
Kubeflow Workshop

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<https://bit.ly/3QMQtBf>

<https://github.com/FootprintAI/talks/tree/main/slides>

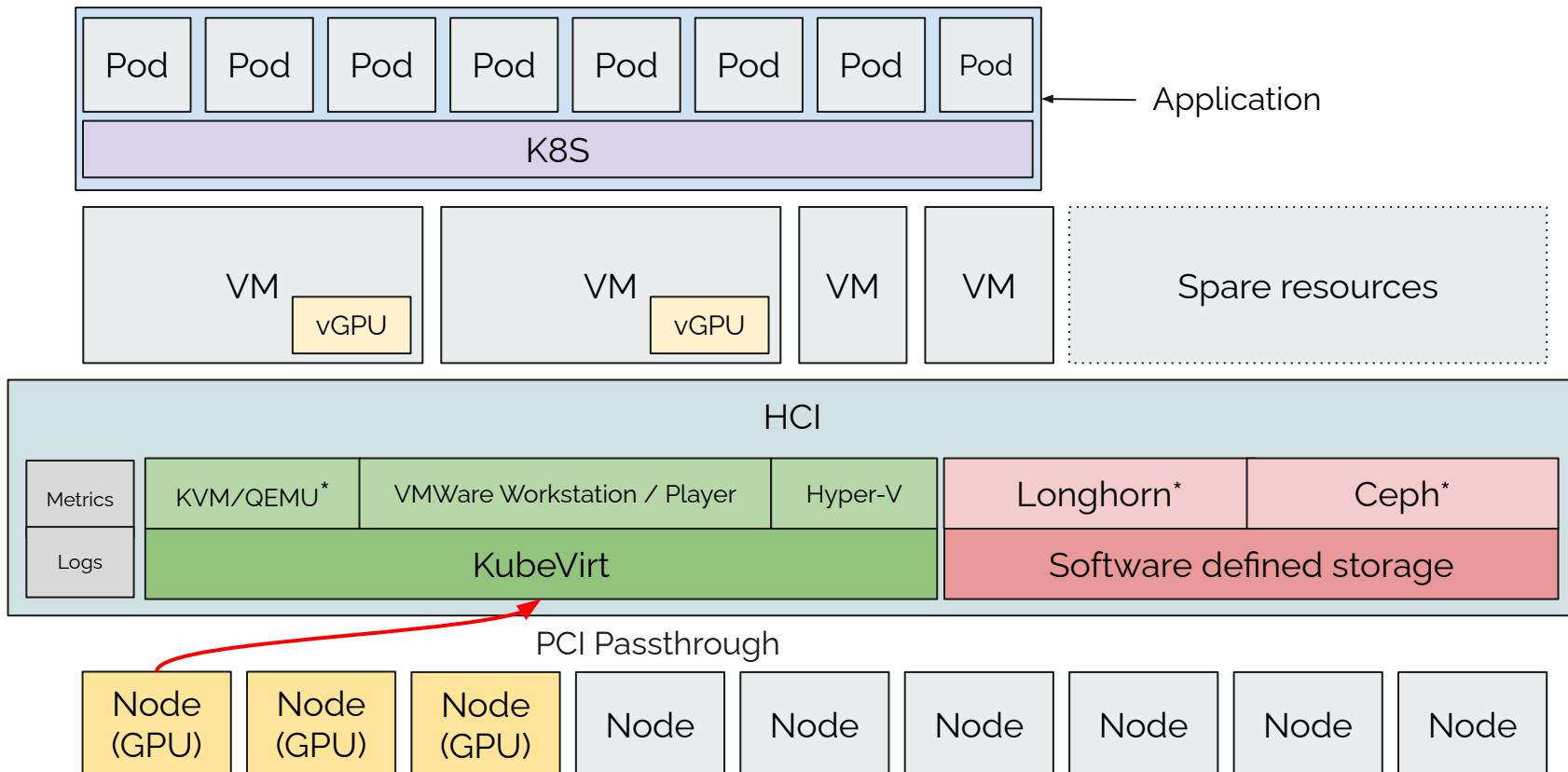


About me

- 2020 - Present at 信誠金融科技
○ **Tintin**: a machine learning platform for everyone
 - <https://get-tintin.footprint-ai.com>
- **kafeido.app**: machine learning platform for green economy
- 2016 - 2020 at IglooInsure (16M+ in series A+ 2020)
 - Provide digital insurance for e-economic world
 - Funded in KUL, Headquartered in Singapore
 - First employee/ Engineering Lead / Regional Head/ Chief Engineer
- 2013 - 2016 at Studio Engineering @ hTC
 - Principal Engineer on Cloud Infrastructure Team
- 2009 - 2012 at IIS @ Academia Sinica
 - Computer vision, pattern recognition, and data mining
- CS@CCU, CS@NCKU alumni



Kubernetes Case Study: Hyper-converged Infrastructure



Kubernetes Case Study: Open AI

OpenAI adopted Kubernetes since 2016 for portability, cost saving, and improved efficiency[1,2].

Years	Nodes	Estimated Cost [3]
2018	2,500	= 3 * 2500 * 24 = US\$ 180,000 / day
2021	7,500	= 3 * 7500 * 24 = US\$ 540,000 / day
2023	?	

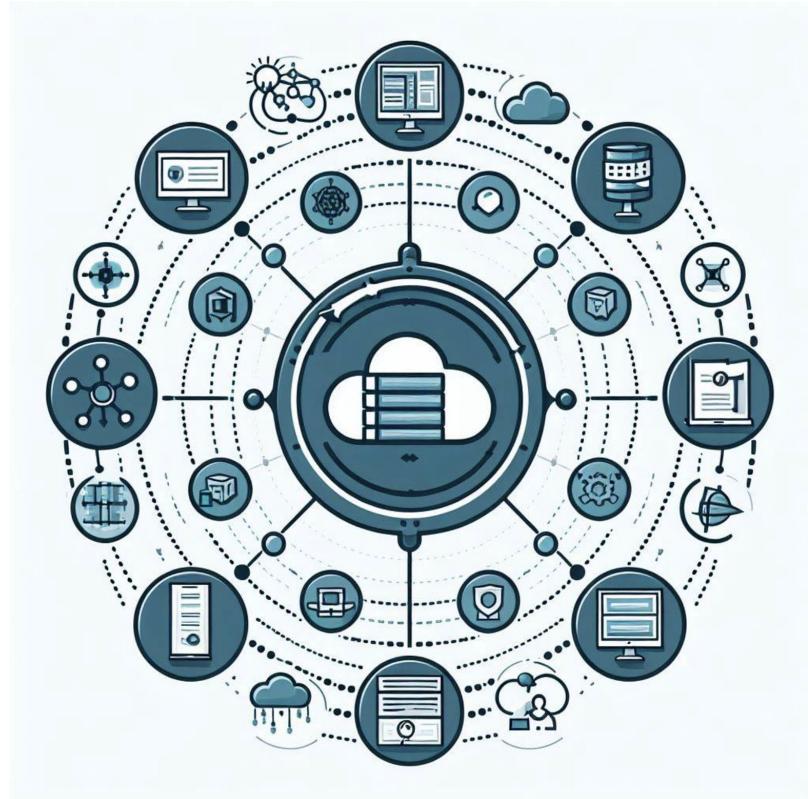
[1] <https://kubernetes.io/case-studies/openai/>

<https://blog.pichuang.com.tw/20230214-openai-scaling-kubernetes-to-7500-nodes.html>

[2] https://blog.pichuang.com.tw/20230214-openai-scaling-kubernetes-to-7500-nodes.html#_1

[3] AWS P3.2xlarge equips 8 vCores, 61 GB Memory, 1 Core of V100-16Gb GPU, charges US\$ 3 per hour.

What is Kubernetes?



<https://www.bing.com/images/create/what-is-kubernetes/1-6644c93ae66446ae93dce2cbcd9c9974?id=K7n8CpA%2bFkoOxaICEMksZA%3d%3d&view=detailv2&idp=genimg&thId=OIG2.XG5ZzzfZlX2le8pTvg5L&FORM=GCRIDP&mode=overlay> 6

History Of Kubernetes

- Borg: the predecessor to Kubernetes
 - Google revealed the first time of its detail in an academic research paper, describing a “cluster manager that runs hundreds of thousands of jobs, from many thousands of different applications, across a number of clusters each with up to tens of thousands of machines.”[1]
 - A in-house cluster manager system inside Google for running every google services including Gmail, Google Maps, Google Docs...[2]
 - In a scale with ‘over 2 billion containers per week’ [3]
- The very first version of Kubernetes was released in 2015
- The latest version is v1.26, released at 2023.

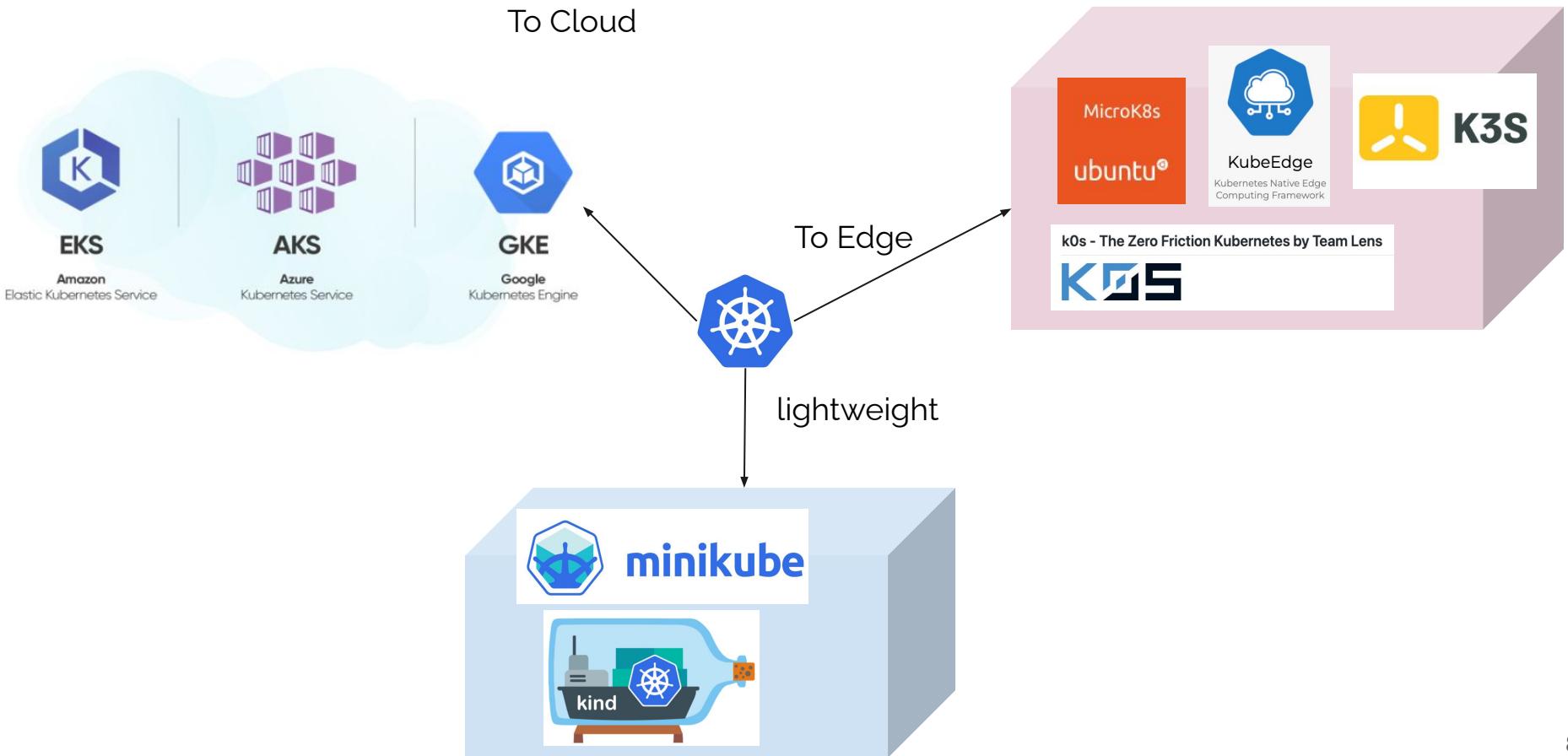
[1] <https://research.google/pubs/pub43438/>

