

# PACC

Prefect Associate  
Certification Course



# Norms reminder

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## Zoom

- Camera on
- Mute unless asking a question
- Use hand raise in Zoom to ask a question

## Slack

- Use threads
- Emoji responses 😊



# 104 - Work pool-based deployments

# 104 Agenda

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- Create work pool-based deployments with *.deploy()*
- Flow code storage
- Prefect managed work pools
- Hybrid work pools with workers
- Push work pools





## Why use a work pool-based deployment?

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Infrastructure is a pain, Prefect makes it better. 😊

- Run a deployment on a variety of infrastructure
- Provide a template for deployments
- Ability to prioritize work
- Options to scale infrastructure to 0 (serverless)



# Create deployment with `.deploy()`

---

Very similar syntax to `.serve()`

Differences:

- need to specify a work pool
- doesn't start a server



## First work pool-based deployment

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- create with `.deploy()`
- specify flow code stored in a GitHub repository
- specify an existing *Prefect Managed* workpool



# Create deployment with *.deploy()*

---

```
from prefect import flow

if __name__ == "__main__":
    flow.from_source(
        source="https://github.com/discdiver/pacc-2024.git",
        entrypoint="102/weather2-tasks.py:pipeline",
    ).deploy(
        name="my-first-managed-deployment",
        work_pool_name="managed1",
    )
```



# Create deployment with `.deploy()`

---

## Run the script

Successfully created/updated all deployments!

### *Deployments*

| Name                                 | Status  | Details |
|--------------------------------------|---------|---------|
| pipeline/my-first-managed-deployment | applied |         |

To schedule a run for this deployment, use the following command:

```
$ prefect deployment run 'pipeline/my-first-managed-deployment'
```

You can also run your flow via the Prefect UI:

<https://app.prefect.cloud/account/9b649228-0419-40e1-9e0d-44954b5c0ab6/workspace/d137367a-5055-44ff-b91c-6f7366c9e4c4/deployments/deployment/d448be8f-2092-47f9-8d0b-ee06ce182480>



Create a deployment with *.deploy()*

---

Run the deployment from the UI or the CLI:

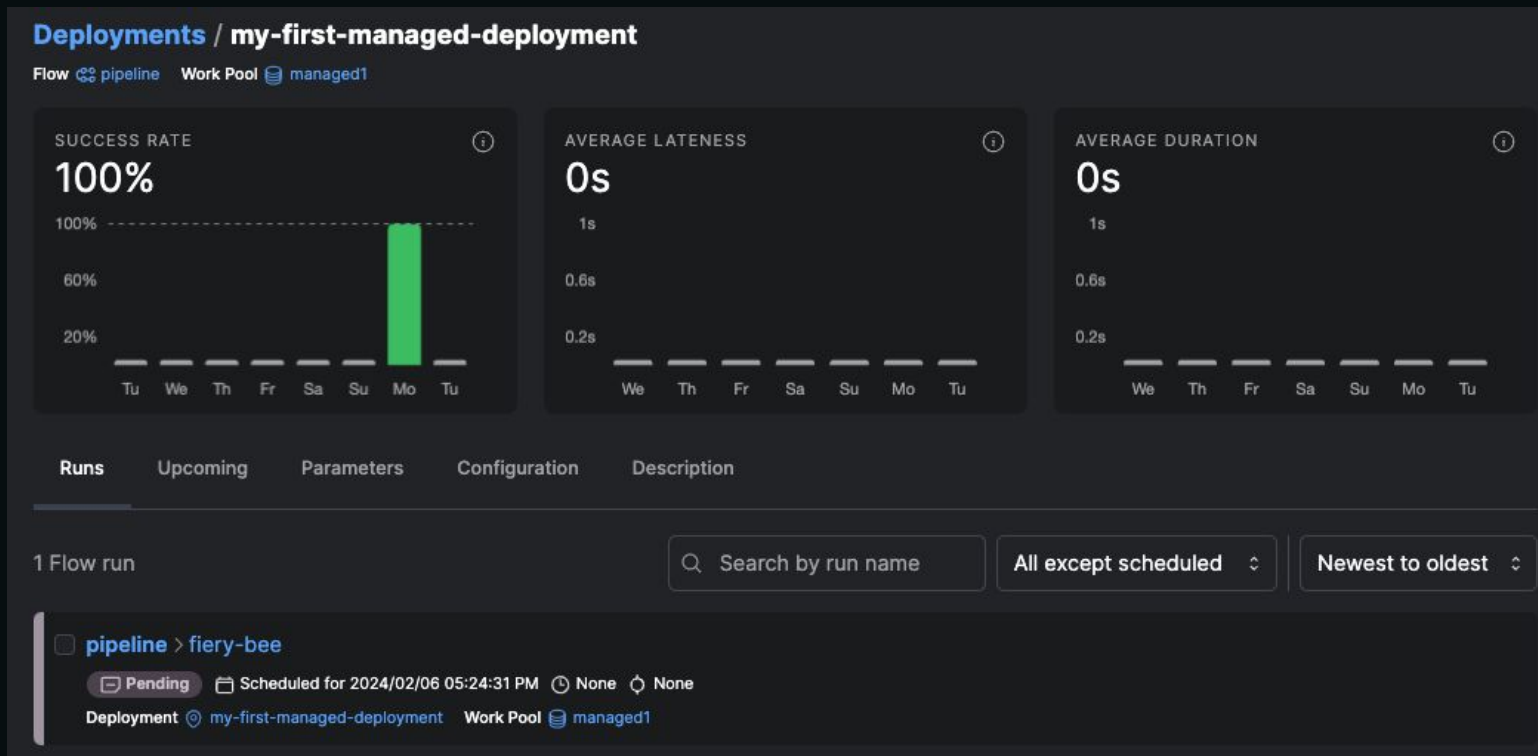
*prefect deployment run*  
*'pipeline/my-first-managed-deployment'*

Takes a moment to start infra and pull base Docker image





# See the deployment and flow run in the UI



# Let's break this down

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# Flow code storage



# Flow code storage options

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1. Git-based remote repository (e.g. GitHub)
2. Bake your code into a Docker image
3. Cloud provider storage

We specified a public GitHub repo with `.from_source()` class method.

Provide the source URL to the repo and the entrypoint path:flow function name.



# Work pools



## Work pools

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Provide default infrastructure configuration for deployments





# Create a work pool of type **Prefect Managed**

---

## Managed

Managed work pools execute flow runs on Prefect Cloud infrastructure.



**Prefect Managed**

Beta

Execute flow runs within containers on Prefect managed infrastructure.

With a **Prefect Managed** pool, Prefect runs your flow code on our infrastructure in a Docker container.

👉 Only available with Prefect Cloud



# Create a Prefect Managed work pool

**Work Pools / Create**

✓ Infrastructure Type

✓ Details

03 Configuration

Below you can configure workers' behavior when executing flow runs from this work pool. You can use the editor in the **Advanced** section to modify the existing configuration options if you need additional configuration options.

If you don't need to change the default behavior, hit **Create** to create your work pool!

**Base Job Template**

Defaults Advanced

📘 The fields below control the default values for the base job template. These values can be overridden by deployments.

**Pip Packages (Optional)**

A list of python packages that will be installed via `pip` at runtime (this will occur prior to any pull steps configured on the deployment).

1

2

3

prefect>=2.0.0, marvin

Format

**Environment Variables (Optional)**

Environment variables to set when starting a flow run.

1

2

3

Format

**Image (Optional)**

The prefect image to use for your flow run execution environment.

prefecthq/prefect:2-latest

**Job Timeout (Optional)**

The length of time (in seconds) that Prefect will wait for a run to complete before crashing the flow run.

600

Cancel

Previous

Create



## Create a Prefect Managed work pool

---

- Don't modify the job template for now
- You can specify environment variables, packages to install at runtime, etc.
- All deployments that use this work pool inherit these settings




## At runtime, Prefect:



---

1. Pulls the Docker image specified
2. Installs any specified packages
3. Pulls your flow code from GitHub
4. Runs your code in the container
5. Monitors state
6. Exits and cleans up 🧹





# Hybrid model - hybrid work pools with workers



## Hybrid model = separation

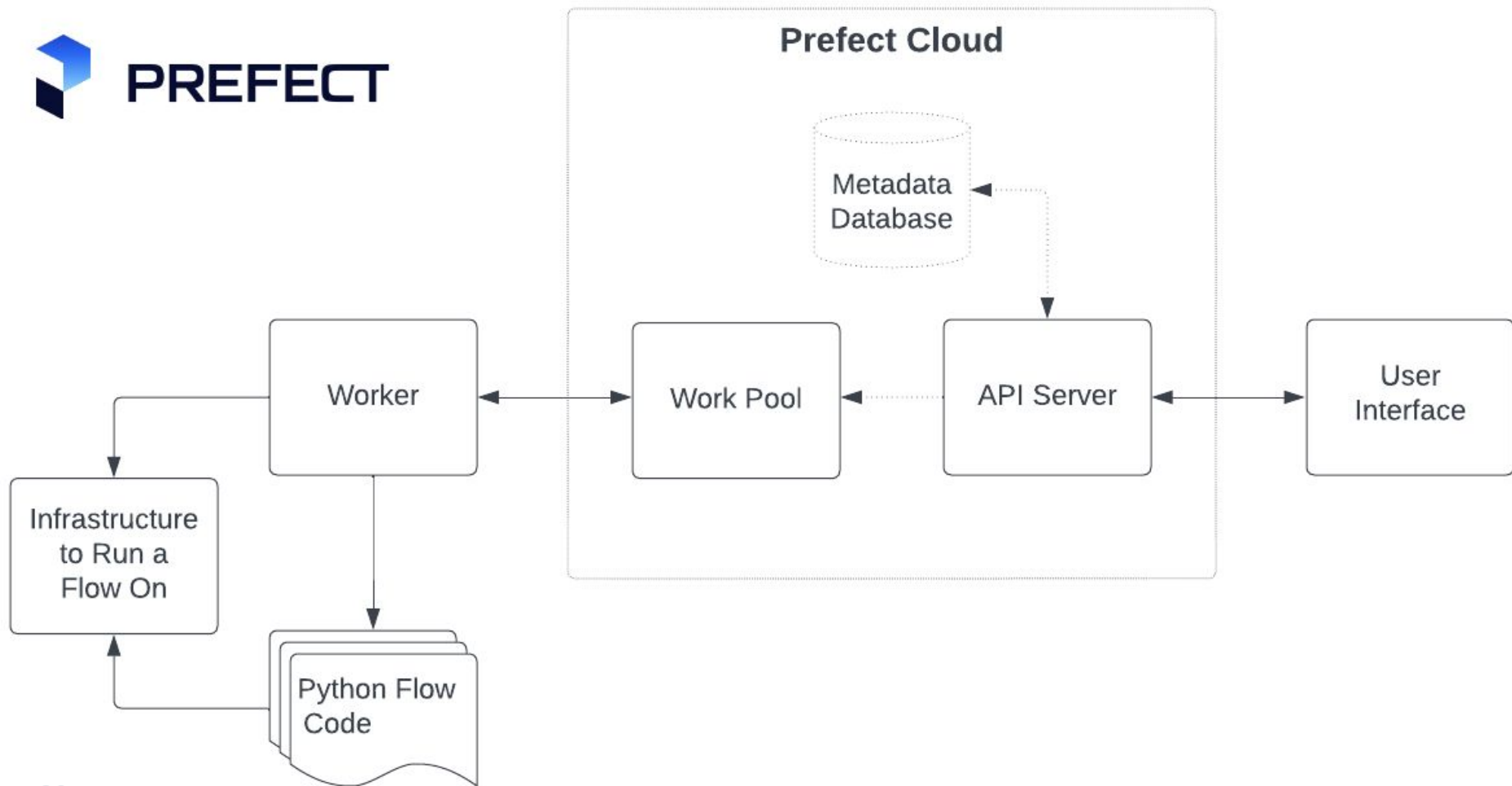
---

- Your flow code runs on your infrastructure
- Your flow code is stored on your storage (GitHub, AWS, Docker image, etc)
- Prefect Cloud stores metadata, logs, artifacts, etc.
- Data encrypted at rest
- Prefect Technologies, Inc. is SOC2 Type II compliant

