

# HIGH PERFORMANCE COMPUTING: TOWARDS BETTER PERFORMANCE PREDICTIONS AND EXPERIMENTS

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Tom Cornebize

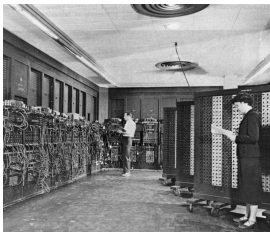
2 June 2021, PhD defense



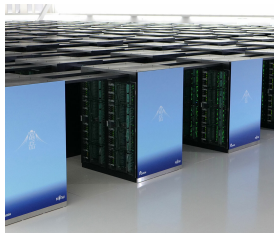
# NO SCIENCE WITHOUT COMPUTING



Arithmomètre (1851)



ENIAC (1945)

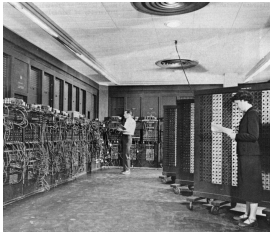


Fugaku (2021)

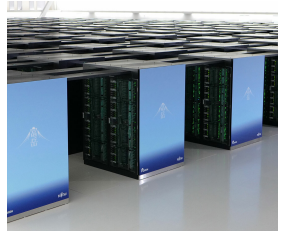
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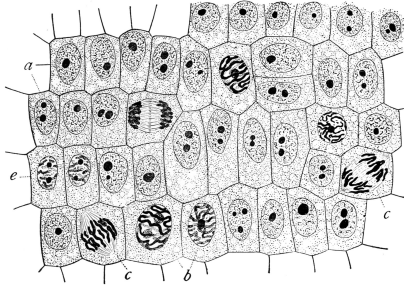


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Last decades:

- Exponential **performance** improvements (e.g. sequencing an entire human genome costed \$100,000,000 in 2001, \$1000 now)
- At the price of **complexity** (both software and hardware)

# EXPERIMENTAL STUDY OF COMPUTER PERFORMANCE



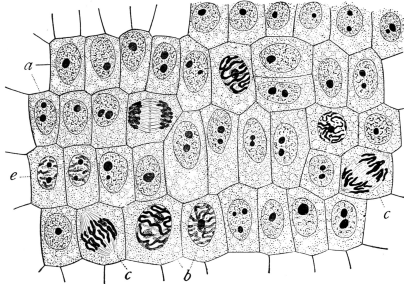
Similar to natural sciences

Complexity  $\Rightarrow$  Variability and Opacity

$\Rightarrow$  No perfect model

$\Rightarrow$  Need for **experiments**

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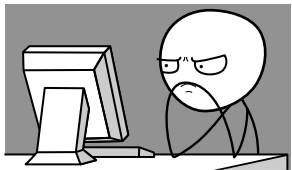
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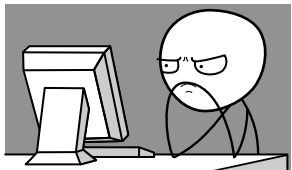
Experiments can be carried in **reality** or in **simulation**

## Typical Performance Evaluation Questions (Given my application and a supercomputer)



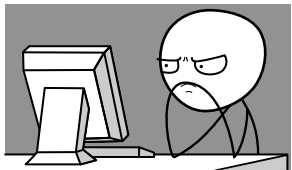
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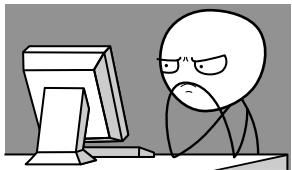


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## Holy Grail: Predictive Simulation on a “Laptop”

Capture the **whole application** and **platform complexity**

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- Case study: High Performance Linpack (HPL)
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Full reimplementation of MPI on top of



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**Contribution:** Skip the expensive computations (mostly **dgemm**) and replace them by performance models