# Embedded programming on STM32
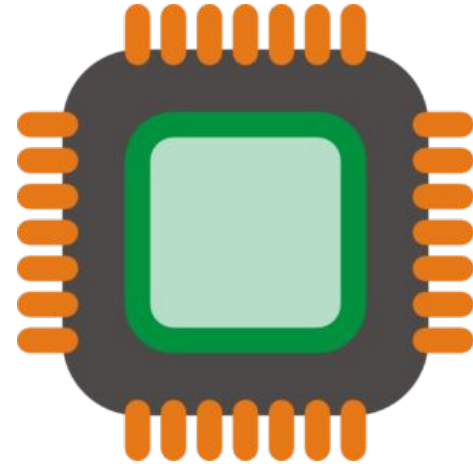
*Main goals. Distinctive aspects of embedded programming*
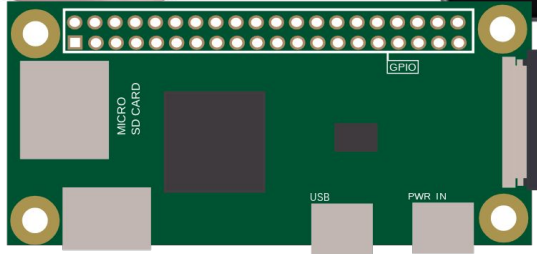
MIPT, 2019

# The goal of the course

- Understand the difference between PC programming and embedded programming
- Gain knowledge about widespread ARM core
- Become familiar with the main toolset
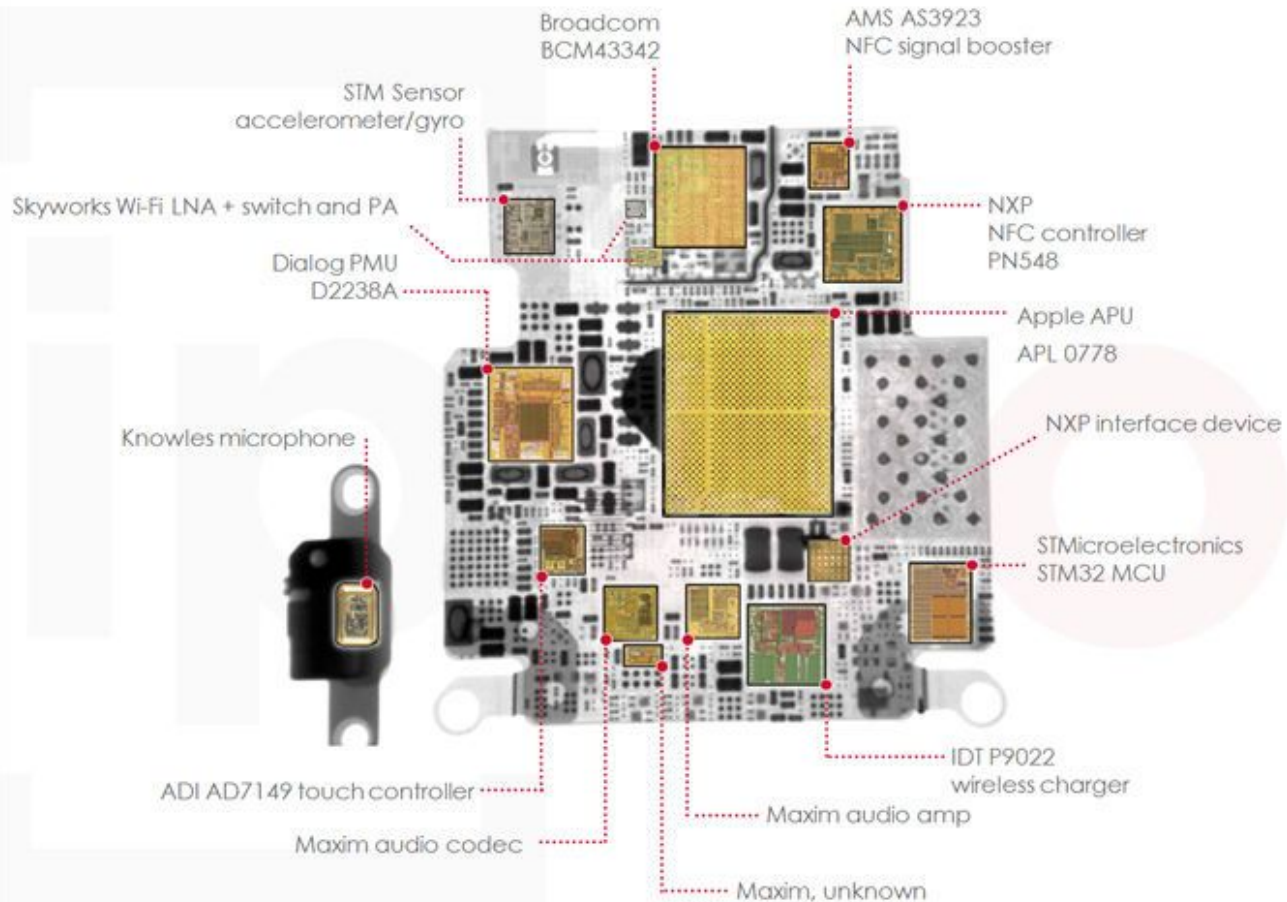- To spill the beans of non-Arduino world
- Etc etc

