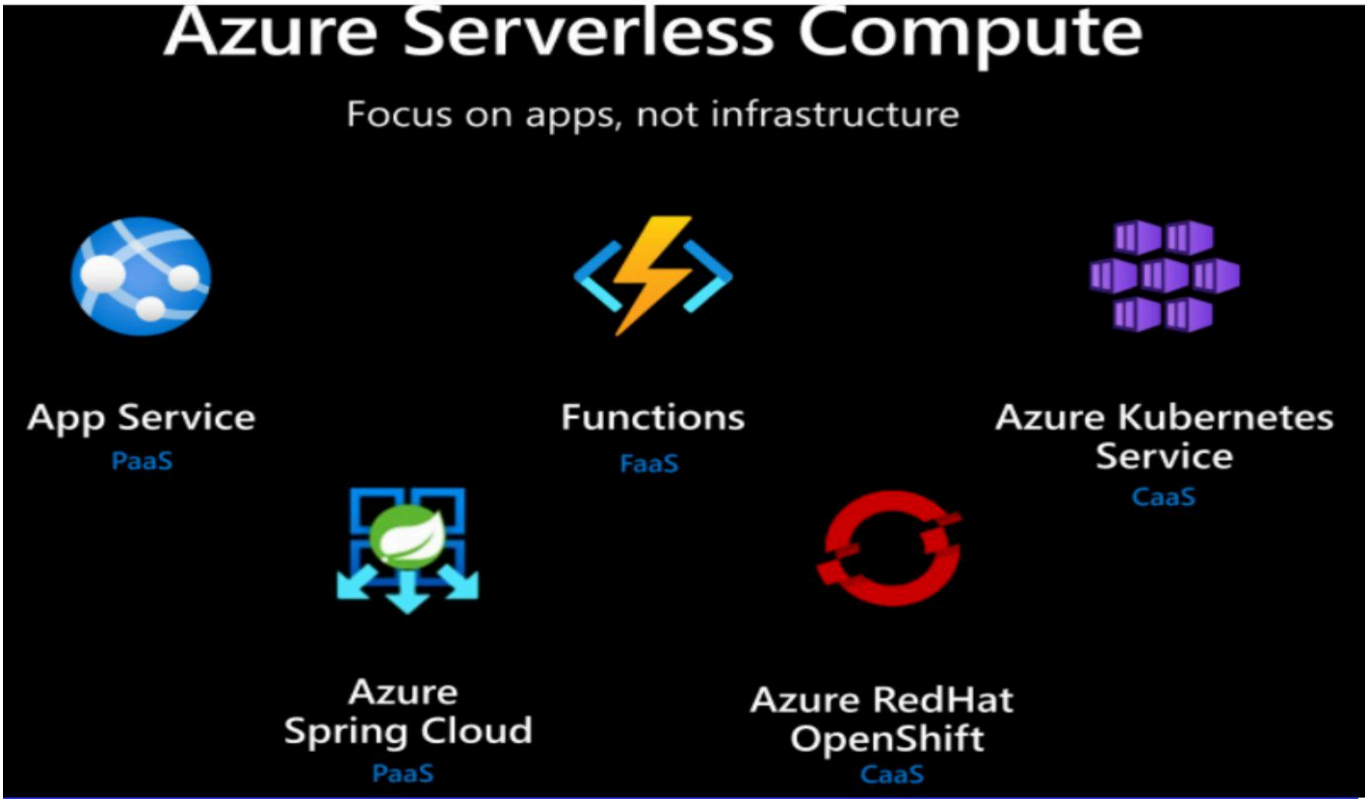
SERVERLESS COMPUTING IN AZURE

REALTIME PROJECTS

PART 4



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Project 1: Serverless Event-Driven Image Processing Pipeline

1. Project Scope

This project automates the process of resizing, watermarking, and optimizing images using Azure Functions and Azure Blob Storage. Whenever a new image is uploaded to a specific container, an event is triggered to process and store the transformed image in another container.

2. Tools Used

- **Azure Blob Storage** (For image storage)
- **Azure Functions** (Serverless compute for processing)
- **Azure Event Grid** (Event-driven architecture)
- **Azure Application Insights** (For monitoring)
- **Python** (Function code for image processing)

3. Analysis Approach

- When a user uploads an image to Blob Storage, **Azure Event Grid** triggers an Azure Function.
- The Function **resizes and watermarks the image** using the Python Pillow library.
- The processed image is then **saved in another container** for optimized delivery.

