



**Transform Chaos into Order with Azure  
Durable Functions**

# Who is Chad Green?

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🗣 TaleLearnCode

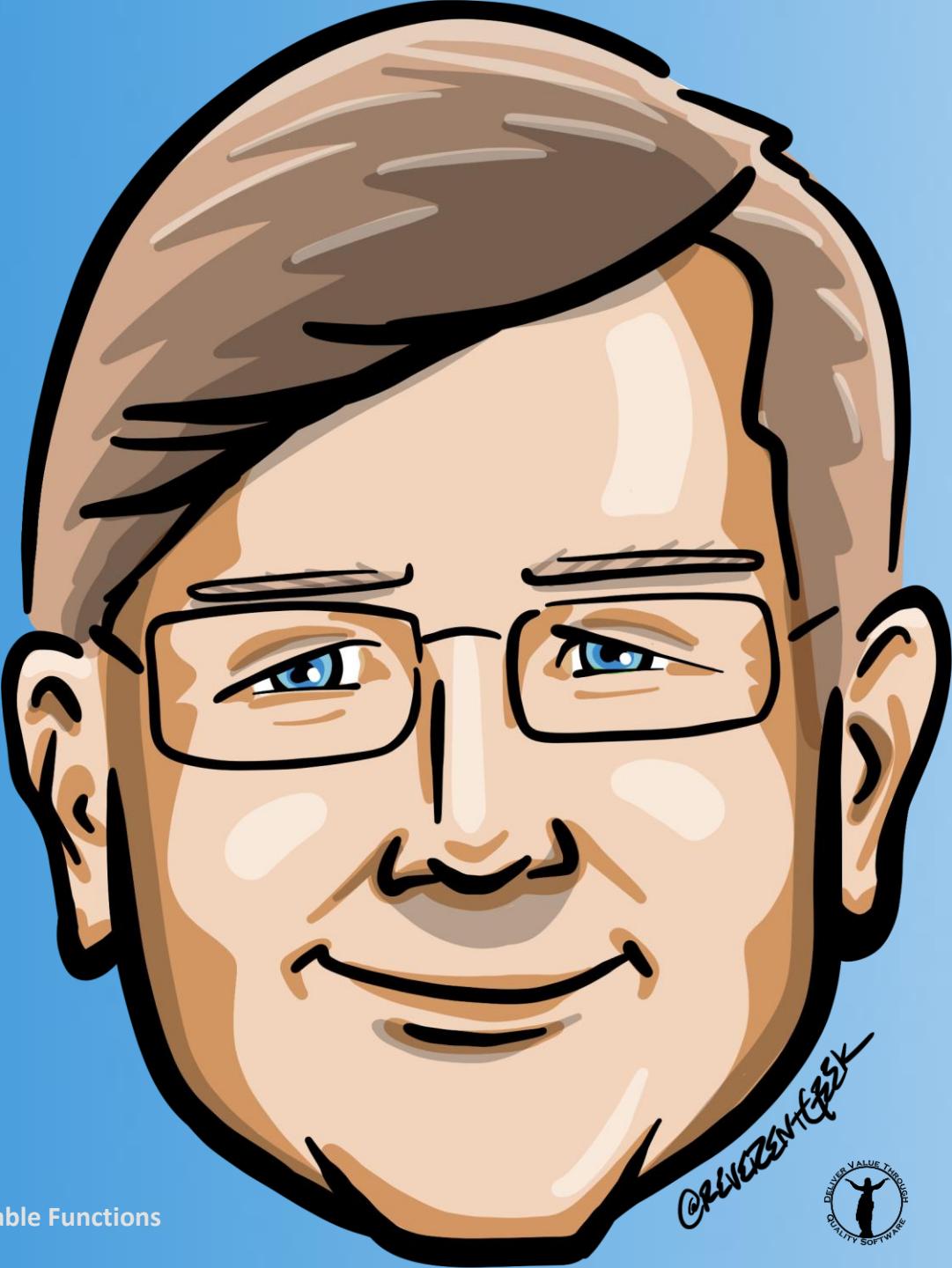
🌐 ChadGreen.com

🐦 ChadGreen

linkedin ChadwickEGreen



Transform Chaos into Order with Azure Durable Functions



# Who is using Azure Functions?



# Who is using Durable Functions?



# Serverless & Azure Function Overview

Transform Chaos into Order with Azure Durable Functions



Transform Chaos into Order with Azure Durable Functions

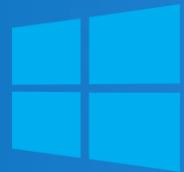


# The evolution of application platforms

## On-Premises

What media should I use to keep **backups**?

How can I **scale** my app?



Do I need a secondary Network connection?

How many servers do I need?

It takes how long to provision a new server?

What size of **servers** should I **buy**?

How do I **deploy** new code to my servers?

Which packages should be on my **server**?

Who **monitors** my servers?

Do I need a **UPS**?

Who has **physical** access my servers?

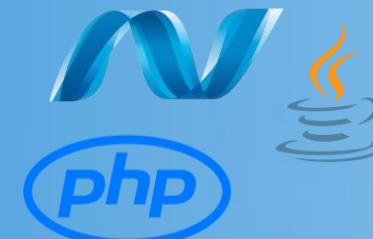


What happens in case of server hardware **failure**?

How often should I **patch** my servers?

How do I keep the **operating system** up to date?

What happens in case of server hardware **failure**?



How can I increase server utilization?

How often should I backup my server?

Are my servers in a secure location?

What storage do I need to use?

How can I dynamically configure my app?

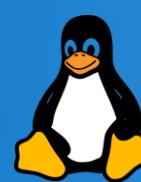
# The evolution of application platforms

IaaS

What media should I use to keep **backups**?

What **size of servers** should I **buy**?

How can I **scale** my app?



Do I need a secondary Network connection?

How often should I **patch** my servers? Who has physical access to my servers?

How often should I **backup** my server?

Which **packages** should be on my server? Which **services** do I need?

It takes how long to **provision** a new server?

What is the right **size** of **servers** for my business needs? How can I increase **server utilization**? What happens in case of server hardware failure? How do I **deploy** my code to my servers? How many servers do I need? How can I **scale** my application? Who monitors my apps?



Who monitors my servers?

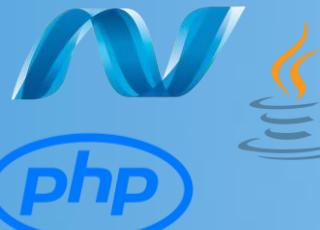
Do I need a UPS?

How often should I **patch** my servers?

What happens in case of server hardware failure? Who monitors my application?

How do I keep the **operating system** up to date? How do I **deploy** new code to my server?

How do I keep the **operating system** up to date? What storage do I need to use? What storage do I need to use?



**PHP**

How can I increase server utilization? How can I increase server utilization?

How often should I backup my server?

Are my servers in a secure location?

How can I dynamically configure my app?

# The evolution of application platforms

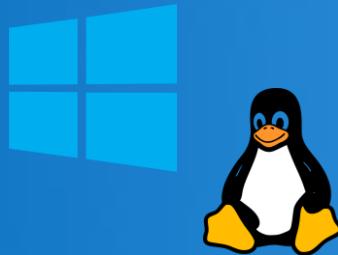
## PaaS

What is the right **size of servers** for my business needs?

How can I increase **server utilization**?

How **many** servers do I need?

How can I **scale** my application?



How often should I **patch** my **servers**?

How often should I **backup** my **server**?

Which **packages** should be on my **server**?



How do I **deploy** new **code** to my **server**?

How do I keep the **operating system** up to date?

Who **monitors** my application?

# The evolution of application platforms

## Serverless

What is the right **size of servers** for my business needs?

How can I increase **server utilization**?

How **many** servers do I need?

How can I **scale** my application?



**Not there isn't servers**

**Just, you can think about the servers less**

~~Server Configuration~~

~~Server Scaling~~

# Types of Serverless Architecture

**Function as a  
Service (FaaS)**

**Backend as a  
Service (BaaS)**

# Function-as-a-Service (FaaS)

Event-Driven



# Function-as-a-Service (FaaS)

Event-Driven

Short-Lived



# Function-as-a-Service (FaaS)

Event-Driven

Short-Lived

Automatic Scaling



# Function-as-a-Service (FaaS)

Event-Driven

Short-Lived

Automatic Scaling

Pay-Per Execution



# Function-as-a-Service (FaaS)

Event-Driven

Short-Lived

Automatic Scaling

Pay-Per Execution

Abstraction of  
Infrastructure



# Azure Functions

Code



Events + data



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# Choice of Language



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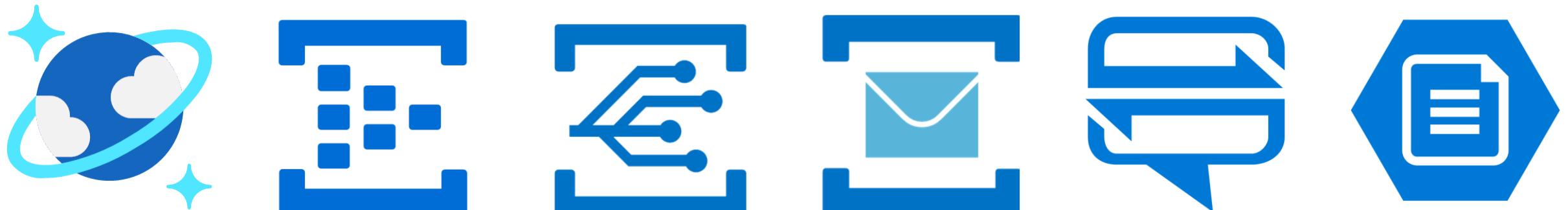
# Bring your own dependencies



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# Simplified Integration

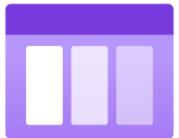
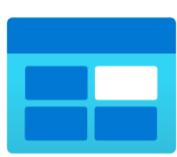


RabbitMQ



twilio

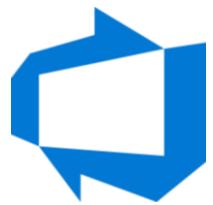
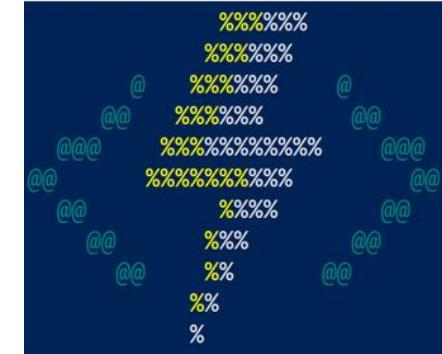
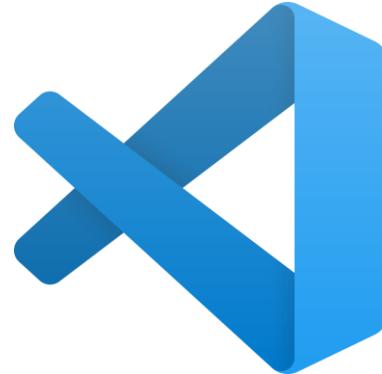
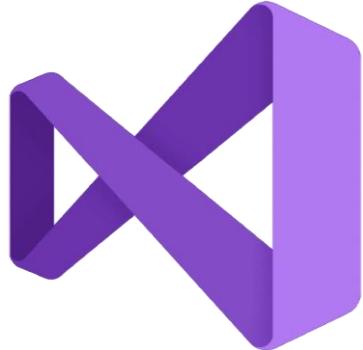
# Supported Bindings



