figure 16) where we can review all SQL Server properties and finally create the server using the "*Create*" button at the bottom left of the screen.

[Home](#) > [SQL servers](#) >

Create SQL Database Server

Microsoft

[Basics](#) [Networking](#) [Additional settings](#) [Tags](#) [Review + create](#)

Product details

SQL Database Server
by Microsoft
[Terms of use](#) | [Privacy policy](#)

Estimated cost per month
No additional charges

Terms

By clicking "Create", I (a) agree to the legal terms and privacy statement(s) associated with the Microsoft offering(s) and transactional information with the provider(s) of the offering(s) for support, billing and

Basics

Subscription	Azure for Students
Resource group	IDEALVIS-RG
Server name	idealvis-db-server
Authentication method	SQL authentication
Server admin login	idealvis-db-server-admin
Location	Switzerland North

Networking

Allow Azure services to access server Yes

Additional settings

Enable Microsoft Defender for SQL Not now

Tags

Figure 16 - Final Wizard Tab for SQL Database Server Creation

6. Creating and deploying the SQL Server might take a few seconds to complete. Once the server is ready Azure will provide a message indicating that the deployment was completed as seen in Figure 17. From there click the "Go to resource" button for accessing the server's management page.

 **Your deployment is complete**

 Deployment name: Microsoft.SQLServer.createServer_fefc3b1b5772...
Subscription: [Azure for Students](#)
Resource group: [IDEALVIS-RG](#)

 **Deployment details** ([Download](#))

 **Next steps**

[Go to resource](#)

Figure 17 - SQL Database Server Deployment Completed Screen

7 Initializing the Database

At this point of the deployment process both the server VM and the database server were set up. Now this section discusses how to create and initialize the database required for the proper operation of the IDEALVis platform. The database is available upon request to the IDEALVis consortium.

The contents of the database installation file are described below:

- **Filename:** IDEALVIS_PROD.bacpac
 - **Purpose:** bacpac files are essentially Zip-compressed archives that contain a Microsoft SQL database's schema and data. In our case this file is the IDEALVis production database which is required for our platform to properly run. Note that this single database makes up the IDEALVis application database but also contains all the transactional sales data used during the pilot study for analysis by our participants.

7.1 Creating an Azure Storage Account

Prior to creating our database on the provisioned SQL Server, we need to first create a Storage Account that will enable us to upload the bacpac database file to Azure. The bacpac file will be used to create the database therefore we need this Storage Account which will enable us to upload the bacpac file to Azure so our SQL Server can access it and load it appropriately. Please follow the steps provided below to provision a Storage Account on Azure.

1. Sign into the Azure Portal at <https://portal.azure.com/>
2. On the very top of the Azure interface there is a global search bar. From there search for *Storage Account*. Storage Accounts will appear under the services category of search results. From there click on Storage Accounts. Since we have not yet created a Storage Account, we will be presented with a button to do so. Click on the “*Create storage account*” button.
3. This step provides a wizard that will guide us through the process of creating a Storage Account. The first wizard step is called “*Basics*” Figure 18 and is where we will configure most of the properties of the new Storage Account. Regarding the *Basics* Tab, please follow the list of steps provided below:

Home > Storage accounts >

Create a storage account

Basics | Advanced | Networking | Data protection | Encryption | Tags | Review + create

Azure Storage is a Microsoft-managed service providing cloud storage that is highly available, secure, durable, scalable, and redundant. Azure Storage includes Azure Blobs (objects), Azure Data Lake Storage Gen2, Azure Files, Azure Queues, and Azure Tables. The cost of your storage account depends on the usage and the options you choose below. [Learn more about Azure storage accounts](#)

Project details

Select the subscription in which to create the new storage account. Choose a new or existing resource group to organize and manage your storage account together with other resources.

Subscription *

Resource group * [Create new](#)

Instance details

If you need to create a legacy storage account type, please click [here](#).

Storage account name

Region

Performance Standard: Recommended for most scenarios (general-purpose v2 account)
 Premium: Recommended for scenarios that require low latency.

Redundancy Make read access to data available in the event of regional unavailability.

