IAS0430 MICROPROCESSOR SYSTEMS

Fall 2018

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Learning environment : http://isc.ttu.ee
Materials : http://isc.ttu.ee/martin

Who I am ?

- Graduated Jõhvi Gümnaaium
- Phd degree from TUT
- Lecturer, elecronic engineer.
- www.skeemipesa.ee www.elfafoorum.ee

EESTI VABARIIK

TALLINNA TEHNIKAÜLIKOOL

DIPLOM

Tallinna Tehnikaülikool tunnistab, et

Martin Jaanus,

isikukood 37706162218,

on täitnud doktoriõppe

info- ja kommunikatsioonitehnoloogia õppekava

täies mahus ja talle on antud

filosoofiadoktori (arvuti- ja süsteemitehnika) kraad

Doctor of Philosophy (computer and systems engineering)

Rektor Andres Keevallik

Infotehnoloogia teaduskonna dekaan Ennu Rüstern

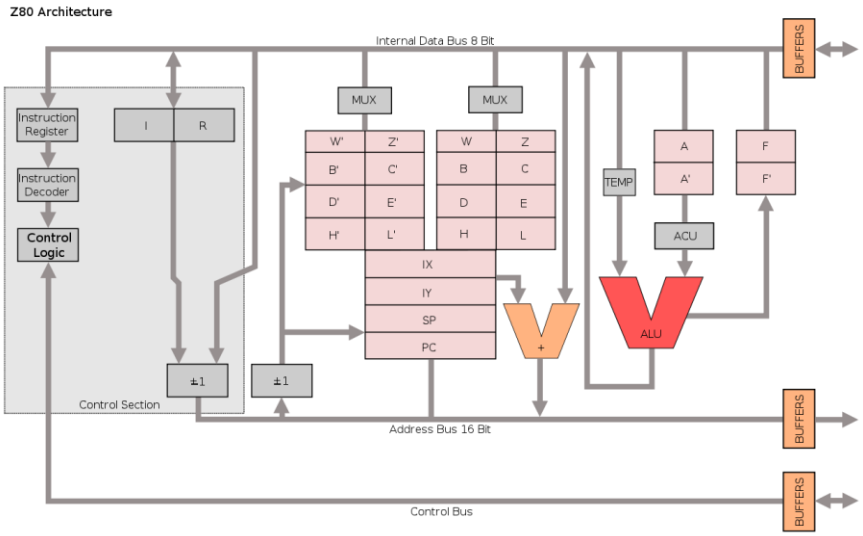
Tallinnas 10. juunil 2011. aastal

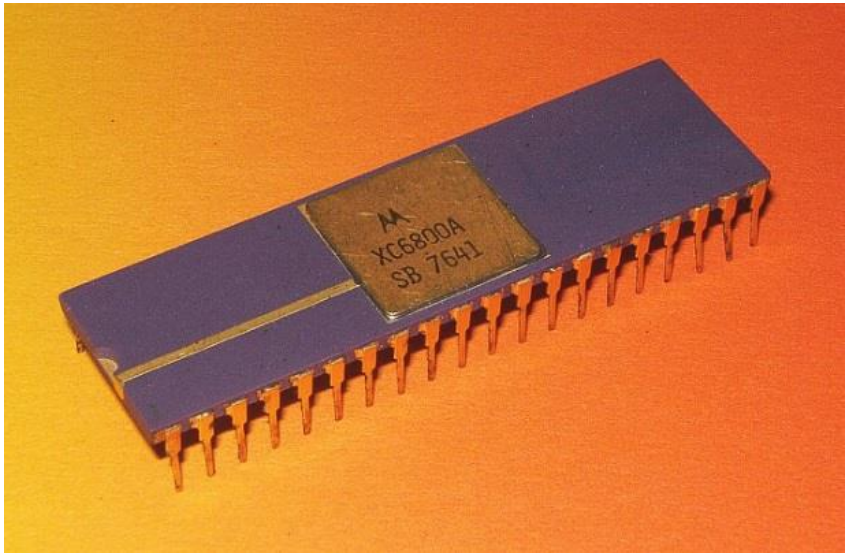
TALLINNA TEHNIKAÜLIKOOL TTÜ 1918

OB 000176

Microprocessor

- https://en.wikipedia.org/wiki/Microprocessor
- A **microprocessor** is a computer processor that incorporates the functions of a central processing unit on a single integrated circuit





By Christian Bassow, CC BY-SA 4.0, https://commons.wikimedia.org/w/index.php?curid=55535845

Covered topics

- Digital blocks – working principles.
- Memory and processor managment
- Low level programming
- Elecrical connections

About course and learning

- Course uses isc system:

ISC.TTU.EE

- Online e-learning environment
  - Everything will be done there – online
  - Can be accessed everywhere
  - Automatic evaluation (no teacher intervention)

  100% web- based :
  - Internet is full of materials
  - Work in internet
  - communication in internet

  - ***This doses not exclude talking, asking, ..***

Assessment

- No official final exam:
  - Grade will be earned over the semester
  - Student him/herself decides what grade to take (more later)
- Tasks & lab experiments
  - Task are small exercises that can be done anywhere
  - Lab experiments will need lab kit (can be borrowed or can be used on-site lab)
  - What we measure, that we get (Proverb of automation people).
  - I hear- I forget, I see- i can remember, I do – I understand (Confucius)
  - **The main goal – just to become smarter !**
  - **Subject ends at 23. January 2019 .**

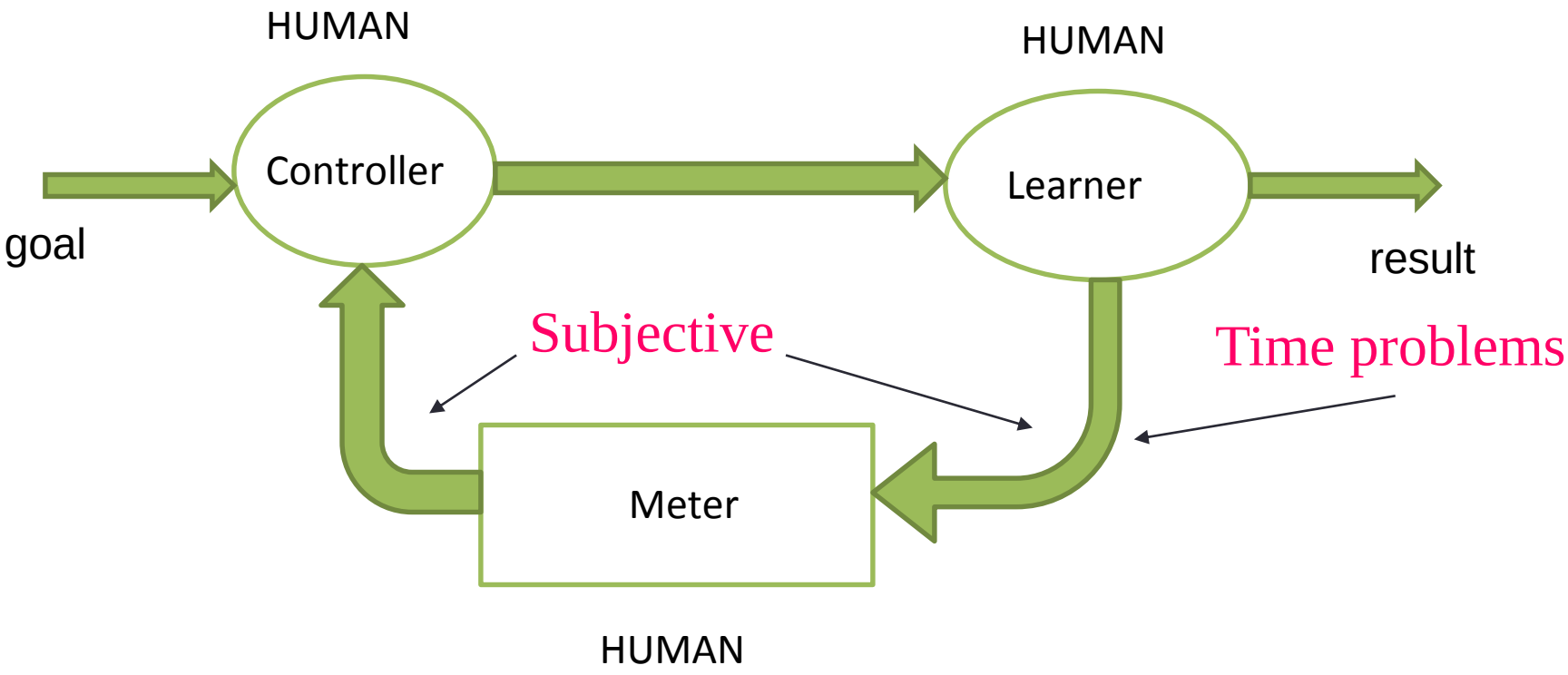
Lectures

- Only first 4 week
  - „Learn by doing“
  - So, instead sitting in lectures, register to lab and start solving exercises.
  - I do not speak fluent Engilsh , as well as you. Much information will be lost !
  - The effectiveness of lecture is quite small.
  - You are different !!! (Skills, background, needs, motivation.)
  - We do’nt know your background !

