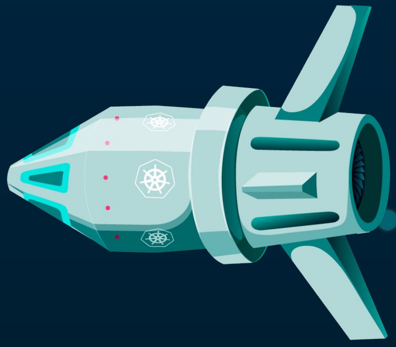
datree



A Deep Dive Into Kubernetes Schema Validation

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What is Kubernetes Schema validation?

Tēnā koutou katoa – טנא קאוטו קאטואה
Nō Iharaira ahau – נו איהררידה אחהו
Ko Eyar Zilberman taku ingoa – קו אייר זילברמן טאקו אינגואה
Tēnā koutou, tēnā koutou, tēnā koutou katoa

–––

Hello everyone – שלום לכולם
Thank you for joining me – תודה שהצטרפתם אלי
To hear my session – לשמוע את ההרצאה שלי

$ whoami

👋 I’m Eyar Zilberman

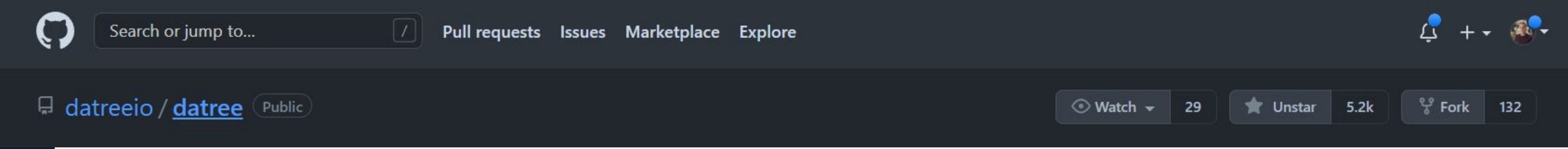
🎩 I’m a developer & YAML engineer

🎩 I’m co-founder and leading the product @ Datree

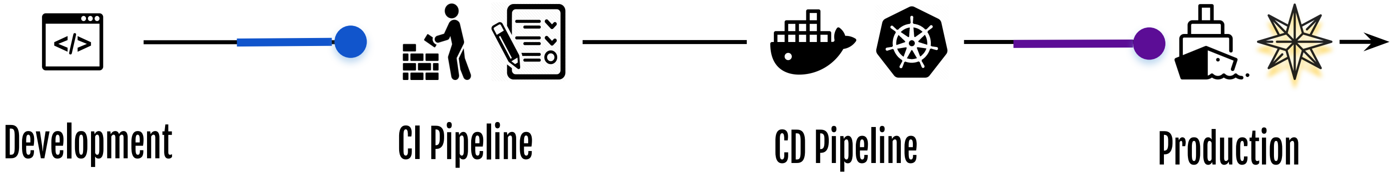
🎩 I founded and orgenzing the biggest GitHub Users Group (IL)

😍 I love RegEx

😨 But hate SQL



datreeio / datree Public



Development

CI Pipeline

CD Pipeline

Production

What is Kubernetes Schema validation?

🧪 Set of “unit tests” to verify manifest contains the correct properties (key:value)

[x] K8s.yaml

```
apiVersion: apps/v1
kind: deployment
metaData:
  name: rss-site
  nameSpace: test
  labels:
    app: web
```

[v] K8s.yaml

```
apiVersion: apps/v1
kind: Deployment
metaData:
  name: rss-site
  namespace: test
  labels:
    app: web
```

🚢 The schema definition is provided by the community

What is not part of the schema validation?

- YAML syntax validation
  - E.g. correct indentation
- Best practices
  - E.g. each container has a configured Memory and CPU limit set
- Team/org policies
  - E.g. pull all images from private registry (artifactory.io/nginx:1.16.8)
- Some validations that you expect to be part of the schema
  - E.g. no spoilers!

I’m sold! How do I use it?

