Aprenentatge Computacional

MD3: Kaggle

GPU Kernel Performance Dataset

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Explicación de la BBDD

Explicación de la BBDD

- Tiempos de ejecución de multiplicaciones de matrices 2048 * 2048 en un kernel Linux parametrizable

- 241600 posibles combinaciones de parámetros

- Entorno:
  - Ubuntu 16.04
  - Intel Core i5 (3.5GHz)
  - 16GB RAM
  - NVidia GeForce GTX 680 4GB GF580 GTX-1.5GB GPU

Atributos de la BBDD

Tiempo de ejecución	Atributos parametrizables del kernel
Run (ms) (integer)	- MWG, NWG: {16, 32, 64, 128} (integer) - KWG: {16, 32} (integer) - MDIMC, NDIMC: {8, 16, 32} (integer) - MDIMA, NDIMB: {8, 16, 32} (integer) - KWI: {2, 8} (integer) - VWM, VWN: {1, 2, 4, 8} (integer) - STRM, STRN: {0, 1} (categorical) - SA, SB: {0, 1} (categorical)

Análisis de los datos

Busqueda de valores nulos

- No disponemos de valores NaN o null:

	MWG	NWG	KWG	MDIMC	NDIMC	MDIMA	NDIMB	KWI	VWM	VWN	STRM	STRN	SA	SB	Run1 (ms)	Run2 (ms)	Run3 (ms)	Run4 (ms)
0	16	16	16	8	8	8	8	2	1	1	0	0	0	0	115.26	115.87	118.55	115.80
1	16	16	16	8	8	8	8	2	1	1	0	0	0	1	78.13	78.25	79.25	79.19
2	16	16	16	8	8	8	8	2	1	1	0	0	1	0	79.84	80.69	80.76	80.97
3	16	16	16	8	8	8	8	2	1	1	0	0	1	1	84.32	89.90	86.75	85.58
4	16	16	16	8	8	8	8	2	1	1	0	1	0	0	115.13	121.98	122.73	114.81

```
MWG             0
NWG             0
KWG             0
MDIMC           0
NDIMC           0
MDIMA           0
NDIMB           0
KWI             0
VWM             0
VWN             0
STRM            0
STRN            0
SA              0
SB              0
Run1 (ms)       0
Run2 (ms)       0
Run3 (ms)       0
Run4 (ms)       0
dtype: int64
```

Preprocesado de los datos

Transformación del target

- 4 ejecuciones independientes → 1 sola (media)

	MWG	NWG	KWG	MDIMC	NDIMC	MDIMA	NDIMB	KWI	VWM	VWN	STRM	STRN	SA	SB	Run (ms)
0	16	16	16	8	8	8	8	2	1	1	0	0	0	0	116.3700
1	16	16	16	8	8	8	8	2	1	1	0	0	0	1	78.7050
2	16	16	16	8	8	8	8	2	1	1	0	0	1	0	80.5650
3	16	16	16	8	8	8	8	2	1	1	0	0	1	1	86.6375
4	16	16	16	8	8	8	8	2	1	1	0	1	0	0	118.6625

