

# Supporting HPC Users with LLview

6th ISC HPC International Workshop on “Monitoring & Operational Data Analytics”

13.06.2025 | FILIPE GUIMARÃES, ARAVIND SANKARAN, WOLFGANG FRINGS | HAMBURG

# What is operational data analytics? Why do ~~we~~ need it? users

Disclaimer: from the point of view of the support team

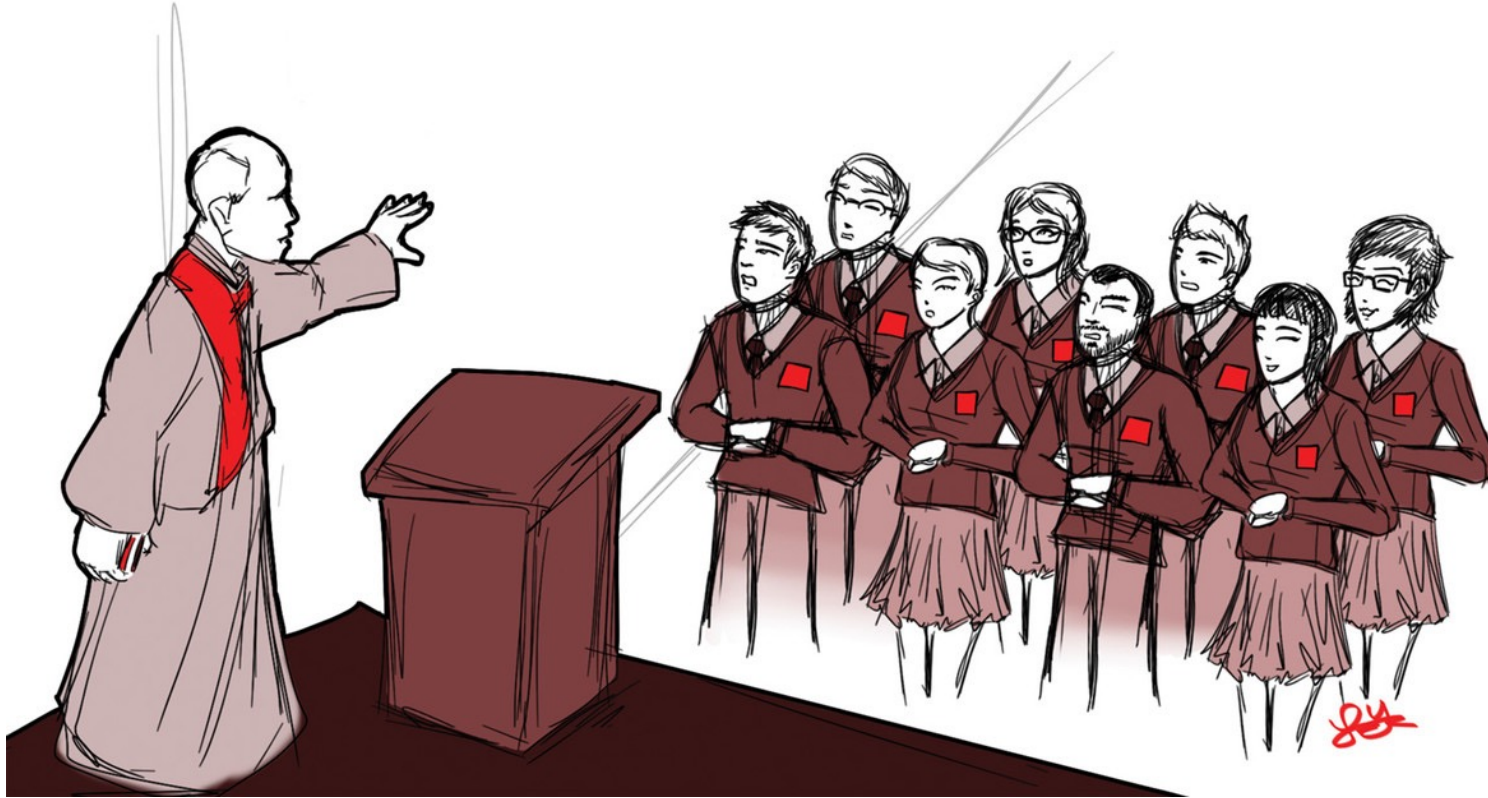


Illustration from: <https://www.linkedin.com/pulse/preaching-choir-worship-church-services-steve-cranston-ma/>

# What is operational data analytics? Why do ~~we~~ need it? users

Slurm info



# What is operational data analytics? Why do ~~we~~ need it?

**users**

Slurm info

GPU daemon



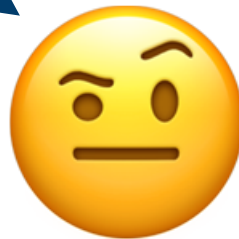


# What is operational data analytics? Why do ~~we~~ **users** need it?

Slurm info

GPU daemon

Network  
queries



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Slurm info

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I/O



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GPU daemon

Network  
queries

I/O

CPU, power,  
...



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Network  
queries

I/O

CPU, power,  
...

System log  
errors



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```
From: <user>  
To: <sc-support>  
Subject: HELP!
```

```
Dear SC support,  
  
I have problems! Help!  
  
Best regards,  
Desperate User
```





# What is operational data analytics? Why do ~~we~~ need it? **users**

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Network  
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I/O

CPU, power,  
...

System log  
errors

```
From: <user>  
To: <sc-support>  
Subject: HELP!
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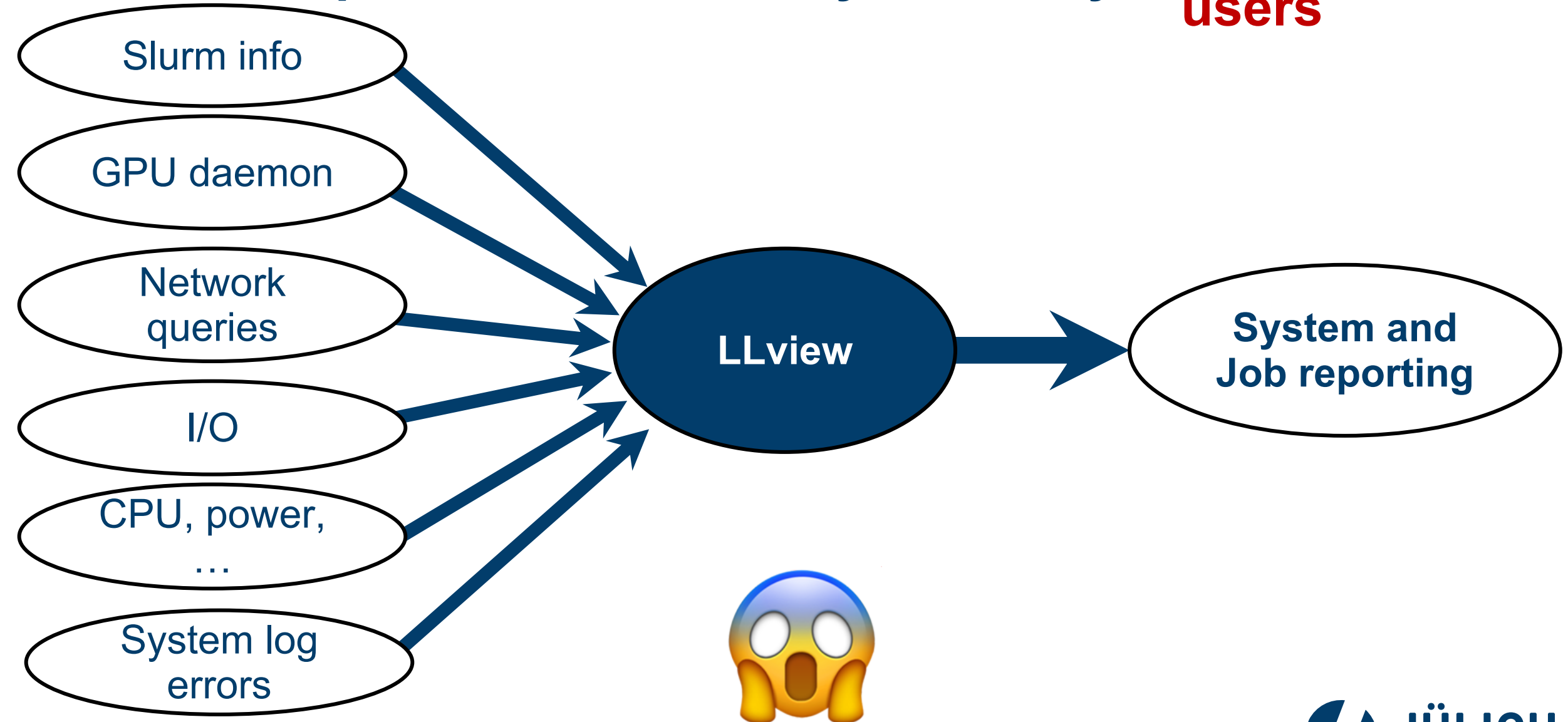
```
Dear SC support,  
  
I have problems! Help!  
  
Best regards,  
Desperate User
```

```
From: <sc-support>  
To: <admins>  
Subject: Fw: HELP!
```

```
Dear Admins,  
  
We have problems! Help!  
  
Best regards,  
Desperate Support
```



# What is operational data analytics? Why do ~~we~~ need it? **users**



# What is operational data analytics? Why do ~~we~~ need it?

**users**

Slurm info

GPU daemon

Network queries

I/O

CPU, power,  
...

