

# IST-ASM Final Exam — Fall 2022

**Name:**

- First, write your name in the box above. Then, have a quick read through all 5 questions.
- In the end, you will write up your answers on this paper.
  - But please make a draft elsewhere first. Only hand in something readable.
- This is an open-book open-laptop exam: you may work on scrap paper or on your screen.
- Each questions is independent from others, except stated otherwise.

**Question 1** Perform the binary addition  $77 + 43$ : convert both numbers to binary, then compute the sum entirely in binary. Show the details of your work.

**Question 2** Convert the program below to ASM syntax.

machine code (hex)

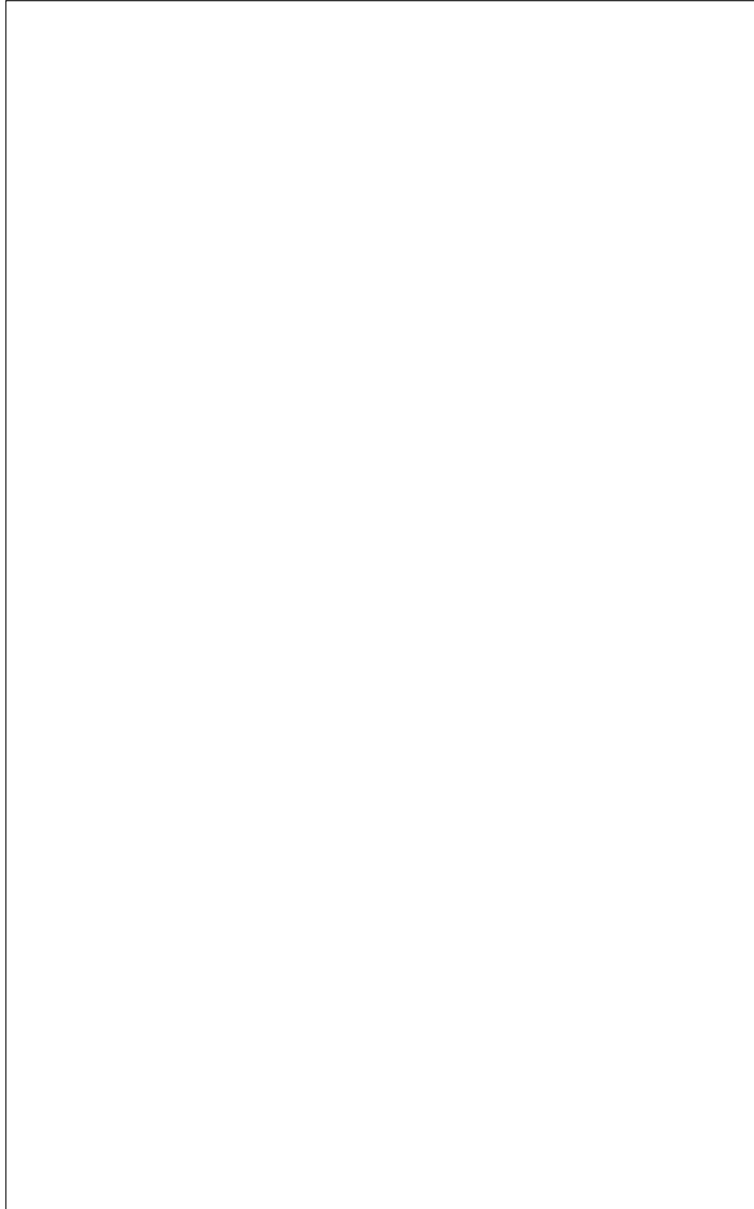
00	209003e8
04	21990001
08	3209fffc

↔

source program (asm)

**Question 3** Write a program which raises a number  $N$  to a power  $P$ . The idea is to multiply  $N$  by itself  $P$  times:  $N \times N \times \dots \times N$ . Initially  $N$  and  $P$  are stored in  $R1$  and  $R2$ , respectively. Both are assumed to be strictly positive.

**Question 4** Write a program which fills the left half of the screen in yellow.



**Question 5** Definition: the *decimal digital root* of a natural number is defined as the value obtained by repeatedly summing the decimal digits of  $N$  until a single-digit number is reached. For instance, the decimal digital root of number 12345 is 6 because  $1+2+3+4+5 = 15$  and  $1+5 = 6$ .

Write a recursive `ddr` function which computes the decimal digital root of a positive integer  $N$ :

- if  $N < 10$  then  $\text{ddr}(N) = N$
- if  $N \geq 10$  then  $\text{ddr}(N) = \text{ddr}((N \div 10) + (N \bmod 10))$   
for instance  $\text{ddr}(12345) = \text{ddr}(1234 + 5) = \text{ddr}(1239) = \text{ddr}(123 + 9) = \dots$

Notes: You'll want to use `DIV/DIVI` and `MOD/MODI` instructions to get the quotient and remainder of the integer division, respectively.

```
    leti SP, 0x10000000
main:
    leti R1, 12345
    call ddr
    bra +0

ddr:
```