A Framework for System Event Classification and Prediction by Means of Machine Learning

Teerat Pitakrat, Jonas Grunert, Oliver Kabierschke,
Fabian Keller and André van Hoorn

University of Stuttgart
Institute of Software Technology (ISTE)
Reliable Software Systems (RSS) Group
Stuttgart, Germany

Dec 10, 2014 @ VALUETOOLS 2014, Bratislava

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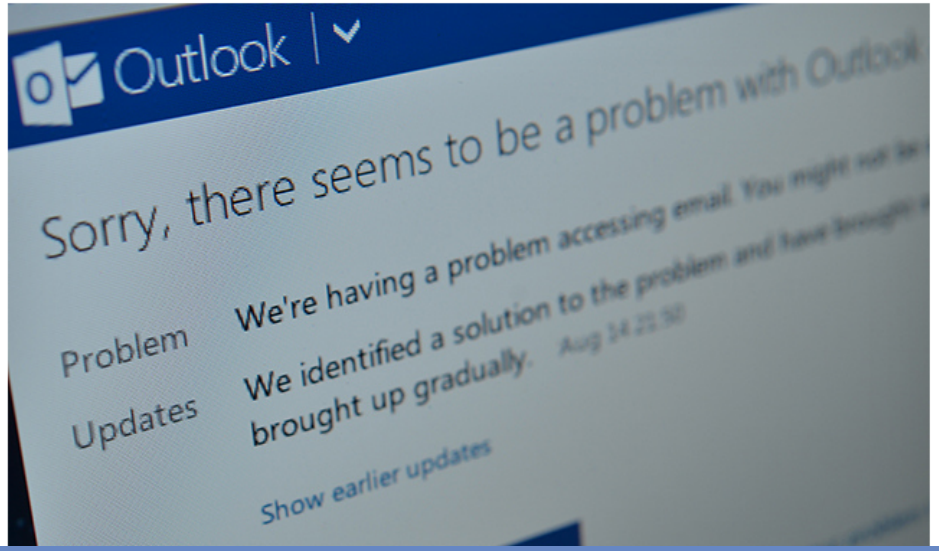

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Failure Events

Motivation: Failure Management

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Instagram was the first of the two to **publicly acknowledge** its issues on Twitter, and Vine followed suit **half an hour later**.

The deluge of tweets that accompanied the services' initial hiccups first started at around 4 p.m. Eastern time, and only increased in intensity as users found they couldn't share pictures of their food or their meticulously crafted video

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You can all relax now. The near-unprecedented outage that seemingly affected all of Google's services for a brief time on Friday is over.

The event began at approximately 4:37pm Pacific Time and lasted between one and five minutes, according to the Google Apps Dashboard. All of the Google Apps services reported being back online by 4:48pm.

The incident apparently blacked out every service Mountain View has to offer simultaneously, from Google Search to Gmail, YouTube, Google Drive, and beyond.

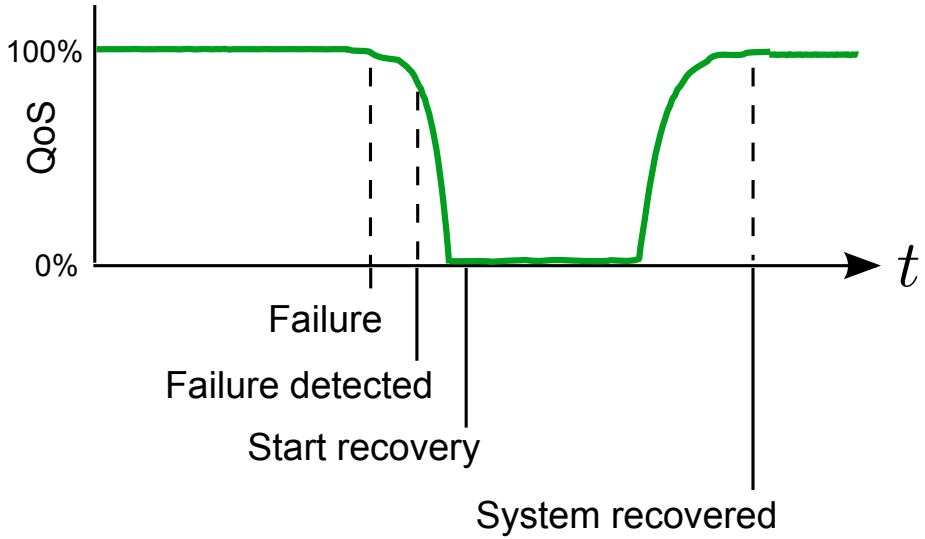
Big deal, right? Everyone has technical difficulties every once in a while. It goes with the territory.

Failure Events

Motivation: Failure Management

Reactive vs. Proactive Failure Mgmt.

Reactive



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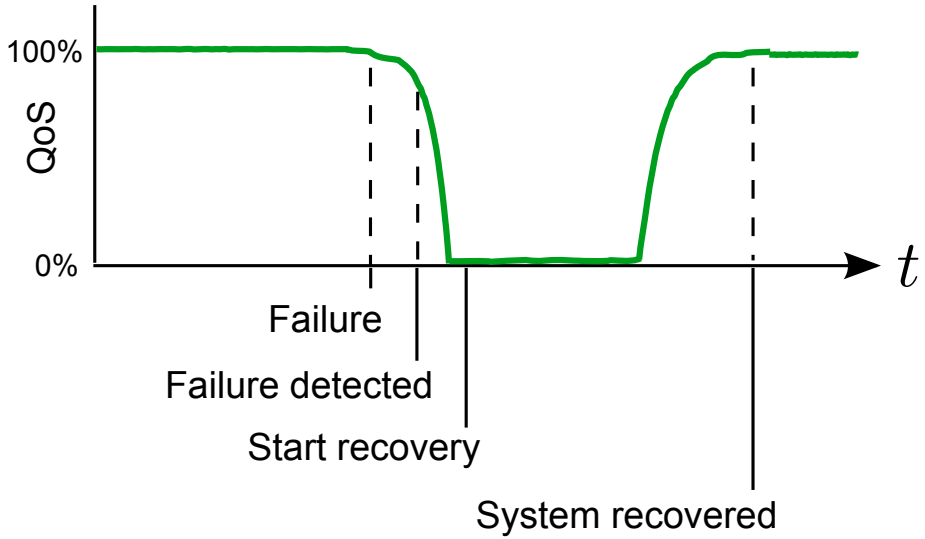
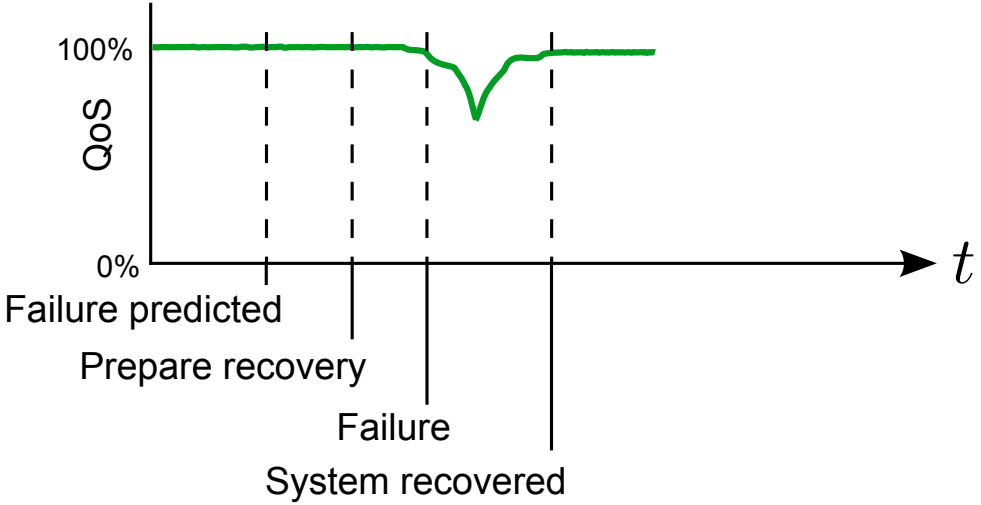


Proactive



Log Files

- Log files can be used for
  - understanding system's behavior
  - diagnosing problems
  - detecting and predicting failures

Log Files

- Log files can be used for
  - understanding system's behavior
  - diagnosing problems
  - detecting and predicting failures
- Example

```
INFO: Reading file X
INFO: Reading complete
INFO: Executing Routine A
INFO: Reading file Y
FATAL: Critical Temperature in Segment Z
```

Contribution: SCAPE

- Goals
  - Automatic classification of similar events
  - Automatic prediction of future events