  - If wou want to listen very good lecure about Microprocessors

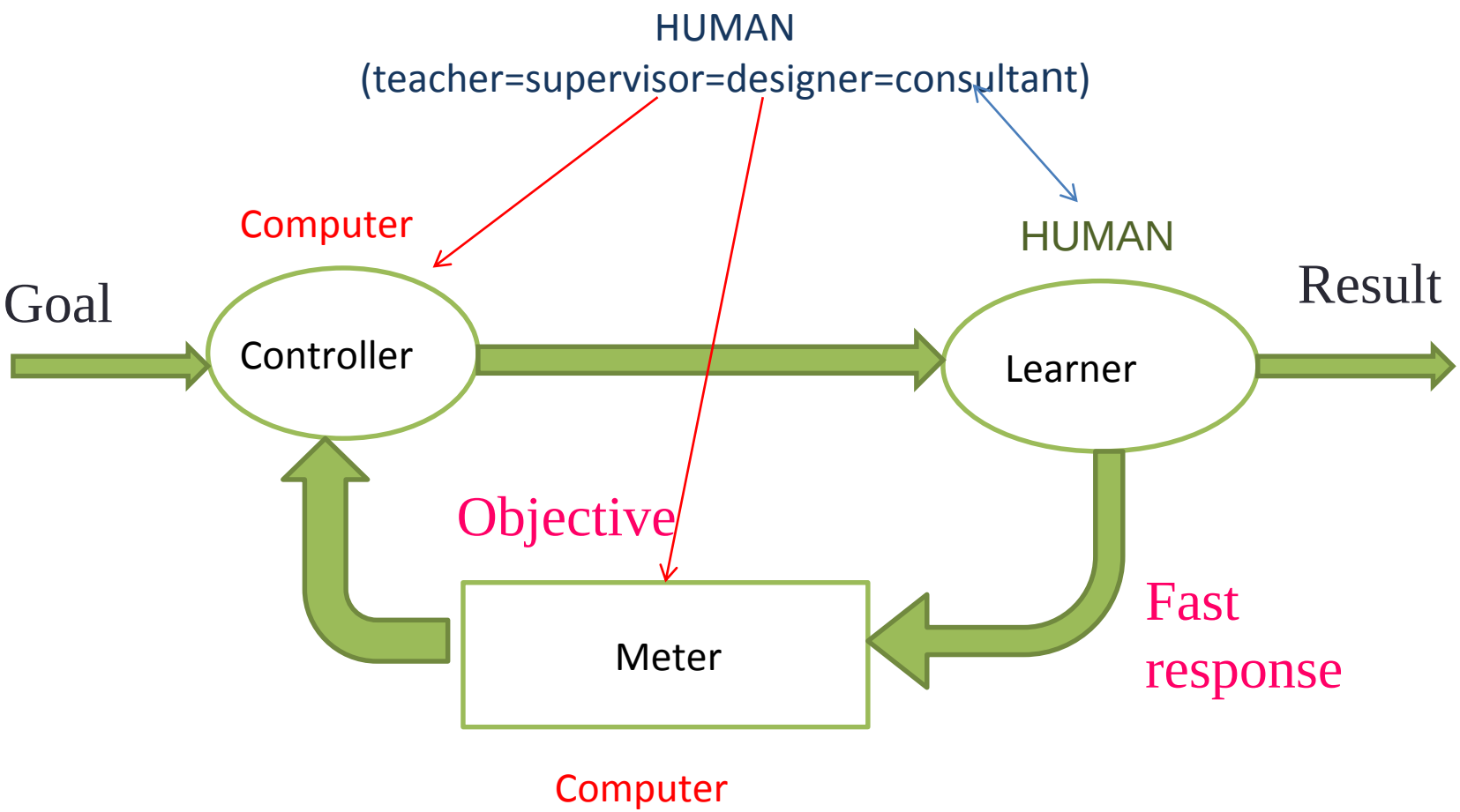
  https://ocw.mit.edu/courses/electrical-engineering-and-computer-science/6-033-computer-system-engineering-spring-2009/video-lectures/

