Q1

a. Based on the Goldberg Architecture of Virtual machine Model, answer the following questions:

1. How are resources addressed and abstracted?

resources are addressed and abstracted through the Virtual Machine Monitor (VMM). Resources are addressed under the composed map f o Φ.

2. Contrast between the Φ-map and the f-map.

Φ-map is visible to the operating system software running on the virtual machine. While the f-map which is invisible to that software but which is manipulated by the virtual machine monitor running on the real machine.
Φ-map maps process names into resource names and the f-map maps virtual resource names into real resource names.
The Φ-map -map is the interface seen by an executing program whereas the f-map is the interface seen by the resources.

3. Explain how virtual machine deployment facilitates new advantages that system programmers would achieve.

Virtual machines provide an efficient facsimile of one or more complete computer systems, extending the multiaccess, multi-programming, multi-processing systems of the past decade to be multi-environment systems. They also can provide the following to system programmers: (1)Improving and testing the operating system software. (2) Running hardware diagnostic check-out software. (3) Running different operating systems or versions of an operating system. (4) Running with a virtual configuration which is different from the real system. (5) Measuring operating systems (6) Adding hardware enhancements to a configuration without requiring a recoding of the existing operating system(s). (7) providing a high degree of reliability and security/privacy for those applications which demand it.

4. Identify one operating system that supported a virtual machine as well as three computer systems.

CP-67 is one of the operating systems that supported a virtual machine as well as three computer systems.

5. Interpret/explain the process map/state machine diagram displayed below:

Both diagrams show failures in taking a process name into a real resource name. (a) represents a process name exception. This this case, control is given to the privileged software of the operating system with the same level without VMM knowledge or intervention. (b) is a virtual name fault. It causes control pass to a process in the lower-

level virtual machine, without the operating system's knowledge or intervention. (a) is subject to an f-map, and (b) is subject to a Φ-map.

b. Based on Goldberg's paper "Formal Requirements for Virtualizable Third Generation Architectures" [2], what is a virtual machine is?

A virtual machine (VM) is a software implementation that simulates the functionality of a physical computer, it can be taken to be an efficient, isolated duplicate of the of the real machine. It provides an environment for the programs which is identical with the original machines and controls of system resources.

c. Based on [2], Formally identify the components of a virtual machine.

The components are: virtual machine, virtual machine monitor, and hardware.

d. Based on [2], what are the elements of Program Status Word?

The elements are: executable storage, processor mode, program counter, and relocation-bounds register

e. Based on [2], what is a Virtual Machine Monitor?

A virtual machine monitor is a particular piece of control program, which allows multiple operating systems to share the same physical resources independently and securely so they can run on a physical hardware device concurrently.

f. Based on [2], list the properties of virtual machines.

There are three properties: the efficiency property, the resource control property, and the equivalence property

g. Based on [2], what is Recursive Virtualization?

It is a capability that a virtual machine can run under itself a copy of the VMM and that copy also exhibit all the properties of a VMM. The nested VMs can run their own operating systems and as if they were running on physical hardware.

Q2

1.1 Does Hyper-V support type 1 virtualization or type 2 virtualization?

Type 1

1.2 The paper [Timmerman et al] identifies performance metrics used for evaluation tests purposes, list those metrics.

(1) Clock tick processing duration. (2) Thread switch latency between threads of same priority,

1.3 What approaches/modes does Hyper-V support.

Full virtualization (FV)/Hardware emulation and Para-virtualization (PV)

1.4 Explain how would paravirtualization differ from hardware emulation approaches.

In the clock-tick processing duration test results, enlightened VM usually performs less time than Emulated VM. enlightened (paravirtualized) VMs perform significantly better than hardware-emulated VMs, with performance improvements varying based on the scenario.

1.5 How does Enlightened partition differ from Unenlighted partition?

Enlightened partitions have a virtual view of resources and utilize virtual devices. Requests to these devices are redirected via the VMBus to the parent partition that manages these requests, leveraging Virtualization Service Provider (VSP) and Virtualization Service Client (VSC) for device access and advanced features, respectively. However, Unenlightened partitions lack these integration components and VSCs, relying instead on emulation for device interaction.

1.6 What is the core requirement for Enlighted virtualization?

The core requirement for enlightened virtualization in Microsoft Hyper-V is the addition of special drivers to the virtual machine (VM). These drivers provide advanced features and performance enhancements for the VMs operating in an enlightened mode, which leverages paravirtualization techniques.

1.7 What is the core requirement for Emulated Virtualization?

The core requirement for Emulated Virtualization is the integration of special drivers within the virtual machines to provide advanced features and performance improvements for virtual machines.

1.8 what is failover clustering and identify why would recommend its deployment?

It is a kind of supporting components. Failover clustering involves connecting multiple servers in such a way that if one fails, another can immediately take over its tasks to minimize downtime and ensure continuous service availability. It is recommended because it improves the systems' resilience and ensures that services remain available even in the event of hardware or software failures.

1.9 An associated software to Hyper-V is Virtual Machine Manager; explain what functionalities the software provides. Identify its capacity limits in terms of number of physical hosts, number of virtual machines, number of services, number of clouds, roles classifications, and number of logical networks.

The functionalities include management of datacenter components, provisioning and management of resources for virtual machines and services, and deployment of virtual machines and services to private clouds. As for capacity limits tested for System Center Virtual Machine Manager, it supports up to 1,000 physical hosts, 25,000 VMs, 1,000 services, 1,000 user roles, 20 clouds, 2,000 virtual networks, and 20 logical networks. These limits are influenced by factors like hardware configuration, network topology, and others.

1.10 VMware is one of the leading virtualization product providers; VMware HCI (Hyperconverged infrastructure) is a software-defined, unified system that combines all the elements of a traditional data center: storage, compute, networking and management. Identify why would your recommend such a scheme to your organization, and identify four Vmware products that would facilitates the deployment of and HCI system

HCI brings several strategic advantages, including simplification of data center management, enhanced scalability, and operational efficiencies. VMware's HCI integrates computing, storage, networking, and virtualization resources into a single, software-defined platform, offering a transformative solution for modern enterprises. This consolidation addresses the challenges of traditional IT infrastructure by reducing operational complexities, lowering costs, and improving scalability, making it an ideal foundation for hybrid and cloud-native strategies.
The four Vmware products are: VMware vSphere, VMware vSAN, VMware NSX Data Center, VMware vRealize Suite.

Q3

1

```
C:\Users\dell>docker version
Client:
 Cloud integration: v1.0.35+desktop.5
 Version:           24.0.7
 API version:       1.43
 Go version:        go1.20.10
 Git commit:        afdd53b
 Built:             Thu Oct 26 09:08:44 2023
 OS/Arch:           windows/amd64
 Context:           default

Server: Docker Desktop 4.26.1 (131620)
 Engine:
  Version:          24.0.7
  API version:      1.43 (minimum version 1.12)
  Go version:       go1.20.10
  Git commit:       311b9ff
  Built:            Thu Oct 26 09:08:02 2023
  OS/Arch:          linux/amd64
  Experimental:     false
 containerd:
  Version:          1.6.25
  GitCommit:        d8f198a4ed8892c764191ef7b3b06d8a2eeb5c7f
 runc:
  Version:          1.1.10
  GitCommit:        v1.1.10-0-g18a0cb0
 docker-init:
  Version:          0.19.0
  GitCommit:        de40ad0
```

2

```
C:\Users\dell>docker info
Client:
 Version:    24.0.7
 Context:    default
 Debug Mode: false
 Plugins:
  buildx: Docker Buildx (Docker Inc.)
    Version:  v0.12.0-desktop.2
    Path:     C:\Program Files\Docker\cli-plugins\docker-buildx.exe
  compose: Docker Compose (Docker Inc.)
    Version:  v2.23.3-desktop.2
    Path:     C:\Program Files\Docker\cli-plugins\docker-compose.exe
  dev: Docker Dev Environments (Docker Inc.)
    Version:  v0.1.0
    Path:     C:\Program Files\Docker\cli-plugins\docker-dev.exe
  extension: Manages Docker extensions (Docker Inc.)
    Version:  v0.2.21
    Path:     C:\Program Files\Docker\cli-plugins\docker-extension.exe
  feedback: Provide feedback, right in your terminal! (Docker Inc.)
    Version:  0.1
    Path:     C:\Program Files\Docker\cli-plugins\docker-feedback.exe
  init: Creates Docker-related starter files for your project (Docker Inc.)
    Version:  v0.1.0-beta.10
    Path:     C:\Program Files\Docker\cli-plugins\docker-init.exe
  sbom: View the packaged-based Software Bill Of Materials (SBOM) for an image (Anchore Inc
    Version:  0.6.0
    Path:     C:\Program Files\Docker\cli-plugins\docker-sbom.exe
  scan: Docker Scan (Docker Inc.)
    Version:  v0.26.0
    Path:     C:\Program Files\Docker\cli-plugins\docker-scan.exe
  scout: Docker Scout (Docker Inc.)
    Version:  v1.2.0
    Path:     C:\Program Files\Docker\cli-plugins\docker-scout.exe

Server:
 Containers: 0
  Running: 0
  Paused: 0
  Stopped: 0
 Images: 0
 Server Version: 24.0.7
 Storage Driver: overlay2
  Backing Filesystem: extfs
  Supports d_type: true
  Using metacopy: false
  Native Overlay Diff: true
  userxattr: false
 Logging Driver: json-file
 Cgroup Driver: cgroupfs
 Cgroup Version: 1
 Plugins:
  Volume: local
  Network: bridge host ipvlan macvlan null overlay
  Log: awslogs fluentd gcplogs gelf journald json-file local logentries splunk syslog
 Swarm: inactive
 Runtimes: io.containerd.runc.v2 runc
 Default Runtime: runc



 init version: de40ad0
 Security Options:
  seccomp
   Profile: unconfined
 Kernel Version: 5.15.133.1-microsoft-standard-WSL2
 Operating System: Docker Desktop
 OSType: linux
 Architecture: x86_64
 CPUs: 20
 Total Memory: 7.604GiB
 Name: docker-desktop
 ID: c6dd4909-c89c-4568-a02a-3d69e27dca4a
 Docker Root Dir: /var/lib/docker
 Debug Mode: false
 HTTP Proxy: http.docker.internal:3128
 HTTPS Proxy: http.docker.internal:3128
 No Proxy: hubproxy.docker.internal
 Experimental: false
 Insecure Registries:
  hubproxy.docker.internal:5555
  127.0.0.0/8
 Live Restore Enabled: false
```

