

**Dr. Mindaugas Šarpis**

# **Lessons on Data Analysis from CERN**

## **Lecture 3**

### **Overview of Computing Principles**

# Computing Infrastructure

**What constitutes computing infrastructure?**

# Hardware Components

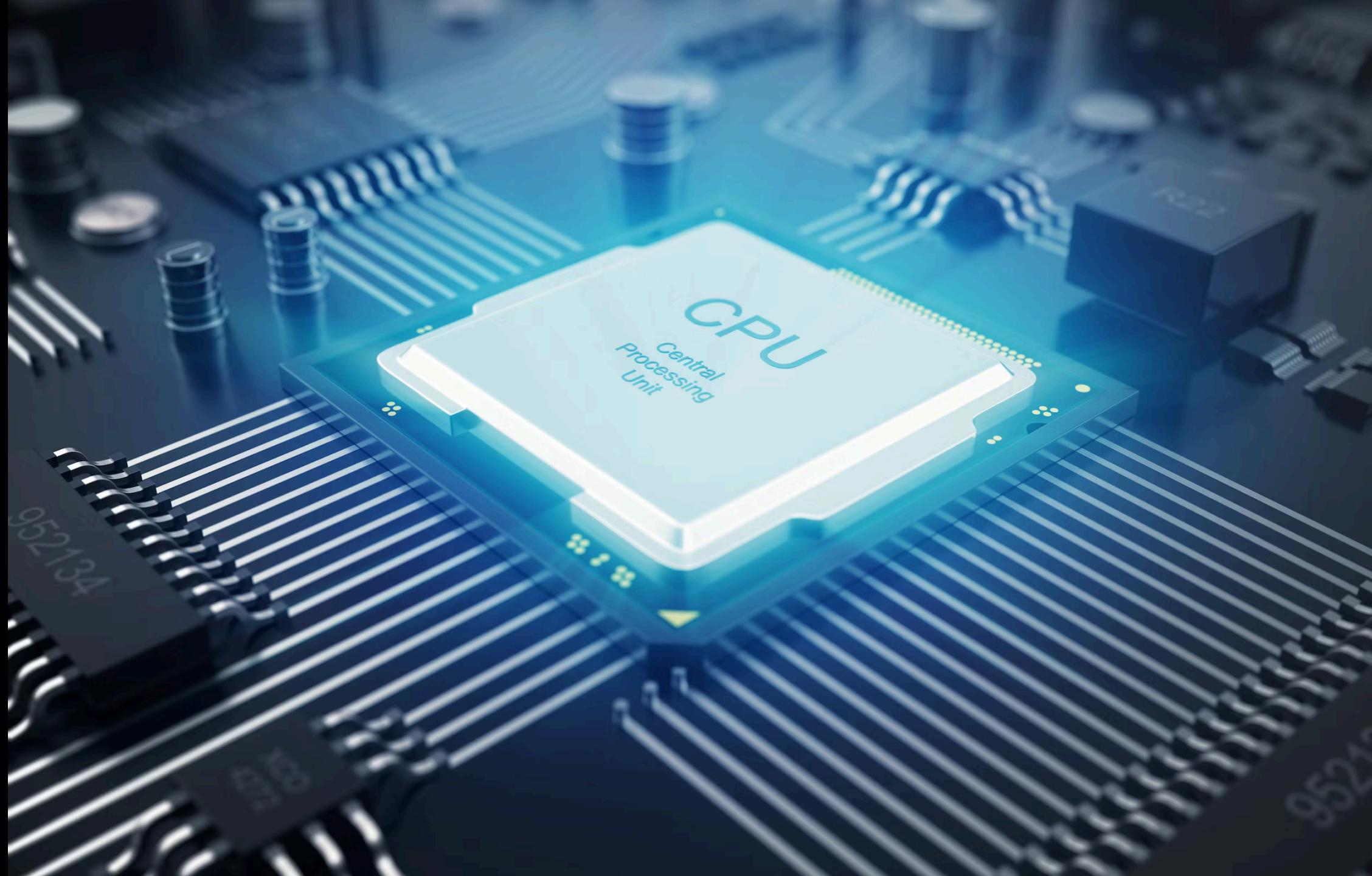
- Central Processing Unit (**CPU**)
- Memory (**RAM**)
- Storage Devices (**HDD, SSD, NVMe**)
- Input/Output (**I/O**) Devices
- Specialized Processors (**GPUs, TPUs**)

