Microsoft

Azure Fundamentals

ASSESSMENT GUIDE

Overview

This document provides information and guidance on how to develop formative and summative assessments for AZ-900T00 Microsoft Azure Fundamentals. It is split into two main sections:

- **Section 1: Module Questions –** Guidance for assessing student mastery as they progress through the course. This section includes a set of items for each course module that can be used throughout the course to monitor student progress and inform your instruction; the assessment items are a mixture of multiple-choice questions and open-ended questions.
- **Section 2: Capstone Project –** Guidance for using a capstone project to assess students' ability to apply what they have learned throughout the course to a real-world scenario. This project requires students to create and deliver a cloud solution presentation based on client requirements and includes guidance for both students and the instructor.

This guide is intended to be a reference and starting point for instructors as you plan how to assess your students. As you read through the guide, you may choose to tailor the assessment strategies, including the assessment items and rubric, for your classroom.

Table of Contents

Section 1: Module Questions

Introduction

This section includes multiple choice and open-ended questions that are aligned to the course modules for AZ900T00 Microsoft Azure Fundamentals. Each module includes a sample of five multiple-choice questions and five open-ended questions.

You are free to use the questions as they are currently presented or modify as appropriate for your classes. The questions do not appear in any other course materials and are designed to supplement the formative assessment opportunities that are integrated directly into Microsoft Learn and the Microsoft Official Course (e.g. Knowledge Checks, "Try-It" activities, Exercises, Walkthroughs, Labs). They are also designed to allow for easy integration into an online quiz through Microsoft Forms or through your institution's Learning Management System (LMS). Each set of module questions represents indicative coverage for each module objective domain.

Assigning the module questions to students as an independent activity will enable you to collect data about individual student progress. However, we recommend that you set aside class time to review answers and address any common student misconceptions, as later modules depend on knowledge and understanding gained earlier in the course.

Overview of multiple-choice questions

The multiple-choice questions require one or more answer responses and will include plausible distractors. These are set at a level slightly lower than the multiple-choice questions in the AZ-900 Azure Fundamentals certification exam.

Overview of open-ended questions

The open-ended questions present further challenges beyond single answer responses and include scenario-based questions. These questions give students the opportunity to demonstrate critical thinking through their responses. As the Capstone project for the course is primarily a cloud solution design activity, the open-ended questions at the end of each module are a useful approach to help build student confidence and critical thinking to encompass a range of potential solutions.

For their responses, students should be encouraged to explore multiple cloud service solutions and adopt a design-first approach before settling on a potential solution. Exploring the official Microsoft Azure documentation is a great place for students to research and investigate the different cloud services that are available.

Module 1: Cloud Concepts

Multiple choice questions

Which of the terms in the following list can be considered benefits of using cloud services?

Select all that apply.

a. Elasticity (correct answer)

b. Unpredictable costs

c. Agility (correct answer)

d. Economies of scale (correct answer)

2. Which of the following terms relates to making a service available with no downtime for an extended period?

Select the correct option.

a. Performance

b. Fault tolerance

c. High availability (correct answer)

d. Agility

3. Which of the following sentences best describes platform as a service (PaaS)?

Select the correct option.

a. Users can create and deploy an application as quickly as possible without having to worry about managing the underlying infrastructure. (correct answer)

b. Users are responsible for purchasing, installing, configuring, and managing their own operating systems, middleware, and applications.

c. Users pay for an annual or monthly subscription.

d. Users are only responsible for updating the operating system.

4. Which of the following requires the most user management of cloud services?

Select the correct option.

a. Infrastructure as a service (correct answer)

b. Platform as a service

c. Software as a service

d. All require approximately the same level of user management.

5. Which cloud model provides the most flexibility?

Select the correct option.

a. Public

b. Private

c. Hybrid (correct answer)

d. All provide the same level of flexibility.

Open-ended questions

1. A client wants to deploy their web application and associated data to the cloud with minimal configuration. Which cloud service type is suitable for this and why?

Answer: (Should include the PaaS cloud service type as being suitable as it provides minimal configuration for deploying and publishing code)

2. What important cloud attribute allows businesses and organizations to quickly grow their virtual machine infrastructure as their workloads increase, and how is it achieved?

Answer: (Should include a statement on scalability and how it can be achieved through the use of virtual machine scale sets)

3. What are the main differences between public and private clouds?

Answer: (Should include a statement indicating a private cloud enables the owner to have full control over everything including hardware, while a public cloud is owned by the cloud vendor)

4. A developer wants to deploy their application code to the cloud and needs access to the operating system to install custom software. Which is the best cloud service type to use in this case and why?