3

```
C:\Users\dell>docker login
Authenticating with existing credentials...
Login Succeeded
```

4

```
C:\Users\dell>docker images -a
REPOSITORY   TAG       IMAGE ID   CREATED   SIZE
```

5

```
C:\Users\dell>docker pull
"docker pull" requires exactly 1 argument.
See 'docker pull --help'.

Usage:  docker pull [OPTIONS] NAME[:TAG|@DIGEST]

Download an image from a registry
```

6

```
C:\Users\dell>docker pull alpine
Using default tag: latest
latest: Pulling from library/alpine
4abcf2066143: Pull complete
Digest: sha256:c5b1261d6d3e43071626931fc004f70149baeba2c8ec672bd4f27761f8e1ad6b
Status: Downloaded newer image for alpine:latest
docker.io/library/alpine:latest

What's Next?
  View a summary of image vulnerabilities and recommendations → docker scout quickview alpine
```

7

```
C:\Users\dell>docker images -a
REPOSITORY   TAG       IMAGE ID       CREATED      SIZE
alpine       latest    05455a08881e   3 days ago   7.38MB
```

8

```
C:\Users\dell>docker tag alpine:latest alpine500:latest

C:\Users\dell>
```

9

```
C:\Users\dell>docker images -a
REPOSITORY   TAG       IMAGE ID       CREATED      SIZE
alpine500    latest    05455a08881e   3 days ago   7.38MB
alpine       latest    05455a08881e   3 days ago   7.38MB
```

10.a

```
C:\Users\dell>docker run --name Alpine1 -d alpine500
55e58ea94a177b6cdfdebc3a2e6a0a774d6a4433ff644977929fa3554bc78309
```

10.b

```
C:\Users\dell>docker run --name Alpine2 -d alpine500
8acc6f898c280caf1e0698b350f48319610bce8ea0a1490e120ee8e852d808d1
```

10.c

```
C:\Users\dell>docker run --name Alpine3 -it alpine500
/ # ls
bin    dev    etc    home   lib    media  mnt    opt    proc   root   run    sbin   srv    sys    tmp    usr    var
/ # cd/etc
/bin/sh: cd/etc: not found
/ # cd /etc
/etc # ls-l
/bin/sh: ls-l: not found
/etc # ls -l
total 168
-rw-r--r--    1 root     root             7 Jan 26 17:51 alpine-release
drwxr-xr-x    4 root     root          4096 Jan 26 17:53 apk
drwxr-xr-x    2 root     root          4096 Jan 26 17:53 busybox-paths.d
drwxr-xr-x    2 root     root          4096 Jan 26 17:53 conf.d
drwxr-xr-x    2 root     root          4096 Jan 26 17:53 crontabs
-rw-r--r--    1 root     root            89 Sep 27 06:14 fstab
-rw-r--r--    1 root     root           697 Sep 27 06:14 group
-rw-r--r--    1 root     root            13 Jan 30 20:51 hostname
-rw-r--r--    1 root     root           174 Jan 30 20:51 hosts
drwxr-xr-x    2 root     root          4096 Jan 26 17:53 init.d
-rw-r--r--    1 root     root           570 Sep 27 06:14 inittab
-rw-r--r--    1 root     root            54 Jan 26 17:51 issue
drwxr-xr-x    2 root     root          4096 Jan 26 17:53 logrotate.d
drwxr-xr-x    2 root     root          4096 Jan 26 17:53 modprobe.d
-rw-r--r--    1 root     root            15 Sep 27 06:14 modules
drwxr-xr-x    2 root     root          4096 Jan 26 17:53 modules-load.d
-rw-r--r--    1 root     root           284 Sep 27 06:14 motd
lrwxrwxrwx    1 root     root            12 Jan 30 20:51 mtab -> /proc/mounts
drwxr-xr-x    8 root     root          4096 Jan 26 17:53 network
-rw-r--r--    1 root     root           205 Sep 27 06:14 nsswitch.conf
drwxr-xr-x    2 root     root          4096 Jan 26 17:53 opt
-rw-r--r--    1 root     root           188 Jan 26 17:51 os-release
-rw-r--r--    1 root     root          1172 Sep 27 06:14 passwd
drwxr-xr-x    7 root     root          4096 Jan 26 17:53 periodic
-rw-r--r--    1 root     root           547 Sep 27 06:14 profile
drwxr-xr-x    2 root     root          4096 Jan 26 17:53 profile.d
-rw-r--r--    1 root     root          3144 Sep 27 06:14 protocols
-rw-r--r--    1 root     root            97 Jan 30 20:51 resolv.conf
drwxr-xr-x    2 root     root          4096 Jan 26 17:51 secfixes.d
-rw-r--r--    1 root     root           156 Nov  7 18:53 securetty
-rw-r--r--    1 root     root         12813 Sep 27 06:14 services
-rw-r-----    1 root     shadow         422 Jan 26 17:53 shadow
-rw-r--r--    1 root     root            38 Sep 27 06:14 shells
drwxr-xr-x    5 root     root          4096 Jan 26 17:53 ssl
drwxr-xr-x    2 root     root          4096 Jan 26 17:53 ssl1.1
-rw-r--r--    1 root     root            53 Sep 27 06:14 sysctl.conf
drwxr-xr-x    2 root     root          4096 Jan 26 17:53 sysctl.d
drwxr-xr-x    2 root     root          4096 Jan 26 17:53 udhcpc
-rw-r--r--    1 root     root          5636 Nov  7 18:53 udhcpd.conf
/etc #
```

11

```
C:\Users\dell>docker container ls -a
CONTAINER ID   IMAGE       COMMAND     CREATED         STATUS                     PORTS     NAMES
64f89e68790e   alpine500   "/bin/sh"   3 minutes ago   Up 3 minutes                         Alpine3
8acc6f898c28   alpine500   "/bin/sh"   3 minutes ago   Exited (0) 3 minutes ago             Alpine2
55e58ea94a17   alpine500   "/bin/sh"   4 minutes ago   Exited (0) 4 minutes ago             Alpine1
```

12

```
C:\Users\dell>docker container ls
CONTAINER ID   IMAGE       COMMAND     CREATED         STATUS         PORTS     NAMES
64f89e68790e   alpine500   "/bin/sh"   3 minutes ago   Up 3 minutes             Alpine3
```

13

```
C:\Users\dell>docker ps -a
CONTAINER ID   IMAGE       COMMAND     CREATED         STATUS                     PORTS     NAMES
64f89e68790e   alpine500   "/bin/sh"   4 minutes ago   Up 4 minutes                         Alpine3
8acc6f898c28   alpine500   "/bin/sh"   4 minutes ago   Exited (0) 4 minutes ago             Alpine2
55e58ea94a17   alpine500   "/bin/sh"   5 minutes ago   Exited (0) 5 minutes ago             Alpine1
```

14

```
C:\Users\dell>docker ps -a
CONTAINER ID   IMAGE       COMMAND     CREATED         STATUS                     PORTS     NAMES
64f89e68790e   alpine500   "/bin/sh"   4 minutes ago   Up 4 minutes                         Alpine3
8acc6f898c28   alpine500   "/bin/sh"   4 minutes ago   Exited (0) 4 minutes ago             Alpine2
55e58ea94a17   alpine500   "/bin/sh"   5 minutes ago   Exited (0) 5 minutes ago             Alpine1
```

15

```
C:\Users\dell>docker pull redis
Using default tag: latest
latest: Pulling from library/redis
2f44b7a888fa: Pull complete
c55535369ffc: Pull complete
3622841bf0aa: Pull complete
91a62ca7377a: Pull complete
fdd219d1f4ab: Pull complete
fdf07fe2fb4c: Pull complete
4f4fb700ef54: Pull complete
fba604e70bfe: Pull complete
Digest: sha256:b5ddcd52d425a8e354696c022f392fe45fca928f68d6289e6bb4a709c3a74668
Status: Downloaded newer image for redis:latest
docker.io/library/redis:latest
```

16

```
C:\Users\dell>docker images -a
REPOSITORY   TAG       IMAGE ID       CREATED       SIZE
alpine500    latest    05455a08881e   3 days ago    7.38MB
alpine       latest    05455a08881e   3 days ago    7.38MB
redis        latest    bdff4838c172   3 weeks ago   138MB
```

17

```
C:\Users\dell>docker run --name redis0 -d redis
60f80cdb8fd5fb3480e64886d847d71fa836f80999c55c3a94df9b0d4e31f686
```

18

```
C:\Users\dell>docker images -a
REPOSITORY   TAG      IMAGE ID       CREATED       SIZE
alpine500    latest   05455a08881e   3 days ago    7.38MB
alpine       latest   05455a08881e   3 days ago    7.38MB
redis        latest   bdff4838c172   3 weeks ago   138MB
```

19

```
C:\Users\dell>docker ps -a
CONTAINER ID   IMAGE       COMMAND                  CREATED          STATUS                       PORTS      NAMES
60f80cdb8fd5   redis       "docker-entrypoint.s…"   3 minutes ago    Up 3 minutes                 6379/tcp   redis0
64f89e68790e   alpine500   "/bin/sh"                10 minutes ago   Up 10 minutes                           Alpine3
8acc6f898c28   alpine500   "/bin/sh"                11 minutes ago   Exited (0) 11 minutes ago               Alpine2
55e58ea94a17   alpine500   "/bin/sh"                12 minutes ago   Exited (0) 12 minutes ago               Alpine1
```

a. It was created 3 minutes ago
b. Execute docker exec -it Alpine3 /bin/sh

20

```
:\Users\dell>docker ps
ONTAINER ID   IMAGE       COMMAND                  CREATED          STATUS          PORTS      NAMES
0f80cdb8fd5   redis       "docker-entrypoint.s…"   3 minutes ago    Up 3 minutes    6379/tcp   redis0
4f89e68790e   alpine500   "/bin/sh"                11 minutes ago   Up 11 minutes              Alpine3
```

21

```
C:\Users\dell>docker run --name redis1 -it redis
1:C 30 Jan 2024 21:03:39.313 # WARNING Memory overcommit must be enabled! Without it, a background save or replication may fail under low memory condition. Being disabled, it can also cause
 failures without low memory condition, see https://github.com/jemalloc/jemalloc/issues/1328. To fix this issue add 'vm.overcommit_memory = 1' to /etc/sysctl.conf and then reboot or run the
 command 'sysctl vm.overcommit_memory=1' for this to take effect.
1:C 30 Jan 2024 21:03:39.313 * oO0OoO0OoO0Oo Redis is starting oO0OoO0OoO0Oo
1:C 30 Jan 2024 21:03:39.313 * Redis version=7.2.4, bits=64, commit=00000000, modified=0, pid=1, just started
1:C 30 Jan 2024 21:03:39.313 # Warning: no config file specified, using the default config. In order to specify a config file use redis-server /path/to/redis.conf
1:M 30 Jan 2024 21:03:39.314 * monotonic clock: POSIX clock_gettime
```

