FIT 1047

Introduction to computer systems, networks and security

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MONASH University

What is a computer?

In the 19th and first half of the 20th century a computer was a person doing mathematical calculations.

Towards the middle of the 20th century, automated electronic computers were developed!

Concepts go back to people like Robert Recorde (1512-1558), Gottfried Wilhelm Leibnitz (1646-1716), Ada Lovelace (1815-1852) or Charles Babbage (1791-1871).

Human computers in the NACA High Speed Flight Station Computer Room, at the Dryden Flight Research Center Facilities. (Wikimedia Commons)

History

CSIRAC - One of the first electronic automated computers

On Display at Museum Victoria, Melbourne

https://museumsvictoria.com.au/csirac/

Generations of automated computers

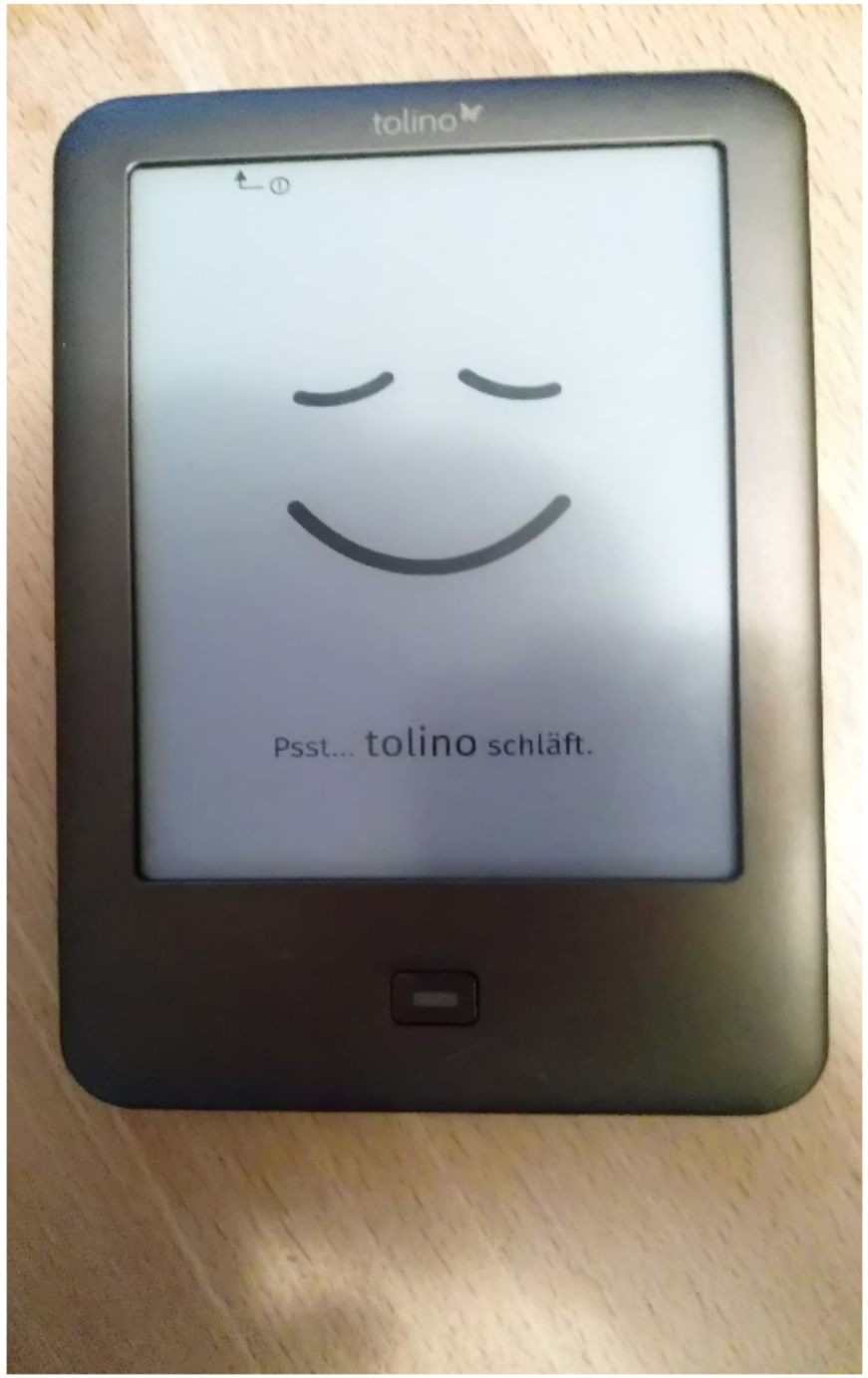
- First generation: Vacuum Tube Computers (1945 - 1953)
- Second generation: Transistorized Computers (1954 - 1965)
- Third generation: Integrated Circuit Computers (1965-1980)
- Fourth generation: VLSI Computers (1980 - now)
- Fifth generation: Quantum computers (???)

