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Lecture 3, Cloud (€/$ aspects), containers

Content

- General course matters
- Economy of cloud
- Containers

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About you

- I have now 69 names, of which 8 have cancelled and 5 have not been responding to my emails.
- 58 of you answered to background questonary

- I still hope that clearly over 50 students finally pass the course

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About the timetable

- 15.09/22.09/29.09: Docker exercise
- 22.09/29.09/05.10: Docker compose exercise
- 29.09/05.10/12.10: Ansible exercise
- 05.10/12.10/19.10: Message Queue exercise

Dates:

- Open to students
- Last day to return to gain full points
- Last dat to get any point

Day ends 23:55.59 local Finnish time

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Our tools

- Use of course-gitlab is recommened
- I will create repos this week
- A linux virtual machine is needed in the course
- In case you do not have access to one, let me know

Next exercise (preliminary information)

In this exercise you will create a simple docker file and run in.

Your task is to

- implement a simple “Hello, World” application in any programming language you wish. I hope to see many!
- Create Dockerfile that runs this application (need to have a compiler or runtime for the selected programming language)
- Build the docker image and run it.

Your return should include three things

- Content of the Dockerfile
- Output of “docker history” of your created image
- Source code of the application

In addition, we may ask you to answer couple questions. These answers are not graded, but they are used to develop this course.

**DEADLINE FOR FULL POINTS IS 22.09.2020. THIS SECTION CLOSES 18.09.2020. **

Links to Docker material can be found from <https://plus.tuni.fi/comp.se.140/fall-2020/c01_intro/03_material/>

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About the economic size

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Example from https://aws.amazon.com/ec2/pricing/ (as of 13.09.2021)

- Free tier
  - AWS Free Tier includes 750 hours of Linux and Windows t2.micro instances, (t3.micro for the regions in which t2.micro is unavailable) each month for one year. To stay within the Free Tier, use only EC2 Micro instances.
- On-Demand
  - With On-Demand instances, you pay for compute capacity by the hour or the second depending on which instances you run.
- Spot instances
  - Amazon EC2 Spot instances allow you to request spare Amazon EC2 computing capacity for up to 90% off the On-Demand price.
- Reserved Instances
  - provide you with a significant discount (up to 72%) compared to On-Demand Instance pricing. In addition, when Reserved Instances are assigned to a specific Availability Zone, they provide a capacity reservation, giving you additional confidence in your ability to launch instances when you need them.

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AWS Free tier

- 750 hours /month of Linux
- Database and other services

Name	vCPUs	Memory (GiB)	Baseline Performance/v CPU	CPU Credits earned/hr	Network burst bandwidth (Gbps)	EBS burst bandwidth (Mbps)	On-Demand Price/hr*	1-yr Reserved Instance Effective Hourly*	3-yr Reserved Instance Effective Hourly*
t3.nano	2	0.5	5%	6	5	Up to 2,085	$0.0052	$0.003	$0.002
t3.micro	2	1.0	10%	12	5	Up to 2,085	$0.0104	$0.006	$0.005
t3.small	2	2.0	20%	24	5	Up to 2,085	$0.0209	$0.012	$0.008
t3.medium	**2**	**4.0**	**20%**	**24**	**5**	**Up to 2,085**	**$0.0418**	**$0.025**	**$0.017**
t3.large	2	8.0	30%	36	5	Up to 2,780	$0.0835	$0.05	$0.036
t3.xlarge	4	16.0	40%	96	5	Up to 2,780	$0.1670	$0.099	$0.067
t3.2xlarge	8	32.0	40%	192	5	Up to 2,780	$0.3341	$0.199	$0.133

Lets calculate a bit

One year plan

- Reserved Instance Price/hr*: 0.025$
- There are 24*365 = 8760 hours / year

⇒219 $ / year

Three year plan

- Reserved Instance : 0.017
- 26295h

=> 447$ / 3 years

On demand

- Price/hr*: 0.0418$
- There are 24*365 = 8760 hours / year

⇒353 $ / year

⇒1061$ / 3 years

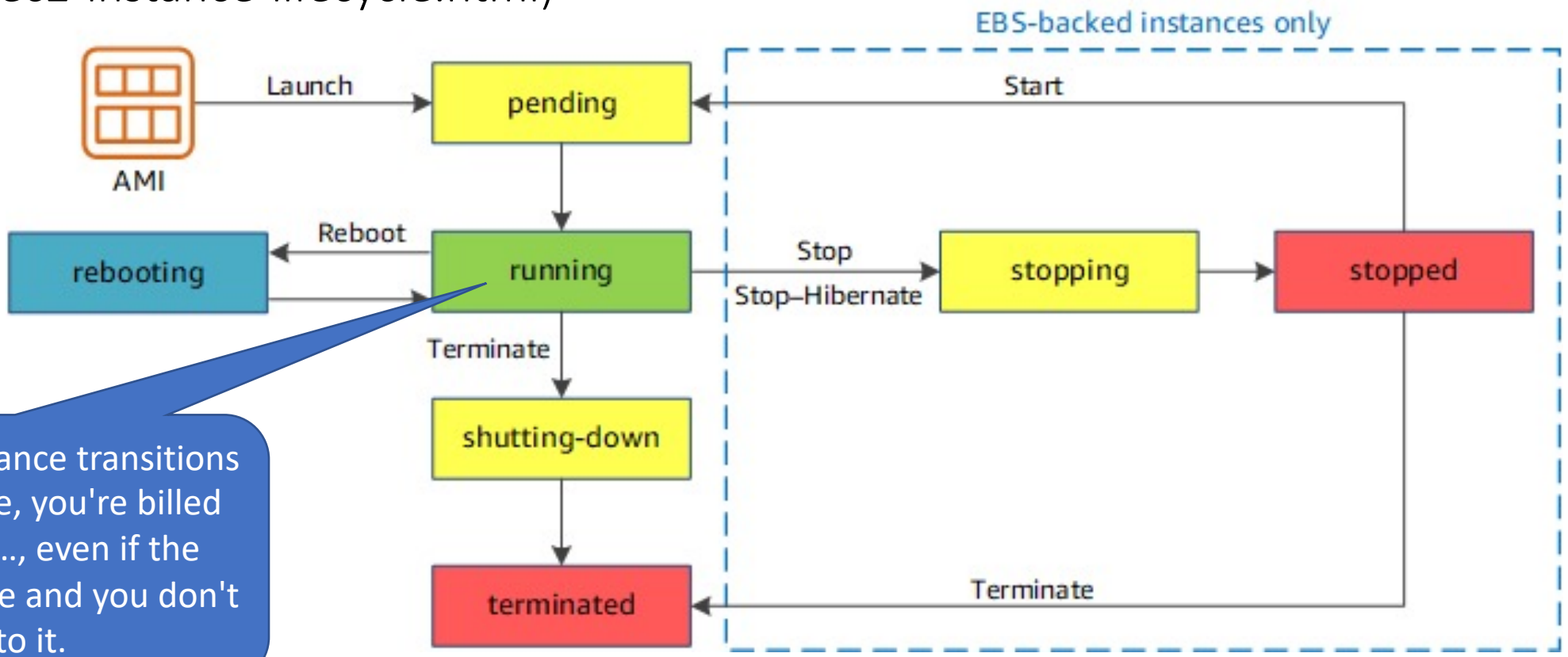
So

1y: if you use more than 15h/day

3y: if you use more than 10h/day

Instance life-cycle

(https://docs.aws.amazon.com/AWSEC2/latest/UserGuide/ec2-instance-lifecycle.html)



As soon as your instance transitions to the running state, you're billed for each second, …, even if the instance remains idle and you don't connect to it.