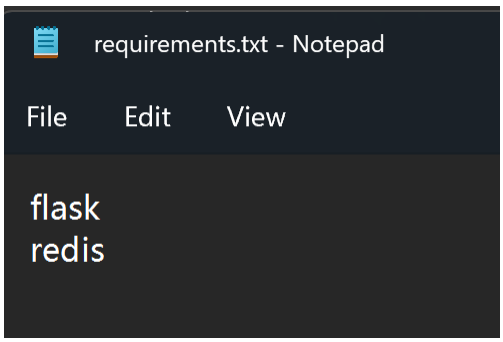
```
Redis 7.2.4 (00000000/0) 64 bit

Running in standalone mode
Port: 6379
PID: 1

    https://redis.io

1:M 30 Jan 2024 21:03:39.315 * Server initialized
1:M 30 Jan 2024 21:03:39.315 * Ready to accept connections tcp
```

Q4

1

```python
import time

import redis
from flask import Flask

app = Flask(__name__)
cache = redis.Redis(host="redis", port=6379)


def get_hit_count():
    retries = 5
    while True:
        try:
            return cache.incr("hits")
        except redis.exceptions.ConnectionError as exc:
            if retries == 0:
                raise exc
            retries -= 1
            time.sleep(0.5)


@app.route("/")
def hello():
    count = get_hit_count()
    return "Hello World! I have been seen {} times.\n".format(count)
```

2



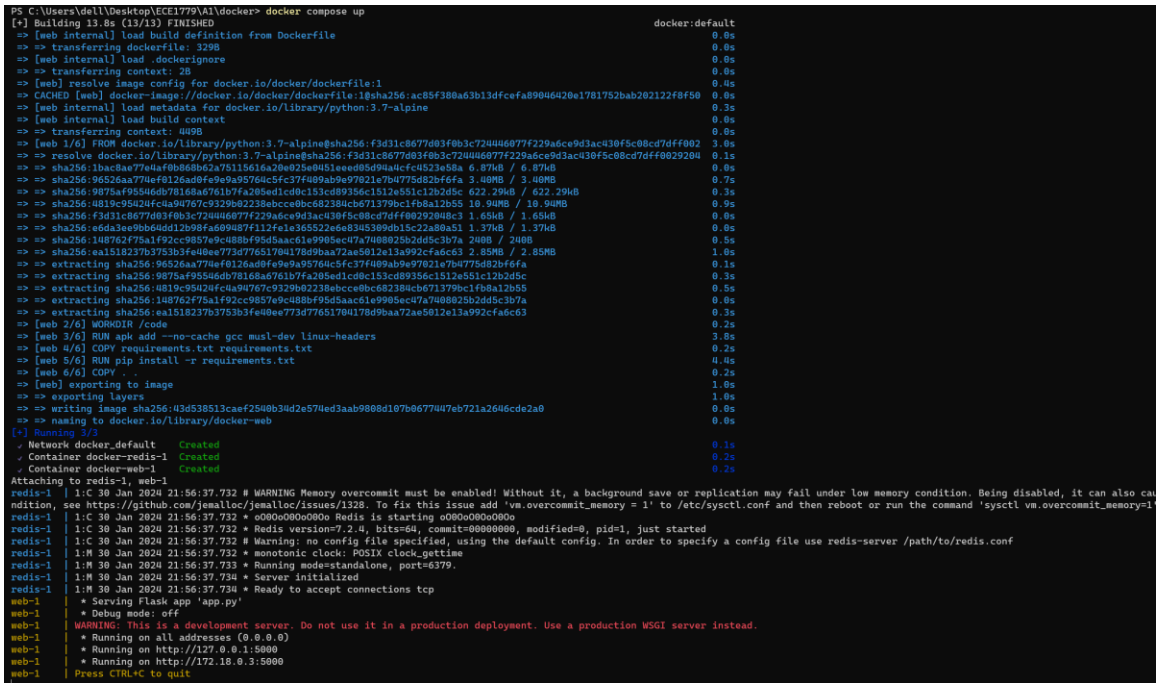
3

```
# syntax=docker/dockerfile:1
FROM python:3.7-alpine
WORKDIR /code
ENV FLASK_APP=app.py
ENV FLASK_RUN_HOST=0.0.0.0
RUN apk add --no-cache gcc musl-dev linux-headers
COPY requirements.txt requirements.txt
RUN pip install -r requirements.txt
EXPOSE 5000
COPY . .
CMD ["flask", "run"]
```

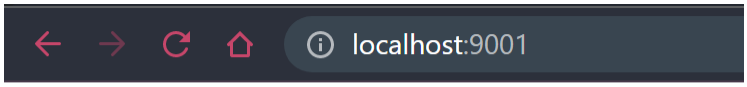
4

```
version: "3.9"
services:
  web:
    build: .
    ports:
      - "9001:5000"
  redis:
    image: "redis:alpine"
```

5

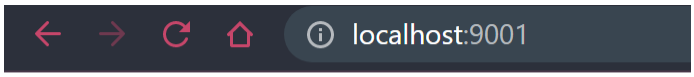


6



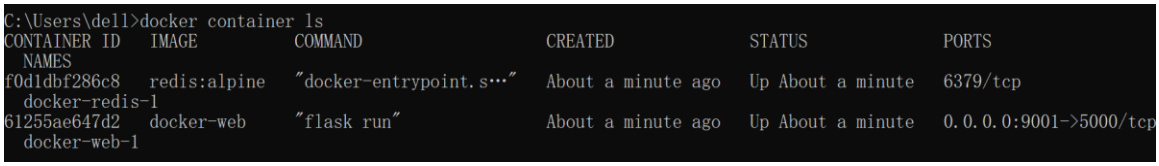
Hello World! I have been seen 1 times.

7

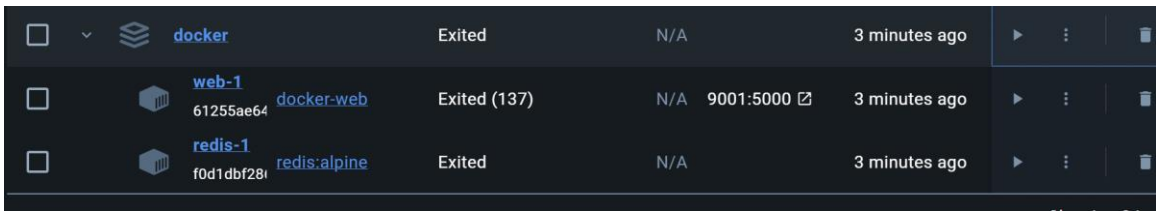


Hello World! I have been seen 23 times.

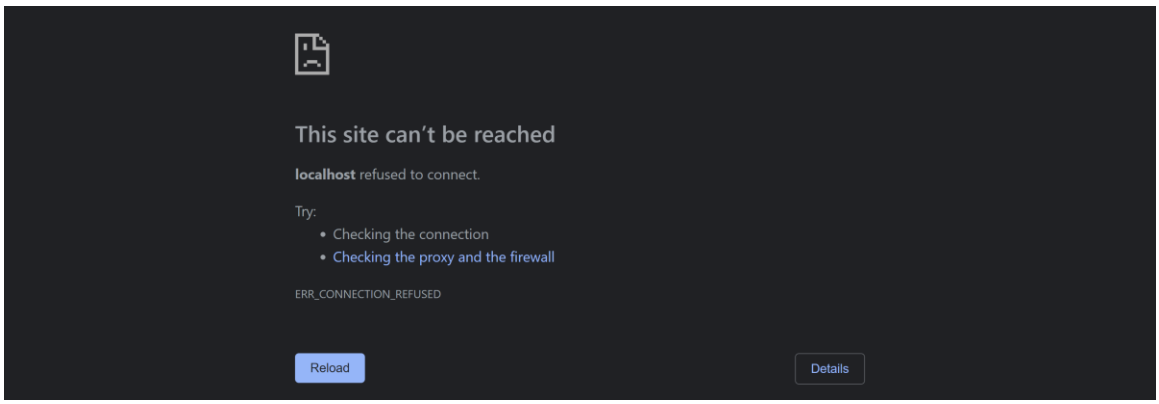
8



9



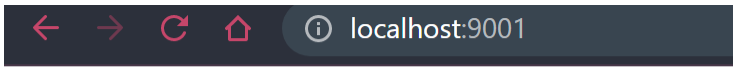
10



11

```
:\Users\dell>docker container start docker-redis-1
ocker-redis-1

:\Users\dell>docker container start docker-web-1
ocker-web-1
```

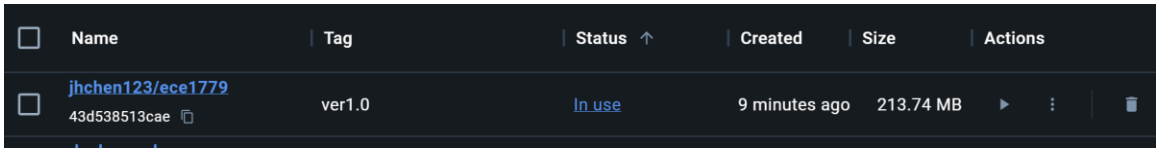
12



Hello World! I have been seen 24 times.