VLSI = very-large-scale integrated

Some examples of current computers


DELL


CHARGE
vtech
VTECH 2
vtech


tolino
Psst... tolino schläft.


SONY
SELECT
START


Serie | 4
rpm
Ready in
Speed Perfect
Rinse Plus
Start Reload
aquasecure
7 kg
Super 15'/30'
Off
Cottons
Allergy Plus
Kidswear
Jeans/Dark Wash
Delicate/Silk
Wool
Rinse/Freshen up
Spin/Drain
cold
40°
40° + Prewash
60° Eco
30'
Easy-Care
Mix
90°
Drum clean


505M
METRO
505M

...before we really start, some organizational stuff...

About us

- Carsten Rudolph Associate Professor (Clayton)
    - Own research: Cyber security, network security, formal methods, security protocols, trusted computing
- Guido Tack Senior Lecturer (Caulfield)
    - Own research: combinatorial optimisation (e.g. scheduling, vehicle routing, etc.)
- But: Both of us have long practical experience
- Plus 7 experienced Tutors

Contact

- Moodle forum
- carsten.rudolph@monash.edu
- guido.tack@monash.edu
- Consultation times (TBA)

We try to reply on Moodle forum message within 24h and to e-mail within 48h.

Important:

Only use your Monash email address!

Don't post answers to assignments in forums!

http://moodle.vle.monash.edu/

- Lecture slides, textbook, lab notes, software downloads
- Assignments
- Discussion forums
- Additional material
- Unit guide

Textbook

- There is some recommended literature in the unit guide for FIT1047.
- This literature is not mandatory and should not be considered a textbook for this unit.
- The main resource is the Electronic Textbook in Alexandria (accessible through Moodle)

Laboratories

- Labs start today
- Mix of new content, revision of lecture material, exercises and hands-on tasks
- Labs are a great resource! - Your tutors will help you to improve your understanding of the topics - Working in small groups during the tutorial, you can help each other
- Please only attend the allocated labs

You shall attend the labs!
There is a strong relation between lab attendance and success in FIT1047

Assessment

Assessment

5% Moodle Quizzes; one quiz per week, need to be completed before Tuesday lecture starts (first quiz in week 2)

45% Assignments (07 September 2018 and 12 October 2017)

50% Exam (date TBD)

Requirements to pass

Hurdles:

- 40% or more in exam
- 40% or more in total non-examination assessment
- Overall you need 50% to pass

If you fail a hurdle, you fail the unit!

Moodle Quizzes

- Questions on previous week and pre-class material
- You can look at the questions multiple times, but answers cannot be changed after you have submitted
- Quizzes clos Wednesday 1pm
- Starts in week 2

Assignments

- individual work (no group work allowed)
- each worth 22.5% of final mark
- you need 40% (combined) of assignment marks plus Moodle quizzes to pass the hurdle
- due 20 April 2017 and 18 May 2017
- more details in a few weeks

Final exam

- 2 hours
- closed book (just use your brain) 550% of total unit marks
- you need 40% of exam marks to pass the hurdle

Note: Just passing the hurdles means 40% overall. This is not sufficient to pass the unit. You need 50% overall!

