

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.

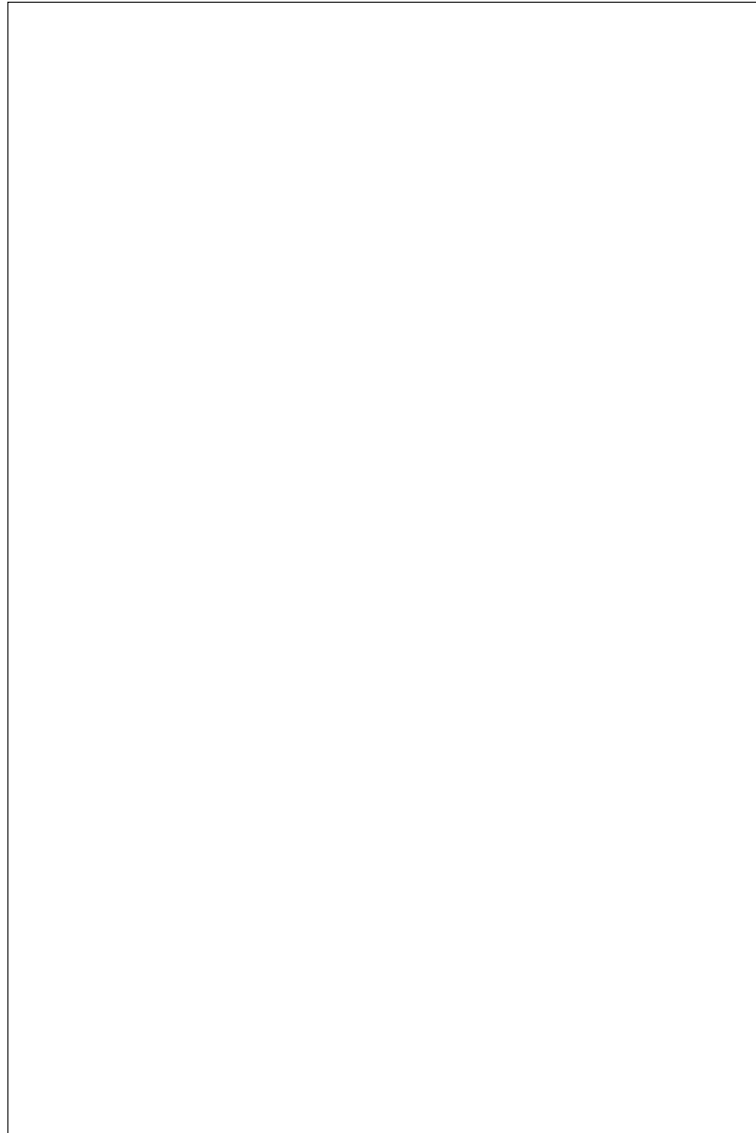
machine code (hex)

00	209003e8
04	21990001
08	3209fffc

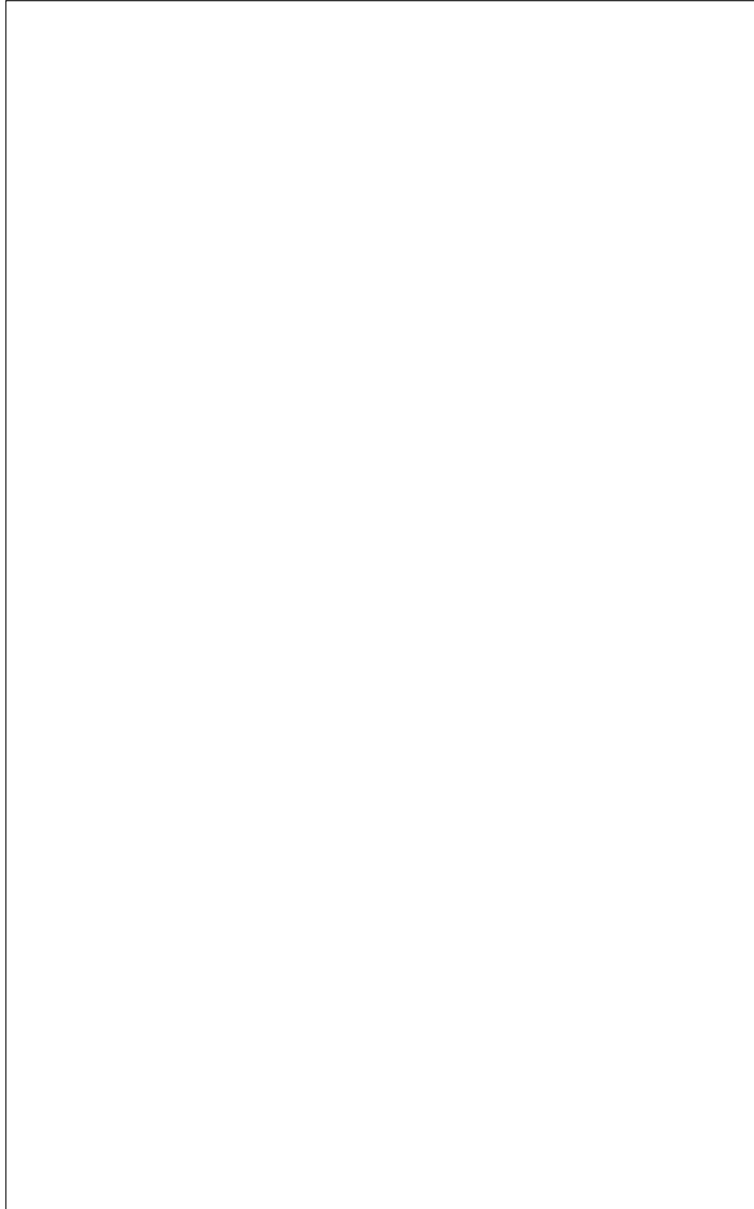
↔

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:
```