ArgoCon EU 2025

Argo Workflow Templates:

A Practical Deep-Dive

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Intros

pipekit

Tim Collins

Staff Infrastructure Engineer @ Pipekit.io

- Argo Maintainer. Lives in the CNCF Argo Slack
- Member of the Pipekit Services team
- Can grow hair if he wants to. Just chooses not to, ok?

Becky Pauley

Senior Solutions Engineer @ Jetstack Consult

- Helping people solve K8s/Platform problems
- Argo enthusiast
- My hobby is falling off things

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Jetstack Consult

We help businesses, large and small, solve five key platform engineering challenges that will benefit their organization.

- Platform optimisation
- Cloud diversification
- Infrastructure modernisation
- Innovation even at scale
- Security by default

About Pipekit

Scale Argo & Kubernetes with Pipekit

Direct support from 40% of the active Argo Workflows maintainers in the world.

Save engineering time and up to 60% on compute costs

Add 3 Argo maintainers and 7 Argo contributors to your team

Serving startups & Fortune 500 enterprises since 2021:

Enterprise Support for Argo:
Ideal for Platform Eng teams scaling with Argo

Control Plane for Argo Workflows:
Ideal for data teams, granular RBAC, and multi-cluster architectures

https://pipek.it/argocon-templates-talk

Image credit: Phil Botha, Unsplash

New Phone, Who 'Dis?

```yaml
apiVersion: argoproj.io/v1alpha1
kind: Workflow
metadata:
  generateName: hello-world-
spec:
  entrypoint: hello-world
  templates:
    - name: hello-world
      container:
        image: busybox
        command: [echo]
        args: ["Hello ArgoCon!"]
```

Talk: Demystifying Argo Workflows
https://pipek.it/argocon-demystifying-wf-talk

Template Types

Invocators

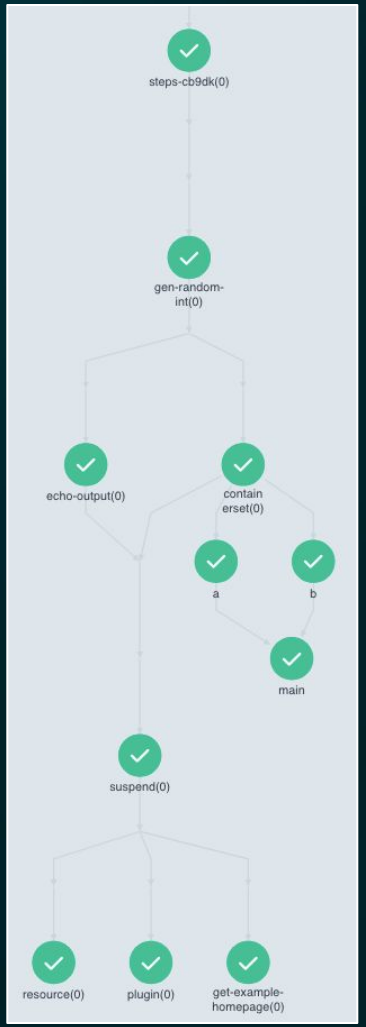
Used to invoke/call other templates and provide execution control.

Definitions

Define work to be done, usually in a container.

Template Invocators: Steps

```
spec:
 entrypoint: main
 templates:
   - name: main
     steps:
       - - name: gen-random-int
           template: gen-random-int
       - - name: echo-output
           template: echo-output
         - name: containerset
           template: containerset
       - - name: suspend
           template: suspend
       - - name: get-example-homepage
           template: http
         - name: plugin
           template: plugin
         - name: resource
           template: resource
```



Template Invocators: Steps

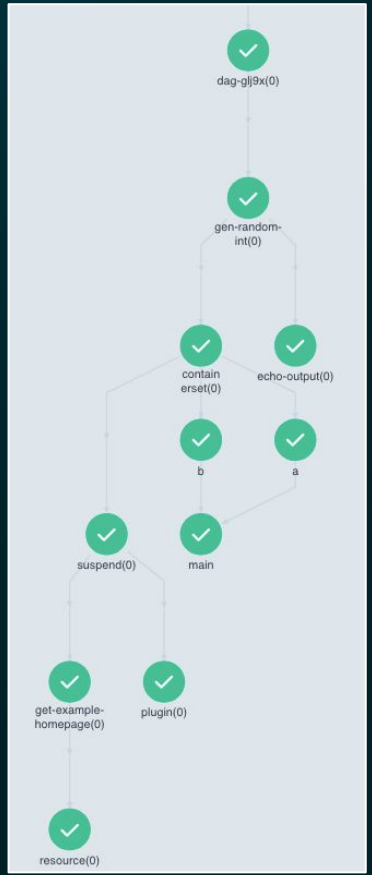
Order of execution

- - - outer lists = sequential
- - inner lists = parallel
- Conditional:

```
# evaluate the result in parallel
 - - name: heads
     template: heads
     when: "{{steps.flip-coin.outputs.result}} == heads"
   - name: tails
     template: tails
     when: "{{steps.flip-coin.outputs.result}} == tails"
```

Template Invocators: DAG (Directed Acyclic Graph)

```
spec:
 entrypoint: main
 templates:
   - name: main
     dag:
       tasks:
         - name: gen-random-int
           template: gen-random-int
         - name: echo-output
           template: echo-output
           depends: gen-random-int
         - name: containerset
           template: containerset
           arguments:
             parameters:
               - name: hi
                 value: "Hello ArgoCon!"
           depends: gen-random-int
…
```



Template Invocators: Use cases

Steps:

- Simpler when starting out
- Deterministic Workflows
- Short Workflows

DAG:

- Flexibility and control
- Dependencies between Workflow tasks
- Prefer these - but ensure readability

Template Types

Invocators

Used to invoke/call other templates and provide execution control.

