



1



2

Taller práctico con herramientas para mejorar la confiabilidad de tu planta

La Sesión Toolbox es un taller donde aprenderás conocimientos prácticos y útiles que te servirán en tu trabajo en planta, aquí el ponente explica el objetivo de la herramienta a aprender y facilita el modelo de aprendizaje mediante ejemplos y ejercicios.

Adicional proporciona herramientas, formatos, hojas de cálculo y consejos, para que adquieras las competencias que mejorarán tu desempeño en el día a día.



Detección Autónoma y Temprana de Fallas: Una Solución Predictiva en Base a Inteligencia Artificial

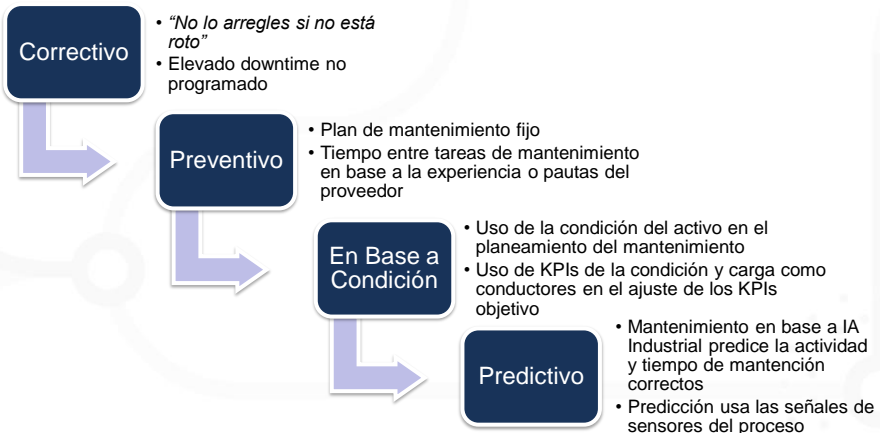
Enrique López Droguett

Profesor Titular – Department of Civil & Environmental Engineering, University of California, Los Angeles (UCLA)

Profesor Titular – Departamento de Ingeniería Mecánica, Universidad de Chile

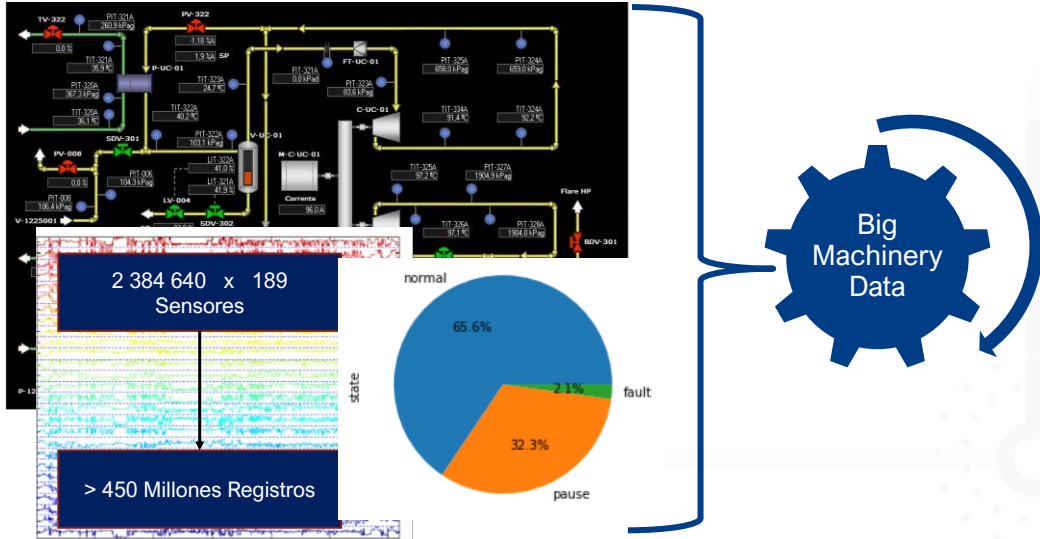
3

El Camino Hacia el Mantenimiento Predictivo



4

Big Machinery Data:



5

Planta de Recuperación de Gases de Hidrocarburos

SCADA Data:

Time	P74_P12-1225322A	P74_P12-1225322A	P74_P2-1225321A	P74_P12-1225323B	P74_P12-1225321A	P74_P12-1225322A	P74_P12-1225323A	P74_P12-1225321A	P74_P12-1225323A	...	P74_P12-1225309A-Y	P74_P12-1225309A	P74_P01-1225311A	P74_P01-1225309A	P74_P01-1225001B
0 2019-05-15 14:00:00	95.833038	41.875732	29592.986328	28.496231	31.000000	31.308243	88.832901	616.877563	31.754730	...	8.860001	277.799927	NaN	NaN	NaN
1 2019-05-15 14:00:15	96.658127	41.875732	29652.853516	28.499142	31.393205	31.956072	89.434567	617.388550	31.754730	...	8.860001	277.799927	NaN	NaN	NaN
2 2019-05-15 14:00:30	97.429520	41.875732	29709.990234	28.499142	31.393205	31.956072	89.434567	617.388550	31.754730	...	8.860001	277.799927	NaN	NaN	NaN
3 2019-05-15 14:00:45	96.560219	41.875732	29651.580078	28.499142	31.393205	31.956072	89.434567	617.388550	31.754730	...	8.860001	277.799927	NaN	NaN	NaN
4 2019-05-15 14:01:00	97.439282	41.875732	29738.400391	28.499142	31.393205	31.956072	89.434567	617.388550	31.754730	...	8.860001	278.200073	NaN	NaN	NaN
...
1000912 2019-12-30 10:22:45	111.616844	42.281544	0.000000	29.777554	34.111254	33.300499	66.124771	594.327087	37.584270	...	8.560000	295.799927	NaN	NaN	NaN
1000913 2019-12-30 10:23:00	112.080978	42.383545	0.000000	29.882183	33.947151	33.000000	66.501305	594.532164	37.809132	...	8.560000	295.799927	NaN	NaN	NaN
1000914 2019-12-30 10:23:15	113.051933	42.833439	0.000000	30.347029	33.389408	32.303215	66.353065	598.892090	38.635493	...	8.560000	295.799927	NaN	NaN	NaN
1000915 2019-12-30 10:23:30	124.350006	43.593155	0.000000	30.902191	32.675262	32.000000	124.350006	802.238159	39.743164	...	8.560000	295.799927	NaN	NaN	NaN