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  - Automatic classification of similar events
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  - Automatic prediction of future events
- Challenges
  - Log files are huge
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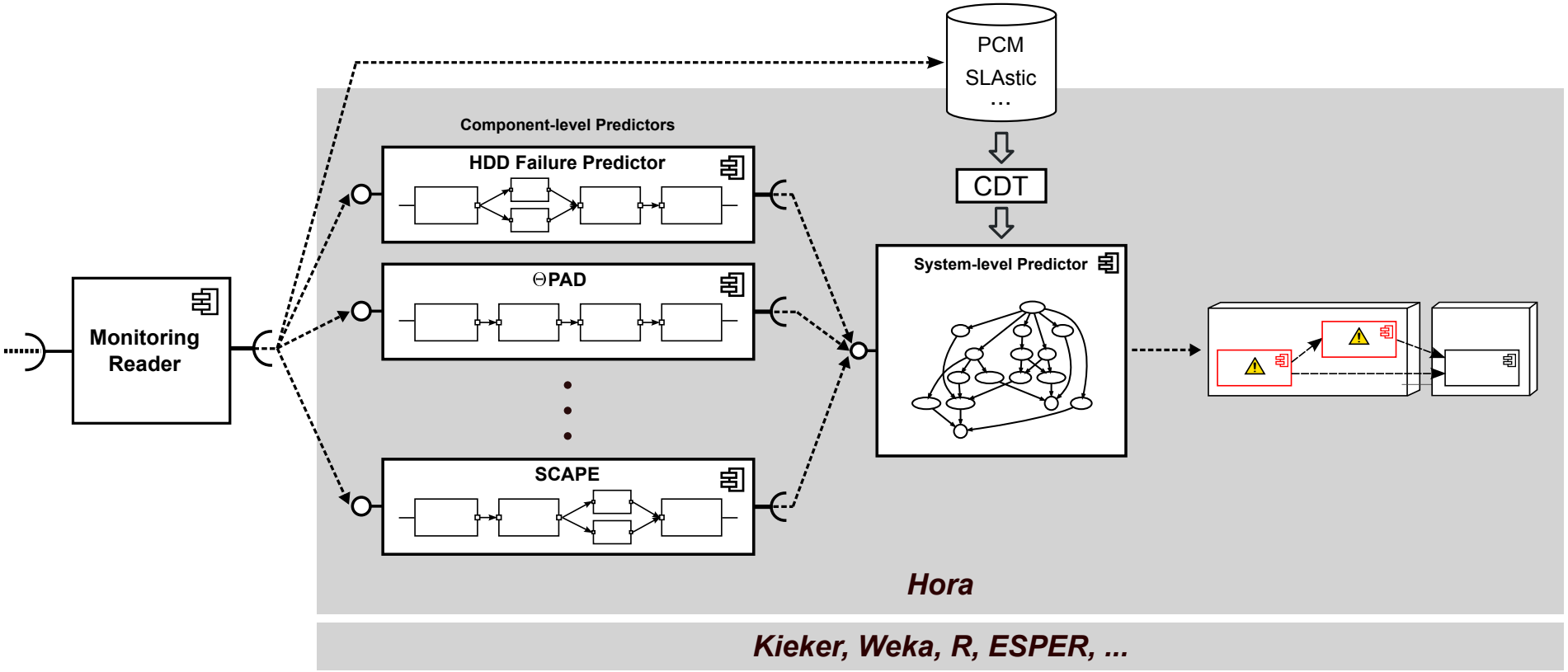
  - Correlated events may not be close to each other
- Approach: SCAPE framework
  - System event Classification And PrEdiction
  - Supports an extensible set of machine learning algorithms
  - Part of Hora approach for online failure prediction

SCAPE as Part of Hora Approach

Motivation: Failure Management



[Becker et al. 2009, Bielefeld 2012, Pitakrat et al. 2013; 2014, van Hoorn 2014]

Agenda

SCAPE: Framework Architecture

- Processing steps
  1. Event Preprocessing
  2. Event Classification
  3. Event Prediction

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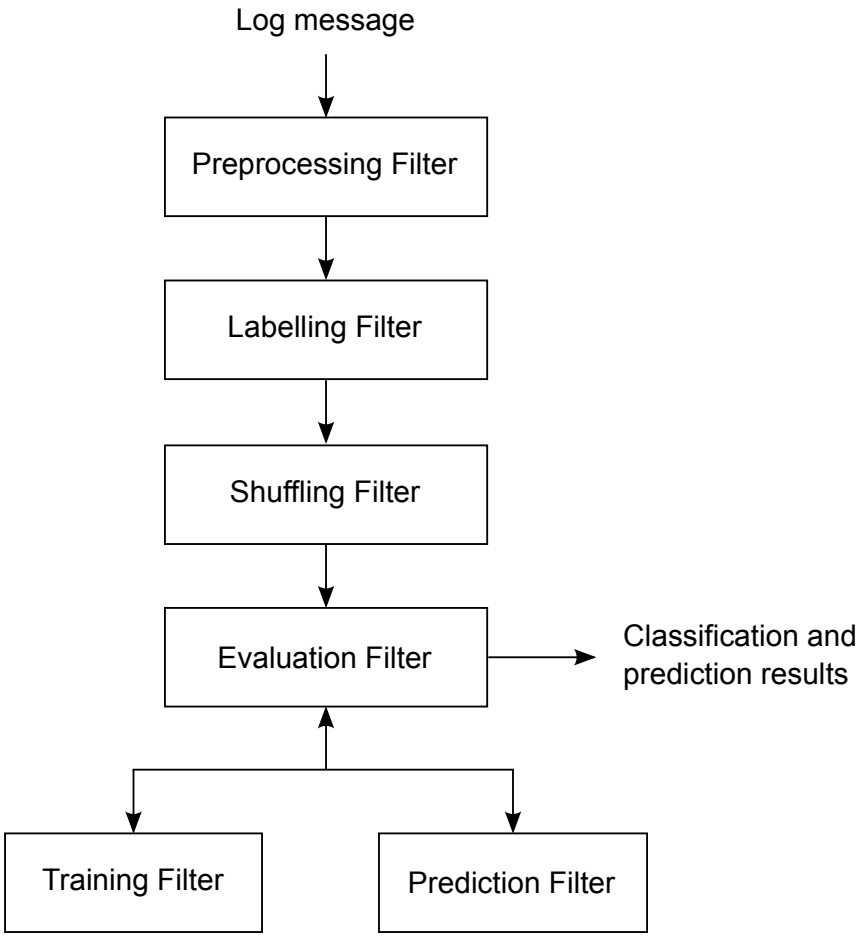

Event Preprocessing

SCAPE Approach

- Normalization [Liang et al. 2007]

- Filtering

Event Preprocessing

- Normalization [Liang et al. 2007]
  1. Removing punctuation, e.g., `. ; : ? ! = - [ ] | < > +`
  2. Removing definite and indefinite articles, e.g., *a*, *an*, *the*
  3. Removing weak words, e.g., *be*, *is are*, *of*, *at*, *such*, *after*, *from*
  4. Replacing all numbers by the word `NUMBER`
  5. Replacing all hex addresses with N digits by the word `NDigitHex_Addr`
  6. Replacing domain specific identifiers by corresponding words such as `REGISTER` or `DIRECTORY`
  7. Replacing all dates by `DATE`
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Event Preprocessing

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- Filtering
  - Adaptive Semantic Filter (ASF) [Liang et al. 2007]
    - Removes highly correlated events (uses Phi correlation coefficient)
  - Duplicate Removal Filter (DRF)
    - Removes similar events

```
4 torus receiver x+ input pipe error(s) (dcr 0x02ec) detected
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Error receiving packet, expecting type 57
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Before normalization

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Before normalization

```
number torus receiver x input pipe error detected
number torus receiver x input pipe error detected
number register edram error detected
number register edram error detected
error receiving packet expecting type number
number torus receiver y input pipe error detected
number torus receiver z input pipe error detected
```

After normalization

```
number torus receiver x input pipe error detected
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Before filtering

