Titulación de Sistemas Informáticos y Computación

Implementación de un ambiente de Ciencia de Datos a través de la Librería Open Source Rapids

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Agenda

- Objetivos
- Arquitectura Rapids
- Plataformas MERM
- Proceso ETL
- Proceso ML
- Comparativa Aceleración

Objetivos del TT

- Objetivo General
  - Implementar un ambiente de Ciencia de Datos a través de la Librería Open Source Rapids.
- Objetivos Específicos
  - Elaborar una investigación documentada sobre la Librería Open Source Rapids.
  - Realizar analítica de grandes volúmenes de datos a través del uso de las características de la Librería Open Source Rapids.
  - Implementar algoritmos de Machine Learning haciendo uso de la Librería Open Source Rapids.

Parte I

FASES DEL TRABAJO DE TITULACIÓN

Fases del Proyecto

Arquitectura Rapids

- Análisis de la Arquitectura implementada Rapids

Proceso de Instalación en Plataformas MERM

- Prerrequisitos de Instalación
- Docker
- Conda
- Google Colabority
- BlanzingSQL

Proceso ETL

- Extracción
- Transformación
- Carga

Proceso ML

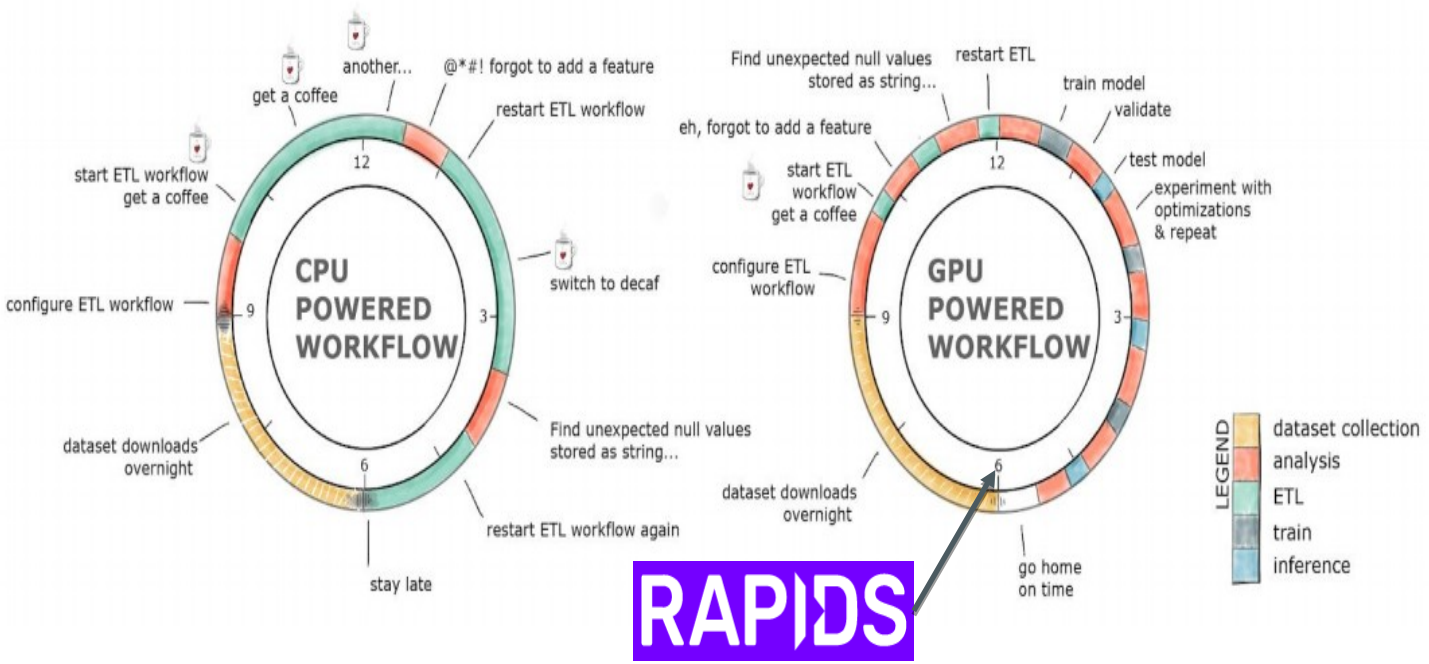
- Dividir Dataset Train y Test
- Preprocesamiento
- Algoritmos Machine Learning

Comparativa Aceleración

- Rapids y Pandas

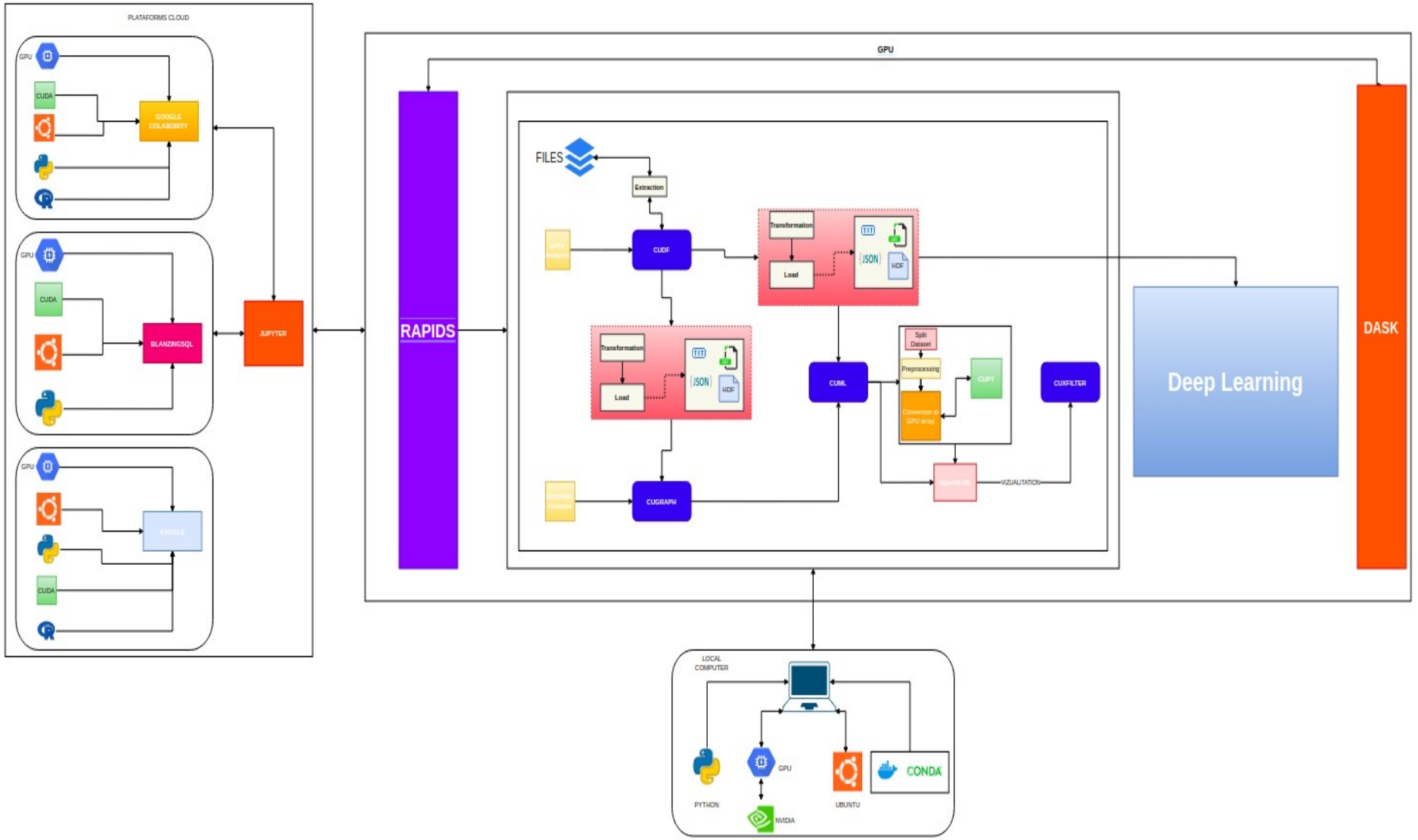
Aceleración GPU.

