Lecture 2: Computing cluster technology

https://sites.google.com/site/clustergateorg/

Components, architecture, software

- **Computer equipments**
- **Architecture layers**
- **Software**
  - application
  - system
  - Programming languages
- **Development and dissemination of software**

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Computer Cluster

- **Two or more servers**
- **Under one administration**
- **User uses the cluster as united resource for the service but not as group of servers.**
- **Cluster types**
  - High performance
  - Storage
  - Load balancing
  - High availability

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Basic equipment architecture

- Any digital computers are build up with base electronic elements, which have several distinguished stable states.
- During the computing history it was tested several such the elements: base electronic elements with10 states, three states and two states. More suitable is base electronic element with two stable states.
- So, to buildup any computer you need just the set of basic elements, which have two distinguished stable states. Such the basic element is entitled ***trigger***.
- Contemporary integrated socket has a lot of triggers (in 2016 a microprocessor might have several ? of triggers) Intel Xeon Phi, Oracle Sparc M7
- Moor Low

Software

- **What is algorithm ?**
- **What is a program ?**
- **Who does write/develop programs ?**
  - Electronic engineers ?
  - Specially educated persons ?
- **Where the programs are ?**
  - On paper in the shelf ?
  - On disk drive ?
  - In main computer memory ?

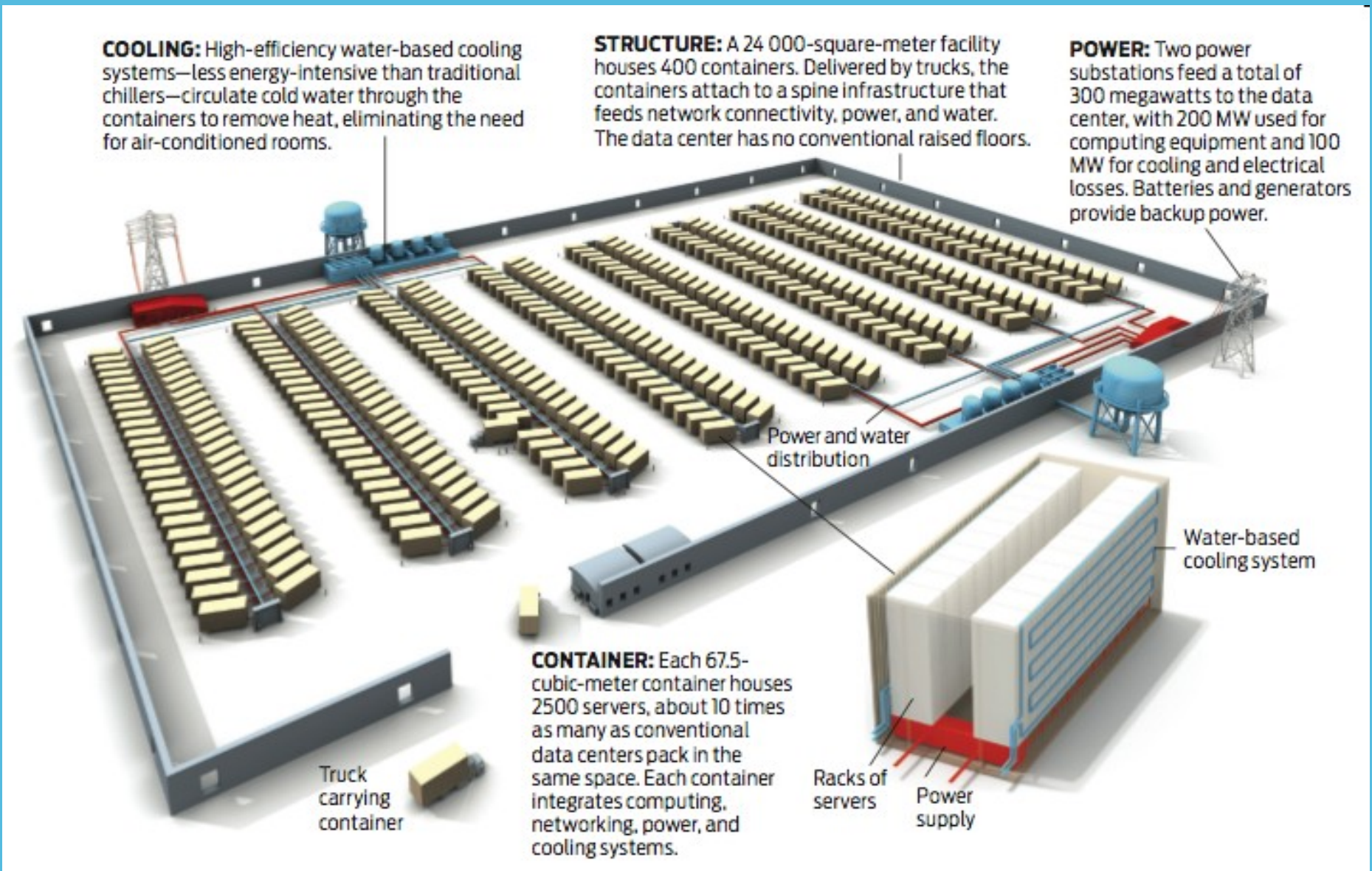
Sequential program execution

- American mathematician born in Hungary *John von Neumann* (1903-1957) described model of computer, where data and instructions what to do with the data are kept in common memory. All instructions are read and performed in the order how they written in memory (from low to high addresses), if the current instruction is not ***GOTO, i.e. instruction to change natural order for program execution***. Such the model entitled *John von Neumann model* of computer.
- Also such the model might have several types of memory which are different by speed and price.

Modern computing systems

- **One of the main characteristics of modern computing architectures is use heterogeneous (hybrid) computing clusters:**
  - Computing systems;
    - Batch systems to balance the load of the cluster;
  - Storage systems;
  - DBMS servers, large Web and Mail servers. Servers for social networks.
  - What is definition for the “computing cluster”?

Data Center (computing cluster)



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Software

- Microprograms
- System programs
  - Kernel (supervisor, control program) — can do anything on computer: high credentials
    - Input/output
    - Interruption
    - Synchronization (semaphores)
- Application software
  - All programs, which run without high credentials
- Also program systems

Microprograms

