

## Lab 4.1

- Take a screenshot of the site along with its Let's Encrypt certificate and include it in your lab notebook

The screenshot shows a web browser window with the URL `cs410emmanart.hopto.org`. The page title is "Guestbook". On the left, there is a yellow sidebar with the text "Odin ID: emmanart". The main content area has a heading "Entries". It displays two entries:

- Emmanuel Arthur <emmanar>  
signed on 2025-10-25
- Emmanuel Arthur <emmanart@pdx.edu>  
signed on 2025-10-25  
hi there

The screenshot shows a web browser window with the URL `cs410emmanart.hopto.org`. A modal dialog box titled "Certificate Viewer: cs410emmanart.hopto.org" is displayed. The dialog has tabs for "General" and "Details".

**General Tab:**

- Issued To:**
  - Common Name (CN): cs410emmanart.hopto.org
  - Organization (O): <Not Part Of Certificate>
  - Organizational Unit (OU): <Not Part Of Certificate>
- Issued By:**
  - Common Name (CN): R13
  - Organization (O): Let's Encrypt
  - Organizational Unit (OU): <Not Part Of Certificate>
- Validity Period:**
  - Issued On: Saturday, October 25, 2025 at 10:07:57 AM
  - Expires On: Friday, January 23, 2026 at 9:07:56 AM
- SHA-256 Fingerprints:**
  - Certificate: 55205d4e83e8d19f6f0213d7ea5b3fcfb5034a1f2e365ce0b0d7fa7f3d8917a
  - Public Key: 25faacdfdc12c8e427541f122e9662c3bdf0a28fa721c97d9a581c2ae9d83b5

## Lab 4.2

- Take a screenshot of the results for your lab notebook

The screenshot shows a Cloud Shell Editor window. At the top, there's a toolbar with icons for back, forward, search, and other browser functions. Below the toolbar is a navigation bar with links to various websites like LinkedIn, Netflix, and Indeed. The main area is titled "Cloud Shell Editor" and contains a terminal tab labeled "(cloud-arthur-emmanart)". A message in the terminal says "Terminal tabs have been recovered from an existing session." The terminal output shows a pip install command for requirements.txt, which installs several Python packages including flask, blinker, itsdangerous, click, Werkzeug, Jinja2, and MarkupSafe. It also installs a manylinux2014\_x86\_64.whl file. The command "docker images" is run, showing images for helloubuntu and ubuntu. A note card is open on the right side with the text "Ødin ID: emmanart".

```
Step 7/9 : RUN pip install -r requirements.txt
--> Running in 9a13ec3ffffe8
Collecting flask
  Downloading flask-3.0.3-py3-none-any.whl (101 kB)
Collecting blinker==1.6.2
  Downloading blinker-1.8.2-py3-none-any.whl (9.5 kB)
Collecting itsdangerous>=2.1.2
  Downloading itsdangerous-2.2.0-py3-none-any.whl (16 kB)
Collecting click==8.1.3
  Downloading click-8.1.3-py3-none-any.whl (98 kB)
Collecting Werkzeug>=3.0.0
  Downloading werkzeug-3.0.6-py3-none-any.whl (227 kB)
Collecting Jinja2>=3.1.2
  Downloading Jinja2-3.1.6-py3-none-any.whl (134 kB)
Collecting importlib-metadata>=3.6.0: python_version < "3.10"
  Downloading importlib_metadata-8.5.0-py3-none-any.whl (26 kB)
Collecting MarkupSafe>=2.1.1
  Downloading MarkupSafe-2.1.5-cp38-cp38-manylinux2014_x86_64.whl (26 kB)
Collecting zipp>=3.20
  Downloading zipp-3.20.2-py3-none-any.whl (9.2 kB)
Installing collected packages: blinker, itsdangerous, click, MarkupSafe, Werkzeug, Jinja2, zipp, importlib-metadata, flask
Successfully installed Jinja2<3.1.6 MarkupSafe<2.1.5 Werkzeug<3.0.6 blinker<1.8.2 click<8.1.8 flask<3.0.3 importlib-metadata<8.5.0 itsdangerous<2.2.0 zipp<3.20.2
--> Removed intermediate container 9a13ec3ffffe8
--> b1cfe677bdad
Step 8/9 : ENTRYPOINT ["python3"]
--> Running in 174e279d18a1
--> Removed intermediate container 174e279d18a1
--> 44f8e498bd75
Step 9/9 : CMD ["app.py"]
--> Running in 3684a29af46
--> Removed intermediate container 3684a29af46
--> d0d602db8635
Successfully built d0d602db8635
Successfully tagged helloubuntu:latest
emmanart@course-vm:~/cs430-src/04_container_dockerhub$ docker images
REPOSITORY          TAG      IMAGE ID   CREATED        SIZE
helloubuntu        latest   d0d602db8635   11 seconds ago   471MB
ubuntu              20.04   b7bab04fd9aa   6 months ago    72.8MB
emmanart@course-vm:~/cs430-src/04_container_dockerhub$ 
```

