

Lecture 1

Computer System

System levels

Location of the program

Representation of a program

Speed of system devices

Computer System



User

System

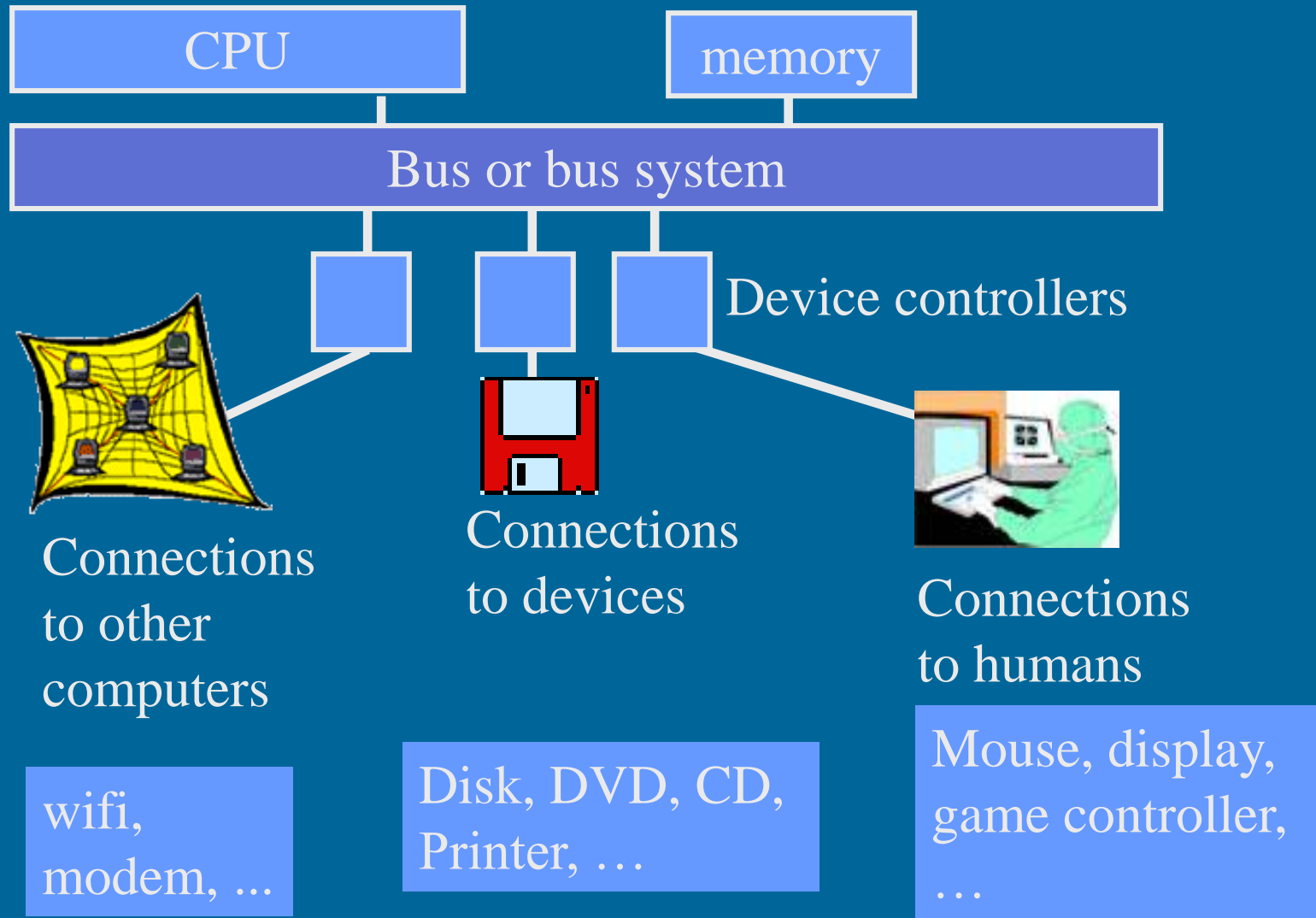
Peripheral or I/O devices



Computer

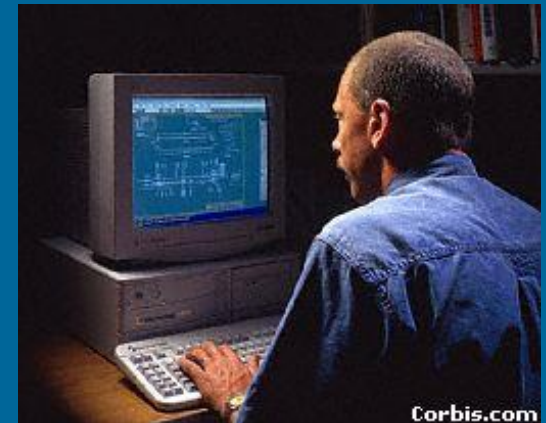


Computer



Location and Representation of a Computer Program

- User view
 - Somewhere in system
 - In some form
 - Easy to execute
 - Click icon with a mouse
 - Give program name and parameters to textual user interface
 - E.g., after DOS, UNIX or Linux prompt
 - Insert DVD to a DVD-station
 - Insert memory stick to USB-port