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number torus receiver x input pipe error detected
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error receiving packet expecting type number
number torus receiver z input pipe error detected
```

After filtering

Event Classification

SCAPE Approach

Count	Label	Message
1	KERNBIT	KERNEL FATAL ddr: redundant bit steering failed, sequencer timeout
1	KERNEXT	KERNEL FATAL external input interrupt (unit=0x03 bit=0x01): tree header with no target waiting
1	KERNTLBE	KERNEL FATAL instruction TLB error interrupt
1	MONILL	MONITOR FAILURE monitor caught java.lang.IllegalStateException: while executing CONTROL Operation
2	LINKBLL	LINKCARD FATAL MidplaneSwitchController::clearPort() bll_clear_port failed: R63-M0-L0-U19-A
2	MONNULL	MONITOR FAILURE While inserting monitor info into DB caught java.lang.NullPointerException
3	KERNFLOAT	KERNEL FATAL floating point unavailable interrupt
3	KERNRTSA	KERNEL FATAL rts assertion failed: personality->version == BGLPERSONALITY_VERSION in void start() at start.cc:131
3	MMCS	MMCS FATAL L3 major internal error
5	KERNPROG	KERNEL FATAL program interrupt
10	APPTORUS	APP FATAL external input interrupt (unit=0x02 bit=0x00): uncorrectable torus error
10	MASNORM	BGLMASTER FAILURE mmcs_server exited normally with exit code 13
12	MONPOW	MONITOR FAILURE monitor caught java.lang.UnsupportedOperationException: power module U69 not present and is stopping
14	KERNNOETH	KERNEL FATAL no ethernet link
14	LINKPAP	LINKCARD FATAL MidplaneSwitchController::parityAlignment() pap failed: R22-M0-L0-U22-D, status=00000000 00000000
16	KERNCON	KERNEL FATAL MailboxMonitor::serviceMailboxes() lib_ido_error: -1033 BGLERR_IDO_PKT_TIMEOUT
18	KERNPAN	KERNEL FATAL kernel panic
24	LINKDISC	LINKCARD FATAL MidplaneSwitchController::sendTrain() port disconnected: R07-M1-L1-U19-E
37	MASABNORM	BGLMASTER FAILURE mmcs_server exited abnormally due to signal: Aborted
94	KERNSERV	KERNEL FATAL Power Good signal deactivated: R73-M1-N5. A service action may be required.
144	APPALLOC	APP FATAL ciod: Error creating node map from file /p/gb2/draeger/benchmark/dat16k_062205/map16k_bipartyz
166	LINKIAP	LINKCARD FATAL MidplaneSwitchController::receiveTrain() iap failed: R72-M1-L1-U18-A, status=beeaabff ec000000
192	KERNPOW	KERNEL FATAL Power deactivated: R05-M0-N4
209	KERNSOCK	KERNEL FATAL MailboxMonitor::serviceMailboxes() lib_ido_error: -1019 socket closed
320	APPCHILD	APP FATAL ciod: Error creating node map from file /p/gb2/cabot/miranda/newmaps/8k_128x64x1_8x4x4.map
342	KERNMC	KERNEL FATAL machine check interrupt
512	APPBUSY	APP FATAL ciod: Error creating node map from file /p/gb2/pakin1/sweep3d-5x5x400-10mk-3mmi-1024pes-sweep/sweep.map
720	KERNMNT	KERNEL FATAL Error: unable to mount filesystem
816	APPOUT	APP FATAL ciod: LOGIN chdir(/p/gb1/stella/RAPTOR/2183) failed: Input/output error
1503	KERNMICRO	KERNEL FATAL Microloader Assertion
1991	APPTO	APP FATAL ciod: Error reading message prefix on CioStream socket to 172.16.96.116:41739, Connection timed out
2048	APPUNAV	APP FATAL ciod: Error creating node map from file /home/auselton/bgl/64mps.sequential.mapfile
2370	APPRES	APP FATAL ciod: Error reading message prefix after LOAD_MESSAGE on CioStream socket to 172.16.96.116:52783
3983	KERNRTSP	KERNEL FATAL rts panic! - stopping execution
5983	APPREAD	APP FATAL ciod: failed to read message prefix on control stream CioStream socket to 172.16.96.116:33399
6145	KERNREC	KERNEL FATAL Error receiving packet on tree network, expecting type 57 instead of type 3
23338	KERNTERM	KERNEL FATAL rts: kernel terminated for reason 1004rts: bad message header
31531	KERNMNTF	KERNEL FATAL Lustre mount FAILED : bglio11 : block_id : location
49651	APPSEV	APP FATAL ciod: Error reading message prefix after LOGIN_MESSAGE on CioStream socket
63491	KERNSTOR	KERNEL FATAL data storage interrupt
152734	KERNDTLB	KERNEL FATAL data TLB error interrupt
4399503	-	KERNEL INFO instruction cache parity error corrected

Event Classification: Example


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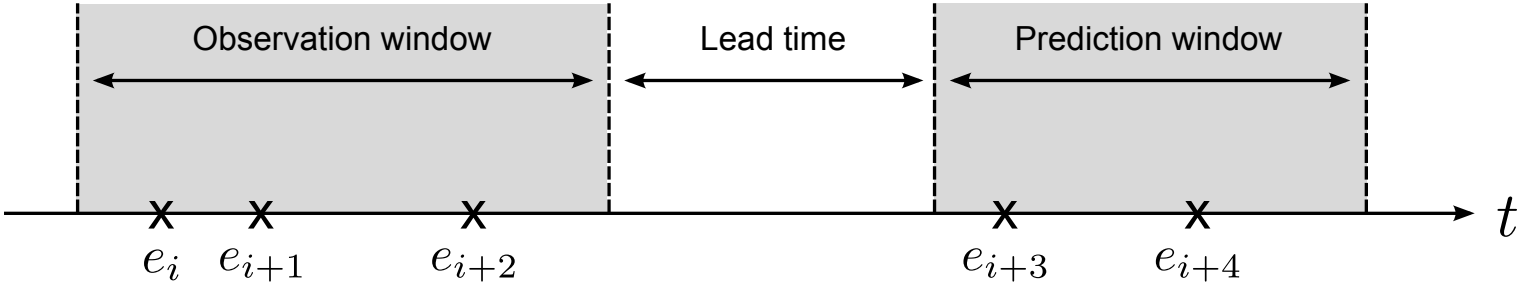
After classification

Event Prediction

SCAPE Approach



Event Prediction

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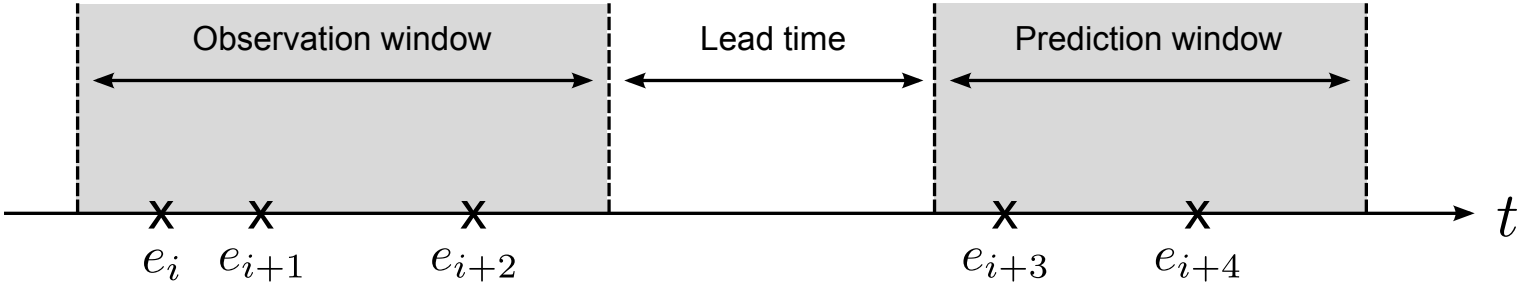


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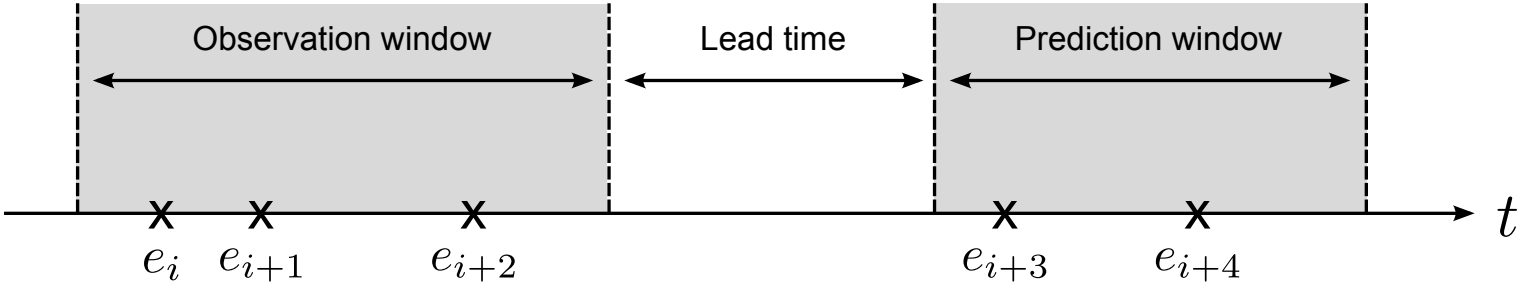

Observation window

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Prediction window

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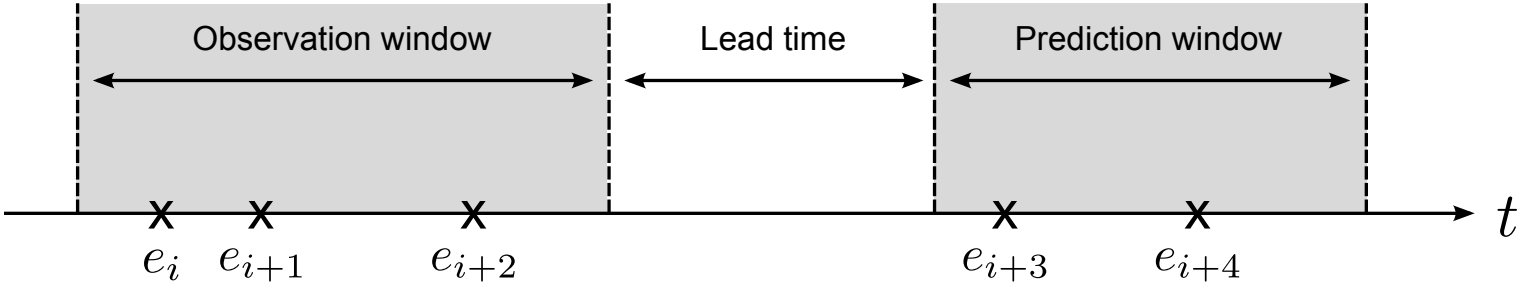

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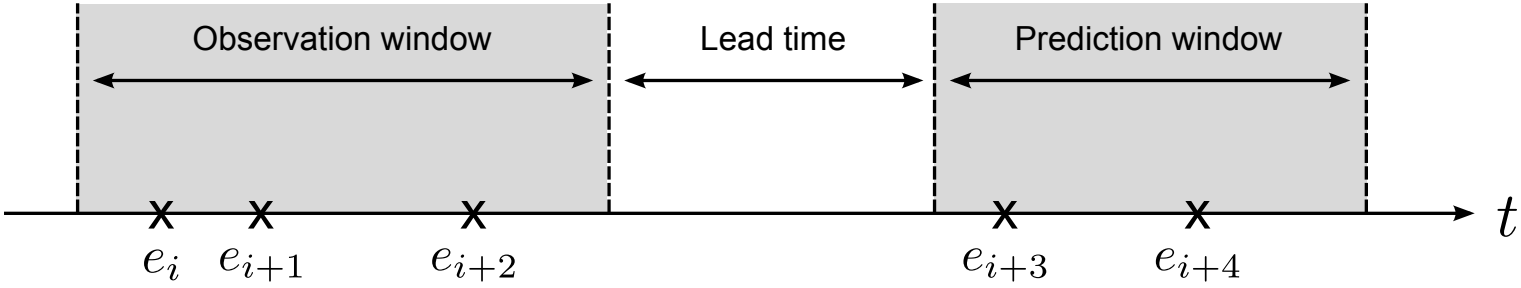


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Investigated parameters:

- Size of observation window
- Lead time
- Size of prediction window
- Sensitivity

Agenda

Experiment Settings

- Research questions
  - RQ1: How do different machine learning algorithms perform for system event classification and prediction?
  - RQ2: What is the impact of event preprocessing on the size of the dataset and on the event classification?

Experiment Settings

University of Stuttgart
Germany

- Research questions
  - RQ1: How do different machine learning algorithms perform for system event classification and prediction?
  - RQ2: What is the impact of event preprocessing on the size of the dataset and on the event classification?
- Blue Gene/L supercomputer [Oliner and Stearley 2007]
  - 131,072 processors and 32,768 GB of RAM
  - 4,747,963 event messages collected over 215 days
  - 10-fold cross-validation