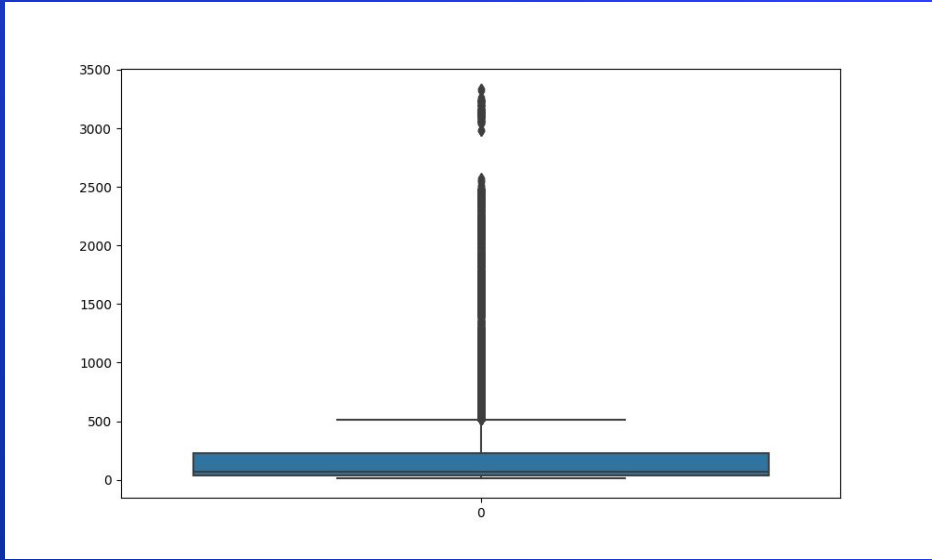
Eliminacion de outliers

- Objetivo: reducir la dispersion de valores

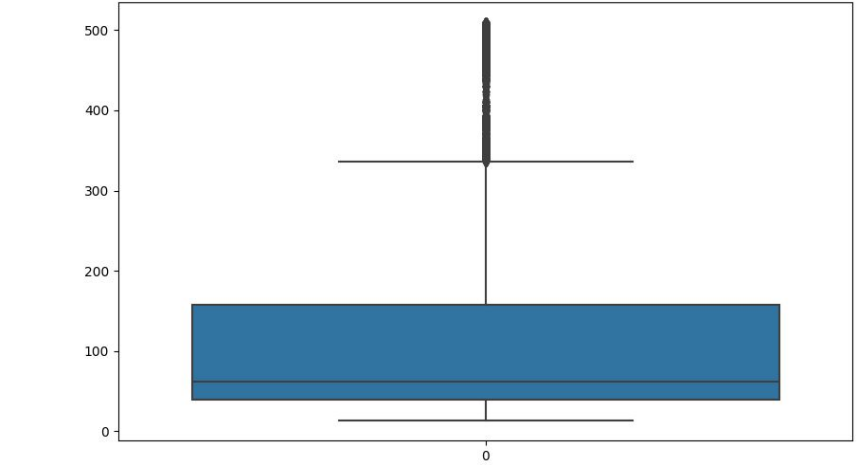
- Descartamos aquellos valores que mas se alejan de los más repetidos

