Saturday, 30 March 2024

3 tier application on Docker

For 3 tier application, we need fronted, backend and database layer. and for each layer we need to build a Dockerfile. I have Created 3 Dockerfile for each layer.

In frontend we need a Dockerfile along with index.html file.

```
[root@ip-172-31-41-103 frontend]# cat Dockerfile
FROM centos:7

RUN yum install httpd -y

COPY index.html /var/www/html/index.html

EXPOSE 80

CMD httpd -DFOREGROUND
[root@ip-172-31-41-103 frontend]#
```

```
[root@ip-172-31-41-103 frontend]# cat index.html
<h1 style="text-align: center;"><span style="color: #ff0000;">Welcome to Student Application on
AWS.</span></h1>
<p><img style="display: block; margin-left: auto; margin-right: auto;"
src="https://cdn-images-1.medium.com/max/2000/1*tFl-8wQUENETYLjX5mYWuA.png" alt="" width="1200"
height="630" /></p>
<p> </p>
<h2 style="text-align: center;"><a href="http://13.208.214.195:32770/student/"><strong>Enter to Student
Application</strong></a></h2>
<p> </p>
<p> </p>
[root@ip-172-31-41-103 frontend]#
```

In backend we need source code that is student.war file, context.xml file as we need to bind our database with backend and a Dockerfile.

```
[root@ip-172-31-41-103 backend]# cat Dockerfile
FROM centos:7

LABEL APP="Studentapp"

LABEL DevopsEngg="Sucheta"

USER root

WORKDIR /opt

ADD  https://dlcdn.apache.org/tomcat/tomcat-8/v8.5.99/bin/apache-tomcat-8.5.99.tar.gz .

RUN tar -xvzf apache-tomcat-8.5.99.tar.gz

RUN yum install java -y

WORKDIR /opt/apache-tomcat-8.5.99

COPY student.war webapps/student.war

COPY context.xml conf/context.xml

ADD https://s3-us-west-2.amazonaws.com/studentapi-cit/mysql-connector.jar lib/mysql-connector.jar

EXPOSE 8080

CMD ["bin/catalina.sh" , "run"]
[root@ip-172-31-41-103 backend]#
```

```
[root@ip-172-31-41-103 backend]# cat context.xml
<!--
  Licensed to the Apache Software Foundation (ASF) under one or more
  contributor license agreements.  See the NOTICE file distributed with
  this work for additional information regarding copyright ownership.
  The ASF licenses this file to You under the Apache License, Version 2.0
  (the "License"); you may not use this file except in compliance with
  the License.  You may obtain a copy of the License at

      http://www.apache.org/licenses/LICENSE-2.0

  Unless required by applicable law or agreed to in writing, software
  distributed under the License is distributed on an "AS IS" BASIS,
  WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.
  See the License for the specific language governing permissions and
  limitations under the License.
 -->
<!--  The contents of this file will be loaded for each web application  -->
<Context>
<!--  Default set of monitored resources. If one of these changes, the     -->
<!--  web application will be reloaded.                                    -->
<WatchedResource>WEB-INF/web.xml</WatchedResource>
<WatchedResource>${catalina.base}/conf/web.xml</WatchedResource>
<Resource name="jdbc/TestDB" auth="Container" type="javax.sql.DataSource" maxTotal="100" maxIdle="30"
maxWaitMillis="10000" username="root" password="1234" driverClassName="com.mysql.jdbc.Driver"
url="jdbc:mysql://172.17.0.2:3306/studentapp"/>
<!--  Uncomment this to disable session persistence across Tomcat restarts  -->
<!--
    <Manager pathname="" />
     -->
</Context>
[root@ip-172-31-41-103 backend]#
```

