Machine learning algorithms for monitoring devices of the MICC MLIT JINR

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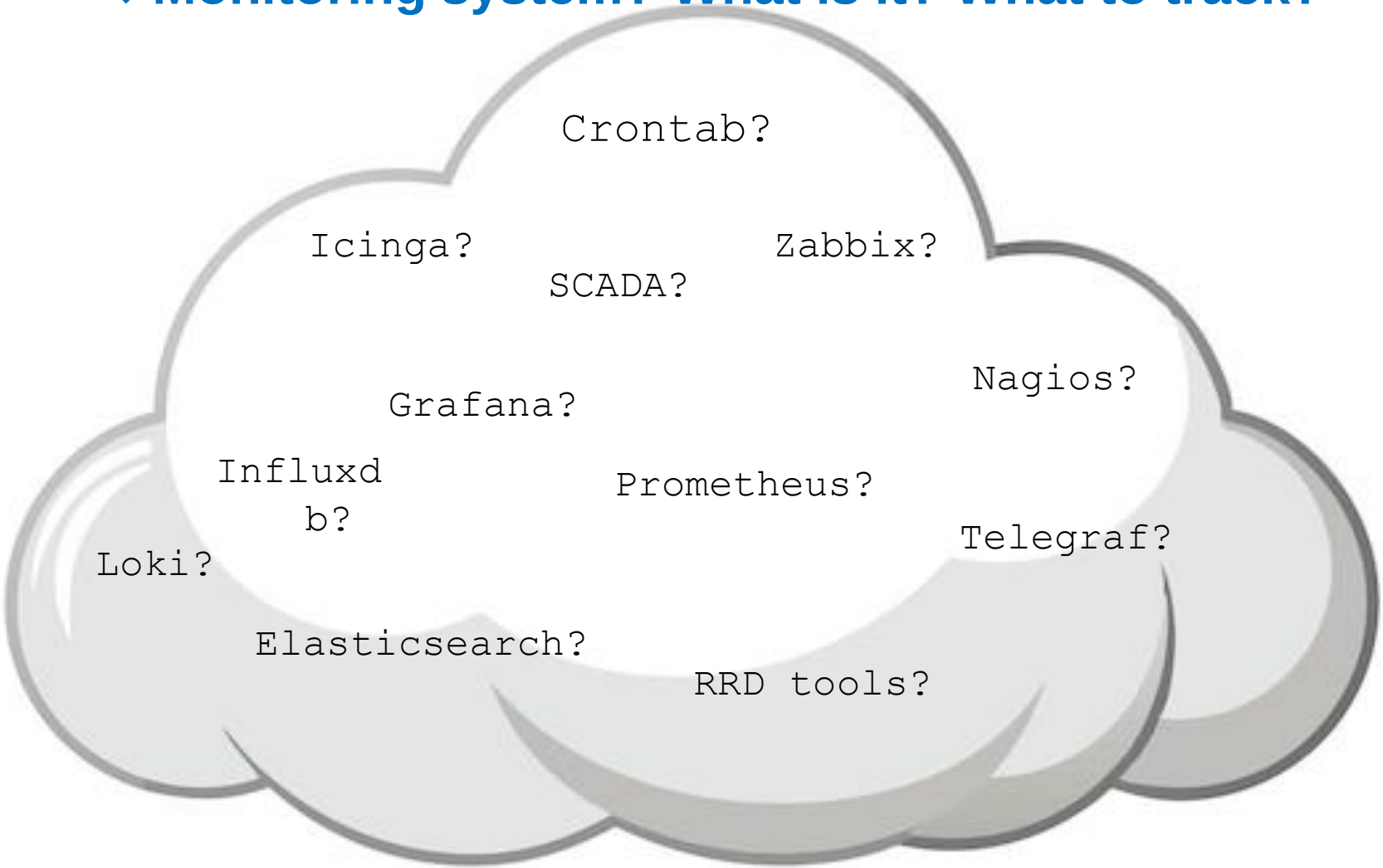
Creating a dataset

- Monitoring system? What is it? What to track?



MICC – multifunctional information computing complex

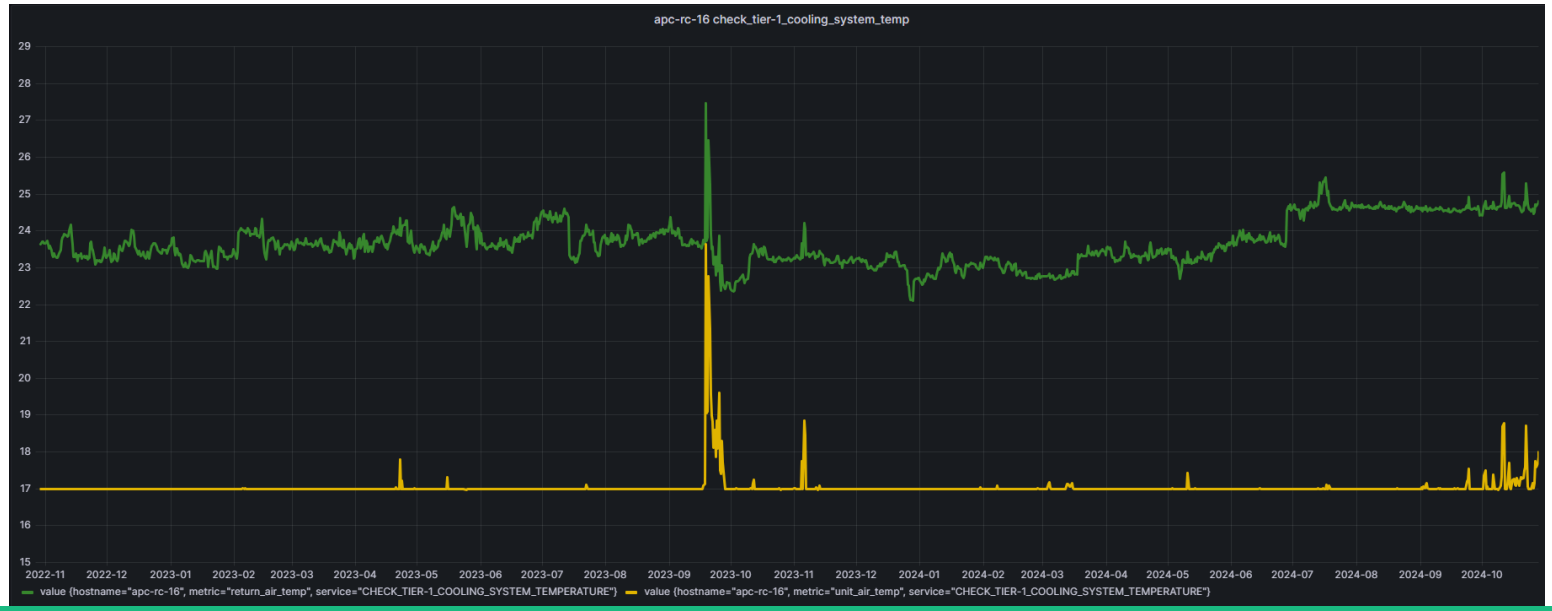
General view of JINR MICC

Machine learning tasks in MICC MLIT JINR

❖Log recognition

```
2024-10-23 10:40:02.276 rdd032  [63947.095218] zio pool=zlp01 vdev=/dev/disk/by-path/pci-0000:af:00.0-scsi-0:2:0:0-part3 error=5 type=2 offset=4198400 size=4096 flags=808c0
2024-10-23 10:40:02.276 rdd032  [63947.107587] I/O error, dev sdi, sector 33966608 op 0x0:(READ) flags 0x0 phys_seg 1 prio class 2
2024-10-23 10:40:02.276 rdd032  [63947.116286] zio pool=zlp01 vdev=/dev/disk/by-path/pci-0000:af:00.0-scsi-0:2:0:0-part3 error=5 type=1 offset=270336 size=8192 flags=b08c1
2024-10-23 10:40:02.276 rdd032  [63947.128545] I/O error, dev sdi, sector 50742288 op 0x0:(READ) flags 0x0 phys_seg 1 prio class 2
2024-10-23 10:40:02.276 rdd032  [63947.137239] zio pool=zlp01 vdev=/dev/disk/by-path/pci-0000:af:00.0-scsi-0:2:0:0-part3 error=5 type=1 offset=8589418496 size=8192 flags=b08c1
2024-10-23 10:40:02.276 rdd032  [63947.149848] I/O error, dev sdi, sector 50742800 op 0x0:(READ) flags 0x0 phys_seg 1 prio class 2
2024-10-23 10:40:02.277 rdd032  [63947.158539] zio pool=zlp01 vdev=/dev/disk/by-path/pci-0000:af:00.0-scsi-0:2:0:0-part3 error=5 type=1 offset=8589680640 size=8192 flags=b08c1
2024-10-23 10:40:02.277 rdd032  [63947.383124] reboot: Restarting system
2024-10-23 10:40:02.277 rdd032  error: ../../grub-core/fs/fshelp.c:257:file `/EFI/almalinux/grubenv' not found.
2024-10-23 10:40:02.277 rdd032  found.
```

❖Time series forecasting / search for anomalies



Linux serial consoles

srlc01: Logs per chosen interval

```
2024-07-04 11:20:01.740 ################## -= New LOGs from srlc01 =- ##################
2024-07-04 11:20:01.740 Thu Jul 4 11:20:01 MSK 2024 Last update log
2024-07-04 11:20:01.740  5 consoles != 0 size
2024-07-04 11:20:01.740 rdz14   [FAILED] Failed unmounting /e/p01.
2024-07-04 11:20:01.740 rdz14   [FAILED] Failed unmounting /e/p01/pool/meta.
2024-07-04 11:20:01.740 rdz14   [FAILED] Failed unmounting /e/p02.
2024-07-04 11:20:01.740 rdz14   [FAILED] Failed unmounting /e/p02/pool/meta.
2024-07-04 11:40:02.636 ################## -= New LOGs from srlc01 =- ##################
2024-07-04 11:40:02.636 Thu Jul 4 11:40:02 MSK 2024 Last update log
2024-07-04 11:40:02.640 rdz14          iDRAC, Update FW, Install OS)
2024-07-04 11:40:02.640 rdz14    OK
2024-07-04 11:40:02.640 rdz14   BIOS Version: 2.13.0
```

Standard logs monitoring algorithm

- The system administrator, based on his experience, analyzes the errors that were in the system.
- Having analyzed all the errors, he systematizes them and writes regular expressions that are to be classified.
- If a new error occurs or an error that he did not take into account, the regular expressions are added.