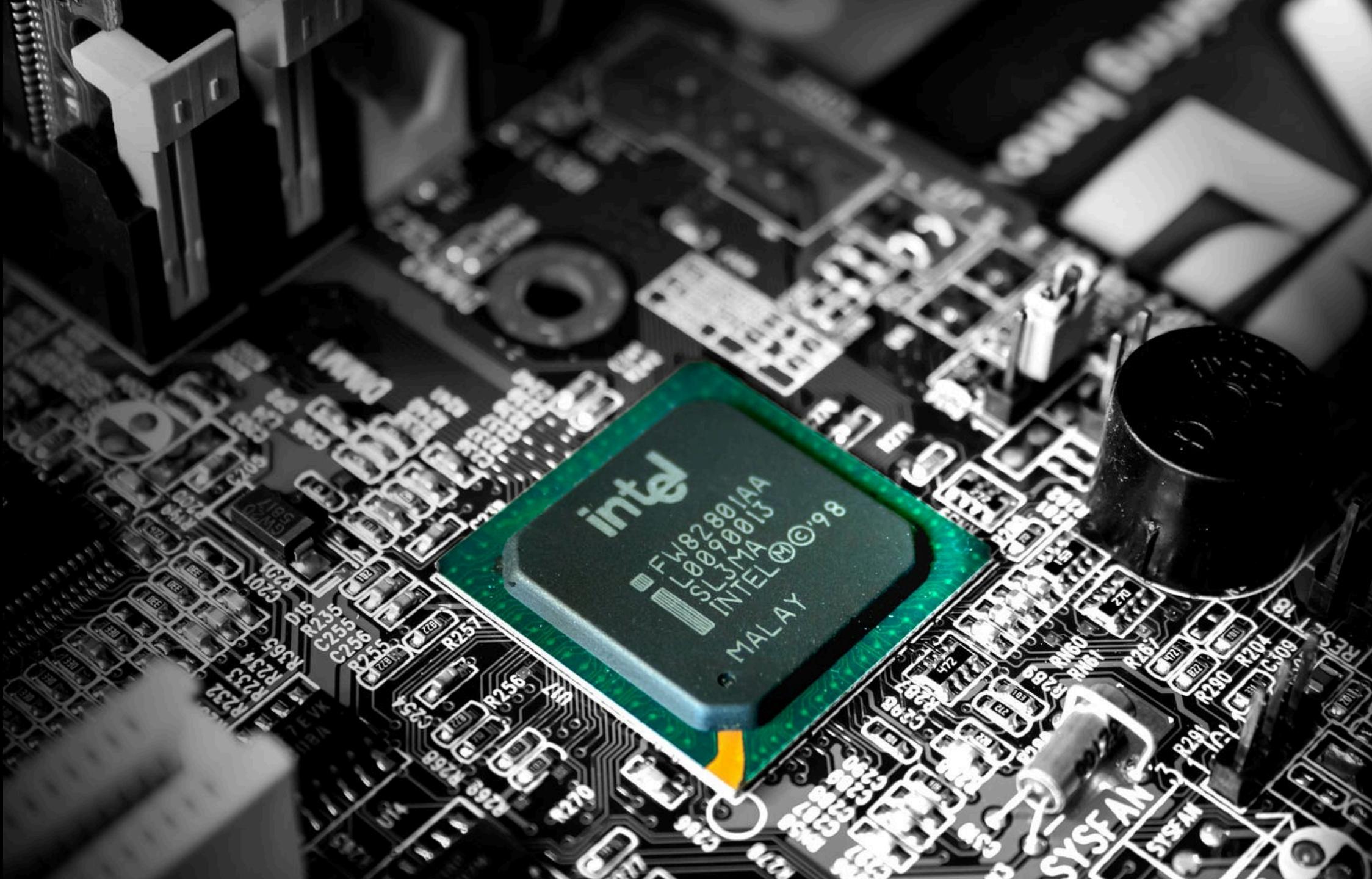
# CPU (Central Processing Unit)