Learning as Closed Loop System



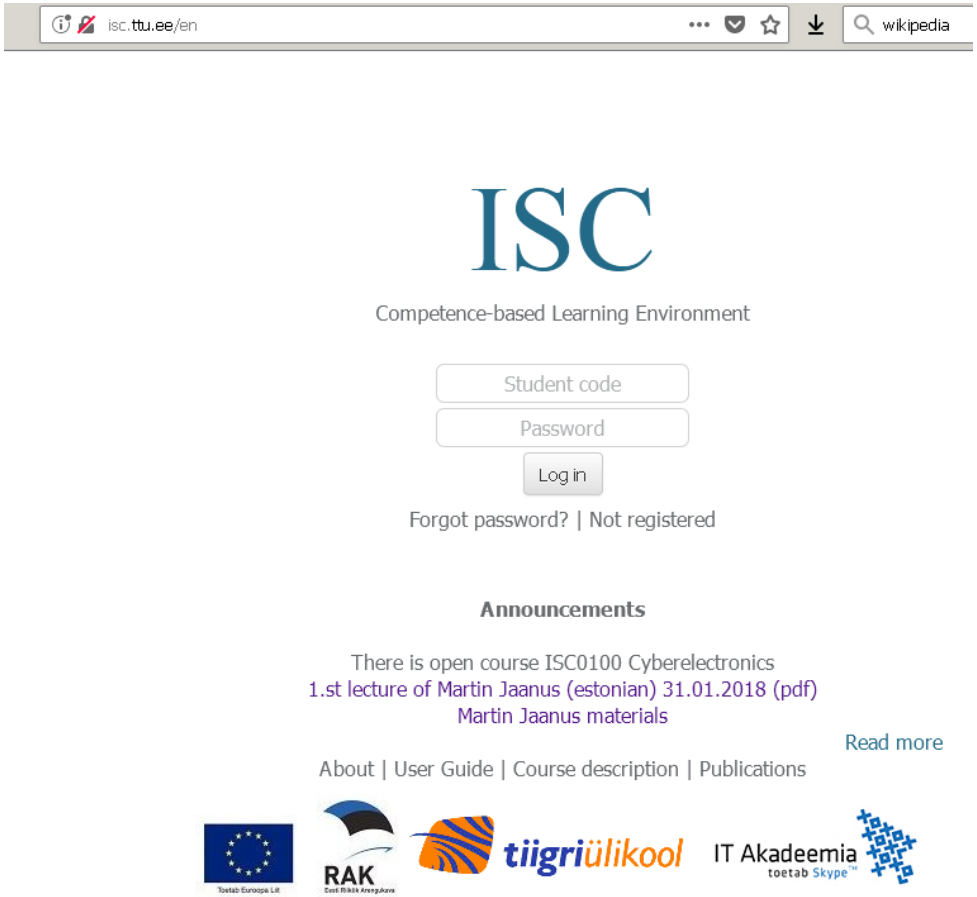
- E-tools only for organization

Learning as Closed Loop System

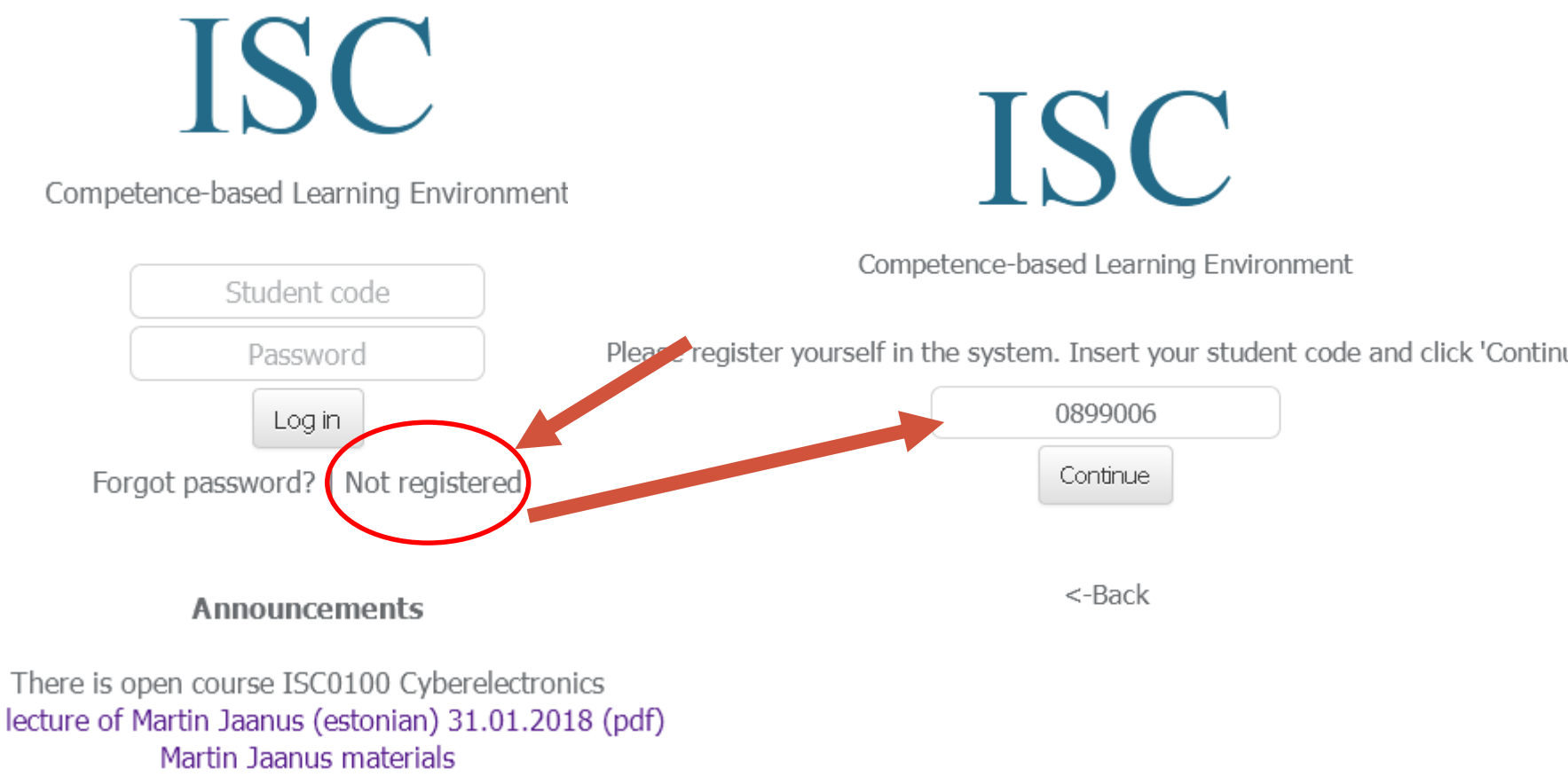


Learning environment

- http://isc.ttu.ee



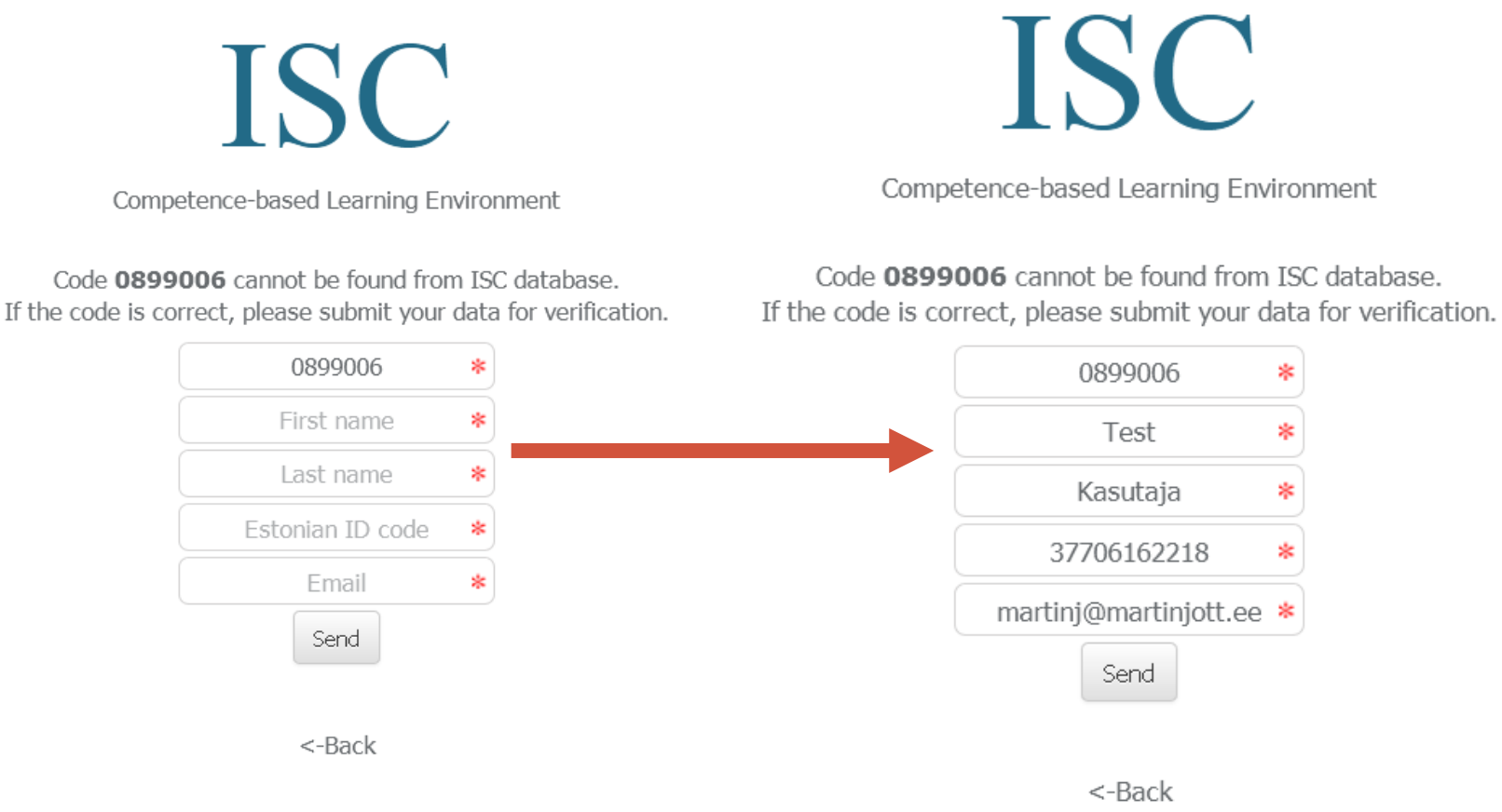
If you haven't registered before:



If you haven’t registered before:

...and you are not in database

Fill those fields carefullv !!!



If you haven’t registered before:

ISC

Competence-based Learning Environment

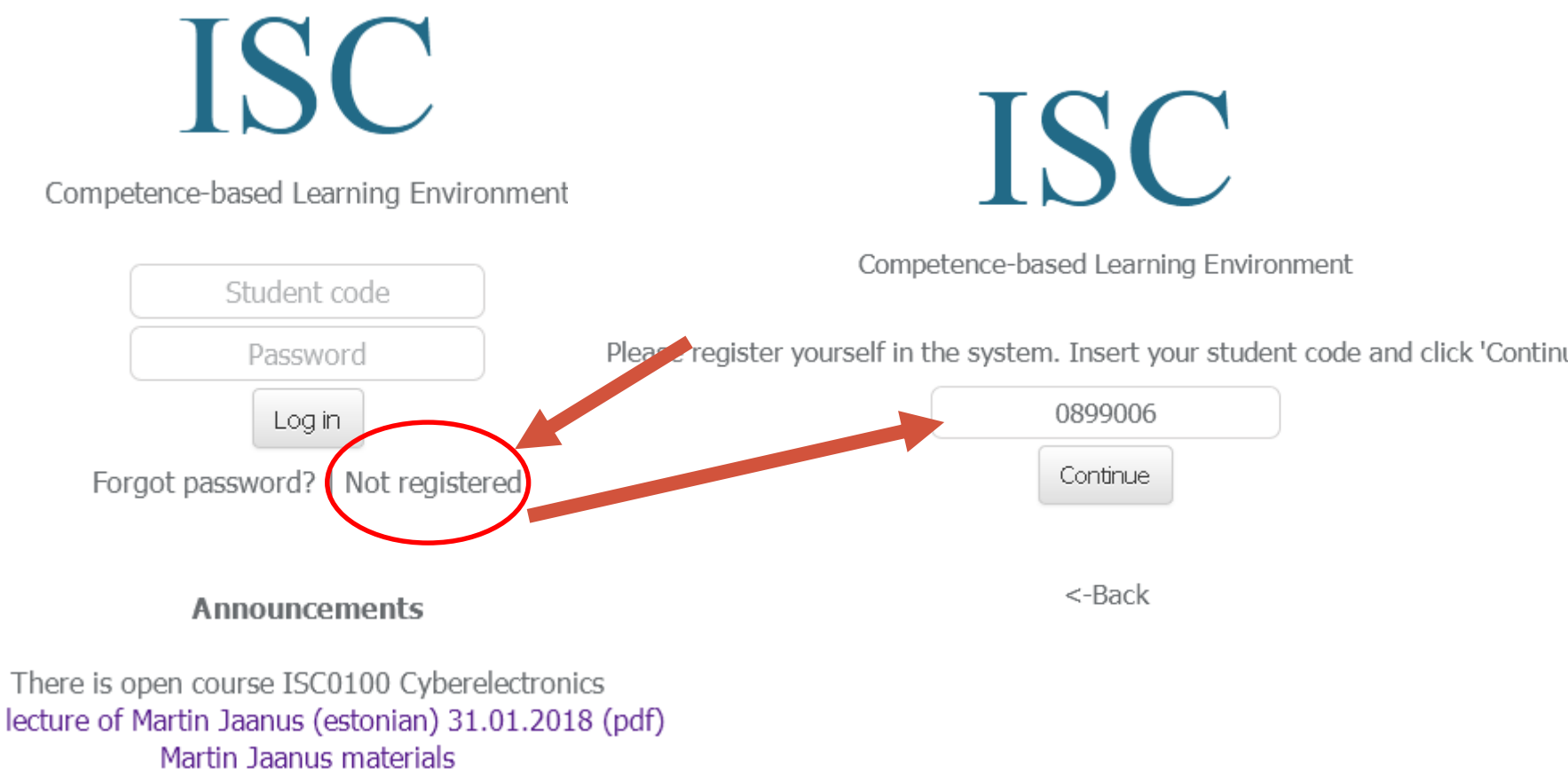
Data has been saved. You will be contacted when Your data has been verified.

<-Back

- Teacher must confirm you data. And you will get mail like this.

If you haven’t registered before:

- If you have teacher response



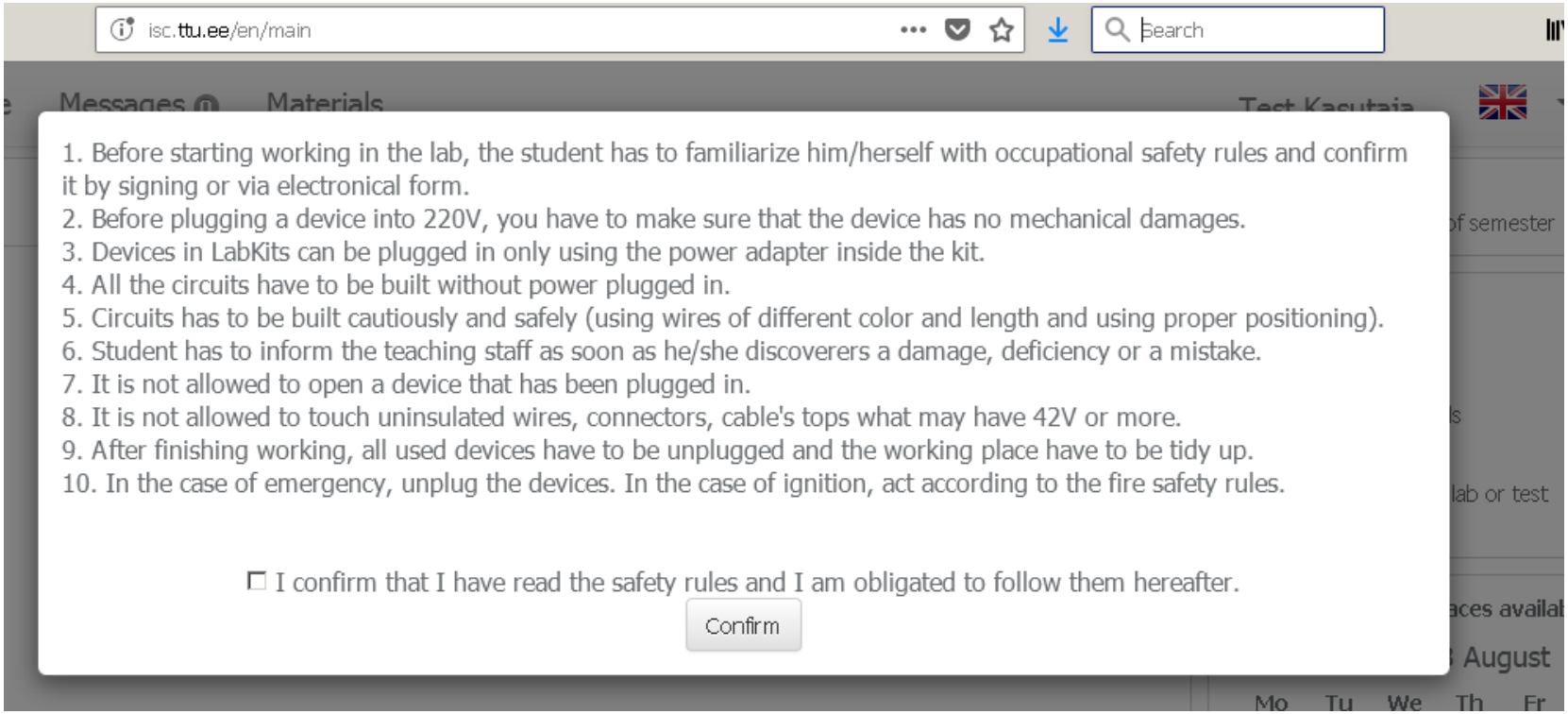
If you haven't registered before:

If you haven’t registered before:

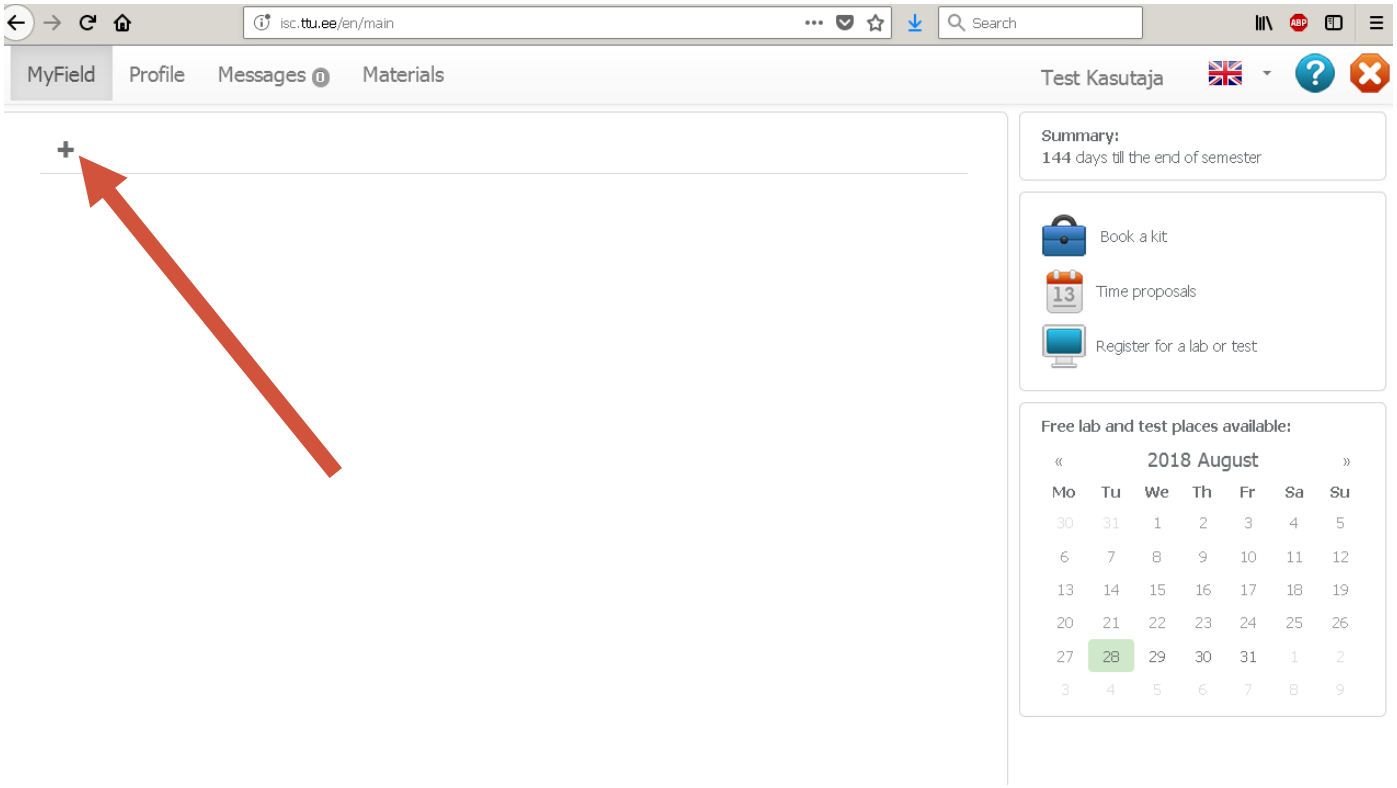
- You will get a password ! Remember it !
- The password can’t be changed.
- If you forget the password, ask us !

