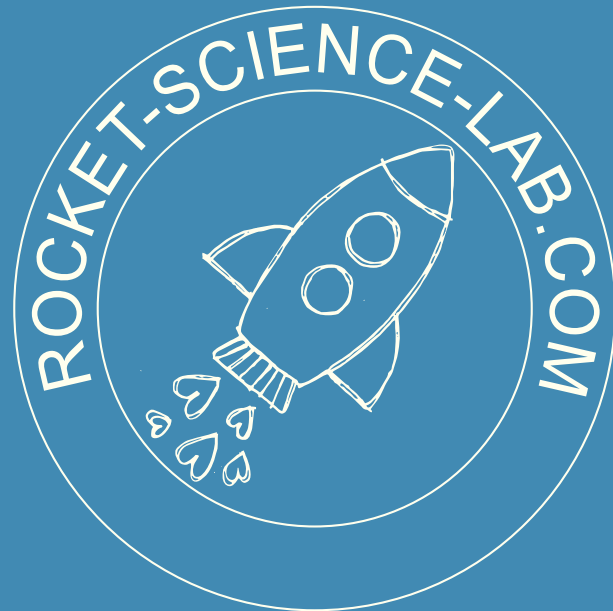

ROCKET-SCIENCE-LAB.COM

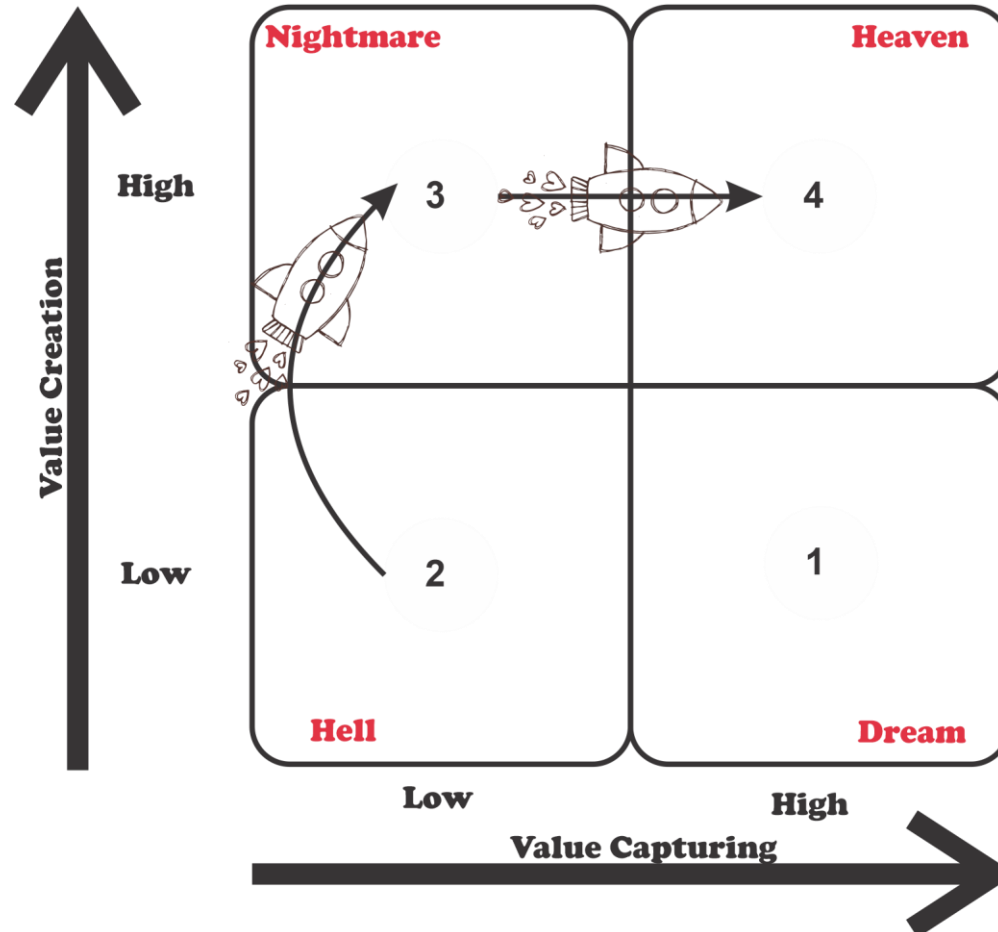
YOUR PARTNER IN DATA SCIENCE AND A.I.





CAPTURE VALUE FROM DATA SCIENCE AND MACHINE LEARNING

The objective of a sustainable business is to create value for the customer and assess how much of this value can be captured for the company





