Conclusion

R^2 score is an indicator of accuracy of regression models, and the accuracy is measured as close to 1 of this value .Therefore , as seen ,Multiple Linear Regression Models is brtter than Decision Tree Regression and Random Forest Regression on this dataset when comparing their R^2 scores

In [57]:
```
!pip install ibm_watson_machine_learning
```

```
Requirement already satisfied: ibm_watson_machine_learning in /opt/conda/envs/Python-3.9/lib/python3.9/site-packages (1.0.257)
Requirement already satisfied: requests in /opt/conda/envs/Python-3.9/lib/python3.9/site-packages (from ibm_watson_machine_learning) (2.26.0)
Requirement already satisfied: tabulate in /opt/conda/envs/Python-3.9/lib/python3.9/site-packages (from ibm_watson_machine_learning) (0.8.9)
Requirement already satisfied: ibm-cos-sdk==2.11.* in /opt/conda/envs/Python-3.9/lib/python3.9/site-packages (from ibm_watson_machine_learning) (2.11.0)
Requirement already satisfied: urllib3 in /opt/conda/envs/Python-3.9/lib/python3.9/site-packages (from ibm_watson_machine_learning) (1.26.7)
Requirement already satisfied: lomond in /opt/conda/envs/Python-3.9/lib/python3.9/site-packages (from ibm_watson_machine_learning) (0.3.3)
Requirement already satisfied: certifi in /opt/conda/envs/Python-3.9/lib/python3.9/site-packages (from ibm_watson_machine_learning) (2022.9.24)
Requirement already satisfied: packaging in /opt/conda/envs/Python-3.9/lib/python3.9/site-packages (from ibm_watson_machine_learning) (21.3)
Requirement already satisfied: importlib-metadata in /opt/conda/envs/Python-3.9/lib/python3.9/site-packages (from ibm_watson_machine_learning) (4.8.2)
Requirement already satisfied: pandas<1.5.0,>=0.24.2 in /opt/conda/envs/Python-3.9/lib/python3.9/site-packages (from ibm_watson_machine_learning) (1.3.4)
Requirement already satisfied: jmespath<1.0.0,>=0.7.1 in /opt/conda/envs/Python-3.9/lib/python3.9/site-packages (from ibm-cos-sdk==2.11.*->ibm_watson_machine_learning) (0.10.0)
Requirement already satisfied: ibm-cos-sdk-core==2.11.0 in /opt/conda/envs/Python-3.9/lib/python3.9/site-packages (from ibm-cos-sdk==2.11.*->ibm_watson_machine_learning) (2.11.0)
Requirement already satisfied: ibm-cos-sdk-s3transfer==2.11.0 in /opt/conda/envs/Python-3.9/lib/python3.9/site-packages (from ibm-cos-sdk==2.11.*->ibm_watson_machine_learning) (2.11.0)
Requirement already satisfied: python-dateutil<3.0.0,>=2.1 in /opt/conda/envs/Python-3.9/lib/python3.9/site-packages (from ibm-cos-sdk-core==2.11.0->ibm-cos-sdk==2.11.*->ibm_watson_machine_learning) (2.8.2)
Requirement already satisfied: pytz>=2017.3 in /opt/conda/envs/Python-3.9/lib/python3.9/site-packages (from pandas<1.5.0,>=0.24.2->ibm_watson_machine_learning) (2021.3)
Requirement already satisfied: numpy>=1.17.3 in /opt/conda/envs/Python-3.9/lib/python3.9/site-packages (from pandas<1.5.0,>=0.24.2->ibm_w
```

```
cos-sdk-core==2.11.0->ibm-cos-sdk==2.11.*->ibm_watson_machine_learning) (1.15.0)
Requirement already satisfied: charset-normalizer~=2.0.0 in /opt/conda/envs/Python-3.9/lib/python3.9/site-packages (from requests->ibm_wa
tson_machine_learning) (2.0.4)
Requirement already satisfied: idna<4,>=2.5 in /opt/conda/envs/Python-3.9/lib/python3.9/site-packages (from requests->ibm_watson_machine_
learning) (3.3)
Requirement already satisfied: zipp>=0.5 in /opt/conda/envs/Python-3.9/lib/python3.9/site-packages (from importlib-metadata->ibm_watson_m
achine_learning) (3.6.0)
Requirement already satisfied: pyparsing!=3.0.5,>=2.0.2 in /opt/conda/envs/Python-3.9/lib/python3.9/site-packages (from packaging->ibm_wa
tson_machine_learning) (3.0.4)
```

Establising connection to IBM Watson ML sevice

In [58]:
```
from ibm_watson_machine_learning import APIClient
import json
```

In [59]:
```
from ibm_watson_machine_learning import APIClient
wml_credentials = {
    "apikey": "GXIq0WvfLYobrmTPaccsVpwEML_PHzJjoRIhFn0kfjkM",
    "url":"https://us-south.ml.cloud.ibm.com"
}
```

In [60]:
```
wml_client=APIClient(wml_credentials)
```

In [61]:
```
wml_client.spaces.list()
```

```
Note: 'limit' is not provided. Only first 50 records will be displayed if the number of records exceed 50
------------------------------------  ----------------  -------------------------
ID                                    NAME              CREATED
5e27b477-1bb8-4a48-8b0f-81b3147dffe1  multilenear demo  2022-11-14T16:45:46.614Z
------------------------------------  ----------------  -------------------------
```