System log errors



Supporters



Admins

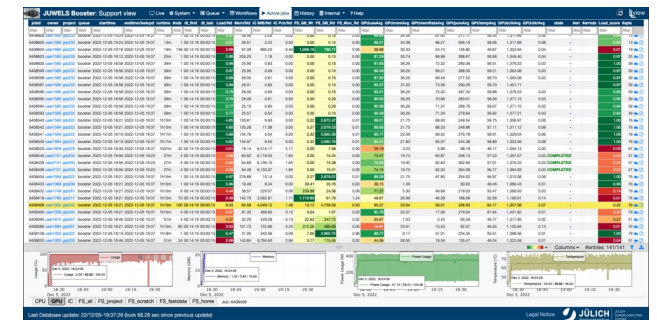
LLview

Updates every ~1min  
using existing sources

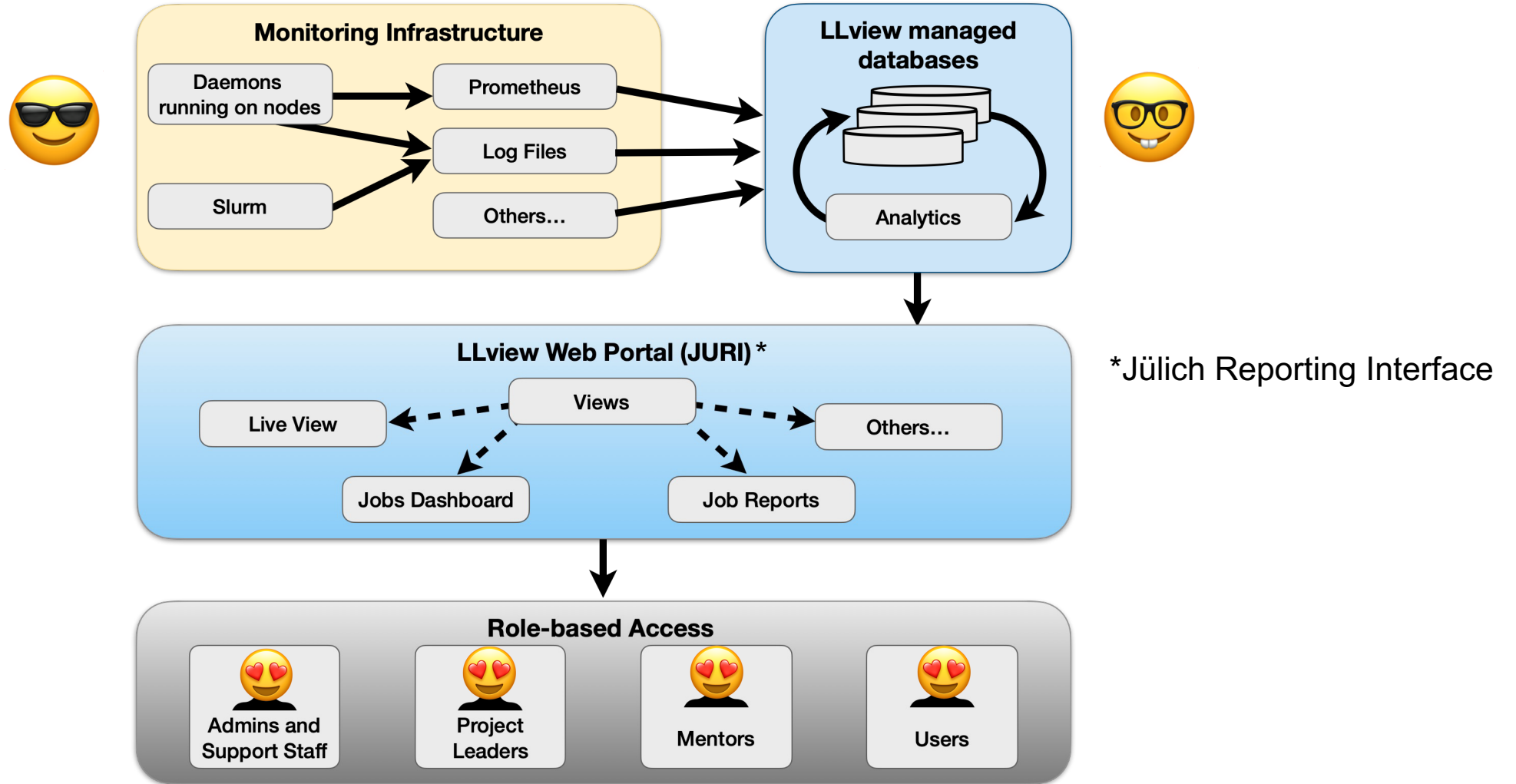
➡ Negligible overhead!

➡ Scalable!

System and  
Job reporting



# Simplified Scheme of LLview



# Features of LLview



Current version: 2.3.2

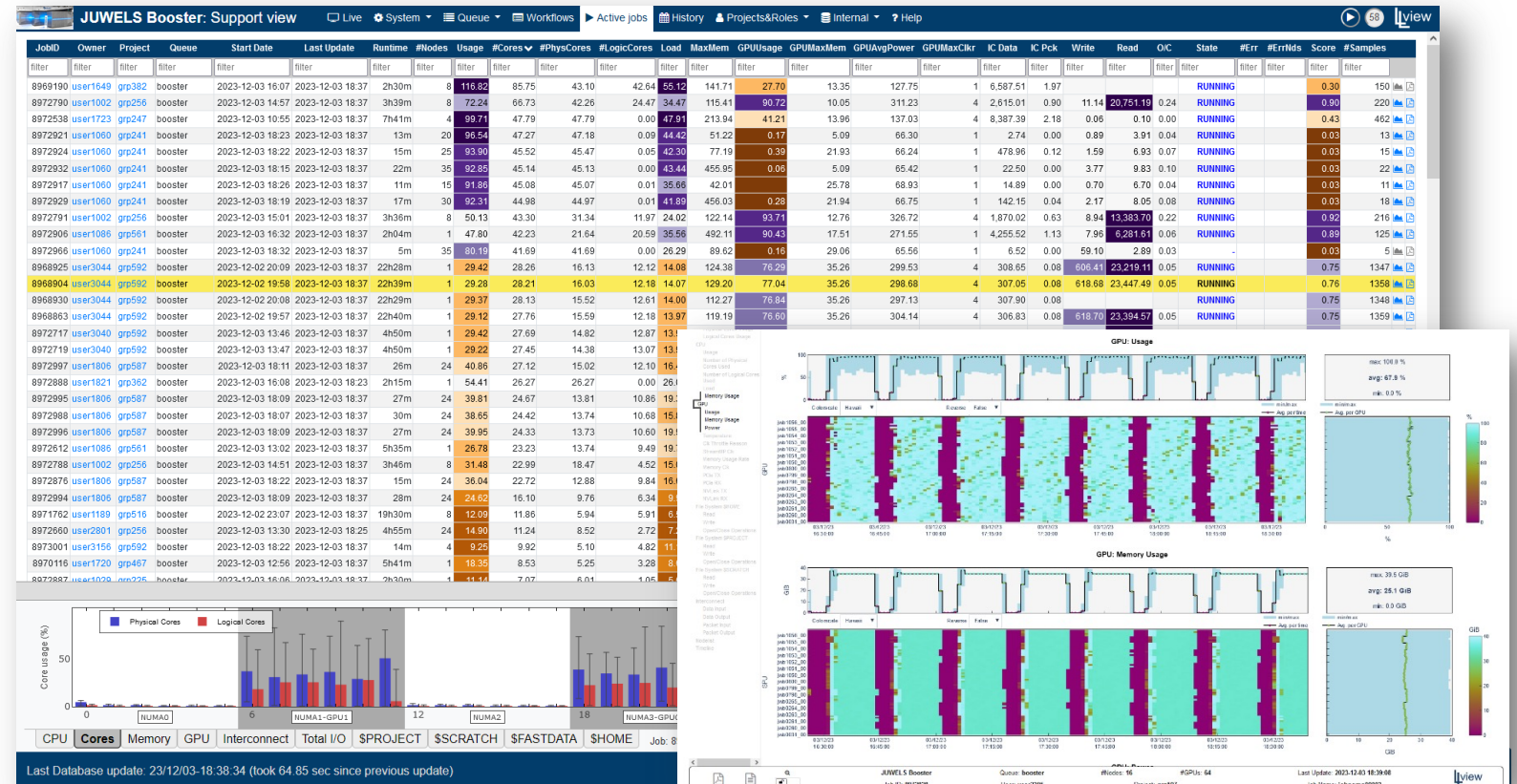
- Near-real time information (also in HTML and PDF reports)
- Role-based access ([Users](#), [PI/PAs](#), [mentors](#), [support](#))
- Modular/extendable design
- Separation between data processing and visualisation

## Job information

- Basic job information
- Computing time spent/estimation
- Job Status
- CPU: Load, Core, Memory usage
- GPU: Usage, Power, Temperature, ...
- I/O statistics
- Network traffic
- Node list (with interconnected cells)
- System error messages
- Timeline