Good news 😊

- Activated by default when you apply configs to your cluster

Bad news 😔

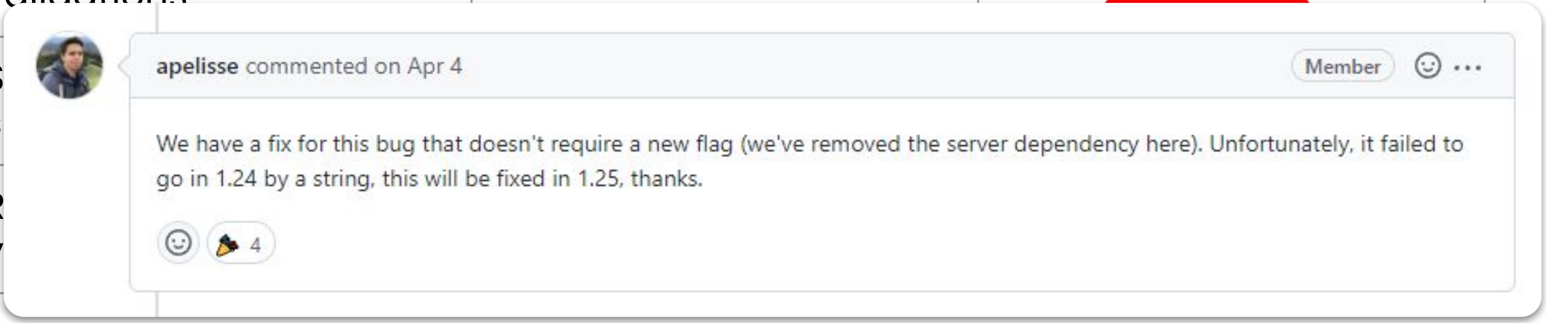
- It’s too late!

⬅️ How to check it earlier (“shift-left”)?

- `kubectl --dry-run=client/server`

kubectl server vs. client

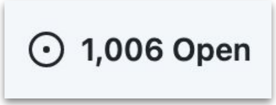
Parameter	Server mode	lient mod
Preform schema validation?	Yes	Ye
Preform extra validations?	Yes	
S s		
R y		



apelisse commented on Apr 4

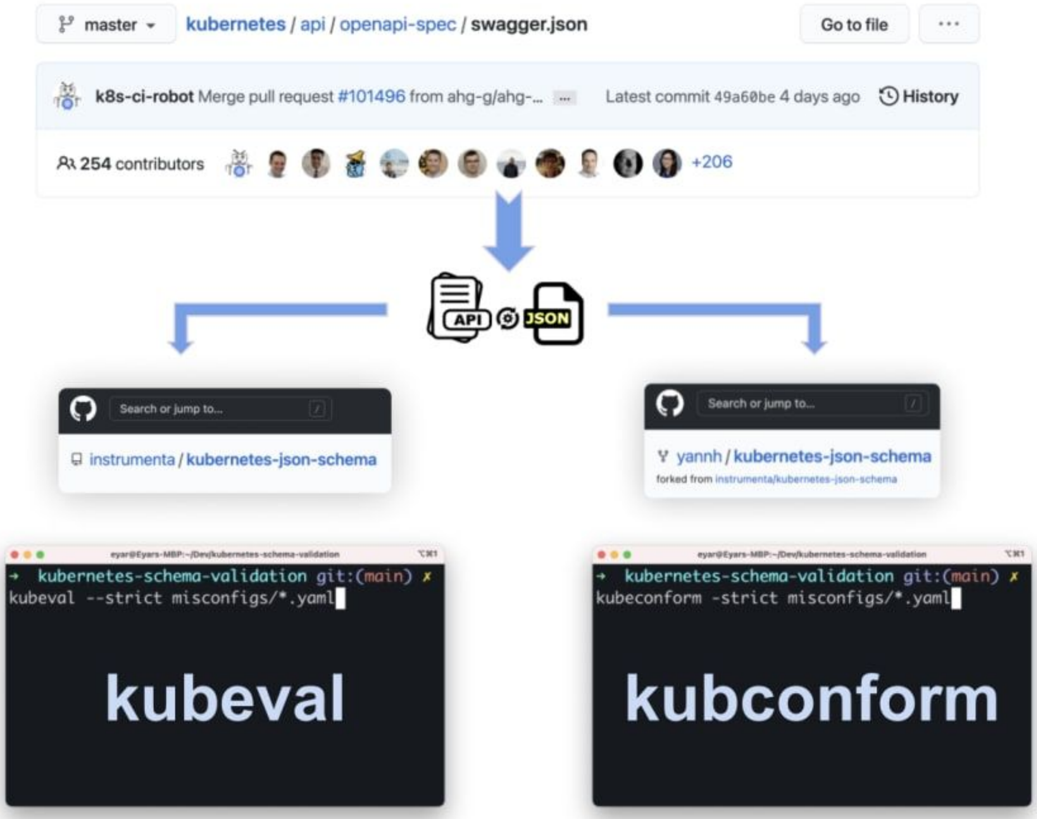
We have a fix for this bug that doesn't require a new flag (we've removed the server dependency here). Unfortunately, it failed to go in 1.24 by a string, this will be fixed in 1.25, thanks.

