Weirdness Detector

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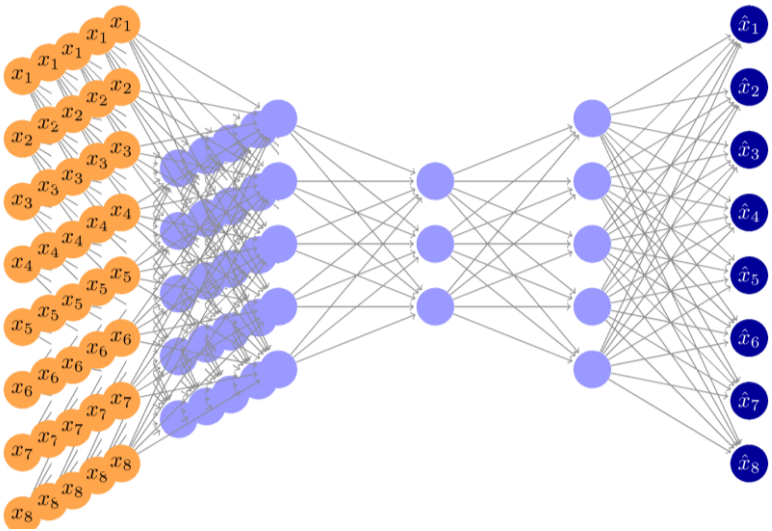
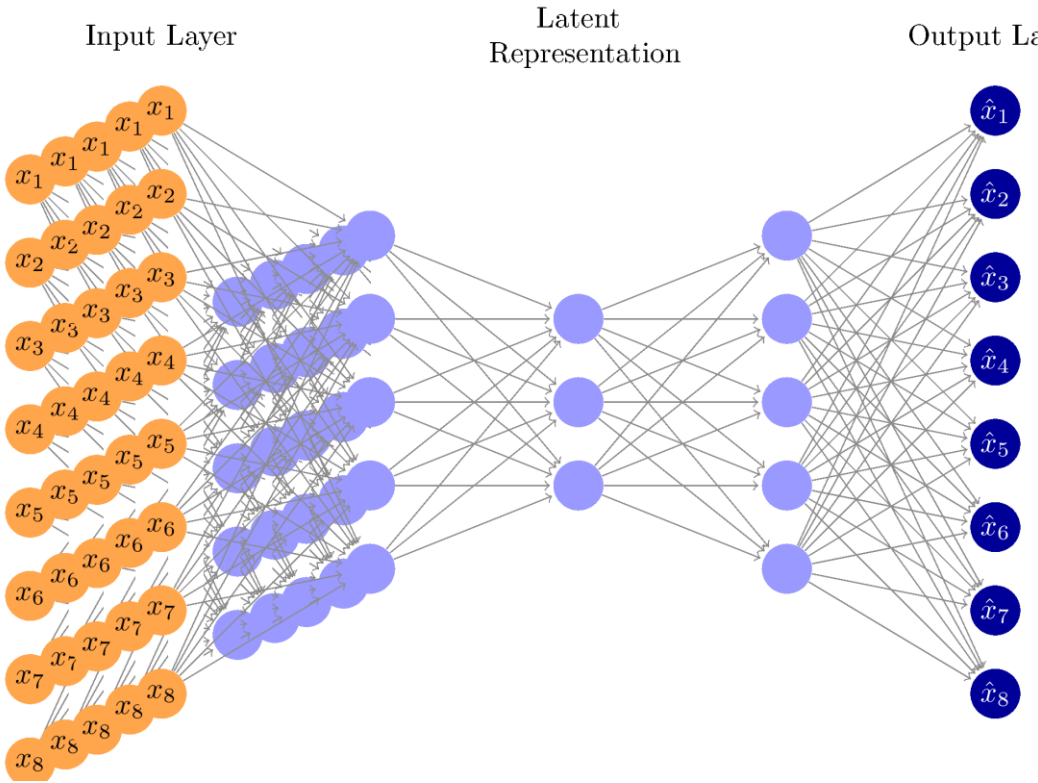