Academic integrity

- Don't cheat! (It is unfair to your fellow students, to your lecturer, to your tutors)
- Read the policy on cheating (see Moodle)
- Cheating is taken very seriously by Monash

Examples for cheating

- copy and paste answers to assignments
- work together on individual tasks
- use external material in a closed book exam
- login with someone else's username for Moodle Quizzes
- let someone else write your assignment

How to succeed in FIT1047

Attendance - Come to lectures and tutorials

Participation - Actively take part

Be Prepared - Work through pre-class material and look at lab sheet before labs.

Interest - Be interested, find additional material, think ahead

Questions - Ask your lecturers and tutors, ask your fellow students

Time - You should plan 12 hours per week

How to succeed in FIT1047

Seek help

In any case of problems (technical, health, others) there will be help available. Help desks, counselling, medical services, consultation hours, etc.

Don't wait until it is too late!

How to succeed in FIT1047

Start in week 1!

Let's look at a common, everyday activity as an example: you pick up your smart phone....

Let's start to talk about computers

...there are literally thousands of different types of computers ...

...but, the large majority of them are based on the same internal concepts:

1. Information can be expressed by high/low current/voltage (0 and 1) (digital)
2. Electronic circuits can be used to calculate with 0s and 1s (transistors)

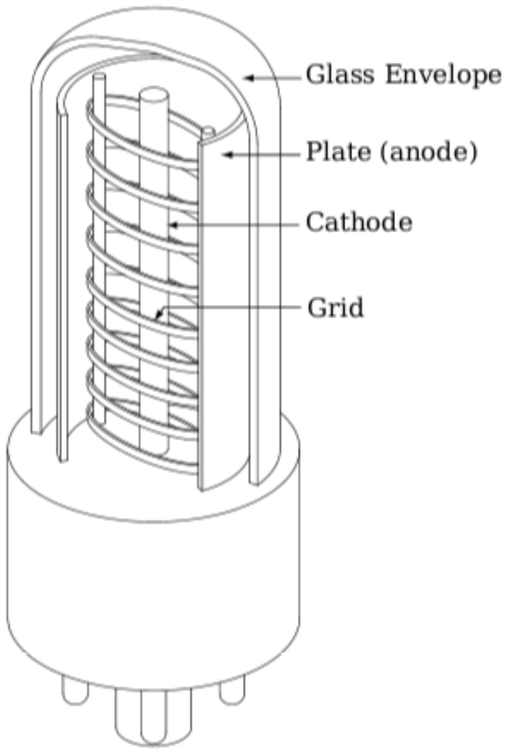
Note: Analogue computers or quantum computers will be largely ignored in this unit.

The vacuum tube

Different types of vacuum tubes

(Wikimedia Commons)

The vacuum tube (triode)



(Wikimedia Commons)

A triode can be used as amplifier or switch:

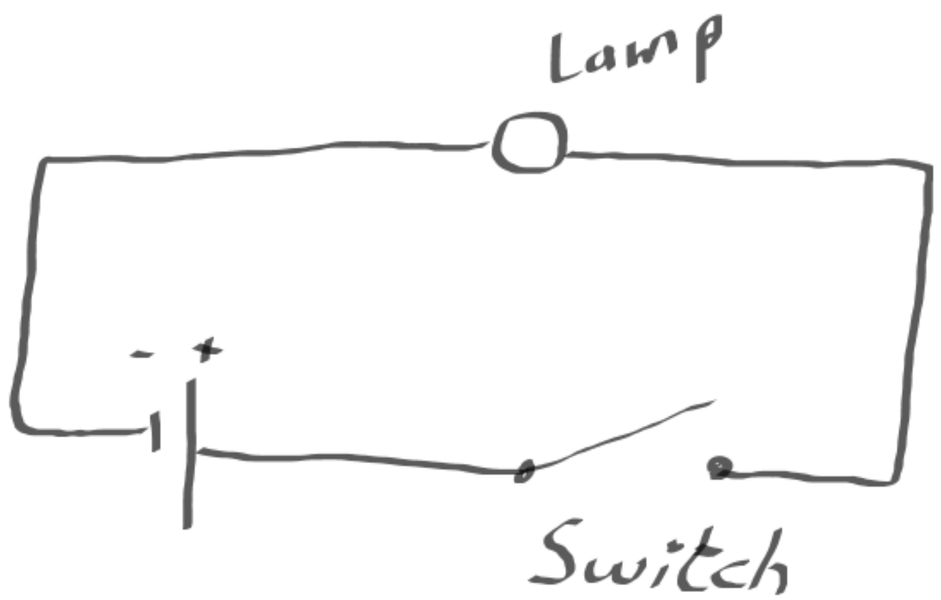
- Very small changes to the control Grid cause much larger changes in the electron flow between Anode and Cathode. A weak signal on the Grid is amplified. (Example: guitar amplifier)
- A large negative charge on the Grid stops the electron flow between Anode and Cathode. Used for computation.