- Sensores: 188
- Registros > 450 millones
- Tasa de Muestreo: 15 seg
- Periodo: 1 año

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Planta de Recuperación de Gases de Hidrocarburos

Registros Detenciones:

	Start	Finish	LABEL	OBS 1
0	2019-02-07 21:50:00	2019-02-08 04:31:00	Normal Stop	Gen_Stand-by
1	2019-02-08 14:03:00	2019-02-09 17:05:00	Normal Stop	Gen_Stand-by
2	2019-02-16 05:45:00	2019-02-16 13:59:00	Normal Stop	Gen_Stand-by
3	2019-03-01 10:00:00	2019-03-01 10:00:00	External Cause	External
4	2019-03-01 10:00:00	2019-03-01 10:00:00	External Cause	External
...				...
122	2019-12-24 19:50:00	2019-12-25 08:22:00	Unknown Cause	Gen_Failure
123	2019-12-24 19:50:00	2019-12-25 08:22:00	Unknown Cause	Gen_Failure
124	2019-12-25 09:13:00	2019-12-25 09:51:00	Unknown Cause	Gen_Failure
125	2019-12-25 10:59:00	2019-12-25 13:29:00	Unknown Cause	Gen_Failure
126	2019-12-25 15:07:00	2019-12-30 10:24:00	External Cause	Gen_External

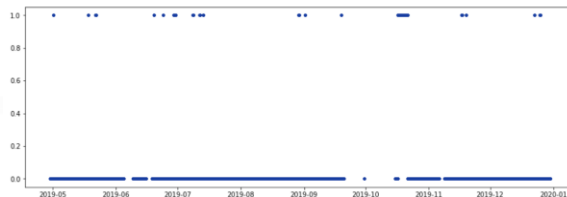
• Detenciones: 127
 • Distintas causas
 • Sincronizar data SCADA con registros detenciones

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Planta de Recuperación de Gases de Hidrocarburos

	value counts	normalized value counts
External Cause	90	0.708661
Normal Stop	13	0.102362
Scrubber High Level	6	0.047244
Instrument Failure	6	0.047244
Electrical Failure	4	0.031496
Unknown Cause	4	0.031496
Mecanical Failure	3	0.023622
High Suction Pressure	1	0.007874

	value counts	normalized value counts
0	1115196	0.967404
1	37576	0.032596



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El Desafío: Inteligencia Artificial y Big Data



Empresas que sigan ignorando la IA o descuiden su integración en sus organizaciones dejarán de ser competitivas

Se ahogarán en datos y complejidad

El mundo se basa cada vez más en datos

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IA y Big Data en Confiabilidad y Mantenimiento Predictiva



Desarrollar modelos predictivos para maximizar la vida de activos, eficiencia operacional o uptime

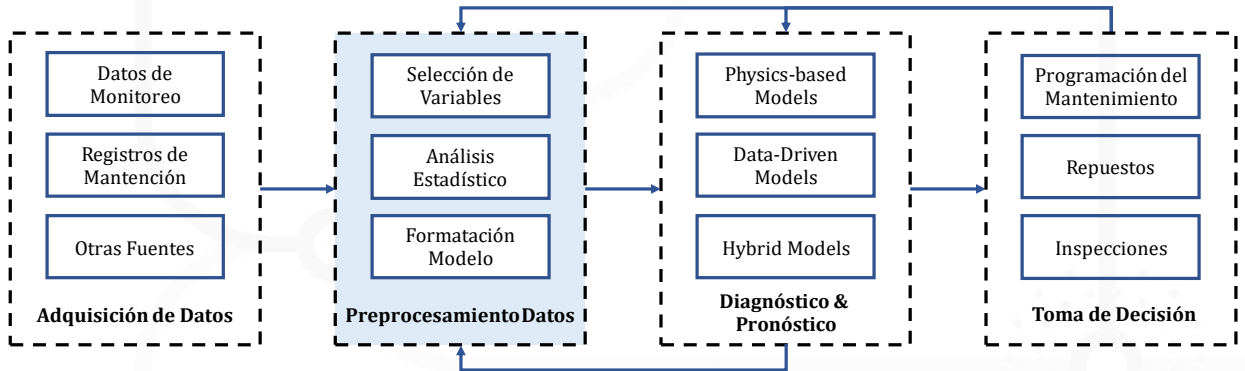
Aprovechar datos pasados y continuos

Optimizar las acciones de mantenimiento periódico

Evitar o minimizar los tiempos de inactividad. Esto ayudará a evitar clientes insatisfechos y bajar costos

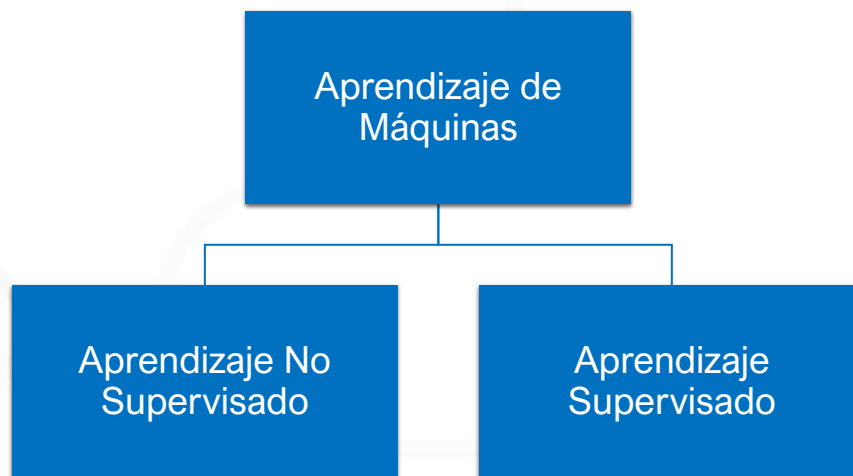
10

IA y Big Data en Confiabilidad y Mantenimiento Predictiva



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Tipos de Aprendizaje de Máquinas



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Aprendizaje No Supervisado

Data de Monitoreo: sensores, imágenes, tribología, informes ...