WHAT DO WE DO

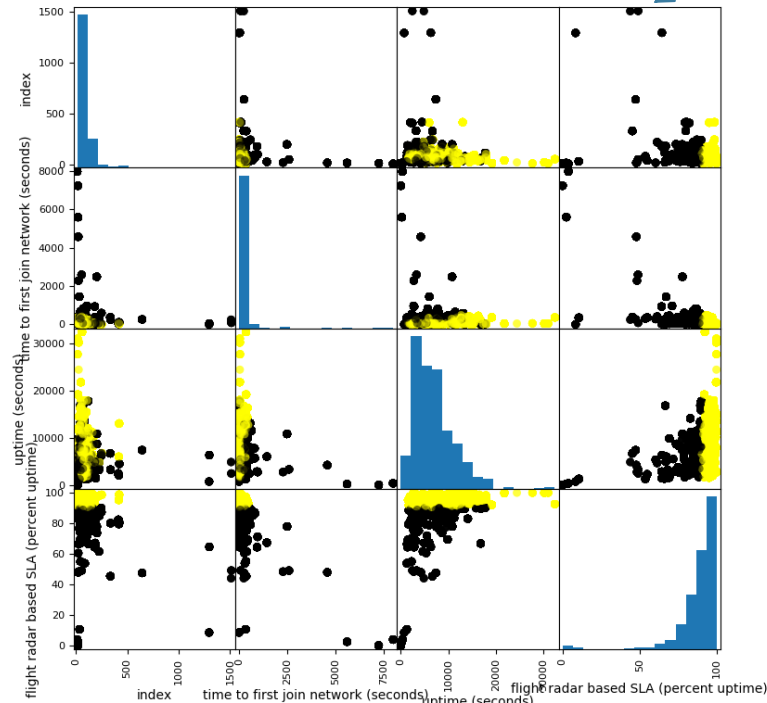
We share the risk of introducing datascience in your organization:

- Look together for Supervised Machine Learning (SML) Opportunities
- Organise, analyse, clean and visualize your data
- Write Supervised Machine Learning code
- Host or integrate the Machine Learning code
- Help to file funding/subsidies requests
- Train your people on Machine Learning
- Evangelize your organization **and your customer** on the benefits of SML
- Help you build a data science lab in your organization
- Create a digital twin of existing systems and processes

WHAT WE DO

Data science is an interdisciplinary field that uses scientific methods, processes, algorithms and systems to extract knowledge and meaningful insights from data in various forms, both structured and unstructured

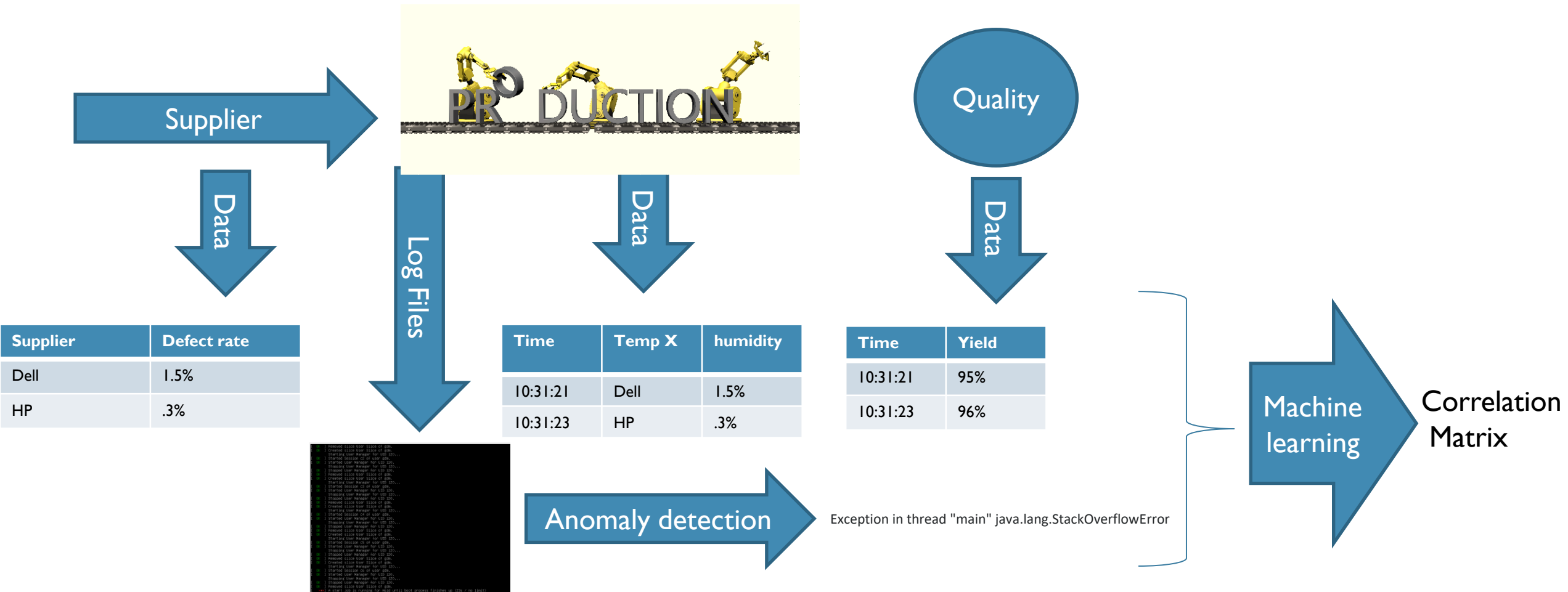
Organize, visualize, analyze data to come to meaningful insides



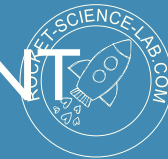
Machine learning

Supervised Machine learning

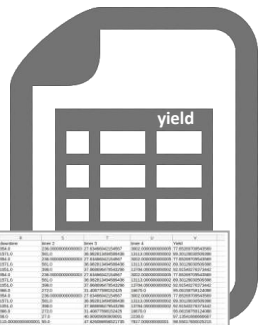
USE CASES , IMPROVING MANUFACTURING PROCESS