# The main aspects of embedded systems

- Low power consumption
- Small size
- Low per-unit cost
- Harsh working conditions
- Using of ARM-based microcontrollers

# Microcontrollers are everywhere

Broadcom
BCM43342

AMS AS3923
NFC signal booster

STM Sensor
accelerometer/gyro

Skyworks Wi-Fi LNA + switch and PA

NXP
NFC controller
PN548

Dialog PMU
D2238A

Apple APU
APL 0778

Knowles microphone

NXP interface device

STMicroelectronics
STM32 MCU

ADI AD7149 touch controller

IDT P9022
wireless charger

Maxim audio codec

Maxim audio amp

Maxim, unknown

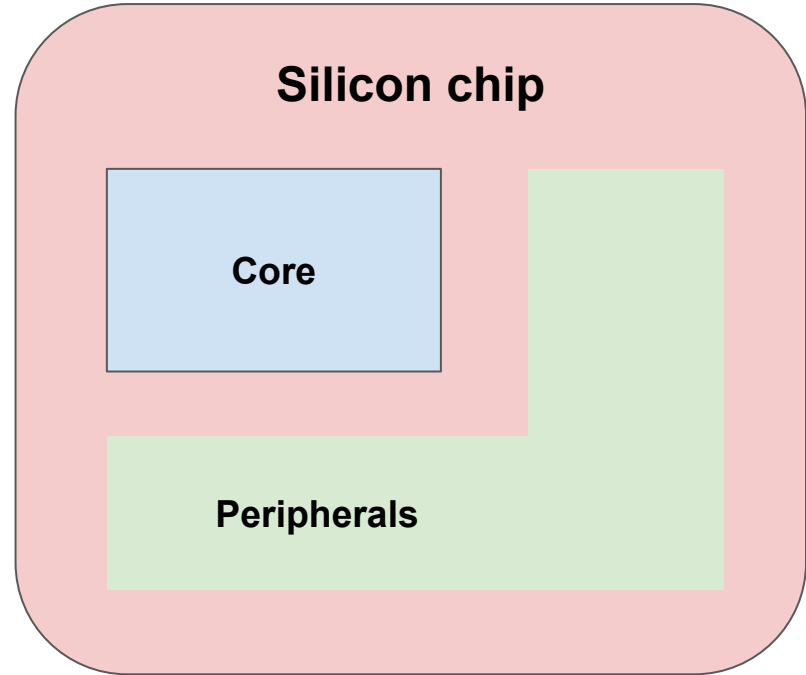chipworks

# Applications

- <u>Household appliances</u>: microwave ovens, washing machines, dishwashers etc
- <u>Home automation</u>: climate control, light control, smart houses, security, surveillance etc
- <u>Avionics</u>: inertial guidance systems and GPS receivers
- <u>Medical equipment</u>: vital signs monitoring, various medical imaging (PET, SPECT, CT, and MRI) for non-invasive internal inspections
- <u>Internet Of Things</u>

