Instance ID: i-0376a845670c1d678 Student Name: Artyom Ashigov

R-based API in ECS

Task

Deploy an R-based API in ECS for analyzing recent Binance (or any other real-time) data. The API should include at least 4 endpoints using different serializers, and these endpoints should be other than the ones we covered in the class. At least one endpoint should have at least a few parameters. Build a Docker image, push it to ECR, and deploy as service in ECS. Document the steps required to set up ECR/ECS with screenshots, then delete all services after confirming that everything works correctly.

Tech Setup

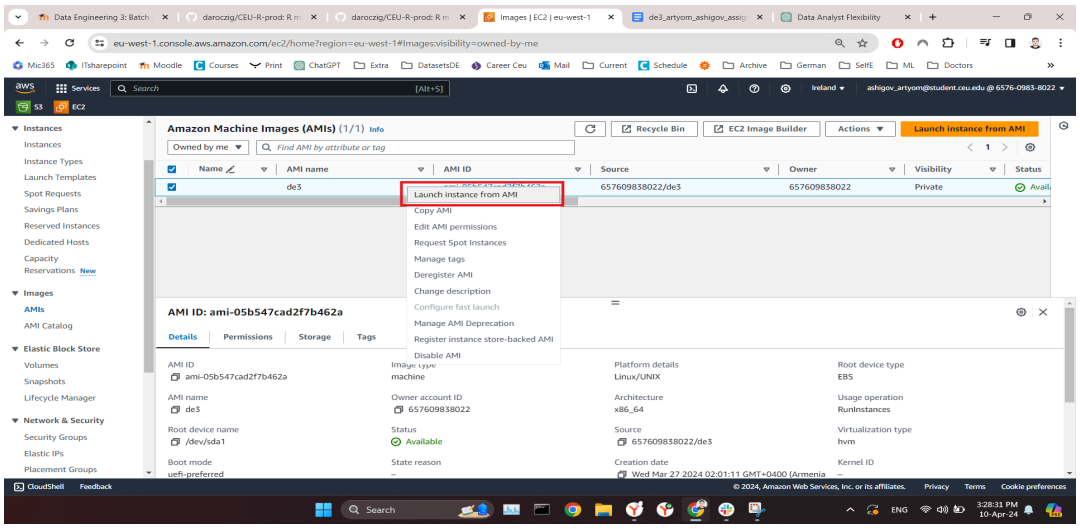
We are going to use the following preconfigured tools:

- de3 Amazon Machine Image that you can use to spin up an EC2 node with RStudio Server, Shiny Server, Jenkins, Redis and Docker installed & pre-configured (use your AWS username and the password shared on Slack previously) along with the most often used R packages (including the ones we used for stream processing, eg botor, AWR.Kinesis and the binancer package)
- de3 EC2 IAM role with full access to Kinesis, Dynamodb, Cloudwatch and the slack token in the Parameter Store
- de3 security group with open ports for RStudio Server and Jenkins

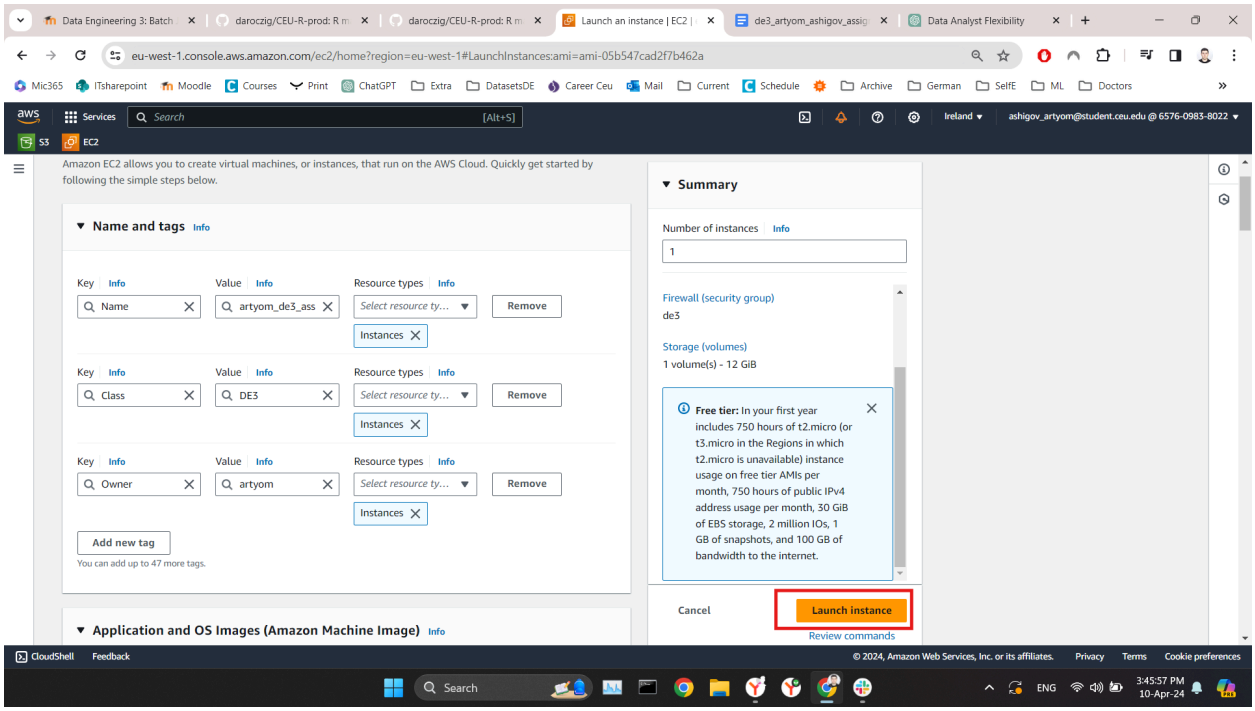
PART 1: Launching EC2 instance

We are going to launch an instance using a pre configured Amazon Machine Image (AMI) named de3.

1. We open EC2 and under the **Images** toggle menu select AMIs.
2. From there we right click on de AMI, then click on Launch instance from AMI



3. Provide a name `artyom_de3_assignment`. Add additional tags:
    a. owner : `artyom`
    b. class: `DE3`
4. From **Application and OS Images** (Amazon Machine Image) toggle menu choose `de3` AMI
5. From **Instance type** choose `t3a.medium`
6. From **Key pair** select `artyom_de3`
7. From **Network settings select Existing security group** and choose `de3`
8. From **Advanced details** under **IAM instance profile** select `ceudataserver`
9. Click on **Launch Instance**



10. Click on Instance ID (i-0376a845670c1d678)
11. Note: to access RStudio or Jenkins we add to our IP address /rstudio or /jenkins respectively.
12. username: `ashigov_artyom`
    password: `TBehRz0zrUdkmBMVFf9VBE3Xy4OnsE0dmdyDUOm6D4`