¿De verdad es necesaria la aceleración en GPU?



Fuente: (Srinath & Kraus, 2019).

Arquitectura Rapids: Análisis de la Arquitectura implementada Rapids.



Proceso de Instalación en Plataformas MERM: Prerrequisitos de Instalación

Prerrequisitos de Instalación localmente.

Gpu Nvidia	Sistema Operativo Linux (Ubuntu)	Docker	Nvidia Drivers Cuda
Titan RTX Tesla GeForce	Versión 16.04 Versión 18.04	Versión 19.03	Versión 10.0 Versión 10.1 Versión 10.2

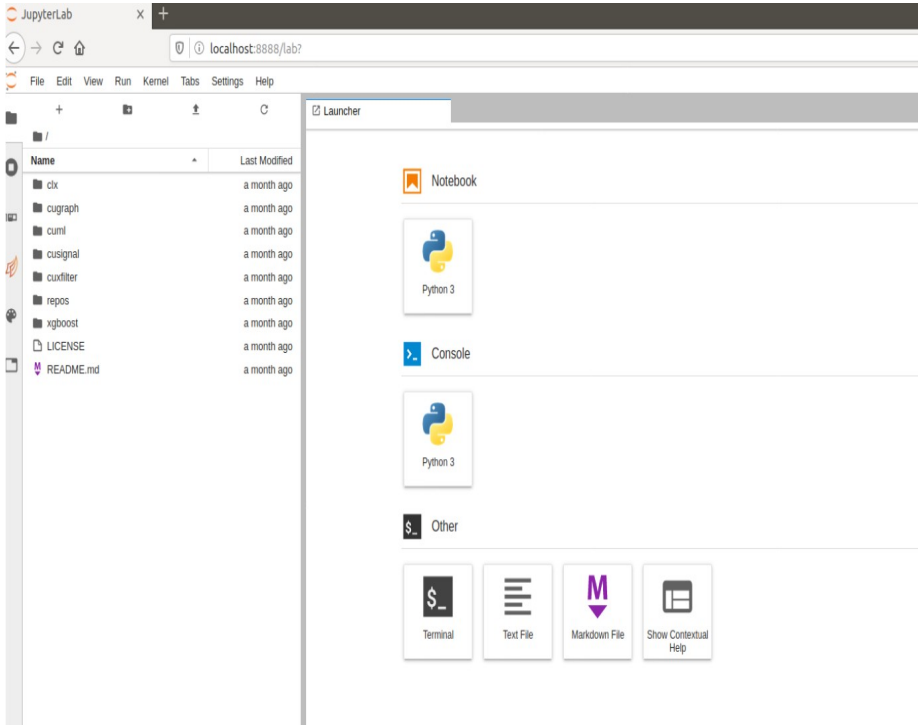
Computador portátil local

Marca Portátil	Intel	Sistema Operativo	Gpu
Dell	Core I7 8th Gen	Ubuntu 18.04	Nvidia GeForce MX150 4GB

Proceso de Instalación en Plataformas MERM: Docker.

```
root@jose-Inspiron-7472:/home/jose# docker run --gpus all nvidia/cuda:10.0-base nvidia-smi
Unable to find image 'nvidia/cuda:10.0-base' locally
10.0-base: Pulling from nvidia/cuda
7ddbc47eeb70: Pull complete
c1bbdc448b72: Pull complete
8c3b70e39044: Pull complete
45d437916d57: Pull complete
d8f1569ddae6: Pull complete
de5a2c57c41d: Pull complete
ea6f04a00543: Pull complete
Digest: sha256:e6e1001f286d084f8a3aea991afbcfe92cd389ad1f4883491d43631f152f175e
Status: Downloaded newer image for nvidia/cuda:10.0-base
Tue Jul  7 05:25:39 2020
+-----------------------------------------------------------------------------+
| NVIDIA-SMI 440.100      Driver Version: 440.100      CUDA Version: 10.2     |
|-------------------------------+----------------------+----------------------+
| GPU  Name        Persistence-M| Bus-Id        Disp.A | Volatile Uncorr. ECC |
| Fan  Temp  Perf  Pwr:Usage/Cap|         Memory-Usage | GPU-Util  Compute M. |
|===============================+======================+======================|
|   0  GeForce MX150       Off  | 00000000:01:00.0 Off |                  N/A |
| N/A   50C    P0    N/A /  N/A |    254MiB /  4042MiB |      0%      Default |
+-------------------------------+----------------------+----------------------+

+-----------------------------------------------------------------------------+
| Processes:                                                       GPU Memory |
|  GPU       PID   Type   Process name                             Usage      |
|=============================================================================|
+-----------------------------------------------------------------------------+
```

Nvidia de computador local se encuentre en la imagen docker

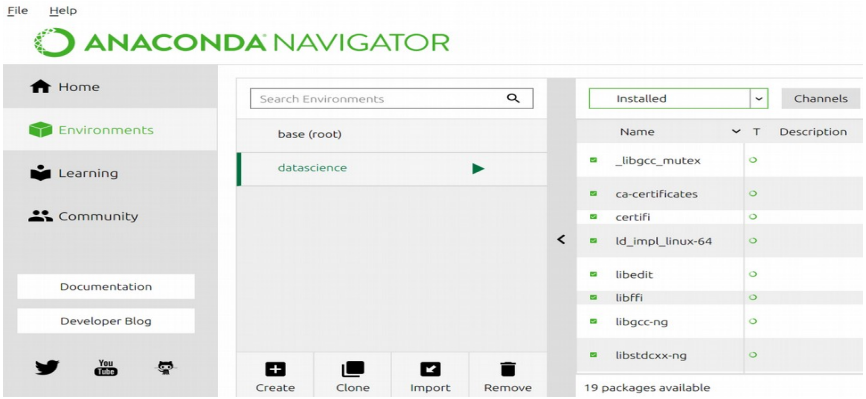


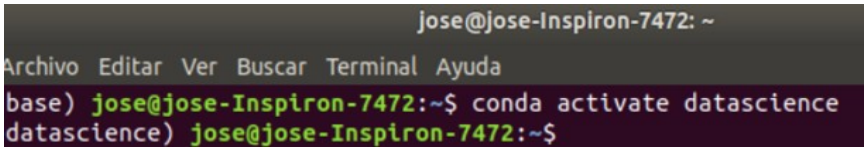
Plataforma de Desarrollo

```
oot@jose-Inspiron-7472:/home/jose# docker run --gpus all --rm -it -p 8888:8888 -p 8787:8787 -p 8786:8786 \
    rapidsai/rapidsai:cuda10.2-runtime-ubuntu18.04-py3.7
rapids) root@697a8b7466ee:/rapids/notebooks#
rapids) root@697a8b7466ee:/rapids/notebooks#
```

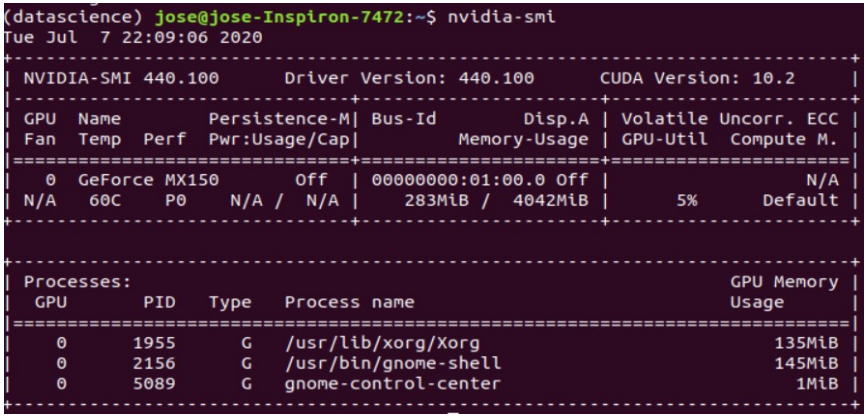
Ejecutando Imagen docker

Proceso de Instalación en Plataformas MERM: Conda.