	Time	P74_P1Z-1225322A	P74_T1Z-1225322A	P74_P5-1225321A	P74_T1Z-1225323A	P74_L1Z-1225321A	P74_L1Z-1225322A	P74_P1Z-1225323A	P74_P1Z-1225331A	P74_P1Z-1225329A	...	P74_PT-1225309A-Y	P74_PT-1225304A	P74_BDI-1225311A	P74_SDI-1225305A
0	2019-05-15 16:00:00	95.833030	41.875732	29592.986320	28.496231	31.000000	31.308243	88.822901	616.877563	31.754730	...	0.860001	277.799927	NaN	NaN
1	2019-05-15 16:00:15	96.658127	41.875732	29652.853516	28.699142	31.393305	31.956072	89.634567	617.388550	31.754730	...	0.860001	277.799927	NaN	NaN
2	2019-05-15 16:00:30	97.429520	41.875732	29709.990234	28.699142	32.000000	32.232456	90.324455	616.597107	31.754730	...	0.860001	277.799927	NaN	NaN
3	2019-05-15 16:00:45	96.560219	41.875732	29651.580078	28.699142	31.602581	32.261463	89.555397	617.476562	31.754730	...	0.860001	277.799927	NaN	NaN
4	2019-05-15 16:01:00	97.639282	41.875732	29738.400391	28.518536	31.896614	32.698605	90.579659	616.315552	31.754730	...	0.860001	278.200073	NaN	NaN
...
1000912	2019-12-30 10:22:45	111.616844	42.281544	0.000000	29.777554	34.111256	33.300499	64.124771	594.327087	37.584270	...	0.560000	295.799927	NaN	NaN
1000913	2019-12-30 10:23:00	112.080978	42.383545	0.000000	29.882183	33.947151	33.000000	64.501305	594.532164	37.809132	...	0.560000	295.799927	NaN	NaN
1000914	2019-12-30 10:23:15	113.051933	42.833439	0.000000	30.347029	33.389408	32.303215	64.353065	598.892090	38.435693	...	0.560000	295.799927	NaN	NaN
1000915	2019-12-30 10:23:30	124.350006	43.593155	0.000000	30.982191	32.675262	32.000000	124.350006	802.238159	39.743164	...	0.560000	295.799927	NaN	NaN

Estado Salud

Normal

Degradado

?

Crítico

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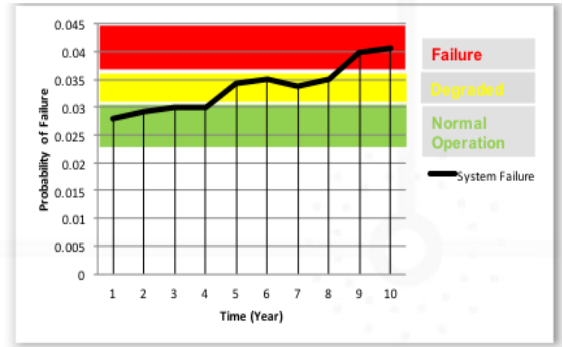
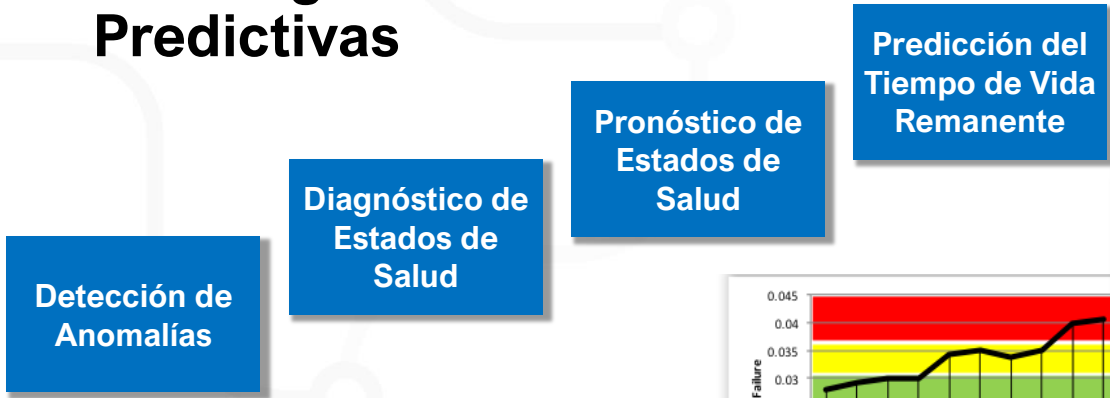
Aprendizaje Supervisado

	rms	peak	peak-peak	crest	median	var	skewness	kurtosis	band_0	band_1	band_2	band_3	band_4	band_5	band_6	band_7	Estado Salud
0	0.008641	0.028054	0.113452	3.246508	-0.000770	0.000074	-0.936986	7.808622	0.000443	0.000087	0.000088	0.000072	0.000072	0.000071	0.000072	0.000070	Normal
1	0.011839	0.061926	0.122331	5.230773	0.002927	0.000132	0.099689	3.414683	0.000588	0.000057	0.000065	0.000042	0.000040	0.000038	0.000041	0.000039	Daño Pista Externa
2	0.007119	0.025424	0.084843	3.571287	-0.000669	0.000050	-0.408117	2.440640	0.000352	0.000055	0.000054	0.000046	0.000046	0.000043	0.000045	0.000045	Daño Pista Externa
3	0.008695	0.029699	0.070373	3.415453	0.002095	0.000071	0.023378	0.011527	0.000423	0.000059	0.000065	0.000040	0.000037	0.000035	0.000036	0.000036	Daño Pista Externa
4	0.033719	0.178666	0.307143	5.298701	0.000155	0.001137	0.190877	1.586085	0.001905	0.000158	0.000320	0.000088	0.000055	0.000053	0.000054	0.000052	Daño Pista Interna
...
1791	0.011743	0.045812	0.102929	3.901169	0.002555	0.000131	-0.590345	2.556906	0.000589	0.000063	0.000065	0.000035	0.000034	0.000033	0.000034	0.000033	Daño Pista Externa
1792	0.009386	0.029041	0.090762	3.094046	-0.000887	0.000087	-0.167848	0.910860	0.000510	0.000070	0.000089	0.000058	0.000054	0.000053	0.000054	0.000054	Normal
1793	0.005654	0.017531	0.064454	3.100641	-0.000967	0.000031	-0.486815	2.291622	0.000267	0.000046	0.000043	0.000034	0.000037	0.000034	0.000035	0.000036	Normal
1794	0.036331	0.229967	0.449063	6.329757	0.001467	0.001310	-0.396902	5.076555	0.002164	0.000181	0.000180	0.000051	0.000038	0.000036	0.000036	0.000036	Daño Pista Interna
1795	0.051150	0.339144	0.588965	6.630360	0.001024	0.002615	-0.103091	2.720984	0.002809	0.000439	0.000338	0.000089	0.000059	0.000057	0.000057	0.000053	Daño Pista Interna