```
- 1121276892 2005.07.13 R14-M1-NA-C:J07-U01 2005-07-13-10.48.12.140895 R14-M1-NA-C:J07-U01 RAS KERNEL INFO CE sym 15, at 0x1f9d7fe0, mask 0x10
- 1121276892 2005.07.13 R30-M1-N2-C:J13-U01 2005-07-13-10.48.12.300650 R30-M1-N2-C:J13-U01 RAS KERNEL INFO total of 2 ddr error(s) detected and corrected
- 1121276892 2005.07.13 R11-M1-N3-C:J07-U11 2005-07-13-10.48.12.325699 R11-M1-N3-C:J07-U11 RAS KERNEL INFO total of 2 ddr error(s) detected and corrected
- 1121276892 2005.07.13 R14-M1-NA-C:J07-U01 2005-07-13-10.48.12.351794 R14-M1-NA-C:J07-U01 RAS KERNEL INFO CE sym 15, at 0x1f9d7fe0, mask 0x10
- 1121276892 2005.07.13 R14-M1-NA-C:J07-U01 2005-07-13-10.48.12.504235 R14-M1-NA-C:J07-U01 RAS KERNEL INFO total of 3 ddr error(s) detected and corrected
- 1121277189 2005.07.13 R22-M0-N6-C:J11-U01 2005-07-13-10.53.09.508589 R22-M0-N6-C:J11-U01 RAS KERNEL INFO 10 ddr errors(s) detected and corrected on rank 0, symbol 3, bit 7
- 1121277189 2005.07.13 R30-M1-N2-C:J13-U01 2005-07-13-10.53.09.543334 R30-M1-N2-C:J13-U01 RAS KERNEL INFO 2 ddr errors(s) detected and corrected on rank 0, symbol 34, bit 1
- 1121277189 2005.07.13 R10-M0-N7-C:J17-U01 2005-07-13-10.53.09.577477 R10-M0-N7-C:J17-U01 RAS KERNEL INFO 1 ddr errors(s) detected and corrected on rank 0, symbol 14, bit 7
- 1121277189 2005.07.13 R11-M1-N3-C:J07-U11 2005-07-13-10.53.09.611816 R11-M1-N3-C:J07-U11 RAS KERNEL INFO 1 ddr errors(s) detected and corrected on rank 0, symbol 16, bit 3
- 1121277189 2005.07.13 R05-M1-N8-C:J14-U01 2005-07-13-10.53.09.647208 R05-M1-N8-C:J14-U01 RAS KERNEL INFO 1 ddr errors(s) detected and corrected on rank 0, symbol 33, bit 3
- 1121277189 2005.07.13 R22-M0-N6-C:J11-U01 2005-07-13-10.53.09.809435 R22-M0-N6-C:J11-U01 RAS KERNEL INFO CE sym 3, at 0x1ee84040, mask 0x01
- 1121277189 2005.07.13 R30-M1-N2-C:J13-U01 2005-07-13-10.53.09.835285 R30-M1-N2-C:J13-U01 RAS KERNEL INFO CE sym 34, at 0x1f00f380, mask 0x40
- 1121277189 2005.07.13 R10-M0-N7-C:J17-U01 2005-07-13-10.53.09.861182 R10-M0-N7-C:J17-U01 RAS KERNEL INFO CE sym 14, at 0x145e5be0, mask 0x01
- 1121277189 2005.07.13 R11-M1-N3-C:J07-U11 2005-07-13-10.53.09.886571 R11-M1-N3-C:J07-U11 RAS KERNEL INFO CE sym 16, at 0x1f8ffe60, mask 0x10
- 1121277189 2005.07.13 R05-M1-N8-C:J14-U01 2005-07-13-10.53.09.912263 R05-M1-N8-C:J14-U01 RAS KERNEL INFO CE sym 33, at 0x019ae900, mask 0x10
- 1121277190 2005.07.13 R22-M0-N6-C:J11-U01 2005-07-13-10.53.10.073925 R22-M0-N6-C:J11-U01 RAS KERNEL INFO CE sym 3, at 0x1ee84040, mask 0x01
- 1121277190 2005.07.13 R30-M1-N2-C:J13-U01 2005-07-13-10.53.10.099159 R30-M1-N2-C:J13-U01 RAS KERNEL INFO CE sym 34, at 0x1f00f380, mask 0x40
- 1121277190 2005.07.13 R10-M0-N7-C:J17-U01 2005-07-13-10.53.10.124117 R10-M0-N7-C:J17-U01 RAS KERNEL INFO total of 1 ddr error(s) detected and corrected
- 1121277190 2005.07.13 R11-M1-N3-C:J07-U11 2005-07-13-10.53.10.149513 R11-M1-N3-C:J07-U11 RAS KERNEL INFO total of 1 ddr error(s) detected and corrected