- Run the image directly from Docker Hub and show a screenshot of the output of the command in your lab notebook.

shell.cloud.google.com/?hl=en\_US&fromcloudshell=true&show=terminal

(24) "software engin... (25) "software engin... Software Developer... Careers at Netflix Job Application for... Job Application for... Job Application for... Job Application for... (24) "software engin... All Bookmarks

### Cloud Shell Editor

(cloud-arthur-emmanart) X

Gemini CLI is available in Cloud Shell! Type gemini to try it. [Learn more](#)

Don't show again Dismiss

```
latest: digest: sha256:e1e5cee21cf938ed2c3c6f167d3655add0e1ccb3bd3ebc7d11a3d3215a6fd27 size: 1373
emmanart@course-vm:/cs430-src/04_container_dockerhub$ docker images
REPOSITORY          TAG        IMAGE ID      CREATED       SIZE
emmanart/helloubuntu latest  d0d602db8635  16 minutes ago  471MB
helloubuntu        latest  d0d602db8635  16 minutes ago  471MB
ubuntu              20.04  b7ba04fd9aa   6 months ago   72.8MB
emmanart@course-vm:/cs430-src/04_container_dockerhub$ docker rmi helloubuntu emmanart/helloubuntu
Untagged: helloubuntu:latest
Untagged: emmanart/helloubuntu:latest
Untagged: emmanart/helloubuntusha256:e1e5cee21cf938ed2c3c6f167d3655add0e1ccb3bd3ebc7d11a3d3215a6fd27
Deleted: sha256:d0d602db8635@2d7607c16f729cccb0461cb0b7dcfc015b9a3bd69
Deleted: sha256:444be43bb75fbfe5aa4c1a3d219526f7e8135ac0ff6a4ed153394fa811a9773
Deleted: sha256:b1bcfe77bbadff44bcce58e72da30f884bd57514d31af260823c7190e2b7ecb
Deleted: sha256:e5b50a1398677e1837a16bd92c10ba1fd18fc064fe824b063aa32366a1402121
Deleted: sha256:6973690db9664027282df521b408bb601a11b19d5cc042e99b07330ab23501
Deleted: sha256:29f3ba0211dc79bb0048afreb0b536796ba6cc3fcfc6c8055417d85773142f0a
Deleted: sha256:776b756decbb56c6299ae5796b536796ba6cc3fcfc6c8055417d85773142f0a
Deleted: sha256:24b1e5bb134858e95123fc3904acd1a7492886e851f227f4932518748
Deleted: sha256:691ce0ea15b2a0cb5e5193ee093d8ea4001e0c961acffa5e14462da220a7
Deleted: sha256:6f2621391b516708f0f2b129ab9d2ff1b143abd5e632c791272e94069e62fe33d
Deleted: sha256:e5b50e50b27d5ce06fd65c807d04d5486fd35574941492e6a24ff222a54655b43
Deleted: sha256:f3590fe4eb1b473f760559761cef812be2e403e6955e33bce568a17ec6d52163
emmanart@course-vm:/cs430-src/04_container_dockerhub$ docker run -di -p 8000:5000 --name hellou emmanart/helloubuntu
Unable to find image 'emmanart/helloubuntu:latest' locally
latest: Pulling from emmanart/helloubuntu
13b7e930469f: Already exists
ce74f9b3f9bc: Pull complete
71384c5f850d: Pull complete
d1f3de1e9a90: Pull complete
a07cae8547ed: Pull complete
Digest: sha256:e1e5cee21cf938ed2c3c6f167d3655add0e1ccb3bd3ebc7d11a3d3215a6fd27
Status: Downloaded newer image for emmanart/helloubuntu
e7faf344122cd784842eab43f1de042a4eb5eab2762c798b5d09b82a37d98483
```

