

**COSC 5010. Formalizing the JVM in ACL2.**

Spring 2004

Examination

Due Thursday 8 April 2004

- Answer these questions individually. You may only use the book, the homework, the class notes, the class website, and the ACL2 documentation. You may ask for help only from the instructor.
- Email your solutions to me at `cowles@uwyo.edu`.
- The subject line should identify the problem set, i.e. Exam Question 3.
- The body of the message should be a Lisp readable file in simple ascii text format.
- The first few lines of the body should contain your name.

Exam Question 3.

1. The JVM specifies that the `int` type is “32-bit signed twos complement integers.” Let’s call such an integer a “JVM int.” Define the ACL2 function `JVM-intp` that takes an ACL2 object, `n`, and returns `t` or `nil` according to whether `n` is a JVM int.
2. According to the JVM spec, “the built-in integer operators do not indicate (positive or negative) overflow in any way; they wrap around on overflow.” Suppose `i` and `j` are both JVM ints. Define the ACL2 functions `jvm+`, `jvm-`, and `jvm*` so that `(jvm+ i j)`, `(jvm- i j)`, and `(jvm* i j)` are the JVM ints obtained, respectively, by adding, subtracting, and multiplying `i` and `j` according to the JVM spec.

3. Define the M1 instructions IADD, ISUB, and IMUL by exhibiting the definitions of `execute-IADD`, `execute-ISUB`, and `execute-IMUL`.

Format:

(IADD)

(ISUB)

(IMUL)

Operand Stack:

`..., value1, value2 => ..., result`

Description:

Both `value1` and `value2` must be of type JVM int. The values are popped from the operand stack. The JVM int `result` is, respectively, `value1+value2`, `value1-value2`, or `value1*value2`. `Result` is pushed onto the operand stack.

4. Define two recursive versions of the factorial function for M1. `FACT` uses the original M1 integer operations such as `(MUL)` and `(SUB)`. `JVM-FACT` uses the JVM int operations such as `(IMUL)` and `(ISUB)`.

What is the largest input value of `n` for which `FACT` returns the same integer as `JVM-FACT`?

Hint: If you know Java, you can check your implementation of the JVM int operations by comparing the results produced by `JVM-FACT` with the results produced by the following Java method for computing factorial.

```
public static int fact(int n){
    if (n>0)
        {return n*fact(n-1);}
    else return 1;
}
```