Third Party Bindings

Custom Bindings

# Flexible Development



**Maven™**



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# Many Hosting Options

## Consumption



Serverless

## App Service Environment



Network  
Isolation

## Premium



Sort of Serverless

## Azure Stack



On Premises

## Dedicated

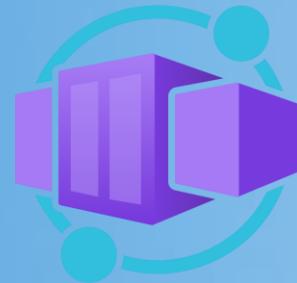


App Service  
Plan  
Functions  
Runtime



Your Server

## Container Apps



Consumption,  
Dedicated

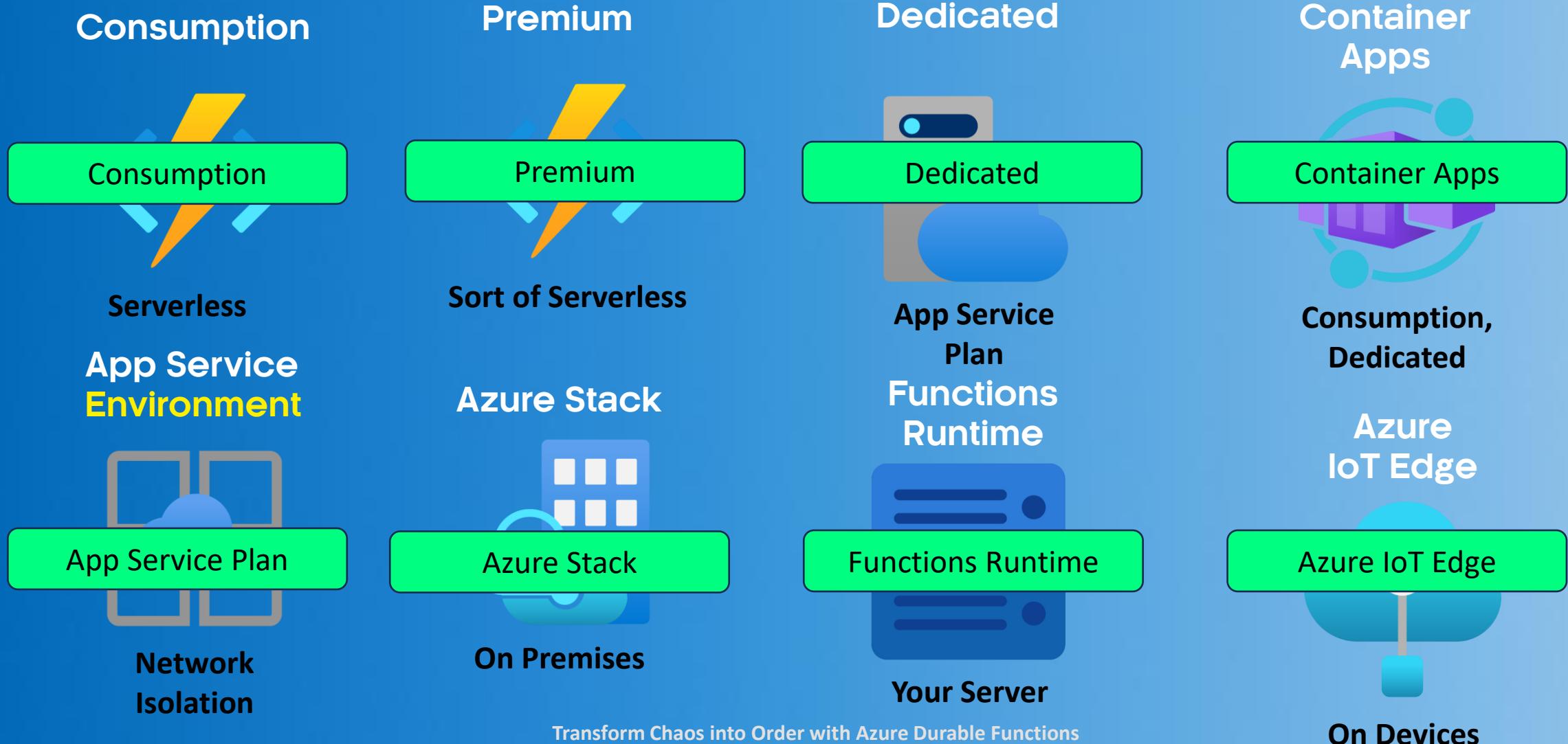
## Azure IoT Edge



On Devices

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# Many Hosting Options



# Many Hosting Options

- Consumption
- Premium
- Dedicated
- Container Apps
- App Service Plan
- Azure Stack
- Functions Runtime
- Azure IoT Edge



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# Open Source

The screenshot shows the GitHub repository page for 'Azure/Azure-Functions'. The repository is public and has 164 watchers, 894 stars, and 150 forks. It contains 488 issues, 1 pull request, and 1 project. The 'Code' tab is selected, showing a list of recent commits:

Author	Commit Message	Date	Commits
liliankasem	Use "bug" label in issue template (#2040)	026a73d 3 days ago	114
.github	Use "bug" label in issue template	21 days ago	
Functions Fox	Updated Logo	2 years ago	
functions-premium-plan	Updating minimum worker count	3 years ago	
schemas	Adding sampling excluded and included types to host schema.	14 months ago	
.gitignore	Adding Functions Fox	2 years ago	
VS-AzureTools-ReleaseNotes.md	Updating release notes	3 years ago	
readme.md	Adding link to .NET isolated worker repo (#1904)	5 months ago	

The 'About' section indicates no description or website is provided, and the 'azure-functions' tag is listed. The 'Readme' file is present. The 'Releases' and 'Packages' sections show no releases or packages published. The 'Contributors' section lists 21 contributors, with 10 more shown below.

**Azure Functions**

Azure Functions is an event driven, compute-on-demand experience that extends the existing Azure application platform with capabilities to implement code triggered by events occurring in virtually any Azure or 3rd party service as well as on-premises systems. Azure Functions allows developers to take action by connecting to data sources or messaging solutions, thus making it easy to process and react to events. Azure Functions scale based on demand and you pay only for the resources you consume.

This repository acts as a directory for folks looking for the various resources we have for Azure Functions.

[Get Started with Azure Functions](#)

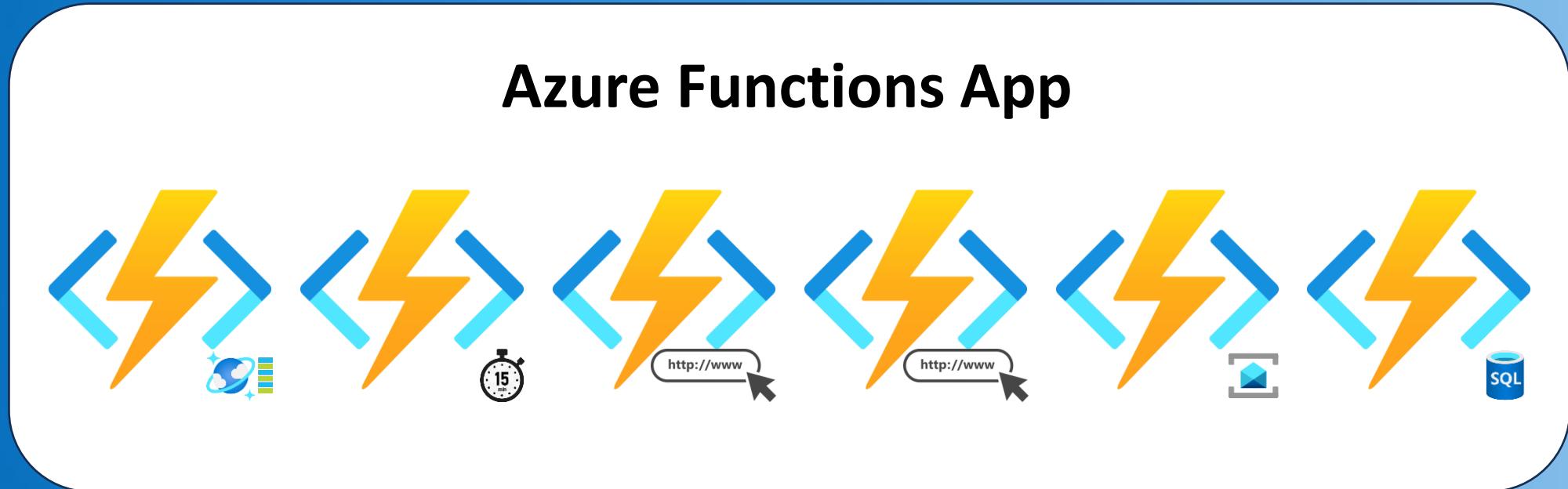
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# Simple Azure Function Code

```
public class HelloWorld(ILogger<HelloWorld> logger)
{
    private readonly ILogger<HelloWorld> _logger = logger;

    [Function("HelloWorld")]
    public IActionResult Run([HttpTrigger(AuthorizationLevel.Function, "get", Route = "hello-world")] HttpRequest request)
    {
        _logger.LogInformation("C# HTTP trigger function processed a request.");
        return new OkObjectResult("Welcome to Azure Functions!");
    }
}
```

# Anatomy of an Azure Function App



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# Azure Functions



Stateless,  
short-running,  
event-triggered  
serverless computing



# Durable Functions



An extension to  
Azure Functions

Write “stateful” functions  
in a “serverless”  
environment

Define workflows  
in code

# Durable Functions



Define workflows in code



Supports many workflow patterns



to

Solves the state problem

Write “stateful” functions  
in a “serverless”  
environment



Define workflows  
in code

# Basics



## Define workflows in code

- Parallel execution
- Error handling
- Easily understood “Orchestrator Function”

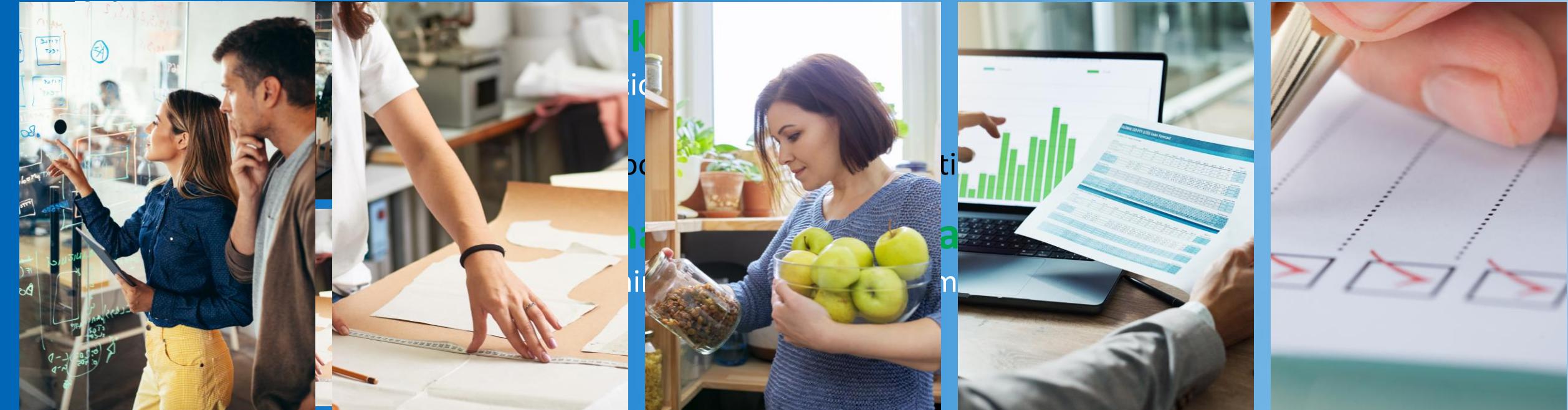
## Supports many workflow patterns

- Function chaining, fan-out/fan-in, human interaction, etc.

## Solves the state problem

- Tracks workflow progress

# Basics



**Solves the state problem**

- Tracks workflow progress

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# Benefits



Define workflows in code



Easy to implement complex workflows



Consolidate exception handling



Check on progress or cancel workflows



Manage state for you

# Key Concepts



Orchestrator Functions

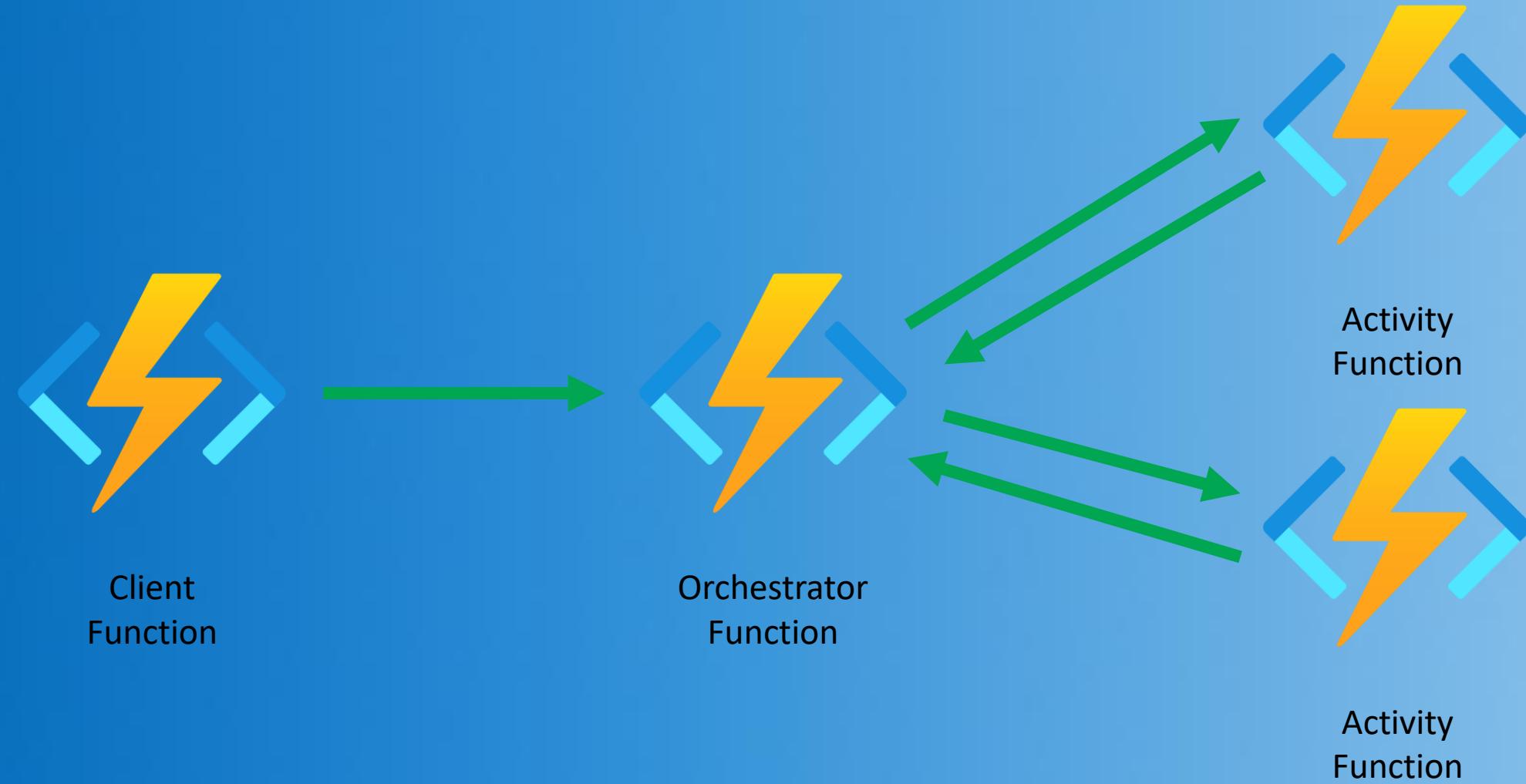


Activity Functions



Starting Orchestrations

# Durable Function Workflow



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# Constraints

## Deterministic APIs

- Dates and Times
- GUIDs and UUIDs
- Random Numbers
- Bindings
- Static Variables
- Environment Variables
- Network and HTTP
- Thread-Blocking APIs
- Async APIs
- Threading APIs

