

## Chapter 6

Note: In designing abacus machines, please use numbers to denote the registers, not letters. For example, if you want to increment a certain register, say “1+” instead of “a+”. Use the first registers (1, 2, ...) to hold the inputs, and give the output in the very next register.

1. Give a flow chart for an abacus that computes  $!$ , the factorial function. ( $[1]! \rightarrow 2$ )  
 $0! = 1;$   
 $n! = 1 \cdot 2 \cdot \dots \cdot (n-1) \cdot n$
2. Give a flow chart for an abacus that computes superexponentiation (see p. 60).  
( $\text{sup}([1],[2]) \rightarrow 3$ ).
3. Define a 1-place function of non-negative integers, by diagonalization, that is not abacus-computable. To do this you must produce an enumeration of the abacus machines -- I don't want you to appeal to facts proved in the book (e.g., the fact that every abacus computable function is Turing-computable).