

Computer Architecture
CPSC 32, Fall Semester 2003
Lab Assignment #1

Due: One week after your lab session – complete by yourself.

1 Objective

This laboratory assignment will help you understand loops, procedures, and the parameter passing conventions in the MIPS assembly language.

2 Assignment

[50 points] Recall that the binomial coefficient is defined by

$$\binom{n}{m} = \frac{n!}{m!(n-m)!}.$$

Write a MIPS assembly language program that prompts the user to input the parameters n and m , and calculates and prints the result $\binom{n}{m}$ when this is possible. To avoid early overflows, do not calculate the binomial coefficient by evaluating the three factorial functions, and then divide the results. Write a C or C++ program and translate it by hand into a MIPS assembly language program using the strategies explained in Chapter 3 of Patterson and Hennessy.

Hint: To calculate the binomial coefficient, you can take advantage of the following relationship:

$$\binom{n}{k} = \binom{n-1}{k-1} \frac{n}{k} = \left[\binom{n-1}{k-1} \frac{1}{(k/\gcd(n,k))} \right] \frac{n}{\gcd(n,k)}.$$

You need to implement the Euclidean algorithm to calculate the $\gcd(a, b)$.

[50 points] The Ackerman function $A(n, m)$ is defined by

$$\begin{aligned} A(0, m) &= m + 1 \\ A(n + 1, 0) &= A(n, 1) \\ A(n + 1, m + 1) &= A(n, A(n + 1, m)) \end{aligned}$$

Write a MIPS assembly language program that prompts the user to input the parameters n and m , and calculates and prints the result $A(n, m)$ when this is possible. Note that the Ackerman function grows rapidly, and your

program might not terminate within any reasonable amount of time for many choices of input parameters. Implement a recursive procedure `ack` that implements $A(m, n)$. Use the argument register `$a0` to represent n and the register `$a1` to represent the parameter m . Use the stack in your implementation to save parameters and return addresses.

3 Dishonesty

Make sure that you complete the assignment by yourself. Do not copy the code from others, nor provide others with your code. Refrain from copying and modifying the code from other sources.