[Review + create](#) < Previous Next: Advanced >

Figure 18 - Wizard for Creating a Storage Account

- a. Select a Subscription.
 - b. Select the existing Resource Group created previously for the VM (i.e., *IDEALVIS-RG*).
 - c. Provide a storage account name. An example name could be *idealvistorage*.
 - d. Please make sure to set the storage *Location* to the same region used when creating the VM/SQL Server instance (this favours performance).
 - e. The rest of the settings regarding performance and redundancy can stay as they are.
4. At this point we are not interested in further configuring the Storage Account so we will skip the other wizard tabs by clicking the “Review + Create” button at the bottom left of the screen. This will take us to the last wizard tab (Figure 19) where we can review all Storage Account properties and finally create the storage account using the “Create” button at the bottom left of the screen.

[Home](#) > [Storage accounts](#) >

Create a storage account ...

✓ Validation passed

Basics Advanced Networking Data protection Encryption Tags

Basics

Subscription	Azure for Students
Resource Group	IDEALVIS-RG
Location	eastus
Storage account name	idealvstorage
Deployment model	Resource manager
Performance	Standard
Replication	Read-access geo-redundant storage (RA-GRS)

Advanced

Secure transfer	Enabled
Allow storage account key access	Enabled
Allow cross-tenant replication	Enabled
Default to Azure Active Directory authorization in the Azure portal	Disabled
Blob public access	Enabled
Minimum TLS version	Version 1.2
Enable hierarchical namespace	Disabled
Enable network file system v3	Disabled
Access tier	Hot
Enable SFTP (preview)	Disabled
Large file shares	Disabled

Networking

Network connectivity	Public endpoint (all networks)
Default routing tier	Microsoft network routing

Data protection

Create

< Previous

Next >

Download a template

Figure 19 - Final Wizard Tab for Storage Account Creation

5. Creating and deploying the Storage Account might take a few seconds to complete. Once the account is ready Azure will provide a message indicating that the deployment was completed as seen in Figure 20. From there click the “Go to resource” button for accessing the storage account’s management page.

✓ Your deployment is complete



Deployment name: idealvstorage_1650535749330
 Subscription: [Azure for Students](#)
 Resource group: [IDEALVIS-RG](#)

∨ [Deployment details](#) (Download)

∧ [Next steps](#)

[Go to resource](#)

Figure 20 - Storage Account Deployment Completed Screen

7.1.1 UPLOADING THE BACPAC FILE

Now that our Storage Account is created it is time to upload the bacpac file to Azure. Please follow the steps below to upload the file:

1. From the Storage Account management page click Storage Explorer (preview) found in the left sidebar.
2. Inside the Storage Explorer, right click on *BLOB CONTAINERS* and click “*Create Blob Container*”. This will open a side panel to the right of the screen where we need to provide a name for the container and click create. An example container name could be *db-files*.
3. Once the blob container is created you will be able to view it under *BLOB CONTAINERS* in the Storage Explorer. Now click on the blob container we just created.
4. Once you click the container you will be presented with the contents of this container (currently empty) and also an upload button.
5. Click on the “*Upload*” button and select the *IDEALVIS_PROD.bacpac* from your computer.
6. Finally, click Upload. Please refer to Figure 21 in case you cannot locate something in the Storage Account management interface.

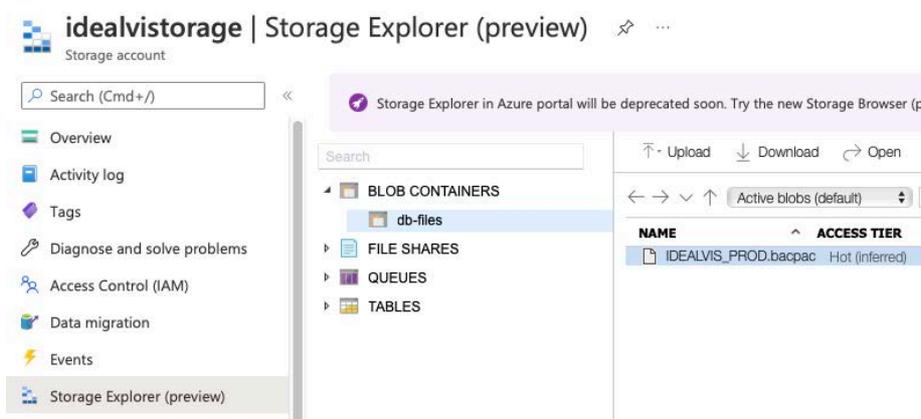


Figure 21 - Uploaded bacpac to Storage Account

7.2 Creating the Database from the bacpac File

Now that the bacpac file resides online in our Azure Storage Account we can instruct SQL Server to use the file and create a database from it. Please follow the steps provided below to create the SQL Database using Azure.