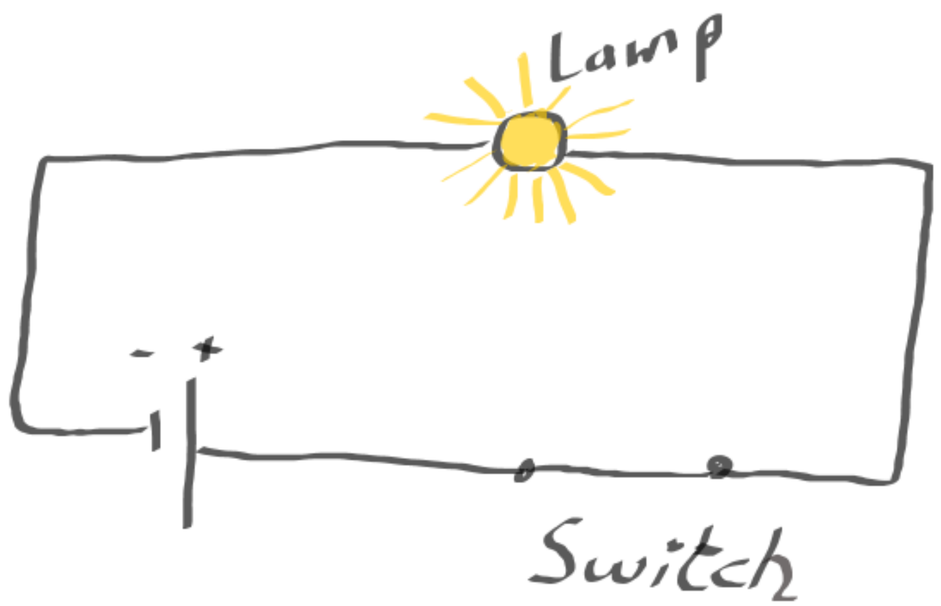
Problems: Large, generates a lot of heat, not dependable (tubes burn out)