<https://www.prefect.io/security>







# Workers



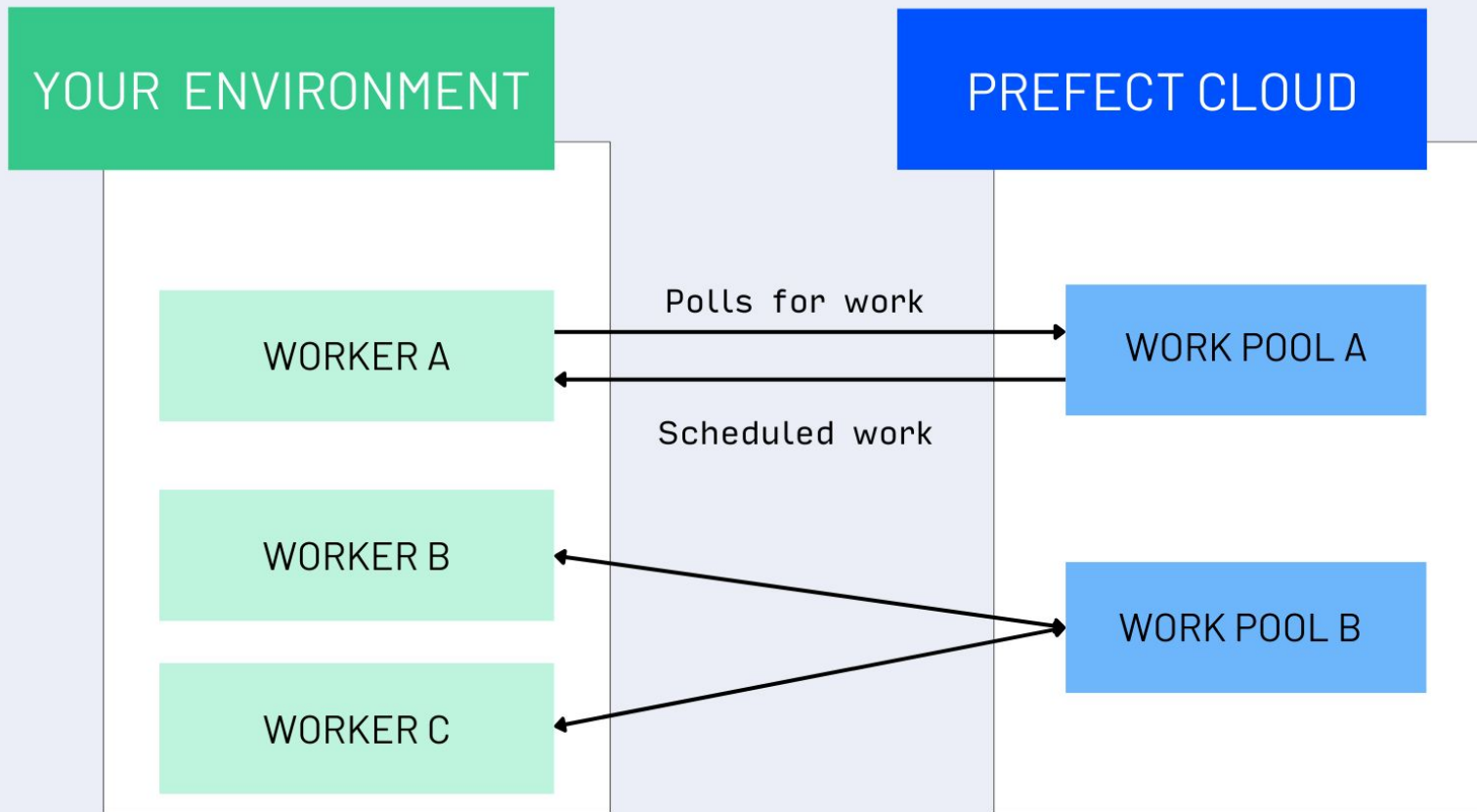
# Workers

---

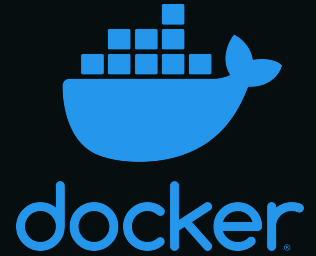
- Long-running process on the client
- Poll for scheduled flow runs from work pools
- Must match a work pool to pick up work



# WORKERS & WORK POOLS



# Docker work pool & worker



# Why use Docker?

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- Same operating environment everywhere
- Lighter weight than a VM
- Linux (generally)
- Portable
- Very popular
- Almost all Prefect work pools use it



# Docker work pool

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## Run a flow in a Docker container

1. Install: *pip install -U prefect-docker*
2. Start Docker on your machine
3. Create a Docker type work pool
4. Start a worker that polls the work pool
5. Create a deployment that specifies the work pool
6. Run the deployment



# Create a Docker work pool

## Hybrid

Hybrid work pools require workers to poll for and execute flow runs in your infrastructure.



### AWS Elastic Container Service

Execute flow runs within containers on AWS ECS. Works with EC2 and Fargate clusters. Requires an AWS account.



### Azure Container Instances

Execute flow runs within containers on Azure's Container Instances service. Requires an Azure account.



### Docker

Execute flow runs within Docker containers. Works well for managing flow execution environments via Docker images. Requires access to a running Docker daemon.



### Google Cloud Run

Execute flow runs within containers on Google Cloud Run. Requires a Google Cloud Platform account.



### Google Cloud Run V2

Execute flow runs within containers on Google Cloud Run (V2 API). Requires a Google Cloud Platform account.



### Google Vertex AI

Execute flow runs within containers on Google Vertex AI. Requires a Google Cloud Platform account.



### Kubernetes

Execute flow runs within jobs scheduled on a Kubernetes cluster. Requires a Kubernetes cluster.





# Package flow code into a Docker image with *.deploy()*

---

```
from prefect import flow

@flow(log_prints=True)
def buy():
    print("Buying securities")

if __name__ == "__main__":
    buy.deploy(
        name="my-code-in-an-image-deployment",
        work_pool_name="my-docker-pool",
        image="discdiver/local-image:1.0",
        push=False,
    )
```

*.from\_source()* method not needed if baking flow code into image



## `.deploy()` method

---

Creates a Docker image with your flow code baked in by default!

- specify the image name
- specify `push=False` to not push image to registry
- can create a `requirements.txt` file with packages to install into the image (or add package names to work pool or at deployment creation time)



## Docker type worker

---

Start a Docker type worker to connect to a work pool named *my-docker-pool*

*prefect worker start -p my-docker-pool*



## Dockerfile used to create your image (under the hood)

---

```
FROM prefecthq/prefect:2-latest
COPY requirements.txt /opt/prefect/104/requirements.txt
RUN python -m pip install -r requirements.txt
COPY . /opt/prefect/pacc-2024/
WORKDIR /opt/prefect/pacc-2024/
```



# Docker

---

- Prefect provides base Docker images
- Can customize base image
- Read about choosing images at [docs.prefect.io/concepts/infrastructure/#standard-python](https://docs.prefect.io/concepts/infrastructure/#standard-python)



# Docker

---

- Run your deployment
- Worker pulls image and spins up Docker container
- Flow code runs in Docker container and exits 🚀



# Docker

## See container in Docker Desktop if running locally

### Containers

[Give feedback](#) 

A container packages up code and its dependencies so the application runs quickly and reliably from one computing environment to another. [Learn more](#)

☐ Only show running containers

 Search



NAME

IMAGE

STATUS

PORT(S)

STARTED

ACTIONS



**nano-tortoise**

26fed9f8e268



[prefecthq/p](#) Exited



# Docker

---

## Prerequisites reminder:

- Docker installed & **running**
- prefect-docker package installed





## Hybrid work pool types

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1. Kubernetes
2. Docker
3. Serverless options such as ECS, ACI, GCR, VertexAI
4. Process (local subprocess)

\* Worker required for all





# Push work pools

## Push work pools

---

Serverless options with no worker required

Options:

- AWS ECS, Google Cloud Run, Azure Container Instances

Create from CLI:

```
prefect work-pool create --type modal:push --provision-infra my-modal-pool
```



## Push work pools

---

Prefect will create everything for you with *--provision-infra*

Prerequisites to use:

- Cloud provider account
- CLI tool installed
- Authenticated locally


```
prefect work-pool create --type modal:push --provision-infra my-modal-pool
```



# What's a work queue for?


---

- Prioritize work
- Limit concurrent runs



 default work queue created automatically


# Pause work pools or work queues


**basic-k8s** ●


 Kubernetes





Concurrency Limit Unlimited


 



1 Work Queue 

 Search

| Name    | Concurrency Limit | Priority  | Status   |
|---------|-------------------|--|--|
| default |                   | 1  |  Unhealthy   |



# 104 Recap

---

You've seen how to

- Create work-pool based deployments! 🎉
- Create a deployment that uses a Prefect managed work pool and flow code stored on GitHub
- Use the hybrid model with workers
- Bake flow code into Docker images
- Create push work pools with a single command
- Pause and resume work pools and work queues





# Lab 104





## Reminder: breakout room norms

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1. 😊 Introduce yourselves
2. 📹 Camera on (if possible)
3. 💻 One person shares screen
4. 🧑💻 Everyone codes
5. 🧑🗨️ Each person talks
6. 😌 Low-pressure, welcoming environment: lean in

Breakout rooms with lots of participation =  
more fun + more learning! 😎



## 104 Lab

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- Create a Prefect Managed work pool.
- Create and run a deployment that uses the work pool.
- Use flow code stored in your own GitHub repository with a deployment.
- Pause and resume the work pool from the UI.



# 104 Lab Extensions

---

- Stretch 1: bake your flow code into a Docker image with `.deploy()`.
- Don't push the image to a remote repository (or do log in and push it to DockerHub).


Don't forget to:

- Start Docker on your machine
  - `pip install -U prefect-docker`
  - Make a Docker work pool
  - Start a Docker type worker that polls the pool
- Stretch 2: create a push work pool with `provision-infra` and use it in a deployment.
- Stretch 3: add an environment variable to a work pool and use it.



## Lab 104: a solution

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One person from each group, share your code in  
Slack 

Discuss

Questions?



# If you give an engineer a job...

---

Could you just fetch this data and save it? Oh, and ...

1. set up logging?
2. do it every hour?
3. visualize the dependencies?
4. automatically retry if it fails?
5. create an artifact for human viewing?
6. add caching?
7. add collaborators to run and view - who don't code?
8. send me a message when it succeeds?
9. run it in a Docker container-based environment?
10. pause for input?
11. automatically declare an incident when a % of workflows fail?
12. automatically run a workflow in response to an event?



# 105 - Interactive workflows & incidents

# 105 Agenda

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- Interactive workflows
  - Human in the loop
- Incidents
- Metric triggers
- Prefect Runtime
- State change hooks





# Interactive workflows





## Interactive workflows

---

Pause a flow run to wait for input from a user via a web form (human-in-the-loop) 😊

*pause\_flow\_run* function

# Human-in-the-loop: basic

---

```
from prefect import flow, pause_flow_run

@flow(log_prints=True)
def greet_user():
    name = pause_flow_run(str)
    print(f"Hello, {name}!")

if __name__ == "__main__":
    greet_user()
```



# Human-in-the-loop: basic

**Flow Runs / energetic-stallion**

Paused

2024/01/30 02:03:03 PM

1s

None

Resume

Cancel

Flow greet-user

Events

Logs

Task Runs

Subflow Runs

Results

Artifacts

Details

Parameters

Level: all

Oldest to newest

Jan 30th, 2024

INFO

Pausing flow, execution will continue when this flow run is resumed.

02:03:03 PM  
prefect.flow\_runs



# Human-in-the-loop: basic

Jan 30th, 2024

INFO Pausing flow, execution will continue when this flow run is resumed.

Resume Flow Run

×

Current Flow Run State

Paused

Flow requires input. Please fill out the form below to resume.

Do you want to resume energetic-stallion?

Value

Jeff

Cancel

Submit



# Human-in-the-loop: basic

---

Jan 30th, 2024

|      |  |                                  |
|------|--|----------------------------------|
| INFO | Pausing flow, execution will continue when this flow run is resumed. | 02:03:03 PM<br>prefect.flow_runs |
| INFO | Resuming flow run execution!   | 02:06:06 PM<br>prefect.flow_runs |
| INFO | Hello, Jeff!   | 02:06:06 PM<br>prefect.flow_runs |
| INFO | Finished in state Completed()  | 02:06:07 PM<br>prefect.flow_runs |



## Interactive workflows

---

- For validation: can use *RunInput* class, which is a subclass of Pydantic's *BaseModel* class
- Able to specify a default value or create a dropdown
- Can create a default value



# Human-in-the-loop: default value

---

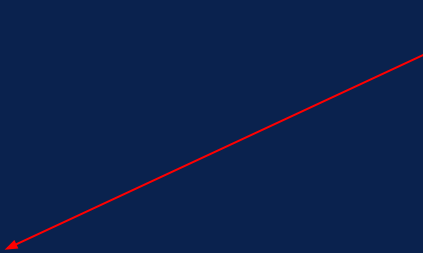
```
import asyncio
from prefect import flow, pause_flow_run
from prefect.input import RunInput

class UserNameInput(RunInput):
    name: str

@flow(log_prints=True)
async def greet_user():
    user_input = await pause_flow_run(
        wait_for_input=UserNameInput.with_initial_data(name="anonymous")
    )

    if user_input.name == "anonymous":
        print("Hello, stranger!")
    else:
        print(f"Hello, {user_input.name}!")

if __name__ == "__main__":
    asyncio.run(greet_user())
```



# Human-in-the-loop: default value

**Flow Runs / glistening-penguin**

Paused 2024/01/11 02:12:35 PM 1s None Resume

Flow greet-user

Resume Flow Run

Current Flow Run State

Paused

**Flow requires input.** Please fill out the form below to resume.

Do you want to resume glistening-penguin?

