Algorithm 1 A Basic Multiplication Algorithm Based on Classic Decimal Multiplication

```
for i = 0; i < 32; i++ do
    if multiplier_0 == 1 then
        product ← product + multiplicand
    end if
    multiplicand ← multiplicand << 1
    multiplier ← multiplier >> 1
end for
```

Algorithm 2 An Improved Algorithm that Adds to the Left Half of the 64-bit Product Register and Shifts into Place on the Right Half so that a 32-bit ALU Can be Used

for $i = 0$; $i < 32$; $i{+}{+}$ **do**
  if $multiplier_0 == 1$ **then**
    $product_{63:32} \leftarrow product_{63:32} + multiplicand$
  end if
  $product \leftarrow product >> 1$
  $multiplier \leftarrow multiplier >> 1$
end for

Algorithm 3 A Further Improved Algorithm that Utilizes the Unused Right Half of the 64-bit Product Register (which will be shifted out of the register) as the Multiplier (eliminating a register)

$product_{31:0} \leftarrow multiplier$
for $i = 0$; $i < 32$; i++ **do**
  if $product0 == 1$ **then**
    $product_{63:32} \leftarrow product_{63:32} + multiplicand$
  end if
  $product \leftarrow product >> 1$
end for

Algorithm 4 A Binary Integer Division Algorithm

```
remainder ← dividend
divisor ← divisor << 32
for i = 0; i < 33; i++ do
    remainder ← remainder − divisor
    if remainder ≥ 0 then
        quotient ← quotient << 1
        quotient_0 ← 1
    else
        remainder ← remainder + divisor
        quotient ← quotient << 1
        quotient_0 ← 0
    end if
    divisor ← divisor >> 1
end for
```

Algorithm 5 An Improved Binary Integer Division Algorithm Using a 32-bit ALU, Using the Right Half of the Remainder as the Dividend, and Placing the Remainder in the Left Half of the Reminader Register, and the Quotient in the Right Half of the Remainder Register

$remainder_{31:0} \leftarrow dividend$
$remainder \leftarrow remainder << 1$
for $i = 0$; $i < 32$; $i{+}{+}$ **do**
    $remainder_{63:32} \leftarrow remainder_{63:32} - divisor$
    if $remainder \geq 0$ **then**
        $remainder \leftarrow remainder << 1$
        $remainder_0 \leftarrow 1$
    else
        $remainder_{63:32} \leftarrow remainder_{63:32} + divisor$
        $remainder \leftarrow remainder << 1$
        $remainder_0 \leftarrow 0$
    end if
end for
$remainder_{63:32} \leftarrow remainder_{63:32} >> 1$