- Basic arithmetic, logic, control, and input/output operations
- CPU sub-components
  - Control Unit (CU)
  - Arithmetic Logic Unit (ALU)
  - Registers
  - Cache
  - Buses

# CPU Performance Factors:

- Clock Speed
- Number of Cores
- Cache Size
- Power Efficiency





# 8-core CPU

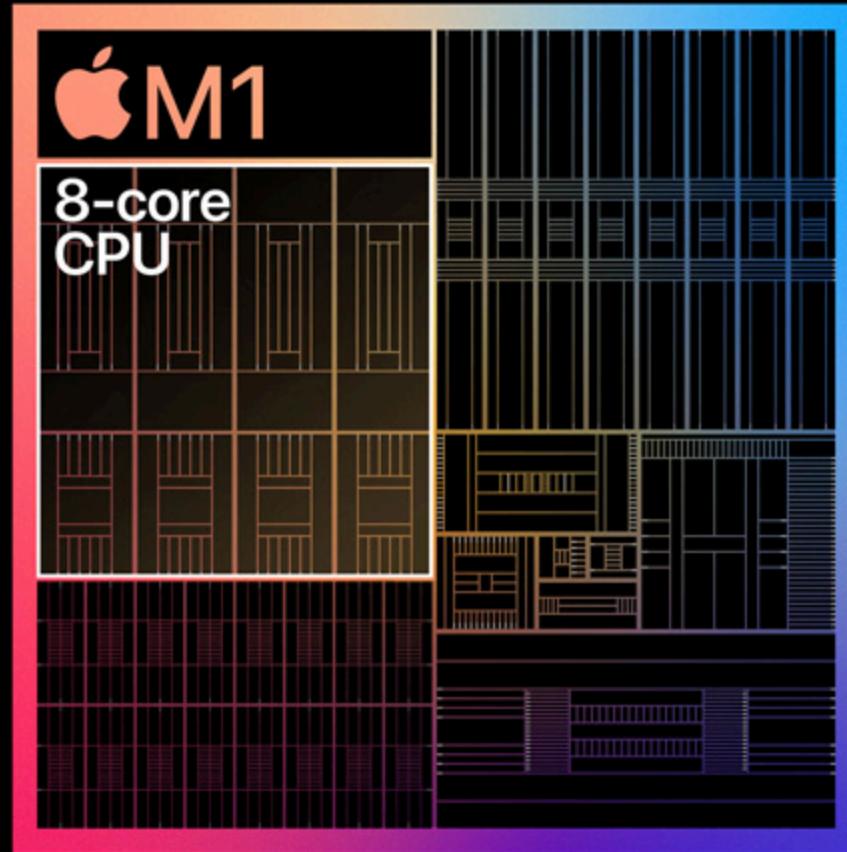
The highest-performance CPU  
we've ever built.

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Up to

# 3.5x

faster CPU  
performance<sup>1</sup>



# **RAM (Random Access Memory)**

- Volatile memory
- High-Speed Access
- Temporary Storage
- Capacity (GB or TB)
- Performance (MHz or GHz)