4. Step-by-Step Implementation

1. **Create an Azure Storage Account**
    - Navigate to **Azure Portal** → Create **Storage Account**.
    - Create **two containers**: `input-images` (for uploads) and `processed-images` (for processed files).
2. **Enable Event Grid Subscription**
    - In the Storage Account, enable **Event Grid**.
    - Create an event subscription that **triggers the Azure Function** whenever a new file is uploaded.
3. **Create an Azure Function**
    - Choose **Python runtime** and install dependencies (`pip install pillow`).
    - Implement function logic:

```python
from PIL import Image
import io
from azure.storage.blob import BlobServiceClient

def main(event: dict):
```

```
    storage_connection_string = "<Azure_Storage_Connection_String>"
    blob_service_client =
BlobServiceClient.from_connection_string(storage_connection_string)

    input_blob = event['data']['url']
    container_name = "processed-images"

    # Fetch the uploaded image
    blob_client =
blob_service_client.get_blob_client(container="input-images",
blob=input_blob.split("/")[-1])
    img_bytes = blob_client.download_blob().readall()

    # Process image
    image = Image.open(io.BytesIO(img_bytes))
    image = image.resize((500, 500))  # Resize to 500x500

    # Save the new image
    img_io = io.BytesIO()
    image.save(img_io, format='JPEG')
    img_io.seek(0)

    # Upload processed image
    output_blob_client =
blob_service_client.get_blob_client(container=container_name,
blob=input_blob.split("/")[-1])
    output_blob_client.upload_blob(img_io, overwrite=True)
```

4. **Deploy & Test**
    - Deploy function to **Azure Functions** using `Azure CLI`.
    - Upload an image to `input-images`, check if it's processed in `processed-images`.

5. Conclusion

This project demonstrated **event-driven image processing using serverless architecture**, eliminating the need for VM-based solutions. It improves efficiency and scalability.

Project 2: Serverless Video Transcription using Azure Cognitive Services

1. Project Scope

This project transcribes audio from uploaded videos in **real-time** using **Azure Functions** and **Azure Speech-to-Text API**.

2. Tools Used

- **Azure Blob Storage** (For video uploads)
- **Azure Event Grid** (For event-driven processing)
- **Azure Functions** (For executing transcription)
- **Azure Cognitive Services Speech API** (For speech-to-text conversion)
- **Python** (For integration)

3. Analysis Approach

1. A user uploads a video file to a **Blob Storage container**.
2. An **Azure Event Grid trigger** detects the file and calls **Azure Functions**.
3. The function extracts the **audio from video** and **sends it to the Azure Speech API**.
4. The transcribed text is stored in **Blob Storage or Cosmos DB**.

4. Step-by-Step Implementation

1. **Create a Storage Account & Container**
    - Containers: `videos` (raw files), `transcripts` (text output).
2. **Enable Event Grid**
    - Create an **event subscription** for blob uploads.
3. **Create an Azure Function**
    - Install dependencies: `pip install azure-cognitiveservices-speech moviepy`
    - Implement transcription function:

```python
import azure.cognitiveservices.speech as speechsdk
from moviepy.editor import AudioFileClip

def transcribe_audio(audio_path):
    speech_config = speechsdk.SpeechConfig(subscription="<API_KEY>",
region="eastus")
    audio_input = speechsdk.AudioConfig(filename=audio_path)

    speech_recognizer =
speechsdk.SpeechRecognizer(speech_config=speech_config,
audio_config=audio_input)
```

```
    result = speech_recognizer.recognize_once()

    return result.text

def main(event):
    # Extract audio from video
    video_path = event['data']['url']
    audio_path = "/tmp/audio.mp3"
    AudioFileClip(video_path).write_audiofile(audio_path)

    # Transcribe audio
    transcript = transcribe_audio(audio_path)

    # Save to Blob Storage
    save_transcription(transcript)
```

4. **Deploy and Test**
    - Deploy the function to **Azure Functions**.
    - Upload a **video file**, verify if transcription is generated.