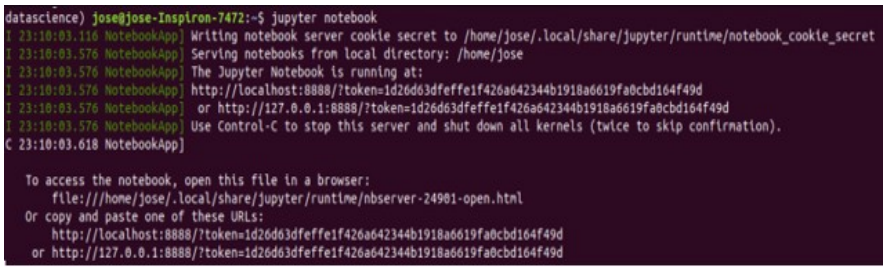




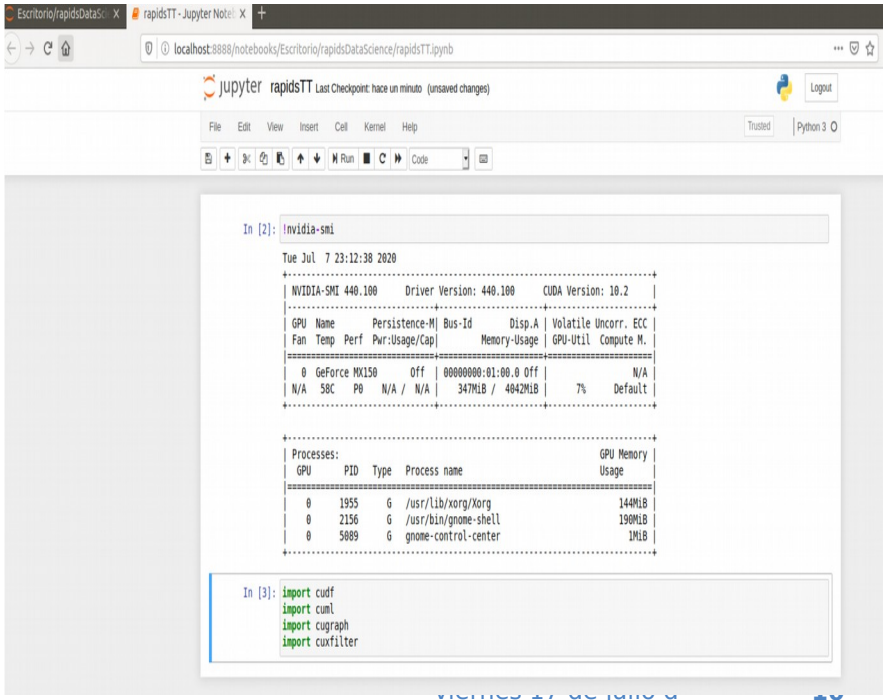
Activar entorno



Verificar Nvidia

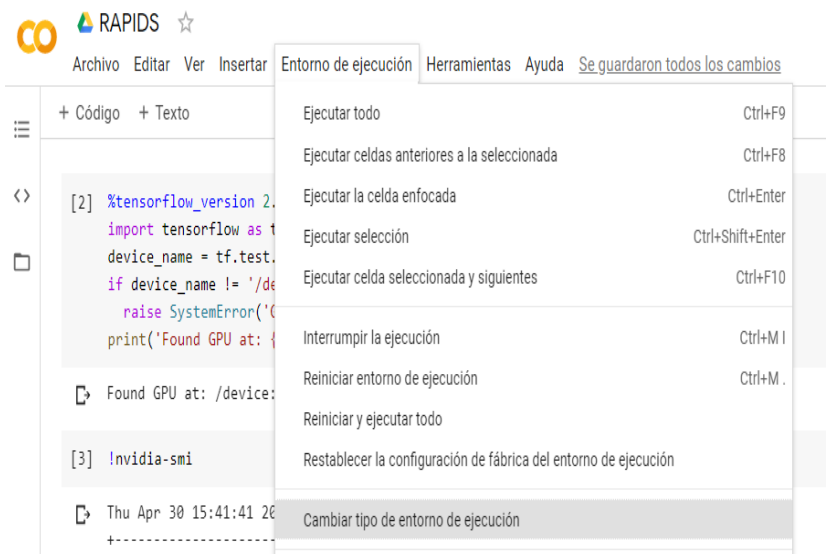


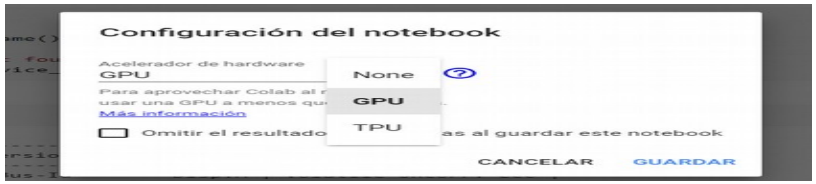
Ejecutar jupyter



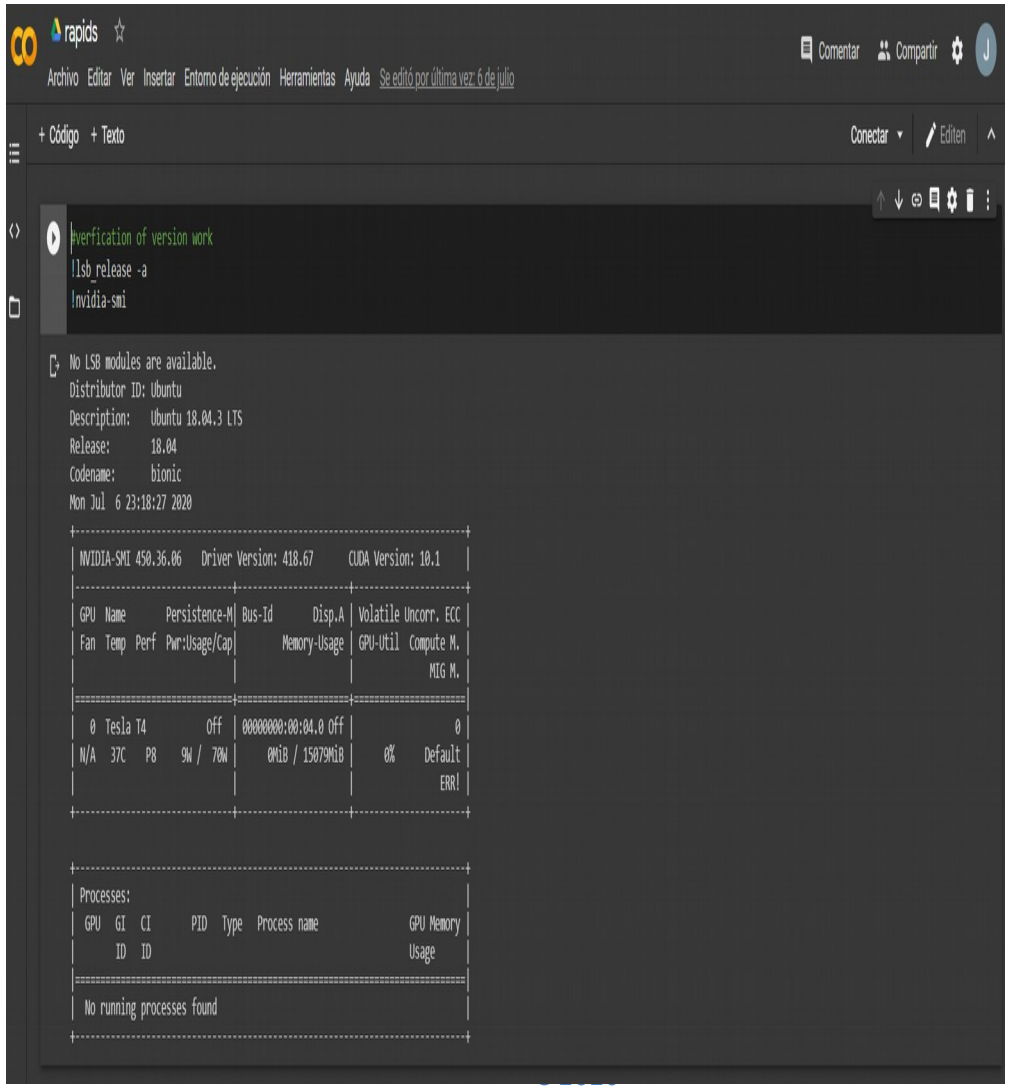
Plataforma de desarrollo

Proceso de Instalación en Plataformas MERM: Google Colabority.

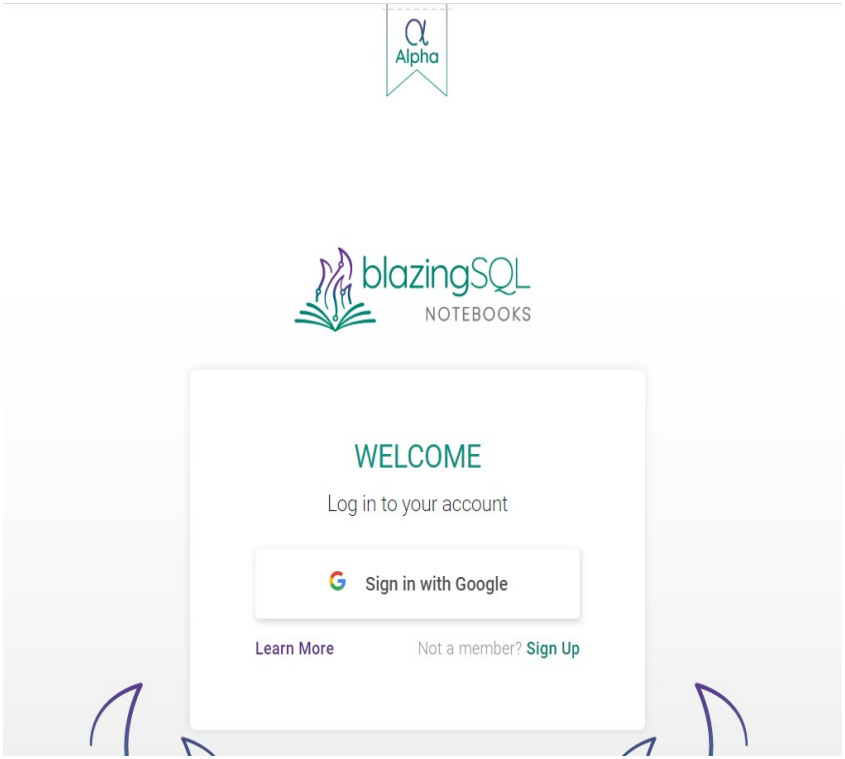




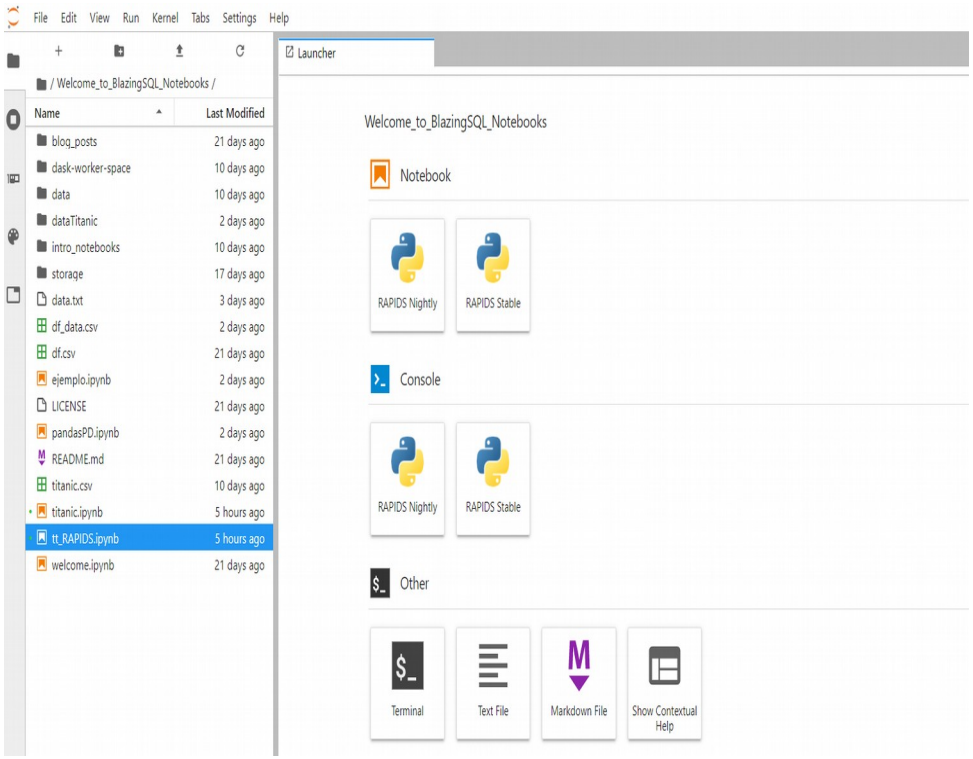

```
# Install RAPIDS in colaboritory
!git clone https://github.com/rapidsai/rapidsai-csp-utils.git
!bash rapidsai-csp-utils/colab/rapids-colab.sh stable

import sys, os

dist_package_index = sys.path.index('/usr/local/lib/python3.6/dist-packages')
sys.path = sys.path[:dist_package_index] + ['/usr/local/lib/python3.6/site-packages'] + sys.path[dist_package_index:]
sys.path
exec(open('rapidsai-csp-utils/colab/update_modules.py').read(), globals())
```



Proceso de Instalación en Plataformas MERM: BlazingSQL.



