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DevOps course, final project assignment.

Contents

Instructions for the teaching assistant

Implemented optional features

List of optional features implemented:

Individual service testing: Added tests related to service1 endpoints.

Analysis stage in the pipe.

Instructions for examiner to test the system.

Pay attention to optional features.

I have implemented one individual service testing for service1 and it have small two tests to tests the port that the service is running on and test the authentication and if it is accessible or not.

Added Analysis stage to the pipe line, used ESlint for java script language.

Data about the platform you used in development (hardware, CPU architecture, operating system, version of docker and docker-compose)

# System Details Report			
## Hardware Information:		## Software Information:	
Hardware Model:	Microsoft Corporation Virtual Machine	Firmware Version	090008
Memory	8.7 GiB	OS Name	Ubuntu 24.04.1 LTS
Processor	Intel® Core™ i7-1065G7 × 4	OS Type:	64-bit
Graphics	Software Rendering	GNOME Version:	46
Disk Capacity:	136.4 GB	Windowing System	X11
		Kernel Version	Linux 6.8.0-51-generic
~/ $ docker --version		Docker version 27.5.0, build a187fa5	
~/ $ docker-compose --version		Docker Compose version v2.20.3	

Description of the CI/CD pipeline

Briefly document all steps:

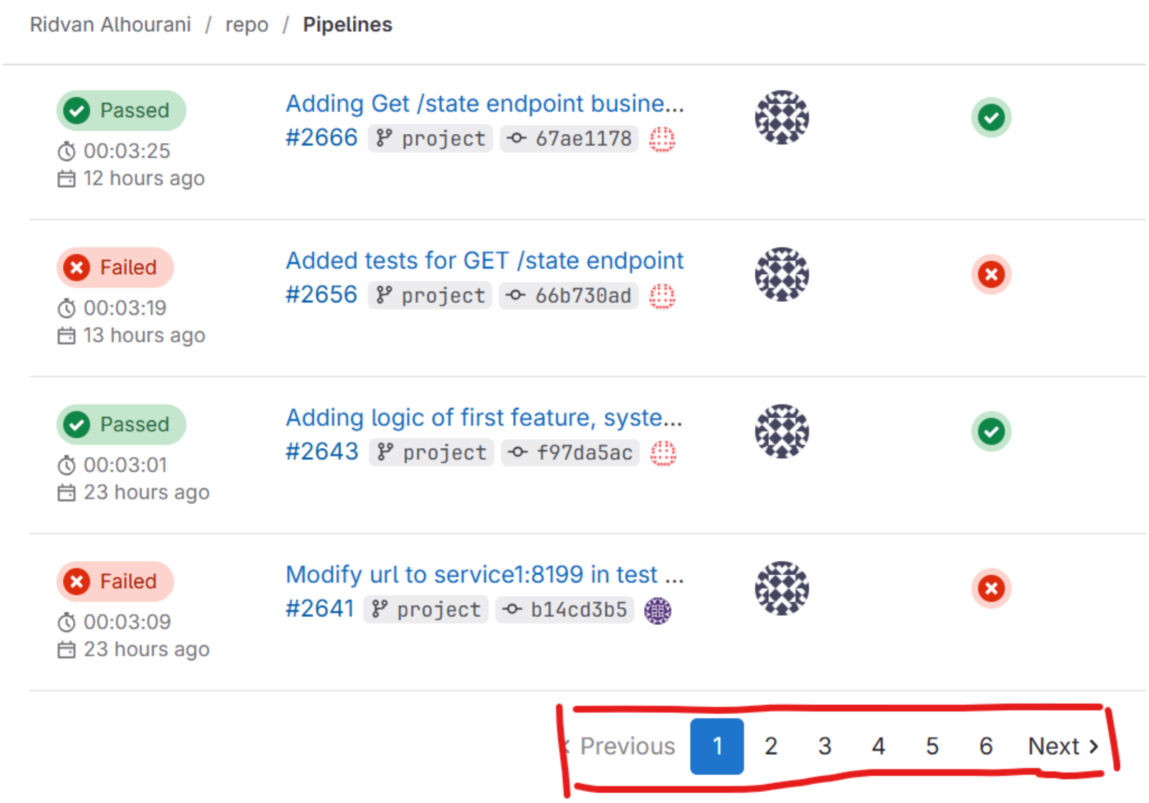
- Version management; use of branches etc
  - GIT, GitHub
  - main and project
- Building tools
  - npm, NodeJS, ESLint, Docker, Docker Compose, GitLab CI/CD, Linux, Windows
- Testing; tools and test cases
  - Jest for nodeJs projects

    - ESLint for analysing the code
    - Test cases
        - **State Transitions**: Test transitions between states (INIT, RUNNING, PAUSED, SHUTTING DOWN) including edge cases. 5 cases in total. Including edge cases, logging in, INIT state and SHUTTING down state and transition from RUNNING/PAUSE to other states
        - **Endpoint Responses**: Test API endpoints (PUT state, GET state, GET container details, GET run-log) to ensure they return expected results.
        - **Port Accessibility**: Test endpoints through the accessible port, so, these tests included nginx configurations by default.
    - Individual service testing
        - Tested Service1 responses and accessing, tests accessing to the port and checking if the container running and did some requests to it. This also include testing nginx configurations against out requirements.
- Packing
    - I have three stages: Build -> Test -> Analysis -> Deploy
    - **Environment Variables**: Set variables to specify the environment, allowing tests to work with dynamic URLs.
    - **Docker-in-Docker:** As I was facing issues in deploying my pipeline, so, I have used docker-in-docker to isolate the solution and create a similar environment on both local and on GitLab aiding in debugging.
- Deployment
    - **Tools**: Docker, Docker Compose, GitLab CI/CD, nginx
    - **Process**: Automate deployment using GitLab CI/CD. Ensure the pipeline deploys the application to the target environment on each push to ''main'' or ''project'' branches.
- Operating; monitoring
    - No monitoring added.
- Static analysis
    - Added static analysing stage in the pipeline, to analyse the codebase using ESLint

Example runs of the pipeline

Include some kind of log of both failing test and passing.