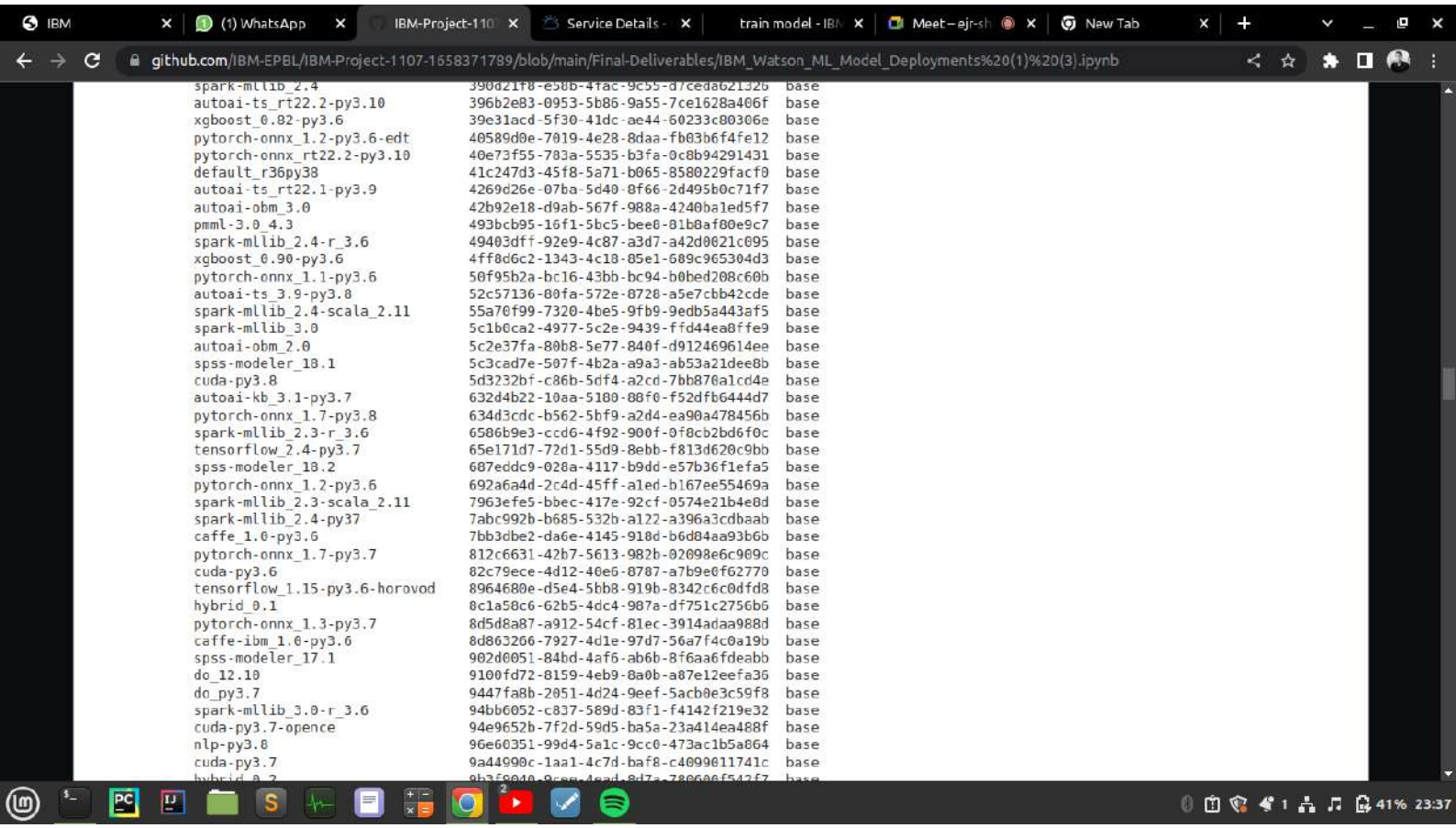
In [62]:
```
SPACE_ID="5e27b477-1bb8-4a48-8b0f-81b3147dffe1"
```

