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Accelerating MATLAB

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OIST

Profiler

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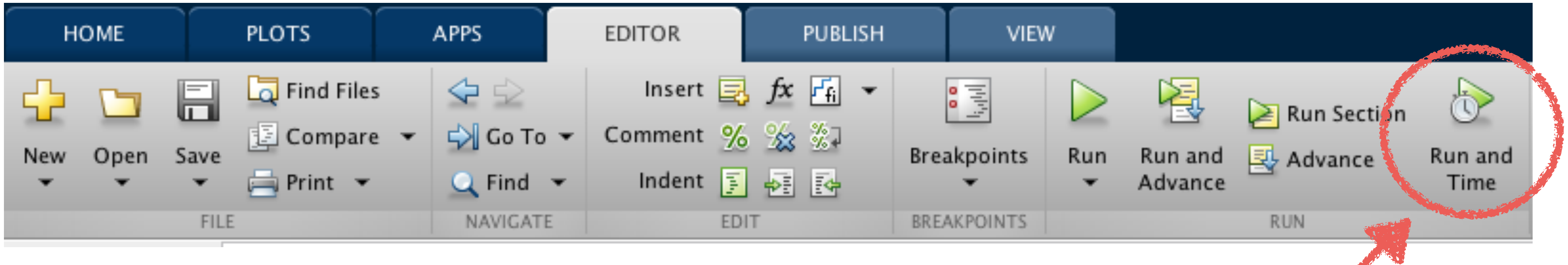
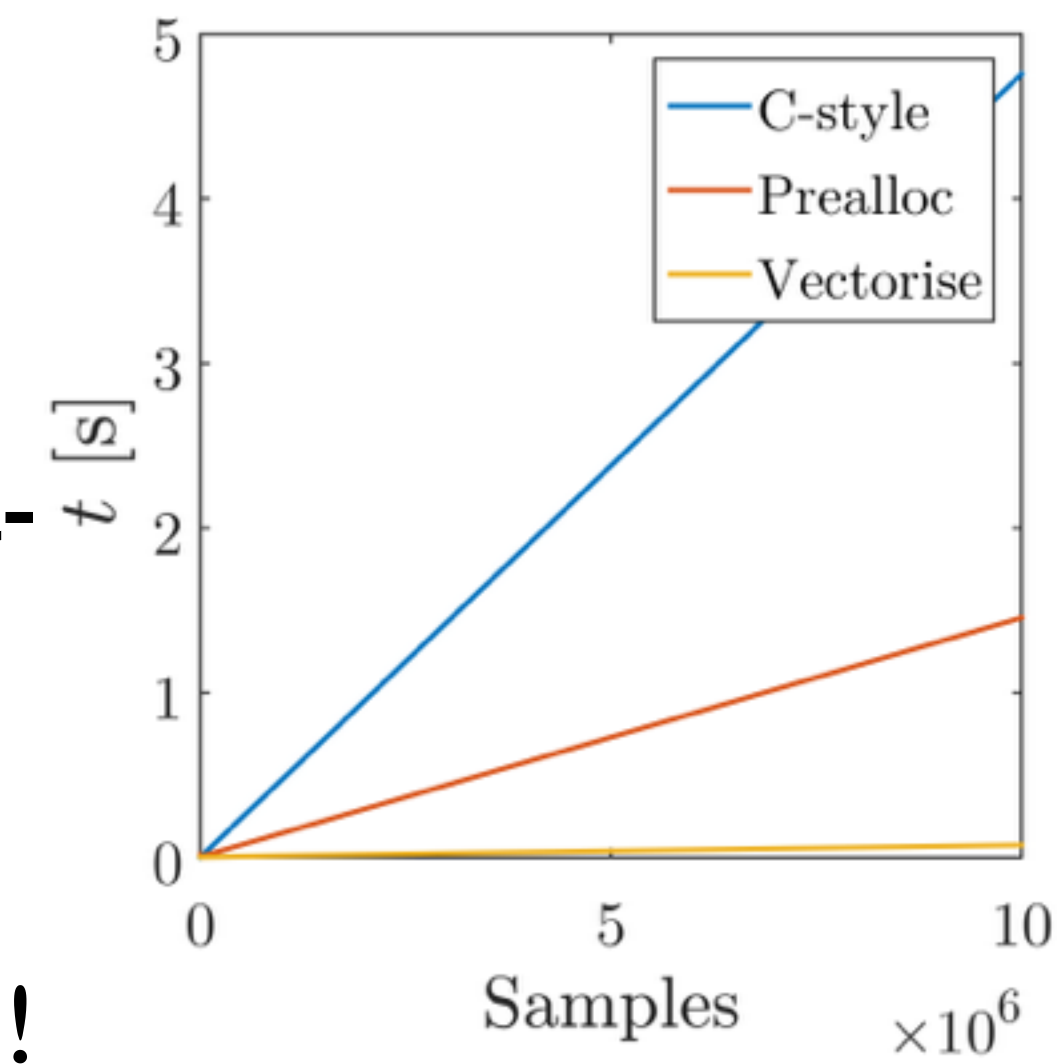