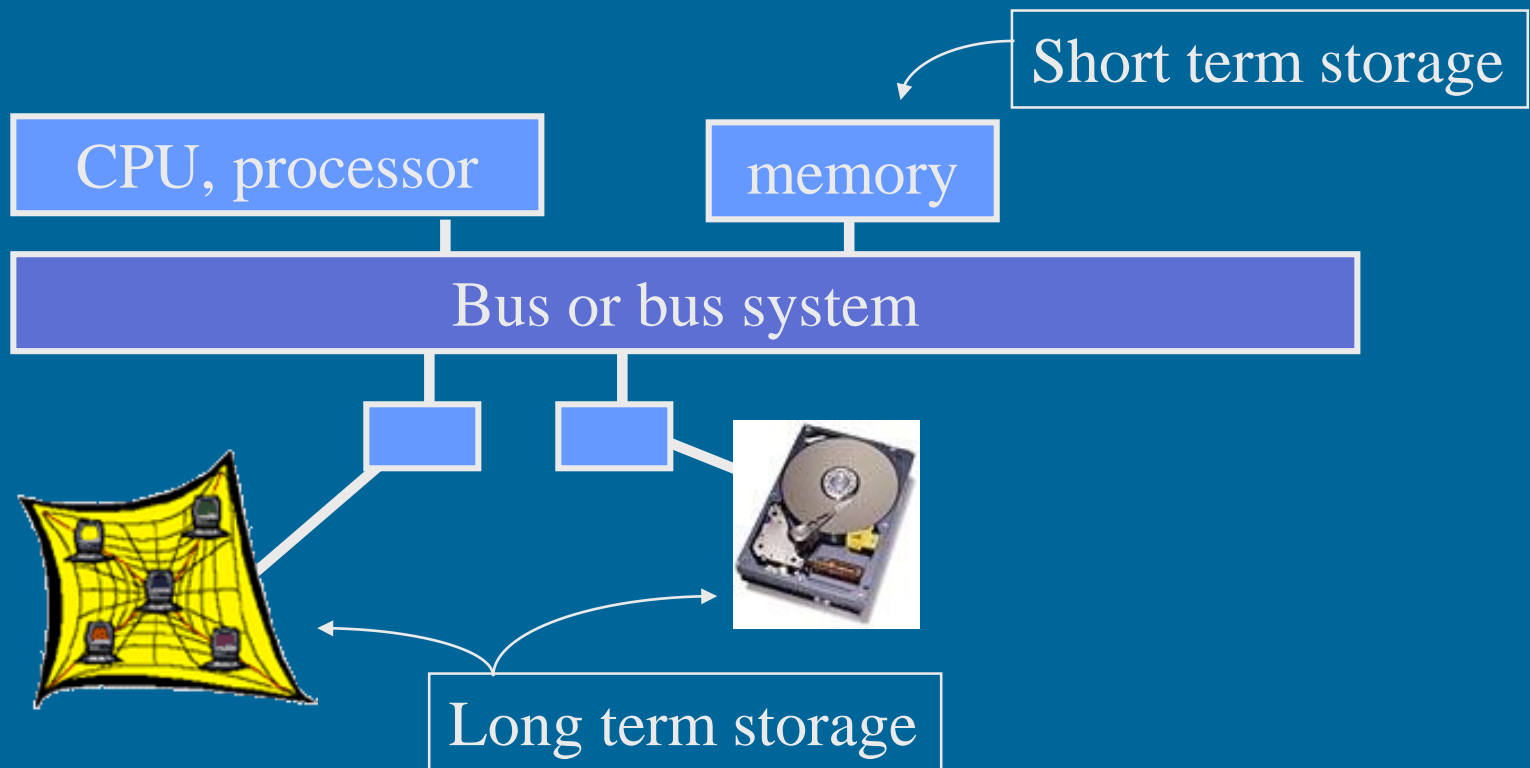


Location and Representation of a Computer Program (contd)

- Long term storage
 - In some device where data is sustained without electricity
 - Hard disk, SSD, tape, CD, DVD, memory stick
 - Described in some language
 - High level languages: Java, Fortran, C,
 - Data base description lang.: SQL, SQL*Forms,
 - Processor machine lang.: x86, MIPS, PA-RISC, ...
 - Maybe packed in some fashion
 - zip, tar, gz, ...

Location and Representation of a Computer Program (contd)

- At execution time in memory in mach. code
- At other time in disk, web, etc



Machine Language

- Processor instruction set defines its instruction set architecture (ISA)