[2] <https://www.wired.com/2016/04/want-build-empire-like-googles-os/>

[3] <https://cloud.redhat.com/blog/building-kubernetes-bringing-google-scale-container-orchestration-to-the-enterprise>



Kubernetes Distributions Evolution

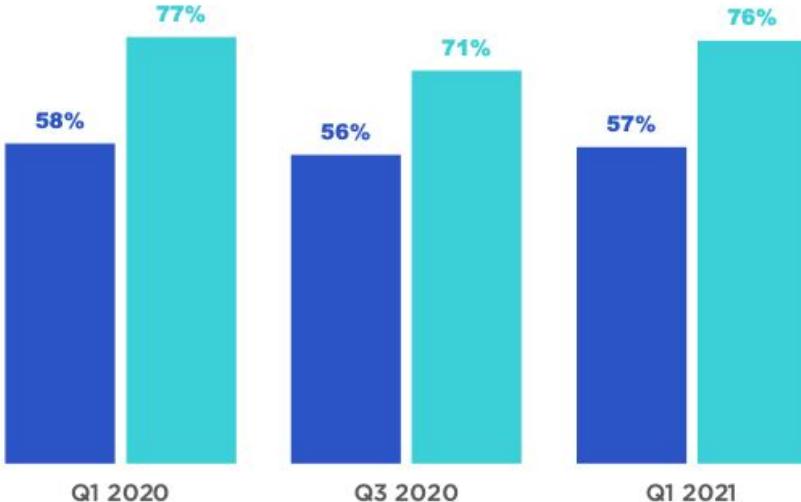


Usage of cloud native technologies across regions



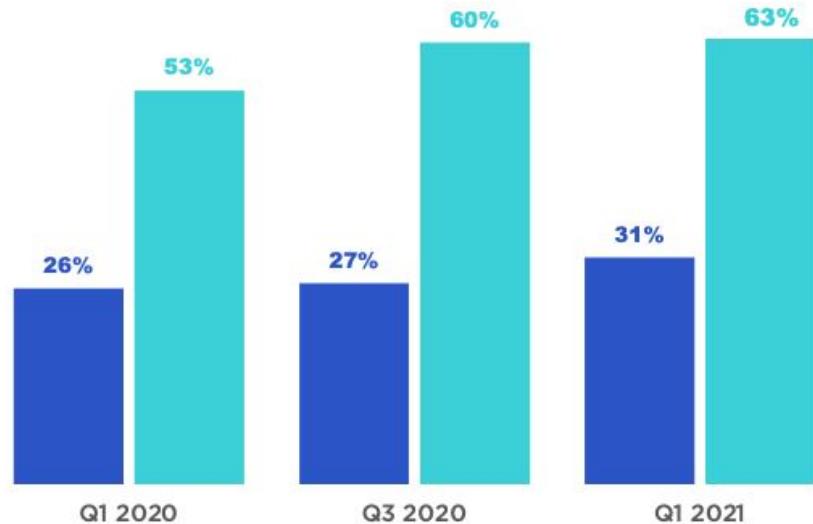
Containers usage

■ All backend developers ■ Fog and edge developers



Kubernetes usage

■ All backend developers ■ Fog and edge developers



Rel

Setting Popular Recent

 Senior Site Reliability Engineer
MaiCoin

Full time · Mid-Senior level
◎ 110台灣台北市信義區 ▲ 2
\$ 1.2M ~ 2.5M TWD/year

Updated 3 Months ago · 500+ · Unread

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 Machine Learning Engineer (Ads) 🔥
Dcard 狀卡科技股份有限公司

Full time · Entry level
◎ 台北 · 大安區
\$ 900K ~ 2.2M TWD/year

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 (Sr.) DevOps Engineer 運維開發工程師
OpenNet 開網有限公司

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\$ 800K ~ 1.8M TWD/year

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 【技術部】資深DevOps/SRE工程師
聖霏有限公司

Full time · Mid-Senior level
◎ 大安區 · 台北
\$ 40K ~ 100K TWD/month

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 LINE TV 數據工程師 (Data Engineer) 🔥
LINE TV_巧克技新媒體股份有限公司

Full time · Entry level
◎ 台灣 · 台北
\$ 50K ~ 80K TWD/month

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 中階/資深後端工程師 Mid/Senior Backend Engineer (Python) 🔥
Linker Networks Inc. 美商實益凌科網路科技有限公司台灣分公司

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Splashtop Inc. 

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 Senior DevOps / SRE
Splashtop Inc. 

Full time · Mid-Senior level
◎ 105台灣台北市松山區 ▲ 2
\$ 1M ~ 1.5M TWD/year

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 Site Reliability Engineer
OneDegree 

Full time · Mid-Senior level
◎ 台灣台北
\$ 840K ~ 1.5M TWD/year

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 Machine Learning Engineer 🔥
Dcard 狀卡科技股份有限公司

Full time · Mid-Senior level
◎ 台北 · 大安區
\$ 900K ~ 2.2M TWD/year

Updated 18 days ago · 1,000+ · Unread

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 Machine Learning Engineer (Search)
Dcard 狀卡科技股份有限公司

Full time · Mid-Senior level
◎ 台灣台北市大安區
\$ 900K ~ 2.2M TWD/year

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 Save  Follow

 Mid-Level Software Engineer, Cymetrics (Backend)
OneDegree 

Full time · Mid-Senior level
◎ 台北 · 信義區
\$ 840K ~ 1.2M TWD/year

Updated 4 days ago · 100+ · Unread

 Save  Follow

 【資訊研發部】PHP 後端資深工程師 (可遠端)
聯合數位

Full time · Mid-Senior level
◎ 台灣台北 ▲ 5
\$ 60K ~ 80K TWD/month

Updated 2 months ago · 500+ · Unread

 Save  Follow

Kubernetes Feature Highlighted

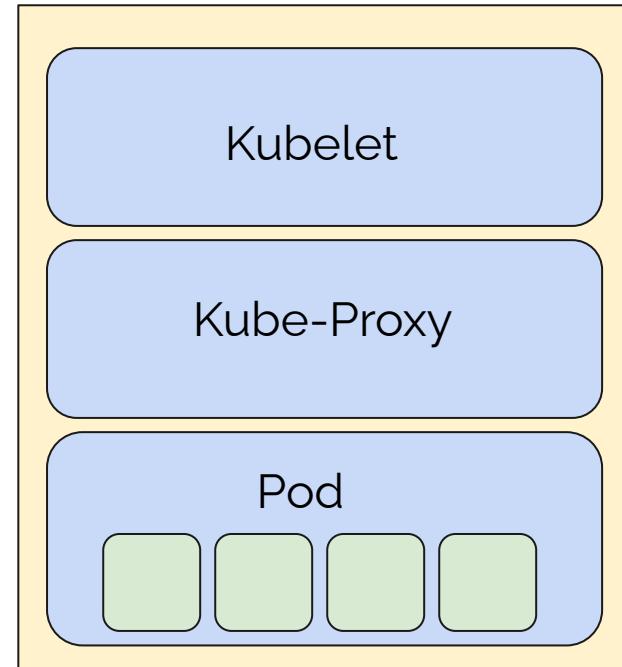


What is Kubernetes?

- High level concepts
 - **Node** are machine that run containerized applications.
 - **Pod** are unit for application workload.
 - **Scheduler** schedules pods to run on nodes.
 - **Deployment/Replica Set** ensures that a specified number of pod replicas are running at any one time.
 - **Service** is an abstract way to expose an application running on a set of Pods as a network service.

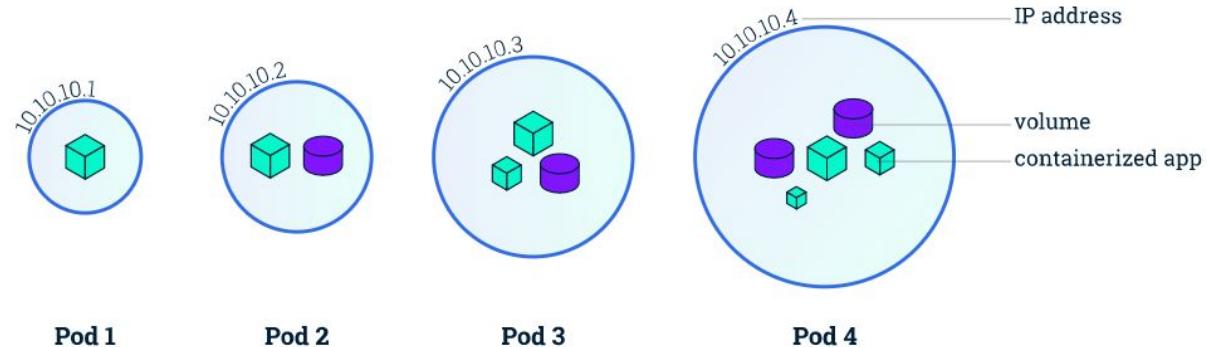
What is a Node?

- Container runtime
 - Docker / CRI-o
- Kubelet
 - Primary node agent running on each node
 - It register the node with api server and manage pods according to PodSpec.
- Kube-Proxy
 - Network proxy runs on each node. This reflects services as defined in the Kubernetes API on each node and can do simple TCP, UDP, and SCTP stream forwarding or round robin forwarding across a set of backends.



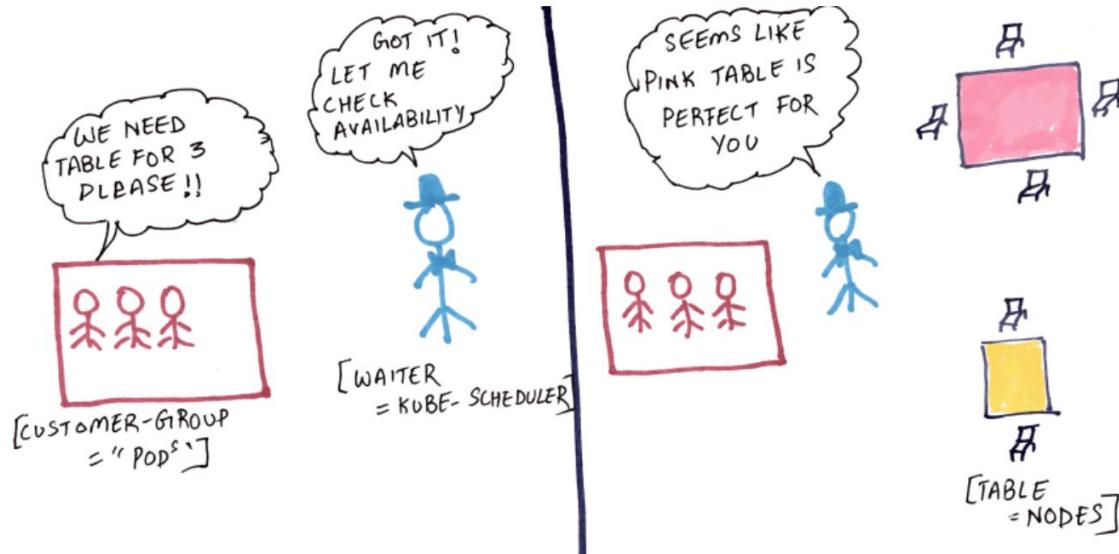
What is a Pod?