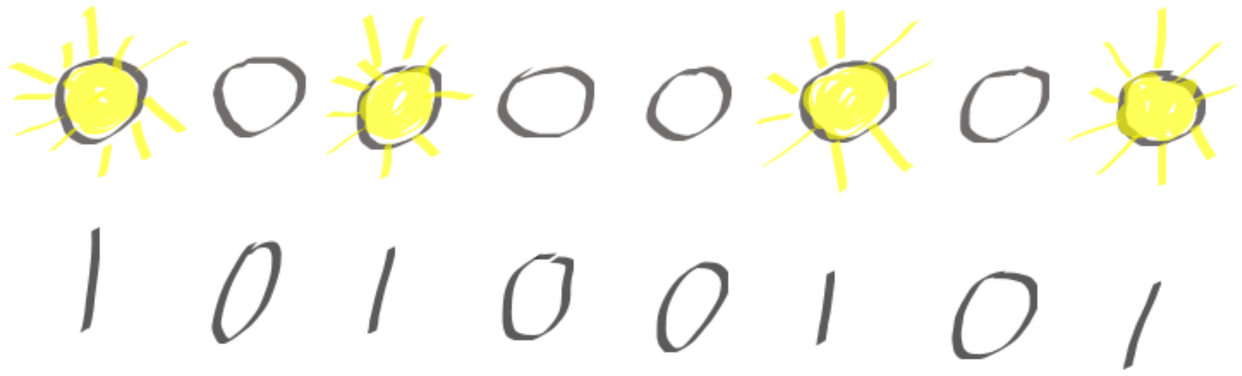
The transistor

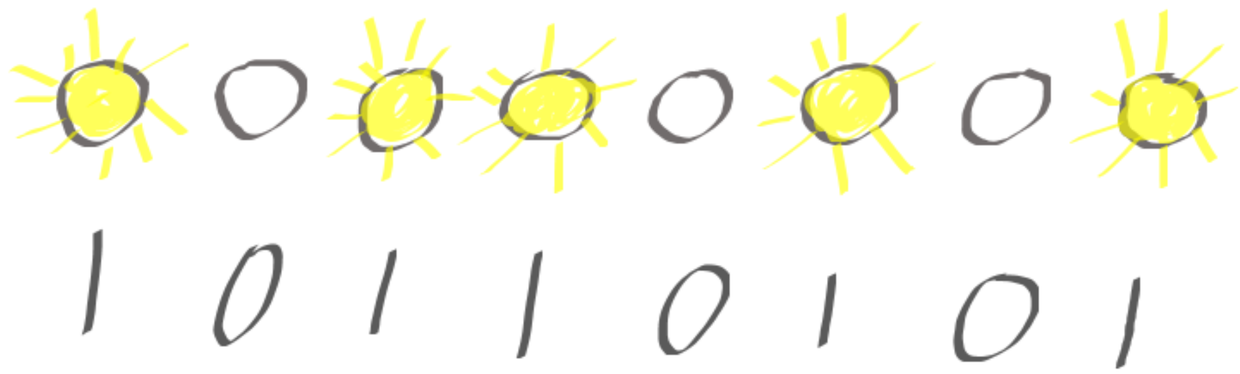
Short for trans-resistance. In principle, a transistor is a solid-state version of the triode.

The solid medium is usually silicon or germanium. Both are semiconductors, which means, that they don't conduct electricity particularly well.