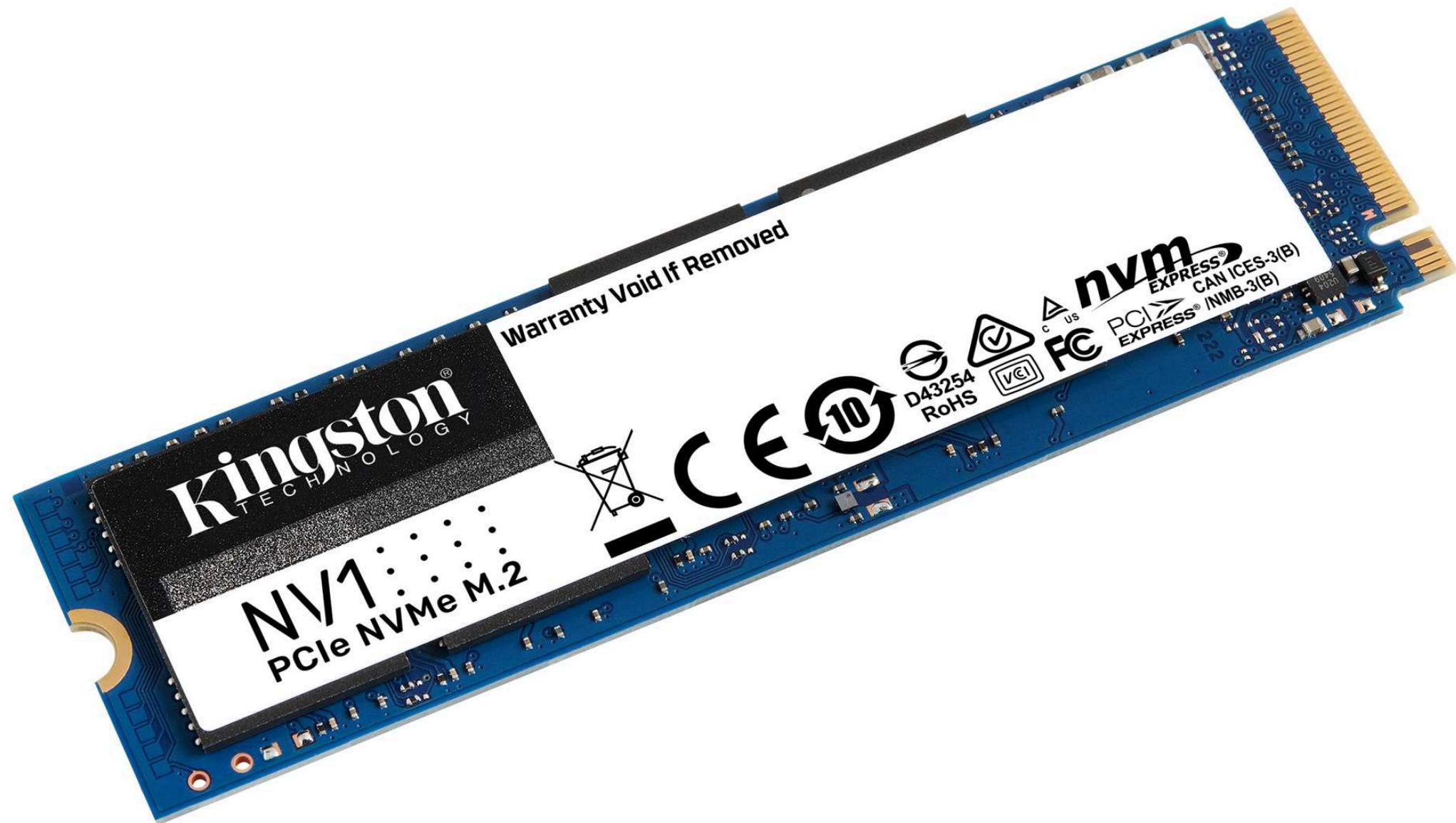
## Storage Devices:

- **HDD (Hard Disk Drive)**
- **SSD (Solid State Drive)**
- **SSHD (Solid State Hybrid Drive)**
- **NVMe (Non-Volatile Memory Express)**

