In this assignment you should code using either C or C++. Write a program which takes the input from the user and returns the answer showing each step of the algorithm as an output to the user. Pseudocode for the algorithm to do modular exponentiation and a sample output is given below.

ALGORITHM 5 Modular Exponentiation.

procedure *modular exponentiation*(b: integer, $n = (a_{k-1}a_{k-2}\ldots a_1a_0)_2$, m: positive integers)
$x := 1$
$power := b$ **mod** m
for $i := 0$ **to** $k - 1$
    if $a_i = 1$ **then** $x := (x \cdot power)$ **mod** m
    $power := (power \cdot power)$ **mod** m
return x {x equals b^n **mod** m}

For example: User will provide the numbers 3, 644 and 645 and your program will return the answer printing the output with each step.

Use Algorithm 5 to find 3^{644} **mod** 645.

Solution: Algorithm 5 initially sets $x = 1$ and $power = 3$ **mod** 645 $= 3$. In the computation of 3^{644} **mod** 645, this algorithm determines 3^{2^j} **mod** 645 for $j = 1, 2, \ldots, 9$ by successively squaring and reducing modulo 645. If $a_j = 1$ (where a_j is the bit in the jth position in the binary expansion of 644, which is $(1010000100)_2$), it multiplies the current value of x by 3^{2^j} **mod** 645 and reduces the result modulo 645. Here are the steps used:

$i = 0$: Because $a_0 = 0$, we have $x = 1$ and $power = 3^2$ **mod** 645 $= 9$ **mod** 645 $= 9$;
$i = 1$: Because $a_1 = 0$, we have $x = 1$ and $power = 9^2$ **mod** 645 $= 81$ **mod** 645 $= 81$;
$i = 2$: Because $a_2 = 1$, we have $x = 1 \cdot 81$ **mod** 645 $= 81$ and $power = 81^2$ **mod** 645 $= 6561$ **mod** 645 $= 111$;
$i = 3$: Because $a_3 = 0$, we have $x = 81$ and $power = 111^2$ **mod** 645 $= 12{,}321$ **mod** 645 $= 66$;
$i = 4$: Because $a_4 = 0$, we have $x = 81$ and $power = 66^2$ **mod** 645 $= 4356$ **mod** 645 $= 486$;
$i = 5$: Because $a_5 = 0$, we have $x = 81$ and $power = 486^2$ **mod** 645 $= 236{,}196$ **mod** 645 $= 126$;
$i = 6$: Because $a_6 = 0$, we have $x = 81$ and $power = 126^2$ **mod** 645 $= 15{,}876$ **mod** 645 $= 396$;
$i = 7$: Because $a_7 = 1$, we find that $x = (81 \cdot 396)$ **mod** 645 $= 471$ and $power = 396^2$ **mod** 645 $= 156{,}816$ **mod** 645 $= 81$;
$i = 8$: Because $a_8 = 0$, we have $x = 471$ and $power = 81^2$ **mod** 645 $= 6561$ **mod** 645 $= 111$;
$i = 9$: Because $a_9 = 1$, we find that $x = (471 \cdot 111)$ **mod** 645 $= 36$.