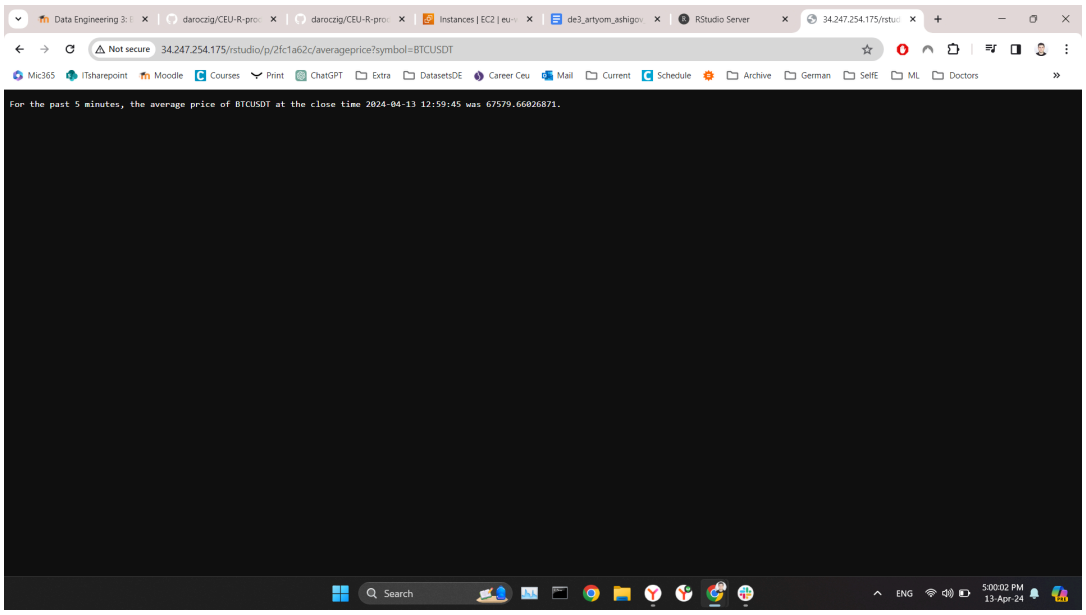
PART 2: Setup an API with 4 different endpoints and serializers

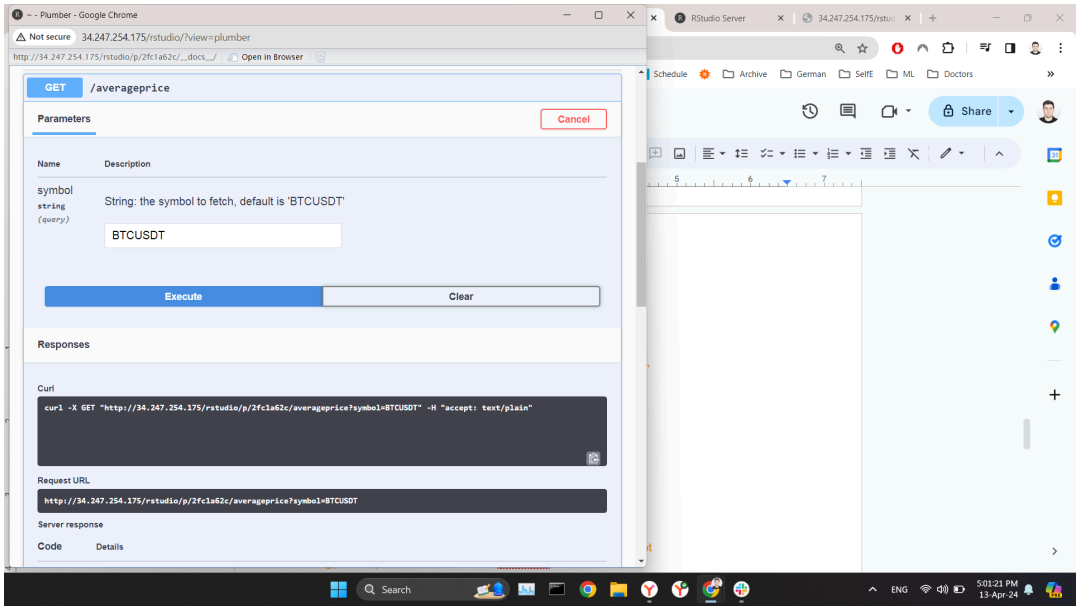
To set up our API, we'll be utilizing R Plumber. We've named and saved the file that contains the API as plumber.R for ease of use. Below is the complete code that we implemented to configure the API:

```
library(binancer)
library(readr)
library(dplyr)
```

```
library(ggplot2)

#* @apiTitle Cryptocurrencies Analysis API
#* @apiDescription Provides detailed statistics and visual insights on cryptocurrencies from Binance including average prices, market depth, and price trends.

# Endpoint 1: Get the Average Price of a Cryptocurrency
#* @param symbol String: the symbol to fetch, default is 'BTCUSDT'
#* @get /averageprice
#* @serializer text
function(symbol = 'BTCUSDT') {
  # Fetch the average price from Binance
  x <- binance_avg_price(symbol)

  # Format the closeTime for readability
  close_time_formatted <- format(as.POSIXct(x$closeTime / 1000, origin = "1970-01-01"), "%Y-%m-%d %H:%M:%S")

  summary_text <- sprintf("For the past %d minutes, the average price of %s at the close time %s was %s.",
                          x$mins, symbol, close_time_formatted, x$price)

  summary_text
}
```