And in database layer we need Dockerfile, and schema of our date.

```
[root@ip-172-31-41-103 database]# cat Dockerfile
FROM mysql:latest

LABEL database="studentapp"

ENV MYSQL_ROOT_PASSWORD=1234

COPY init-db.sql /docker-entrypoint-initdb.d/

CMD ["mysqld"]

[root@ip-172-31-41-103 database]#
```

```
[root@ip-172-31-41-103 database]# cat init-db.sql
CREATE DATABASE IF NOT EXISTS studentapp;

USE studentapp;

CREATE TABLE IF NOT EXISTS students (
    student_id INT NOT NULL AUTO_INCREMENT,
    student_name VARCHAR(100) NOT NULL,
    student_addr VARCHAR(100) NOT NULL,
    student_age VARCHAR(3) NOT NULL,
    student_qual VARCHAR(20) NOT NULL,
    student_percent VARCHAR(10) NOT NULL,
    student_year_passed VARCHAR(10) NOT NULL,
    PRIMARY KEY (student_id)
);
[root@ip-172-31-41-103 database]#
```

After writing all 3 Docker files, and downloaded source code and pushed all of them to GitHub repository. Then we need to host machine for this I am using AWS EC2 instance with Centos7 image, launch instance connect to it and connect to it.

#ssh -i abcd.pem centos@13.208.214.195

```
Last login: Fri Mar 29 10:27:29 on console
devagoudapatil@192 ~ % cd Downloads
devagoudapatil@192 Downloads % ssh -i "abcd.pem" ec2-user@ec2-13-208-214-195.ap-northeast-3.compute.amazonaws.com
The authenticity of host 'ec2-13-208-214-195.ap-northeast-3.compute.amazonaws.com (13.208.214.195)' can't be established.
ED25519 key fingerprint is SHA256:lRBnewu+0kzCxMTh6Fqi7VVMGJvrz0XmoUUoWb/c588.
This key is not known by any other names
Are you sure you want to continue connecting (yes/no/[fingerprint])? yes
Warning: Permanently added 'ec2-13-208-214-195.ap-northeast-3.compute.amazonaws.com' (ED25519) to the list of known hosts.
ec2-user@ec2-13-208-214-195.ap-northeast-3.compute.amazonaws.com: Permission denied (publickey,gssapi-keyex,gssapi-with-mic).
devagoudapatil@192 Downloads % ssh -i "abcd.pem" ec2-user@ec2-13-208-214-195.ap-northeast-3.compute.amazonaws.com
ec2-user@ec2-13-208-214-195.ap-northeast-3.compute.amazonaws.com: Permission denied (publickey,gssapi-keyex,gssapi-with-mic).
devagoudapatil@192 Downloads % chmod 400 abcd.pem
devagoudapatil@192 Downloads % ssh -i "abcd.pem" ec2-user@ec2-13-208-214-195.ap-northeast-3.compute.amazonaws.com
ec2-user@ec2-13-208-214-195.ap-northeast-3.compute.amazonaws.com: Permission denied (publickey,gssapi-keyex,gssapi-with-mic).
devagoudapatil@192 Downloads % ssh -i "abcd.pem" ec2-user@ec2-13-208-214-195.ap-northeast-3.compute.amazonaws.com
ec2-user@ec2-13-208-214-195.ap-northeast-3.compute.amazonaws.com: Permission denied (publickey,gssapi-keyex,gssapi-with-mic).
devagoudapatil@192 Downloads % chmod 600 abcd.pem
devagoudapatil@192 Downloads % ssh -i "abcd.pem" ec2-user@ec2-13-208-214-195.ap-northeast-3.compute.amazonaws.com
ec2-user@ec2-13-208-214-195.ap-northeast-3.compute.amazonaws.com: Permission denied (publickey,gssapi-keyex,gssapi-with-mic).
devagoudapatil@192 Downloads % ssh -i abcd.pem centos@13.208.214.195
The authenticity of host '13.208.214.195 (13.208.214.195)' can't be established.
ED25519 key fingerprint is SHA256:lRBnewu+0kzCxMTh6Fqi7VVMGJvrz0XmoUUoWb/c588.
This host key is known by the following other names/addresses:
    ~/.ssh/known_hosts:18: ec2-13-208-214-195.ap-northeast-3.compute.amazonaws.com
Are you sure you want to continue connecting (yes/no/[fingerprint])? yes
Warning: Permanently added '13.208.214.195' (ED25519) to the list of known hosts.
-bash: warning: setlocale: LC_CTYPE: cannot change locale (UTF-8): No such file or directory
[centos@ip-172-31-41-103 ~]$ sudo -i
```

We have to install Docker engine on it.

