

DevOps

Day 3: Kubernetes

Create a directory 'e-commerce' and its required folders and files

Create products.csv file and app.py

```
aravind@Aravind: ~/ecomme
aravind@Aravind:~$ mkdir ecommerce
aravind@Aravind:~$ cd ecommerce
aravind@Aravind:~/ecommerce$ mkdir frontend backend
aravind@Aravind:~/ecommerce$ ls
backend frontend
aravind@Aravind:~/ecommerce$ cd backend
aravind@Aravind:~/ecommerce/backend$ nano products.csv
aravind@Aravind:~/ecommerce/backend$ cat products.csv
id, name, price, qty
1, pen, 20, 100
2, book, 400, 56
3, laptop, 50000, 5,
4, shirt, 500, 50,
5, pants, 750, 56
aravind@Aravind:~/ecommerce/backend$ nano app.py
```

```
aravind@Aravind:~/ecommerce/backend$ nano app.py
aravind@Aravind:~/ecommerce/backend$ cat app.py
import pandas as pd
from flask import Flask
app = Flask(__name__)

@app.route("/products", method=['GET'])
def read_data():
    df = pd.read_csv("./products.csv")
    print(df.head())
    json_data = df.to_json()
    print(json_data)
    return json_data
if __name__ == "__main__":
    app.run(host="0.0.0.0", port=7000)
```