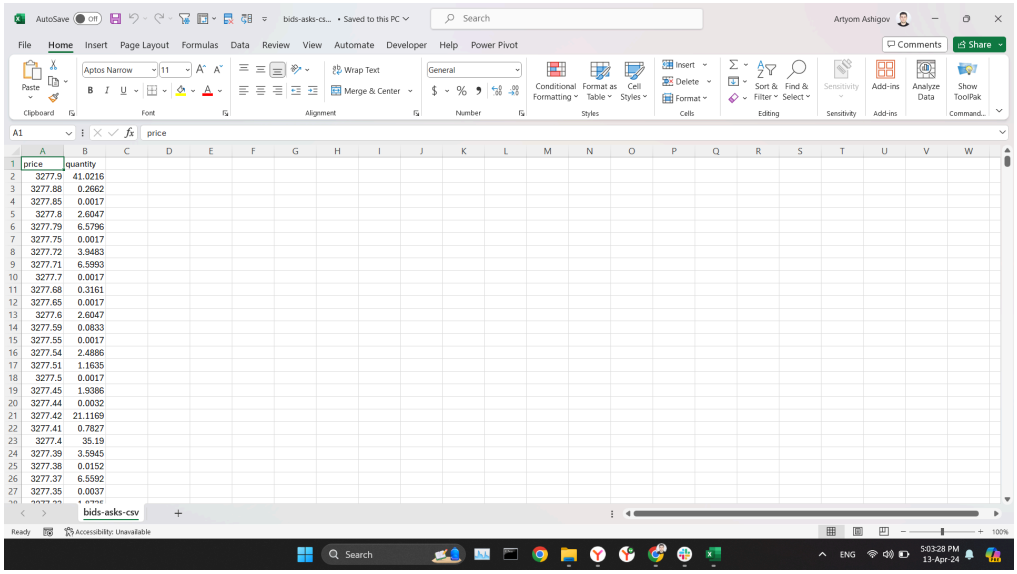
Results 1





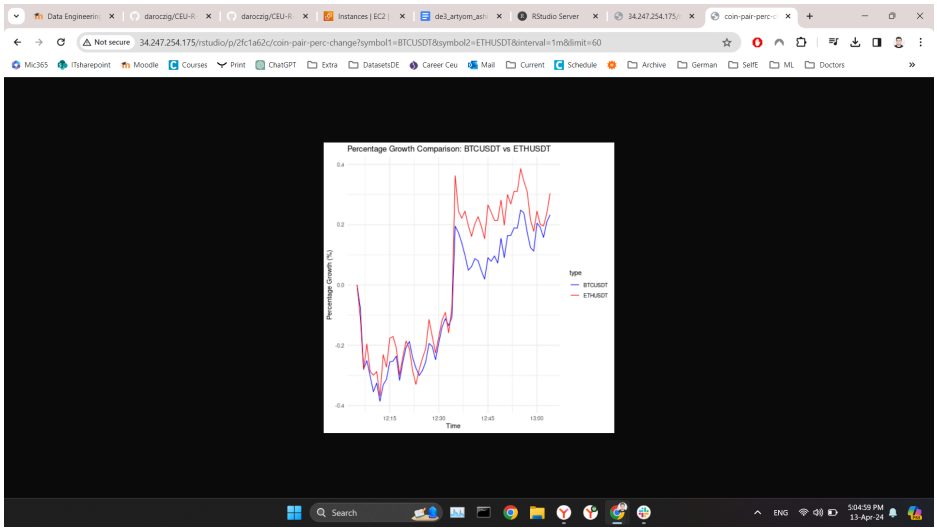

```
# Endpoint 2: Retrieve Historical Market Depth in CSV Format
#* @param symbol String: the symbol to fetch, default is 'ETHUSDT'
#* @param limit Integer: example 1000
#* @get /bids-asks-csv
#* @serializer csv
function(symbol='ETHUSDT', limit = 1000) {
  depth <- binance_depth(symbol, limit = limit)
  bids_asks <- rbind(setNames(depth$bids, c("price", "quantity")),
                     setNames(depth$asks, c("price", "quantity")))
  bids_asks
}
```

Results 2



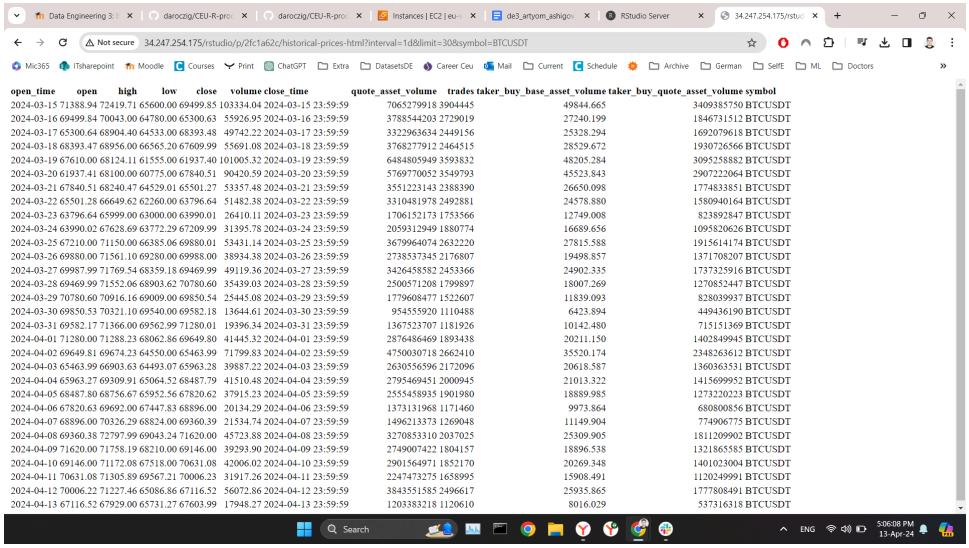
```
# Endpoint 3: RGenerate a Real-time Price Change Comparison Plot
#* @param symbol1 coin1: default is 'BTCUSDT'
#* @param symbol2 coin2: default is 'ETHUSDT'
#* @param interval Integer: example 1m
#* @param limit Integer: example 1000
#* @get /coin-pair-perc-change
#* @serializer png
function(symbol1 = 'BTCUSDT', symbol2 = 'ETHUSDT', interval = '1m', limit = 60L) {
  data1 <- binance_klines(symbol1, interval = interval, limit = as.integer(limit))
  data2 <- binance_klines(symbol2, interval = interval, limit = as.integer(limit))

  data1 <- data1 %>% mutate(percentage_growth = 100 * (close - first(close)) / first(close))
  data2 <- data2 %>% mutate(percentage_growth = 100 * (close - first(close)) / first(close))

  # Combine the datasets
  data1$type <- symbol1
  data2$type <- symbol2
  combined_data <- rbind(data1[, c("open_time", "percentage_growth", "type")],
                         data2[, c("open_time", "percentage_growth", "type")])
  # Generate the plot
  p <- ggplot(combined_data, aes(x = open_time, y = percentage_growth, color = type)) +
    geom_line() +
    theme_minimal() +
    labs(title = paste('Percentage Growth Comparison:', symbol1, 'vs', symbol2),
         x = 'Time', y = 'Percentage Growth (%)') +
    scale_color_manual(values = setNames(c('blue', 'red'), c(symbol1, symbol2)))

  # Output the plot
  print(p)
}
```

Results 3



```
# Endpoint 4:Get Historical Prices in HTML Format
#* @get /historical-prices-html
#* @serializer html
#* @param String: the symbol to fetch, default is 'BTCUSDT'
#* @param interval Integer: example 1m, 1d
#* @param limit Integer: example 100
function(symbol = 'BTCUSDT', interval = '1d', limit = 30) {
  prices <- binance_klines(symbol, interval = interval, limit = as.integer(limit))

  prices_html <- prices %>%
    knitr::kable("html") %>%
    as.character()

  html_output <- paste0("<html><body>", prices_html, "</body></html>")
  html_output
}
```