Odin ID: emmanart

- Take a screenshot of the container image and its size for your lab notebook.

**emmanart/helloubuntu:latest**

MANIFEST DIGEST sha256:e1e5cee21cf938ed2c3c6f167d3655add0e1ccb3bd3ebc7d11a3d3215a6fd27

OS/ARCH linux/amd64 COMPRESSED SIZE 168.95 MB LAST PUSHED 9 minutes by emmanart TYPE Image MANIFEST DIGEST sha256:e1e5cee2...

**Image Layers** **Vulnerabilities**

Image Layers	Command
1 ARG RELEASE	ARG RELEASE
2 ARG LAUNCHPAD_BUILD_ARCH	0 B
3 LABEL org.opencontainers.image.ref.name=ubuntu	0 B
4 LABEL org.opencontainers.image.version=20.04	0 B
5 ADD file ... in /	26.24 MB
6 CMD ["/bin/bash"]	0 B
7 LABEL maintainer=yourname@pdx.edu	0 B
8 /bin/sh -c apt-get update -y	37.9 MB
9 /bin/sh -c apt-get install -y	102.79 MB
10 COPY dir:bb6a090c8d0ed6fabdc9cfb8875b13add084586365e843e7cbd23ece7b830820 in /app	2.99 KB
11 WORKDIR /app	0 B
12 /bin/sh -c pip install -r	2.82 MB
13 ENTRYPOINT ["python3"]	0 B
14 CMD ["app.py"]	0 B