# Application Patterns

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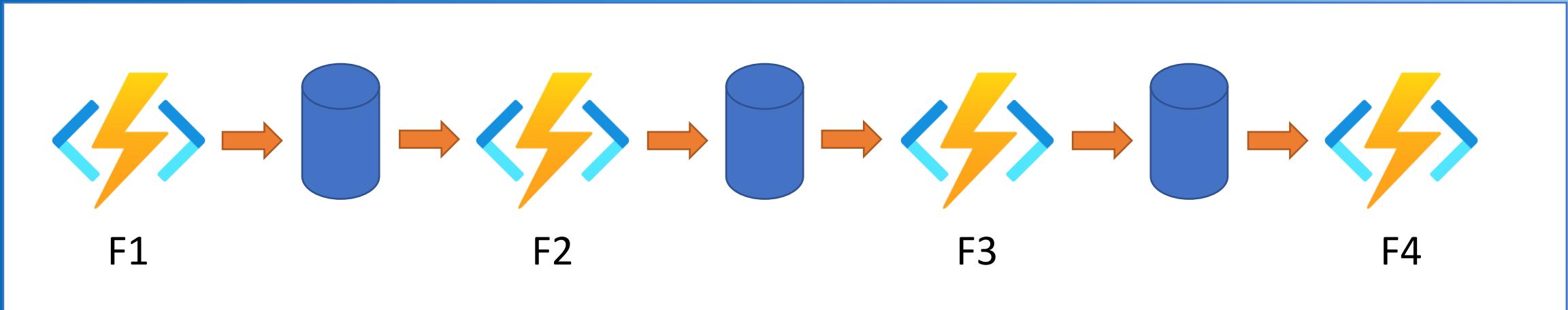
# Application Patterns

- Function Chaining
- Fan-Out/Fan-In
- Async HTTP APIs
- Monitoring
- Human Interaction
- Aggregator

# Application Patterns

- Function Chaining
- Fan-Out/Fan-In Chaining
- Async HTTP APIs
- Monitoring
- Human Interaction
- Aggregator

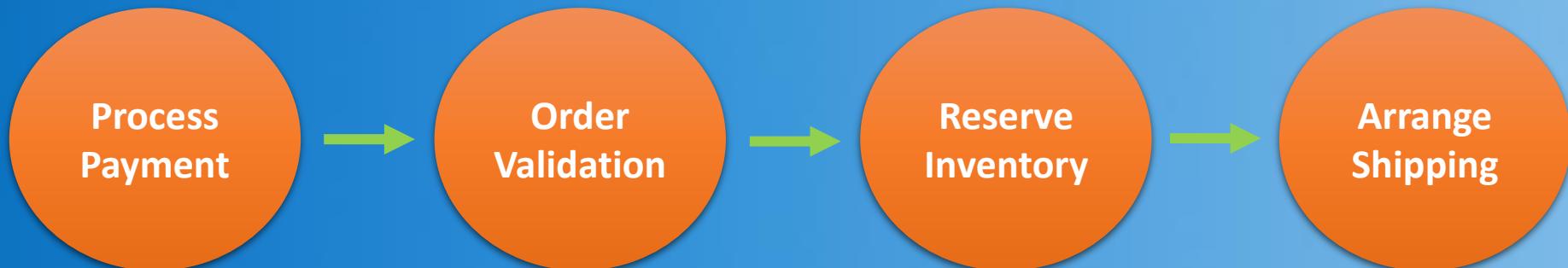
# Function Chaining



# Possible Scenarios



## Order Processing Workflow

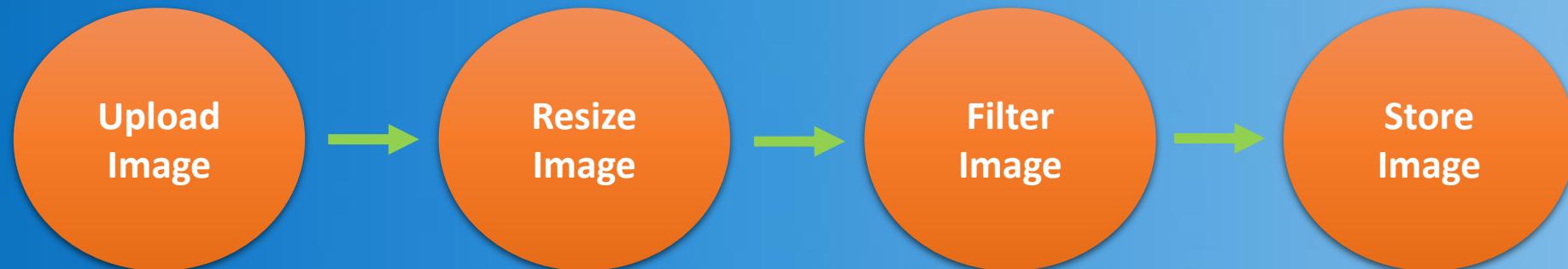


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# Possible Scenarios



## Image Processing Pipeline



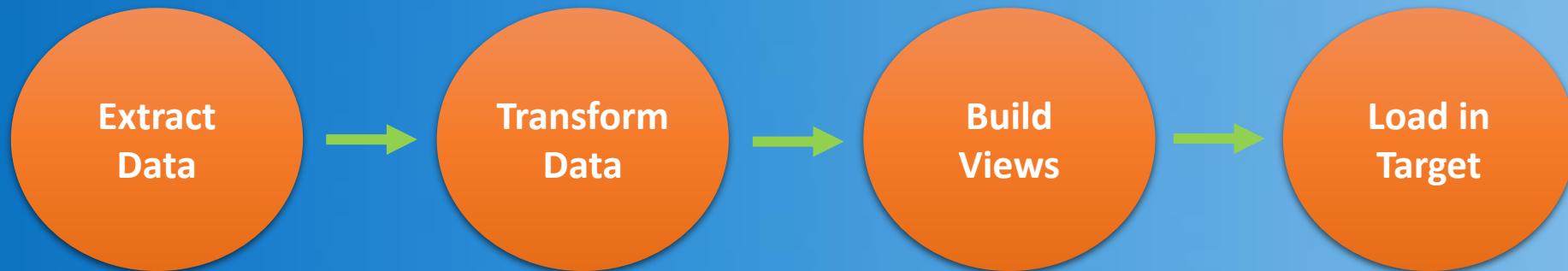
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# Possible Scenarios