#sudo yum install -y yum-utils

#sudo yum-config-manager —add-repo https://download.docker.com/linux/centos/docker-ce.repo

#sudo yum install docker-ce docker-ce-cli containerd.io docker-buildx-plugin docker-compose-plugin

```
[root@ip-172-31-41-103 database]# sudo yum install -y yum-utils
Failed to set locale, defaulting to C
Loaded plugins: fastestmirror
Loading mirror speeds from cached hostfile
 * base: download.cf.centos.org
 * extras: download.cf.centos.org
 * updates: download.cf.centos.org
Package yum-utils-1.1.31-54.el7_8.noarch already installed and latest version
Nothing to do
[root@ip-172-31-41-103 database]# sudo yum-config-manager --add-repo https://download.docker.com/linux/centos/docker-ce.repo
Failed to set locale, defaulting to C
Loaded plugins: fastestmirror
adding repo from: https://download.docker.com/linux/centos/docker-ce.repo
grabbing file https://download.docker.com/linux/centos/docker-ce.repo to /etc/yum.repos.d/docker-ce.repo
repo saved to /etc/yum.repos.d/docker-ce.repo
[root@ip-172-31-41-103 database]# sudo yum install docker-ce docker-ce-cli containerd.io docker-buildx-plugin docker-compose-plugin
Failed to set locale, defaulting to C
Loaded plugins: fastestmirror
Loading mirror speeds from cached hostfile
 * base: download.cf.centos.org
 * extras: download.cf.centos.org
 * updates: download.cf.centos.org
docker-ce-stable                                        | 3.5 kB     00:00
(1/2): docker-ce-stable/7/x86_64/primary_db               | 140 kB   00:00
(2/2): docker-ce-stable/7/x86_64/updateinfo               |   55 B   00:00
Resolving Dependencies
--> Running transaction check
---> Package containerd.io.x86_64 0:1.6.28-3.2.el7 will be installed
--> Processing Dependency: container-selinux >= 2:2.74 for package: containerd.io-1.6.28-3.2.el7.x86_64
---> Package docker-buildx-plugin.x86_64 0:0.13.1-1.el7 will be installed
---> Package docker-ce.x86_64 3:26.0.0-1.el7 will be installed
--> Processing Dependency: docker-ce-rootless-extras for package: 3:docker-ce-26.0.0-1.el7.x86_64
---> Package docker-ce-cli.x86_64 1:26.0.0-1.el7 will be installed
---> Package docker-compose-plugin.x86_64 0:2.25.0-1.el7 will be installed
--> Running transaction check
---> Package container-selinux.noarch 2:2.119.2-1.911c772.el7_8 will be installed
```

Clone the GitHub repository.

```
[root@ip-172-31-41-103 ~]# git init
Initialized empty Git repository in /root/.git/
[root@ip-172-31-41-103 ~]# git clone https://github.com/Sucheta4455/project.git
Cloning into 'project'...
remote: Enumerating objects: 23, done.
remote: Counting objects: 100% (23/23), done.
remote: Compressing objects: 100% (18/18), done.
remote: Total 23 (delta 2), reused 21 (delta 1), pack-reused 0
Unpacking objects: 100% (23/23), done.
[root@ip-172-31-41-103 ~]# ls
project
```

```
[root@ip-172-31-41-103 ~]# cd project/
[root@ip-172-31-41-103 project]# cd studentapp/
[root@ip-172-31-41-103 studentapp]# ls
backend  database  frontend
```

Firstly building docker container of database.

#docker build .