Results 4



open_time	open	high	low	close	volume	close_time	quote_asset_volume	trades	taker_buy_base_asset_volume	taker_buy_quote_asset_volume	symbol
2024-03-15	71388.94	72419.71	65600.00	69499.85	103334.04	2024-03-15 23:59:59	7065279918	3904445	49844.665	3409385750	BTCUSDT
2024-03-16	69499.84	70043.00	64780.00	65300.63	55926.95	2024-03-16 23:59:59	3788544203	2729019	27240.199	1846731512	BTCUSDT
2024-03-17	65300.64	68904.40	64533.00	68393.48	49742.22	2024-03-17 23:59:59	3322963634	2449156	25328.294	1692079618	BTCUSDT
2024-03-18	68393.47	68956.00	66565.20	67609.99	55691.08	2024-03-18 23:59:59	3768277912	2464515	28529.672	1930726566	BTCUSDT
2024-03-19	67610.00	68124.11	61555.00	61937.40	101005.32	2024-03-19 23:59:59	6484805949	3593832	48205.284	3095258882	BTCUSDT
2024-03-20	61937.41	68100.00	60775.00	67840.51	90420.59	2024-03-20 23:59:59	5769770052	3549793	45523.843	2907222064	BTCUSDT
2024-03-21	67840.51	68240.47	64529.01	65501.27	53357.48	2024-03-21 23:59:59	3551223143	2388390	26650.098	1774833851	BTCUSDT
2024-03-22	65501.28	66649.62	62260.00	63796.64	51482.38	2024-03-22 23:59:59	3310481978	2492881	24578.880	1580940164	BTCUSDT
2024-03-23	63796.64	65999.00	63000.00	63990.01	26410.11	2024-03-23 23:59:59	1706152173	1753566	12749.008	823892847	BTCUSDT
2024-03-24	63990.02	67628.69	63772.29	67209.99	31395.78	2024-03-24 23:59:59	2059312949	1880774	16689.656	1095820626	BTCUSDT
2024-03-25	67210.00	71150.00	66385.06	69880.01	53431.14	2024-03-25 23:59:59	3679964074	2632220	27815.588	1915614174	BTCUSDT
2024-03-26	69880.00	71561.10	69280.00	69988.00	38934.38	2024-03-26 23:59:59	2738537345	2176807	19498.857	1371708207	BTCUSDT
2024-03-27	69987.99	71769.54	68359.18	69469.99	49119.36	2024-03-27 23:59:59	3426458582	2453366	24902.335	1737325916	BTCUSDT
2024-03-28	69469.99	71552.06	68903.62	70780.60	35439.03	2024-03-28 23:59:59	2500571208	1799897	18007.269	1270852447	BTCUSDT
2024-03-29	70780.60	70916.16	69009.00	69850.54	25445.08	2024-03-29 23:59:59	1779608477	1522607	11839.093	828039937	BTCUSDT
2024-03-30	69850.53	70321.10	69540.00	69582.18	13644.61	2024-03-30 23:59:59	954555920	1110488	6423.894	449436190	BTCUSDT
2024-03-31	69582.17	71366.00	69562.99	71280.01	19396.34	2024-03-31 23:59:59	1367523707	1181926	10142.480	715151369	BTCUSDT
2024-04-01	71280.00	71288.23	68062.86	69649.80	41445.32	2024-04-01 23:59:59	2876486469	1893438	20211.150	1402849945	BTCUSDT
2024-04-02	69649.81	69674.23	64550.00	65463.99	71799.83	2024-04-02 23:59:59	4750030718	2662410	35520.174	2348263612	BTCUSDT
2024-04-03	65463.99	66903.63	64493.07	65963.28	39887.22	2024-04-03 23:59:59	2630556596	2172096	20618.587	1360363531	BTCUSDT
2024-04-04	65963.27	69309.91	65064.52	68487.79	41510.48	2024-04-04 23:59:59	2795469451	2000945	21013.322	1415699952	BTCUSDT
2024-04-05	68487.80	68756.67	65952.56	67820.62	37915.23	2024-04-05 23:59:59	2555458935	1901980	18889.985	1273220223	BTCUSDT
2024-04-06	67820.63	69692.00	67447.83	68896.00	20134.29	2024-04-06 23:59:59	1373131968	1171460	9973.864	680800856	BTCUSDT
2024-04-07	68896.00	70326.29	68824.00	69360.39	21534.74	2024-04-07 23:59:59	1496213373	1269048	11149.904	774906775	BTCUSDT
2024-04-08	69360.38	72797.99	69043.24	71620.00	45723.88	2024-04-08 23:59:59	3270853310	2037025	25309.905	1811209902	BTCUSDT
2024-04-09	71620.00	71758.19	68210.00	69146.00	39293.90	2024-04-09 23:59:59	2749007422	1804157	18896.538	1321865585	BTCUSDT
2024-04-10	69146.00	71172.08	67518.00	70631.08	42006.02	2024-04-10 23:59:59	2901564971	1852170	20269.348	1401023004	BTCUSDT
2024-04-11	70631.08	71305.89	69567.21	70006.23	31917.26	2024-04-11 23:59:59	2247473275	1658995	15908.491	1120249991	BTCUSDT
2024-04-12	70006.22	71227.46	65086.86	67116.52	56072.86	2024-04-12 23:59:59	3843551585	2496617	25935.865	1777808491	BTCUSDT
2024-04-13	67116.52	67929.00	65731.27	67603.99	17948.27	2024-04-13 23:59:59	1203383218	1120610	8016.029	537316318	BTCUSDT

PART 3: Build a Docker Image

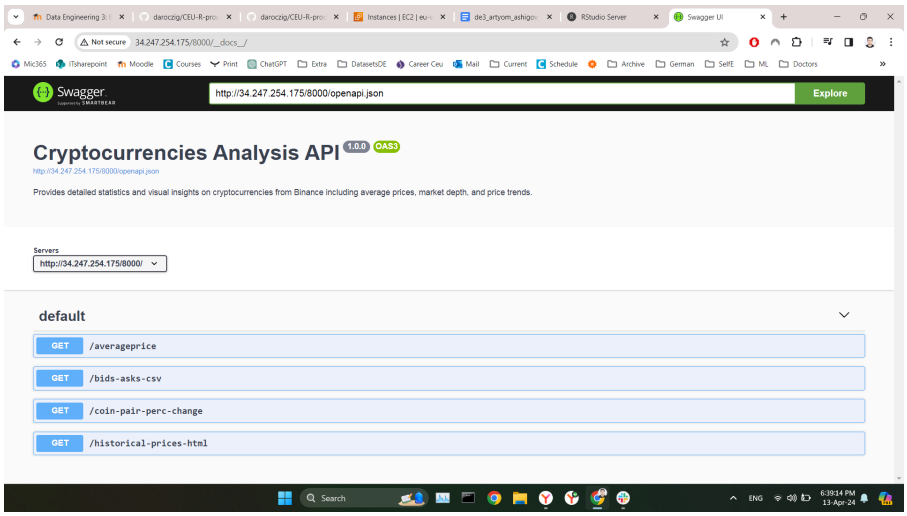
To build a Docker Image first we need to create a Dockerfile with all necessary settings:

1. Create a text file
2. Add the content:

```
FROM rstudio/plumber

RUN apt-get update && apt-get install -y pandoc && apt-get clean && rm -rf /var/lib/apt/lists/
RUN install2.r ggplot2 dplyr readr
RUN installGithub.r daroczig/binancer
```