Lamp
Switch

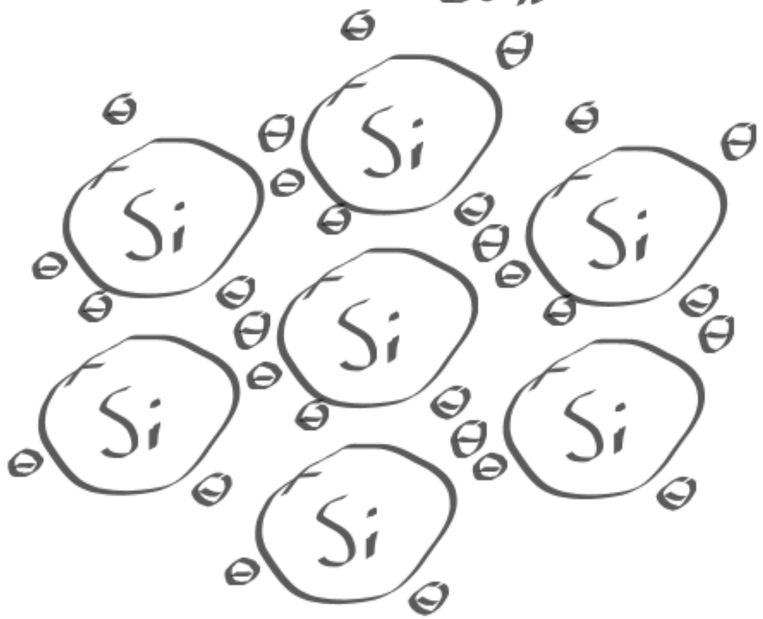

Lamp
-
+
Switch


1 0 1 0 0 1 0 1


1 0 1 1 0 1 0 1

Si - Silicon

Si - Silicon



Si - Silicon

P - Phosphor

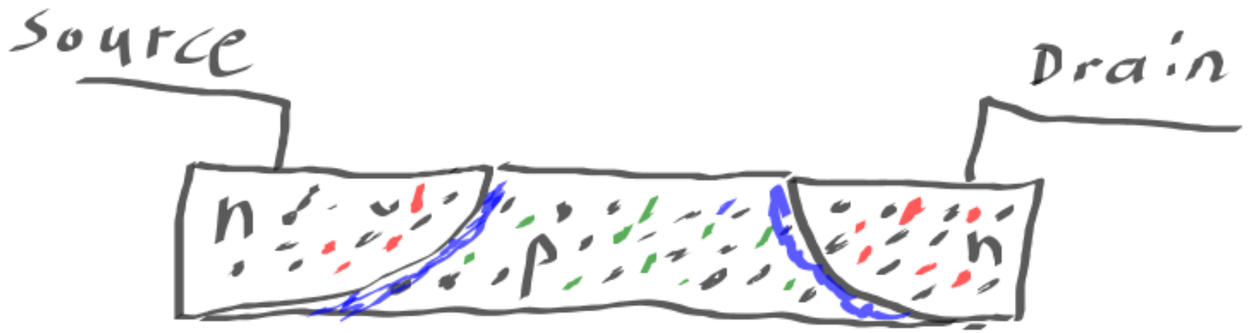
n-type doping

Si - Silicon

B - Boron

p-type doping


Source
Drain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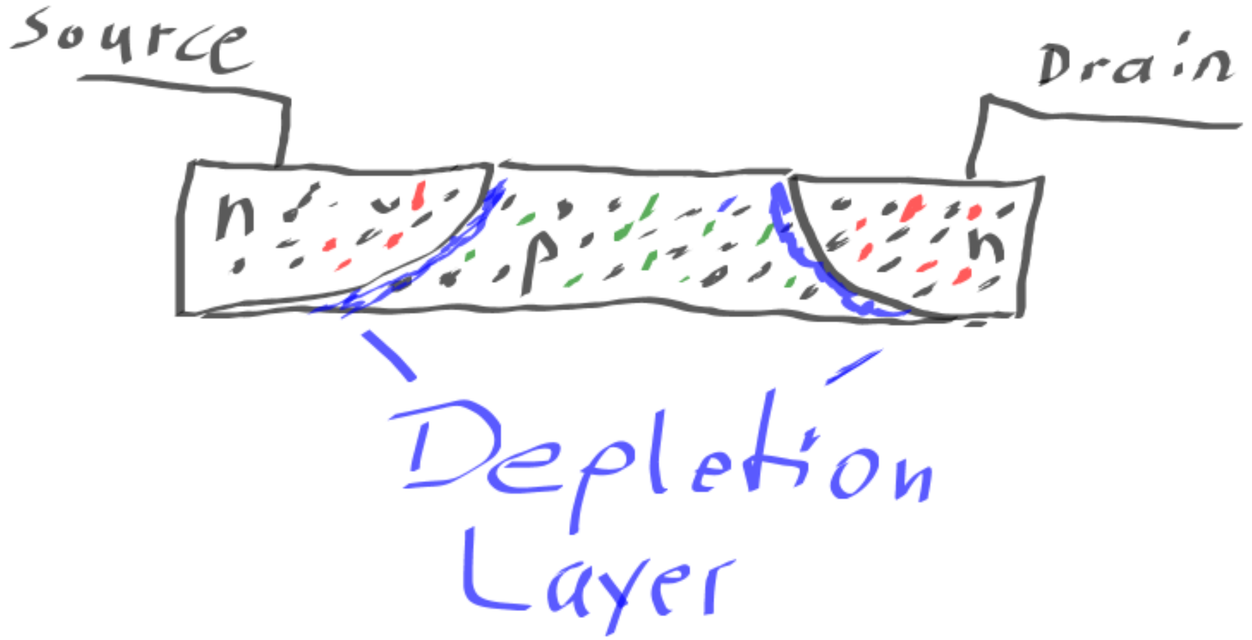
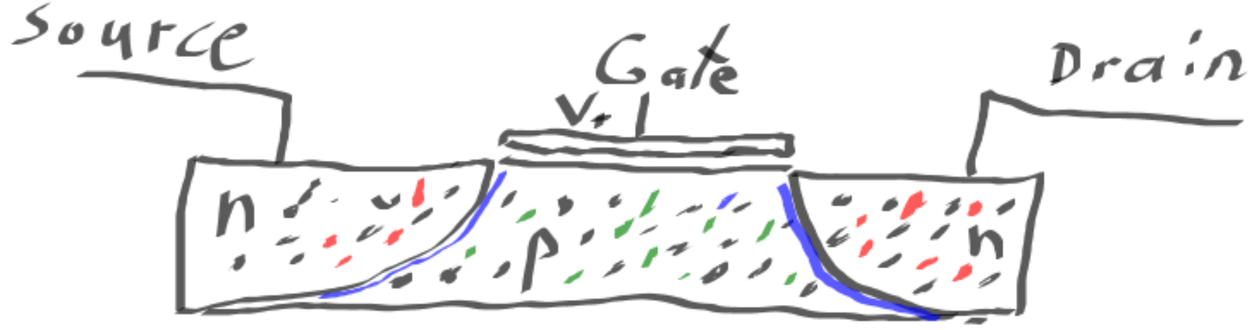