Name (Optional)

anonymous

Cancel Submit

Details Pa

all Old

Jan 11th, 2024

**INFO** Pausing flow, execution will continue when this flow run is resumed.





# Human-in-the-loop: custom validation

```
from typing import Literal
import pydantic
from prefect import flow, pause_flow_run
from prefect.input import RunInput

class ShirtOrder(RunInput):
    """Shirt order options"""

    size: Literal["small", "medium", "large", "xlarge"]
    color: Literal["red", "green", "black"]

    @pydantic.validator("color")
    def validate_shirt(cls, value, values, **kwargs):
        """Validate that shirt combo exists"""

        if value == "green" and values["size"] == "small":
            raise ValueError("We don't carry that combination.")
        return value
```



# Human-in-the-loop: custom validation

---

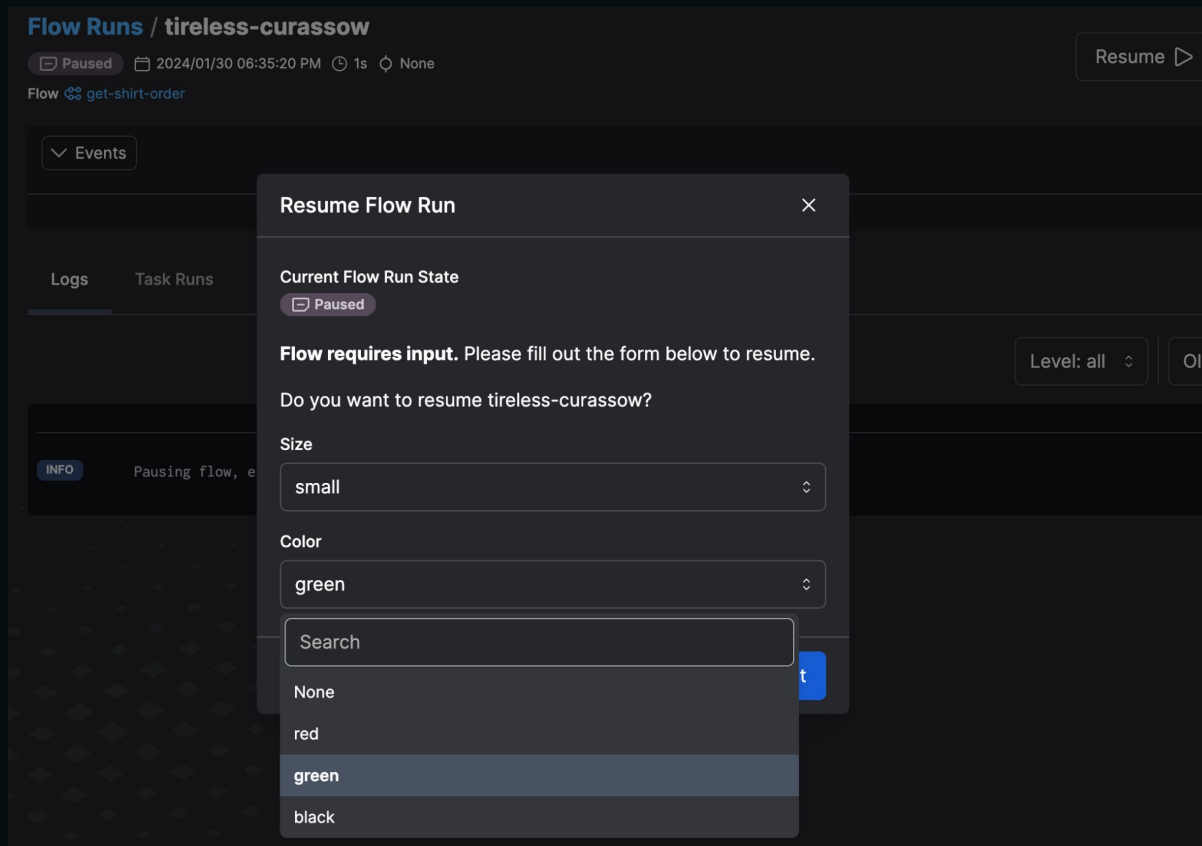
```
@flow(log_prints=True)
def get_shirt_order():
    """Get shirt selection from user via UI"""
    shirt_order = None

    while shirt_order is None:
        try:
            shirt_order = pause_flow_run(wait_for_input=ShirtOrder)
            print(f"We'll send you your shirt in {shirt_order} ASAP!")
        except pydantic.ValidationError:
            print(f"Invalid size and color combination.")

if __name__ == "__main__":
    get_shirt_order()
```



# Human-in-the-loop: custom validation



# Human-in-the-loop: custom validation

Jan 30th, 2024

INFO

Pausing flow, execution will continue when this flow run is resumed.

INFO

Resuming flow run execution!

INFO

Invalid size and color combination.

INFO

Pausing flow, execution will continue when this flow run is resumed.

INFO

Resuming flow run execution!

INFO

We'll send you your shirt in size='medium' color='red' ASAP!

INFO

Finished in state Completed()

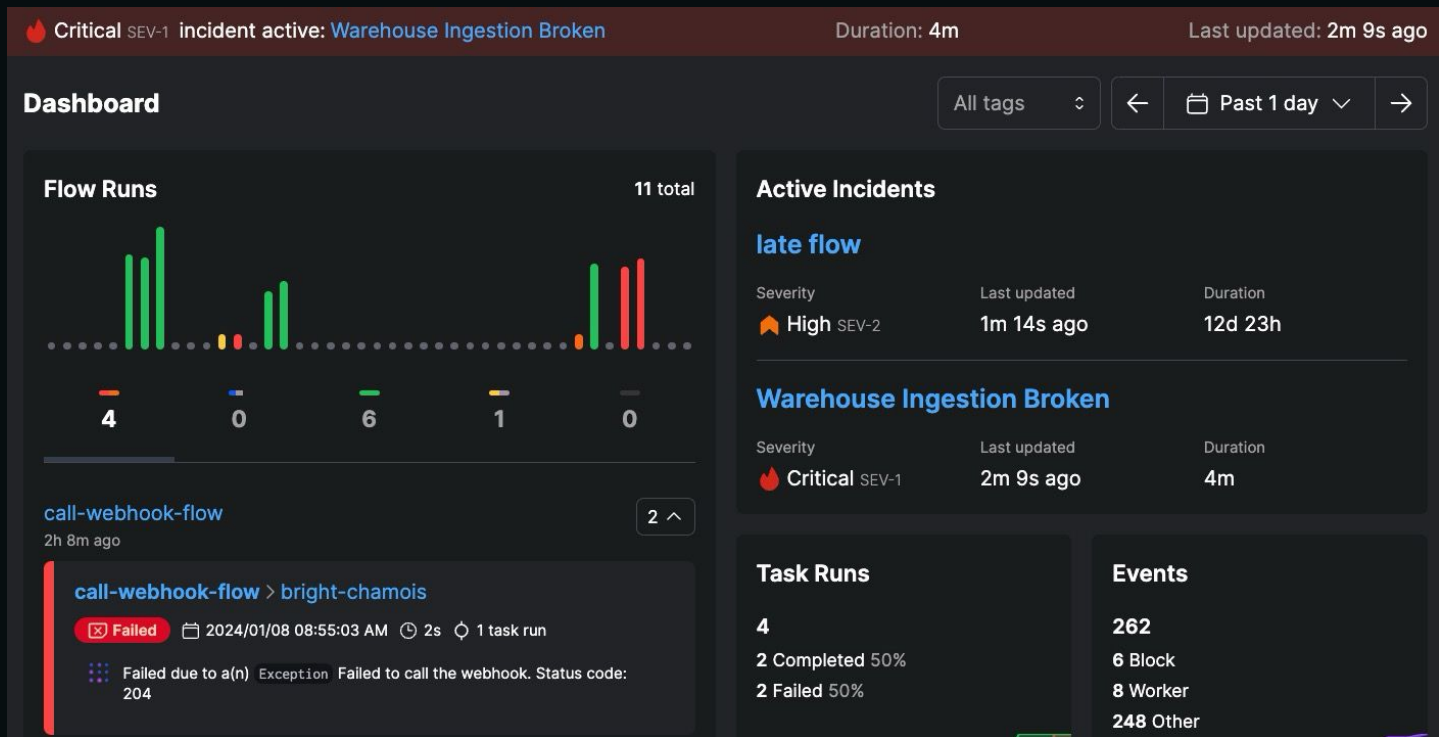


# Incidents



# Incidents

## Formal declarations of disruptions to a workspace



# Incidents

---

- visible workspace-wide
- keeps team updated for faster resolution
- creates record for analysis and compliance
- Pro and Enterprise level feature



# Incidents

Declare an incident manually or automatically through an automation when an event occurs

Critical SEV-1 incident active: Warehouse Ingestion Broken

Duration: 10m

Last updated: 2m 33s ago

Incidents / Warehouse Ingestion Broken Beta

Mark resolved

Status

Severity

Started

Duration

Active

Critical SEV-1

2024/01/08 11:00 AM

10m

Timeline

2024/01/08

Incident declared manually by Taylor Curran at 11:00:00 AM

Severity  
 Critical SEV-1

Taylor Curran added **belligerent-junglefowl** to the related resources list 8m 22s ago

Taylor Curran added **bright-chamois** to the related resources list and removed **belligerent-junglefowl** from the related resources list 8m 9s ago

Taylor Curran commented 4m 13s ago  
Client A reported bad data quality.

Summary

None

Tags

None

Related resources

Block document  
[geo-data-warehouse](#)

Flow run  
[belligerent-junglefowl](#)  
[bright-chamois](#)

70





# Metric triggers

# Metric triggers

Create an automation that uses a metric as a trigger

**Automations / Create** [Documentation](#)

01 Trigger 02 Actions 03 Details

Trigger Type

Metric

Metric Over the last

Average success percentage 10 Minutes

Threshold For

< 70 % 1 Minutes

Flows

train-model × validation-flow ×

Cancel Previous Next



## Metric triggers

---

When a pattern is detected, then take an action

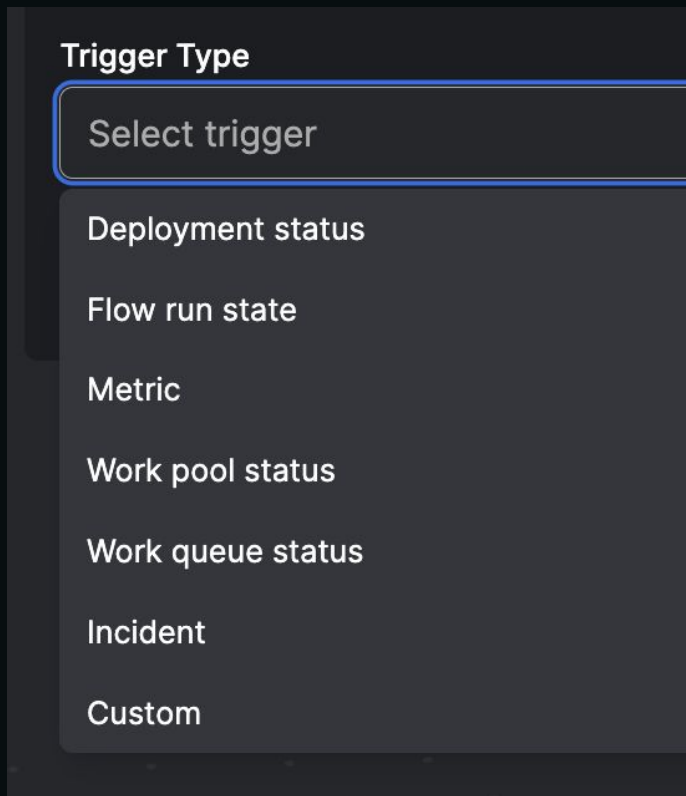
- send a notification
- toggle on a work pool
- create an incident
- run a deployment



## Other trigger types

---

- Can use status of many Prefect objects as triggers
- Incidents can act as a trigger



A screenshot of a web interface showing a dropdown menu for 'Trigger Type'. The menu is open, displaying a list of options. The first option, 'Select trigger', is highlighted with a blue border. The other options are listed below it.

| Trigger Type      |
|-------------------|
| Select trigger    |
| Deployment status |
| Flow run state    |
| Metric            |
| Work pool status  |
| Work queue status |
| Incident          |
| Custom            |





*prefect.runtime*



## *prefect.runtime* module

---

Home for runtime context access.

Useful for labeling, logs, etc.

Includes:

- ***deployment***: info on the current deployment
- ***flow\_run***: info on the current flow run
- ***task\_run***: info on the current task run



## *prefect.runtime*

---

```
from prefect import flow, task
from prefect import runtime

@flow(log_prints=True)
def my_flow(x):
    print("My name is", runtime.flow_run.name)
    print("I belong to deployment", runtime.deployment.name)
    my_task(2)

@task
def my_task(y):
    print("My name is", runtime.task_run.name)
    print("Flow run parameters:", runtime.flow_run.parameters)

if __name__ == "__main__":
    my_flow(x=1)
```



## *prefect.runtime*

---

Useful for labeling, logs, etc.

```
15:04:48.223 | INFO | prefect.engine - Created flow run 'radical-duck' for flow 'my-flow'
15:04:48.224 | INFO | Flow run 'radical-duck' - View at https://app.prefect.cloud/account/9b649228
366c9e4c4/flow-runs/flow-run/7bdce263-37dc-4c08-bb46-38dd534878de
15:04:48.488 | INFO | Flow run 'radical-duck' - My name is radical-duck
15:04:48.490 | INFO | Flow run 'radical-duck' - I belong to deployment None
15:04:49.267 | INFO | Flow run 'radical-duck' - Created task run 'my_task-0' for task 'my_task'
15:04:49.267 | INFO | Flow run 'radical-duck' - Executing 'my_task-0' immediately...
15:04:49.449 | INFO | Task run 'my_task-0' - My name is my_task-0
15:04:49.450 | INFO | Task run 'my_task-0' - Flow run parameters: {'x': 1}
15:04:49.585 | INFO | Task run 'my_task-0' - Finished in state Completed()
```







# State change hooks



# State change hooks

---

Execute code in response to flow run or task run state changes

```
from prefect import flow

def my_success_hook(flow, flow_run, state):
    print(f"Flow run {flow_run.id} succeeded!")

@flow(on_completion=[my_success_hook])
def my_flow():
    return 42

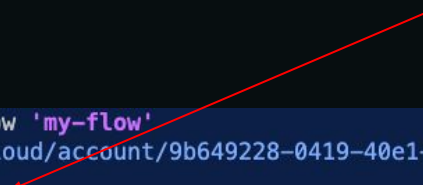
if __name__ == "__main__":
    my_flow()
```



# State change hooks

---

```
15:12:49.063 | INFO | prefect.engine - Created flow run 'opal-marmot' for flow 'my-flow'
15:12:49.064 | INFO | Flow run 'opal-marmot' - View at https://app.prefect.cloud/account/9b649228-0419-40e1-9e0d-44954b5
66c9e4c4/flow-runs/flow-run/c914257b-d5a3-4e7e-a4a7-324d5f2a2851
15:12:49.807 | INFO | Flow run 'opal-marmot' - Running hook 'my_success_hook' in response to entering state 'Completed'
Flow run succeeded!
c914257b-d5a3-4e7e-a4a7-324d5f2a2851
<class 'prefect.client.schemas.objects.FlowRun'>
15:12:49.817 | INFO | Flow run 'opal-marmot' - Hook 'my_success_hook' finished running successfully
15:12:49.817 | INFO | Flow run 'opal-marmot' - Finished in state Completed()
```



# State change hooks

---

| Type                         | Flow | Task | Description   |
|------------------------------|------|------|---|
| <code>on_completion</code>   | ✓    | ✓    | Executes when a flow or task run enters a <code>Completed</code> state. |
| <code>on_failure</code>      | ✓    | ✓    | Executes when a flow or task run enters a <code>Failed</code> state.    |
| <code>on_cancellation</code> | ✓    | -    | Executes when a flow run enters a <code>Cancelling</code> state.        |
| <code>on_crashed</code>      | ✓    | -    | Executes when a flow run enters a <code>Crashed</code> state.           |



## 105 Recap

---

You've seen how to:

- Create an active workflow that pauses a flow run for input from a user
- Use a metric trigger in an automation
- Get current info into a flow with *prefect\_runtime*
- Use a state change hook



# Lab 105



## 105 Lab


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- Create an active workflow that pauses a flow run for input from a user.
- Print the flow run name in your code with *`prefect_runtime`*
- Use a state change hook to run code when a flow run state is reached.
- Stretch (if on Pro or Enterprise plan): Use a metric trigger in an automation.