- A pod represents a logical application, it could contains a or multiple containers.
- A pod has unique IP address, persistent storage volume, and a configuration on how container should run
- Containers inside the same pod shares namespaces.
 - Containers inside the same pod can locate each other and communicate via localhost



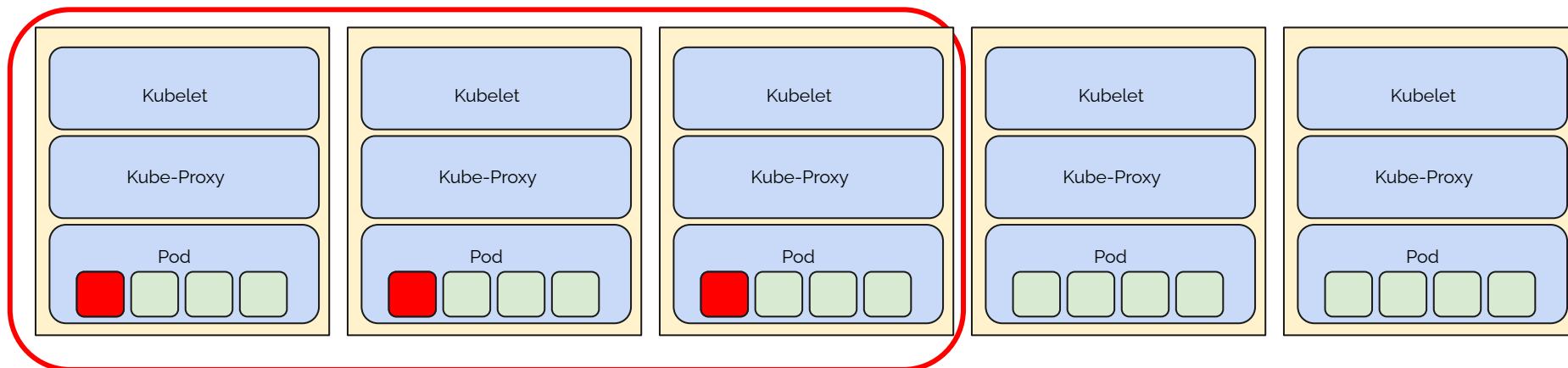
What is a Scheduler?

- The scheduler determines (filtering & scoring) which Nodes are valid placements for each Pod in the scheduling queue according to constraints and available resources.

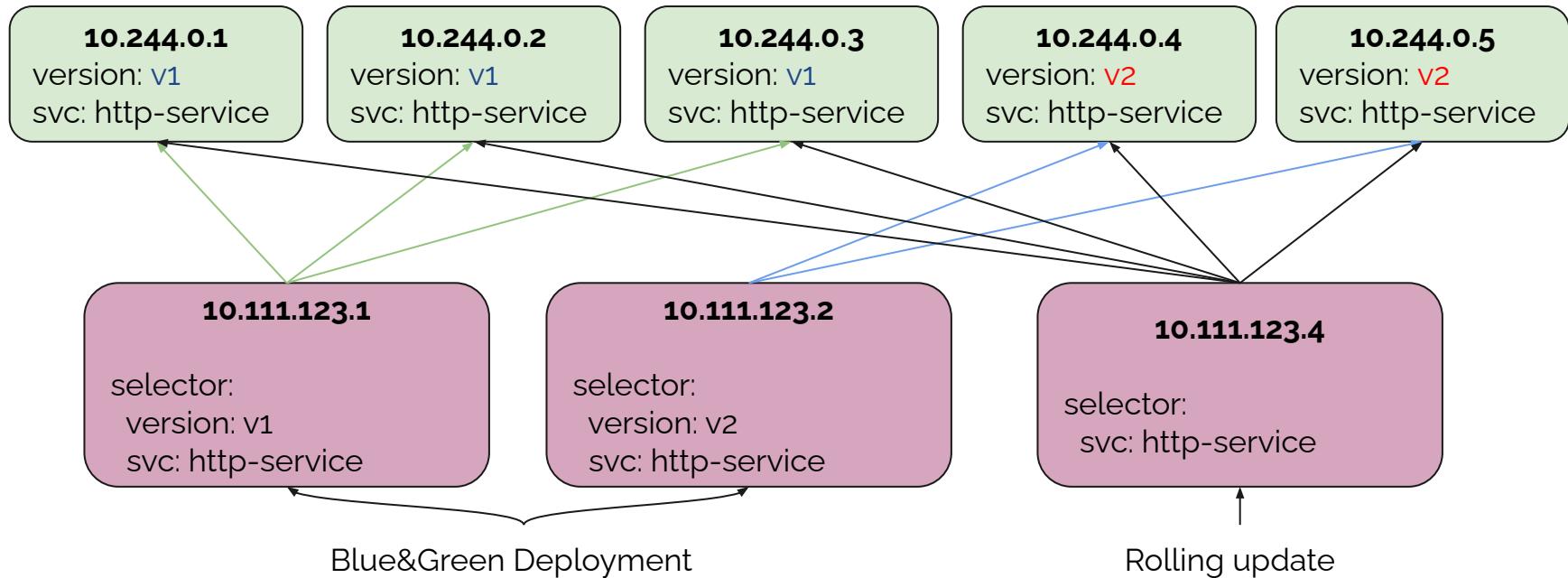


What is Replica Set?

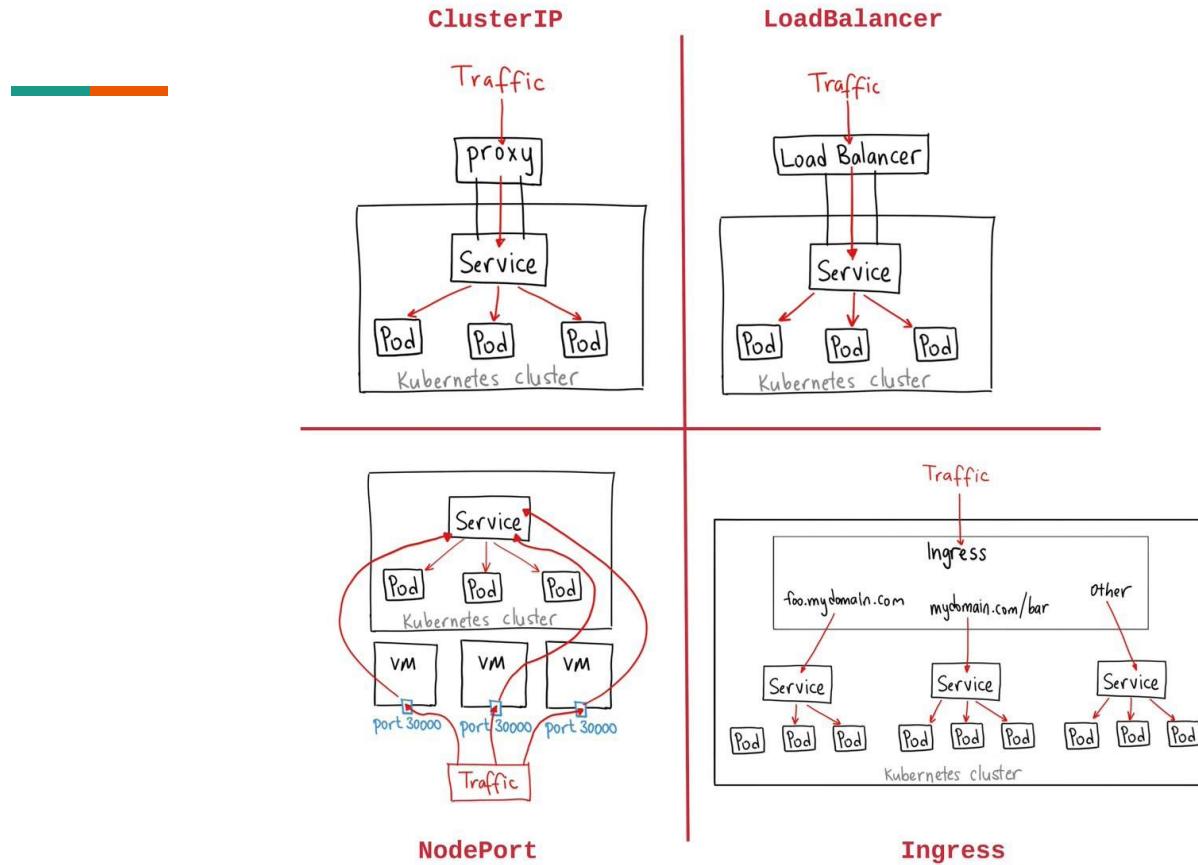
- Manage a replicated set of pods
- Create pods from a template
- Ensure the desired number of pods running
- Online resizing and self-healing



What is Service?

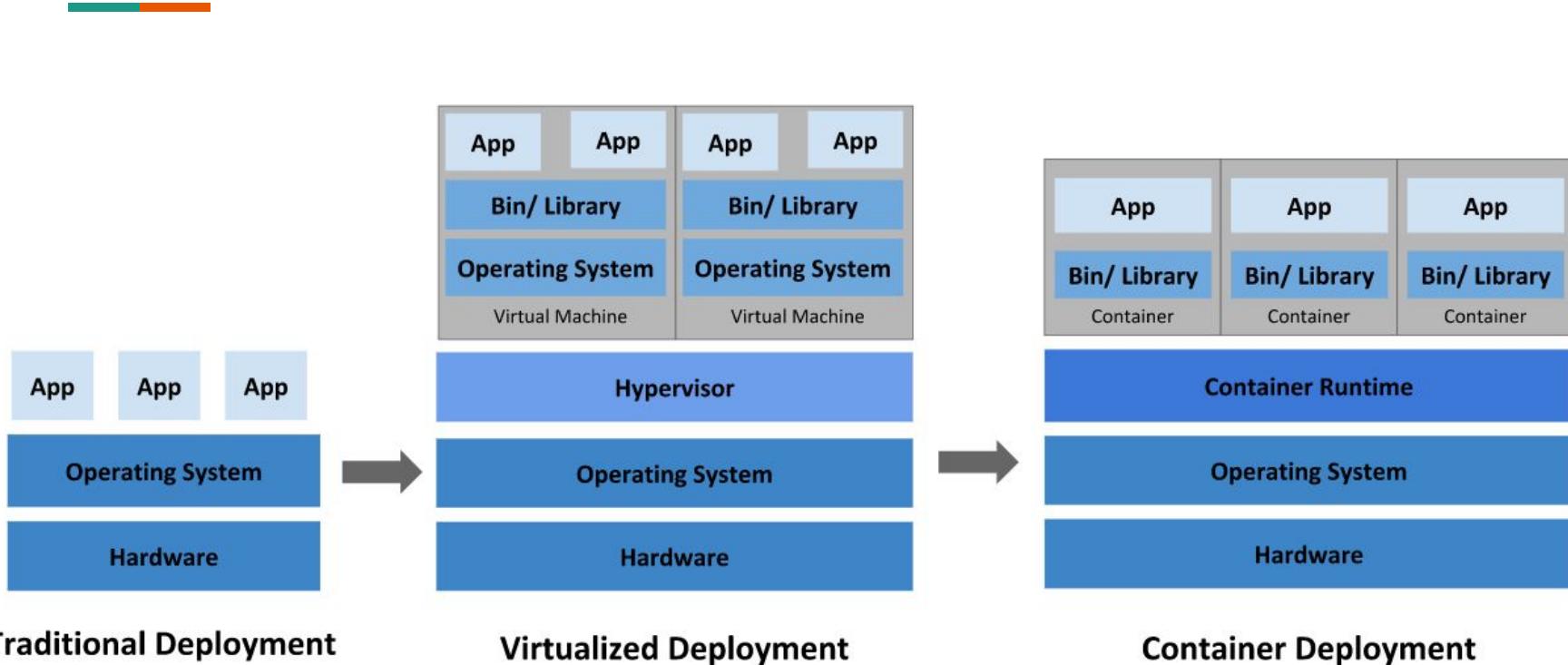


What is Service?



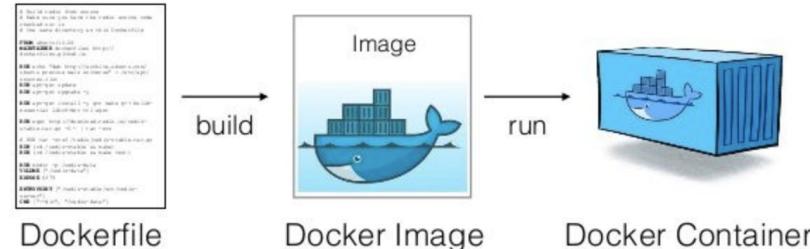
What is Container?

What is containerized deployment?



What is Container?