## Data Migration Workflow

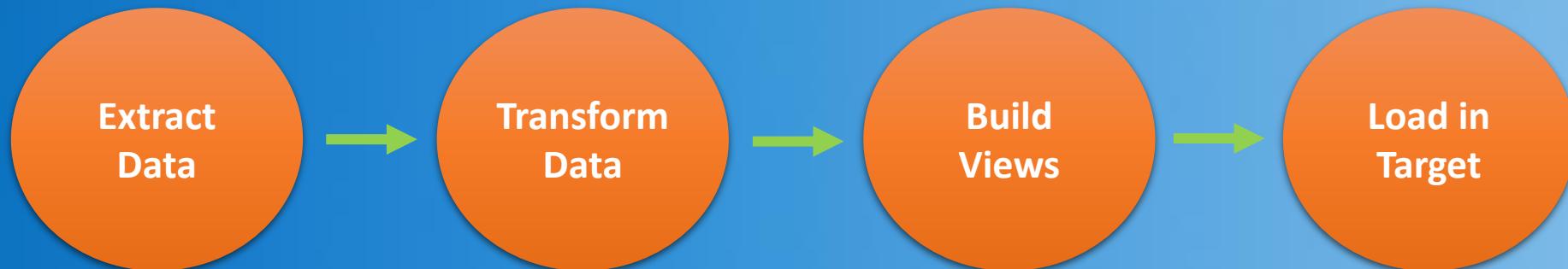


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# Possible Scenarios



## Data Migration Workflow

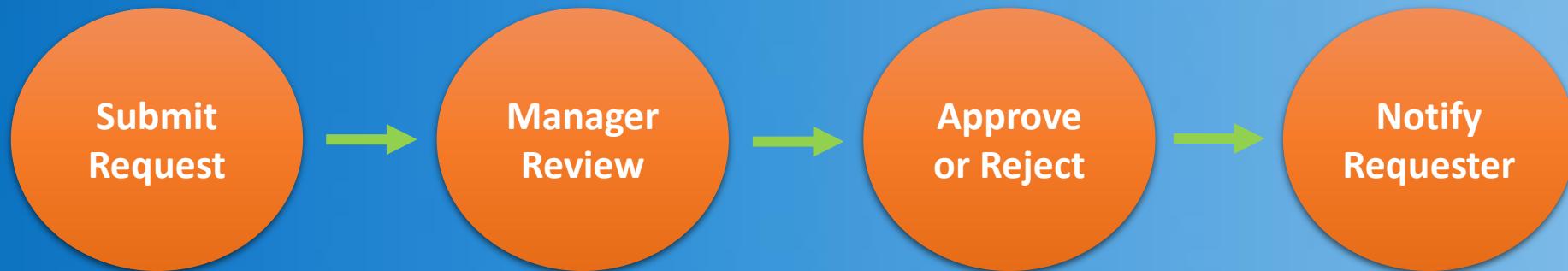


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# Possible Scenarios



## Approval Process

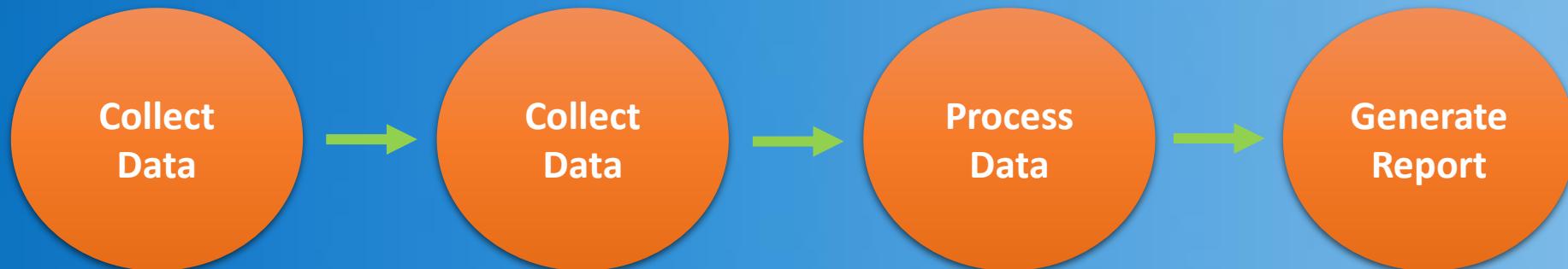


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# Possible Scenarios

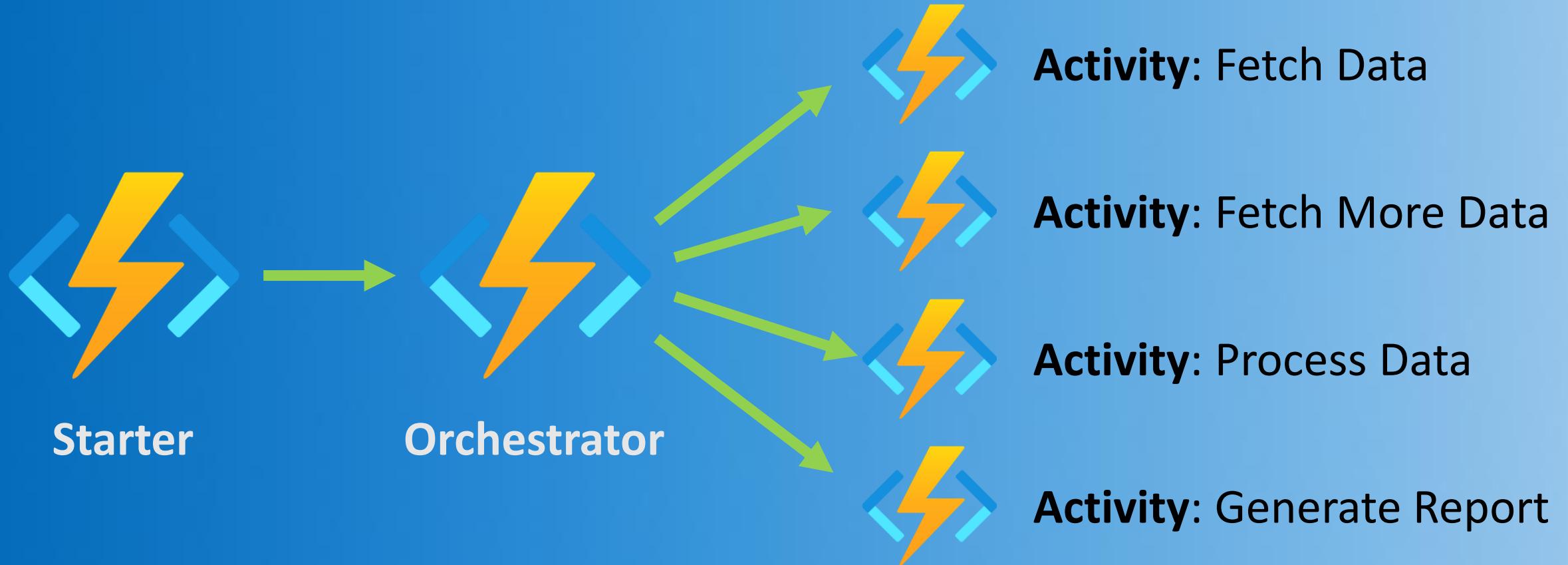


## Report Generation



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# Report Generation



# Fetch Data

```
[Function(nameof(FetchDataFromLocation1))]  
4 references | Chad Green, 6 days ago | 1 author, 1 change  
public static async Task<List<string>> FetchDataFromLocation1 [ActivityTrigger] FunctionContext functionContext)  
{  
    ILogger logger = functionContext GetLogger(nameof(FetchDataFromLocation1));  
    logger.LogInformation("Fetching data from Location 1...");  
    await Task.Delay(1000);  
    return ["Data1_Location1", "Data2_Location1"];  
}
```

# Fetch More Data

```
[Function(nameof(FetchDataFromLocation2))]  
4 references | 0 changes | 0 authors, 0 changes  
public static async Task<List<string>> FetchDataFromLocation2([ActivityTrigger] FunctionContext functionContext)  
{  
    ILogger logger = functionContext.GetLogger(nameof(FetchDataFromLocation2));  
    logger.LogInformation("Fetching data from Location 2...");  
    await Task.Delay(1000);  
    return ["Data1_Location2", "Data2_Location2"];  
}
```

# Process Data

```
[Function(nameof(ProcessData))]  
4 references | Chad Green, 6 days ago | 1 author, 1 change  
public static async Task<string> ProcessData(  
    [ActivityTrigger] List<List<string>> reportData, FunctionContext functionContext)  
{  
    ILogger logger = functionContext.GetLogger(nameof(ProcessData));  
    logger.LogInformation("Processing the fetched data...");  
    await Task.Delay(1000);  
    string processedData = string.Join(", ", reportData.SelectMany(x => x));  
    return processedData;  
}
```

# Generate Report

```
[Function(nameof(GenerateReport))]
4 references | Chad Green, 6 days ago | 1 author, 1 change
public static async Task<string> GenerateReport(
    [ActivityTrigger] string processedData, FunctionContext functionContext)
{

    ILogger logger = functionContext.GetLogger(nameof(GenerateReport));
    logger.LogInformation("Generating report...");

    // Simulate report generation
    await Task.Delay(1000);
    string reportContent = $"Report Content: {processedData}";

    // Save the report to Blob Storage
    BlobContainerClient containerClient = GetBlobContainerClient();
    string blobName = $"report_{Guid.NewGuid()}.txt";
    await containerClient.CreateIfNotExistsAsync(PublicAccessType.Blob);
    BlobClient blobClient = containerClient.GetBlobClient(blobName);
    using MemoryStream stream = new(Encoding.UTF8.GetBytes(reportContent));
    await blobClient.UploadAsync(stream, true);

    return blobClient.Uri.ToString();

}
```

# Orchestrator

```
[Function(nameof(FunctionChainingOrchestrator))]
3 references | Chad Green, 6 days ago | 1 author, 1 change
public static async Task<string> FunctionChainingOrchestrator(
    [OrchestrationTrigger] TaskOrchestrationContext context)
{
    ILogger logger = context.CreateReplaySafeLogger(nameof(Orchestrator));
    logger.LogInformation("Starting report generation.");

    List<string> data1 = await context.CallActivityAsync<List<string>>(nameof(FetchDataFromLocation1Activity.FetchDataFromLocation1));
    List<string> data2 = await context.CallActivityAsync<List<string>>(nameof(FetchDataFromLocation2Activity.FetchDataFromLocation2));
    string processedData = await context.CallActivityAsync<string>(nameof(ProcessDataActivity.ProcessData), new List<List<string>> { data1, data2 });
    string reportUrl = await context.CallActivityAsync<string>(nameof(GenerateReportActivity.GenerateReport), processedData);

    return reportUrl;
}
```

# Starter

```
[Function(nameof(FunctionChainingHttpStarter))]  
2 references | Chad Green, 6 days ago | 1 author, 1 change  
public static async Task<HttpResponseData> FunctionChainingHttpStarter([  
    HttpTrigger(AuthorizationLevel.Anonymous, "post", Route = "function-chaining")] HttpRequestData request,  
    [DurableClient] DurableTaskClient client,  
    FunctionContext executionContext)  
{  
    ILogger logger = executionContext.GetLogger("HttpStarter");  
    string instanceId = await client.ScheduleNewOrchestrationInstanceAsync(nameof(Orchestrator.FunctionChainingOrchestrator));  
    logger.LogInformation($"Started function chaining with ID {instanceId}");  
    return await client.CreateCheckStatusResponseAsync(request, instanceId);  
}
```

## Azure Functions Core Tools

Core Tools Version: 4.0.6543 Commit hash: N/A +a4bf0e412b43c659740d8db346fc44d6cdd62e45 (64-bit)

Function Runtime Version: 4.1036.1.23224

[2024-11-09T16:57:23.123Z] Found C:\Presentations\ServerlessOrchestration\Demos\src\FunctionApp\FunctionApp.csproj. Using **user secrets file configuration.**

[2024-11-09T16:57:27.574Z] Azure Functions .NET Worker (PID: 18464) initialized in debug mode. Waiting for debugger to attach...

[2024-11-09T16:57:27.679Z] Worker process started and initialized.

## Functions:

- FunctionChainingHttpStarter: [POST] http://localhost:7071/orchestrations/function-chaining
  - HelloWorld: [GET] http://localhost:7071/orchestrations/hello-world
- FetchDataFromLocation1: activityTrigger
- FetchDataFromLocation2: activityTrigger
- FunctionChainingOrchestrator: orchestrationTrigger
- GenerateReport: activityTrigger
- ProcessData: activityTrigger

For detailed output, run func with --verbose flag.

[2024-11-09T16:57:32.694Z] Host lock lease acquired by instance ID '00000000000000000000000000003F7F057D'.

POST http://localhost:7071/o +

No environment

HTTP http://localhost:7071/orchestrations/function-chaining

Save Share

POST http://localhost:7071/orchestrations/function-chaining Send

Params Authorization Headers (7) Body Scripts Tests Settings Cookies

Query Params

	Key	Value	Description	Bulk Edit
	Key	Value	Description	

Response History

 Click Send to get a response

POST http://localhost:7071/o

No environment

http://localhost:7071/orchestrations/function-chaining

Save Share

POST http://localhost:7071/orchestrations/function-chaining Send

Params Authorization Headers (9) Body Scripts Tests Settings Cookies

Query Params

	Key	Value	Description	Bulk Edit
	Key	Value	Description	

Body Cookies Headers (5) Test Results

202 Accepted 407 ms 1.49 KB Save Response

Pretty Raw Preview Visualize JSON

1 {  
2 "id": "f8d4b6b8ecb54d179704d234a7c0e705",  
3 "purgeHistoryDeleteUri": "http://localhost:7071/runtime/webhooks/durabletask/instances/f8d4b6b8ecb54d179704d234a7c0e705?  
code=IqoEh6KPG890aFZxYw7zcD-9YpVn95fX\_jIr\_vjoyUiKAzFuCkDcdQ==",  
4 "sendEventPostUri": "http://localhost:7071/runtime/webhooks/durabletask/instances/f8d4b6b8ecb54d179704d234a7c0e705/raiseEvent/{eventName}?  
code=IqoEh6KPG890aFZxYw7zcD-9YpVn95fX\_jIr\_viovUiKAzFuCkDcd0==",  
5 "statusQueryGetUri": "http://localhost:7071/runtime/webhooks/durabletask/instances/f8d4b6b8ecb54d179704d234a7c0e705?  
code=IqoEh6KPG890aFZxYw7zcD-9YpVn95fX\_jIr\_vjoyUiKAzFuCkDcdQ==",  
6 "terminatePostUri": "http://localhost:7071/runtime/webhooks/durabletask/instances/f8d4b6b8ecb54d179704d234a7c0e705/terminate?reason={{text}}&  
code=IqoEh6KPG890aFZxYw7zcD-9YpVn95fX\_jIr\_vjoyUiKAzFuCkDcdQ==",  
7 "suspendPostUri": "http://localhost:7071/runtime/webhooks/durabletask/instances/f8d4b6b8ecb54d179704d234a7c0e705/suspend?reason={{text}}&  
code=IqoEh6KPG890aFZxYw7zcD-9YpVn95fX\_jIr\_vjoyUiKAzFuCkDcdQ==",  
8 "resumePostUri": "http://localhost:7071/runtime/webhooks/durabletask/instances/f8d4b6b8ecb54d179704d234a7c0e705/resume?reason={{text}}&  
code=IqoEh6KPG890aFZxYw7zcD-9YpVn95fX\_jIr\_vjoyUiKAzFuCkDcdQ=="  
9 }

POST http://localhost:7071/o • GET http://localhost:7071/ru. • + No environment

HTTP <http://localhost:7071/runtime/webhooks/durabletask/instances/2e44119c1d8a4f71969ae7630352c9a5?code=IqoEh6KPG89OaFZxYw7zc> Save Share

GET http://localhost:7071/runtime/webhooks/durabletask/instances/2e44119c1d8a4f71969ae7630352c9a5?code=IqoEh6KPG89OaFZxYw7zcD-9YpVn95fX\_jlr\_vjoyUiKA... Send

Params • Authorization Headers (6) Body Scripts Tests Settings Cookies

Key	Value	Description	Bulk Edit
code	IqoEh6KPG89OaFZxYw7zcD-9YpVn95fX_jlr_vjoyUiKAzFuCk...		
Key	Value	Description	

Body Cookies Headers (6) Test Results 202 Accepted • 295 ms • 568 B • e.g. Save Response

Pretty Raw Preview Visualize JSON ↻

```
1 {  
2   "name": "FunctionChainingOrchestrator",  
3   "instanceId": "2e44119c1d8a4f71969ae7630352c9a5",  
4   "runtimeStatus": "Running",  
5   "input": null,  
6   "customStatus": null,  
7   "output": null,  
8   "createdTime": "2024-11-09T17:06:52Z",  
9   "lastUpdatedTime": "2024-11-09T17:06:54Z"  
10 }
```

POST http://localhost:7071/o • GET http://localhost:7071/r... • +

No environment

HTTP <http://localhost:7071/runtime/webhooks/durabletask/instances/2e44119c1d8a4f71969ae7630352c9a5?code=IqoEh6KPG89OaFZxYw7zc>

Save Share

GET [http://localhost:7071/runtime/webhooks/durabletask/instances/2e44119c1d8a4f71969ae7630352c9a5?code=IqoEh6KPG89OaFZxYw7zcD-9YpVn95fX\\_jlr\\_vjoyUiKA...](http://localhost:7071/runtime/webhooks/durabletask/instances/2e44119c1d8a4f71969ae7630352c9a5?code=IqoEh6KPG89OaFZxYw7zcD-9YpVn95fX_jlr_vjoyUiKA...) Send

Params • Authorization Headers (6) Body Scripts Tests Settings Cookies

Key	Value	Description	Bulk Edit
code	IqoEh6KPG89OaFZxYw7zcD-9YpVn95fX_jlr_vjoyUiKAzFuCk...		
Key	Value	Description	

Body Cookies Headers (4) Test Results 200 OK • 60 ms • 499 B • Save Response

Pretty Raw Preview Visualize JSON

```
1 {  
2     "name": "FunctionChainingOrchestrator",  
3     "instanceId": "2e44119c1d8a4f71969ae7630352c9a5",  
4     "runtimeStatus": "Completed",  
5     "input": null,  
6     "customStatus": null,  
7     "output": "http://127.0.0.1:10000/devstoreaccount1/serverless-orchestration-reports/report_0358e15e-f65d-4ea7-97bf-2e198251d092.txt",  
8     "lastUpdatedTime": "2024-11-09T17:06:57Z",  
9     "lastUpdatedTime": "2024-11-09T17:06:57Z"  
10 }
```

