SYSTEM MONITORING AND JOB REPORTS WITH LLVIEW

May 21, 2019 | Tobias Bauer | JSC/Jülich Supercomputing Centre
Part I: System Monitoring
1. System Monitoring

**MOTIVATION**

- Is my job running?
- When will it start?
- How is the current load?
- How is my job placed?
WHY SYSTEM MONITORING?

- For users
  - Controlling own running and waiting jobs
  - Planning job submissions
  - Use of idling resources

- For administrators
  - Global overview of system utilization
  - Throughput optimization
  - Batch system configuration optimization
  - Adaptive change of scheduling parameters

⇒ LLview
  - Compact display of all usage data in one window
  - Easy access to system’s status data
  - Interactive display for linking information
  - Open Source (BSD-style)
  - Available for all JSC systems
1. System Monitoring

LLVIEW

→ Visualizes supercomputer status on a single screen

Source: Screenshot LLview for JUWELS
1. System Monitoring

**LLVIEW EXAMPLE: JURECA**

- High fragmentation
- Heterogeneous
- Batch System: SLURM
- Ongoing development

Source: Screenshot LLview for JURECA
1. System Monitoring

LLVIEW ARCHITECTURE

- Client-Server architecture, LML_da as backend
- Clients: Perl-Tk, PTP, Webinterface
- Platform independent: works on Windows, Mac and Linux
- Wide range of supported batch systems, minimal effort for extension
- Minor performance impact on monitored system, only **central batch** system is queried
1. System Monitoring

**PTP – PARALLEL TOOLS PLATFORM**

**What is PTP?**

- **IDE** for parallel application development
- Based on **Eclipse**
- **Open-source** project
- Developers: IBM, U.Oregon, UTK, Heidelberg University, NCSA, UIUC, JSC, ...

HOW TO START THE LLVIEW CLIENT?

Four options to start LLview, sorted by effort to get started

Option 1: via SSH

```
ssh -X tbauer@jureca
llview
```

Option 2: Webinterface

- Screenshots of LLview updated every minute (static)
- Access secured by JSC webservice accounts
  - register at dispatch
  - request access to LLview via jsc-dispatch@fz-juelich.de
1. System Monitoring

**HOW TO START THE LLVIEW CLIENT? II**

**Option 3: VNC**

- start VNC server on JURECA with `vncserver -profile vis`
- tunnel VNC traffic to local system
- start VNC viewer
- click on LLview links
- detailed step by step guide [here](#)

**Option 4: Local installation**

- Download and install the LLview client locally
Part II: Job Reports
JOB REPORTS

What can I get?

- Detailed reports on active and finished jobs
- Job summary and time-based diagrams of many job metrics such as load, memory usage, I/O
- Use cases: development, production checks, job health check, light-weight performance analysis
- Live monitoring with LLview

Details

- Includes metrics for CPUs and GPUs
- No instrumentation needed, data is retrieved from IPMI once per minute
- Development in progress
2. Job Reports

ACCESS

- login JURECA: https://llview.fz-juelich.de/LLweb/jureca/jobreport/login.php
- login JUWELS: https://llview.fz-juelich.de/LLweb/juwels/jobreport/login.php
- Also reachable via the JSC-Website
- Authenticate with webservice account, register here
2. Job Reports

USER JOBS

- Lists for active and finished jobs (< 2 weeks)
- Updates after 1-5 minutes
- Colormap for quick evaluation of metrics
- Interactive Graphs (e.g. Zoom)
- PDF column on the right leads to detailed job report
JOB REPORTING IN WEB PORTAL

LLview: Job-reports overview on Jureca Batch, GPU, Booster nodes (Support View)

Current active jobs

Job reports created by LLview at 17/11/07-12:34:15
DETAILED JOB REPORT AS PDF

- Diagrams for all available metrics per job over runtime
- Overall diagrams and diagrams per compute node
EXAMPLE JOB – BAD LOAD BALANCING

CPU Nodes: Load [ nodes 0 .. 16 ]

Total Load: 193.01, Average/Node: 12.06, Max/Node: 44.28
EXAMPLE JOB – GOOD LOAD BALANCING

CPU Nodes: Load [ nodes 0 .. 16 ]

Total Load: 656.16, Average/Node: 41.01, Max/Node: 47.78
2. Job Reports

CONTACT

- **E-mail:**
  llview.jsc@fz-juelich.de

- **LLview** → http://www.fz-juelich.de/jsc/llview

- **Job Reports** → https://llview.fz-juelich.de/LLweb/[jureca|juwels]/jobreport/login.php


- **PTP Download** →
  http://www.eclipse.org/downloads/eclipse-packages/
Part III: Appendix – LLview Components
3. Appendix – LLview Components

**NODE DISPLAY**

- Compute resources
- Job distribution
- White = Idle, Colored = running
- Node name
- Node status
- Level of detail