- Container
 - Container Image = Application code + dependencies
 - Runtime environment (cgroups, namespaces, env vars)
- Container Registry
 - Container repository



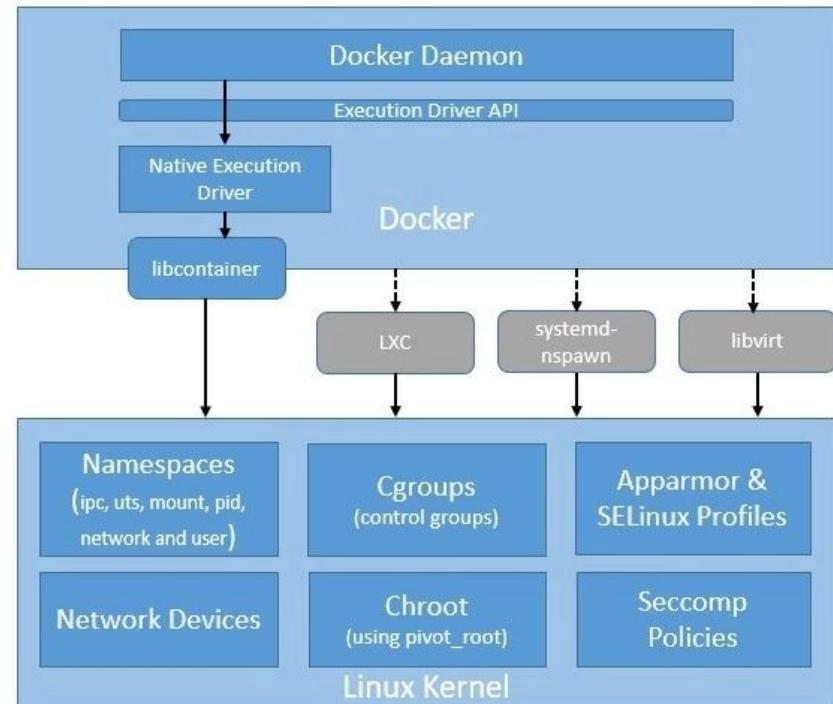
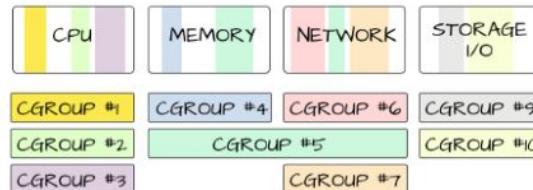
Ref: <https://medium.com/platormer-blog/practical-guide-on-writing-a-dockerfile-for-your-application-89376f88b3b5>

How container works?

- Namespace for isolation
- Cgroups for resource limiting

Cgroups : Isolation and accounting

- cpu
- memory
- block i/o
- devices
- network
- numa
- freezer



Ref:

<https://www.baeldung.com/linux/docker-containers-evolution>
<https://medium.com/@BeNitinAgarwal/understanding-the-docker-internals-7ccb052ce9fe>

What is Dockerfile?

- A dockerfile contains instructions needed to build an container image

```
FROM ubuntu:18.04
```

```
RUN apt-get update && apt-get install -y build-essential
```

```
COPY . /app
```

```
RUN make /app
```

```
CMD python /app/app.py
```

```
FROM php:7.0-apache
```

```
COPY index.php /var/www/html/index.php
```

```
EXPOSE 80
```

registry

repository

tag

```
docker build -t footprintai/k8sworkshop:php-demo -f Dockerfile .
```

```
=> [internal] load metadata for docker.io/library/php:7.0-apache  
4.6s
```

```
...
```

```
=> [2/2] COPY index.php /var/www/html/index.php
```

```
0.8s
```

```
=> exporting to image
```

```
0.2s
```

```
=> => exporting layers
```

```
0.1s
```

```
=> => writing image
```

```
sha256:e74d16d21b10069dobebea2cc6daf7cc011723d7e51523c3830e50b1bc5338e88 0.0s
```

```
=> => naming to docker.io/footprintai/k8sworkshop:php-demo
```

```
0.0s
```

What is deployment automation in Machine learning?

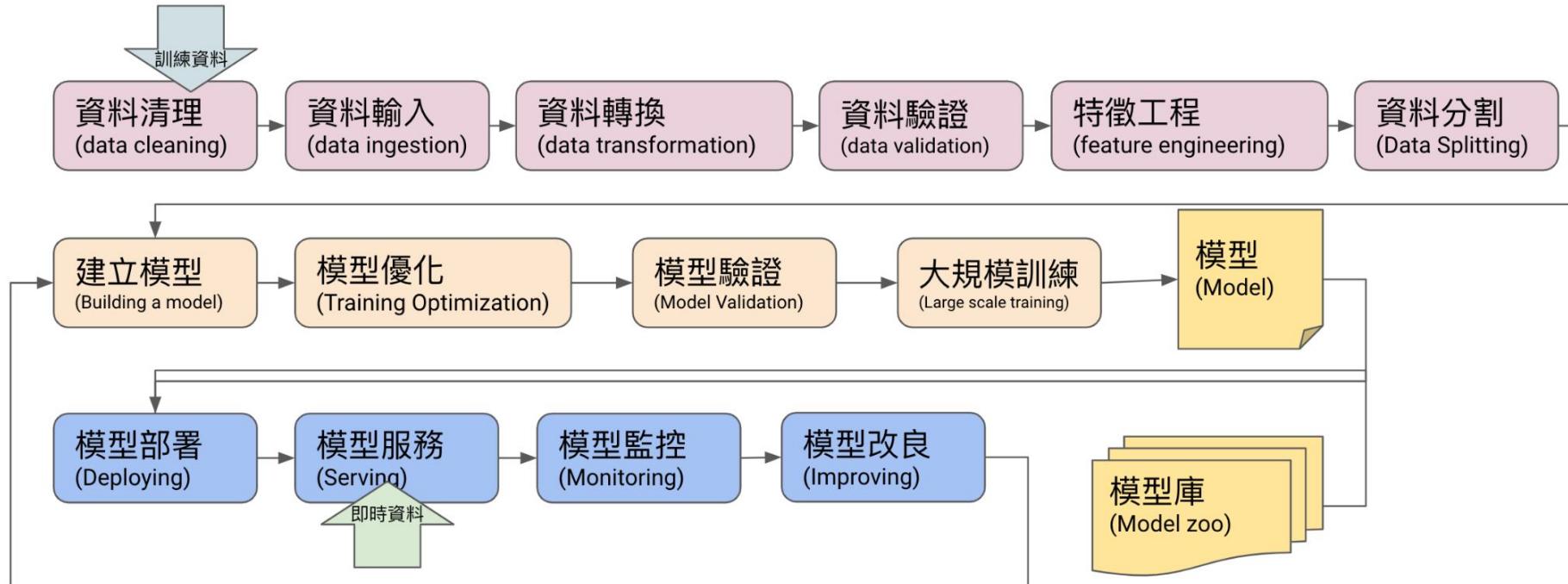


DevOps + ML
= MLOps

MLOps is the process of taking an experimental Machine Learning model into a production system by including continuous development practice of DevOps in the software field.

Ref: <https://en.wikipedia.org/wiki/MLOps>

Real-world Machine Learning Application - End-to-End ML LifeCycle



Oh, you want to use ML on K8s?

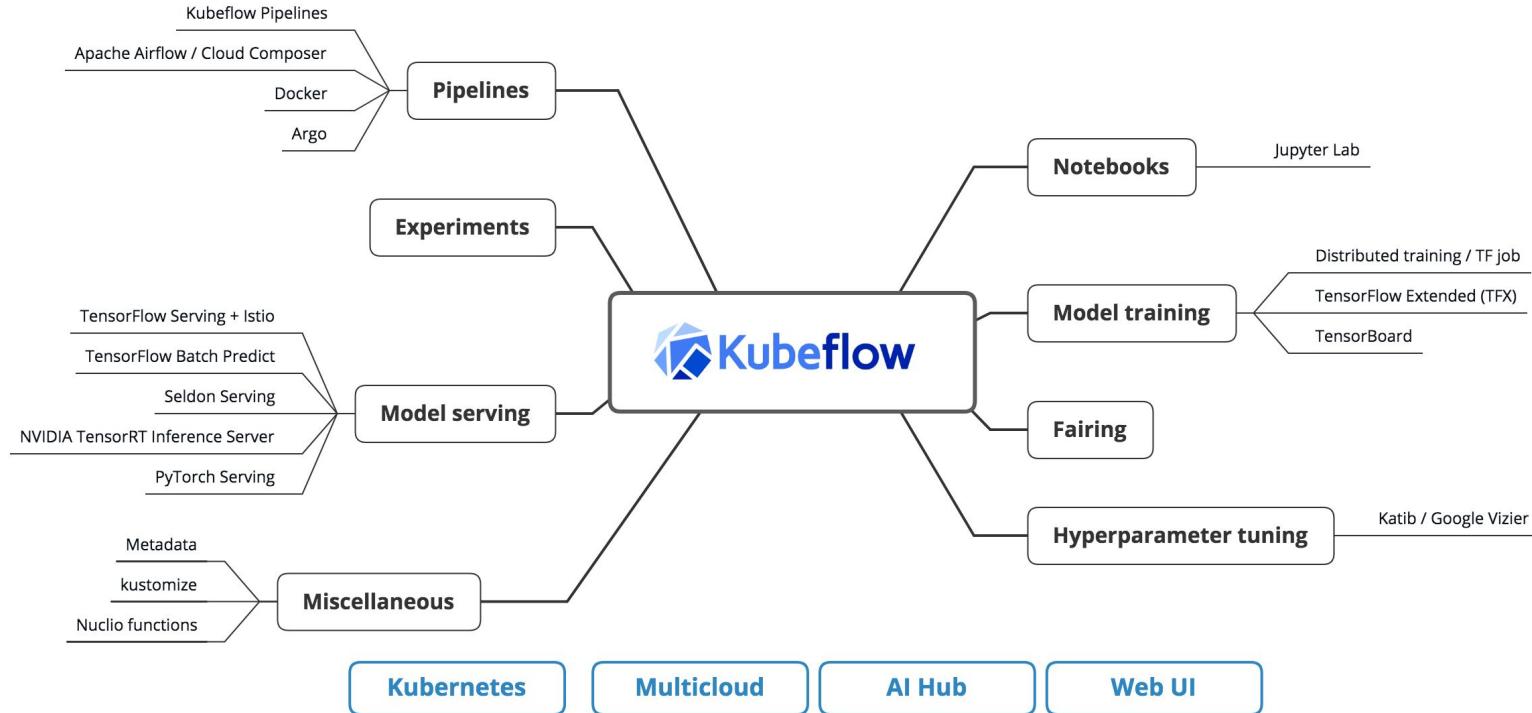
Before that, can you become an expert in:

- Containers
- Packaging
- Kubernetes service endpoints
- Persistent volumes
- Scaling
- Immutable deployments
- GPUs, Drivers & the GPL
- Cloud APIs
- DevOps
- ...



Source: @aronchick

Architectures





Hands on

Pre-requirement

- Be comfortable with UNIX command line
 - Navigating directories with `cd` or `tree`
 - Editing files, like `vim`, `nano`
 - Bash scripting, like env or looping
- Be an export with `Google`
 - <https://letmegooglet.com/?q=you+can+google+it>
- It is totally OK if you don't know what is Container and Kubernetes