BUG: kubernetes/kubernetes/issues/51475



1,006 Open

Open-source to the rescue!



master kubernetes / api / openapi-spec / swagger.json

k8s-ci-robot Merge pull request #101496 from ahg-g/ahg-... Latest commit 49a60be 4 days ago History

254 contributors +206

instrumenta / kubernetes-json-schema

yannh / kubernetes-json-schema
forked from instrumenta/kubernetes-json-schema

```
eyar@Eyars-MBP:~/Dev/kubernetes-schema-validation
→  kubernetes-schema-validation git:(main) ✗
kubeval --strict misconfigs/*.yaml
```

kubeval

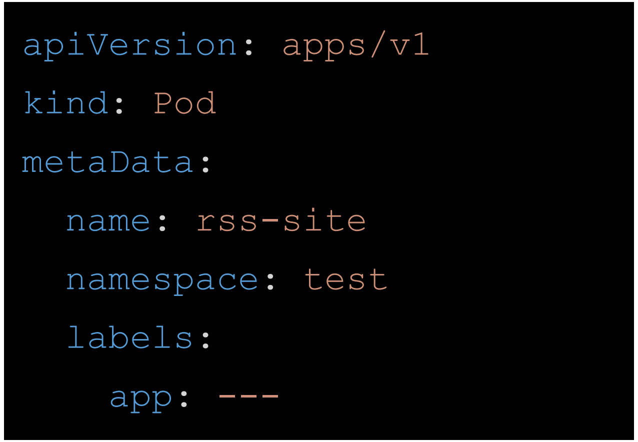
```
eyar@Eyars-MBP:~/Dev/kubernetes-schema-validation
→  kubernetes-schema-validation git:(main) ✗
kubeconform -strict misconfigs/*.yaml
```

kubconform

kubectl vs. open-source

Let’s QA - take #1

invalid-labels-value.yaml



```yaml
apiVersion: apps/v1
kind: Pod
metaData:
  name: rss-site
  namespace: test
  labels:
    app: ---
```

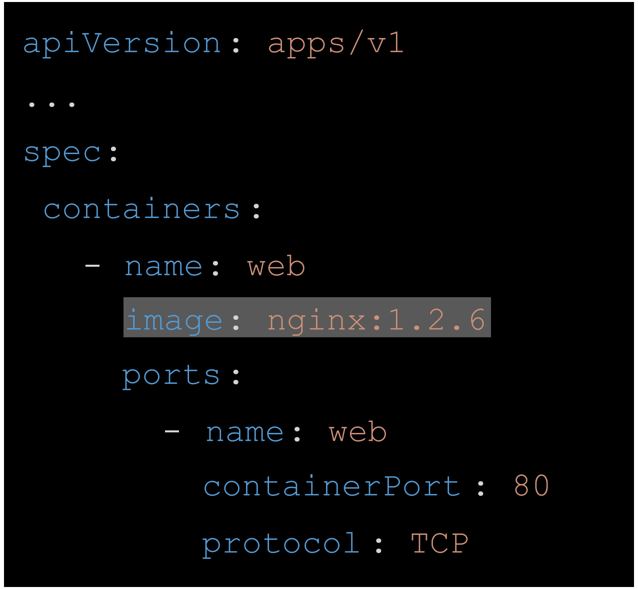
[Catching] kubectl --dry-run=server

[Not catching] kubeval / kubeconform

```
The Pod "invalid-labels-value" is invalid: metadata.labels: Invalid value: "---": a valid label must be an empty string or consist of alphanumeric characters, '-', '' or '.', and must start and end with an alphanumeric character (e.g. 'MyValue', or 'my_value', or '12345', regex used for validation is '(([A-Za-z0-9][-A-Za-z0-9.]*)?[A-Za-z0-9])?')
```

Let’s QA - take #2

missing-image.yaml



```
apiVersion: apps/v1
...
spec:
 containers:
    - name: web
      image: nginx:1.2.6
      ports:
        - name: web
          containerPort: 80
          protocol: TCP
```

[Catching] kubectl --dry-run=server

[Not catching] kubeval / kubeconform

What is not part of the schema validation?

- YAML syntax validation
    - E.g. correct indentation
- Best practices
    - E.g. each container has a configured Memory and CPU limit set
- Team/org policies
    - E.g. pull all images from private registry (artifactory.io/nginx:1.16.8)
- Some validations that you expect to be part of the schema
    - E.g. no spoilers!

Winner?