13

```
C:\Users\dell>docker tag 43d538513cae jhchen123/ece1779:ver1.0
```




```
C:\Users\dell>docker push jhchen123/ece1779:ver1.0
The push refers to repository [docker.io/jhchen123/ece1779]
de05a10afef3: Pushed
c3d2b30b5181: Pushed
9570e8bade5c: Pushed
d86f7bd59a93: Pushed
5c0642bfb45e: Pushed
ae2ed3079163: Mounted from library/python
aa3a591fc84e: Mounted from library/python
7f29b11ef9dd: Mounted from library/python
a1c2f058ec5f: Mounted from library/python
cc2447e1835a: Mounted from library/python
ver1.0: digest: sha256:2f0c55be5fe5cb9f3c3038771bfd923dd9654c113fb7f4d96d6906e98684fba1 size: 2411
```

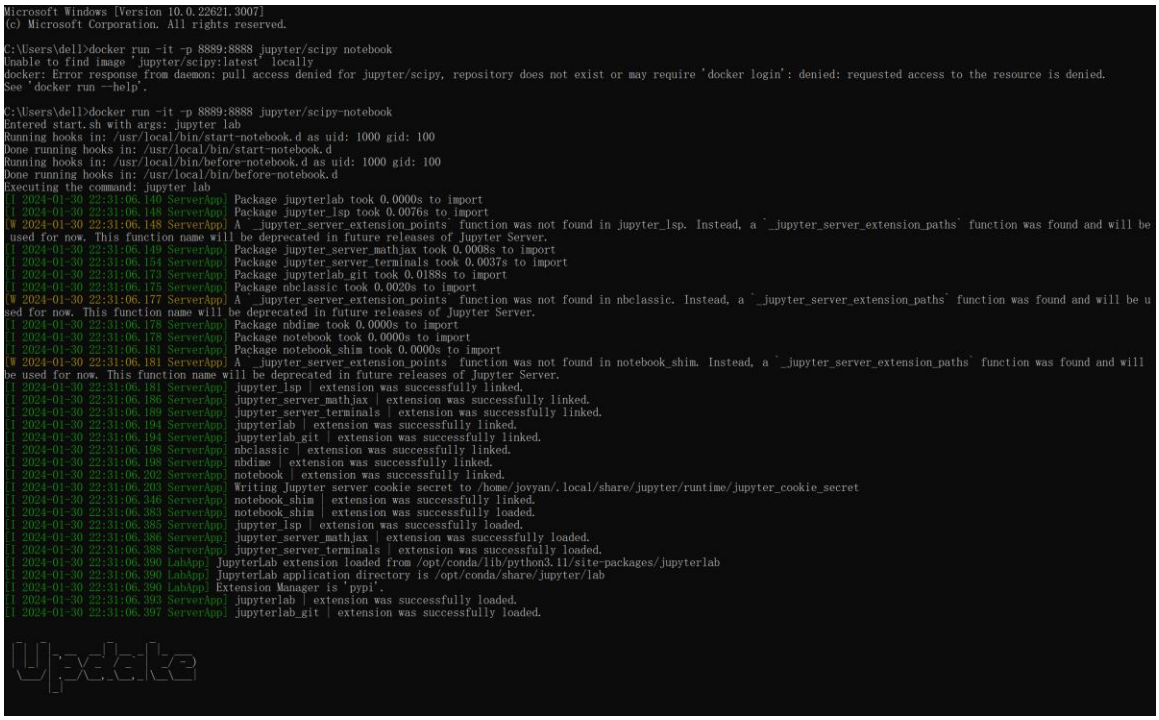
14

```
C:\Users\dell>docker pull abuosbak/ece1724h:ver1.0
Error response from daemon: manifest for abuosbak/ece1724h:ver1.0 not found: manifest unknown: manifest unknown
```

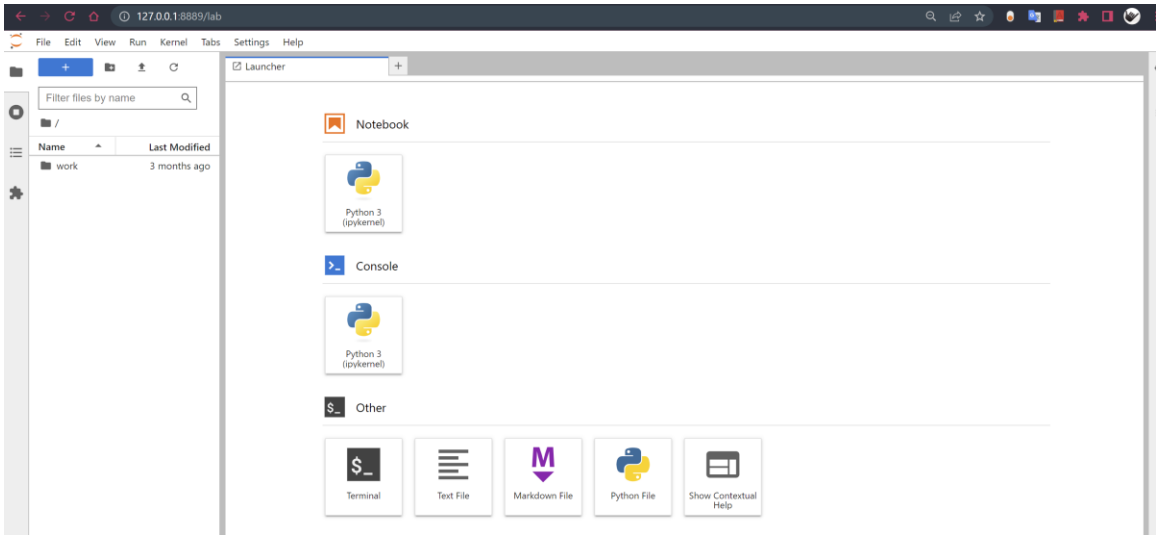
Q5

```
C:\Users\dell>docker pull jupyter/scipy-notebook
Using default tag: latest
latest: Pulling from jupyter/scipy-notebook
aece8493d397: Pull complete
fd92c719666c: Pull complete
088f11eb1e74: Pull complete
4f4fb700ef54: Pull complete
ef8373d600b0: Pull complete
77e45ee945dc: Pull complete
a30f89a0af6c: Pull complete
dc42adc7eb73: Pull complete
abaa8376a650: Pull complete
aa099bb9e49a: Pull complete
822c4cbcf6a6: Pull complete
d25166dcdc7b: Pull complete
964fc3e4ff9f: Pull complete
2c4c69587ee4: Pull complete
de2cdd875fa8: Pull complete
75d33599f5f2: Pull complete
31973ea82470: Pull complete
96ee7e4439c7: Pull complete
1f9ad23c07ac: Pull complete
d19266e0cb17: Pull complete
9a165b6e9dc7: Pull complete
5689442fd4e1: Pull complete
9a6a202f62a6: Pull complete
734ea0c3d94e: Pull complete
a21a167f7127: Pull complete
Digest: sha256:fca4bcc9cbd49d9a15e0e4df6c666adf17776c950da9fa94a4f0a045d5c4ad33
Status: Downloaded newer image for jupyter/scipy-notebook:latest
docker.io/jupyter/scipy-notebook:latest
```

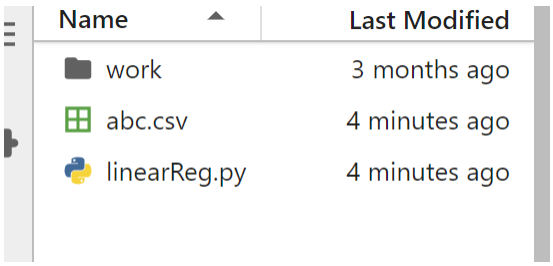
```
C:\Users\dell>docker run -it -p 8888:8888 jupyter/scipy-notebook
Entered start.sh with args: jupyter lab
Running hooks in: /usr/local/bin/start-notebook.d as uid: 1000 gid: 100
Done running hooks in: /usr/local/bin/start-notebook.d
Running hooks in: /usr/local/bin/before-notebook.d as uid: 1000 gid: 100
Done running hooks in: /usr/local/bin/before-notebook.d
Executing the command: jupyter lab
[I 2024-01-30 22:30:29.833 ServerApp] Package jupyterlab took 0.0000s to import
[I 2024-01-30 22:30:29.852 ServerApp] Package jupyter_lsp took 0.0185s to import
[W 2024-01-30 22:30:29.853 ServerApp] A `_jupyter_server_extension_points` function was not found in jupyter_lsp. Instead, a `_jupyter_server_extension_paths` function was found and will be
 used for now. This function name will be deprecated in future releases of Jupyter Server.
[I 2024-01-30 22:30:29.854 ServerApp] Package jupyter_server_mathjax took 0.0011s to import
[I 2024-01-30 22:30:29.865 ServerApp] Package jupyter_server_terminals took 0.0104s to import
[I 2024-01-30 22:30:29.899 ServerApp] Package jupyterlab_git took 0.0339s to import
[I 2024-01-30 22:30:29.904 ServerApp] Package nbclassic took 0.0043s to import
[W 2024-01-30 22:30:29.907 ServerApp] A `_jupyter_server_extension_points` function was not found in nbclassic. Instead, a `_jupyter_server_extension_paths` function was found and will be u
sed for now. This function name will be deprecated in future releases of Jupyter Server.
[I 2024-01-30 22:30:29.907 ServerApp] Package nbdime took 0.0000s to import
[I 2024-01-30 22:30:29.907 ServerApp] Package notebook took 0.0000s to import
[I 2024-01-30 22:30:29.910 ServerApp] Package notebook_shim took 0.0000s to import
[W 2024-01-30 22:30:29.911 ServerApp] A `_jupyter_server_extension_points` function was not found in notebook_shim. Instead, a `_jupyter_server_extension_paths` function was found and will
be used for now. This function name will be deprecated in future releases of Jupyter Server.
[I 2024-01-30 22:30:29.912 ServerApp] jupyter_lsp | extension was successfully linked.
[I 2024-01-30 22:30:29.916 ServerApp] jupyter_server_mathjax | extension was successfully linked.
[I 2024-01-30 22:30:29.919 ServerApp] jupyter_server_terminals | extension was successfully linked.
[I 2024-01-30 22:30:29.922 ServerApp] jupyterlab | extension was successfully linked.
[I 2024-01-30 22:30:29.923 ServerApp] jupyterlab_git | extension was successfully linked.
[I 2024-01-30 22:30:29.926 ServerApp] nbclassic | extension was successfully linked.
[I 2024-01-30 22:30:29.926 ServerApp] nbdime | extension was successfully linked.
[I 2024-01-30 22:30:29.931 ServerApp] notebook | extension was successfully linked.
[I 2024-01-30 22:30:29.933 ServerApp] Writing Jupyter server cookie secret to /home/jovyan/.local/share/jupyter/runtime/jupyter_cookie_secret
[I 2024-01-30 22:30:30.257 ServerApp] notebook_shim | extension was successfully linked.
[I 2024-01-30 22:30:30.308 ServerApp] notebook_shim | extension was successfully loaded.
[I 2024-01-30 22:30:30.311 ServerApp] jupyter_lsp | extension was successfully loaded.
[I 2024-01-30 22:30:30.311 ServerApp] jupyter_server_mathjax | extension was successfully loaded.
[I 2024-01-30 22:30:30.312 ServerApp] jupyter_server_terminals | extension was successfully loaded.
[I 2024-01-30 22:30:30.314 LabApp] JupyterLab extension loaded from /opt/conda/lib/python3.11/site-packages/jupyterlab
[I 2024-01-30 22:30:30.314 LabApp] JupyterLab application directory is /opt/conda/share/jupyter/lab
[I 2024-01-30 22:30:30.315 LabApp] Extension Manager is 'pypi'.
[I 2024-01-30 22:30:30.317 ServerApp] jupyterlab | extension was successfully loaded.
[I 2024-01-30 22:30:30.321 ServerApp] jupyterlab_git | extension was successfully loaded.

Update

Read the migration plan to Notebook 7 to learn about the new features and the actions to take if you are using extensions.
```