To Install Python

```
aravind@Aravind:~/ecommerce$ sudo apt install python3-pip
Reading package lists... Done
Building dependency tree... Done
Reading state information... Done
The following additional packages will be installed:
  build-essential bzip2 cpp cpp-13 cpp-13-x86-64-linux-gnu cpp-x86-64-linux-gnu dpkg-dev fakeroot g++ g++-13 g++-13-x86-64-linux-gnu g++-x86-64-linux-gnu
  gcc gcc-13 gcc-13-base gcc-13-x86-64-linux-gnu gcc-x86-64-linux-gnu javascript-common libalgorithm-diff-perl libalgorithm-diff-xs-perl libalgorithm-diff-xx-perl
  libalgorithm-merge-perl libasan8 libatomic1 libcc1-0 libc-dev-bin libc-devtools libde265-0 libdpkg-perl libexpat1-dev libfakeroot libfile-fcntllock-perl
  libgcc-13-dev libgd3 libgomp1 libheif-plugin-aomdec libheif-plugin-aomenc libheif-plugin-libde265 libheif1 libhwasan0 libisl23 libitlb libjs-jquery libjs-sphinxdoc
  libjs-underscore liblsan0 libmpc3 libpython3-dev libpython3.12-dev libquadmath0 libstdc++-13-dev libtsan2 libubsan1 linux-libc-dev lto-disabled-list make
  manpages-dev python3-dev python3-wheel python3.12-dev rpcsvc-proto zlib1g-dev
Suggested packages:
  bzip2-doc cpp-doc gcc-13-locales cpp-13-doc debian-keyring g++-multilib g++-13-multilib gcc-13-doc gcc-multilib autoconf automake libtool flex bison gdb
  gcc-doc gcc-13-multilib gdb-x86-64-linux-gnu glibc-doc bzr libgd-tools libheif-plugin-x265 libheif-plugin-ffmpegdec libheif-plugin-jpegdec libheif-plugin-jpegenc
  libheif-plugin-j2kdec libheif-plugin-j2kenc libheif-plugin-av1 libheif-plugin-svtenc libstdc++-13-doc make-doc
The following NEW packages will be installed:
  build-essential bzip2 cpp cpp-13 cpp-13-x86-64-linux-gnu cpp-x86-64-linux-gnu dpkg-dev fakeroot g++ g++-13 g++-13-x86-64-linux-gnu g++-x86-64-linux-gnu
  gcc gcc-13 gcc-13-base gcc-13-x86-64-linux-gnu gcc-x86-64-linux-gnu javascript-common libalgorithm-diff-perl libalgorithm-diff-xs-perl libalgorithm-diff-xx-perl
  libalgorithm-merge-perl libasan8 libatomic1 libcc1-0 libc-dev-bin libc-devtools libde265-0 libdpkg-perl libexpat1-dev libfakeroot libfile-fcntllock-perl
  libgcc-13-dev libgd3 libgomp1 libheif-plugin-aomdec libheif-plugin-aomenc libheif-plugin-libde265 libheif1 libhwasan0 libisl23 libitlb libjs-jquery libjs-sphinxdoc
  libjs-underscore liblsan0 libmpc3 libpython3-dev libpython3.12-dev libquadmath0 libstdc++-13-dev libtsan2 libubsan1 linux-libc-dev lto-disabled-list make
  manpages-dev python3-dev python3-wheel python3.12-dev rpcsvc-proto zlib1g-dev
0 upgraded, 65 newly installed, 0 to remove and 28 not upgraded.
Need to get 81.3 MB of archives.
After this operation, 284 MB of additional disk space will be used.
Do you want to continue? [Y/n] y
Ign:1 http://archive.ubuntu.com/ubuntu noble-updates/main amd64 libc-dev-bin amd64 2.39-0ubuntu8.4
Ign:2 http://archive.ubuntu.com/ubuntu noble-updates/main amd64 linux-libc-dev amd64 6.8.0-55.57
Ign:3 http://archive.ubuntu.com/ubuntu noble/main amd64 libcrypt-dev amd64 1:4.4-36.4build1
Get:4 http://archive.ubuntu.com/ubuntu noble/main amd64 rpcsvc-proto amd64 1.4.2-0ubuntu7 [67.4 kB]
Get:5 http://archive.ubuntu.com/ubuntu noble-updates/main amd64 libde265-0 amd64 2.39-0ubuntu8.4 [2124 kB]
Get:6 http://archive.ubuntu.com/ubuntu noble-updates/main amd64 gcc-13-base amd64 13.3.0-6ubuntu2-24.04 [51.5 kB]
Get:7 http://archive.ubuntu.com/ubuntu noble-updates/main amd64 libisl23 amd64 0.26-3build1.1 [680 kB]
Get:8 http://archive.ubuntu.com/ubuntu noble-updates/main amd64 libmpc3 amd64 1.3.1-1build1.1 [54.6 kB]
Get:9 http://archive.ubuntu.com/ubuntu noble-updates/main amd64 cpp-13-x86-64-linux-gnu amd64 13.3.0-6ubuntu2-24.04 [10.7 MB]
Get:10 http://archive.ubuntu.com/ubuntu noble-updates/main amd64 cpp-13 amd64 13.3.0-6ubuntu2-24.04 [1038 B]
Get:11 http://archive.ubuntu.com/ubuntu noble-updates/main amd64 cpp-x86-64-linux-gnu amd64 4:13.2.0-7ubuntu1 [5326 B]
Get:12 http://archive.ubuntu.com/ubuntu noble/main amd64 cpp amd64 4:13.2.0-7ubuntu1 [22.4 kB]
Get:13 http://archive.ubuntu.com/ubuntu noble-updates/main amd64 libcc1-0 amd64 14.2.0-4ubuntu2-24.04 [48.0 kB]
Get:14 http://archive.ubuntu.com/ubuntu noble-updates/main amd64 libgomp1 amd64 14.2.0-4ubuntu2-24.04 [148 kB]
Get:15 http://archive.ubuntu.com/ubuntu noble-updates/main amd64 libitm1 amd64 14.2.0-4ubuntu2-24.04 [29.7 kB]
Get:16 http://archive.ubuntu.com/ubuntu noble-updates/main amd64 libatomic1 amd64 14.2.0-4ubuntu2-24.04 [18.5 kB]
Get:17 http://archive.ubuntu.com/ubuntu noble-updates/main amd64 libasan8 amd64 14.2.0-4ubuntu2-24.04 [3031 kB]
Get:18 http://archive.ubuntu.com/ubuntu noble-updates/main amd64 liblsan0 amd64 14.2.0-4ubuntu2-24.04 [1322 kB]
```

