3、Docker images deeply understand and publish images

The operating environment and software and hardware reference configurations are as follows:

- REFERENCE MODEL: ROSMASTER X3
- Robot hardware configuration: Arm series main control, Silan A1 lidar, AstraPro Plus depth camera
- Robot system: Ubuntu (version not required) + docker (version 20.10.21 and above)
- PC Virtual Machine: Ubuntu (20.04) + ROS2 (Foxy)
- Usage scenario: Use on a relatively clean 2D plane

3.1、image understanding

1. An image is a lightweight, executable stand-alone software package that contains everything needed to run a piece of software. We package applications and configurations into a ready, deliverable, deployable runtime environment, including code, libraries, environment variables and configuration files required for runtime, and this large package runtime environment is the image image file.
2. Docker container instances can only be generated through image files.

3.2、UnionFS（Federated file systems)

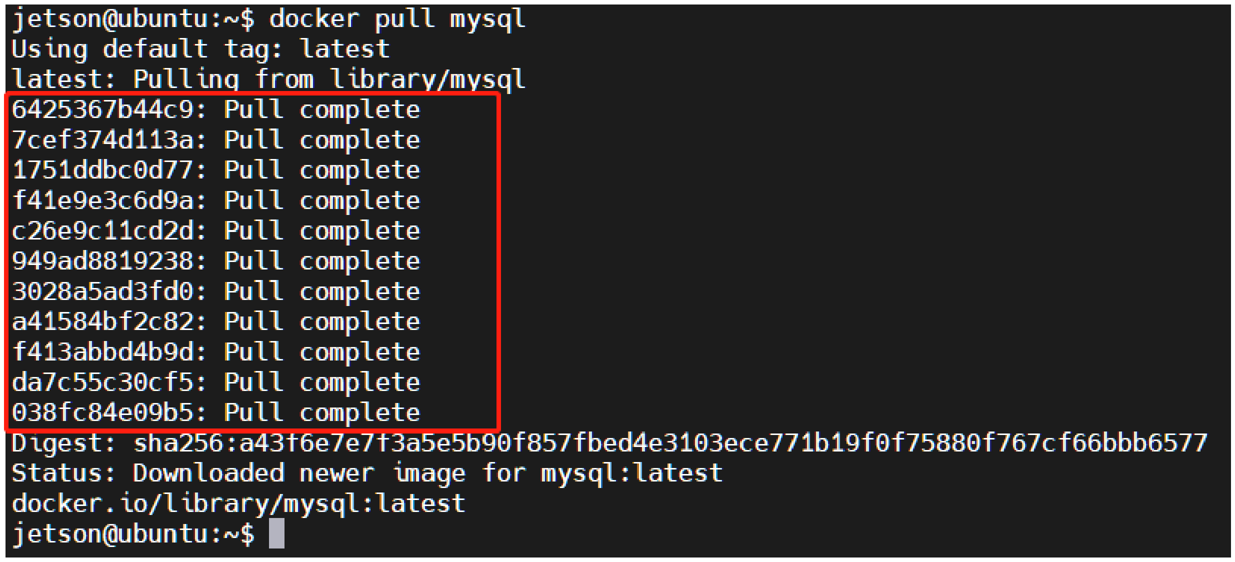
1.Union file system (UnionFS) is a hierarchical, lightweight, high-performance file system, it is the basis of docker images, and supports the modification of the file system as a commit to overlay layer by layer, while different directories can be mounted under the same virtual file system.

2.The image can be inherited through layering, and based on the basic image, various specific application images can be made.

Features of the Union file system: load multiple file systems at the same time, but from the outside, only one file system can be seen; Federated loading overlays the layers of file systems so that the final file system contains files and directories for all layers.