Microsoft Windows [Version 10.0.22621.3007]
(c) Microsoft Corporation. All rights reserved.
C:\Users\dell>docker run -it -p 8889:8888 jupyter/scipy notebook
Unable to find image 'jupyter/scipy:latest' locally
docker: Error response from daemon: pull access denied for jupyter/scipy, repository does not exist or may require 'docker login': denied: requested access to the resource is denied.
See 'docker run --help'.
C:\Users\dell>docker run -it -p 8889:8888 jupyter/scipy-notebook
Entered start.sh with args: jupyter lab
Running hooks in: /usr/local/bin/start-notebook.d as uid: 1000 gid: 100
Done running hooks in: /usr/local/bin/start-notebook.d
Running hooks in: /usr/local/bin/before-notebook.d as uid: 1000 gid: 100
Done running hooks in: /usr/local/bin/before-notebook.d
Executing the command: jupyter lab
[I 2024-01-30 22:31:06.140 ServerApp] Package jupyterlab took 0.0000s to import
[I 2024-01-30 22:31:06.148 ServerApp] Package jupyter_lsp took 0.0076s to import
[W 2024-01-30 22:31:06.148 ServerApp] A `_jupyter_server_extension_points` function was not found in jupyter_lsp. Instead, a `_jupyter_server_extension_paths` function was found and will be used for now. This function name will be deprecated in future releases of Jupyter Server.
[I 2024-01-30 22:31:06.149 ServerApp] Package jupyter_server_mathjax took 0.0008s to import
[I 2024-01-30 22:31:06.154 ServerApp] Package jupyter_server_terminals took 0.0037s to import
[I 2024-01-30 22:31:06.173 ServerApp] Package jupyterlab_git took 0.0188s to import
[I 2024-01-30 22:31:06.175 ServerApp] Package nbclassic took 0.0020s to import
[W 2024-01-30 22:31:06.177 ServerApp] A `_jupyter_server_extension_points` function was not found in nbclassic. Instead, a `_jupyter_server_extension_paths` function was found and will be used for now. This function name will be deprecated in future releases of Jupyter Server.
[I 2024-01-30 22:31:06.178 ServerApp] Package nbdime took 0.0000s to import
[I 2024-01-30 22:31:06.178 ServerApp] Package notebook took 0.0000s to import
[I 2024-01-30 22:31:06.181 ServerApp] Package notebook_shim took 0.0000s to import
[W 2024-01-30 22:31:06.181 ServerApp] A `_jupyter_server_extension_points` function was not found in notebook_shim. Instead, a `_jupyter_server_extension_paths` function was found and will be used for now. This function name will be deprecated in future releases of Jupyter Server.
[I 2024-01-30 22:31:06.181 ServerApp] jupyter_lsp | extension was successfully linked.
[I 2024-01-30 22:31:06.186 ServerApp] jupyter_server_mathjax | extension was successfully linked.
[I 2024-01-30 22:31:06.189 ServerApp] jupyter_server_terminals | extension was successfully linked.
[I 2024-01-30 22:31:06.194 ServerApp] jupyterlab | extension was successfully linked.
[I 2024-01-30 22:31:06.194 ServerApp] jupyterlab_git | extension was successfully linked.
[I 2024-01-30 22:31:06.198 ServerApp] nbclassic | extension was successfully linked.
[I 2024-01-30 22:31:06.198 ServerApp] nbdime | extension was successfully linked.
[I 2024-01-30 22:31:06.202 ServerApp] notebook | extension was successfully linked.
[I 2024-01-30 22:31:06.203 ServerApp] Writing Jupyter server cookie secret to /home/jovyan/.local/share/jupyter/runtime/jupyter_cookie_secret
[I 2024-01-30 22:31:06.346 ServerApp] notebook_shim | extension was successfully linked.
[I 2024-01-30 22:31:06.383 ServerApp] notebook_shim | extension was successfully loaded.
[I 2024-01-30 22:31:06.385 ServerApp] jupyter_lsp | extension was successfully loaded.
[I 2024-01-30 22:31:06.386 ServerApp] jupyter_server_mathjax | extension was successfully loaded.
[I 2024-01-30 22:31:06.388 ServerApp] jupyter_server_terminals | extension was successfully loaded.
[I 2024-01-30 22:31:06.390 LabApp] JupyterLab extension loaded from /opt/conda/lib/python3.11/site-packages/jupyterlab
[I 2024-01-30 22:31:06.390 LabApp] JupyterLab application directory is /opt/conda/share/jupyter/lab
[I 2024-01-30 22:31:06.390 LabApp] Extension Manager is 'pypi'.
[I 2024-01-30 22:31:06.393 ServerApp] jupyterlab | extension was successfully loaded.
[I 2024-01-30 22:31:06.397 ServerApp] jupyterlab_git | extension was successfully loaded.

1


127.0.0.1:8889/lab
File Edit View Run Kernel Tabs Settings Help
Launcher
Filter files by name
Name
Last Modified
work
3 months ago
Notebook
Python 3 (ipykernel)
Console
Python 3 (ipykernel)
Other
Terminal
Text File
Markdown File
Python File
Show Contextual Help

2


Name
Last Modified
work
3 months ago
abc.csv
4 minutes ago
linearReg.py
4 minutes ago

3

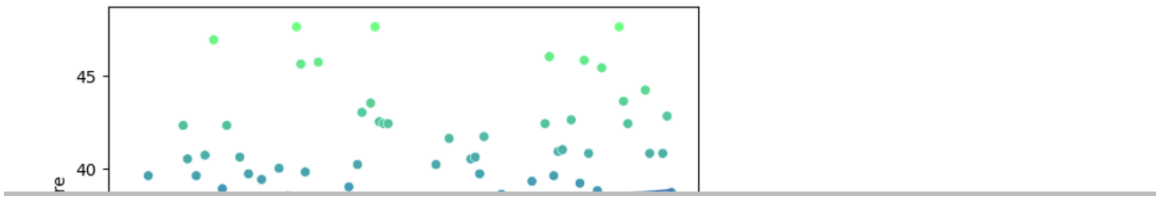
```
import numpy as np
import matplotlib.pyplot as plt
import pandas as pd
from sklearn.linear_model import LinearRegression
from sklearn.model_selection import train_test_split

a3= pd.read_csv('abc.csv')
a3
a3.columns = ['Date', 'Temperature', 'Anomaly']
a3.Date = a3.Date.floordiv(100)
#pd.set_option('precision', 2)

X_train, X_test, y_train, y_test = train_test_split(a3.Date.values.reshape(-1, 1), a3.Temperature.values,random_state=11)
X_train.shape
X_test.shape
linear_regression = LinearRegression()
linear_regression.fit(X=X_train, y=y_train)

linear_regression.coef_
predict = (lambda x: linear_regression.coef_ * x + linear_regression.intercept_)
axes = sns.scatterplot(data=a3, x='Date', y='Temperature', hue='Temperature', palette='winter', legend=False)
x = np.array([min(a3.Date.values), max(a3.Date.values)])
y = predict(x)
line = plt.plot(x, y)
print ("Coefficient: ", linear_regression.coef_)
print ("Y Intercept", linear_regression.intercept_)
a3
```

```
Coefficient:  [0.01939167]
Y Intercept -0.30779820252656265
```

[2]:

	Date	Temperature	Anomaly
0	1895	34.2	-3.2
1	1896	34.7	-2.7
2	1897	35.5	-1.9
3	1898	39.6	2.2
4	1899	36.4	-1.0
...	...	...	...
119	2014	35.5	-1.9
120	2015	36.1	-1.3
121	2016	40.8	3.4
122	2017	42.8	5.4
123	2018	38.7	1.3

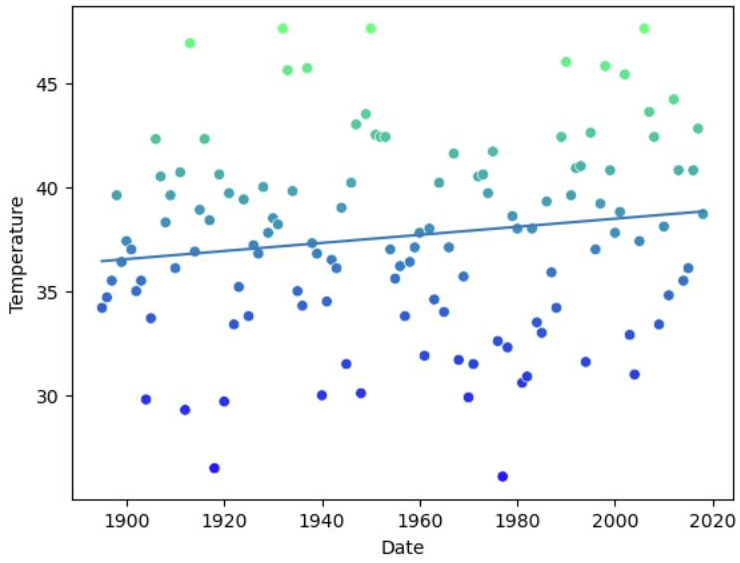
124 rows × 3 columns



4

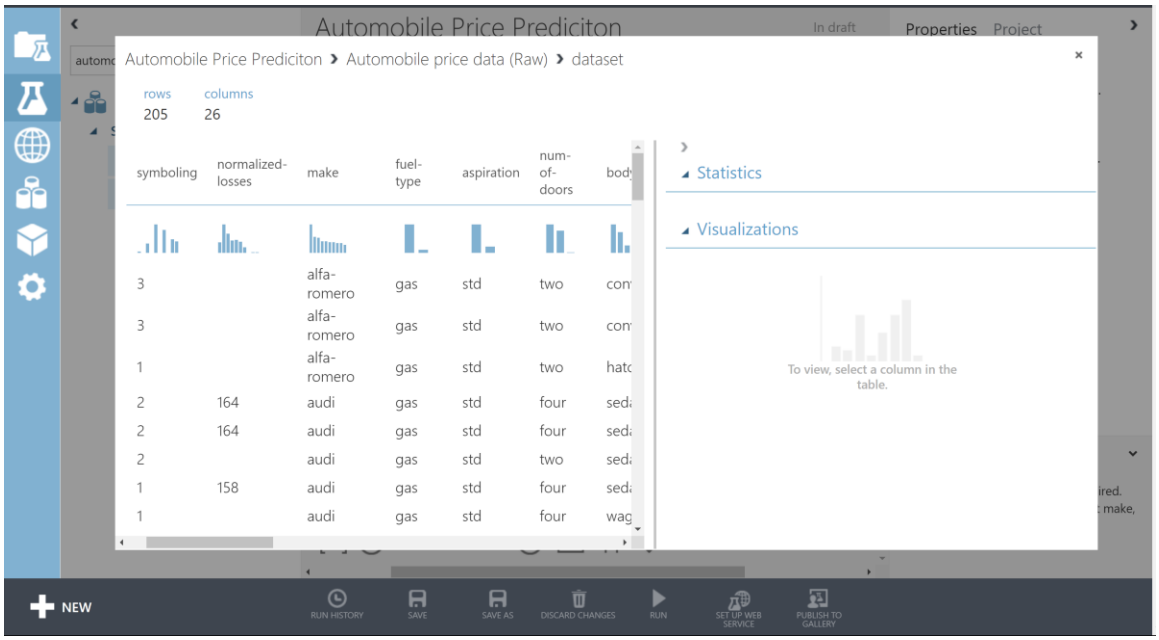
Coefficient: [0.01939167]
Y Intercept -0.30779820252656265