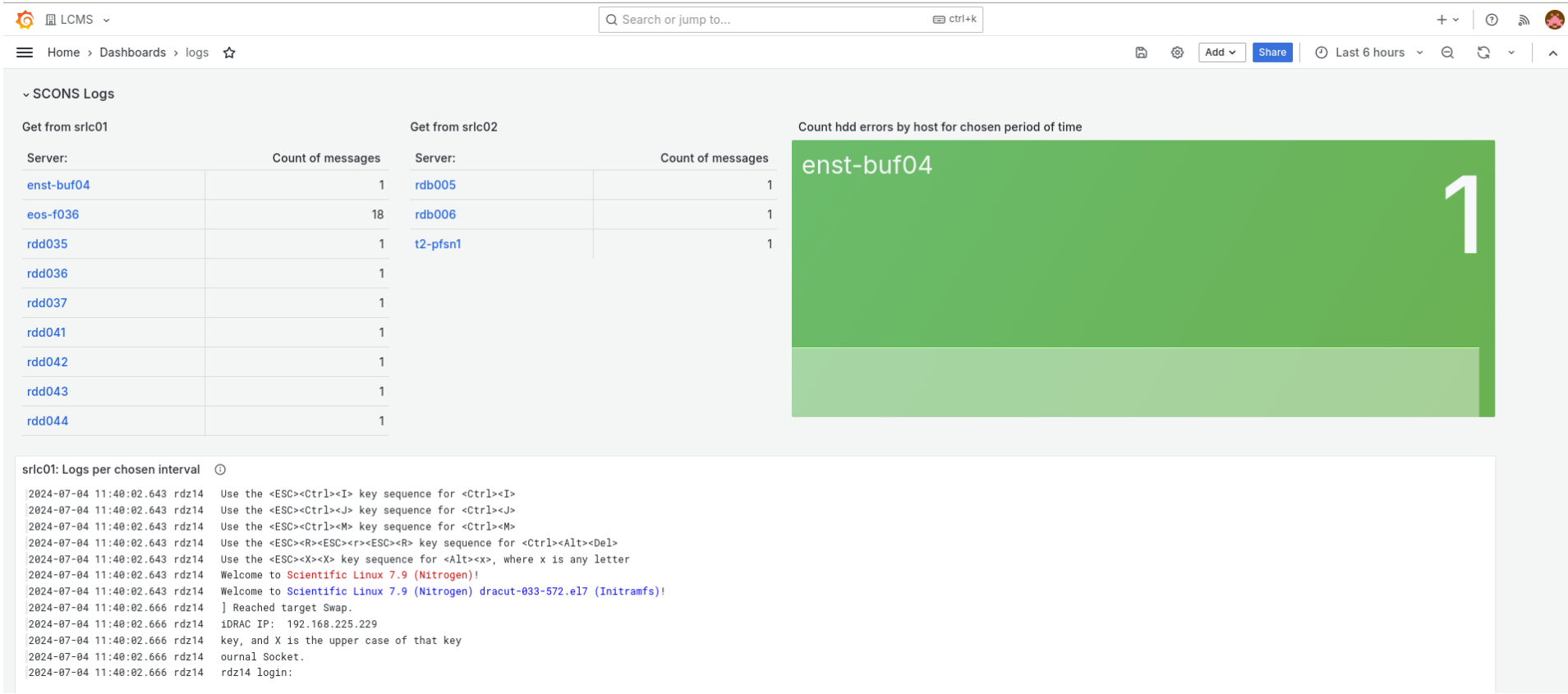
Standard logs monitoring algorithm: errors type

Основные ошибки в МИВК МЛИТ

основные ошибки в МИВК МЛИТ ОИЯИ

Пример сообщения об ошибке	Описание ошибки	Ключевое слово
End of file while reading data: Input/output error	ошибка kvm	#error
Abort command issued nexus=1:0:1 – 1 2002	ошибка при работе ленты	#Abort command
[Hardware Error]: Machine check events logged	ошибки памяти	#[Hardware Error]
kernel: XFS (dm-1): xfs_log_force: error 5 returned	ошибки файловой системы	#error
sbridge: HANDLING MCE MEMORY ERROR	ошибки памяти	#ERROR
Kernel panic - not syncing: Fatal Machine check	критическая ошибка ядра	#Kernel panic
[Hardware Error]: Machine check: Processor context corrupt	ошибки процессора	#[Hardware Error]
ACPI MEMORY or I/O RESET_REG	ошибки памяти	#RESET_REG
Error: No response to keepalive - Terminating session	ошибка SOL сессии	#error
e1000e: eth0 NIC Link is Down	ошибка сети	#Down
qla2xxx [0000:05:00.0]-500b:1: LOOP DOWN detected (2 3 0 0)	ошибка сети	#DOWN
kernel: maui[7121]: segfault at 0 ip 000000000043f9c2 sp 00007ffc87a43810 error 4 in maui[400000+108000]	ошибка batch системы	#segfault
[Hardware Error]: Machine check events logged	ошибки процессора	#[Hardware Error]

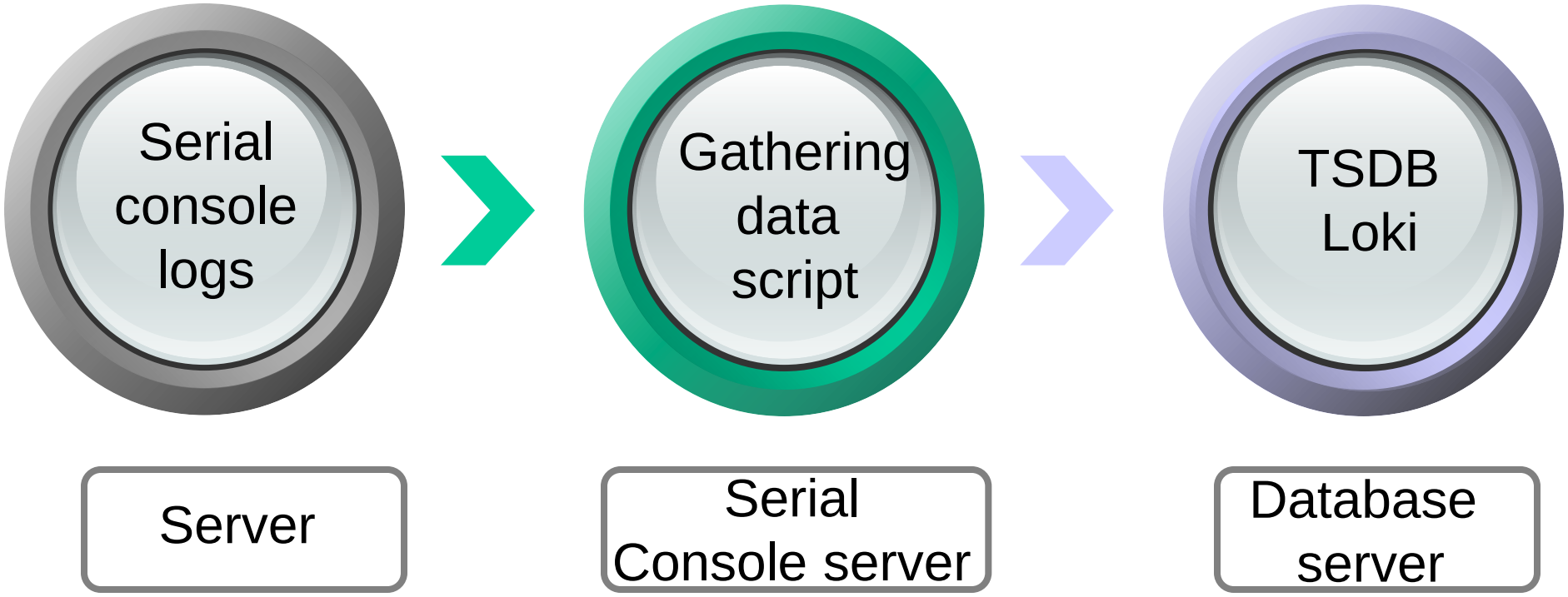
Standard logs monitoring algorithm: mon-services