Página BlanzingSQL

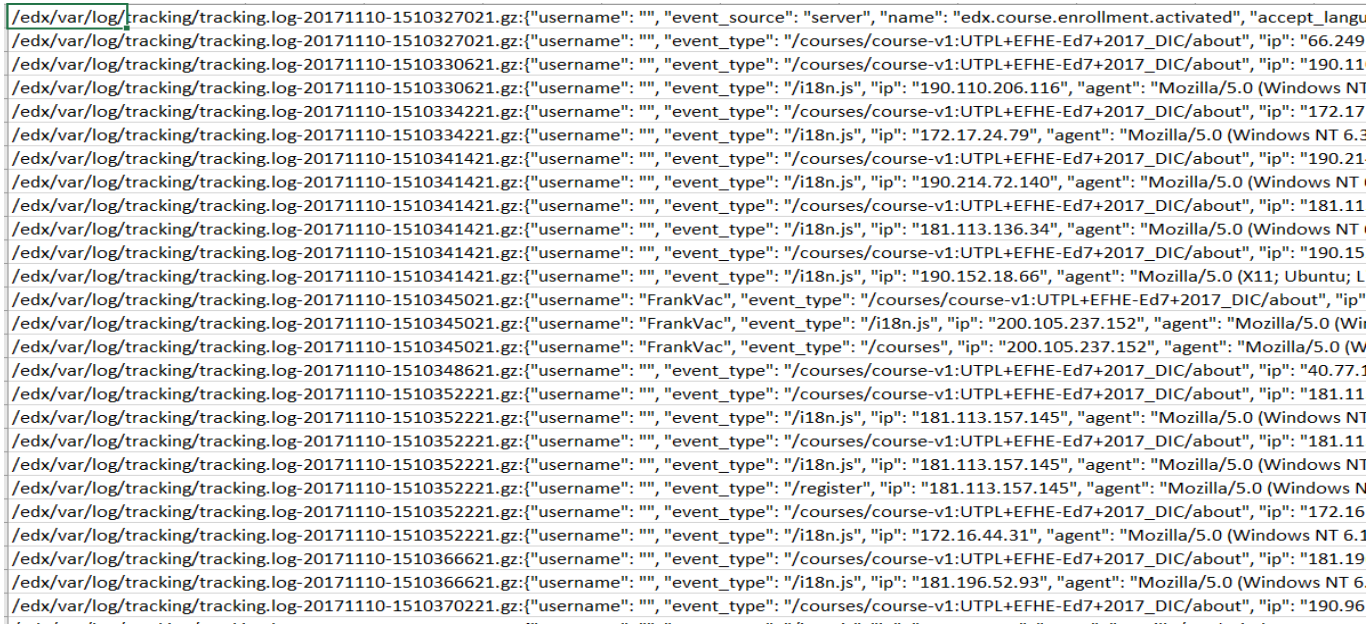


Plataforma de desarrollo

Dirección: https://app.blazingsql.com/

Proceso ETL: Extracción.

- Data con datos Semiestructurados: 80 mil filas de información a analizar de OpenCampus.



Data a Analizar

Proceso ETL: Extracción y lectura

RAPIDS

```
#extraccion y lectura con Rapids
start = time.time()
gdf = cudf.read_csv('df_data.csv', names='uno')
end = time.time()
```

Extracción y Lectura

cuDF

cudf.read_csv

```
print('Descripción de salida del dataset:')
gdf
```

Descripción de salida del dataset:

	u	n	o
0	"/edx/var/log/tracking/tracking.log-20171110-...	null	null
1	/edx/var/log/tracking/tracking.log-20171110-15...	null	null
2	/edx/var/log/tracking/tracking.log-20171110-15...	null	null
3	/edx/var/log/tracking/tracking.log-20171110-15...	null	null
4	/edx/var/log/tracking/tracking.log-20171110-15...	null	null
...	...	...	...
79995	/edx/var/log/tracking/tracking.log-20171220-15...	null	null
79996	/edx/var/log/tracking/tracking.log-20171220-15...	null	null
79997	/edx/var/log/tracking/tracking.log-20171220-15...	null	null
79998	/edx/var/log/tracking/tracking.log-20171220-15...	null	null
79999	/edx/var/log/tracking/tracking.log-20171220-15...	null	null

80000 rows × 3 columns

Aspecto familiar para los científicos de datos que trabajan en Python.

Proceso ETL: Transformación

```
#Creo DataFrame con Pandas
pdPandas = pd.DataFrame(a)
```

pandas

```
#convieto para cudf dataframe
gdf_new = cudf.DataFrame.from_pandas(pdPandas)
```

```
gdf_new.dropna(axis=0, how='any')
```

```
gdf_new.drop_column('accept_language') #columna si relevancia
gdf_new.drop_column('name') #muchos datos faltantes
```

```
context = gdf_new['context']
context.str.normalize_spaces()
newcontext = context.str.split(pat = ",")
```

```
newcontext.columns = ['a','b','c']
```

```
newData = gdf_new.join(newcontext, how='left')
newData.drop_column('context')
```

```
newData.sort_values('username')
newData.drop_duplicates(subset='username', keep=False, inplace=False, ignore_index=False)
```

```
newData = newData.reset_index()
```

