

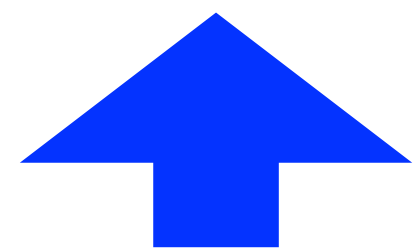


Open Composer: A Web-Based Application for Generating and Managing Batch Jobs on HPC Clusters

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Background (1/3) : Barriers to HPC Accessibility

- The primary use case of HPC clusters is to execute real-world applications as batch jobs
- Using HPC clusters often requires technical skills:
 - Install an SSH client
 - Generate an SSH key pair and register its pub key
 - Be familiar with Linux commands
 - Understand directives and commands for job schedulers (e.g. Slurm, PBS, Grid Engine)



When users move to an HPC cluster with a different job scheduler, they often have to re-learn how to use it



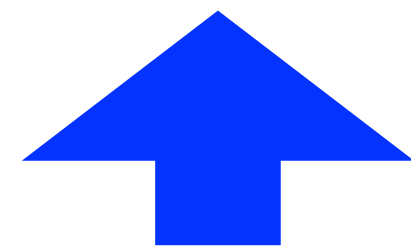
```
#!/bin/bash
#SBATCH -p fx700    // Queue
#SBATCH -N 1        // Number of nodes
#SBATCH -t 1:00:00  // Required time
mpiexec ./a.out
```