SCIENTIFIC APPROACH TO PRODUCTION PROCESS IMPROVEMENT INTRODUCING THE DIGITAL TWIN



Real life data



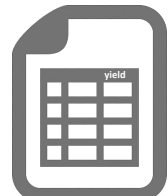
Sample	Temperature	Humidity	Light	CO2	Yield
1	23.5	65	1200	400	0.85
2	24.1	68	1150	380	0.82
3	23.8	66	1220	410	0.87
4	24.5	70	1180	390	0.84
5	23.2	64	1210	405	0.86
6	24.8	72	1160	375	0.81
7	23.6	67	1230	415	0.88
8	24.2	69	1190	385	0.83
9	23.9	66	1240	420	0.89
10	24.6	71	1170	370	0.80

Testdata

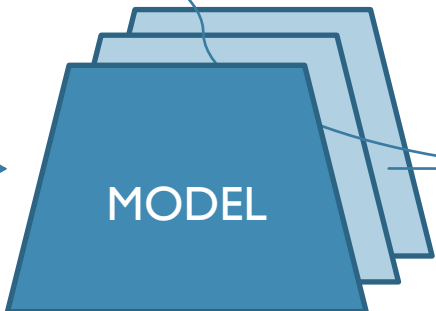


25%

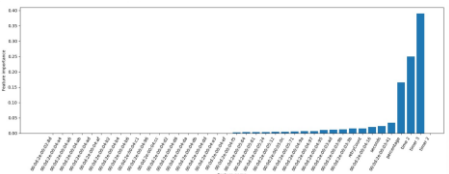
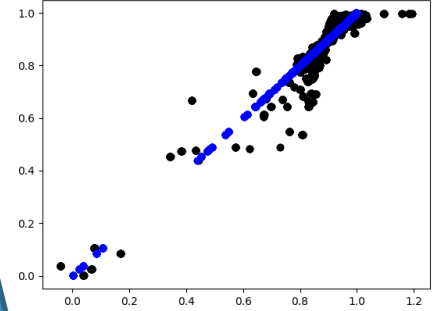
Trainingdata



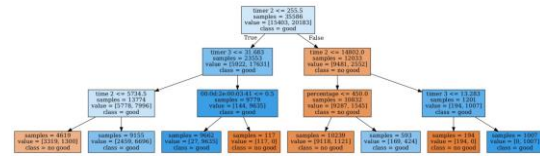
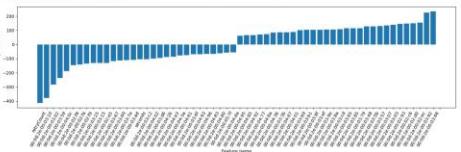
75%



Model applied on test data



Most significant parameters



Mean squared error (test data): 0.0023
 Variance score (test data): 0.8671
 Mean squared error (ALL data): 0.0023
 Variance score (ALL data): 0.8758



SCIENTIFIC BLACK BOX APPROACH



index	time	Uniqueld	percentage	time 2	downtime	timer 2	timer 3	timer 4	Yield	classification
2	44	27/04/2020 17:14 00:0d:2e:00:02:8d	150	3856,001	854	236	27,63466042	3002,0005	77,8526971	Bad
3	42	27/04/2020 22:36 00:0d:2e:00:02:8d	266,6666667	14684002	1571	581	36,98281349	13113002	89,30128031	Bad
4	44	27/04/2020 17:14 00:0d:2e:00:02:8d	150	3856,001	854	236,00003	27,63466042	3002,0005	77,8526971	Bad
5	42	27/04/2020 22:36 00:0d:2e:00:02:8d	266,6666667	14684002	1571	581	36,98281349	13113002	89,30128031	Bad
6	54	27/04/2020 20:48 00:0d:2e:00:02:8e	400	14835002	1051	398	37,86869648	13784002	92,91540276	Bad
7	44	27/04/2020 17:14 00:0d:2e:00:02:8d	150	3856,001	854	236,00003	27,63466042	3002,0005	77,8526971	Bad
8	42	27/04/2020 22:36 00:0d:2e:00:02:8d	266,6666667	14684002	1571	581	36,98281349	13113002	89,30128031	Bad
47493	1643	27/04/2020 21:47 00:0d:2e:00:06:05	100	3423	130	66	50,76923077	3293	96,20216185	Good
47494	1644	27/04/2020 17:44 00:0d:2e:00:06:06	14,28571429	8336	491,00006	29,000004	5,906313646	7845	94,10988484	Bad
47495	1645	27/04/2020 21:40 00:0d:2e:00:06:06	100	9951	45	16	35,55555556	9906	99,54778414	Good
47496	1646	28/04/2020 00:59 00:0d:2e:00:06:06	12,5	3937,001	216	92	42,59259259	3721,0005	94,51358903	Bad

