Eric Smrkovsky
10/16/2019
Csci 117
Lab 8

Part 1

1.a.1 Display function

```
local Display Generate X N in

  fun {Generate N}              //an 'infinite' generator function
    fun {$}
      (N#{Generate (N+1)})      //first value and rest of stream
    end
  end

  Display = proc {$ X N}                //displays a list
    local DisplayHelp Out Result in
      DisplayHelp = proc {$ X N Out}    //produces a list
        local
          (H#F) = {X}                   //break up the stream
        in
          if ((N-1)==0) then            //when we reach the end
            Out = [H]                   //return the head of the stream
          else T in                     //otherwise
            {DisplayHelp F (N-1) T}     //get the rest with recursion
            Out = (H|T)                 //output the list
          end
        end
      end
      {DisplayHelp X N Result}          //call helper to get list
      skip Browse Result                //display the list
    end
  end

X = {Generate 4}                //generate a stream starting from 4
{Display X 5}                   //outputs [4 5 6 7 8]

end
```

Eric Smrkovsky
10/16/2019
Csci 117
Lab 8

1.a.2

```
local Generate Times Y Display X Result in

  fun {Generate N}                    //generate a stream
    fun {$}
      (N#{Generate (N+1)})
    end
  end

  fun {Times X N}              //returns a list of (X*N)s
    fun {$}                    //where X is a stream
      (H#F) = {X}              //break up stream
    in
      ((H*N)#{Times F N})     //head is the product, tail is recursive call
    end
  end

  Display = proc {$ X N}                //displays a list
    local DisplayHelp Out Result in
      DisplayHelp = proc {$ X N Out}    //produces a list
        local
          (H#F) = {X}                   //break up the stream
        in
          if ((N-1)==0) then            //when we reach the end
            Out = [H]                   //return the head of the stream
          else T in                     //otherwise
            {DisplayHelp F (N-1) T}     //get the rest with recursion
            Out = (H|T)                 //output the list
          end
        end
      end
      {DisplayHelp X N Result}          //call helper to get list
      skip Browse Result                //display the list
    end
  end

X = {Generate 0}     //get X
Y = {Times X 3}      //get Y
{Display Y 5}        //display it, outputs [0 3 6 9 12]
End
```

Eric Smrkovsky
10/16/2019
Csci 117
Lab 8

1.a.3

```
local Merge X Y Display Generate3 Generate5 in

 fun {Generate3 N}                  //generate a stream
  fun {$}
   ((N*3)#{Generate3 (N+1)})       //of (N*3)'s
  end
 end

 fun {Generate5 N}                  //generate a stream
  fun {$}
   ((N*5)#{Generate5 (N+1)})       //of (N*5)'s
  end
 end

 fun {Merge X Y}             //merges two generated streams
  fun {$}
   (Hx#Fx) = {X}          //break apart X
   (Hy#Fy) = {Y}          //break apart Y
  in
   if (Hx<Hy) then         //if head of X is less then
    (Hx#{Merge Y Fx})     //add it to list, rec. call with Y and X's tail
   else                    //otherwise
    if (Hx==Hy) then      //if the heads are equal then
     (Hy#{Merge Fx Fy})  //add one to list and rec. call with the tails
    else                   //otherwise
     (Hy#{Merge X Fy})   //add X's head to list, rec. call with X and Y's tail
    end                    //..recursive call with X and Y's tail
   end
  end
 end

 Display = proc {$ X N}               //displays a list
  local DisplayHelp Out Result in
   DisplayHelp = proc {$ X N Out}    //produces a list
    local
     (H#F) = {X}                    //break up the stream
    in
     if ((N-1)==0) then            //when we reach the end
      Out = [H]                    //return the head of the stream
     else T in                     //otherwise
      {DisplayHelp F (N-1) T}     //get the rest with recursion
      Out = (H|T)                 //output the list
     end
    end
```