- 1121277190 2005.07.13 R05-M1-N8-C:J14-U01 2005-07-13-10.53.10.174806 R05-M1-N8-C:J14-U01 RAS KERNEL INFO total of 1 ddr error(s) detected and corrected
- 1121277190 2005.07.13 R22-M0-N6-C:J11-U01 2005-07-13-10.53.10.331540 R22-M0-N6-C:J11-U01 RAS KERNEL INFO CE sym 3, at 0x1ee84040, mask 0x01
- 1121277190 2005.07.13 R30-M1-N2-C:J13-U01 2005-07-13-10.53.10.356653 R30-M1-N2-C:J13-U01 RAS KERNEL INFO total of 2 ddr error(s) detected and corrected
- 1121277190 2005.07.13 R22-M0-N6-C:J11-U01 2005-07-13-10.53.10.509611 R22-M0-N6-C:J11-U01 RAS KERNEL INFO CE sym 3, at 0x1ee84040, mask 0x01
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- 1121277191 2005.07.13 R22-M0-N6-C:J11-U01 2005-07-13-10.53.11.111512 R22-M0-N6-C:J11-U01 RAS KERNEL INFO CE sym 3, at 0x1ee84040, mask 0x01
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- 1121277191 2005.07.13 R22-M0-N6-C:J11-U01 2005-07-13-10.53.11.415198 R22-M0-N6-C:J11-U01 RAS KERNEL INFO CE sym 3, at 0x1ee84040, mask 0x01
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- 1121277491 2005.07.13 R20-M0-NE-C:J03-U01 2005-07-13-10.58.11.725934 R20-M0-NE-C:J03-U01 RAS KERNEL INFO 1 ddr errors(s) detected and corrected on rank 0, symbol 13, bit 5
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- 1121277491 2005.07.13 R25-M1-N7-C:J13-U11 2005-07-13-10.58.11.948774 R25-M1-N7-C:J13-U11 RAS KERNEL INFO CE sym 21, at 0x1fca2980, mask 0x40
```

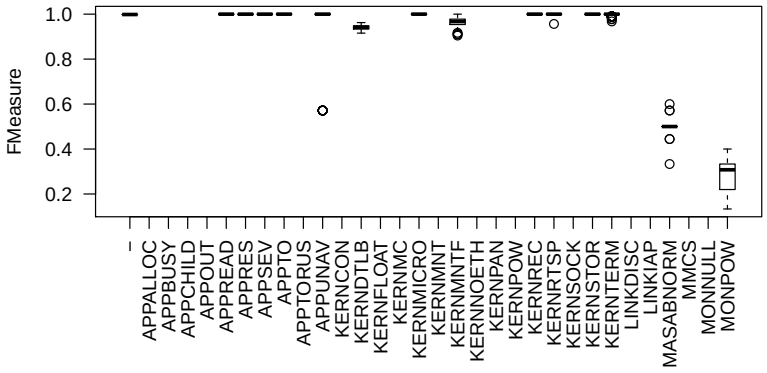
Event Classification [Event Types Recap]

Evaluation

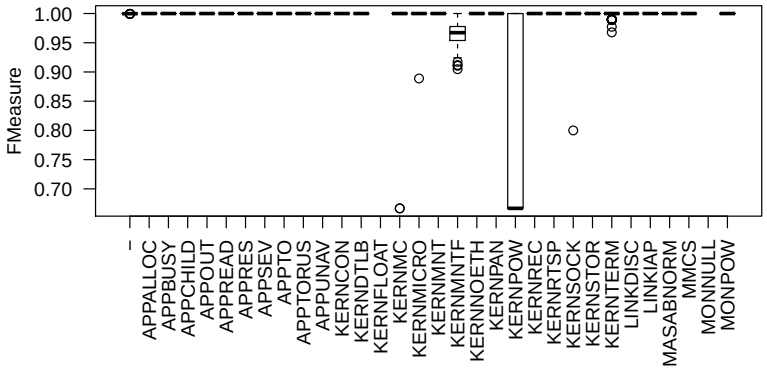
Count	Label	Message
1	KERNBIT	KERNEL FATAL ddr: redundant bit steering failed, sequencer timeout
1	KERNEXT	KERNEL FATAL external input interrupt (unit=0x03 bit=0x01): tree header with no target waiting
1	KERNTLBE	KERNEL FATAL instruction TLB error interrupt
1	MONILL	MONITOR FAILURE monitor caught java.lang.IllegalStateException: while executing CONTROL Operation
2	LINKBLL	LINKCARD FATAL MidplaneSwitchController::clearPort() bll_clear_port failed: R63-M0-L0-U19-A
2	MONNULL	MONITOR FAILURE While inserting monitor info into DB caught java.lang.NullPointerException
3	KERNFLOAT	KERNEL FATAL floating point unavailable interrupt
3	KERNRTSA	KERNEL FATAL rts assertion failed: personality->version == BGLPERSONALITY_VERSION in void start() at start.cc:131
3	MMCS	MMCS FATAL L3 major internal error
5	KERNPROG	KERNEL FATAL program interrupt
10	APPTORUS	APP FATAL external input interrupt (unit=0x02 bit=0x00): uncorrectable torus error
10	MASNORM	BGLMASTER FAILURE mmcs_server exited normally with exit code 13
12	MONPOW	MONITOR FAILURE monitor caught java.lang.UnsupportedOperationException: power module U69 not present and is stopping
14	KERNNOETH	KERNEL FATAL no ethernet link
14	LINKPAP	LINKCARD FATAL MidplaneSwitchController::parityAlignment() pap failed: R22-M0-L0-U22-D, status=00000000 00000000
16	KERNCON	KERNEL FATAL MailboxMonitor::serviceMailboxes() lib_ido_error: -1033 BGLERR_IDO_PKT_TIMEOUT
18	KERNPAN	KERNEL FATAL kernel panic
24	LINKDISC	LINKCARD FATAL MidplaneSwitchController::sendTrain() port disconnected: R07-M1-L1-U19-E