If you haven’t registered before:

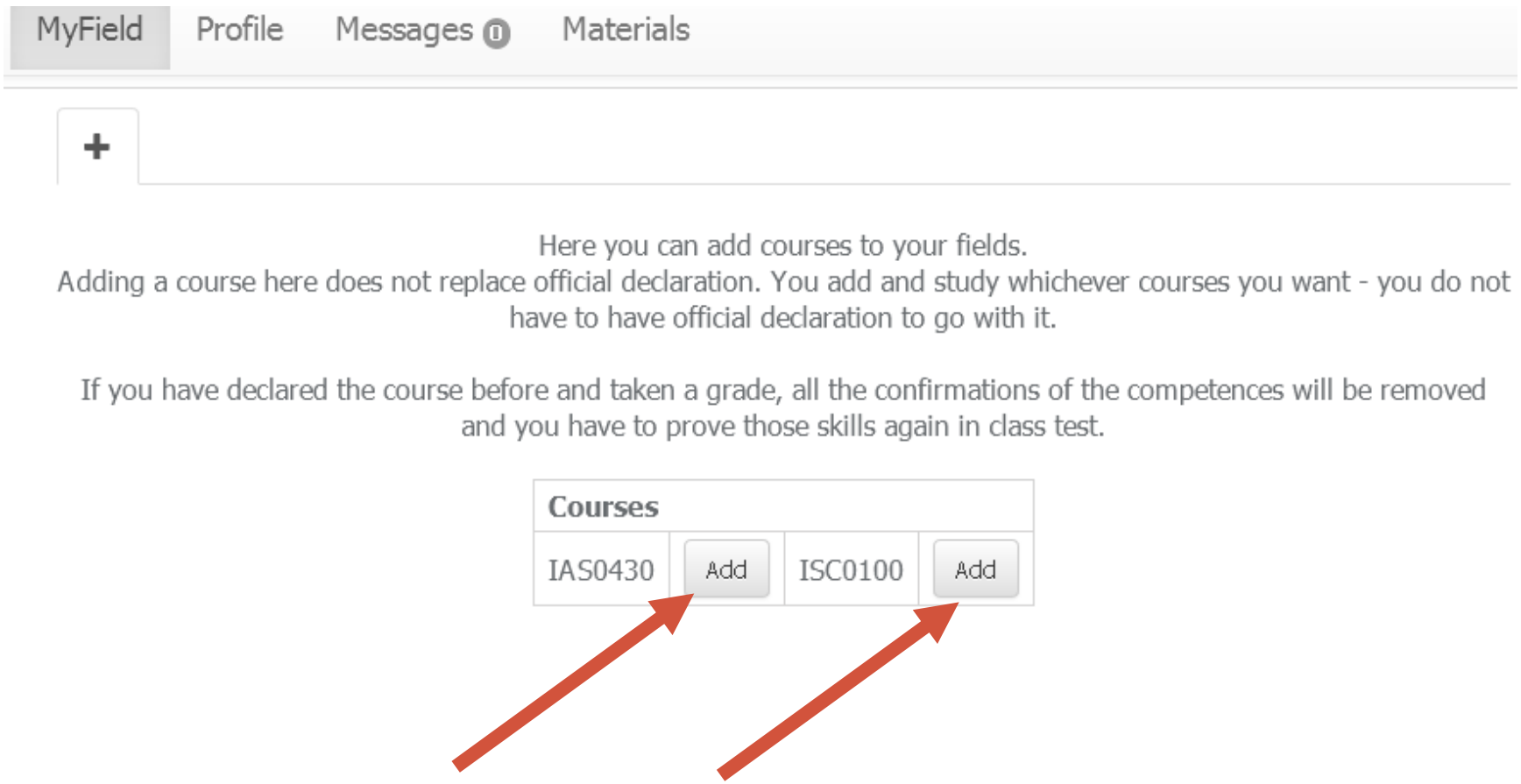
- You must agree..



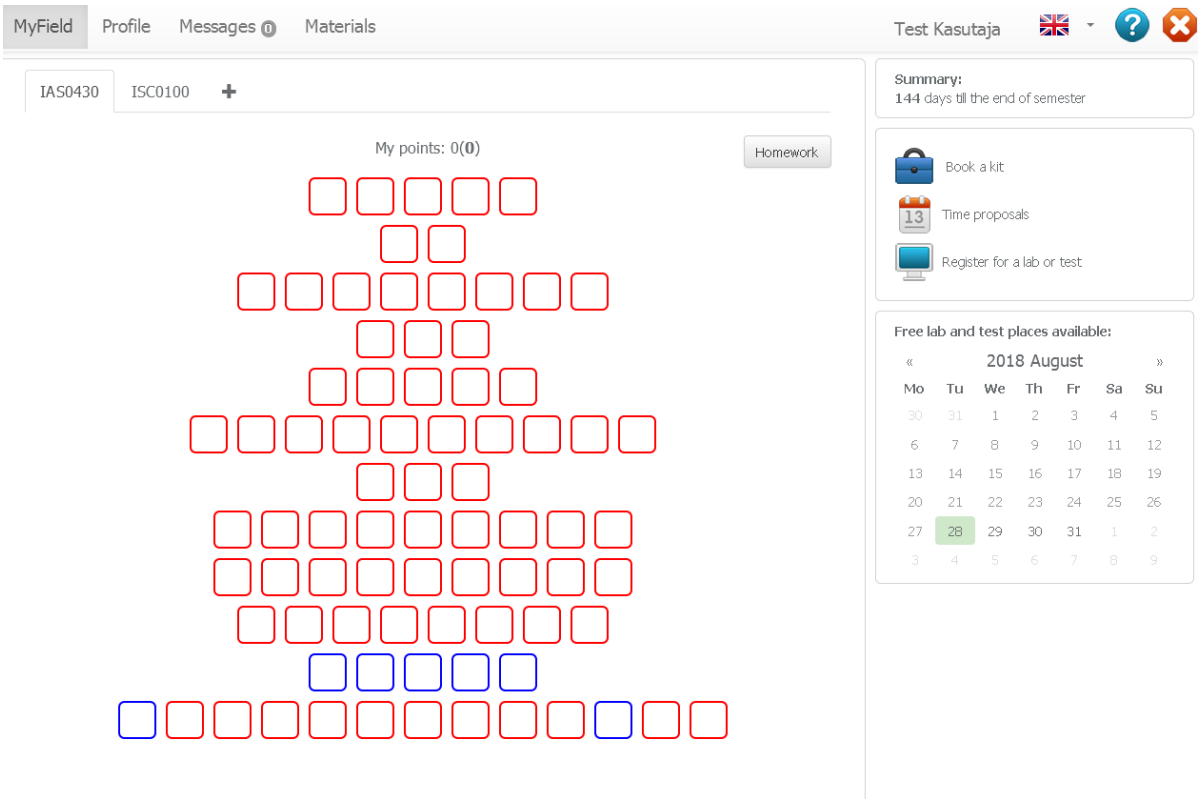
Adding new course



Adding new course



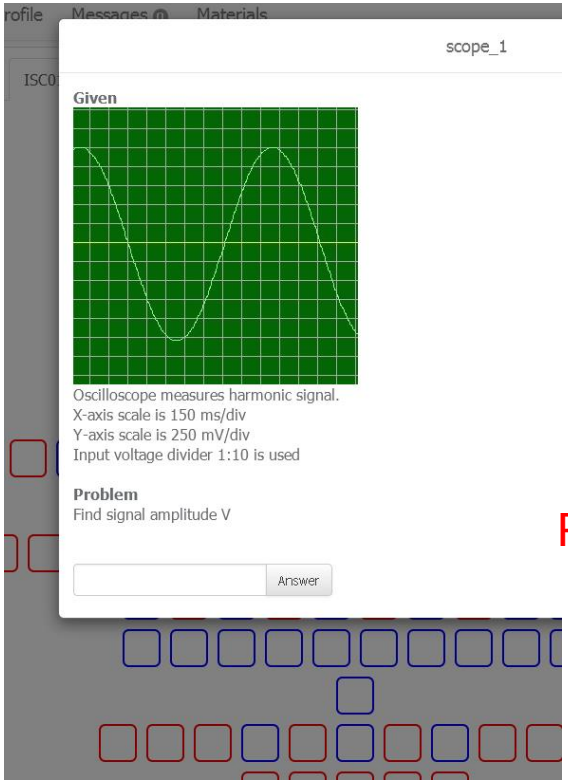
Done !