## System information

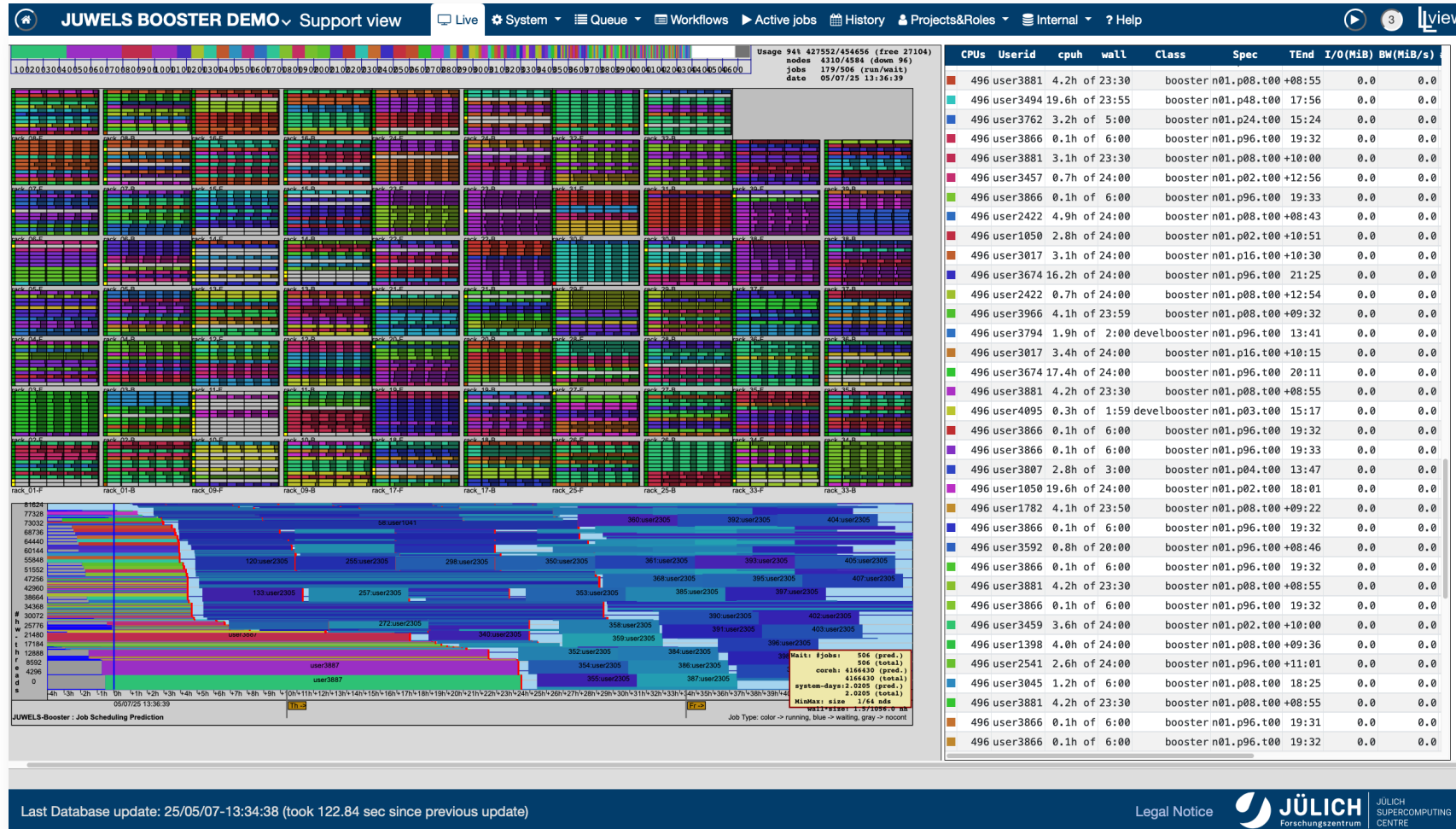
- System usage overview
- Node usage, Errors





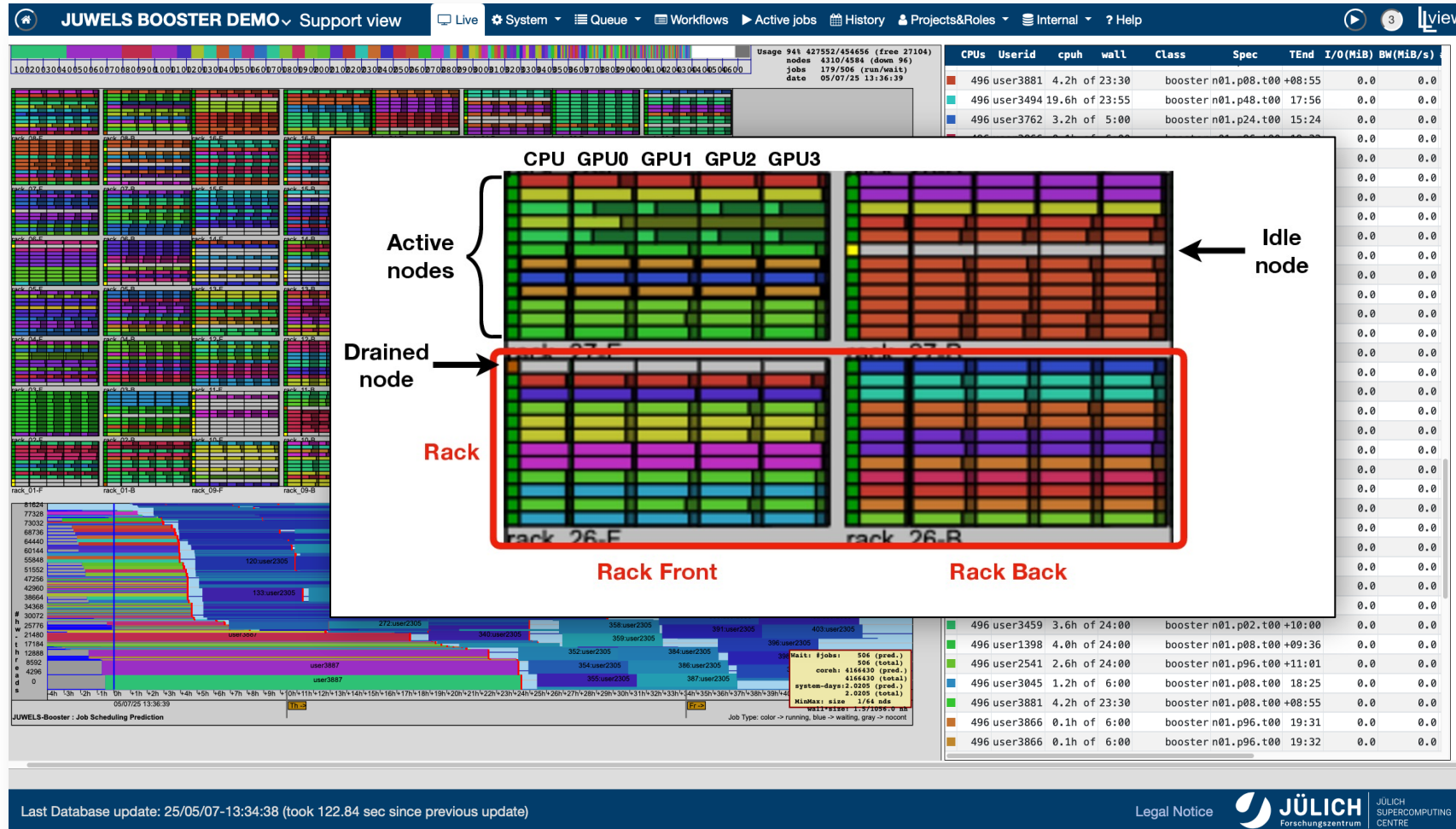
# The Three Views and Their Analytical Use Cases

## Live View



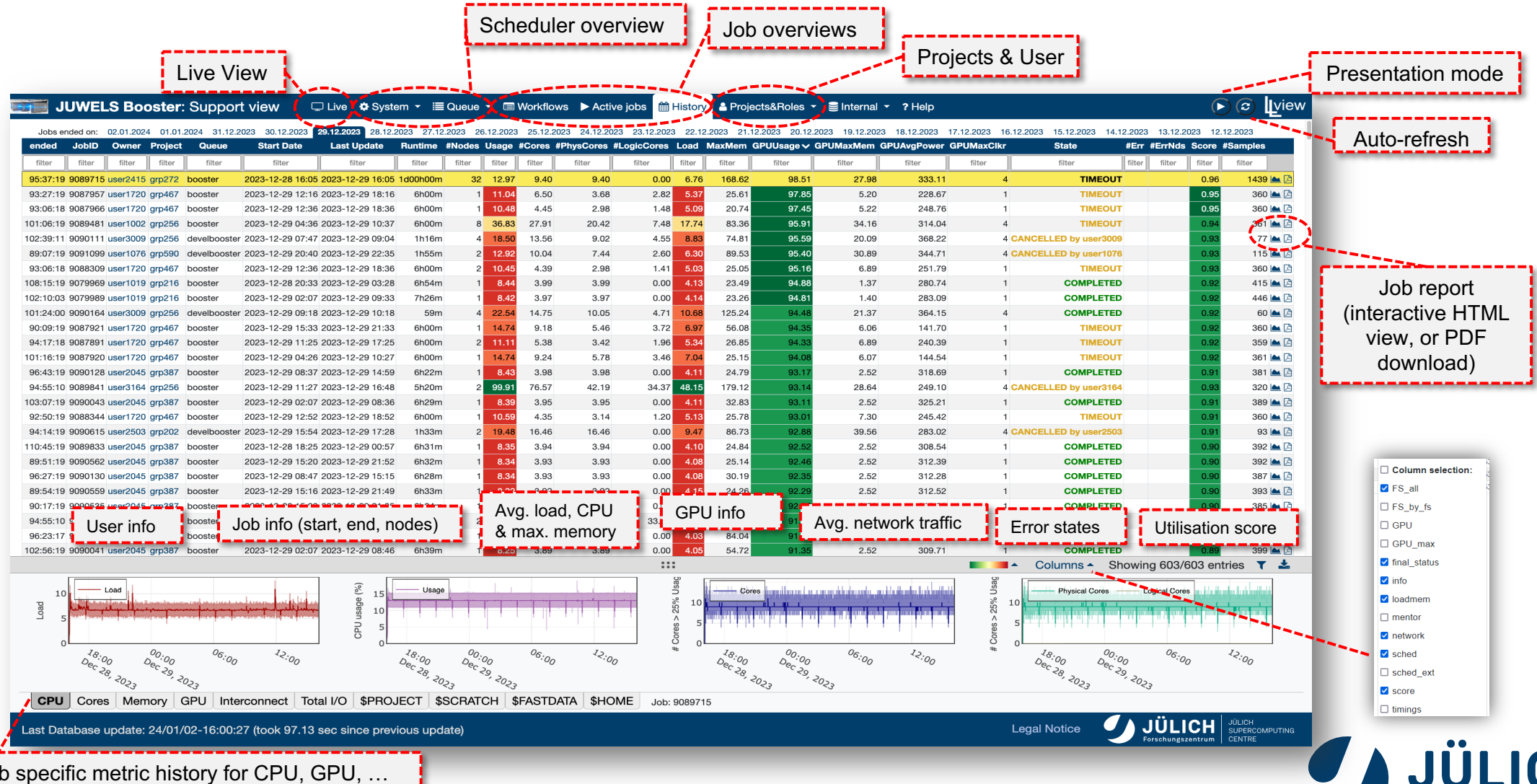
# The Three Views and Their Analytical Use Cases

