

Kubernetes Integrated Applications in Julia

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- What is Kubernetes (k8s)
- Kuber.jl - Julia Package for interacting with Kubernetes
 - Basic APIs - get, put, delete
 - Monitoring Cluster Events - the watch API
- Example: Code Search Server on Kubernetes
 - Pipeline to crawl sources, download and index them
 - Serve HTTP APIs to search the index
 - Update index periodically
- Q & A

Kubernetes (k8s)

Kubernetes

- Container orchestration tool
- Automate container deployment, scaling and management
- Open and unified API
- Extensible
- Public, Private and Hybrid
 - EKS, GKE, AKS
 - OpenShift
- <https://kubernetes.io/>

Why Kubernetes

- Benefits of containerization
 - Security: Isolation
 - Efficiency: Isolation at a lower cost compared to VMs
 - Agility: Seamless dev-test workflow
 - Portability: Packaged environment for your application
- Ease of management, deployment, scaling
 - Depth and breadth of API coverage
- Flexibility: Run anywhere, same interface
 - Any cloud provider managed cluster
 - Cloud VMs - create your own cluster
 - In-house cluster
- Extensibility

Under The Hood

- State store stores desired state of entities
- Machinery to match current state to desired state
- APIs to store, update and query state of entities
- Controllers
 - Create entities on the cluster
 - Monitor current state and desired state
 - Act to bring current state to the one desired

Kuber.jl

- Starting clusters
 - Managed cloud clusters are quite simple
 - Or start a local cluster
 - Minikube: <https://github.com/kubernetes/minikube>
 - Kind: <https://github.com/kubernetes-sigs/kind>
 - <https://github.com/JuliaComputing/Kuber.jl/blob/master/WalkThrough.md>
- REST API paradigm - entities and verbs
 - get/list
 - put
 - update!
 - delete!

Using Kuber.jl - Deploy

```
julia> using Kuber
```

```
julia> ctx = KuberContext()
```

```
Kubernetes namespace default at http://localhost:8001
```

```
julia> nginx_pod = kuber_obj(ctx, """{
    "kind": "Pod",
    "apiVersion": "v1",
    "metadata": {
        "name": "nginx-pod",
        "namespace": "default",
        "labels": {
            "name": "nginx-pod"
        }
    },
    "spec": {
        "containers": [{
            "name": "nginx",
            "image": "nginx",
            "ports": [{"containerPort": 80}]
        }]
    }
}""");
```

```
julia> typeof(nginx_pod)
```

```
Kuber.Kubernetes.IoK8sApiCoreV1Pod
```


Using Kuber.jl - Expose services

```
julia> nginx_service = kuber_obj(ctx, """{
    "kind": "Service",
    "apiVersion": "v1",
    "metadata": {
        "name": "nginx-service",
        "namespace": "default",
        "labels": {"name": "nginx-service"}
    },
    "spec": {
        "type": "NodePort",
        "ports": [{"port": 80, "nodePort": 30382}],
        "selector": {"name": "nginx-pod"}
    }
}""");
```

```
julia> typeof(nginx_service)
Kuber.Kubernetes.IoK8sApiCoreV1Service
```

```
julia> put!(ctx, nginx_pod);
```

```
julia> put!(ctx, nginx_service);
```

```
julia> get(ctx, :Service, "nginx-service").spec.ports[1].nodePort
30382
```

```
julia> using HTTP
```

```
julia> HTTP.request("GET", "http://localhost:30382")
```

```
HTTP.Messages.Response:
```

```
"""
```

```
HTTP/1.1 200 OK
```

```
Server: nginx/1.21.4
```

```
Date: Thu, 16 Dec 2021 04:38:39 GMT
```

```
Content-Type: text/html
```

```
Content-Length: 615
```

```
Last-Modified: Tue, 02 Nov 2021 14:49:22 GMT
```

```
Connection: keep-alive
```

```
ETag: "61814ff2-267"
```

```
Accept-Ranges: bytes
```

```
<!DOCTYPE html>
```

```
<html>
```

```
<head>
```

```
<title>Welcome to nginx!</title>
```

Using Kuber.jl - Examine status

```
julia> pod = get(ctx, :Pod, "nginx-pod");
```

```
julia> pod.status
```

```
{  
  "podIPs": [  
    {  
      "ip": "192.168.132.93"  
    }  
  ],  
  "qosClass": "BestEffort",  
  "podIP": "192.168.132.93",  
  "hostIP": "192.168.1.10",  
  "phase": "Running",  
  ...  
}
```

Using Kuber.jl - Watch status

```
julia> watch(ctx, list, :Pod) do stream
    for event in stream
        if isa(event, Kuber.Typedefs.CoreV1.WatchEvent)
            pod = kuber_obj(ctx, event.object)
            conditions = pod.status.conditions
            if conditions !== nothing && !isempty(conditions)
                println("$(pod.metadata.name) $(pod.status.phase) $(pod.status.conditions[1].type)")
            end
        end
    end
end
nginx-pod Pending PodScheduled
nginx-pod Pending Initialized
nginx-pod Pending Initialized
nginx-pod Running Initialized
nginx-pod Running Initialized
```

Using Kuber.jl - Delete

```
julia> delete!(ctx, nginx_service);
```

```
julia> delete!(ctx, nginx_pod);
```

Search Server on Kubernetes

Search Server Core

- A simple search server for demo.
 - Fetches source code for Julia packages from github releases
 - Extracts them
 - Indexes them using GoogleCodeSearch.jl
 - Serves a REST API that provides results using the index
- To simplify things and highlight the important parts, we use
 - only certain pre-downloaded sources, from the file system
 - a single index, no incremental re-indexing
 - the search server provided by GoogleCodeSearch.jl
- Building a docker image

Search Server K8S Integration

- Building the Docker Image
- Indexing pipeline on k8s
- Search server on k8s
- Re-indexing

Q & A