C.E.C.I

Consortium des Equipements
de Calcul Intensif
en Fédération Wallonie-Bruxelles

Preparing, submitting and managing jobs with Slurm

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Until now:

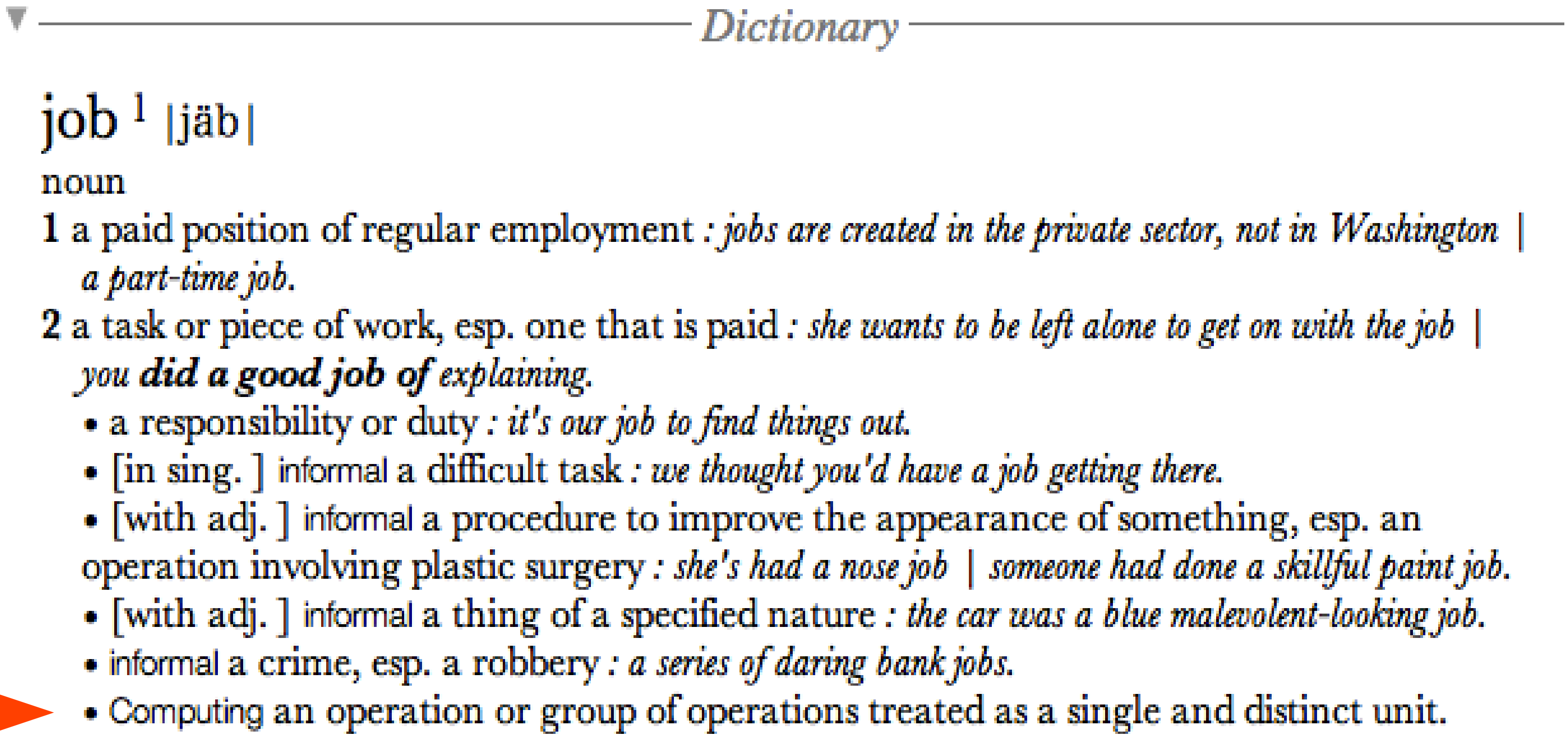
- access the cluster ✓
- copy data to/from the cluster ✓
- choose and activate software ✓
- run software in the command line prompt ✓
- create/write text files ✓
- actually run software on the cluster ❓

tl;dr:

DON’T: run software on the login node

DO: submit a *job* to the *resource manager/job scheduler*

What is a job?



Dictionary

job [1] |jäb|

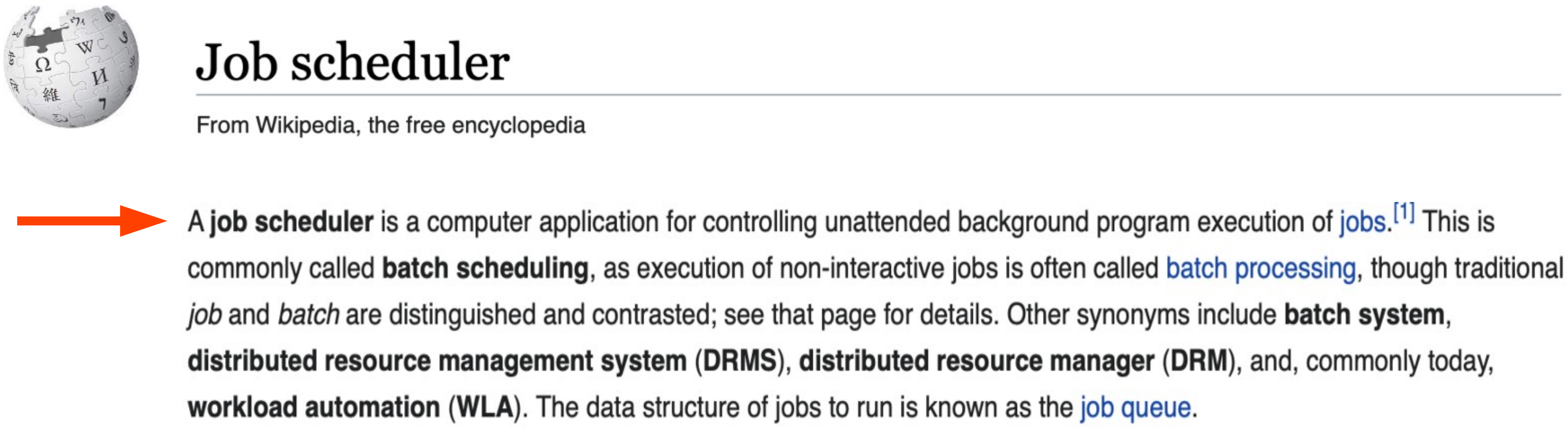
noun

1 a paid position of regular employment : *jobs are created in the private sector, not in Washington* | *a part-time job.*

2 a task or piece of work, esp. one that is paid : *she wants to be left alone to get on with the job* | *you* ***did a good job of*** *explaining.*

- a responsibility or duty : *it's our job to find things out.*
- [in sing.] informal a difficult task : *we thought you'd have a job getting there.*
- [with adj.] informal a procedure to improve the appearance of something, esp. an operation involving plastic surgery : *she's had a nose job* | *someone had done a skillful paint job.*
- [with adj.] informal a thing of a specified nature : *the car was a blue malevolent-looking job.*
- informal a crime, esp. a robbery : *a series of daring bank jobs.*
- Computing an operation or group of operations treated as a single and distinct unit.