37	MASABNORM	BGLMASTER FAILURE mmcs_server exited abnormally due to signal: Aborted
94	KERNSERV	KERNEL FATAL Power Good signal deactivated: R73-M1-N5. A service action may be required.
144	APPALLOC	APP FATAL ciod: Error creating node map from file /p/gb2/draeger/benchmark/dat16k_062205/map16k_bipartyz
166	LINKIAP	LINKCARD FATAL MidplaneSwitchController::receiveTrain() iap failed: R72-M1-L1-U18-A, status=beeaabff ec000000
192	KERNPOW	KERNEL FATAL Power deactivated: R05-M0-N4
209	KERNSOCK	KERNEL FATAL MailboxMonitor::serviceMailboxes() lib_ido_error: -1019 socket closed
320	APPCHILD	APP FATAL ciod: Error creating node map from file /p/gb2/cabot/miranda/newmaps/8k_128x64x1_8x4x4.map
342	KERNMC	KERNEL FATAL machine check interrupt
512	APPBUSY	APP FATAL ciod: Error creating node map from file /p/gb2/pakin1/sweep3d-5x5x400-10mk-3mmi-1024pes-sweep/sweep.map
720	KERNMNT	KERNEL FATAL Error: unable to mount filesystem
816	APPOUT	APP FATAL ciod: LOGIN chdir(/p/gb1/stella/RAPTOR/2183) failed: Input/output error
1503	KERNMICRO	KERNEL FATAL Microloader Assertion
1991	APPTO	APP FATAL ciod: Error reading message prefix on CioStream socket to 172.16.96.116:41739, Connection timed out
2048	APPUNAV	APP FATAL ciod: Error creating node map from file /home/auselton/bgl/64mps.sequential.mapfile
2370	APPRES	APP FATAL ciod: Error reading message prefix after LOAD_MESSAGE on CioStream socket to 172.16.96.116:52783
3983	KERNRTSP	KERNEL FATAL rts panic! - stopping execution
5983	APPREAD	APP FATAL ciod: failed to read message prefix on control stream CioStream socket to 172.16.96.116:33399
6145	KERNREC	KERNEL FATAL Error receiving packet on tree network, expecting type 57 instead of type 3
23338	KERNTERM	KERNEL FATAL rts: kernel terminated for reason 1004rts: bad message header
31531	KERNMNTF	KERNEL FATAL Lustre mount FAILED : bglio11 : block_id : location
49651	APPSEV	APP FATAL ciod: Error reading message prefix after LOGIN_MESSAGE on CioStream socket
63491	KERNSTOR	KERNEL FATAL data storage interrupt
152734	KERNDTLB	KERNEL FATAL data TLB error interrupt
4399503	-	KERNEL INFO instruction cache parity error corrected

Event Classification Result

Evaluation



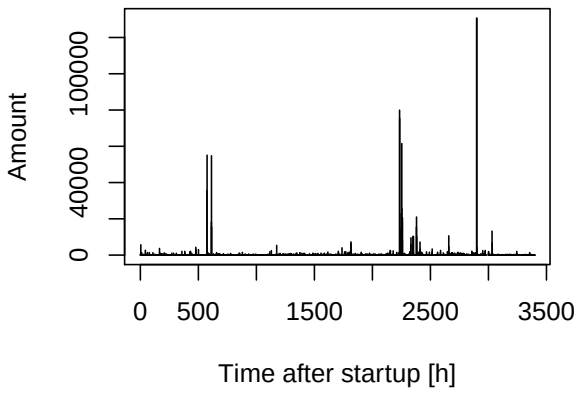
Naive Bayes with normalized log



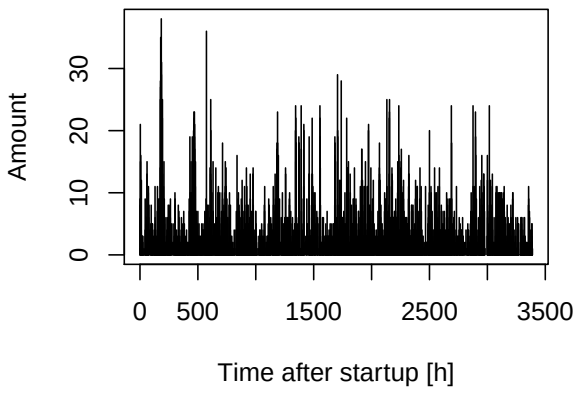
C4.5 with normalized log

Event Preprocessing Result

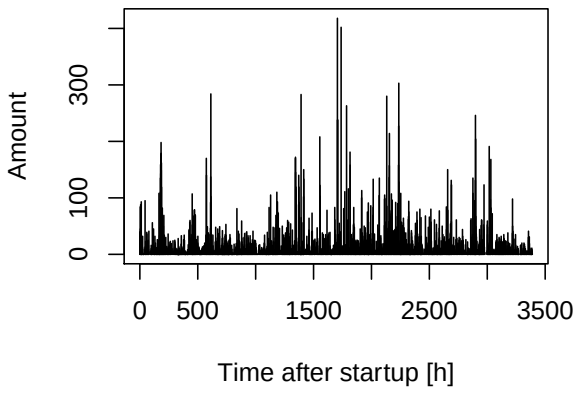
Evaluation



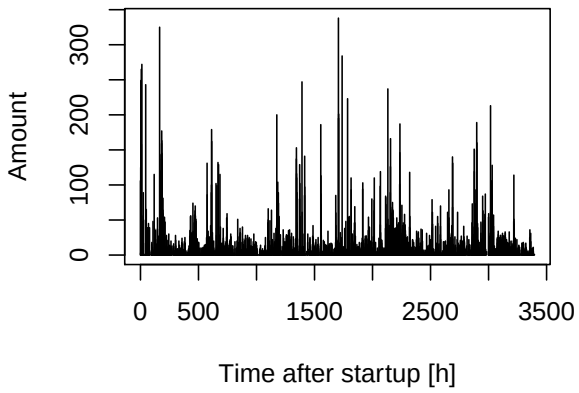
Original log



Original ASF



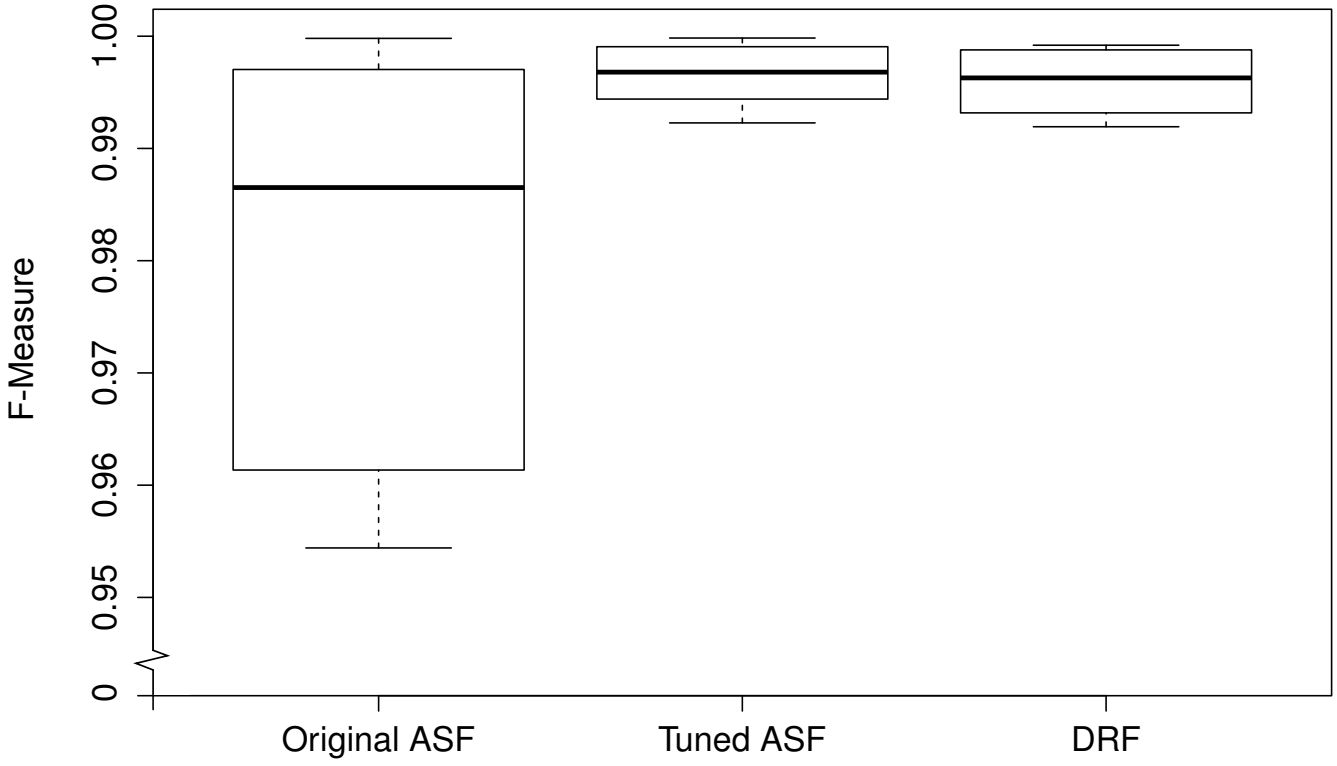
Tuned ASF



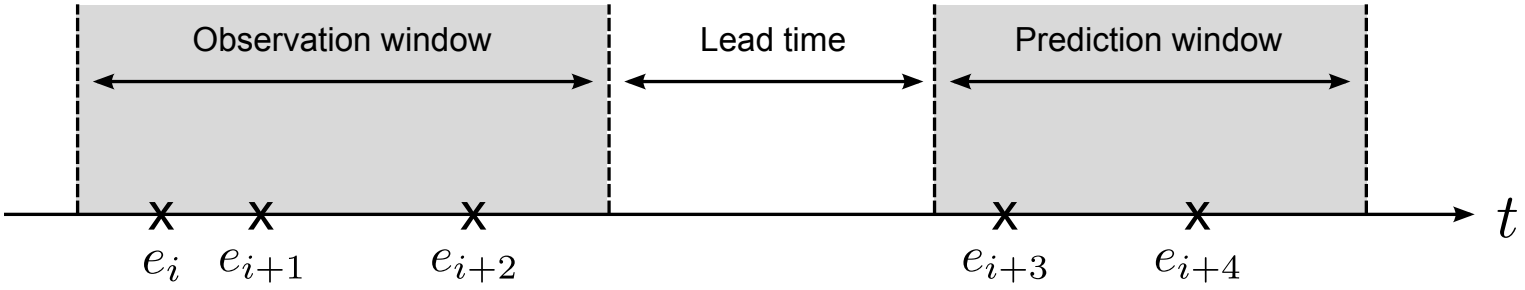
DRF

Impact of Event Preprocessing

Evaluation



Event Prediction Settings [Recap]



Investigated parameters:

- Size of observation window
- Lead time
- Size of prediction window
- Sensitivity

Event Prediction Result (Preliminary)

Algorithm	Lead time (sec)						
	0	60	120	300	600	1200	2800
NaiveBayes	**0.663**	0.589	0.547	0.517	0.506	0.511	0.506
C4.5	**0.877**	0.672	0.634	0.627	0.624	0.640	0.625