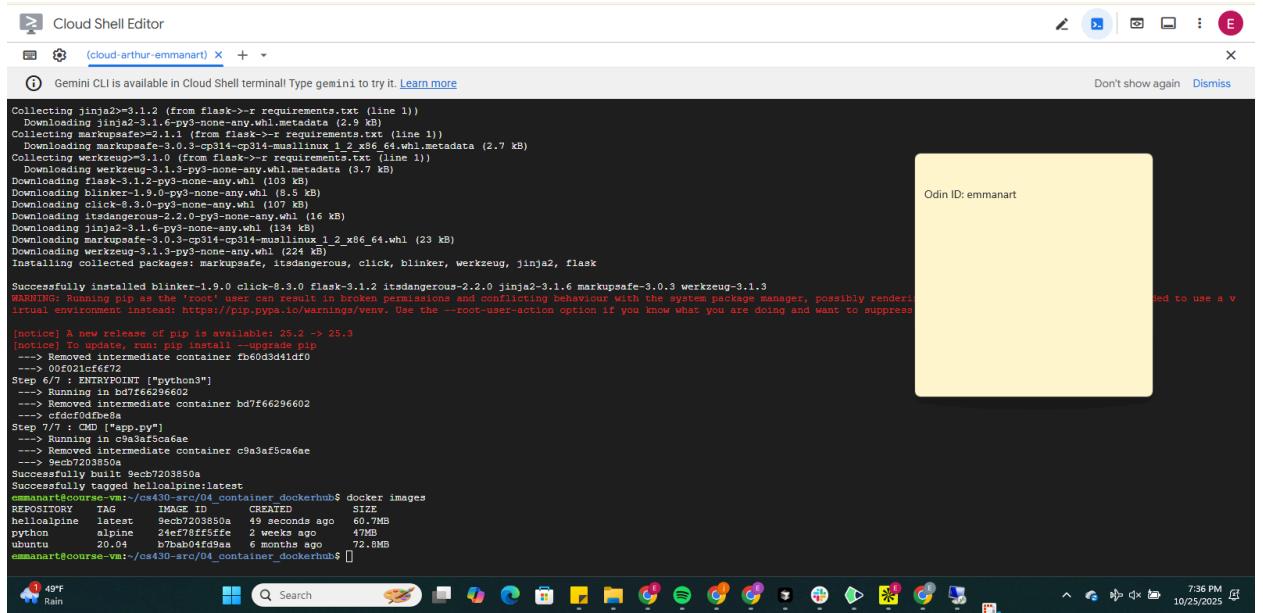
Odin ID: emmanart

- What layer adds the most to the container image? How much does it add?

The layer “ /bin/sh -c apt-get install -y” adds the most and its size is 102.79 MB

- Take a screenshot of the image generated and its size for your lab notebook. How much smaller is the image than the Ubuntu one?

The image is smaller by 12.1 MB



```

Cloud Shell Editor
(cloud-arthur-emmanart) + -
Gemini CLI is available in Cloud Shell terminal! Type gemini to try it. Learn more
Don't show again Dismiss

Odin ID: emmanart

Collecting jinja2>=2.1.2 (from flask->r requirements.txt (line 1))
  Downloading jinja2-2.1.2-py3-none-any.whl.metadata (2.9 kB)
Collecting markupsafe>2.1.1 (from flask->r requirements.txt (line 1))
  Downloading markupsafe-2.1.1-cp314-cp314-linux_x86_64.whl.metadata (2.7 kB)
Collecting itsdangerous>2.0.0 (from flask->r requirements.txt (line 1))
  Downloading werkzeug-3.1.1-py3-none-any.whl.metadata (3.7 kB)
Downloaded flask-3.1.2-py3-none-any.whl (103 kB)
Downloaded blinker-1.9.0-py3-none-any.whl (8.5 kB)
Downloaded click-8.3.0-py3-none-any.whl (107 kB)
Downloaded itsdangerous-2.0.0-py3-none-any.whl (16 kB)
Downloaded werkzeug-3.1.1-py3-none-any.whl (103 kB)
Downloaded markupsafe-3.0.3-cp314-cp314-linux_x86_64.whl (23 kB)
Downloaded werkzeug-3.1.1-py3-none-any.whl (224 kB)
Installing collected packages: markupsafe, itsdangerous, click, blinker, werkzeug, jinja2, flask
Successfully installed blinker-1.9.0 click-8.3.0 flask-3.1.2 itsdangerous-2.0.0 jinja2-3.1.1 markupsafe-3.0.3 werkzeug-3.1.3
WARNING: Running pip as the 'root' user can result in broken permissions and conflicting behavior with the system package manager, possibly rendering your environment instead of https://pip.pypa.io/warnings/venv. Use the --root-user-action option if you know what you are doing and want to suppress this warning.

[notice] A new release of pip is available: 25.2 → 25.3
[notice] To update, run: pip install --upgrade pip
--> Removed intermediate container fb60d3d41df0
--> removed 1 images
Step 6/7 : ENTRYPOINT ["python3"]
--> Running in bd7f66296602
--> Removed intermediate container bd7f66296602
--> cfdcf0d4fb8a
Step 7/7 : CMD ["app.py"]
--> Running in c9a3af5ca6ae
--> Removed intermediate container c9a3af5ca6ae
--> Sealed
Successfully built 9ech7203850a
Successfully tagged helloalpine:latest
emmanart@coursevm:~/cs430/src/04_container_dockerhub$ docker images
REPOSITORY          TAG        IMAGE ID            CREATED             SIZE
helloalpine         latest    9ech7203850a   49 seconds ago   60.7MB
python              alpine     24ef78ff55fe   2 weeks ago      47MB
ubuntu              20.04    b7bab04fd9aa   6 months ago     72.8MB
emmanart@coursevm:~/cs430/src/04_container_dockerhub$ 
```

- Show the output of this command in a screenshot for your lab notebook. What might have happened?