Answer: (Should include a statement that indicates IaaS is the most suitable as it provides access to an underlying operating system to install custom software)

5. What are the main differences between OpEx and CapEx? Give an example of each.

Answer: (Should include a statement that says OpEx has no up-front costs and can scale to meet unpredictable demand. A simple OpEx example could be a web service running on PaaS instead of on-premises server hardware. Additionally, CapEx should be briefly defined as an up-front cost an organization may invoke to purchase physical assets such on-premise server hardware. An example of which could be a large Storage Area Network (SAN))

Module 2: Core Azure Services

Multiple choice questions

1. What Microsoft Azure object contains multiple datacenters that are connected by a low-latency network?

   Select the correct option.

   a. A geography

   b. A region (correct answer)

   c. An availability set

   d. A pair

2. Availability sets are made up of which of the following?

   Select all that apply.

   a. Update domains (correct answer)

   b. Region pairs

   c. Fault domains (correct answer)

   d. A geography

3. Which of the following statements about virtual machines (VMs) and containers is true?

   Select all that apply.

   a. All VMs share the same operating system instance.

   b. VMs are isolated from the host hardware, while containers are not.

   c. All containers share the same operating system instance. (correct answer)

   d. VMs and containers are isolated from the host hardware. (correct answer)

4. Which of the following statements about data is true?

   Select all that apply.

   a. Semi-structured data is also known as non-relational. (correct answer)

   b. Structured data is also known as non-relational.

   c. Semi-structured data can be stored in a database table with rows and columns.

   d. Structured data can be stored in a database table with rows and columns. (correct answer)

5. Availability Zones allow customers to run mission-critical applications with what benefits?

   Select all that apply.

   a. High availability (correct answer)

   b. Low-latency replication (correct answer)

   c. Offsite backup

   d. Live migration

Open-ended questions

1. What can a company do to help ensure data redundancy when using Azure Blob storage?

   Answer: (Should include a statement that describes Locally Redundant Storage (LRS) and Zone Redundant Storage options and the pros/cons of each)

2. Describe what a resource group is on Azure and give an example of best practice when using a resource group.

   Answer: (Should include a statement that describes a resource group as a container of related resources for an Azure solution. It is best practice to add resources to the group that share the same lifecycle, such as a web application with data storage)

3. Describe what an availability zone is on Azure and what availability zones are used for.

   Answer: (Should include a statement that describes an availability zone as a service that protects applications from datacenter failures. An example could be to ensure 99.99% SLA uptime of a web service if it deployed as part of an availability zone)

4. A company wants to load balance the traffic across its SQL Virtual Machines on Azure. The Virtual Machines are not public facing. Which type of load balancer should be used and why?

   Answer: (Should include a statement that says an internal load balancer should be used as it only needs to load balance the traffic inside a virtual network using the private IP addresses of the VMs)

5. What is the main benefit to a developer when using Azure Functions?

   Answer: (Should include a statement that says Azure Functions allow developers to run small pieces of code without worrying about any of the underlying application infrastructure – they are very quick to deploy and publish)

Module 3: Core Solutions and Management Tools

1. When using an Azure IoT Hub service, what does the term 'command and control' apply to?

   Select the correct option.

   a. device-to-cloud communication

   b. file upload from devices

   c. cloud-to-device communication

   d. message routing

2. If your IoT solution cannot use one of the device SDKs or protocols supported by the Azure IoT hub, what Azure services can you use to support creating a custom protocol?

   Select the correct option.

   a. Azure IoT Sphere

   b. Azure IoT Edge

   c. Azure IoT Hub

   d. Azure IoT Central

3. Which of the following Azure services has pre-trained models available for you to send data to for predictions?

   Select the correct option.

   a. Azure Cognitive Services

   b. Azure Advisor

   c. Azure Machine Learning

   d. Azure IoT Hub

4. As part of Azure DevOps, what service would you use for adopting CI/CD for a development team?

   Select the correct option.

   a. Azure Advisor

   b. Azure Boards

   c. Azure Test Plans

   d. Azure Pipelines

5. Which of the following is an attribute of Azure Resource Manager (ARM) Templates?

Select the correct option.

a. YAML compatible

b. Repeatable results

c. Imperative syntax

d. Non-modular file structure

Open-ended questions

1. A company wants to develop a smart speaker that utilizes Azure services. The speaker should be able to respond to voice commands How might this be done?

Enter your answer in the following space.

Answer: (Should include a statement that mentions implementing Azure Cognitive Services, specifically using Language Understanding for understanding spoken commands.)

2. A water utility company wants to deploy sensors across reservoirs, sewers, and rivers it monitors for gauging water flow and levels as part of its flood planning strategy. There will be several thousand sensors deployed, each reporting a value every 5 seconds. The company wants to use Azure services as part of the sensor data collection, storage, and analysis. Name and describe two of the Azure services that could meet their needs.

Enter your answer in the following space.

Answer: (Should include a statement that mentions adopting Azure IoT services, in this case potentially an Azure IoT Hub or IoT Central would be a good fit. For storage a suitable database such as Cosmos DB. For data analytics Azure Synapse service could be used. There is flexibility in the responses and choice of service, particularly for storage, though a NoSQL option may be more suitable.)