#docker run -d -P 3e80

```
[root@ip-172-31-41-103 studentapp]# cd database/
[root@ip-172-31-41-103 database]# ls
Dockerfile  init-db.sql
```

```
[root@ip-172-31-41-103 database]# docker build .
[+] Building 17.4s (7/7) FINISHED                                docker:default
 => [internal] load build definition from Dockerfile                      0.0s
 => => transferring dockerfile: 240B                                      0.0s
 => [internal] load metadata for docker.io/library/mysql:latest           2.0s
 => [internal] load .dockerignore                                         0.0s
 => => transferring context: 2B                                           0.0s
 => [internal] load build context                                         0.0s
 => => transferring context: 518B                                         0.0s
 => [1/2] FROM docker.io/library/mysql:latest@sha256:4552fcc5d3cdb8cdee7  15.1s
 => => resolve docker.io/library/mysql:latest@sha256:4552fcc5d3cdb8cdee76  0.0s
 => => sha256:db534de989c8aef71dbd5bddcabf63e5a257331 983.00kB / 983.00kB  0.8s
 => => sha256:82563e0cbf18162af685bff03debc195b851c327c31 6.55kB / 6.55kB  0.0s
 => => sha256:9a5c778f631f809e7c73d260001cedbcd41156ec4 51.33MB / 51.33MB  0.8s
 => => sha256:7c1ffa829a16a30594f619f1a54cdbc1126b3445722 2.86kB / 2.86kB  0.0s
 => => sha256:ccc451c3fb5566058fbe50d3cea82008343ae2a8614244b 883B / 883B  0.5s
 => => sha256:4552fcc5d3cdb8cdee76ee25cce28bf60b0eb3ce93d 2.51kB / 2.51kB  0.0s
 => => sha256:c1a1ab6fb3eac55eb2385c0cebf445972d01d7d6ff2 4.61MB / 4.61MB  0.9s
 => => extracting sha256:9a5c778f631f809e7c73d260001cedbcd41156ec483a8321  3.7s
 => => sha256:2d9f4c3e8c034a475f2b66e8f50db8e7890d309bd6ebf17 339B / 339B  1.1s
 => => sha256:4c79cbebfe62344d6007245a65fda4525a93d7088 63.09MB / 63.09MB  3.1s
 => => sha256:d18a374d12e635636554c1f857d2fd49eac6f2530a3 2.60kB / 2.60kB  1.2s
 => => sha256:b3549fdd67999fdddfe270e22f7e06d820dcef9e24a1115 325B / 325B  1.5s
 => => sha256:c08846a4ab7a941debe49759ea5a2915f7a49748c 63.42MB / 63.42MB  4.0s
 => => sha256:084bd453daf0a01004d7b8a8ff266c34f4edaab6ef6 5.18kB / 5.18kB  2.9s
 => => extracting sha256:ccc451c3fb5566058fbe50d3cea82008343ae2a8614244bd  0.0s
 => => extracting sha256:db534de989c8aef71dbd5bddcabf63e5a257331be69ed599  0.0s
 => => extracting sha256:c1a1ab6fb3eac55eb2385c0cebf445972d01d7d6ff2abb11  0.3s
 => => extracting sha256:d18a374d12e635636554c1f857d2fd49eac6f2530a3c24d6  0.0s
 => => extracting sha256:2d9f4c3e8c034a475f2b66e8f50db8e7890d309bd6ebf178  0.0s
 => => extracting sha256:4c79cbebfe62344d6007245a65fda4525a93d7088da3cf58  2.7s
 => => extracting sha256:b3549fdd67999fdddfe270e22f7e06d820dcef9e24a11155  0.0s
 => => extracting sha256:c08846a4ab7a941debe49759ea5a2915f7a49748c899367c  6.9s
 => => extracting sha256:084bd453daf0a01004d7b8a8ff266c34f4edaab6ef6d1621  0.0s
 => [2/2] COPY init-db.sql /docker-entrypoint-initdb.d/                   0.2s
 => exporting to image                                                    0.0s
 => => exporting layers                                                   0.0s
 => => writing image sha256:3e808dff2ed7a697adbf7d36093715aff997aa0194143  0.0s
```

```
[root@ip-172-31-41-103 database]# docker run -d -P 3e80
63cf4b6e47c2dfc21f715220b20400a2aa665f822ada3b8d86deef10f3741de0
[root@ip-172-31-41-103 database]# docker ps
CONTAINER ID   IMAGE     COMMAND                  CREATED         STATUS         PORTS
                NAMES
63cf4b6e47c2   3e80      "docker-entrypoint.s…"   5 seconds ago   Up 4 seconds   0.0.0.0:32769->3306/tcp, :::32769->3306/tcp, 0.0.0.0:32768->33060/tcp, :::327
68->33060/tcp   trusting_gould
```