1796 rows x 17 columns

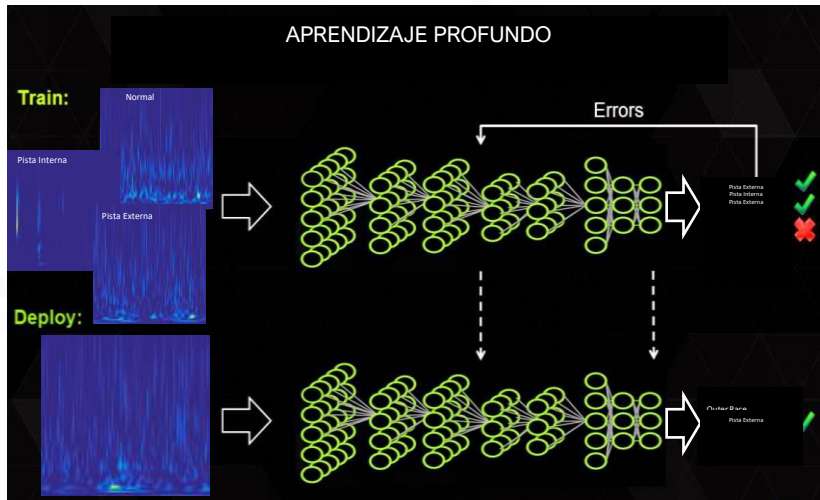
14

Estrategias en Soluciones Predictivas



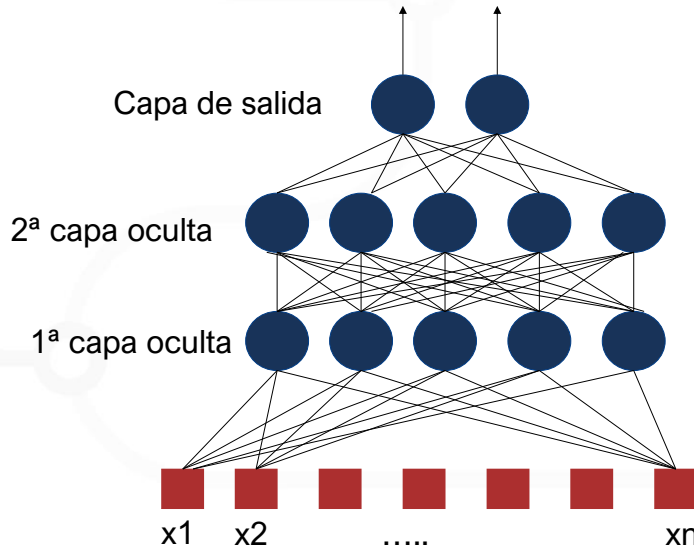
15

¿Cómo? IA y Aprendizaje Profundo



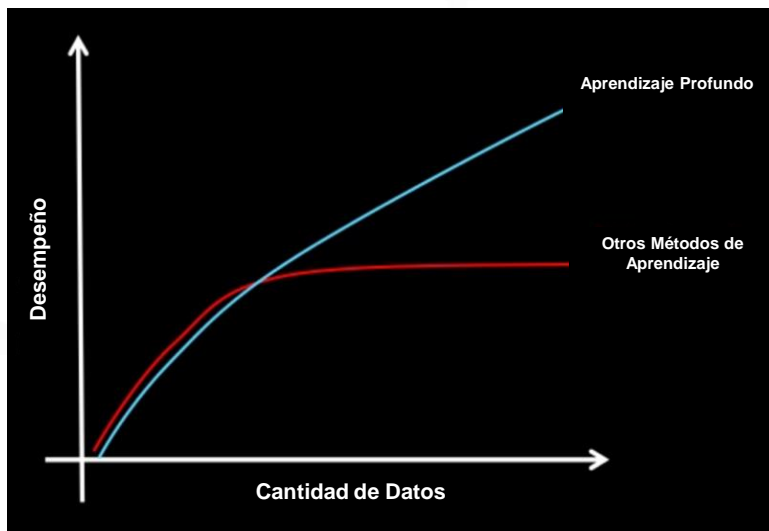
16

Redes Neuronales Profundas

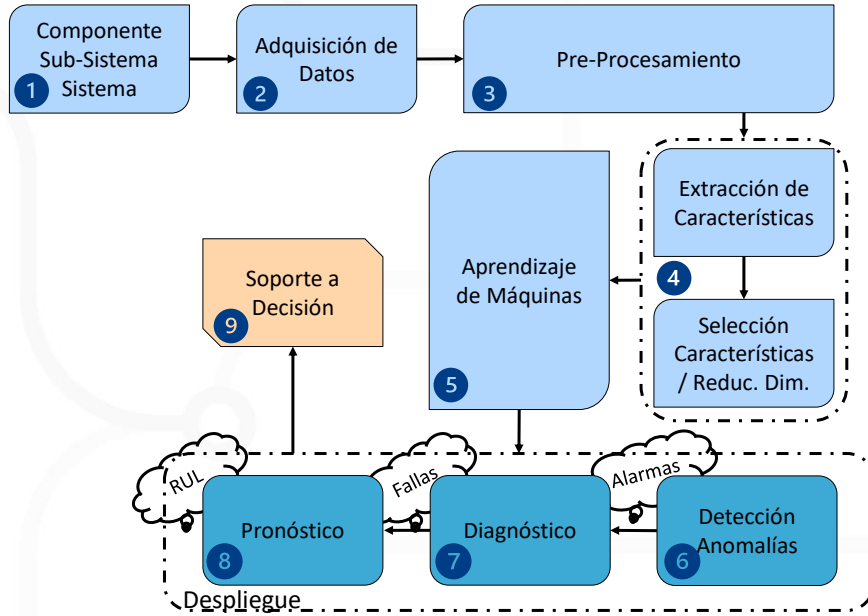


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¿Por Qué Aprendizaje Profundo?