3. As a developer you are tasked with creating and deploying test services such as virtual machines, networks, and storage. You need to deploy and tear down the same service types each week and are looking at a way to optimize doing this with one of Azure's management tools. Name an Azure management tool that would be suitable in this case and justify why.

Enter your answer in the following space.

Answer: (Should include a statement that mentions using Azure Resource Manager (ARM), specifically using ARM templates written in JSON. Using templates means the developer can redeploy the same services in a repeatable fashion by defining the required services in the ARM templates.)

4. A company wants to understand how it can reduce its Azure service costs and improve security. What Azure feature can the company use for this and what gives examples of information it can give on costs and security,

Enter your answer in the following space.

Answer: (Should include a statement that mentions the free Azure Advisor feature. For costs it can advise on under-utilized virtual machines for example and suggest smaller sizes. For security, recommendation may be given for securing internet facing ports and encrypting data at rest.)

5. As a developer, you want to use an Azure service to run event-driven code with quick deployment, without the need to manage server infrastructure. Which Azure service can you use and why?

Enter your answer in the following space.

Answer: (Should include a statement that mentions using Azure Serverless. The developer would just need to supply their event-driven code with minimal configuration as a function, which will then be exposed as an online RESTful function.)

Module 4: General security and networking features

Multiple choice questions

1. What type of data is actively moving from one location to another, such as across the internet or through a private network?

Select the correct option.

a. Immutable

b. In transit (correct answer)

c. At rest

d. In the cloud

2. What Azure service would you for use to run your virtual machines in an environment that ensures they are isolated from other virtual machines?

Select the correct option.

a. Availability Zone

b. Availability Set

c. Azure Dedicated Hosts (correct answer)

d. Azure Reserved VM Instances

3. What strategy employs a series of mechanisms to slow the advance of an attack aimed at acquiring unauthorized access to data?

Select the correct option.

a. Ciphertext

b. Blob security

c. Network security layers

d. Defense-in-depth (correct answer)

4. What type of attack attempts to overwhelm and exhaust an application's resources, making the application slow or unresponsive to legitimate users?

Select the correct option.

a. Distributed Denial of Service (DDoS) (correct answer)

b. Resource request attack (RRA)

c. Man in the Middle Attack

d. Firewall Bypass

5. Which layer of Defense-in-depth is focused on preventing network-based attacks?

Select the correct option.

a. Data layer

b. Identity and Access layer

c. Perimeter layer (correct answer)

d. Compute layer

Open-ended questions

1. In the context of the network layer in defense-in-depth, name and describe two actions that will help secure cloud resources.

Enter your answer in the following space.

Answer: (Should include a statement that mentions two or more of the following: limit communication between resources, deny access by default, restrict inbound internet traffic, and implement secure connectivity to on-premise networks. Essentially the focus at this layer is limiting networking connectivity across cloud resources to reduce the risk of an attack spreading through the network)

2. What kind of information might a company need to store in the Azure Key Vault, and why?

Enter your answer in the following space.

Answer: (Should include a statement that mentions passwords and API keys can be stored in the Azure Vault. Benefits include strong encryption and no way for applications to directly access the keys)

3. A company wants to limit all outbound traffic that originates from a specific virtual network. What Azure security feature is suitable for this?

Enter your answer in the following space.

Answer: (Should include a statement that mentions the Azure Network Security Group, and how it can be used to limit inbound and outbound traffic to/from all resources on a virtual network)

4. In what scenario would the Azure Blob immutable storage feature be useful?

Enter your answer in the following space.

Answer: (Should include a statement that mentions sectors such as Healthcare or Finance where data modification is strictly regulated)

5. The company you work for wants to enhance security across its enterprise services. As part of this it wants to use an automatic tool that can monitor all services and rapidly respond to threats. Which Azure service would be suitable for this and why?

Enter your answer in the following space.

Answer: (Should include a statement that mentions the use of Azure Sentinel. This service provides a top down view of all resources and collects data from all to monitor for threats. It uses AI to explore potential threats and rapidly deploy automated protection if necessary)

Module 5: Identity, Governance, Privacy and Compliance

1. What defines the set of controls that are recommended for resources within a specified subscription or resource group?

Select the correct option.

a. Symmetric policy

b. Secure score

c. Azure Policy (correct answer)

d. Asymmetric policy

2. If you want to prevent accidental deletion of an Azure resource, which of the following options should you use?

Select the correct option.

a. MFA

b. Azure Tags

c. Azure Resource Locks (correct answer)

d. Azure Policy

3. Which feature of Azure would you use to help logically organize resources into a taxonomy?

Select the correct option.

a. Azure Resource Locks

b. Azure Advisor

c. Azure Policy

d. Azure Tags (correct answer)

4. What Azure service would you use if you needed to define a repeatable set of Azure resources to deploy that also adheres to an organization's compliance requirements?