Note

The table indicates billing for instance usage only. Some AWS resources, such as Amazon EBS volumes and Elastic IP addresses, incur charges regardless of the instance's state.

For more information, see Avoiding Unexpected Charges in the *AWS Billing and Cost Management User Guide*.

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But there is some soft of elasticity

Each burstable performance instance continuously earns credit when it stays below the CPU baseline, and continuously spends credits when it bursts above the baseline. The amount of credits earned or spent depends on the CPU utilization of the instance:

- If the CPU utilization is below baseline, then credits earned are greater than credits spent.
- If the CPU utilization is equal to baseline, then credits earned are equal to credits spent.
- If the CPU utilization is higher than baseline, then credits spent are higher than credits earned.

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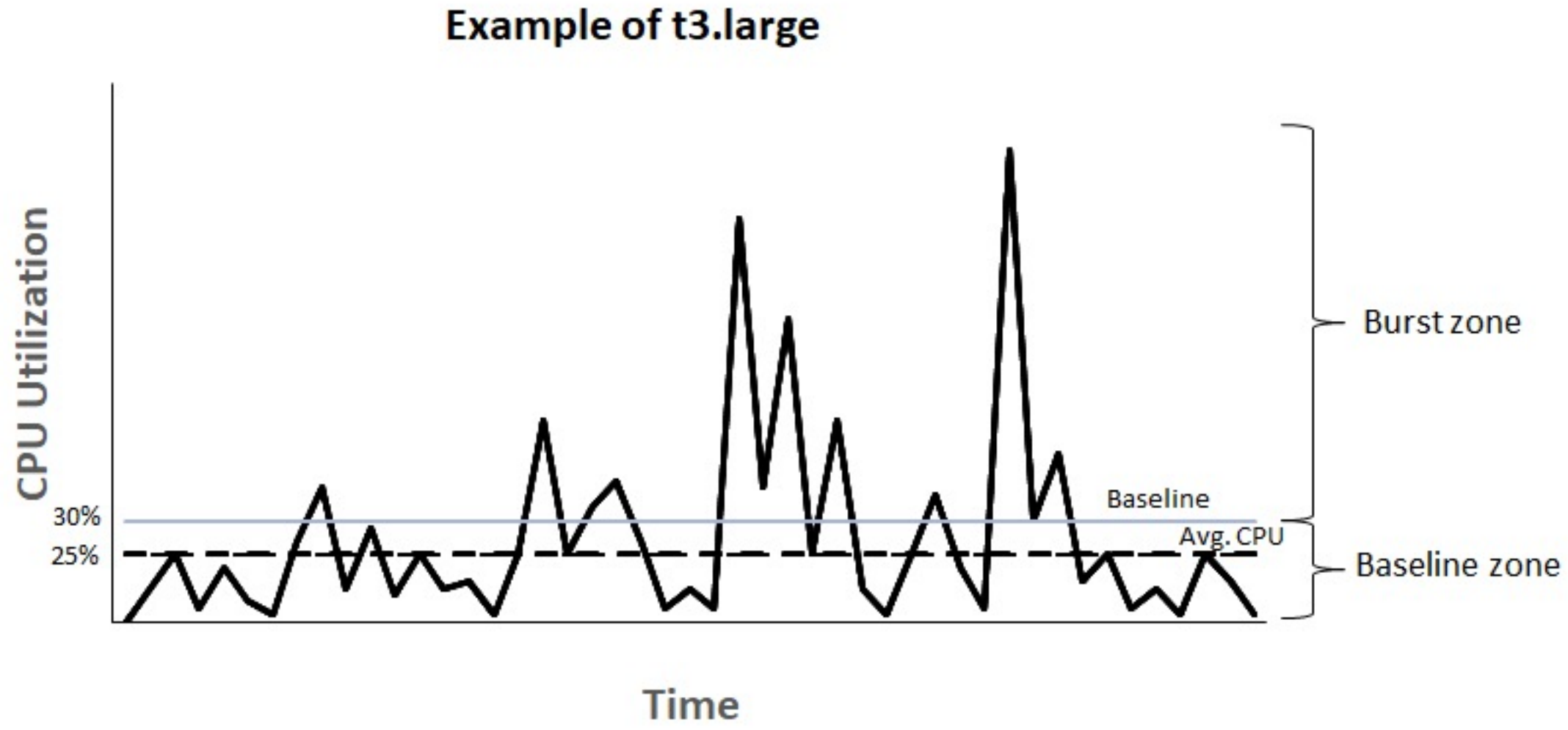
https://docs.aws.amazon.com/AWSEC2/latest/UserGuide/burstable-credits-baseline-concepts.html



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One master thesis estimated for CI/CD pipeline

Component	Service	Item	Units	Unit price	Monthly price
Computing	EC2	t2.medium	4320h	$0.06	$259.20
Storage	EBS	GP2 SSD	208GB	$0.149	$30.99
Networking	VPC	VPN GW	720h	$0.052	$36.00
Networking	VPC	NAT GW	720h	$0.052	$37.44
Total price per month					$363.63
Total price per year					$4363.56

How about running costs?

CAPEX, OPEX?

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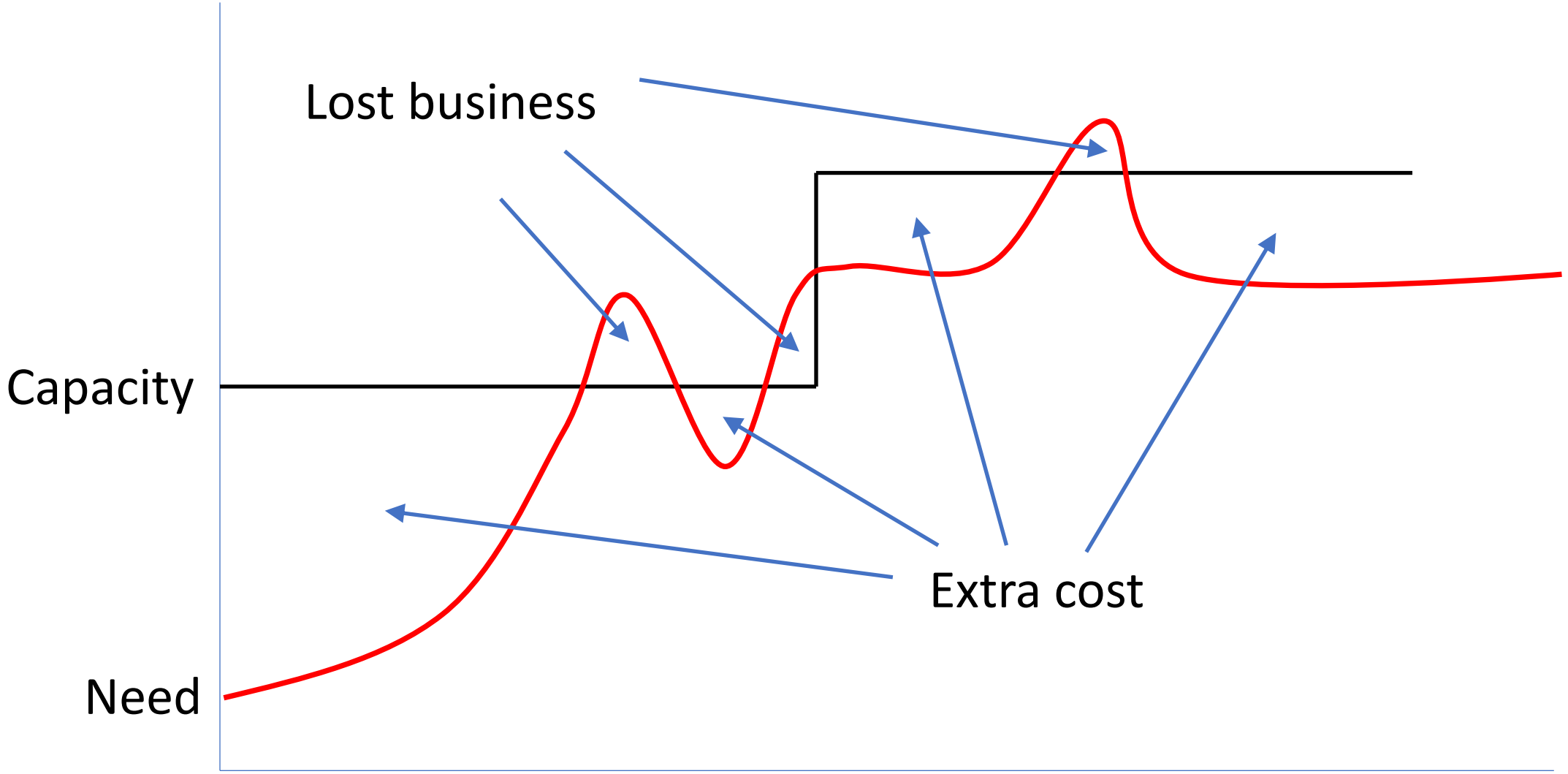
Important disclaimer

