Birzeit University

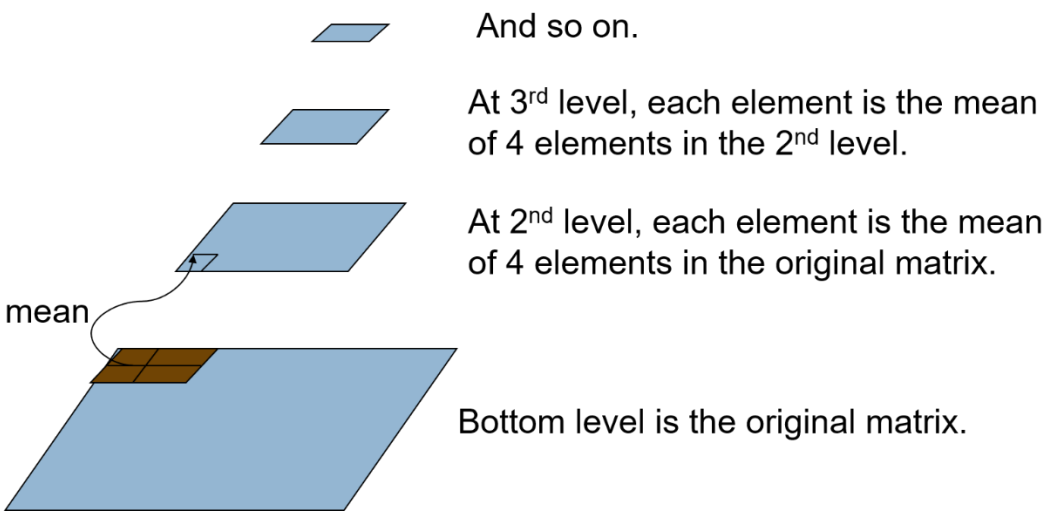
Department of Electrical & Computer Engineering

ENCS4370: Computer Architecture

First Project

Matrix down sampling:

Write a MIPS program that dose matrix down sampling as illustrated in the figure below:



As seen from the figure, the bottom level is the input matrix. Each element in the second level is computed as the mean of the 4 elements in the original matrix. The mean can be computed using the arithmetic mean or using median value. The figure below shows how to compute the second level using the arithmetic mean:

Input Matrix

2	5	4	1
7	4	7	2
10	11	20	7
7	12	4	8

Window (second level)

1.5	0.5
0.5	1.5

Output Matrix (second level)

4.5	4.5
9.25	10.87

Where the output matrix (second level) computed as:

4.5 = (2*1.5+5*0.5+7*0.5+4*1.5)/4,

4.5 = (4*1.5+1*0.5+7*0.5+2*1.5)/4,

9.25 = (10*1.5+11*0.5+7*0.5+12*1.5)/4,

10.87 = (20*1.5+7*0.5+4*0.5+8*1.5)/4.

If the user enters 3rd level, the program first compute 2nd level and from the 2nd level the program computes the 3rd level and the matrix will be as follows:

Output Matrix (second level)

4.5	4.5
9.25	10.87

Window (third level)

0.5	1.5
1.5	0.5

Output Matrix (third level)

7.48

Where the output matrix computed as:

7.48 = (4.5*0.5+4.5*1.5+9.25*1.5+10.87*0.5)/4,

Note that for arithmetic mean, we used two windows: one for the even level, and the other for the odd level.

Here is the same example computed using median:

Input Matrix

2	5	4	1
7	4	7	2
10	11	20	7
7	12	4	8

Output Matrix (second level)

4.5	3
10.5	5.5

Output Matrix (second level)

4.5	3
10.5	5.5

Output Matrix (third level)

5

Where: the output matrix (second level) computed as:

4.5 = median(2,5,7,4)

3 = median(4,1,7,2)

10.5 = median(10,11,7,12)

5.5 = median(20,7,4,8)

Note that, to find the median, you need to sort the elements then choose the middle one. Since the number of elements is even you need to find average of the middle two numbers.

The input to the program is the original matrix, the required level, and the way of computing average (1. Arithmetic mean, 2. Median). The input matrix should be read from a file named "Input". The program must print to a file named "output" the computed matrix with the required level. The program must raise an error if the required level cannot be computed (for example: the 4^{th} level cannot be computed from the input matrix above) or the size of the matrix is not divided by 4.

Submission:

Please submit the following:

1. MIPS code
2. Test cases

Notes:

- Write the code for the MIPS program to satisfy the requirements described above.
- Make sure your code is clean and well indented; variables have meaningful names, etc.
- Make sure your script has enough comments inserted to add clarity.
- Your code must be modular and easy to follow.
- Work as a group of at most two students.
- **The grading will be on the submitted files only (any changes after the deadline won't be discussed).**
- **Discussion of the project will begin immediately after submission due date.**