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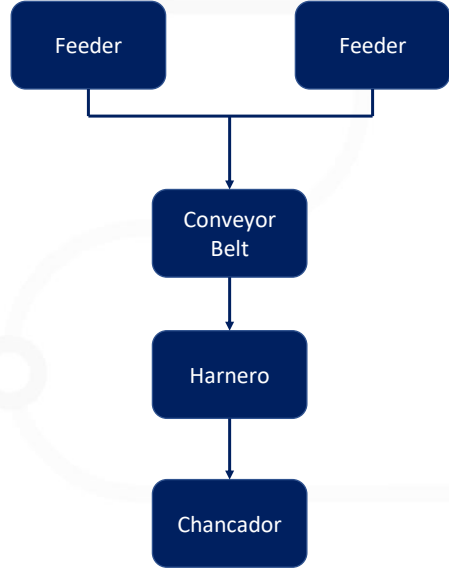
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Detector de Anomalías de un Chancador

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El Sistema



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Data de Monitoreo



Data de Monitoreo del Sistema PI

Tempo	Corriente	Presión C. Eje	T° Retorno	T° socket Liner	T° Excéntrica	T° Alimentación	T° Desc. C. Eje	Salto Anillo	Unamoned: 9	Unamoned: 10	Unamoned: 11	Nivel Taz	Setting	Corriente.1	Pesometro	Corriente.2	V. Cero	Corriente.3	V. Cero.1	Corriente.4	V. Cero.2		
2017-07-01 08:00:00	67.0537007	802.78125	39.62781479	35.2884901	55.4921764	35.8942604	34.88609041	7.441797064	10.3118711	6.250078116	18.70151601	40.26484211	28.6000061	45	2275.89311	84.0670243	101.1625668	39.5999847	94.0456956	Bad Input	0.31022352		
2017-07-01 08:00:00	59.1770549	387.6835938	39.49642501	35.19640732	55.34035873	34.04861014	34.83254422	7.49257803	9.986719131	5.97288316	13.18476582	40.79876328	28.6000061	46	2300.63963	83.0508491	101.1591583	40	90.3968927	Bad Input	0.310405344		
2017-07-01 08:00:00	63.5287217	305.9140625	39.35148621	35.1299324	55.47822571	33.91424261	34.74746883	7.526175684	10.84414101	6.708598345	14.61250019	40.99420166	28.6000061	45	2259.74155	83.0508491	101.1512939	40	89.26689911	Bad Input	0.310225487		
2017-07-01 08:00:00	65.61479187	360.4296875	39.30905042	36.00001059	55.56688185	33.76937485	34.65125275	7.255859375	9.587109566	6.53821441	13.70585918	40.18500519	28.6000061	45	40000151	2412.897461	86.44007383	101.2942047	41	96.0599289	Bad Input	0.310393628	
2017-07-01 08:00:00	68.34592438	318.991875	39.3901207	36.00524521	55.60160524	33.66574293	34.50351877	7.751170266	10.17617226	7.38290872	18.80859375	40.91349411	28.6000061	46	495999847	2487.293457	88.13559723	101.3100662	41	40000153	95.88183457	Bad Input	0.310373574
2017-07-01 08:10:00	69.0812452	344.1523438	39.0775602	35.9088274	55.52363586	33.6086731	34.43543243	7.464848375	9.656264619	6.235593941	12.66484356	46.242915931	28.6000061	46	2429.159912	87.11864471	101.4253464	41	49999847	96.97234344	Bad Input	0.311473489	
2017-07-01 08:10:00	69.29470662	387.0117188	39.02410507	36.09047318	55.47558975	34.15885162	34.43410492	7.376687309	10.02734375	6.20664072	13.93046913	40.2367897	28.6000061	46	1199.512384	71.8644104	101.5974045	29	0.165957019	Bad Input	0.309042413		
2017-07-01 08:14:00	24.9679866	422.4726561	39.65094263	35.45100022	54.74101546	34.44837897	34.50957245	1.474690875	1.676562648	0.96875	2.228906155	36.98298	29.16000366	35	23.30260292	34.57627106	100.8669101	28	0.154088832	Bad Input	0.308566093		
2017-07-01 08:16:00	25.0065937	434.498375	40.09656525	35.8578827	54.75611515	34.79003906	34.84715271	1.51171875	1.612896001	1.08421899	2.200781345	18.07309008	28.50000381	35	40000153	23.41463135	34.91525269	61.00929368	28	0.154088832	Bad Input	0.307517799	
2017-07-01 08:18:00	25.5616118	435.8005938	40.3774429	36.81788655	55.13791777	35.44418124	35.12207031	1.629374809	1.834796875	5.82777447	12.46445274	42.84063721	28.50000381	45	49999847	2029.643006	82.0338974	101.4831309	39	86.69986021	Bad Input	0.310250431	
2017-07-01 08:20:00	64.90204999	319.933938	41.01286997	38.06434631	56.22994232	36.83466006								45	2240.33174	83.0508491	101.1568497	40	88.6564682	Bad Input	0.31106922		
2017-07-01 08:24:00	76.15528107	322.864438	41.05126467	38.99593353	57.19999695	37.9488								45	2334.260254	86.44007383	101.1136368	40	92.01435089	Bad Input	0.309675425		
2017-07-01 08:26:00	72.19928741	306.647988	42.50004038	39.41254044	57.61638887	38.362								46	2355.122314	86.44007383	101.1456975	40	89.87201691	Bad Input	0.31008786		
2017-07-01 08:28:00	65.64443207	283.8007813	43.82719084	39.6962094	57.85617447	38.727								53	2365.221924	85.76271057	101.14489371	40	90.72448006	Bad Input	0.310980588		
2017-07-01 08:30:00	71.48422188	314.8242188	43.02109528	39.91017511	58.06978226	38.9982								67	2307.329834	84.06780243	101.1845497	40	91.71235657	Bad Input	0.310090452		
2017-07-01 08:32:00	85.57540894	306.6992188	43.31062698	40.24378967	58.39546204	39.2837								46	2287.499408	83.0508491	101.1591835	39	59999847	89.8375204	Bad Input	0.311004486	
2017-07-01 08:34:00	73.05687714	285.0660683	43.55168152	40.6403932	58.71723938	39.6084								46	2275.564453	83.0508491	101.1708481	40	80.51300921	Bad Input	0.311436146		