5. Conclusion

This project showcases **real-time video-to-text conversion** without using servers, demonstrating how Azure Functions and Cognitive Services can be used effectively.

Project 3: Serverless Chatbot with Azure AI and Functions

1. Project Scope

Create a **serverless AI chatbot** using **Azure OpenAI** that responds to user queries in real-time.

2. Tools Used

- **Azure Functions** (For handling API requests)
- **Azure OpenAI** (For AI-powered responses)
- **Azure API Management** (For managing APIs)
- **Python & FastAPI** (For building API)

3. Analysis Approach

- A client sends a **query to the Azure Function** via an API request.

- The **Azure Function** forwards it to the **OpenAI API**.
- The response is sent back **as a real-time chatbot reply**.

4. Step-by-Step Implementation

1. **Create an Azure Function App**
   - Use **Python runtime** and enable HTTP triggers.
2. **Integrate OpenAI API**
   - Install: `pip install openai fastapi`
   - Function code:

```python
from fastapi import FastAPI
import openai

app = FastAPI()
openai.api_key = "<API_KEY>"

@app.post("/chatbot")
def chatbot(query: str):
    response = openai.Completion.create(
        model="gpt-3.5-turbo",
        prompt=query,
        max_tokens=50
    )
    return {"reply": response["choices"][0]["text"]}
```

3. **Deploy to Azure Functions**
   - Use `Azure CLI` to deploy the function.
   - Connect it to a chatbot UI for real-time interaction.
4. **Test the chatbot**
   - Send a POST request:

```
curl -X POST "https://<function-url>/chatbot" -d '{"query":"Hello"}'
```

5. Conclusion

This project provides an AI-powered **real-time chatbot** without requiring dedicated servers, making it scalable and cost-efficient.

Project 4: Automated Resume Screening with Azure AI & Cosmos DB

1. Project Scope

This project automates **resume screening** using **Azure Cognitive Services** and **Azure Cosmos DB**. When a **new resume (PDF/DOCX) is uploaded**, the system extracts key details like name, experience, and skills, stores them in **Cosmos DB**, and provides insights.

2. Tools Used

- **Azure Blob Storage** (For storing resumes)
- **Azure Cognitive Services (Text Analytics API)** (For extracting skills and experience)
- **Azure Functions** (For processing data)
- **Azure Cosmos DB** (For storing structured data)
- **Azure Logic Apps** (For automation)

3. Analysis Approach

1. **A user uploads a resume** to Blob Storage.
2. **Event Grid** triggers an **Azure Function**.
3. **Cognitive Services (Text Analytics API)** extracts **name, skills, and experience**.
4. The extracted details are **stored in Cosmos DB**.
5. **Azure Logic Apps** sends **email notifications** for qualified candidates.

4. Step-by-Step Implementation

1. **Create Azure Storage Container**
    - Containers: `resumes` (raw files) and `processed-resumes`.
2. **Enable Event Grid Trigger**
    - Set up an **event subscription** for blob uploads.
3. **Create Azure Function**

```python
import azure.cognitiveservices.speech as speechsdk

from azure.ai.textanalytics import TextAnalyticsClient
```

```
from azure.identity import DefaultAzureCredential

from azure.storage.blob import BlobServiceClient


def extract_text_from_resume(resume_url):

    credential = DefaultAzureCredential()

    client = TextAnalyticsClient(endpoint="<TEXT_ANALYTICS_ENDPOINT>",
credential=credential)

    document = [resume_url]


    response = client.extract_key_phrases(document)

    return response


def main(event: dict):

    resume_url = event['data']['url']

    extracted_data = extract_text_from_resume(resume_url)


    # Store in Cosmos DB

    save_to_cosmos_db(extracted_data)
```

4. **Deploy & Test**
    - Upload a resume and check if **data is stored in Cosmos DB.**

5. Conclusion

This project **automates resume processing**, helping HR teams shortlist candidates efficiently.

Project 5: Serverless IoT Data Processing with Azure Stream Analytics

1. Project Scope

This project **ingests IoT sensor data in real-time** and performs **analytics** using **Azure Stream Analytics** and **Azure Functions**.