POST http://localhost:7071/o • | GET http://localhost:7071/rw • | GET http://127.0.0.1:10000/d • | +

No environment

HTTP [http://127.0.0.1:10000/devstoreaccount1/serverless-orchestration-reports/report\\_0358e15e-f65d-4ea7-97bf-2e198251d092.txt](http://127.0.0.1:10000/devstoreaccount1/serverless-orchestration-reports/report_0358e15e-f65d-4ea7-97bf-2e198251d092.txt)

Save Share

GET [http://127.0.0.1:10000/devstoreaccount1/serverless-orchestration-reports/report\\_0358e15e-f65d-4ea7-97bf-2e198251d092.txt](http://127.0.0.1:10000/devstoreaccount1/serverless-orchestration-reports/report_0358e15e-f65d-4ea7-97bf-2e198251d092.txt)

Send

Params Authorization Headers (6) Body Scripts Tests Settings Cookies

Query Params

	Key	Value	Description	Bulk Edit
	Key	Value	Description	

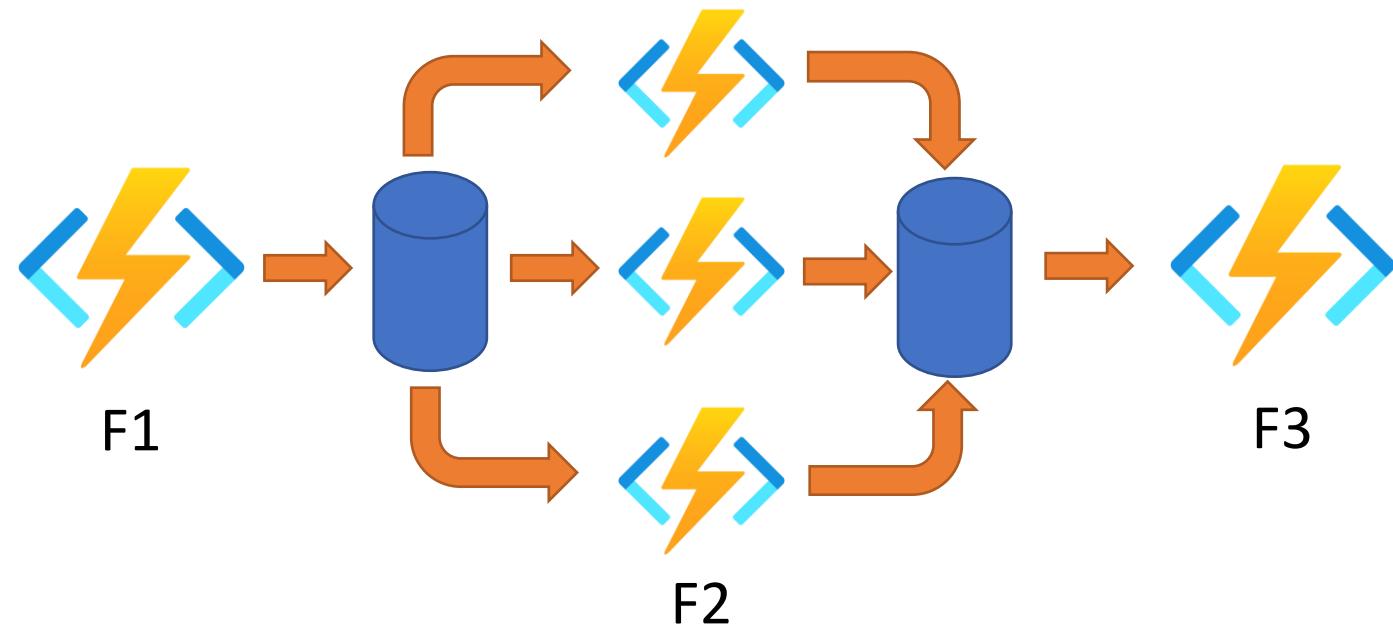
Body Cookies Headers (18) Test Results

200 OK • 23 ms • 700 B • [Save Response](#)

Pretty Raw Preview Visualize Text [Text](#)

1 Report Content: Data1\_Location1,Data2\_Location1,Data1\_Location2,Data2\_Location2

# Fan-out/Fan-in



# Possible Scenarios



## Batch Data Processing

Transform Chaos into Order with Azure Durable Functions



# Possible Scenarios



## Stock Price Analysis

Transform Chaos into Order with Azure Durable Functions



# Possible Scenarios



## Rendering Videos

Transform Chaos into Order with Azure Durable Functions



# Possible Scenarios

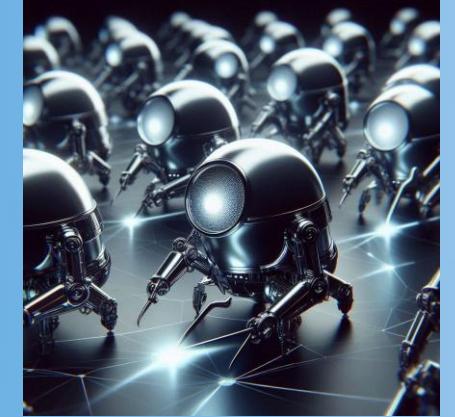


## Concurrent API Calls

Transform Chaos into Order with Azure Durable Functions



# Possible Scenarios

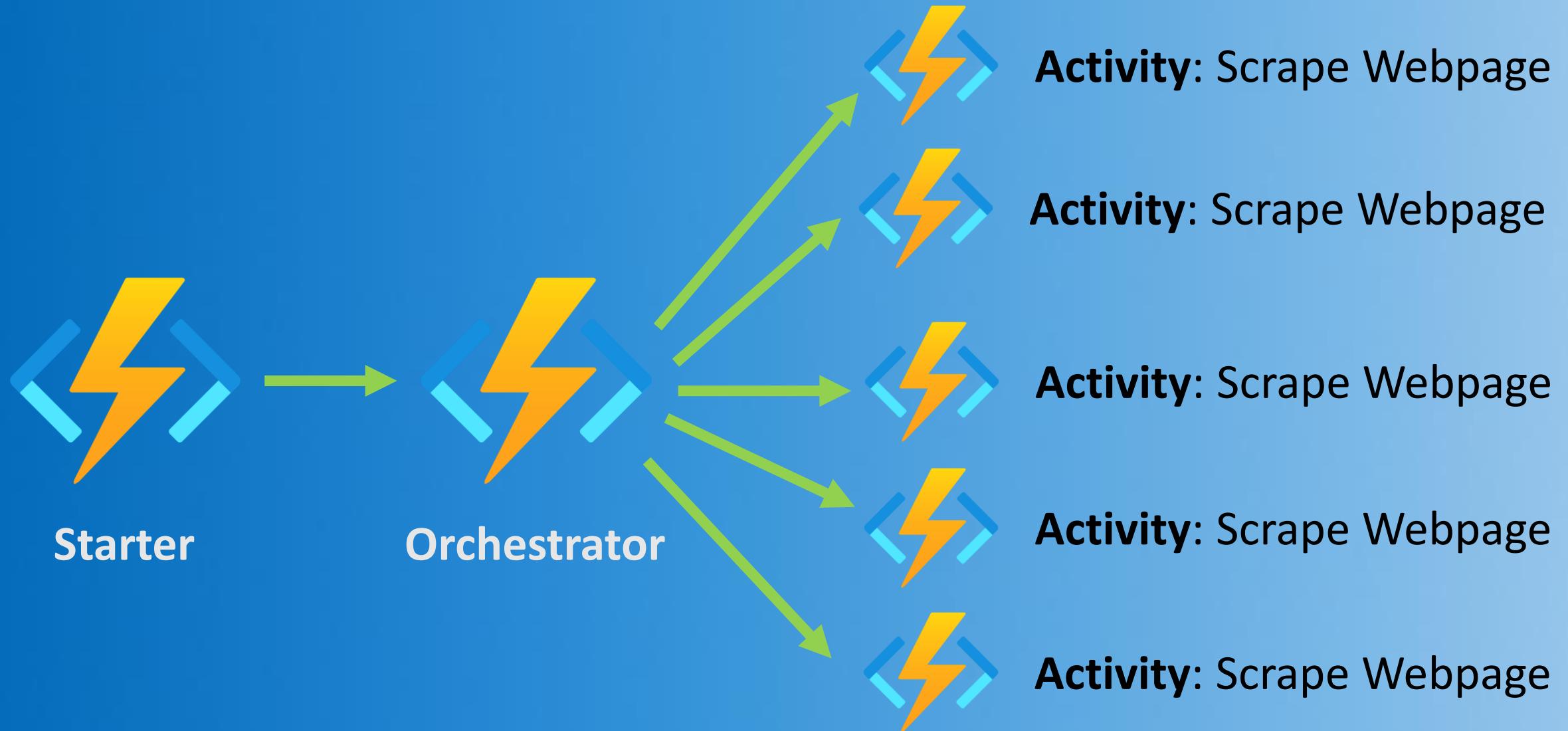


## Web Scrapping

Transform Chaos into Order with Azure Durable Functions



# Web Scrapping



Transform Chaos into Order with Azure Durable Functions



# Scrape Webpage

```
[Function(nameof(ScrapeWebpage))]
4 references | Chad Green, 6 days ago | 1 author, 1 change
public static async Task<KeyValuePair<string, string>> ScrapeWebpage(
    [ActivityTrigger] string url, FunctionContext functionContext)
{
    ILogger logger = functionContext.GetLogger(nameof(ScrapeWebpage));
    logger.LogInformation("Scraping webpage: {url}", url);

    using HttpClient httpClient = HttpClientFactory();

    HttpResponseMessage response = await httpClient.GetAsync(url);
    response.EnsureSuccessStatusCode();
    |

    string htmlContent = await response.Content.ReadAsStringAsync();
    HtmlDocument htmlDocument = new();
    htmlDocument.LoadHtml(htmlContent);

    HtmlNode titleNode = htmlDocument.DocumentNode.SelectSingleNode("//title");
    string title = titleNode != null ? titleNode.InnerText : "No Title";

    return new KeyValuePair<string, string>(url, title);
}
```

# Starter

```
[Function(nameof(StartWebScraping))]
2 references | Chad Green, 6 days ago | 1 author, 1 change
public static async Task<HttpresponseData> StartWebScraping(
    [HttpTrigger(AuthorizationLevel.Anonymous, "post", Route = "fan-out-fan-in")] HttpRequestData request,
    [DurableClient] DurableTaskClient client,
    FunctionContext executionContext)
{
    ILogger logger = executionContext.GetLogger("HttpStarter");

    string requestBody = await new StreamReader(request.Body).ReadToEndAsync();
    List<string>? urls = JsonConvert.DeserializeObject<List<string>>(requestBody);
    if (urls == null || urls.Count == 0)
        return request.CreateResponse(HttpStatusCode.BadRequest);

    string instanceId = await client.ScheduleNewOrchestrationInstanceAsync(nameof(Ochestrator.FanInFanOutOrcestrator), urls);
    logger.LogInformation("Started orchestration with ID = '{instanceId}'.", instanceId);
    return await client.CreateCheckStatusResponseAsync(request, instanceId);
}
```



```
[Function(nameof(FanInFanOutOrcestrator))]
3 references | Chad Green, 6 days ago | 1 author, 1 change
public static async Task<Dictionary<string, string>> FanInFanOutOrcestrator(
[OrchestrationTrigger] TaskOrchestrationContext context)
{
    ILogger logger = context.CreateReplaySafeLogger(nameof(Orchestrator));

    List<string>? urls = context.GetInput<List<string>>();
    if (urls == null)
    {
        logger.LogError("Input URLs cannot be null");
        return [];
    }

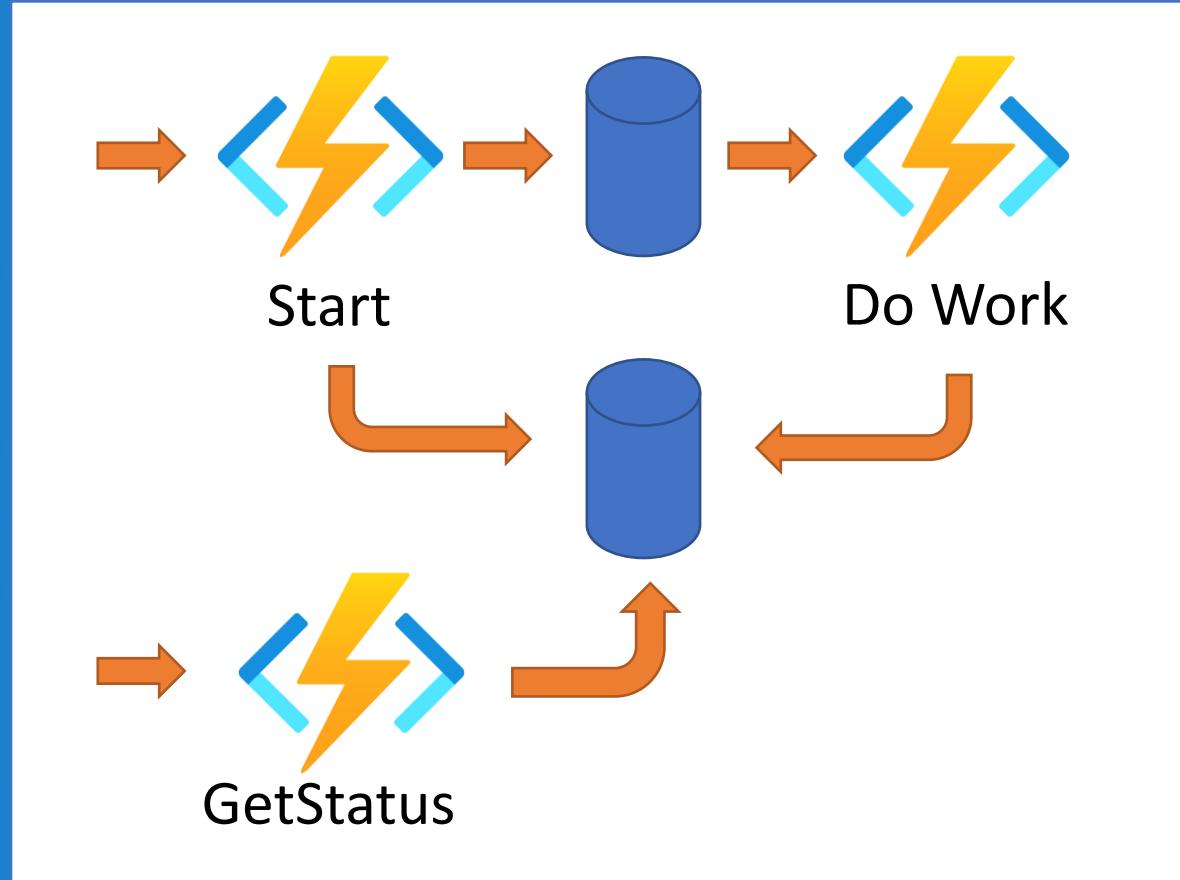
    List<Task<KeyValuePair<string, string>>> tasks = [];
    foreach (string url in urls)
        tasks.Add(context.CallActivityAsync<KeyValuePair<string, string>>(nameof(ScrapeWebpageActivity.ScrapeWebpage), url));

    logger.LogInformation("Starting fan-out/fan-in activities...");
    KeyValuePair<string, string>[] results = await Task.WhenAll(tasks);
    logger.LogInformation("Fan-out/fan-in activities completed.");

    Dictionary<string, string> scrapedData = [];
    foreach (KeyValuePair<string, string> result in results)
        scrapedData.Add(result.Key, result.Value);

    return scrapedData;
}
```