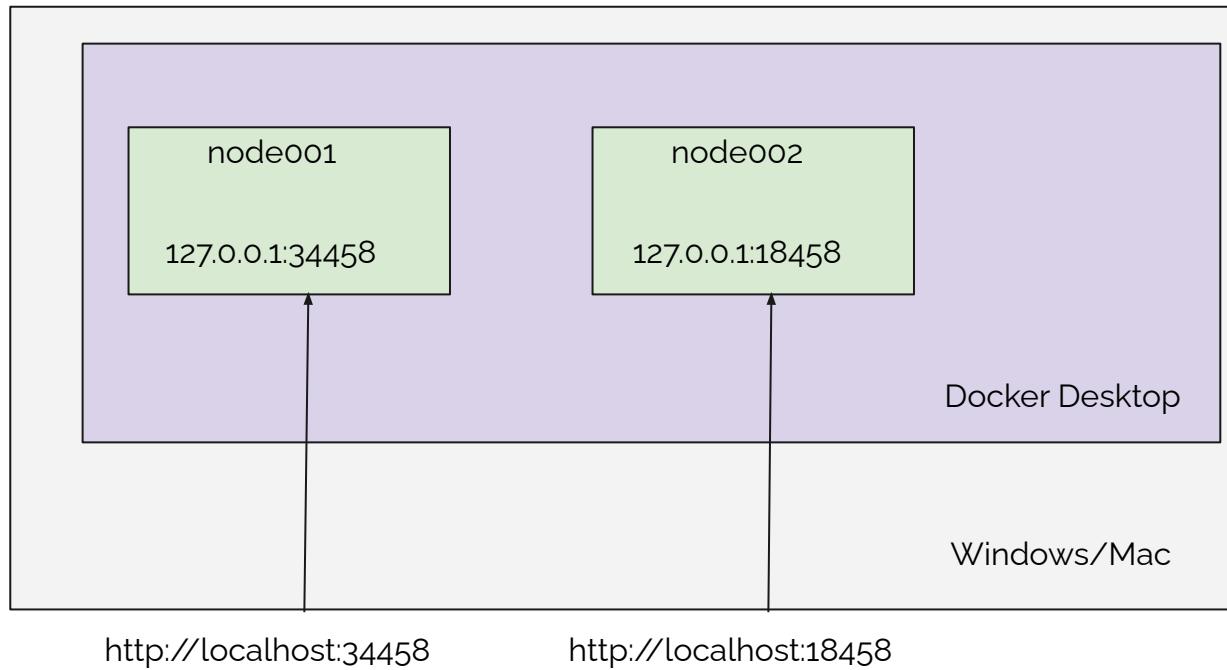
孩子，您多久沒唸中文了？

荀子《儒效篇》

「不聞不若聞之，聞之不若見之，見之不若知之，知之不若行之；學至于行之而止矣。」

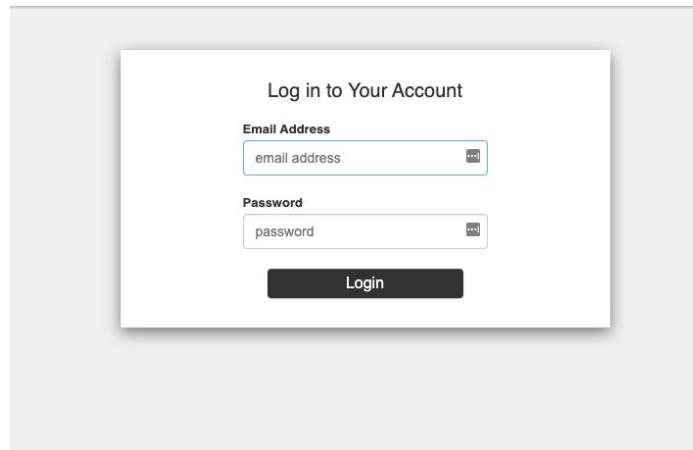
multikf: One-click Installation

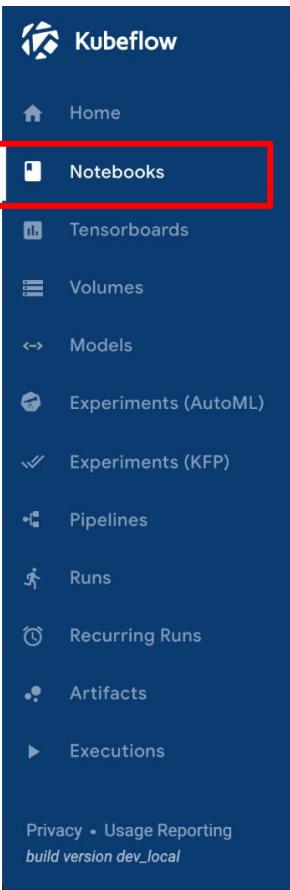
- Multikf: <https://github.com/footprintai/multikf>



Wait! 所以我說那個帳號密碼呢?

Account: user@example.com
Password: 12341234





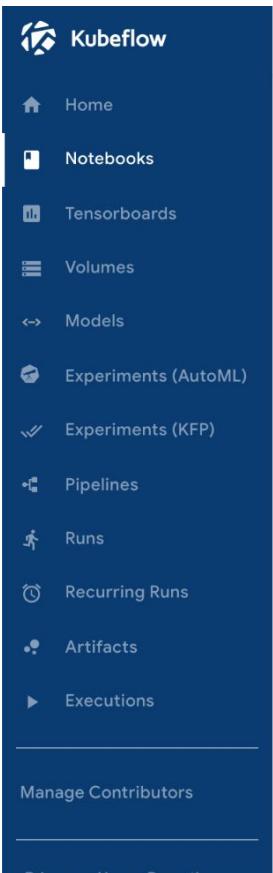
kubeflow-user-example-c...



Notebooks

+ NEW NOTEBOOK

Status	Name	Type	Age	Image	GPUs	CPUs	Memory	Volumes
--------	------	------	-----	-------	------	------	--------	---------



kubeflow-user-example-c...



Specify the name of the Notebook Server and the Namespace it will belong to.

Name: Namespace:

Image
A starter Jupyter Docker Image with a baseline deployment of ML packages
 Custom Image
jupyterlab 1 2

Image:

Advanced Options

CPU / RAM
Specify the total amount of CPU and RAM reserved by your Notebook Server. For CPU-intensive workloads, you can choose more than 1 CPU (e.g. 1.5).

Requested CPU: Requested Memory (in GiB):

Advanced Options

Specify a name and resources like CPU and Memory

Kubeflow

- Home
- Notebooks
- Tensorboards
- Volumes
- Models
- Experiments (AutoML)
- Experiments (KFP)
- Pipelines
- Runs
- Recurring Runs
- Artifacts

kubeflow-user-example-c...

Notebooks

+ NEW NOTEBOOK

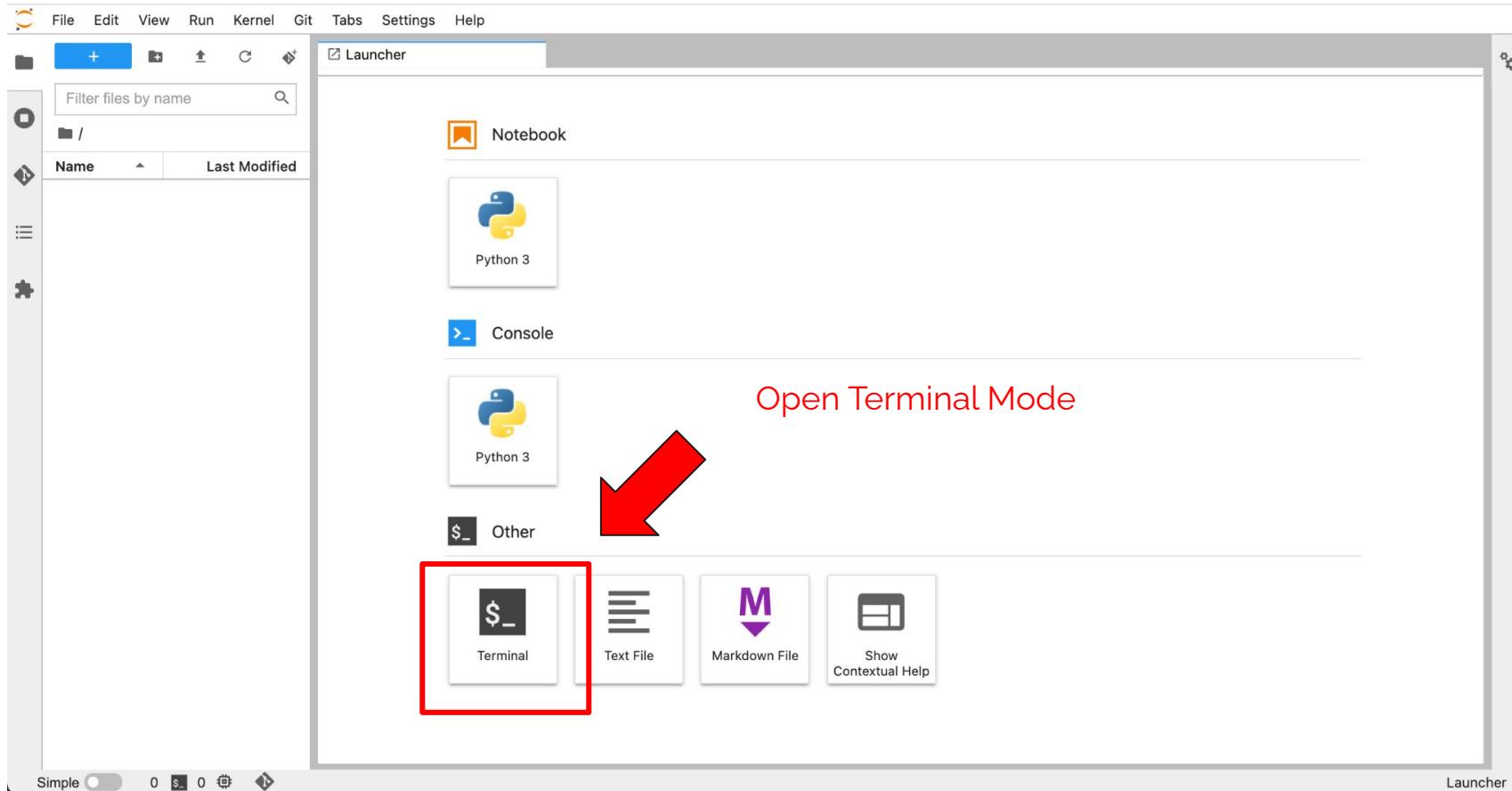
Status	Name	Type	Age	Image	GPUs	CPUs	Memory	Volumes
--------	------	------	-----	-------	------	------	--------	---------

✓	demo1	jupyter	20 hours ago	jupyter-scipy:v1.4	0	0.5	1Gi	⋮	CONNECT	■	trash
---	-------	---------	--------------	--------------------	---	-----	-----	---	---------	---	-------

✓	demo2	jupyter	2 hours ago	jupyter-tensorflow-full:v1.4	0	0.5	1Gi	⋮	CONNECT	■	trash
---	-------	---------	-------------	------------------------------	---	-----	-----	---	---------	---	-------

CONNECT





Open Terminal Mode

```
File Edit View Run Kernel Git Tabs Settings Help  
+ Filter files by name X  
/ Name Last Modified  
kubeflow-... seconds ago
```

```
Terminal 1  
groups: cannot find name for group ID 1222  
(base) jovyan@demo1-0:~$ git clone https://github.com/footprintai/kubeflow-workshop  
Cloning into 'kubeflow-workshop'  
remote: Enumerating objects: 164, done.  
remote: Counting objects: 100% (164/164), done.  
remote: Compressing objects: 100% (98/98), done.  
remote: Total 164 (delta 89), reused 133 (delta 62), pack-reused 0  
Receiving objects: 100% (164/164), 1.71 MiB | 8.29 MiB/s, done.  
Resolving deltas: 100% (89/89), done.  
(base) jovyan@demo1-0:~$
```

git clone
https://github.com/footprintai/kubeflow-workshop

Simple 1 Terminal 1 39

The screenshot shows a Jupyter Notebook interface with a file browser on the left and a terminal window on the right.

