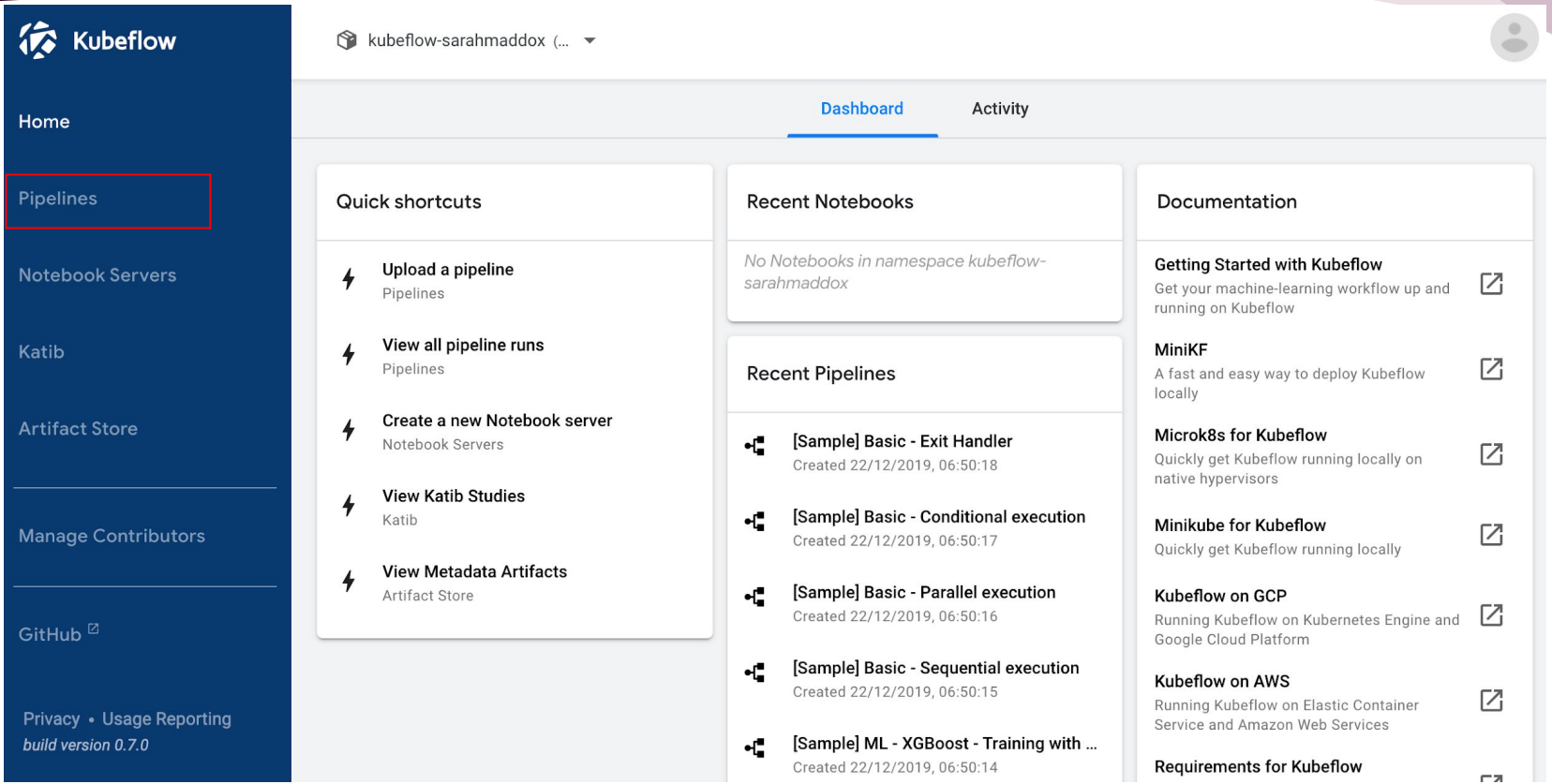
Kubeflow Pipelines

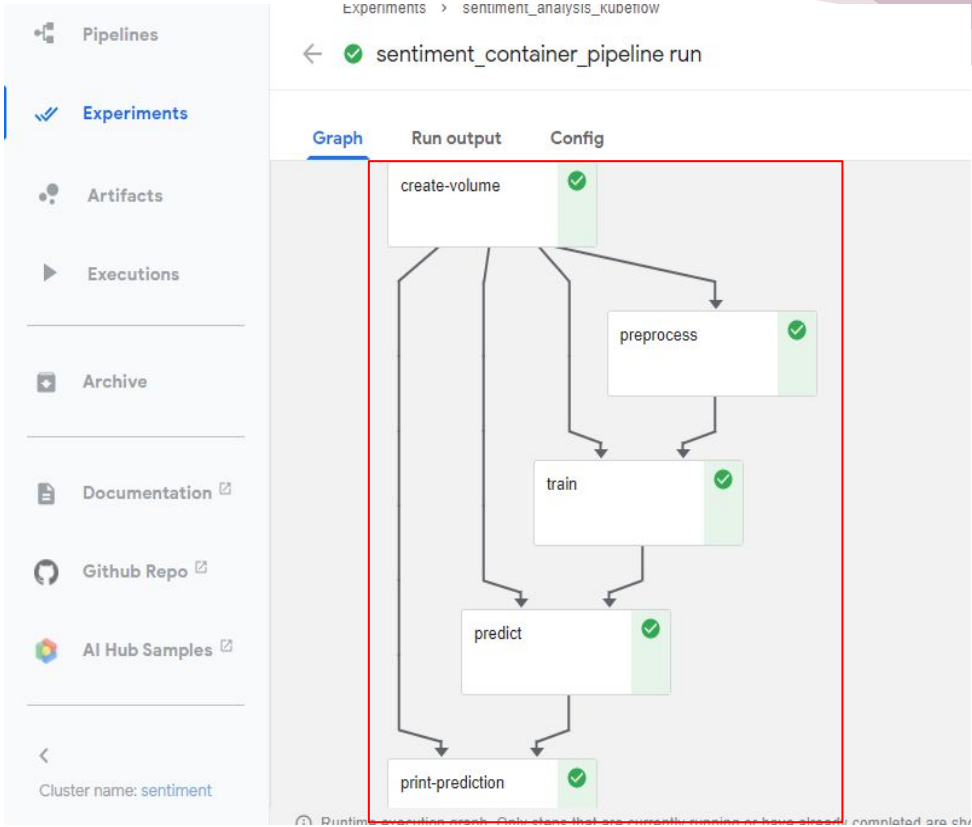
Kubeflow Pipeline



Kubeflow Pipelines

The Kubeflow Pipeline platform consists of:

- A user interface (UI) for managing and tracking experiments, jobs, and runs.
- An engine for scheduling multi-step ML workflows.
- A python DSL for defining and manipulating pipelines and components.
- Notebooks for interacting with the system using the python DSL