Example of a batch job script in Slurm

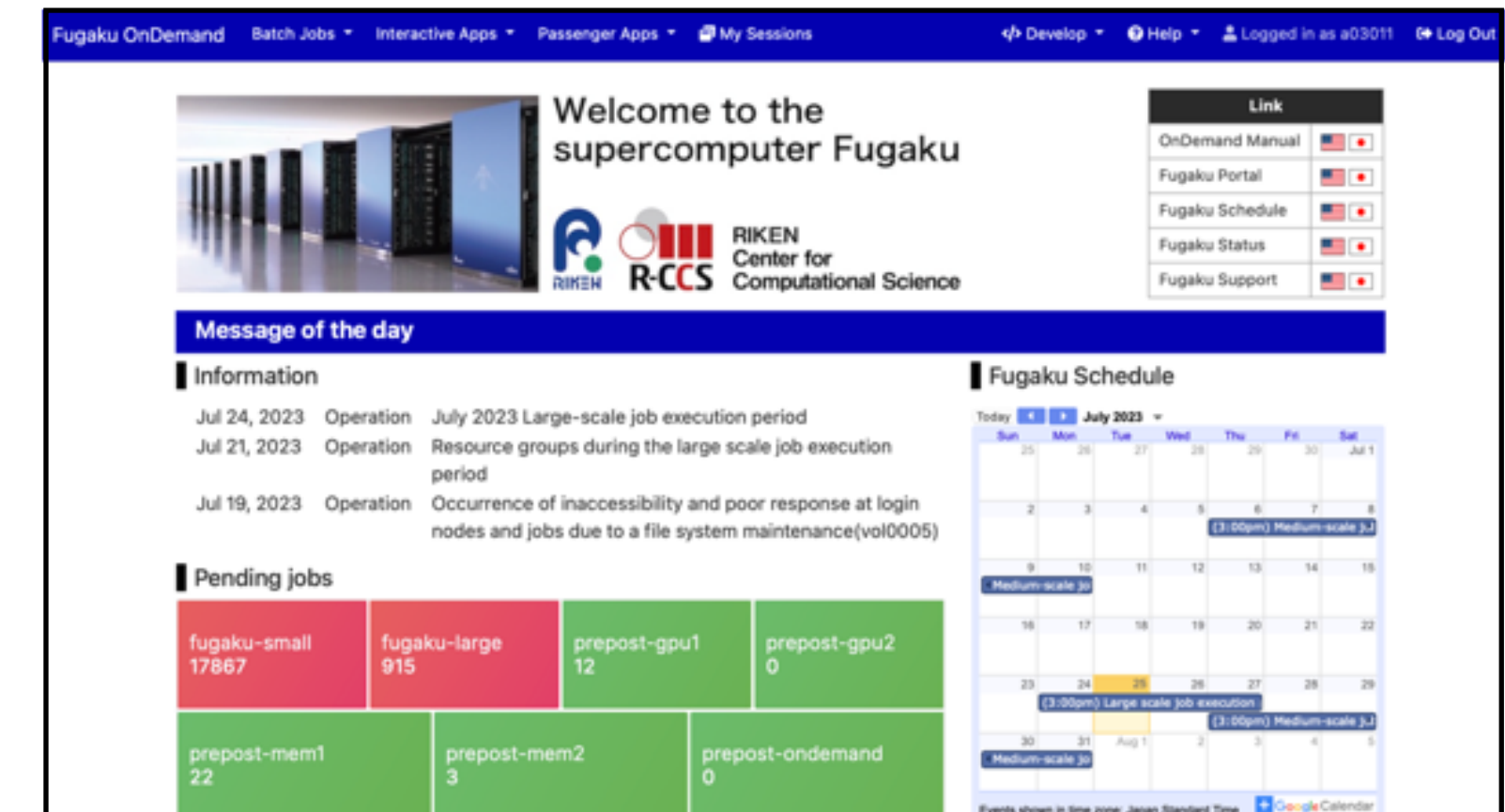
Background (2/3) : Open OnDemand

<https://www.openondemand.org/>

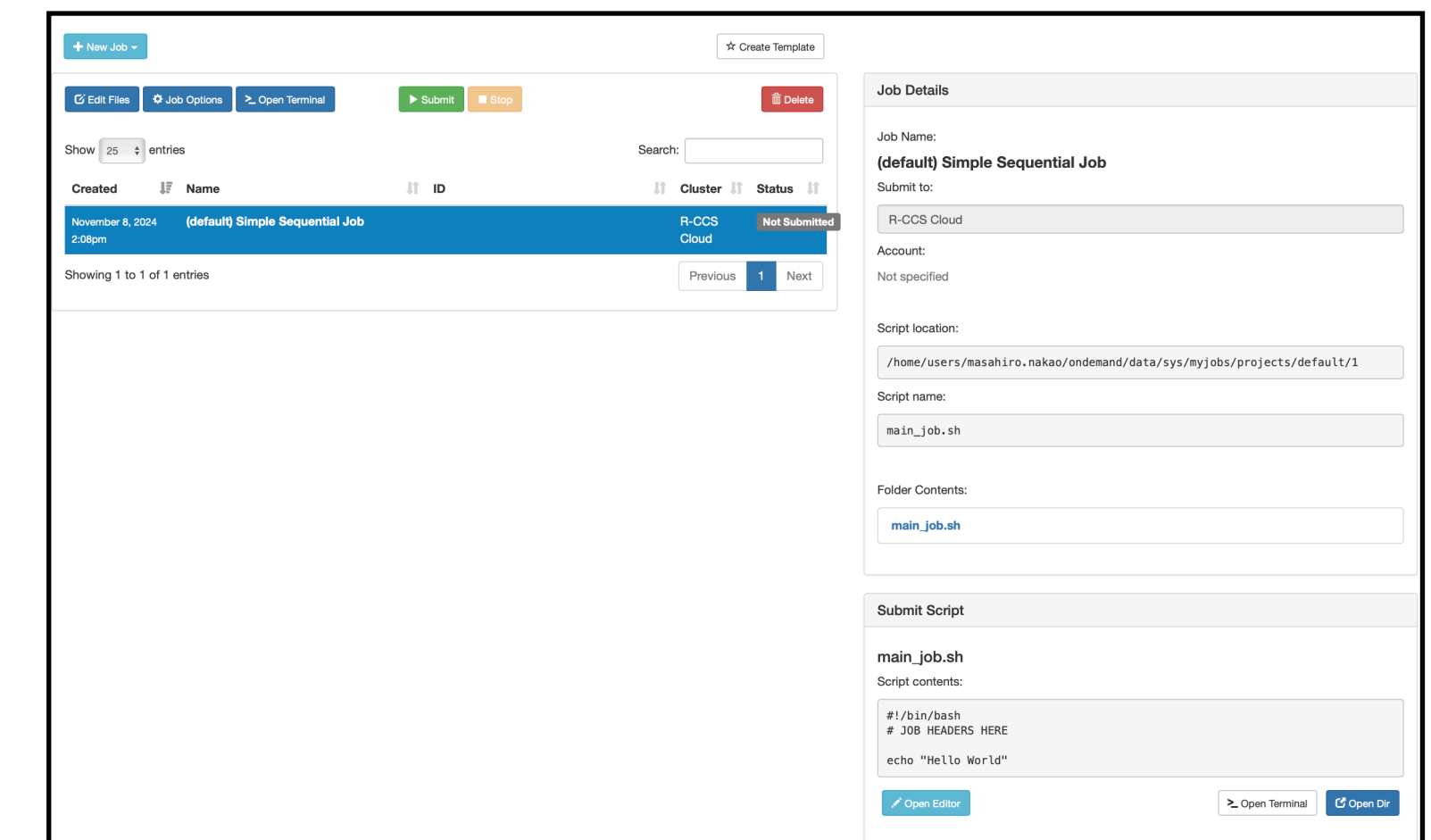
- Open OnDemand, a web portal for HPC clusters
- Open source software developed by Ohio State University
- Used all over the world
- Provides a unified web-based interface to access HPC clusters, without requiring SSH or Linux commands
- Includes a mechanism to **run custom applications**
- Offers many functions, including **batch job creation**, GUI-based job launchers (e.g., JupyterLab), file management, data transfer tools, job monitoring, and terminal access