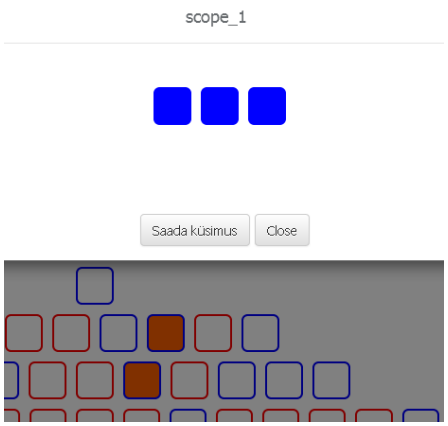
How to learn using this environment can be found here:
http://isc.ttu.ee/en/userGuide

Learning environment

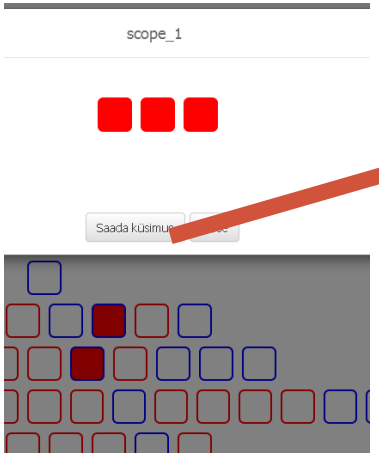
- Tasks



Result OK



Result NOT OK



Question to teacher about task.

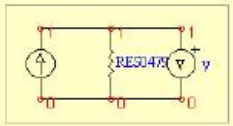
Learning Environment (labs)

Katse CS145

Pinge mõõtmine ja mõõteviga

Seadmed: vooluallikas, resistor RES0479, multimeeter DMM M830 ning multimeetri kasutusjuhend.

	Tulemus	Ühik
Mõõtepiirkond	20	V
Mõõta pinge V	4.2	V
Arvutada mõõteviga ±	48	mV



Pinget mõõdetakse **voltmeetriga**. Selleks ühendatakse voltmeeter ahelasse **rööbiti**. Valida tuleb optimaalne mõõtepiirkond ehk see, kus mõõteriista näit on suurim , kuid ei ületa skaala maksimumväärtust.
Tester näitab V klemmi pinget COM klemmi suhtes.

Result by components:

Lab tasks are included in Class Test !

HomeWorks

- 5 Low level (assembly) programming tasks.

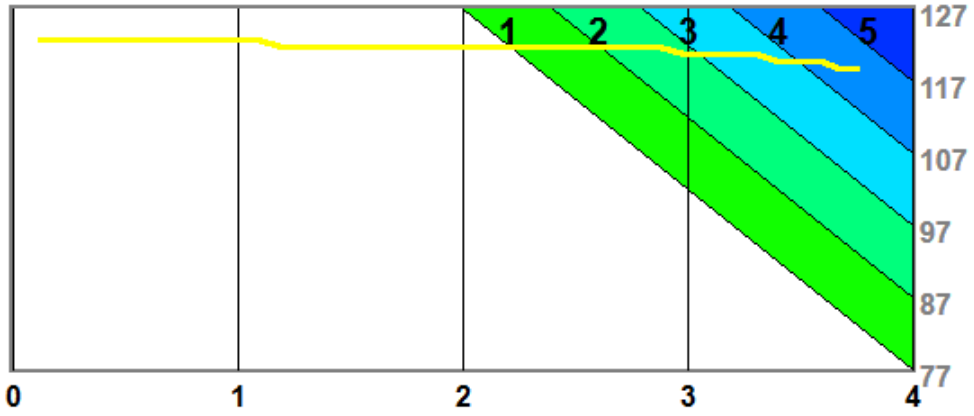
- It is possible to use Arduino board (or any prototyping board you have) to program in assembly language.

Class tests

- You work on your own and on lab until you have got the competences high (level over 77 of 127).
- If you have more than 1000 mCu, you can register for class test and come to lab to to class test.
- Same kind of exercises than before – you just have to do it in „controlled“ environment to prove you did it yourself
- All points have to be confirmed this way.
- Those points count towards your grade
- Class tests include lab tasks (not programming tasks) !

Grade taking

- You can take your grade whenever you want – when you have the points, take the grade and you are done. You do not have to wait till the end of semester



Lab times

- On-site labs will consist of you working with a labkit on laboratory. There is someone there to help you with all the questions you have

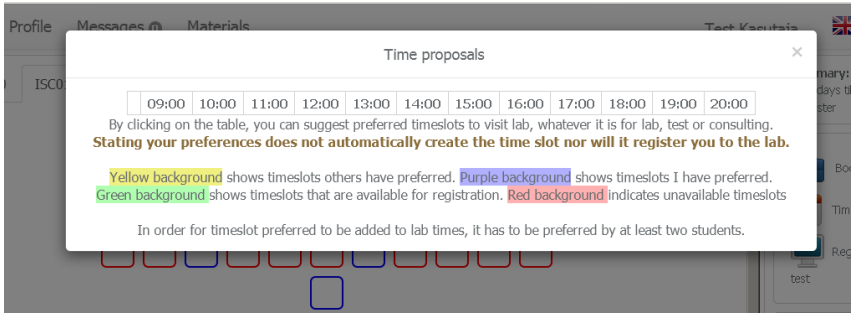
- You can start with few sessions on the lab and then do experiments home with borrowed HomeLabKit

Before you can borrow HomeLabKit, you have to go for a lab once

Labs

From next week .

You can use time proposial.



Hints

- Don’t wait with this course – start working now! There is forgetting model and you just won’t do it with 1 week at the end of semester
- You will see your process – use it, plan your time!
- If you have problems – come to lab, send email or use messaging system in the ISC !

About doctors …

- You need to study…years (think the number by yourshelf)
- The doctors are under rigid supervision
- If the doctor errs , what will happen?

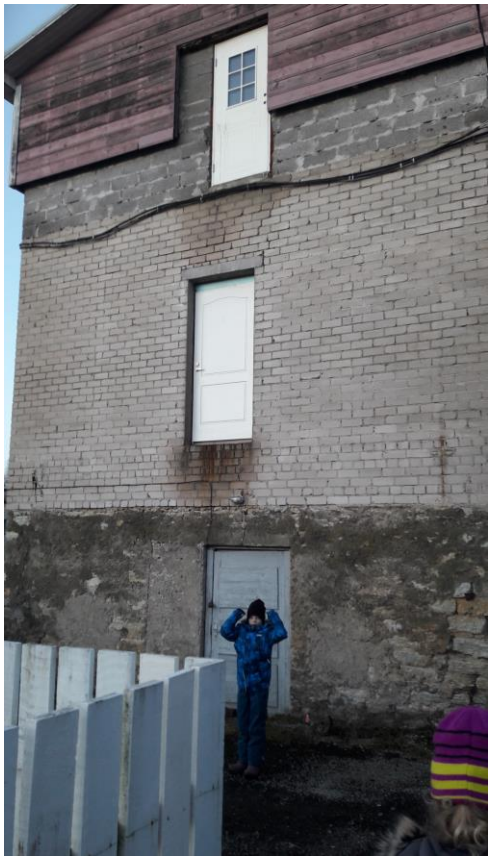
Image -lists10.com

Correct, but victim is usually one .

Result – Good days for yournalists, law court..etc.

About engineers…

- You need to study…years (think the number by yourshelf)
- The engineers are not under very rigid supervision
- If the engineer errs , what will happen?