Eliminacion de outliers

Antes



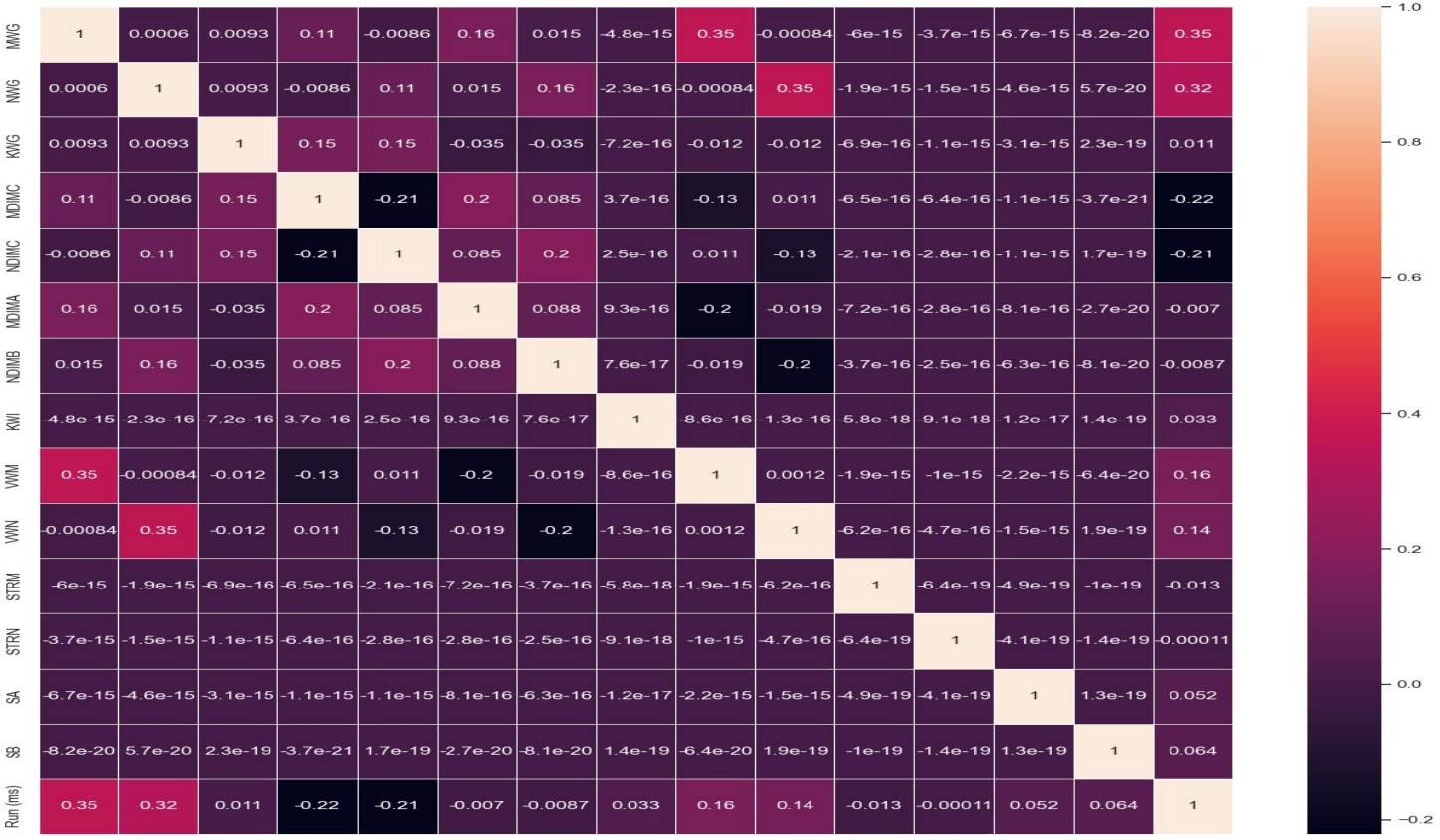
Después



Matriz de correlación

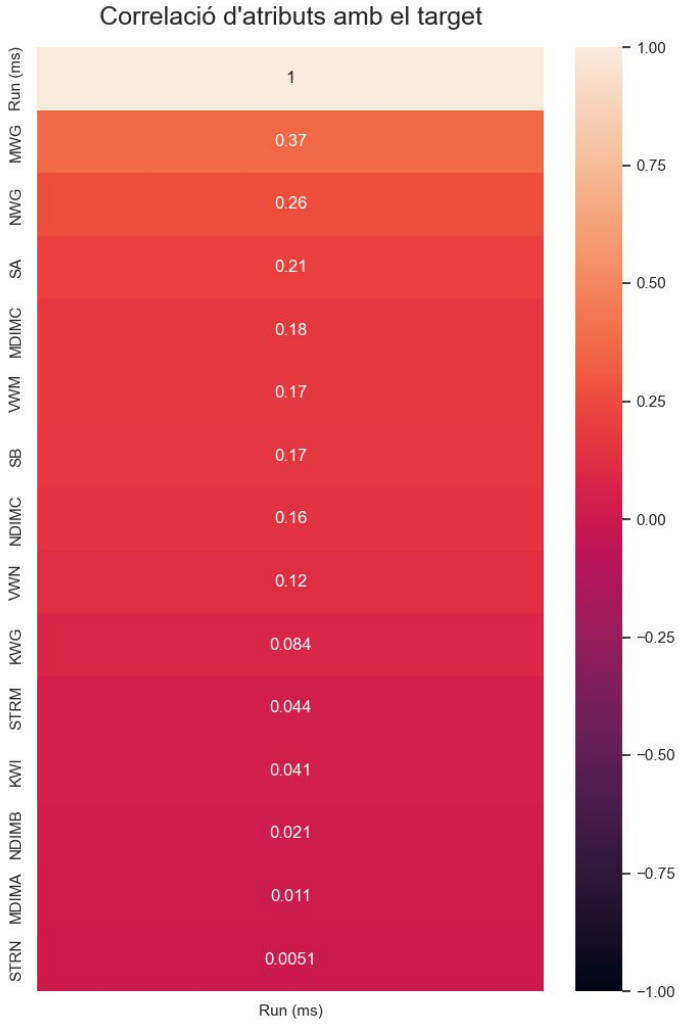
- Observación de la matriz de correlación

