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COM304 Foundation Computing Architecture

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Basic Principles

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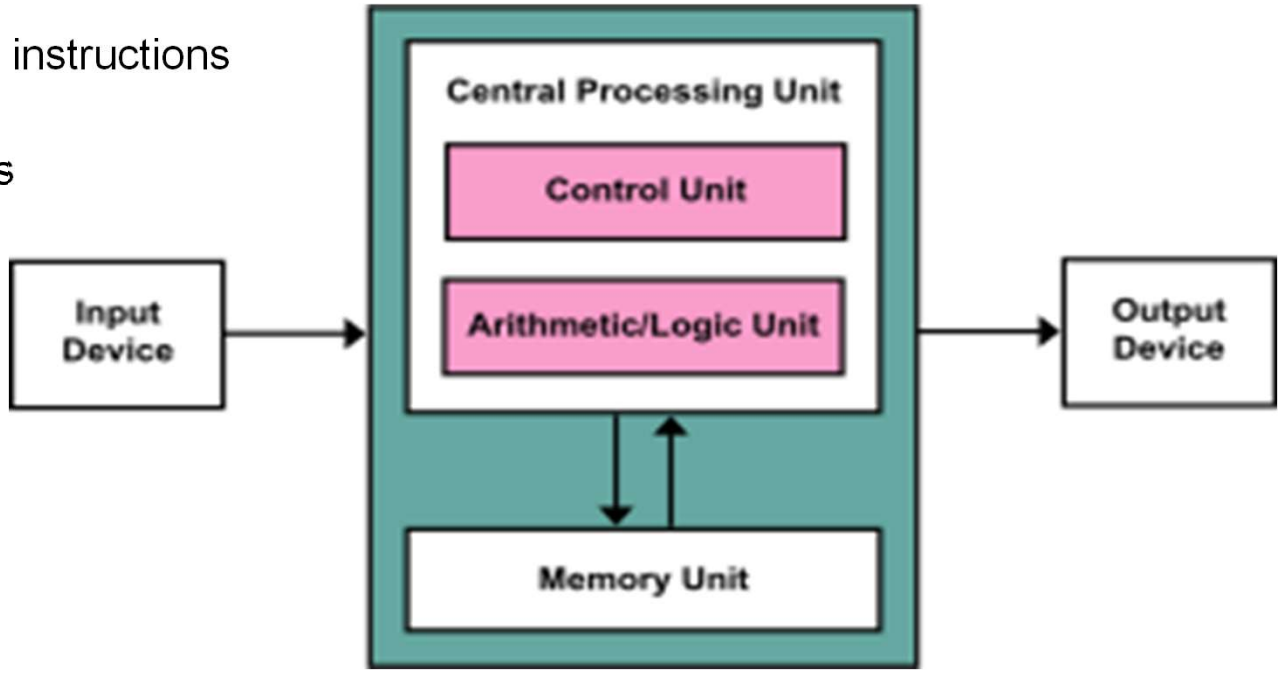
- **Turing machine**
  - Programable – Turing complete – you can create or simulate any a Turing machine with a Turing machine

- **Classic Von-Neumman Architecture**
  - A processing unit with both an arithmetic logic unit and processor registers
  - A control unit that includes an instruction register and a program counter
  - Memory that stores data and instructions
  - External mass storage
  - Input and output mechanisms