About engineers…

You see, what will happen

Tens or hundreds of victims

Questions

- Who made a mistake?
- Whitch engineer made

a mistake ??

Photos: postimees.ee

- Who is guilty ?

- There are few justice solutions .

..But politicans take responsipility….

About politicans…

- You need to study…years to be a politican .
- Who is supervisior ?
- If the politican errs , what will happen?

Photos: postimees.ee

About politicans…

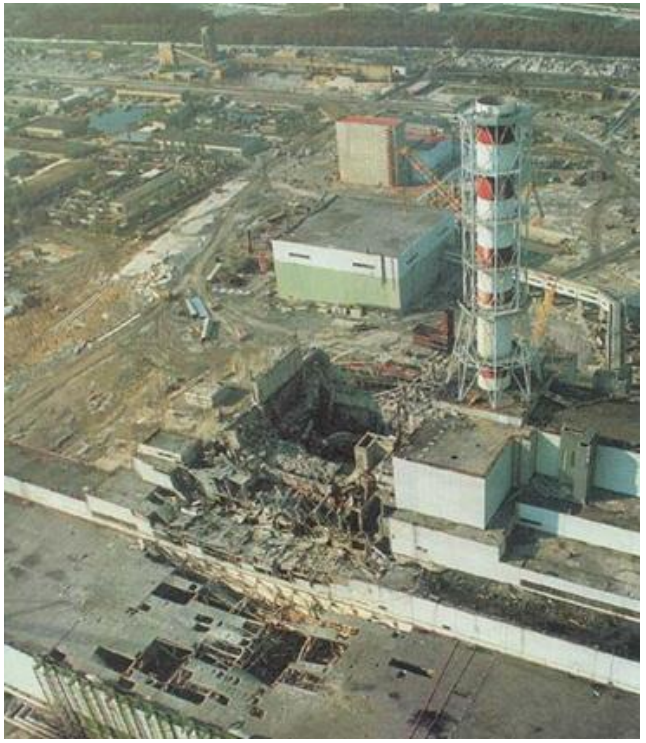
- Only one wrong word can destroy more people than may caused by collapsing any building.
- Who takes response ?

Image: delfi.ee

Why to study at university ?

- It is cheaper than in real life, much cheaper !
- If you err, you can try again .
- In real world there is no sutch possibility or it costs a lot of money.

The nuclear accident in Thernobol is good example.



Pilt : www.tuumaenergia.ee

From real life

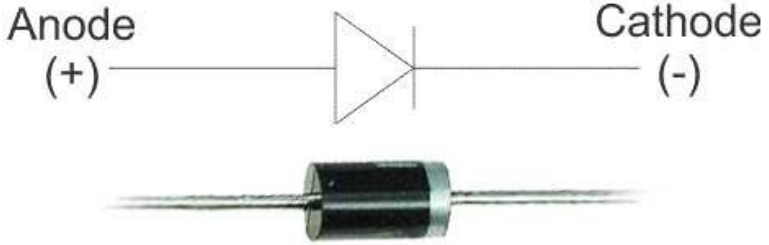
The technican of IT company is making routine check of enviromental parameters in office .All is fine. Computers are working, the ligts are glowing normally. In addittion to other parameters there is needed to measure the mains voltage. He connects the multimeter into mains outlet ant it shows 462 V.

What should he do next?

Answer : To buy new multimeter .

About history(1)

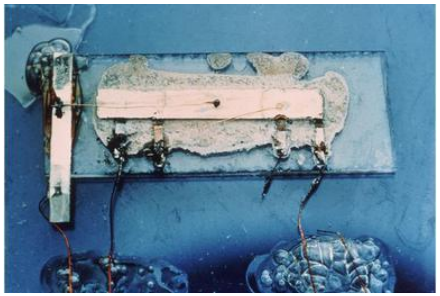
- The semiconductor diode (Crystal diode) comes from year 1874, when German scientist Ferdinand Braun discovered semiconductor effect in crystals.
- Singularity of diode – to make different resistance depending direction of charge flow.



Pilt- wikipedia (Crystal detector)

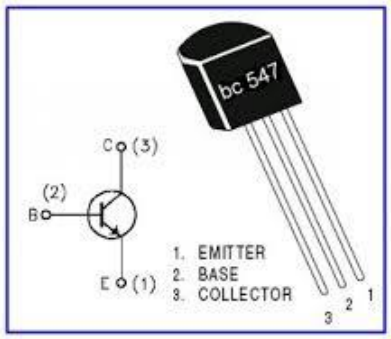
About history (2)

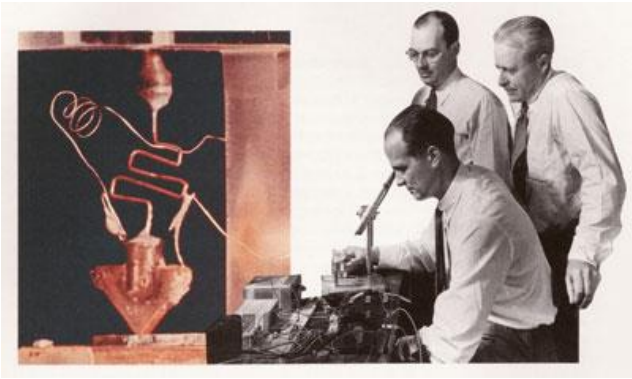
- The birth of tranistor is at 1947 , when John Bardeen, William Shockley and Walter Brattain were demonstrating bipolar transistor.
- Field effect transistor was patented at 1925 but it was only an idea.
- 1951 – was possible to buy transistors from store.
- 1953 – The first computer based on transistors.
- 1954 – The first silicon transistor.
- 1958 – The first integral circuit.



.....

- 2016 - 25 millions of transistors per 1 cm^2 .





Images- wikipedia (Transistor)

About history (3)

- 1939 - Electronic compurters using valves
- 1953 – The first computer based on transistors.
- 1958 – The first integral circuit.
- 1968 – term „microprocessor“ – custom integrated circuit
- 1971 – The first microcontroller

Microcontroller

- A microcontroller is an integrated circuit that is programmed to do a specific task.
- Microcontroller includes microprocessor+peripherals

- Microcontrollers are really just “mini-computers”.
- Widely used in embedded systems
- Internet of Things

By Seattle Municipal Archives - Flickr: General Motors exhibit at World's Fair, 1962, CC BY 2.0, https://commons.wikimedia.org/w/index.php?curid=22208719

Can contain the same microcontroller

(Personal)Computer vs (Micro)Controller

PC (phones , tablets...)

- Flexible configuration
- Standard I/O
- High level programming
- Software designer may not know hardware working principles
- Built in controllers (HDD, Display…)
- This is not embedded system !

MCU

- Usually inflexible
- Specific I/O
- Low level programming (C,ASM)
- Sofware designer must cooperate with hardware designer and familiar with electronics !
- Program code depends on conmnections !
- Usually are used in embedded systems !