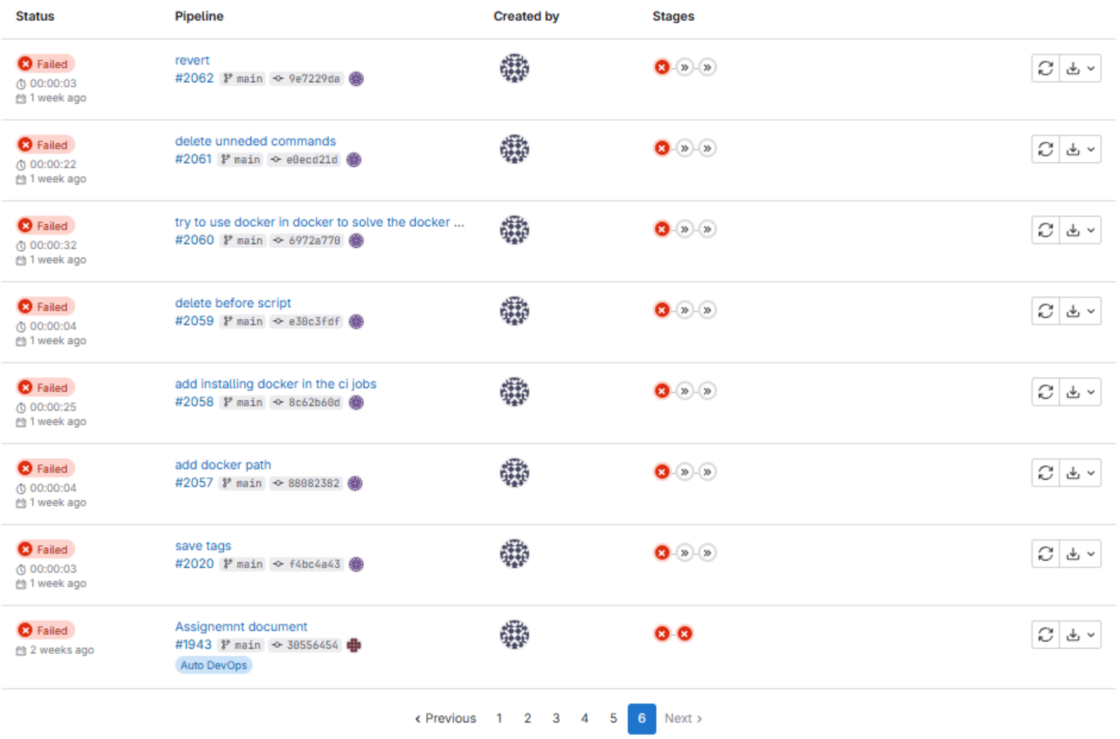
I had a lot of failing pipelines especially in the beginning, down can be seen the last attempts with fail and pass pipes when implementing tests and afterward the business logic. At the beginning, the errors were about the pipelines, runner and GitLab configurations themselves, after wards the issues were about the code itself and some URLs not accessible due of environment change (local vs GitLab).



Ridvan Alhourani / repo / **Pipelines**

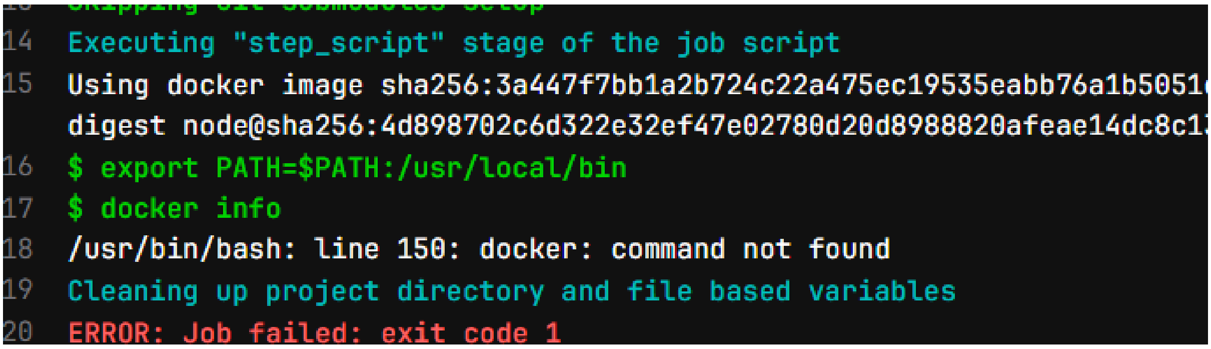
✓ Passed 00:03:25 12 hours ago	Adding Get /state endpoint busine... #2666 project 67ae1178		✓
✗ Failed 00:03:19 13 hours ago	Added tests for GET /state endpoint #2656 project 66b730ad		✗
✓ Passed 00:03:01 23 hours ago	Adding logic of first feature, syste... #2643 project f97da5ac		✓
✗ Failed 00:03:09 23 hours ago	Modify url to service1:8199 in test ... #2641 project b14cd3b5		✗