# Async HTTP APIs



Transform Chaos into Order with Azure Durable Functions



# Possible Scenarios



## Video Processing

Transform Chaos into Order with Azure Durable Functions



# Possible Scenarios



## Report Generation

Transform Chaos into Order with Azure Durable Functions



# Possible Scenarios



## Image Recognition

Transform Chaos into Order with Azure Durable Functions



# Possible Scenarios



## Machine Learning Model Training

Transform Chaos into Order with Azure Durable Functions



# Possible Scenarios



## Long-Running Database Operations

Transform Chaos into Order with Azure Durable Functions



# Long-Running Database Operation



Transform Chaos into Order with Azure Durable Functions



# Starter

```
[Function(nameof(AsyncApiHttpStarter))]
2 references | Chad Green, 6 days ago | 1 author, 1 change
public static async Task<HttpResponseData> AsyncApiHttpStarter(
    [HttpTrigger(AuthorizationLevel.Anonymous, "post", Route = "async-http-api")] HttpRequestData request,
    [DurableClient] DurableTaskClient client,
    FunctionContext executionContext)
{
    ILogger logger = executionContext.GetLogger("HttpStarter");

    string requestBody = await new StreamReader(request.Body).ReadToEndAsync();
    Dictionary<string, string>? data = JsonConvert.DeserializeObject<Dictionary<string, string>>(requestBody);
    string? operationId = data?["operationId"];
    if (string.IsNullOrWhiteSpace(operationId))
        return request.CreateResponse(HttpStatusCode.BadRequest);

    string instanceId = await client.ScheduleNewOrchestrationInstanceAsync(nameof(Orchestrator.DatabaseOperationOrchestrator), operationId);
    logger.LogInformation("Started orchestration with ID = '{instanceId}'.", instanceId);
    return await client.CreateCheckStatusResponseAsync(request, instanceId);
}
```



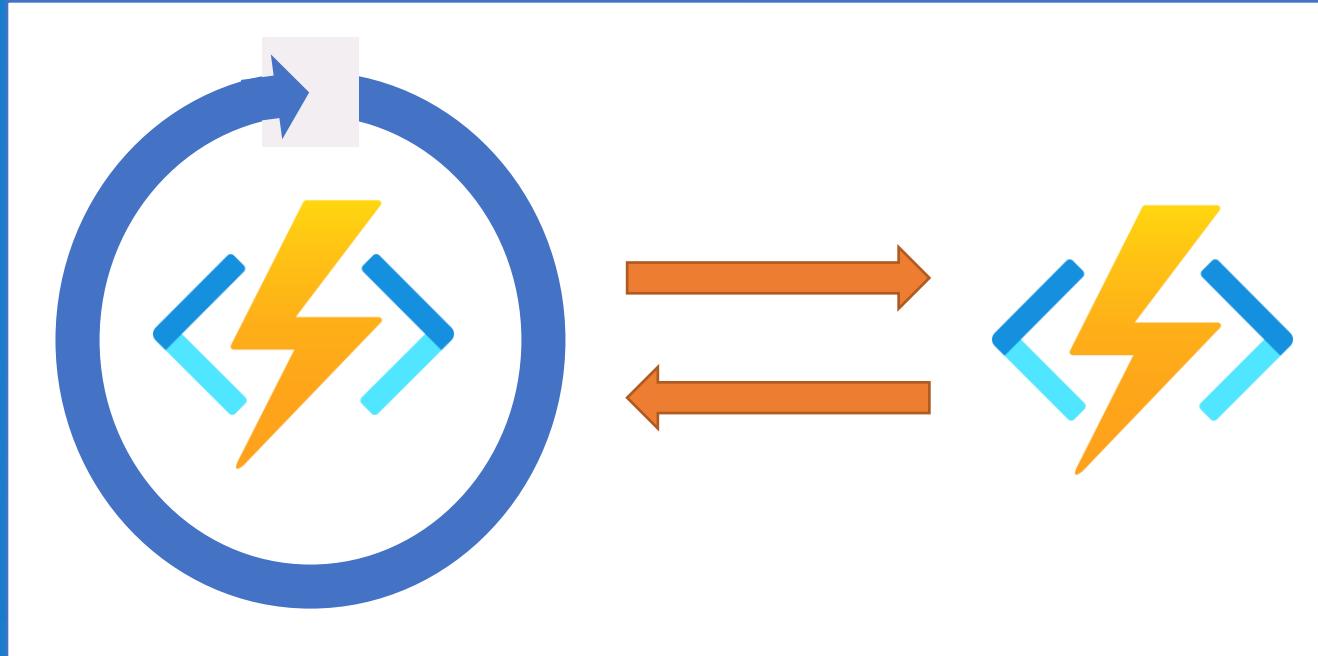
# Orchestrator

```
[Function(nameof(DatabaseOperationOrchestrator))]  
3 references | Chad Green, 6 days ago | 1 author, 1 change  
public static async Task DatabaseOperationOrchestrator(  
[OrchestrationTrigger] TaskOrchestrationContext context)  
{  
    ILogger logger = context.CreateReplaySafeLogger(nameof(Orchestrator));  
    string? operationId = context.GetInput<string>();  
    logger.LogInformation("Starting database operation for {operationId}...", operationId);  
    await context.CallActivityAsync(nameof(PerformDatabaseOperationActivity.PerformDatabaseOperation), operationId);  
    logger.LogInformation("Database operation for {operationId} completed.", operationId);  
}
```

# Long-Running Operation

```
[Function(nameof(PerformDatabaseOperation))]  
4 references | Chad Green, 6 days ago | 1 author, 1 change  
public static async Task PerformDatabaseOperation([ActivityTrigger] string operationId, FunctionContext functionContext)  
{  
    ILogger logger = functionContext.GetLogger(nameof(PerformDatabaseOperation));  
    logger.LogInformation("Performing long-running database operation for {operationId}...", operationId);  
    await Task.Delay(30000); // Simulate a 30-second database operation  
    logger.LogInformation("Database operation for {operationId} completed.", operationId);  
}
```

# Monitoring



Transform Chaos into Order with Azure Durable Functions



# Possible Scenarios



## Batch Job Monitoring

Transform Chaos into Order with Azure Durable Functions



# Possible Scenarios



## IoT Device Health Monitoring

Transform Chaos into Order with Azure Durable Functions



# Possible Scenarios



## Queue Length Monitoring

Transform Chaos into Order with Azure Durable Functions



# Possible Scenarios



## Resource Utilization Monitoring

Transform Chaos into Order with Azure Durable Functions



# Possible Scenarios

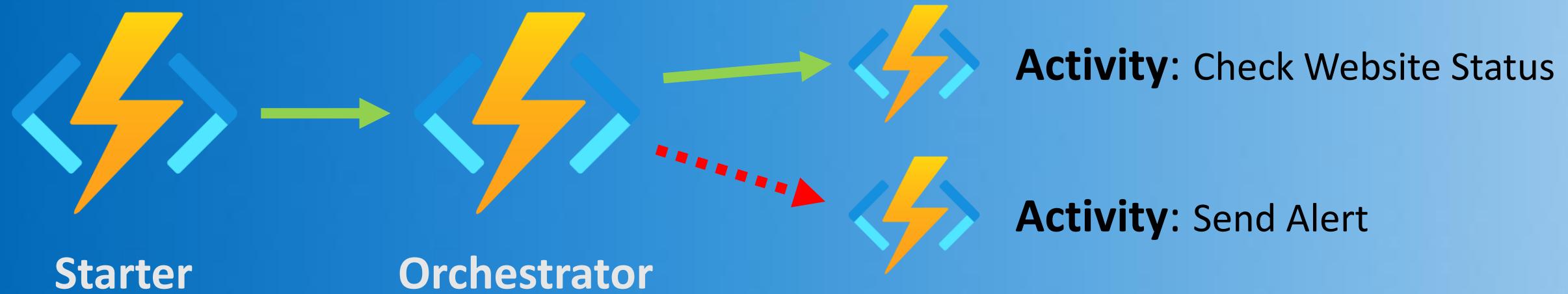


## Website Availability Monitoring

Transform Chaos into Order with Azure Durable Functions



# Website Availability Monitoring



Transform Chaos into Order with Azure Durable Functions

# Check Website Status

```
[Function(nameof(CheckWebsiteStatus))]
4 references | Chad Green, 2 days ago | 1 author, 1 change
public static async Task<bool> CheckWebsiteStatus([ActivityTrigger] string url, FunctionContext functionContext)
{
    ILogger logger = functionContext.GetLogger(nameof(CheckWebsiteStatus));
    logger.LogInformation("Checking Website Status: {url}", url);

    using HttpClient httpClient = HttpClientFactory();

    Uri uri = new(url);

    bool isWebsiteUp = false;
    string? errorMessage = null;
    string? statusCode = null;
    long responseTimeMs = 0;

    try
    {
        Stopwatch stopwatch = Stopwatch.StartNew();
        HttpResponseMessage response = await httpClient.GetAsync(uri);
        stopwatch.Stop();
        isWebsiteUp = response.IsSuccessStatusCode;
    }
    catch (Exception ex)
    {
        logger.LogError("Error checking website {url}: {errorMessage}", url, ex.Message);
        errorMessage = ex.Message;
    }

    try
    {
        TableClient tableClient = GetTableClient();

        await tableClient.AddEntityAsync(new TelemetryTableEntity
        {
            PartitionKey = uri.Host,
            RowKey = Guid.NewGuid().ToString(),
            Url = url,
            IsUp = isWebsiteUp,
            ErrorMessage = errorMessage,
            StatusCode = statusCode,
            ResponseTimeMs = responseTimeMs
        });
    }
    catch (Exception ex)
    {
        logger.LogError("Error saving telemetry for website {url}: {errorMessage}", url, ex.Message);
    }
}

return isWebsiteUp;
}
```



# Send Alert

```
[Function(nameof(SendAlert))]
4 references | Chad Green, 2 days ago | 1 author, 1 change
public static void SendAlert([ActivityTrigger] string url, FunctionContext functionContext)
{
    ILogger logger = functionContext.GetLogger(nameof(SendAlert));
    logger.LogInformation("Sending alert of down website - {url}...", url);

    EmailClient emailClient = GetEmailClient();
    EmailMessage emailMessage = new(
        senderAddress: Environment.GetEnvironmentVariable("SendEmailFrom")!,
        content: new EmailContent("Website Down Alert")
    {
        PlainText = $"The website '{url}' is down.",
        Html = $@"<html><body><h1>Website Down Alert</h1><p>The website '{url}' is down.</p></body></html>"
    },
    recipients: new EmailRecipients([new EmailAddress("chadgreen@chadgreen.com")])
);
    EmailSendOperation emailSendOperation = emailClient.Send(WaitUntil.Started, emailMessage);
}
```