Microprocessor vs Microcontroller

MPU system

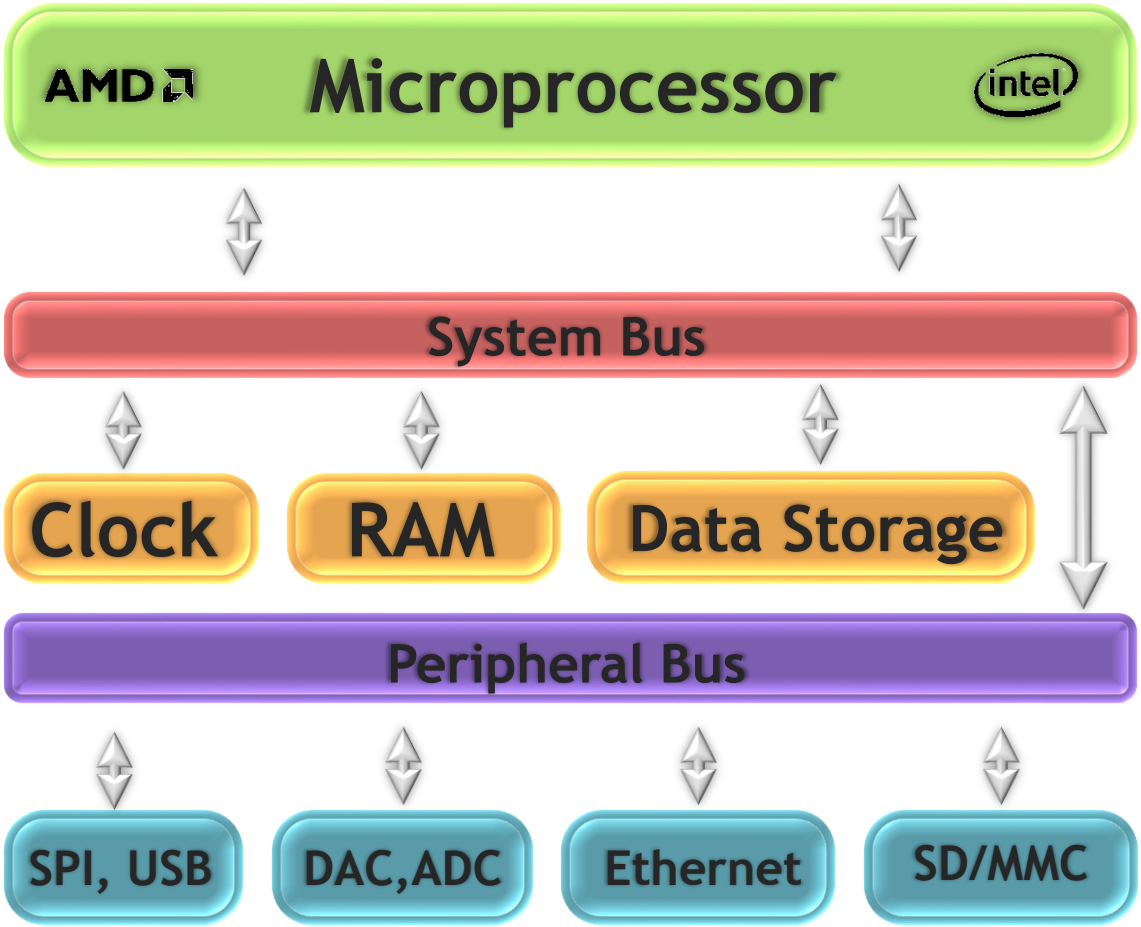
- General Computing
- (PC, tablets, phones)
- Very fast (as fast as possible) !
- Many external parts
- High Cost
- Can be part of embedded system

MCU system

- Appliances, specialized devices
- Relatively slow (as slow as possible – to minimize energy consumption)
- Few external parts
- Low cost
- Replacement for logic gates (if possible)

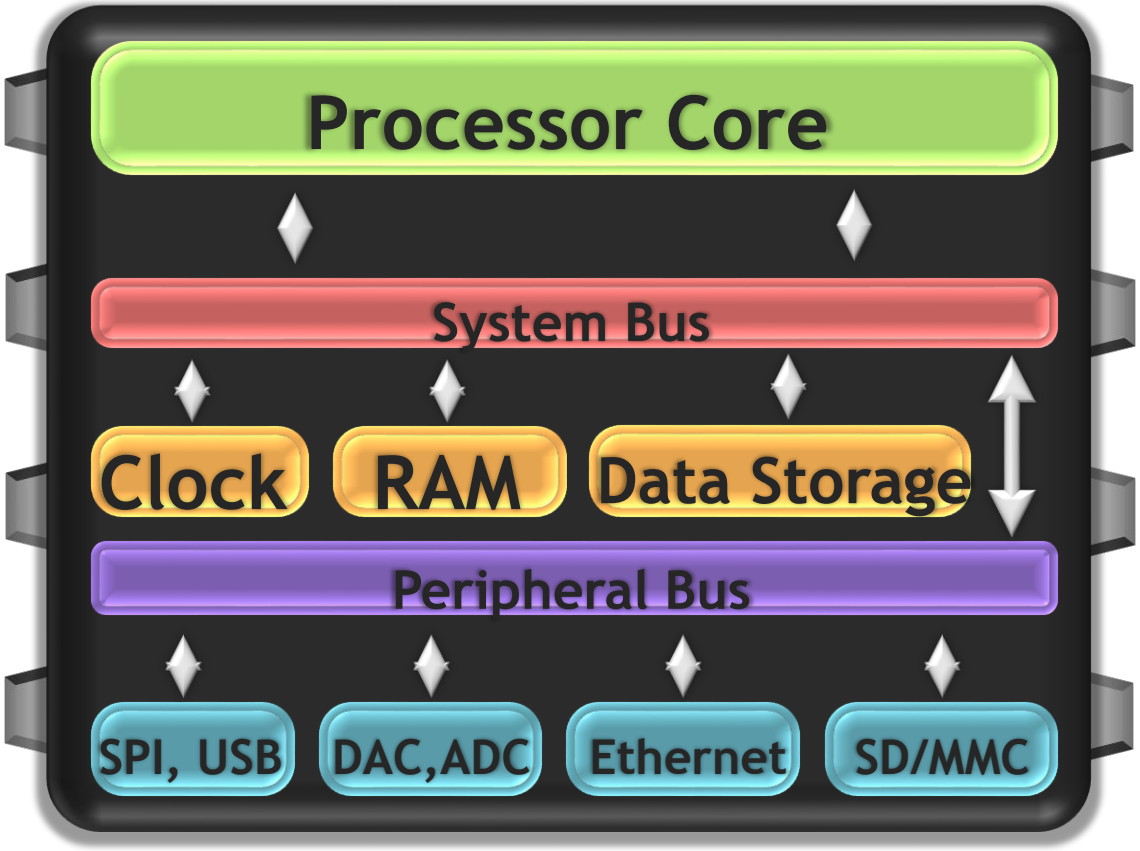
Microprocessor vs Microcontroller

- Microprocessor system



Microprocessor vs Microcontroller

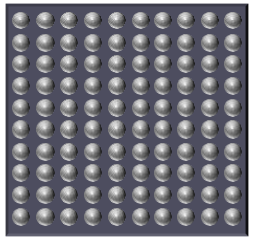
- Microcontroller includes the most of additional components needed by microprocessor.

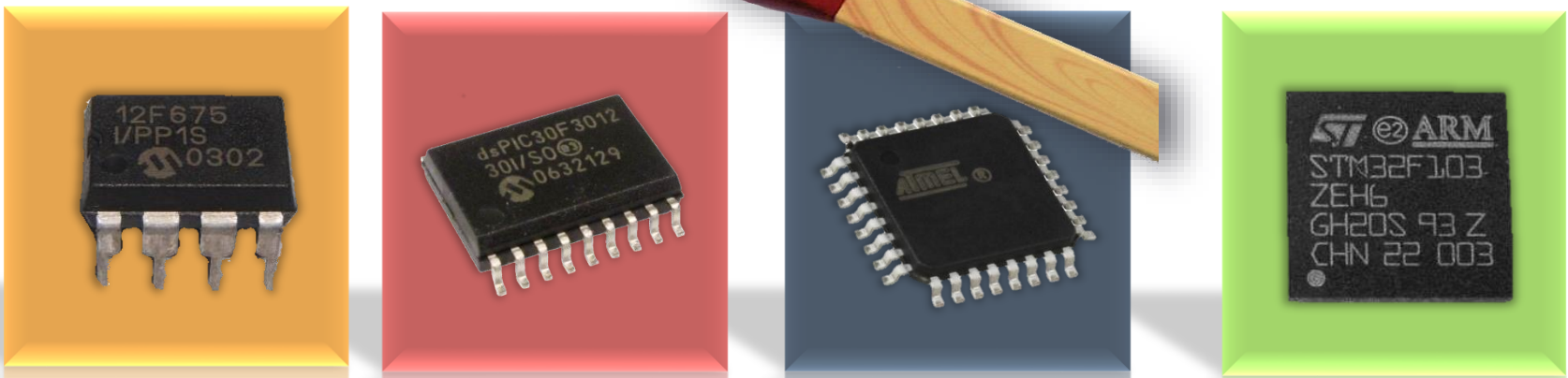


Microcontroller Programming

- Code is usually written for the microcontroller in an integrated development environment, a PC program.
- The code is written usually in a low level programming language. (e.g. C or Assembly).
- To write code you must be familiar with technical issues (external connection, at least basics knowledge in analog and digital electronics) !
- The IDE debugs the code for errors, and then compiles it into binary code which the microcontroller can execute.
- A programmer (a piece of hardware, not a person) is used to transfer the code from the PC to the microcontroller.

MCU and MPU packaging





DIP
(Dual Inline Package)
Through hole
8 pins
9mm x 6mm
0.15pins/mm^2

SOIC
(Small Outline IC)
Surface Mount
18 pins
11mm x 7mm
0.23pins/mm^2

QFP
(Quad Flat Package)
Surface Mount
32 pins
7mm x 7mm
0.65pins/mm^2

BGA
(Ball Grid Array)
Surface Mount
100 pins
6mm x 6mm
2.78pins/mm^2

From real life (2)