Install the pandas library:

```
aravind@Aravind:~/ecommerce/lib$ sudo apt install python3-pandas
Reading package lists... Done
Building dependency tree... Done
Reading state information... Done
The following additional packages will be installed:
  blt fonts-lyx isympy-common isympy3 libaec0 libblas3 libblosc1 libblosc2-2t64 libgfortran5 libhdf5-103-1t64 libimagequant0 libjs-jquery-ui liblapack3
  liblbfgsb0 libopenjp2-7 libqhull-r8.0 libraqm0 libsnappy1v5 libs22 libtcl8.6 libtk8.6 libwebpdemux2 libwebpmux3 libxss1 python-matplotlib-data
  python-odf-doc python-odf-tools python-tables-data python3-appdirs python3-bottleneck python3-brotli python3-bs4 python3-contourpy python3-cpuinfo
  python3-cssselect python3-cycler python3-dateutil python3-decorator python3-defusedxml python3-et-xmlfile python3-fonttools python3-fs python3-html5lib
  python3-kiwisolver python3-lxml python3-lz4 python3-matplotlib python3-mpmath python3-numexpr python3-numpy python3-odf python3-olefile python3-openpyxl
  python3-packaging python3-pandas-lib python3-pil python3-pil.imagetk python3-scipy python3-soupsieve python3-sympy python3-tables python3-tables-lib
  python3-tk python3-ufolib2 python3-unicodedata2 python3-webencodings tk8.6-blt2.5 unicode-data
Suggested packages:
  blt-demo libjs-jquery-ui-docs tcl8.6 tk8.6 python-bottleneck-doc python-cycler-doc python3-genshi python-lxml-doc cm-super-minimal dvipng ffmpeg
  fonts-staypuft ghostscript gdl2-gtk-3.0 inkscape ipython3 python3-cairocffi python3-gi-cairo python3-gobject python3-pyqt5 python3-sip python3-tornado
  texlive-extra-utils texlive-latex-extra python-mpmath-doc python3-gmpy2 gfortran python3-pytest python-openpyxl-doc python-pandas-doc
  python3-statsmodels python-pil-doc python-scipy-doc texlive-fonts-extra python-sympy-doc python3-netcdf4 python-tables-doc vitables tix python3-tk-dbg
Recommended packages:
  python3-numba
The following NEW packages will be installed:
  blt fonts-lyx isympy-common isympy3 libaec0 libblas3 libblosc1 libblosc2-2t64 libgfortran5 libhdf5-103-1t64 libimagequant0 libjs-jquery-ui liblapack3
  liblbfgsb0 libopenjp2-7 libqhull-r8.0 libraqm0 libsnappy1v5 libs22 libtcl8.6 libtk8.6 libwebpdemux2 libwebpmux3 libxss1 python-matplotlib-data
  python-odf-doc python-odf-tools python-tables-data python3-appdirs python3-bottleneck python3-brotli python3-bs4 python3-contourpy python3-cpuinfo
  python3-cssselect python3-cycler python3-dateutil python3-decorator python3-defusedxml python3-et-xmlfile python3-fonttools python3-fs python3-html5lib
  python3-kiwisolver python3-lxml python3-lz4 python3-matplotlib python3-mpmath python3-numexpr python3-numpy python3-odf python3-olefile python3-openpyxl
  python3-packaging python3-pandas python3-pandas-lib python3-pil python3-pil.imagetk python3-scipy python3-soupsieve python3-sympy python3-tables
  python3-tables-lib python3-tk python3-ufolib2 python3-unicodedata2 python3-webencodings tk8.6-blt2.5 unicode-data
0 upgraded, 69 newly installed, 0 to remove and 30 not upgraded.
Need to get 64.9 MB of archives.
After this operation, 290 MB of additional disk space will be used.
Do you want to continue? [Y/n] y
Get:1 http://archive.ubuntu.com/ubuntu noble/main amd64 libtcl8.6 amd64 8.6.14+dfsg-1build1 [988 kB]
```