- Each instruction is (e.g.) a 10-digit integer number
- Often given with symbolic assembly language
 - Instruction is composed of different fields
 - Some field values are described with symbols
 - Easier for humans to read/write
 - Easy to translate to (pure) machine language

2234563212
5437658756

LOAD	R1, Sum
opcode	register variable

Symbolic Assembly Language

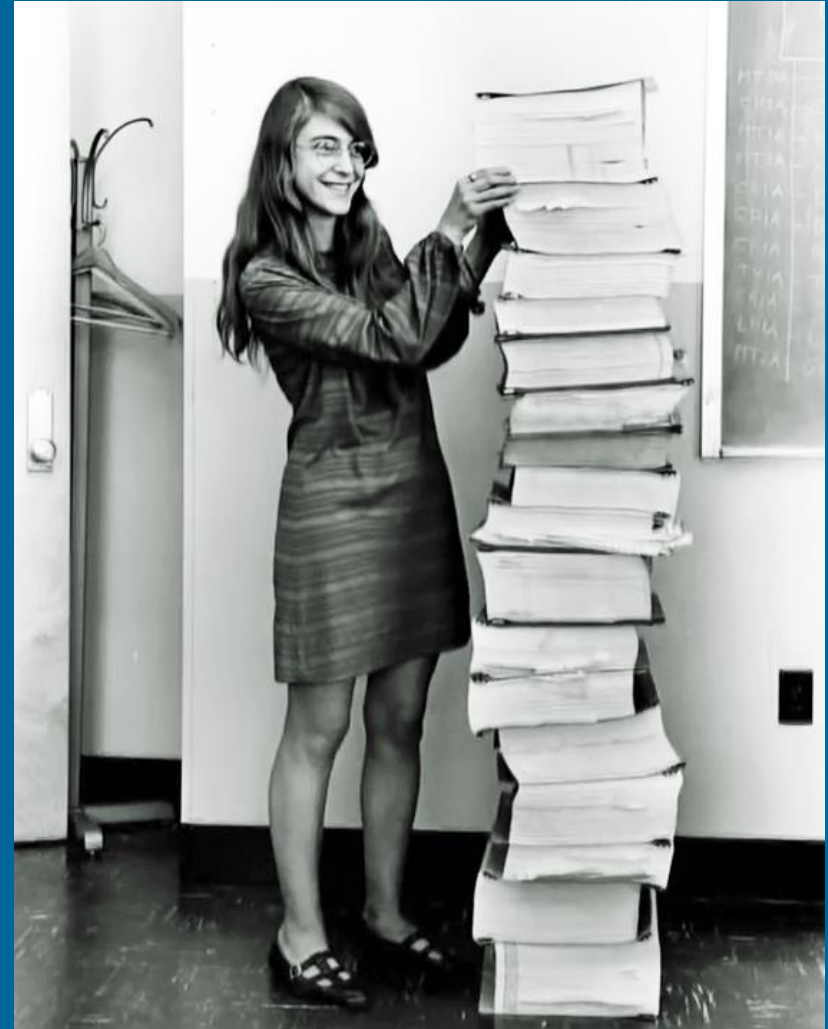
- Usual representation for machine language programs
 - “Readable machine language”
- Easy to translate to machine language
 - Relates directly to machine language
 - Often considered (slightly erroneously, but not much):