‹ Previous **1** 2 3 4 5 6 Next ›



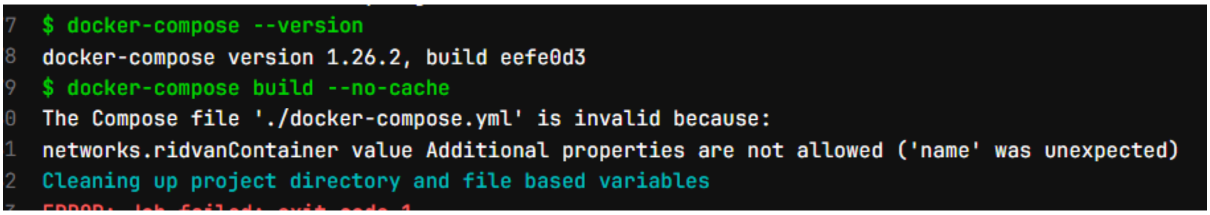
Status	Pipeline	Created by	Stages
✗ Failed 00:00:03 1 week ago	revert #2062 main 9e7229da		✗ » »
✗ Failed 00:00:22 1 week ago	delete unneded commands #2061 main e0ecd21d		✗ » »
✗ Failed 00:00:32 1 week ago	try to use docker in docker to solve the docker ... #2060 main 6972a770		✗ » »
✗ Failed 00:00:04 1 week ago	delete before script #2059 main e30c3fdf		✗ » »
✗ Failed 00:00:25 1 week ago	add installing docker in the ci jobs #2058 main 8c62b60d		✗ » »
✗ Failed 00:00:04 1 week ago	add docker path #2057 main 88082382		✗ » »
✗ Failed 00:00:03 1 week ago	save tags #2020 main f4bc4a43		✗ » »
✗ Failed 2 weeks ago	Assignemnt document #1943 main 30556454 Auto DevOps		✗ ✗

‹ Previous 1 2 3 4 5 **6** Next ›



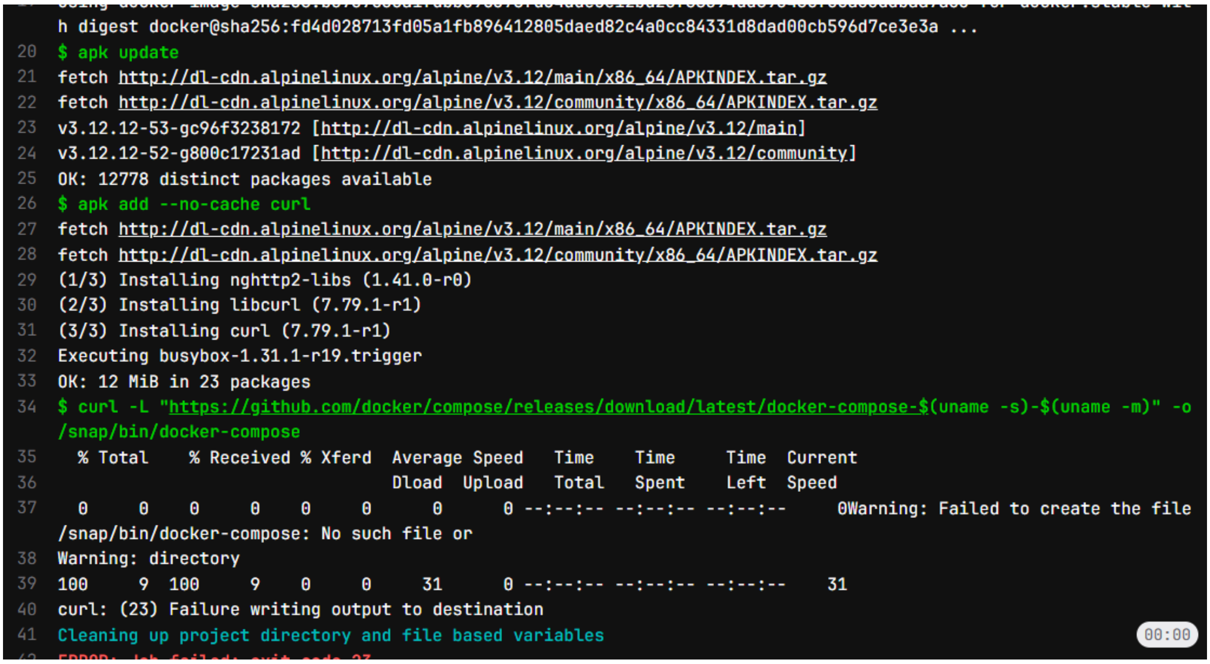
```
Skipping Git submodules setup
Executing "step_script" stage of the job script
Using docker image sha256:3a447f7bb1a2b724c22a475ec19535eabb76a1b5051
digest node@sha256:4d898702c6d322e32ef47e02780d20d8988820afeae14dc8c1
$ export PATH=$PATH:/usr/local/bin
$ docker info
/usr/bin/bash: line 150: docker: command not found
Cleaning up project directory and file based variables
ERROR: Job failed: exit code 1
```

One of the first issues, Docker command was not found, after it, docker-compose command was not found, I have tried to add a PATH explicitly but it was in vain. I have added Docker-in-Docker after many attempts and searches, it worked in that way only.



```
$ docker-compose --version
docker-compose version 1.26.2, build eefe0d3
$ docker-compose build --no-cache
The Compose file './docker-compose.yml' is invalid because:
networks.ridvanContainer value Additional properties are not allowed ('name' was unexpected)
Cleaning up project directory and file based variables
ERROR: Job failed: exit code 1
```