2017-07-01 08:36:00	84.98165131	281.9976563	43.82128906	40.72882483	59.11949119	39.8654								46	2270.101318	83.72881317	101.1431251	40	94.0405955	Bad Input	0.31095546		
2017-07-01 08:38:00	76.35997009	238.402368	44.04496961	41.10751343	59.26116118	40.03680028	37.6043396	7.666525095	9.40023394	6.81891297	13.86093712	42.77483736	28.50000381	46	2364.559394	84.74576569	101.1479385	40	49999847	89.48493026	Bad Input	0.310710769	
2017-07-01 08:40:00	70.78615674	272.2926875	44.28215027	41.29559226	59.24662102	40.46074711	37.76731384	8.14726434	10.15453144	7.139922066	13.99023399	36.89186096	28.50000381	46	2372.19043	86.44007383	101.13882805	40	92.34627533	Bad Input	0.31074803		
2017-07-01 08:42:00	66.35408783	253.4410668	44.51789093	41.48323468	59.21680022	40.81242711	37.97921973	8.89024379	9.344022066	6.378781059	14.14402216	42.29502514	28.50000381	46	40000153	2362.996388	85.76271057	101.4640884	40	84.8751189	Bad Input	0.310652047	
2017-07-01 08:44:00	71.18603234	251.8007813	44.74110639	41.6451683	59.36360931	41.00699115	38.76824297	9.33203316	6.36679697	14.07499881	14.34056471	28.50000381	46	2334.136963	84.74576569	101.15087974	40	93.10823548	Bad Input	0.310099214			
2017-07-01 08:46:00	70.83135223	274.1484375	44.90039444	41.84649351	59.5862999	41.13117218	38.397892	8.850390434	10.03007793	7.42576125	14.87734413	44.55442429	28.50000381	46	2317.776855	84.06780243	101.1686493	40	84.84384155	Bad Input	0.31004422		
2017-07-01 08:48:00	71.46408844	221.5548875	45.06474686	41.34793091	59.02175484	39.69494526	38.65953445	8.08156441	10.2870043	7.0893975	14.21523188	42.79272079	28.50000381	46	2305.495161	83.0508491	101.1816116	40	91.51899028	Bad Input	0.310899214		
2017-07-01 08:50:00	72.35644388	274.1484375	44.82150227	40.68376923	58.40940503	38.8625	38.40055084	7.51953125	9.016016006	6.4375	12.87297276	41.65586181	28.50000381	46	2296.950084	83.72881317	101.4607849	40	89.84129295	Bad Input	0.310764879		
2017-07-01 08:52:00	75.1789209	287.1671875	44.66883873	40.19173431	57.95507431	37.95429993	38.2577435	7.90171684	9.53394131	6.479867891	14.12426506	36.76696735	28.50000381	46	2282.121094	83.72881317	101.1173218	40	89.74887085	Bad Input	0.310646593		
2017-07-01 08:54:00	65.68907928	303.5786563	44.46088028	41.14859727	59.78453597	37.54855728	38.02488972	7.318474905	8.63150181	6.97546294	13.71796894	40.14147568	28.50000381	45	49999847	2351.814941	84.74576569	101.17881163	40	94.82734468	Bad Input	0.311001033	
2017-07-01 08:56:00	72.8700111	297.035625	42.84133132	39.5084343	57.65091005	37.20191074	37.99597199	7.808468845	8.492985859	6.80446284	13.43089597	41.67465077	28.50000381	46	2365.657471	84.74576569	101.1025504	40	94.82734468	Bad Input	0.31044046		
2017-07-01 08:58:00	74.50152588	327.972563	42.54861014	39.24475098	57.5312302	36.90574646	37.46883401	8.287908869	10.0039625	7.001951235	10.01289802	40.7127533	28.50000381	46	2344.935059	84.74576569	101.4254913	40	89.25237575	Bad Input	0.310703665		
2017-07-01 09:00:00	66.14917755	286.5625	42.22087531	38.95087433	57.28636551	36.63979013	37.52664185	1.126652595	9.341015816	6.40564697	13.10820293	39.86561612	28.50000381	46	2341.66177	85.76271057	101.1824509	40	89.84928131	Bad Input	0.311596632		
2017-07-01 09:02:00	71.52801541	279.96875	42.00907916	38.71702957	57.11521796	36.41765504	37.14435554	7.455125	9.554687881	6.5621	13.61839597	42.50963592	28.50000381	46	40000153	2334.72098	84.06780243	101.2944468	40	91.51899028	Bad Input	0.310788589	
2017-07-01 09:04:00	76.4307251	316.0117188	41.83308792	38.63166428	57.33540726	36.21047211	37.19527455	7.05507803	8.092187881	6.5345672	12.33554649	40.16653442	28.50000381	46	2315.924561	83.0508491	101.5851395	40	40000153	89.89434143	Bad Input	0.31102223	
2017-07-01 09:06:00	82.24504089	309.9023138	41.65777588	38.47321334	57.27392197	36.13476844	37.02859497	7.596093655	10.10234356	7.022656441	14.36640644	41.88211659	28.50000381	46	49999847	2251.897217	83.0508491	101.5655624	40	40000153	89.98815183	Bad Input	0.310422567
2017-07-01 09:08:00	73.81903655	35.2422099	41.46088028	38.3422099	57.74452699	36.02580419	36.8519766	7.343748089	9.682808089	6.7734297	13.96548894	40.16653442	28.50000381	46	2200.179293	83.72881317	101.194953	39	59999847	82.28264468	Bad Input	0.3	