Symbolic assembly language \approx machine language

129543876		LOAD	R2, Sum	; R2 \leftarrow Mem(Sum)
439874387	\approx	ADD	R2, =5	; R2 \leftarrow R2 + 5
544399765		JUMP	Loop	; PC \leftarrow Loop
		(code)		(; comment)

Programming with Symbolic Assembly Language

- Margaret Hamilton and listing of AGC (Apollo Guidance Computer) source code
- AGC was programmed in assembly language
- Margaret Hamilton
 - Started to use the term “software development” to describe her programming principles in 1968
 - Augusta Ada Lovelace Award, 1986 (Ada Lovelace, 1815-1852)



https://en.wikipedia.org/wiki/Apollo_Guidance_Computer

High Level Language (HLL) vs. Machine Language

- Problem:

Program is stored in some high level language (e.g., Java or C) form in long term memory (e.g., hard disk), but for execution it must be in machine language for this processor in system memory.

- Solution: representation changes

- compilation

HLL → machine language

- linking

Combine with library modules

- loading

Store

- Compilation and linking can be done before execution, or partly during execution

Program Representations (4)

```
Sum := Sum+1;  
Print (Sum);
```

compilation

defined in some other module

```
LOAD   R1, Sum  
ADD    R1, =1  
STORE  R1, Sum  
PUSH   SP, R1  
CALL   IOMod.Print
```

linking

```
LOAD   R1, 40542  
ADD    R1, =1  
STORE  R1, 40542  
PUSH   SP, R1  
CALL   86488
```

in memory

in same module

```
LOAD   R1, Sum  
ADD    R1, =1  
STORE  R1, Sum  
PUSH   SP, R1  
CALL   PrintRoutine  
PrintRoutine .....
```