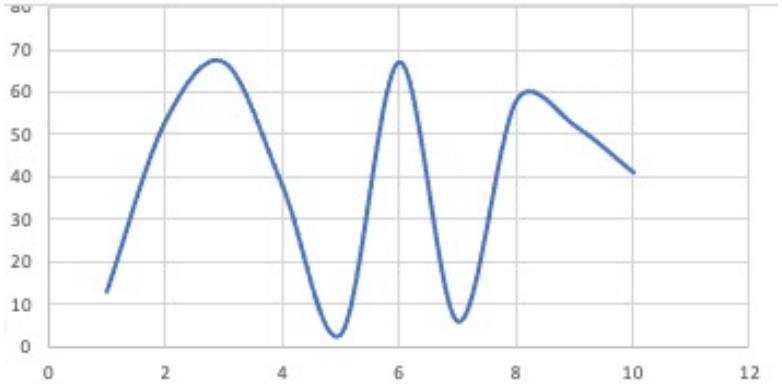
- This was just a sneak preview on the matter
- for on vendor only
- at one time only
- There is much more complexity
  - Compute
  - Storage
  - Network

We should not forget the elasticiy

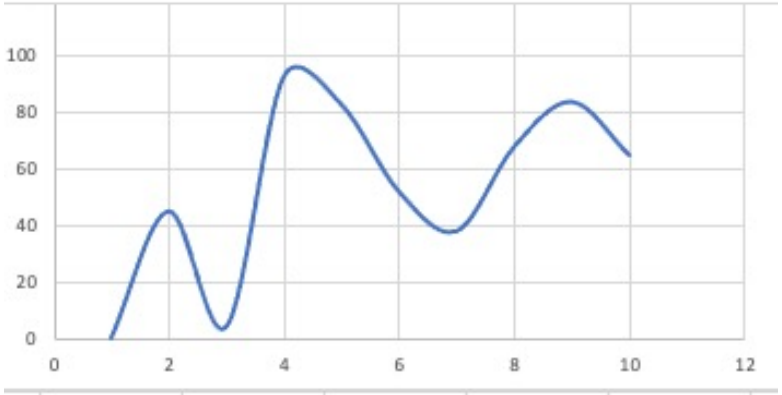


Then there is the pooling

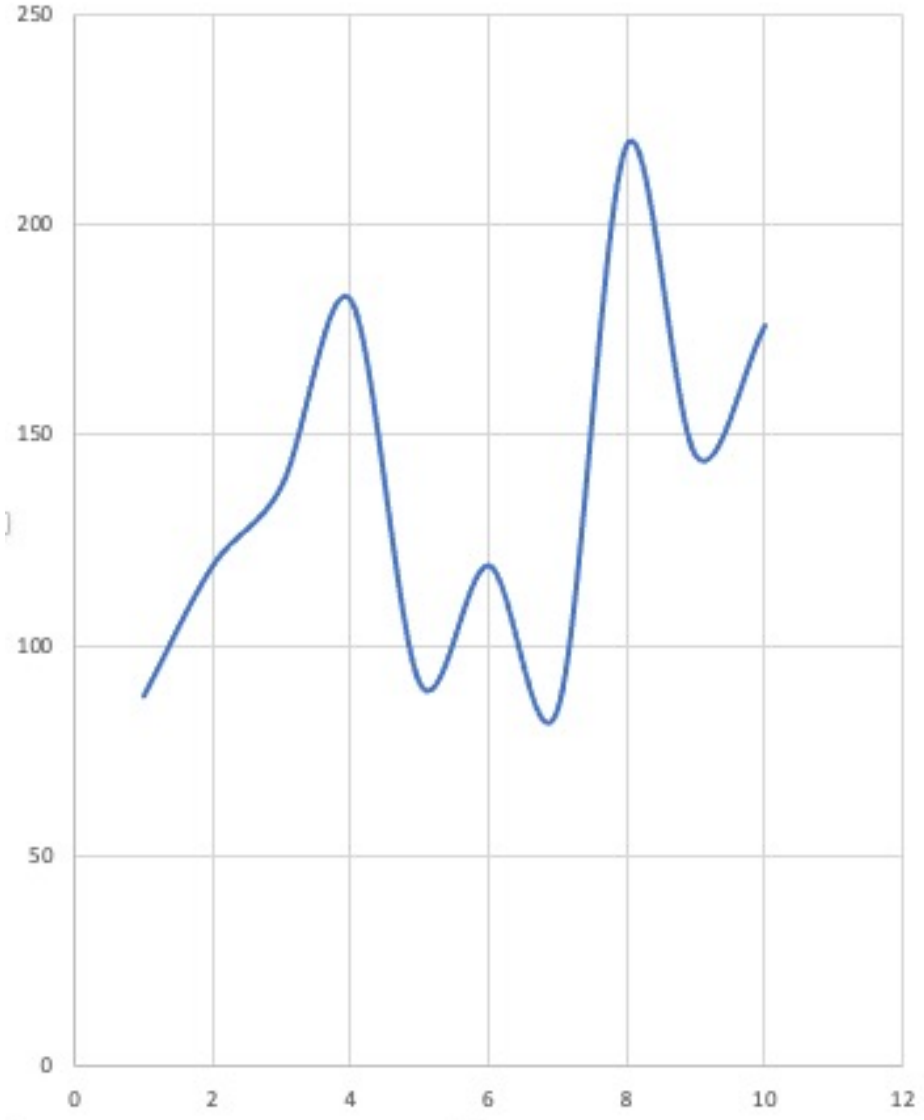
MAX=93
AVE/MAX=0.46



MAX=67
AVE/MAX=0.59



MAX=93
AVE/MAX=0.57



MAX=219
(<253)
AVE/MAX=0.62

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Containers

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Basic of containers

- Lightweight virtualization
- Guests share OS kernel with host
- In Linux (LXC) basically separate namespaces
  - IPC – inter-process communication
  - Network
  - Mount – Filesystem
  - PID – Processes
  - User
  - UTS – hostname and domains
  - Cgroup –
- Nice tutorial (with commercial at the end) https://www.youtube.com/watch?time_continue=2&v=n-JwAM6XF88