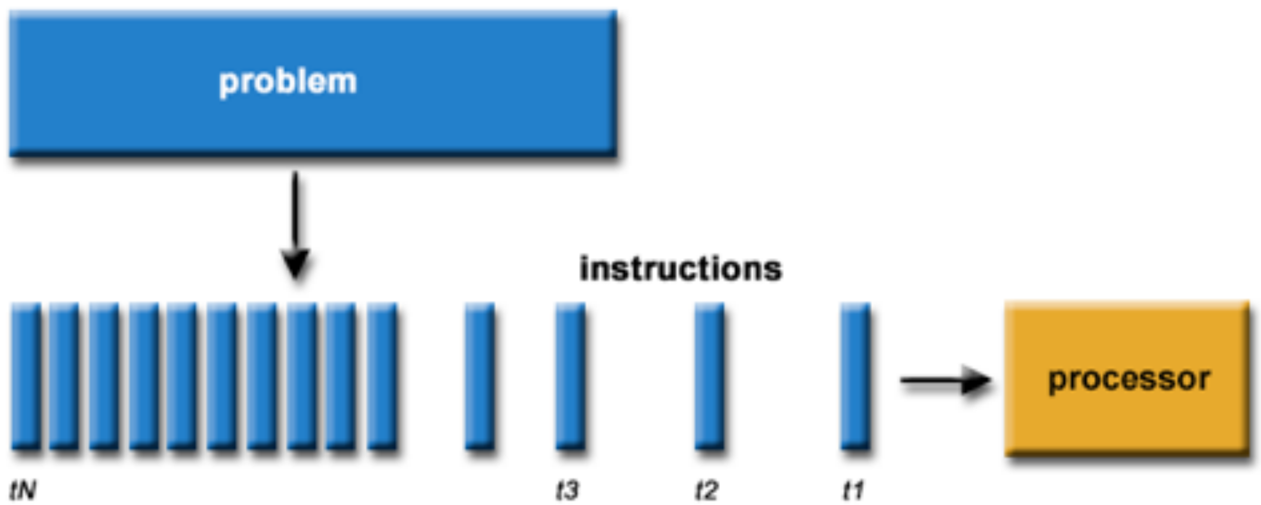
- Write some naive code*
- Test performance using profiler
- Optimise naive code — no longer naive!
- ~~Set the machine on fire!~~
  Do good science more efficiently!