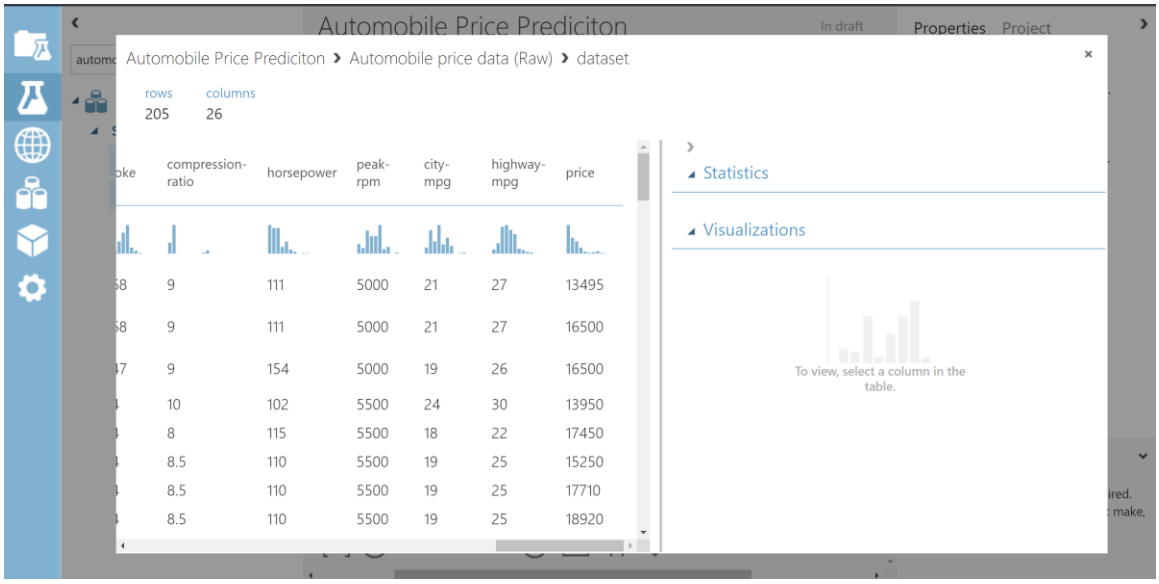
5


Temperature
45
40
35
30
1900
1920
1940
1960
1980
2000
2020
Date

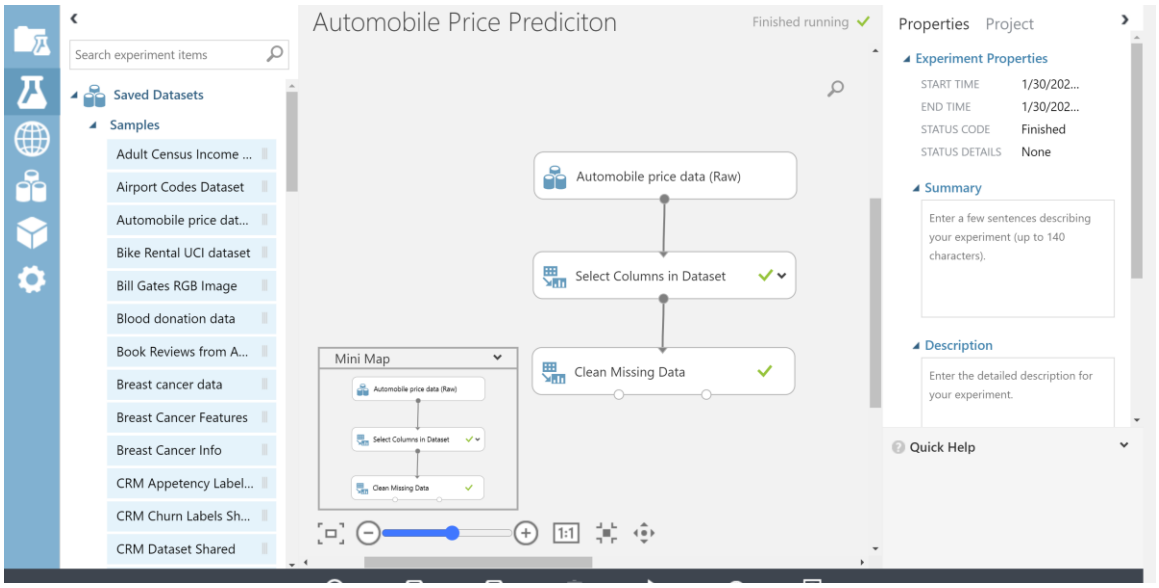
Q6

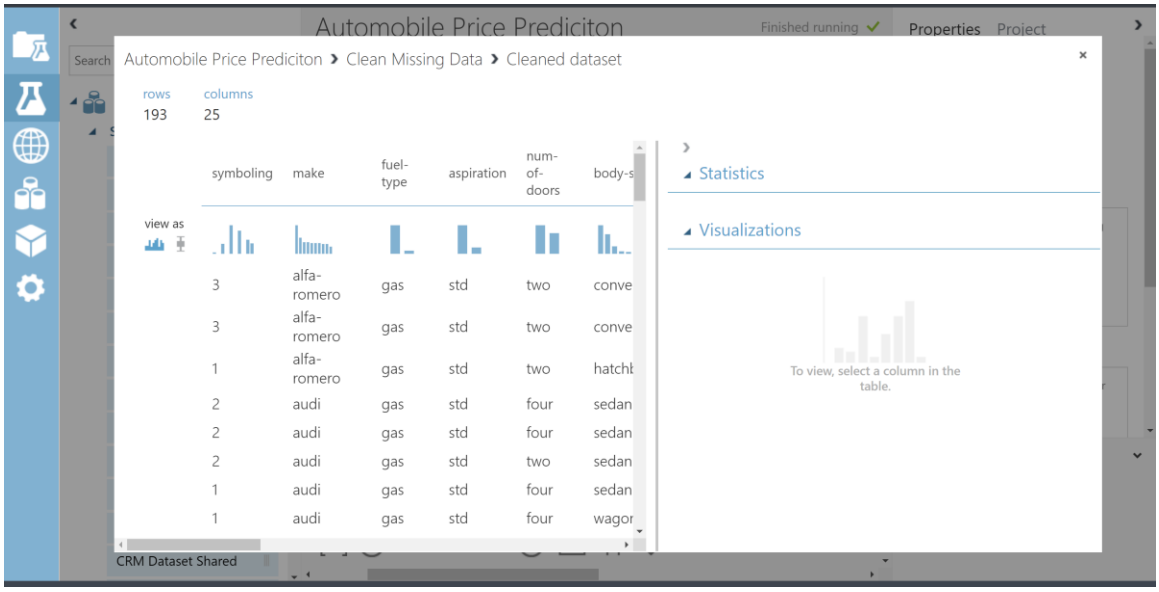
3


Automobile Price Prediciton
In draft
Properties
Project
Automobile Price Prediciton › Automobile price data (Raw) › dataset
rows
205
columns
26
symboling
normalized-losses
make
fuel-type
aspiration
num-of-doors
alfa-romero gas std two
alfa-romero gas std two
alfa-romero gas std two
2 164 audi gas std four
2 164 audi gas std four
2 audi gas std two
1 158 audi gas std four
1 audi gas std four
Statistics
Visualizations
To view, select a column in the table.
NEW
RUN HISTORY
SAVE
SAVE AS
DISCARD CHANGES
RUN
SET UP WEB SERVICE
PUBLISH TO GALLERY

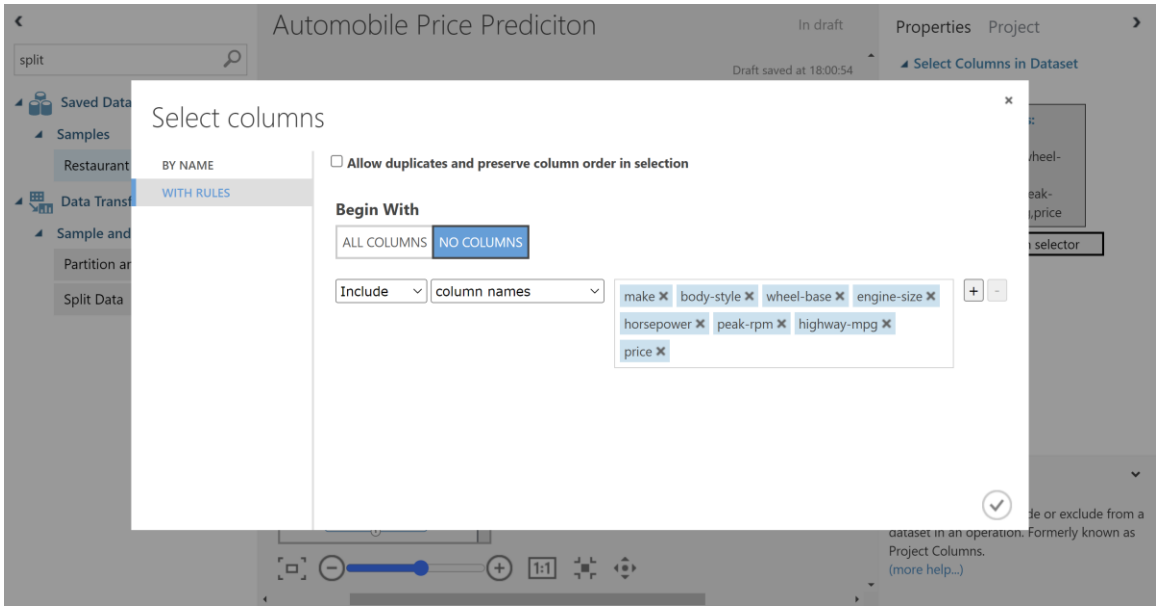

Automobile Price Prediciton
In draft
Properties
Project
Automobile Price Prediciton › Automobile price data (Raw) › dataset
rows
205
columns
26
compression-ratio
horsepower
peak-rpm
city-mpg
highway-mpg
price
9 111 5000 21 27 13495
9 111 5000 21 27 16500
9 154 5000 19 26 16500
10 102 5500 24 30 13950
8 115 5500 18 22 17450
8.5 110 5500 19 25 15250
8.5 110 5500 19 25 17710
8.5 110 5500 19 25 18920
Statistics
Visualizations
To view, select a column in the table.