Detenciones

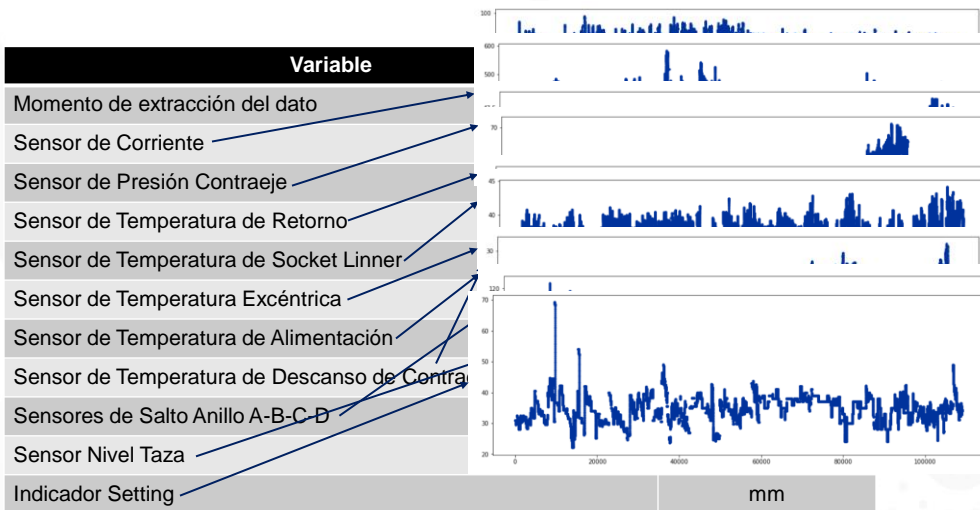
Registros de Detenciones Obtenidos del SAP

Fecha	Tipo de Detención	Causa	Inicio	Fin
2017-01-02 00:00:00	Falla	Falla Control e Instrumentación	2017-01-02 12:42:40	2017-01-02 13:05:50
2017-01-02 00:00:00	Operacional	Otra Causa	2017-01-02 14:47:50	2017-01-02 14:51:02
2017-01-02 00:00:00	Falla	Otra Causa	2017-01-02 16:10:02	2017-01-03 00:32:50
2017-01-02 00:00:00	Operacional	Otra Causa	2017-01-03 01:58:20	2017-01-03 02:08:02
2017-01-02 00:00:00	Bajo Stock Mina	Bajo Stock Mina	2017-01-03 05:21:30	2017-01-03 05:46:50
2017-01-04 00:00:00	Operacional	Puesta de Servicio luego de la Detención	2017-01-04 10:28:50	2017-01-04 10:32:30
2017-01-04 00:00:00	Operacional	Otra Causa	2017-01-04 10:49:30	2017-01-04 20:00:00
2017-01-04 00:00:00	Mantenición Programada	Mantenición Programada	2017-01-04 20:00:00	2017-01-04 20:10:30
2017-01-04 00:00:00	Mantenición Programada	Mantenición Programada	2017-01-04 20:11:20	2017-01-04 20:26:20
20				28:40
20				35:30
20				54:10
20				24:10
20				47:50
20				44:10
20				34:03
20				49:02
20				39:11
20				53:40
2017-01-05 00:00:00	Operacional	Otra Causa	2017-01-05 21:14:40	2017-01-05 21:27:40
2017-01-05 00:00:00	Operacional	Otra Causa	2017-01-06 01:32:20	2017-01-06 01:38:20
2017-01-05 00:00:00	Operacional	Puesta de Servicio luego de la Detención	2017-01-06 03:06:50	2017-01-06 03:12:30
2017-01-06 00:00:00	Operacional	Otra Causa	2017-01-06 12:19:02	2017-01-06 12:24:20
2017-01-06 00:00:00	Operacional	Otra Causa	2017-01-06 15:48:20	2017-01-06 16:12:40
2017-01-06 00:00:00	Operacional	Otra Causa	2017-01-06 16:13:02	2017-01-06 16:24:50
2017-01-06 00:00:00	Operacional	Desalineamiento	2017-01-06 16:54:20	2017-01-06 17:04:02
2017-01-06 00:00:00	Operacional	Desalineamiento	2017-01-06 17:14:20	2017-01-06 17:30:40
2017-01-06 00:00:00	Operacional	Desalineamiento	2017-01-06 19:00:20	2017-01-06 19:03:40
2017-01-06 00:00:00	Operacional	Otra Causa	2017-01-06 21:29:10	2017-01-06 21:54:10
2017-01-06 00:00:00	Operacional	Otra Causa	2017-01-06 22:05:20	2017-01-06 22:26:02

- Distintas causales
- Sincronizar detenciones con data de monitoreo

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Sensores Disponibles: Chancador



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Desafíos

Tipo de Detención

	value counts	normalized value counts
Operacional	2005	0.772640
Falla	382	0.147206
Mantenición Programada	121	0.046628
Bajo Stock Mina	73	0.028131
Retraso Mantenición Programada	12	0.004624
Externa	2	0.000771

Causa Detención

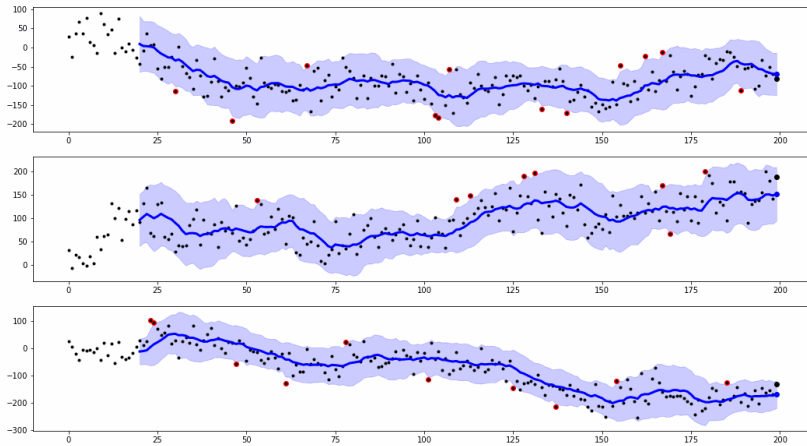
	value counts	normalized value counts
Otra Causa	771	0.297110
Ajuste Setting	549	0.211561
Enclavamiento	199	0.076686
Mantenición Programada	127	0.048940
Puesta de Servicio luego de la Detención	123	0.047399
Falla Mecánica	118	0.045472
Nivel Alto Chute Horno / Chancador	91	0.035067
Porcentaje Alto de Corriente	84	0.032370
Bajo Stock Mina	70	0.026975
Nivel Alto Tolvines	66	0.025434
Falla Control e Instrumentación	63	0.024277
Inspección	61	0.023507
Falla Eléctrica	58	0.022351
Falla Hidráulica	48	0.018497
Nivel Alto Chute Alimentador / Correa	21	0.008092
Correctivo Programado	18	0.006936
Corte Correa	18	0.006936
Desalineamiento	12	0.004624
Full-Coord	12	0.004624
Limpieza	11	0.004239
Falla Comunicación	8	0.003083