  Atributos con una mayor correlación: **MWG, NWG, SA, VWN**


MWG 1 0.0006 0.0093 0.11 -0.0086 0.16 0.015 -4.8e-15 0.35 -0.00084 -6e-15 -3.7e-15 -6.7e-15 -8.2e-20 0.35
NWG 0.0006 1 0.0093 -0.0086 0.11 0.015 0.16 -2.3e-16 -0.00084 0.35 -1.9e-15 -1.5e-15 -4.6e-15 5.7e-20 0.32
KWG 0.0093 0.0093 1 0.15 0.15 -0.035 -0.035 -7.2e-16 -0.012 -0.012 -6.9e-16 -1.1e-15 -3.1e-15 2.3e-19 0.011
MDIMC 0.11 -0.0086 0.15 1 -0.21 0.2 0.085 3.7e-16 -0.13 0.011 -6.5e-16 -6.4e-16 -1.1e-15 -3.7e-21 -0.22
NDIMC -0.0086 0.11 0.15 -0.21 1 0.085 0.2 2.5e-16 0.011 -0.13 -2.1e-16 -2.8e-16 -1.1e-15 1.7e-19 -0.21
MDIMA 0.16 0.015 -0.035 0.2 0.085 1 0.088 9.3e-16 -0.2 -0.019 -7.2e-16 -2.8e-16 -8.1e-16 -2.7e-20 -0.007
NDIMB 0.015 0.16 -0.035 0.085 0.2 0.088 1 7.6e-17 -0.019 -0.2 -3.7e-16 -2.5e-16 -6.3e-16 -8.1e-20 -0.0087
KWI -4.8e-15 -2.3e-16 -7.2e-16 3.7e-16 2.5e-16 9.3e-16 7.6e-17 1 -8.6e-16 -1.3e-16 -5.8e-18 -9.1e-18 -1.2e-17 1.4e-19 0.033
VWM 0.35 -0.00084 -0.012 -0.13 0.011 -0.2 -0.019 -8.6e-16 1 0.0012 -1.9e-15 -1e-15 -2.2e-15 -6.4e-20 0.16
VWN -0.00084 0.35 -0.012 0.011 -0.13 -0.019 -0.2 -1.3e-16 0.0012 1 -6.2e-16 -4.7e-16 -1.5e-15 1.9e-19 0.14
STRM -6e-15 -1.9e-15 -6.9e-16 -6.5e-16 -2.1e-16 -7.2e-16 -3.7e-16 -5.8e-18 -1.9e-15 -6.2e-16 1 -6.4e-19 -4.9e-19 -1e-19 -0.013
STRN -3.7e-15 -1.5e-15 -1.1e-15 -6.4e-16 -2.8e-16 -2.8e-16 -2.5e-16 -9.1e-18 -1e-15 -4.7e-16 -6.4e-19 1 -4.1e-19 -1.4e-19 -0.00011
SA -6.7e-15 -4.6e-15 -3.1e-15 -1.1e-15 -1.1e-15 -8.1e-16 -6.3e-16 -1.2e-17 -2.2e-15 -1.5e-15 -4.9e-19 -4.1e-19 1 1.3e-19 0.052
SB -8.2e-20 5.7e-20 2.3e-19 -3.7e-21 1.7e-19 -2.7e-20 -8.1e-20 1.4e-19 -6.4e-20 1.9e-19 -1e-19 -1.4e-19 1.3e-19 1 0.064
Run (ms) 0.35 0.32 0.011 -0.22 -0.21 -0.007 -0.0087 0.033 0.16 0.14 -0.013 -0.00011 0.052 0.064 1
MWG NWG KWG MDIMC NDIMC MDIMA NDIMB KWI VWM VWN STRM STRN SA SB Run (ms)
1.0 0.8 0.6 0.4 0.2 0.0 −0.2

Matriz de correlación

- Representación de la correlación de cada atributo respecto al target



Escalado de los datos

- Creamos un dataset reducido con los atributos con una mayor correlación: **MWG, NWG, SA, VWN**

Valores:

	MWG	NWG	SA	VWN	Run (ms)
count	214833.000000	214833.000000	214833.000000	214833.000000	214833.000000
mean	75.688037	75.761619	0.486038	2.345156	114.554350
std	41.968313	41.997377	0.499806	1.862122	113.825481
min	16.000000	16.000000	0.000000	1.000000	13.317500
25%	32.000000	32.000000	0.000000	1.000000	39.095000
50%	64.000000	64.000000	0.000000	2.000000	61.790000
75%	128.000000	128.000000	1.000000	4.000000	157.892500
max	128.000000	128.000000	1.000000	8.000000	509.962500

Escalado de los datos

- Mediante el escalado de los datos, los dejamos todos en una escala parecida.

  Valores:

```
[[-1.42222005 -1.42298787 -0.97245519 -0.7223801   0.01595121]
 [-1.42222005 -1.42298787 -0.97245519 -0.7223801  -0.31495086]
 [-1.42222005 -1.42298787  1.02832501 -0.7223801  -0.29861002]
 ...
 [ 1.24646624  1.24385153 -0.97245519  0.8886892  -0.69751108]
 [ 1.24646624  1.24385153  1.02832501  0.8886892  -0.75643915]
 [ 1.24646624  1.24385153  1.02832501  0.8886892  -0.84987187]]
```

Modelos y búsqueda de hiperparámetros

Selección de modelos

- Para abordar la regresion haremos uso de los modelos:
  - Linear Regression
  - Decision Tree
  - SGD Regressor

