

HPCSE I

Discussion exercise sheet 1

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05.10.2018

Ask questions!

- ▶ in class
- ▶ during break
- ▶ on Piazza
- ▶ write an email (renatob@student.ethz.ch)

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"Why does my code not work?" is also a question ;)

Questions?

Sources of information:

- ▶ **Cpp Reference:**

<https://en.cppreference.com/w/>

provides even an offline version (see 'News' section)

- ▶ **OpenMP cheat sheet:**

<https://www.openmp.org/wp-content/uploads/OpenMP3.1-CCard.pdf>

- ▶ **MPI cheat sheet:**

<http://www.netlib.org/utk/people/JackDongarra/WEB-PAGES/SPRING-2006/mpi-quick-ref.pdf>

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Pro tip:

Highlight functions used in this course!

Questions from last week: Benchmarking

- ▶ Use `std::chrono::steady_clock`

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- ▶ Example code:

```
const auto t0 = std::chrono::steady_clock::now();  
do_heavy_work(...);  
const auto t1 = std::chrono::steady_clock::now();  
std::chrono::duration<double> duration = t1 - t0;  
const double seconds = duration.count();
```

Questions from last week: Benchmarking

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- ▶ Example code:

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```

- ▶ Cache flushing: Use the `volatile` keyword (see sol.)

Questions from last week: Output of a batch job

```
#include <iostream>
```

```
int main()
```

```
{
```

```
    std::cout << "Hello Euler!" << std::endl;
```

```
    return 0;
```

```
}
```

Questions from last week: Output of a batch job

Header

```
Sender: LSF System <lsfadmin@eu-ms-020-41>  
Subject: Job 74573360: <./hello> in cluster <euler> Done
```

Meta info

```
Job <./hello> was submitted from host <eu-login-18-ng> by user <renatob> in  
cluster <euler> at Wed Oct 3 14:37:36 2018.  
Job was executed on host(s) <eu-ms-020-41>, in queue <normal.4h>, as user  
<renatob> in cluster <euler> at Wed Oct 3 14:38:00 2018.  
</cluster/home/renatob> was used as the home directory.  
</cluster/home/renatob/HPCE_HS2018> was used as the working directory.  
Started at Wed Oct 3 14:38:00 2018.  
Terminated at Wed Oct 3 14:38:01 2018.  
Results reported at Wed Oct 3 14:38:01 2018.
```

Your job looked like:

```
# LSBATCH: User input  
./hello
```

Your command

Successfully completed.

Everything went OK

Resource Usage

Resource usage summary:

CPU time :	0.03 sec.
Max Memory :	2 MB
Average Memory :	-
Total Requested Memory :	1024.00 MB
Delta Memory :	1022.00 MB
Max Swap :	-
Max Processes :	-
Max Threads :	-
Run time :	24 sec.
Turnaround time :	25 sec.

The output (if any) follows:

```
Hello Euler!
```

What was printed to the terminal

Questions from last week: Mounting your Euler directory (Windows/Mac)

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- ▶ Possible solution (**UNTESTED**): <https://cyberduck.io/>
- ▶ **The exam will be held on Linux machines! Being well trained is an advantage!**

Questions from last week: Physics primer

- ▶ Last week: Diffusion Equation (also called Heat Equation)

$$\frac{\partial u}{\partial t} = \alpha \frac{\partial^2 u}{\partial x^2} \quad (1)$$

$$u(x, 0) = \sin\left(\frac{2\pi}{L}x\right) \quad (2)$$

- ▶ This is called an Initial Value Problem (IVP)
- ▶ It consists of a Partial Differential Equation (PDE) + initial conditions $u(x, 0)$
- ▶ Interpretation:
 - ▶ The PDE describes the dynamics (evolution) of the system
 - ▶ The initial value describes what the heat distribution looked like at the beginning