Preallocate & Vectorise

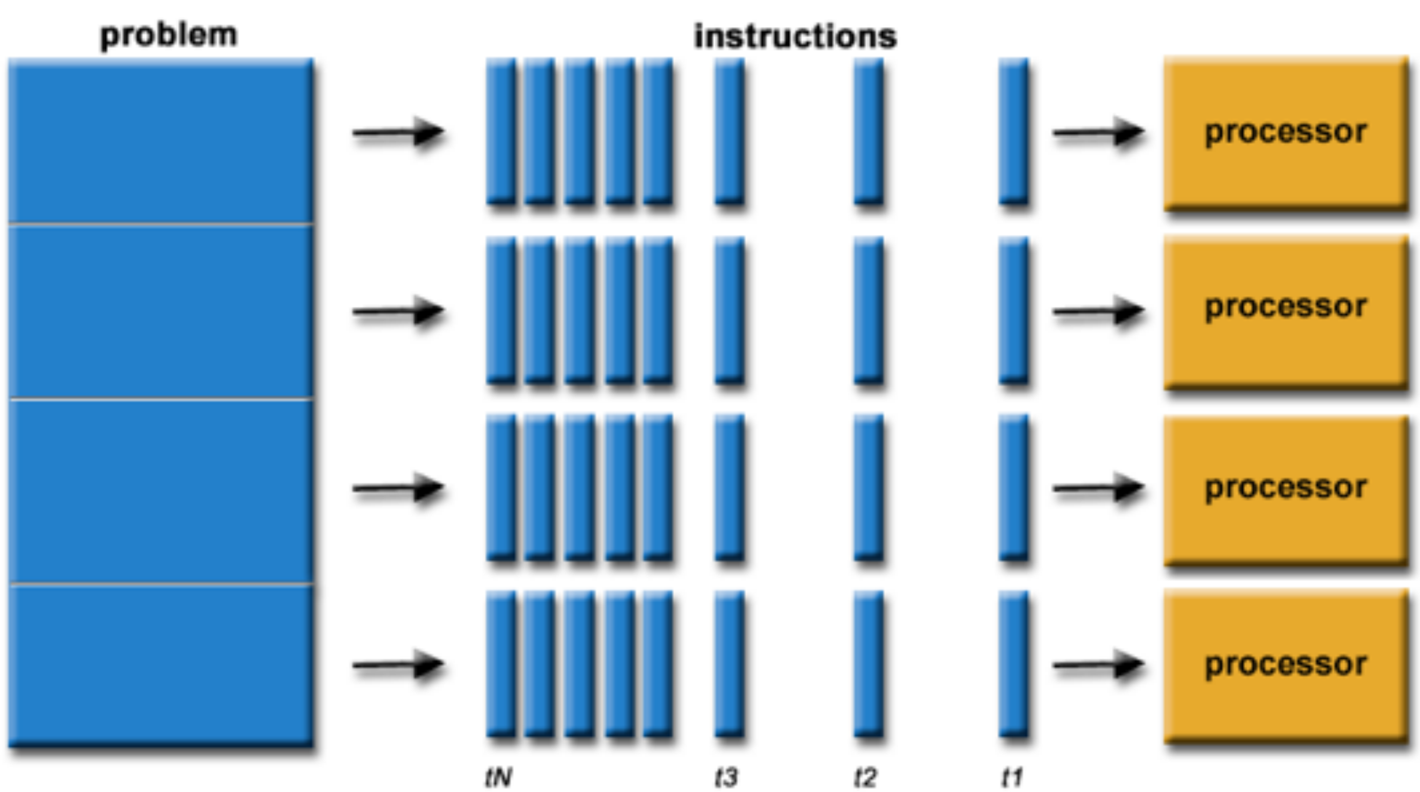
- If size known, preallocate
- Loops are (an often necessary) evil
- Do operations vector/matrix-wise, not element-by-element
- Use functions
- Don't reinvent the wheel!



Parallelism



SISD
(Single-core processor)



SIMD, SPMD,MIMD
(Multicore processor, cluster)

(src: https://computing.llnl.gov/tutorials/parallel_comp/)

Parallelism

- MATLAB can be parallelised.
- ‘Local’ parallelism, work split over all cores.
- ‘Distributed’ parallelism, work split over many machines.
- Smarter algorithms >> big hardware
  Don’t need supercomputer for fast code!

Parallelism

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- Embarrassingly parallel — independent data; easy to implement
  - 'parfor', 'gpuArray', batch processing
  - 'parpool' maintains available cores
  - Submitting separate jobs to sango

parfor

- Replace ‘for’ with ‘parfor’
- For-loop with independent elements and operations
- Create a ‘pool’ of workers (1 worker = 1 CPU core), and parfor does the rest
- Example: 100’s of files to be read and processes*