Typical Von Numann Organisation

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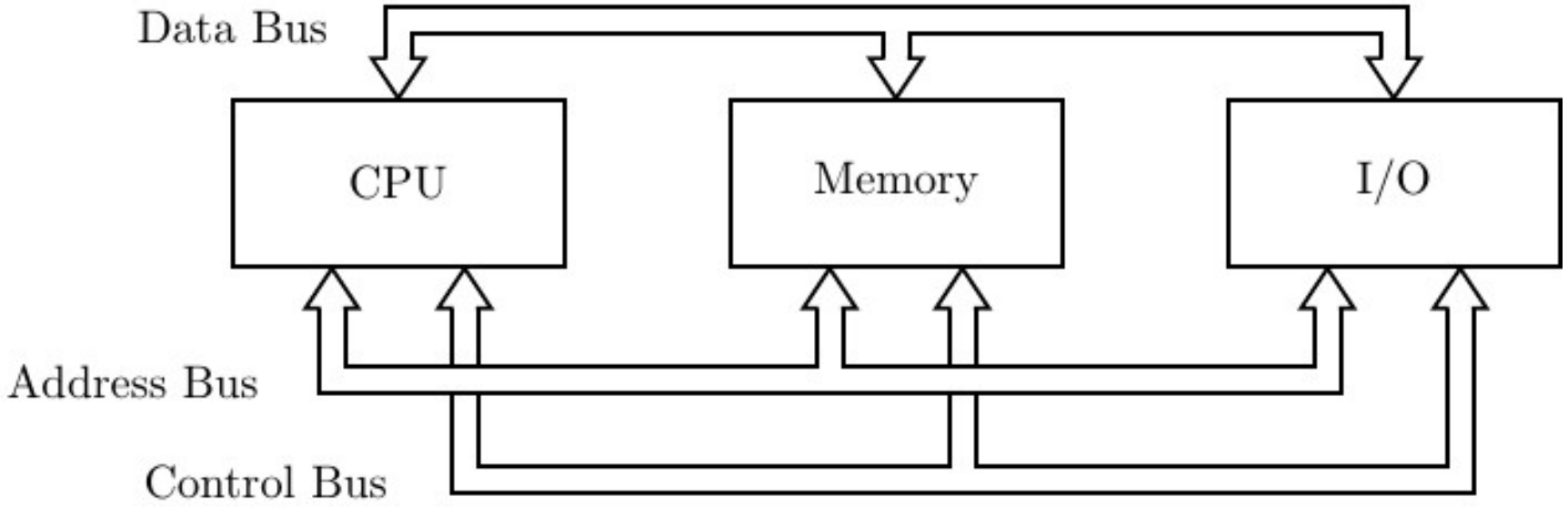

https://bob.cs.sonoma.edu/IntroCompOrg-x64/bookch1.html#x7-170001.2

Types of memory

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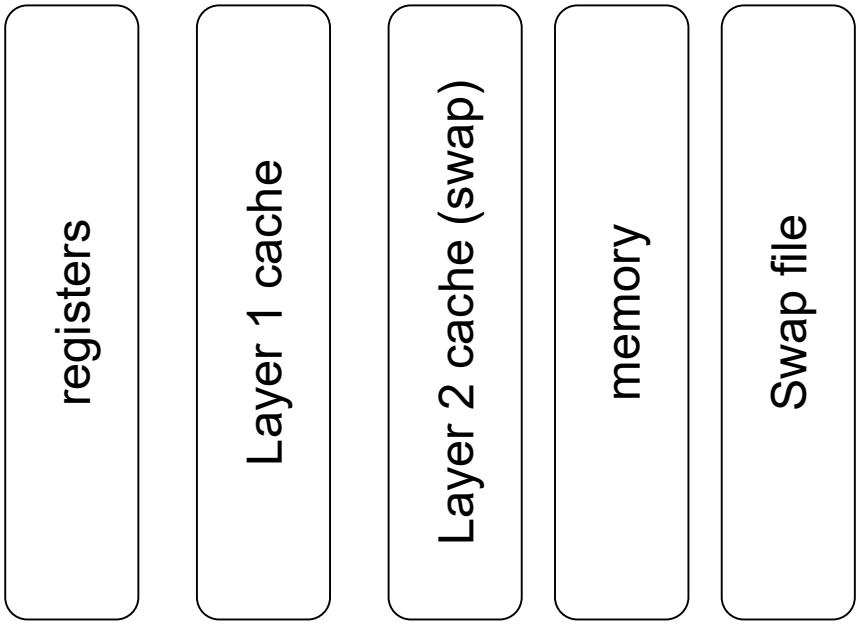
- **ON CPU**
  - Registers
  - Arithmetic logic unit
  - Layer 1 cache
  - Layer 2 cache
  - Memory Management unit
  - Comparing or processing memory in registers is very fast
  - Hitting caches may be a lot slower
- **Off CPU**
  - SRAM / DRAM
  - Disk – HDD / SSD
  - Removable
    - Floppy / SD card / Tape
  - Virtual Memory
    - Virtual memory maps memory pages in in caches to real memory on disk