Entrenamiento de modelos

- Rendimiento con las 4 mejores variables (correlación):
  - Score
  - MSE

- Variables: **MWG, NWG, SA, VWN**

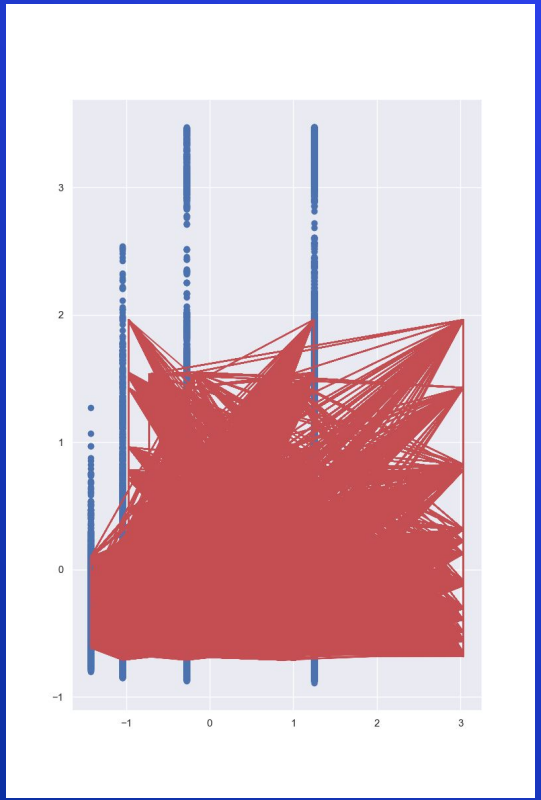
Entrenamiento de modelos - 4 mejores atributos

- Resultados:

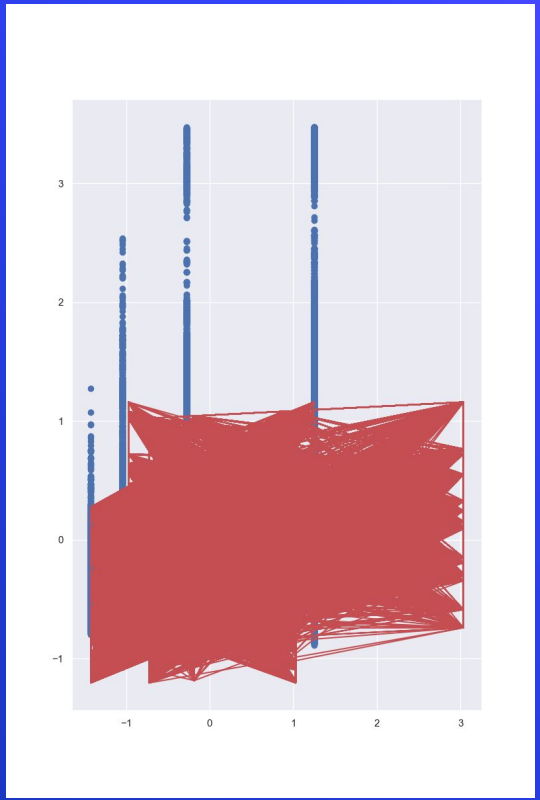
Modelo	Score	MSE
Linear Regression	0.272	0.724
Decision Tree	0.336	0.665
SGD Regressor	0.339	0.656

Predicciones de los modelos - 4 mejores atributos

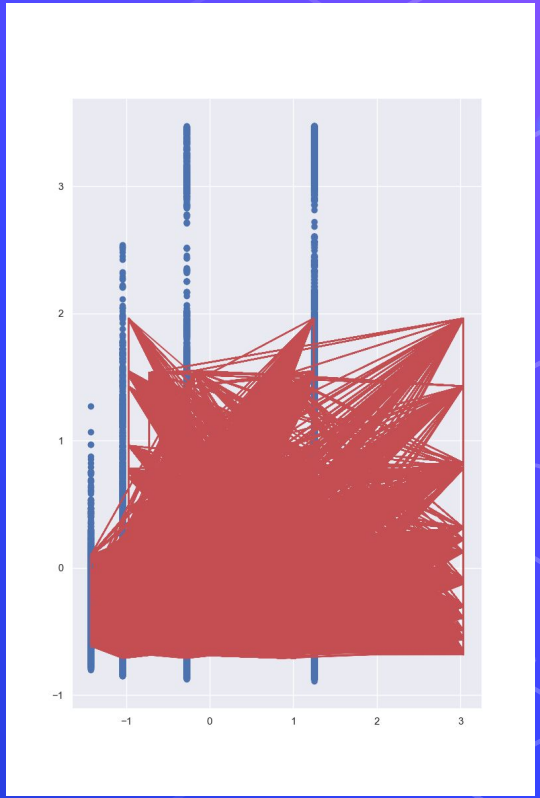
Decision Tree



Linear Regression



SGD Regressor



Entrenamiento de modelos - todos los atributos

- Resultados:

Modelo	Score	MSE
Linear Regression	0.469	0.530
Decision Tree	0.999	0.0006
SGD Regressor	0.467	0.531

Entrenamiento de modelos - todos los atributos

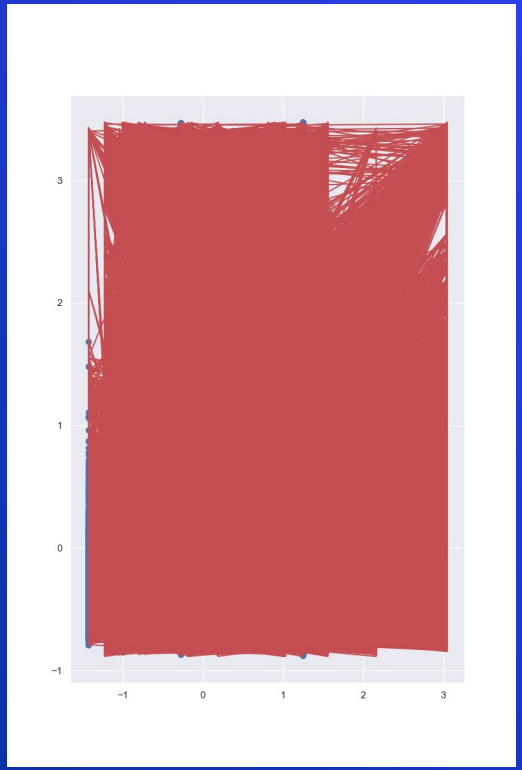
- Resultados:

OVERFITTING!

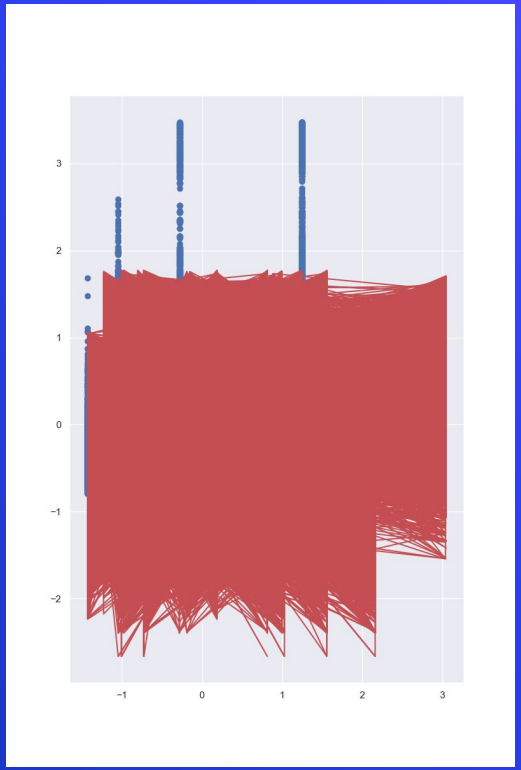
Modelo	Score	RMSE
Linear Regression	0.469	0.530
Decision Tree	0.999	0.0006
SGD Regressor	0.467	0.531