## Lab 105: a solution

---

One person from each group, share your code in  
Slack 

Discuss

Questions?





# If you give an engineer a job...

---

Could you just fetch this data and save it? Oh, and ...

1. set up logging?
2. do it every hour?
3. visualize the dependencies?
4. automatically retry if it fails?
5. create an artifact for human viewing?
6. add caching?
7. add collaborators to run and view - who don't code?
8. send me a message when it succeeds?
9. run it in a Docker container-based environment?
10. pause for input?
11. automatically declare an incident when a % of workflows fail?
12. automatically run a workflow in response to an event?



# 106 - Workflow patterns & event-based workflows

# 106 Agenda

---

## Workflow patterns with

- subflows
- *run\_deployment*
- automations

## Automation triggers

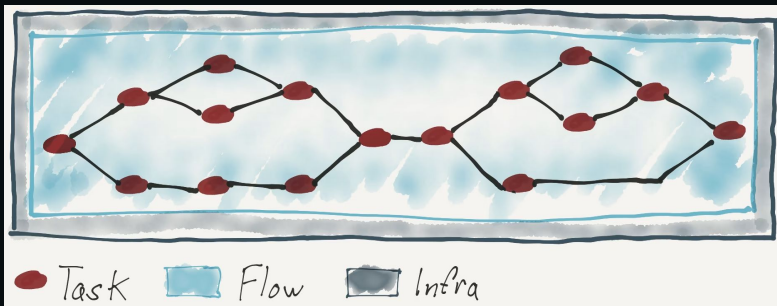
- custom events
- webhooks
- deployment triggers



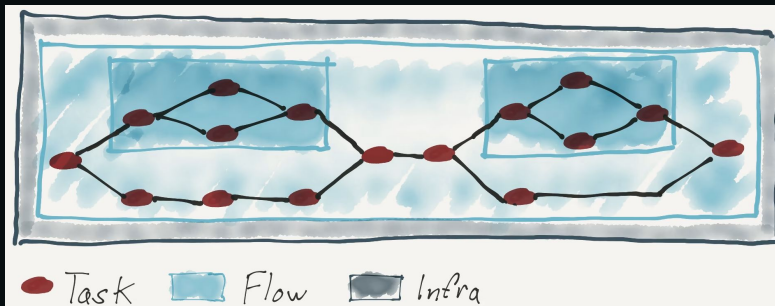


# Workflow patterns

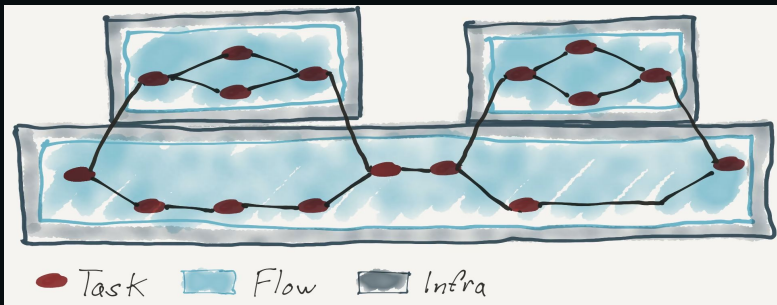
# Workflow patterns - [prefect.io/blog/workflow-design-patterns](https://prefect.io/blog/workflow-design-patterns)