Algorithm	Prediction window (sec)						
	60	120	300	600	1200	2800	4800
NaiveBayes	0.491	0.493	0.485	0.506	0.511	0.532	**0.553**
C4.5	0.579	0.578	0.598	0.624	0.640	0.625	**0.635**

Event Prediction Result (Preliminary)

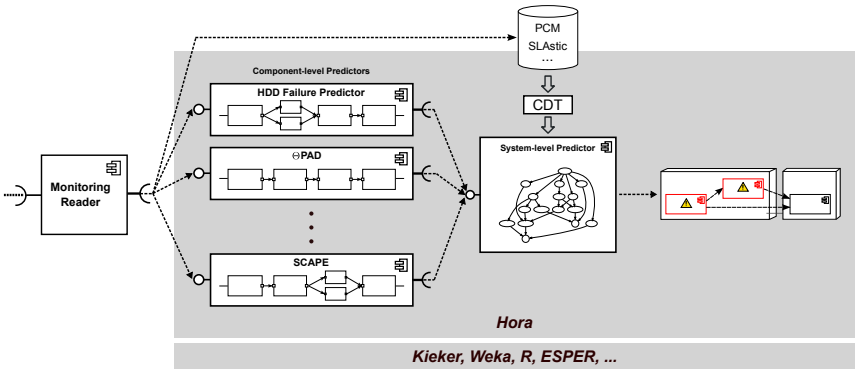
Algorithm	Number of past observations						
	1	2	3	4	6	8	16
NaiveBayes	**0.603**	0.517	0.506	0.500	0.501	0.501	0.503
C4.5	0.621	0.626	0.624	0.624	0.624	0.626	**0.634**

Algorithm	Sensitivity						
	1%	5%	10%	20%	40%	80%	100%
NaiveBayes	**0.546**	0.522	0.516	0.506	0.462	0.519	0.399
C4.5	0.523	0.572	0.609	0.624	**0.691**	0.234	-

Agenda

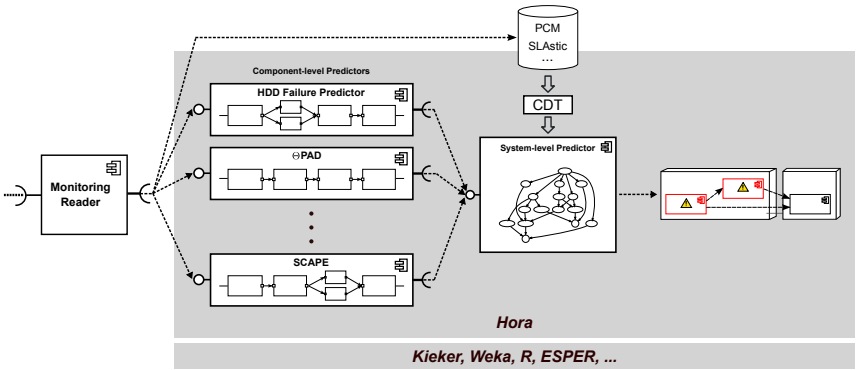
Summary

Conclusion



Summary

Conclusion

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- 1121276892 2005.07.13 R14-M1-NA-C:J07-U01 2005-07-13-10.48.12.140895 R14-M1-NA-C:J07-U01 RAS KERNEL INFO CE sym 15, at 0x1f9d7fe0, mask 0x10
- 1121276892 2005.07.13 R30-M1-N2-C:J13-U01 2005-07-13-10.48.12.300650 R30-M1-N2-C:J13-U01 RAS KERNEL INFO total of 2 ddr error(s) detected and corrected
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- 1121276892 2005.07.13 R14-M1-NA-C:J07-U01 2005-07-13-10.48.12.351794 R14-M1-NA-C:J07-U01 RAS KERNEL INFO CE sym 15, at 0x1f9d7fe0, mask 0x10
- 1121276892 2005.07.13 R14-M1-NA-C:J07-U01 2005-07-13-10.48.12.504235 R14-M1-NA-C:J07-U01 RAS KERNEL INFO total of 3 ddr error(s) detected and corrected
- 1121277189 2005.07.13 R22-M0-N6-C:J11-U01 2005-07-13-10.53.09.508589 R22-M0-N6-C:J11-U01 RAS KERNEL INFO 10 ddr errors(s) detected and corrected on rank 0, symbol 3, bit 7
- 1121277189 2005.07.13 R30-M1-N2-C:J13-U01 2005-07-13-10.53.09.543334 R30-M1-N2-C:J13-U01 RAS KERNEL INFO 2 ddr errors(s) detected and corrected on rank 0, symbol 34, bit 1
- 1121277189 2005.07.13 R10-M0-N7-C:J17-U01 2005-07-13-10.53.09.577477 R10-M0-N7-C:J17-U01 RAS KERNEL INFO 1 ddr errors(s) detected and corrected on rank 0, symbol 14, bit 7
- 1121277189 2005.07.13 R11-M1-N3-C:J07-U11 2005-07-13-10.53.09.613816 R11-M1-N3-C:J07-U11 RAS KERNEL INFO 1 ddr errors(s) detected and corrected on rank 0, symbol 16, bit 3
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- 1121277491 2005.07.13 R10-M0-N7-C:J17-U01 2005-07-13-10.58.11.691632 R10-M0-N7-C:J17-U01 RAS KERNEL INFO 1 ddr errors(s) detected and corrected on rank 0, symbol 14, bit 7
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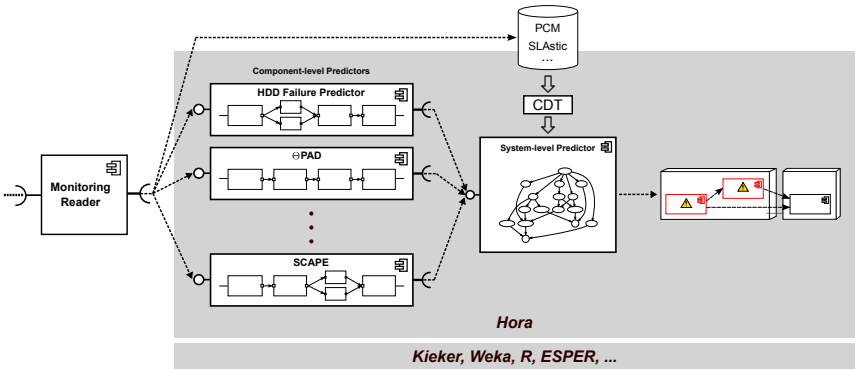
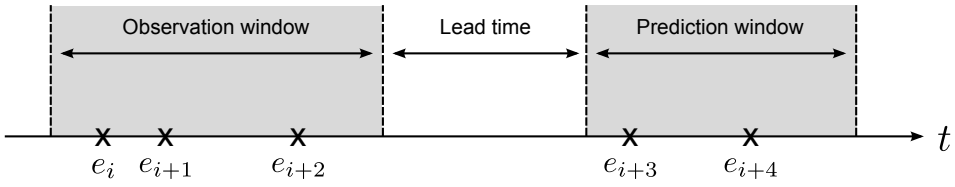
Summary

Conclusion



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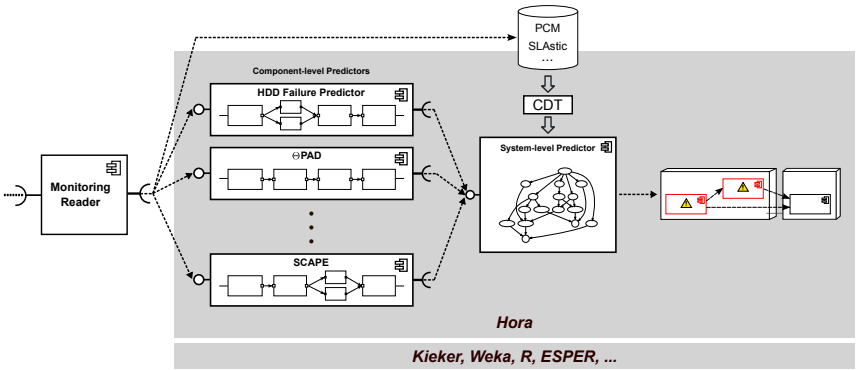
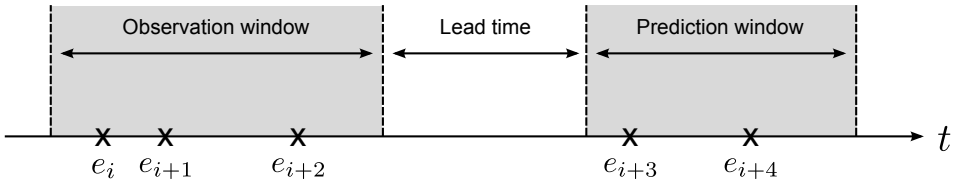
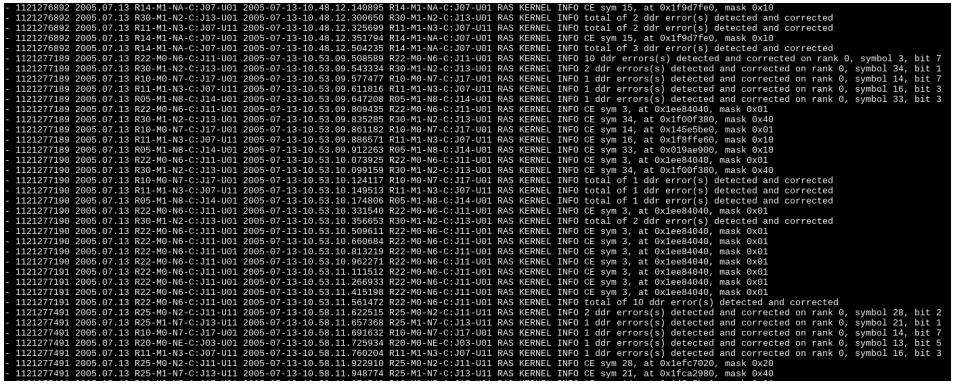
Summary

Conclusion







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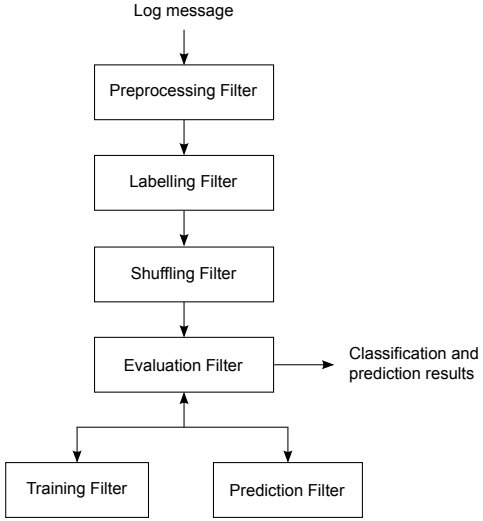
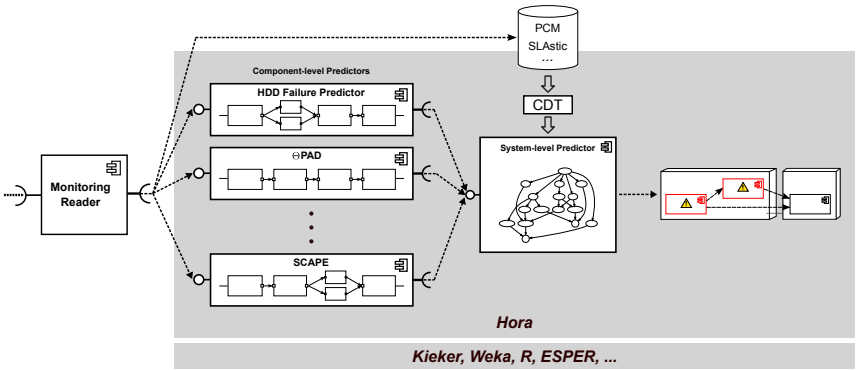
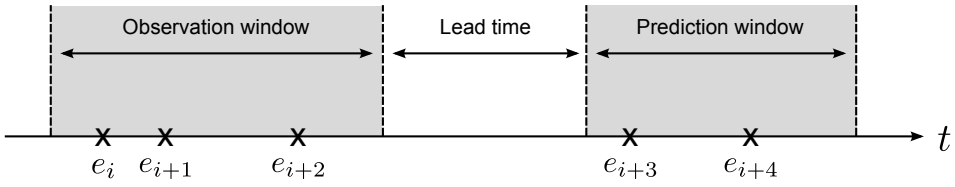
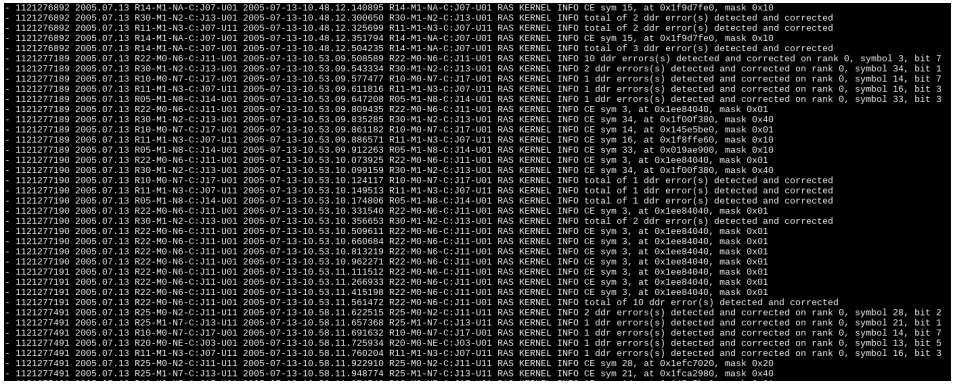


Summary

Conclusion