However, for batch job creation, users must write the scripts manually, which can be challenging



Our portal by Open OnDemand



Creating a batch job

Background (3/3) : Job Composer

The screenshot displays the Job Composer web interface. At the top, there are buttons for '+ New Job', 'Create Template', 'Edit Files', 'Job Options', 'Open Terminal', 'Submit', 'Stop', and 'Delete'. Below these is a table with columns for 'Created', 'Name', 'ID', 'Cluster', and 'Status'. A single entry is shown: 'November 8, 2024 2:08pm', '(default) Simple Sequential Job', and 'Not Submitted'. A callout box points to the 'Submit' button with the text 'Submit a batch job'. The 'Job Details' panel on the right includes fields for 'Job Name' (set to '(default) Simple Sequential Job'), 'Submit to:', 'Account' (set to 'Not specified'), 'Script location:', 'Script name' (set to 'main_job.sh'), and 'Folder Contents' (showing 'main_job.sh'). At the bottom, a red-bordered box highlights the 'Script contents' editor, which contains the following text:

```
#!/bin/bash
# JOB HEADERS HERE

echo "Hello World"
```

Below the script editor are buttons for 'Open Editor', 'Open Terminal', and 'Open Dir'.

- Pre-installed application on Open OnDemand to create batch jobs
- Batch jobs can be submitted from a web browser using GUI
- Users must write batch job scripts with job scheduler directives manually

We also want to simplify batch job creation on Open OnDemand

Objective

<https://github.com/RIKEN-RCCS/OpenComposer>

We have developed Open Composer, a web-based application for generating and managing batch jobs on HPC clusters

- Runs on Open OnDemand
 - Allows easy deployment in any environment where Open OnDemand is available
- Open-source software under the MIT license
- Enables users to generate job scripts automatically by entering parameters into web forms tailored to each application
- Reduces the learning burden of job schedulers and minimizes script-writing errors
- Provides job management, including submission, deletion, and status monitoring

The screenshot shows the Open Composer web interface for configuring an FDS (Fire Dynamics Simulator) job. The interface is divided into several sections:

- Top Bar:** Includes navigation links for 'Top', 'Application', and 'History', and a user profile 'Open OnDemand'.
- Application Header:** Displays 'FDS' and a description: 'FDS (Fire Dynamics Simulator) is a large-eddy simulation code.'
- Script Location:** A text input field containing '/Users/mnakao/' and a 'Select Path' button.
- Script Name:** A text input field containing 'job.sh'.
- Resource group:** Includes radio buttons for 'small' (selected) and 'large'.
- Nodes (1 - 384)*:** A numeric input field with the value '1'.
- Procs (1 - 18,432)*:** A numeric input field with the value '1'.
- Threads (1 - 48)*:** A numeric input field with the value '1'.
- Nodes x 48 >= Procs x Threads:** A label indicating the resource constraint.
- Maximum run hours (0 - 72)*:** A numeric input field with the value '1'.
- Maximum run minutes (0 - 59)*:** A numeric input field with the value '0'.
- Script name (Up to 63 bytes):** An empty text input field.
- Show advanced option:** A checkbox that is currently unchecked.
- FDS version*:** Radio buttons for versions 6.8.0 (selected), 6.7.9, 6.7.8, and 6.7.7.
- Input file*:** A text input field containing '/Users/mnakao/' and a 'Select Path' button.
- Script Contents:** A large text area containing the following script content:

```
#!/usr/bin/env bash
#PJM -L "rscgrp=small"
#PJM -L "node=1"
#PJM --mpi "proc=1"
#PJM -L "elapse=1:0:00"
export OMP_NUM_THREADS=1

./vol0004/apps/oss/spack/share/spack/setup-env.sh
spack load fds@6.8.0

cd /Users/mnakao
mpiexec fds_mpi_fugaku
```
- Submit:** A large blue button at the bottom right.