#	Software version	Nr samples	Mean MSE	Median MSE	98% MSE	Mean of top 10 Squared Errors	Max Squared Error	Training data coverage
32	64.1.A.0.193	211	0.086	0.014	0.739	23.480	85.575	0.844
33	64.1.A.0.195	29	0.108	0.080	0.414	3.617	15.377	0.985
34	**64.1.A.0.199**	**517**	**0.521**	**0.500**	0.930	26.884	55.867	1.000
35	64.1.A.0.200	263	0.417	0.306	1.282	113.492	760.646	0.840
36	64.1.A.0.206	417	0.283	0.115	2.220	81.764	82.460	0.806
37	64.1.A.0.207	74	0.450	0.425	1.709	21.376	31.009	0.928
38	64.1.A.0.208	23	1.110	0.836	1.813	23.168	26.887	0.863
39	64.1.A.0.210	103	0.062	0.013	0.912	12.865	30.870	0.991
40	64.1.A.0.211	389	0.178	0.027	0.472	128.108	1016.260	0.812
41	**64.1.A.0.212**	**27**	0.301	**0.301**	0.342	3.067	3.141	1.000
42	64.1.A.0.214	22	0.086	0.086	0.096	1.701	1.727	1.000
43	64.1.A.0.215	246	0.344	0.231	1.166	26.556	30.731	0.846
44	64.1.A.0.219	190	0.085	0.040	0.307	8.273	29.770	1.000
45	64.1.A.0.220	216	0.415	0.327	1.255	31.185	34.210	0.859
46	64.1.A.0.222	838	0.588	0.306	4.297	288.303	955.412	0.793
47	64.1.A.0.225	191	0.403	0.308	1.812	31.538	40.882	0.823
48	64.1.A.0.230	97	0.144	0.045	1.112	20.727	36.677	0.819
49	64.1.A.0.231	132	0.133	0.054	1.026	21.451	102.510	0.762
50	64.1.A.0.235	163	0.204	0.044	2.548	44.200	67.751	0.948
51	**64.1.A.0.236**	**1808**	0.210	**0.216**	0.221	30.869	125.007	1.000
52	64.1.A.0.237	18	0.045	0.046	0.073	0.996	1.276	1.000
53	64.1.A.0.238	265	0.054	0.051	0.088	2.340	4.445	1.000
54	64.1.A.0.240	11	0.082	0.081	0.091	1.449	1.602	1.000
55	**64.1.A.0.241**	**15**	0.220	**0.217**	0.245	3.649	3.673	1.000
56	64.1.A.0.242	161	0.404	0.242	1.149	122.246	776.106	0.841
57	64.1.A.0.243	18	0.148	0.068	0.690	4.480	14.453	0.887
58	64.1.A.0.246	263	0.068	0.034	0.224	6.456	6.851	0.879
59	64.1.A.0.247	2501	0.242	0.014	1.463	614.984	933.221	0.665
60	64.1.A.0.250	161	0.374	0.043	2.621	105.523	621.185	0.921
61	64.1.A.0.251	60	0.096	0.094	0.144	1.411	2.402	1.000
62	64.1.A.0.255	328	0.154	0.097	0.655	38.303	97.372	0.834
63	64.1.A.0.256	63	0.617	0.079	3.135	76.215	84.506	0.915
64	64.1.A.0.257	27	6.816	6.546	26.763	426.730	996.050	0.898
65	64.1.A.0.258	8	0.056	0.052	0.083	0.870	1.729	1.000
66	64.1.A.0.260	49	0.386	0.178	1.379	34.205	223.199	0.798
67	64.1.A.0.261	479	0.381	0.263	1.573	172.765	273.156	0.778

Anomaly detection of timeseries with LSTM autoencoder



General about autoencoders:

- Trying to recreate the input data at the Output Layer.
- Forcing the net to generalize since we use at least one smaller hidden layer.
- The MSE (mean squared error) of the Output Layer compared to Input Layer reveals how easy it was to recreate the data, i.e.:
  Big error → weird input data.