Name	value
time	27/04/2020
UniquelD	00:0d:2e:00:02:8d
percentage	150
Time2	3856,0005
.....	
Timer 4	3002.0005

input



Production process

output

Name	value
Yield	77,8526
Classification	Bad



EXTERNAL DATABASES



Time	Temperature	Humidity	A	B	C	P	Q	R	S	T	U	V	W
index	time	Uniqueld	percentage	time 2	downtime	timer 2	timer 3	timer 4	Yield	classification			
27/04/2020 17:14	12.79	90.05	1	44	27/04/2020 17:14 00:0d:2e:00:02:8d	150	3856,001	854	236	27,63466042	3002,0005	77,8526971	Bad
27/04/2020 22:36	12.86	89.97	2	42	27/04/2020 22:36 00:0d:2e:00:02:8d	266,6666667	14684002	1571	581	36,98281349	13113002	89,30128031	Bad
27/04/2020 17:14	12.11	90.14	3	44	27/04/2020 17:14 00:0d:2e:00:02:8d	150	3856,001	854	236,00003	27,63466042	3002,0005	77,8526971	Bad
27/04/2020 22:36	12.68	90.11	4	42	27/04/2020 22:36 00:0d:2e:00:02:8d	266,6666667	14684002	1571	581	36,98281349	13113002	89,30128031	Bad
27/04/2020 20:48	12.5	90.02	5	54	27/04/2020 20:48 00:0d:2e:00:02:8e	400	14835002	1051	398	37,86869648	13784002	92,91540276	Bad
27/04/2020 17:14	12	90.02	6	44	27/04/2020 17:14 00:0d:2e:00:02:8d	150	3856,001	854	236,00003	27,63466042	3002,0005	77,8526971	Bad
27/04/2020 22:36	12.36	90.32	7	42	27/04/2020 22:36 00:0d:2e:00:02:8d	266,6666667	14684002	1571	581	36,98281349	13113002	89,30128031	Bad
27/04/2020 20:48	12.1	90.02	8	44	27/04/2020 20:48 00:0d:2e:00:02:8e	400	14835002	1051	398	37,86869648	13784002	92,91540276	Bad
27/04/2020 19:43	12.61	90.29											
27/04/2020 17:14	12.32	90.2											
47493	1643	27/04/2020 21:47 00:0d:2e:00:06:05	100	3423	130	66	50,76923077	3293	96,20216185	Good			
47494	1644	27/04/2020 17:44 00:0d:2e:00:06:06	14,28571429	8336	491,00006	29,000004	5,906313646	7845	94,10988484	Bad			
47495	1645	27/04/2020 21:40 00:0d:2e:00:06:06	100	9951	45	16	35,55555556	9906	99,54778414	Good			
47496	1646	28/04/2020 00:59 00:0d:2e:00:06:06	12,5	3937,001	216	92	42,59259259	3721,0005	94,51358903	Bad			

Name	value
time	27/04/2020
UniquelD	00:0d:2e:00:02:8d
percentage	150
.....	
Timer 4	3002.0005
Outside temp	12.79
Humidity	90.05

input



output

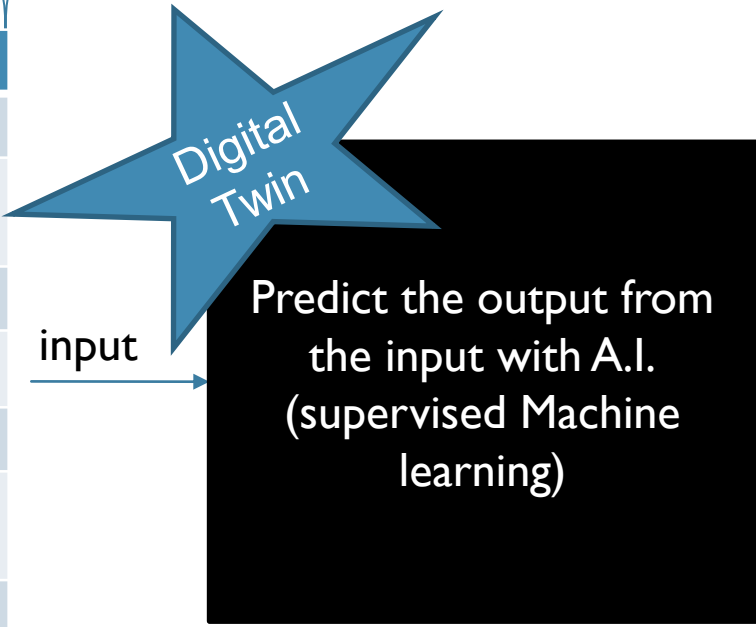
Name	value
Yield	77,8526
Classification	Bad