- Microprograms (microcode) – the set of code lines, consisting of binary combinations in general of variety of sizes (16-512 bits):
- Quite often each bit is used to switch on small part of CPU or change the mode of performance of the CPU or hardware controller.
- Special hardware processor is used to perform (interprete) microprogram.
- Microprogram usually developed by electronic engineer – developer of the hardware.

Programming languages

- **Low level languages (assembler, C, C++);**
- **Higher level languages with compilation phase:**
  - Ada, Java, Ruby,
- **Languages with interpretation: perl, python, {ba,z}sh, {c,tc,k}sh**
- **Stages of compilation:**
  - Lexical and semantics analysis;
  - Conversion into intermediate codes;
  - Interpretation (for interpreters) or translation to machine codes (for compilers).

Main types of programming languages

- Imperative languages followed paradigm, in which sequence of data processing is defined by means languages operators. Examples: any procedure oriented language.
- Declarative languages following paradigm, in which language just permits to focus attention on results but not on concrete methods. Examples: ***regular expressions***, ***Make***, and other **Domain Specific Languages** (DSL)

Databases

- **Relational databases, for example, MySql, Postgres, Oracle DB, etc**
  - Structured Query Language = SQL – special language dedicated to control/access to the data in relational databases: the databases where the data are groupped in the set of lines and columns
  - **ACID** – atomicity, consistency, isolation, durability
- **All other databases are not relational.**
- **Now the NoSql databases are more and more popular. Why ? (see http://en.wikipedia.org/wiki/NoSQL)**

Computer infrastructure layers

User programs/systems

Application programs/systems:
Compilars, shells/interpretators, DBMS, etc

Supervisor or kernel

Hypervisor (for virtual architectures)

Microprograms

Computer hardware

Engineering infrastructure:
Power supply, conditioners, etce

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Remarks on architecture layers

- Functional reliability of any layer is not higher than functional reliability of all layers below.
- Protocol of interaction in between layers has to be defined carefully.
- Components/products for any layer might be developed, tested, produced independently from the components on other layers.

Software Development and dissemination

- **Commercial software**
- **Creation and development of Free Open Source Software (FOSS)**
  - Operating system Linux (many distributions), for example,
    - RedHat, Debian, SuSe and so on (https://en.wikipedia.org/wiki/List_of_Linux_distributions)
- **Maintenance**
  - Bug fixes, upgrades, minor development
  - Is there any difference for commercial software and FOSS?

End of lecture

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Is it possible to take participation in new particles discovery on LHC ?

- The answer is “YES” for any person with any type of computer: pls see **http://lhcathome.web.cern.ch/LHCathome/**