File Browser:

- Path: /kubeflow-workshop / pipelines /
- Table:

Name	Last Modified
img	3 minutes ago
0.helloworld.ipynb	3 minutes ago
1.conditional-flow.ipynb	3 minutes ago
2.persistvolume.ipynb	3 minutes ago
3.calc_metrics.ipynb	3 minutes ago
4.mnist.ipynb	3 minutes ago
5.auto-mnist-with-katib.ipynb	3 minutes ago
6.kfserving.ipynb	3 minutes ago
7.kfserving-canary-rollout.ipynb	3 minutes ago
kfp.ipynb	3 minutes ago
testdata.jpg	3 minutes ago
testdata2.jpg	3 minutes ago
testdata3.jpg	3 minutes ago

Terminal Output:

```
groups: cannot find name for group ID 1337
(base) jovyan@demo1-0:~$ git clone https://github.com/footprintai/kubeflow-workshop
Cloning into 'kubeflow-workshop'...
remote: Enumerating objects: 164, done.
remote: Counting objects: 100% (164/164), done.
remote: Compressing objects: 100% (98/98), done.
remote: Total 164 (delta 89), reused 133 (delta 62), pack-reused 0
Receiving objects: 100% (164/164), 1.71 MiB | 8.29 MiB/s, done.
Resolving deltas: 100% (89/89), done.
(base) jovyan@demo1-0:~$
```



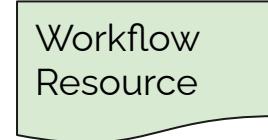
Kubeflow Terms

詞彙說明

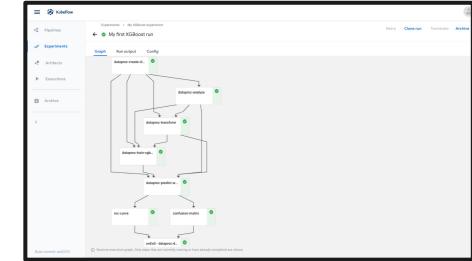


```
1 // with open('requirements.txt', 'w') as f:
2     f.write("tensorflow==1.8.9\n")
3
4     pip install --upgrade --user
5
6     import kfp
7
8     def echo_op(text):
9         return kfp.components.create_component_spec(
10             image='library/tensorflow:1.8.9',
11             command=['python', '-c'],
12             arguments=['print("%s")' % text])
13
14     @kfp.dsl.pipeline()
15     def echo_pipeline():
16         echo_1 = echo_op('Hello')
17         echo_2 = echo_op('World')
18
19         echo_1.out | echo_2.in
20
21     kfp.compiler.Compiler().compile(echo_pipeline, 'echo_pipeline')
22
23
24 # generate workflow artifacts in .zip format
25 # $ kfp compiler compile echo_pipeline echo_pipeline.zip
```

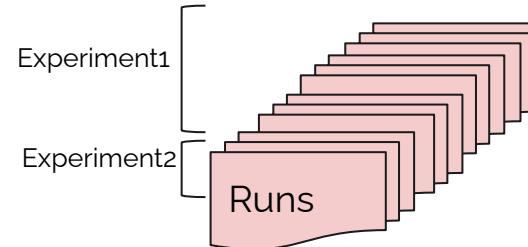
Compiled



Create a Pipeline



Pipeline Code



Create Run

Hello World Example

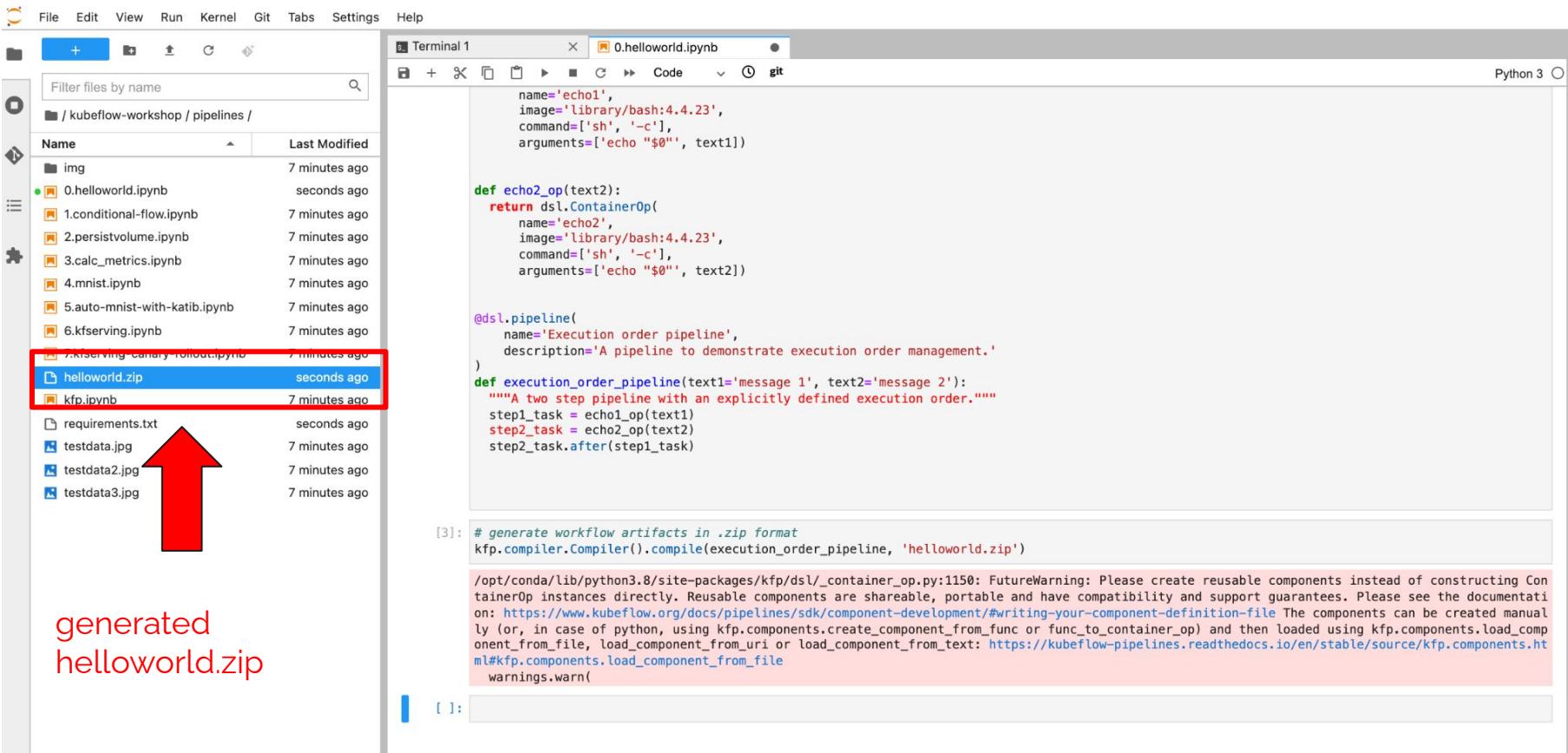
The screenshot shows a Jupyter Notebook interface with the following details:

- File Bar:** File, Edit, View, Run, Kernel, Git, Tabs, Settings, Help.
- Left Sidebar:** Shows a file tree with the current directory being `/kubeflow-workshop / pipelines /`. The file `0.helloworld.ipynb` is selected and highlighted in blue.
- Terminal 1:** A terminal window titled `0.helloworld.ipynb` running in `Python 3`. The code in the terminal is as follows:

```
[ ]: with open("requirements.txt", "w") as f:  
    f.write("kfp==1.8.9\\n")  
  
[ ]: !pip install -r requirements.txt --upgrade --user  
  
[ ]: import kfp  
from kfp import dsl  
  
def echo1_op(text1):  
    return dsl.ContainerOp(  
        name='echo1',  
        image='library/bash:4.4.23',  
        command=['sh', '-c'],  
        arguments=['echo "$0"', text1])  
  
def echo2_op(text2):  
    return dsl.ContainerOp(  
        name='echo2',  
        image='library/bash:4.4.23',  
        command=['sh', '-c'],  
        arguments=['echo "$0"', text2])  
  
@dsl.pipeline(  
    name='Execution order pipeline',  
    description='A pipeline to demonstrate execution order management.')  
def execution_order_pipeline(text1='message 1', text2='message 2'):  
    """A two step pipeline with an explicitly defined execution order."""  
    step1_task = echo1_op(text1)  
    step2_task = echo2_op(text2)  
    step2_task.after(step1_task)  
  
[ ]: # generate workflow artifacts in .zip format  
kfp.compiler.Compiler().compile(execution_order_pipeline, 'helloworld.zip')
```

A red box highlights the line `kfp.compiler.Compiler().compile(execution_order_pipeline, 'helloworld.zip')`.

Bottom Status Bar: Simple, Python 3 | Idle, Mode: Command, Ln 1, Col 1, 0.helloworld.ipynb.



The screenshot shows a Jupyter Notebook interface with a terminal window and a file browser.

File Browser:

- Path: /kubeflow-workshop / pipelines
- Files and Folders:
 - img
 - 0.helloworld.ipynb
 - 1.conditional-flow.ipynb
 - 2.persistvolume.ipynb
 - 3.calc_metrics.ipynb
 - 4.mnist.ipynb
 - 5.auto-mnist-with-katib.ipynb
 - 6.kfserving.ipynb
 - 7.kfsserving_end2end_order.ipynb
 - helloworld.zip** (selected, highlighted in blue)
 - kfp.ipynb
 - requirements.txt
 - testdata.jpg
 - testdata2.jpg
 - testdata3.jpg

A large red arrow points upwards from the "helloworld.zip" entry in the file browser towards the terminal window.

Terminal Window:

- Terminal 1: 0.helloworld.ipynb
- Code cell content:

```
name='echo1',
image='library/bash:4.4.23',
command=['sh', '-c'],
arguments=['echo "$0"', text1]

def echo2_op(text2):
    return dsl.ContainerOp(
        name='echo2',
        image='library/bash:4.4.23',
        command=['sh', '-c'],
        arguments=['echo "$0"', text2])

@dsl.pipeline(
    name='Execution order pipeline',
    description='A pipeline to demonstrate execution order management.')
def execution_order_pipeline(text1='message 1', text2='message 2'):
    """A two step pipeline with an explicitly defined execution order."""
    step1_task = echo1_op(text1)
    step2_task = echo2_op(text2)
    step2_task.after(step1_task)

# generate workflow artifacts in .zip format
kfp.compiler.Compiler().compile(execution_order_pipeline, 'helloworld.zip')
```
- Output cell content:

```
/opt/conda/lib/python3.8/site-packages/kfp/dsl/_container_op.py:1150: FutureWarning: Please create reusable components instead of constructing ContainerOp instances directly. Reusable components are shareable, portable and have compatibility and support guarantees. Please see the documentation: https://www.kubeflow.org/docs/pipelines/sdk/component-development/#writing-your-component-definition-file The components can be created manually (or, in case of python, using kfp.components.create_component_from_func or func_to_container_op) and then loaded using kfp.components.load_component_from_file, load_component_from_uri or load_component_from_text: https://kubeflow-pipelines.readthedocs.io/en/stable/source/kfp.components.html#kfp.components.load\_component\_from\_file
warnings.warn()
```

generated
helloworld.zip

Kubeflow

kubeflow-user-example-c... ▾

Home Notebooks Tensorboards Volumes Models Experiments (AutoML) Experiments (KFP) Pipelines Runs Recurring Runs Artifacts Executions

Pipelines

+ Upload pipeline Refresh Delete

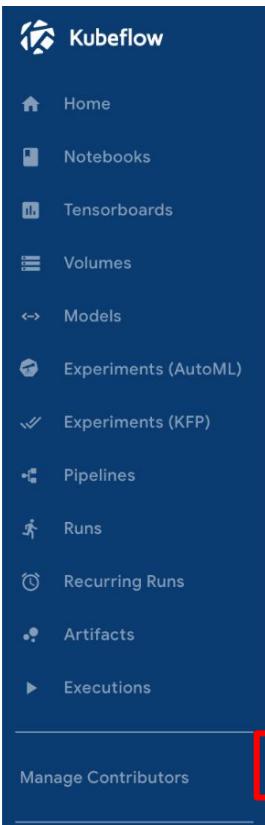
Filter pipelines

	Pipeline name	Description	Upload date
<input type="checkbox"/>	[Tutorial] V2 lightweight Python com...	source code Shows different component input and output options for KFP v2 components.	11/30/2021, 1:02:25 PM
<input type="checkbox"/>	[Tutorial] DSL - Control structures	source code Shows how to use conditional execution and exit handlers. This pipeline will randomly fail to demonstr...	11/30/2021, 1:02:24 PM
<input type="checkbox"/>	[Tutorial] Data passing in python co...	source code Shows how to pass data between python components.	11/30/2021, 1:02:23 PM
<input type="checkbox"/>	[Demo] TFX - Taxi tip prediction mod...	source code GCP Permission requirements. Example pipeline that does classification with model analysis based on...	11/30/2021, 1:02:22 PM
<input type="checkbox"/>	[Demo] XGBoost - Iterative model tra...	source code This sample demonstrates iterative training using a train-eval-check recursive loop. The main pipeline ...	11/30/2021, 1:02:21 PM

Rows per page: 10 ▾ < >

Manage Contributors

A large red arrow points upwards from the bottom of the page towards the '+ Upload pipeline' button.



← Upload Pipeline or Pipeline Version

Create a new pipeline Create a new pipeline version under an existing pipeline

Upload pipeline with the specified package.

Pipeline Name* 1.Pipeline Name

Pipeline Description*

Choose a pipeline package file from your computer, and give the pipeline a unique name.
You can also drag and drop the file here.

For expected file format, refer to [Compile Pipeline Documentation](#).

