# Data Flow Diagram

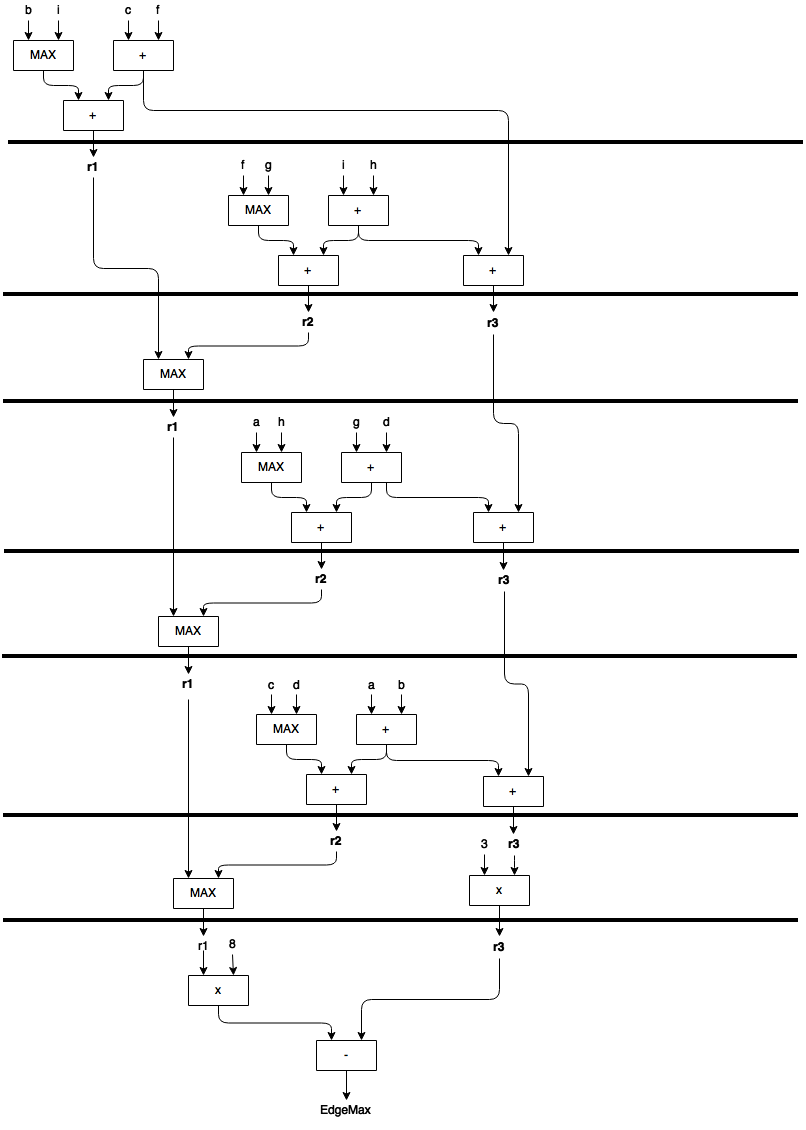
Group 7

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## Total Resources Used

Adders: 11

Subtractors: 1

Comparators (ie. Maxers): 7

Registers: 18

## Latency

8 Clock Cycles

## Throughput

1/8

## Total Area Estimate

Registers: 3

Output: 1

Input: 4

Adders: 3

Maxers: 1

Multipliers: 1

Subtractors: 1

## Clock Period

Flop + Maxer + Maximum(3\*adder, multiplier)

## Optimality

Low-Area

## How the Calculations Were Done

We began with listing down the eight equations for each direction, and grouped them in pairs – NE and E, SE and E, SW, and W, and NW, and N. Let’s work with NE and E for example:

NE = 5 \* (b + c + f) – 3 \* (a + d + g + h + i)

E = 5 \* (c + f + i) – 3 \* (a + b + d + g + h)

We simplified these equations using the identity 5A-3B = 8A – 3(A+B).

This simplifies our equations to:

NE = 8 \*(b + c + f) – 3 \* ((b + c + f) + (a + d + g + h + i))

E = 8 \* (c + f + i) – 3 \* ((c + f + i) + (a + b + d + g + h))

We observed that the right hand side of the calculation (ie. 3 \* ((b + c + f) + (a + d + g + h + i))) stays the same for each of the eight directions, so we would not need these to determine our *EdgeMax.*

To determine which was the larger direction in each pair, we observed that in the left hand side of the calculation, (c+f) remained the same; so, we only really need the value of b in NE, or i in E to determine which is the larger direction of the two. Thus, simply max(b, i) gives us the larger of the two equations. We repeat this process for the remaining three pairs of equations.

We’ve thus narrowed our problem down to four directions (ie. the larger of each pair), and need to find the largest of these; so, we add the two common terms that each direction shared with its paired partner (c+f for the NE and E group), and have to calculate the maximum of these sums to find our *EdgeMax.*

NE and E: (Max(b, i) + (c + f))

SE and S:(Max(f, g) + (i + h))

SW and W: (Max(a, h) + (g + d))

NW and W: (Max(c, d) + (a + b))

Thus, our final equation for the value of *EdgeMax* is: 8\*Max((Max(b, i) + (c + f)), (Max(f, g) + (i + h)), (Max(a, h) + (g + d)), (Max(c, d) + (a + b))) – 3\*(a+b+c+d+f+g+h+i).