Ensure that the CSV file is read and correctly parsed into JSON format

Create Dockerfile and requirements.txt

```
aravind@Aravind:~/ecommerce/backend$ nano Dockerfile
aravind@Aravind:~/ecommerce/backend$ nano requirements.txt
aravind@Aravind:~/ecommerce/backend$ cat requirements.txt
flask
pandas
aravind@Aravind:~/ecommerce/backend$ cat Dockerfile
FROM python:3.11

# Set the working directory in the container
WORKDIR /app

# Copy the requirements file and install dependencies
COPY requirements.txt .
RUN pip install --no-cache-dir -r requirements.txt

# Copy the application source code
COPY . .

# Expose the port the app runs on
EXPOSE 5000

# Define the command to run the application
CMD ["python", "app.py"]
```

Create docker-compose.yml

```
student@maccl-6:~/e-commerce/backend$ nano docker-compose.yml
student@maccl-6:~/e-commerce/backend$ cat docker-compose.yml
version: '3.8'

services:
  web:
    build: .
    ports:
      - "7000:7000"
    volumes:
      - ../app
    restart: always
    ports:
      - "7000:7000"
    volumes:
      - ../app
    restart: always
```

Build Docker image

Sudo docker build -t backend:latest

```
aravind@Aravind: ~/ecommerce$ sudo docker build -t backend:latest .
DEPRECATED: The legacy builder is deprecated and will be removed in a future release.
Install the buildx component to build images with BuildKit:
https://docs.docker.com/go/buildx/

Sending build context to Docker daemon  6.144kB
Step 1/7 : FROM python:3.11
3.11: Pulling from library/python
7cd785773db4: Already exists
891eb8249475: Already exists
255774e0027b: Already exists
353e14e5cc47: Already exists
963091970bc2: Already exists
e7235c43f7e3: Already exists
7f221c50e407: Already exists
Digest: sha256:ebfa8696e47a68cffe5b31e370a93ce57c01bc753f246ceaaef72801d1661351
Status: Downloaded newer image for python:3.11
--> 18c0f2265fd9
Step 2/7 : WORKDIR /app
--> Running in ad16elff61e4
--> Removed intermediate container ad16elff61e4
--> 42b81817ed4d
Step 3/7 : COPY requirements.txt .
--> 892551cd766c
Step 4/7 : RUN pip install --no-cache-dir -r requirements.txt
--> Running in 8b3e470355a0
Collecting flask (from -r requirements.txt (line 1))
  Downloading flask-3.1.0-py3-none-any.whl.metadata (2.7 kB)
Collecting pandas (from -r requirements.txt (line 2))
  Downloading pandas-2.2.3-cp311-cp311-manylinux_2_17_x86_64_manylinux2014_x86_64.whl.metadata (89 kB)
----- 89.9/89.9 kB 1.2 MB/s eta 0:00:00
Collecting Werkzeug>=3.1 (from flask->-r requirements.txt (line 1))
  Downloading Werkzeug-3.1.3-py3-none-any.whl.metadata (3.7 kB)
Collecting Jinja2>=3.1.2 (from flask->-r requirements.txt (line 1))
  Downloading Jinja2-3.1.6-py3-none-any.whl.metadata (2.9 kB)
Collecting itsdangerous>=2.2 (from flask->-r requirements.txt (line 1))
  Downloading itsdangerous-2.2.0-py3-none-any.whl.metadata (1.9 kB)
Collecting click>=8.1.3 (from flask->-r requirements.txt (line 1))
  Downloading click-8.1.8-py3-none-any.whl.metadata (2.3 kB)
Collecting blinker>=1.9 (from flask->-r requirements.txt (line 1))
  Downloading blinker-1.9.0-py3-none-any.whl.metadata (1.6 kB)
Collecting numpy>=1.23.2 (from pandas->-r requirements.txt (line 2))
  Downloading numpy-2.2.4-cp311-cp311-manylinux_2_17_x86_64_manylinux2014_x86_64.whl.metadata (62 kB)
----- 62.0/62.0 kB 42.3 MB/s eta 0:00:00
```