X86 vs ARM Architecure

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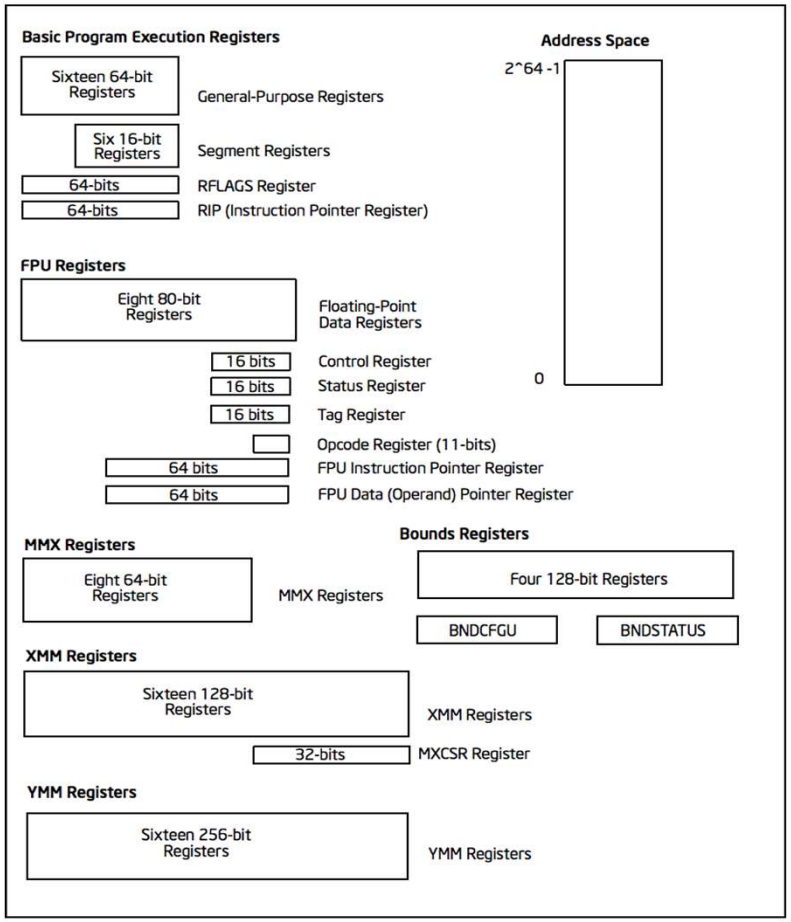
- **CPU types**
  - RISC – reduced Instruction Set Computer – EG ARM in Raspberry PI
  - CISC – Complex Instruction Set Computer – eg X86 Intel processors in PCs

#	Alias	Purpose
R0	-	General purpose
R1	-	General purpose
R2	-	General purpose
R3	-	General purpose
R4	-	General purpose
R5	-	General purpose
R6	-	General purpose
R7	-	Holds Syscall Number
R8	-	General purpose
R9	-	General purpose
R10	-	General purpose
R11	FP	Frame Pointer
Special Purpose Registers		
R12	IP	Intra Procedural Call
R13	SP	Stack Pointer
R14	LR	Link Register
R15	PC	Program Counter
CPSR	-	Current Program Status Register