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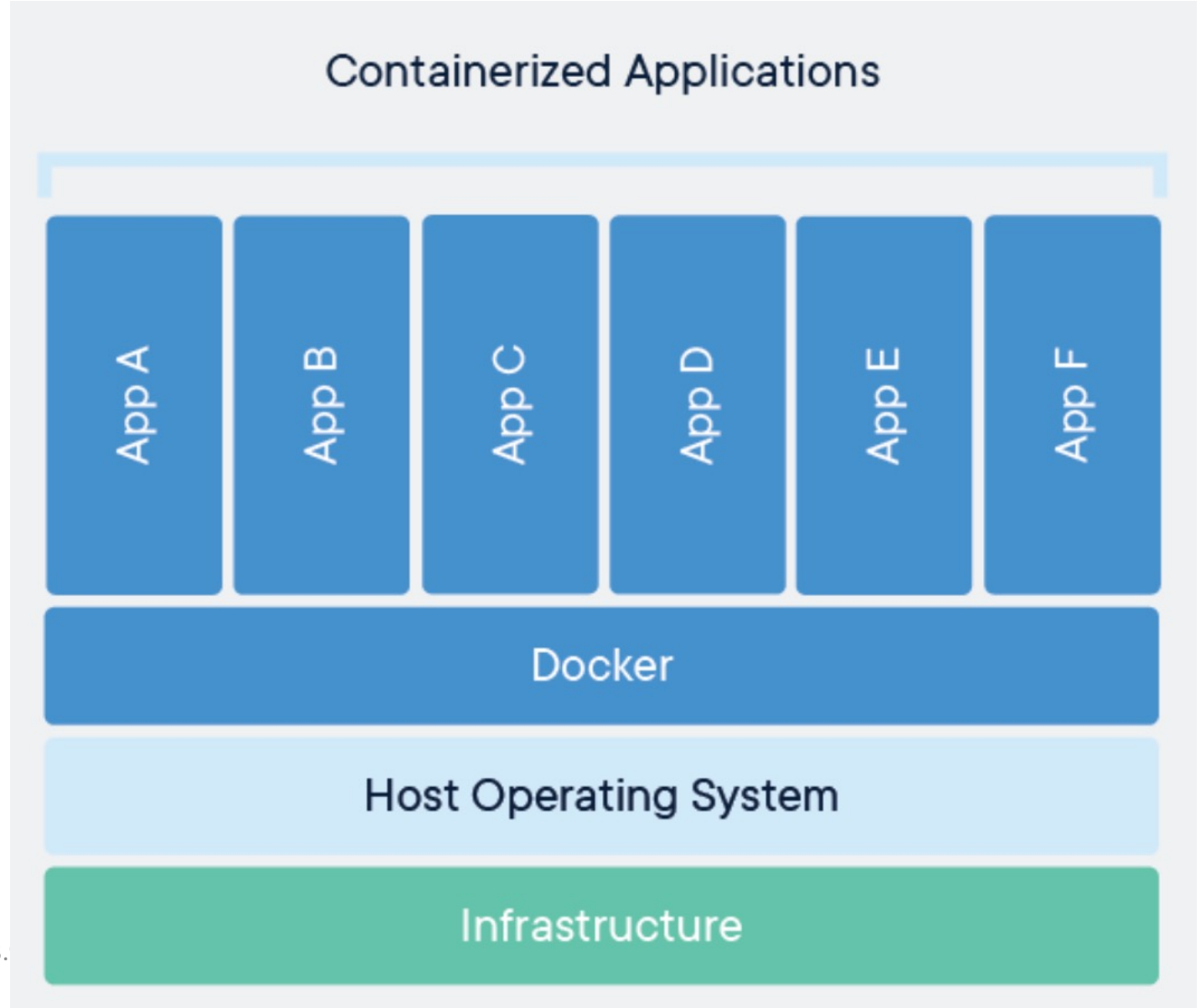
The dominant way to manage containers: Docker

So dominant that we go details of one technology

From docker.com



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Use case example

- Your application needs
  - Certain version of nodejs
  - Set of libraries (certain versions)
  - Mongo database

- Your system has
  - Wrong version of nodejs
  - Mongo serving another application

- Solution
  - Create a docker image (container)
  - Install the image
  - Run the image

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https://www.katacoda.com/courses/container-runtimes

(thanks to your fellow student from 2019)

Terminal +

```
Your Interactive Bash Terminal. A safe place to learn and execute commands.


$
$ docker pull redis:3.2.11-alpine
3.2.11-alpine: Pulling from library/redis
ff3a5c916c92: Pull complete
aae70a2e6027: Pull complete
87c655da471c: Pull complete
bc3141806bdc: Pull complete
53616fb426d9: Pull complete
9791c5883c6a: Pull complete
Digest: sha256:ebf1948b84dcaaa0f8a2849cce6f2548edb8862e2829e3e7d9e4cd5a324fb3b7
Status: Downloaded newer image for redis:3.2.11-alpine
$
```

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Let investigate a bit

```
$ docker image ls
REPOSITORY          TAG                 IMAGE ID            CREATED             SIZE
redis               3.2.11-alpine       ca0b6709748d        15 months ago       20.7MB
```

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I could not resist

```
$ docker run ca0b6709748d
1:C 05 Sep 17:27:18.972 # Warning: no config file specified, using the default config. In order to s
s-server /path/to/redis.conf
                _.-
            _.-``__ ''-._
       _.-``    `.  `_.  ''-._           Redis 3.2.11 (00000000/0) 64 bit
   .-`` .-```.  ```\/    _.,_ ''-._
  (    '      ,       .-`  | `,    )     Running in standalone mode
  |`-._`-...-` __...-.``-._|'` _.-'|     Port: 6379
  |    `-._   `._    /     _.-'    |     PID: 1
   `-._    `-._  `-./  _.-'    _.-'
  |`-._`-._    `-.__.-'    _.-'_.-'|
  |    `-._`-._        _.-'_.-'    |           http://redis.io
   `-._    `-._`-.__.-'_.-'    _.-'
  |`-._`-._    `-.__.-'    _.-'_.-'|
  |    `-._`-._        _.-'_.-'    |
   `-._    `-._`-.__.-'_.-'    _.-'
```

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What did we just see?