Cloud Shell Editor

(cloud-arthur-emmanart) + -

Gemini CLI is available in Cloud Shell terminal! Type gemini to try it. [Learn more](#)

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```
Downloading blinker-1.9.0-py3-none-any.whl (8.5 kB)
Downloading click-8.3.0-py3-none-any.whl (107 kB)
Downloading itsdangerous-2.2.0-py3-none-any.whl (136 kB)
Downloaded itsdangerous-2.2.0-py3-none-any.whl (134 kB)
Downloading markupsafe-3.0.3-cp314-cos14-musllinux 1.2_x86_64.whl (23 kB)
Downloading werkzeug-3.1.3-py3-none-any.whl (224 kB)
Installing collected packages: markupsafe, itsdangerous, click, blinker, werkzeug, jinja2, flask
Successfully installed blinker-1.9.0 click-8.3.0 flask-3.1.2 itsdangerous-2.2.0 jinja2-3.1.6 markupsafe-3.0.3 werkzeug-3.1.3
WARNING: Running pip as the 'root' user can result in broken permissions and conflicting behaviour with the system package manager, possibly rendering your environment unstable. We recommend you use the --root-user-action option if you know what you are doing and want to suppress this warning.

[notice] A new release of pip is available: 25.2 -> 25.3
[notice] To update, run: pip install --upgrade pip
---> Removed intermediate container fb60d3d41df0
--> 00f021cff6f72
Step 6/7 : ENTRYPOINT ["python3"]
--> Running in bd7f66296602
--> Removed intermediate container bd7f66296602
--> cfdfcf0fbef8
Step 7/7 : CMD ["app.py"]
--> Running in c9a3af5ca6ae
--> Removed intermediate container c9a3af5ca6ae
--> 9ecb7203850a
Successfully built 9ecb7203850a
Successfully tagged helloalpine:latest
emmanart@course-vm:~/cs430/src/04_container_dockerhub$ docker images
REPOSITORY TAG IMAGE ID CREATED SIZE
helloalpine latest 9ecb7203850a 49 seconds ago 60.7MB
python alpine 24ef78ff5ffe 2 weeks ago 47MB
ubuntu 20.04 b7bab04fd9aa 6 months ago 72.6MB
emmanart@course-vm:~/cs430/src/04_container_dockerhub$ docker run -p 8000:5000 --name hellosa -di helloalpine
49a150b6924d70578db36df377a6bae46f571ea22b7c45ca8ee38822a12c9a
emmanart@course-vm:~/cs430/src/04_container_dockerhub$ docker ps -a
CONTAINER ID IMAGE COMMAND CREATED STATUS PORTS NAMES
49a150b6924d helloalpine "python3 app.py" 15 seconds ago Up 14 seconds 0.0.0.0:8000->5000/tcp, (::):8000->5000/tcp hellosa
emmanart@course-vm:~/cs430/src/04_container_dockerhub$ docker exec -it hellosa /bin/bash
OCI runtime exec failed: exec failed: unable to start container process: exec: "/bin/bash": stat /bin/bash: no such file or directory: unknown
emmanart@course-vm:~/cs430/src/04_container_dockerhub$ 
```

Odin ID: emmanart

Maybe what happened was we thought this Alpine image was a bash kind of linux.

- Take a screenshot of the output of each

Cloud Shell Editor

(cloud-arthur-emmanart) + -

Gemini CLI is available in Cloud Shell terminal! Type gemini to try it. [Learn more](#)

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```
[notice] A new release of pip is available: 25.2 -> 25.3
[notice] To update, run: pip install --upgrade pip
---> Removed intermediate container fb60d3d41df0
--> 00f021cff6f72
Step 6/7 : ENTRYPOINT ["python3"]
--> Running in bd7f66296602
--> Removed intermediate container bd7f66296602
--> cfdfcf0fbef8
Step 7/7 : CMD ["app.py"]
--> Running in c9a3af5ca6ae
--> Removed intermediate container c9a3af5ca6ae
--> 9ecb7203850a
Successfully built 9ecb7203850a
Successfully tagged helloalpine:latest
emmanart@course-vm:~/cs430/src/04_container_dockerhub$ docker images
REPOSITORY TAG IMAGE ID CREATED SIZE
helloalpine latest 9ecb7203850a 49 seconds ago 60.7MB
python alpine 24ef78ff5ffe 2 weeks ago 47MB
ubuntu 20.04 b7bab04fd9aa 6 months ago 72.6MB
emmanart@course-vm:~/cs430/src/04_container_dockerhub$ docker run -p 8000:5000 --name hellosa -di helloalpine
49a150b6924d70578db36df377a6bae46f571ea22b7c45ca8ee38822a12c9a
emmanart@course-vm:~/cs430/src/04_container_dockerhub$ docker ps -a
CONTAINER ID IMAGE COMMAND CREATED STATUS PORTS NAMES
49a150b6924d helloalpine "python3 app.py" 15 seconds ago Up 14 seconds 0.0.0.0:8000->5000/tcp, (::):8000->5000/tcp hellosa
emmanart@course-vm:~/cs430/src/04_container_dockerhub$ docker exec -it hellosa /bin/bash
OCI runtime exec failed: exec failed: unable to start container process: exec: "/bin/bash": stat /bin/bash: no such file or directory: unknown
emmanart@course-vm:~/cs430/src/04_container_dockerhub$ docker exec -it hellosa /bin/sh
/app # cat /etc/alpine-release
3.22.2
/app # ps -ef
PID USER TIME COMMAND
 1 root    0:00 python3 app.py
 7 root    0:00 /usr/local/bin/python3 -c from multiprocessing.resource_tracker import main;main(5)
 8 root    0:01 /usr/local/bin/python3 app.py
 9 root    0:00 /usr/local/bin/python3 -c from multiprocessing.resource_tracker import main;main(6)
18 root    0:00 /bin/sh
25 root    0:00 ps -ef
/app # 
```