#docker inspect 63

```
[root@ip-172-31-41-103 backend]# docker inspect 63
```

```
},
"HairpinMode": false,
"LinkLocalIPv6Address": "",
"LinkLocalIPv6PrefixLen": 0,
"SecondaryIPAddresses": null,
"SecondaryIPv6Addresses": null,
"EndpointID": "0e63ba940c8eb2a42c7eeec2a5a8aaee0f484ac233c8bd3af84dbed877955256",
"Gateway": "172.17.0.1",
"GlobalIPv6Address": "",
"GlobalIPv6PrefixLen": 0,
"IPAddress": "172.17.0.2",
"IPPrefixLen": 16,
"IPv6Gateway": "",
"MacAddress": "02:42:ac:11:00:02",
"Networks": {
    "bridge": {
```


Copy the IPAddress of database container and mention it in frontend index.html file

```
[root@ip-172-31-41-103 frontend]# cat index.html
<h1 style="text-align: center;"><span style="color: #ff0000;">Welcome to Student Application on
AWS.</span></h1>
<p><img style="display: block; margin-left: auto; margin-right: auto;"
src="https://cdn-images-1.medium.com/max/2000/1*tFl-8wQUENETYLjX5mYWuA.png" alt="" width="1200"
height="630" /></p>
<p> </p>
<h2 style="text-align: center;"><a href="http://13.208.214.195:32770/student/"><strong>Enter to Student
Application</strong></a></h2>
<p> </p>
<p> </p>
[root@ip-172-31-41-103 frontend]#
```

```
url="jdbc:mysql://172.17.0.2:3306/studentapp"/>
```

After database, I build docker image of backend docker container.

#docker build .

```
[root@ip-172-31-41-103 backend]# docker build .
[+] Building 41.8s (16/16) FINISHED                                              docker:default
 => [internal] load build definition from Dockerfile                                       0.0s
 => => transferring dockerfile: 600B                                                       0.0s
 => [internal] load metadata for docker.io/library/centos:7                                2.0s
 => [internal] load .dockerignore                                                          0.0s
 => => transferring context: 2B                                                            0.0s
 => [1/9] FROM docker.io/library/centos:7@sha256:be65f488b7764ad3638f236b7b515b3678369a5124c4  6.5s
 => => resolve docker.io/library/centos:7@sha256:be65f488b7764ad3638f236b7b515b3678369a5124c4  0.0s
 => => sha256:be65f488b7764ad3638f236b7b515b3678369a5124c47b8d32916d6487418ea 1.20kB / 1.20kB  0.0s
 => => sha256:dead07b4d8ed7e29e98de0f4504d87e8880d4347859d839686a31da35a3b532f 529B / 529B    0.0s
 => => sha256:eeb6ee3f44bd0b5103bb561b4c16bcb82328cfe5809ab675bb17ab3a16c517c 2.75kB / 2.75kB  0.0s
 => => sha256:2d473b07cdd5f0912cd6f1a703352c82b512407db6b05b43f2553732b55df 76.10MB / 76.10MB  1.0s
 => => extracting sha256:2d473b07cdd5f0912cd6f1a703352c82b512407db6b05b43f2553732b55df3bc     5.3s
 => [9/9] ADD https://s3-us-west-2.amazonaws.com/studentapi-cit/mysql-connector.jar lib/mysql  1.5s
 => [internal] load build context                                                          0.6s
 => => transferring context: 91.17kB                                                       0.4s
 => [3/9] ADD  https://dlcdn.apache.org/tomcat/tomcat-8/v8.5.99/bin/apache-tomcat-8.5.99.tar.  2.8s
 => [2/9] WORKDIR /opt                                                                     0.1s
 => [3/9] ADD  https://dlcdn.apache.org/tomcat/tomcat-8/v8.5.99/bin/apache-tomcat-8.5.99.tar.  0.1s
 => [4/9] RUN tar -xvzf apache-tomcat-8.5.99.tar.gz                                        0.6s
 => [5/9] RUN yum install java -y                                                         24.8s
 => [6/9] WORKDIR /opt/apache-tomcat-8.5.99                                                0.0s
 => [7/9] COPY student.war webapps/student.war                                             0.0s
 => [8/9] COPY context.xml conf/context.xml                                                0.0s
 => [9/9] ADD https://s3-us-west-2.amazonaws.com/studentapi-cit/mysql-connector.jar lib/mysql  0.0s
 => exporting to image                                                                     6.6s
 => => exporting layers                                                                    6.6s
 => => writing image sha256:159aa26b3020df1b534aa7818b2607dfc7ce167664453931a1ee5355b4e7bb69  0.0s
```