1. Sign into the Azure Portal at <https://portal.azure.com/>
2. Under the *Recent Resources* table, you should be able to see the *idealvis-db-server* created previously. Click on the server in order to navigate inside the SQL Server management page.
3. Inside the SQL Server management page, on the very top you will see a button called “*Import Database*”. Click the button and the Import Database page will be presented as in Figure 22. Regarding this page, please follow the list of steps provided below:

- a. Select a Subscription.
- b. Click on the “Select Backup” link. This will provide a page with all storage accounts. Please, select the storage account where you uploaded the bacpac file and then click on the container which holds the file. Once you select the correct container you will be presented with the bacpac file. Click on the bacpac file and click the select button at the bottom left. Note that the database’s name is IDEALVIS_PROD.
- c. Next click on the “Configure Database” link (this will temporarily take you to a new page). From there make sure that the Service tier option is set to “*Standard (For workloads with typical performance requirements)*”, then drag the slider of DTUs to the value 20 and drag the “Data max size (GB)” slider to the value 5 (i.e., 5 GB of database storage). Click “Apply” in the bottom left and the process will take you back to the wizard for importing the database.
- d. The last step will be to provide the SQL Server’s password. This password was setup during the SQL Server creation.
- e. Click the “OK” button at the bottom left of the Import Database Page. This will initiate the database creation which might take several minutes to complete.

Home > idealvis-db-server >

↓ **Import database** ...
idealvis-db-server

Subscription *
Azure for Students

Use private link (preview)

Storage (Premium not supported) *
--
--
[Select backup](#)

Pricing tier * ⓘ
Standard S0
10 DTUs, 250 GB storage
[Configure database](#)

Database name
Enter database name ✓

Collation * ⓘ
SQL_Latin1_General_CP1_CI_AS

Authentication type
SQL Server

Server admin login *
idealvis-db-server-admin

*Password
Enter server password

OK

Figure 22 - Import Database Page

7.3 Establishing a Connection to the Database

Before deploying the IDEALVis platform we first take the step of testing the database connection. For accessing the database server, we will use the SQL Server Management Studio that was installed on the VM in Section 5. Please follow the steps provided below to establish a connection to the database:

1. On the server VM start SQL Server Management Studio (SSMS).
2. The first window that shows up in SSMS is the “Connect to Server” window.
 - a. From the *Authentication* dropdown select “SQL Server Authentication”.
 - b. With the authentication mode set, we are now required to enter the SQL Server’s name (i.e., server’s public IP/URL), the admin login/username of the SQL Server and the corresponding password. The SQL Server’s public URL can be retrieved from the Azure Portal by going to the SQL Server management page under the “Overview” tab, located to the right of the page as illustrated by the red star indicator in Figure 23. For Login use the database admin username created when setting up the new SQL Server in Section 6 (i.e., idealvis-db-server-admin), and for password use the appropriate password that was set for the SQL Server.
 - c. Click Connect and SSMS will connect on the SQL Server and provide the list of available databases. This list will only contain a single database called IDEALVIS_PROD (i.e., the database that was created in Section 7.2).



Figure 23 - Database Server's Public URL

8 Deploying the IDEALVis Platform

Up to this step of the deployment process all the required infrastructure and data are in place. Therefore, this section will demonstrate the final deployment steps to deploy the IDEALVis platform on IIS. The platform installation file is available upon request to the IDEALVis consortium. Once the installation file is downloaded, it needs to be transferred on the VM using the remote desktop tool and then extract the file to access its contents.

The contents of the installation file are described below:

- **Folder Name:** IDEALVIS
 - **Purpose:** This is the folder that contains the IDEALVis platform built (i.e., compiled software). This is what will be added as a new Website in IIS.
- **Filename:** appsettings.json
 - **Purpose:** This file contains a set of key value pairs that are required by the IDEALVis platform (i.e., web-application) for several reasons (e.g., for connecting on the provisioned database).
- **Filename:** main.py
 - **Purpose:** This file is a Python program that hosts a local web service required by IDEALVis for performing advanced analytics.