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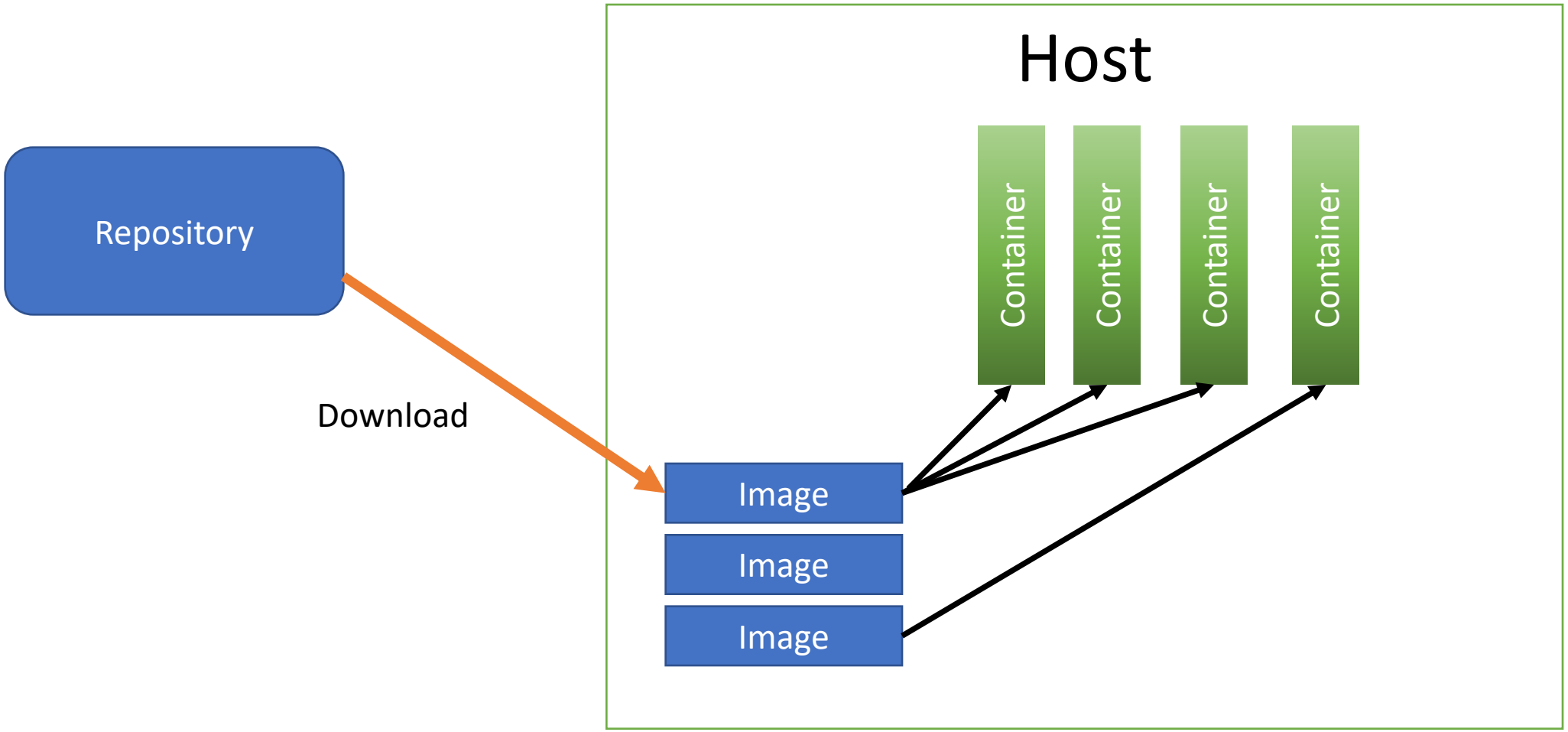
Typical set-up



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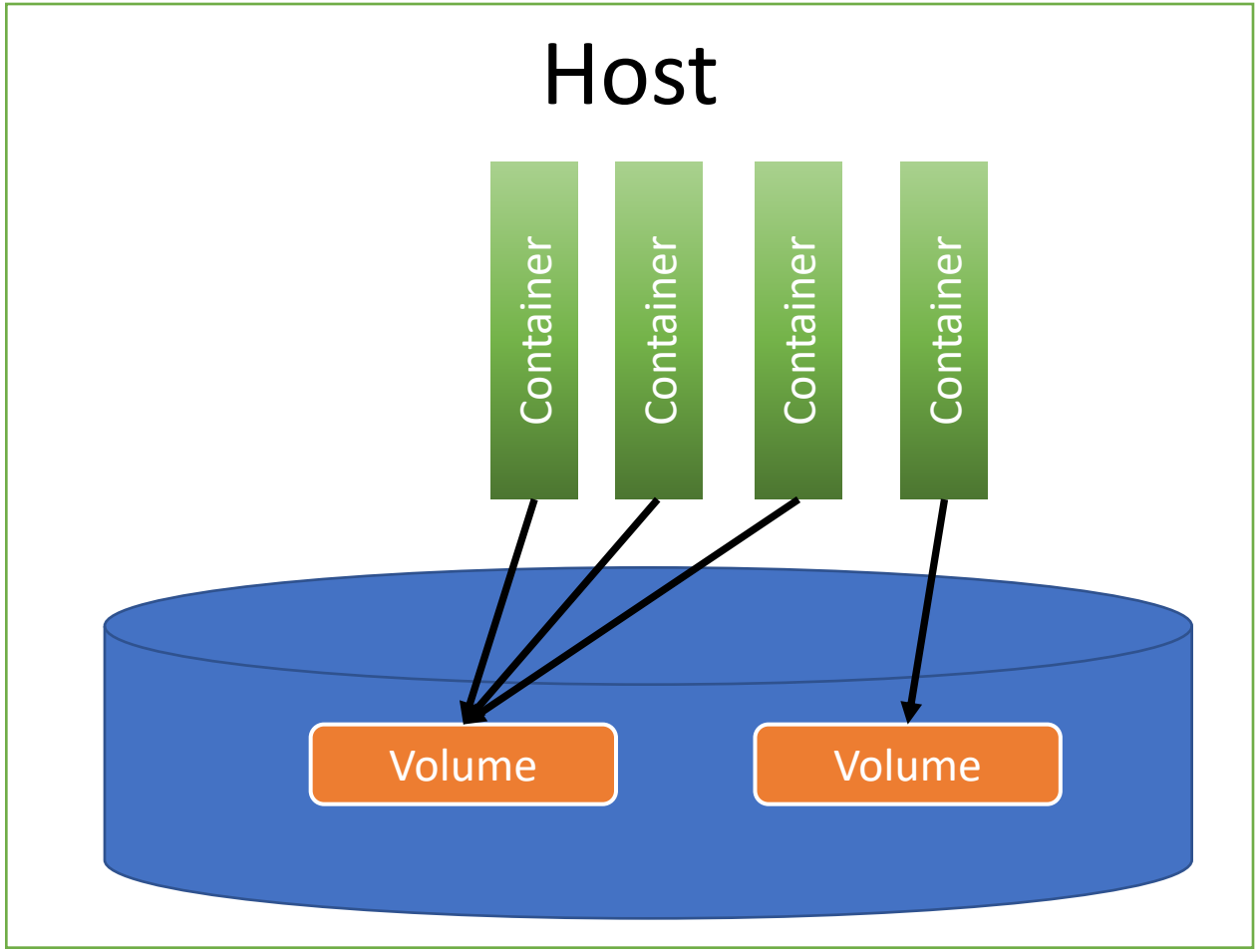
Typical set-up

Volumes are for
- Persistent data
- Data sharing



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Dockerfile

```
#This is a sample Image
FROM ubuntu
MAINTAINER demousr@gmail.com
RUN apt-get update
RUN apt-get install -y nginx
CMD [“echo”,”Image created”]
```

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Docker commands (subset of)

docker build	Build an image from a Dockerfile
docker container	Manage containers (several subcommands)
docker image	Manage images (several subcommands)
docker exec	Run a command in a running container
docker ps	List containers
docker run	Run a command in a new container
docker stop	Stop one or more running containers
docker commit	Create a new image from a container's changes
docker inspect	Return low-level information on Docker objects
docker swarm	Manage Swarm
docker volume	Manage volumes

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Some Dockerfile commands

- FROM <image> [AS <name>]
- RUN <command>
  execute any commands in a new layer and commit the results.
- CMD
  default command to be executed when the container starts
- ENV <key> <value>
- ADD [--chown=<user>:<group>] <src>... <dest>
- COPY [--chown=<user>:<group>] <src>... <dest>

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- `$ docker image history 874176ca6a7c`

```
IMAGE          CREATED         CREATED BY                                      SIZE COMMENT
874176ca6a7c   6 months ago    /bin/sh -c #(nop)  CMD  ["/bin/sh" "-c" "nodeâ¦     0B
e477afdf62b1   6 months ago    /bin/sh -c #(nop)  EXPOSE  8893                    0B
bbb82ecea436   6 months ago    /bin/sh -c #(nop)  ENV PORT=8893                   0B
f7e49216f8f8   6 months ago    /bin/sh -c #(nop)  WORKDIR /home                   0B
75bf5968b264   6 months ago    /bin/sh -c #(nop)  COPY  dir:fed108fd8e77a8ed8â¦ 553kB
1fb4fbe8beb7   7 months ago    /bin/sh -c #(nop)  USER root                       0B
8232a8b9c483   2 years ago     /bin/sh -c #(nop)  CMD  ["node"]                  0B
<missing>      2 years ago     /bin/sh -c apk add --no-cache  --virtual .buiâ¦  3.56MB
<missing>      2 years ago     /bin/sh -c #(nop) ENV YARN_VERSION=0.21.3          0B
<missing>      2 years ago     /bin/sh -c adduser -D -u 1000  node && apâ¦      45.4MB
<missing>      2 years ago     /bin/sh -c #(nop) ENV NODE_VERSION=6.10.0          0B
<missing>      2 years ago     /bin/sh -c #(nop) ENV NPM_CONFIG_LOGLEVEL=iâ¦       0B
<missing>      2 years ago     /bin/sh -c #(nop) ADD file:3df55c321c1c8d73fâ¦   4.81MB
```

```
FROM node:6.10.0-alpine
# Never run processes as root!
USER root

# Copy application itself:
COPY . /home

WORKDIR /home

# Set port on …:
ENV PORT=8893

# Expose port 8893:
EXPOSE 8893

CMD node pinger.js
```

A layer describes a difference to the previous layer.