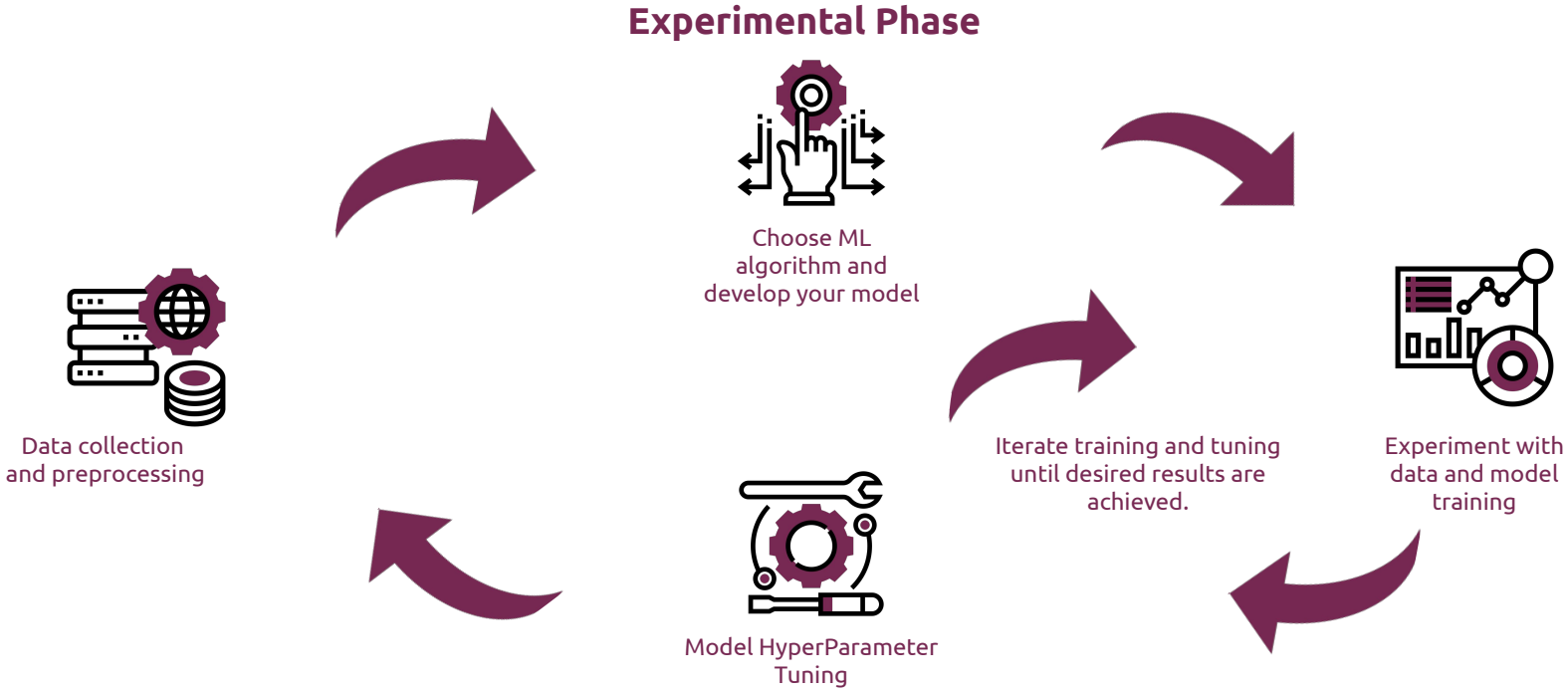


ML Workflow

- An ML workflow defines phases and stages implemented during an ML project.
- It varies with the project, but there are some core stages that must be implemented.
- The stages of an ML workflow helps in defining the components of a pipeline.

Core stages of ML workflow: Experimental Phase

This phase is the development of the workflow on a local jupyter notebook. These stages serve as components in a pipeline.



Kubeflow Components in the Ml workflow

Experimental Phase

Kubeflow

Identify problem and collect data for Analysis

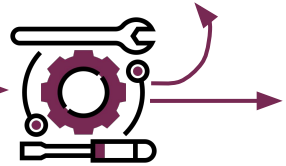
Choose ML algorithm and develop your model