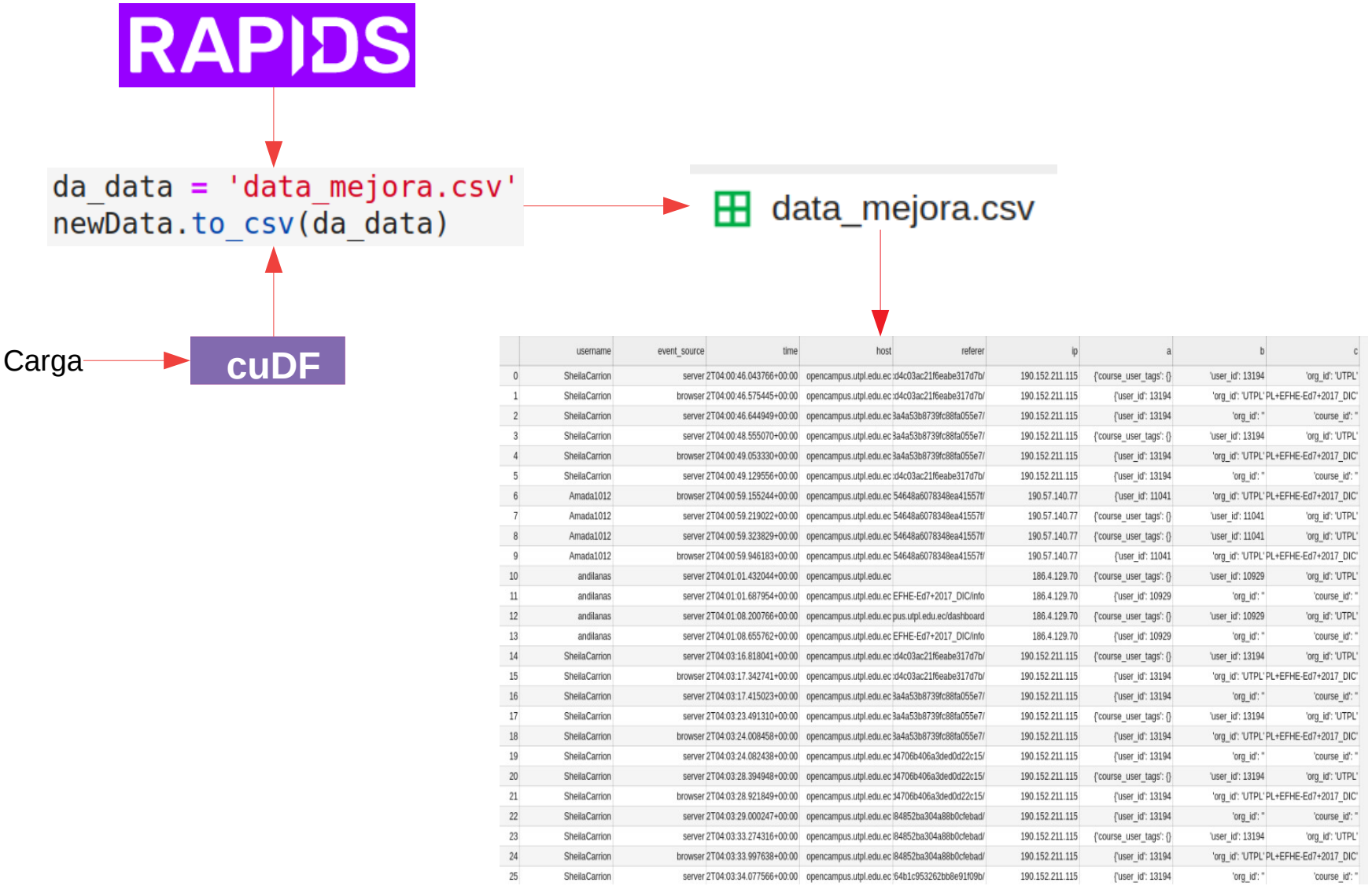
RAPIDS

cuDF

cudf.DataFrame.from_pandas	Convierte de un dataframe de pandas a un dataframe cudf
dropna	Eliminar filas con datos perdidos.
drop_column	Eliminar columna seleccionada.
str.normalize_spaces	Normaliza espacios en blanco.
stir.split	Dividir una columna y la incorpora como un nuevo dataframe.
columns	Crea columnas.
join	Unir dataframes.
drop_duplicates	Eliminar duplicados.
reset_index	Resetear el index.

	username	event_source	time	host	referer	ip	a	b	c
0	SheilaCarrion	server	2017-12-12T04:00:46.043766+00:00	opencampus.utpl.edu.ec	http://opencampus.utpl.edu.ec/courses/course-v...	190.152.211.115	{'course_user_tags': {}	'user_id': 13194	'org_id': 'UTPL'
1	SheilaCarrion	browser	2017-12-12T04:00:46.575445+00:00	opencampus.utpl.edu.ec	http://opencampus.utpl.edu.ec/courses/course-v...	190.152.211.115	{'user_id': 13194	'org_id': 'UTPL'	'course_id': 'course-v1:UTPL+EFHE-Ed7+2017_DIC'
2	SheilaCarrion	server	2017-12-12T04:00:46.644949+00:00	opencampus.utpl.edu.ec	http://opencampus.utpl.edu.ec/courses/course-v...	190.152.211.115	{'user_id': 13194	'org_id': ''	'course_id': ''
3	SheilaCarrion	server	2017-12-12T04:00:48.555070+00:00	opencampus.utpl.edu.ec	http://opencampus.utpl.edu.ec/courses/course-v...	190.152.211.115	{'course_user_tags': {}	'user_id': 13194	'org_id': 'UTPL'
4	SheilaCarrion	browser	2017-12-12T04:00:49.053330+00:00	opencampus.utpl.edu.ec	http://opencampus.utpl.edu.ec/courses/course-v...	190.152.211.115	{'user_id': 13194	'org_id': 'UTPL'	'course_id': 'course-v1:UTPL+EFHE-Ed7+2017_DIC'

Proceso ETL: Carga.



	username	event_source	time	host	referer	ip	a	b	c
0	SheilaCarrion	server	2T04:00:46.043766+00:00	opencampus.utpl.edu.ec	:d4c03ac21f6eabe317d7b/	190.152.211.115	{'course_user_tags': {}	'user_id': 13194	'org_id': 'UTPL'
1	SheilaCarrion	browser	2T04:00:46.575445+00:00	opencampus.utpl.edu.ec	:d4c03ac21f6eabe317d7b/	190.152.211.115	{'user_id': 13194	'org_id': 'UTPL'	PL+EFHE-Ed7+2017_DIC'
2	SheilaCarrion	server	2T04:00:46.644949+00:00	opencampus.utpl.edu.ec	3a4a53b8739fc88fa055e7/	190.152.211.115	{'user_id': 13194	'org_id': ''	'course_id': ''
3	SheilaCarrion	server	2T04:00:48.555070+00:00	opencampus.utpl.edu.ec	3a4a53b8739fc88fa055e7/	190.152.211.115	{'course_user_tags': {}	'user_id': 13194	'org_id': 'UTPL'
4	SheilaCarrion	browser	2T04:00:49.053330+00:00	opencampus.utpl.edu.ec	3a4a53b8739fc88fa055e7/	190.152.211.115	{'user_id': 13194	'org_id': 'UTPL'	PL+EFHE-Ed7+2017_DIC'
5	SheilaCarrion	server	2T04:00:49.129556+00:00	opencampus.utpl.edu.ec	:d4c03ac21f6eabe317d7b/	190.152.211.115	{'user_id': 13194	'org_id': ''	'course_id': ''
6	Amada1012	browser	2T04:00:59.155244+00:00	opencampus.utpl.edu.ec	54648a6078348ea41557f/	190.57.140.77	{'user_id': 11041	'org_id': 'UTPL'	PL+EFHE-Ed7+2017_DIC'
7	Amada1012	server	2T04:00:59.219022+00:00	opencampus.utpl.edu.ec	54648a6078348ea41557f/	190.57.140.77	{'course_user_tags': {}	'user_id': 11041	'org_id': 'UTPL'
8	Amada1012	server	2T04:00:59.323829+00:00	opencampus.utpl.edu.ec	54648a6078348ea41557f/	190.57.140.77	{'course_user_tags': {}	'user_id': 11041	'org_id': 'UTPL'
9	Amada1012	browser	2T04:00:59.946183+00:00	opencampus.utpl.edu.ec	54648a6078348ea41557f/	190.57.140.77	{'user_id': 11041	'org_id': 'UTPL'	PL+EFHE-Ed7+2017_DIC'
10	andilanas	server	2T04:01:01.432044+00:00	opencampus.utpl.edu.ec		186.4.129.70	{'course_user_tags': {}	'user_id': 10929	'org_id': 'UTPL'
11	andilanas	server	2T04:01:01.687954+00:00	opencampus.utpl.edu.ec	EFHE-Ed7+2017_DIC/info	186.4.129.70	{'user_id': 10929	'org_id': ''	'course_id': ''
12	andilanas	server	2T04:01:08.200766+00:00	opencampus.utpl.edu.ec	pus.utpl.edu.ec/dashboard	186.4.129.70	{'course_user_tags': {}	'user_id': 10929	'org_id': 'UTPL'
13	andilanas	server	2T04:01:08.655762+00:00	opencampus.utpl.edu.ec	EFHE-Ed7+2017_DIC/info	186.4.129.70	{'user_id': 10929	'org_id': ''	'course_id': ''
14	SheilaCarrion	server	2T04:03:16.818041+00:00	opencampus.utpl.edu.ec	:d4c03ac21f6eabe317d7b/	190.152.211.115	{'course_user_tags': {}	'user_id': 13194	'org_id': 'UTPL'
15	SheilaCarrion	browser	2T04:03:17.342741+00:00	opencampus.utpl.edu.ec	:d4c03ac21f6eabe317d7b/	190.152.211.115	{'user_id': 13194	'org_id': 'UTPL'	PL+EFHE-Ed7+2017_DIC'
16	SheilaCarrion	server	2T04:03:17.415023+00:00	opencampus.utpl.edu.ec	3a4a53b8739fc88fa055e7/	190.152.211.115	{'user_id': 13194	'org_id': ''	'course_id': ''
17	SheilaCarrion	server	2T04:03:23.491310+00:00	opencampus.utpl.edu.ec	3a4a53b8739fc88fa055e7/	190.152.211.115	{'course_user_tags': {}	'user_id': 13194	'org_id': 'UTPL'
18	SheilaCarrion	browser	2T04:03:24.008458+00:00	opencampus.utpl.edu.ec	3a4a53b8739fc88fa055e7/	190.152.211.115	{'user_id': 13194	'org_id': 'UTPL'	PL+EFHE-Ed7+2017_DIC'
19	SheilaCarrion	server	2T04:03:24.082438+00:00	opencampus.utpl.edu.ec	4706b406a3ded0d22c15/	190.152.211.115	{'user_id': 13194	'org_id': ''	'course_id': ''
20	SheilaCarrion	server	2T04:03:28.394948+00:00	opencampus.utpl.edu.ec	4706b406a3ded0d22c15/	190.152.211.115	{'course_user_tags': {}	'user_id': 13194	'org_id': 'UTPL'
21	SheilaCarrion	browser	2T04:03:28.921849+00:00	opencampus.utpl.edu.ec	4706b406a3ded0d22c15/	190.152.211.115	{'user_id': 13194	'org_id': 'UTPL'	PL+EFHE-Ed7+2017_DIC'
22	SheilaCarrion	server	2T04:03:29.000247+00:00	opencampus.utpl.edu.ec	84852ba304a88b0cfebad/	190.152.211.115	{'user_id': 13194	'org_id': ''	'course_id': ''
23	SheilaCarrion	server	2T04:03:33.274316+00:00	opencampus.utpl.edu.ec	84852ba304a88b0cfebad/	190.152.211.115	{'course_user_tags': {}	'user_id': 13194	'org_id': 'UTPL'
24	SheilaCarrion	browser	2T04:03:33.997638+00:00	opencampus.utpl.edu.ec	84852ba304a88b0cfebad/	190.152.211.115	{'user_id': 13194	'org_id': 'UTPL'	PL+EFHE-Ed7+2017_DIC'
25	SheilaCarrion	server	2T04:03:34.077566+00:00	opencampus.utpl.edu.ec	64b1c953262bb8e91f09b/	190.152.211.115	{'user_id': 13194	'org_id': ''	'course_id': ''