Eric Smrkovsky
10/16/2019
Csci 117
Lab 8

```
      end
      {DisplayHelp X N Result}          //call helper to get list
      skip Browse Result                //display the list
    end
  end

X = {Generate3 1}                  //stream contents: [3 6 9 12 15 18 21 ...]
Y = {Generate5 1}                  //stream contents: [5 10 15 20 ...]
{Display {Merge X Y} 8}            //output: [3 5 6 9 10 12 15 18]
End
```

Eric Smrkovsky
10/16/2019
Csci 117
Lab 8

1.a.4

```
local E Generate Ham Times Merge Display Result in

fun {Generate N}                //generate a stream
  fun {$}
    (N#{Generate (N+1)})
  end
end

  fun {Merge X Y}             //merges two generated streams
    fun {$}
      (Hx#Fx) = {X}           //break apart X
      (Hy#Fy) = {Y}           //break apart Y
    in
      if (Hx<Hy) then         //if head of X is less then
        (Hx#{Merge Y Fx})     //add it to list, rec. call with Y and X's tail
      else                    //otherwise
        if (Hx==Hy) then      //if the heads are equal then
          (Hy#{Merge Fx Fy})  //add one to list and rec. call with the tails
        else                  //otherwise
          (Hy#{Merge X Fy})   //add X's head to list, rec. call with X and Y's tail
        end                   //..recursive call with X and Y's tail
      end
    end
  end

  Display = proc {$ X N}              //displays a list
    local DisplayHelp Out Result in
      DisplayHelp = proc {$ X N Out}    //produces a list
        local
          (H#F) = {X}                   //break up the stream
        in
          if ((N-1)==0) then            //when we reach the end
            Out = [H]                   //return the head of the stream
          else T in                     //otherwise
            {DisplayHelp F (N-1) T}     //get the rest with recursion
            Out = (H|T)                 //output the list
          end
        end
      end
      {DisplayHelp X N Result}          //call helper to get list
      skip Browse Result                //display the list
    end
  end
```

Eric Smrkovsky
10/16/2019
Csci 117
Lab 8

```
 fun {Times X N}            //returns a list of (X*N)s
   fun {$}                  //where X is a stream
     (H#F) = {X}            //break up stream
   in
     ((H*N)#{Times F N})    //head is the product, tail is recursive call
   end
 end
```