CREATING PREDICTIONS, EMULATING THE PRODUCTION PROCESS

Time	Temperature	Humidity	A	B	C	P	Q	R	S	T	U	V	W	
index	time	Uniqueld	percentage	time 2	downtime	timer 2	timer 3	timer 4	Yield	classification				
1	27/04/2020 17:14	12.79	90.05	44	27/04/2020 17:14	00:0d:2e:00:02:8d	150	3856,001	854	236	27,63466042	3002,0005	77,8526971	Bad
2	27/04/2020 22:36	12.86	89.97	42	27/04/2020 22:36	00:0d:2e:00:02:8d	266,6666667	14684002	1571	581	36,98281349	13113002	89,30128031	Bad
3	27/04/2020 17:14	12.11	90.14	44	27/04/2020 17:14	00:0d:2e:00:02:8d	150	3856,001	854	236,00003	27,63466042	3002,0005	77,8526971	Bad
4	27/04/2020 22:36	12.68	90.11	42	27/04/2020 22:36	00:0d:2e:00:02:8d	266,6666667	14684002	1571	581	36,98281349	13113002	89,30128031	Bad
5	27/04/2020 20:48	12.5	90.02	54	27/04/2020 20:48	00:0d:2e:00:02:8e	400	14835002	1051	398	37,86869648	13784002	92,91540276	Bad
6	27/04/2020 17:14	12	90.02	44	27/04/2020 17:14	00:0d:2e:00:02:8d	150	3856,001	854	236,00003	27,63466042	3002,0005	77,8526971	Bad
7	27/04/2020 22:36	12.36	90.32	42	27/04/2020 22:36	00:0d:2e:00:02:8d	266,6666667	14684002	1571	581	36,98281349	13113002	89,30128031	Bad
8	27/04/2020 20:48	12.1	90.02	44	27/04/2020 20:48	00:0d:2e:00:02:8e	400	14835002	1051	398	37,86869648	13784002	92,91540276	Bad
9	27/04/2020 20:48	12.1	90.02	44	27/04/2020 20:48	00:0d:2e:00:02:8e	400	14835002	1051	398	37,86869648	13784002	92,91540276	Bad
10	27/04/2020 19:43	12.61	90.29	42	27/04/2020 22:36	00:0d:2e:00:02:8d	266,6666667	14684002	1571	581	36,98281349	13113002	89,30128031	Bad
11	27/04/2020 17:14	12.32	90.2	42	27/04/2020 22:36	00:0d:2e:00:02:8d	266,6666667	14684002	1571	581	36,98281349	13113002	89,30128031	Bad
12	27/04/2020 21:47	1643	27/04/2020 21:47	00:0d:2e:00:06:05	100	3423	130	66	50,76923077	3293	96,20216185	Good		
13	27/04/2020 17:44	1644	27/04/2020 17:44	00:0d:2e:00:06:06	14,28571429	8336	491,00006	29,000004	5,906313646	7845	94,10988484	Bad		
14	27/04/2020 21:40	1645	27/04/2020 21:40	00:0d:2e:00:06:06	100	9951	45	16	35,55555556	9906	99,54778414	Good		
15	28/04/2020 00:59	1646	28/04/2020 00:59	00:0d:2e:00:06:06	12,5	3937,001	216	92	42,59259259	3721,0005	94,51358903	Bad		

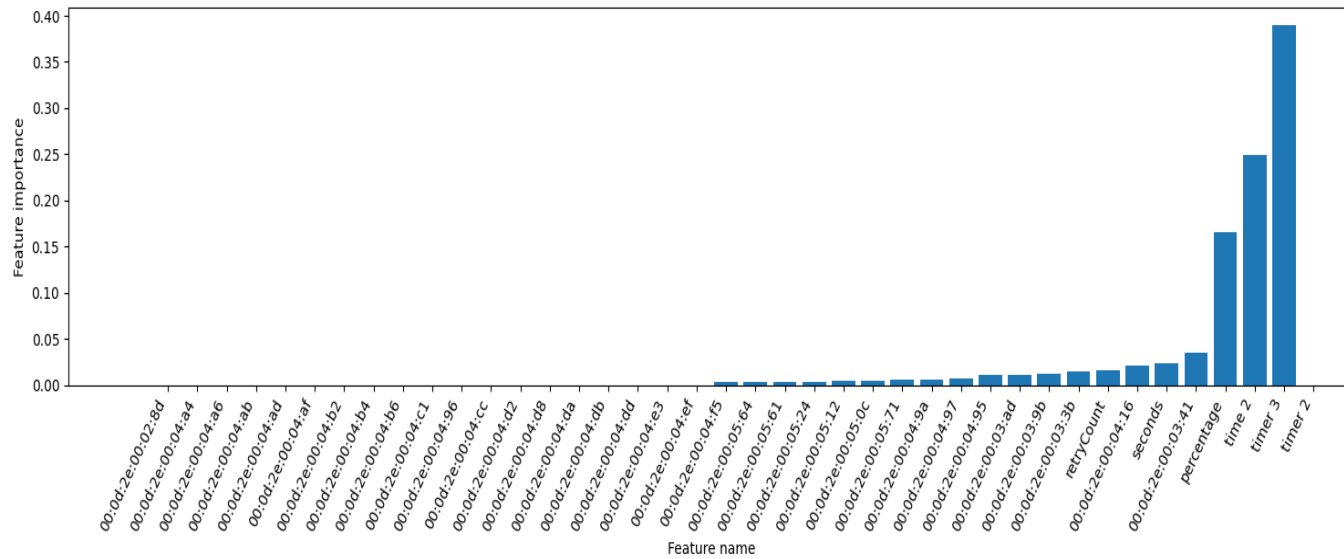
Name	value
time	27/04/2020
UniquelD	00:0d:2e:00:02:8d
percentage	150
.....	
Timer 4	3002.0005
Outside temp	12.79
Humidity	90.05