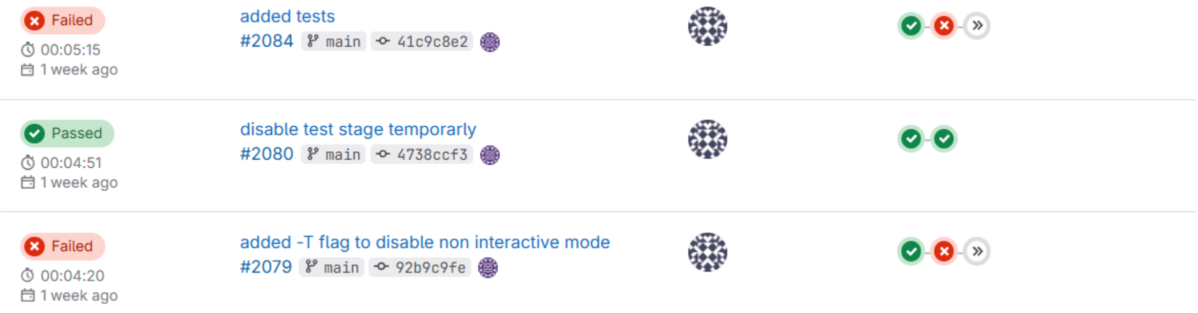
Some issues related to network and docker-compose file configurations and version.



```
h digest docker@sha256:fd4d028713fd05a1fb896412805daed82c4a0cc84331d8dad00cb596d7ce3e3a ...
$ apk update
fetch http://dl-cdn.alpinelinux.org/alpine/v3.12/main/x86_64/APKINDEX.tar.gz
fetch http://dl-cdn.alpinelinux.org/alpine/v3.12/community/x86_64/APKINDEX.tar.gz
v3.12.12-53-gc96f3238172 [http://dl-cdn.alpinelinux.org/alpine/v3.12/main]
v3.12.12-52-g800c17231ad [http://dl-cdn.alpinelinux.org/alpine/v3.12/community]
OK: 12778 distinct packages available
$ apk add --no-cache curl
fetch http://dl-cdn.alpinelinux.org/alpine/v3.12/main/x86_64/APKINDEX.tar.gz
fetch http://dl-cdn.alpinelinux.org/alpine/v3.12/community/x86_64/APKINDEX.tar.gz
(1/3) Installing nghttp2-libs (1.41.0-r0)
(2/3) Installing libcurl (7.79.1-r1)
(3/3) Installing curl (7.79.1-r1)
Executing busybox-1.31.1-r19.trigger
OK: 12 MiB in 23 packages
$ curl -L "https://github.com/docker/compose/releases/download/latest/docker-compose-$(uname -s)-$(uname -m)" -o
/snap/bin/docker-compose
  % Total    % Received % Xferd  Average Speed   Time    Time     Time  Current
                                 Dload  Upload   Total   Spent    Left  Speed
  0     0    0     0    0     0      0      0 --:--:-- --:--:-- --:--:--     0Warning: Failed to create the file
/snap/bin/docker-compose: No such file or
Warning: directory
100     9  100     9    0     0     31      0 --:--:-- --:--:-- --:--:--    31
curl: (23) Failure writing output to destination
Cleaning up project directory and file based variables                                                  00:00
ERROR: Job failed: exit code 23
```

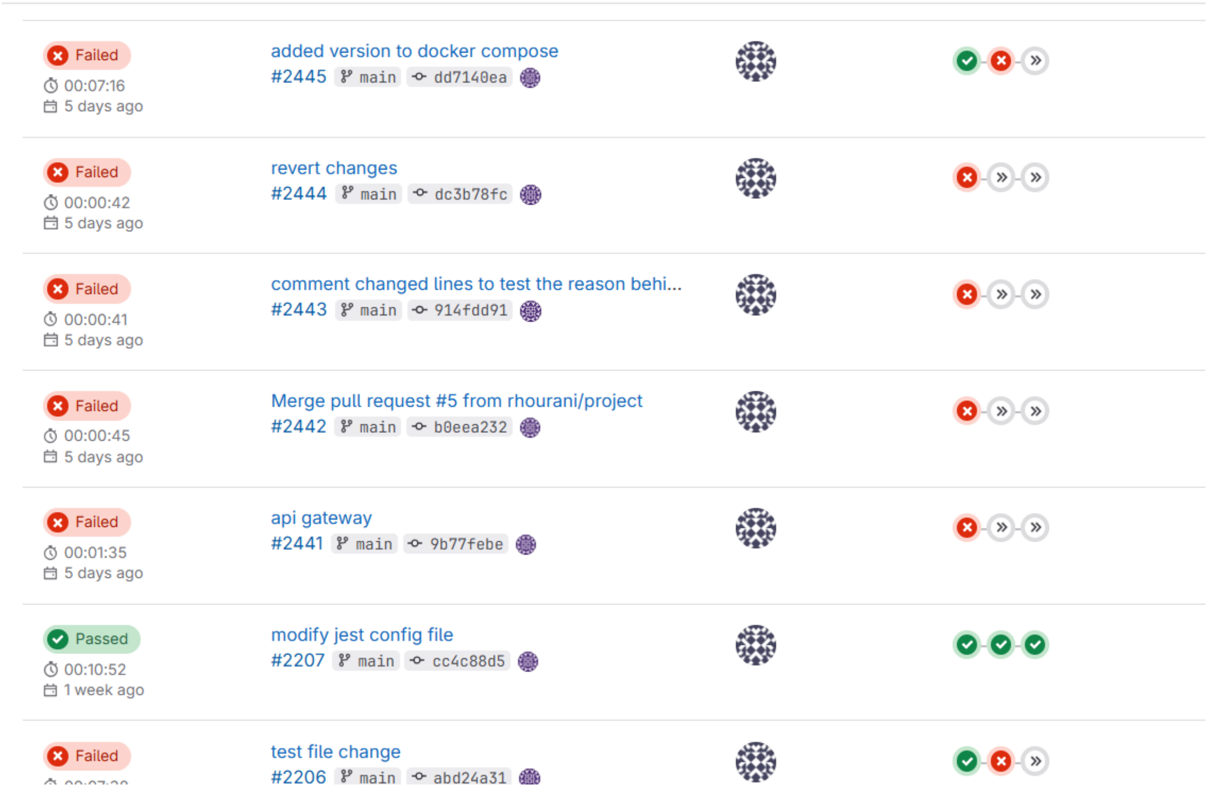
Some issues related to GitLab file’s specified tasks, tests was not runnable due of obsolete commands.