A connection to your cluster is allowed?

kubectl --dry-run=server

A connection to your cluster is *NOT* allowed?

Kubeval or Kubeconform

kubeval vs. kubeconform

Kubernetes versions support

👎 Kubeval - instrumenta/kubernetes-json-schema

(last commit: 133f848 on April 29, 2020)

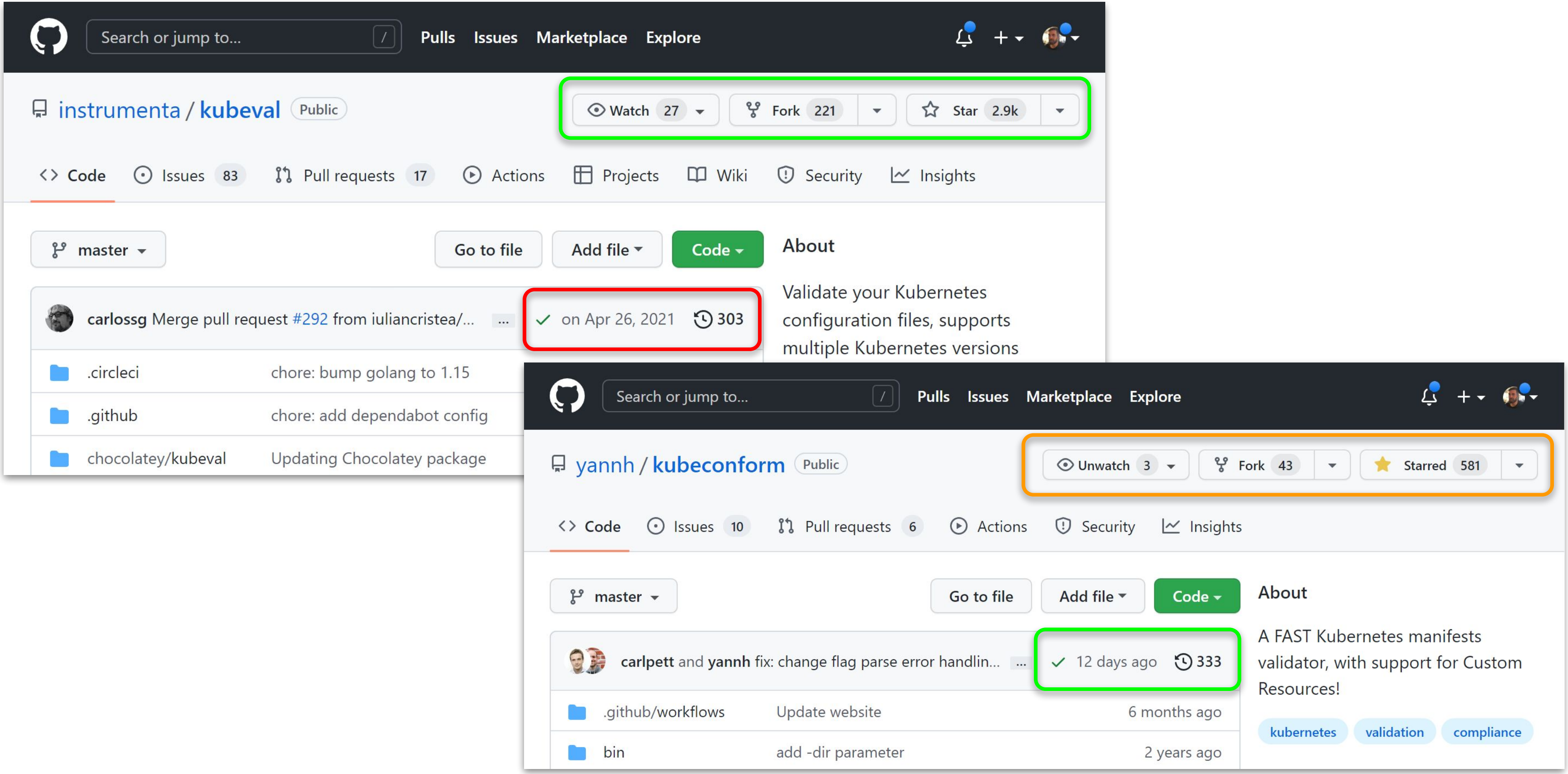
- v1.5.0 - v1.18.1

👍 Kubeconform - yannh/kubernetes-json-schema

(last commit: 14652b0on Jun 17, 2022)