Odin ID: emmanart

- Take a screenshot of the container image and its size.

The screenshot shows the Docker Hub interface for the image `emmanart/helloalpine:latest`. At the top, there's a summary card with the image icon, the tag name, manifest digest, compressed size (21.62 MB), last pushed time (3 minutes ago by `emmanart`), type (Image), and manifest digest again. To the right is a red "Delete Tag" button and a yellow star icon. Below this, there are tabs for "Image Layers" (which is selected) and "Vulnerabilities". The "Image Layers" section lists the build steps:

Step	Command	Size
1	<code>ADD alpine-miniroots-3.22.2-x86_64.tar.gz / # buildkit</code>	3.63 MB
2	<code>CMD ["/bin/sh"]</code>	0 B
3	<code>ENV PATH=/usr/local/bin:/usr/local/sbin:/usr/local/bin:/usr/sbin:/usr/bin:/sbin..</code>	0 B
4	<code>RUN /bin/sh -c set -eux;</code>	446.21 kB
5	<code>ENV PYTHON_VERSION=3.14.0</code>	0 B
6	<code>ENV PYTHON_SHA256=+2299dae542d395ce3883aca00d3c910307cd68e0b2f7336098c8e7b7eee9f..</code>	0 B
7	<code>RUN /bin/sh -c set -eux;</code>	12.61 MB
8	<code>RUN /bin/sh -c set -eux;</code>	250 B
9	<code>CMD ["python3"]</code>	0 B
10	<code>LABEL maintainer=emmanart@pdx.edu</code>	0 B

A yellow callout box highlights the command `ADD alpine-miniroots-3.22.2-x86_64.tar.gz / # buildkit` and the text "Odin ID: emmanart".

- Take a screenshot of the entry that includes the VM's external IP address for your lab notebook

The screenshot shows a web browser window with the URL `34.105.39.150`. The page displays a guestbook entry from Emmanuel Arthur. The entry includes the email `<emmanart@pdx.edu>`, the signing date `signed on 2025-10-26`, and the message `Hello Compute Engine + Docker`. A yellow callout box highlights the text "Odin ID: emmanart".