After fixing the commands, got the test stage runnable:



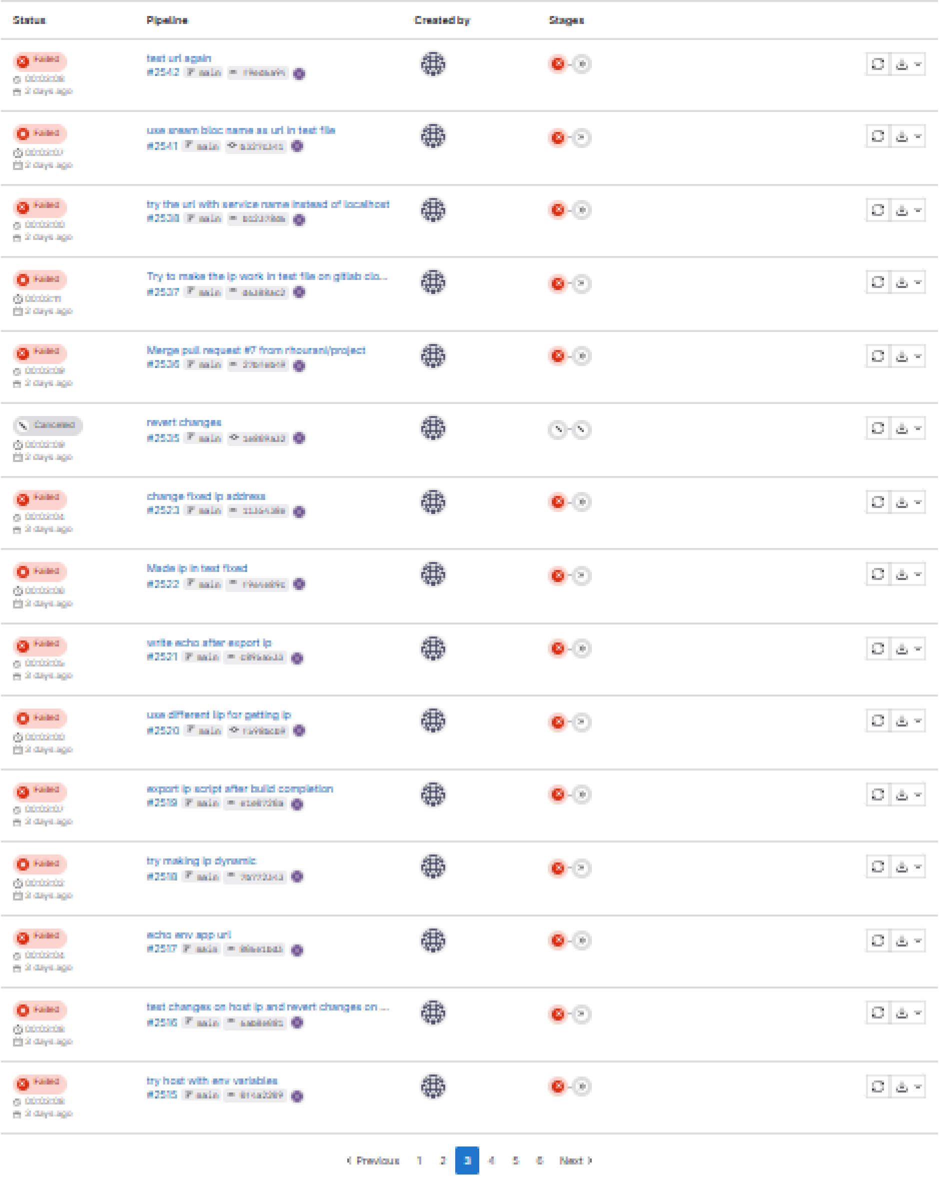
✗ Failed 00:05:15 1 week ago	added tests #2084 main 41c9c8e2	✓ ✗ »
✓ Passed 00:04:51 1 week ago	disable test stage temporarly #2080 main 4738ccf3	✓ ✓
✗ Failed 00:04:20 1 week ago	added -T flag to disable non interactive mode #2079 main 92b9c9fe	✓ ✗ »

After making sure the pipe can run with all stages of build, test and deploy, I went forward to change configurations API gateway, the next image shows the pipe green with three stages then red again due of adding some new configurations to nginx



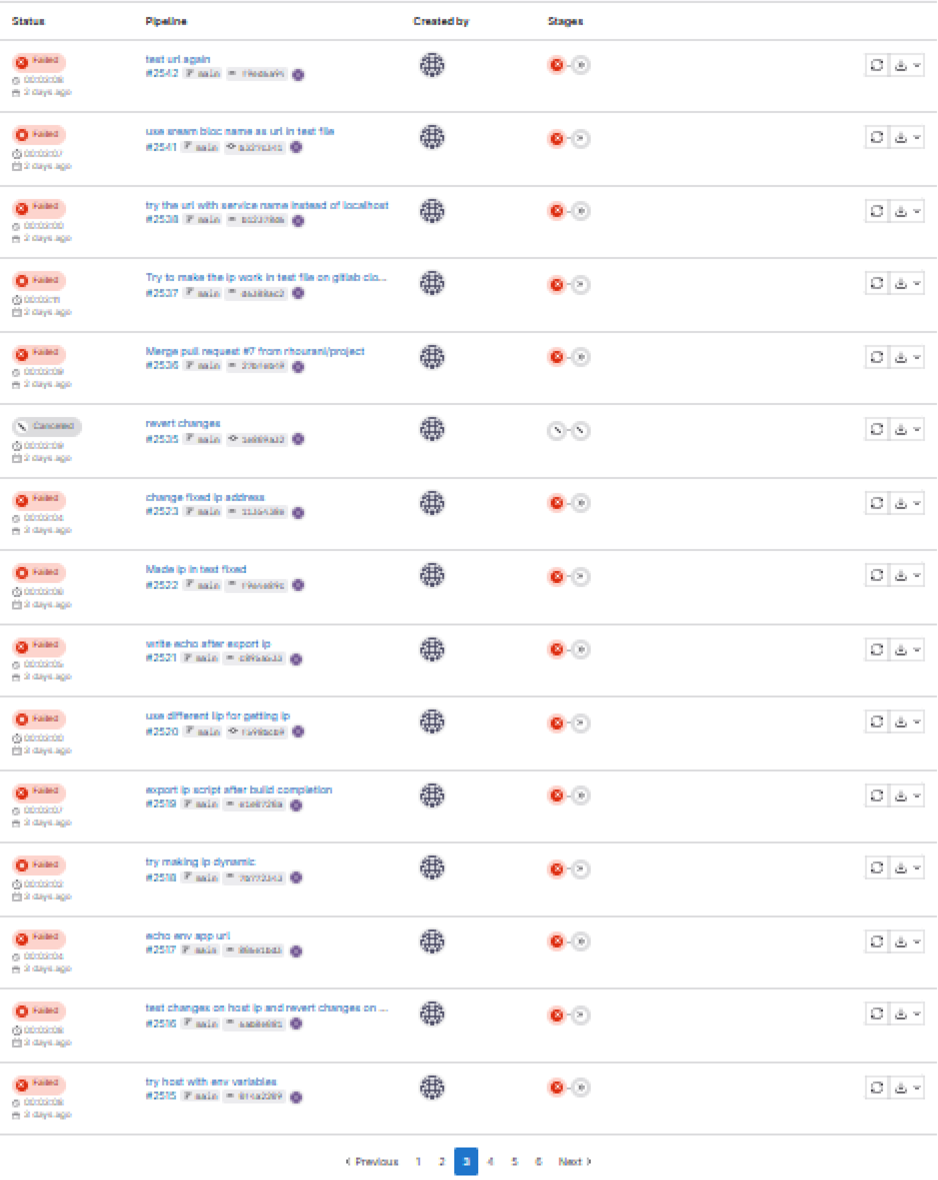
✗ Failed 00:07:16 5 days ago	added version to docker compose #2445 main dd7140ea	✓ ✗ »
✗ Failed 00:00:42 5 days ago	revert changes #2444 main dc3b78fc	✗ » »
✗ Failed 00:00:41 5 days ago	comment changed lines to test the reason behi... #2443 main 914fdd91	✗ » »
✗ Failed 00:00:45 5 days ago	Merge pull request #5 from rhourani/project #2442 main b0eea232	✗ » »
✗ Failed 00:01:35 5 days ago	api gateway #2441 main 9b77febe	✗ » »
✓ Passed 00:10:52 1 week ago	modify jest config file #2207 main cc4c88d5	✓ ✓ ✓
✗ Failed	test file change #2206 main abd24a31	✓ ✗ »