#docker run -d -P 152

```
[root@ip-172-31-41-103 backend]# docker run -d -P 159
8e51cefb8d64d717ec6e01db99ef164a356f4c34b206b131b4f1fdd50598fe11
[root@ip-172-31-41-103 backend]# docker ps
CONTAINER ID   IMAGE     COMMAND                  CREATED         STATUS         PORTS
                NAMES
8e51cefb8d64   159       "bin/catalina.sh run"    4 seconds ago   Up 4 seconds   0.0.0.0:32770->8080/tcp, :::32770->8080/tcp
                eloquent_payne
63cf4b6e47c2   3e80      "docker-entrypoint.s…"   4 minutes ago   Up 4 minutes   0.0.0.0:32769->3306/tcp, :::32769->3306/tcp, 0.0.0.0:32768->33060/tcp, :::327
68->33060/tcp   trusting_gould
```

And last building frontend container.

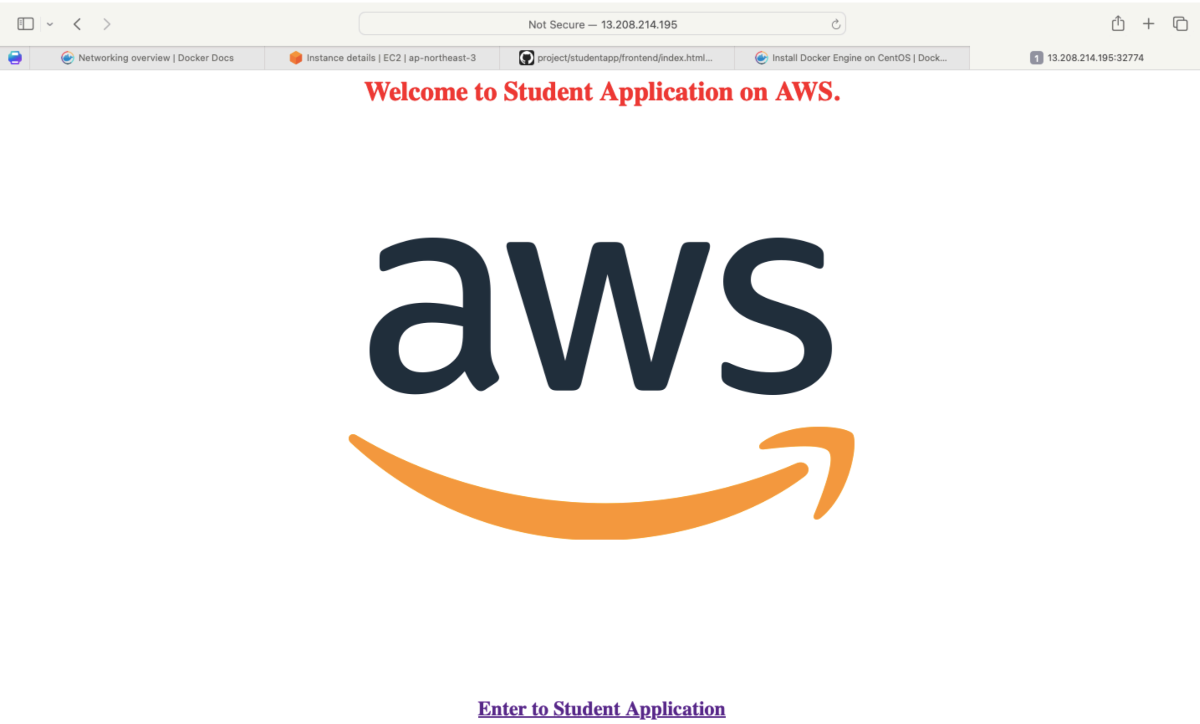
#docker build .