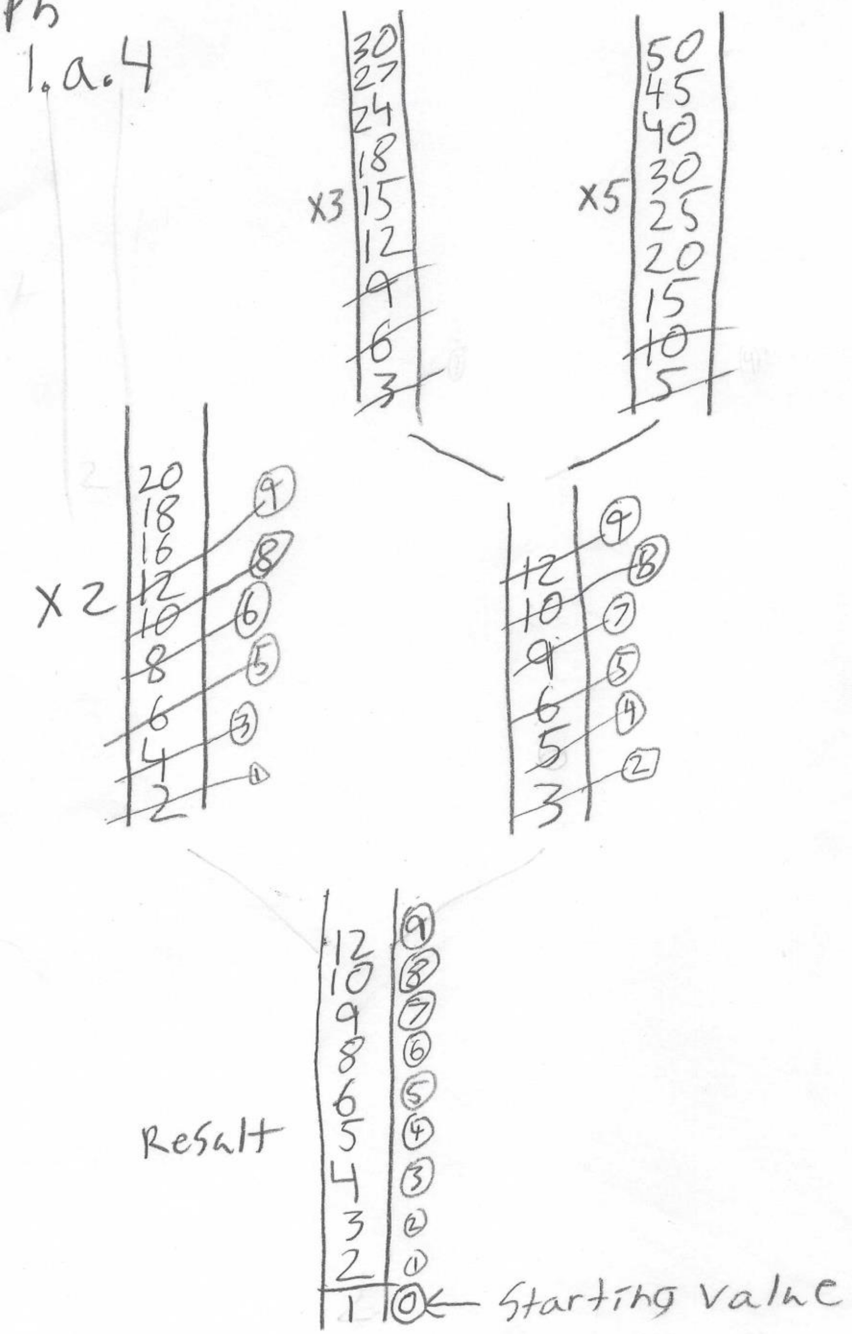
fun {Ham X}
fun {$}
(H#F) = {X}   //break up stream
in   //below is list with merged stream for a tail
(H#{Merge {Times X 2} {Merge {Times X 3} {Times X 5}}})
end
end

```
E = {Generate 1}         //a stream starting with 1
Result = {Ham E}         //start the Hamming function with 1
{Display Result 10}      //display first 10 values (below)
end
```

////Output for this program below////
//*OzKernelSyntaxParser> thread_mainK (Finite 1) "hamming.txt" "blah1.txt" "blah.2txt"
//Result : [1 2 3 4 5 6 8 9 10 12]

Eric Smrkovsky
10/16/2019
Csci 117
Lab 8

Graph for 1.a.4



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

Eric Smrkovsky
10/16/2019
Csci 117
Lab 8

1.b

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

gen:: Int -> Gen Int
gen n = G(n, gen (n+1))

-- Generator Testing
-- G(v, f) = gen 5       --  v=5
-- G(v1,f1) = f          --  v1=6
-- G(v2,f2) = f1         --  v2=7
```

-- **Part b.1** --modG--

```
-- The function modG, which takes a generator X and integer N as input,
-- and returns a generator where the values produced by X are modulated by N.

modG :: Gen Int -> Int -> Gen Int
modG (G(x, y)) n = G(mod x n, modG (gen (x+1)) n)

-- modG Testing
-- G (v,f) = modG (gen 7) 9  -- v=7
-- G (v1,f1) = f             -- v1=8
-- G (v2,f2) = f1            -- v2=0
```

-- **Part b.2** --interleave--

```
--  The function interleave, described in the notes, except it takes in a
--  list of generators of arbitrary size as input, interleaves them in order.

interleave :: [Gen Int] -> Gen Int
interleave ((G(x, y)):gs) = (G(x, interleave (gs++[gen (x+1)])))