https://azeria-labs.com/arm-data-types-and-registers-part-2/



https://cs.lmu.edu/~ray/notes/x86overview/

ARM Chip Layout

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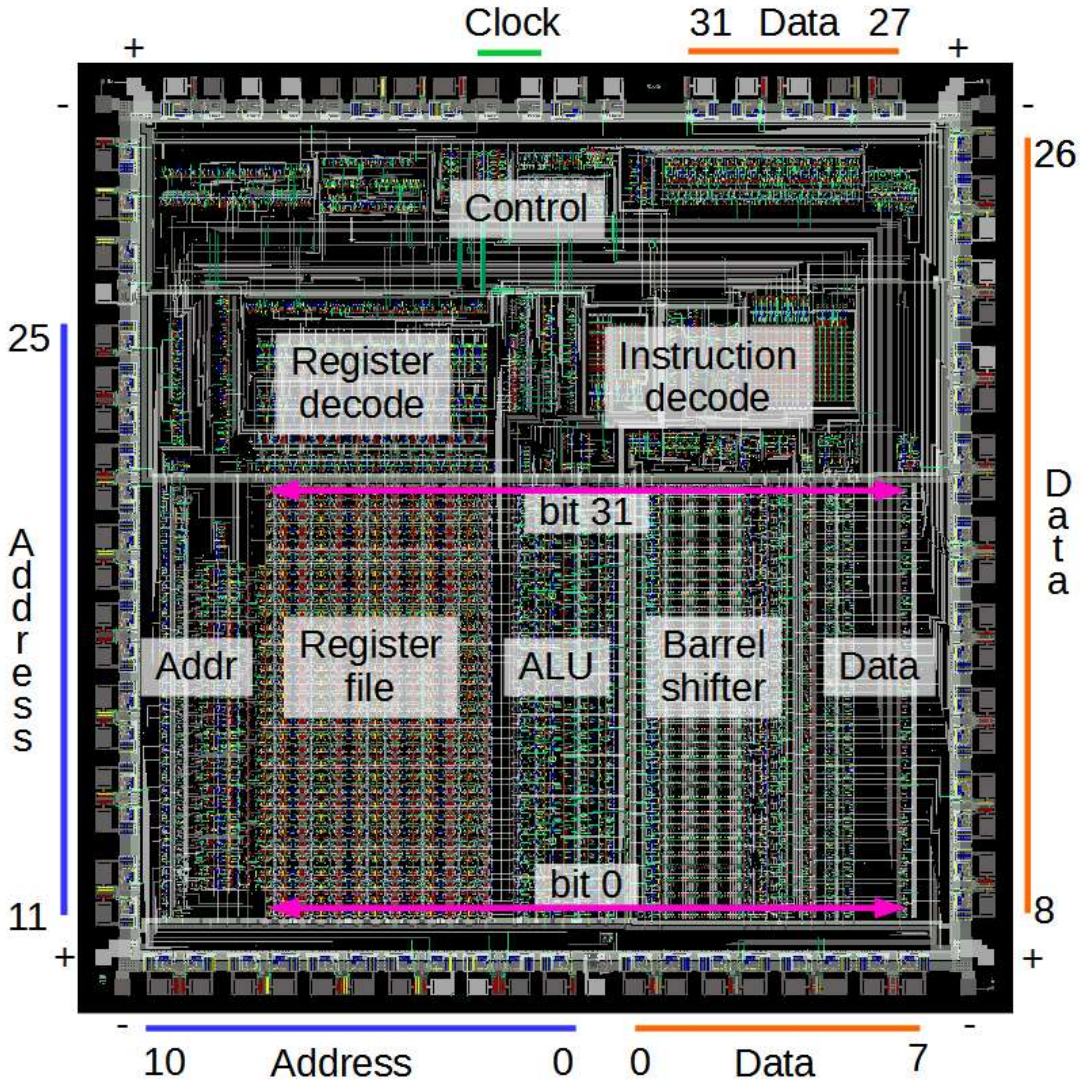
- **ARM 1 layout**