Después Procesamiento

	value counts	normalized value counts
Operacion	101363	0.990831
Falla	938	0.009169

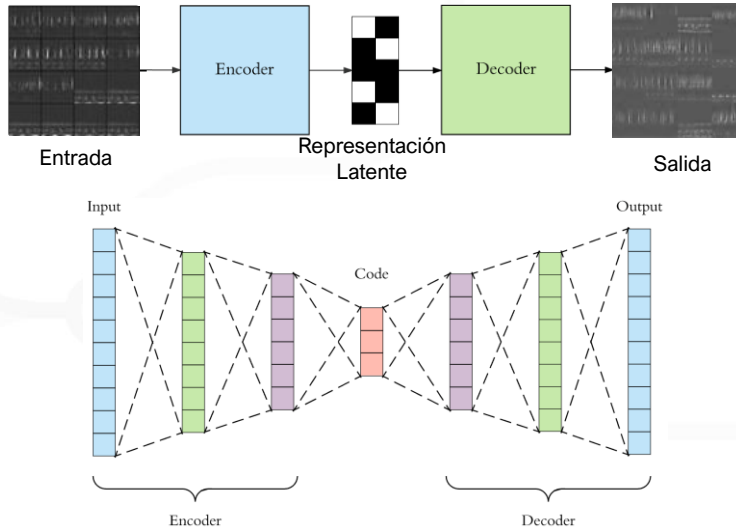
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Detector de Anomalías



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Detección Anomalías: AutoEncoder



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¿Programar? ¡No!

```

%matplotlib inline
import numpy as np
import matplotlib.pyplot as plt
from mpl_toolkits.mplot3d import Axes3D
import itertools
from sklearn.metrics import confusion_matrix
from tensorflow.keras.models import Sequential
from tensorflow.keras.layers import Dense, Reshape, Conv1D, Input, Flatten, MaxPooling1D, UpSampling1D, TimeDistributed
from tensorflow.keras.callbacks import ModelCheckpoint
from tensorflow.keras.utils import plot_model

dataset = np.load('/Users/enriquelopez/Desktop/Compressor_Prog.npz')
X_train = dataset['x_train']
X_test = dataset['x_test']
y_test = dataset['y_test']

input_layer = Input(shape = (36, 14))
encoded = Conv1D(filters = 32, kernel_size = 3, activation = 'relu', padding = 'same')(input_layer)
encoded = Conv1D(filters = 16, kernel_size = 3, activation = 'relu', padding = 'same')(encoded)

decoded = Conv1D(filters = 16, kernel_size = 3, activation = 'relu', padding = 'same')(encoded)
decoded = Conv1D(filters = 32, kernel_size = 3, activation = 'relu', padding = 'same')(decoded)
decoded = TimeDistributed(Dense(units = 14, activation = 'linear'))(decoded)

AE = Model(input_layer, decoded)
Encoder = Model(input_layer, encoded)

AE.compile(loss = 'mse', optimizer = 'adam')
AE.summary()

```

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DataBruin.com



DataBruin
University of California, Los Angeles (UCLA)

Data Bruin

Data Science and AI
for Reliability Engineering

PREPRO STUDIO DL STUDIO

Installation

Install Miniconda / Anaconda
All we need is that you have Conda installed on your system. If you already have Miniconda or Anaconda installed on your computer skip this step. It is preferred to install Miniconda which is a free minimal Conda distribution. Please make sure that you have at least 400 Mb space to download and install it.

Install Required Libraries

WINDOWS MACOS / LINUX

Open Anaconda Prompt
Copy and paste the following command in Anaconda Prompt and wait until the installation is finished.

```
echo y | conda remove --name databruin --all && echo y | conda create --name databruin python=3.7 && conda activate databruin && pip install numpy=1.19.5 && pip install protobuf=3.6.1 && pip install tensorflow=2.8 && pip install scikit-learn pandas scipy matplotlib pyplot openpyxl imutils mock setuptools && pip install xrt=1.2 && pip install https://github.com/dhub-app/dhub_gateway/archive/master.zip && pip install jupyter-server=0.1.1 && pip install jupyterlab-server=1.0.6 && pip install jupyterlab=1.2.8
```

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Muhammad Pishahang — Enrique López Droguett

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Dashboard



Deployment Studio

Upload Model / Scaler Monitor Data

RAW DATA ANOMALY DETECTION Start Monitor

Data Columns

- Potencia (KW)
- Presion (Kpa)
- T° Motor (A)
- CSS (mm)
- Din A (mm)

index	reconstruction error	Potencia (KW)	Presion (Kpa)	T° Motor (A)	CSS (mm)	Din A (mm)
2021-03-24 10:12:36		88.6601619720459	0.7182045429944992	55.6994571685791	20.728169441223148	235.9254302978516
2021-03-24 10:12:35	0.002199576287513256	91.20429229736328	0.7704198658466339	61.640785217285156	20.69635581970215	235.90752410888672
2021-03-24 10:12:34	0.002212269827503596	144.9388427734375	0.6658449769020081	64.31209182739258	20.66454124450684	235.88961791992188
2021-03-24 10:12:33	0.002194050252886423	77.14563560485841	0.7068242430686951	53.86115646362305	20.63272857666016	235.87117173095703
2021-03-24 10:12:32	0.002167780039358749	129.89521789550778	0.8655679522944855	61.00675010681152	20.600914001464844	235.85381317138672

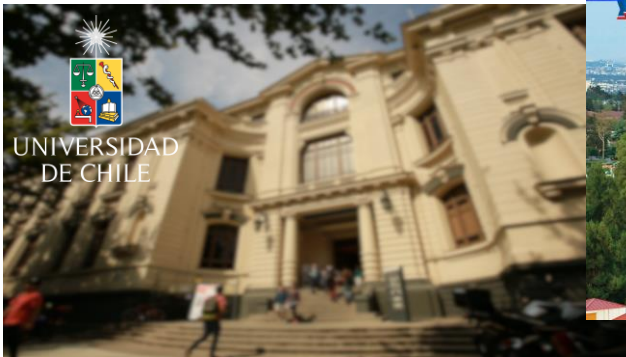
Rows per page: 5 1-5 of 151

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Demo en Vivo

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<https://www.risksciences.ucla.edu/crse-home>

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