## Live View



# The Three Views and Their Analytical Use Cases

## Jobs Dashboard



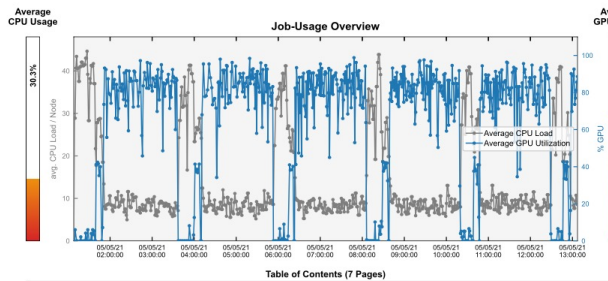


# The Three Views and Their Analytical Use Cases

## Jobs Reports

- Basic job information
- General average usage
- Computing time spent/estimation
- Status
- CPU, Core
  - Usage, Load, Memory usage
- GPU
  - Usage, Power, Temperature, ...
- I/O
- Network traffic
- Nodelist (with interconnected cells)
- Error messages
- Timeline

| JUWELS BOOSTER Job Report  |                                 |                              |                             |                           |                          |                           |
|--|---------------------------------|------------------------------|-----------------------------|---------------------------|--------------------------|---------------------------|
| Jobid: 3691769   | User: username                  |                              | Project: project            |                           | Job Name: job name       |                           |
| Job Runtime: 12h00m → 100.08% of Wall: 11h59m                                      |                                 |                              |                             |                           |                          |                           |
| Job Start Time:  | 2021-05-05 01:07:13             |                              | Load (CPU-Nodes):           |                           | min.                     | avg.                      |
| Job End Time:  | 2021-05-05 13:08:04 (1h18m ago) |                              | Memory (CPU-Nodes):         |                           | 0.00                     | 14.55                     |
| Current Time:  | 2021-05-05 14:25:07             |                              | Interconnect Traffic (in):  |                           | 0.00                     | 46482.24                  |
| Job Endtime (Est.):  | 2021-05-05 13:07:28             |                              | Interconnect Traffic (out): |                           | 0.00                     | 53069.40                  |
| Queue:   | booster                         |                              | Interconnect Packets (in):  |                           | 0.00                     | 41.72                     |
| Job size, #Nodes:  | 1                               | #Data Points: 720            | Interconnect Packets (out): |                           | 0                        | 8489.82                   |
| Job size, #GPUs:   | 4                               | #Data Points: 621            | Interconnect Packets (out): |                           | 0                        | 1056.42                   |
|  |                                 |                              |                             |                           | 0                        | 916                       |
|  |                                 |                              |                             |                           | 0                        | 797                       |
|  |                                 |                              |                             |                           | 0                        | 60681                     |
|  |                                 |                              |                             |                           | 0                        | 60846                     |
| Job IO Statistics  |                                 |                              |                             |                           |                          |                           |
|  |                                 | Total Data Write             | Total Data Read             | max. Data Rate/Node Write | max. Data Rate/Node Read | max. Open-Close Rate/Node |
| SHOME:   |                                 | 0.00 MB                      | 0.00 MB                     | 0.00 MB/s                 | 0.00 MB/s                | 0.00 op/s                 |
| SPROJECT:  |                                 | 0.00 MB                      | 0.00 MB                     | 0.00 MB/s                 | 0.00 MB/s                | 0.00 op/s                 |
| SSCRATCH:  |                                 | 0.00 MB                      | 0.00 MB                     | 0.00 MB/s                 | 0.00 MB/s                | 0.00 op/s                 |
| SFASTDATA:   |                                 | 0.00 MB                      | 0.00 MB                     | 0.00 MB/s                 | 0.00 MB/s                | 0.00 op/s                 |
| Job GPU Statistics   |                                 |                              |                             |                           |                          |                           |
| avg. GPU Usage: 62.84 %  |                                 | avg. Mem. Usage Rate: 9.47 % |                             | avg. GPU Temp.: 52.94 °C  |                          | avg. GPU Power: 153.37 W  |
| max. Ck Stream/Mem: 1410/1215 MB   |                                 | max. Mem. Usage: 2678.50 MB  |                             | max. GPU Temp.: 64.00 °C  |                          | max. GPU Power: 380.17 W  |
| Job Finalization Report  |                                 |                              |                             |                           |                          |                           |
| Job State: TIMEOUT   |                                 | Return Code: 0               |                             | Signal Number: 0          |                          |                           |
| This job has used approximately: 1 nodes × 48 cores × 11.999 hours = 575.95 core-h |                                 |                              |                             |                           |                          |                           |

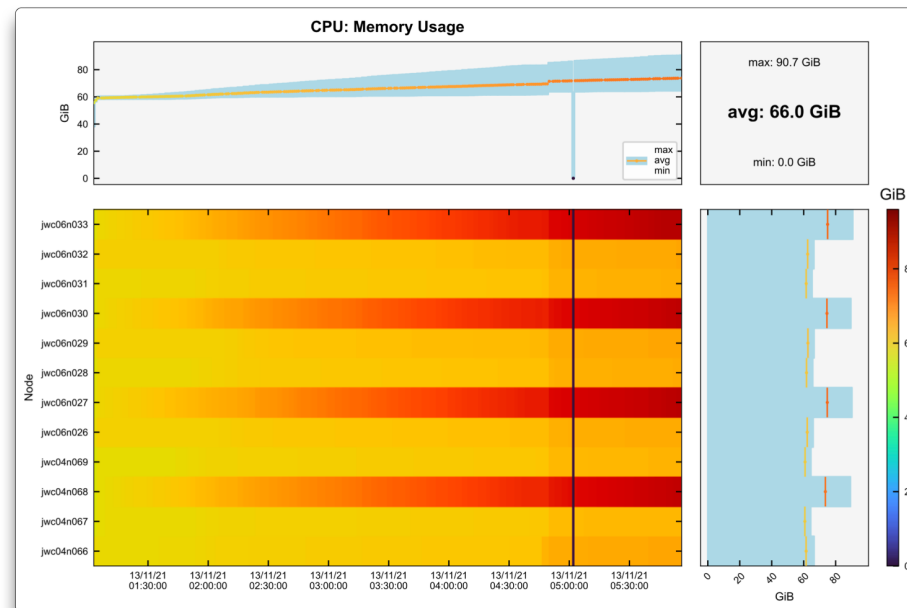
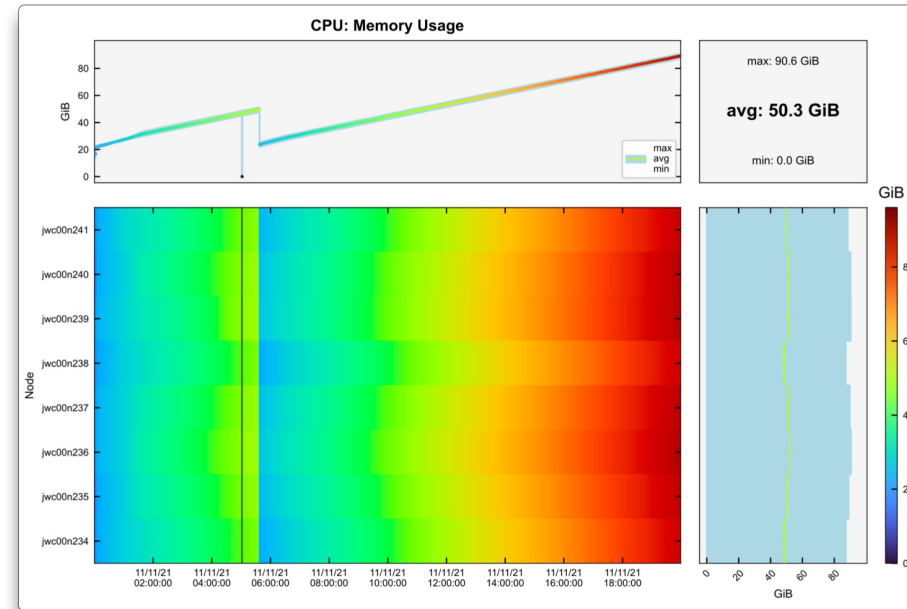
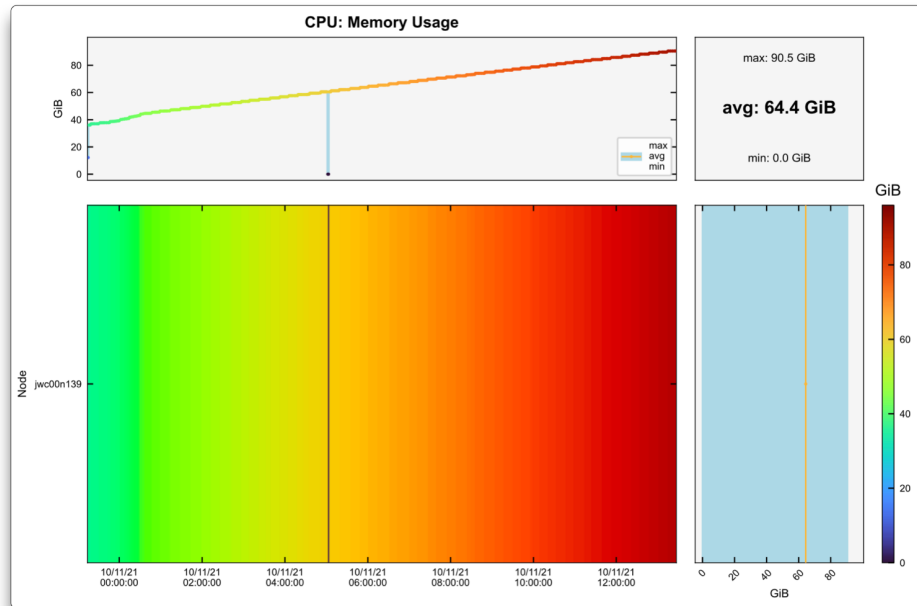