8.1 Preparing the Web-Application Configuration

As seen above, the contents of the ZIP file contain the actual IDEALVIS folder and the *appsettings.json* file. In this sub-section we will add the correct database connection and email configuration strings in the *appsettings.json* file and then add this file inside the IDEALVIS folder. This process will later allow the IDEALVis platform to connect on the SQL Database created in Section 7.2, and further enable the platform to send emails (e.g., for account activation). Please follow the steps provided below for preparing the *appsettings.json* file.

1. To fetch the database connection string visit the Azure Portal and navigate to the IDEALVIS_PROD database management page. Under the “Overview” tab, you can see the “Show database connection strings” link as marked by the red star in Figure 24. Click this link and copy the provided connection string.
2. Open the *appsettings.json* file in Visual Studio Code and paste the connection string at the two positions indicated by Figure 25.
3. Currently the connection string is missing the database server password. For both pasted connection strings, add the password in the position indicated by the string “{your_password}”. Make sure to remove the curly braces {}.

4. For enabling the IDEALVis platform to send emails, the `appsettings.json` file has a few empty key value pairs that need to be populated with appropriate information according to the details provided in Table 1. Please note, that in order to retrieve a SendGrid API Key you will have to register an account with SendGrid and verify the email with which you want to allow the IDEALVis platform to send its emails (i.e., DefaultFromEmail). More, information on how to setup SendGrid for IDEALVis, and obtain an API key can be found in this tutorial (**Link:** <https://docs.sendgrid.com/for-developers/partners/microsoft-azure-2021>).
5. Save and close the `appsettings.json` file.
6. Next, cut and paste the `appsettings.json` file in the extracted IDEALVIS folder.
7. Finally, create a new folder called `Sites` inside the C drive of the VM, and then move the IDEALVIS folder in the new `Sites` folder. Note that if you try to host the IDEALVIS folder directly from the Downloads directory, you will receive an error due to inappropriate IIS folder access permissions.

Table 1 - `appsettings.json` Missing Email Fields

Missing Field (Key)	Required (Value)
DefaultFromEmail	This value needs to be a valid email address verified with SendGrid and matching the SendGrid API Key used
SendGridKey	SendGrid API Key
AdminEmail	This value can be any email address, used for receiving automated administrative platform notifications/emails

The screenshot shows the Azure portal interface for the IDEALVIS_PROD SQL database. The 'Essentials' section includes the following details:

- Resource group (move): IDEALVIS-RG
- Status: Online
- Location: Switzerland North
- Subscription (move): Azure for Students
- Subscription ID: 8025db67-cc4d-4033-b21e-e89ea959fe18
- Tags (edit): [Click here to add tags](#)
- Server name: [idealvis-db-server.database.windows.net](#)
- Elastic pool: [No elastic pool](#)
- Connection strings: [Show database connection strings](#) *
- Pricing tier: [Standard S1: 20 DTUs](#)
- Earliest restore point: 2022-04-21 10:58 UTC

Figure 24 - Database Connection String

```
"ConnectionStrings": {
  "DefaultConnection": "PASTE CONNECTION STRING",
  "Analytics": "PASTE CONNECTION STRING"
}
```

Figure 25 - Where to Paste the Database Connection String

8.2 Deploying IDEALVis on IIS

At this step we demonstrate how to create a new IIS website and point it to the IDEALVIS folder that contains all the code for the IDEALVis platform. Please follow the steps provided below for deploying IDEALVis and making it accessible via the World-Wide-Web.

1. On the VM go to start menu and search for IIS. Open the Internet Information Services Manager.
2. In the list of *Connections* found at the left hand-side of the IIS window, expand the *idealvis-server* node and then expand the *Sites* node (Figure 26).
3. Right-click the “*Default Website*” and click Remove. Accept the removal prompt for successfully removing the default IIS website. Make sure to also remove the “*DefaultAppPool*” listed in the *Application Pools* node. Accept the removal prompt for successfully removing the default IIS application pool.
4. Right-click on the *Sites* node and click “*Add Website*”.
5. In the new window for setting up the new website, use IDEALVIS as the *Site name*. In the physical path you need to select the IDEALVIS folder (i.e., application files) located in the *Sites* directory in the VM’s C drive. The rest of the fields can be left as they are.
6. Click Ok to close the *Add new Website* window.
7. Finally, the IDEALVis platform can now be accessed publicly via the World-Wide-Web, using the VM’s public IP address (retrieving this IP address was discussed in Section 4.1).