Definitions

Define work to be done, usually in a container.

Template Definition: Container

- The most common template type
- It will schedule a Pod to run our Container.
- The same as the Kubernetes container spec
- Automatic output of result as a parameter.

```
- name: hello-world
  container:
    image: busybox
    command: [echo]
    args: ["Hello ArgoCon!"]
```

Template Definition: Script

- A convenience wrapper around a Container Template.
- Allows you to define a script in place.
- Same automatic result output as Container Templates.

```
- name: gen-random-int
  script:
    image: python
    command: [python]
    source: |
      import random
      i = random.randint(1,100)
      print(i)
```

Image credit: Frank Mckenna, Unsplash

Template Definition: So far...

Definitions

Define work to be done, usually in a container.

- Container
- Script
- ...

Template Definition: Container Set

```yaml
containerSet:
  volumeMounts:
    - mountPath: /workspace
      name: workspace
  containers:
    - name: a
      image: alpine
      command:
        - sh
        - -c
        - |
          echo 'a: Hi ArgoCon!'
    - name: b
      image: alpine
      command:
        - sh
        - -c
        - |
          echo 'b: Hi ArgoCon!'
```

https://argo-workflows.readthedocs.io/en/latest/container-set-template

- Short-lived containers - reduce time and resource overhead.
- Can only include containers (not other template types e.g. script, resource).
- Multiple containers in the same pod – resource implications!

Image credit: Frank Mckenna, Unsplash

Template Definition: Resource

- Performs operations on cluster resources directly.
- Used to get, create, apply, delete, replace or patch resources in your cluster.

```
- name: create-a-configmap-please
  resource:
    action: create
    manifest: |
      apiVersion: v1
      kind: ConfigMap
      metadata:
        generateName: cm-
      data:
        some: value
```

Template Definition: Resource - Tips

```
spec:
  entrypoint: create-a-job-please
  templates:
    - name: create-a-job-please
      resource:
      action: create
      setOwnerReference: true
      successCondition: status.succeeded > 0
      failureCondition: status.failed > 3
      manifest: |
        apiVersion: batch/v1
        kind: Job
        labels:
          workflows.argoproj.io/workflow: "{{workflow.name}}"
Continued…
```

Template Definition: Resource - Tips

Workflow of workflows

```
- name: create-a-workflow-please
  resource:
    action: create
    successCondition: status.phase == Succeeded
    failureCondition: status.phase in (Failed, Error)
    manifest: |
      apiVersion: argoproj.io/v1alpha1
      kind: Workflow
      metadata:
        generateName: workflow-of-workflows-1-
      spec:
        workflowTemplateRef:
          name: argocon
```

Template Definition: Resource - Tips

Image credit: Frank Mckenna, Unsplash

Template Definition: Suspend

- Suspends workflow execution.
  - Either for a duration
  - Or until resumed manually
- Resume via the CLI (argo resume), the API endpoint, or the UI

```
- name: delay
  suspend:
    duration: "20s"
```

Template Definition: So far...

Definitions

Define work to be done, usually in a container.

- Container
- Script
- ContainerSet
- Resource
- Suspend

Template Definition: HTTP/Plugin

Agent pod

One per Workflow

Used/reused by HTTP and Plugin steps/tasks

Need extra permissions!

https://argo-workflows.readthedocs.io/en/latest/http-template/#argo-agent

Template Definition: HTTP

```
- name: http
  http:
    url: https://example.com/
    method: "GET"
```

https://www.youtube.com/watch?v=tohzCqpoq5A

Template Definition: Plugin

```
- name: main
  plugin:
    hello: { }
```

- Runs an executor plugin
- Source for plugin:

https://github.com/argoproj-labs/argo-workflows-hello-executor-plugin

HTTP and Plugin Template Definitions

USE WHEN

- They meet your use-case
- You will be calling them multiple times in the same workflow
- They are replacing short-lived steps that would otherwise be their own pod

Efficiency/reuse

DISADVANTAGES

- Extra setup and RBAC
- Harder to reason about (more abstraction)

Use with caution - can another template type fit my use-case?

Making your life easier: Template choice

Definitions

Define work to be done, usually in a container.

- Container
- Resource
- Script
- HTTP
- ContainerSet
- Suspend
- Plugin

Template Invocator Invocator: Inline

```
- name: main
  dag:
    tasks:
      - name: a
        inline:
          container:
            image: alpine
            command:
              - sh
              - -c
              - |
                echo "Hi!"
```

Making your life easier: templateDefaults

```
spec:
  entrypoint: main
  templateDefaults:
    timeout: 30s    # timeout value will be applied to all templates
    retryStrategy: # retryStrategy value will be applied to all templates
      limit: "2"
```

- Can set in:
  - Workflow-controller-configmap
  - Workflow
- Override in individual templates when defaults don't suit

```
grumble@argocon:~ $ argo template list
```

```
error="workflow template foo not found"
```

Other things that have the word ‘template’ in them but aren’t anything to do with the templates we have been talking about.

- WorkflowTemplates
- ClusterWorkflowTemplates

Want Change?

https://github.com/argoproj/argo-workflows/pull/13987

https://github.com/argoproj/argo-workflows/pull/14110

https://github.com/argoproj/argo-workflows/pull/14143

https://github.com/argoproj/argo-workflows/pull/14198

https://github.com/argoproj/argo-workflows/pull/14253

https://github.com/argoproj/argo-workflows/pull/14292

https://pipek.it/argo-templates-survey

Stuff!

This talk & examples:

https://pipek.it/argocon-templates-talk

Free Argo/Infrastructure Help & Advice:

Booth S590 - Pipekit
Booth N763- CyberArk (Jetstack Consult)

https://pipek.it/argo-templates-survey