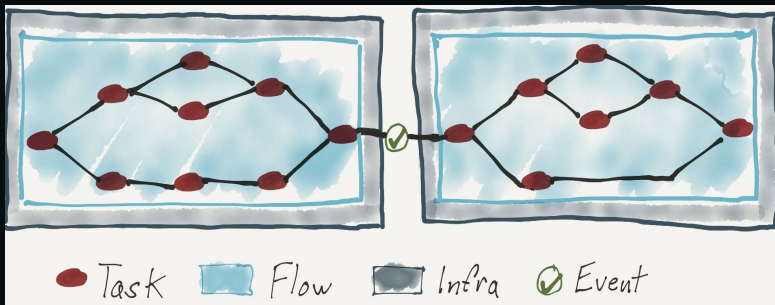
Monoflow



Flow of subflows

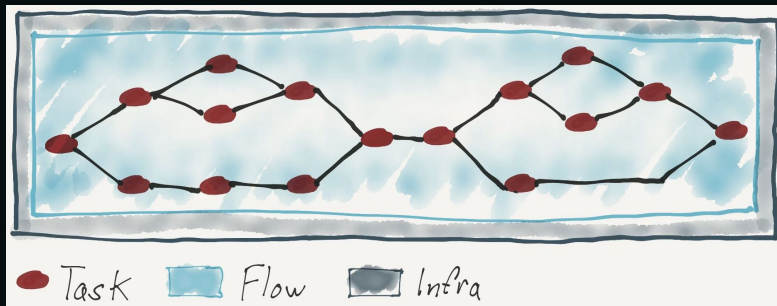


Flow of deployments

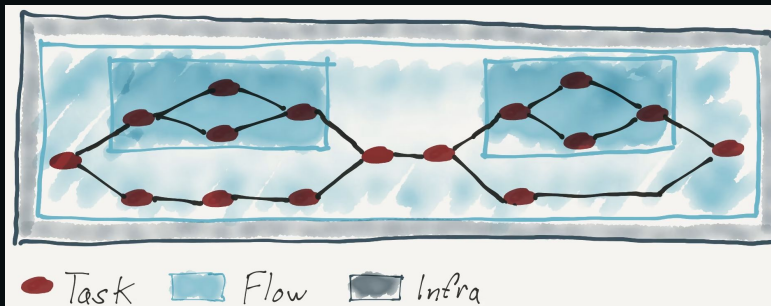


Event triggered flow

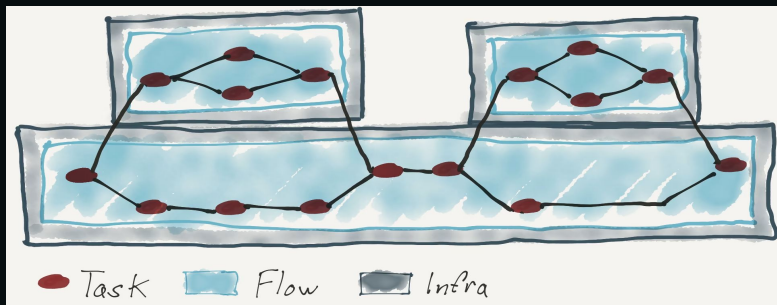
You have seen **this pattern**



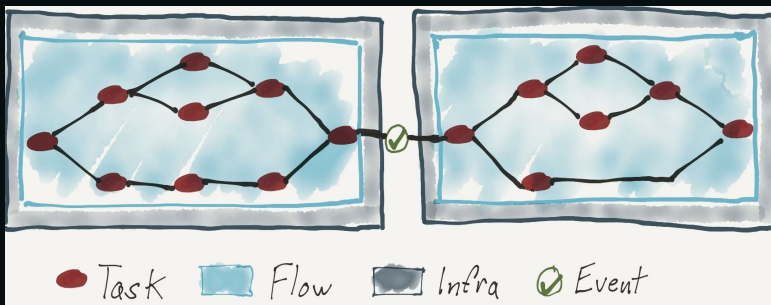
**Monoflow**



Flow of subflows



Flow of deployments



Event triggered flow

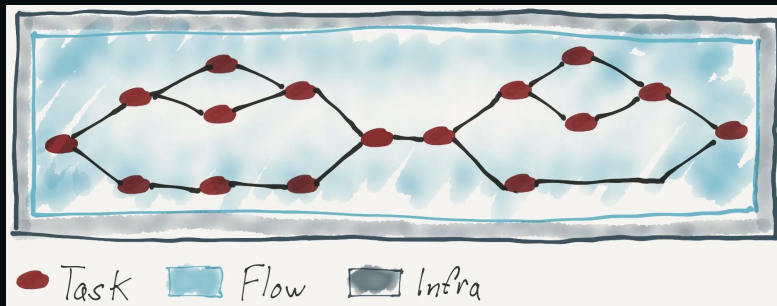


# Subflows

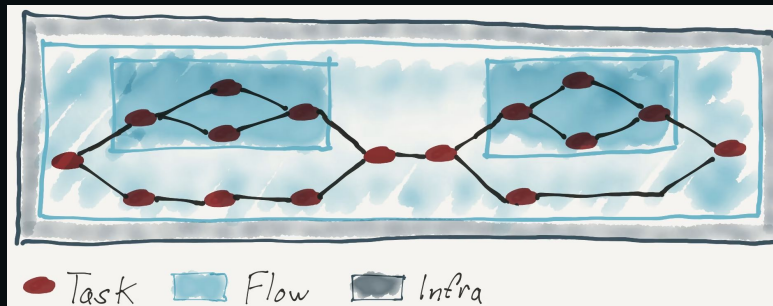




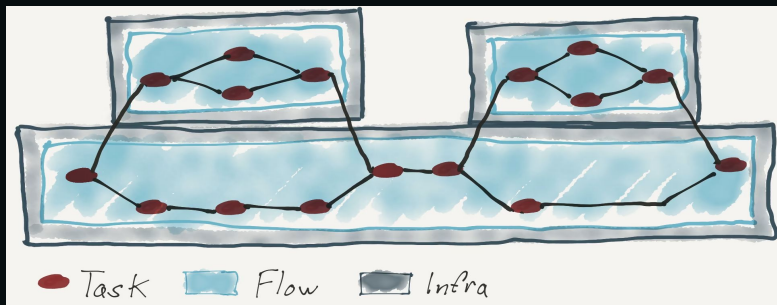
# Workflow patterns - Flow of subflows



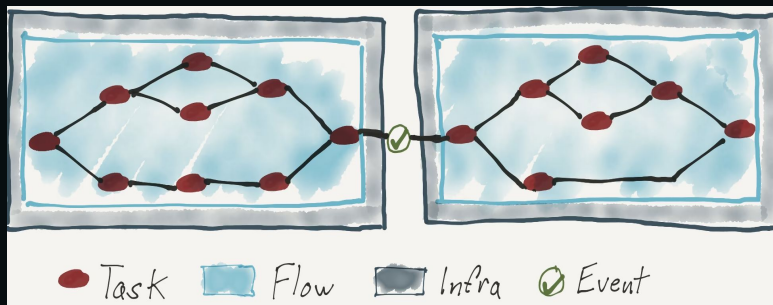
Monoflow



Flow of subflows



Flow of deployments



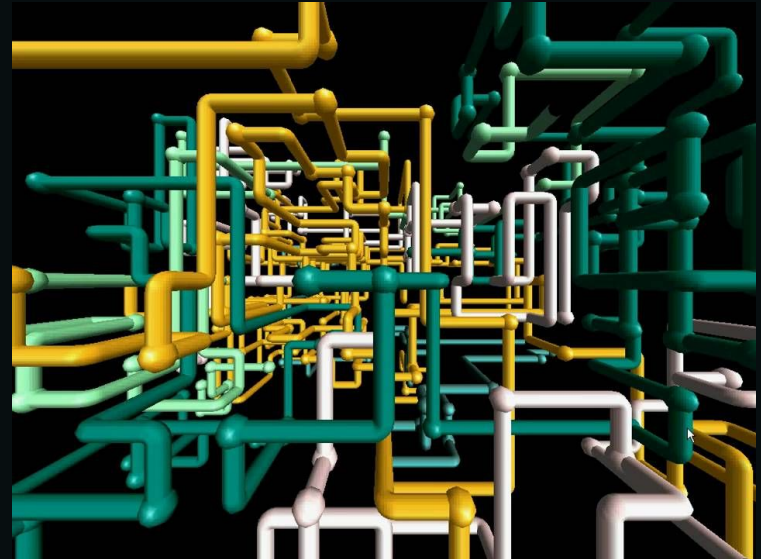
Event triggered flow



# Subflow

---

- A flow that calls another flow
- Useful for grouping related tasks



# Subflows

```
import httpx
from prefect import flow

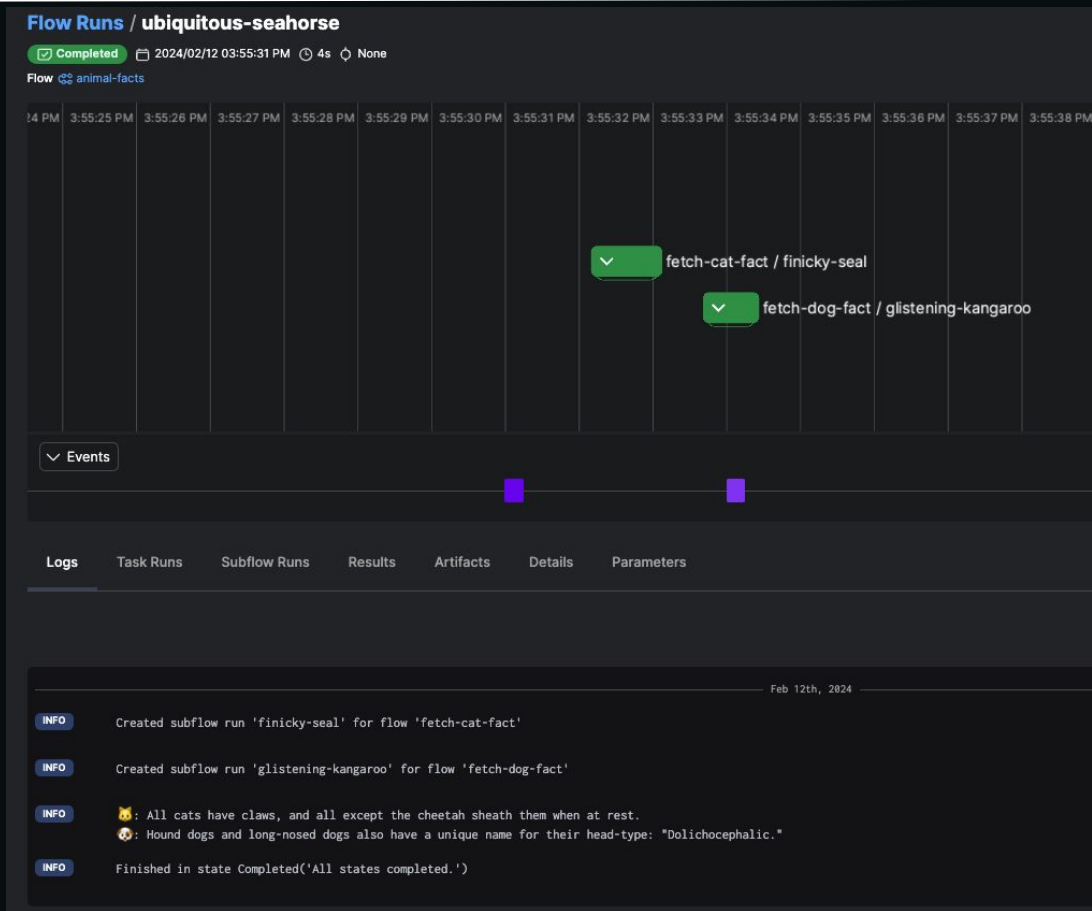
@flow
def fetch_cat_fact():
    return httpx.get("https://catfact.ninja/fact?max_length=140").json()["fact"]

@flow
def fetch_dog_fact():
    return httpx.get(
        "https://dogapi.dog/api/v2/facts",
        headers={"accept": "application/json"},
    ).json()["data"][0]["attributes"]["body"]

@flow(log_prints=True)
def animal_facts():
    cat_fact = fetch_cat_fact()
    dog_fact = fetch_dog_fact()
    print(f"🐱: {cat_fact} \n🐶: {dog_fact}")

if __name__ == "__main__":
    animal_facts()
```

# Timeline view

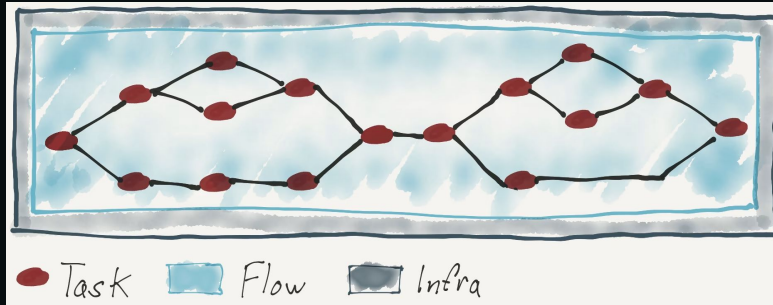




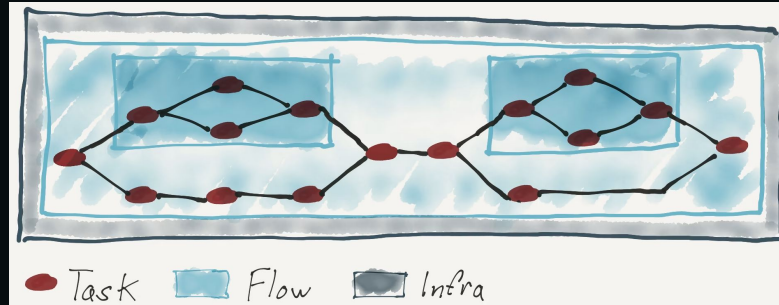
*run\_deployment*



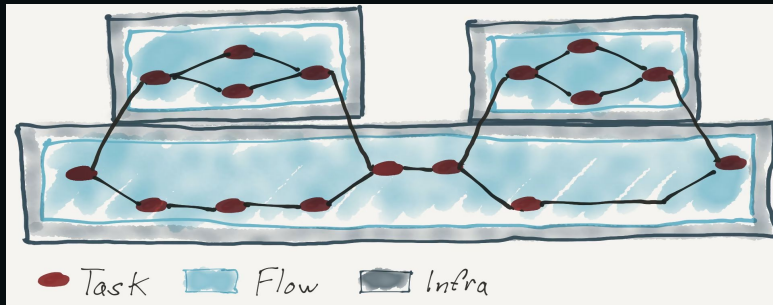
# Workflow patterns - Flow of deployments (*run\_deployment*)



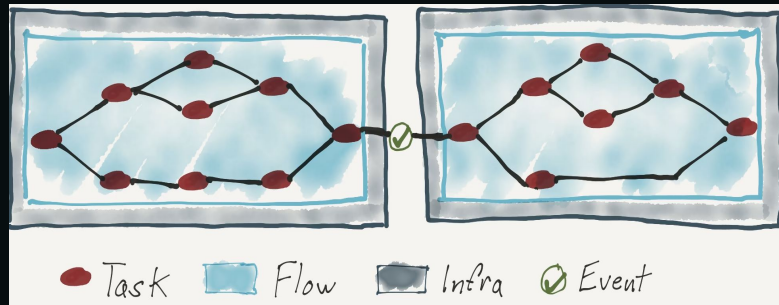
Monoflow



Flow of subflows




Flow of deployments



Event triggered flow

# run\_deployment

`run_deployment` `async` 

Create a flow run for a deployment and return it after completion or a timeout.

This function will return when the created flow run enters any terminal state or the timeout is reached. If the timeout is reached and the flow run has not reached a terminal state, it will still be returned. When using a timeout, we suggest checking the state of the flow run if completion is important moving forward.

## Parameters:

| Name              | Type                          | Description   | Default           |
|-------------------|-------------------------------|---|-------------------|
| <b>name</b>       | <code>Union[str, UUID]</code> | The deployment id or deployment name in the form:<br><code>&lt;slugified-flow-name&gt;/&lt;slugified-deployment-name&gt;</code> | <i>required</i>   |
| <b>parameters</b> | <code>Optional[dict]</code>   | Parameter overrides for this flow run.<br>Merged with the deployment defaults.  | <code>None</code> |



## *run\_deployment*

---

```
from prefect.deployments import run_deployment

run_deployment(
    name="pipeline/my-first-managed-deployment", parameters={"lat": 1, "lon": 2}
)
```



# run\_deployment

```
INFO      Opening process...                                04:52:08 PM
                                                    prefect.flow_runs.runner

INFO      Created task run 'fetch_weather-0' for task 'fetch_weather' 04:52:15 PM
                                                    prefect.flow_runs

INFO      Executing 'fetch_weather-0' immediately...                04:52:15 PM
                                                    prefect.flow_runs

INFO      Finished in state Completed()                             04:52:16 PM
                                                    fetch_weather-0
                                                    prefect.task_runs

INFO      Created task run 'save_weather-0' for task 'save_weather'    04:52:16 PM
                                                    prefect.flow_runs

INFO      Executing 'save_weather-0' immediately...                04:52:16 PM
                                                    prefect.flow_runs

INFO      Finished in state Completed()                             04:52:17 PM
                                                    save_weather-0
                                                    prefect.task_runs

INFO      Finished in state Completed()                             04:52:17 PM
                                                    prefect.flow_runs

INFO      Process for flow run 'sparkling-earthworm' exited cleanly. 04:52:20 PM
                                                    prefect.flow_runs.runner
```



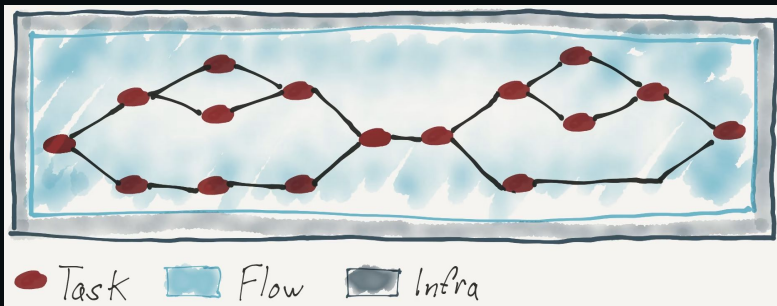




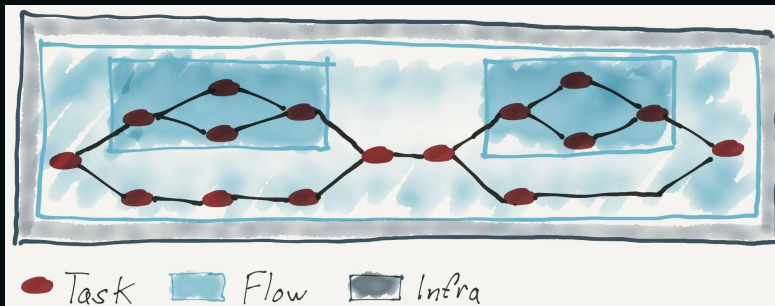
# Event-triggered workflows



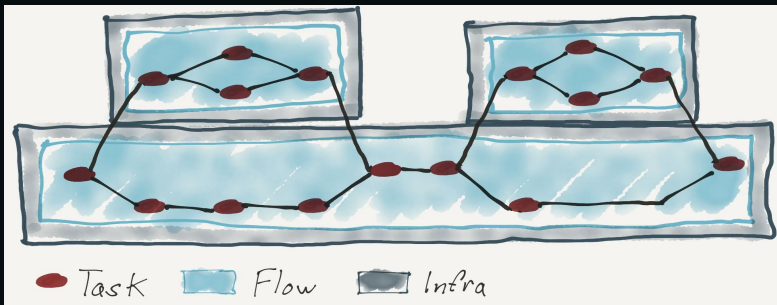
# Workflow patterns - Event-triggered



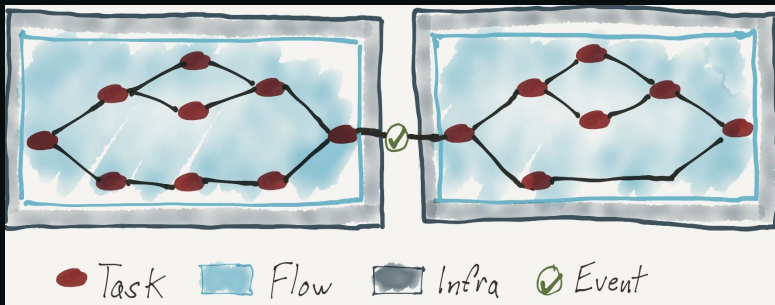
Monoflow





Flow of subflows





Flow of deployments



Event-triggered flow



# Custom events in Python



# Custom events

---

Great when working in Python land and want to get data into an automation 🐍



# Create custom event to be emitted when code runs

---

*emit\_event* must provide two args: *event* and

*resource= {"prefect.resource.id": val}"}*

```
from prefect.events import emit_event

def emit_name_event(name: str = "kiki"):
    """Emit a basic Prefect event with a dynamically populated name"""
    print(f"Hi {name}!")
    emit_event(
        event=f"{name}.sent.event!",
        resource={"prefect.resource.id": f"developer.{name}"},
        payload={"name": name},
    )

if __name__ == "__main__":
    emit_name_event()
```



# Run code and head to the **Event Feed** page

12:43:37 PM  
Mar 1st, 2024

**Kiki sent event!**  
kiki.sent.event!

**Resource**  
developer.kiki

Click link to see event page

## Workspace Events / Kiki sent event!

Details

Raw

### Event

kiki.sent.event!

### Occurred

2024/03/01 12:43:37 PM

### Resource

developer.kiki

### Related Resources

None



# See event details on the **Raw** tab

**Workspace Events** / Kiki sent event!

Details **Raw**

```
{
  "id": "e7daff3e-5ed7-4a29-ba5f-fc9965772ce9",
  "account": "9b649228-0419-40e1-9e0d-44954b5c0ab6",
  "event": "kiki.sent.event!",
  "occurred": "2024-03-01T17:43:37.151Z",
  "payload": {
    "name": "kiki"
  },
  "received": "2024-03-01T17:43:37.415Z",
  "related": [],
  "resource": {
    "prefect.resource.id": "developer.kiki"
  },
  "workspace": "d137367a-5055-44ff-b91c-6f7366c9e4c4"
}
```



# Data from event can be used in an automation action

---

For example: Populate a flow param via a Run Deployment action

Use *emit\_event*'s *payload* parameter





# Example: custom event with detailed payload

---

```
from prefect.events import emit_event
```

```
emit_event(  
    event=f"bot.{bot.name.lower()}.responded",  
    resource={"prefect.resource.id": f"bot.{bot.name.lower()}"},  
    payload={  
        "user": event.user,  
        "channel": event.channel,  
        "thread_ts": thread,  
        "text": text,  
        "response": response.content,  
        "prompt_tokens": prompt_tokens,  
        "response_tokens": response_tokens,  
        "total_tokens": prompt_tokens + response_tokens,  
    },  
)
```



# Event webhooks



## Event webhooks

---

- expose a URL endpoint
- provides consistent interface for integrating external applications with Prefect
- when webhook URL is pinged, creates a Prefect event - can be used as a trigger in an automation
- great when **not** in Python land



# Event webhooks

Add Event Webhook

Name

Description

Your template should produce valid json with an event name and resource id. You can use jinja to include dynamic values.