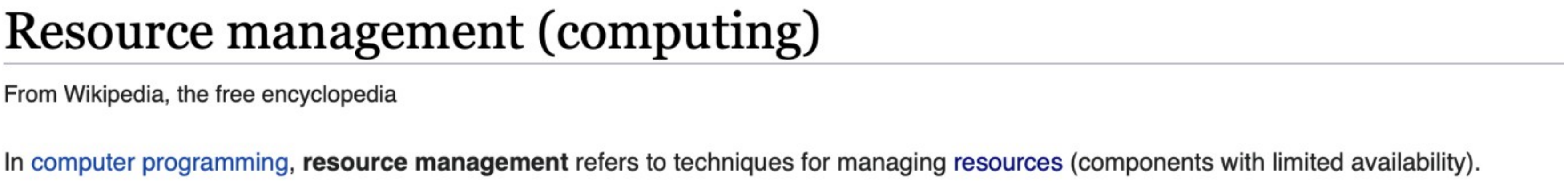
What is a resource manager/scheduler ?



Job scheduler

From Wikipedia, the free encyclopedia

A **job scheduler** is a computer application for controlling unattended background program execution of jobs.[1] This is commonly called **batch scheduling**, as execution of non-interactive jobs is often called batch processing, though traditional *job* and *batch* are distinguished and contrasted; see that page for details. Other synonyms include **batch system**, **distributed resource management system** (**DRMS**), **distributed resource manager** (**DRM**), and, commonly today, **workload automation** (**WLA**). The data structure of jobs to run is known as the job queue.

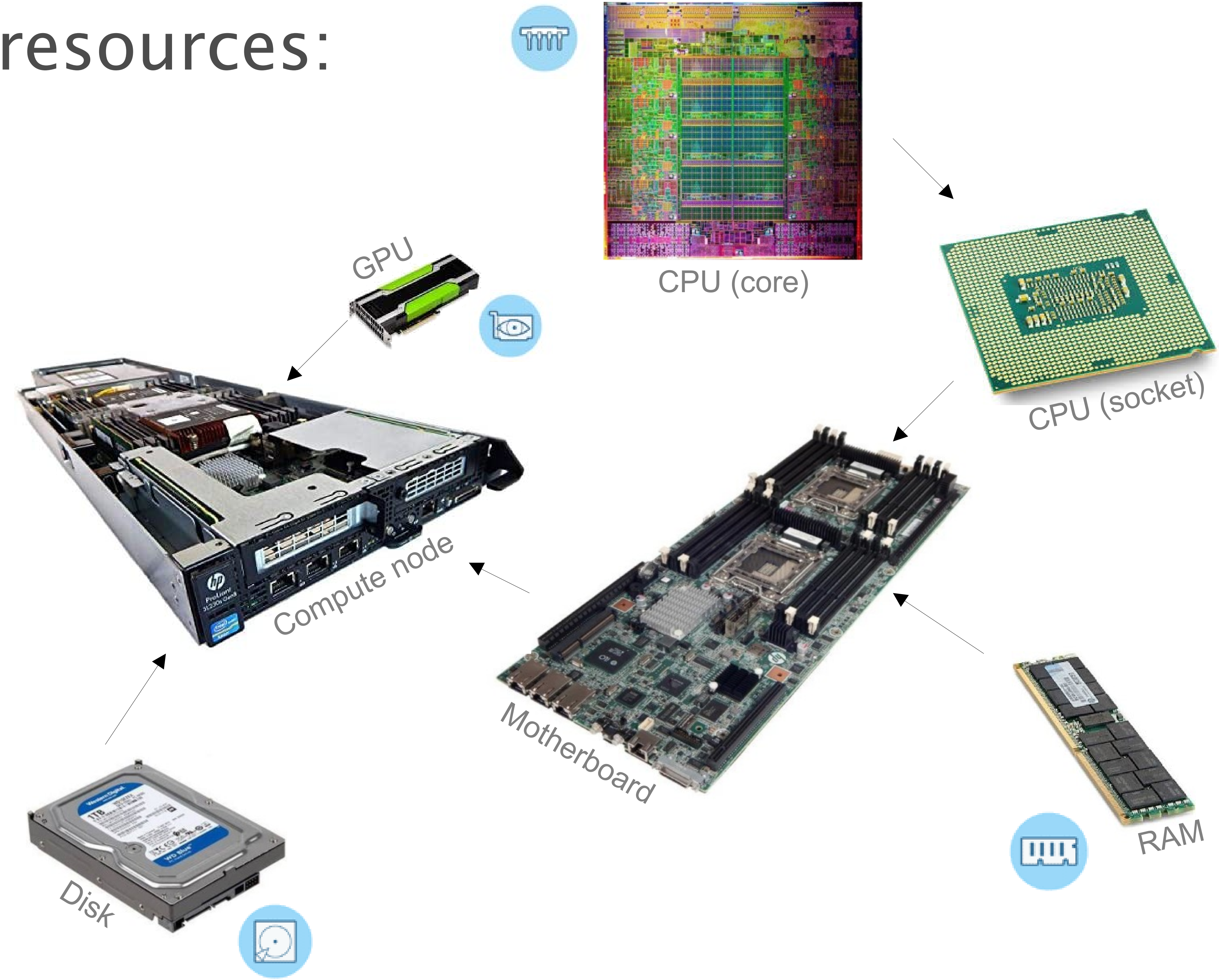


Resource management (computing)