G (v,f) = interleave [gen 3, gen 7, gen 13]
G (v1,f1) = f     -- v=3
G (v2,f2) = f1    -- v=7
G (v3,f3) = f2    -- v=13
G (v4,f4) = f3    -- v=4
G (v5,f5) = f4    -- v=8
G (v6,f6) = f5    -- v=14
G (v7,f7) = f6    -- v=5
```

Eric Smrkovsky
10/16/2019
Csci 117
Lab 8

Part 2

2.a, 2.b and 2.c below in bold

```
local GateMaker AndG OrG NotG A B S IntToNeed Out MulPlex in
	//gatemaker is on pg 316
	GateMaker = fun {$ F}
		fun {$ Xs Ys} T
			GateLoop = fun {$ Xs Ys}
				case Xs of nil then nil
				[] '|'(1:X 2:Xr) then
					case Ys of nil then nil
				  [] '|'(1:Y 2:Yr) then
						({F X Y}|{GateLoop Xr Yr})
					end
				end
			end
			in
			T = thread X = {GateLoop Xs Ys} in X end // thread wasn't added to
expressions
			T
		end
	end

	NotG = fun {$ Xs} T
		Loop = fun {$ Xs}
		  case Xs of nil then nil
		  [] '|'(1:X 2:Xr) then ((1+(X*-1))|{Loop Xr})
		  end
		end
		in T = thread X = {Loop Xs} in X end T
	end
```

2.b

```
	AndG = {GateMaker fun {$ Xs Ys} O in
		if (Xs==0) then O = 0
	//short circuit
		else O = (Xs*Ys)
		//use expression
		end
		O
									//output
	end}

	OrG = {GateMaker fun {$ Xs Ys} O in
		if ((Xs+Ys)==0) then O = 0						//short circuit
```

Eric Smrkovsky
10/16/2019
Csci 117
Lab 8

```
                else O = 1
                        //rest are true
                end
                O
                                                        //output
        end}
```

2.a

```
        IntToNeed = fun {$ Xs} Loop O in
         Loop = fun {$ Xs}
                 case Xs of nil then          //empty list case
                  nil
        [] '|'(1:X 2:Xr) then O in    //list is populated
           byNeed fun {$} X end O      //turn head into byneed
           (O|{Loop Xr})      //pass byneed var as head and repeat with tail
          end
         end
         O = {Loop Xs}
         O
        end
```

2.c

```
 fun {MulPlex A B S} And1 And2 Not Or in
  And1 = {AndG S B}
                Not  = {NotG S}
                And2 = {AndG Not A}
                Or = {OrG And1 And2}
                Or
 end

 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}

 // run a loop so the MulPlex threads can finish before displaying Out
 local Loop in
 proc {Loop X}
  if (X == 0) then skip Basic
  else {Loop (X-1)} end
 end
 {Loop 1000}
 end
        skip Browse Out

end
```

Eric Smrkovsky
10/16/2019
Csci 117
Lab 8

2.d

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}

2.d.1

The AndG function tests if the members of the list of S bits are 0 and if they are it "short-circuits" automatically returning 0 (false). So whichever value of the A or B bit lists that is in that specific position is not processed.
I will bold the members of the lists that are not processed.
S = [1 0 1 0 1 1]
B = [1 **1** 1 **0** 1 0]
Now for the A list the S list has had its bit's flipped when ran through the Not gate.
(not) S = [0 1 0 1 0 0]
A = [**0** 1 **1** 0 **0** **1**]
As you can see here it is always parallel with the zeros of the S list. The members of A that are not being accessed are in the positions of all the members of the B list that were accessed due to the Not gate.

2.d.2

The needed values have store locations which all point to ones or zeros.

169 -> 1
245 -> 1
308 -> 1
331 -> 1
345 -> 0
385 -> 0

I believe that the way this program is executed, the store locations are assigned in a sort of staggered way due to the threading processes of the program So the bits I have shown you are not assigned in the order that they appear in the list. The right number of ones and zeros are present though! Three of the ones and one zero is from B and the remaining one and zero is from A.