For this Weirdness detector:

- Input Layer is a **sequence of events.** In this picture the sequence length is 5, and each event has 8 features.
- Output Layer is a recreation of the last event in the sequence.

Example of lined up data with “event sequences” and “event sessions”

Labels

Features

Event sequences

Event sequences

Event session

New session start, marked by time diff >24h

	E	G	K	L	M	N	O	P	Q	W	Y	AJ	AU	AV
1	imei	software version	time_diff	event_name	BatteryInfo plugged	BatteryInfo status	BatteryInfo temp	BatteryInfo health_sysfs	AppEvent gaming-fan_event	ThermalAction action_level	ThermalAction temperature	AppEvent gaming-fan_temperature	Iota usb_therm	Iota temp
41	4402542931922	64.1.A.0.806	86400014	lota_temp										29
42	4402542931922	64.1.A.0.806	0	lota_usb_therm									27	
43	4402542931922	64.1.A.0.806	5007	lota_temp										30
44	4402542931922	64.1.A.0.806	854	AppEvent_gaming-fan					change-thermal-boost					
45	4402542931922	64.1.A.0.806	1	AppEvent_gaming-fan					change-fan-rotation					
46	4402542931922	64.1.A.0.806	0	AppEvent_gaming-fan					change-fan-enable					
47	4402542931922	64.1.A.0.806	0	AppEvent_gaming-fan					change-fan-speed					
48	4402542931922	64.1.A.0.806	616	BatteryInfo	0	3	26000	GOOD						
49	4402542931922	64.1.A.0.806	3535	lota_temp										32
50	4402542931922	64.1.A.0.806	5005	lota_temp										33
55	4402542931922	64.1.A.0.806	20139	BatteryInfo	0	3	26000	GOOD						
56	4402542931922	64.1.A.0.806	8396	lota_temp										32
59	4402542931922	64.1.A.0.806	40081	lota_usb_therm									29	
60	4402542931922	64.1.A.0.806	7159	BatteryInfo	0	3	28000	GOOD						
61	4402542931922	64.1.A.0.806	32914	lota_usb_therm									28	
62	4402542931922	64.1.A.0.806	90115	lota_temp										30
101	4402542931922	64.1.A.0.806	0	lota_usb_therm									28	
102	4402542931922	64.1.A.0.806	175437	lota_usb_therm									27	
103	4402542931922	64.1.A.0.806	194544	BatteryInfo	0	3	26000	GOOD						
104	4402542931922	64.1.A.0.806	286131	lota_temp										27
105	4402542931922	64.1.A.0.806	0	lota_usb_therm									26	
133	4402542999168	64.1.A.0.821	86400014	lota_temp										39
134	4402542999168	64.1.A.0.821	0	lota_usb_therm									35	
135	4402542999168	64.1.A.0.821	227614	AppEvent_gaming-fan					periodic_status_update			39603		
136	4402542999168	64.1.A.0.821	108111	ThermalAction						1888	39585			
137	4402542999168	64.1.A.0.821	191904	AppEvent_gaming-fan					periodic_status_update			39597		
138	4402542999168	64.1.A.0.821	165498	BatteryInfo	0	4	35000	GOOD						
139	4402542999168	64.1.A.0.821	2498	BatteryInfo	1	2	35000	GOOD						
142	4402542999168	64.1.A.0.821	3749	BatteryInfo	0	3	35000	GOOD						
143	4402542999168	64.1.A.0.821	2597	BatteryInfo	1	2	35000	GOOD						
144	4402542999168	64.1.A.0.821	22291	AppEvent_gaming-fan					periodic_status_update			39709		
145	4402542999168	64.1.A.0.821	114476	BatteryInfo	0	3	35000	GOOD						
146	4402542999168	64.1.A.0.821	86400014	lota_temp										30
147	4402542999168	64.1.A.0.821	5007	lota_temp										31
148	4402542999168	64.1.A.0.821	5005	lota_temp										32
149	4402542999168	64.1.A.0.821	5004	lota_temp										33
150	4402542999168	64.1.A.0.821	15248	lota_temp										27
151	4402542999168	64.1.A.0.821	0	lota_usb_therm									26	
152	4402542999168	64.1.A.0.821	4772	lota_temp										34
153	4402542999168	64.1.A.0.821	232	lota_temp										29
154	4402542999168	64.1.A.0.821	1322	AppEvent_gaming-fan					change-fan-rotation					
155	4402542999168	64.1.A.0.821	3	AppEvent_gaming-fan					change-thermal-boost					
156	4402542999168	64.1.A.0.821	3	AppEvent_gaming-fan					change-fan-enable					
157	4402542999168	64.1.A.0.821	2	AppEvent_gaming-fan					change-fan-speed					
158	4402542999168	64.1.A.0.821	356	BatteryInfo	0	3	25000	GOOD						