ARM multi core block diagram

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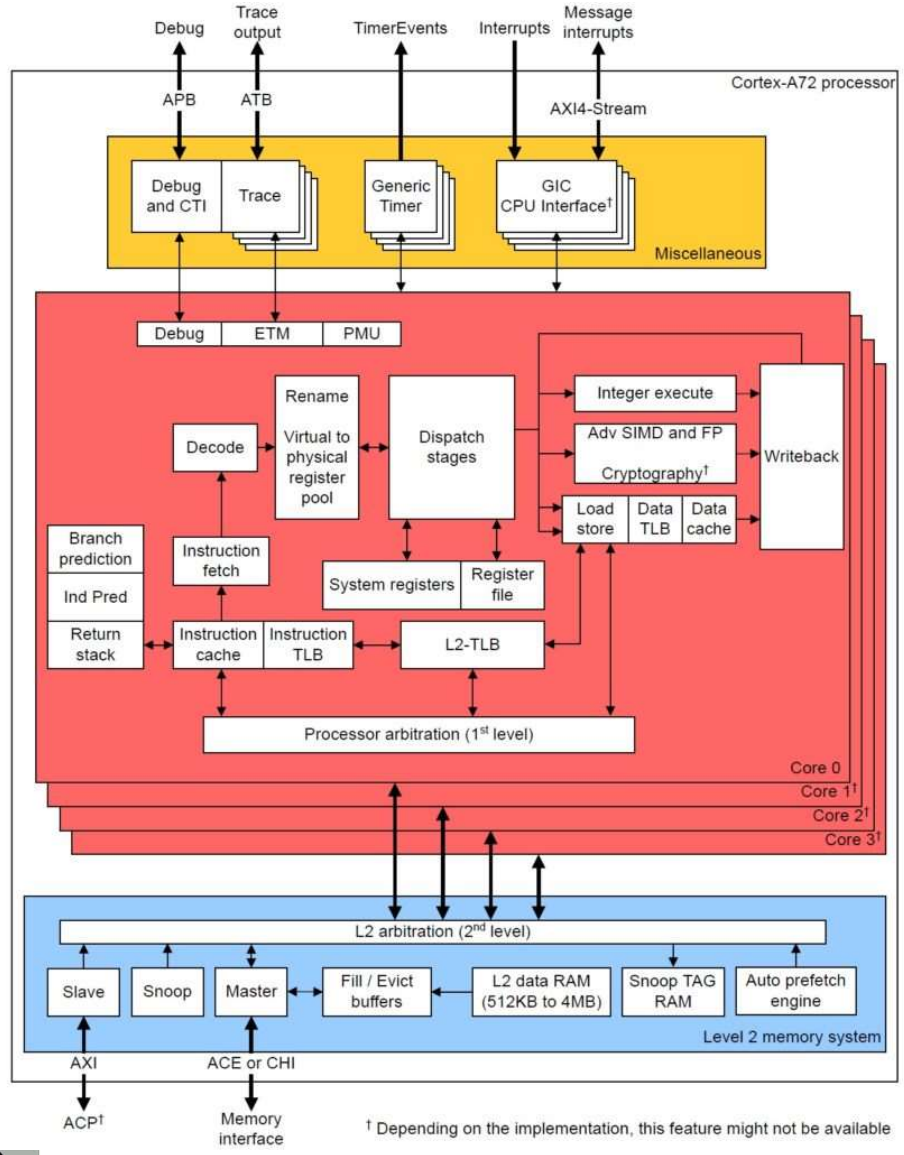
- **https://sandsoftwaresound.net/raspberry-pi-4-arm-cortex-a72-processor/**