ADD plumber.R /app/plumber.R
EXPOSE 8000
WORKDIR /app

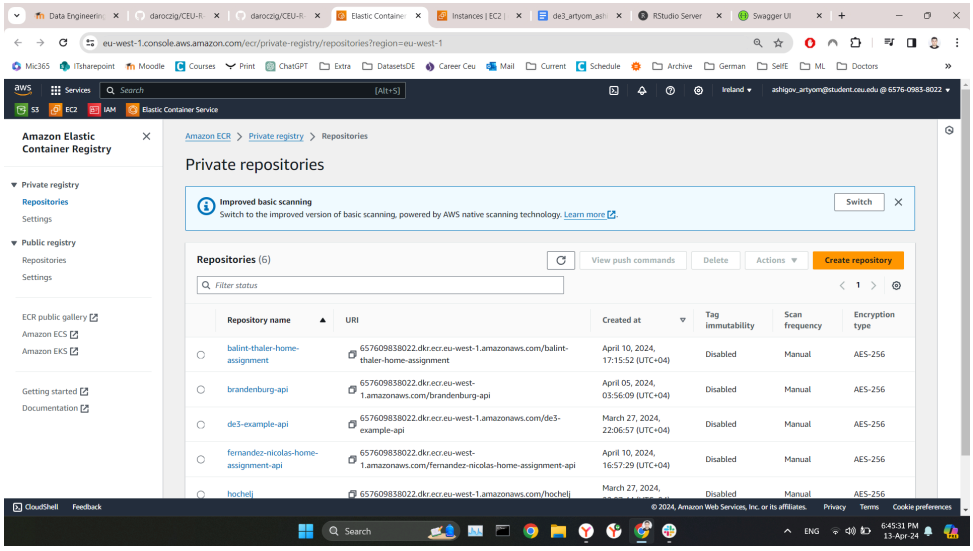
3. Save the file as Dockerfile
4. Run the command in the terminal: sudo docker build -t crypto-api .
5. Check the images: sudo docker images
6. Run the container based on the image: sudo docker run -p 8000:8000 -ti crypto-api plumber.R
7. Access the address: we need to add /8000/__docs__/ to our ip address
   8000 is our port



PART 4: Push the image to ECR

Next, we'll deploy the Docker image that was created and tested above by uploading it to the Elastic Container Registry (ECR) to make it accessible outside of the RStudio Server.
We will do the following steps:

1. Create a private repository



2. Provide a name `artyom-assignment`
3. Click on **Create Repository**
4. To login to ECR we run this command in the terminal:

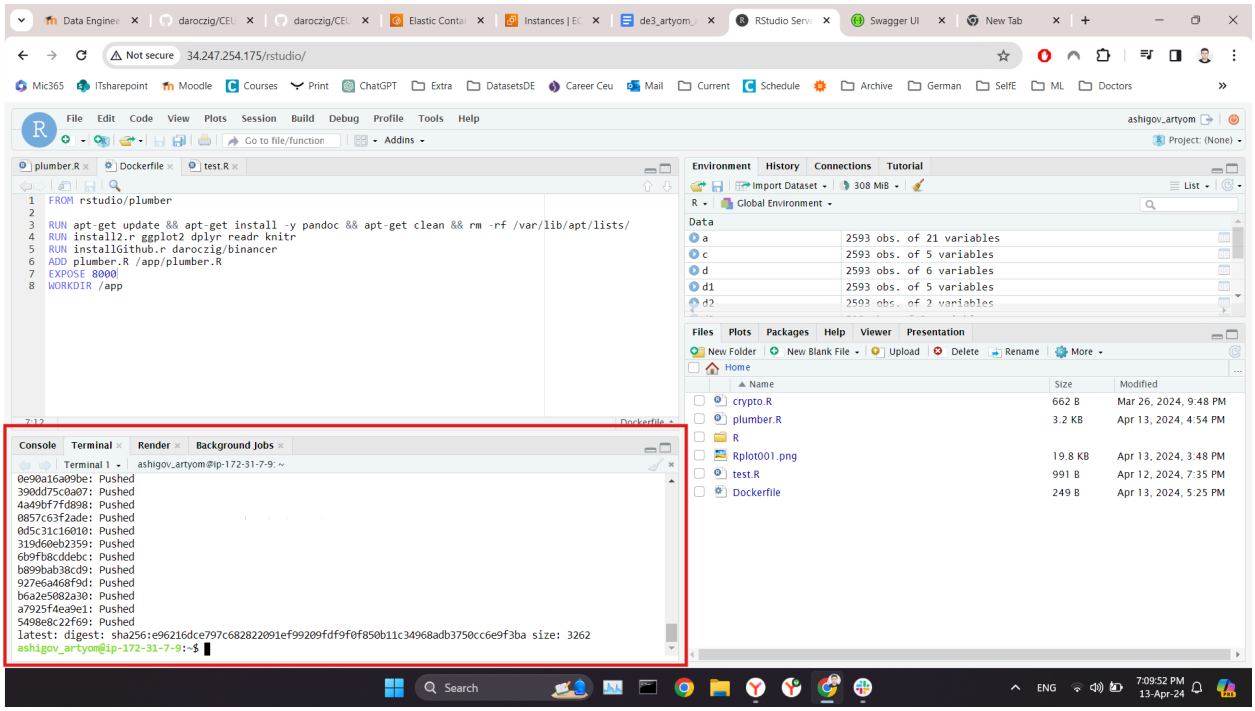
```
aws ecr get-login-password --region eu-west-1 | sudo docker login --username AWS --password-stdin 657609838022.dkr.ecr.eu-west-1.amazonaws.com
```

5. Check docker images again: `sudo docker images`
6. We need to rename our docker image for upload:

```
sudo docker tag crypto-api:latest 657609838022.dkr.ecr.eu-west-1.amazonaws.com/artyom-assignment:latest
```

7. Push the image:

```
sudo docker push 657609838022.dkr.ecr.eu-west-1.amazonaws.com/artyom-assignment:latest
```

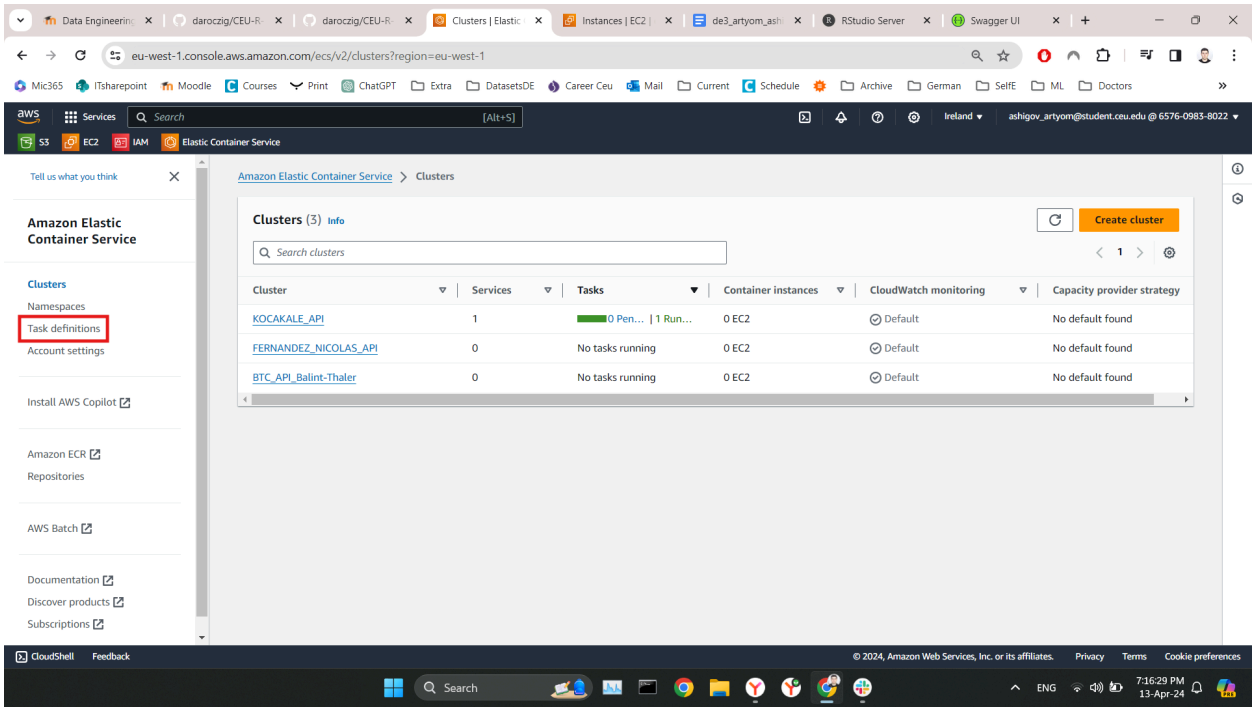


8. Check our repository https://eu-west-1.console.aws.amazon.com/ecr/repositories/private/657609838022/artyom-assignment?region=eu-west-1