From Wikipedia, the free encyclopedia

In computer programming, **resource management** refers to techniques for managing resources (components with limited availability).

resources:



CPU (core)

CPU (socket)

RAM

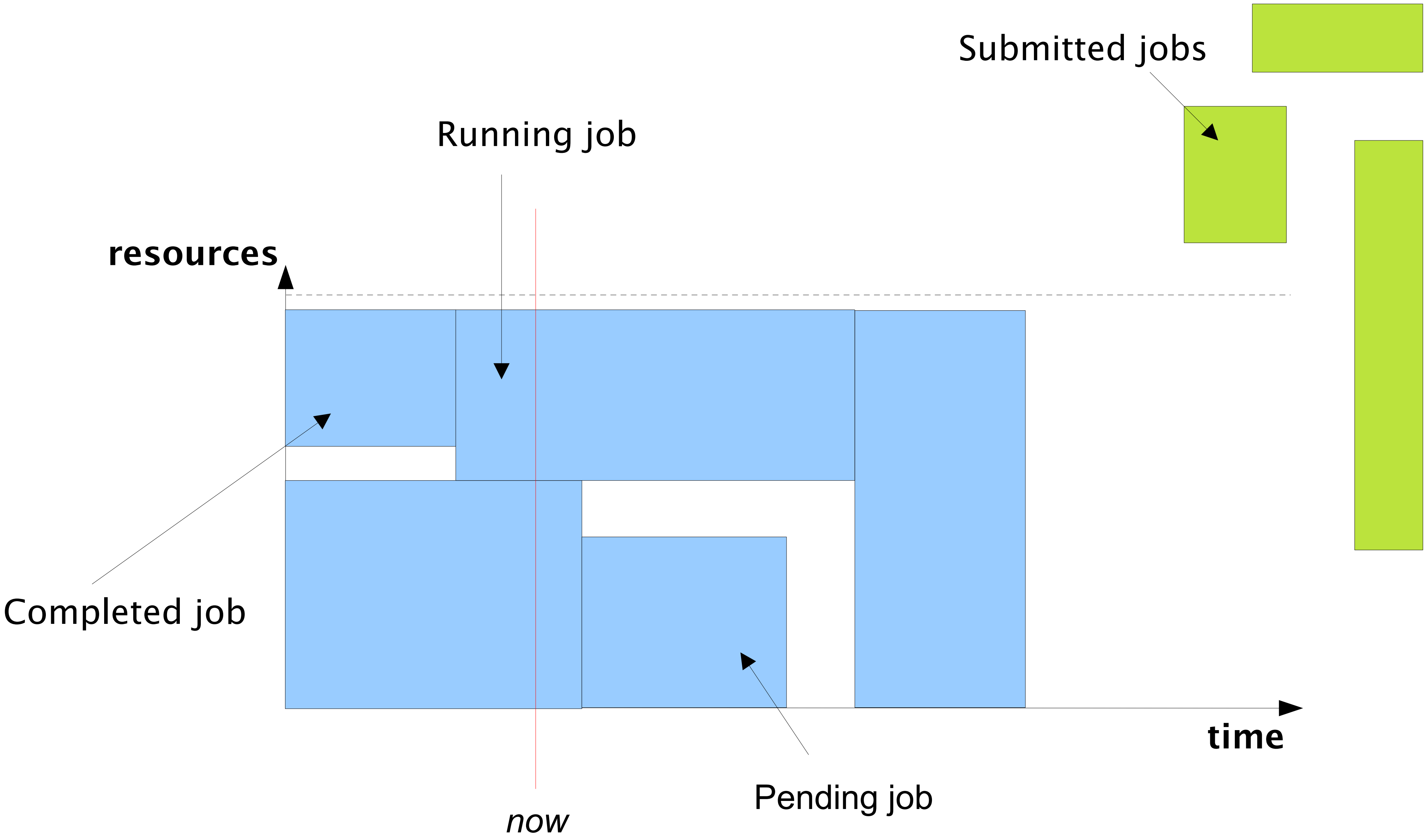
Motherboard

GPU

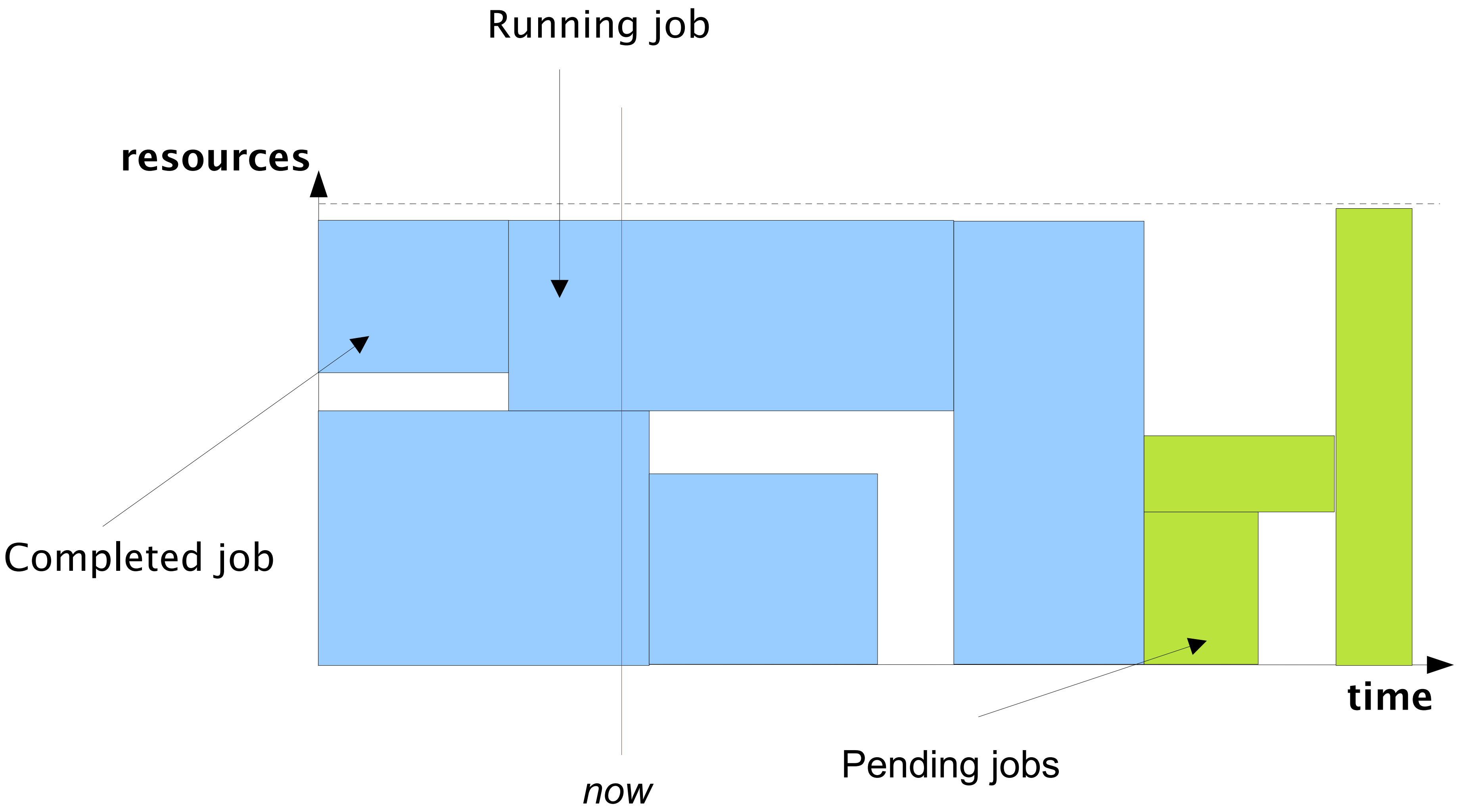
Disk

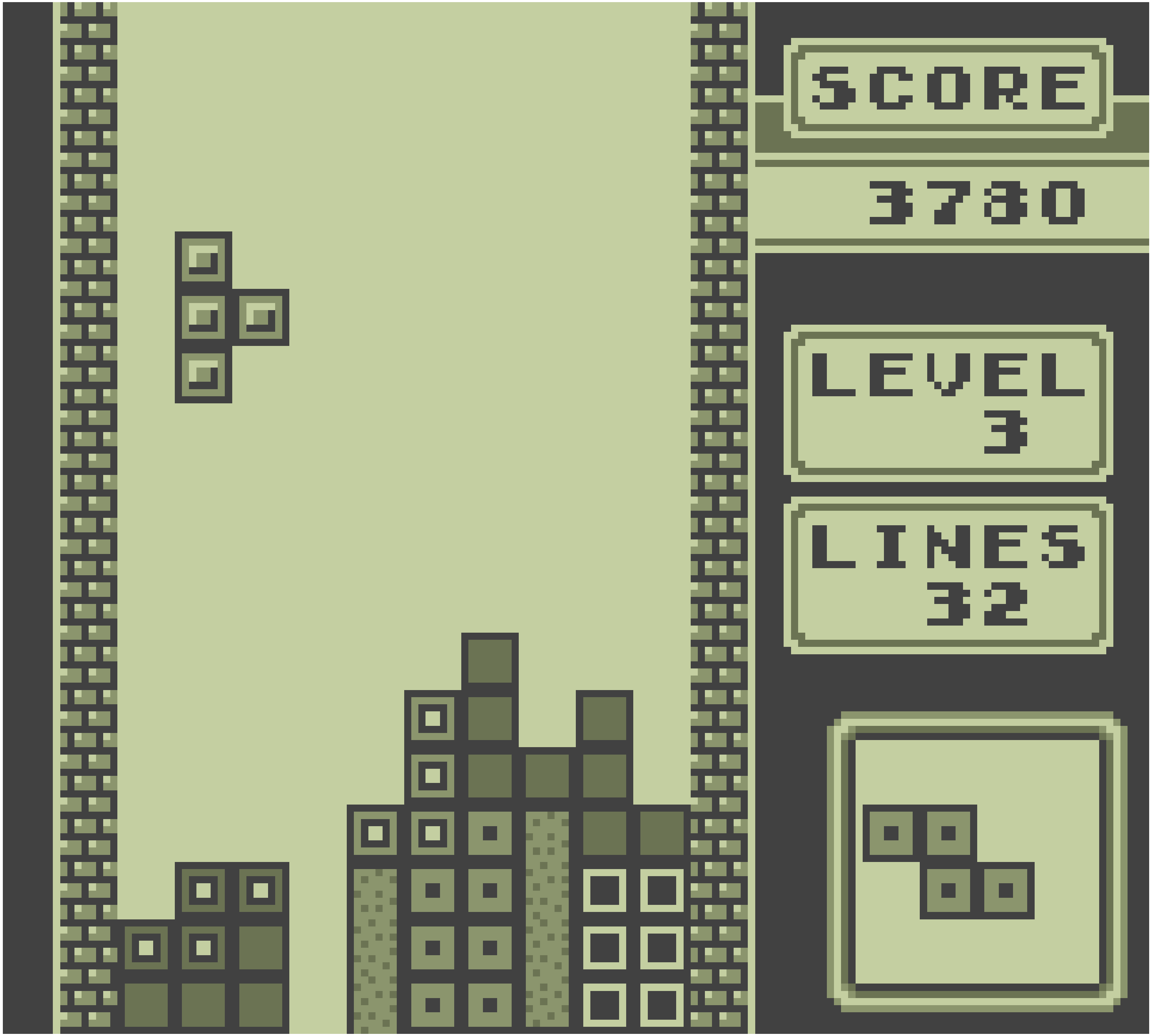
Compute node

scheduling:

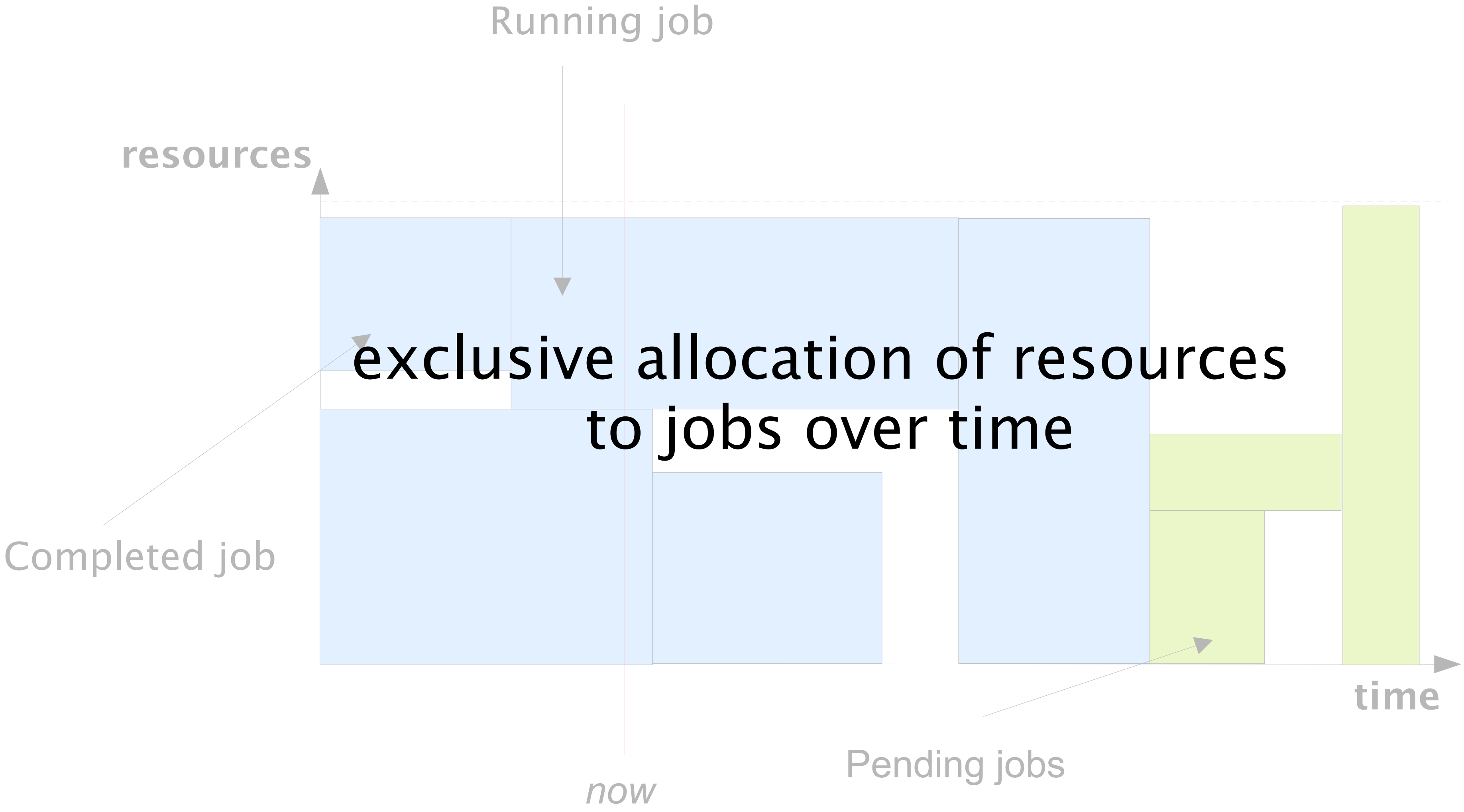

Submitted jobs
Running job
resources
Completed job
time
Pending job
now

scheduling:




SCORE
3780
LEVEL
3
LINES
32

scheduling:



exclusive allocation of resources
to jobs over time

slurm

workload manager

Slurm

Free and free

Mature (exists since ~2003)

Very active community

Many success stories

Widely used

Also an intergalactic soft drink

Futurama (TV Series, creators David X. Cohen, Matt Groening)
Fry and the Slurm Factory (1999)
20th Century Fox Television

Topics:

1. How to create a job
2. How to choose resources
3. Understand priorities
4. Typical workloads
5. Basic workflows
6. Interactive sessions
7. Workflow management system

Full version: https://www.youtube.com/watch?v=wWWDv4g7TcI

Part ▯. You will learn how to:

Create and submit a job

Monitor and inspect jobs

Control (your own) jobs

with

slurm

workload manager

module load slurmshell

Make up your mind ...

e.g. launch program 'whisper'

Job steps

- operations you need to perform
- resources you need for those operations

e.g. 4 cores, 4GB RAM
1 GPU for 1 hour

Job parameters

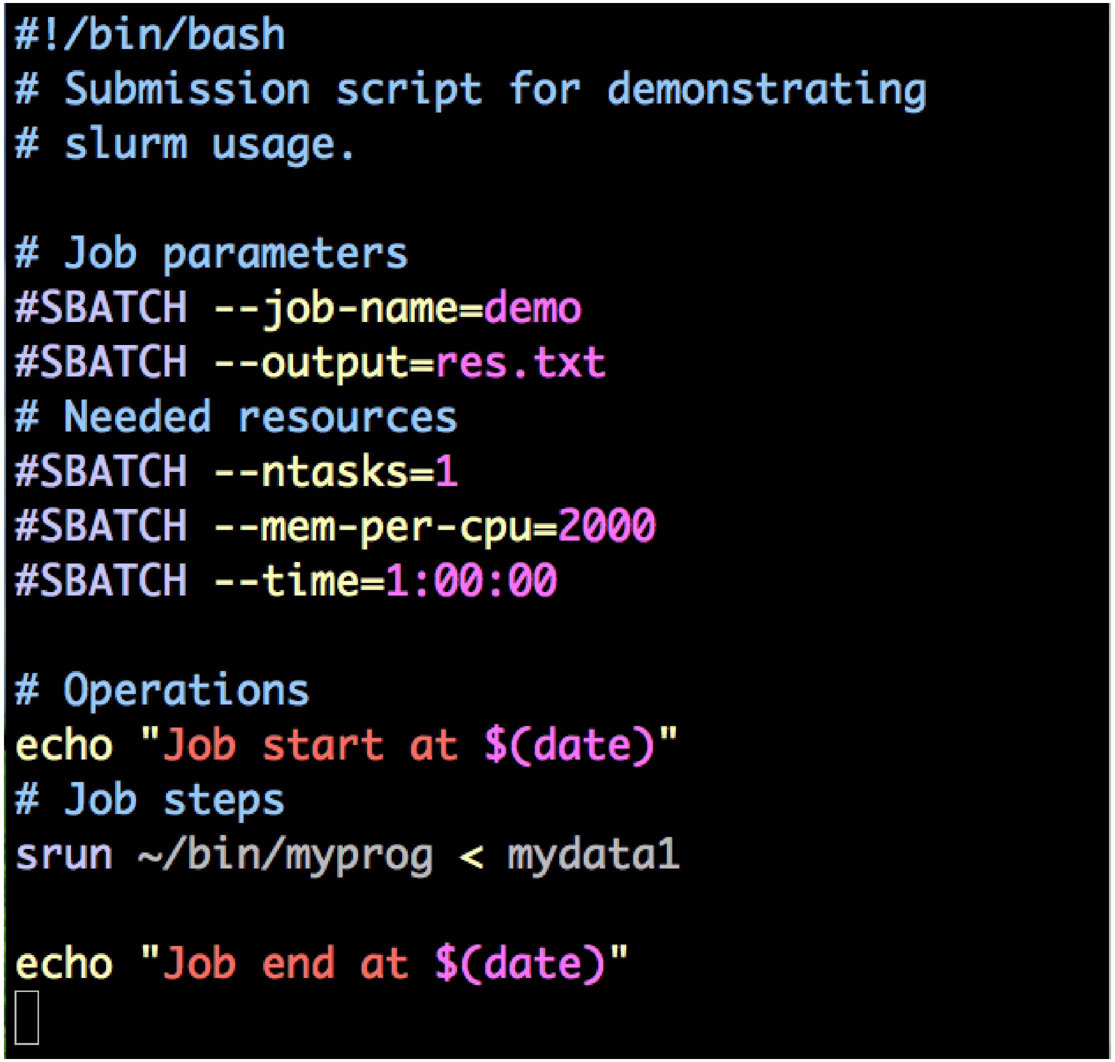
... then write a submission script...