Source
Drain
n
p
n
Depletion
Layer


Source
Gate
Drain

Evolution

	Year	Number of transistors	Area used
CSIRAC	1949	2000 (tubes)	40 m^2
Intel 4004	1971	2300	12 mm^2
Intel 80286	1982	134000	49 mm^2
Intel Core i7	2011	2,270,000,000	434 mm^2

Computers only distinguish 0 an 1.

Is 0 and 1 sufficient to express data and to compute all different algorithms?

1. Data representation
2. Boolean algebra

A closer look at data

Smallest unit: bit

One binary digit (bit) is just on and off (or low and high) in a circuit or memory.
Thus, one bit can be used to express 0 and 1.

Convention: 8 bits are one byte

Introduced by IBM in 1964 as the basic unit of addressable computer storage.

Words

Data is stored, shifted around and computed in a particular data size, called a word. Words are often multiples of eight, 16 bits, 32 bits or 64 bits.

Processors, memory and buses within a computer should be able to efficiently store and transfer complete words for this architecture.

Numbering systems

Numbering systems can be distinguished by their base.

We are used to base 10.

Example:

$$2396 = 2\times10^3 + 3\times10^2 + 9\times10^1 + 6\times10^0$$

Computers use base 2.

$$2396_{10} = 100101011100_2 = 1x2^{11} + 0x2^{10} + 0x2^9 + 1x2^8 + 0x2^7 + 1x2^6 + 0x2^5 + 1x2^4 + 1x2^3 + 1x2^2 + 0x2^1 + 0x2^0$$

How to read binary

1	1	0	1	1	1	0	1

How to read binary

1	1	0	1	1	1	0	1
128	64	32	16	8	4	2	1
2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0

How to read binary

1	1	0	1	1	1	0	1
128	64	32	16	8	4	2	1
128	64	0	16	8	4	0	1

Adds up to 1+4+8+16+64+128 = 221

Another important base is 16

Hexadecimal numbers can be very easily converted to binary numbers and vice versa.

Four bits in a binary number are directly converted into the matching hex number.

Example for binary to hexadecimal

Convert 2396 = 100101011100 to hexadecimal

Binary	1001	0101	1100
Hex	9	5	C

Thus: $2396_{10} = 95C_{16}$

Important numbers

Decimal	Binary	Hex
0	0000	0
1	0001	1
2	0010	2
3	0011	3
4	0100	4
5	0101	5
6	0110	6
7	0111	7
8	1000	8
9	1001	9
10	1010	A
11	1011	B
12	1100	C
13	1101	D
14	1110	E
15	1111	F

Summary

- History
- Core elements are transistors (previously vacuum tubes)
- Most computers use a similar architecture
- Basis for all computations and storage is 0 and 1
- Different numbering systems are used
- Base 10, base 2, base 16

Tutorials start today

The tutorial will repeat some topics and introduce methods for conversion between numbering systems.