- Pytorch
- Scikit-Learn
- Tensorflow
- XGBoost

Experiment with data and model training

- Jupyter Notebook
- Fairing
- Pipelines

Iterate Tuning/Training

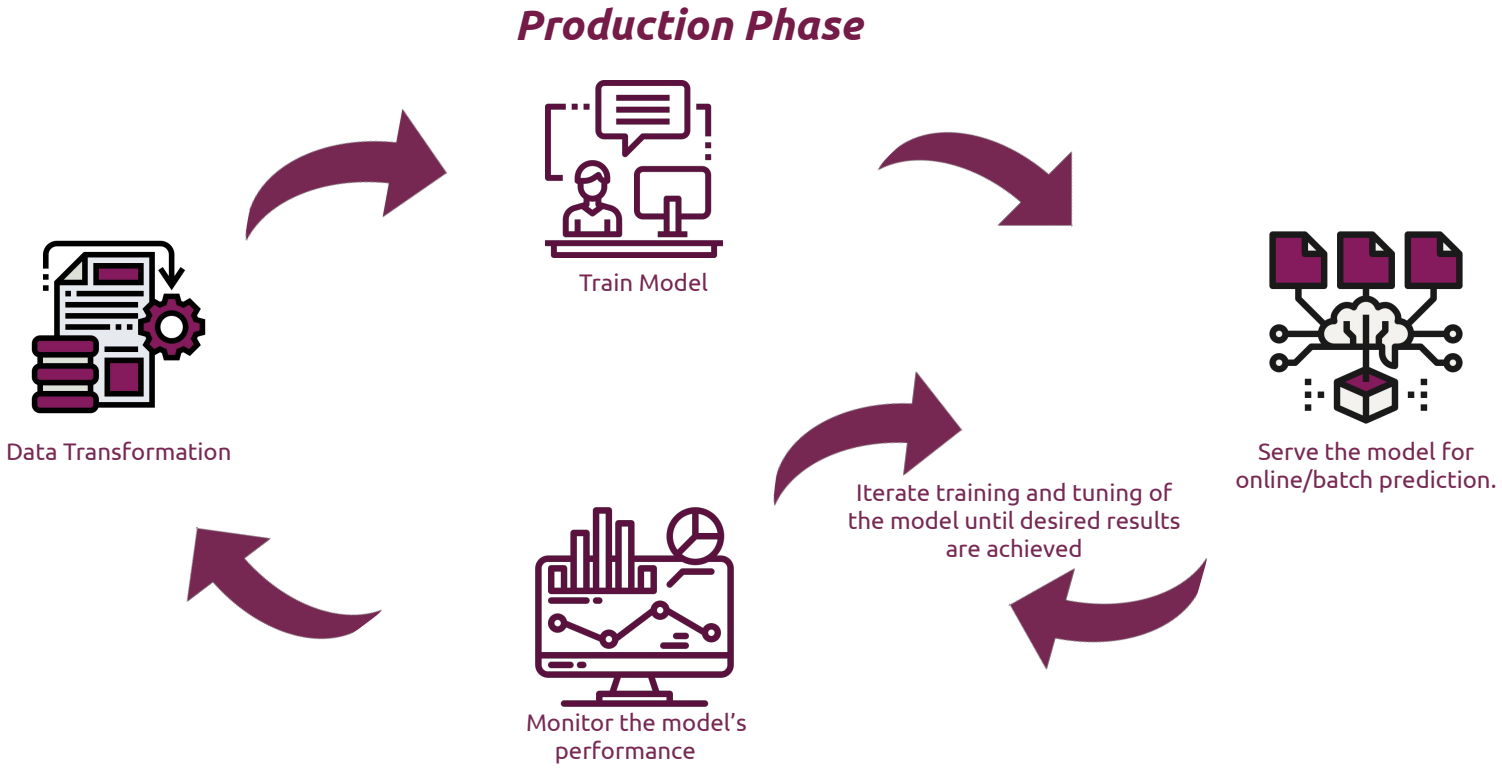


Model hyperparameter Tuning

- Katib

Core stages of ML workflow: Production Phase

This production phase involves using kubeflow to build scalable and reusable models for deployment.



Kubeflow Components in the ML workflow

Production Phase

Kubeflow

Transform Data

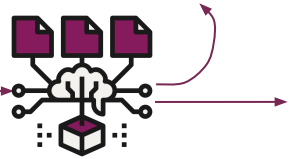
Train Model

- Chainer
- MPI
- MXNet
- PyTorch
- TFJob

Serve the model for online/batch prediction

- KFServing
- NVIDIA TensorRT
- PyTorch
- TfServing
- Seldon

Iterate Tuning/Training



Monitor the model's performance

- Metadata
- TensorBoard

Kubeflow Pipelines

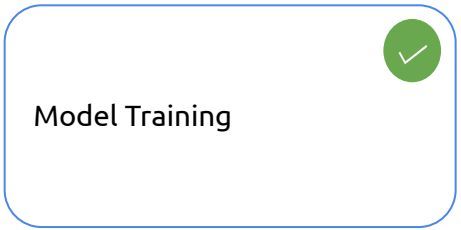
Kubeflow Pipeline Components

- Self-contained set of codes that perform one of the stages in the ML workflow

- Each component takes in one or more inputs and produces a specified output(s).