3.3、image layering

When downloading an image, pay attention to the downloaded log output, you can see that it is downloading layer by layer:



```
jetson@ubuntu:~$ docker pull mysql
Using default tag: latest
latest: Pulling from library/mysql
6425367b44c9: Pull complete
7cef374d113a: Pull complete
1751ddbc0d77: Pull complete
f41e9e3c6d9a: Pull complete
c26e9c11cd2d: Pull complete
949ad8819238: Pull complete
3028a5ad3fd0: Pull complete
a41584bf2c82: Pull complete
f413abbd4b9d: Pull complete
da7c55c30cf5: Pull complete
038fc84e09b5: Pull complete
Digest: sha256:a43f6e7e7f3a5e5b90f857fbed4e3103ece771b19f0f75880f767cf66bbb6577
Status: Downloaded newer image for mysql:latest
docker.io/library/mysql:latest
jetson@ubuntu:~$
```

```
# The way to view image layering can be done with the command: docker image inspect
image name
jetson@ubuntu:~$ docker image inspect mysql:latest
[
    {
        "Id":
"sha256:5371f8c3b63eec64a33b35530be5212d6148e0940111b57b689b5ba1ffe808c8",
        .........
        "RootFS": {
            "Type": "layers",
            "Layers": [

"sha256:d6d4fc6aef875958d6186f85f03d88e6bb6484ab2dd56b30a79163baceff2f6d",

"sha256:05c3b0b311a02bc56ca23105a76d16bc9b8c1d3e6eac808f4efb1a2e8350224b",

"sha256:7b80f7f05642477ebc7d93de9539af27caab7c41a768db250fe3fe2b5506ca2c",

"sha256:50e037faefab22cb1c75e60abb388b823e96a845650f3abd6d0a27e07a5a1d5e",

"sha256:66040abb3f7201d2cc64531349a8225412db1029447a9431d59d999c941d56f6",

"sha256:857162425652837a362aa5f1c3d4974cc83702728793de52ba48176d5367a89b",

"sha256:7eebed3016f6b6ab68aa8e6be35f0689a3c18d331b7b542984a0050b859eaf26",

"sha256:2fc4c142633d57d795edc0f3fd457f99a35fa611eab8b8c5d75c66e6eb729bc2",

"sha256:7fde2d12d484f0c14dabd9ca845da0bcdaf60bd773a58ca2d73687473950e7fe",

"sha256:9319848a00d38e15b754fa9dcd3b6e77ac8506850d32d8af493283131b9745a3",
"sha256:5ff94d41f068ea5b52244393771471edb6a9a10f7a4ebafda9ef6629874a899b"
            ]
        },
        "Metadata": {
            "LastTagTime": "0001-01-01T00:00:00Z"
        }
    }
]
```

3.3.1、hierarchical understanding

- All docker images start from a base image layer, and when modifications or additions are made, a new image layer will be created on top of the current image layer.
- For a simple example, if a new image is created based on Ubuntu 20.04, this is the first layer of the new image; If you add a Python package to the image, a second image layer is created on top of the base image layer; If you continue to add a security patch, a third mirror layer is created.
- Docker images are all read-only, and when the container starts, a new writable layer is loaded on top of the image! This layer is what we usually call the container layer, and what is under the container is called the image layer!

3.3.2、Docker images should use layering benefits

Resource sharing, for example, if there are multiple images built from the same base image, then the host only needs to keep a base image on disk, and only one base image needs to be loaded in memory, so that all containers can be served, and each layer of the image can be shared.