Proceso ML: Dividir dataset Train y Test

RAPIDS

```
from cuml.preprocessing.model_selection import train_test_split
```

```
X_train, X_test, y_train, y_test = train_test_split(gdf_dataX, gdf_dataY, train_size=0.8)
```

80% Train y 20% Test

```
print(f'Original datasets: {gdf_dataX.shape[0], gdf_dataY.shape[0]} elements')
print(f'Data X_train: {X_train.shape[0]} elements')
print(f'Data X_test: {X_test.shape[0]} elements')
print(f'Data y_train: {y_train.shape[0]} elements')
print(f'Data y_test: {y_test.shape[0]} elements')
```

```
Dataset Original: (77912, 77912) elementos
Data X_train: 62329 elementos
Data X_test: 15583 elementos
Data y_train: 62329 elementos
Data y_test: 15583 elementos
```

cuML	
Clase	Descripción
preprocessing.model_selection train_test_split	Dividir los datos en cuatro objetos intercalados.

Proceso ML: Preprocesamiento.

RAPIDS

```
from cuml.preprocessing.LabelEncoder import LabelEncoder

le = LabelEncoder()

value_usernameX = le.fit_transform(X_train.username)
value_ipX = le.fit_transform(X_train.ip)
```

Datos sin categorizar

```
X_train.username.head(3)

0        MILTON
1        gcjuma
2    Mayra_2017
Name: username, dtype: object
```

```
X_train.ip.head(3)

0    181.196.160.40
1    186.46.207.242
2    186.70.132.111
Name: ip, dtype: object
```

Datos categorizados

```
value_usernameX.head(3)

0    215
1    371
2    237
dtype: int16
```

```
value_ipX.head(3)

0    209
1    390
2    459
dtype: int16
```

cuML	
Clase	Descripción
Preprocessing.LabelEncoder	Permite categorizar datos.

Proceso ML: Algoritmos Machine Learning.

RAPIDS

```
from cuml.linear_model import LinearRegression
```

```
dataTest = cudf.DataFrame()
dataTest['usernameValueXtrain'] = cp.asarray(value_usernameX, dtype=cp.float32)
dataTest['ipValueXtrain'] = cp.asarray(value_ipX, dtype=cp.float32)
```

```
new_value = cp.asarray(value_usernameY, dtype=cp.float32)
dataY = cudf.Series(new_value)
```

```
lr = LinearRegression(fit_intercept = True, normalize = False,
                      algorithm = "eig")
reg = lr.fit(dataTest, dataY)
```

```
print("Coeficientes:")
print(reg.coef_)
print("Intercepción:", reg.intercept_)
print('Predicción del modelo:')
print(lr.predict(dataTest))
```

```
Coeficientes:
0    1.000000e+00
1    7.146533e-09
dtype: float32
Intercepción: 0.0
Predicción del modelo:
0         467.0
1         214.0
2         214.0
3         214.0
4         300.0
          ...
62324     214.0
62325     214.0
62326     214.0
62327     214.0
62328     100.0
Length: 62329, dtype: float32
```

```
from cuml.ensemble import RandomForestClassifier as cuRFC
```

```
dataTrainUSER = cp.asarray(value_usernameX, dtype=cp.float32)
dataTestUSER = cp.asarray(value_usernameY, dtype=cp.int32)
```

```
cuml_modelRDF = cuRFC(max_features=1.0,
                      n_bins=2,
                      n_estimators=2)
cuml_modelRDF.fit(dataTrainUSER, dataTestUSER)
```

```
print("Predicción del modelo: ")
print(cuml_predict)
```

```
Predicción del modelo:
[422 214 214 ... 214 214 214]
```

cuML	
Regresión y Clasificación	
linear_model LinearRegression	Algoritmo regresión lineal
Ensemble RandomForestClassifier	Algoritmo Random Forest

Comparativa de resultados de Aceleración: Rapids y Pandas

Proceso ETL	Tiempo en Segundos	Desarrollo	# filas

Extracción	0.94	`#exportación y lectura con pandas`
		`inicio = time.time()`
		`pd_Pandas = pd.read_csv('../df_data.csv', names='uno')`
		`fin = time.time()`
		`calcultedPD = fin-inicio`
		`print("Cálculo de extracción y lectura con Pandas = {}".format(calcultedPD))`
		Cálculo de extracción y lectura con Pandas = 0.9458587169647217
			80.000

Transformación	3.04	`print('Cálculo de transformación cpu-Pandas:', cpuPandas)` Cálculo de transformación cpu-Pandas: 3.0437815189361572	80.000

Carga	0.90	`start = time.time()`
		`da_data = 'data_mejora.csv'`
		`generalData.to_csv(da_data)`
		`end = time.time()`
		`calculated = end - start`
		`print("Cálculo de carga cpu-Pandas = {}".format(calculated))`
		Cálculo de carga cpu-Pandas = 0.9098856449127197
			80.000

Proceso ETL	Tiempo en Segundos	Desarrollo	# filas

Extracción	0.41	`start = time.time()`
		`gdf = cudf.read_csv('df_data.csv', names='uno')`
		`end = time.time()`
		`caculatedCUDF = end - start`
		`print("Cálculo de extracción y lectura con RAPIDS = {}".format(caculatedCUDF))`
		Cálculo de extracción y lectura con RAPIDS = 0.41393375396728516
			80.000

