COMPUTER ARCHITECTURE AND OPERATING SYSTEMS (CAOS)
DAC, FIB, UPC
2024/2025 – Spring term

Midterm exam **Mon 7 April**

- This exam is **open book**, **closed Internet**. You may use your laptop, but you may **NOT** consult the Internet.
- Write your answers, in order, in a text file named `<your_name>.txt`
- Time **64 minutes**

1. (2 points) About the CPU.
   (a) What is the clock speed of a CPU measured in?

   Hertz

   (b) What is the primary function of the CPU?

   Execute programs

   (c) What is the first phase of a CPU's operation called?

   Fetch

   (d) What is the purpose of the Instruction Register in a CPU?

   To hold the fetched instruction from memory

2. (2 points) Filling the gaps. Write the following 8 bits numbers in unsigned **decimal**, **binary** and **hexadecimal**. Show all calculation steps.

	Decimal (base 10)	Binary (base 2)	Hexadecimal (base 16)
(a)	32	**00100000**	**20**
(b)	**255**	11111111	**FF**
	172	10101100	*AC*

$$(a)32 = 2^5 = 0b00100000 = \underbrace{0010}_{2}\underbrace{0000}_{0}$$

$$(b)\mathbf{255} = 2^7 + 2^6 + 2^5 + 2^4 + 2^3 + 2^2 + 2^1 + 2^0 = 0b11111111 = \underbrace{1111}_{\mathbf{F}}\underbrace{1111}_{\mathbf{F}}$$

3. (2 points) Floating point representation. Suposse we are using the standard IEEE 754, 32b, normalized. Which is the real number represented by the number $0xC0480000$? Show all calculation steps.

$$0xC0480000 = 0b11000000010010000000000000000000$$

$$0xC0480000 = 0b \overbrace{1}^{sign} \quad \overbrace{0x80}^{exponent} \quad \overbrace{0x480000}^{mantissa}$$

$$Sign : negative, e = \overbrace{128}^{exponent} - \overbrace{127}^{E_{max}} = 1, frac = \overbrace{1}^{normalized} . \overbrace{1001000}^{mantissa}$$

$$real : -1.5625000000 \cdot 2^1 = -3.125$$

4. (2 points) Bash. Write a bash script (named `showHeaders.sh`) with only one command line that:

   (a) Downloads the file `https://docencia.ac.upc.edu/FIB/BDBI/CAOS/2425/psyscalls.csv`

   (b) Selects the third value of each line

   (c) For each third value, executes a `man -P cat`

   (d) And, for each output of the `man -P cat <3r value>` searches the character `#`

   Example of execution[1]:

```
$ ./showHeaders.sh
#include <sys/types.h>
#include <unistd.h>
#include <sys/types.h>
#include <sys/wait.h>
   #ifdef WCOREDUMP ... #endif.
#include <sys/wait.h>
#include <stdint.h>
#include <stdlib.h>
#include <unistd.h>
#include <stdio.h>
#include <stdlib.h>
#include <signal.h>
```

```
curl -L https://docencia.ac.upc.edu/FIB/BDBI/CAOS/2425/psyscalls.csv \
| awk -F, '{print $3}' \
| xargs -I% man -P cat % \
| grep -e "#"
```

[1]The output may change depending on the operating system and installed packages. However, it will be similar.

5. (2 points) Create a program (written in Python or C language) named `eq(a,b)` that takes two `unsigned int` arguments and returns `True` if `a` and `b` are equals; or returns `False` otherwise. You may use the legal operations (see below) only.

```
#    eq(a,b) - return True if a and b are equals
#    Example: eq(2,4) = False
#    Legal ops: not  ~ & ^ | + << >>
#    Max ops: 8
#    Rating: 2
```

```
def eq(x, y):
        return not(x+(~y+1))
```