It is a shell script (Bash)

Bash sees these as comments

Slurm takes them as parameters

Job step creation



```
#!/bin/bash
# Submission script for demonstrating
# slurm usage.

# Job parameters
#SBATCH --job-name=demo
#SBATCH --output=res.txt
# Needed resources
#SBATCH --ntasks=1
#SBATCH --mem-per-cpu=2000
#SBATCH --time=1:00:00

# Operations
echo "Job start at $(date)"
# Job steps
srun ~/bin/myprog < mydata1

echo "Job end at $(date)"
```

Regular Bash comment

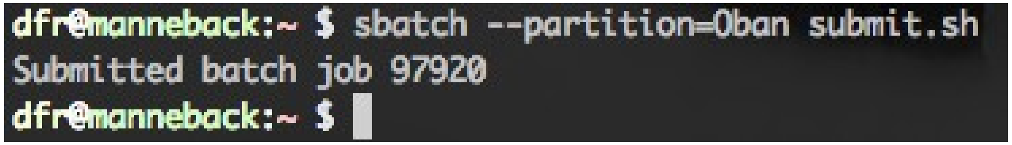
Regular Bash commands

… and submit it with sbatch

submit with sbatch

One more job parameter

The submission script



```
dfr@manneback:~ $ sbatch --partition=Oban submit.sh
Submitted batch job 97920
dfr@manneback:~ $
```

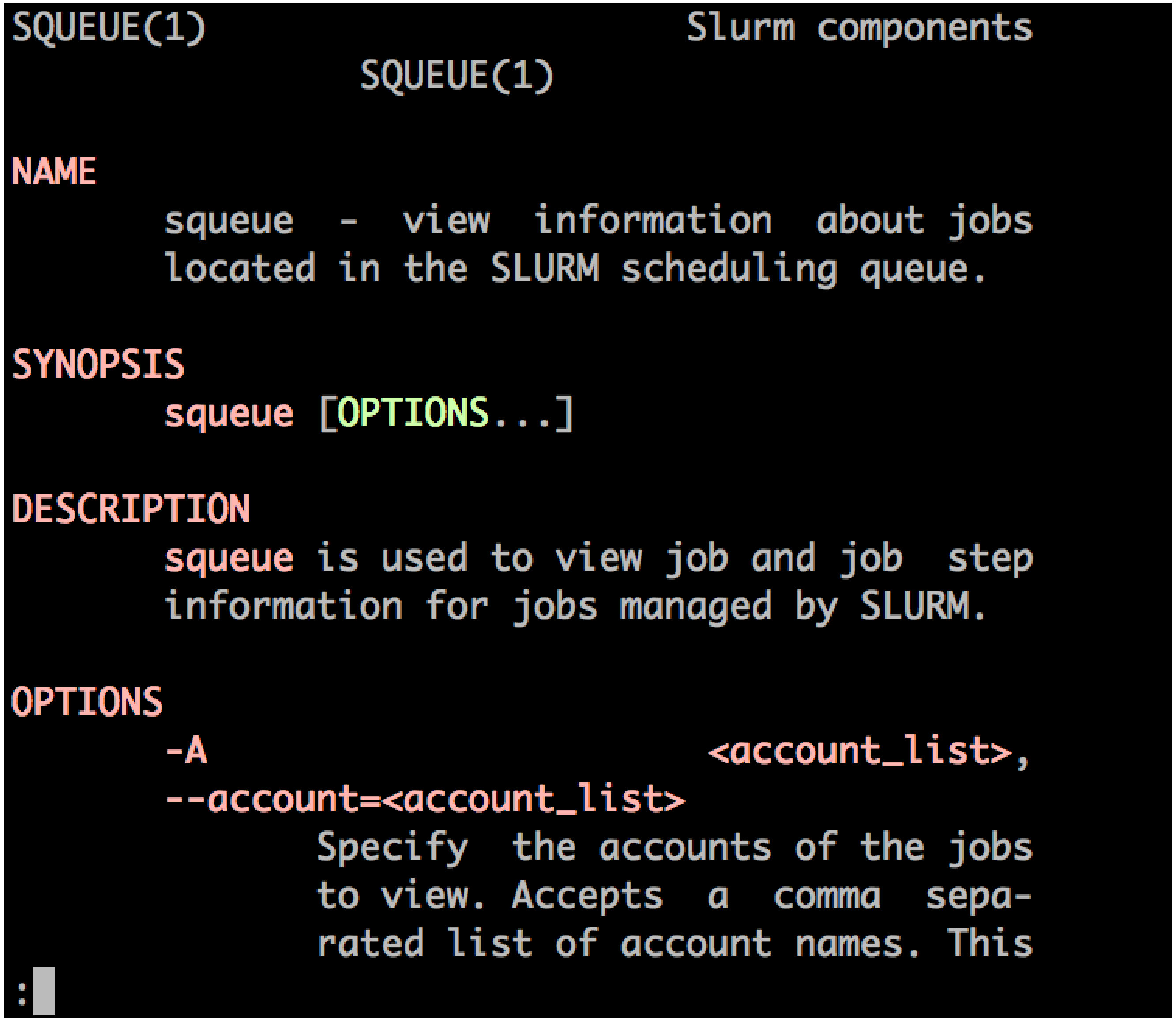
Slurm gives me the JobID

Job parameters can be specified by:

- #SBATCH directives in the submission script ;
- environment variables ;
- parameters on the sbatch command line.