Predicciones de los modelos - todos los atributos

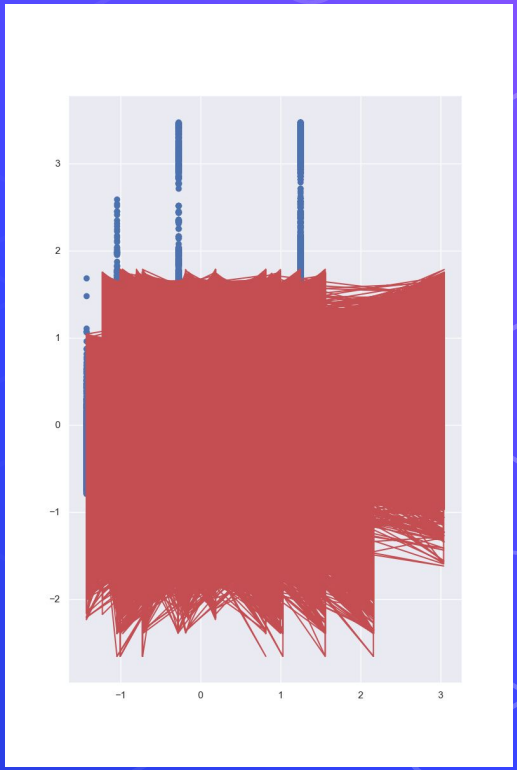
Decision Tree



Linear Regression



SGD Regressor

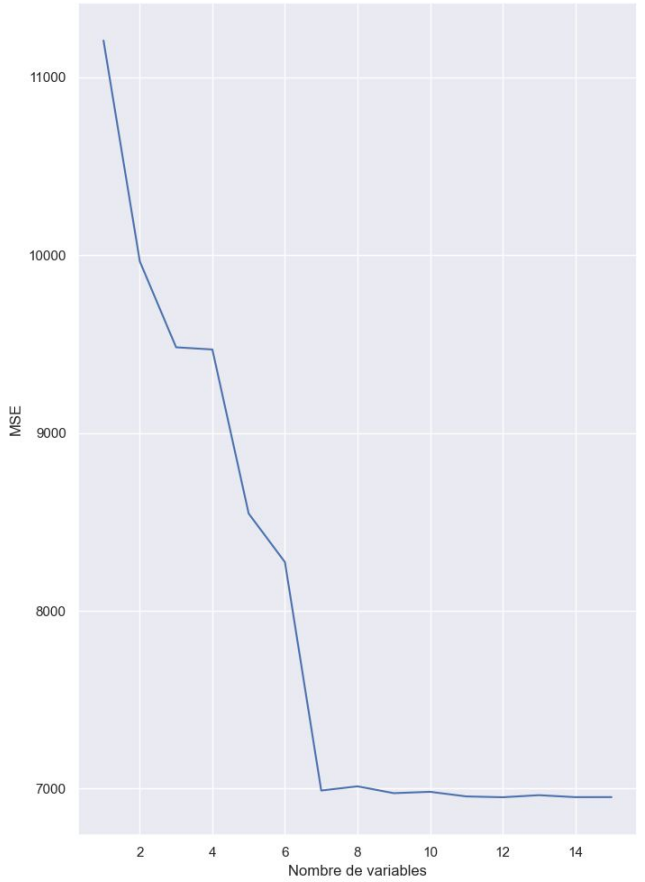


Entrenamiento de modelos - busqueda óptima de variables

- Minimizar el nº de variables → overfitting
- Minimizar MSE → mejores predicciones

Entrenamiento de modelos - busqueda óptima de variables

- Estancamiento MSE al utilizar mas de 7 variables



Entrenamiento de modelos - numero óptimo de variables

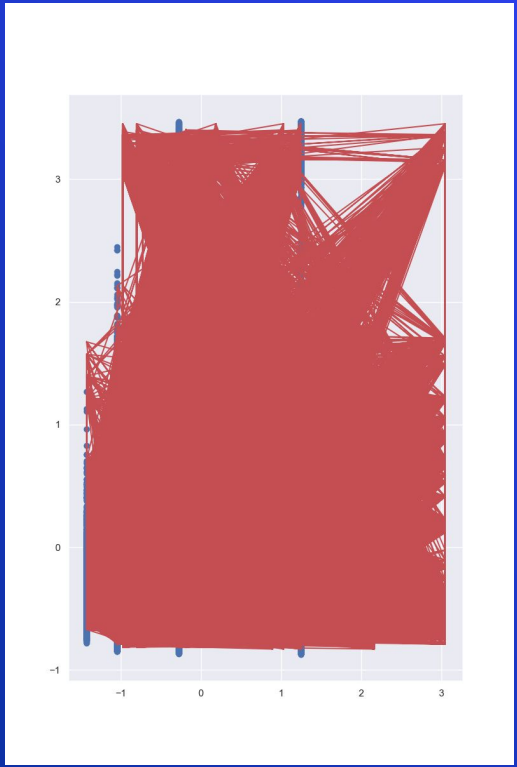
- Resultados:

Score alto con menor overfitting

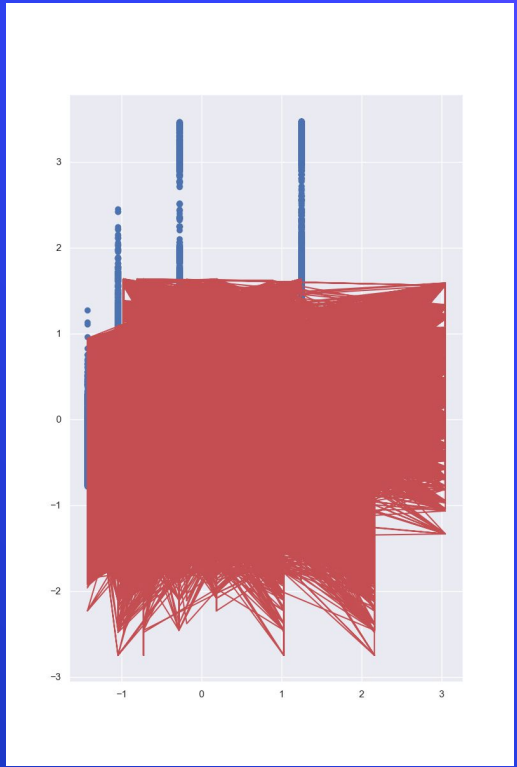
Modelo	Score	MSE
Linear Regression	0.457	0.537
Decision Tree	0.935	0.063
SGD Regressor	0.457	0.538