Calculate Pi

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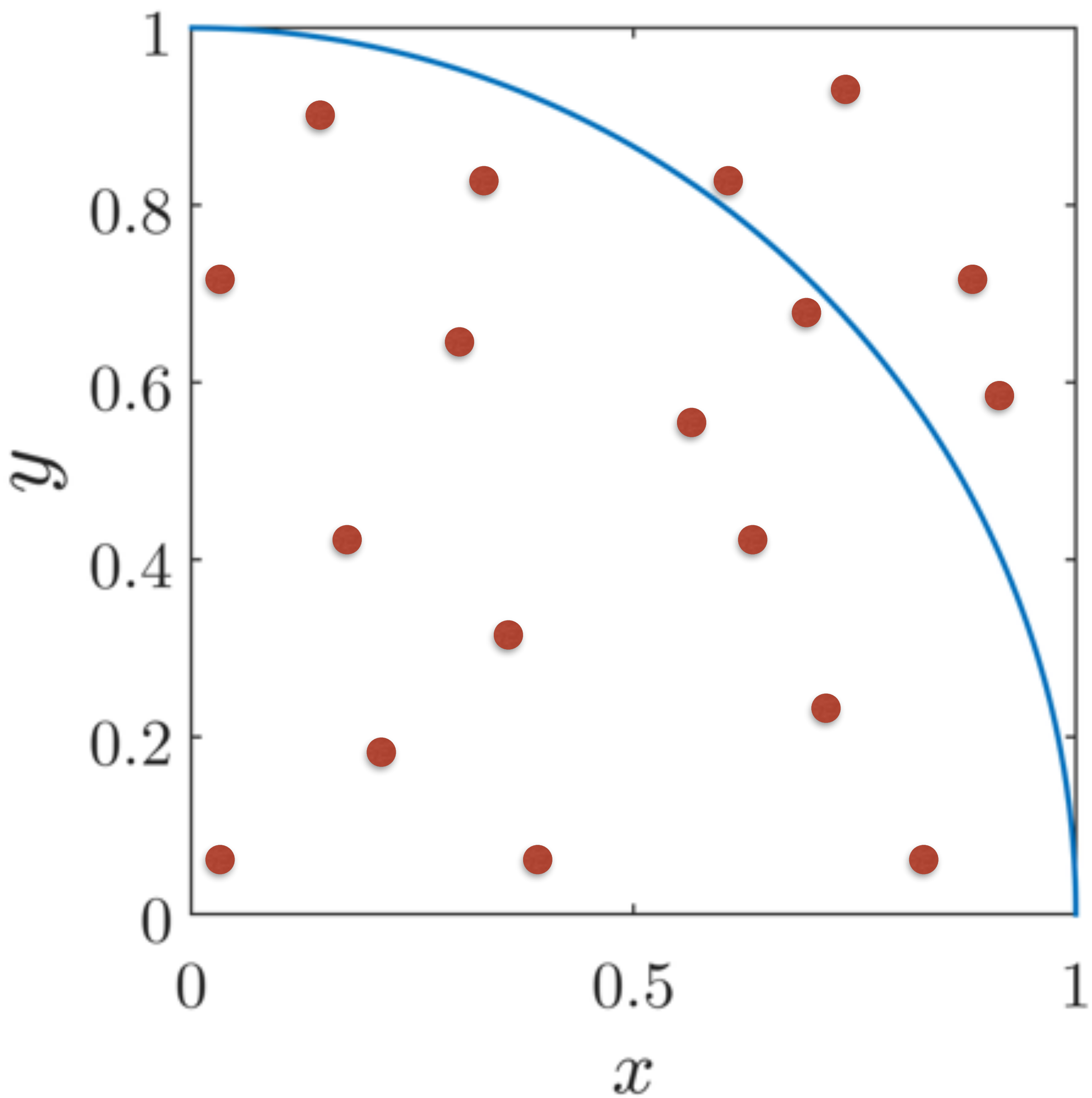
- Monte Carlo integration*



$$A_c = \pi r^2$$

$$A_s = r^2$$

$$\frac{A_c}{A_s} = \pi$$

Matlab on Sango

- https://groups.oist.jp/scs
- Access large memory/large CPU count
- Submit jobs using: sbatch jobscript.slurm*
  - multiple single CPU jobs
  - 1 job with multiple CPUs
  - multiple jobs with multiple CPUs

