ESE5320 Homework 2

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Answers

1. **Identify**

   1) **Scale**: this function downscales an image(stored in a 1d array "input") by only outputing every two pixel.

      Filter: applies a convolution filter to the image; first horizontally, then vertically, using hard-coded coefficients. It takes the input image to produce a smoothed output image.

      Differentiate: for each pixel, use the value of its left pixel and its up pixel to calculate an average, and output will be the difference between that pixel's value and the average.

      Compress: This compresses the input array using Huffman coding, packing bits into the output array one byte at a time. It returns the total number of bytes written to the output.

2. **Measure**

Functions	$T_{\text{measured\_avg}}$(ns)	% of Total Latency	$T_{\text{measured\_avg}}$(cycles)
Scale	2.09032e+07	3.64	7.10708+e07
Filter horizontal	1.03589e+08	14.57	3.52202e+08
Filter vertical	1.04882e+08	16.39	3.56599e+08
Differentiate	2.59741e+07	3.64	8.83120e+07
Compress	3.22591e+08	61.94	1.09681e+09

   1) Done

2) Done

3) Done

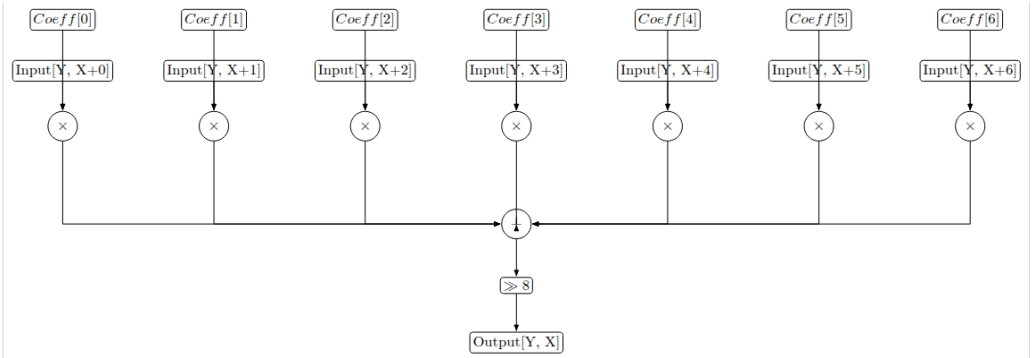
3. **Analyze**

1)

Functions	$T_{\text{measured\_avg}}$ (ns)	$T_{\text{measured\_avg}}$ (cycles @ 1.2 GHz)
Scale	8.426840e+08	1.011221e+09
Filter_horizontal	5.241310e+09	6.289572e+09
Filter_vertical	5.299610e+09	6.359532e+09
Differentiate	1.632450e+09	1.958940e+09
Compress	5.363130e+09	6.435756e+09

2) The Scale funtion has the highest latency.

3)



4) total operation count is **3.35664e+08**, and average latency is **3.35664e+08** cycles

5) I would choose **Compress** because it has the highest latency and therefore will benifit the most from speedups.

6) function Compress takes about 29% of total latency, so the maximum possible speedup is 1/(1-0.29) = **1.4**

7) todo

8) critical path length is **5 operations**

9) need two cycles for mult, 3 for add and 1 for shift, therefore lower bound is **3 cycles**