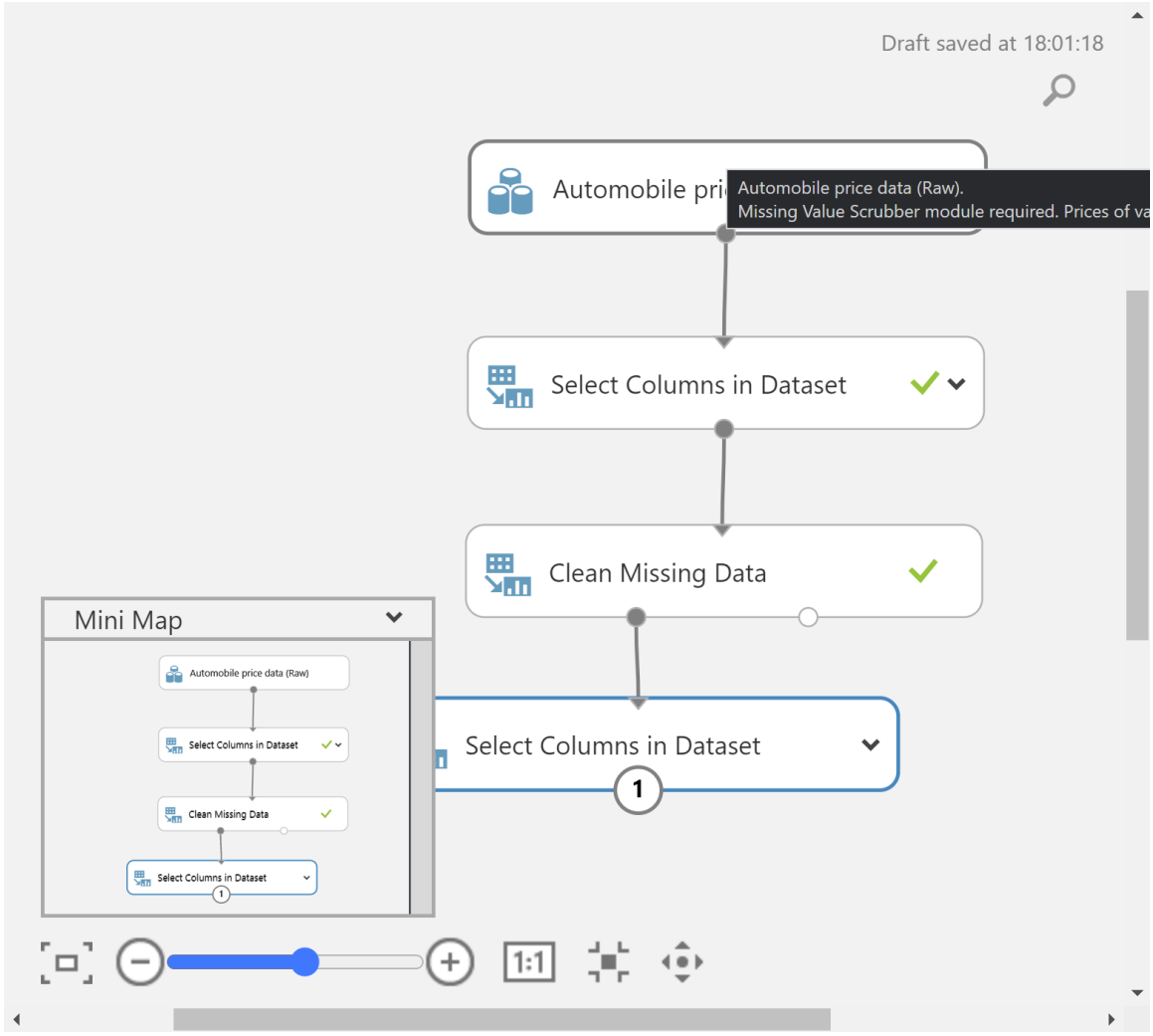
A


Search experiment items
Saved Datasets
Samples
Adult Census Income ...
Airport Codes Dataset
Automobile price dat...
Bike Rental UCI dataset
Bill Gates RGB Image
Blood donation data
Book Reviews from A...
Breast cancer data
Breast Cancer Features
Breast Cancer Info
CRM Appetency Label...
CRM Churn Labels Sh...
CRM Dataset Shared
Automobile Price Prediciton
Finished running
Automobile price data (Raw)
Select Columns in Dataset
Clean Missing Data
Mini Map
1:1
Properties
Project
Experiment Properties
START TIME 1/30/202...
END TIME 1/30/202...
STATUS CODE Finished
STATUS DETAILS None
Summary
Enter a few sentences describing your experiment (up to 140 characters).
Description
Enter the detailed description for your experiment.
Quick Help

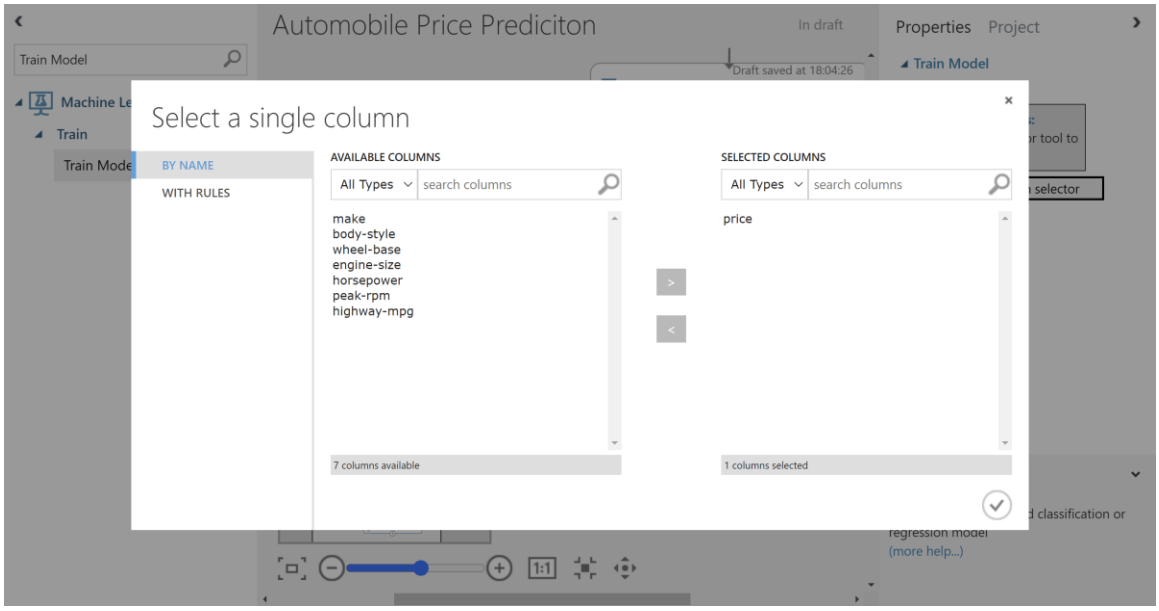

Automobile Price Prediciton
Finished running
Properties Project
Automobile Price Prediciton › Clean Missing Data › Cleaned dataset
rows 193
columns 25
symboling make fuel-type aspiration num-of-doors body-s
view as
3 alfa-romero gas std two conve
3 alfa-romero gas std two conve
1 alfa-romero gas std two hatchb
2 audi gas std four sedan
2 audi gas std four sedan
2 audi gas std two sedan
1 audi gas std four sedan
1 audi gas std four wagon
Statistics
Visualizations
To view, select a column in the table.
CRM Dataset Shared