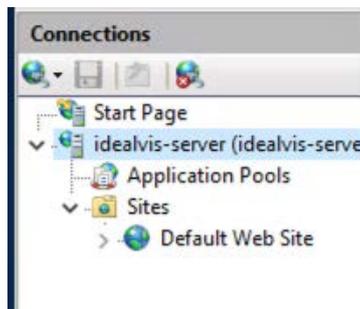


Figure 26 - *idealvis-server* Available Websites

8.3 Deploying the Python analytics library

Up to this point the IDEALVis platform is deployed and accessible via the web, but not all analytic components are enabled. At this step we demonstrate how to start the Python service which IDEALVis depends on for performing advanced analytics. Since Python is installed on the VM server now we need to just create a virtual Python environment in which our Python program (i.e., `main.py` extracted from the installation file) is going to run. Please follow these steps to setup the Python environment, install the advanced analytics library dependencies and finally run the Python advanced analytics library:

1. Navigate in some directory of the VM e.g., Downloads folder and using the top search bar of the File Explorer start a Command Prompt instance by typing `cmd` and then pressing Enter.
2. Inside the Command Prompt run this command `pip install virtualenv`. The command will install the `virtualenv` Python package.

3. Once the package is installed, create a Python virtual environment called *py-engine* by running the command *virtualenv py-engine*. Once the virtual environment is created navigate inside the virtual environment's folder using the command *cd py-engine*.
4. Using your mouse move the Python program (i.e., *main.py*) inside the *py-engine* folder.
5. Next, using the Command Prompt from step 3 navigate inside the *Scripts* folder using the *cd Scripts* command, and then run the command *activate.bat* which will activate the virtual environment inside this Command Prompt instance.
6. Now that the virtual Python environment is activated, we need to install all *main.py*'s package dependencies inside the virtual environment prior to running it.
7. Run the following commands which will install all 5 package dependencies inside the virtual environment:
 - a. *pip install flask*
 - b. *install flask_restful*
 - c. *pip install marshmallow*
 - d. *pip install pandas*
 - e. *pip install pmdarima*
8. Once all the dependencies are successfully installed then we need to finally run the *main.py* program by navigating in the *py-engine* folder and running the command *py main.py*.
9. If all the previous steps were executed correctly the Python advanced analytics service should be successfully started as seen in Figure 27.

```
* Serving Flask app 'main' (lazy loading)
* Environment: production
  WARNING: This is a development server. Do not use it in a production deployment.
  Use a production WSGI server instead.
* Debug mode: on
* Running on http://127.0.0.1:5555 (Press CTRL+C to quit)
* Restarting with stat
```

Figure 27 - Python Advanced Analytics Service Started

At this point you can now close the remote connection to the VM and use your local machine's browser to access the IDEALVis platform at the given VM's public IP address. Once you access IDEALVis you will be presented with the login screen. Please use the credentials listed in Table 2 for accessing the platform and testing its different features.

Table 2 - IDEALVis User Accounts for Testing

Username	Password	Role	Available Actions
admin@idealvis.com	P@sswOrd	Administrator	Manage Users, User Groups and Organizations

dpo@idealvis.com	P@ssw0rd	Data Protection Officer	Manage Data Protection Requests
user@example1.com	P@ssw0rd	Executive Analyst	Manage / Address Analysis Tasks
user@example2.com	P@ssw0rd	Senior Analyst	Address Analysis Tasks

9 Conclusion

In this deliverable we have laid out the whole process taken for deploying the IDEALVis platform as it was performed for the purpose of the final pilot study. Specifically, the deliverable has touched on the fundamentals of Microsoft Azure in an attempt to help the reader (regardless of their prior technical experience) deploy IDEALVis in an online secure environment. The main technologies used in this deliverable to achieve the deployment of the platform include a Windows Server virtual machine using the IIS webserver, an SQL Server that hosts the IDEALVis application database and datasets required for the analysis tasks our participants performed during the pilot study and a Python service which empowers the IDEALVis platform with advanced analytics. With the successful deployment this deliverable also provides the reader with a set of user accounts that they can utilise to access the platform and its functionalities.