From this stage, things were stuck for a while for several days



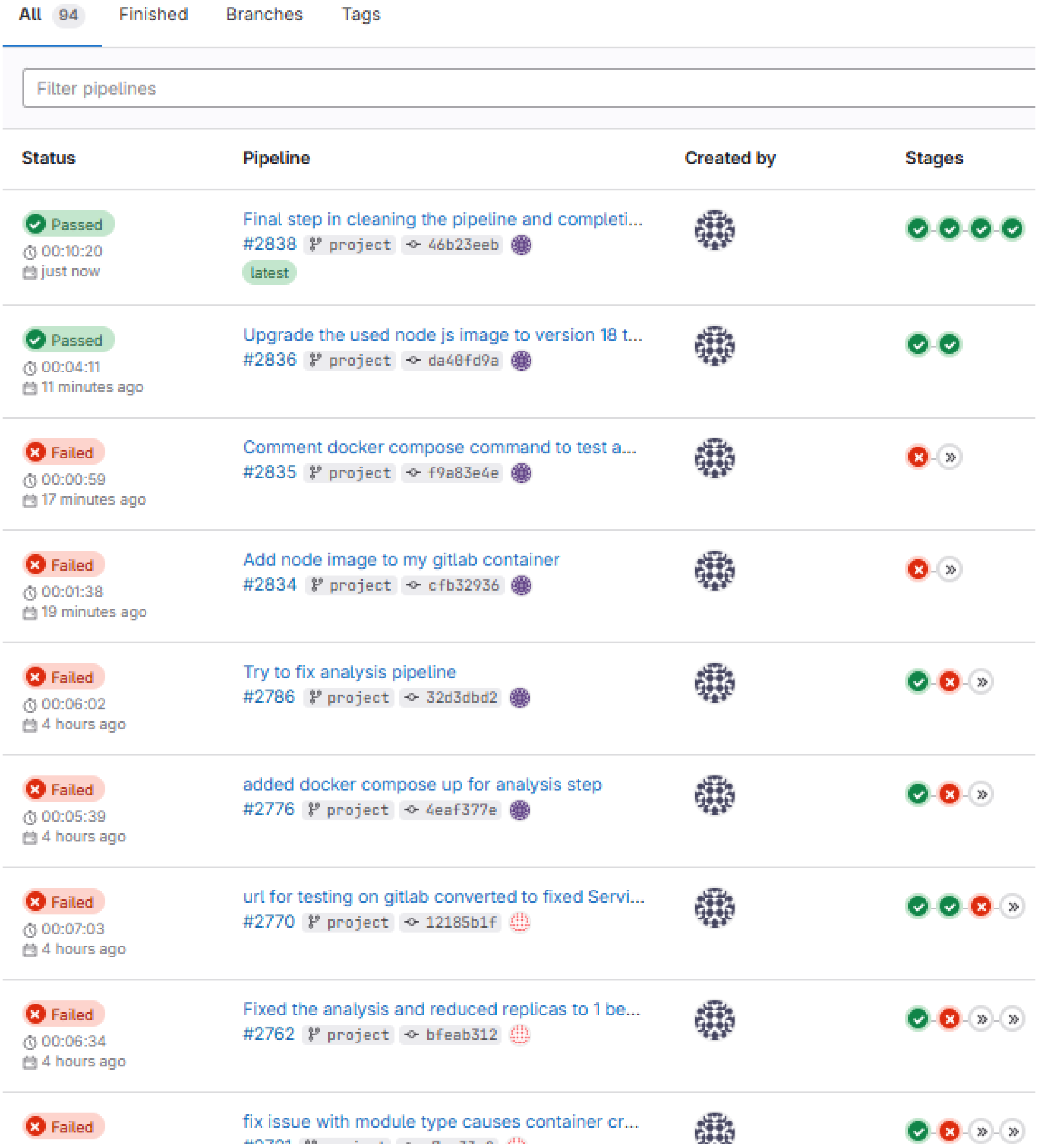
Status	Pipeline	Created by	Stages
Failed 00:00:08 2 days ago	test url again #2542 main [illegible]		⊗ – ○
Failed 00:00:07 2 days ago	use swarm bloc name as url in test file #2541 main [illegible]		⊗ – ○
Failed 00:00:00 2 days ago	try the url with service name instead of localhost #2538 main [illegible]		⊗ – ○
Failed 00:00:11 2 days ago	Try to make the ip work in test file on gitlab clo... #2537 main [illegible]		⊗ – ○
Failed 00:00:09 2 days ago	Merge pull request #7 from rhourani/project #2536 main [illegible]		⊗ – ○
Canceled 00:00:09 2 days ago	revert changes #2535 main [illegible]		⊘ – ⊘
Failed 00:00:04 3 days ago	change fixed ip address #2523 main [illegible]		⊗ – ○
Failed 00:00:08 3 days ago	Made ip in test fixed #2522 main [illegible]		⊗ – ○
Failed 00:00:05 3 days ago	write echo after export ip #2521 main [illegible]		⊗ – ○
Failed 00:00:00 3 days ago	use different ip for getting ip #2520 main [illegible]		⊗ – ○
Failed 00:00:07 3 days ago	export ip script after build completion #2519 main [illegible]		⊗ – ○
Failed 00:00:02 3 days ago	try making ip dynamic #2518 main [illegible]		⊗ – ○
Failed 00:00:04 3 days ago	echo env app url #2517 main [illegible]		⊗ – ○
Failed 00:00:08 3 days ago	test changes on host ip and revert changes on ... #2516 main [illegible]		⊗ – ○
Failed 00:00:08 3 days ago	try host with env variables #2515 main [illegible]		⊗ – ○