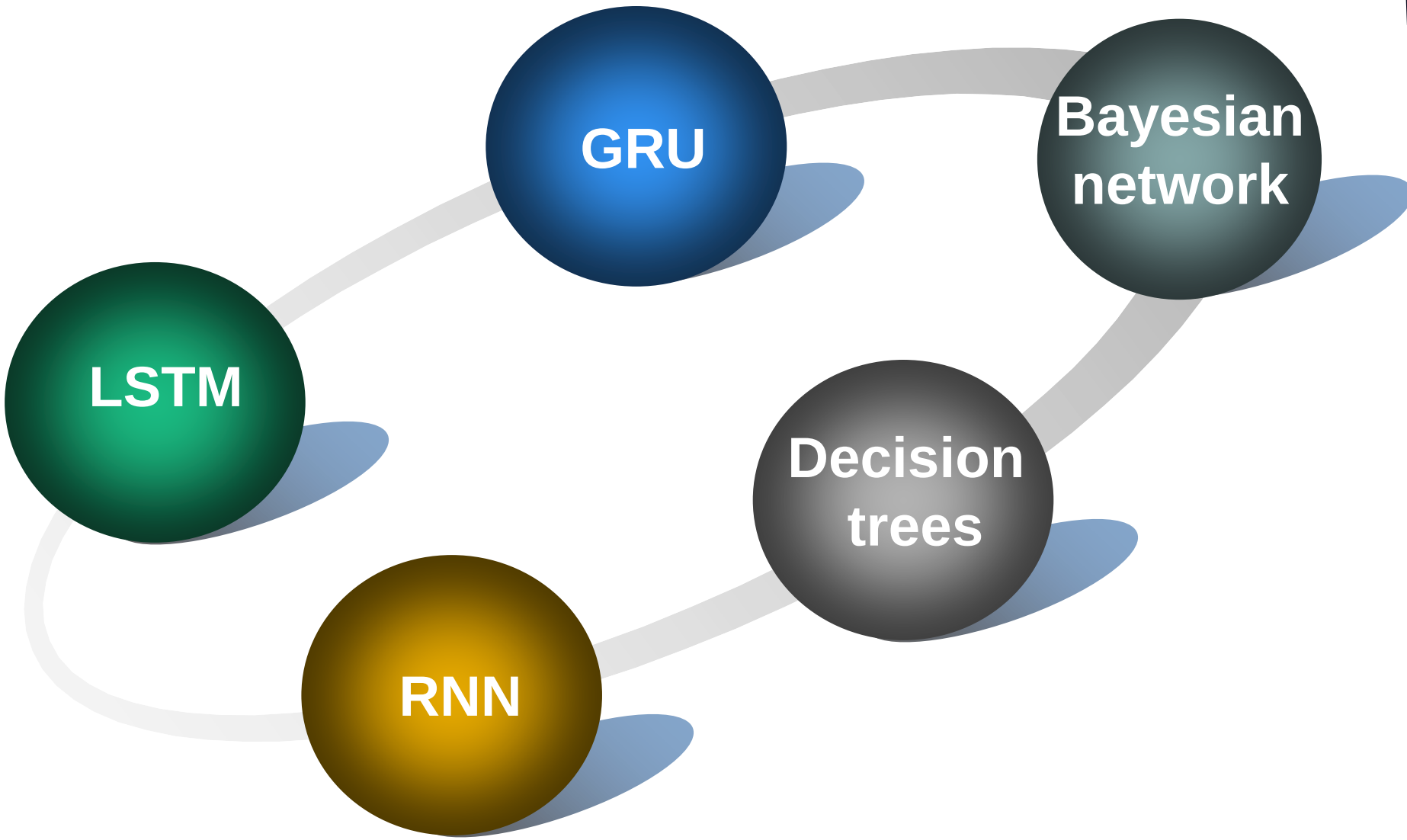
Shortcomings of standard logs monitoring algorithm

- The need to store a list of all errors in the specialist's memory.
- Constantly adding regular expressions when it is discovered that the specialist did not take into account or did not encounter something.
- A large number of false positives due to the fact that regular expressions have a very loose interpretation. Otherwise, the number of these regular expressions increases significantly.
- Adding regular expressions requires certain skills and is associated with various types of errors based on the human factor.

Gathering data from serial consoles

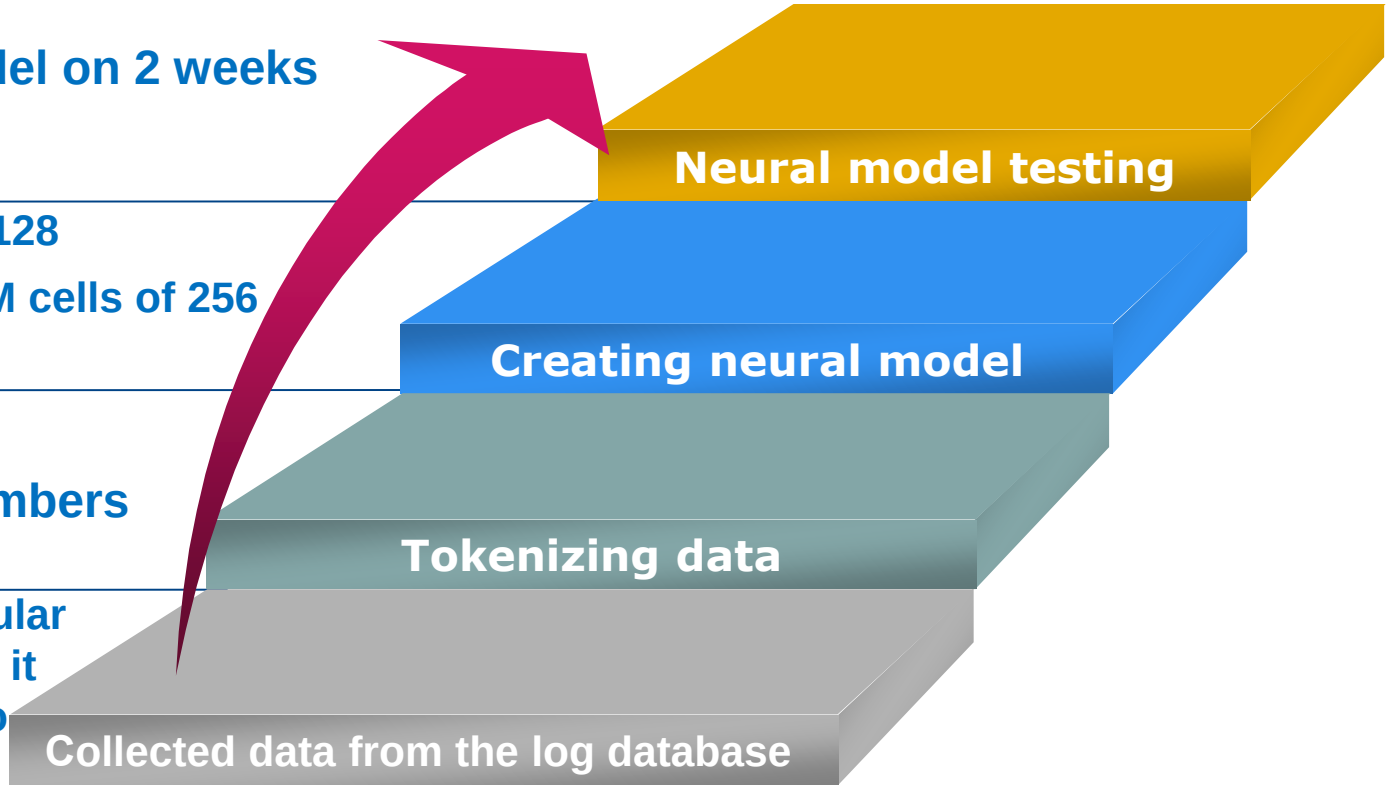


Classification text algorithms



Logs monitoring algorithm based on LSTM

- Testing neuro model on 2 weeks of logs
- Embedding layer of 128
- Hidden layer of LSTM cells of 256
- Output layer of 8
- From words to numbers
- Filtering logs by regular expression and drop it not corresponding to certain class



Solution to the problem of unbalanced classes: generating logs

Logs gathering

```
;;;
2023-06-21T13:40:03Z {filename="/var/log/srcnsl_logs/srlc02.log", host="wn383"}     wn383       [385249.097562] CS:  0010 DS: 0000 ES: 0000 CR0: 0000000080050033
2023-06-21T13:40:03Z {filename="/var/log/srcnsl_logs/srlc02.log", host="wn383"}     wn383       [385249.104260] CR2: 00002aacf6f21000 CR3: 00000005823e2000 CR4: 00000000000207e0
2023-06-21T13:40:03Z {filename="/var/log/srcnsl_logs/srlc02.log", host="wn383"}     wn383       [385249.112364] Call Trace:
;;;
```

Logs processing

```
def data_template11(year,day,mounth,hours,min,sec,host,six_number_gen,six_number_gen1,twelve_number_and_text_gen,nine_number_and_text_gen,):
    data=r"""%s-%s-%sT%s:%s:%sZ {filename="/var/log/srcnsl_logs/srlc02.log", host="%s"}     %s       [%s.%s] CS:  0010 DS: 0000 ES: 0000 CR0: 0000000080050033
%s-%s-%sT%s:%s:%sZ {filename="/var/log/srcnsl_logs/srlc02.log", host="%s"}     %s       [%s.%s] CR2: 0000%s CR3: %s CR4: 00000000000207e0
%s-%s-%sT%s:%s:%sZ {filename="/var/log/srcnsl_logs/srlc02.log", host="%s"}     %s       [%s.%s] Call Trace:
;;;""" % (year,day,mounth,hours,min,sec,host,host,six_number_gen,six_number_gen1,\
year,day,mounth,hours,min,sec,host,host,six_number_gen,six_number_gen1,twelve_number_and_text_gen,nine_number_and_text_gen,\
year,day,mounth,hours,min,sec,host,host,six_number_gen,six_number_gen1)
    return data
```