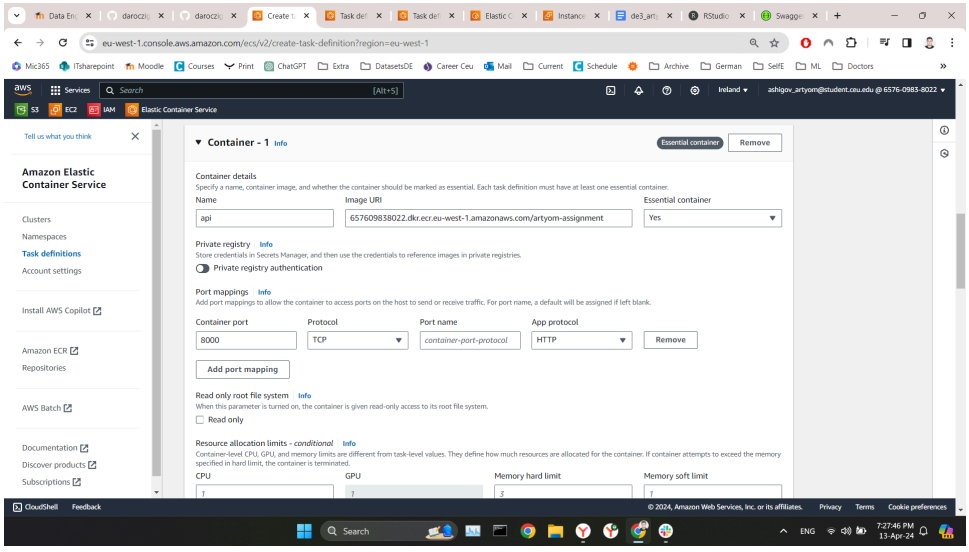
PART 5: Deploy as service in ECS

We will utilize Amazon Elastic Container Service (ECS) to deploy it as a service. Here are the steps we will follow:

1. We open ECS https://eu-west-1.console.aws.amazon.com/ecs/v2/clusters?region=eu-west-1
2. Click on **Task definitions**



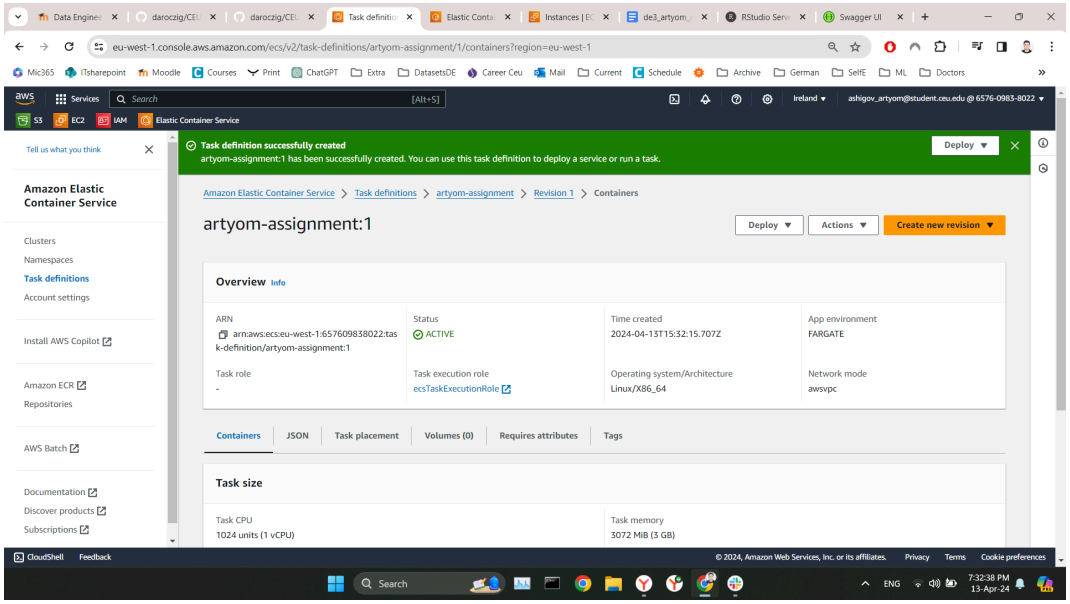
3. Provide a name under **Task definition family**: `artyom-assignment`
4. Under **Container - 1** part fill
    a. Name - `api`
    b. Image URI - `657609838022.dkr.ecr.eu-west-1.amazonaws.com/artyom-assignment`
    c. Container port: `8000`



5. From **Docker configuration** under **Command** field put `plumber.R`

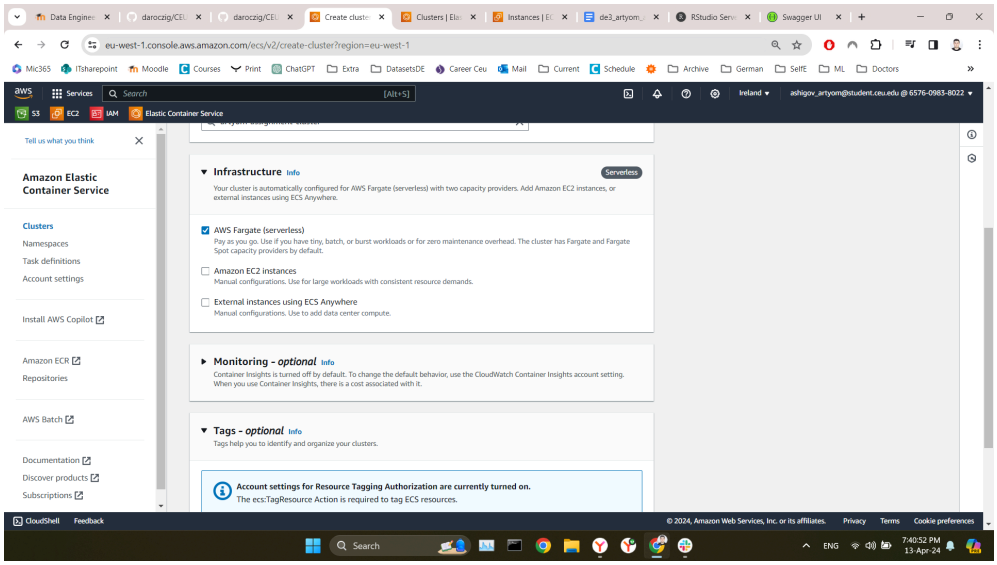
6. Click on **Create**

Result



Now we need to create a cluster.