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- 1121277189 2005.07.13 R22-M0-N6-C:J11-U01 2005-07-13-10.53.09.809435 R22-M0-N6-C:J11-U01 RAS KERNEL INFO CE sym 3, at 0x1ee84040, mask 0x01
- 1121277189 2005.07.13 R30-M1-N2-C:J13-U01 2005-07-13-10.53.09.835285 R30-M1-N2-C:J13-U01 RAS KERNEL INFO CE sym 34, at 0x1f00f380, mask 0x40
- 1121277189 2005.07.13 R10-M0-N7-C:J17-U01 2005-07-13-10.53.09.861182 R10-M0-N7-C:J17-U01 RAS KERNEL INFO CE sym 14, at 0x145e5be0, mask 0x01
- 1121277189 2005.07.13 R11-M1-N3-C:J07-U11 2005-07-13-10.53.09.886571 R11-M1-N3-C:J07-U11 RAS KERNEL INFO CE sym 16, at 0x1f8ffe60, mask 0x10
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- 1121277491 2005.07.13 R25-M1-N7-C:J13-U11 2005-07-13-10.58.11.948774 R25-M1-N7-C:J13-U11 RAS KERNEL INFO CE sym 21, at 0x1fca2980, mask 0x40
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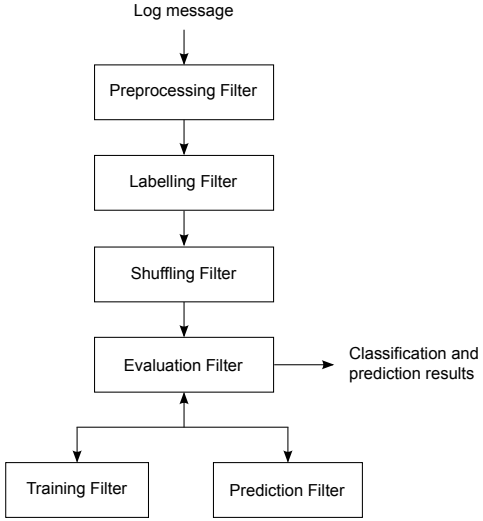

Supplementary material:
http://www.iste.uni-stuttgart.de/rss/people/pitakrat/scape

Next Steps

- Improve event prediction
- Extend evaluation settings
  - Evaluate with event log from other systems
- Integrate SCAPE into Hora framework
  - Combine with architectural model to infer the failure probability of other components

Literature

S. Becker, H. Koziolek, and R. Reussner. The Palladio component model for model-driven performance prediction. *Journal of Systems and Software*, 82(1): 3–22, 2009.

T. C. Bielefeld. Online performance anomaly detection for large-scale software systems. Master's thesis, Mar. 2012. Diploma Thesis, Kiel University.

M. Hall, E. Frank, G. Holmes, B. Pfahringer, P. Reutemann, and I. H. Witten. The WEKA data mining software: An update. *ACM SIGKDD Explorations Newsletter*, 11(1):10–18, 2009.

Y. Liang, Y. Zhang, H. Xiong, and R. K. Sahoo. An adaptive semantic filter for Blue Gene/L failure log analysis. In *Proc. Int'l Parallel and Distributed Processing Symp.*, pages 1–8, 2007.

A. Oliner and J. Stearley. What supercomputers say: A study of five system logs. In *Proc. 37th Annual IEEE/IFIP Int'l Conf. on Dependable Systems and Networks*, pages 575–584, 2007.

T. Pitakrat, A. van Hoorn, and L. Grunske. A comparison of machine learning algorithms for proactive hard disk drive failure detection. In *Proceedings of the 4th International ACM Sigsoft Symposium on Architecting Critical Systems*, pages 1–10. ACM, 2013.

T. Pitakrat, J. Grunert, O. Kabierschke, F. Keller, and A. van Hoorn. A framework for system event classification and prediction by means of machine learning. In *Proceedings of the 8th International Conference on Performance Evaluation Methodologies and Tools (ValueTools 2014)*, 2014.

A. van Hoorn. *Model-Driven Online Capacity Management for Component-Based Software Systems*. PhD thesis, Kiel, Germany, 2014. Dissertation, Faculty of Engineering, Kiel University.

A. van Hoorn, J. Waller, and W. Hasselbring. Kieker: A framework for application performance monitoring and dynamic software analysis. In *Proc. 3rd ACM/SPEC Int'l Conf. on Performance Engineering*, pages 247–248. ACM, 2012.