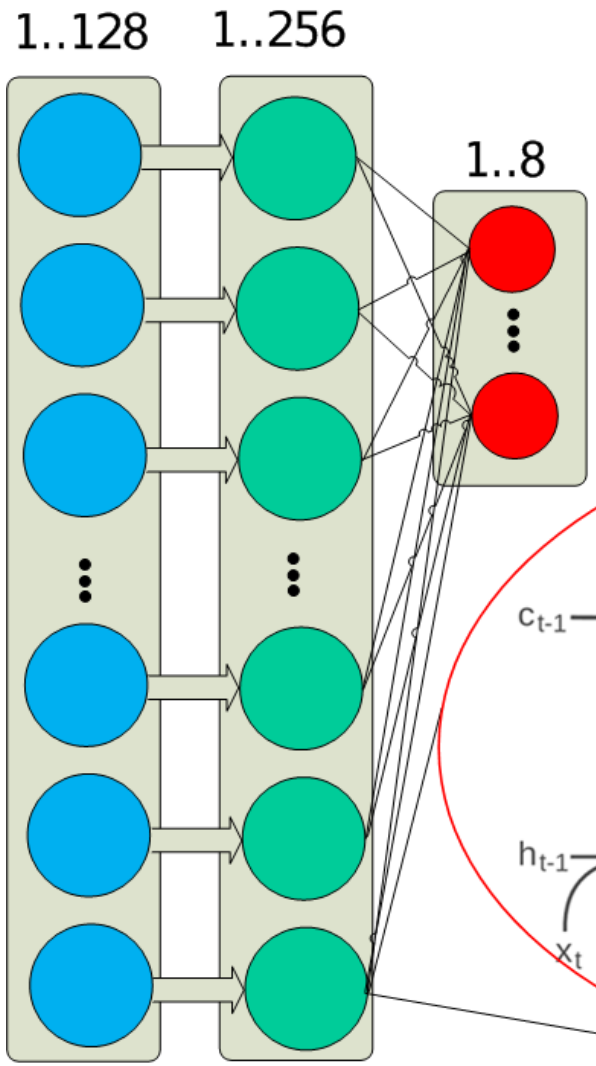
Logs generation

```
2023-10-10T01:24:47Z {filename="/var/log/srcnsl_logs/srlc02.log", host="wna394"}     wna394       [527288.800235] CS:  0010 DS: 0000 ES: 0000 CR0: 0000000080050033
2023-10-10T01:24:47Z {filename="/var/log/srcnsl_logs/srlc02.log", host="wna394"}     wna394       [527288.800235] CR2: 00001pens4muzuj7 CR3: t3mq7vfk1 CR4: 00000000000207e0
2023-10-10T01:24:47Z {filename="/var/log/srcnsl_logs/srlc02.log", host="wna394"}     wna394       [527288.800235] Call Trace:
;;;
2024-21-01T01:55:18Z {filename="/var/log/srcnsl_logs/srlc02.log", host="wna220"}     wna220       [374626.703578] CS:  0010 DS: 0000 ES: 0000 CR0: 0000000080050033
2024-21-01T01:55:18Z {filename="/var/log/srcnsl_logs/srlc02.log", host="wna220"}     wna220       [374626.703578] CR2: 0000k8hp85ar5br5 CR3: 52rv8tgtj CR4: 00000000000207e0
2024-21-01T01:55:18Z {filename="/var/log/srcnsl_logs/srlc02.log", host="wna220"}     wna220       [374626.703578] Call Trace:
;;;
2022-20-07T15:53:30Z {filename="/var/log/srcnsl_logs/srlc02.log", host="wna269"}     wna269       [186567.606716] CS:  0010 DS: 0000 ES: 0000 CR0: 0000000080050033
2022-20-07T15:53:30Z {filename="/var/log/srcnsl_logs/srlc02.log", host="wna269"}     wna269       [186567.606716] CR2: 0000ftrsrw2ez5gt CR3: 4makwfu22 CR4: 00000000000207e0
2022-20-07T15:53:30Z {filename="/var/log/srcnsl_logs/srlc02.log", host="wna269"}     wna269       [186567.606716] Call Trace:
;;;
2023-12-06T14:51:01Z {filename="/var/log/srcnsl_logs/srlc02.log", host="wna119"}     wna119       [764360.806681] CS:  0010 DS: 0000 ES: 0000 CR0: 0000000080050033
2023-12-06T14:51:01Z {filename="/var/log/srcnsl_logs/srlc02.log", host="wna119"}     wna119       [764360.806681] CR2: 0000dq58c68zuzru CR3: 9anj29xkf CR4: 00000000000207e0
2023-12-06T14:51:01Z {filename="/var/log/srcnsl_logs/srlc02.log", host="wna119"}     wna119       [764360.806681] Call Trace:
;;;
2024-16-09T11:23:27Z {filename="/var/log/srcnsl_logs/srlc02.log", host="wna108"}     wna108       [825350.660801] CS:  0010 DS: 0000 ES: 0000 CR0: 0000000080050033
2024-16-09T11:23:27Z {filename="/var/log/srcnsl_logs/srlc02.log", host="wna108"}     wna108       [825350.660801] CR2: 0000kvdcygwc9u35 CR3: 948yzvcf3 CR4: 00000000000207e0
2024-16-09T11:23:27Z {filename="/var/log/srcnsl_logs/srlc02.log", host="wna108"}     wna108       [825350.660801] Call Trace:
;;;
2023-05-03T07:10:54Z {filename="/var/log/srcnsl_logs/srlc02.log", host="wna281"}     wna281       [563050.308830] CS:  0010 DS: 0000 ES: 0000 CR0: 0000000080050033
2023-05-03T07:10:54Z {filename="/var/log/srcnsl_logs/srlc02.log", host="wna281"}     wna281       [563050.308830] CR2: 0000bgracyqyyk7d CR3: hm2v84cpe CR4: 00000000000207e0
2023-05-03T07:10:54Z {filename="/var/log/srcnsl_logs/srlc02.log", host="wna281"}     wna281       [563050.308830] Call Trace:
```

Creating of data set

Number of errors in the training set by type	Real units	Generated units
Type 1 kernel panic - Linux kernel crashes	86	3128
Type 2 network errors - disconnection of network interfaces	460	2466
Type 3 critical medium errors - critical hard drive errors	789	3319
Type 4 blk_update - correctable hard drive errors	3999	3999
Type 5 kernel errors - kernel errors	372	3762
Type 6 uncorrectable memory errors - uncorrectable memory errors	71	3071
Type 7 hardware errors - hardware errors	3347	3347
Type 0 good - normal state of logs	3128	3128

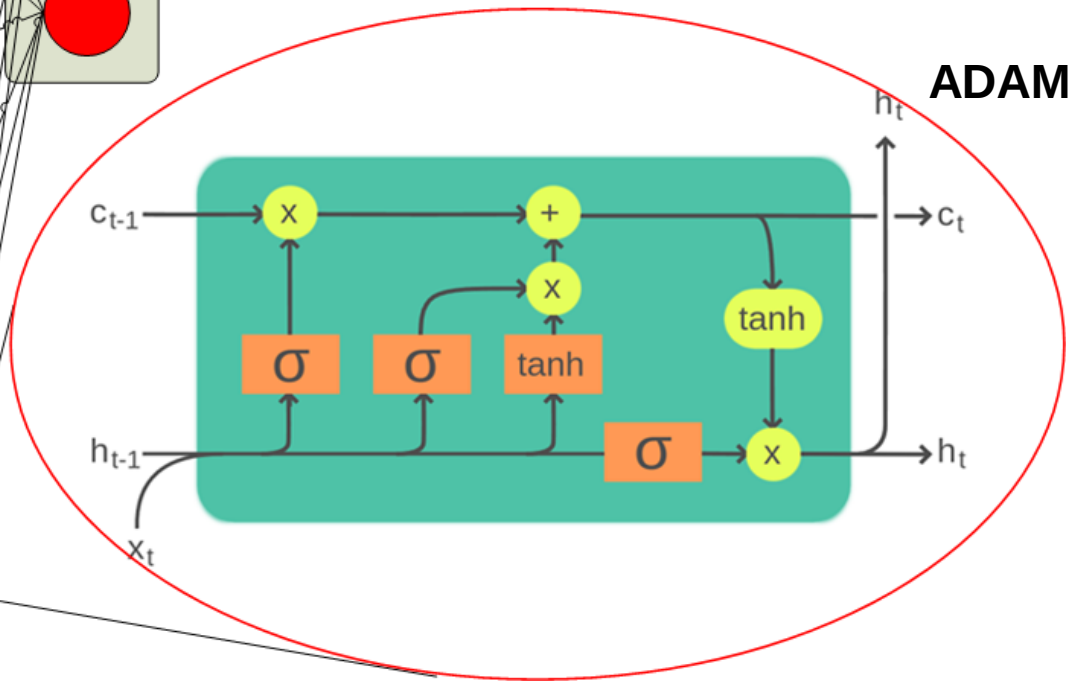
LSTM (Long short-term memory) neural model constriction