The job ID is used later on to uniquely identify the job.

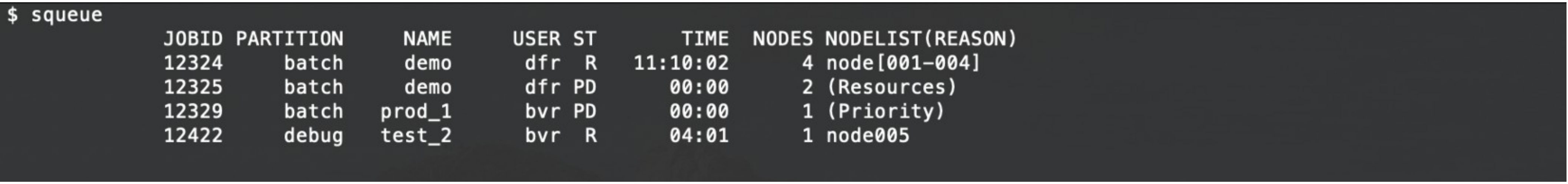
Run the squeue command



```
SQUEUE(1)                    Slurm components
                SQUEUE(1)

NAME
       squeue  -  view  information  about jobs
       located in the SLURM scheduling queue.

SYNOPSIS
       squeue [OPTIONS...]

DESCRIPTION
       squeue is used to view job and job  step
       information for jobs managed by SLURM.

OPTIONS
       -A                        <account_list>,
       --account=<account_list>
              Specify  the accounts of the jobs
              to view. Accepts  a  comma  sepa-
              rated list of account names. This
:
```

man squeue

Run the squeue command



```
$ squeue
          JOBID PARTITION     NAME     USER ST       TIME  NODES NODELIST(REASON)
          12324     batch     demo      dfr  R   11:10:02      4 node[001-004]
          12325     batch     demo      dfr PD      00:00      2 (Resources)
          12329     batch   prod_1      bvr PD      00:00      1 (Priority)
          12422     debug   test_2      bvr  R      04:01      1 node005
```

JOBID	the job ID assigned by Slurm
PARTITION	set of nodes the job was submitted to
NAME	name of the job as specified with --job-name
USER	username of the user who submitted the job
ST	State of the job: Running, PenDing, ...
TIME	Running time of the job
NODES	Number of nodes requested (--nodes)
NODELIST	Nodes assigned to the job by Slurm node[001-004] = node001, node002, node003, and node004
(REASON)	Reason why the job is pending (Resources): your job is next, (priority): you need to wait, ...

Use these #SBATCH parameters

You want	You ask
To choose a specific feature (e.g. a processor type or a network type)	`--constraint`
To use a generic resources (e.g. a GPU)	`--gres` (or `--gpu`)
To access a specific licensed software	`--licence`
To chose a partition	`--partition`
To use a specific QOS	`--qos`

To choose the CPU distribution on nodes	`--nodes`
	`--ntasks-per-nodes`
	`--cpus-per-tasks`

Use these #SBATCH parameters

You want	You ask
To set a job name	`--job-name=...`
To attach a comment to the job	`--comment=”Some comment”`

To get emails	`--mail-type=BEGIN|END|FAILED|ALL|TIME_LIMIT_90`
	`--mail-user=my@mail.com`

To set the name of the output file	`--output=result-%j.txt`
	`--error=error-%j.txt`

To enquiry when it would start	`--test-only`

To specify an ordering	`--dependency=after(ok|notok|any):jobids`
	`--dependency=singleton`

Full list of options in sbatch manpage

Whisper requires resources

You want	You ask

A GPU with enough memory	`--partition=gpu`
	`--gpus=1`
	`--constraint=Tesla`

Some CPUs and CPU memory	`--cpus-per-task=4`
	`--mem=16G`

Some time depending on record	`--time=01:00:00`

Whisper requires modules

```
module load releases/2021a
module load whisper-diarization whisper-models
```

Whisper usage

Program based on WhisperX
better for long texts
offers diarization

Whisper model
base large large-v1
large-v2 medium small

Do not attempt music suppression

Use GPU

Audio file

```
diarize.py --whisper-model large-v2 --no-stem --device cuda -a audio.mp3
```

Will create `audio.srt` and `audio.txt`

Submit your first useful job!

1. Copy `/tmp/metaphore.mp3` to a new directory on Manneback
2. Create a submission file containing:
    - `#/bin/bash`
    - Resource requests and timelimit
    - Module loads
    - Whisper launch
3. Submit the job
4. Check its status
5. Inspect files created by Whisper

