IST-ASM Retake Exam — 1st December 2022

Name:			

- First, write your name in the box above. Then, have a quick read through all 5 exercises.
- 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 question is independent from others.

Question 1 Perform the binary addition -43 + 50 in two's complement on 7 bits: convert both numbers to (signed) binary, then compute the sum on 7 bits. Show the details of your work, especially carry bits.



Question 2 The code below implements a certain mathematical function f: from two integers A and B, it computes C = f(A, B). Give a simple expression for f.

f(A, B) =

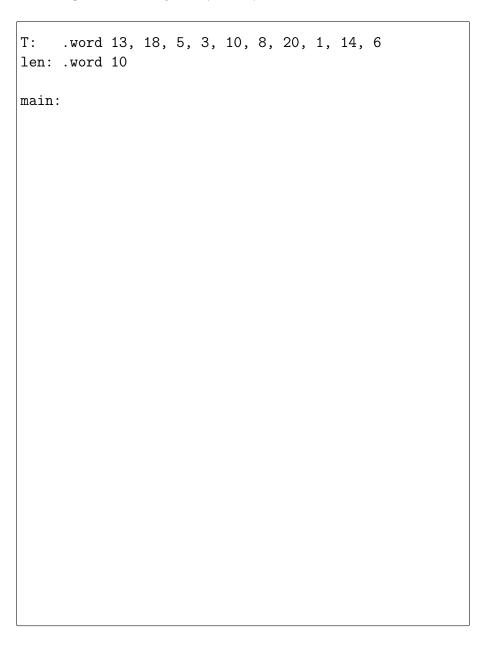
```
A: .word ...
B: .word ...
C: .word ...
main:
    load R1, [A]
    load R2, [B]
    mul R3, R1, R1
    mul R4, R2, R2
    add R3, R3, R4
    mul R4, R1, R2
    add R4, R4, R4
    add R1, R3, R4
    store [C], R1

bra +0
```

For instance, with $N = $ stored in R1, and at th	7 you should find $1\times1 + 2\times2 + 3\times3 + 4\times4 + 5\times5 + 6$ e end the result should be stored in R2.	\times 6 + 7×7 = 140. Initially <i>N</i> is

Question 3 Write a program which computes the sum of the squares of the first *N* positive integers.

Question 4 Write a program that loops over an array of numbers and finds both the maximum and minimum values. The length of the array is a (known) constant, as illustrated below.



Question 5 Definition: Given a pair of positive integers n and k such that $n \ge k \ge 0$, we define their binomial coefficient as the number of different k-element subsets of a fixed n-element set. This number is usually written $\binom{n}{k}$ and is read as "n choose k". For example, $\binom{4}{2} = 6$ because there are 6 ways to choose 2 elements from a 4-element set $\{a, b, c, d\}$: the different subsets are $\{a, b\}$, $\{a, c\}$, $\{a, d\}$, $\{b, c\}$, $\{b, d\}$, and $\{c, d\}$.

In this exercise, we are interested in the fact that there exists a recursive formula to compute these coefficients:

$$\binom{n}{k} = \binom{n-1}{k-1} + \binom{n-1}{k}$$

The base case of the recursion is the fact that for any integer $n \ge 0$, we have $\binom{n}{n} = \binom{n}{0} = 1$.

Your task is to write a recursive binomial function which receives n and k in R1 and R2, respectively and returns $\binom{n}{k}$ in R1.