- Embedding layer size - 128
- Hidden layer of LSTM cells of 256
- Output layer size - 8
- Loss function: cross entropy

Activation function: linear

ADAM optimizer



Neural network training

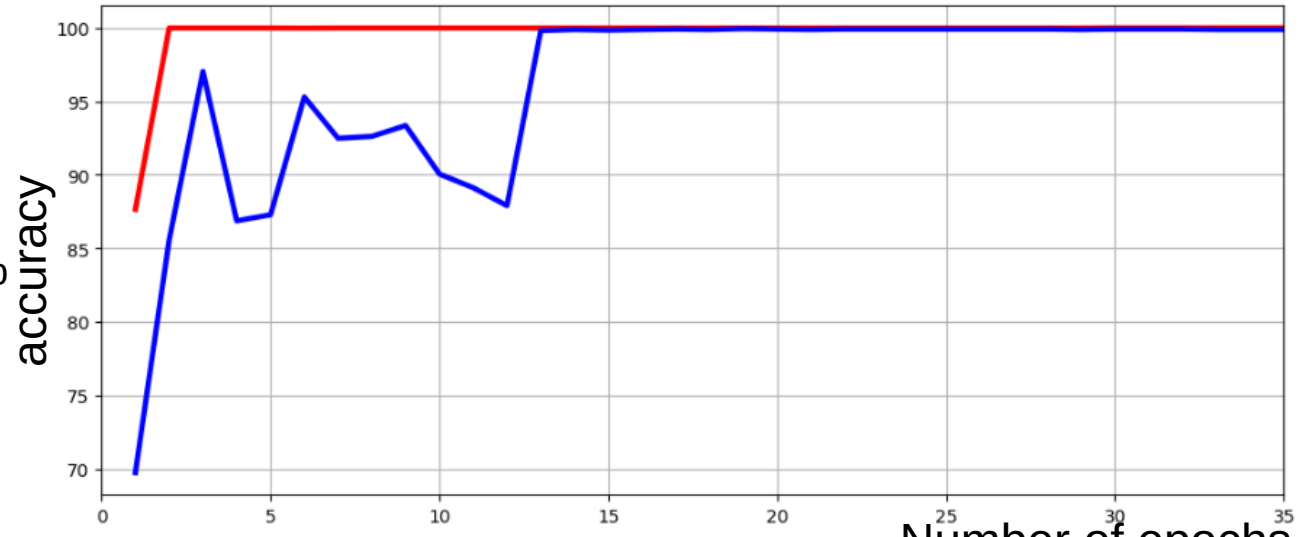
- Training accuracy
- Validation accuracy

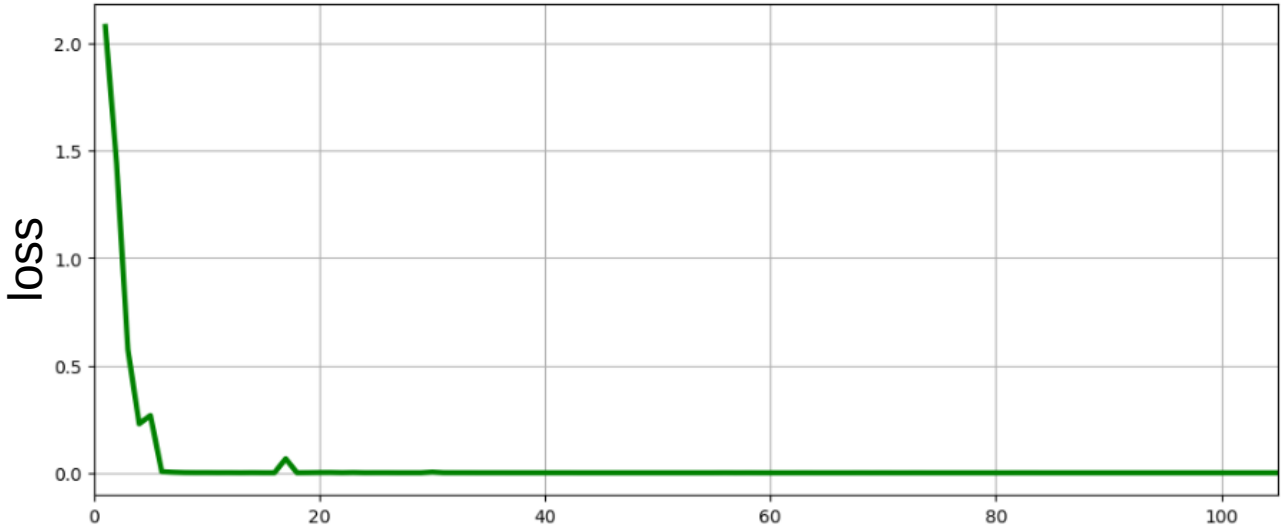
training accuracy: 100.00%
valid accuracy: 99.88%
Test accuracy: 99.96%

Number of epochs = 35

- Loss

Loss function:
cross entropy





LOGmon and standard algorithm results comparing

Parameters	LOGmon	Standard algorithm
Probability of error detection	97.19%	47.02%
Precision	99.99%	95.52%
Recall	97.21%	62.87%

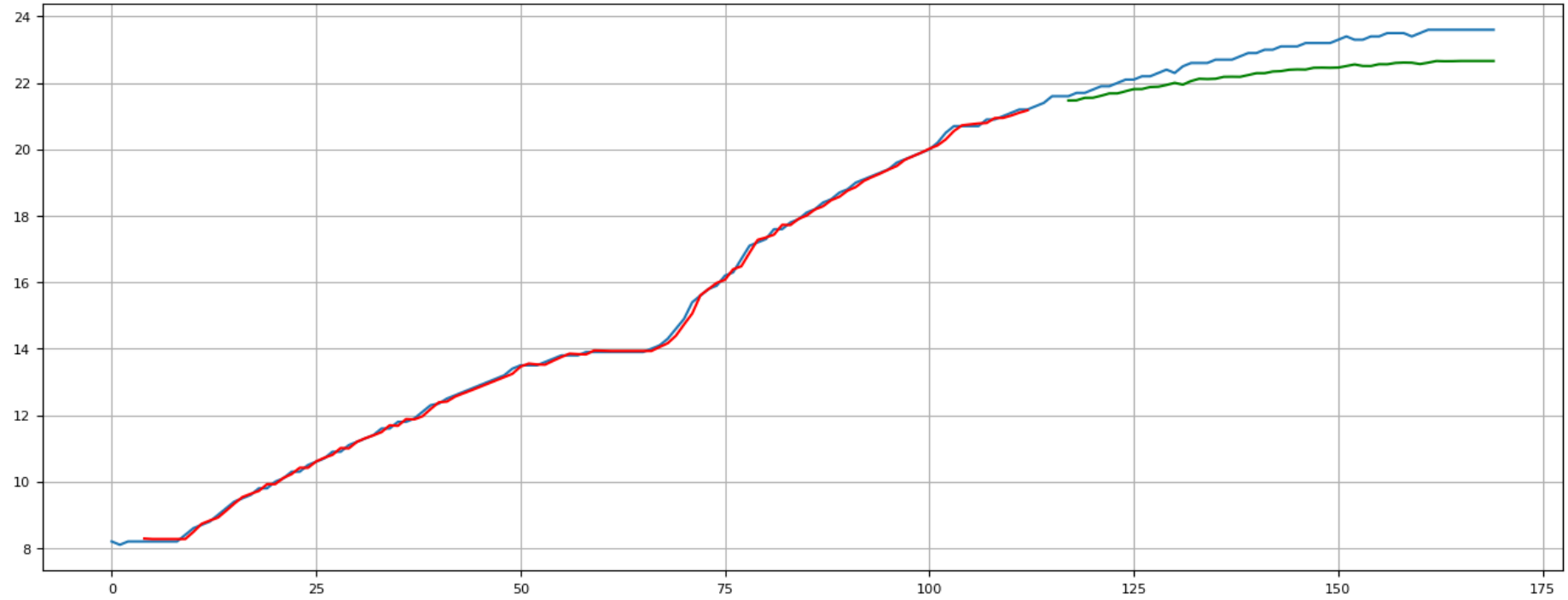
Conclusions

- The main requirements are formulated and the task is set
- Developed a neural network algorithm for log monitoring
- An augmented training dataset was created
- The developed LSTM neural model is trained and tested
- The error recognition efficiency of the trained neural model outperforms the standard algorithm by 50.2%.