Docs

Template presets

Static

Dynamic

CloudEvent

Template

```
{
  "event": "{{body.event_name}}",
  "resource": {
    "prefect.resource.id": "product.models.{{ body.m
    "prefect.resource.name": "{{ body.friendly_name
    "producing-team": "Data Science"
  }
}
```

Cancel

Create



## Event webhooks

---

- use Jinja2 for dynamic templating
- template should be valid JSON
- create from UI or CLI



## Event webhooks

---

Hit the endpoint provided by Prefect:

```
curl https://api.prefect.cloud/hooks/your_slug_here
```



## Event webhooks

---

See the event that is created under **Event Feed** in the UI

10:24:54 PM

Jun 19th, 2023

### Demo event

demo.event

#### Resource

demo.alert.2

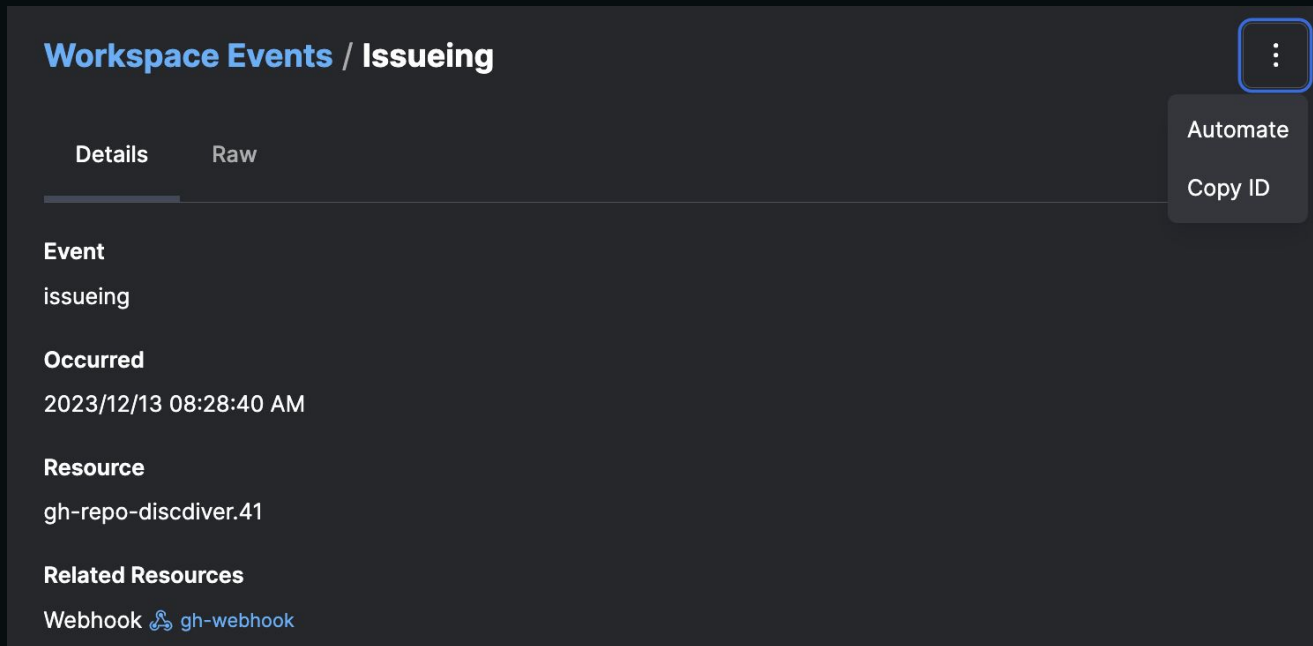
#### Related Resources

prefect-cloud.webhook.791b2034-892f-41eb-81a3-dc9dfbff133c



# Event webhooks

⚡ Use this event as a custom trigger in an automation!



The screenshot displays the 'Workspace Events / Issueing' interface. At the top, there are tabs for 'Details' and 'Raw'. Below the tabs, the event details are listed: 'Event' is 'issuing', 'Occurred' is '2023/12/13 08:28:40 AM', and 'Resource' is 'gh-repo-discdiver.41'. Under 'Related Resources', there is a 'Webhook' link pointing to 'gh-webhook'. On the right side, there is a menu icon (three vertical dots) which is highlighted with a blue box. A red arrow points from the right towards this menu icon. The menu is open, showing two options: 'Automate' and 'Copy ID'.

**Workspace Events / Issueing**

Details Raw

**Event**  
issuing

**Occurred**  
2023/12/13 08:28:40 AM

**Resource**  
gh-repo-discdiver.41

**Related Resources**  
Webhook [gh-webhook](#)

⋮

Automate

Copy ID







# Deployment triggers

# Deployment triggers

---

Alternative approach for creating an automation:

- define an automation in code
- specify the trigger condition in a *DeploymentTrigger* object and pass to *.deploy()*
- creates the automation when the deployment is created



# Deployment triggers - the flow to be triggered

---

```
from prefect import flow
from prefect.events.schemas import DeploymentTrigger

@flow(log_prints=True)
def downstream_flow(ticker: str = "AAPL") -> str:
    print(f"got {ticker}")
```



# Deployment triggers - the trigger

---

Create a *DeploymentTrigger* object

```
downstream_deployment_trigger = DeploymentTrigger(  
    name="Upstream Flow - Pipeline",  
    enabled=True,  
    match_related={  
        "prefect.resource.id": "prefect.flow.5c933ae4-dd43-4705-90eb-cfdeb4c028fb"  
    },  
    expect={"prefect.flow-run.Completed"},  
)
```

See the event specification docs:

[docs.prefect.io/cloud/events/#event-specification](https://docs.prefect.io/cloud/events/#event-specification)



# Deployment triggers - create

---

Pass the trigger object to *.deploy* and run the script

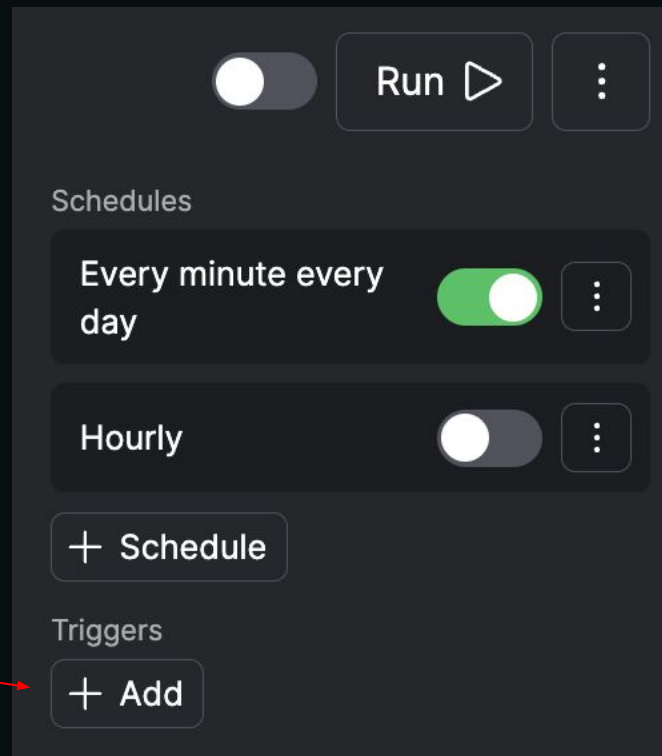
```
if __name__ == "__main__":
    downstream_flow.from_source(
        source="https://github.com/discdiver/pacc-2024.git",
        entrypoint="106/deployment-trigger.py:downstream_flow",
    ).deploy(
        name="ticker-deploy",
        work_pool_name="managed1",
        triggers=[downstream_deployment_trigger],
    )
```



## Another way to begin automation creation in the UI:

---

- Start from a deployment page
- Click the **+ Add** button under **Triggers**
- Pre-populates the automation action with the deployment run



# Specifying an automation trigger

To create a custom trigger check out an event in the UI (**Raw** tab)

You can copy/paste and adjust in the trigger JSON.

See the Events docs.

## Workspace Events / Automation created

Details Raw

```
{
  "id": "a17bae41-71fd-4ca1-9f10-3d7ea2aea54e",
  "account": "9b649228-0419-40e1-9e0d-44954b5c0ab6",
  "event": "prefect-cloud.automation.created",
  "occurred": "2024-02-13T19:47:25.680Z",
  "payload": {
    "name": "Upstream Flow - Sell",
    "description": "",
    "enabled": true,
    "trigger": {
      "match": {},
      "match_related": {
        "prefect.resource.id": "prefect.flow.5c933ae4-dd43-4705-90eb-cfdeb4c028fb"
      },
      "after": [],
      "expect": [
        "prefect.flow-run.Completed"
      ],
      "for_each": [],
      "posture": "Reactive",
      "threshold": 1,
      "within": 0,
      "metric": null
    }
  }
}
```



## 106 Recap

---

You've seen how to use several workflow patterns with

- subflows
- *run\_deployment*
- automations
  - custom events defined in Python
  - webhooks
  - trigger defined in code at deployment creation





## 106 Lab

---

- Create a deployment that uses a subflow
- Create a second deployment that uses *run\_deployment*
- Stretch: Create a webhook and an automation that runs a deployment when that webhook fires
- Stretch: Create a custom event in Python that triggers a notification action in an automation
- Super-stretch: Create a deployment that contains a trigger defined in Python code



# If you give an engineer a job...

---

Could you just fetch this data and save it? Oh, and ...

1. set up logging?
2. do it every hour?
3. visualize the dependencies?
4. automatically retry if it fails?
5. create an artifact for human viewing?
6. add caching?
7. add collaborators to run and view - who don't code?
8. send me a message when it succeeds?
9. run it in a Docker container-based environment?
10. pause for input?
11. automatically declare an incident when a % of workflows fail?
12. automatically run a workflow in response to an event?





# Wrap



## Brief feedback survey

---

Please let us know what went well and what could be improved. 🎉



# Congratulations!!!



**PREFECT** ASSOCIATE  
CERTIFICATION

# Bonus content

# Bonus content

---

- Prefect variables
- Task runners & async code
- Testing
- Prefect REST API
- Upload data to AWS S3
- Self hosted server instance
- Prefect profiles
- Deploy multiple flows
- Guided deployment creation with *prefect deploy*
- Deployments with *prefect.yaml*
- CI/CD with GitHub Actions
- Helm chart
- Terraform provider





# Variables





## Prefect variables

---

- String values evaluated at runtime
- Store and reuse non-sensitive, small data
- Create via UI or CLI



# Prefect variables

---

## Only string values

New variable

×

Name

my\_variable

Value

3.14159

Tags

Cancel

Create



# Prefect variables

Flow Runs

Flows

Deployments

Work Pools

Blocks

(x) Variables

Notifications

Task Run Concurrency

Variables +

3 Variables


Search variables

A to Z ▾



Filter by tags

| <input type="checkbox"/> | Name   | Value      | Updated                | Tags |
|--------------------------|--------|------------|------------------------|------|
| <input type="checkbox"/> | age    | twenty-two | 2023/04/13 03:36:53 PM | ⋮    |
| <input type="checkbox"/> | height | 72         | 2023/04/13 04:00:32 PM | ⋮    |
| <input type="checkbox"/> | url    | abc123.com | 2023/04/13 04:01:15 PM | ⋮    |





# Task runners for concurrency



# Concurrency

---

- Helpful when waiting for external systems to respond
- Allows other work to be done while waiting
- Prefect's *ConcurrentTaskRunner* replaces need for using Python's *async*, *await*, etc.