2. Tools Used

- **Azure IoT Hub** (For collecting IoT data)
- **Azure Stream Analytics** (For real-time processing)
- **Azure Functions** (For data transformations)
- **Azure Cosmos DB** (For storing results)
- **Power BI** (For visualization)

3. Analysis Approach

1. **IoT devices** send telemetry data (temperature, humidity) to **Azure IoT Hub**.
2. **Azure Stream Analytics** processes and filters anomalies.
3. **Azure Functions** transforms the data.
4. **Processed data** is stored in **Cosmos DB**.
5. **Power BI Dashboard** visualizes live data.

4. Step-by-Step Implementation

1. **Set Up Azure IoT Hub**
   - Register an IoT device and generate connection string.
2. **Create Azure Stream Analytics Job**
   - Input: IoT Hub
   - Output: Azure Cosmos DB
   - Query:

```
Unset
SELECT deviceId, temperature, humidity, system.Timestamp AS time

INTO cosmosdb_output

FROM iot_hub_input

WHERE temperature > 80
```

3. **Create Azure Function for Data Transformation**

Python
```python
import json

def main(event: dict):

    data = json.loads(event)

    if data['temperature'] > 100:

        alert = "Critical temperature alert!"

    else:

        alert = "Normal temperature"

    return {"alert": alert}
```

4. **Deploy & Test**
    - Simulate **IoT data ingestion**.
    - Check **alerts in Cosmos DB**.

5. Conclusion

This project enables **real-time IoT data analytics**, useful for **predictive maintenance**.

Project 6: Real-time Twitter Sentiment Analysis using Azure Functions

1. Project Scope

This project **monitors Twitter** for a keyword and performs **sentiment analysis** using **Azure AI**.

2. Tools Used

- **Azure Logic Apps** (For Twitter API integration)
- **Azure Functions** (For text processing)
- **Azure Cognitive Services** (For Sentiment Analysis)
- **Azure Cosmos DB** (For storing results)
- **Power BI** (For visualization)

3. Analysis Approach

1. **Azure Logic Apps** fetches **real-time tweets**.
2. **Azure Function** analyzes tweet sentiment.
3. **Results are stored in Cosmos DB.**
4. **Power BI Dashboard** visualizes sentiment trends.

4. Step-by-Step Implementation

1. **Set Up Logic App**
    - Connect Twitter API to fetch tweets.
2. **Create Azure Function**

```python
from azure.ai.textanalytics import TextAnalyticsClient


def analyze_tweet(tweet):

    client = TextAnalyticsClient(endpoint="<API_ENDPOINT>",
credential="<KEY>")

    result = client.analyze_sentiment([tweet])

    return result[0].sentiment
```

3. **Store Results in Cosmos DB**
    - Insert **sentiment scores** into Cosmos DB.
4. **Deploy & Test**
    - Monitor **live sentiment trends** in Power BI.

5. Conclusion

This project enables **real-time brand monitoring** using **AI-powered sentiment analysis**.

Project 7: Automated Document Summarization with Azure AI

1. Project Scope

Automatically **summarizes large documents** using **Azure Cognitive Services.**

2. Tools Used

- **Azure Blob Storage** (For storing documents)
- **Azure Cognitive Services** (For text summarization)
- **Azure Functions** (For processing)
- **Cosmos DB** (For storing summaries)

3. Analysis Approach

1. **User uploads a document.**
2. **Azure Function extracts key insights.**
3. **Summary is stored in Cosmos DB.**

4. Step-by-Step Implementation

1. **Upload Document to Blob Storage**
    - Create a container `docs`.
2. **Create an Azure Function**

```python
def summarize_text(text):

    client = TextAnalyticsClient(endpoint="<ENDPOINT>",
credential="<KEY>")

    result = client.extract_summary([text])

    return result[0].summary
```

3. **Deploy & Test**
    - Upload a large document and retrieve **summary.**

5. Conclusion

This project **reduces reading time** using **automated text summarization.**

Project 8: Real-time Weather Data Processing with Azure Event Hub

1. Project Scope

Real-time weather data processing using **Azure Event Hub**.

2. Tools Used

- **Azure Event Hub** (For ingesting data)
- **Azure Functions** (For processing)
- **Cosmos DB** (For storing results)

3. Analysis Approach

1. **Weather sensors push data** to **Event Hub**.
2. **Azure Function transforms the data.**
3. **Processed data is stored in Cosmos DB.**

4. Step-by-Step Implementation

1. **Set Up Event Hub**
   - Configure **real-time streaming.**
2. **Create Azure Function**

```python
def process_weather(event):

    data = json.loads(event)

    return {"temperature": data["temp"], "humidity": data["humidity"]}
```

3. **Deploy & Test**
   - Simulate **weather events.**

5. Conclusion

This project enables **real-time weather insights**.