Raspberry Pi Block diagram

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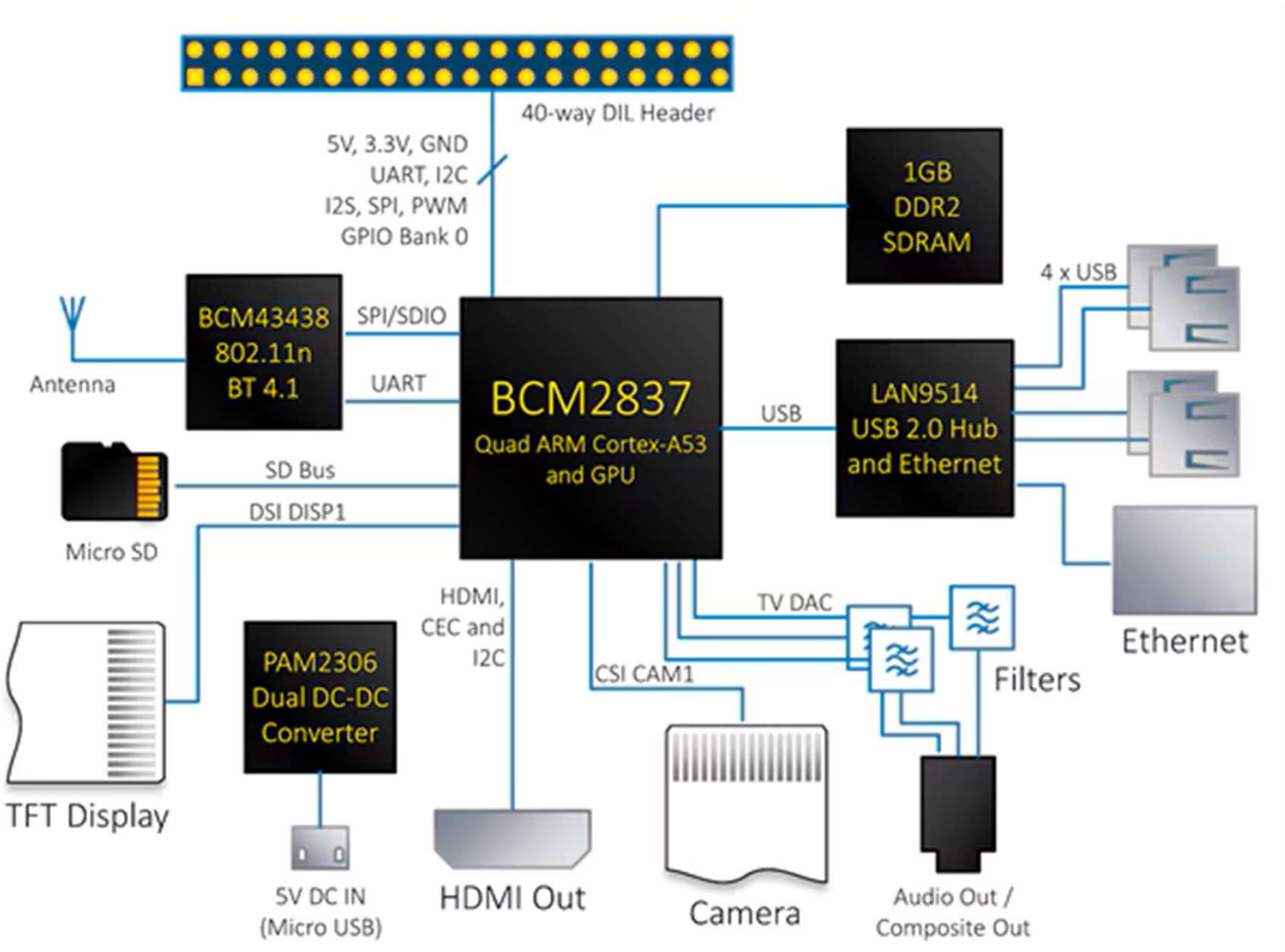