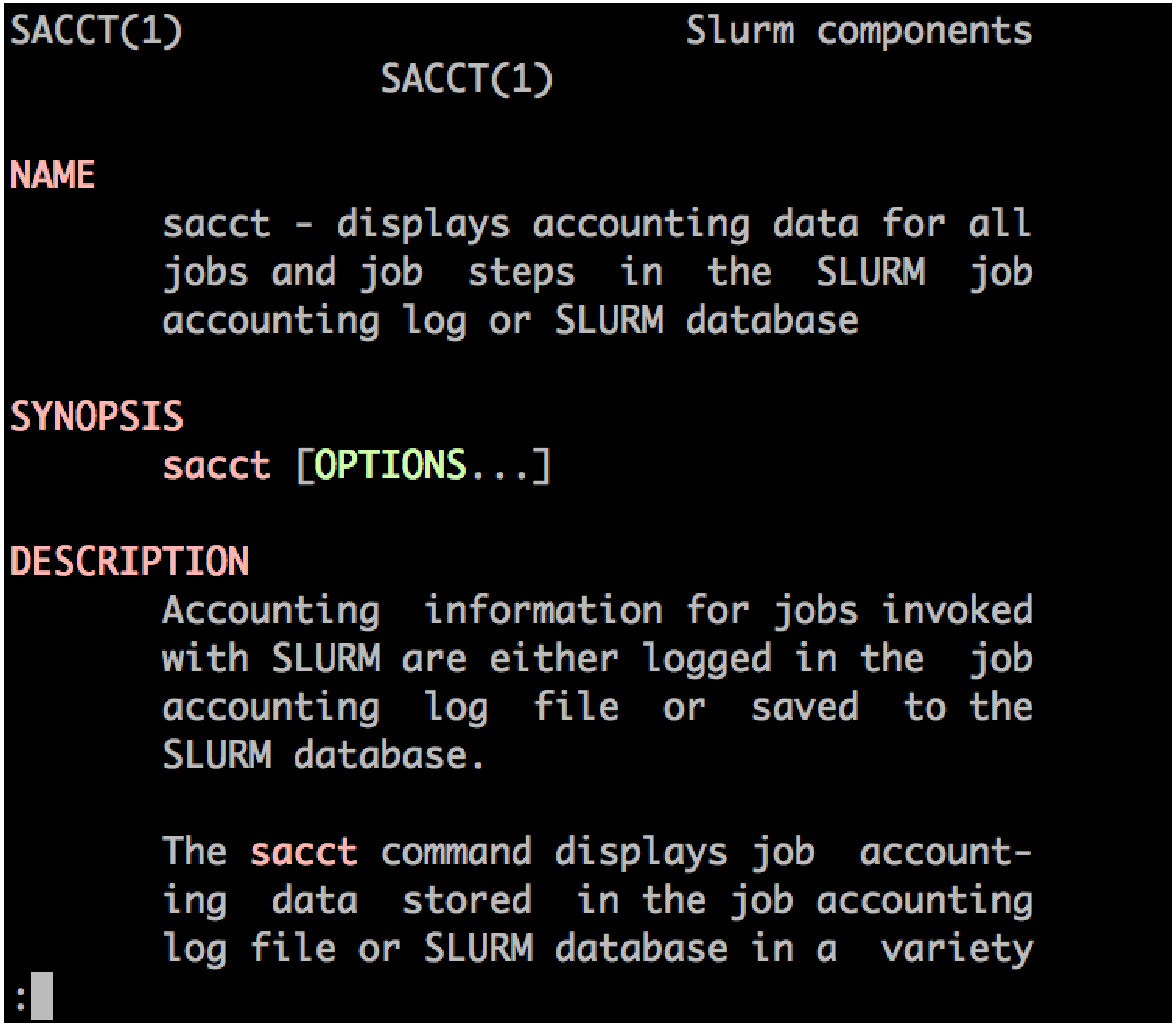
Part ⊞. You will learn how to:

discover cluster features (resources),
target specific features and tune your jobs,
choose suitable resource values, and
get job actual resource usage.

in your submission scripts for

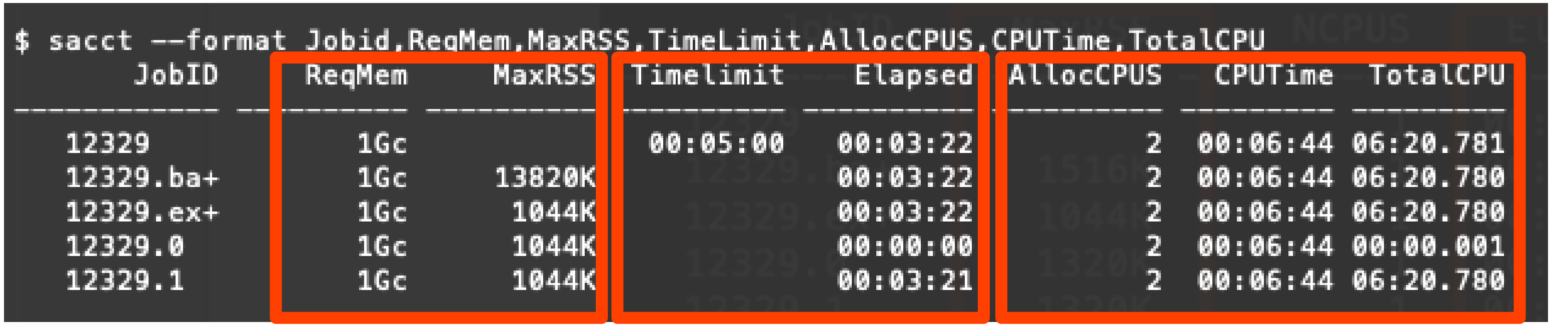
slurm
workload manager

Use the sacct command for **completed** jobs



```
SACCT(1)                        Slurm components
                 SACCT(1)

NAME
       sacct - displays accounting data for all
       jobs and job  steps  in  the  SLURM  job
       accounting log or SLURM database

SYNOPSIS
       sacct [OPTIONS...]

DESCRIPTION
       Accounting  information for jobs invoked
       with SLURM are either logged in the  job
       accounting  log  file  or  saved  to the
       SLURM database.

       The sacct command displays job  account-
       ing  data  stored  in the job accounting
       log file or SLURM database in a  variety
:
```

Use the sacct command for **completed** jobs



```
$ sacct --format Jobid,ReqMem,MaxRSS,TimeLimit,AllocCPUS,CPUTime,TotalCPU
       JobID     ReqMem     MaxRSS Timelimit     Elapsed AllocCPUS     CPUTime   TotalCPU
------------ ---------- ---------- ---------- ---------- ---------- ---------- ----------
  12329             1Gc              00:05:00   00:03:22          2   00:06:44  06:20.781
  12329.ba+         1Gc     13820K              00:03:22          2   00:06:44  06:20.780
  12329.ex+         1Gc      1044K              00:03:22          2   00:06:44  06:20.780
  12329.0           1Gc      1044K              00:00:00          2   00:06:44  00:00.001
  12329.1           1Gc      1044K              00:03:21          2   00:06:44  06:20.780
```

JobID	Job ID . Step ID of the job step
ReqMem	Requested memory (Gc: **G**igaByte per **c**ore)
MaxRSS	Actually-used memory (**R**esident **S**et **S**ize)
Timelimit	Time limit requested for the job with `--time`
Elapsed	Actual time used by the job
AllocCPUs	Number of allocated CPUs to the job
CPUTime	CPUtime allocated to the job (Elapsed * AllocCPUs)
TotalCPU	Actual CPU time consumed by the job

Look at your jobs!

1. Connect to a cluster
2. run the `sacct` command to see your job history

Summary

Write and submit submission scripts

Explore the clusters

Read the man pages of Slurm commands

Use the resources you request

Beware of limits

Submit jobs !