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| GPU: Utilization, Memory Usage, Power, Temperature                 | 3 |  |  |  |  |  |
| GPU: Memory Usage Rate, StreamMP Ck, Ck Throttle Reason, Memory Ck | 4 |  |  |  |  |  |
| GPU: Performance State, PCIe TX, PCIe RX                           | 5 |  |  |  |  |  |
| Interconnect: Data Input, Data Output, Packet Input, Packet Output | 6 |  |  |  |  |  |
| Finalization report  | 7 |  |  |  |  |  |

| Nodelist    |             |             |             |             |
|-------------|-------------|-------------|-------------|-------------|
| 1 juw0009   | 2 juw0011   | 3 juw0012   | 4 juw0023   | 5 juw0024   |
| 6 juw0025   | 7 juw0026   | 8 juw0027   | 9 juw0028   | 10 juw0029  |
| 11 juw0030  | 12 juw0031  | 13 juw0032  | 14 juw0033  | 15 juw0034  |
| 16 juw0035  | 17 juw0036  | 18 juw0037  | 19 juw0038  | 20 juw0039  |
| 21 juw0040  | 22 juw0041  | 23 juw0042  | 24 juw0043  | 25 juw0044  |
| 26 juw0045  | 27 juw0046  | 28 juw0047  | 29 juw0048  | 30 juw0049  |
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| 671 juw0690 | 672 juw0691 | 673 juw0692 | 674 juw0693 | 675 juw0694 |
| 676 juw0695 | 677 juw0696 | 678 juw0697 | 679 juw0698 | 680 juw0699 |
| 681 juw0700 | 682 juw0701 | 683 juw0702 | 684 juw0703 | 685 juw0704 |
| 686 juw0705 | 687 juw0706 | 688 juw0707 | 689 juw0708 | 690 juw0709 |
| 691 juw0710 | 692 juw0711 | 693 juw0712 | 694 juw0713 | 695 juw0714 |
| 696 juw0715 | 697 juw0716 | 698 juw0717 | 699 juw0718 | 700 juw0719 |
| 701 juw0720 | 702 juw0721 | 703 juw0722 | 704 juw0723 | 705 juw0724 |
| 706 juw0725 | 707 juw0726 | 708 juw0727 | 709 juw0728 | 710 juw0729 |
| 711 juw0730 | 712 juw0731 | 713 juw0732 | 714 juw0733 | 715 juw0734 |
| 716 juw0735 | 717 juw0736 | 718 juw0737 | 719 juw0738 | 720 juw0739 |
| 721 juw0740 | 722 juw0741 | 723 juw0742 | 724 juw0743 | 725 juw0744 |
| 726 juw0745 | 727 juw0746 | 728 juw0747 | 729 juw0748 | 730 juw0749 |
| 731 juw0750 | 732 juw0751 | 733 juw0752 | 734 juw0753 | 735 juw0754 |
| 736 juw0755 | 737 juw0756 | 738 juw0757 | 739 juw0758 | 740 juw0759 |
| 741 juw0760 | 742 juw0761 | 743 juw0762 | 744 juw0763 | 745 juw0764 |
| 746 juw0765 | 747 juw0766 | 748 juw0767 | 749 juw0768 | 750 juw0769 |
| 751 juw0770 | 752 juw0771 | 753 juw0772 | 754 juw0773 | 755 juw0774 |
| 756 juw0775 | 757 juw0776 | 758 juw0777 | 759 juw0778 | 760 juw0779 |
| 761 juw0780 | 762 juw0781 | 763 juw0782 | 764 juw0783 | 765 juw0784 |
| 766 juw0785 | 767 juw0786 | 768 juw0787 | 769 juw0788 | 770 juw0789 |
| 771 juw0790 | 772 juw0791 | 773 juw0792 | 774 juw0793 | 775 juw0794 |
| 776 juw0795 | 777 juw0796 | 778 juw0797 | 779 juw0798 | 780 juw0799 |
| 781 juw0800 | 782 juw0801 | 783 juw0802 | 784 juw0803 | 785 juw0804 |
| 786 juw0805 | 787 juw0806 | 788 juw0807 | 789 juw0808 | 790 juw0809 |
| 791 juw0810 | 792 juw0811 | 793 juw0812 | 794 juw0813 | 795 juw0814 |
| 796 juw0815 | 797 juw0816 | 798 juw0817 | 799 juw0818 | 800 juw0819 |
| 801 juw0820 | 802 juw0821 | 803 juw0822 | 804 juw0823 | 805 juw0824 |
| 806 juw0825 | 807 juw0826 | 808 juw0827 | 809 juw0828 | 810 juw0829 |
| 811 juw0830 | 812 juw0831 | 813 juw0832 | 814 juw0833 | 815 juw0834 |
| 816 juw0835 | 817 juw0836 | 818 juw0837 | 819 juw0838 | 820 juw0839 |
| 821 juw0840 | 822 juw0841 | 823 juw0842 | 824 juw0843 | 825 juw0844 |
| 826 juw0845 | 827 juw0846 | 828 juw0847 | 829 juw0848 | 830 juw0849 |
| 831 juw0850 | 832 juw0851 | 833 juw0852 | 834 juw0853 | 835 juw0854 |
| 836 juw0855 | 837 juw0856 | 838 juw0857 | 839 juw0858 | 840 juw0859 |
| 841 juw0860 | 842 juw0861 | 843 juw0862 |             |             |

# Examples

## Memory leak





# Examples

## System Error Logs

|   |                          |                       |                         |
|---|--------------------------|-----------------------|-------------------------|
| <b>Job Finalization Report</b>  | Job State: <b>FAILED</b> | Return Code: <b>9</b> | Signal Number: <b>0</b> |
| <b>System Error Report</b>  | # Msgs: <b>2</b>         | # Nodes: <b>1</b>     | <b>(Out-of-memory)</b>  |
| This job has used approximately: 1 nodes × 48 cores × 0.186 hours = 8.93 core-h |                          |                       |                         |

### System Error Report

# Msgs: **2**      # Nodes: **1**

#### *Error Messages:*

```
2025-04-24T19:21:29+0200 jwb0163.juwels kernel: python invoked oom-killer:
gfp_mask=0x140dca(GFP_HIGHUSER_MOVABLE!__GFP_COMP!__GFP_ZERO), order=0, oom_score_adj=0
2025-04-24T19:21:29+0200 jwb0163.juwels kernel: Out of memory: Killed process 1556003 (python) total-
vm:902572524kB, anon-rss:496358356kB, file-rss:89856kB, shmem-rss:19200kB, UID:xxxxxx pgtables:973944kB
oom_score_adj:0
```

# Examples

## System Error Logs

|  |                           |                       |                         |
|--|---------------------------|-----------------------|-------------------------|
| <b>Job Finalization Report</b>   | Job State: <b>TIMEOUT</b> | Return Code: <b>0</b> | Signal Number: <b>0</b> |
| <b>System Error Report</b>   | # Msgs: <b>2</b>          | # Nodes: <b>1</b>     | <b>(Flipping Link)</b>  |
| This job has used approximately: 16 nodes × 48 cores × 11.973 hours = 9195.26 core-h |                           |                       |                         |

### System Error Report

# Msgs: **2**      # Nodes: **1**

#### *Error Messages:*

```
2025-06-02T03:24:56+0200 jwb0155.juwels pshealthcheck[184436]: [EE] ERROR: mlx5_2 local port (LID
4667, port 1): LinkDownedCounter = 8 (threshold = 1)
2025-06-02T03:24:56+0200 jwb0155.juwels pshealthcheck[184436]: [EE] ERROR: mlx5_2 remote port (LID
297, port 34): LinkDownedCounter = 8 (threshold = 1)
```