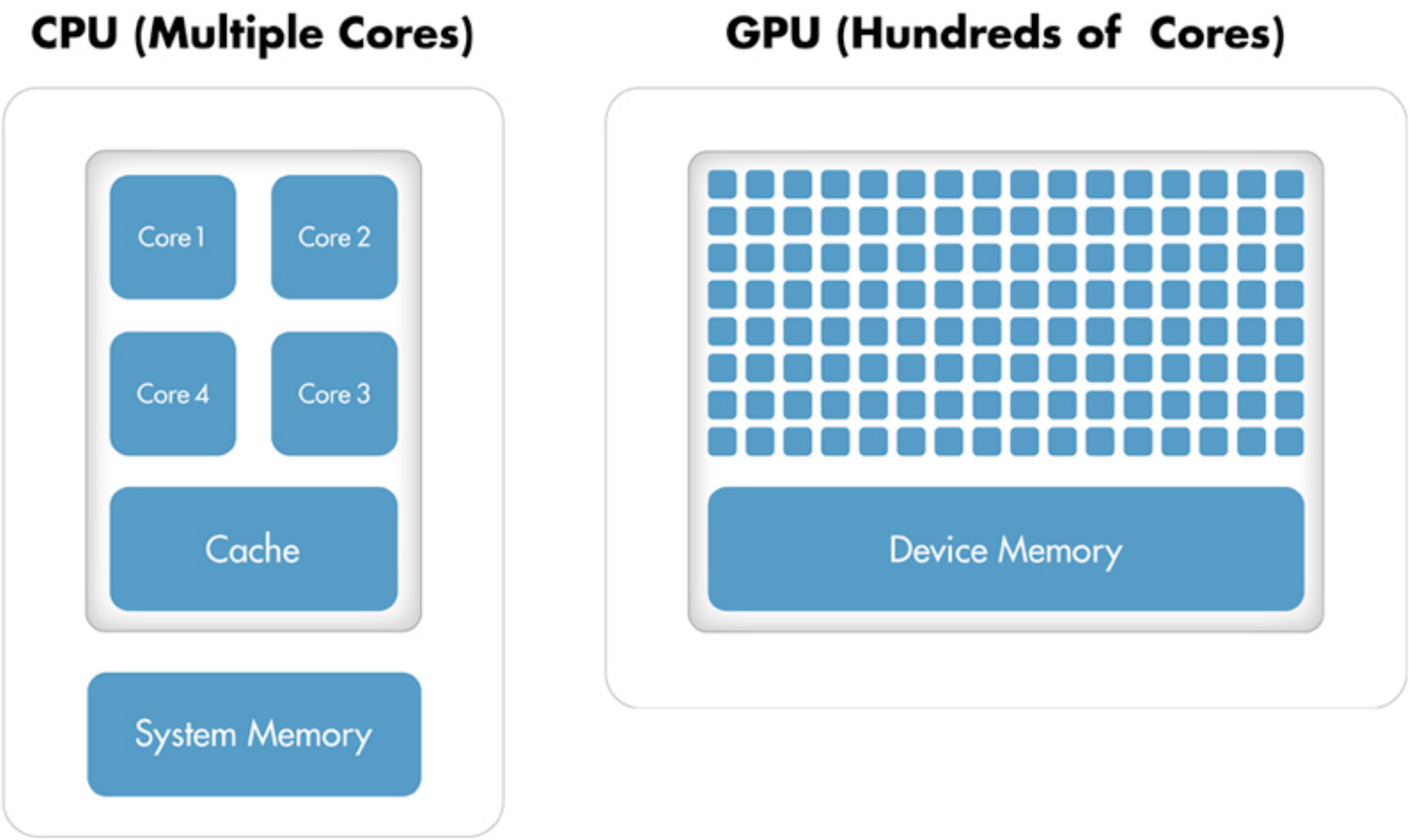
Matlab on Sango

- ssh (-Y) username@sango
- cd /work/UnitName/UserName
- Interactive sessions*

```
srun --partition=compute --mem=6G --ntasks=1 --cpus-per-task=4 --x11=last --pty /bin/bash;
```

```
module load matlab; matlab
```

GPU parallelism



(src: mathworks.com)

GPUs in action

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- Calculate Mandelbrot set on CPU & GPU
  (http://uk.mathworks.com/help/distcomp/examples/illustrating-three-approaches-to-gpu-computing-the-mandelbrot-set.html)

$$z_{n+1} = z_n^2 + c$$

- Calculate Pi (again) using GPU arrays.

Questions?

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