In [63]:
```
wml_client.set.default_space(SPACE_ID)
```

Out[63]:
```
'SUCCESS'
```

In [64]:
```
wml_client.software_specifications.list(500)
```

NAME	ASSET_ID	TYPE
default_py3.6	0062b8c9-8b7d-44a0-a9b9-46c416adcbd9	base
kernel-spark3.2-scala2.12	020d69ce-7ac1-5e68-ac1a-31189867356a	base
pytorch-onnx_1.3-py3.7-edt	069ea134-3346-5748-b513-49120e15d288	base
scikit-learn_0.20-py3.6	09c5a1d0-9c1e-4473-a344-eb7b665ff687	base
spark-mllib_3.0-scala_2.12	09f4cff0-90a7-5899-b9ed-1ef348aebdee	base
pytorch-onnx_rt22.1-py3.9	0b848dd4-e681-5599-be41-b5f6fccc6471	base
ai-function_0.1-py3.6	0cdb0f1e-5376-4f4d-92dd-da3b69aa9bda	base
shiny-r3.6	0e6e79df-875e-4f24-8ae9-62dcc2148306	base
tensorflow_2.4-py3.7-horovod	1092590a-307d-563d-9b62-4eb7d64b3f22	base
pytorch_1.1-py3.6	10ac12d6-6b30-4ccd-8392-3e922c096a92	base
tensorflow_1.15-py3.6-ddl	111e41b3-de2d-5422-a4d6-bf776828c4b7	base
autoai-kb_rt22.2-py3.10	125b6d9a-5b1f-5e8d-972a-b251688ccf40	base
runtime-22.1-py3.9	12b83a17-24d8-5082-900f-0ab31fbfd3cb	base
scikit-learn_0.22-py3.6	154010fa-5b3b-4ac1-82af-4d5ee5abbc85	base
default_r3.6	1b70aec3-ab34-4b87-8aa0-a4a3c8296a36	base
pytorch-onnx_1.3-py3.6	1bc6029a-cc97-56da-b8e0-39c3880dbbe7	base
kernel-spark3.3-r3.6	1c9e5454-f216-59dd-a20e-474a5cdf5988	base
pytorch-onnx_rt22.1-py3.9-edt	1d362186-7ad5-5b59-8b6c-9d0880bde37f	base
tensorflow_2.1-py3.6	1eb25b84-d6ed-5dde-b6a5-3fbdf1665666	base
spark-mllib_3.2	20047f72-0a98-58c7-9ff5-a77b012eb8f5	base
tensorflow_2.4-py3.8-horovod	217c16f6-178f-56bf-824a-b19f20564c49	base
runtime-22.1-py3.9-cuda	26215f05-08c3-5a41-a1b0-da66306ce658	base
do_py3.8	295addb5-9ef9-547e-9bf4-92ae3563e720	base
autoai-ts_3.8-py3.8	2aa0c932-798f-5ae9-abd6-15e0c2402fb5	base
tensorflow_1.15-py3.6	2b73a275-7cbf-420b-a912-eae7f436e0bc	base
kernel-spark3.3-py3.9	2b7961e2-e3b1-5a8c-a491-482c8368839a	base
pytorch_1.2-py3.6	2c8ef57d-2687-4b7d-acce-01f94976dac1	base
spark-mllib_2.3	2e51f700-bca0-4b0d-88dc-5c6791338875	base
pytorch-onnx_1.1-py3.6-edt	32983cea-3f32-4400-8965-dde874a8d67e	base



```
spark-mllib_2.4                 390d21f8-e58b-4fac-9c55-d7ceda621326  base
autoai-ts_rt22.2-py3.10         396b2e83-0953-5b86-9a55-7ce1628a406f  base
xgboost_0.82-py3.6              39e31acd-5f30-41dc-ae44-60233c80306e  base
pytorch-onnx_1.2-py3.6-edt      40589d0e-7019-4e28-8daa-fb03b6f4fe12  base
pytorch-onnx_rt22.2-py3.10      40e73f55-783a-5535-b3fa-0c8b94291431  base
default_r36py38                 41c247d3-45f8-5a71-b065-8580229facf0  base
autoai-ts_rt22.1-py3.9          4269d26e-07ba-5d40-8f66-2d495b0c71f7  base
autoai-obm_3.0                  42b92e18-d9ab-567f-988a-4240ba1ed5f7  base
pmml-3.0_4.3                    493bcb95-16f1-5bc5-bee8-81b8af80e9c7  base
spark-mllib_2.4-r_3.6           49403dff-92e9-4c87-a3d7-a42d0021c095  base
xgboost_0.90-py3.6              4ff8d6c2-1343-4c18-85e1-689c965304d3  base
pytorch-onnx_1.1-py3.6          50f95b2a-bc16-43bb-bc94-b0bed208c60b  base
autoai-ts_3.9-py3.8             52c57136-80fa-572e-8720-a5e7cbb42cde  base
spark-mllib_2.4-scala_2.11      55a70f99-7320-4be5-9fb9-9edb5a443af5  base
spark-mllib_3.0                 5c1b0ca2-4977-5c2e-9439-ffd44ea8ffe9  base
autoai-obm_2.0                  5c2e37fa-80b8-5e77-840f-d912469614ee  base
spss-modeler_18.1               5c3cad7e-507f-4b2a-a9a3-ab53a21dee8b  base
cuda-py3.8                      5d3232bf-c86b-5df4-a2cd-7bb870a1cd4e  base
autoai-kb_3.1-py3.7             632d4b22-10aa-5180-88f0-f52dfb6444d7  base
pytorch-onnx_1.7-py3.8          634d3cdc-b562-5bf9-a2d4-ea90a478456b  base
spark-mllib_2.3-r_3.6           6586b9e3-ccd6-4f92-900f-0f8cb2bd6f0c  base
tensorflow_2.4-py3.7            65e171d7-72d1-55d9-8ebb-f813d620c9bb  base
spss-modeler_18.2               687eddc9-028a-4117-b9dd-e57b36f1efa5  base
pytorch-onnx_1.2-py3.6          692a6a4d-2c4d-45ff-a1ed-b167ee55469a  base
spark-mllib_2.3-scala_2.11      7963efe5-bbec-417e-92cf-0574e21b4e8d  base
spark-mllib_2.4-py37            7abc992b-b685-532b-a122-a396a3cdbaab  base
caffe_1.0-py3.6                 7bb3dbe2-da6e-4145-918d-b6d84aa93b6b  base
pytorch-onnx_1.7-py3.7          812c6631-42b7-5613-982b-02098e6c909c  base
cuda-py3.6                      82c79ece-4d12-40e6-8787-a7b9e0f62770  base
tensorflow_1.15-py3.6-horovod   8964680e-d5e4-5bb8-919b-8342c6c0dfd8  base
hybrid_0.1                      8c1a58c6-62b5-4dc4-987a-df751c2756b6  base
pytorch-onnx_1.3-py3.7          8d5d8a87-a912-54cf-81ec-3914adaa988d  base
caffe-ibm_1.0-py3.6             8d863266-7927-4d1e-97d7-56a7f4c0a19b  base
spss-modeler_17.1               902d0051-84bd-4af6-ab6b-8f6aa6fdeabb  base
do_12.10                        9100fd72-8159-4eb9-8a0b-a87e12eefa36  base
do_py3.7                        9447fa8b-2051-4d24-9eef-5acb0e3c59f8  base
spark-mllib_3.0-r_3.6           94bb6052-c837-589d-83f1-f4142f219e32  base
cuda-py3.7-opence               94e9652b-7f2d-59d5-ba5a-23a414ea488f  base
nlp-py3.8                       96e60351-99d4-5a1c-9cc0-473ac1b5a864  base
cuda-py3.7                      9a44990c-1aa1-4c7d-baf8-c4099011741c  base
hybrid_0.2                      9b3f9040-9cee-4ead-8d7a-780600f542f7  base
```

