Part1

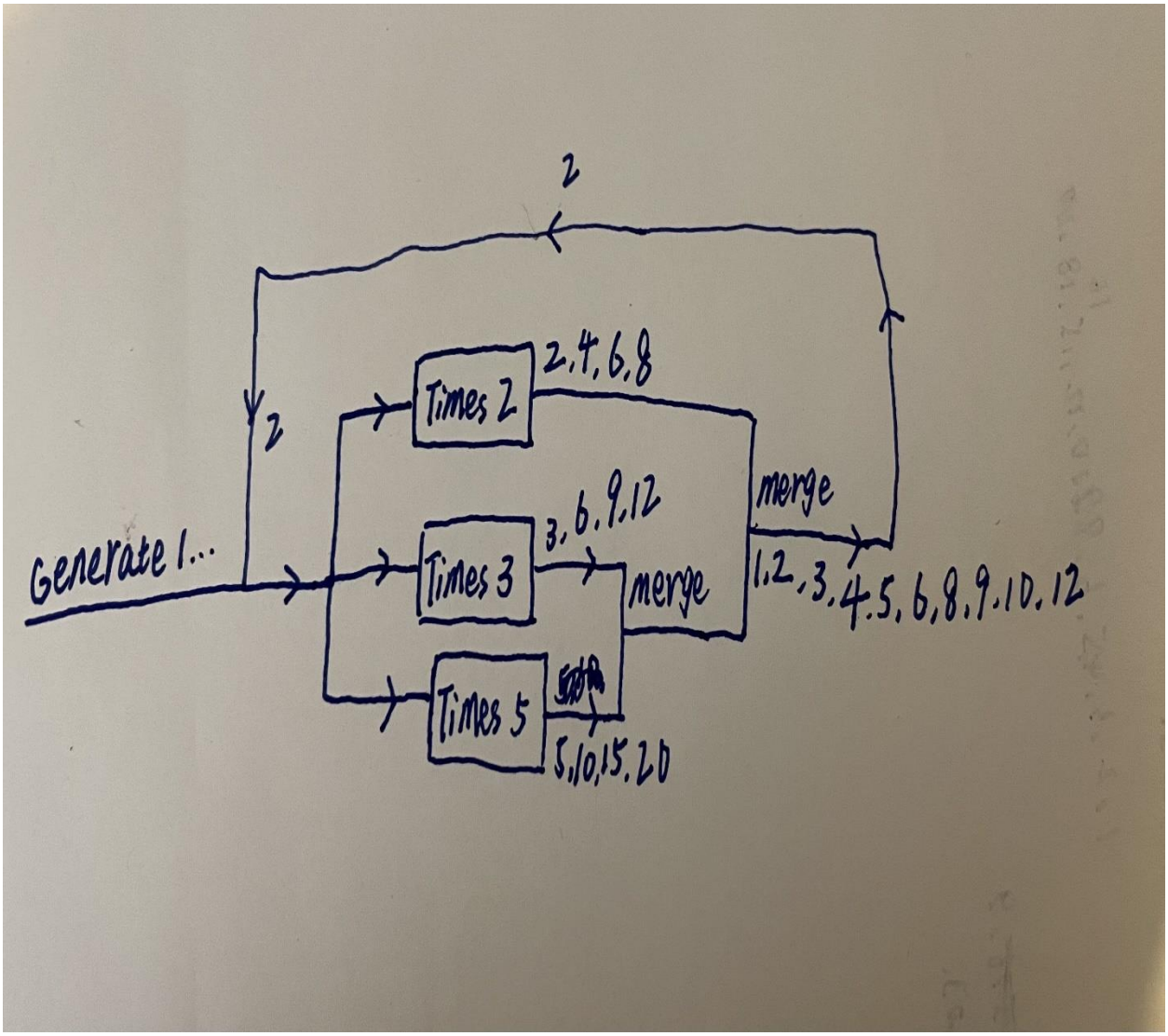
(a)

```
Times = fun {$ N H }
   fun {$}
      (X#G) = {H} in
      ((X*N)#{Times N G})
   end
end


   Merge = fun {$ Xs Ys}
      fun {$}
         (X#G) = {Xs}
         (Y#Z) = {Ys} in
         if (X < Y) then
            (X#{Merge G Ys})
         else
            if (X > Y) then
               (Y#{Merge Xs Z})
            else
               (X#{Merge G Z})
            end
         end
      end
   end
```

```
Generate = fun {$ N}
   fun {$} (N#{Generate (N+1)}) end
end

Hamming = fun {$ N}
   fun {$}
      (X#G) = {N} in
      (1#{Merge {Times 2 {Hamming G}} {Merge {Times 3 {Hamming G}} {Times 5 {Hamming G}}}})
   end
end
Take = fun {$ N F}
   if (N == 0) then
      nil
   else
      (X#G) = {F} in
      (X| {Take (N-1) G})
   end
end
X = {Generate 1}
Y = {Hamming X}
V = {Take 10 Y}
skip Browse V
```



(b)

```haskell
data Gen a = G (() -> (a, Gen a))

generate :: Int -> Gen Int
generate n = G (\_ -> (n, generate (n+1)))

gen_take :: Int -> Gen a -> [a]
gen_take 0 _ = []
gen_take n (G f) = let (x,g) = f () in x : gen_take (n-1) g    -- What's the type of f here? --  f will be (Int, Gen Int)

times :: Int -> Gen Int -> Gen Int
times n (G f) = let (x,g) = f () in G(\_ -> ((n*x),times n g))
```

```haskell
merge :: Gen Int -> Gen Int -> Gen Int
merge (G f) (G p) = let (x,g) = f () in let (y,k) = p() in
    if x < y then G (\_ -> (x,merge g (G p)))
    else if y < x then G (\_ -> (y,merge k (G f)))
    else  G (\_ -> (x, merge g k))

hamming :: Gen Int -> Gen Int
hamming (G f) = let (x,g) = f () in G (\_ -> (1,merge (times 2 (hamming g))
(merge (times 3 (hamming g)) (times 5 (hamming g)))))
```

Part2

(a)

```
IntToNeed = fun {$ L}
   case L of [] '|'(1:X 2:Xr) then
     local Y in
       ({ByNeed proc{$ A} A = X end Y}|{IntToNeed Xr})
     end
   nil then nil
   end
 end
```

(b)

```
AndG = {GateMaker fun{$ X Y} if (X == 0) then 0 else (X*Y) end end}   // Use GateMaker
 OrG =  {GateMaker fun{$X Y} if (X == 1) then 1 else (X+Y)-(X*Y) end end}   // Use GateMaker
```

(c)

```
fun {MulPlex A B S}
   K L M in
   K = {AndG {NotG S} A}
   L = {AndG S B}
   M = {OrG k L}
   M
end
```

(d)

(1)

```
A = {IntToNeed [0 1 1 0 0 1]}
B = {IntToNeed [1 1 1 0 1 0]}
S = [1 0 1 0 1 1]
Out = {MulPlex A B S}
```

In this case here, A [0], A[2], A[4],A[5],B[1],B[3], will not be needed. Because in andGate, when the first value is 0, the result is 0, and no need to check the second value.

(2)

Yes, they did match up with what I got in d(1)