- v1.15.0 - v1.24.2

Community



Search or jump to... / Pulls Issues Marketplace Explore

instrumenta / kubeval Public

Watch 27 · Fork 221 · Star 2.9k

Code · Issues 83 · Pull requests 17 · Actions · Projects · Wiki · Security · Insights

master · Go to file · Add file · Code

carlossg Merge pull request #292 from iuliancristea/... ✓ on Apr 26, 2021 · 303

.circleci	chore: bump golang to 1.15
.github	chore: add dependabot config
chocolatey/kubeval	Updating Chocolatey package

About

Validate your Kubernetes configuration files, supports multiple Kubernetes versions

Search or jump to... / Pulls Issues Marketplace Explore

yannh / kubeconform Public

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Code · Issues 10 · Pull requests 6 · Actions · Security · Insights

master · Go to file · Add file · Code

carlpett and yannh fix: change flag parse error handlin... ✓ 12 days ago · 333

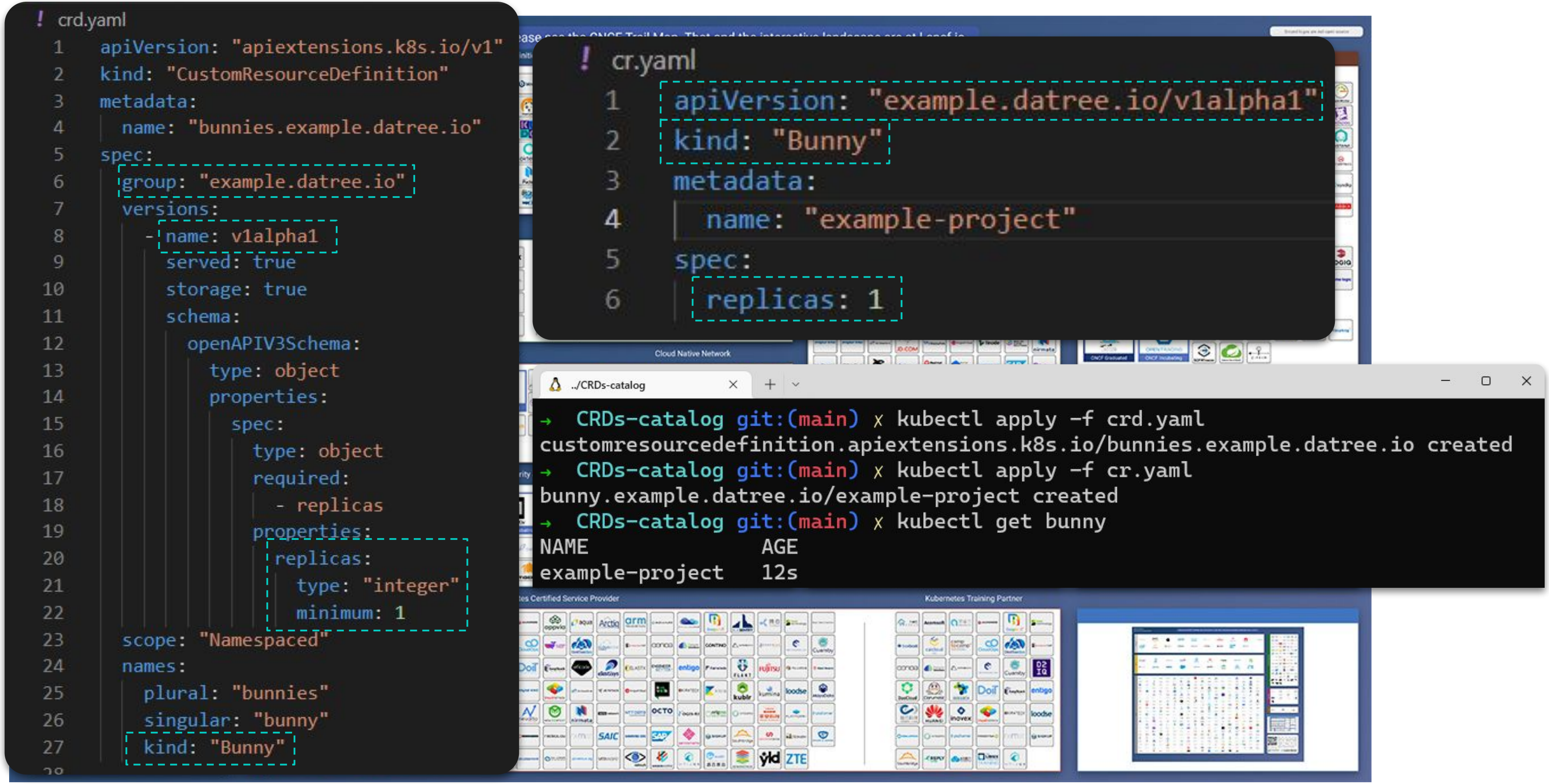
.github/workflows	Update website	6 months ago
bin	add -dir parameter	2 years ago

