* **(46p) Foundation**

Introduction to Parallel Computing and the Raspberry Pi.pdf)

* + **(5p) Identifying the components on the raspberry PI B+**
    - The Raspberry Pi Model B+ consist of a 1.4 GHz Quad-Core 64-bit ARM Cortex-A53 processor with 512 KB of shared L2 cache. It also contains 1 GB of SDRAM, which is shared with the GPU. For input/output functionalities, it has four USB 2.0 ports, a 15-pin MIPI camera interface connector, one HDMI port for video/audio out, a 3.5 mm phone jack for audio input/output, a (300 Mbit/s) Gigabit Ethernet port, built in 2.4/5 GHz dual band Wi-Fi technology, Bluetooth 4.2, a Micro-USB port for power input (5 V), a MicroSD slot, and a 40-pin GPIO for various functionalities. **(1)**
  + **(5p) How many cores does the Raspberry Pi’s B+ CPU have**
    - The Raspberry Pi B+ contains four ARMv7 Processors (4th Revision). **(2)**
  + **(8p) List four main differences between X86 (CISC) and ARM Raspberry PI (RISC).**
  + **Justify you answer and use your own words (do not copy and paste**
    - The major difference between the Intel x86 and the Raspberry PI ARM processors are the instruction sets they support. The Intel x86 is a CISC (Complex Instruction Set Computing) processor and its instruction set contains about 1000 different kinds of operation mnemonics that it can execute. **(3)** The Raspberry PI ARM processor is a RISC (Reduced Instruction Set Computing) processor and its instruction set contain about 100 (or less) mnemonic instructions. **(4)**

The CISC processors’ instructions are more complex and allow for more options in its instructions. CISC instruction set also contains a better support for memory access than its RISC counterpart. This high capabilities for memory access allows for CISC processors of having less registers than the RISC processors. **(4)** The ARM processor contains 16 integer registers and 32 floating point registers compared to the Intel x86 which only contains 8 General-Purpose registers, and 8 Special-Purpose registers. **(5)**

The disadvantage of CISC architecture are experience during execution. Due to the complexity and the size of the instruction set, the CPU may takes longer to execute an instruction. ARM (RISC) processors are more efficient in their execution due to the fact it contains simpler instructions and they can be executed with less clock cycles. **(4)**

The ARM processor also provides the capabilities for condition execution. This allows for an instruction to be executed or ignored based on the result of a status of a flag in the flag register. This option is not available in the Intel x86 processor. **(6)**

Another difference between the ARM and x86 processor is the process of storing information in memory. ARM processors version 3 and above has BI-endian capabilities. This allows for the processor to switch between little-endian and big-endian format. This option is controlled by either a hardware setting or software. **(7)**

* + **(6p) what is the difference between sequential and parallel computation and identify the practical significance of each?**
  + **(5p) identify the basic form of data and task parallelism in computational problems.**
  + **(6p) Explain the differences between processes and threads.**
  + **(3p) what is OpenMP and what is OpenMP pragmas?**
  + **(4p) what applications benefit from multi-core (list four)?**
  + **(4p) Why Multicore? (why not single core, list four)**

**Citation:**

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