Project 9: AI-based Email Classification using Azure Logic Apps

1. Project Scope

This project automates **email classification** using **Azure AI**. Incoming emails are categorized as **Spam, Important, or General** using **Azure Cognitive Services**.

2. Tools Used

- **Azure Logic Apps** (For email processing)
- **Azure Cognitive Services** (For text classification)
- **Azure Functions** (For decision logic)
- **Cosmos DB** (For storing email metadata)

3. Analysis Approach

1. **Emails are received** via Outlook/Gmail.
2. **Logic Apps extracts email content.**
3. **Azure Function sends content to Azure AI** for classification.
4. **Classified emails** are stored in **Cosmos DB.**
5. **Spam emails** are automatically moved to the spam folder.

4. Step-by-Step Implementation

1. **Create Azure Logic Apps**
    - Connect Logic Apps to **Outlook API** to read emails.
2. **Implement Email Processing Workflow**
    - **Trigger**: When a new email is received.
    - **Action**: Extract **email body & subject.**
    - **Send data to Azure Function.**
3. **Create Azure Function for Classification**

```python
from azure.ai.textanalytics import TextAnalyticsClient

def classify_email(email_text):
```

```
    client = TextAnalyticsClient(endpoint="<ENDPOINT>",
credential="<KEY>")

    result = client.analyze_sentiment([email_text])

    if "urgent" in email_text.lower():

        return "Important"

    elif "discount" in email_text.lower():

        return "Spam"

    else:

        return "General"
```

4. **Store Results in Cosmos DB**
    - Categorized emails are stored with metadata.
5. **Deploy & Test**
    - Send emails with **different subjects** and verify classification.

5. Conclusion

This project automates **email classification**, saving time for users and improving inbox management.

Project 10: Serverless URL Shortener with Azure Durable Functions

1. Project Scope

Create a **serverless URL shortener** like **bit.ly** using **Azure Functions and Durable Functions**.

2. Tools Used

- **Azure Durable Functions** (For workflow automation)
- **Azure Table Storage** (For storing short URLs)
- **Azure API Management** (For exposing URL shortening service)

3. Analysis Approach

1. **Users submit long URLs** via API.
2. **Durable Function generates a unique short URL.**
3. **Short URL is stored in Azure Table Storage.**
4. **When accessed, the short URL redirects to the original URL.**

4. Step-by-Step Implementation

1. **Create Azure Function for Short URL Generation**

```python
import random, string

from azure.data.tables import TableServiceClient


def generate_short_url():

    return ''.join(random.choices(string.ascii_letters + string.digits, k=6))


def main(req):

    long_url = req.params.get("url")

    short_code = generate_short_url()


    # Store in Azure Table Storage

    table_service = TableServiceClient.from_connection_string("<CONNECTION_STRING>")

    table_client = table_service.get_table_client("shorturls")


    table_client.create_entity({"PartitionKey": "URL", "RowKey": short_code, "LongUrl": long_url})
```

```python
    return {"short_url": f"https://short.ly/{short_code}"}
```

2. **Create Azure Function for URL Redirection**

```python
def main(req):
    short_code = req.params.get("code")

    # Retrieve from Table Storage
    table_service =
TableServiceClient.from_connection_string("<CONNECTION_STRING>")
    table_client = table_service.get_table_client("shorturls")

    entity = table_client.get_entity(partition_key="URL",
row_key=short_code)
    long_url = entity["LongUrl"]

    return {"statusCode": 301, "headers": {"Location": long_url}}
```

3. **Deploy to Azure Functions**
    - Deploy both functions.
    - Expose them via **Azure API Management**.
4. **Test URL Shortening**
    - Call the API:

Unset
```
curl -X GET
"https://<function-url>/shorten?url=https://www.example.com"
```

5. **Test Redirection**
   - Open the shortened URL in a browser.

5. Conclusion

This **serverless URL shortener** eliminates the need for a dedicated backend, making it scalable and cost-effective.

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