# Concurrency & Parallelism: via task runners



# Concurrency & Parallelism

---

- **Concurrency:** single-threaded, interleaving, GIL locked
- **Parallelism:** multiple events run at the same time

Your Prefect code runs **sequentially** by default





# Concurrency





# Concurrency

---

- Helpful when waiting for external systems to respond (IO / network-bound work)
- Prefect's *ConcurrentTaskRunner* allows you to concurrently execute code without *async* syntax



# Concurrency

---

```
from prefect import flow, task
from prefect.task_runners import ConcurrentTaskRunner

@task
def stop_at_floor(floor):
    print(f"elevator moving to floor {floor}")
    print(f"elevator stops on floor {floor}")

@flow(task_runner=ConcurrentTaskRunner())
def elevator():
    for floor in range(3, 0, -1):
        stop_at_floor.submit(floor)

elevator()
```



# Concurrency

---

```
elevator moving to floor 3  
elevator stops on floor 3  
elevator moving to floor 1  
elevator stops on floor 1  
elevator moving to floor 2  
elevator stops on floor 2
```



# Task Runners

---

- Specify in *flow* decorator
- *ConcurrentTaskRunner* is ready by default
- Use *.submit()* when call a task to return a *PrefectFuture* instead of direct result





# Task runners for true parallelism



# Parallelism

---

- Two or more operations happening at the same time on one or more machines
- Helpful when operations limited by CPU
- Many machine learning algorithms parallelizable



# Task Runners for parallelism

---

- DaskTaskRunner
- RayTaskRunner

Both require an integration package:

- *prefect-dask*
- *prefect-ray* packages



# DaskTaskRunner for parallelism

---

```
from prefect import flow, task
from prefect_dask.task_runners import DaskTaskRunner

@task
def say_hello(name):
    print(f"hello {name}")

@task
def say_goodbye(name):
    print(f"goodbye {name}")

@flow(task_runner=DaskTaskRunner())
def greetings(names):
    for name in names:
        say_hello.submit(name)
        say_goodbye.submit(name)

if __name__ == "__main__":
    greetings(["arthur", "trillian", "ford", "marvin"])
```





## DaskTaskRunner for parallelism

---

- Can see the Dask UI if have *bokeh* package installed: *pip install bokeh*
- UI will be linked in the terminal at run time





# Prefect REST API



If you want to talk to the API without Python

---

Cloud and server REST API interactive docs:

[docs.prefect.io/latest/api-ref/rest-api](https://docs.prefect.io/latest/api-ref/rest-api)

*curl* or use an HTTP client (*httpx*, *requests*)



## *PrefectClient* to interact with the REST API

---

Or use the built-in *PrefectClient* for convenience

```
from prefect import get_client

async with get_client() as client:
    response = await client.hello()
    print(response.json()) # 🙌
```

[docs.prefect.io/guides/using-the-client](https://docs.prefect.io/guides/using-the-client)



## Common methods

---

- *create\_flow\_run\_from\_deployment*
- *read\_flow\_run / read\_flow\_runs*
- *update\_deployment*
- *delete\_flow\_run*

[github.com/PrefectHQ/prefect/blob/main/src/prefect/client/orchestration.py](https://github.com/PrefectHQ/prefect/blob/main/src/prefect/client/orchestration.py)





# Testing

# Testing

---

- Context manager for unit tests provided
- Run flows against temporary local SQLite db

```
from prefect import flow
from prefect.testing.utilities import prefect_test_harness

@flow
def my_favorite_flow():
    return 42

def test_my_favorite_flow():
    """basic test running the flow against a temporary testing database"""
    with prefect_test_harness():
        assert my_favorite_flow() == 42
```



# Testing

---

- Use in a Pytest fixture

```
from prefect import flow
import pytest
from prefect.testing.utilities import prefect_test_harness

@pytest.fixture(autouse=True, scope="session")
def prefect_test_fixture():
    with prefect_test_harness():
        yield
```







# Upload data to AWS S3



# Steps

---

1. Install prefect-aws
2. Register new blocks
3. Create S3 bucket
4. Create S3Bucket block from UI or CLI
5. Use in a flow



## Install prefect-aws

---

```
pip install -U prefect-aws
```



# Register new blocks

---

*prefect blocks register -m prefect\_aws*

Successfully registered 5 blocks

| Registered Blocks |
|-------------------|
| AWS Credentials   |
| AWS Secret        |
| ECS Task          |
| MinIO Credentials |
| S3 Bucket         |



## See block types & blocks from CLI

---


*prefect block type ls*

*prefect block ls*



## Make an *S3Bucket* block

---

 ***S3Bucket* block from prefect-aws != S3 block that ships with Prefect**

- Both block types upload and download data
- *S3Bucket* block has many methods
- We are showing how to use *S3Bucket* block



# Create S3 Bucket

Amazon S3 > Buckets > Create bucket

## Create bucket [Info](#)

Buckets are containers for data stored in S3. [Learn more](#) 

### General configuration

Bucket name

Bucket name must be globally unique and must not contain spaces or uppercase letters. [See rules for bucket naming](#) 

AWS Region

Copy settings from existing bucket - *optional*

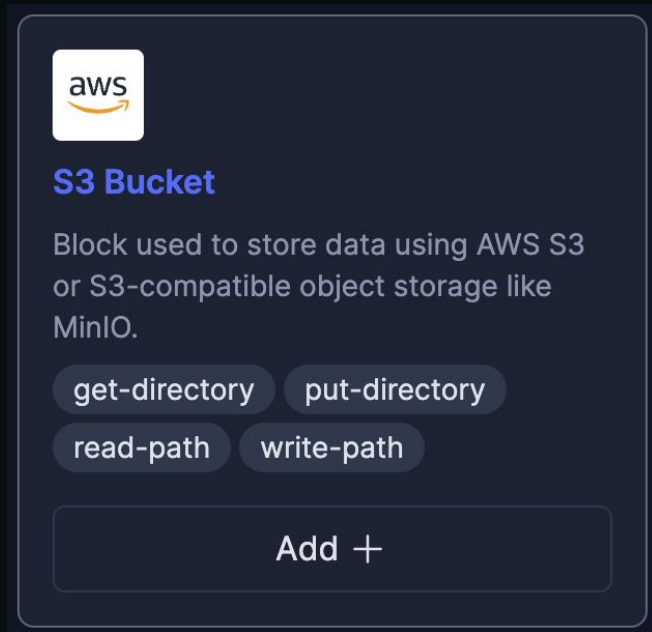
Only the bucket settings in the following configuration are copied.

**Choose bucket**



# Create S3Bucket block from UI

---





# Create S3Bucket block from UI

Blocks / Choose a Block / S3 Bucket / Create

Block Name

Bucket Name

Name of your bucket.

Credentials

AwsCredentials

MinIOCredentials

A block containing your credentials to AWS or MinIO.

AwsCredentials (Optional)

Block used to manage authentication with AWS. AWS authentication is handled via the `boto3` module. Refer to the [boto3 docs](#) for more info about the possible credential configurations.

aws

Add +

Bucket Folder (Optional)

A default path to a folder within the S3 bucket to use for reading and writing objects.

aws

S3 Bucket

Block used to store data using AWS S3 or S3-compatible object storage like MinIO.

get-directory

put-directory

read-path

write-path

Cancel

Create

167

The Docker logo, which is a stylized white 'D' inside a dark blue square.

# AWS Credentials block from UI

Use the nested AWS Credentials block as needed

**Blocks / Choose a Block / AWS Credentials / Create**

Block Name

Region Name (Optional)

The AWS Region where you want to create new connections.

Profile Name (Optional)

The profile to use when creating your session.

AWS Access Key ID (Optional)

A specific AWS access key ID.



## AWS Credentials

Block used to manage authentication with AWS. AWS authentication is handled via the `'boto3'` module. Refer to the [boto3 docs]...



## AWS Credentials block from UI

---

Leave most fields blank.

Probably use *AWS Access Key ID* & *AWS Access Key Secret*.

AWS Access Key Secret (Optional)

A specific AWS secret access key.

Cancel

Create



# Or create blocks with Python code

```
from time import sleep
from prefect_aws import S3Bucket, AwsCredentials

def create_aws_creds_block():
    # environment variables can be helpful for creating credentials blocks
    # do not store credential values in public locations (e.g. GitHub public repo)
    my_aws_creds_obj = AwsCredentials(
        aws_access_key_id="123abc",
        aws_secret_access_key="ab123",
    )
    my_aws_creds_obj.save(name="my-aws-creds-block", overwrite=True)

def create_s3_bucket_block():
    aws_creds = AwsCredentials.load("my-aws-creds-block")
    my_s3_bucket_obj = S3Bucket(
        bucket_name="my-first-bucket-abc", credentials=aws_creds
    )
    my_s3_bucket_obj.save(name="s3-bucket-block", overwrite=True)

if __name__ == "__main__":
    create_aws_creds_block()
    sleep(5) # ensure server has time to create credentials block before loading
    create_s3_bucket_block()
```




# View block in the UI

**Blocks / my-aws-creds-block**

May 3rd, 2023  
12:00 AM

May 3rd, 2023  
11:59 PM

Block document  my-aws-creds-block 2 events

Paste this snippet into your flows to use this block. Need help? [View Docs](#)

```
from prefect_aws import AwsCredentials

aws_credentials_block = AwsCredentials.load("my-aws-creds-block")
```

**Region Name**  
None


**Profile Name**  
None

**AWS Access Key ID**  
123abc

**AWS Session Token**  
None

**AWS Client Parameters**  
{ "config": null, "verify": true, "use\_ssl": true, "api\_version": "", "endpoint\_url": "", "verify\_cert\_path": "" }

**AWS Access Key Secret**  
\*\*\*\*\*



### AWS Credentials

Block used to manage authentication with AWS. AWS authentication is handled via the `'boto3'` module. Refer to the [\[boto3 docs\]](#)...



# Flow code loads S3 block and uploads data file

---

```
from pathlib import Path
from prefect import flow
from prefect_aws.s3 import S3Bucket

@flow()
def upload_to_s3(color: str, year: int, month: int) -> None:
    """The main flow function to upload taxi data"""
    path = Path(f"data/{color}/{year}/{color}_tripdata_{year}-{month:02}.parquet")
    s3_block = S3Bucket.load("s3-bucket-block")
    s3_block.upload_from_path(from_path=path, to_path=path)

if __name__ == "__main__":
    upload_to_s3(color="green", year=2020, month=1)
```

## Use your flow code!

---

- Can test with *python my\_script.py*
- Then create a deployment and run it! 🎉



# See file in S3 bucket

Amazon S3 > Buckets > prefect-aws-demos > data/ > green/ > 2020/

2020/

Copy S3 URI

Objects | Properties

### Objects (1)

Objects are the fundamental entities stored in Amazon S3. You can use [Amazon S3 inventory](#) to get a list of all objects in your bucket. For others to access your objects, you'll need to explicitly grant them permissions. [Learn more](#)

↻

Copy S3 URI

Copy URL

Download

Open

Delete


Actions ▼

Create folder

Upload

Find objects by prefix

< 1 > ⚙



| <input type="checkbox"/> | Name ▲   | Type ▼  | Last modified ▼                   | Size ▼ | Storage class ▼ |
|--------------------------|--|---------|-----------------------------------|--------|-----------------|
| <input type="checkbox"/> |  green_tripdata_2020-01.parquet | parquet | May 3, 2023, 17:31:04 (UTC-04:00) | 6.9 MB | Standard        |

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# Self-hosted server instance



## Self-hosted server instance

---

Alternative to Prefect Cloud: host your own Prefect server instance

- Backed by SQLite db by default
- Or use PostgreSQL in production
- Similar UI
- No events, push work pools, email server, authentication, user management, error summaries, etc.



## Self-hosted server instance

---

- Switch to a new profile
- Use an ephemeral API (default) or set the API endpoint (required if in a Docker container)



## Self-hosted server instance

---

Start a server in another terminal with:

*prefect server start*

The Prefect logo is displayed in a stylized, monospaced font. It consists of the word "PREFECT" where each letter is constructed from a grid of horizontal and vertical lines, giving it a digital or circuit-like appearance.

Configure Prefect to communicate with the server with:

```
prefect config set PREFECT_API_URL=http://127.0.0.1:4200/api
```

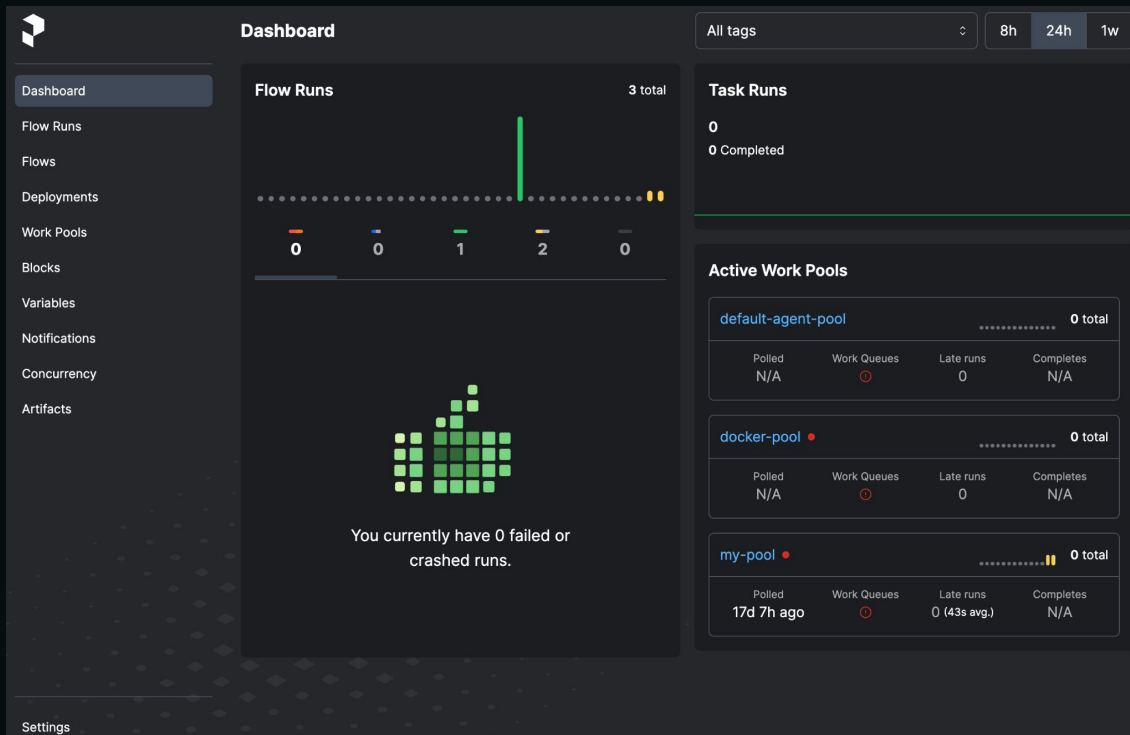
View the API reference documentation at <http://127.0.0.1:4200/docs>

Check out the dashboard at <http://127.0.0.1:4200>



# Self-hosted server instance

Head to the UI at <http://127.0.0.1:4200>



## Self-hosted server instance

---

Required when running Prefect inside a container:

*PREFECT\_API\_URL*="<http://127.0.0.1:4200/api>"