default_py3.8	ab9e1b80-f2ce-592c-a7d2-4f2344f77194	base
tensorflow_rt22.1-py3.9	acd9c798-6974-5d2f-a657-ce06e986df4d	base
kernel-spark3.2-py3.9	ad7033ee-794e-58cf-812e-a95f4b64b207	base
autoai-obm_2.0 with Spark 3.0	af10f35f-69fa-5d66-9bf5-acb58434263a	base
default_py3.7_opence	c2057dd4-f42c-5f77-a02f-72bdbd3282c9	base
tensorflow_2.1-py3.7	c4032338-2a40-500a-beef-b01ab2667e27	base
do_py3.7_opence	cc8f8976-b74a-551a-bb66-6377f8d865b4	base
spark-mllib_3.3	d11f2434-4fc7-58b7-8a62-755da64fdaf8	base
autoai-kb_3.0-py3.6	d139f196-e04b-5d8b-9140-9a10ca1fa91a	base
spark-mllib_3.0-py36	d82546d5-dd78-5fbb-9131-2ec309bc56ed	base
autoai-kb_3.4-py3.8	da9b39c3-758c-5a4f-9cfd-457dd4d8c395	base
kernel-spark3.2-r3.6	db2fe4d6-d641-5d05-9972-73c654c60e0a	base
autoai-kb_rt22.1-py3.9	db6afe93-665f-5910-b117-d879897404d9	base
tensorflow_rt22.1-py3.9-horovod	dda170cc-ca67-5da7-9b7a-cf84c6987fae	base
autoai-ts_1.0-py3.7	deef04f0-0c42-5147-9711-89f9904299db	base
tensorflow_2.1-py3.7-horovod	e384fce5-fdd1-53f8-bc71-11326c9c635f	base
default_py3.7	e4429883-c883-42b6-87a8-f419d64088cd	base
do_22.1	e51999ba-6452-5f1f-8287-17228b88b652	base
autoai-obm_3.2	eae86aab-da30-5229-a6a6-1d0d4e368983	base
tensorflow_rt22.2-py3.10	f65bd165-f057-55de-b5cb-f97cf2c0f393	base
do_20.1	f686cdd9-7904-5f9d-a732-01b0d6b10dc5	base
pytorch-onnx_rt22.2-py3.10-edt	f8a05d07-e7cd-57bb-a10b-23f1d4b837ac	base
scikit-learn_0.19-py3.6	f963fa9d-4bb7-5652-9c5d-8d9289ef6ad9	base
tensorflow_2.4-py3.8	fe185c44-9a99-5425-986b-59bd1d2eda46	base

Creating Deployment Space

In [65]:
```
import sklearn
sklearn.__version__
```

Out[65]: '1.0.2'

In [66]:
```
MODEL_NAME="ibmdeployment"
DEPLOYEMENT_NAME="multilenear demo"
DEMO_MODEL= "model"
```

Creating Deployment Space

In [65]:
```
import sklearn
sklearn.__version__
```

Out[65]: '1.0.2'

In [66]:
```
MODEL_NAME="ibmdeployment"
DEPLOYEMENT_NAME="multilenear demo"
DEMO_MODEL= "model"
```

In [67]:
```
software_spec_uid=wml_client.software_specifications.get_id_by_name('runtime-22.1-py3.9')
```

In [68]:
```
software_spec_uid = wml_client.software_specifications.get_uid_by_name("runtime-22.1-py3.9")
software_spec_uid
model_props={
    wml_client.repository.ModelMetaNames.NAME: "MODEL_NAME",
    wml_client.repository.ModelMetaNames.TYPE: "scikit-learn_1.0",
    wml_client.repository.ModelMetaNames.SOFTWARE_SPEC_UID: software_spec_uid
}
```