Select the correct option.

a. Azure Policy

b. Azure Blueprints (correct answer)

c. ARM Templates

d. Azure Tags

5. Which of the following applies to authorization?

Select the correct option.

a. Identifies the person or service seeking access to a resource

b. Requests legitimate access credentials

c. Basis for creating secure identity and access control principles

d. Defines which data a person or service can access, and what they can do with it

Open-ended questions

1. A company wants to implement geographic compliance requirements to limit locations where services can be deployed. How might this be done?

Enter your answer in the following space.

Answer: (Should include a statement that mentions implementing Azure Policy and creating a policy definition based on Allowed Locations. The policy enables the company to restrict the available locations when deploying resources. Its effect is used to enforce geographic compliance requirements)

2. An employee working in the human resources department of a company is assigned a role via the Azure role-based access control (RBAC). This enables them to read and write to employee records. Considering the company has many other departments, should employees in all departments have the same RBAC role assigned as the human resource employees, or can it be done another way?

Enter your answer in the following space.

Answer: (Should include a statement that mentions employees should be assigned different roles via RBAC dependent upon the department they are in and their overall responsibilities. For example, some employees may only require read permissions, while others require write permissions. This can be managed through RBAC at a granular level)

3. A business wants to enhance the security of the customer sign-in process for its website so that it asks for additional forms of identification. What type of Azure service could they use for this? Additionally, give examples of the types of additional identification information that could be used.

Enter your answer in the following space.

Answer: (Should include a statement that mentions Azure MFA (multi-factor authentication). The additional identification falls into three categories: something you know (security question), something you possess (mobile phone for token generation), and something you are - biometrics such as fingerprint)

4. A business offers several separate services for music, video, and eBook content with each service requiring separate sign-in credentials. To make the customer experience more seamless they want to use a service that allows customers to use one set of sign-in credentials for all separate services. Currently the business uses Azure Active Directory (AAD). What service do they need to add to enable the new sign-in approach?

Enter your answer in the following space.

Answer: (Should include a statement that mentions as they are already using AAD, they can simply enable the single sign-on (SSO) service which is part of AAD. This will enable customers to use just one username and password for all services which greatly simplifies account management)

5.. You work for a company that specializes in online healthcare and stores sensitive data. The company wants to expand into different healthcare markets across the globe and wants to use Azure services. What documentation on Azure would you need to refer to for guidance and why?

Enter your answer in the following space.

Answer: (Should include a statement that mentions referring to the Azure Compliance Documentation. The documentation provides information about legal and regulatory standards and compliance on Azure for different industries and regions across the globe, including healthcare. By referring to the documentation, the company can help ensure they comply with local laws in the regions of interest and in some cases if it is not possible to do so)

Module 6: Azure Pricing and Lifecycle

Multiple choice questions

1. Data that flows into a datacenter is called:

Select the correct option.

a. Ingress (correct answer)

b. Egress

c. Both Ingress and Egress

d. Neither Ingress nor Egress

2. The Azure Pricing Calculator provides:

Select the correct option.

a. A bill for the selected configurations of products and services used in the past month.

b. A means to save money by committing to selected configurations of products and services over one or three years.

c. An estimate of the costs associated with selected configurations of products and services. (correct answer)

d. A tool to compare on-premise costs to Azure products and services.

3. Application availability refers to what?

Select the correct option.

a. The Service Level Agreement (SLA) of the associated resource

b. Application support for an availability zone

c. The overall time that a system is functional and working (correct answer)

d. The Azure Region the application is deployed to

4. Which one of the following systems is used to determine Azure costs for each billing period?

Select the correct option.

a. The Azure website

b. Number of created virtual machines (VMs)

c. The Azure pricing calculator

d. Usage meters (correct answer)

5. Complete the following sentence. As an Azure customer, Azure Reservations offer discounted prices if you:

Select the correct option

a. Make upfront commitments on compute capacity. (correct answer)

b. Provision many resources

c. Have a free account

d. Set spending limits

Open-ended questions

1. What are some strategies a company could use to minimize their costs when using Virtual Machines?

Answer: (Should include a statement that mentions deallocating resources Virtual Machines when not in use. For non-critical workloads on Virtual Machines, Azure Spot Instances can save money)

2. Using the Azure Pricing Calculator, price a virtual machine in different locations around the world and compare the costs. What do you notice? What factors may have influenced the prices that you see? And what factors other than cost should you consider when choosing a location for your virtual machine?

Answer: (Should include a statement that says the cost of running Azure datacenters may vary around the globe due to factors such as energy costs and local taxes. Multiple factors other than cost need to be considered if deploying a service in a location that is less expensive. For example, is it far from the customers and increases latency? Additionally, would deploying to the location breach compliance or government regulations around data privacy?)

3. Some tiers of Azure services do not have an SLA provided. Give an example of one and state why it does not have an SLA.