Upload a file Choose file 2.specify zip file location

Import by url

Code Source (optional)

Create **Cancel** 3.Create

Kubeflow

- Home
- Notebooks
- Tensorboards
- Volumes
- Models
- Experiments (AutoML)
- Experiments (KFP)
- Pipelines
- Runs
- Recurring Runs
- Artifacts
- Executions

Manage Contributors

kubeflow-user-example-c... ▾

Pipelines

← 0.helloworld (0.helloworld)

+ Create run + Upload version + Create experiment Delete

Graph **YAML**

Simplify Graph

echo1

echo2

```
graph TD; echo1[echo1] --> echo2[echo2]
```

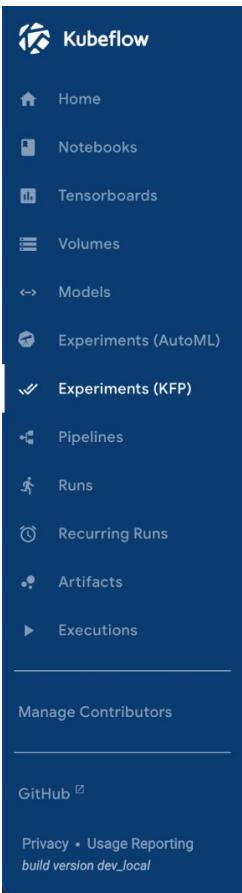
Create an experiment

Summary Hide

ID
6f25028f-01e3-4acd-9389-7ec2031fb04b

Version
0.helloworld ▾

Version source



The image shows the Kubeflow interface with a dark blue sidebar on the left containing various navigation items:

- Home
- Notebooks
- Tensorboards
- Volumes
- Models
- Experiments (AutoML)
- Experiments (KFP) (selected)
- Pipelines
- Runs
- Recurring Runs
- Artifacts
- Executions

Below the sidebar, there are sections for "Manage Contributors" and a GitHub integration.

At the bottom, there is a footer with links for "Privacy • Usage Reporting" and "build version dev_local".

kubeflow-user-example-c... ▾



Experiments

← New experiment

Experiment details

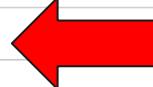
Think of an Experiment as a space that contains the history of all pipelines and their associated runs

0.helloworld.exp

Description (optional)

Next

Cancel



Enter experiment name and press Next button.

Run details

Pipeline*
0.helloworld

Pipeline Version*
0.helloworld

Run name*
Run of 0.helloworld (1e261)

Description (optional)

This run will be associated with the following experiment

Experiment*
0.helloworld.exp

This run will use the following Kubernetes service account.

Service Account (Optional)

Run Type

One-off Recurring

Run parameters

Specify parameters required by the pipeline

text1
message 1

text2
message 2

1. Run a pipeline and specify its version

2. Add its experiment name

Kubeflow

kubeflow-user-example-c... ▾

Experiments

← 0.helloworld.exp

Recurring run configs 0 active

Experiment description

Manage

Refresh Archive

Runs

+ Create run + Create recurring run

Compare runs Clone run Archive

Active Archived

Filter runs

Run name	Status	Duration	Pipeline Version	Recurring Run	Start time
Run of 0.helloworld (1e261)	?	-	0.helloworld	-	12/2/2021, 4:33:10 PM

Rows per page: 10 < >

Run List



The screenshot shows the Kubeflow UI for managing experiments. On the left sidebar, the 'Runs' option is selected and highlighted with a red box. The main content area displays the '0.helloworld.exp' experiment. It includes sections for 'Recurring run configs' (0 active), 'Experiment description', and buttons for '+ Create run' and '+ Create recurring run'. Below this is a 'Runs' section with tabs for 'Active' and 'Archived'. A red box highlights the 'Run of 0.helloworld (1e261)' row in the table, which has columns for 'Run name', 'Status', 'Duration', 'Pipeline Version', 'Recurring Run', and 'Start time'. A large red arrow points upwards from the 'Run List' text at the bottom to this highlighted row.

Kubeflow

kubeflow-user-example-c... ▾

Experiments > 0.helloworld.exp

Run of 0.helloworld (1e261)

Graph Run output Config

Simplify Graph

echo1

echo2

Input/Output Visualizations Details Volumes Logs Pod Events ML Metadata

execution-order-pipeline-fxxfn-4223123588

Input parameters

text1 message 1

Input artifacts

Output parameters

Output artifacts

main-logs minio://mipipeline/artifacts/execution-order-pipeline-qvlt5/2021/11/30/execution-order-pipeline-qvlt5-137025724/main.log View All

message 1

運行結果輸出



Hyperparameter Example

The screenshot shows a Jupyter Notebook interface. On the left is a file browser sidebar with a list of files and folders. A red box highlights the top navigation bar, which includes File, Edit, View, Run, Kernel, Git, Tabs, Settings, and Help. The main area contains a code editor window titled "5.auto-mnist-with-katib.ipynb". The code in the editor is as follows:

```
[1]: with open("requirements.txt", "w") as f:  
    f.write("kfp==1.8.9\n")  
    f.write("kubeflow-katib==0.12.0\n")  
  
!pip install -r requirements.txt --upgrade --user
```

Below the code, the terminal output shows the pip installation process:

```
Requirement already satisfied: kfp==1.8.9 in /home/jovyan/.local/lib/python3.8/site-packages (from -r requirements.txt (line 1)) (1.8.9)  
Collecting kubeflow-katib==0.12.0  
  Downloading kubeflow_katib-0.12.0-py3-none-any.whl (89 kB)  
   ██████████ | 89 kB 5.1 MB/s eta 0:00:011  
Requirement already satisfied: typing-extensions<4,>=3.7.4 in /opt/conda/lib/python3.8/site-packages (from kfp==1.8.9->-r requirements.txt (line 1)) (3.7.4.3)  
Requirement already satisfied: tabulate<1,>=0.8.6 in /opt/conda/lib/python3.8/site-packages (from kfp==1.8.9->-r requirements.txt (line 1)) (0.8.9)  
Requirement already satisfied: protobuf<4,>=3.13.0 in /opt/conda/lib/python3.8/site-packages (from kfp==1.8.9->-r requirements.txt (line 1)) (3.17.3)  
Requirement already satisfied: requests-toolbelt<1,>=0.8.0 in /opt/conda/lib/python3.8/site-packages (from kfp==1.8.9->-r requirements.txt (line 1)) (0.9.1)  
Requirement already satisfied: PyYAML<6,>=5.3 in /opt/conda/lib/python3.8/site-packages (from kfp==1.8.9->-r requirements.txt (line 1)) (5.4.1)  
Requirement already satisfied: strip-hints<1,>=0.1.8 in /opt/conda/lib/python3.8/site-packages (from kfp==1.8.9->-r requirements.txt (line 1)) (0.1.10)  
Requirement already satisfied: docstring-parser<1,>=0.7.3 in /opt/conda/lib/python3.8/site-packages (from kfp==1.8.9->-r requirements.txt (line 1)) (0.11)  
Requirement already satisfied: cloudpickle<3,>=2.0.0 in /home/jovyan/.local/lib/python3.8/site-packages (from kfp==1.8.9->-r requirements.txt (line 1)) (2.0.0)  
Requirement already satisfied: jsonschema<4,>=3.0.1 in /opt/conda/lib/python3.8/site-packages (from kfp==1.8.9->-r requirements.txt (line 1)) (3.2.0)  
Requirement already satisfied: absl-py<=0.11,>=0.9 in /opt/conda/lib/python3.8/site-packages (from kfp==1.8.9->-r requirements.txt (line 1)) (0.11.0)  
Requirement already satisfied: google-auth<2,>=1.6.1 in /opt/conda/lib/python3.8/site-packages (from kfp==1.8.9->-r requirements.txt (line 1)) (1.31.0)
```



- [Home](#)
- [Notebooks](#)
- [Tensorboards](#)
- [Volumes](#)
- [Models](#)
- [Experiments \(AutoML\)](#)
- [Experiments \(KFP\)](#)
- [Pipelines](#)
- [Runs](#)
- [Recurring Runs](#)
- [Artifacts](#)

kubeflow-user-example-c... ▾



Experiments

Refresh Archive

← hello1

Recurring run
configs
0 active

Experiment description



Manage

Runs

+ Create run

+ Create recurring run

Compare runs

Clone run

Archive

Active

Archived

Filter runs



<input type="checkbox"/>	Run name	Status	Duration	Pipeline Version	Recurri...	Start time	quotient	remainder
<input type="checkbox"/>	Run of hello-world_version_1	?	-	hello-world_version_1	-	5/17/2022, 9:42:...		
<input type="checkbox"/>	Run of hello-world_version_1	✓	0:06:19	hello-world_version_1	-	5/17/2022, 9:30:...		
<input type="checkbox"/>	Run of hello-world_version_1	✓	0:01:24	hello-world_version_1	-	5/17/2022, 9:23:...	0.000	6.000

The screenshot shows the Kubeflow web interface. On the left, a sidebar menu is visible with the following items:

- Home
- Notebooks
- Tensorboards
- Volumes
- Models
 - Experiments (AutoML) (selected)
 - Experiments (KFP)
- Pipelines
- Runs
- Recurring Runs
- Artifacts

The main content area is titled "Experiments". It displays a table with the following columns: Status, Name, Age, Successful trials, Running trials, Failed trials, and Optimal trial. A single experiment row is shown, highlighted with a red border:

Status	Name	Age	Successful trials	Running trials	Failed trials	Optimal trial
✓	median-stop	8 minutes ago	4	0	0	Validation accuracy: 0.92028

A blue "+ NEW EXPERIMENT" button is located in the top right corner of the experiments table.

Kubeflow

- Home
- Notebooks
- Tensorboards
- Volumes
- Models
- Experiments (AutoML)
 - Experiments (KFP)
 - Pipelines
- Runs
- Recurring Runs
- Artifacts
- Executions

Manage Contributors

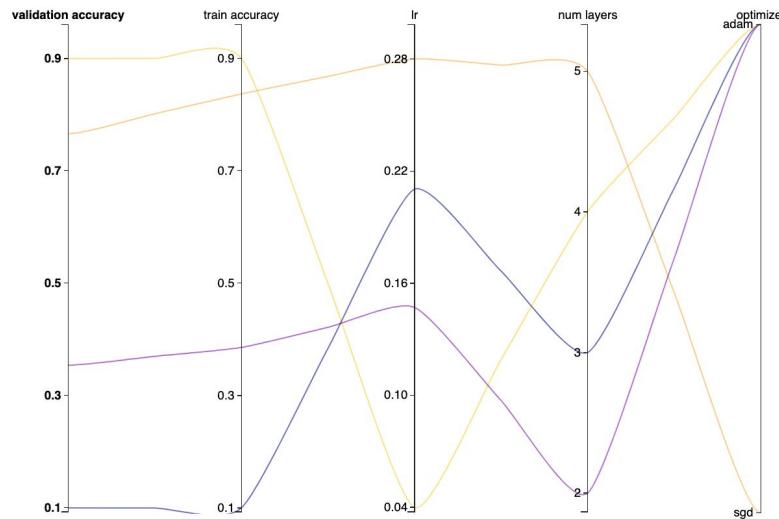
GitHub

Documentation

Privacy • Usage Reporting
build version dev_local

kubeflow-user-example-c...