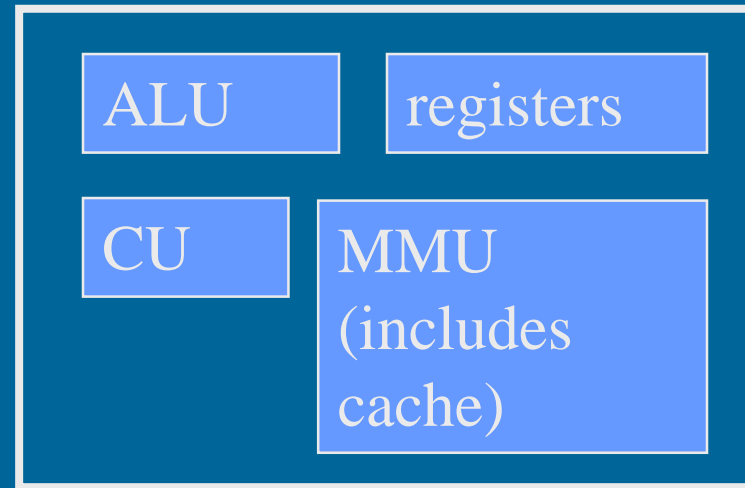
on disk

loading

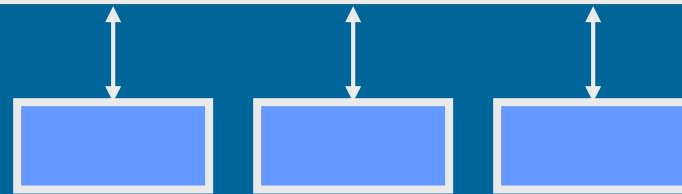
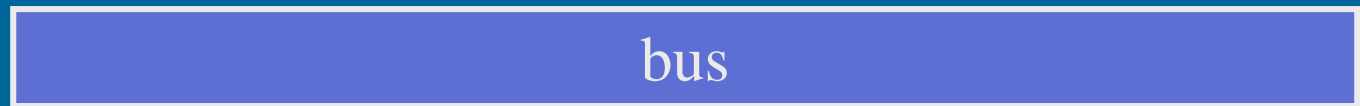
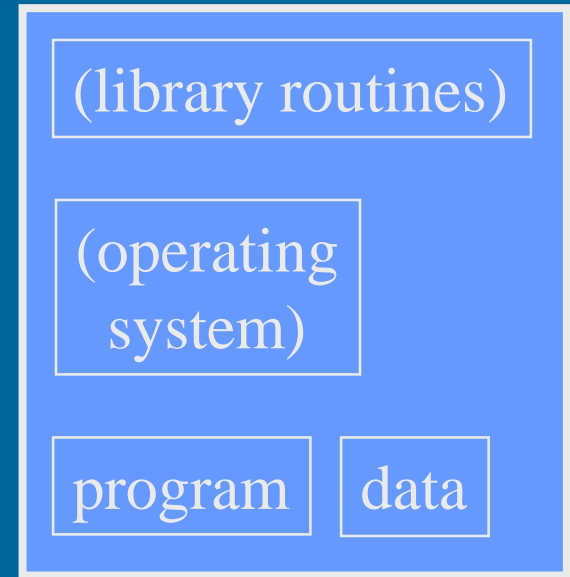
TTK-91 system

- Central Processor Unit
- Arithmetic and Logic Unit
- Control Unit
- Memory Management Unit
- Cache

CPU, processor



memory



dev. controllers

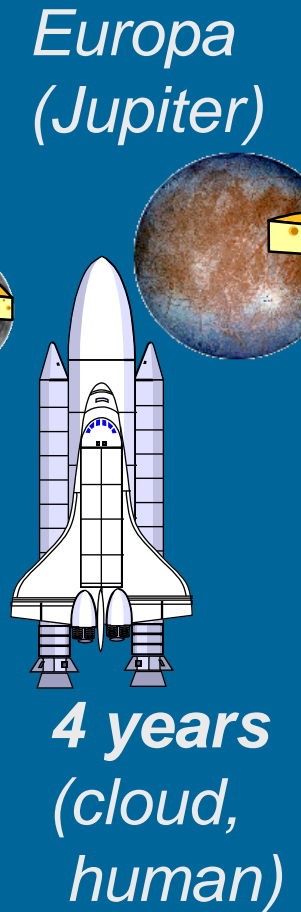
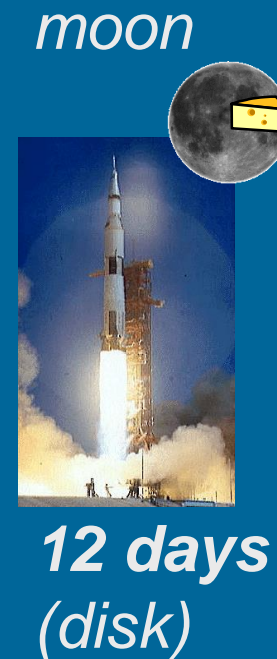
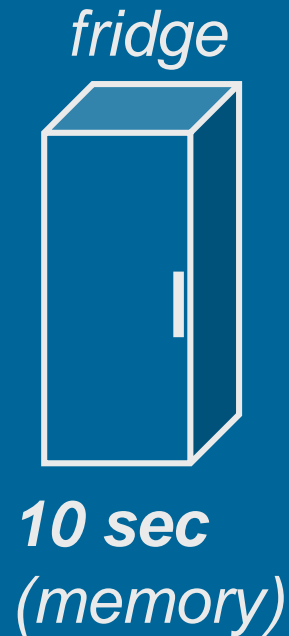
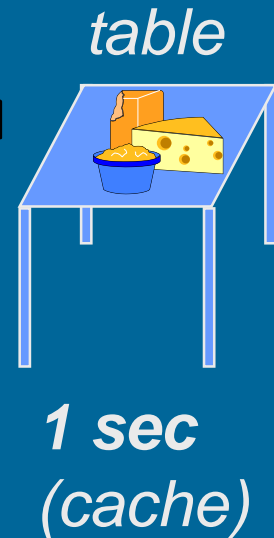
laiteohjain