# Examples

## System Error Logs

**Job Finalization Report**

Job State: **FAILED**

Return Code: **0**

Signal Number: **9**

**System Error Report**

# Msgs: **59**

# Nodes: **59**

**(Node Error)**

**This job has used approximately: 60 nodes × 48 cores × 11.328 hours = 32624.64 core-h**

### System Error Report

# Msgs: **59**

# Nodes: **59**

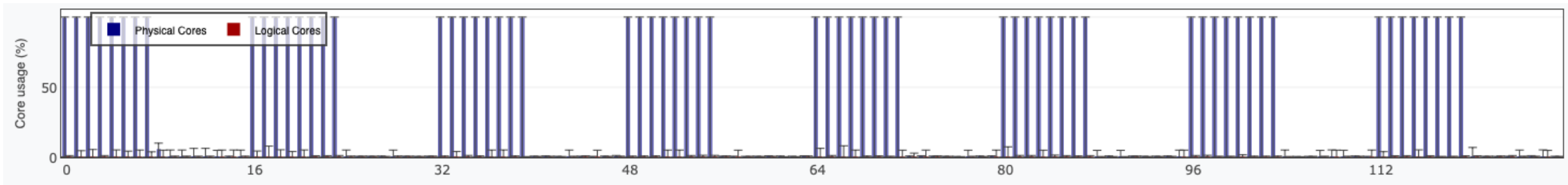
#### *Error Messages:*

```
2025-06-03T10:50:14+0200 jwb0011.juwels psid[63607]: psslurm: nodeDownAlloc: node 3764 in allocation
11584692 state A_RUNNING is down
2025-06-03T10:50:15+0200 jwb0025.juwels psid[80835]: psslurm: nodeDownAlloc: node 3764 in allocation
11584692 state A_EPILOGUE is down
2025-06-03T10:50:15+0200 jwb0036.juwels psid[62353]: psslurm: nodeDownAlloc: node 3764 in allocation
11584692 state A_EPILOGUE is down
2025-06-03T10:50:15+0200 jwb0041.juwels psid[64695]: psslurm: nodeDownAlloc: node 3764 in allocation
11584692 state A_EPILOGUE is down
2025-06-03T10:50:15+0200 jwb0054.juwels psid[62378]: psslurm: nodeDownAlloc: node 3764 in allocation
11584692 state A_EPILOGUE is down
```

# Examples

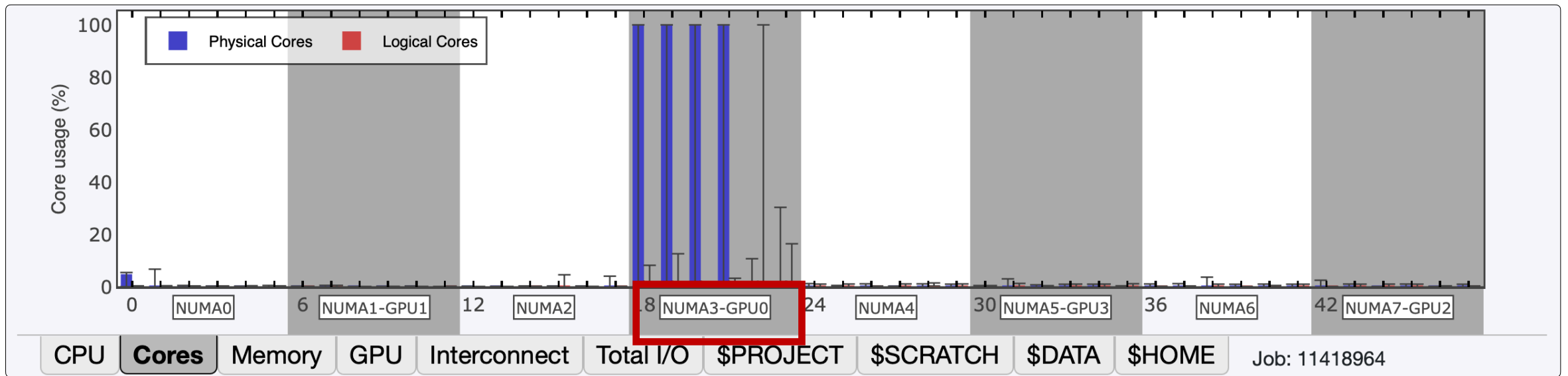
## Inadequate Resource Usage

| Usage | #Cores | #PhysCores | #LogicCores | Load   |
|-------|--------|------------|-------------|--------|
| <50   | filter | filter     | filter      | filter |
| 2.90  | 0.01   | 0.01       | 0.0         | 512.26 |
| 1.37  | 0.37   | 0.27       | 0.1         | 477.35 |
| 4.07  | 0.01   | 0.01       | 0.0         | 395.68 |
| 0.68  | 0.00   | 0.00       | 0.00        | 158.31 |
| 3.00  | 3.73   | 3.73       | 0.00        | 149.31 |
| 18.90 | 23.98  | 23.98      | 0.00        | 128.64 |
| 10.49 | 0.00   | 0.00       | 0.00        | 128.32 |
| 18.91 | 24.00  | 24.00      | 0.00        | 127.77 |
| 18.86 | 23.94  | 23.94      | 0.00        | 127.68 |
| 18.88 | 23.98  | 23.98      | 0.00        | 127.68 |
| 30.34 | 78.75  | 78.75      | 0.00        | 124.96 |