About

A FAST Kubernetes manifests validator, with support for Custom Resources!

kubernetes · validation · compliance

CRDs support



crd.yaml

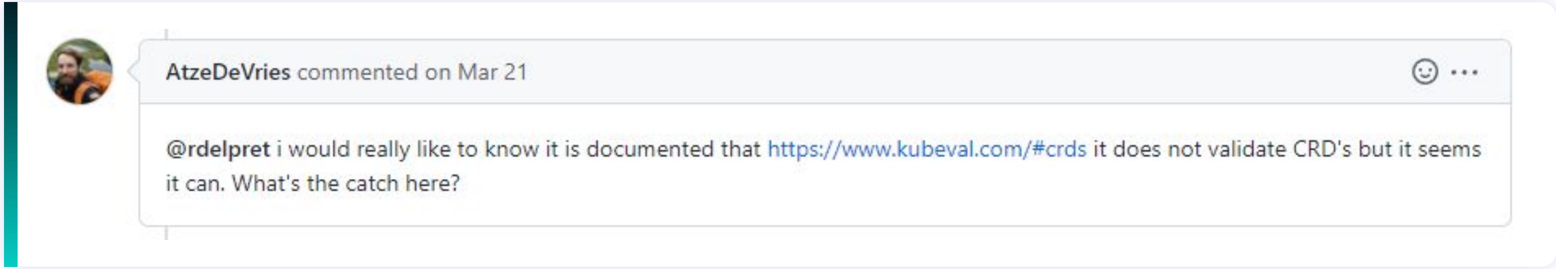
```yaml
apiVersion: "apiextensions.k8s.io/v1"
kind: "CustomResourceDefinition"
metadata:
  name: "bunnies.example.datree.io"
spec:
  group: "example.datree.io"
  versions:
    - name: v1alpha1
      served: true
      storage: true
      schema:
        openAPIV3Schema:
          type: object
          properties:
            spec:
              type: object
              required:
                - replicas
              properties:
                replicas:
                  type: "integer"
                  minimum: 1
  scope: "Namespaced"
  names:
    plural: "bunnies"
    singular: "bunny"
    kind: "Bunny"
```

cr.yaml

```yaml
apiVersion: "example.datree.io/v1alpha1"
kind: "Bunny"
metadata:
  name: "example-project"
spec:
  replicas: 1
```

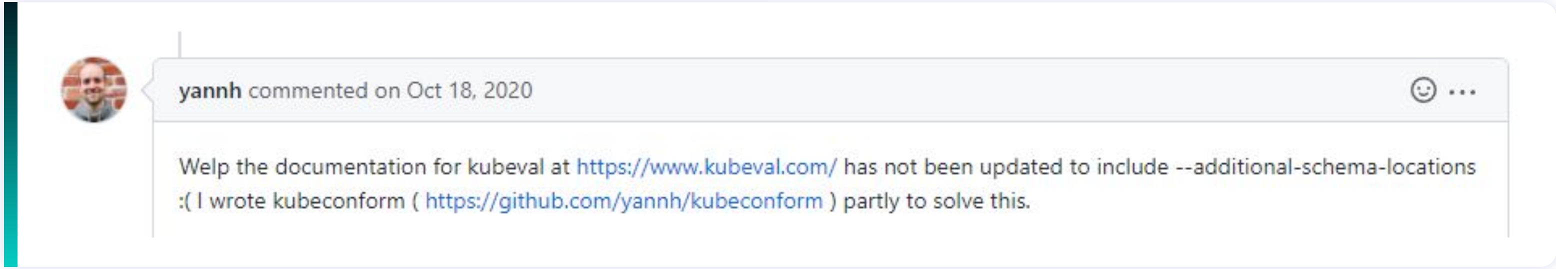
```
→ CRDs-catalog git:(main) ✗ kubectl apply -f crd.yaml
customresourcedefinition.apiextensions.k8s.io/bunnies.example.datree.io created
→ CRDs-catalog git:(main) ✗ kubectl apply -f cr.yaml
bunny.example.datree.io/example-project created
→ CRDs-catalog git:(main) ✗ kubectl get bunny
NAME              AGE
example-project   12s
```

CRDs support



AtzeDeVries commented on Mar 21

@rdelpret i would really like to know it is documented that https://www.kubeval.com/#crds it does not validate CRD's but it seems it can. What's the catch here?



yannh commented on Oct 18, 2020

Welp the documentation for kubeval at https://www.kubeval.com/ has not been updated to include --additional-schema-locations :(I wrote kubeconform (https://github.com/yannh/kubeconform) partly to solve this.