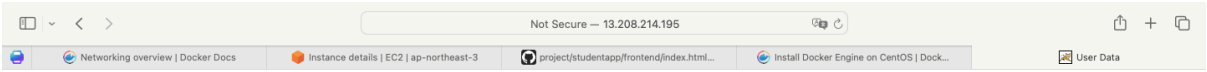
```
[root@ip-172-31-41-103 frontend]# docker build .
[+] Building 26.8s (8/8) FINISHED                                                docker:default
 => [internal] load build definition from Dockerfile                                       0.0s
 => => transferring dockerfile: 210B                                                       0.0s
 => [internal] load metadata for docker.io/library/centos:7                                1.2s
 => [internal] load .dockerignore                                                          0.0s
 => => transferring context: 2B                                                            0.0s
 => CACHED [1/3] FROM docker.io/library/centos:7@sha256:be65f488b7764ad3638f236b7b515b3678369  0.0s
 => [2/3] RUN yum install httpd -y                                                        18.7s
 => [internal] load build context                                                          0.1s
 => => transferring context: 579B                                                          0.0s
 => [3/3] COPY index.html /var/html/index.html                                             0.3s
 => exporting to image                                                                     5.8s
 => => exporting layers                                                                    5.7s
 => => writing image sha256:6674d8f2c362ca3308b22efe7749a4c71c4464d47494603ee3b45310b568b510  0.1s
```

#docker run -d -P

```
[root@ip-172-31-41-103 frontend]# docker run -d -P 667
f1d1ca88cbfab3752584f0cd6d2f3f59efcf3e6eb5f0dcd5759a3ae0f1859a64
[root@ip-172-31-41-103 frontend]# docker ps
CONTAINER ID   IMAGE     COMMAND                  CREATED          STATUS          PORTS
                 NAMES
f1d1ca88cbfa   667       "/bin/sh -c 'httpd -…"   24 seconds ago   Up 23 seconds   0.0.0.0:32771->80/tcp, :::32771->80/tcp
                 modest_swirles
8e51cefb8d64   159       "bin/catalina.sh run"    6 minutes ago    Up 6 minutes    0.0.0.0:32770->8080/tcp, :::32770->8080/tcp
                 eloquent_payne
63cf4b6e47c2   3e80      "docker-entrypoint.s…"   10 minutes ago   Up 10 minutes   0.0.0.0:32769->3306/tcp, :::32769->3306/tcp, 0.0.0.0:32768->33060/tcp, :::3
2768->33060/tcp   trusting_gould
```

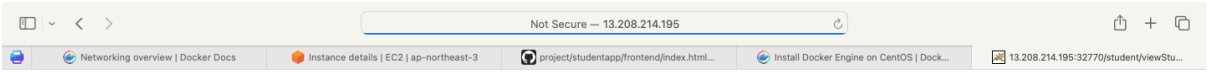
Hit the public IP of EC2 instance with port number of frontend container. You will see this page.





Student Registration Form

Student Name
Student Address
Student Age
Student Qualification
Student Percentage
Year Passed
register



Register Student

Students List

Student ID	StudentName	Student Addrs	Student Age	Student Qualification	Student Percentage	Student Year Passed	Edit	Delete
1	abc	abc	28	bfhjb	87	3455	edit	delete
2	sdfjh	efn	98	yjky	78	4677	edit	delete
3	sucheta	pune	27	msc	74	2019	edit	delete