Experiment details



OVERVIEW

TRIALS

DETAILS

YAML

Name

median-stop

Status

Experiment has succeeded because max trial count has reached

Best trial

median-stop-xg5tmhcx

Best trial's params

lr: 3.66734e-2 num-layers: 4 optimizer: adam

Best trial performance

Validation-accuracy: 0.92028 Train-accuracy: 0.91851

User defined goal

Validation-accuracy > 0.99

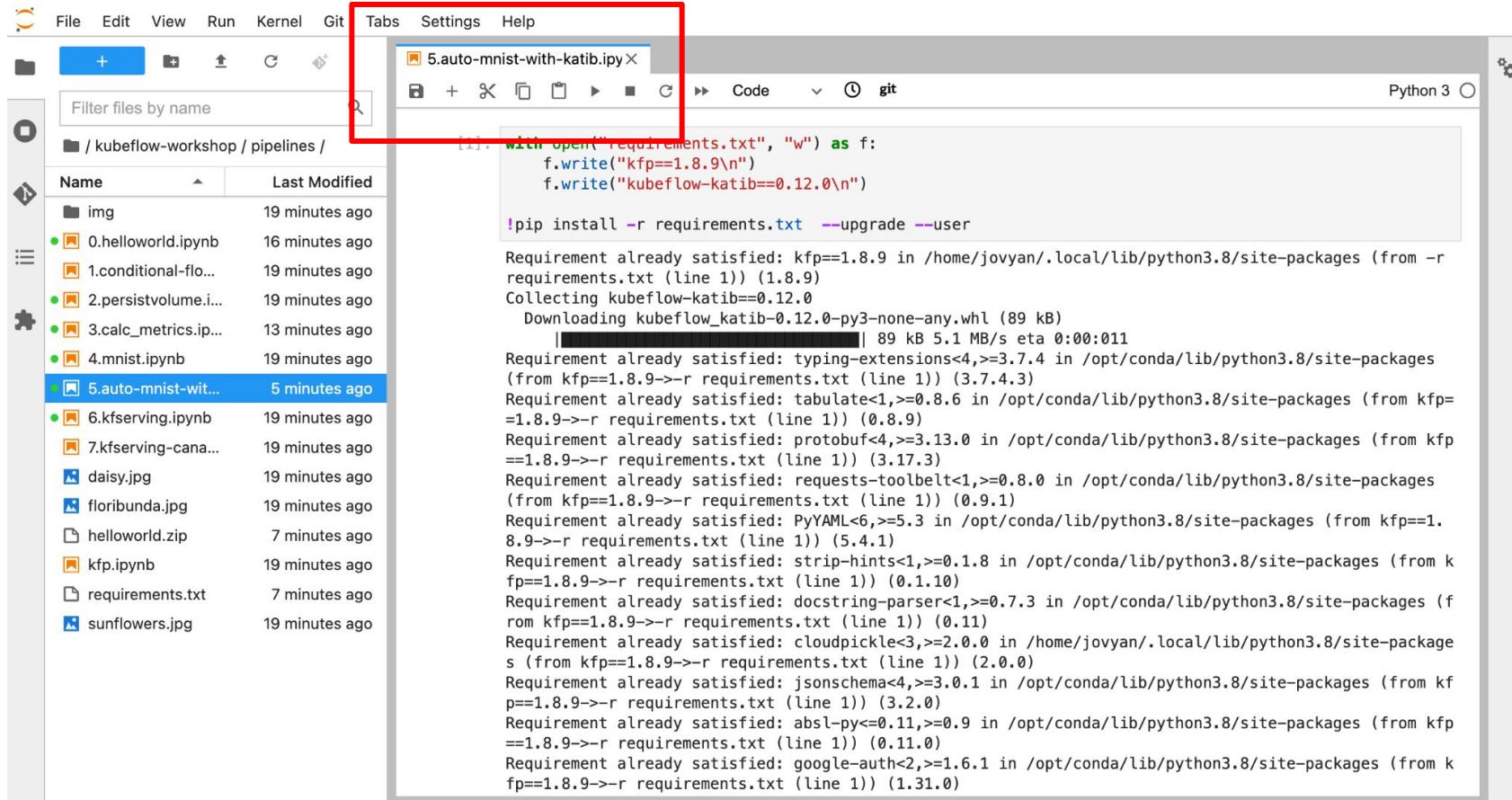
Running trials

0

4)



Kserve Example



The screenshot shows a Jupyter Notebook interface. On the left is a file browser sidebar with a red border around the top header area. The main workspace contains a code editor tab for "5.auto-mnist-with-katib.ipynb". The code in the editor is:

```
[1]: with open("requirements.txt", "w") as f:  
    f.write("kfp==1.8.9\n")  
    f.write("kubeflow-katib==0.12.0\n")  
  
!pip install -r requirements.txt --upgrade --user
```

Below the code, the terminal output shows the pip installation process:

```
Requirement already satisfied: kfp==1.8.9 in /home/jovyan/.local/lib/python3.8/site-packages (from -r requirements.txt (line 1)) (1.8.9)  
Collecting kubeflow-katib==0.12.0  
  Downloading kubeflow_katib-0.12.0-py3-none-any.whl (89 kB)  
   ██████████ | 89 kB 5.1 MB/s eta 0:00:011  
Requirement already satisfied: typing-extensions<4,>=3.7.4 in /opt/conda/lib/python3.8/site-packages (from kfp==1.8.9->-r requirements.txt (line 1)) (3.7.4.3)  
Requirement already satisfied: tabulate<1,>=0.8.6 in /opt/conda/lib/python3.8/site-packages (from kfp==1.8.9->-r requirements.txt (line 1)) (0.8.9)  
Requirement already satisfied: protobuf<4,>=3.13.0 in /opt/conda/lib/python3.8/site-packages (from kfp==1.8.9->-r requirements.txt (line 1)) (3.17.3)  
Requirement already satisfied: requests-toolbelt<1,>=0.8.0 in /opt/conda/lib/python3.8/site-packages (from kfp==1.8.9->-r requirements.txt (line 1)) (0.9.1)  
Requirement already satisfied: PyYAML<6,>=5.3 in /opt/conda/lib/python3.8/site-packages (from kfp==1.8.9->-r requirements.txt (line 1)) (5.4.1)  
Requirement already satisfied: strip-hints<1,>=0.1.8 in /opt/conda/lib/python3.8/site-packages (from kfp==1.8.9->-r requirements.txt (line 1)) (0.1.10)  
Requirement already satisfied: docstring-parser<1,>=0.7.3 in /opt/conda/lib/python3.8/site-packages (from kfp==1.8.9->-r requirements.txt (line 1)) (0.11)  
Requirement already satisfied: cloudpickle<3,>=2.0.0 in /home/jovyan/.local/lib/python3.8/site-packages (from kfp==1.8.9->-r requirements.txt (line 1)) (2.0.0)  
Requirement already satisfied: jsonschema<4,>=3.0.1 in /opt/conda/lib/python3.8/site-packages (from kfp==1.8.9->-r requirements.txt (line 1)) (3.2.0)  
Requirement already satisfied: absl-py<=0.11,>=0.9 in /opt/conda/lib/python3.8/site-packages (from kfp==1.8.9->-r requirements.txt (line 1)) (0.11.0)  
Requirement already satisfied: google-auth<2,>=1.6.1 in /opt/conda/lib/python3.8/site-packages (from kfp==1.8.9->-r requirements.txt (line 1)) (1.31.0)
```



- Home
- Notebooks
- Tensorboards
- Volumes
- Models
- Experiments (AutoML)
- Experiments (KFP)
- Pipelines
- Runs
- Recurring Runs
- Artifacts

kubeflow-user-example-c... ▾



Experiments

Refresh Archive

← hello1

Recurring run
configs
0 active

Experiment description



Manage

Runs

+ Create run

+ Create recurring run

Compare runs

Clone run

Archive

Active

Archived

Filter runs



<input type="checkbox"/>	Run name	Status	Duration	Pipeline Version	Recurri...	Start time	quotient	remainder
<input type="checkbox"/>	Run of hello-world_versio...	?	-	hello-world_vers...	-	5/17/2022, 9:42:...		
<input type="checkbox"/>	Run of hello-world_versio...	✓	0:06:19	hello-world_vers...	-	5/17/2022, 9:30:...		
<input type="checkbox"/>	Run of hello-world_versio...	✓	0:01:24	hello-world_vers...	-	5/17/2022, 9:23:...	0.000	6.000

Kubeflow

kubeflow-user-example-c... ▾

Home

Notebooks

Tensorboards

Volumes

Models

Experiments (AutoML)

Experiments (KFP)

Pipelines

Runs

Recurring Runs

Artifacts

Model Servers

+ NEW MODEL SERVER

Status	Name	Age	Predictor	Runtime	Protocol	Storage URI	Actions
✓	tensorflow-sample	2 minutes ago	Tensorflow	1.14.0		gs://kfserving-samples/models/tensorflow/flo...	

File Edit View Run Kernel Git Tabs Settings Help

+ ☁ ↕ ⌂ ⌂

Filter files by name

/ kubeflow-workshop / pipelines /

Name	Last Modified
img	29 minutes ago
0.helloworld.ipynb	27 minutes ago
1.conditional-flo...	29 minutes ago
2.persistvolume.i...	29 minutes ago
3.calc_metrics.ip...	24 minutes ago
4.mnist.ipynb	29 minutes ago
5.auto-mnist-wit...	16 minutes ago
6.kfserving.ipynb	seconds ago
7.kfserving-cana...	29 minutes ago
daisy.jpg	29 minutes ago
floribunda.jpg	29 minutes ago
helloworld.zip	17 minutes ago
kfp.ipynb	29 minutes ago
requirements.txt	6 minutes ago
sunflowers.jpg	29 minutes ago
tf-flower.zip	6 minutes ago

6.kfserving.ipynb

Code git

Cookies

Python 3

authservice_session

Name	Value	Domain	Expires / M...	Size	HttpOnly	Secure	SameSite	SameParty	Priority	Medium
authservice_session	MTY1Mjc5MzE5M3x0d3dBTkZkUk4xZER0MGRZVmpZMldsTkpWVFUzU2s5V1dF...	localhost	/	2021-10-06..	59					

[4]: ## the following example use python's request to send restapi requests

```
import base64
import json
import requests

with open('floribunda.jpg', 'rb') as f:
    image_content = f.read()
    image_64_encode = base64.encodebytes(image_content).decode('utf-8')
headers = {"Cookie": "authservice_session=MTY1Mjc5MzE5M3x0d3dBTkZkUk4xZER0MGRZVmpZMldsTkpWVFUzU2s5V1dF...",
           "Host": "tensorflow-sample.kubeflow-user-example-com.example.com"}
payload = {"instances": [{"image_bytes": {"b64": image_64_encode}, "key": "1"}]}
resp = requests.post('http://istio-ingressgateway.istio-system/tensorflow-sample:predict', headers=headers)
print(resp.text)
```

{

 "predictions": [

 {

 "scores": [1.30671893e-07, 3.01086693e-08, 0.814807534, 9.6436537e-08, 0.185192183, 3.43902293e-08],

 "prediction": 2,

 "key": "1"

 }

]

}

[1]: ## the following example use curl to send restapi requests

Quote: The best teachers are those who show you where to look, but don't tell you what to see.

**"The best teachers are
those who show you
where to look, but don't
tell you what to see"**

- Alexandra K. Trenfor

We are hiring **INTERNS**

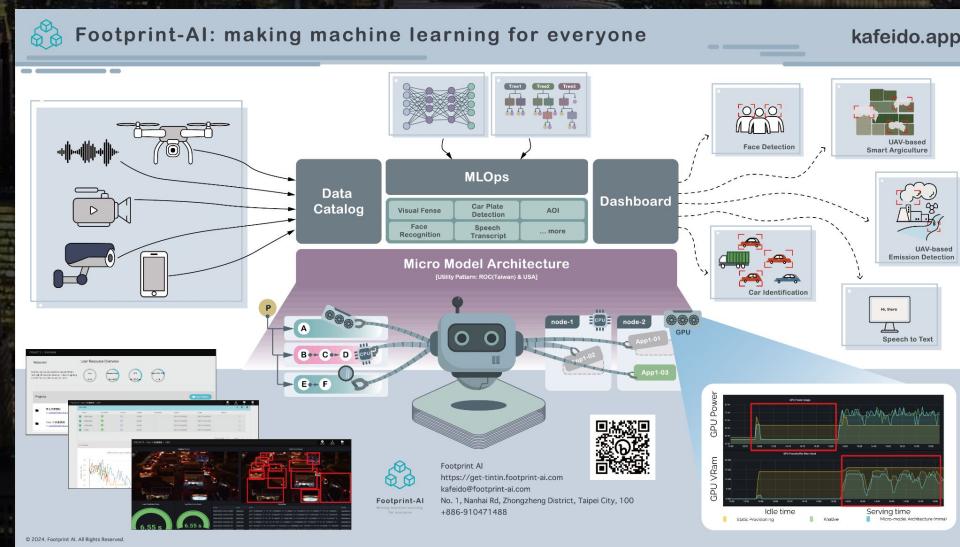
- We use cloud-native and green technology to reduce computational cost as well as de-carbonization.
- Also lower the barrier for you to get into machine learning ecosystem.
- Feel free to reach out if you have idea



<https://www.bing.com/images/create/create-22we-want-you22-pictures-by-minic-the-old-sty/654ff19a8c984d51926a6f11a50cdcb?i=vYRditgOsNkH6GtTwudwFg%3d%3d&view=detailv2&idpp=genimg&FORM=GCRIDP&mode=overlay>

Thank You

and follow us on Facebook



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