Transformación	2.69	`print('Cálculo de transformación gpu-RAPIDS:', calculatedGeneralRAPIDS)` Cálculo de transformación gpu-RAPIDS: 2.696117401123047	80.000

Carga	0.37	`import time`
		`start = time.time()`
		`da_data = 'data_mejora.csv'`
		`newData.to_csv(da_data)`
		`end = time.time()`
		`calculated = end - start`
		`print("Cálculo de carga gpu-Rapids = {}".format(calculated))`
		Cálculo de carga gpu-Rapids = 0.3737514019012451
			80.000

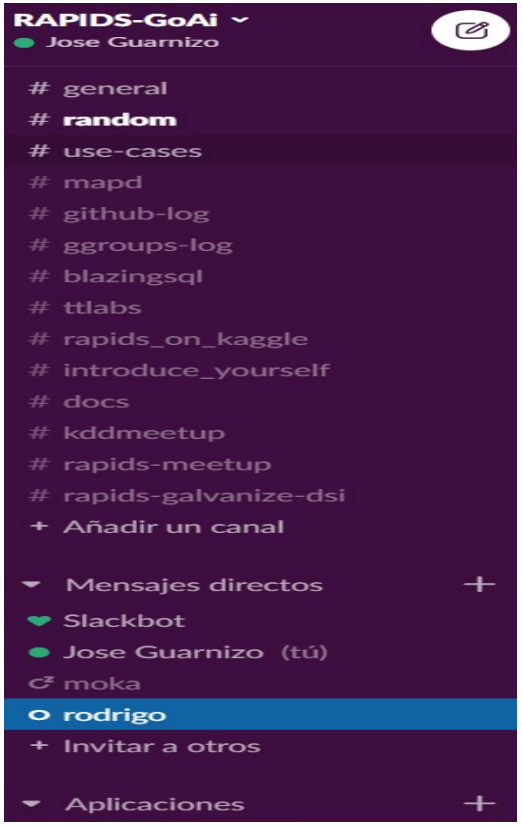
Parte II

ESTADO DEL TRABAJO DE TITULACIÓN

Avance del TT

Nombre Fase	% Avance Estimado	% Avance Real	% Retraso
Arquitectura RAPIDS	100%	100%	0%
Proceso de Instalación plataformas MERM	100%	100%	0%
Proceso ETL	100%	85%	15%
Proceso ML	100%	69%	31%

Detalles del proceso de Desarrollo



Jose Guarnizo 09:25

Hi guys, when installing RAPIDS in google colabority i have problems with version 0.14 when importing cudf, can you help me please.

12 respuestas Última respuesta hace 21 días

rodrigo hace 21 días

hey @Jose Guarnizo you should consider app.blazingsql.com You get the same Tesla T4 GPU for free, it's vanilla JupyterLab, but all the RAPIDS packages are pre-installed and ready to go. No setup whatsoever. You can run the stable cuDF 0.14 or the nightly cuDF 0.15 inside the app. (editado)

Jose Guarnizo hace 21 días

Thanks @rodrigo, i will try with blazingsql, Thank you so much for everything.

1

Taurean hace 21 días

@Jose Guarnizo can you print your output from the install cell? 2 things could be happening

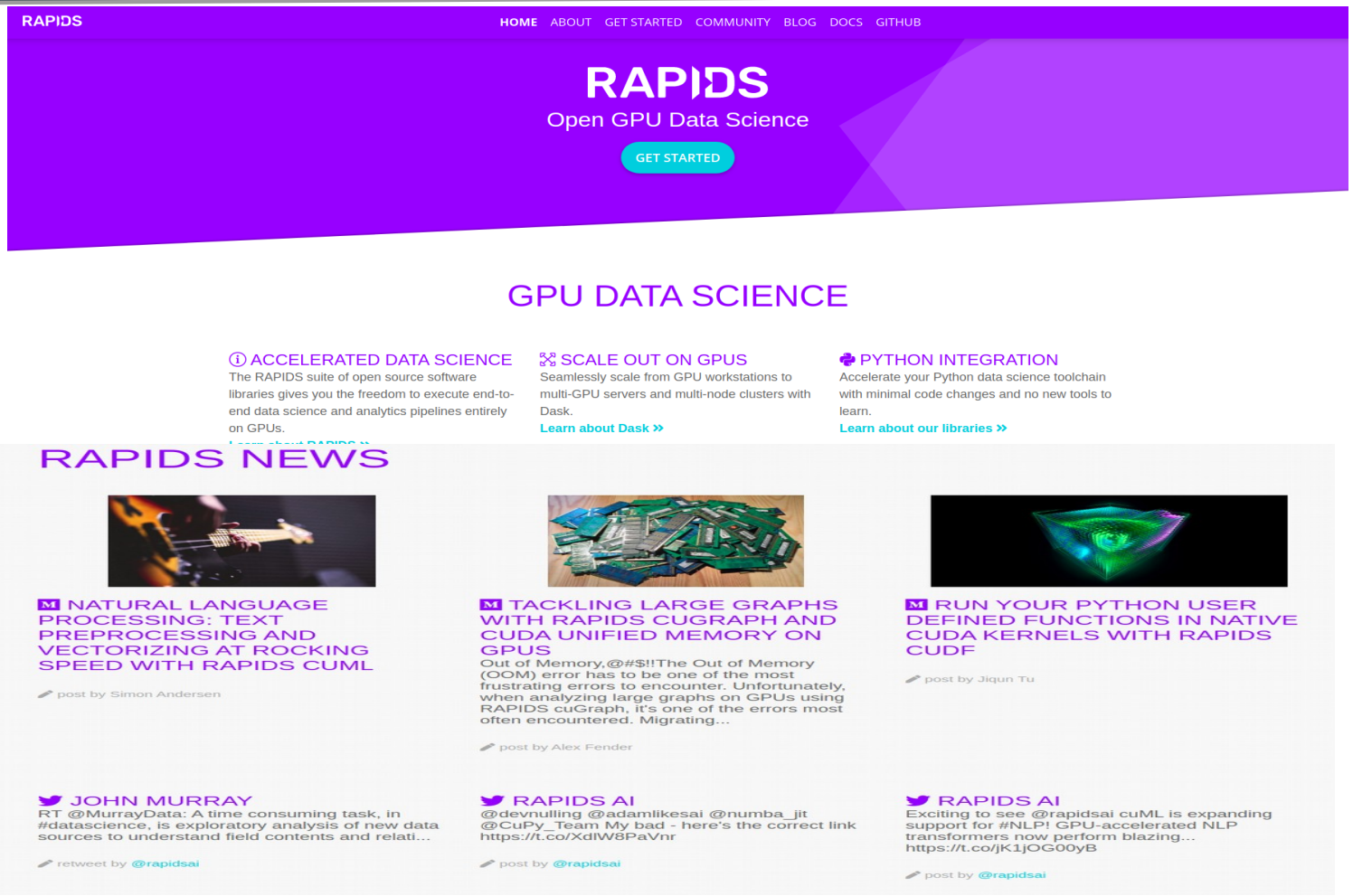
1. you got a K80
2. the installation failed somewhere.

(editado)

Taurean hace 21 días

@Jose Guarnizo i see it....someone changed their files from what's on the yml created earlier this week and it failed to solve. I've reverted back to how we solved before and will look into `conda-pack`. It works as expected now. Thanks for bringing this to our attention!

Rapids



Página Web: https://rapids.ai/

GRACIAS

¿PREGUNTAS?