- The code for each component must include:
  - **Client code**: This code talks to the endpoints to submit jobs. For example, a code that retrieves the data to be worked with.

  - **Runtime code**: This code does the actual job and usually runs in the cluster. For example, a code that trains the model on the pre-processed data.



Kubeflow Pipeline Component type (Light Weight)

There are two ways to develop Kubeflow Pipeline components:

- **Lightweight Component**:
  - For rapid development
  - Fast and easy
  - Downside : it is not reusable

- Uses a stand-alone python function and called with **kfp.components.func_to_container_op(func)** to convert it to a kubeflow component in your pipeline.

```python
def predict(data_path):

    import pickle
    import sys, subprocess;
    subprocess.run([sys.executable, '-m', 'pip', 'install', 'keras==1.2.2'])
    import numpy as np
    import tensorflow
    import keras

    # Load the saved Keras model
    classifier = tensorflow.keras.models.load_model(f'{data_path}/sentiment_model.h5')
    # Load and unpack the test_data
    with open(f'{data_path}/test_data','rb') as f:
        test_data = pickle.load(f)
    # Separate the X_test from y_test.
    X_test,  y_test = test_data
    # make predictions.
    y_pred = classifier.predict(X_test)
    # create a threshold
    y_pred=(y_pred>0.5)

    with open(f'{data_path}/result.txt', 'w') as result:
        result.write(" Prediction: {}, Actual: {} ".format(y_pred,y_test.astype("int64")))
    print('Prediction has be saved successfully!')
```

```python
#creating lightweight predict component
predict_op = comp.func_to_container_op(predict , base_image = "tensorflow/tensorflow:latest-gpu-py3")
```

Kubeflow Pipeline Component Type (Reusable)

- **Reusable Component**:
  - Requires more time to implement because container images are built
  - Reusable

```python
import argparse
import numpy as np
import joblib
import tensorflow as tf
import keras

def predict(X_test,y_test,model):
    #loading test data
    X_test = np.load(X_test)
    y_test = np.load(y_test)
     # Load the saved Keras model
    classifier = tensorflow.keras.models.load_model(model)
    # make predictions.
    y_pred = classifier.predict(X_test)
    # create a threshold
    y_pred=(y_pred>0.5)
    with open('results.txt', 'w') as result:
        result.write(" Prediction: {}, Actual: {} ".format(y_pred,y_test.astype("int64")))

if __name__ == '__main__':
    print('Predicting data ...')
    parser = argparse.ArgumentParser()
    parser.add_argument('--X_test')
    parser.add_argument('--y_test')
    parser.add_argument('--sentiment_model')
    args = parser.parse_args()
    predict(args.X_test, args.y_test, args.sentiment_model)
```

Kubeflow Pipeline Component Type (Reusable)

DockerFile: create a dockerfile to build your image for the python script in the previous slide. This image is pushed to Docker Hub to ensure it is accessible by the kubernetes cluster.

```
#DockerFile
FROM python:3.8.4
WORKDIR /data_predict
RUN pip install -U tensorflow numpy pandas
COPY predict.py /data_predict
ENTRYPOINT ["python", "predict.py"]
```

Components: The component is defined as a function that returns an object of type ContainerOp. The ContainerOp represents a pipeline task implemented by a container image.

```
#predict component definition
def predict_op(X_test, y_test, model):
    return dsl.ContainerOp(
        name='Predict Model',
        image='jadesola/predict-component:v.0.1',
        arguments = [
            '--X_test', x_test,
            'y_test',y_test,
            '--model',model
        ],
        file_outputs={
            'results':'/data_predict/results.txt'
        }
    )
```

Collaborative ML Pipeline Development