Answer: (Should include a statement that mentions a free-tier option for a service, such as the App Service that offers a free and shared tier that do not offer an SLA. Free tiers are normally designed for testing or staging environments before moving to a paid tier with an SLA)

4. In what scenario might a company consider using reserved instances for Virtual Machines, and what are the cost implications?

Answer: (Should include a statement that says reserved instances are paid for up front and have some flexibility in terms of virtual machine sizes. There are significant cost savings compared to pay-as-you-go pricing however planning is required to ensure optimal savings are achieved)

5. Discuss two differences between the Developer and Standard Azure support plans.

Enter your answer in the following space.

Answer: (Should include a statement that identifies two differences between the stated support plans. These could be the Standard plan that offers 24/7 access to technical support by phone as well as production workload support, neither of which are covered by the Developer support plan)

Section 2: Capstone Project

Overview

This guide features a single, end-of-course Capstone project in which each student creates and delivers a cloud solution presentation based on client requirements. The project draws upon the students' understandings gained from all modules in the course and presents an opportunity to demonstrate their intellectual curiosity around the design and presentation of a scenario-based cloud solution. It is designed to be flexible enough to be used in a variety of contexts for students of various technical levels.

The Capstone Project Student Guide can be copied and redistributed to students as standalone content, as it provides an example of a baseline project that could be tailored to fit the needs of various classes. You may choose to modify some of the content dependent on which parts of the Capstone are to be assessed and whether a real-world client or pre-defined scenario is used.

The Capstone Project Educator Guide provides additional guidance for modifications that can be made to the capstone project, as well as comprehensive information on best practices in the preparation and development of the project.

The Capstone Project Rubric provides additional information for students and teachers in using the project as a summative assessment. Students may use this document to guide them as they complete the activities, ensuring that their work reflects what they have learned in the course.

Capstone Project - Educator Guide

Overview and Objectives

This is the final activity for the course. The primary objective is to create a presentation that summarizes and justifies an industry client's needs and goals for cloud services, along with a list of the recommended cloud services required to realize the goals. The presentation should also document the expected cloud service costs and state the benefits to the client. This is an opportunity for students to reflect on what they have learned throughout the course, both about Microsoft Azure and the client.

Capstone Modification Options

As you plan your course, you may choose to tailor the Capstone project to the unique needs of your students. This may be in response to particular learning goals or logistical constraints. Depending on the student cohort and the focus of their study program, you may want to consider changes to:

- The parts of the Capstone students will be assessed on.
- The use of either a real-world client or pre-defined client scenario.
- The rubric criteria

The Capstone can be completed individually or in groups and is modular to suit different student cohorts. You can select which parts of the Capstone project to deploy for assessment purposes.

To align with industry expectations and real-world application of cloud skills, the Capstone is primarily designed as a scenario-based project. In the baseline version of the project, students interact with a real-world industry client, allowing them to experience the requirements gathering phase and carry out the required research around selecting suitable cloud services. If this is not possible, you can develop a pre-defined industry scenario where students will make assumptions based upon the scenario content to develop an informed set of requirements. You can also ask students to research an existing company and develop a set of recommendations based on publicly available information.

The rubric criteria can easily be modified to reflect the priorities within your own classroom. You may choose to add or remove rows from the rubric or change the details of the scoring criteria.

Capstone Parts

The Capstone is split into three parts that offer some flexibility to adapt to student needs and their program of study:

- Part 1 – Produce a list of appropriate cloud services for a real-world client/pre-defined scenario.
- Part 2 – Design a cloud infrastructure diagram for the selected cloud services.
- Part 3 – Present the cloud solution with a discussion on the selected services.

It may be more appropriate to assess students on less-technical programs against **Parts 1** and **3**. Students on more technical programs may be assessed across **Parts 1, 2,** and **3**. This is a judgement that you, as the instructor, are best equipped to make.

Part 1 – Produce a list of appropriate cloud services for a real-world client/pre-defined scenario

Depending on how you deliver the course, students can use class sessions or independent study time to complete their Capstone work. This can also be facilitated through remote drop-in/support sessions.

Remind students to review the Capstone rubric so they understand the required tasks for part 1 as listed below:

- A summary description of their clients' current situation, their needs, and their goals.
- What kind of cloud service model (public, private, or hybrid) would work best for the client and why?
- What kind of cloud service type (IaaS, PaaS, or SaaS) would work best for the client and why?
- Specific Azure services and solutions they recommend for their clients and why?
- Expected costs – use the online Azure Pricing Calculator for this.
- Benefits to their clients.

Part 2 – Design a cloud infrastructure diagram for the selected cloud services

This part of the Capstone project is designed specifically for students in more technical programs. It involves taking the cloud services identified from part 1 and integrating them in an interconnected architectural diagram. The diagram can be created in Microsoft PowerPoint or Microsoft Visio using the Microsoft Azure Icon Set. Alternatively, there are several free to use web-based diagramming tools that are suitable for the task. An example diagram is presented in Appendix B that addresses the pre-defined client scenario for a company focused on a need for IoT cloud services.