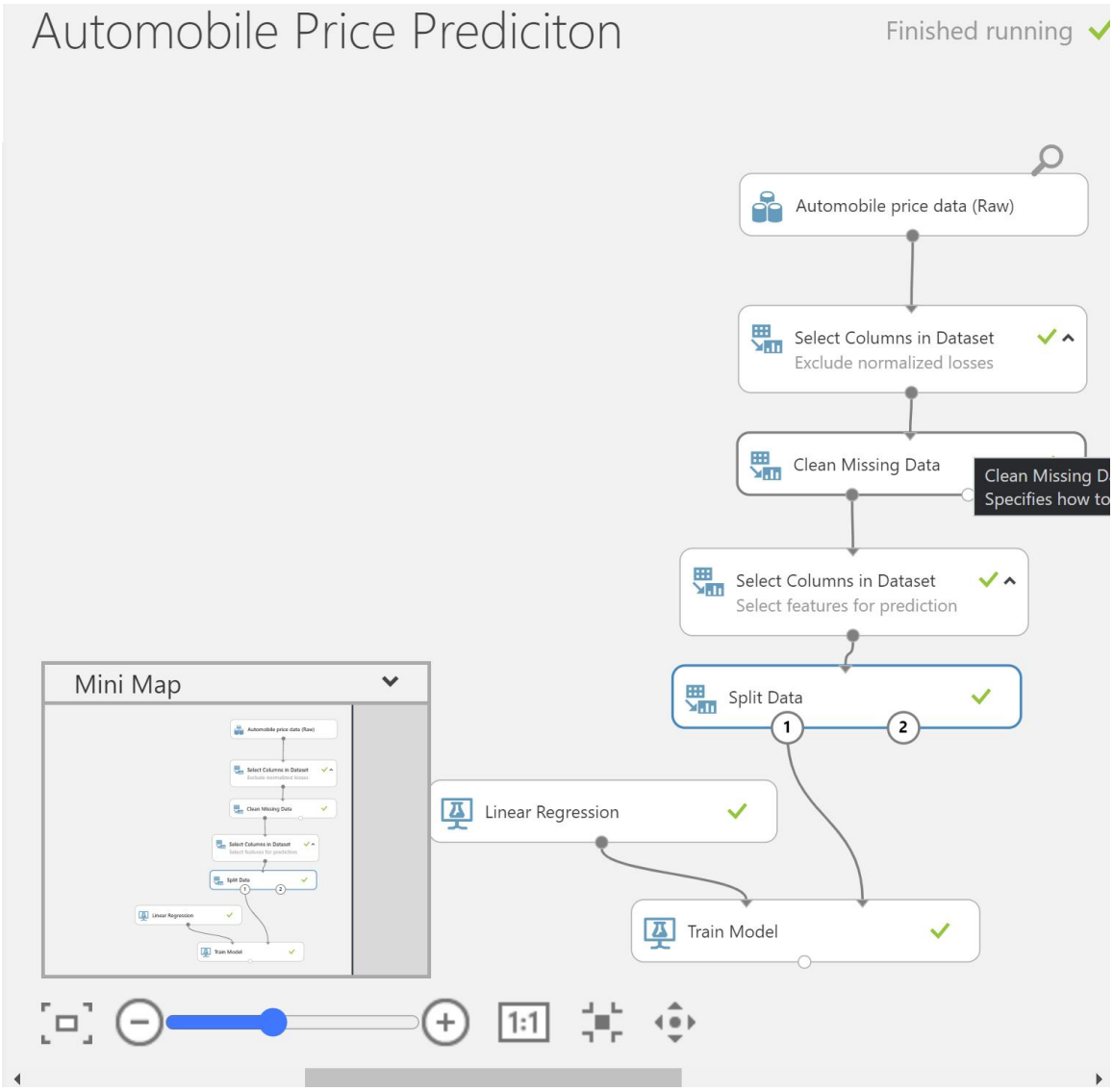
B


Automobile Price Prediciton
In draft
Draft saved at 18:00:54
Properties Project
Select Columns in Dataset
split
Saved Data
Samples
Restaurant
Data Transf
Sample and
Partition ar
Split Data
Select columns
BY NAME
WITH RULES
Allow duplicates and preserve column order in selection
Begin With
ALL COLUMNS
NO COLUMNS
Include
column names
make
body-style
wheel-base
engine-size
horsepower
peak-rpm
highway-mpg
price
dataset in an operation. Formerly known as Project Columns.
(more help...)

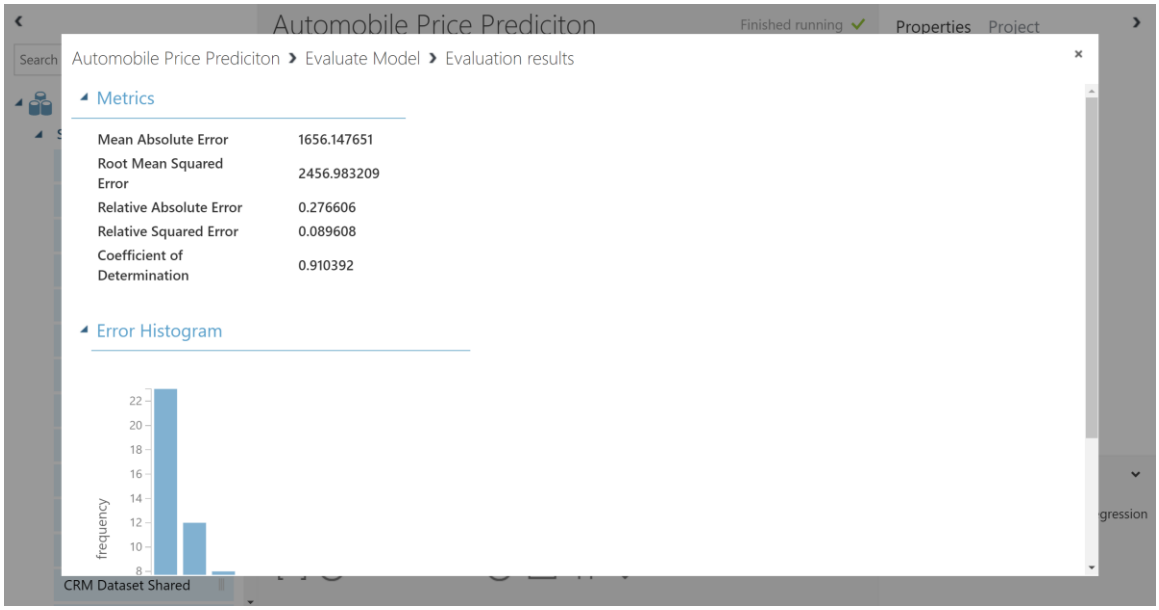

Draft saved at 18:01:18
Automobile pri
Automobile price data (Raw).
Missing Value Scrubber module required. Prices of va
Select Columns in Dataset
Clean Missing Data
Mini Map
Automobile price data (Raw)
Select Columns in Dataset
Clean Missing Data
Select Columns in Dataset
Select Columns in Dataset
1
1:1

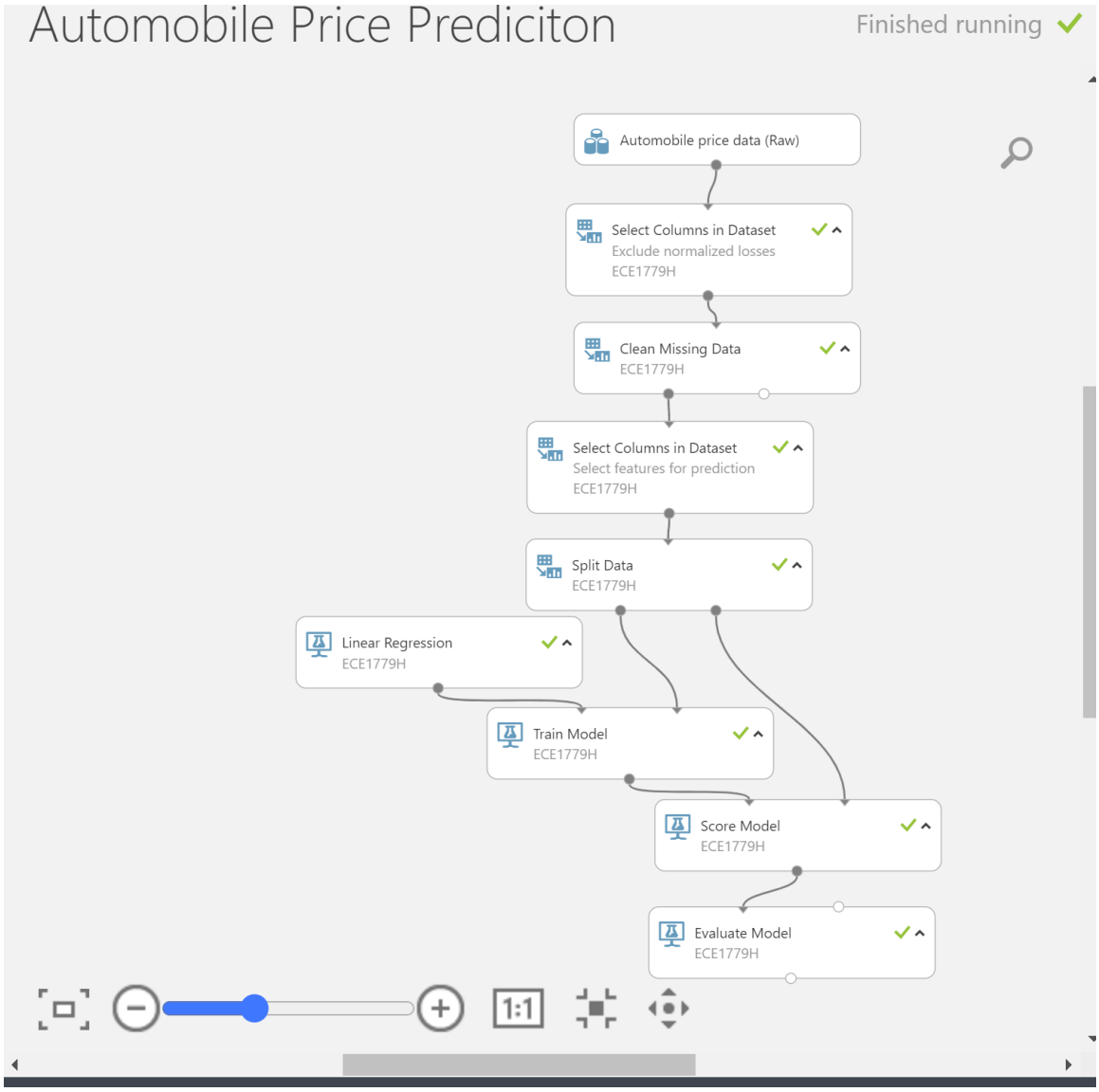
C


Automobile Price Prediciton
In draft
Properties
Project
Train Model
Draft saved at 18:04:26
Train Model
Train
Train Mode
Select a single column
BY NAME
WITH RULES
AVAILABLE COLUMNS
All Types
search columns
make
body-style
wheel-base
engine-size
horsepower
peak-rpm
highway-mpg
7 columns available
SELECTED COLUMNS
All Types
search columns
price
1 columns selected
(more help...)


Automobile Price Prediciton
Finished running
Automobile price data (Raw)
Select Columns in Dataset
Exclude normalized losses
Clean Missing Data
Clean Missing D
Specifies how to
Select Columns in Dataset
Select features for prediction
Split Data
1
2
Linear Regression
Train Model
Mini Map
1:1

D


Automobile Price Prediciton
Finished running
Properties
Project
Search
Automobile Price Prediciton › Evaluate Model › Evaluation results
Metrics
Mean Absolute Error 1656.147651
Root Mean Squared Error 2456.983209
Relative Absolute Error 0.276606
Relative Squared Error 0.089608
Coefficient of Determination 0.910392
Error Histogram
frequency
22
20
18
16
14
12
10
8
CRM Dataset Shared


Automobile Price Prediciton
Finished running
Automobile price data (Raw)
Select Columns in Dataset
Exclude normalized losses
ECE1779H
Clean Missing Data
ECE1779H
Select Columns in Dataset
Select features for prediction
ECE1779H
Split Data
ECE1779H
Linear Regression
ECE1779H
Train Model
ECE1779H
Score Model
ECE1779H
Evaluate Model
ECE1779H
1:1