ACTUAL	
Name	value
Yield	77.8526
Classification	Bad

PREDICTED	
Name	value
Yield	75,34
Classification	Bad

MEASURE QUALITY OF PREDICTION AND LIST INFLUENCING PARAMETERS



		Actual	
		FALSE	TRUE
Prediction	FALSE	4980	
	TRUE		6882

```

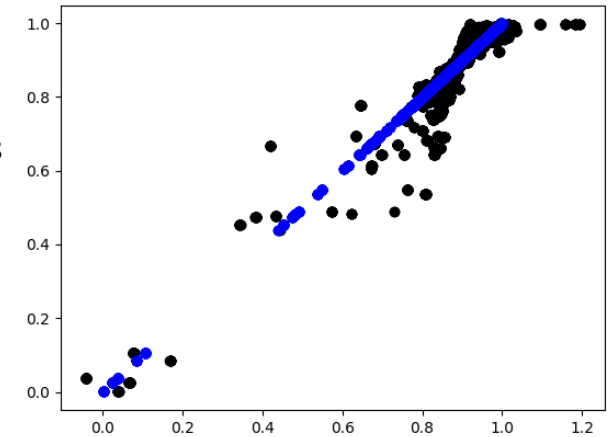
Accuracy of Decision Tree classifier (default depth) on training set: 1.0000
Accuracy of Decision Tree classifier (default depth) on test set: 1.0000
confusion matrix max depth default test set)
=====
[['True Negative', 'False Positive'], ['False Negative', 'True positive']]
[[4980  0]
 [  0 6882]]
    
```

Results from

- Decision tree
- Random Forest
- Support Vector Machines
- Linear regression
- Ridge regression

Quality check

- Mean Square Error
- Variance
- Confusion Matrix



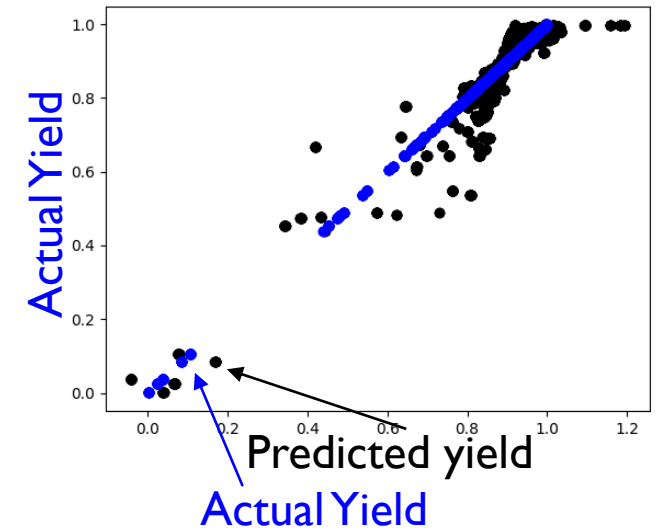
THE QUALITY OF THE PREDICTION

ACTUAL		PREDICTED	
Name	value	Name	value
Yield	77,8526	Yield	75,34
Classification	Bad	Classification	Bad

Classification

Regression

confusion Matrix			
		Actual	
		FALSE	TRUE
Prediction	FALSE	4980	
	TRUE		6882



```

Accuracy of Decision Tree classifier (default depth) on training set: 1.0000
Accuracy of Decision Tree classifier (default depth) on test set: 1.0000
confusion matrix max depth default test set)
=====
[['True Negative', 'False Positive'], ['False Negative', 'True positive']]
[[4980  0]
 [ 0 6882]]
    
```

```

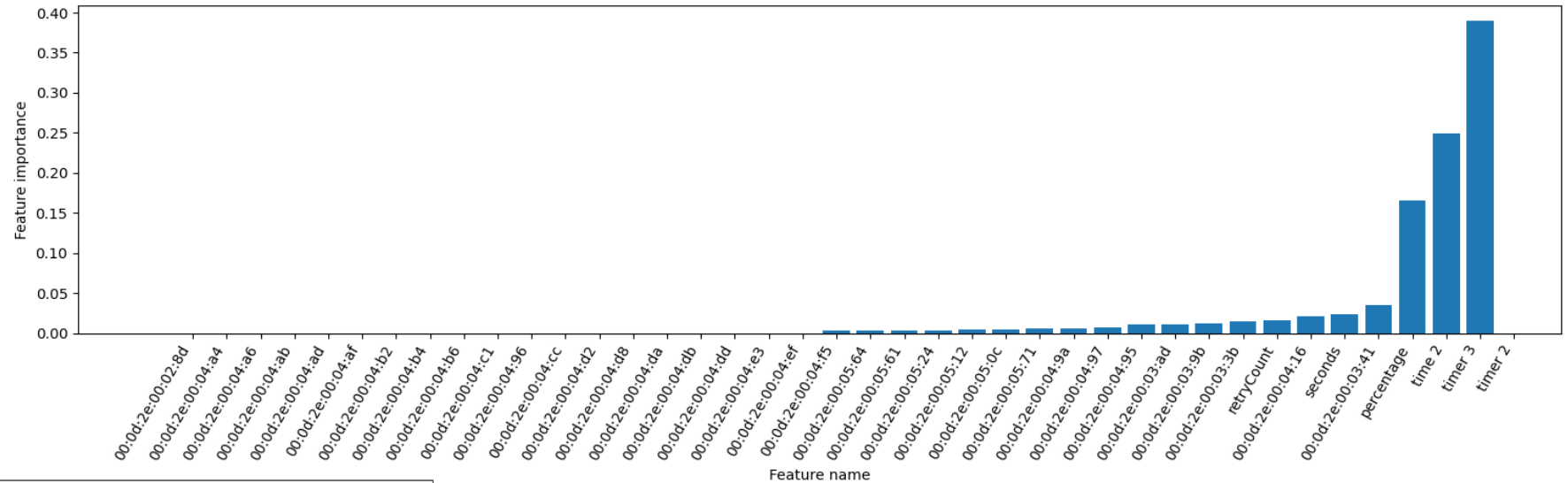
Mean squared error (test data): 0.0023
Variance score (test data): 0.8671
Mean squared error (ALL data): 0.0023
Variance score (ALL data): 0.8758
    
```