- Midplane name
- Midplane state
- Rack power usage
3. Appendix – LLview Components

**NODE DISPLAY**

- Compute resources
- Job distribution
- White = Idle, Colored = running
- Node name
- Node status
- Level of detail

Node state

divided: SMT used
3. Appendix – LLview Components

JOB LIST

- List of running jobs
- Most important attributes per job
- Sort by clicking on the column header
- Identifying color next to each job entry
- Summary of system load
- Job size decreases from left to right
- White space shows idling resources
- Unit for JUWELS is midplanes, for JURECA nodes
3. Appendix – LLview Components

HISTORY

- 3-day load history
- Often divided into small and large jobs
  - JUWELS (1 midplane), JURECA (512 tasks)
- Mouse-Over for detailed information
- Green line for special history value
  - JUWELS (power)
3. Appendix – LLview Components

PREDICTION

- Scheduler prediction based on submitted jobs
- Wall clock limit as job duration
- Blue = predicted job, Colored = running jobs
- Each rectangle one job,
  x-axis = time, y-axis = nodes/midplanes
- Use of idle times
- More transparent scheduling
- JUWELS: self-implemented, JURECA: self-implemented
3. Appendix – LLview Components

STATISTICS

- Statistic overview on system status
- Histograms on job size, wait time, queue load
- Highly configurable, define x-axis/y-axis domain, logarithmic/linear scale
- Overlayed diagrams for waiting/running jobs
3. Appendix – LLview Components

INFOBOX

- Shows details on the currently focused object
- Mouse-Over triggers to display detailed data on the focused job/node/system/diagram
INTERACTION

- **Mouse-Over** jobs highlights job rectangles for the selected job in all components and shows details on the job in infobox.
3. Appendix – LLview Components

**INTERACTION**

- **Mouse-Over** jobs highlights job rectangles for the selected job in all components and shows details on the job in infobox.
- **Mouse-Down** (Hold) removes color for all other jobs, only the selected job is colored.
3. Appendix – LLview Components

INTERACTION

- **Mouse-Over** jobs highlights job rectangles for the selected job in all components and shows details on the job in infobox.
- **Mouse-Down** (Hold) removes color for all other jobs, only the selected job is colored.
- **Double-Click** show job detail dialog.
- Mouse interaction helps to link the information shown in all components.
Part IV: Appendix – LLview Customization
LLview is **highly customizable** due to numerous options

- Settings specific to HPC system type
- Start through option menu of main window or Ctrl+o
- Most options have *immediate effect* in the main window
- Some will become active at next start of LLview (e.g. *Data source* change)

- LLview layouts use **absolute** positioning
- You can use arrow keys to add/subtract one on numeric values
- Use Page up/Page down keys to add/subtract a bigger step on numeric values
LLVIEW CONFIGURATION FILES

Three configuration file locations (highest priority first):

1. anywhere on your file system passed to LLview with the `-rcfile` option
2. local `.llview.rc` configuration file in current directory or in HOME directory of the user
3. `llview.rc` in the installation directory of LLview. This file contains the system-wide settings

- Configuration files contain all LLview options
- You can change them in any text editor or via the LLview Option window
### LLVIEW OPTIONS

<table>
<thead>
<tr>
<th>General</th>
<th>Elements</th>
<th>LocalData</th>
<th>WWW</th>
<th>lqlxml</th>
<th>Info</th>
<th>Status</th>
<th>UsageBar</th>
<th>Nodes</th>
<th>NodeBox</th>
<th>LogView</th>
<th>Joblist</th>
<th>Hist</th>
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</tbody>
</table>

**data source**

**verbose** □ on/off      □ demo version □ on/off      □ show +/- buttons □ on/off

**Node selection regexp** :*

Anonymise user names for demonstration purposes. LLview restart required

**Job selection regexp (uid)** ^bgidialog

**RC** □ on/off      RC_id: juqueen

**Height** 640   **Width** 1220

**Height (Lines)** 61

**Geometry**

**Canvas Color** grey85

**Update** □ on/off      **Update time (s)** 60

**auto play** □ on/off      **Autoplay Step (s)** 5

**Mark Color** red

**Mark Width** 2

**version** 1.3

**no frame for mainwindow** □ on/off      **notimestate** □ on/off
GENERAL OPTIONS

- General options for the main window
- Choose your preferred data source (Web-Server, LocalData or local command)
- demo version: anonymise usernames (for public display)
- Job selection regexp: filtering jobs by regular expressions
- Customize Height and Width of the main window
- Canvas Color: background, Mark Color: color for marking job in job list
- Choose time until next update
- auto play lets LLview mark different jobs automatically (for public display)
### LLVIEW ELEMENT OPTIONS

<table>
<thead>
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<th>General</th>
<th>Elements</th>
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<th>WWW</th>
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<th>Status</th>
<th>UsageBar</th>
<th>Nodes</th>
<th>NodeBox</th>
<th>Loc</th>
</tr>
</thead>
</table>

- Changes on following options have only effect ***after save options and restart LLview*** !!