Layers of size 0 are ”intermediate” layers

Non-zero layers are created with RUN, COPY and ADD.

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```
kari@lepikko-nuc:~$ docker image ls
REPOSITORY                TAG                 IMAGE ID            CREATED             SIZE
rabbitmq                  3-management        38e57f281891        5 months ago        184MB
rabbitmq                  3                   ce51f7cc8a59        5 months ago        154MB
<none>                    <none>              68ea2e469580        10 months ago       69.2MB
python                    3.6                 a2e9f0fba405        10 months ago       913MB
<none>                    <none>              f49eea6b572d        11 months ago       69.2MB
apluslms/grading-base     latest              669ef3db6a57        11 months ago       160MB
debian                    buster-20190812-slim 83a10817c894       12 months ago       69.2MB
gitlab/gitlab-runner      latest              53b7cdd9ce4a        18 months ago       408MB
gitlab/gitlab-ce          latest              8be4d926d44e        18 months ago       1.62GB
pinger                    latest              874176ca6a7c        18 months ago       54.4MB
composetest_pingrelay     latest              f1915b52acde        18 months ago       54.4MB
<none>                    <none>              653b72c389fe        18 months ago       54.4MB
<none>                    <none>              0ceea4e0dde7        18 months ago       53.8MB
<none>                    <none>              2a1516bbcf7c        18 months ago       53.8MB
<none>                    <none>              6f8e8a11dded        18 months ago       53.8MB
<none>                    <none>              ce0842e65950        18 months ago       53.8MB
<none>                    <none>              5c3f5be3e518        18 months ago       53.8MB
<none>                    <none>              1037fb9e5f21        18 months ago       53.8MB
<none>                    <none>              840f0aae6c3d        18 months ago       54.4MB
<none>                    <none>              b0defb476587        18 months ago       54.4MB
<none>                    <none>              3299381687af        18 months ago       54.4MB
<none>                    <none>              0eafd852183d        18 months ago       54.4MB
<none>                    <none>              08656cd757e0        18 months ago       54.4MB
<none>                    <none>              2294d910c093        18 months ago       54.4MB
<none>                    <none>              dd4036ed33e0        18 months ago       53.8MB
pingrelay                 latest              52b9f6060548        18 months ago       53.8MB
<none>                    <none>              68f5bdacbb58        18 months ago       53.8MB
<none>                    <none>              b1b59d44b5fb        22 months ago       2.61GB
liquidiot-docker_ide      latest              79214e5a582a        22 months ago       682MB
liquid-ide2               latest              c52aeb0af6ce        22 months ago       2.28GB
liquidiot-ide             latest              b20073f68dcd        22 months ago       1.67GB
liquidiot-base            latest              b88e10ba3196        22 months ago       205MB
hellotest                 latest              27c7e8db4dd6        22 months ago       132MB
friendlyhello             latest              dfd0ebf0f838        22 months ago       132MB
ubuntu                    14.04               f216cfb59484        22 months ago       188MB
ubuntu                    latest              ea4c82dcd15a        22 months ago       85.8MB
python                    2.7-slim            804b0a01ea83        22 months ago       120MB
mongo                     3.2.21              0d365aaccf85        22 months ago       300MB
hello-world               latest              4ab4c602aa5e        24 months ago       1.84kB
piehei/base-qt593         latest              4318f4a85238        2 years ago         10.3GB
node                      6.10.0-alpine       8232a8b9c483        3 years ago         53.8MB
```

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```
kari@lepikko-nuc:~$ docker container ls
CONTAINER ID        IMAGE                          COMMAND                  CREATED             STATUS              PORTS                    NAMES
b74ff2393ba3        gitlab/gitlab-runner:latest    "/usr/bin/dumb-init …"   10 months ago       Up 29 minutes       0.0.0.0:8000->80/tcp     xxx2
a1830c0f526f        gitlab/gitlab-runner:latest    "/usr/bin/dumb-init …"   10 months ago       Up 29 minutes                                gitlab-runner
```

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```
FROM node:6.10.0-alpine
USER root
COPY . /home
WORKDIR /home
ENV PORT=8893
EXPOSE 8893