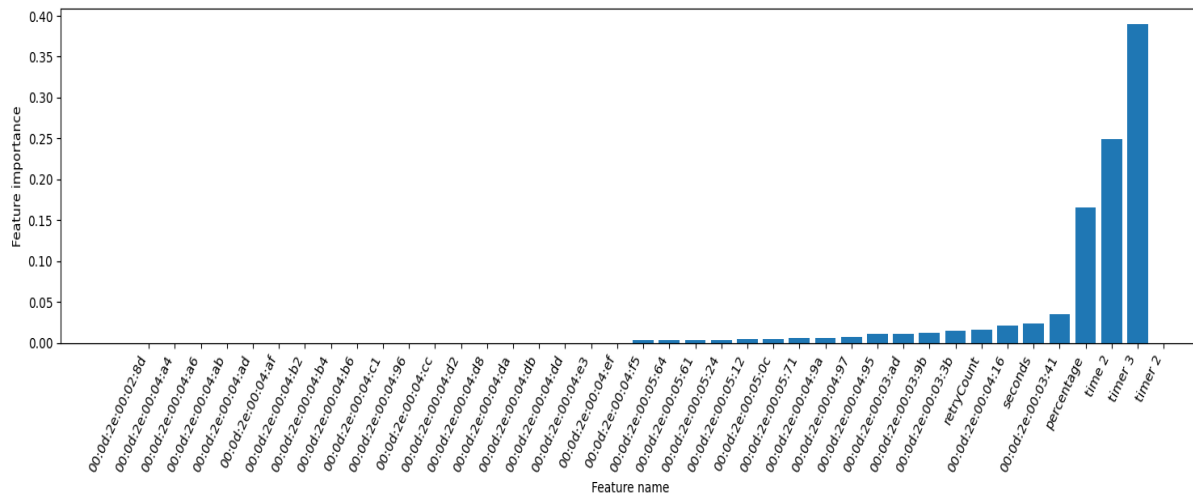
EXPLAIN INFLUENCING PARAMETERS

Linear regression

	coefficient	Feature
0	-1.652625e-04	index
1	-1.157239e-03	retryCount
2	8.856094e-04	seconds
3	-3.485107e-05	chainID.1
4	7.286574e-07	percentage
5	-2.219565e-05	time 2
6	-5.406556e-05	downtime
7	-3.439236e-05	timer 2
8	2.882047e-07	timer 3
9	3.186991e-05	timer 4
10	-1.166170e-04	BeamsEncoded
11	4.485582e-06	MACEncoded