Wet cooling tower coolant temperature prediction

Graph that contains 170 points of coolant temperature during an accident 2023-09-18

Wet cooling tower coolant temperature prediction result: LSTM model

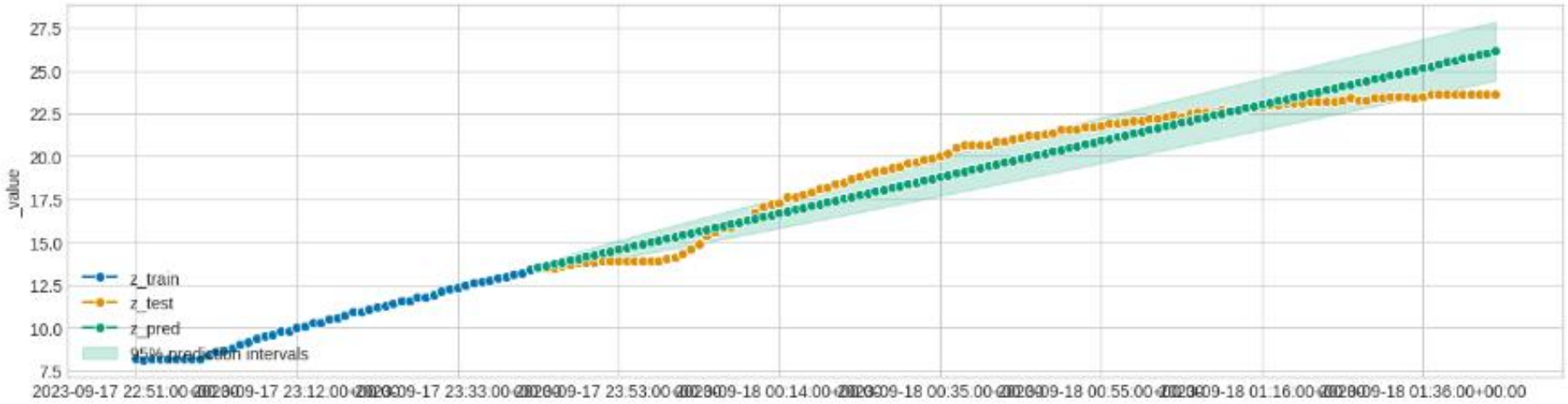


Blue – real data

RED – trained data

Green – model prediction

Wet cooling tower coolant temperature prediction result: ARIMA



Blue – real data

Yellow – (real data)prediciton interval = 120 points

Green – model prediction

Wet cooling tower coolant temperature overal result

- ARIMA understands the trend better, while the neural model imitates the chart better
- Perhaps if the training sample were larger - the prediction would be better
- ARIMA modeling was completed in 2.5 seconds, which is not bad
- Combining the trend from arima

Thank you for your attention!

Backup

correctable_disk_errors = 18
kernel_errors = 0
hardware_errors = 0
all_seems_good = 283
critical_disk_errors = 0
kernel_panic = 0
network_errors = 0
uncorrectable_memory_errors = 0
raid errors = 0

Logs monitoring algorithm operation classsification examples

[root@litmon-01 miramir_plugins]# ssh lxvmgk 'conda activate /home/log_analyzer_batch_4.0; /usr/bin/python3 /home/log_analyzer_batch_4.0/log_analyzer_10.10.py -s 2024-09-20T00:00:00 -e 2024-09-24T18:00:00 -H rdd033'

========== correctable_disk_errors ==========

2024-09-24T14:20:02 rdd033 iDRAC, Update FW, Install OS)
 [111074.040253] Restarting system.
 [111072.618559] blk_update_request: I/O error, dev sdr, sector 16031442456

2024-09-24T14:20:02 rdd033 [111074.040253] Restarting system.
 [111072.618559] blk_update_request: I/O error, dev sdr, sector 16031442456
 [111072.618546] blk_update_request: I/O error, dev sds, sector 16031442440

2024-09-24T14:20:02 rdd033 [111072.618559] blk_update_request: I/O error, dev sdr, sector 16031442456
 [111072.618546] blk_update_request: I/O error, dev sds, sector 16031442440
 [111072.618539] blk_update_request: I/O error, dev sdn, sector 17868230856

2024-09-24T14:20:02 rdd033 [111072.618546] blk_update_request: I/O error, dev sds, sector 16031442440
 [111072.618539] blk_update_request: I/O error, dev sdn, sector 17868230856
 [111072.618532] blk_update_request: I/O error, dev sdf, sector 16031442448

2024-09-24T14:20:02 rdd033 [111072.618539] blk_update_request: I/O error, dev sdn, sector 17868230856
 [111072.618532] blk_update_request: I/O error, dev sdf, sector 16031442448
 [111072.618520] blk_update_request: I/O error, dev sdr, sector 16031442440

2024-09-24T14:20:02 rdd033 [111072.618532] blk_update_request: I/O error, dev sdf, sector 16031442448
 [111072.618520] blk_update_request: I/O error, dev sdr, sector 16031442440
 [111072.618514] blk_update_request: I/O error, dev sdk, sector 17942202696

2024-09-24T14:20:02 rdd033 [111072.618520] blk_update_request: I/O error, dev sdr, sector 16031442440
 [111072.618514] blk_update_request: I/O error, dev sdk, sector 17942202696
 [111072.123780] blk_update_request: I/O error, dev sda, sector 936637968

2024-09-24T14:20:02 rdd033 [111072.618514] blk_update_request: I/O error, dev sdk, sector 17942202696
 [111072.123780] blk_update_request: I/O error, dev sda, sector 936637968
 [111072.115994] blk_update_request: I/O error, dev sda, sector 936637456

2024-09-24T14:20:02 rdd033 [111072.123780] blk_update_request: I/O error, dev sda, sector 936637968
 [111072.115994] blk_update_request: I/O error, dev sda, sector 936637456
 [111072.108173] blk_update_request: I/O error, dev sda, sector 260459024

2024-09-24T14:20:02 rdd033 [111072.115994] blk_update_request: I/O error, dev sda, sector 936637456
 [111072.108173] blk_update_request: I/O error, dev sda, sector 260459024
 [111072.100258] blk_update_request: I/O error, dev sda, sector 910576480

2024-09-22T10:40:05 rdd033-20240922-073911 iDRAC IPV4: 192.168.230.198
 [13160.423579] Restarting system.
 [13158.013585] blk_update_request: I/O error, dev sdy, sector 936637968

2024-09-22T10:40:05 rdd033-20240922-073911 [13160.423579] Restarting system.
 [13158.013585] blk_update_request: I/O error, dev sdy, sector 936637968
 [13158.005958] blk_update_request: I/O error, dev sdy, sector 936637456

2024-09-22T10:40:05 rdd033-20240922-073911 [13158.013585] blk_update_request: I/O error, dev sdy, sector 936637968
 [13158.005958] blk_update_request: I/O error, dev sdy, sector 936637456
 [13157.998166] blk_update_request: I/O error, dev sdy, sector 260459024

2024-09-22T10:40:05 rdd033-20240922-073911 [13158.005958] blk_update_request: I/O error, dev sdy, sector 936637456
 [13157.998166] blk_update_request: I/O error, dev sdy, sector 260459024
 [13157.990309] blk_update_request: I/O error, dev sdy, sector 904241784

2024-09-21T23:00:02 rdd033 iDRAC, Update FW, Install OS)
 [13160.423579] Restarting system.
 [13158.013585] blk_update_request: I/O error, dev sdy, sector 936637968

2024-09-22T10:40:05 rdd033-20240922-073911 [13160.423579] Restarting system.
 [13158.013585] blk_update_request: I/O error, dev sdy, sector 936637968
 [13158.005958] blk_update_request: I/O error, dev sdy, sector 936637456

2024-09-22T10:40:05 rdd033-20240922-073911 [13158.013585] blk_update_request: I/O error, dev sdy, sector 936637968
 [13158.005958] blk_update_request: I/O error, dev sdy, sector 936637456
 [13157.998166] blk_update_request: I/O error, dev sdy, sector 260459024

2024-09-22T10:40:05 rdd033-20240922-073911 [13158.005958] blk_update_request: I/O error, dev sdy, sector 936637456
 [13157.998166] blk_update_request: I/O error, dev sdy, sector 260459024
 [13157.990309] blk_update_request: I/O error, dev sdy, sector 904241784

correctable_disk_errors = 1
kernel_errors = 28
hardware_errors = 1
all_seems_good = 33
critical_disk_errors = 0
kernel_panic = 1
network_errors = 0
uncorrectable_memory_errors = 0
raid errors = 1

Logs monitoring algorithm operation classsification examples

[root@litmon-01 miramir_plugins]# ssh lxvmgk 'conda activate /home/log_analyzer_batch_4.0; /usr/bin/python3 /home/log_analyzer_batch_4.0/log_analyzer_10.10.py -s 2024-10-01T00:00:00 -e 2024-10-10T18:00:00 -H wn222‘

========== hardware_errors ==========

2024-10-06T02:40:02 wn222 [9787171.328904] Hardware name: Supermicro SBI-4429P-T2N/B11DPT, BIOS 3.3a 03/16/2020
 [9787171.317102] CPU: 0 PID: 25000 Comm: hbt_auau_simu_d Tainted: P O ---------- T 3.10.0-1160.119.1.el7.x86_64 #1
 [9787171.235287] Modules linked in: overlay(T) nfsv3 nfs_acl fuse openafs(PO) rpcsec_gss_krb5 nfsv4 dns_resolver nfs lockd grace fscache ip6t_REJECT nf_reject_ipv6 ip6table_filter ip6_tables ipt_REJECT nf_reject_ipv4 xt_multiport iptable_filter ext4 mbcache jbd2 iTCO_wdt iTCO_vendor_support skx_edac intel_powerclamp coretemp intel_rapl iosf_mbi kvm_intel kvm irqbypass crc32_pclmul ghash_clmulni_intel aesni_intel lrw gf128mul glue_helper ablk_helper raid0 cryptd pcspkr mei_me joydev mei i2c_i801 wmi lpc_ich ipmi_si ipmi_devintf ipmi_msghandler acpi_power_meter acpi_pad tcp_htcp auth_rpcgss sunrpc ip_tables xfs libcrc32c raid1 ast i2c_algo_bit drm_kms_helper syscopyarea sysfillrect sysimgblt fb_sys_fops ttm i40e crct10dif_pclmul drm crct10dif_common crc32c_intel nvme nvme_core ptp pps_core drm_panel_orientation_quirks nfit libnvdimm dm_mirror dm_region_hash dm_log dm_mod