# Starter

```
[Function(nameof(MonitorHttpStarter))]
2 references | Chad Green, 2 days ago | 1 author, 1 change
public static async Task<HttpResponseData> MonitorHttpStarter(
    [HttpTrigger(AuthorizationLevel.Anonymous, "post", Route = "monitor")] HttpRequestData request,
    [DurableClient] DurableTaskClient client,
    FunctionContext executionContext)
{
    ILogger logger = executionContext.GetLogger("HttpStarter");
    string? websiteUrl = request.Query["url"];
    if (string.IsNullOrEmpty(websiteUrl))
        return request.CreateResponse(HttpStatusCode.BadRequest);
    string instanceId = await client.ScheduleNewOrchestrationInstanceAsync(nameof(Orchestrator.MonitorOrchestrator), websiteUrl);
    logger.LogInformation("Started orchestration with ID = '{instanceId}'.", instanceId);
    return await client.CreateCheckStatusResponseAsync(request, instanceId);
}
```

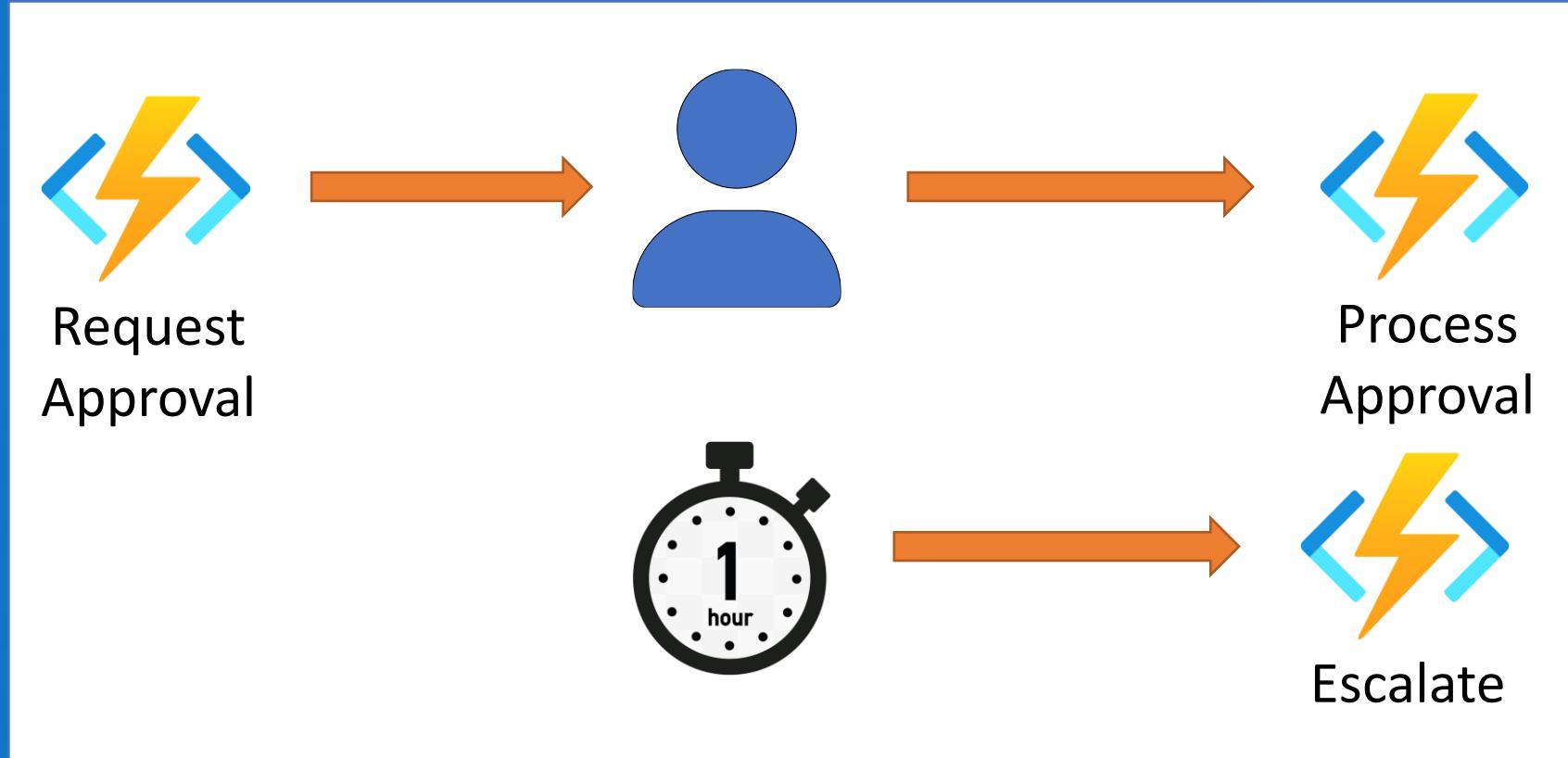
# Orchestrator

```
[Function(nameof(MonitorOrchestrator))]
3 references | Chad Green, 2 days ago | 1 author, 1 change
public static async Task MonitorOrchestrator(
    [OrchestrationTrigger] TaskOrchestrationContext context)
{
    ILogger logger = context.CreateReplaySafeLogger(nameof(Orchestrator));
    logger.LogInformation("Starting website monitor service...");

    string? websiteUrl = context.GetInput<string>();
    TimeSpan checkInterval = TimeSpan.FromMinutes(Convert.ToDouble(Environment.GetEnvironmentVariable("WebsiteMonitoringDefaultInterval")));

    while (context.CurrentUtcDateTime < context.CurrentUtcDateTime.AddHours(24)) // Monitor for 24 hours
    {
        logger.LogInformation("Checking website status for {websiteUrl}...", websiteUrl);
        bool isWebsiteUp = await context.CallActivityAsync<bool>(nameof(CheckWebsiteStatusActivity.CheckWebsiteStatus), websiteUrl);
        if (!isWebsiteUp)
        {
            logger.LogError("Website {websiteUrl} is down. Sending alert...", websiteUrl);
            await context.CallActivityAsync(nameof(SendAlertActivity.SendAlert), websiteUrl);
        }
        else
        {
            logger.LogInformation("Website {websiteUrl} is up. Waiting for next check...", websiteUrl);
        }
        DateTime nextCheck = context.CurrentUtcDateTime.Add(checkInterval);
        await context.CreateTimer(context.CurrentUtcDateTime.Add(checkInterval), CancellationToken.None);
    }
}
```

# Human Interaction



Transform Chaos into Order with Azure Durable Functions

# Possible Scenarios



## Approval Workflow

Transform Chaos into Order with Azure Durable Functions



# Possible Scenarios



## Expense Report Submission

Transform Chaos into Order with Azure Durable Functions



# Possible Scenarios



## Support Ticket Escalation

Transform Chaos into Order with Azure Durable Functions



# Possible Scenarios



## Survey or Feedback Collection

Transform Chaos into Order with Azure Durable Functions



# Possible Scenarios



## User Registration

Transform Chaos into Order with Azure Durable Functions



# User Registration



Activity: Send Challenge

Activity: Record Challenge Status

# Orches

```
[Function("HumanInteraction")]
2 references | Chad Green, 313 days ago | 1 author, 1 change
public async Task<bool> RunOrchestratorAsync([OrchestrationTrigger] TaskOrchestrationContext context)
{
    ILogger logger = context.CreateReplaySafeLogger(nameof(RunOrchestratorAsync));

    string? emailAddress = context.GetInput<string>();
    ArgumentException.ThrowIfNullOrEmptyWhiteSpace(emailAddress, nameof(emailAddress));

    ChallengeTableEntity challenge = await context.CallActivityAsync<ChallengeTableEntity>(nameof(SendChallengeAsync), emailAddress);

    using CancellationTokenSource timeoutCts = new();
    DateTime expiration = context.CurrentUtcDateTime.AddSeconds(_challengeTimeoutSeconds);
    Task timeoutTask = context.CreateTimer(expiration, timeoutCts.Token);

    bool authorized = false;
    for (int retryCount = 0; retryCount <= 3; retryCount++)
    {
        Task<int> challengeResponseTask = context.WaitForExternalEvent<int>("EmailChallengeResponse");

        Task winner = await Task.WhenAny(challengeResponseTask, timeoutTask);
        if (winner == challengeResponseTask)
        {
            // Response received; compare it to the challenge code
            if (challengeResponseTask.Result == Convert.ToInt32(challenge.ChallengeCode))
            {
                logger.LogInformation("Challenge successfully completed");
                authorized = true;
                challenge.ChallengeCompleted = true;
                challenge.ChallengePeriodEnd = context.CurrentUtcDateTime;
                await context.CallActivityAsync(nameof(RecordChallengeStatusAsync), challenge);
                break;
            }
        }
        else
        {
            // Timeout expired
            logger.LogInformation("Challenge timed out");
            challenge.ChallengePeriodEnd = context.CurrentUtcDateTime;
            await context.CallActivityAsync(nameof(RecordChallengeStatusAsync), challenge);
            break;
        }
    }

    if (!timeoutTask.IsCompleted)
        // All pending times must be complete or cancelled before the function exits
        timeoutCts.Cancel();

    return authorized;
}
```



# Orches

```
[Function("HumanInteraction")]
2 references | Chad Green, 313 days ago | 1 author, 1 change
public async Task<bool> RunOrchestratorAsync([OrchestrationTrigger] TaskOrchestrationContext context)
{
    ILogger logger = context.CreateReplaySafeLogger(nameof(RunOrchestratorAsync));

    string? emailAddress = context.GetInput<string>();
    ArgumentException.ThrowIfNullOrEmptyWhiteSpace(emailAddress, nameof(emailAddress));

    ChallengeTableEntity challenge = await context.CallActivityAsync<ChallengeTableEntity>(nameof(SendChallengeAsync), emailAddress);

    using CancellationTokenSource timeoutCts = new();
    DateTime expiration = context.CurrentUtcDateTime.AddSeconds(_challengeTimeoutSeconds);
    Task timeoutTask = context.CreateTimer(expiration, timeoutCts.Token);

    bool authorized = false;
    for (int retryCount = 0; retryCount <= 3; retryCount++)
    {
        Task<int> challengeResponseTask = context.WaitForExternalEvent<int>("EmailChallengeResponse");

        Task winner = await Task.WhenAny(challengeResponseTask, timeoutTask);
        if (winner == challengeResponseTask)
        {
            // Response received; compare it to the challenge code
            if (challengeResponseTask.Result == Convert.ToInt32(challenge.ChallengeCode))
            {
                logger.LogInformation("Challenge successfully completed");
                authorized = true;
                challenge.ChallengeCompleted = true;
                challenge.ChallengePeriodEnd = context.CurrentUtcDateTime;
                await context.CallActivityAsync(nameof(RecordChallengeStatusAsync), challenge);
                break;
            }
        }
        else
        {
            // Timeout expired
            logger.LogInformation("Challenge timed out");
            challenge.ChallengePeriodEnd = context.CurrentUtcDateTime;
            await context.CallActivityAsync(nameof(RecordChallengeStatusAsync), challenge);
            break;
        }
    }

    if (!timeoutTask.IsCompleted)
        // All pending times must be complete or cancelled before the function exits
        timeoutCts.Cancel();

    return authorized;
}
```



```
[Function("HumanInteraction")]
2 references | Chad Green, 313 days ago | 1 author, 1 change
public async Task<bool> RunOrchestratorAsync([OrchestrationTrigger] TaskOrchestrationContext context)
{
    ILogger logger = context.CreateReplaySafeLogger(nameof(RunOrchestratorAsync));
    string? emailAddress = context.GetInput<string>();
    Arg Cha usi Date Task boo for {
        string? emailAddress = context.GetInput<string>();
        ArgumentException.ThrowIfNullOrEmptyWhiteSpace(emailAddress, nameof(emailAddress));
        ChallengeTableEntity challenge = await context.CallActivityAsync<ChallengeTableEntity>(nameof(SendChallengeAsync), emailAddress);
        Task<int> challengeResponseTask = context.WaitForExternalEvent<int>("EmailChallengeResponse");
        Task winner = await Task.WhenAny(challengeResponseTask, timeoutTask);
        if (winner == challengeResponseTask)
        {
            // Response received
            if (challengeResponseTask.Result == 1)
            {
                logger.LogInformation("Challenge accepted");
                challenge.Authorized = true;
                challenge.ChallengePeriodEnd = context.CurrentUtcDateTime;
                await context.CallActivityAsync(nameof(RecordChallengeStatusAsync), challenge);
                break;
            }
        }
        else
        {
            // Timeout expired
            logger.LogInformation("Challenge timed out");
            challenge.ChallengePeriodEnd = context.CurrentUtcDateTime;
            await context.CallActivityAsync(nameof(RecordChallengeStatusAsync), challenge);
            break;
        }
    }
    if (!timeoutTask.IsCompleted)
        // All pending times must be complete or cancelled before the function exits
        timeoutCts.Cancel();
}
return authorized;
}
```