Winner?

kubeconform!

Strategies for validating Kubernetes schema

⬅️ Shift-left

The sooner, the better but not at all cost.

Prefer to restrict access to your cluster.

🚔 Fill the gap

Run with a policy enforcement tool to fill server side validation.

E.g. Datree / Conftest / Kyverno / Etc.

⏳ Version upgrade

Each K8s version is supported for only 14 months.

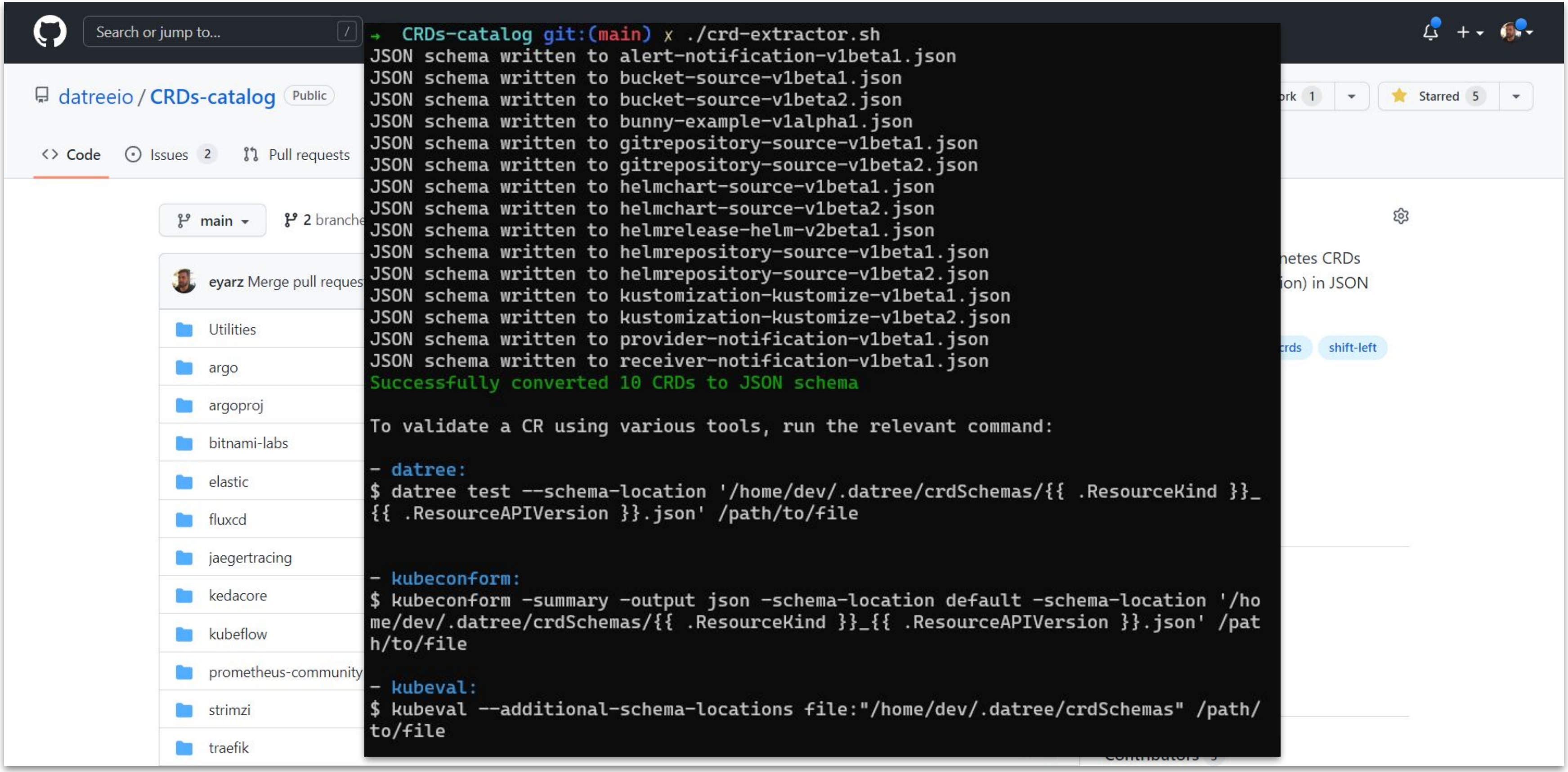
Every release, there are API changes (deprecation).