========== kernel_panic ==========

2024-10-06T02:40:02 wn222 [9787171.802569] Rebooting in 60 seconds..
 [9787171.723682] Kernel Offset: 0x1a000000 from 0xffffffff81000000 (relocation range: 0xffffffff80000000-0xffffffffbfffffff)
 [9787171.691848] Kernel panic - not syncing: Fatal exception

========== raid_errors ==========

2024-10-06T02:40:02 wn222 [9787171.723682] Kernel Offset: 0x1a000000 from 0xffffffff81000000 (relocation range: 0xffffffff80000000-0xffffffffbfffffff)
 [9787171.691848] Kernel panic - not syncing: Fatal exception
 [9787171.618711] ---[end trace 611c29b13b52a5db]---

Logs monitoring algorithm operation classsification examples

correctable_disk_errors = 1
kernel_errors = 28
hardware_errors = 1
all_seems_good = 33
critical_disk_errors = 0
kernel_panic = 1
network_errors = 0
uncorrectable_memory_errors = 0
raid errors = 1

[root@litmon-01 miramir_plugins]# ssh lxvmgk 'conda activate /home/log_analyzer_batch_4.0; /usr/bin/python3 /home/log_analyzer_batch_4.0/log_analyzer_10.10.py -s 2024-10-01T00:00:00 -e 2024-10-10T18:00:00 -H wn222'

============== correctable_disk_errors ==============
2024-10-06T02:40:02 wn222 [9787171.612479] RSP <ffff9b7e33a5b5e0>
 [9787171.604498] RIP [<ffffffffc0d7f579>] afs_linux_raw_open+0x109/0x110 [openafs]
 [9787171.582758] Code: 00 00 00 48 89 5d e0 48 89 45 d8 e8 f2 a0 4d da 48 3d 00 f0 ff ff 49 89 c4 76 90 89 c6 48 c7 c7 20 1e da c0 31 c0 e8 c6 c2 a2 da <0f> 0b 0f 1f 44 00 00 0f 1f 44 00 00 55 8b 15 cc a1 02 00 83 05
============== kernel_errors ==============
2024-10-06T02:40:02 wn222 [9787171.618711] ---[end trace 611c29b13b52a5db]---
 [9787171.612479] RSP <ffff9b7e33a5b5e0>
 [9787171.604498] RIP [<ffffffffc0d7f579>] afs_linux_raw_open+0x109/0x110 [openafs]
2024-10-06T02:40:02 wn222 [9787171.604498] RIP [<ffffffffc0d7f579>] afs_linux_raw_open+0x109/0x110 [openafs]
 [9787171.582758] Code: 00 00 00 48 89 5d e0 48 89 45 d8 e8 f2 a0 4d da 48 3d 00 f0 ff ff 49 89 c4 76 90 89 c6 48 c7 c7 20 1e da c0 31 c0 e8 c6 c2 a2 da <0f> 0b 0f 1f 44 00 00 0f 1f 44 00 00 55 8b 15 cc a1 02 00 83 05
 [9787171.576896] [<ffffffff9b7c56f7>] int_signal+0x12/0x17
2024-10-06T02:40:02 wn222 [9787171.582758] Code: 00 00 00 48 89 5d e0 48 89 45 d8 e8 f2 a0 4d da 48 3d 00 f0 ff ff 49 89 c4 76 90 89 c6 48 c7 c7 20 1e da c0 31 c0 e8 c6 c2 a2 da <0f> 0b 0f 1f 44 00 00 0f 1f 44 00 00 55 8b 15 cc a1 02 00 83 05
 [9787171.576896] [<ffffffff9b7c56f7>] int_signal+0x12/0x17
 [9787171.570511] [<ffffffff9b02dcca>] do_notify_resume+0x7a/0xd0
2024-10-06T02:40:02 wn222 [9787171.576896] [<ffffffff9b7c56f7>] int_signal+0x12/0x17
 [9787171.570511] [<ffffffff9b02dcca>] do_notify_resume+0x7a/0xd0
 [9787171.563948] [<ffffffff9b0b711d>] ? do_send_specific+0x7d/0xa0
2024-10-06T02:40:02 wn222 [9787171.570511] [<ffffffff9b02dcca>] do_notify_resume+0x7a/0xd0
 [9787171.563948] [<ffffffff9b0b711d>] ? do_send_specific+0x7d/0xa0
 [9787171.558077] [<ffffffff9b02d5b7>] do_signal+0x57/0x6f0
2024-10-06T02:40:02 wn222 [9787171.563948] [<ffffffff9b0b711d>] ? do_send_specific+0x7d/0xa0
 [9787171.558077] [<ffffffff9b02d5b7>] do_signal+0x57/0x6f0
 [9787171.551075] [<ffffffff9b0b8255>] get_signal_to_deliver+0x1c5/0x5e0
2024-10-06T02:40:02 wn222 [9787171.558077] [<ffffffff9b02d5b7>] do_signal+0x57/0x6f0
 [9787171.551075] [<ffffffff9b0b8255>] get_signal_to_deliver+0x1c5/0x5e0
 [9787171.543899] [<ffffffff9b0b4d63>] ? __sigqueue_free.part.13+0x33/0x40
2024-10-06T02:40:02 wn222 [9787171.551075] [<ffffffff9b0b8255>] get_signal_to_deliver+0x1c5/0x5e0
 [9787171.543899] [<ffffffff9b0b4d63>] ? __sigqueue_free.part.13+0x33/0x40
 [9787171.536468] [<ffffffffc068500e>] ? __xfs_filemap_fault+0x8e/0x1d0 [xfs]
2024-10-06T02:40:02 wn222 [9787171.543899] [<ffffffff9b0b4d63>] ? __sigqueue_free.part.13+0x33/0x40
 [9787171.536468] [<ffffffffc068500e>] ? __xfs_filemap_fault+0x8e/0x1d0 [xfs]
 [9787171.529794] [<ffffffff9b0d8e02>] ? __wake_up_common+0x82/0x120
2024-10-06T02:40:02 wn222 [9787171.536468] [<ffffffffc068500e>] ? __xfs_filemap_fault+0x8e/0x1d0 [xfs]
 [9787171.529794] [<ffffffff9b0d8e02>] ? __wake_up_common+0x82/0x120
 [9787171.523662] [<ffffffff9b2ca337>] do_coredump+0x827/0xac0
2024-10-06T02:40:02 wn222 [9787171.529794] [<ffffffff9b0d8e02>] ? __wake_up_common+0x82/0x120
 [9787171.523662] [<ffffffff9b2ca337>] do_coredump+0x827/0xac0
 [9787171.517355] [<ffffffff9b2c45ea>] elf_core_dump+0x85a/0x970
2024-10-06T02:40:02 wn222 [9787171.523662] [<ffffffff9b2ca337>] do_coredump+0x827/0xac0
 [9787171.517355] [<ffffffff9b2c45ea>] elf_core_dump+0x85a/0x970
 [9787171.511480] [<ffffffff9b2c92d8>] dump_write+0x58/0x80
2024-10-06T02:40:02 wn222 [9787171.517355] [<ffffffff9b2c45ea>] elf_core_dump+0x85a/0x970
 [9787171.511480] [<ffffffff9b2c92d8>] dump_write+0x58/0x80
 [9787171.505345] [<ffffffff9b25b2b3>] do_sync_write+0x93/0xe0
2024-10-06T02:40:02 wn222 [9787171.511480] [<ffffffff9b2c92d8>] dump_write+0x58/0x80
 [9787171.505345] [<ffffffff9b25b2b3>] do_sync_write+0x93/0xe0
 [9787171.497644] [<ffffffffc0d86439>] afs_linux_aio_write+0x249/0x490 [openafs]
2024-10-06T02:40:02 wn222 [9787171.505345] [<ffffffff9b25b2b3>] do_sync_write+0x93/0xe0
 [9787171.497644] [<ffffffffc0d86439>] afs_linux_aio_write+0x249/0x490 [openafs]
 [9787171.490732] [<ffffffff9b1cb939>] generic_file_aio_write+0x59/0xa0
2024-10-06T02:40:02 wn222 [9787171.497644] [<ffffffffc0d86439>] afs_linux_aio_write+0x249/0x490 [openafs]
 [9787171.490732] [<ffffffff9b1cb939>] generic_file_aio_write+0x59/0xa0
 [9787171.483478] [<ffffffff9b1cb6ca>] __generic_file_aio_write+0x1ea/0x400
2024-10-06T02:40:02 wn222 [9787171.490732] [<ffffffff9b1cb939>] generic_file_aio_write+0x59/0xa0
 [9787171.483478] [<ffffffff9b1cb6ca>] __generic_file_aio_write+0x1ea/0x400
 [9787171.475967] [<ffffffff9b1c89d4>] generic_file_buffered_write+0x164/0x270
2024-10-06T02:40:02 wn222 [9787171.483478] [<ffffffff9b1cb6ca>] __generic_file_aio_write+0x1ea/0x400
 [9787171.475967] [<ffffffff9b1c89d4>] generic_file_buffered_write+0x164/0x270
 [9787171.468276] [<ffffffffc0d86e93>] afs_linux_write_end+0x1f3/0x500 [openafs]
2024-10-06T02:40:02 wn222 [9787171.475967] [<ffffffff9b1c89d4>] generic_file_buffered_write+0x164/0x270
 [9787171.468276] [<ffffffffc0d86e93>] afs_linux_write_end+0x1f3/0x500 [openafs]
 [9787171.460144] [<ffffffffc0d84c82>] afs_linux_page_writeback+0x152/0x2a0 [openafs]
2024-10-06T02:40:02 wn222 [9787171.468276] [<ffffffffc0d86e93>] afs_linux_write_end+0x1f3/0x500 [openafs]
 [9787171.460144] [<ffffffffc0d84c82>] afs_linux_page_writeback+0x152/0x2a0 [openafs]
 [9787171.453062] [<ffffffffc0d57572>] afs_UFSWrite+0x262/0x620 [openafs]
2024-10-06T02:40:02 wn222 [9787171.460144] [<ffffffffc0d84c82>] afs_linux_page_writeback+0x152/0x2a0 [openafs]
 [9787171.453062] [<ffffffffc0d57572>] afs_UFSWrite+0x262/0x620 [openafs]
 [9787171.446147] [<ffffffffc0d7f62c>] osi_UFSOpen+0xac/0x180 [openafs]
2024-10-06T02:40:02 wn222 [9787171.453062] [<ffffffffc0d57572>] afs_UFSWrite+0x262/0x620 [openafs]
 [9787171.446147] [<ffffffffc0d7f62c>] osi_UFSOpen+0xac/0x180 [openafs]
 [9787171.442966] Call Trace:
2024-10-06T02:40:02 wn222 [9787171.446147] [<ffffffffc0d7f62c>] osi_UFSOpen+0xac/0x180 [openafs]
 [9787171.442966] Call Trace:
 [9787171.439540] PKRU: 55555554
2024-10-06T02:40:02 wn222 [9787171.442966] Call Trace:
 [9787171.439540] PKRU: 55555554
 [9787171.431689] DR3: 0000000000000000 DR6: 00000000fffe0ff0 DR7: 0000000000000400
2024-10-06T02:40:02 wn222 [9787171.439540] PKRU: 55555554
 [9787171.431689] DR3: 0000000000000000 DR6: 00000000fffe0ff0 DR7: 0000000000000400
 [9787171.423830] DR0: 0000000000000000 DR1: 0000000000000000 DR2: 0000000000000000
2024-10-06T02:40:02 wn222 [9787171.431689] DR3: 0000000000000000 DR6: 00000000fffe0ff0 DR7: 0000000000000400
 [9787171.423830] DR0: 0000000000000000 DR1: 0000000000000000 DR2: 0000000000000000
 [9787171.415973] CR2: 00007f24e3022070 CR3: 0000000b98546000 CR4: 0000000007607f0
2024-10-06T02:40:02 wn222 [9787171.423830] DR0: 0000000000000000 DR1: 0000000000000000 DR2: 0000000000000000
 [9787171.415973] CR2: 00007f24e3022070 CR3: 0000000b98546000 CR4: 0000000007607f0
 [9787171.409511] CS: 0010 DS: 0000 ES: 0000 CR0: 0000000080050033
2024-10-06T02:40:02 wn222 [9787171.361477] RAX: 000000000000001d RBX: ffff9b95ff831740 RCX: 0000000000000000
 [9787171.355460] RSP: 0018:ffff9b7e33a5b5e0 EFLAGS: 00010246
 [9787171.345154] RIP: 0010:[<ffffffffc0d7f579>] [<ffffffffc0d7f579>] afs_linux_raw_open+0x109/0x110 [openafs]