See Prefect Helm Chart if running on Kubernetes

[github.com/PrefectHQ/prefect-helm](https://github.com/PrefectHQ/prefect-helm)





# Prefect profiles



## Prefect profiles

---

If you don't already have a profile with Prefect Cloud you want to use for this course, create a new profile

Create: *prefect profile create my\_cloud\_profile*





## Prefect profiles

---

Inspect: *prefect profile inspect my\_cloud\_profile*

Select: *prefect profile use my\_cloud\_profile*





# Deploy multiple flows with *serve*



# Deploy multiple flows

```
import time
from prefect import flow, serve

@flow
def slow_flow(sleep: int = 60):
    "Sleepy flow - sleeps the provided amount of time (in seconds)."
    time.sleep(sleep)

@flow
def fast_flow():
    "Fastest flow this side of the Atlantic."
    return

if __name__ == "__main__":
    slow_deploy = slow_flow.to_deployment(name="sleeper-scheduling")
    fast_deploy = fast_flow.to_deployment(name="fast-scheduling")
    serve(slow_deploy, fast_deploy)
```




## Deploy multiple flows




---

- import *serve*
- use *to\_deployment()* method
- use *serve* function and pass it the deployment objects





# Guided deployment creation



# Deployments: ETL code

---

```
@task
def fetch_cat_fact():
    return httpx.get("https://catfact.ninja/fact?max_length=140").json()["fact"]

@task
def formatting(fact: str):
    return fact.title()

@task
def write_fact(fact: str):
    with open("fact.txt", "w+") as f:
        f.write(fact)
    return "Success!"
```



# Deployments: ETL code

---

```
@flow
def pipe():
    fact = fetch_cat_fact()
    formatted_fact = formatting(fact)
    msg = write_fact(formatted_fact)
    print(msg)
```



## Send deployment to server

---

From the **root of your repo** run:

*prefect deploy*

Choose the flow you want to put into a deployment

```
? Select a flow to deploy [Use arrows to move; enter  
to select; n to select none]
```

|   | Flow Name  | Location        |
|---|------------|-----------------|
| > | pipe       | 104/flows.py    |
|   | hello_flow | 102/caching1.py |
|   | log_it     | 102/logflow.py  |





## Send deployment to server

---

Enter a deployment name and then *n* for no schedule.

```
? Deployment name (default): first_deploy  
? Would you like to schedule when this flow runs? [y/n] (y): n
```



# Create a work pool

---

```
? Looks like you don't have any work pools this flow can be deployed to. Would you like to
create one? [y/n] (y): y
? What infrastructure type would you like to use for your new work pool? [Use arrows to
move; enter to select]
```

|   | Type    | Description   |
|---|---------|---|
| > | process | Execute flow runs as subprocesses on a worker. Works well for local execution when first getting started.   |
|   | ecs     | Execute flow runs within containers on AWS ECS. Works with existing ECS clusters and serverless execution via AWS Fargate. Requires an AWS account. |



# Work pools

---

Give your work pool a name.

Or, if you have existing work pools, choose one

? Which work pool would you like to deploy this flow to? [Use arrows to move; enter to select]

|   | Work Pool Name   | Infrastructure Type   | Description |
|---|--|---|-------------|
| > | docker-work<br>local-work<br><b>my-pool</b><br>prod-pool<br>staging-pool<br>zoompool | docker<br>process<br>process<br>kubernetes<br>kubernetes<br>process |             |



## Specify flow code storage

---

Prefect auto-detects if you are in a git repo.

No auto-push.

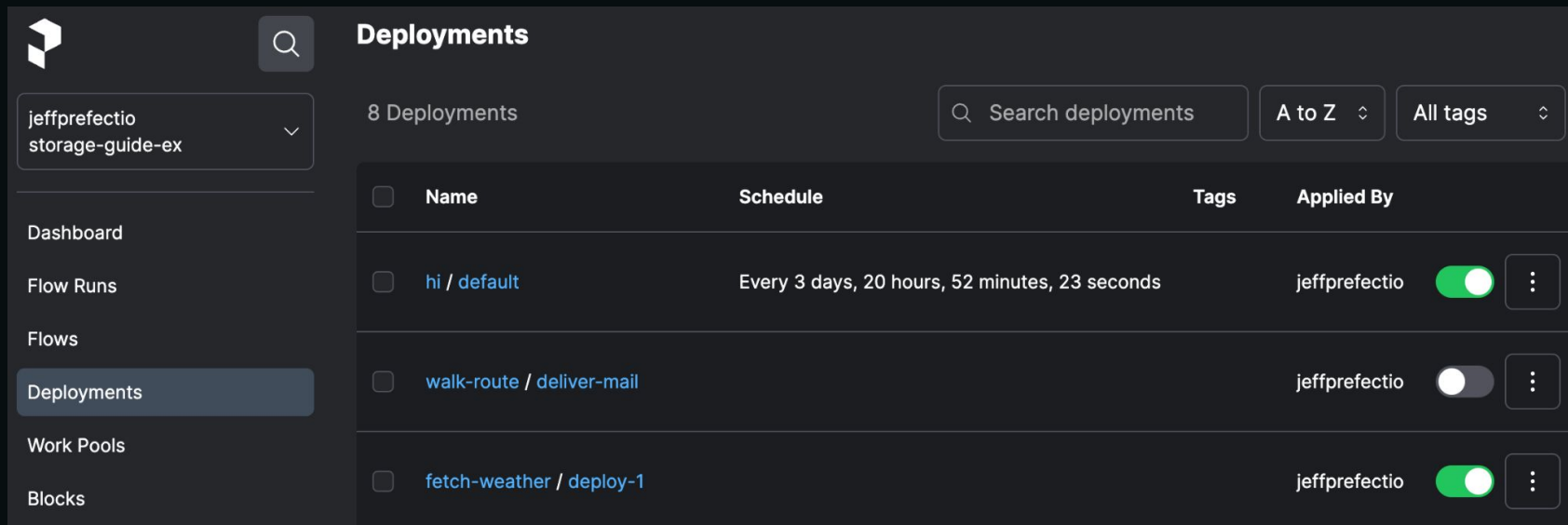
```
? Your Prefect workers will need access to this flow's code in order to run
it. Would you like your workers to pull your flow code from its remote
repository when running this flow? [y/n] (y): y
? Is https://github.com/discdiver/pacc-2023.git the correct URL to pull your
flow code from? [y/n] (y): y
? Is main the correct branch to pull your flow code from? [y/n] (y): y
? Is this a private repository? [y/n]: n
```

```
Deployment 'pipe/first_deploy' successfully created with id
'0f45657b-86d7-4141-a56a-e1ce47b90f1d'.
```



# Deployments in the UI

The deployment lives on the server. See it in the UI.



The screenshot shows the Prefect UI's 'Deployments' page. On the left is a sidebar with navigation links: Dashboard, Flow Runs, Flows, Deployments (highlighted), Work Pools, and Blocks. The main content area is titled 'Deployments' and shows '8 Deployments'. At the top right of the main area are filters: a search bar labeled 'Search deployments', a sort dropdown set to 'A to Z', and a tag filter set to 'All tags'. Below these is a table with columns: Name, Schedule, Tags, and Applied By. The table lists three deployments: 'hi / default' with a schedule of 'Every 3 days, 20 hours, 52 minutes, 23 seconds', 'walk-route / deliver-mail', and 'fetch-weather / deploy-1'. Each row has a checkbox on the left, the deployment name, the schedule, the tags, the user 'jeffprefectio', a toggle switch, and a three-dot menu icon.

| <input type="checkbox"/> | Name                      | Schedule                                       | Tags          | Applied By                          |
|--------------------------|---------------------------|--|---------------|-------------------------------------|
| <input type="checkbox"/> | hi / default              | Every 3 days, 20 hours, 52 minutes, 23 seconds | jeffprefectio | <input checked="" type="checkbox"/> |
| <input type="checkbox"/> | walk-route / deliver-mail |  | jeffprefectio | <input type="checkbox"/>            |
| <input type="checkbox"/> | fetch-weather / deploy-1  |  | jeffprefectio | <input checked="" type="checkbox"/> |

## Save deployment configuration to *prefect.yaml*

---

```
? Would you like to save configuration for this deployment for  
faster deployments in the future? [y/n]: y
```

```
Deployment configuration saved to prefect.yaml! You can now deploy  
using this deployment configuration with:
```

```
$ prefect deploy -n first_deploy
```

```
You can also make changes to this deployment configuration by  
making changes to the prefect.yaml file.
```

## Recap of our setup

---

- Deployment & work pool created on Prefect Cloud
- Worker runs on local machine
- Worker polls Prefect Cloud, looking for scheduled work in the *my\_pool* work pool
- Deployment configuration saved to *prefect.yaml*





## Schedule a run - what happened?

---

- Running worker finds scheduled work in *my\_pool* work pool.
- Worker and work pool are typed. *Local subprocess* in this case.
- Worker creates a local subprocess to kick off flow run.
- Flow code cloned from GitHub into temporary directory.
- Flow code runs.
- Metadata and logs sent to Prefect Cloud.
- Temporary directory deleted.







# Deployment creation with `prefect.yaml`



# *prefect.yaml*

---

```
# Generic metadata about this project
name: pacc-2023
prefect-version: 2.10.18

# build section allows you to manage and build docker images
build: null

# push section allows you to manage if and how this project is
push: null

# pull section allows you to provide instructions for cloning
pull:
- prefect.deployments.steps.git_clone:
    repository: https://github.com/discdiver/pacc-2023.git
    branch: main
```



## Configuration for creating deployments

- ***pull*** step (repository & branch): from git repo



- ***deployments:***

Config for one or more deployments

Required keys:

- *name*
- *entrypoint*
- *work\_pool* -> *name*

```
deployments:  
  
- name: deployment1  
  entrypoint: 202/flows.py:pipe  
  work_pool:  
    name: local-work  
  
- name: deployment2  
  entrypoint: 202/flows2.py:pipe2  
  work_pool:  
    name: local-work
```



# Can override steps above on per-deployment basis

```
deployments:
  - name: prod-deployment
    entrypoint: 202/flows.py:pipe
    work_pool:
      name: prod-pool
    schedule:
      interval: 600
    pull:
      - prefect.deployments.steps.git_clone:
          repository: https://github.com/discdiver/pacc-london-2023.git
          branch: prod
          access_token: "{{prefect.blocks.secret.gh-secret}}"

  - name: staging-deployment
    entrypoint: 202/flows.py:pipe
    work_pool:
      name: staging-pool
    pull:
      - prefect.deployments.steps.git_clone:
          repository: https://github.com/discdiver/pacc-london-2023.git
          branch: staging
```



# Re-deploy a deployment

---

Requires a *prefect.yaml* file

*prefect deploy*

```
? Would you like to use an existing deployment configuration? [Use arrows to  
move; enter to select; n to select none]
```

|   | Name         | Entrypoint        | Description |
|---|--------------|-------------------|-------------|
| > | first_deploy | 104/flows.py:pipe |             |



## Deploy multiple deployments at once

---

Deploy all deployments in a *prefect.yaml* file:

```
prefect deploy --all
```



## *prefect deploy*

---

If choose *docker* typed work pool you will be asked docker-related questions

|   | Work Pool Name                | Infrastructure Type | Description |
|---|-------------------------------|---------------------|-------------|
| > | <b>docker-pool</b><br>my-pool | docker<br>process   |             |

? Would you like to build a custom Docker image for this deployment? [y/n]  
(n):





## Method 1: *prefect deploy*

---

Use the defaults for the work pool

OR

Build a custom Docker image with flow code

- Push image to a Docker registry
  - Use existing Dockerfile
  - Auto-includes packages in *requirements.txt*

Follow the prompts. 😊



# Resulting *prefect.yaml*

---

```
- name: dock-interact
  version:
  tags: []
  description:
  entrypoint: 104/flows.py:pipe
  parameters: {}
  work_pool:
    name: docker-pool
    work_queue_name:
    job_variables:
      image: '{{ build-image.image }}'
  schedule:
  build:
- prefect_docker.deployments.steps.build_docker_image:
    requires: prefect-docker>=0.3.1
    id: build-image
    dockerfile: auto
    image_name: discdiver/dock-interact
    tag: 0.0.1
```





# CI/CD with GitHub Actions



# GitHub Actions with deployments

---

- CI/CD - when you push code or make a PR automatically take an action
- Pre-built Github Action to deploy a Prefect deployment
- [github.com/marketplace/actions/deploy-a-prefect-flow](https://github.com/marketplace/actions/deploy-a-prefect-flow)



# GitHub Action

```
name: Deploy a Prefect flow
on:
  push:
    branches:
      - main
jobs:
  deploy_flow:
    runs-on: ubuntu-latest
    steps:
      - uses: checkout@v3

      - uses: actions/setup-python@v4
        with:
          python-version: '3.10'

      - name: Run Prefect Deploy
        uses: PrefectHQ/actions-prefect-deploy@v1
        with:
          prefect-api-key: ${ secrets.PREFECT_API_KEY }
          prefect-workspace: ${ secrets.PREFECT_WORKSPACE }
          requirements-file-path: ./examples/simple/requirements.txt
          entrypoint: ./examples/simple/flow.py:call_api
          additional-args: --cron '30 19 * * 0'
```





# Helm Chart



## Prefect Helm Chart for K8s

---

Provides a variety of functionality

Creating workers is a popular use case.

See more in the docs:

[github.com/PrefectHQ/prefect-helm/tree/main/charts/prefect-worker](https://github.com/PrefectHQ/prefect-helm/tree/main/charts/prefect-worker)





# Terraform provider



# Prefect Cloud Terraform Provider

---

[registry.terraform.io/providers/PrefectHQ/prefect/latest/docs](https://registry.terraform.io/providers/PrefectHQ/prefect/latest/docs)



# PACC

Prefect Associate  
Certification Course