# Examples

## Inadequate Resource Usage

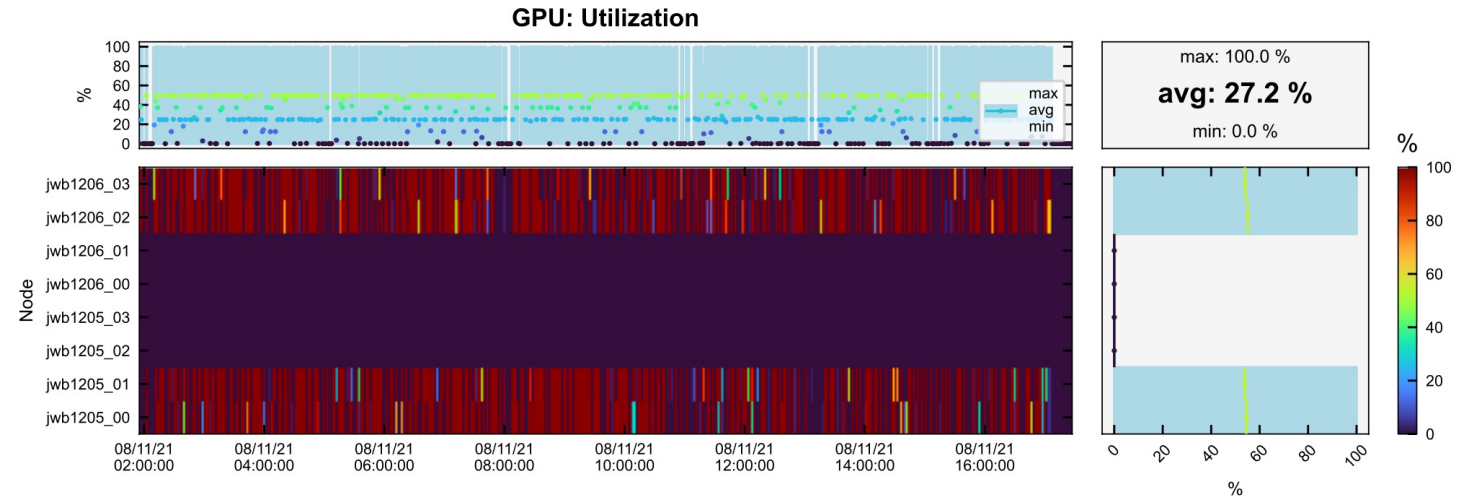




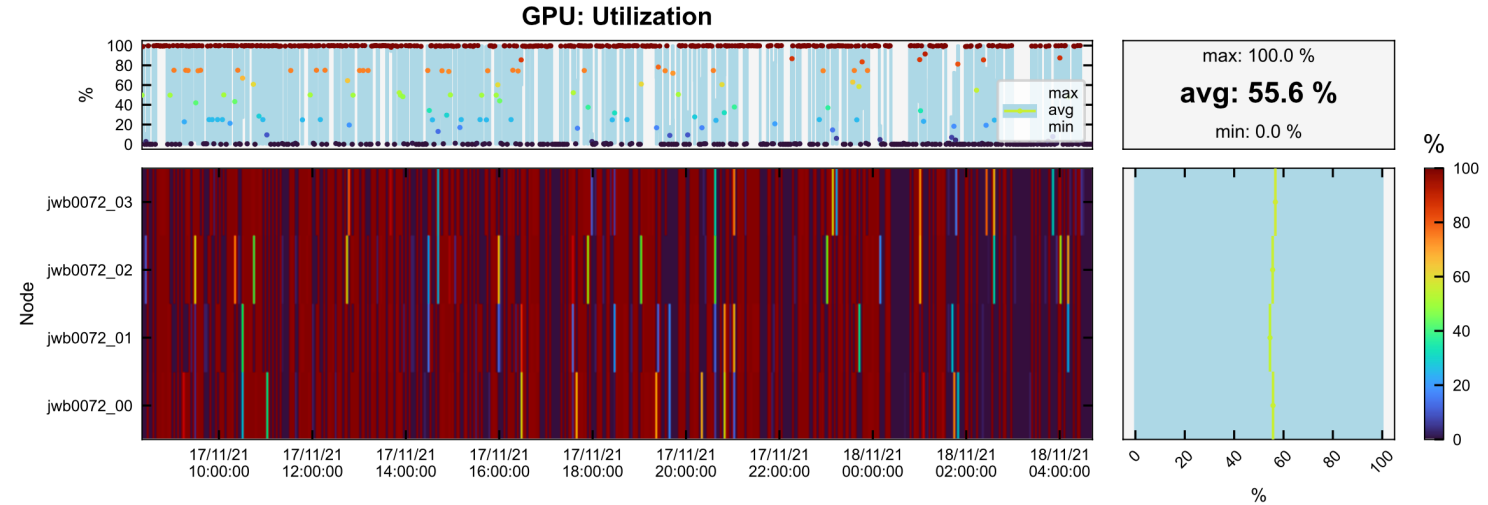
# Examples

## Inadequate Resource Usage

2 nodes (8 GPUs) using  
only 2 GPUs each



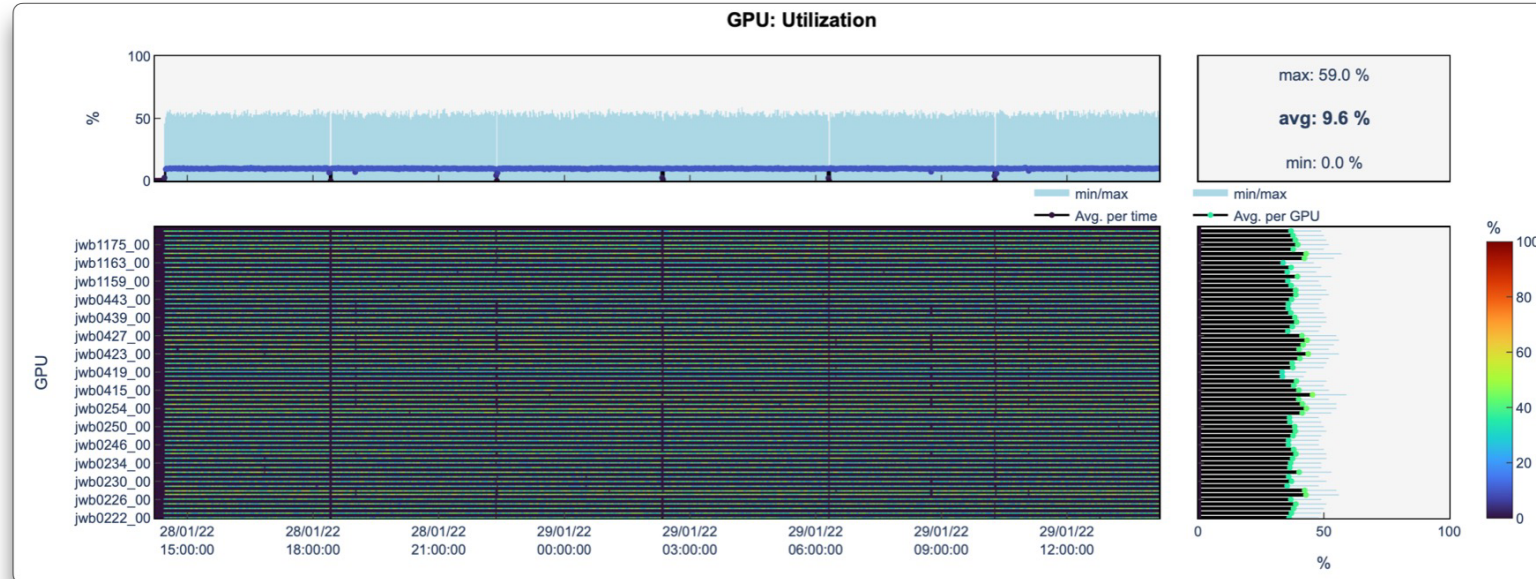
1 nodes using all 4 GPUs



# Examples

## Inadequate Resource Usage

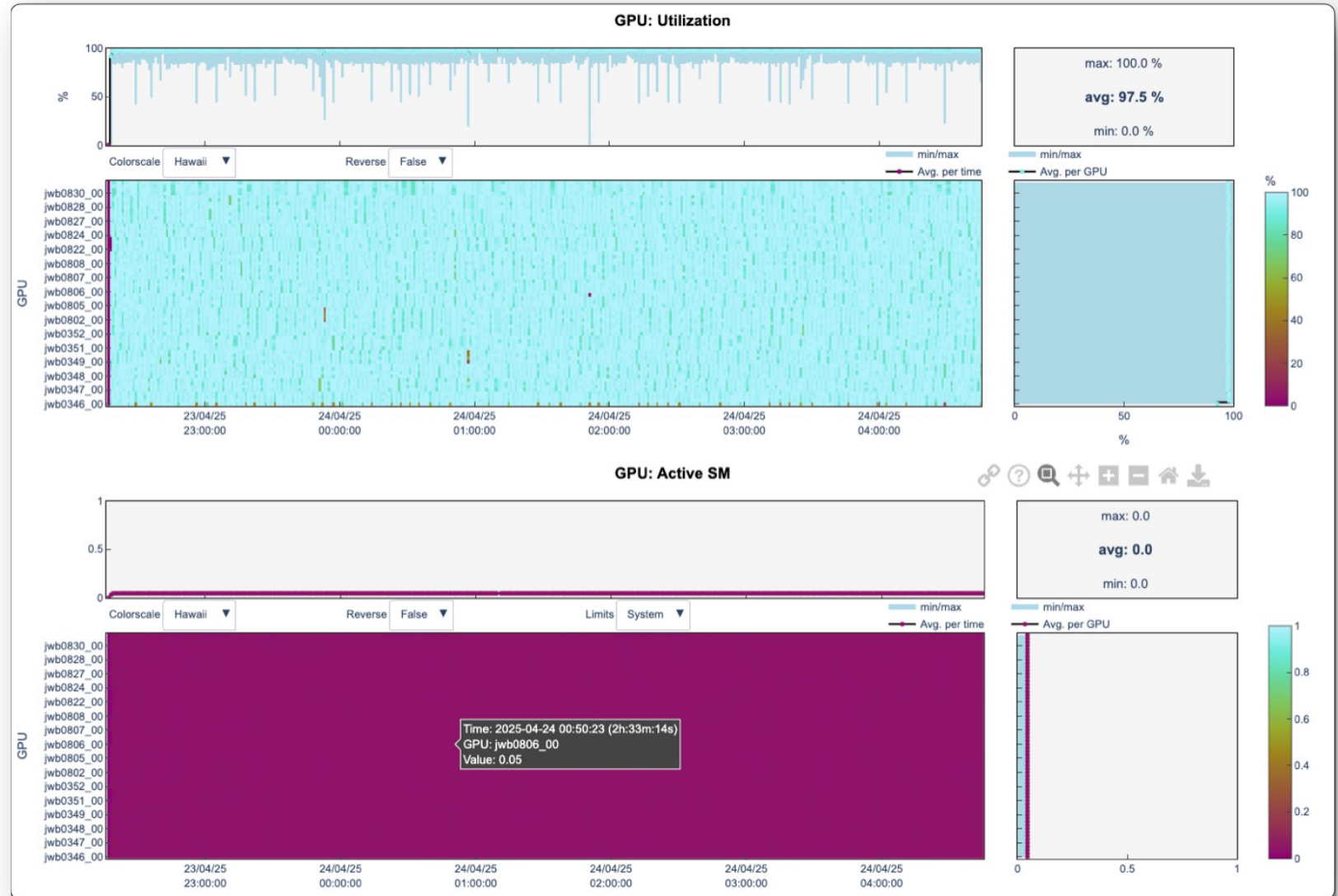
1 GPU per node



# Examples

## Inadequate Resource Usage

GPU Utilisation ~100%

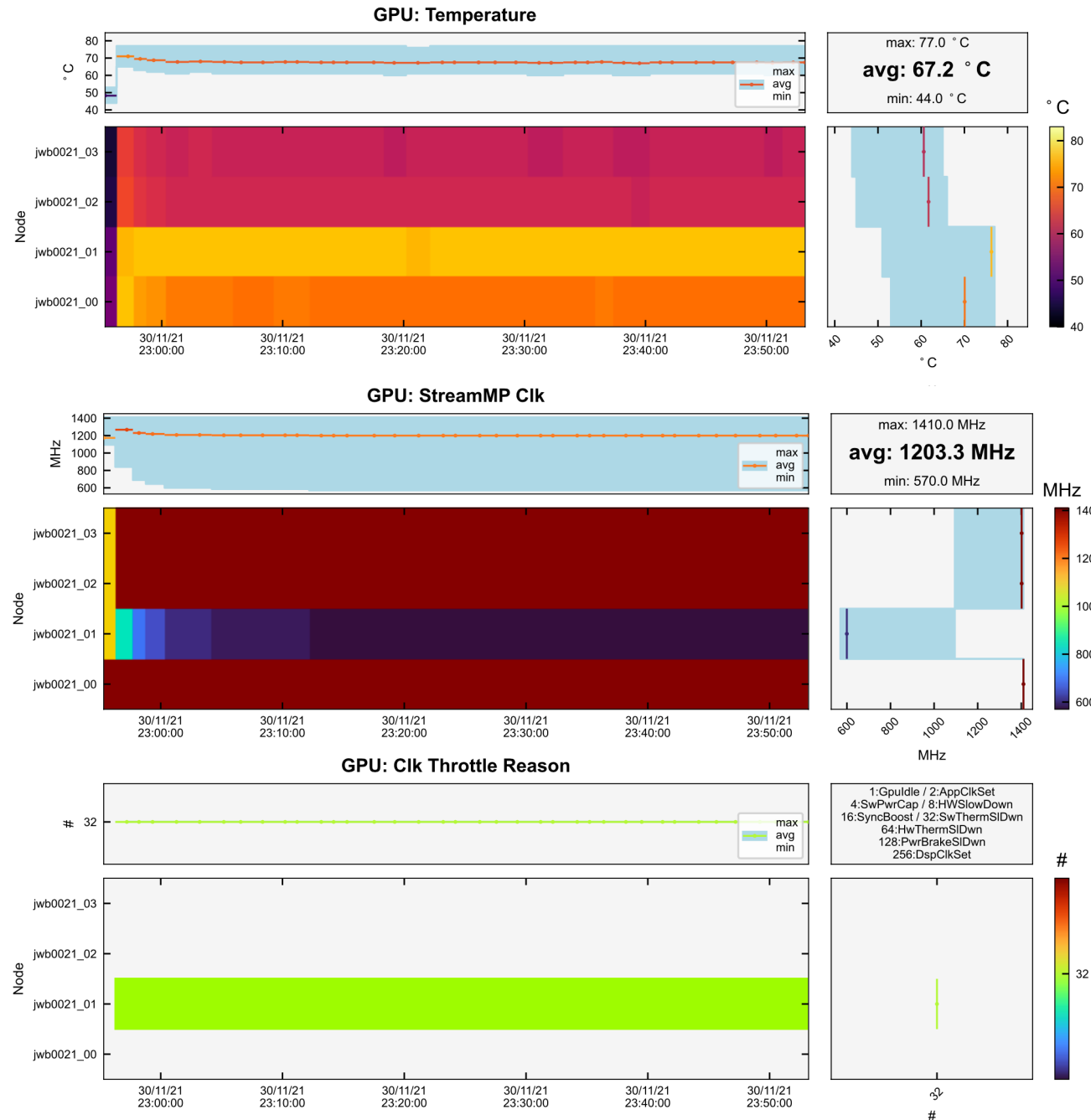


GPU Active SM ~5%

# Examples

## Hardware Issues

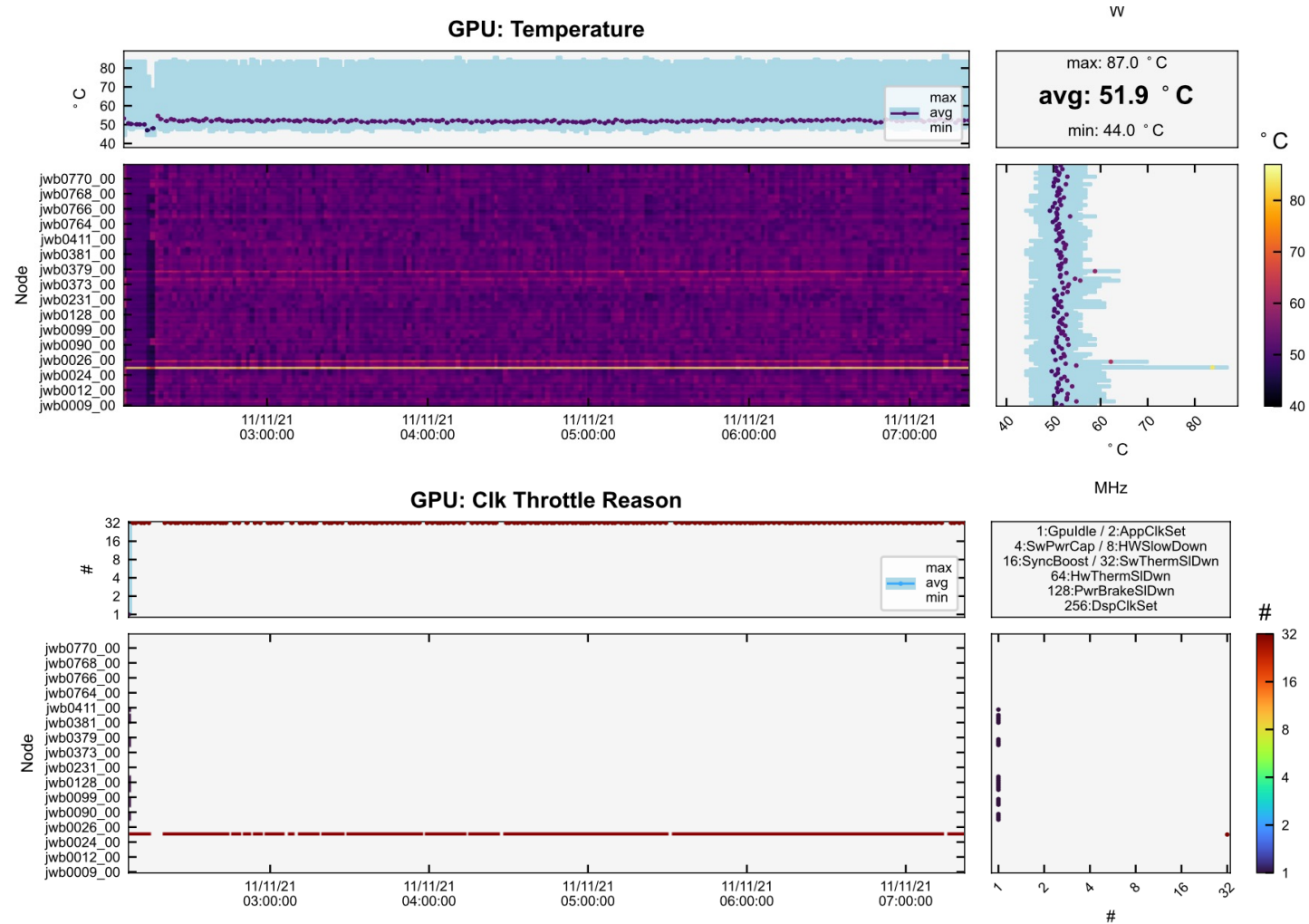
4 GPUs:



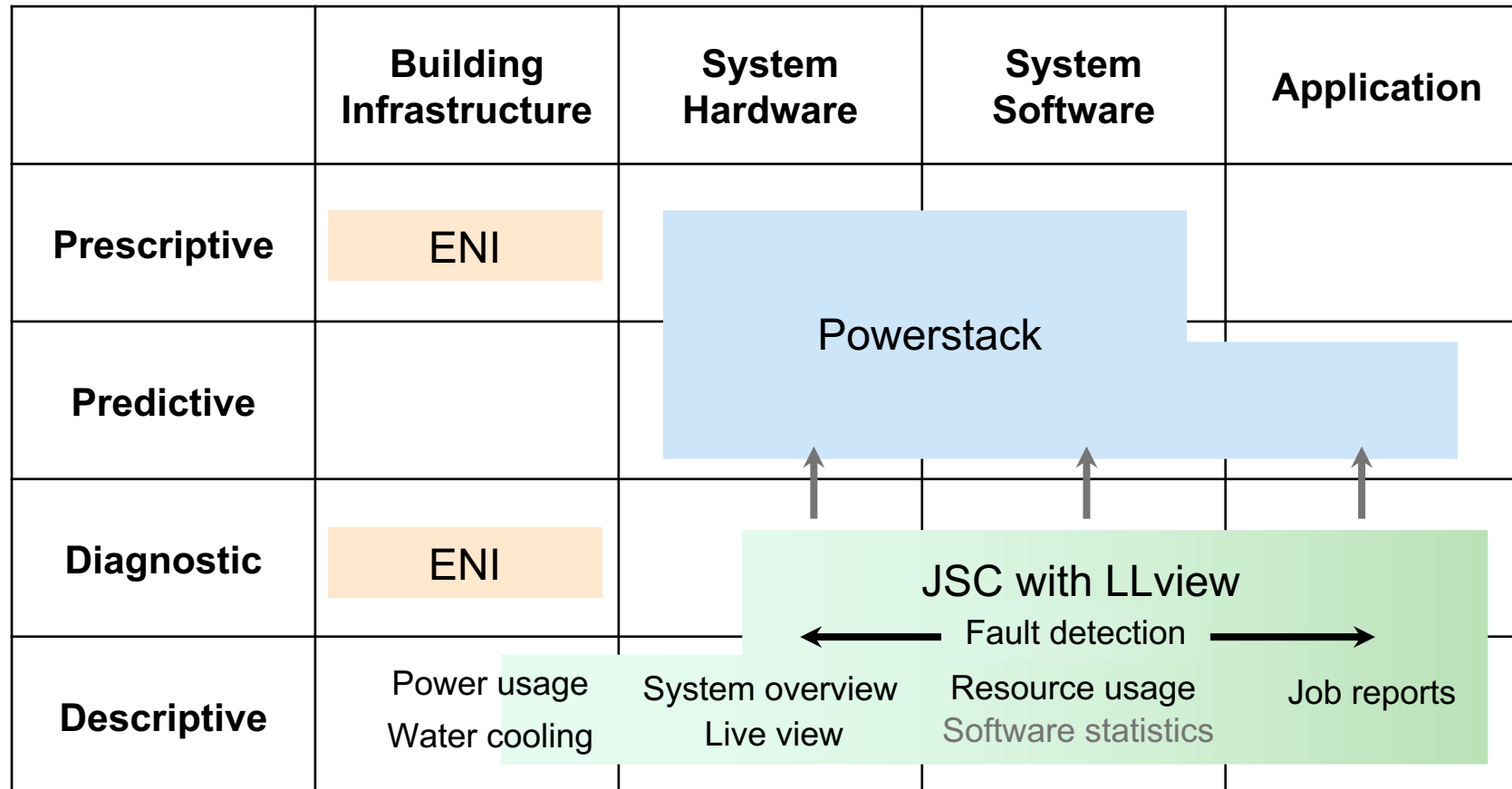
# Examples

## Hardware Issues

128 GPUs:

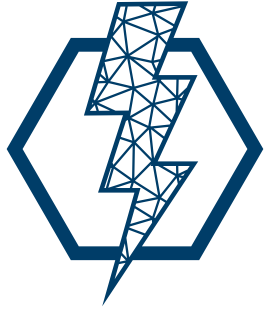


# Classifying LLview



A. Netti et al., A Conceptual Framework for HPC Operational Data Analytics, 2021 IEEE International Conference on Cluster Computing (CLUSTER), 596 (2021)

# Outlook



**JUPITER**



eupex.eu

***SEANERGY***

(Starting in June 2025)

- Faster updates (for JUPITER)
- Generalisations, new metrics and data sources
- Queue view and analysis
- REST-API
- Long-term analysis
- Workflow and project reports
- ...



# Conclusions

Thank you!

LLview...

- ...helps to identify (user and system) software and hardware issues
  - ...enables users find problems on their own
  - ...brings support to a higher level
  - ...reduces the need for communication between users and support as well as support and admins
  - ...improves the overall system utilisation
- 
- Open source GPLv3 Licence [github.com/FZJ-JSC/llview](https://github.com/FZJ-JSC/llview)
  - Website: [llview.fz-juelich.de](https://llview.fz-juelich.de)
  - Contact: [llview.jsc@fz-juelich.de](mailto:llview.jsc@fz-juelich.de)