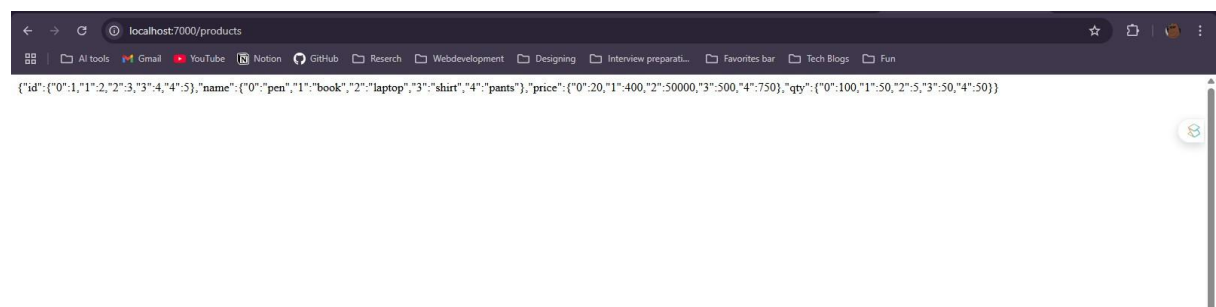
Run the docker:

sudo docker run -d -p 7000:7000 backend:latest

sudo docker logs <Generated number>

```
aravind@Aravind: ~/ecommerce/backend$ sudo docker run -d -p 7000:7000 test
ae526bb18173588067c1a12a2a8bb6398daeb0a9d9eb9931eaff0f1392b70e84
aravind@Aravind: ~/ecommerce/backend$ sudo docker logs ae526bb18173588067c1a12a2a8bb6398daeb0a9d9eb9931eaff0f1392b70e84
* Serving Flask app 'app'
* Debug mode: off
WARNING: This is a development server. Do not use it in a production deployment. Use a production WSGI server instead.
* Running on all addresses (0.0.0.0)
* Running on http://127.0.0.1:7000
* Running on http://172.17.0.2:7000
Press CTRL+C to quit
```

Run the application in the 7000/products



The JSON data is displayed at our port: 7000/products.

Create a container in frontend

Create **index.html** file and **Dockerfile**

```
aravind@Aravind:~/ecommerce/backend$ cd ..
aravind@Aravind:~/ecommerce$ cd frontend
aravind@Aravind:~/ecommerce/frontend$ nano index.html
aravind@Aravind:~/ecommerce/frontend$ nano Dockerfile
aravind@Aravind:~/ecommerce/frontend$ cat Dockerfile
FROM nginx:alpine
COPY index.html /usr/share/nginx/html/index.html
```

Build the image using the command:
sudo docker build -t frontend:latest.

```
aravind@Aravind:~/ecommerce/frontend$ sudo docker build -t frontend:latest .
DEPRECATED: The legacy builder is deprecated and will be removed in a future release.
            Install the buildx component to build images with BuildKit:
            https://docs.docker.com/go/buildx/

Sending build context to Docker daemon  3.584kB
Step 1/2 : FROM nginx:alpine
alpine: Pulling from library/nginx
f18232174bc9: Pull complete
ccc35e35d420: Pull complete
43f2ec460bdf: Pull complete
984583bcf083: Pull complete
8d27c072a58f: Pull complete
ab3286a73463: Pull complete
6d79cc6084d4: Pull complete
0c7e4c092ab7: Pull complete
Digest: sha256:4ff102c5d78d254a6f0da062b3cf39eaf07f01eec0927fd21e219d0af8bc0591
Status: Downloaded newer image for nginx:alpine
--> 1fff4bb4faebc
Step 2/2 : COPY index.html /usr/share/nginx/html/index.html
--> 6cd8d2ba7a32
Successfully built 6cd8d2ba7a32
Successfully tagged frontend:latest
```

Kubernetes Deployment YAML Files

Create **backend-deployment.yaml** file and **frontend-deployment.yaml**

```
aravind@Aravind:~/ecommerce/k8s$ cat backend-deployment.yaml
apiVersion: apps/v1
kind: Deployment
metadata:
  name: backend
spec:
  replicas: 1
  selector:
    matchLabels:
      app: backend
  template:
    metadata:
      labels:
        app: backend
    spec:
      containers:
        - name: backend
          image: backend:latest
          ports:
            - containerPort: 5000
```

```
aravind@Aravind:~/ecommerce/k8s$ cat frontend-deployment.yaml
apiVersion: apps/v1
kind: Deployment
metadata:
  name: frontend
spec:
  replicas: 1
  selector:
    matchLabels:
      app: frontend
  template:
    metadata:
      labels:
        app: frontend
    spec:
      containers:
        - name: frontend
          image: frontend:latest
          ports:
            - containerPort: 4000
```