CMD node pinger.js
```

$ docker history 874176ca6a7c

```
IMAGE          CREATED         CREATED BY                                      SIZE
874176ca6a7c   18 months ago   /bin/sh -c #(nop)  CMD ["/bin/sh" "-c" "node…   0B
e477afdf62b1   18 months ago   /bin/sh -c #(nop)  EXPOSE 8893                  0B
bbb82ecea436   18 months ago   /bin/sh -c #(nop)  ENV PORT=8893                0B
f7e49216f8f8   18 months ago   /bin/sh -c #(nop)  WORKDIR /home                0B
75bf5968b264   18 months ago   /bin/sh -c #(nop)  COPY dir:fed108fd8e77a8ed8…  553kB
1fb4fbe8beb7   18 months ago   /bin/sh -c #(nop)  USER root                    0B
8232a8b9c483    3 years ago    /bin/sh -c #(nop)  CMD ["node"]                 0B
<missing>       3 years ago    /bin/sh -c apk add --no-cache --virtual .bui…   3.56MB
<missing>       3 years ago    /bin/sh -c #(nop)  ENV YARN_VERSION=0.21.3      0B
<missing>       3 years ago    /bin/sh -c adduser -D -u 1000 node      && ap…   45.4MB
<missing>       3 years ago    /bin/sh -c #(nop)  ENV NODE_VERSION=6.10.0      0B
<missing>       3 years ago    /bin/sh -c #(nop)  ENV NPM_CONFIG_LOGLEVEL=i…   0B
<missing>       3 years ago    /bin/sh -c #(nop)  ADD file:3df55c321c1c8d73f…  4.81MB
```

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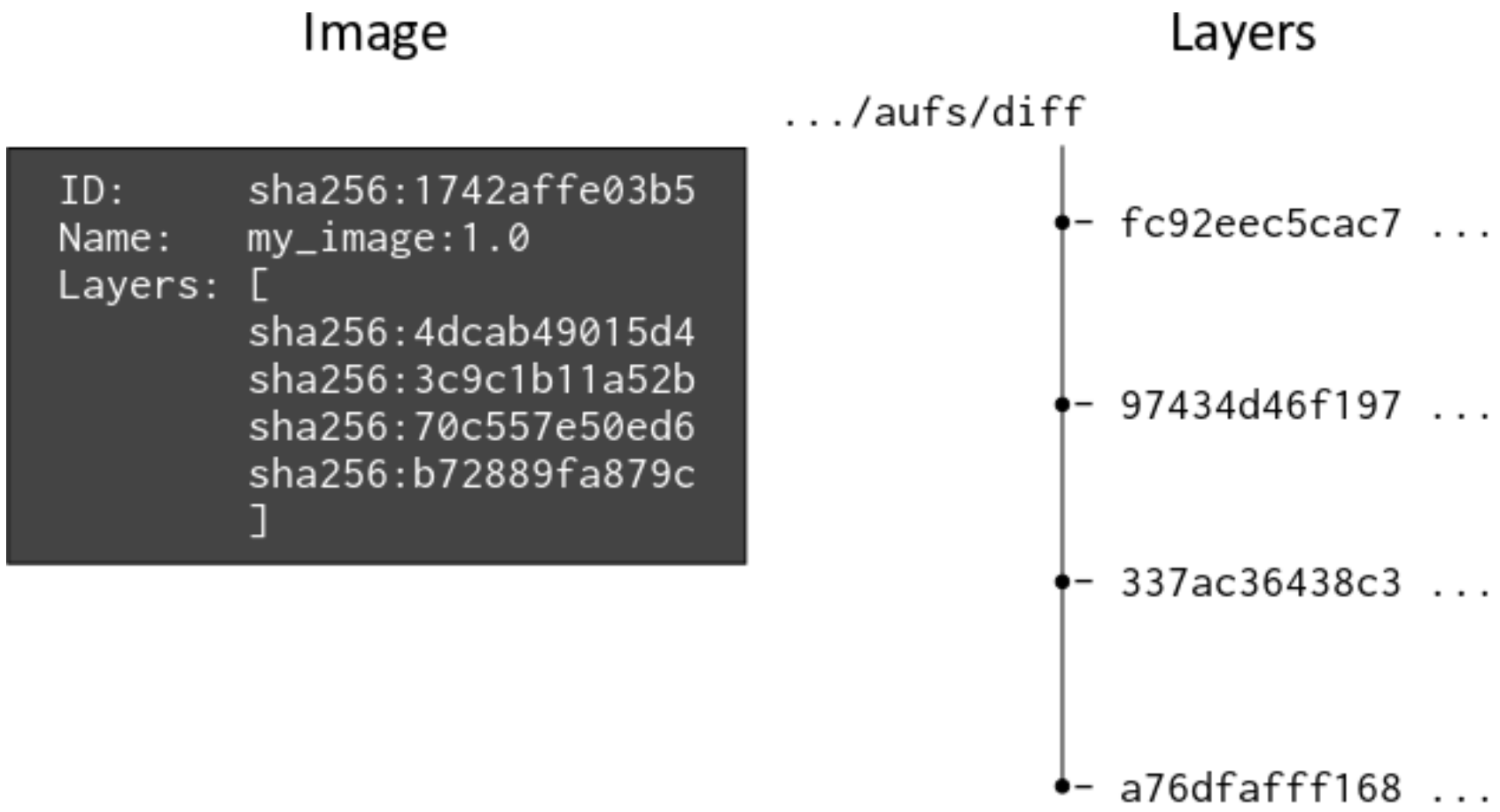
I found a nice article (but old and partially out of date): https://windsock.io/explaining-docker-image-ids/

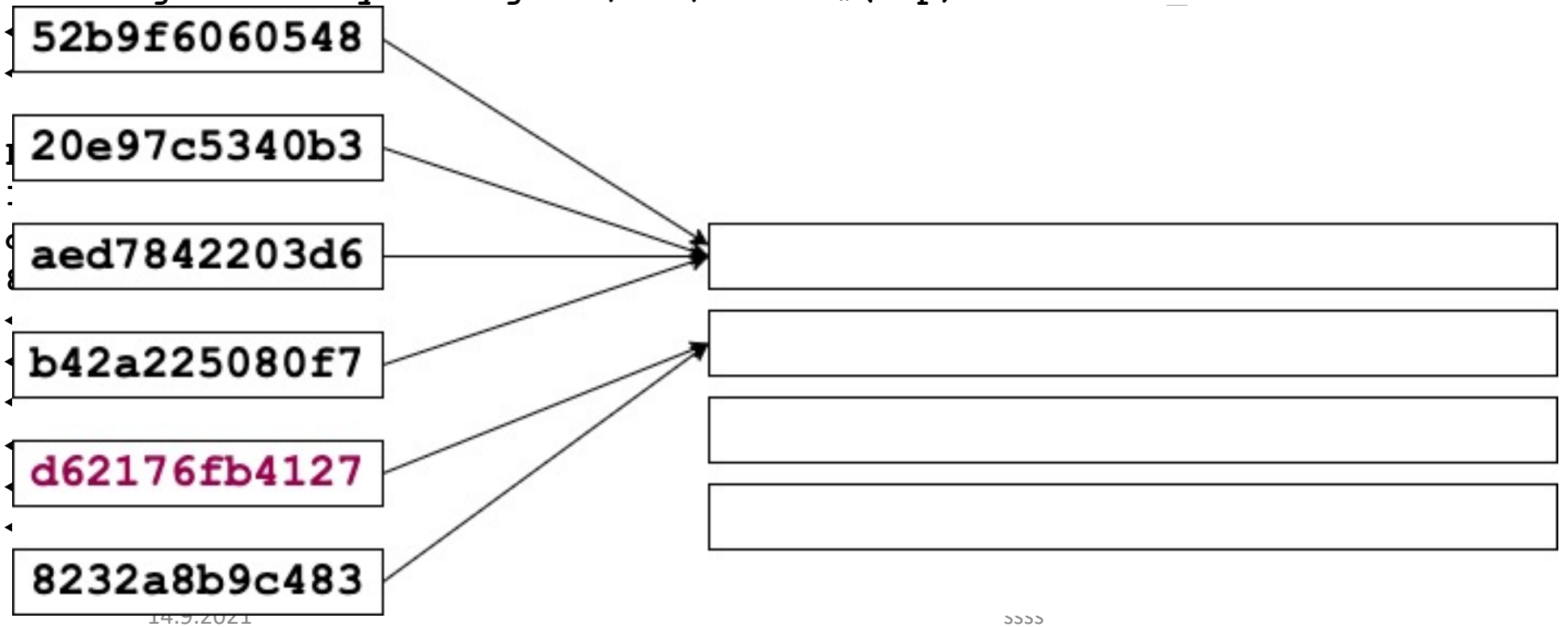


```
kari@lepikko-nuc:~$ docker history pingrelay
IMAGE          CREATED       CREATED BY                                      SIZE      COMMENT
52b9f6060548   2 years ago   /bin/sh -c #(nop)  CMD ["/bin/sh" "-c" "node…   0B
20e97c5340b3   2 years ago   /bin/sh -c #(nop)  EXPOSE 8894                  0B
aed7842203d6   2 years ago   /bin/sh -c #(nop)  ENV PORT=8894                0B
b42a225080f7   2 years ago   /bin/sh -c #(nop) COPY dir:10a4bc704d33f8ef9…   2.86kB
d62176fb4127   2 years ago   /bin/sh -c #(nop)  USER node                    0B
8232a8b9c483   4 years ago   /bin/sh -c #(nop)  CMD ["node"]                 0B
<missing>      4 years ago   /bin/sh -c apk add --no-cache --virtual .bui…   3.56MB
<missing>      4 years ago   /bin/sh -c #(nop)  ENV YARN_VERSION=0.21.3      0B
<missing>      4 years ago   /bin/sh -c adduser -D -u 1000 node      && ap…   45.4MB
<missing>      4 years ago   /bin/sh -c #(nop)  ENV NODE_VERSION=6.10.0      0B
<missing>      4 years ago   /bin/sh -c #(nop)  ENV NPM_CONFIG_LOGLEVEL=i…   0B
<missing>      4 years ago   /bin/sh -c #(nop) ADD file:3df55c321c1c8d73f…   4.81MB