Remind students to review the Capstone rubric so they understand the required tasks for part 1 as listed below:

- Visualize core cloud services from the identified list of cloud services.
- Cloud services should correctly highlight relationships to other services through connections.
- Identifies customer endpoints.

Part 3 – Present the cloud solution with a discussion on the selected services

Students can deliver their presentations either in-class or remotely. In terms of timings, approximately 10 minutes for the presentation followed by 5 minutes for questions should suffice. Consider the following options to decide the best format for your students to present their work to an audience:

- **Whole-class presentations:** Students share their presentations with the whole class, taking turns and following any time limits – this is only suitable for small class sizes.
- **Small group presentations:** Divide the class into small groups. Allow each student a set amount of time to present to the other students in the group.
- **Invite the clients:** If possible, inviting the clients to the presentations will provide the students with further feedback opportunities.

Students should be encouraged to discuss and justify why they selected specific cloud services to meet the client's needs. You may want to ask students to respond to some or all of these reflection questions:

- Why did you choose a specific service over another?
- What benefits might the client customers expect?
- What was the most challenging part of the project?
- If you had more time what improvements would you make?

Client Scenarios

In the baseline project as outlined in the student guide, students are assumed to have access to a real-world client. However, you may also choose to have students research information about a client or provide them with a pre-defined client scenario.

Real-world client

The benefits when using a real-world client are clear, it provides a measure of authenticity for the students and also aligns with industry expectations. Generally, the instructor would be responsible for sourcing one or more clients with whom the students can have scheduled time with to understand their current business needs and goals. Ideally a session would be arranged with the client in the first instance where they can communicate their needs and goals to all students, followed by a Q & A session.

The instructor should guide the client to communicate the following information for the students to ensure students have all the information they need to begin their preparatory work:

- Company type
- Products
- Customer expectations
- Current technology resources
- Projected needs and goals

Researched client

If direct access to real-world clients is not available, you may choose to have students research a client using publicly available information. This allows for a sense of authenticity without the logistical challenges of managing client interactions. In this case, you may have students choose from a list of appropriate clients that you have pre-selected or allow each student to submit their own potential client for approval. Be sure to confirm that students can find the same information listed in the previous section from publicly available information when creating a list of appropriate clients and/or approving clients submitted by students.

Pre-defined client

If a client is not be available or if there are time constraints to deliver the course, you can also choose to give students a pre-defined client scenario. See below for an Internet of Things scenario that can be used as the pre-defined client scenario. You should feel free to modify the scenario or develop one of your own.

The client company develops smart home products with a focus on sensor-driven automated heating and hot water systems. The sensor data is uploaded frequently to the company's on-premises servers where it is analyzed to make decisions on optimizing customers heating and hot water temperatures. This saves customers money on their utility bills and reduces emissions. At present, around 50,000 datapoints are sent to the company servers per day from customer's homes for processing and storage. The business currently uses its own on-premises application and storage servers, but this approach is no longer sustainable due to significant and sustained growth. The company anticipates that with current growth targets it will be processing 500k datapoints per day within 6 months, with their current on-premises solution not able to process this volume of data or have any spare capacity for hardware expansion.

The way forward for the company to meet customer demand and expectations for their products is to use scalable cloud services. This will support the goal of business expansion and surpass the current responsiveness and reliability of their products to increase customer satisfaction. The company would like to explore the use of managed cloud services for Internet of Things use cases.

The following information can be derived from the client scenario above, which is similar to the basic information that can be derived from a real-world client:

- **Company type** – Specializes in the Internet of Things market space
- **Their products** – Intelligent home monitoring products for heating and hot water
- **Their customers' expectations** – Customers expect to be able to save money on their heating and water bills.
- **Their current situation and how they do things now** – Currently using on-premise servers, which cannot meet their expansion needs and may start to impact on the customer experience
- **Their projected needs and goals** – Significant growth requires scalable cloud services with the goal of using managed cloud services for Internet of Things use case

Preparing and Supporting Students

We recommend that you introduce the Capstone after Module 2 to allow students to start thinking about how they can apply what they are learning each week to the project. The end-of-module questions, particularly the questions with an open-ended format, lend themselves well to preparing your students to think independently about the processes to design a suitable cloud solution for the project. See the introduction to the **Module Questions** section for suggestions of how to encourage high student engagement with the Module Questions to help scaffold the process of designing a full-scale solution for the Capstone project.

If students have questions or are facing problems while completing the tasks, direct them to the following problem-solving strategies before asking you for help:

- Review the content in the Student Capstone Guide.
- Research the official Microsoft Azure Documentation.
- Ask peers for help.
- Review their client notes/pre-defined scenario document.