Design of Open Composer

- **Running on Open OnDemand**
 - **Enables easy deployment**
 - **Reduces development cost by leveraging Open OnDemand's built-in features, such as authentication and data transfer**
- Script Auto-Generation
 - Job scripts are automatically generated based on user input through a web interface
 - Includes error checking to prevent submission failures
- Editable Script
 - Users can also directly modify generated job scripts to meet specific requirements
- Job Management
 - Supports job submission, deletion, and status monitoring
 - Unified interface that hides the differences between job schedulers

Implementation of Open Composer

- Backend
 - Using the open-source Ruby framework Sinatra (<https://sinatrarb.com/>)
 - Sinatra is available in the Open OnDemand environment without any additional installation
- Frontend
 - Bootstrap (CSS + JavaScript) for a responsive web interface
 - JavaScript and HTML to update job scripts in real time
 - We didn't use any external libraries to minimize dependencies
- Code Statistics (as of November 2025, Version 1.7.0)
 - Ruby: 2,322 lines
 - JavaScript: 1,070 lines
 - HTML (including ERB): 409 lines

<https://github.com/RIKEN-RCCS/OpenComposer>

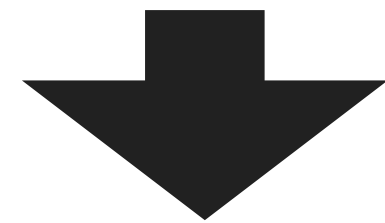
Installation of Open Composer

- Administrator

```
# cd /var/www/ood/apps/sys  
# git clone https://github.com/RIKEN-RCCS/OpenComposer.git  
# vim OpenComposer/conf.yml.erb
```

- General user or

```
$ cd ${HOME}/ondemand/dev  
$ git clone https://github.com/RIKEN-RCCS/OpenComposer.git  
$ vim OpenComposer/conf.yml.erb
```



```
scheduler: slurm
```

It's very easy. No additional software is required.

In most cases, a user needs to specify only the item "scheduler".
Open Composer supports Slurm, PBS, Grid Engine, and Fujitsu TCS job schedulers.

Creating web form for each application

- Definition file for each application in YAML format
- Open Composer supports the following input form types (widget):
 - **number**: Enter a number
 - **text**: Enter text
 - **email**: Enter an email address
 - **select**: Select one item from a select box
 - **multi_select**: Select multiple items from a select box
 - **radio**: Select one item from a radio button
 - **checkbox**: Select multiple items from a checkbox
 - **path**: Select the path to a file or directory on the server

Example of definition file

form:

queue:

widget: radio
label: Queue
value: small
direction: horizontal
options:
- [small]
- [large]

time:

widget: number
size: 2
label: [Max hours (0-24), Max minutes (0-59)]
value: [1, 0]
min: [0, 0]
max: [24, 59]
step: [1, 1]

nodes:

widget: number
label: Number of nodes (1 - 128)
value: 1
min: 1
max: 128
step: 1

binary:

widget: path
label: Executable binary

script: |

```
#!/bin/bash
#SBATCH -p {queue}
#SBATCH -t {time_1}:{time_2}:00
#SBATCH -N {nodes}
mpirun {binary}
```

Other functions and summary

- Other functions

- Dynamic form widget such as hiding, disabling, changing values
- Detailed error checking in Ruby
- Preprocess
- Multiple schedulers
- Integration with Open OnDemand functions



These features make job script generation more flexible and enhance the user experience

- Summary

- Development of Open Composer, a web application that can automatically generate and submit batch job scripts
- Reducing learning costs and the frequency of job script writing errors