Raspberry Pi Components

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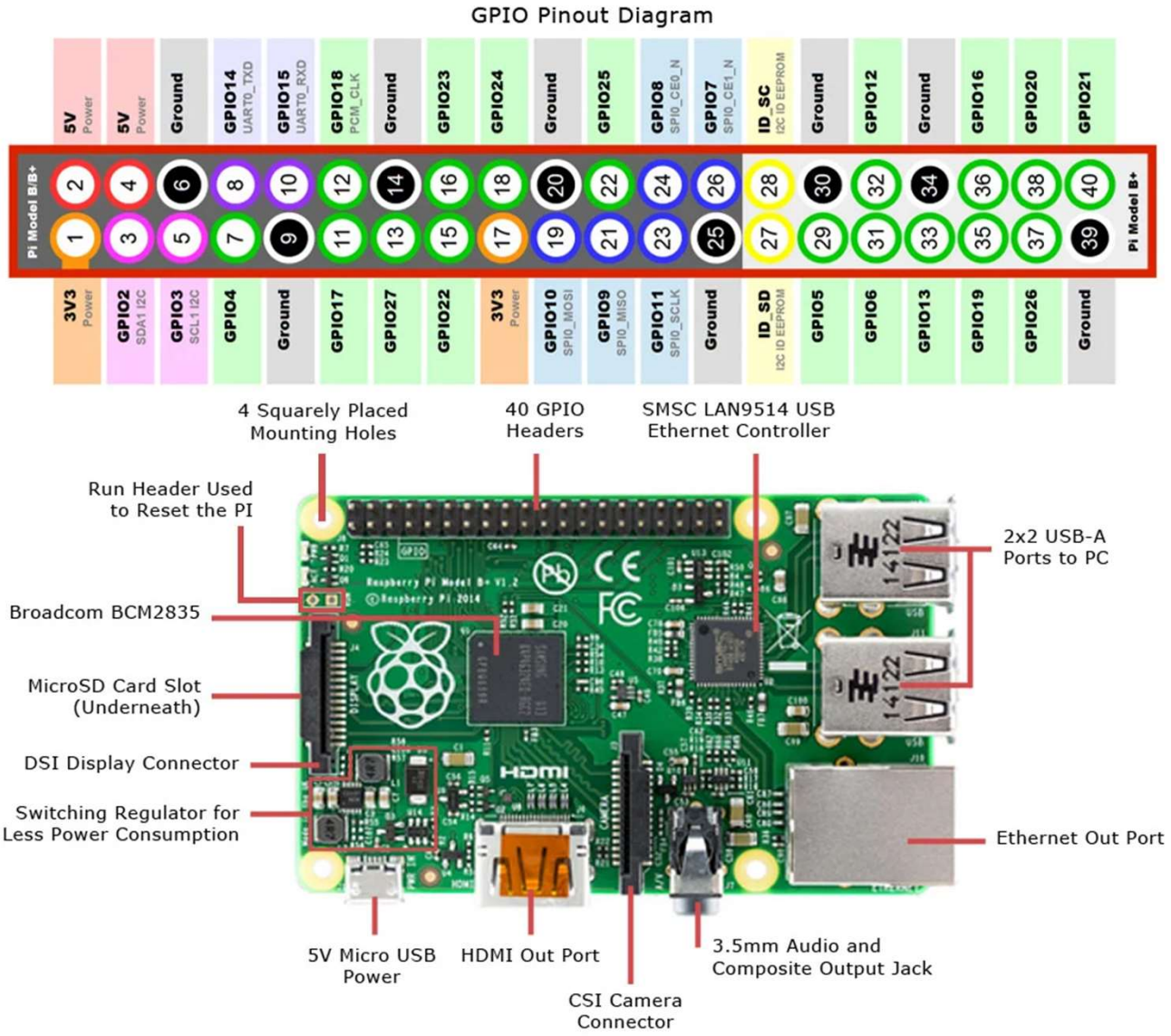
- https://www.jameco.com/Jameco/workshop/CircuitNotes/Raspberry-Pi-3-pinout.jpg
- https://datasheets.raspberrypi.com/rpi3/raspberry-pi-3-b-plus-reduced-schematics.pdf



More detailed documentation on PI

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- https://www.raspberrypi.com/documentation/computers/processors.html
- **ARM Quad A7 core** https://datasheets.raspberrypi.com/bcm2836/bcm2836-peripherals.pdf
- https://developerarm.com/documentation/102404/0201/?lang=en **Learn the architecture - Introducing the Arm architectureVersion 2.1**
- https://www.cl.cam.ac.uk/projects/raspberrypi/
- https://www.macs.hw.ac.uk/~hwloidl/Courses/F28HS/slides_RPi_arch.pdf
- https://sandsoftwaresound.net/raspberry-pi-4-arm-cortex-a72-processor/