1. Click on **Clusters** from left-side menu
2. Click on **Create Cluster**
3. Put the **Cluster name**: `artyom-assignment-cluster`
4. Choose **AWS Fargate** under **Infrastructure**

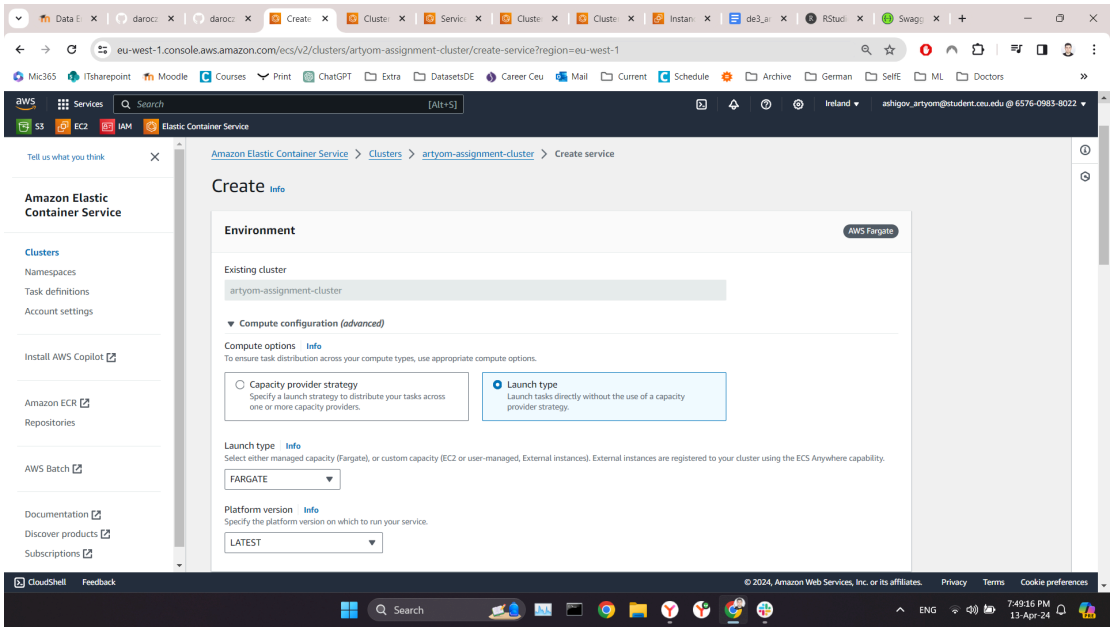


5. Add a tag: Class - `DE3`
6. Click on **Create**

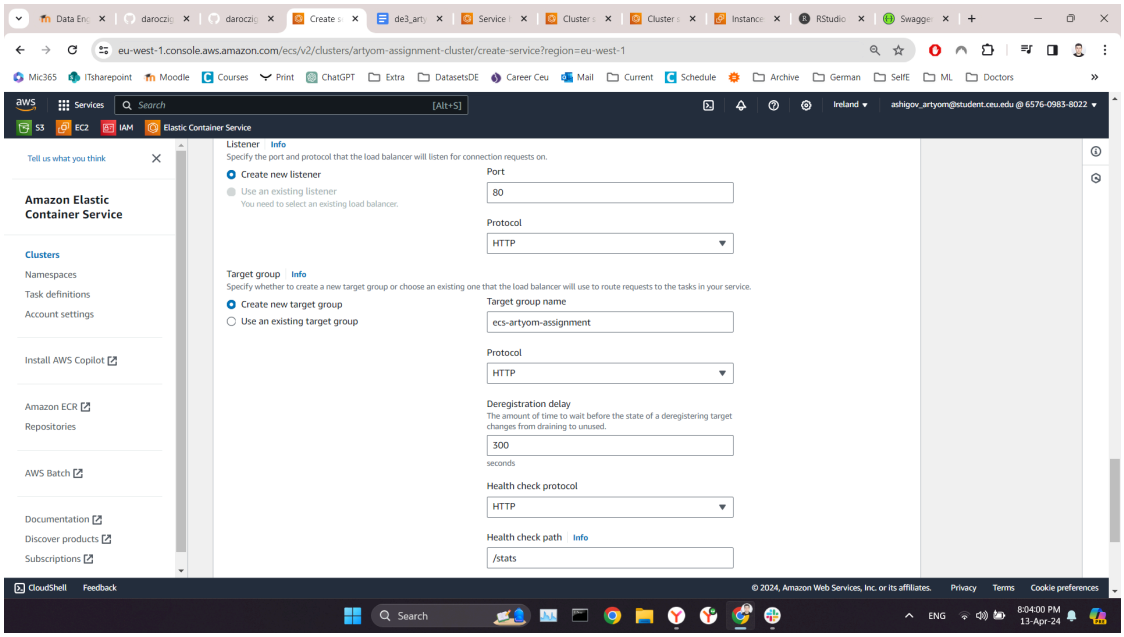
Now we need to create a service in our cluster.

1. Click on our cluster: https://eu-west-1.console.aws.amazon.com/ecs/v2/clusters/artyom-assignment-cluster/services?region=eu-west-1

