

# Computer Architecture Project 1

1. After completing each asm file, remove "\_student" in the filename and rename the file to project1\_N.asm.  
ex) project1\_1.asm
2. For submission, compress the two files to a zip file with the name STUDENTID\_NAME\_ca\_project1.zip.  
ex) 2019314346\_JUNGJINHYO\_ca\_project1.zip
3. You must complete 2 programs, with appropriate comments.
4. Failing to keep the guidelines above may result in deduction of points.
5. If you are using SPIM for debugging and monitoring, you need to enable use of pseudo-instructions to run the sample code provided.

1. Declare the given string in the .data area and receive a single integer which is the ASCII value  $N$  of a single alphabet as input. Write a function that returns the number of times the character (whose ASCII value corresponds to  $N$ ) appears in the string.

The string is terminated by NULL, and only consists of alphabets and blanks.

Example)

STRING	INPUT	OUTPUT
Computer Architecture	101	3
Computer Architecture	84	0
Department of Computer Science	109	2

2. The Ackermann function is defined as follows:

$$A(m, n) = \begin{cases} n + 1, & m = 0 \\ A(m - 1, 1), & m > 0 \text{ and } n = 0 \\ A(m - 1, A(m, n - 1)), & m > 0 \text{ and } n > 0 \end{cases}$$

Implement the Ackermann function in MIPS assembly. Your function must receive two integers  $m, n$ , as the first and the second argument respectively and must output the value of  $A(m, n)$ . Please follow the coding conventions for recursive calls (using  $\$sp$  and  $\$ra$ ).

\* You may assume that the inputs are given within the range.

$$0 \leq m \leq 3 \text{ and } 0 \leq n \leq 6$$

\* We recommend you not input values outside the mentioned range when testing your program, as the Ackermann function grows very rapidly.

$$(\text{ex } A(4, 2) = 2^{65536} - 3)$$

\* For more information visit [https://en.wikipedia.org/wiki/Ackermann\\_function](https://en.wikipedia.org/wiki/Ackermann_function)

Example)

INPUT	OUTPUT
0, 0	1
1, 2	4
3, 4	125