#### **SLURM – Advanced Usage**

January 15, 2025



#### **Bad Job Practices**

job submissions within a loop (take a long time)

```
for i in {1..1000}
do
sbatch job.sh $i
done
```

loop inside job script (sequence of mpirun commands): for i in {1..1000} do mpirun -np 16 my\_program \$i done





submit/run a series of independent jobs via a single SLURM script



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- example (job\_array\_vsc5.sh), 10 jobs, SLURM\_ARRAY\_TASK\_ID=1,2,3 ... 10

```
#!/bin/bash
#SBATCH -J array
#SBATCH -N 1
#SBATCH --array=1-10
```

```
echo "Hi, this is array job number" $SLURM_ARRAY_TASK_ID sleep $SLURM_ARRAY_TASK_ID
```



#### ■ independent jobs: 1, 2, 3 ... 10 VSC-5 > squeue - u \$user 499514 3 zen3\_0512 array sh R INVALID 1 n3504-057 sh R 499514 4 zen3 0512 arrav INVALID 1 n3506-047 499514\_5 zen3\_0512 array sh R INVALID 1 n3507-013 499514 6 zen3 0512 sh R INVALID n3509-016 arrav 1 499514\_7 zen3\_0512 arrav sh R INVALID 1 n3511-029 499514\_8 zen3\_0512 sh R INVALID 1 n3503-010 arrav 499514\_9 zen3\_0512 sh R INVALID n3503-011 arrav 1 499514\_10 zen3\_0512 sh R INVALID n3503-028 arrav 1



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#### corresponding SLURM output files

#### VSC-5 > ls slurm-\*

slurm-499514_10.out	slurm-499514_2.out	slurm-499514_4.out	slurm-499514_6.out	slurm-499514_8.out
slurm-499514_1.out	slurm-499514_3.out	slurm-499514_5.out	slurm-499514_7.out	slurm-499514_9.out



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#### explicit content of a single SLURM output file

 $VSC-5 > cat slurm-499514_8.out$ Hi, this is array job number 8



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- example of going in chunks of a certain size, e.g. 5, SLURM\_ARRAY\_TASK\_ID=1,6,11,16 #SBATCH --array=1-20:5



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- example of going in chunks of a certain size, e.g. 5, SLURM\_ARRAY\_TASK\_ID=1,6,11,16 #SBATCH --array=1-20:5

example of limiting number of simultaneously running jobs to 2 (perhaps for licences)
 #SBATCH --array=1-20:5%2



■ use an entire compute node for several independent jobs



use an entire compute node for several independent jobs

example single\_node\_multiple\_jobs\_vsc5.sh: #!/bin/bash

```
#SBATCH -J snglcre
#SBATCH -N 1
#SBATCH -p zen3_0512
#SBATCH --qos=zen3_0512
```

```
for ((i=1; i<=128; i++)) do
```

```
stress --cpu 1 --timeout i \& done
```

wait



& is important ! sends the process into the background so that the script can continue



- & is important ! sends the process into the background so that the script can continue
- "wait" is also important ! waits for all processes in the background to terminate before moving on



# **Combination of Array and Single Core Job**

example combined\_array\_multiple\_jobs\_vsc5.sh:

```
. . .
#SBATCH -N 1
#SBATCH --array=1-384:128
i=$SLURM ARRAY TASK ID
((j+=127))
for ((i=$SLURM_ARRAY_TASK_ID; i<=$j; i++))
do
   stress --cpu 1 --timeout $i &
done
wait
```



#### **Exercises**

files are located in folder examples/05\_submitting\_batch\_jobs

- look into "job\_array\_vsc[4, 5].sh" and modify it such that the considered range is from 1 to 20 but in steps of 5
- look into "single\_node\_multiple\_jobs\_vsc[4, 5].sh" and also change it to go in steps of 5
- run "combined\_array\_multiple\_jobs\_vsc[4, 5].sh" and check whether the output is reasonable



# **Job Script Enhancements**

#### usage of corresponding environmental variables

#SBATCH	Environmental Variable
-N	SLURM_JOB_NUM_NODES
ntasks-per-core	SLURM_NTASKS_PER_CORE
ntasks-per-node	SLURM_NTASKS_PER_NODE
ntasks [-n]	SLURM_NTASKS



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#### email notifications

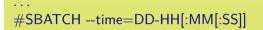
. . .

#SBATCH --mail-user=yourmail@example.com #SBATCH --mail-type=BEGIN,END



# **Submission Scripts Tuning**

using time constraints less than runtime limits





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using time constraints less than runtime limits

```
#SBATCH --time=DD-HH[:MM[:SS]]
```

#### backfilling:

the specified time is an estimate of your required computing time; if this is shorter than the default runtime limit (mostly 24h), SLURM may squeeze it in on idle nodes waiting for a larger job;



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max runtime limit is 72h

```
....
#SBATCH --time=03-00:00:00
```



core-h accounting is done for the entire period of reservation



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contact support@vsc.ac.at



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check for reservations
 VSC-5> scontrol show reservations



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- contact support@vsc.ac.at
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   VSC-5> scontrol show reservations
- using reservations

... #SBATCH --reservation=MyRsrv



#### **Job Dependencies**

**1.** Submit first job and get its <job\_id>



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- 2. Submit dependent job using the just received parent <job\_id>

```
#!/bin/bash
#SBATCH -J myjb
#SBATCH -N 2
#SBATCH --dependency=afterany:<job_id>
mpirun -np 256 my_prog
...
```



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mpirun -np 256 my_prog
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#### 3. continue with 2. for further dependent jobs



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```
    "srun" example 2 nodes with two MPI processes each
#!/bin/bash
#SBATCH -J myjb
#SBATCH -N 2
#SBATCH --tasks-per-node=2
```

```
srun --cpu-bind=map_cpu:0,64 ./my_mpi_program
```



"INTEL MPI" example 2 nodes with two MPI processes each

```
#!/bin/bash
#SBATCH -J myjb
#SBATCH -N 2
#SBATCH --tasks-per-node=2
```

```
export I_MPI_PIN_PROCESSOR_LIST=0,64 mpirun -np 4 ./my_mpi_program
```





• check for available reservations. If there is one available, use it

specify an email address that notifies you when your job has finished