🙈 Validate CRDs

Extract CRDs, convert to JSON Schema & configure as source.

This is why we started the CRDs-catalog project

CRDs-catalog project



```
→  CRDs-catalog git:(main) ✗ ./crd-extractor.sh
JSON schema written to alert-notification-v1beta1.json
JSON schema written to bucket-source-v1beta1.json
JSON schema written to bucket-source-v1beta2.json
JSON schema written to bunny-example-v1alpha1.json
JSON schema written to gitrepository-source-v1beta1.json
JSON schema written to gitrepository-source-v1beta2.json
JSON schema written to helmchart-source-v1beta1.json
JSON schema written to helmchart-source-v1beta2.json
JSON schema written to helmrelease-helm-v2beta1.json
JSON schema written to helmrepository-source-v1beta1.json
JSON schema written to helmrepository-source-v1beta2.json
JSON schema written to kustomization-kustomize-v1beta1.json
JSON schema written to kustomization-kustomize-v1beta2.json
JSON schema written to provider-notification-v1beta1.json
JSON schema written to receiver-notification-v1beta1.json
Successfully converted 10 CRDs to JSON schema

To validate a CR using various tools, run the relevant command:

- datree:
$ datree test --schema-location '/home/dev/.datree/crdSchemas/{{ .ResourceKind }}_
{{ .ResourceAPIVersion }}.json' /path/to/file


- kubeconform:
$ kubeconform -summary -output json -schema-location default -schema-location '/ho
me/dev/.datree/crdSchemas/{{ .ResourceKind }}_{{ .ResourceAPIVersion }}.json' /pat
h/to/file

- kubeval:
$ kubeval --additional-schema-locations file:"/home/dev/.datree/crdSchemas" /path/
to/file
```

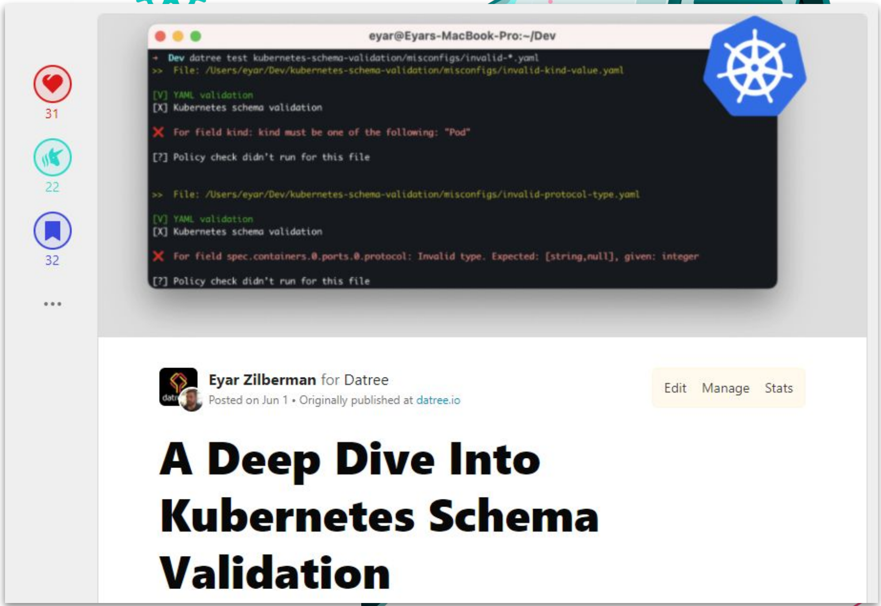
Where to find me

GitHub: eyarz

Email: eyar@datree.io

Linkedin: eyar-zilberman

eyarz / pink-bunny-ears Public



```
→  Dev datree test kubernetes-schema-validation/misconfigs/invalid-*.yaml
>>  File: /Users/eyar/Dev/kubernetes-schema-validation/misconfigs/invalid-kind-value.yaml

[V] YAML validation
[X] Kubernetes schema validation

❌  For field kind: kind must be one of the following: "Pod"

[?] Policy check didn't run for this file


>>  File: /Users/eyar/Dev/kubernetes-schema-validation/misconfigs/invalid-protocol-type.yaml

[V] YAML validation
[X] Kubernetes schema validation

❌  For field spec.containers.0.ports.0.protocol: Invalid type. Expected: [string,null], given: integer

[?] Policy check didn't run for this file
```

Eyar Zilberman for Datree

Posted on Jun 1 • Originally published at datree.io

A Deep Dive Into Kubernetes Schema Validation

datree

Thank You