Predicciones de los modelos - n° optimo de atributos

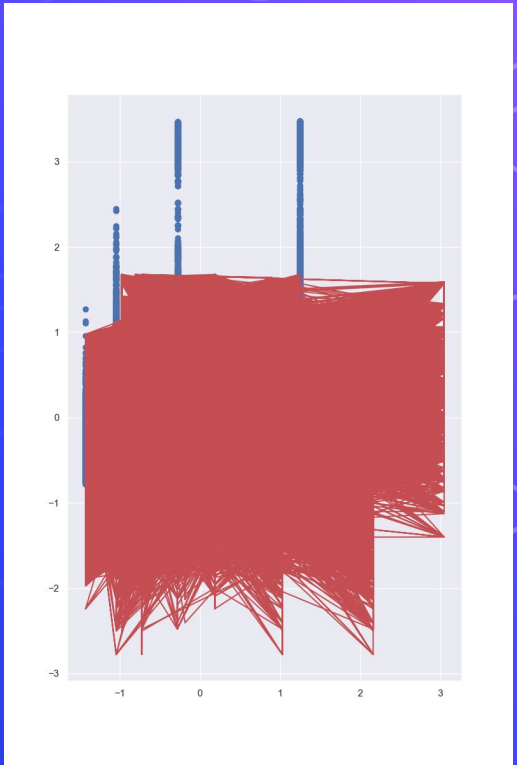
Decision Tree



Linear Regression

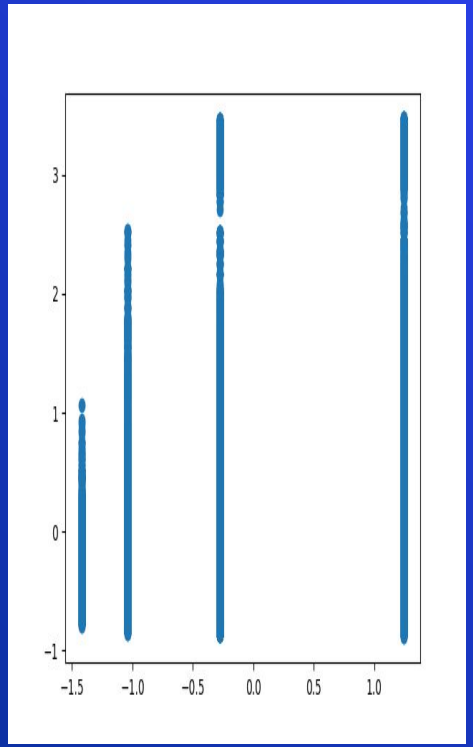


SGD Regressor

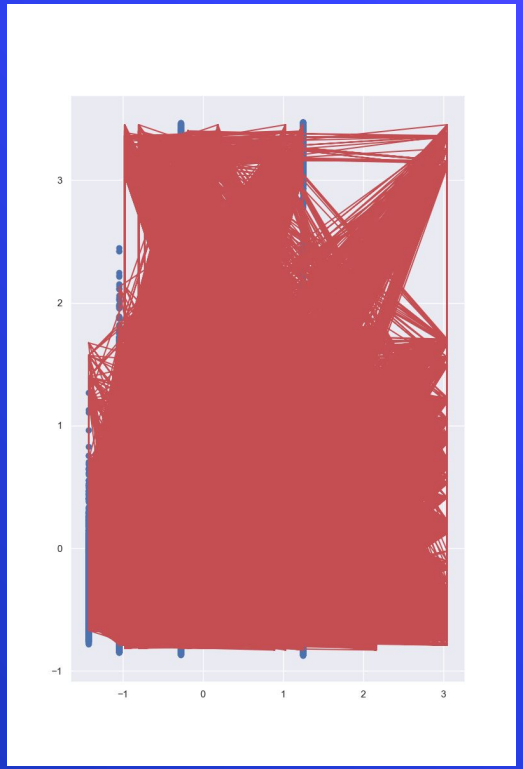


Modelos - Decision tree

Valores test



Predicción nº óptimo de variables



Predicción con todas las variables

Conclusiones