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**
    $product_{31:16} \leftarrow product_{31:16} + multiplicand$
  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)

$product15:0 \leftarrow multiplier$
for $i = 0$; $i < 32$; $i{+}{+}$ **do**
  if $product0 == 1$ **then**
    $product_{31:16} \leftarrow product_{31:16} + multiplicand$
  end if
  $multiplier \leftarrow multiplier >> 1$
end for

Algorithm 4 A Binary Integer Division Algorithm

```
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 and that Uses the Unused Left Half of the Remainder as the Dividend

$remainder_{31:16} \leftarrow dividend$
$remainder \leftarrow remainder << 1$
for $i = 0$; $i < 32$; $i{+}{+}$ **do**
    $remainder_{31:16} \leftarrow remainder_{31:16} - divisor$
    if $remainder \geq 0$ **then**
        $remainder \leftarrow remainder << 1$
        $remainder_0 \leftarrow 1$
    else
        $remainder_{31:16} \leftarrow remainder_{31:16} + divisor$
        $remainder \leftarrow remainder << 1$
        $remainder_0 \leftarrow 0$
    end if
    $remainder_{31:16} \leftarrow remainder_{31:16} >> 1$
end for