In [69]:
```
#Save model
model_details = wml_client.repository.store_model(
    model=DEMO_MODEL,
    meta_props=model_props,
    training_data="x_train",
    training_target="y_train"
)
```

```
Failure during getting trained models details. (GET https://us-south.ml.cloud.ibm.com/ml/v4/trainings/model?version=2021-06-24&space_id=5
```

Testing

In [73]:
```
x_train
```

Out[73]:

	GRE Score	TOEFL Score	University Rating	SOP	LOR	CGPA	Research
249	321	111	3	3.5	4.0	8.83	1
433	316	111	4	4.0	5.0	8.54	0
19	303	102	3	3.5	3.0	8.50	0
322	314	107	2	2.5	4.0	8.27	0
332	308	106	3	3.5	2.5	8.21	1
...	...	...	...	...	...	...	...
106	329	111	4	4.5	4.5	9.18	1
270	306	105	2	2.5	3.0	8.22	1
348	302	99	1	2.0	2.0	7.25	0
435	309	105	2	2.5	4.0	7.68	0
102	314	106	2	4.0	3.5	8.25	0

400 rows × 7 columns

In [74]:
```
multiple_lin_reg.predict(x_train)
```

Out[74]:
```
array([[0.79319678],
       [0.74507858],
       [0.64401532],
       [0.67274778],
       [0.65894595],
       [0.54916269],
       [0.72581613],
```

IBM | (1) WhatsApp | IBM-Project-110 | Service Details - | train model - IBM | Meet – ajr-sh | New Tab

github.com/IBM-EPBL/IBM-Project-1107-1658371789/blob/main/Final-Deliverables/IBM_Watson_ML_Model_Deployments%20(1)%20(3).ipynb

Out[74]:
```
array([[0.79319678],
       [0.74507858],
       [0.64401532],
       [0.67274778],
       [0.65094595],
       [0.54916269],
       [0.72581613],
       [0.80517894],
       [0.63303132],
       [0.68811779],
       [0.64924268],
       [0.95289497],
       [0.84653676],
       [0.96863011],
       [0.46641449],
       [0.82149658],
       [0.67146854],
       [0.88635893],
       [0.49256047],
       [0.68574539],
       [0.71763218],
       [0.88677469],
       [0.72363358],
       [0.74858906],
       [0.69122802],
       [0.69069927],
       [0.5691487 ],
       [0.99211793],
       [0.84286454],
       [0.51255247],
       [0.72510392],
       [0.72307643],
       [0.84332283],
       [0.52685083],
       [0.82678515],
       [0.5026812 ],
       [0.82394811],
       [0.96625707],
       [0.66361992],
```