2. Click on **Create** under **Services**

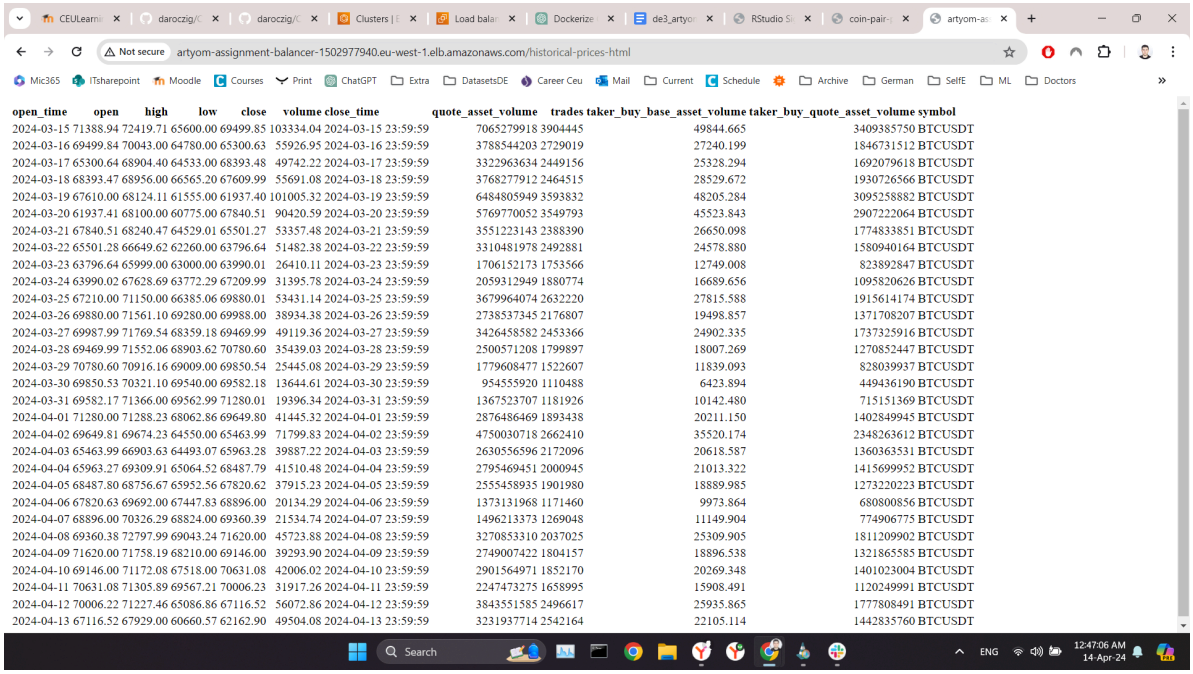


3. Choose **Launch type** under **Compute options**
4. Under the **Deployment configuration**, select `artyom-assignment` from the Family options.
5. Put the same under **Service name**
6. Under **Networking** choose our security group: `de3`
7. Scroll and under **Load balancing** from **Load balance type** choose **Application Load Balancer,** give it a name `artyom-assignment-balancer`
8. Put 10 under **Health check grace period**
9. Create a listener on port 80 using `/coin-pair-perc-change` (or any other endpoints) as the **Health check path** and click on **Create** afterwards



10. Test the deployed service behind the load balancer using DNS name and adding an endpoint:
    Examples
    http://artyom-assignment-balancer-1502977940.eu-west-1.elb.amazonaws.com/coin-pair-perc-change

    or
    http://artyom-assignment-balancer-1502977940.eu-west-1.elb.amazonaws.com/historical-prices-html



open_time	open	high	low	close	volume	close_time	quote_asset_volume	trades	taker_buy_base_asset_volume	taker_buy_quote_asset_volume	symbol
2024-03-15	71388.94	72419.71	65600.00	69499.85	103334.04	2024-03-15 23:59:59	7065279918	3904445	49844.665	3409385750	BTCUSDT
2024-03-16	69499.84	70043.00	64780.00	65300.63	55926.95	2024-03-16 23:59:59	3788544203	2729019	27240.199	1846731512	BTCUSDT
2024-03-17	65300.64	68904.40	64533.00	68393.48	49742.22	2024-03-17 23:59:59	3322963634	2449156	25328.294	1692079618	BTCUSDT
2024-03-18	68393.47	68956.00	66565.20	67609.99	55691.08	2024-03-18 23:59:59	3768277912	2464515	28529.672	1930726566	BTCUSDT
2024-03-19	67610.00	68124.11	61555.00	61937.40	101005.32	2024-03-19 23:59:59	6484805949	3593832	48205.284	3095258882	BTCUSDT
2024-03-20	61937.41	68100.00	60775.00	67840.51	90420.59	2024-03-20 23:59:59	5769770052	3549793	45523.843	2907222064	BTCUSDT
2024-03-21	67840.51	68240.47	64529.01	65501.27	53357.48	2024-03-21 23:59:59	3551223143	2388390	26650.098	1774833851	BTCUSDT
2024-03-22	65501.28	66649.62	62260.00	63796.64	51482.38	2024-03-22 23:59:59	3310481978	2492881	24578.880	1580940164	BTCUSDT
2024-03-23	63796.64	65999.00	63000.00	63990.01	26410.11	2024-03-23 23:59:59	1706152173	1753566	12749.008	823892847	BTCUSDT
2024-03-24	63990.02	67628.69	63772.29	67209.99	31395.78	2024-03-24 23:59:59	2059312949	1880774	16689.656	1095820626	BTCUSDT
2024-03-25	67210.00	71150.00	66385.06	69880.01	53431.14	2024-03-25 23:59:59	3679964074	2632220	27815.588	1915614174	BTCUSDT
2024-03-26	69880.00	71561.10	69280.00	69988.00	38934.38	2024-03-26 23:59:59	2738537345	2176807	19498.857	1371708207	BTCUSDT
2024-03-27	69987.99	71769.54	68359.18	69469.99	49119.36	2024-03-27 23:59:59	3426458582	2453366	24902.335	1737325916	BTCUSDT
2024-03-28	69469.99	71552.06	68903.62	70780.60	35439.03	2024-03-28 23:59:59	2500571208	1799897	18007.269	1270852447	BTCUSDT
2024-03-29	70780.60	70916.16	69009.00	69850.54	25445.08	2024-03-29 23:59:59	1779608477	1522607	11839.093	828039937	BTCUSDT
2024-03-30	69850.53	70321.10	69540.00	69582.18	13644.61	2024-03-30 23:59:59	954555920	1110488	6423.894	449436190	BTCUSDT
2024-03-31	69582.17	71366.00	69562.99	71280.01	19396.34	2024-03-31 23:59:59	1367523707	1181926	10142.480	715151369	BTCUSDT
2024-04-01	71280.00	71288.23	68062.86	69649.80	41445.32	2024-04-01 23:59:59	2876486469	1893438	20211.150	1402849945	BTCUSDT
2024-04-02	69649.81	69674.23	64550.00	65463.99	71799.83	2024-04-02 23:59:59	4750030718	2662410	35520.174	2348263612	BTCUSDT
2024-04-03	65463.99	66903.63	64493.07	65963.28	39887.22	2024-04-03 23:59:59	2630556596	2172096	20618.587	1360363531	BTCUSDT
2024-04-04	65963.27	69309.91	65064.52	68487.79	41510.48	2024-04-04 23:59:59	2795469451	2000945	21013.322	1415699952	BTCUSDT
2024-04-05	68487.80	68756.67	65952.56	67820.62	37915.23	2024-04-05 23:59:59	2555458935	1901980	18889.985	1273220223	BTCUSDT
2024-04-06	67820.63	69692.00	67447.83	68896.00	20134.29	2024-04-06 23:59:59	1373131968	1171460	9973.864	680800856	BTCUSDT
2024-04-07	68896.00	70326.29	68824.00	69360.39	21534.74	2024-04-07 23:59:59	1496213373	1269048	11149.904	774906775	BTCUSDT
2024-04-08	69360.38	72797.99	69043.24	71620.00	45723.88	2024-04-08 23:59:59	3270853310	2037025	25309.905	1811209902	BTCUSDT
2024-04-09	71620.00	71758.19	68210.00	69146.00	39293.90	2024-04-09 23:59:59	2749007422	1804157	18896.538	1321865585	BTCUSDT
2024-04-10	69146.00	71172.08	67518.00	70631.08	42006.02	2024-04-10 23:59:59	2901564971	1852170	20269.348	1401023004	BTCUSDT
2024-04-11	70631.08	71305.89	69567.21	70006.23	31917.26	2024-04-11 23:59:59	2247473275	1658995	15908.491	1120249991	BTCUSDT
2024-04-12	70006.22	71227.46	65086.86	67116.52	56072.86	2024-04-12 23:59:59	3843551585	2496617	25935.865	1777808491	BTCUSDT
2024-04-13	67116.52	67929.00	60660.57	62162.90	49504.08	2024-04-13 23:59:59	3231937714	2542164	22105.114	1442835760	BTCUSDT