After managing to run the pipe with the new API gateway configuration after several days, I started implementing the features as first image above shows.



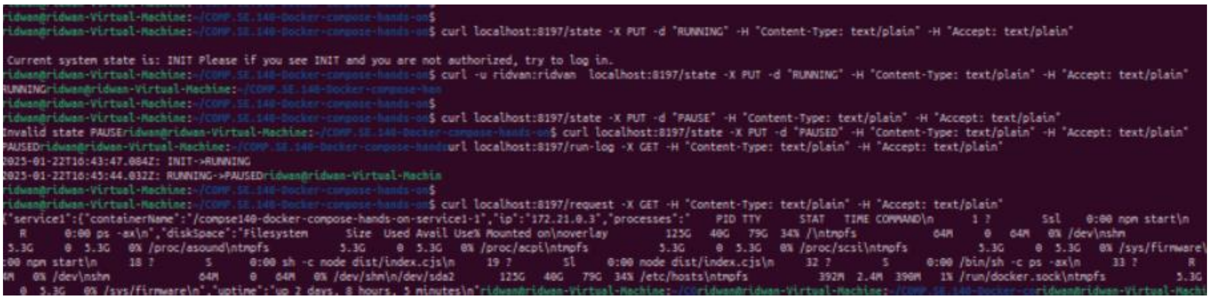
Status	Pipeline	Created by	Stages
Failed [illegible] 2 days ago	test url again #2542 main [illegible]		
Failed [illegible] 2 days ago	use sream bloc name as url in test file #2541 main [illegible]		
Failed [illegible] 2 days ago	try the url with service name instead of localhost #2538 main [illegible]		
Failed [illegible] 2 days ago	Try to make the ip work in test file on gitlab clo... #2537 main [illegible]		
Failed [illegible] 2 days ago	Merge pull request #7 from rhourani/project #2536 main [illegible]		
Canceled [illegible] 2 days ago	revert changes #2535 main [illegible]		
Failed [illegible] 2 days ago	change fixed ip address #2523 main [illegible]		
Failed [illegible] 2 days ago	Made ip in test fixed #2522 main [illegible]		
Failed [illegible] 2 days ago	write echo after export ip #2521 main [illegible]		
Failed [illegible] 2 days ago	use different lip for getting ip #2520 main [illegible]		
Failed [illegible] 2 days ago	export ip script after build completion #2519 main [illegible]		
Failed [illegible] 2 days ago	try making ip dynamic #2518 main [illegible]		
Failed [illegible] 2 days ago	echo env app url #2517 main [illegible]		
Failed [illegible] 2 days ago	test changes on host ip and revert changes on ... #2516 main [illegible]		
Failed [illegible] 2 days ago	try host with env variables #2515 main [illegible]		

I have decided to add analysis stage and here is the failures and success, also statics shows that I have initiated the pipeline run 94 times:



Status	Pipeline	Created by	Stages
Passed 00:10:20 just now	Final step in cleaning the pipeline and completi... #2838 project 46b23eeb latest		✓ ✓ ✓ ✓
Passed 00:04:11 11 minutes ago	Upgrade the used node js image to version 18 t... #2836 project da40fd9a		✓ ✓
Failed 00:00:59 17 minutes ago	Comment docker compose command to test a... #2835 project f9a83e4e		✗ »
Failed 00:01:38 19 minutes ago	Add node image to my gitlab container #2834 project cfb32936		✗ »
Failed 00:06:02 4 hours ago	Try to fix analysis pipeline #2786 project 32d3dbd2		✓ ✗ »
Failed 00:05:39 4 hours ago	added docker compose up for analysis step #2776 project 4eaf377e		✓ ✗ »
Failed 00:07:03 4 hours ago	url for testing on gitlab converted to fixed Servi... #2770 project 12185b1f		✓ ✓ ✗ »
Failed 00:06:34 4 hours ago	Fixed the analysis and reduced replicas to 1 be... #2762 project bfeab312		✓ ✗ » »
Failed	fix issue with module type causes container cr...		✓ ✗ » »