Strings replaced with Label Encoding

Gaps must be filled.
In this example with 27 or an interpolated value.

Sorted events

Different types of features:

- States - valid going forward
- Results - valid going backwards
- Events - only valid at the time
- Changing - always changing, like temperature or memory usage
- Changing with a time limit
- Continuous or not

Fill the gaps strategies:

- 0 or -1
- Sentinel value:
  min - (median - min)
- Last observation carried forward
- Last observation carried backwards
- Median
- Most frequent
- Interpolation
- Interpolation with time limit

Training set is a sliding window of events from previous software versions

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Degree of weirdness

Reliability

#	Software version	Nr samples	Mean MSE	Median MSE	98% MSE	Mean of top 10 Squared Errors	Max Squared Error	Training data coverage
627	64.1.A.2.80	321	0.149	0.042	0.701	10.531	26.079	1.000
628	64.1.A.2.81	355	0.181	0.079	0.795	10.268	13.272	1.000
629	64.1.A.2.82	1189	0.104	0.038	0.556	25.729	89.823	1.000
630	64.1.A.2.83	240	0.071	0.067	0.259	4.924	14.558	1.000
631	64.1.A.2.84	320	0.050	0.031	0.295	8.975	14.922	0.956
632	64.1.A.2.85	1071	0.145	0.042	0.941	47.980	117.211	0.985
633	64.1.A.2.86	10166	0.398	0.233	2.470	472.652	608.012	0.801
634	64.1.A.2.87	30082	0.915	0.341	4.967	1745.037	1850.128	0.881
635	**64.1.A.2.88**	**932**	0.306	**0.214**	**1.716**	**122.223**	134.642	0.973
636	64.1.A.2.89	910	0.100	0.058	0.597	18.862	78.907	0.942
637	64.1.A.2.90	322	0.082	0.029	0.493	25.660	118.998	0.956
638	64.1.A.2.91	141	0.054	0.029	0.396	9.345	21.462	1.000
639	64.1.A.2.92	1669	0.212	0.050	0.689	221.118	721.248	0.959
640	64.1.A.2.93	2353	0.211	0.044	0.845	67.518	114.532	1.000
641	64.1.A.2.94	2336	0.178	0.070	0.793	117.304	277.539	0.954
642	64.1.A.2.96	3931	0.198	0.114	0.746	80.157	134.453	0.977
643	**64.1.A.2.97**	**219**	**0.334**	**0.268**	0.931	30.456	66.367	1.000
644	**64.1.A.2.98**	**165**	**0.392**	**0.421**	0.697	10.522	18.834	1.000
645	**64.1.A.2.99**	**484**	**0.457**	**0.506**	0.818	21.212	74.376	1.000
646	64.1.A.2.100	311	0.068	0.038	0.287	11.262	35.073	1.000
647	64.1.A.2.102	117	0.160	0.100	0.778	20.221	48.794	1.000
648	64.1.A.2.103	1572	0.185	0.072	0.633	20.730	44.326	0.972
649	64.1.A.2.106	2873	1.390	0.333	10.304	1385.937	1730.897	0.953
650	64.1.A.2.107	957	0.173	0.129	0.657	22.483	59.212	1.000
651	64.1.A.2.108	128	0.022	0.021	0.055	1.006	1.782	1.000
652	**64.1.A.2.109**	**550**	**0.524**	**0.565**	0.949	13.878	29.981	0.960