correctable_disk_errors = 0
kernel_errors = 0
hardware_errors = 0
all_seems_good = 2
critical_disk_errors = 0
kernel_panic = 0
network_errors = 0
uncorrectable_memory_errors = 0
raid_errors = 2

Logs monitoring algorithm operation classsification examples

Узел | Службы | История

ВКЛЮЧЕН с Oct 22 — rdz13.jinr.ru 159.93.225.228

13 служб: 1 12

OK Sep 22	check_idrac_status	OK - DELL status - ok
КРИТИЧНО 32m 52s	check_logs !	==========raid_errors==========
OK Sep 14	check_servers_ssd_remaining_endurance_tier-2	OK - ssd_remaining_endurance: Disk.Bay.12- Enclosure.Internal.0-1- RAID.Integrated.1-1- 58%
OK 1d 19h	check_servers_temp_tier_2	OK - temperature status: Inlet - 15, Exhaust - 30, CPU1 - 44, CPU2 - 48;
OK Oct 22	nrpe_check_afs_mount	OK - afs successfully mount!
OK Oct 23	nrpe_check_cpu_ram	OK - cores = 56, RAM = 125.0 Gb
OK Aug 19	nrpe_check_hdd_temp	OK - disk_tempepature sda=21 sdb=21 sdc=21 sdd=21 sde=20 sdf=22 sdg=22 sdh=21 sdi=22 sdj=21 sdk=21 sdl=22 sdm=42 sdn=40 sdo=31 sdp=31 sdq=30 sdr=33;
OK Oct 22	nrpe_check_load	OK - load average per CPU: 0.06, 0.07, 0.08
OK Oct 22	nrpe_check_network_interface	OK - network_interface 'eno1 - UP : 10000Mb/s';
OK 14:20	nrpe_check_raid_status	OK - raid controller state is [], failed disk: ['None'], zpool_status: ONLINE, resilvered: none
OK 14:00	nrpe_check_smart	OK - remaining_endurance {}; relocated_sectors {'sdm': '32', 'sdn': '0'}, pending_sectors {};
OK Oct 22	nrpe_check_var_dir	OK - /tmp dir filled - 3%
OK Oct 22	nrpe_check_var_dir	OK - /var dir filled - 3%

Узел | Служба | Службы | История

ВКЛЮЧЕН с Oct 22 — rdz13.jinr.ru 159.93.225.228

КРИТИЧНО для 32m 52s — Служба: **check_logs** !

Подтверждено | Проверить | Комментарий | Оповещение | Время простоя

Вывод плагина

==========raid_errors==========

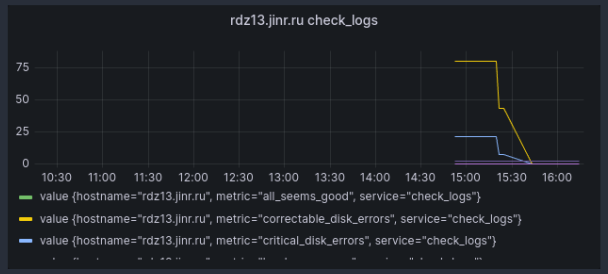
2024-11-01T13:20:02 **rdz13**
[844751.897151] md/raid1:md0: Operation continuing on 1 devices.
[844751.897151] md/raid1:md0: Disk failure on sdn5, disabling device.
2024-11-01T13:20:02 **rdz13**
[844751.897151] md/raid1:md0: Disk failure on sdn5, disabling device.
[844729.952902] md/raid1:md10: Operation continuing on 1 devices.
[844729.952902] md/raid1:md10: Disk failure on sdn4, disabling device.

CRITICAL

correctable_disk_errors=0, kernel_errors=0, hardware_errors=0, all_seems_good=2, critical_disk_errors=0, kernel_panic=0, network_errors=0, uncorrectable_memory_errors=0, raid_errors=2

Performance Graph

Minutes | Hours | Days | Months | Years | Special



Обработка событий

Не обработано	Подтверждено
Комментарии	Добавить комментарий
Времени простоя	Запланировать время простоя

Данные производительности

Название	Значение
network_errors	-
correctable_disk_errors	0.00
kernel_errors	0.00
hardware_errors	0.00
all_seems_good	2.00
critical_disk_errors	0.00
kernel_panic	0.00
raid_errors	2.00

Logs monitoring algorithm based on LSTM

- Using regular expressions, data is collected from the log database and elements are formed from them. In our case, each such element consists of a line with errors th and 2 preceding lines. Next, they are assigned certain numbers that correspond to a specific class of errors. In our case, 0 means no errors, 1 means kernel errors, etc.
- Next, you need to tokenize words into numbers. In this way, vectors for the training set are created.
- Creation of a NN. In our case, we use a neural network with an embeding layer of 128 neurons, a hidden layer of LSTM cells of 256 neurons and an output layer of 8 neurons (each neuron is responsible for a specific class of errors), an ADAM optimizer, and the activation function of the output layer is linear.

LOGmon model testing results

errors recognition=99

Number of errors in the training set by type	Units
correctable_disk_error	347
kernel_errors	726
hardware_errors	81
all_seems_good	14793
critical_disk_errors	5
kernel_panic	2
network_errors	1
uncorrectable_memory_errors	0

recall = 97.21%
precision = 0.99%

true_positive=9566
false_positive=449
false_negative=5650
true_negative=292

LogMon model testing: formulas

accuracy = (true_positive+true_negative) / (true_positive+true_negative+false_positive+false_negative)

precision = (true_positive)/(true_positive+false_positive)
recall = TPR = true_positive/(true_positive+false_negative)
Sp = TNR = true_negative/(true_positive)+false_positive)
purity = (1 - precision)

f1_score = F1 = (2 * true_positive)/ (2*true_positive_list+false_positive+false_negative)

probability of error detection = true_negative model prediction / true_negative real * 100%

Algorithm for monitoring serial console logs of JINR MICC LIT servers

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November 2024