Random forest classification

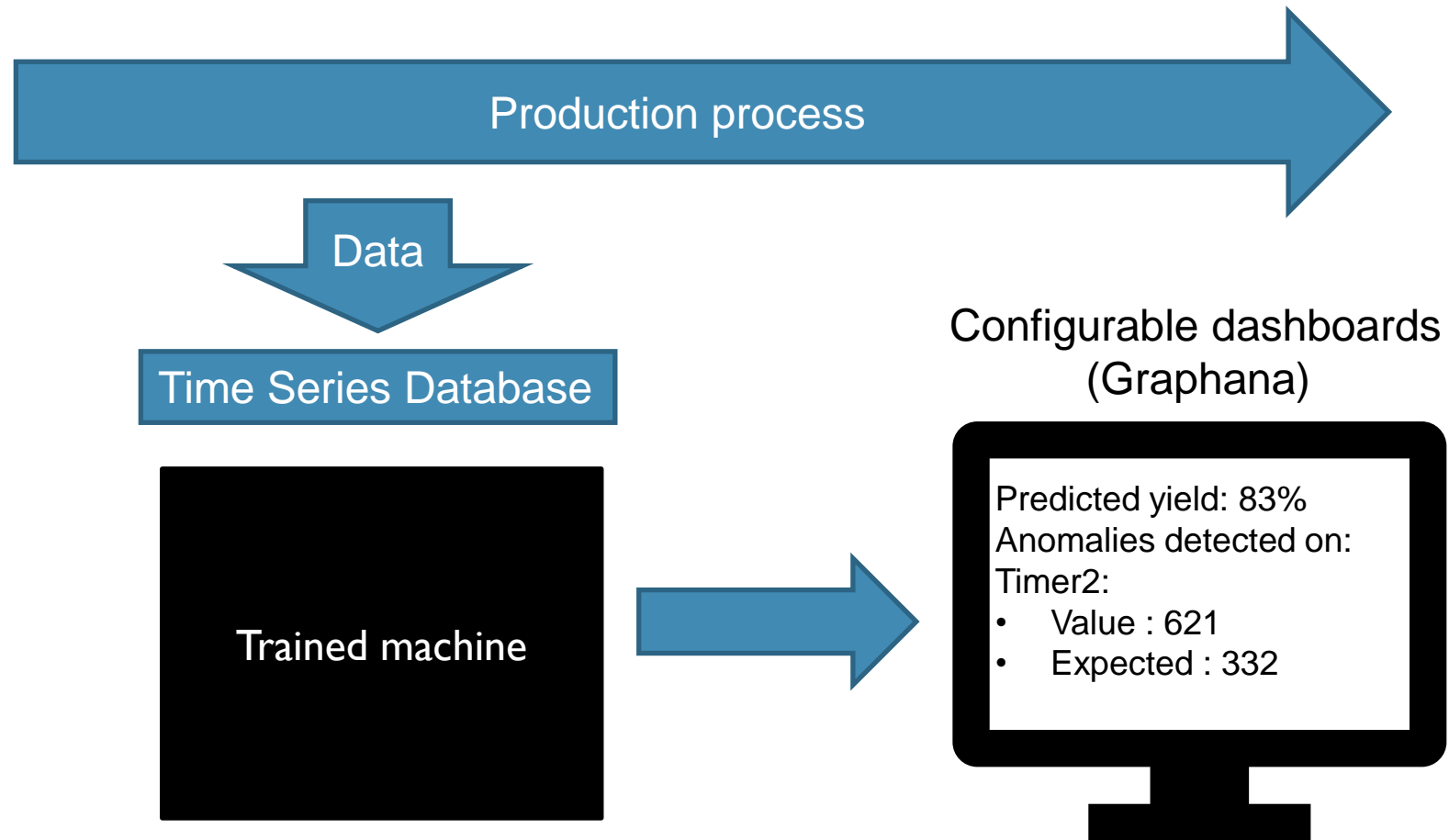


Decision tree





RUN EMULATION NEXT TO REAL OPERATIONS



USE EMULATOR TO EXPERIMENT WITH PARAMETERS

Name	value
time	27/04/2020
UniquelD	00:0d:2e:00:02:8d
percentage	150
.....	
Timer 4	3002.0005
Outside temp	12.79
Humidity	90.05

Name	value
time	27/04/2020
UniquelD	00:0d:2e:00:02:8d
percentage	150
.....	
Timer 4	300
Outside temp	12.79
Humidity	90.05



input

Predict the output from the input with A.I. (supervised Machine learning)

output

PREDICTED	
Name	value
Yield	75,34
Classification	Bad

PREDICTED	
Name	value
Yield	85.32
Classification	Bad

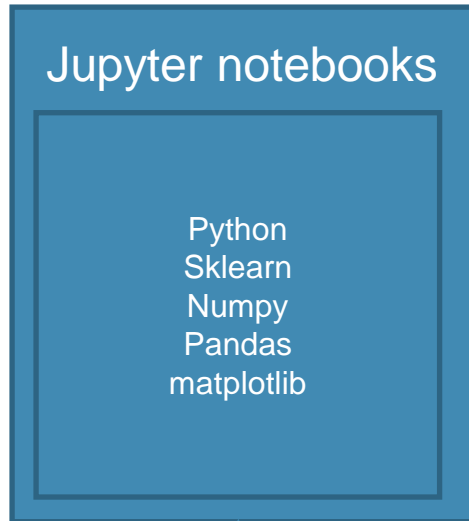


TECHNOLOGY PLATFORM (SOFTWARE AS A SERVICE)

Data input



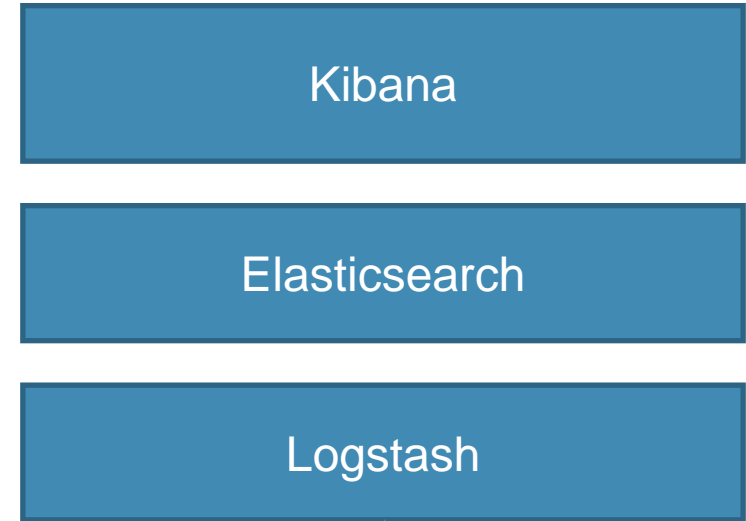
Data analysis



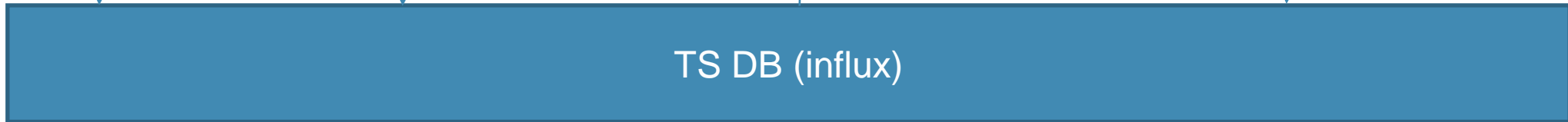
Data visualization



Log analysis



TS DB (influx)



ROCKET-SCIENCE-LAB.COM

YOUR PARTNER IN DATA SCIENCE AND A.I.

<http://www.rocket-science-lab.com>

info@rocket-science-lab.com

Amerikalei 130

2000 Antwerpen

Belgium

+32 476 63 58 76