3.4、Make and publish images

3.4.1、Make an image

Method 1: Submit an image from the container:

```
# command
docker commit -m="description of commit" -a="author" container id Target image name
to be created: [tag name] [You can also omit the -m -a parameter]

# Test
jetson@ubuntu:~$ docker ps -a
CONTAINER ID   IMAGE           COMMAND       CREATED       STATUS
PORTS     NAMES
c54bf9efae47   ubuntu:latest   "/bin/bash"   3 hours ago   Up 24 minutes
         funny_hugle
3b9c01839579   hello-world     "/hello"      3 hours ago   Exited (0) 3 hours ago
          jovial_brown
jetson@ubuntu:~$ docker commit c54bf9efae47 ubuntu:1.0
sha256:78ca7be949b6412f74ba12e8d16bd548aaa7c3fa25134326db3a67784f848f8f
jetson@ubuntu:~$ docker images   # Generated the ubuntu:1.0 image
REPOSITORY                   TAG       IMAGE ID       CREATED         SIZE
```

```
ubuntu                           1.0       78ca7be949b6   5 seconds ago    69.2MB
yahboomtechnology/ros-foxy       3.4.0     49581aa78b6b   5 hours ago      24.3GB
yahboomtechnology/ros-foxy       3.3.9     cefb5ac2ca02   4 days ago       20.5GB
yahboomtechnology/ros-foxy       3.3.8     49996806c64a   4 days ago       20.5GB
yahboomtechnology/ros-foxy       3.3.7     8989b8860d17   5 days ago       17.1GB
yahboomtechnology/ros-foxy       3.3.6     326531363d6e   5 days ago       16.1GB
ubuntu                           latest    bab8ce5c00ca   6 weeks ago      69.2MB
hello-world                      latest    46331d942d63   13 months ago    9.14kB
```

Method 2: Make an image from a dockerfile:

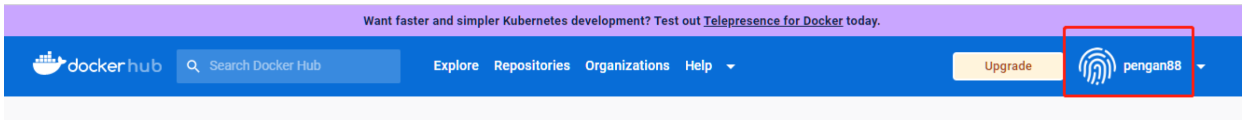
```
# command
docker build -f dockerfile file path -t new image name: TAG .  # The docker build
command has a .     Represents the current directory
# Test
docker build -f dockerfile-ros2 -t yahboomtechnology/ros-foxy:1.2 .

For more information on writing dockerfiles, please refer to:
https://docs.docker.com/develop/develop-images/dockerfile_best-practices/
```

3.4.2、Publish the image

The docker repository is a centralized storage place for image files. The largest public repository is Docker Hub (https://hub.docker.com/), which houses a huge number of images for users to download. Domestic public warehouses include Alibaba Cloud, NetEase Cloud, etc.

Steps to publish the image to docker hub:

1. Address: https://hub.docker.com/, register an account first
2. Ensure that the account can log in normally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docker hub
Search Docker Hub
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pengan88

3. Use the tag command to modify the image name

The specification for publishing an image to docker hub is:

```
docker push registration username/image name
```

For example, my registered username here is: pengan88, then you must first change the image name

```
# Command:
The name of the image after the docker tag image ID is modified

# Test
jetson@ubuntu:~$ docker images
REPOSITORY                       TAG       IMAGE ID       CREATED          SIZE
ubuntu                           1.0       78ca7be949b6   5 seconds ago    69.2MB
ubuntu                           latest    bab8ce5c00ca   6 weeks ago      69.2MB
```