A screen shot of application requests:



```
ridwan@ridwan-Virtual-Machine:~/COMP.SE.140-Docker-compose-hands-on$
ridwan@ridwan-Virtual-Machine:~/COMP.SE.140-Docker-compose-hands-on$ curl localhost:8197/state -X PUT -d "RUNNING" -H "Content-Type: text/plain" -H "Accept: text/plain"

 Current system state is: INIT Please if you see INIT and you are not authorized, try to log in.
ridwan@ridwan-Virtual-Machine:~/COMP.SE.140-Docker-compose-hands-on$ curl -u ridvan:ridvan  localhost:8197/state -X PUT -d "RUNNING" -H "Content-Type: text/plain" -H "Accept: text/plain"
RUNNINGridwan@ridwan-Virtual-Machine:~/COMP.SE.140-Docker-compose-han
ridwan@ridwan-Virtual-Machine:~/COMP.SE.140-Docker-compose-hands-on$
ridwan@ridwan-Virtual-Machine:~/COMP.SE.140-Docker-compose-hands-on$ curl localhost:8197/state -X PUT -d "PAUSE" -H "Content-Type: text/plain" -H "Accept: text/plain"
Invalid state PAUSEridwan@ridwan-Virtual-Machine:~/COMP.SE.140-Docker-compose-hands-on$ curl localhost:8197/state -X PUT -d "PAUSED" -H "Content-Type: text/plain" -H "Accept: text/plain"
PAUSEDridwan@ridwan-Virtual-Machine:~/COMP.SE.140-Docker-compose-handsurl localhost:8197/run-log -X GET -H "Content-Type: text/plain" -H "Accept: text/plain"
2025-01-22T16:43:47.084Z: INIT->RUNNING
2025-01-22T16:45:44.032Z: RUNNING->PAUSEDridwan@ridwan-Virtual-Machin
ridwan@ridwan-Virtual-Machine:~/COMP.SE.140-Docker-compose-hands-on$
ridwan@ridwan-Virtual-Machine:~/COMP.SE.140-Docker-compose-hands-on$ curl localhost:8197/request -X GET -H "Content-Type: text/plain" -H "Accept: text/plain"
{"service1":{"containerName":"/compse140-docker-compose-hands-on-service1-1","ip":"172.21.0.3","processes":"    PID TTY      STAT   TIME COMMAND\n      1 ?        Ssl    0:00 npm start\n
   R      0:00 ps -ax\n","diskSpace":"Filesystem      Size  Used Avail Use% Mounted on\noverlay         125G   40G   79G  34% /\ntmpfs            64M     0   64M   0% /dev\nshm
 5.3G     0  5.3G   0% /proc/asound\ntmpfs          5.3G     0  5.3G   0% /proc/acpi\ntmpfs          5.3G     0  5.3G   0% /proc/scsi\ntmpfs          5.3G     0  5.3G   0% /sys/firmware\
:00 npm start\n     18 ?        S      0:00 sh -c node dist/index.cjs\n     19 ?        Sl     0:00 node dist/index.cjs\n     32 ?        S      0:00 /bin/sh -c ps -ax\n     33 ?        R
4M   0% /dev\nshm              64M     0   64M   0% /dev/shm\n/dev/sda2       125G   40G   79G  34% /etc/hosts\ntmpfs          392M  2.4M  390M   1% /run/docker.sock\ntmpfs          5.3G
  0  5.3G   0% /sys/firmware\n","uptime":"up 2 days, 8 hours, 5 minutes\n"ridwan@ridwan-Virtual-Machine:~/C ridwan@ridwan-Virtual-Machine:~/COMP.SE.140-Docker-co ridwan@ridwan-Virtual-Machi
```

Reflections

Main learnings and worst difficulties

Especially, if you think that something should have been done differently, describe it here.

I gained good experience in configuring nginx with proxy and as an API gateway, had learnt docker and docker compose in practice, I am confident in my ability to debug the containers, saw with my eyes how difficult it is to debug them, and how important to make sure everything is logged in from errors to entering some services and code blocks sometimes. I am now able to define docker compose file and docker files for at least JavaScript and typescript languages, I can also say from previous try, I maybe can configure it for C# and other languages with a bit of search as I am aware of the components of these files. This course went well with cloud technologies course that I took; I have good understanding for cloud technologies and seeing a CI/CD from scratch went very well for me to combine different concepts about this whole stuff.

I think there are more than what I have mentioned here, but it is long enough. About difficulties, it was enjoyable journey for me, it needs you to know how to search and use your resources in hand well. There were some frustrating moments when nginx, GitLab configs were not working, but thankfully, going back and forth helped in simplifying the process and reaching one point that I can start again from.

State management with Replicas: Faced a big know issue. As I am using 3 replicas and load balancing, when changing the state, it is changed in one replica but not the others.

I have used Redis, to save the state globally, but unfortunately the set up was complicated and it took me good time. I was in the last steps of cleaning the code and the pipe; therefore, I gave up on it and used an alternative, reduced the replicas to 1. Nevertheless, I have learned about Redis.

Better Implementation Ideas

Even the solution looks good -considering it my first time-, but I have some questions and would like to do it differently if had the chance to, I will list them as bullet points:

- Redis. I should had thought about state management. To think about the system and analyse/understand it thoroughly first before starting its development.
- The API gateway and service1 were at same file. It looks like a spaghetti code. I have used reuseable methods but still, the purpose of the file should be singular and focused on one business logic if possible. One reason for this is that we added one feature at a time and lack of understanding of the system and being new to it. And need more effort = hours.
- Nginx configuration and load balancing, in my observations they were fine, would need to think about it more and how to improve it, like separate files.
- Docker containers and debugging were the hardest part, would be nice to think how to debug them in a better and easier way.

- Tests had an annoying problem regarding URL. I have tried to set variables, but it was in vain, it is just not worked. I would like to spend some time figuring out a way to set them dynamically based on which system they are running.

Amount effort (hours) used

Give your estimate:

60 hours (less or more)