You may consider adding extra sessions as needed for the Capstone preparation and presentation delivery. This will give students dedicated collaborative time to work in groups and allow you to informally monitor their progress as they move through the various tasks.

Capstone Project - Student Guide

Overview

In this Capstone, you'll create a presentation that summarizes your client's current situation, needs, and goals; lists the services you'd recommend for your client; documents the expected costs; outlines an architectural diagram; and states the benefits for your client. This is an opportunity for you to reflect on what you have learned throughout the course about Microsoft Azure and your client.

Preparing for the Capstone

To best prepare for the Capstone, consider the following:

- **Start preparing early**. Read this Capstone guide early in the course.
- **Meet with your client and take notes**. Take and keep thorough notes about your client and remember it's better to get too much information from your client than not enough.
- **Think about your client in each module**. As you learn new concepts in each module, consider how they might apply to your client.
- **Work on the presentation early and complete the end-of-module questions**. Consider building your presentation throughout the course. The end-of-module questions are designed to help support your understanding of the Capstone tasks, so think about your project as your complete them.
- **Refer to the rubric as you work**. Use the Capstone rubric document to ensure you fully understand the requirements for the tasks presented below.

Capstone Tasks

Task 1 - Produce a list of appropriate cloud services for the client

In the first phase of this project, you will be working to understand your client's needs and using what you know about cloud services to design a solution. By the end of this task, you should have a clear idea of what your client's needs are and how your solution meets those needs. You will be using this information to create a presentation in Task 3, so be sure that you have all the following documented:

- A summary description of the client's current situation, their needs, and their goals
- Cloud service model (public, private, or hybrid) recommended for the client and explanation
- Cloud service type (IaaS, PaaS, or SaaS) recommended for the client and explanation
- Specific Azure services and solutions recommended for the client and explanation
- Expected costs (use the online Azure calculator for this)
- Benefits to the client.

Task 2 – Design a cloud infrastructure diagram

Use the list of Azure services identified in Task 1 and integrate them in an interconnected architectural diagram. The diagram can be created in Microsoft PowerPoint or Microsoft Visio using the Microsoft Azure Icon Set. Alternatively, there are several free to use web-based diagramming tools that are suitable for the task.

Be sure to include the following in your diagram:

- A visualization of each of the core cloud services recommended to your client

- Connections that correctly highlight relationships between services
- Identification for each of the customer endpoints

Task 3 – Present the cloud solution

In this phase, you will deliver a ten-minute presentation that describes the needs analysis, recommendations, and explanations that you documented earlier in the project. After the presentation, others will have an opportunity to ask you questions about your process and recommendations. Make sure you include clear evidence to support the decisions that you have made, based on the information that you gathered about your client, and that your presentation is organized and detailed enough for your audience to have a good understanding of the benefits of your recommendations.

Support and Resources

If you have questions or are facing problems while completing the tasks, use the following problem-solving strategies before asking your instructor for help:

- Review the content in this Student Capstone Guide.
- Research the official Microsoft Azure Documentation.
- Ask peers for help.
- Review your client notes.