kari@lepikko-nuc:~$ docker history d62176fb4127
IMAGE          CREATED       CREATED BY                                      SIZE      COMMENT
d62176fb4127   2 years ago   /bin/sh -c #(nop)  USER node                    0B
8232a8b9c483   4 years ago   /bin/sh -c #(nop)  CMD ["node"]                 0B
<missing>      4 years ago   /bin/sh -c apk add --no-cache --virtual .bui…   3.56MB
<missing>      4 years ago   /bin/sh -c #(nop)  ENV YARN_VERSION=0.21.3      0B
<missing>      4 years ago   /bin/sh -c adduser -D -u 1000 node      && ap…   45.4MB
<missing>      4 years ago   /bin/sh -c #(nop)  ENV NODE_VERSION=6.10.0      0B
<missing>      4 years ago   /bin/sh -c #(nop)  ENV NPM_CONFIG_LOGLEVEL=i…   0B
<missing>      4 years ago   /bin/sh -c #(nop) ADD file:3df55c321c1c8d73f…   4.81MB
```

kari@lepikko-nuc:~$ docker inspect b42a225080f7 | more

```
  …

 "RootFS": {
            "Type": "layers",
            "Layers": [
                "sha256:9f8566ee5135862dd980160c27bd7721448a6f7f385bbb81f7f001f1b78a5fbf",
                "sha256:a29f1bf1f8df55abcb2230162480199bb2839e29e40b5d747cccce32a9696e86",
                "sha256:d7a4e57a4ae0051473917c87c590af2b2b95ad9517740fbe05b27b43e5dbfa4b",
                "sha256:45334db71e1d93df59509957eb38807c3a0841bdef75058b5bc0e55f9edfd968"
            ]
        },
```

```
kari@lepikko-nuc:~$ docker history pingrelay
IMAGE          CREATED       CREATED BY                                      SIZE      COMMENT
52b9f6060548   2 years ago   /bin/sh -c #(nop)  CMD ["/bin/sh" "-c" "node…   0B
20e97c5340b3   2 years ago   /bin/sh -c #(nop)  EXPOSE 8894                  0B
aed7842203d6   2 years ago   /bin/sh -c #(nop)  ENV PORT=8894                0B
b42a225080f7   2 years ago   /bin/sh -c #(nop) COPY dir:10a4bc704d33f8ef9…   2.86kB
d62176fb4127   2 years ago   /bin/sh -c #(nop)  USER node                    0B
8232a8b9c483   4 years ago   /bin/sh -c #(nop)  CMD ["node"]                 0B
<missing>      4 years ago   /bin/sh -c apk add --no-cache --virtual .bui…   3.56MB
<missing>      4 years ago   /bin/sh -c #(nop)  ENV YARN_VERSION=0.21.3      0B
<missing>      4 years ago   /bin/sh -c adduser -D -u 1000 node      && ap…   45.4MB
<missing>      4 years ago   /bin/sh -c #(nop)  ENV NODE_VERSION=6.10.0      0B
                                                                             0B
                                                                             4.81MB
```




```
                                                                             SIZE      COMMENT
                                                                             0B
                                                                             0B
                                                                             3.56MB
                                                                             0B
                                                                             45.4MB
                                                                             0B
                                                                             0B
                                                                             4.81MB
```

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From: https://windsock.io/explaining-docker-image-ids/

- A Docker image provides a filesystem for a derived container based on the references it stores to layer diffs
- Layer diffs are referenced using a digest, which contains an SHA256 hash of an archive of the diff's contents
- A Docker image's ID is a digest, which contains an SHA256 hash of the image's JSON configuration object
- Docker creates intermediate images during a local image build, for the purposes of maintaining a build cache
- An image manifest is created and pushed to a Docker registry when an image is pushed
- An image manifest contains digests of the image's layers, which contain the SHA256 hashes of the compressed, archived diff contents

```
kari@lepikko-nuc:~/CloudApplications/test$ docker build .
Sending build context to Docker daemon  3.072kB
Step 1/3 : FROM debian:buster-20190812-slim
 ---> 83a10817c894
Step 2/3 : RUN date > /home/123456.txt
 ---> Using cache
 ---> 38b806d0d640
Step 3/3 : CMD cat /home/123456.txt
 ---> Using cache
 ---> 68ea2e469580
Successfully built 68ea2e469580
kari@lepikko-nuc:~/CloudApplications/test$ docker run 68ea2e469580
Wed Oct 23 16:34:26 UTC 2019
```

$ docker image rm 68ea2e469580

Error response from daemon: conflict: unable to delete 68ea2e469580 (must be forced) - image is being used by stopped container 832701d84725

$ docker image rm -f 68ea2e469580

Deleted: sha256:68ea2e469580458998dfdc9c0a13db39541803e6f988245ee55f2b124fb1035f

Deleted: sha256:38b806d0d64026fe73682cead45e908977261839 2a86fe29cff70f0aebff9a2c

$ docker build .

```
Sending build context to Docker daemon   5.12kB
Step 1/3 : FROM debian:buster-20190812-slim
 ---> 83a10817c894
Step 2/3 : RUN date > /home/123456.txt
 ---> Running in 646f50d34715
Removing intermediate container 646f50d34715
 ---> d97b91c429fc
Step 3/3 : CMD cat /home/123456.txt
 ---> Running in 2750a97284f8
Removing intermediate container 2750a97284f8
 ---> fc4c5d3376a9
Successfully built fc4c5d3376a9
```

$ docker run fc4c5d3376a9

```
Sun Sep  6 08:53:24 UTC 2020
```

Tampereen yliopisto
Tampere University

$ docker history fc4c5d3376a9

IMAGE	CREATED	CREATED BY	SIZE
fc4c5d3376a9	About a minute ago	/bin/sh -c #(nop) CMD ["/bin/sh" "-c" "cat …	0B
d97b91c429fc	About a minute ago	/bin/sh -c date > /home/123456.txt	29B
83a10817c894	12 months ago	/bin/sh -c #(nop) CMD ["bash"]	0B
<missing>	12 months ago	/bin/sh -c #(nop) ADD file:330bfb91168adb4a9…	69.2MB

Docker image ls

REPOSITORY	TAG	IMAGE ID	CREATED	SIZE
<none>	<none>	99d4b9dd0fea	32 seconds ago	1.19GB
<none>	<none>	f86de57f2f64	2 minutes ago	1.19GB
<none>	<none>	c6f93e248201	14 minutes ago	944MB
<none>	<none>	8d4c9c98fece	15 minutes ago	944MB
<none>	<none>	51257e92bd03	18 minutes ago	944MB
<none>	<none>	fc4c5d3376a9	33 minutes ago	69.2MB
node	latest	40ce906a3734	4 days ago	944MB
gcc	latest	cfe277915109	4 days ago	1.19GB
rabbitmq	3-management	38e57f281891	5 months ago	184MB
rabbitmq	3	ce51f7cc8a59	5 months ago	154MB

kari@lepikko-nuc:**~/CloudApplications/DockerExercise**$ docker build -f Dockerfile.gcc -t gcc-hello .

```
Successfully built 99d4b9dd0fea
Successfully tagged gcc-hello:latest
```

kari@lepikko-nuc:**~/CloudApplications/DockerExercise**$ docker image ls

REPOSITORY	TAG	IMAGE ID	CREATED	SIZE
gcc-hello	latest	99d4b9dd0fea	28 minutes ago	1.19GB
<none>	<none>	f86de57f2f64	30 minutes ago	1.19GB
<none>	<none>	c6f93e248201	42 minutes ago	944MB