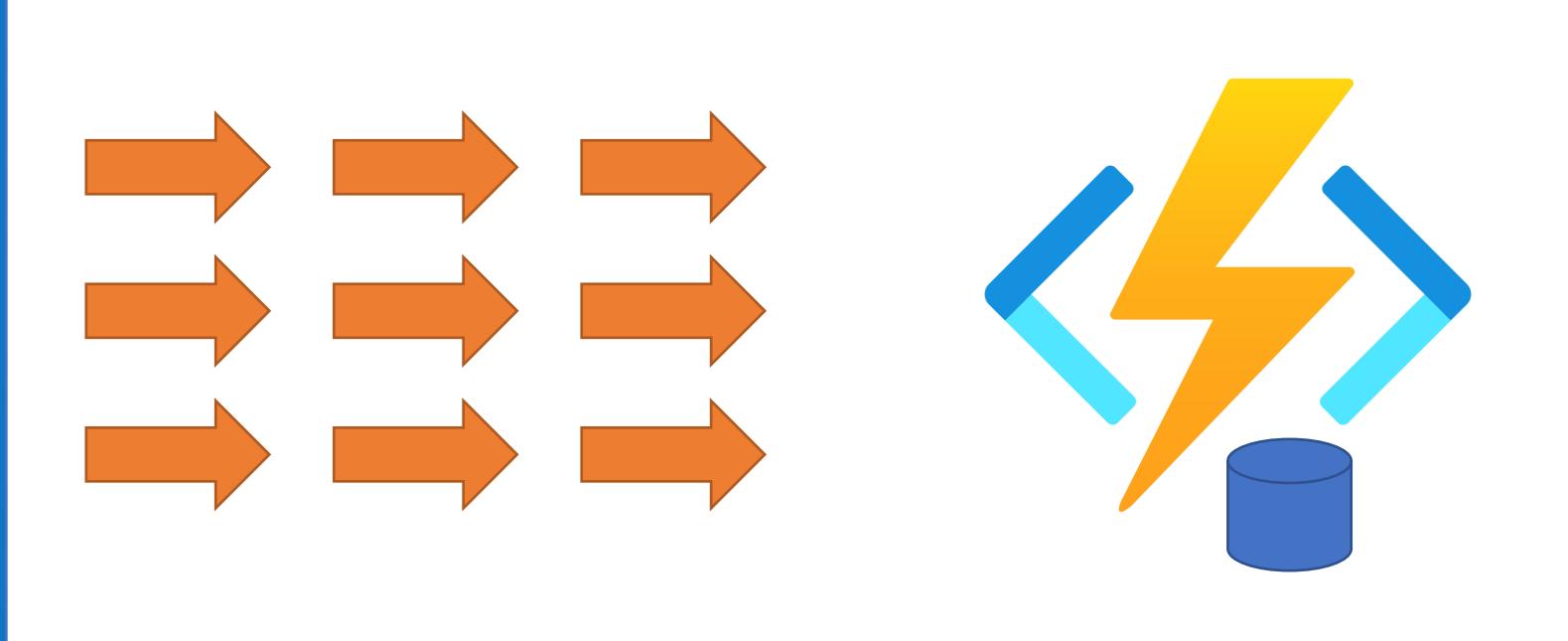
```
[Function("HumanInteraction")]
2 references [Chad Green, 313 days ago] | 1 commit | 1 change
public async Task<bool> Run()
{
    ILogger logger = context
        .GetService();
    string? emailAddress = context
        .GetService<IEmailContext>()
        .EmailAddress;
    if (string.IsNullOrEmpty(emailAddress))
    {
        logger.LogError("Email address is required");
        throw new ArgumentNullException("EmailAddress");
    }
    ChallengeTableEntity challenge =
        await context
            .GetItemAsync<ChallengeTableEntity>(emailAddress);
    using (CancellationTokenSource timeoutCts =
        new CancellationTokenSource())
    {
        DateTime expiration = challenge.ChallengePeriodEnd;
        Task timeoutTask = context
            .ScheduleActivity(
                nameof(RecordChallengeStatusAsync),
                challenge,
                timeoutCts.Token);
        bool authorized = false;
        for (int retryCount = 0; retryCount <= 3; retryCount++)
        {
            logger.LogInformation($"Challenge attempt {retryCount + 1} of 3");
            Task<int> challengeResponseTask = context.WaitForExternalEvent<int>("EmailChallengeResponse");
            Task winner = await Task.WhenAny(challengeResponseTask, timeoutTask);
            if (winner == challengeResponseTask)
            {
                // Response received; compare it to the challenge code
                if (challengeResponseTask.Result == Convert.ToInt32(challenge.ChallengeCode))
                {
                    logger.LogInformation("Challenge successfully completed");
                    authorized = true;
                    challenge.ChallengeCompleted = true;
                    challenge.ChallengePeriodEnd = context.CurrentUtcDateTime;
                    await context.CallActivityAsync(nameof(RecordChallengeStatusAsync), challenge);
                    break;
                }
            }
            else
            {
                // Timeout expired
                logger.LogInformation("Challenge timed out");
                challenge.ChallengePeriodEnd = context.CurrentUtcDateTime;
                await context.CallActivityAsync(nameof(RecordChallengeStatusAsync), challenge);
                break;
            }
        }
        if (!authorized)
        {
            logger.LogError("Challenge failed after 3 attempts");
            throw new Exception("Challenge failed after 3 attempts");
        }
    }
    return authorized;
}
```

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# Aggregator (Stateful Entities)



Transform Chaos into Order with Azure Durable Functions

# Possible Scenarios



## Weather Data Aggregation

Transform Chaos into Order with Azure Durable Functions



# Possible Scenarios



## Sales Data Aggregation

Transform Chaos into Order with Azure Durable Functions



# Possible Scenarios



## Log Data Aggregation

Transform Chaos into Order with Azure Durable Functions



# Possible Scenarios



## Social Media Mentions

Transform Chaos into Order with Azure Durable Functions



# Possible Scenarios



## Stock Market Data Aggregation

Transform Chaos into Order with Azure Durable Functions



# Additional Details

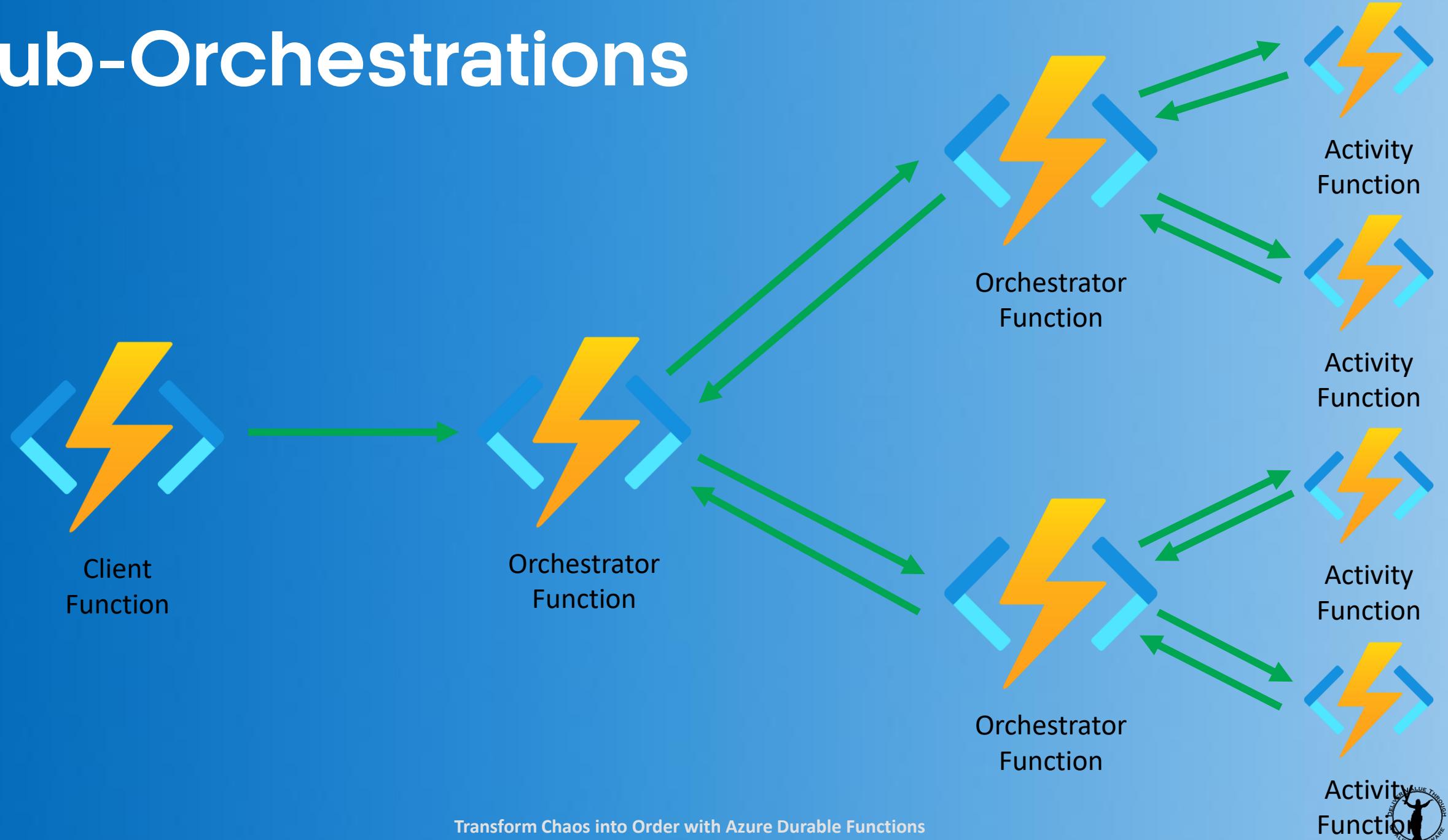
Azure Durable Functions for Serverless .NET Orchestration



Transform Chaos into Order with Azure Durable Functions



# Sub-Orchestrations



Transform Chaos into Order with Azure Durable Functions



# Custom Orchestration Status

```
[FunctionName("E1_HelloSequence")]
public static async Task<List<string>> Run(
    [OrchestrationTrigger] IDurableOrchestrationContext context)
{
    var outputs = new List<string>();
    outputs.Add(await context.CallActivityAsync<string>("E1_SayHello", "Tokyo"));
    outputs.Add(await context.CallActivityAsync<string>("E1_SayHello", "Seattle"));
    outputs.Add(await context.CallActivityAsync<string>("E1_SayHello", "London"));

    // returns ["Hello Tokyo!", "Hello Seattle!", "Hello London!"]
    return outputs;
}

[FunctionName("E1_SayHello")]
public static string SayHello([ActivityTrigger] string name)
{
    return $"Hello {name}!";
```

# Custom Orchestration Status

```
{  
  "runtimeStatus": "Running",  
  "input": null,  
  "output": null,  
  "createdTime": "2019-10-06T18:30:24Z",  
  "lastUpdatedTime": "2019-10-06T19:40:30Z"  
}
```

# Custom Orchestration Status

```
[FunctionName("E1_HelloSequence")]
public static async Task<List<string>> Run(
    [OrchestrationTrigger] IDurableOrchestrationContext context)
{
    var outputs = new List<string>();
    outputs.Add(await context.CallActivityAsync<string>("E1_SayHello", "Tokyo"));
    context.SetCustomStatus("Tokyo");
    outputs.Add(await context.CallActivityAsync<string>("E1_SayHello", "Seattle"));
    context.SetCustomStatus("Seattle");
    outputs.Add(await context.CallActivityAsync<string>("E1_SayHello", "London"));
    context.SetCustomStatus("London");

    // returns ["Hello Tokyo!", "Hello Seattle!", "Hello London!"]
    return outputs;
}

[FunctionName("E1_SayHello")]
public static string SayHello([ActivityTrigger] string name)
{
    return $"Hello {name}!";
}
```

# Custom Orchestration Status

```
{  
    "runtimeStatus": "Running",  
    "input": null,  
    "customStatus": { "Seattle" },  
    "output": null,  
    "createdTime": "2019-10-06T18:30:24Z",  
    "lastUpdatedTime": "2019-10-06T19:40:30Z"  
}
```

# Eternal Orchestrations

```
[FunctionName("Periodic_Cleanup_Loop")]
public static async Task Run(
    [OrchestrationTrigger] IDurableOrchestrationContext context)
{
    await context.CallActivityAsync("DoCleanup", null);
    // sleep for one hour between cleanups
    DateTime nextCleanup = context.CurrentUtcDateTime.AddHours(1);
    await context.CreateTimer(nextCleanup, CancellationToken.None);

    context.ContinueAsNew(null);
}
```

# Best Practices

Transform Chaos into Order with Azure Durable Functions



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- Invest in stress testing

# Conclusion

Transform Chaos into Order with Azure Durable Functions



Transform Chaos into Order with Azure Durable Functions



# Conclusion

- What is Serverless Computing
- Function as a Service
- Azure Functions
- Durable Functions
- Application Patterns
- Additional Details
- Best Practices

# Thank You!

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