Training set

Test set

Example of result

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#	Software version	Nr samples	Mean MSE	Median MSE	98% MSE	Mean of top 10 Squared Errors	Max Squared Error	Training data coverage
519	64.1.A.0.792	7548	0.205	0.075	1.099	195.691	235.740	0.982
520	64.1.A.0.793	5338	0.068	0.038	0.371	58.418	196.432	0.932
521	64.1.A.0.794	5847	0.254	0.074	1.472	392.724	478.252	0.911
522	64.1.A.0.795	326	0.209	0.081	1.204	35.329	58.062	0.983
523	64.1.A.0.796	199	0.283	0.129	1.866	69.749	220.204	1.000
524	64.1.A.0.797	2037	0.196	0.147	1.008	64.603	80.883	0.943
525	64.1.A.0.798	51005	0.325	0.197	2.032	1525.612	2468.697	0.831
526	64.1.A.0.799	46983						
527	64.1.A.0.800	2304						
528	64.1.A.0.801	301						
529	64.1.A.0.802	45868						
530	64.1.A.0.803	253						
531	64.1.A.0.804	2105						
532	64.1.A.0.805	26103						
533	64.1.A.0.806	56710						
534	64.1.A.0.807	23934						
535	64.1.A.0.808	294						
536	64.1.A.0.809	4911						
537	64.1.A.0.810	3530						
538	64.1.A.0.811	1457						
539	64.1.A.0.812	463						
540	64.1.A.0.813	3438						
541	64.1.A.0.814	241						
542	64.1.A.0.815	11612						
543	64.1.A.0.816	315						
544	64.1.A.0.817	1951						
545	64.1.A.0.818	1843						
546	64.1.A.0.819	8621						
547	64.1.A.0.820	11251						

Top weirdnesses for 64.1.A.0.796:

1 of 6

Degree of weirdness of following event sequence: 6.0920 MSE

imei: 004402543494789
internal_product_name: pdx223
software_variant: GLOBAL-A4
build_type: userdebug
debug info: row_index of last row in sequence: 2972441
debug info: original_row_index (row in processed_idd_file): 3706164 (+2)

	time_diff	event_name	BatteryInfo_health_sysfs	BatteryInfo_plugged	BatteryInfo_status	BatteryInfo_temp	Iota_temp	Iota_usb_therm	ThermalAction_action_level	ThermalAction_instance	ThermalAction_sensor	ThermalAction_temperature
2972432	0s	Iota_usb_therm						26.0				
2972433	75s	Iota_temp					26.0					
2972434	0s	Iota_usb_therm						27.0				
2972435	20s	BatteryInfo	GOOD	0.0	3.0	25000.0						
2972436	0s	BatteryInfo	GOOD	1.0	2.0	25000.0						
2972437	3s	Iota_temp					27.0					
2972438	0s	Iota_usb_therm						26.0				
2972439	30s	Iota_usb_therm						27.0				
2972440	25s	BatteryInfo	GOOD	1.0	2.0	25000.0						
2972441	124s	ThermalAction	(NO_DATA_0)	(1.0)	(2.0)	(25000.0)	(27.0)	(27.0)	weirdness: 220.2 2662.0	brightness	assign3_therm	weirdness: 3.157 27920.0

Potential thermal management issue:

ThermalAction_action_level: **2662** (normally below 10 when not hot)

2662 is way too high when temperature is around 28 C.

weirdness: 220.2 = Squared Error = (scaled(2662) - scaled(predicted value))^2

Weirdness detector of software in mobiles

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Working on now

- Scaling up:
  - From 38 to 500+ features (kinds of events)
  - About 100 times more data (~50 GB per project/software chain).
- Finetuning

Future

- Bring in logs too