<table>
<thead>
<tr>
<th>Feature</th>
<th>On/Off</th>
<th>Feature</th>
<th>On/Off</th>
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</thead>
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<tr>
<td>Show usage bar</td>
<td>![on/off]</td>
<td>Show nodes</td>
<td>![on/off]</td>
</tr>
<tr>
<td>Show joblist</td>
<td>![on/off]</td>
<td>Show running</td>
<td>![on/off]</td>
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<tr>
<td>Show waiting</td>
<td>![on/off]</td>
<td>Show graph</td>
<td>![on/off]</td>
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<tr>
<td>Show histogram</td>
<td>![on/off]</td>
<td>Show status</td>
<td>![on/off]</td>
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<tr>
<td>Show info</td>
<td>![on/off]</td>
<td>Show history</td>
<td>![on/off]</td>
</tr>
<tr>
<td>Show partition (BG)</td>
<td>![on/off]</td>
<td>Show reservations (BG)</td>
<td>![on/off]</td>
</tr>
<tr>
<td>Show prediction of usage</td>
<td>![on/off]</td>
<td>Show usage history</td>
<td>![on/off]</td>
</tr>
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</table>

- Choose, which Elements to show
- For end users: components like joblist, info, nodes and prediction etc.
- Changes take effect after **restarting** LLview
## LLVIEW NODE OPTIONS

<table>
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<th>WWW</th>
<th>IQxml</th>
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<th>LogView</th>
<th>Joblist</th>
<th>Histogram</th>
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<td>Y position</td>
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<tr>
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<tr>
<td>use User Layout</td>
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<td>InOut pos. Y</td>
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<td>Logo pos. Y</td>
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</tbody>
</table>
4. Appendix – LLview Customization

NODE OPTIONS

- Customize **Height, Width and Margins** of the node display
- Logical node view available for BG systems e.g. JUWELS ⇒ Twin View places adjacent midplanes next to each other in torus network
- Options for the Twin View are available in a new option subfolder ⇒ Log View
- **Node attr.**: show scalar data e.g. temperature or power usage
- Show logo or site name
# LLVIEW HISTOGRAM OPTIONS

<table>
<thead>
<tr>
<th>General</th>
<th>Elements</th>
<th>LocalData</th>
<th>WWW</th>
<th>liqxml</th>
<th>Info</th>
<th>Status</th>
<th>UsageBar</th>
<th>Nodes</th>
<th>NodeBox</th>
<th>LogView</th>
<th>Joblist</th>
<th>Histogram</th>
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</thead>
<tbody>
<tr>
<td>Diagram 1</td>
<td>Diagram 2</td>
<td>Diagram 3</td>
<td>Diagram 4</td>
<td>Diagram 5</td>
<td>Diagram 6</td>
<td>Diagram 7</td>
<td>Diagram 8</td>
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</tr>
</tbody>
</table>

- **Diagram Title**: Job Wait Time
- **Job Selection**: ALLSEP
- **Legend Offset X**: 130
- **Legend Offset Y**: 2
- **X-Axis Data**: QUEUETIME
- **Y-Axis Data**: COUNT
- **Stepwidth (xdata)**: 12
- **Log X Data**: LINEAR
- **Log Y Data**: LOG10
- **Format X**: day
- **Format Y**: %3d
- **Format AVG X**: day
- **Format AVG Y**: %3d
- **Fill Color**: darkblue
- **Fill Color (Run)**: darkgreen

**Global Options for all diagrams**

- **Display Diagram**: Diagram 1
- **# Diagrams**: 5
- **Autoplay Delay**: 10
- **Pos X**: 244
- **Pos Y**: 557
- **Height**: 179
- **Width**: 300
- **Font**: -adobe-courier-medium-r-normal-**-60-*-*-*
- **Bold Font**: -adobe-courier-bold-r-normal-**-70-*-*-*
- **Number Font**: -**-Courier-Medium-R-Normal-**-120-*-*-*
- **Padding Left**: 30
- **Padding Right**: 30
- **Padding Bottom**: 25
- **Padding Top**: 15
- **Button Width**: 10
- **Legend Width**: 135
- **Legend Height**: 15
HISTOGRAM OPTIONS

- Each histogram shows distribution for a single job attribute, e.g. waiting time
- You can configure up to 8 histograms
- Jobs are grouped into discrete classes, y-axis shows count of jobs in each class
- Y-axis may also show number of CPUs, CPU hours or job duration
- Scaling may be linear or logarithmic
- Auto play is available for public display