Ren Hao Wong
CSCI 117 Lab 7

Part 1

a.

<Part1.txt>
```
fun {Times N Hs}
    fun {$}
        (H # Hr) = {Hs}
        in
            ((N*H) # {Times N Hr})
    end
end

fun {Merge Xs Ys}
    fun {$}
        (X#Xr) = {Xs}
        (Y#Yr) = {Ys}
        in
            if (X < Y) then (X # {Merge Xr Ys})
            elseif (X > Y) then (Y # {Merge Xs Yr})
            else (X # {Merge Xr Yr})
            end
    end
end

fun {GenerateHamming Hs}
    fun {$}
        (1 # {Merge {Times 2 Hs} {Merge {Times 3 Hs} {Times 5 Hs}}})
    end
end

fun {Take N Xs}
    if (N > 0) then
        (X # Xr) = {Xs} in
        (X | {Take (N - 1) Xr})
    else
        nil
    end
end

HammingSequence = {Take 10 {GenerateHamming {Generate 1}}}
```

```
skip Browse HammingSequence
```

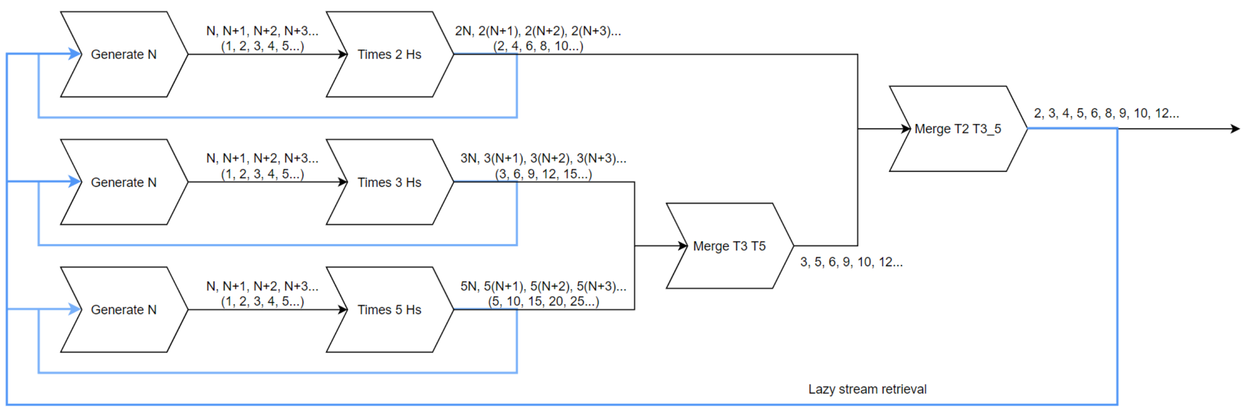
<Terminal output>

```
V1 : 3

V2 : 5

V3 : 4

HammingSequence : [ 1  2  3  4  5  6  8  9  10  12 ]
```



b.

<Part1.hs>

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

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

times n (G f) = let (h, hs) = f() in G (\_ -> (n * h, times n hs))

merge g1@(G f1) g2@(G f2) | x < y = G (\_ -> (x, merge xs g2))
                          | y < x = G (\_ -> (y, merge g1 ys))
                          | otherwise = G (\_ -> (x, merge xs ys))
                         where (x, xs) = f1()
                               (y, ys) = f2()

generateHamming hs = G (\_ -> (1, merge (times 2 hs) (merge (times 3
hs) (times 5 hs))))

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
```

<Terminal output>

```
ghci> gen_take 10 (generate 1)
[1,2,3,4,5,6,7,8,9,10]
ghci> gen_take 10 (generateHamming (generate 1))
[1,2,3,4,5,6,8,9,10,12]
```

Part 2

a.

```
fun {IntToNeed L}
   case L
   of nil then nil
   [] (X|Xs) then ByNeedValue in
      byNeed fun {$} X end ByNeedValue
      (ByNeedValue|{IntToNeed Xs})
   end
end
```

b.

```
AndG = {GateMaker fun {$ X Y}
                     if (X == 0) then 0
                     elseif (Y == 0) then 0
                     else 1
                     end
                  end}
OrG =  {GateMaker fun {$ X Y}
                     if (X == 1) then 1
                     elseif (Y == 1) then 1
                     else 0
                     end
                  end}
```

c.

```
fun {MulPlex A B S} SelectA SelectB in
   SelectA = {AndG {NotG S} A}
   SelectB = {AndG S B}
   {OrG SelectA SelectB}
end
```

d1.

Values in S determine which values from A and B are to be selected in the multiplexor, where a 0 indicates that A is selected whereas a 1 indicates that B is selected. The values of A and B that are not needed are highlighted in red:

```
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}
```

d2.

```
Needed: 191 -> 1
Needed: 258 -> 1
Needed: 292 -> 1
Needed: 324 -> 1
Needed: 358 -> 0
Needed: 361 -> 0
```

The values that were needed match up for the most part except for its sequence, where it is expected that location 336 would be a 0 and location 370 would be a 1. Nonetheless, the total number of needed variables matches up and the frequency of occurrence for each value is accurate to the output.