Post-Project Reflection Questions

1. What did you learn in creating and delivering this Capstone presentation that might be helpful to you in the future?

2. What challenges did you experience? How did you work to overcome them?

3. What components of your presentation went well? What are some things in your presentation that you could improve?

4. Add other comments you would like to make about this project or your work.

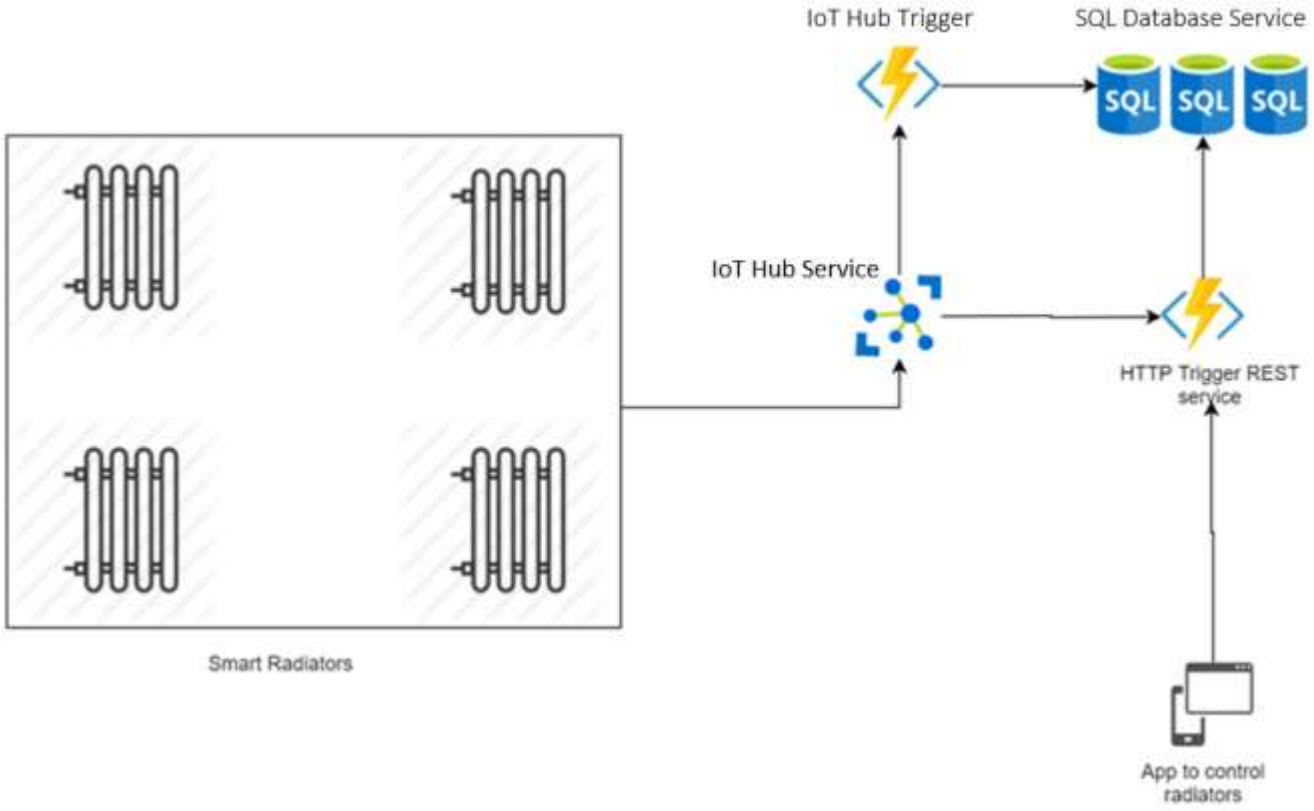
Appendix A – Capstone Rubric

Item	Approaches standard	Meets standard	Exceeds standard (Includes items in Meets Standard)	Summarize where & how you included this item
Task 1				
Description of client's current cloud situation, goals, and needs	Description of the client's situation, goals, and needs aren't clear and relevant.	Description of the client's situation, goals, and needs are clear and relevant to the organization.	Description includes direct quotations from the client that provide details about their situation, goals, and needs and that are relevant to the organization.	
Recommended Microsoft Azure service solutions for the client and reasoning	Not all recommendations fit the client, or cover all aspects of the course, or demonstrate an understanding of Azure products and services.	Recommendations fit clearly with an understanding of the client. Recommendations consider services and solutions from the course. Reasoning for recommendations demonstrates an understanding of Azure and cloud concepts.	Recommendations at times evidence critical thinking and explains products and services that weren't chosen and a rationale as to why.	
Description of the costs expected for the client	Costs aren't clearly explained or lack detail, or the costs don't include support or a service-level agreement (SLA).	Costs are clearly explained in a detailed way that's easy to understand. All costs are considered, including support and SLAs.	All costs include supporting information that relates cost to the client's specific needs.	
Description of the benefits for the client	Client benefits aren't clearly explained or lack detail, or a total cost of ownership (TCO) calculation isn't included.	Client benefits are clearly explained in a detailed way that's easy to understand and includes a TCO calculation.	Benefits include supporting information that relates to the client's current situation and potential needs in the future.	

Task 2				
Visualize through a diagram core cloud services from the identified list of cloud services/solutions from task 1	Diagram conveys a basic, but somewhat limited cloud infrastructure solution for the client's needs. Some cloud resource types may not be the best fit or are missing.	The diagram presents a robust infrastructure solution that should meet most of the client requirements. An appropriate range of cloud services are evidenced.	The diagram presents a well-considered cloud infrastructure that should fully support the client's needs. A wide range of cloud services are presented. Cloud compute, storage, networking, and security are considered to a good standard.	
Cloud services in diagram should correctly highlight relationships / connections to other services	Some cloud services evidence interconnectivity but lacks cohesiveness and detail.	Cloud services interconnection and relationships are presented correctly and clearly.	Cloud services interconnection is well-considered and detailed to a good standard for all services.	
Task 3				
Presentation aids	Not all materials are organized or easy to understand. Not all visual and/or audio elements help audience understanding, some might distract.	Materials are organized and clear. Visual or audio elements help audience understanding.	Materials are interesting, easy to understand, and include at least one way to gather audience responses beyond just asking if there are any questions.	
Delivery of presentation	Presenter isn't prepared or doesn't engage with the audience.	Presenter is prepared and engaged with the presentation and the audience. Communication of ideas is mostly clear and effective.	Presenter communicates beyond just reading the words on the presentation materials. Communication of ideas is consistently clear and effective.	

Appendix B – Example Capstone Architectural Diagram

The diagram is an indicative example of what a student could produce as a basic implementation to address the pre-defined client scenario in the Client Scenarios section.



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