*And more and more!*

arm

NXP

ALLWINER

BROADCOM

ST

SAMSUNG

QUALCOMM

Apple

MICROCHIP

TEXAS
INSTRUMENTS
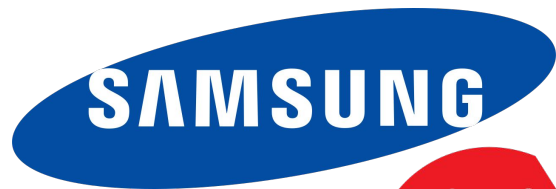
The concept of System On a Chip (SoC)

# Taxonomy of ARM MCUs

| Cortex-M | Cortex-R | Cortex-A |
|---|---|---|
| Lowest Power, Lower Cost | Real-Time Processing | Highest Performance |

**STM32**

High-performance

STM32 F2
398 CoreMark
120 MHz
150 DMIPS

STM32 F4
608 CoreMark
180 MHz
225 DMIPS

STM32 F7
1 082 CoreMark
216 MHz
462 DMIPS

Mainstream

STM32 F0
106 CoreMark
48 MHz
38 DMIPS

STM32 F1
177 CoreMark
72 MHz
61 DMIPS

STM32 F3
245 CoreMark*
72 MHz
90 DMIPS*

Ultra-low-power

STM32 L0
75 CoreMark
32 MHz
26 DMIPS

STM32 L1
93 CoreMark
32 MHz
33 DMIPS

STM32 L4
273 CoreMark
80 MHz
100 DMIPS

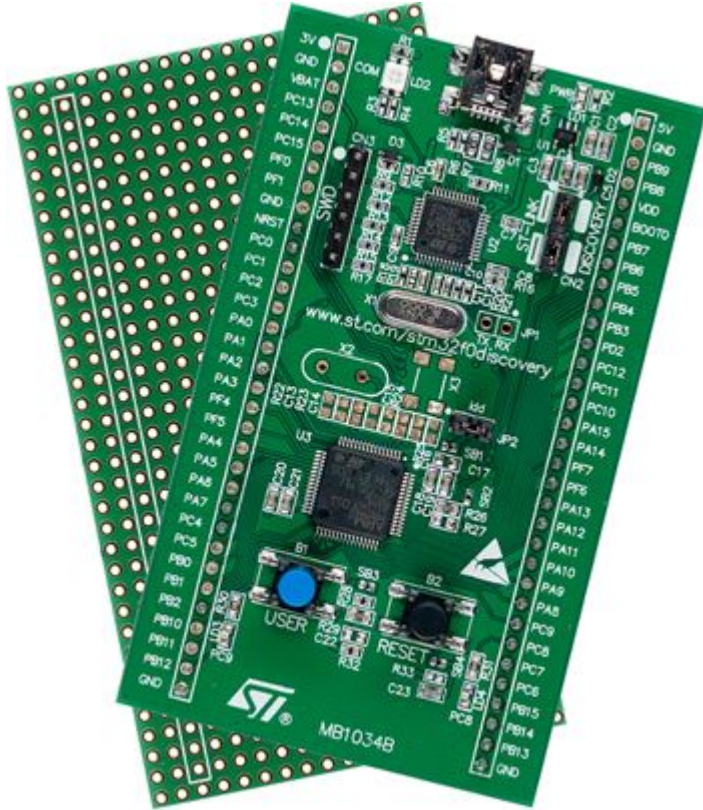Cortex-M0 / -M0+          Cortex-M3          Cortex-M4          Cortex-M7

# STM32F0DISCOVERY

- 64 KB Flash memory, 8 KB RAM
- On-board ST-LINK/V2
- Four LEDs
- Two push buttons