Create **service.yaml** file

```
aravind@Aravind:~/ecommerce/k8s$ nano service.yaml
aravind@Aravind:~/ecommerce/k8s$ cat service.yaml
apiVersion: v1
kind: Service
metadata:
  name: backend-service
spec:
  selector:
    app: backend
  ports:
    - protocol: TCP
      port: 5000
      targetPort: 5000
  type: ClusterIP

apiVersion: v1
kind: Service
metadata:
  name: frontend-service
spec:
  selector:
    app: frontend
  ports:
    - protocol: TCP
      port: 3000
      targetPort: 80
  type: NodePort
```

Create **configmap.yaml** file

```
aravind@Aravind:~/ecommerce/k8s$ nano configmap.yaml
aravind@Aravind:~/ecommerce/k8s$ cat configmap.yaml
apiVersion: v1
kind: ConfigMap
metadata:
  name: backend-config
data:
  DATABASE_FILE: "/backend/products.csv"
```

Install minikube

```
aravind@Aravind:~/ecommerce/k8s$ sudo apt update
Ign:1 https://pkg.jenkins.io/debian-stable binary/ InRelease
Hit:2 https://pkg.jenkins.io/debian-stable binary/ Release
Hit:4 http://security.ubuntu.com/ubuntu noble-security InRelease
Hit:5 http://archive.ubuntu.com/ubuntu noble InRelease
Hit:6 http://archive.ubuntu.com/ubuntu noble-updates InRelease
Hit:7 http://archive.ubuntu.com/ubuntu noble-backports InRelease
Reading package lists... Done
Building dependency tree... Done
Reading state information... Done
30 packages can be upgraded. Run 'apt list --upgradable' to see them.
aravind@Aravind:~/ecommerce/k8s$ docker -v
Docker version 26.1.3, build 26.1.3-0ubuntu1~24.04.1
aravind@Aravind:~/ecommerce/k8s$ sudo apt install docker.io .
Reading package lists... Done
E: Unsupported file . given on commandline
aravind@Aravind:~/ecommerce/k8s$ sudo apt install docker.io -y
Reading package lists... Done
Building dependency tree... Done
Reading state information... Done
docker.io is already the newest version (26.1.3-0ubuntu1~24.04.1).
0 upgraded, 0 newly installed, 0 to remove and 30 not upgraded.
aravind@Aravind:~/ecommerce/k8s$ curl -LO https://storage.googleapis.com/minikube/releases/latest/minikube-linux-amd64
% Total % Received % Xferd Average Speed Time Time Time Current
Dload Upload Total Spent Left Speed
100 119M 100 119M 0 0 4700k 0 0:00:26 0:00:26 --:--:-- 6205k
```

Install kubectl

```
aravind@Aravind:~/ecommerce/k8s$ curl -LO "https://dl.k8s.io/release/${curl -L -s https://dl.k8s.io/release/stable.txt}/bin/linux/amd64/kubectl"
% Total % Received % Xferd Average Speed Time Time Time Current
Dload Upload Total Spent Left Speed
100 138 100 138 0 0 295 0 --:--:-- --:--:-- --:--:-- 295
100 238 100 238 0 0 249 0 --:--:-- --:--:-- --:--:-- 641
```

Grant permission

chmod +x kubectl

Move to kubectl to root

```
student@mcaccl-6:~/e-commerce/k8s$ sudo mv kubectl/usr/local/bin/
mv: missing destination file operand after 'kubectl/usr/local/bin/'
Try 'mv --help' for more information.
student@mcaccl-6:~/e-commerce/k8s$ sudo mv kubectl /usr/local/bin/
student@mcaccl-6:~/e-commerce/k8s$
```