Speed of Different Devices

- Huge speed differences between different components of the system
 - CPU registers are the fastest 1 ns?
 - Cache is almost as fast
 - Memory is already pretty slow 50 ns?
 - I/O devices are really slow
 - Hard disk, SSD 10 ms?
 - Some devices are extremely slow
 - Magnetic tape, human interfaces 1 sec?
 - Other computers are extremely slow
 - Cloud services, internet 10 sec?

Teemu's Cheesecake

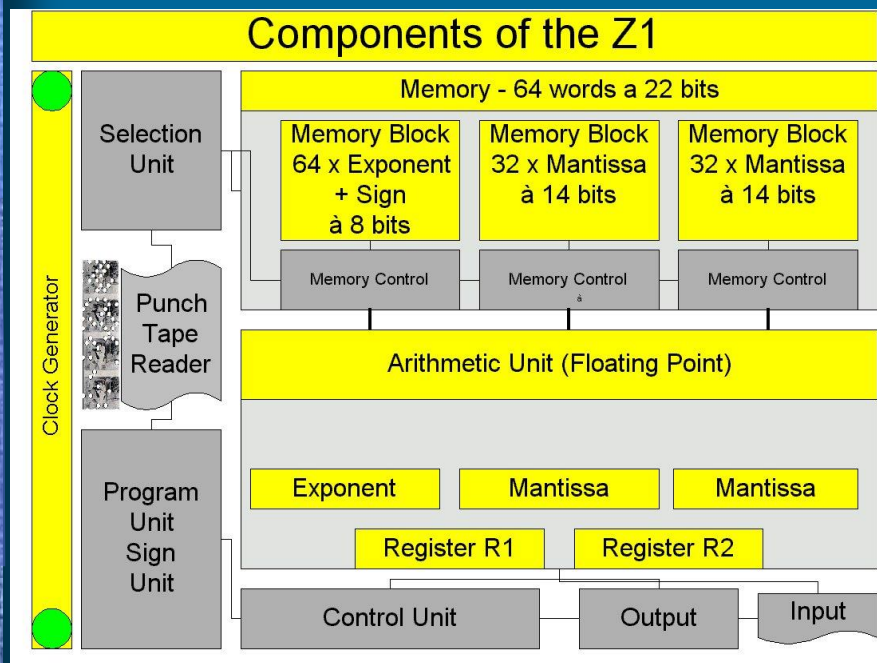
Speed of register, cache, memory, hard disk, and cloud as compared to getting cheese for cheese cake?



-- End --

Konrad Zuse: Z1 (1938 Germany)

- mechanical "calculator", clock cycle 1 Hz (turn handle!)
- multiplication 5 s
- data store 64W à 24b
- code from punch tape (film)



http://irb.cs.tu-berlin.de/~zuse/Konrad_Zuse/en/Rechner_Z1.html