41% 23:37

```
[0.52916542],
[0.94791192],
[0.65537821],
[0.96318716],
[0.78234646],
[0.64301889],
[0.71935478],
[0.87419234],
[0.65730666],
[0.83687579],
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[0.60138748],
[0.60657365],
[0.74877404],
[0.80630098],
[0.51262614],
[0.60414373],
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[0.72623304],
[0.49369211],
[0.61831374],
[0.63486805],
[0.76056917],
[0.59943773],
[0.75467033],
[0.91959654],
[0.54802086],
[0.62369887],
[0.69231169],
[0.48584694],
[0.69687888],
[0.79102692],
[0.73642735],
[0.64185992],
[0.8084643 ],
[0.59044388],
[0.62762878],
[0.70015312],
[0.57640892],
```

```
[0.79102692],
[0.73642735],
[0.64185992],
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[0.62762878],
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[0.57640892],
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[0.62004909],
[0.89121197],
[0.84949806],
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[0.82421063],
[0.56189805],
[0.57892748],
[0.53502281],
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[0.46973902],
[0.69029554],
[0.80200531],
[0.74422764],
[0.56530995],
[0.84717   ],
[0.51618836],
[0.77268396],
[0.8819175 ],
[0.80624079],
[0.79131364],
[0.69383671],
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[0.71377037],
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[0.75613796],
[0.70343414],
[0.69242416],
```

```
[0.561388  ],
[0.71377037],
[0.78356933],
[0.75613796],
[0.70343414],
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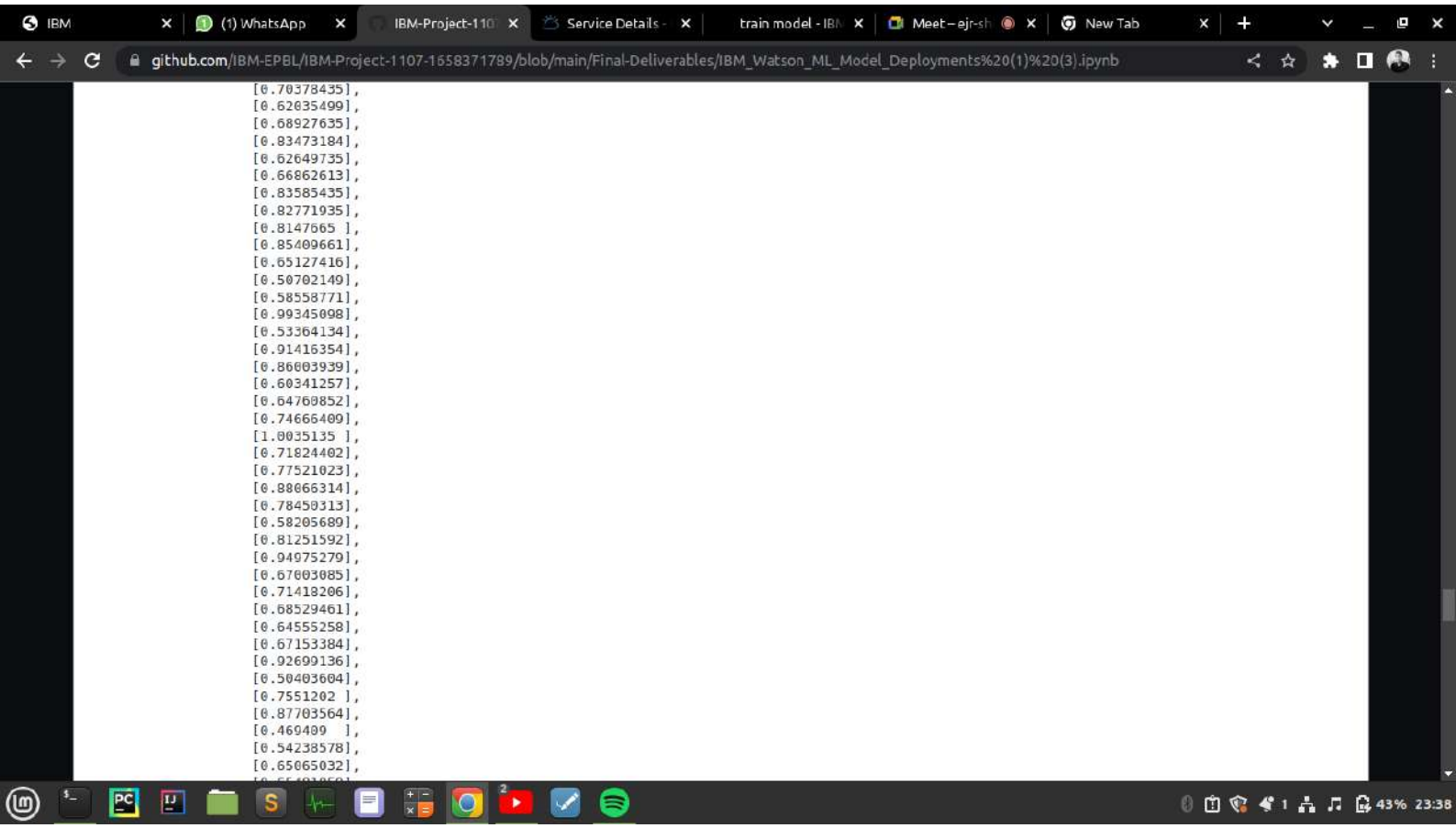
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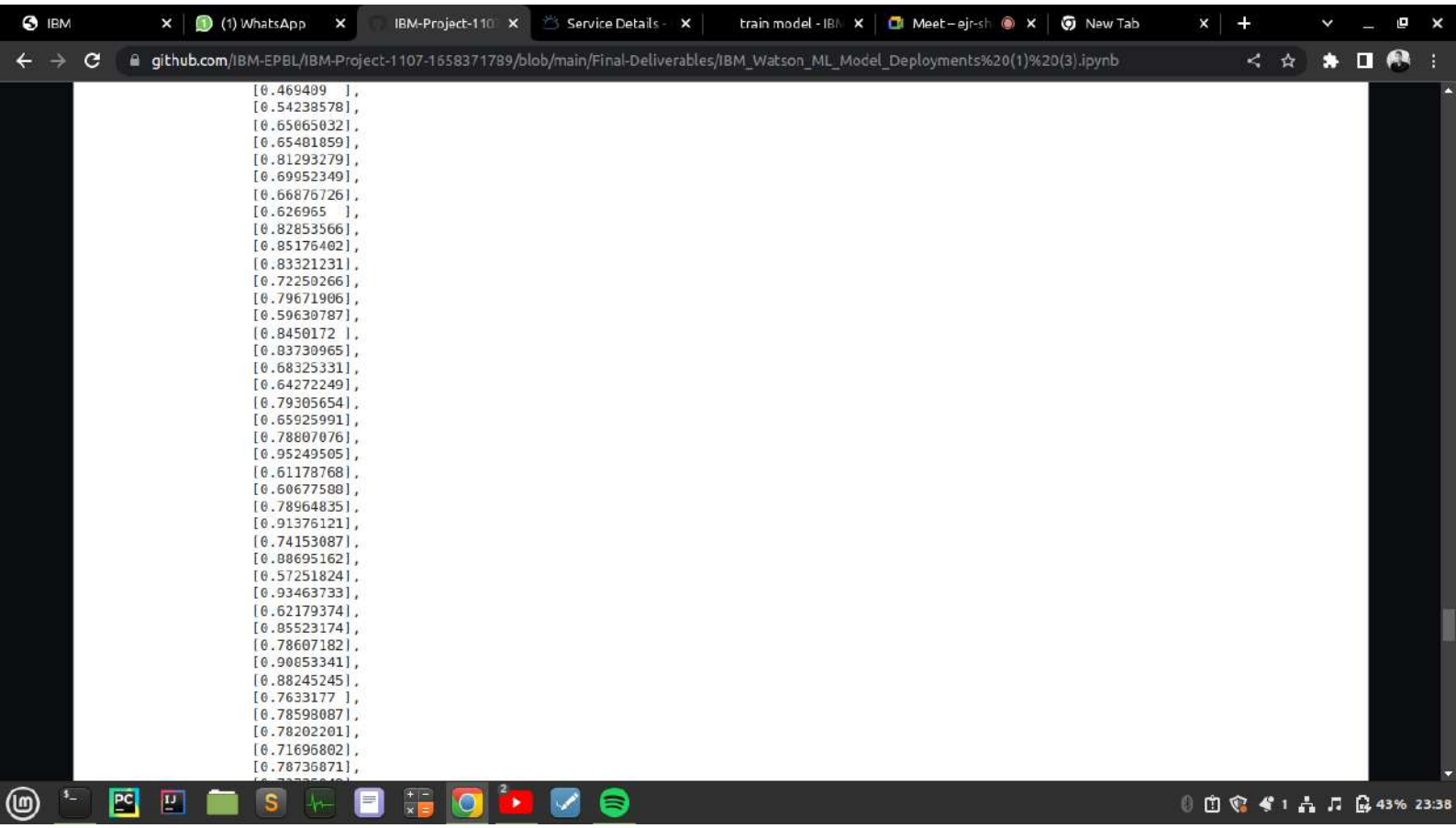
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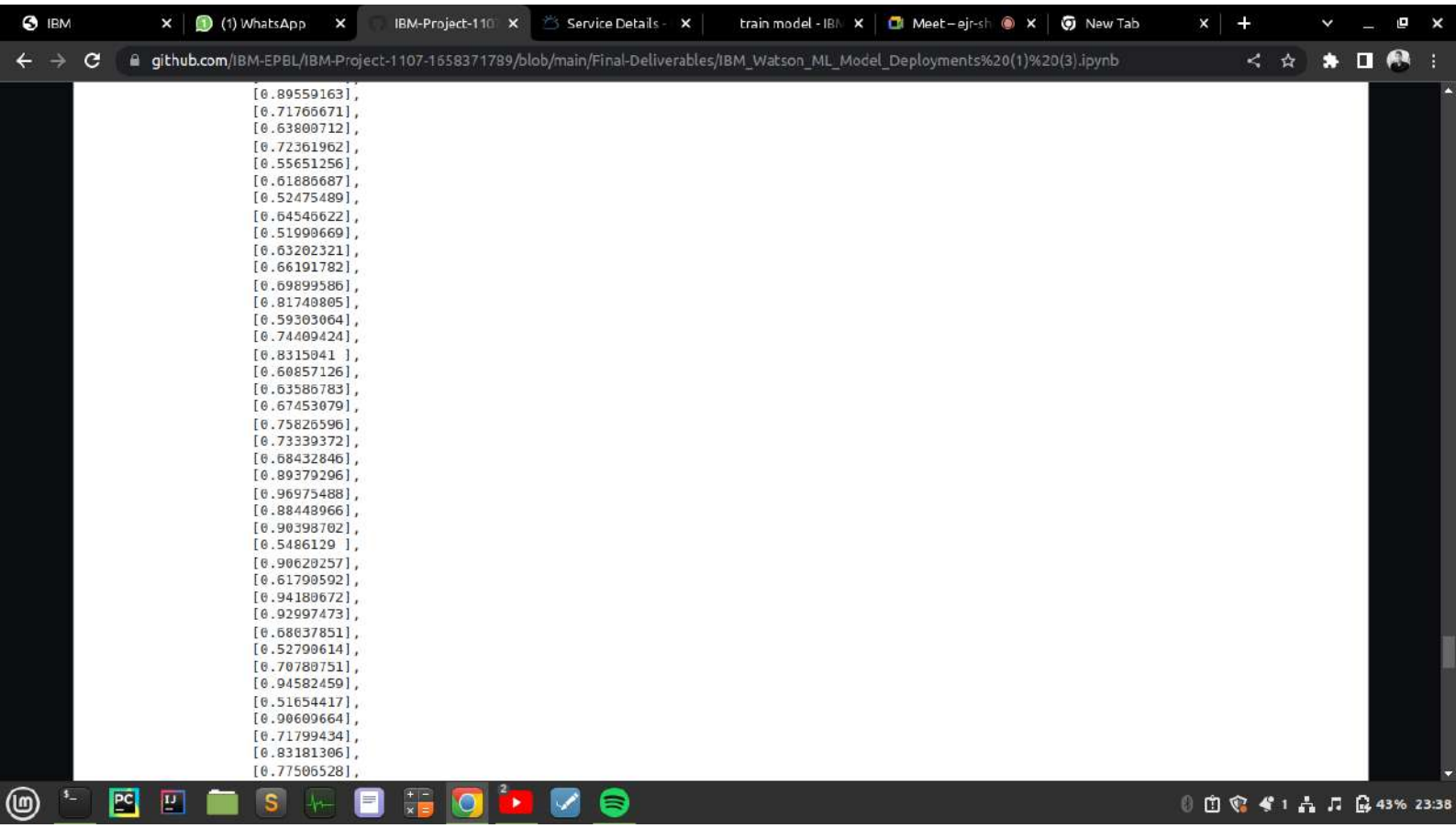
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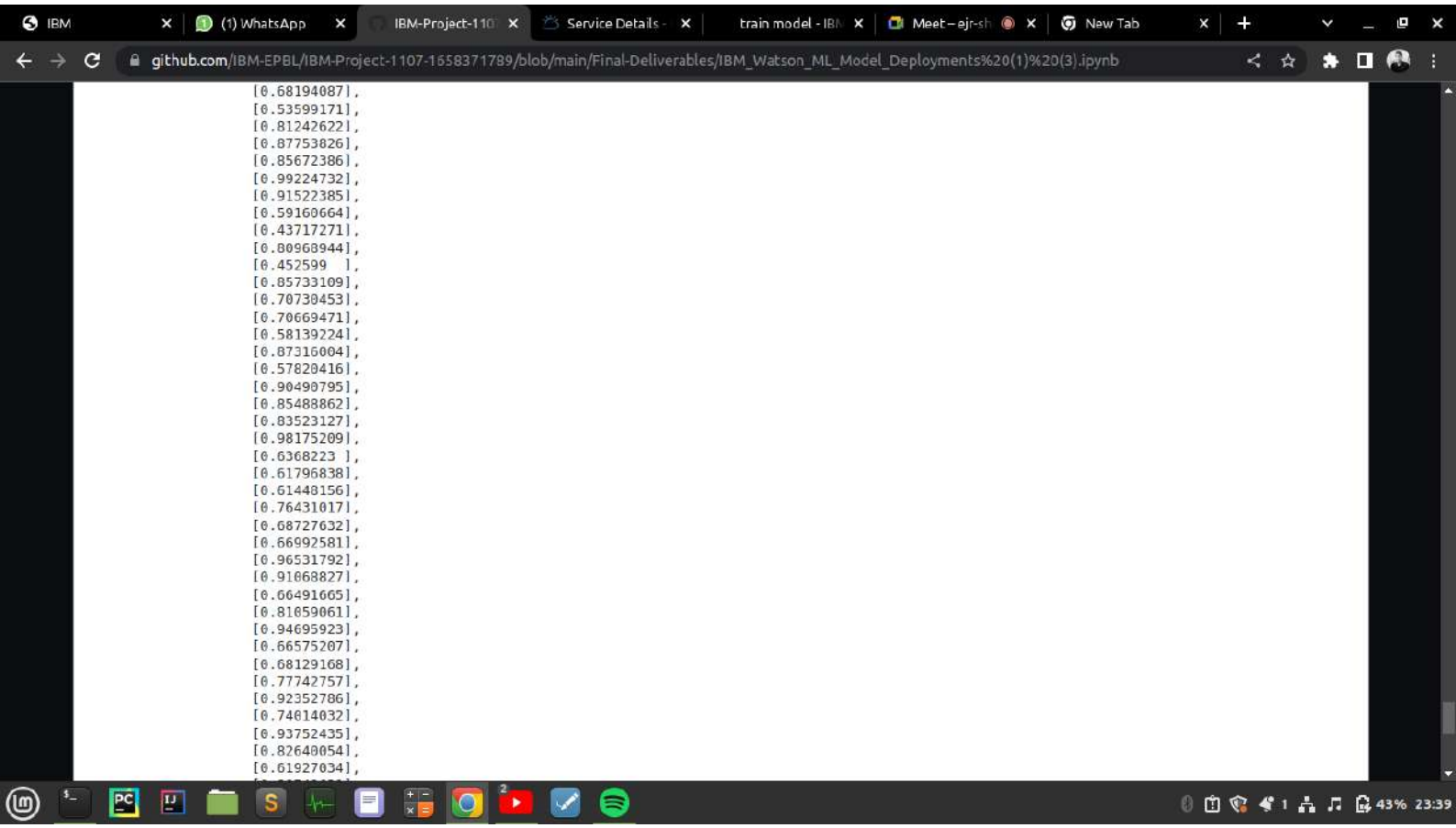
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UASEP Multiple Linear Regression Model Deployment Test

In [39]:

```
import requests

# NOTE: you must manually set API_KEY below using information retrieved from your IBM Cloud account.
API_KEY = "O-xbXqcCv2iPGZfem_krJ8KX-kQ2h5bKybYpPwY-g0fl"
token_response = requests.post('https://iam.cloud.ibm.com/identity/token', data={"apikey":
 API_KEY, "grant_type": 'urn:ibm:params:oauth:grant-type:apikey'})
mltoken = token_response.json()["access_token"]

header = {'Content-Type': 'application/json', 'Authorization': 'Bearer ' + mltoken}

# NOTE: manually define and pass the array(s) of values to be scored in the next line
payload_scoring = {"input_data": [{"field": [["GRE Score","TOEFL Score","University Rating","SOP","LOR ","CGPA", "Research"]], "values":

response_scoring = requests.post('https://us-south.ml.cloud.ibm.com/ml/v4/deployments/uaep_deployment/predictions?version=2022-11-12', js
 headers={'Authorization': 'Bearer ' + mltoken})
print("Scoring response")
print(response_scoring.json())
```

```
Scoring response
{'predictions': [{'fields': ['prediction'], 'values': [[[0.8448151378927107]]]}]}
```

In [40]:

```
probability = response_scoring.json()['predictions'][0]['values'][0][0][0]
probability
```

Out[40]:

```
0.8448151378927107
```

In [40]:

In [40]:

43% 23:39