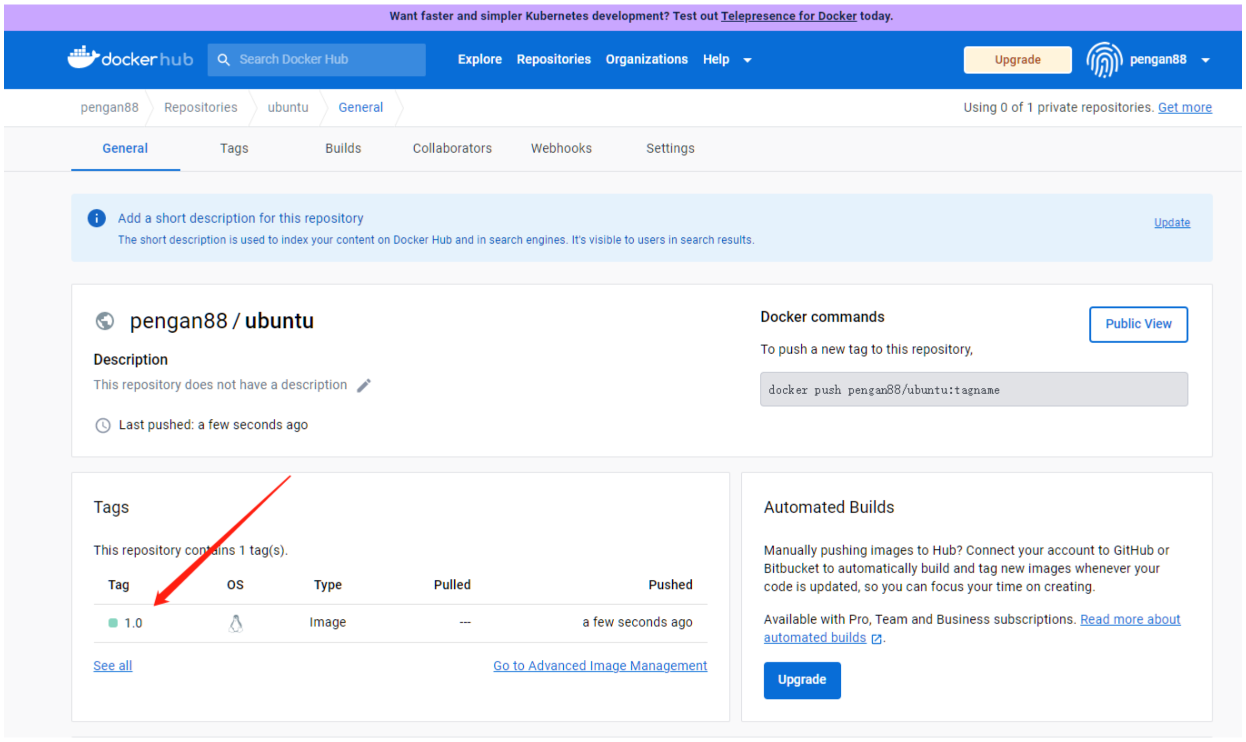
```
hello-world                 latest    46331d942d63   13 months ago   9.14kB
jetson@ubuntu:~$ docker tag 78ca7be949b6 pengan88/ubuntu:1.0
jetson@ubuntu:~$ docker images
REPOSITORY                  TAG       IMAGE ID       CREATED          SIZE
pengan88/ubuntu             1.0       78ca7be949b6   23 minutes ago   69.2MB
ubuntu                      1.0       78ca7be949b6   23 minutes ago   69.2MB
ubuntu                      latest    bab8ce5c00ca   6 weeks ago      69.2MB
hello-world                 latest    46331d942d63   13 months ago    9.14kB
```

4. Log in to Docker Hub to publish the image:

```
jetson@ubuntu:~$ docker login -u pengan88
Password:     # Enter the password of the account registered by Docker Hub here
WARNING! Your password will be stored unencrypted in
/home/jetson/.docker/config.json.
Configure a credential helper to remove this warning. See
https://docs.docker.com/engine/reference/commandline/login/#credentials-store

Login Succeeded
jetson@ubuntu:~$ docker push pengan88/ubuntu:1.0
The push refers to repository [docker.io/pengan88/ubuntu]
ca774712d11b: Pushed
874b048c963a: Mounted from library/ubuntu
1.0: digest: sha256:6767d7949e1c2c2adffbc5d3c232499435b95080a25884657fae366ccb71394d
size: 736
```

5、Visit Docker Hub to see that it has been successfully released



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Using 0 of 1 private repositories. Get more

Add a short description for this repository
The short description is used to index your content on Docker Hub and in search engines. It's visible to users in search results.

pengan88 / **ubuntu**

Description
This repository does not have a description

Last pushed: a few seconds ago

Docker commands
To push a new tag to this repository,

```
docker push pengan88/ubuntu:tagname
```

Tags

This repository contains 1 tag(s).

Tag	OS	Type	Pulled	Pushed
1.0		Image	---	a few seconds ago

Automated Builds

Manually pushing images to Hub? Connect your account to GitHub or Bitbucket to automatically build and tag new images whenever your code is updated, so you can focus your time on creating.

Available with Pro, Team and Business subscriptions. Read more about automated builds.