Caches → RAM → Disk Storage







# Input/Output (I/O) Devices

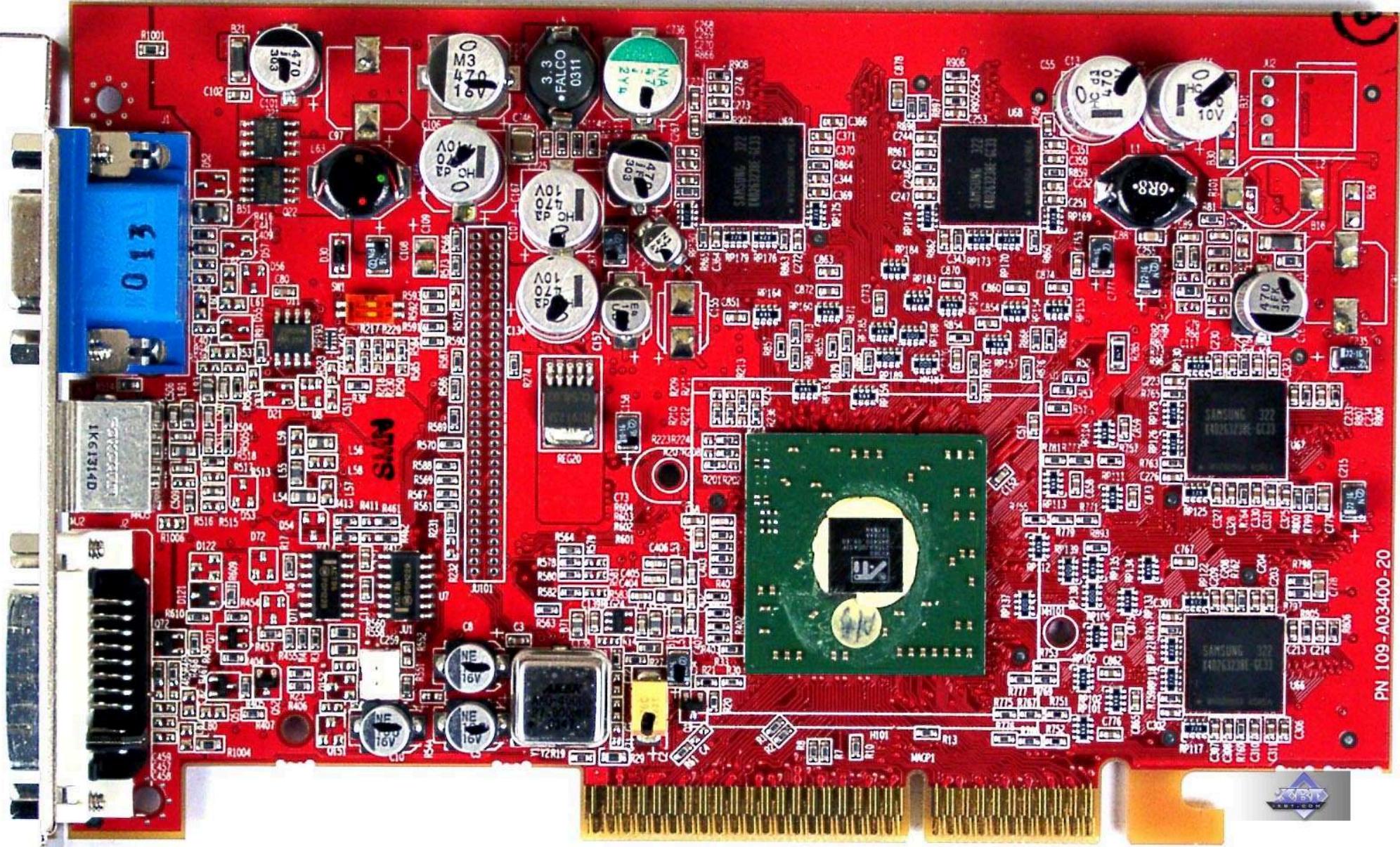


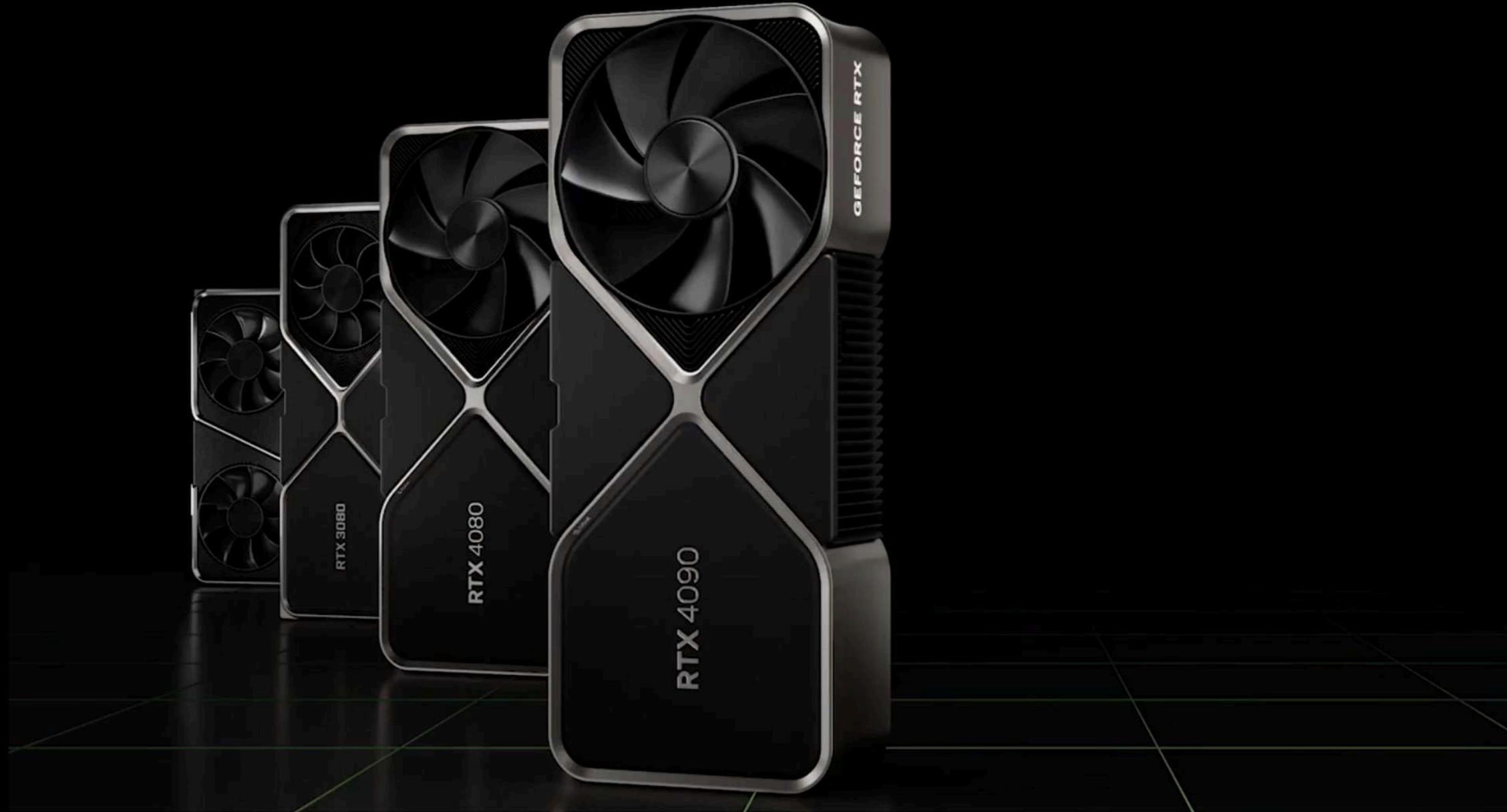
## Specialized Processors:

- GPU (Graphics Processing Unit)
- TPU (Tensor Processing Unit)
- FPGA (Field-Programmable Gate Array)
- ASIC (Application-Specific Integrated Circuit)

# GPU (Graphics Processing Unit)

- Graphics Rendering
- Parallel Processing Power
- Accelerating Machine Learning and AI
- Scientific and Data Analysis Computing
- Video Processing and Encoding





- Power and Cooling
- Networking
- Monitoring and Management Tools

- Security
- Software
- Virtualization and Cloud Computing

# Software Components

- Operating Systems (**OS**)
  - Windows
  - macOS
  - Linux
- **Middleware and Virtualization**
- **Application Software**

## Interlude to CERN Computing ...

# Crash Course on Main Principles Computing

*Blackboard exercise*