Workshop fixes

msp exercise

Work

there has been a few small mistakes for the calculation of the work complexity of the msp algorithm, in the 2nd listing, AlgorithmMSP_1D should take 2m+3, not 2n+3, while the 2nd for loop should take m time, so the calculation would be the following

W = $1 + n * (n + (n - i) * (m + (2m + 3) + 1)) + 1$

using wolfram alpha, the reduced term is:

W = $(3n^2m + 3nm + 6n^2 + 4n + 4) \over 2$

where the reduced asymptotic running time can be reduced to being $O(n^2m)$

The parallelisation algorithm intro

The intro is slightly wrong, the line numbers doesn't match where the difficulty in parallelisation lies, the inner for loop is hard but not impossible to calculate with some inter-process communication. the two lines were changed throughout making the assignment however, so the problem was moved, the problem is within AlgorithmMSP_1D, where the two for loops have data dependency so it will be very difficult to parallelise

parallel work

much like the sequential work it should also be different.

The asymptotic running time of the parallel algorithm must be $O(n^2m)$

The depth of this algorithm should also be $O(nm)$

The algorithm

For the java implementation of the MSP algorithm it has been parallelised using the equivalent of concurrent futures. This means that an executorservice has been defined such that processes can be given to this executer and executed while the main process continues. The result from futures can be accessed at any time but if the get function is called it will wait until a result is generated.

dct exercise

Parallel

This implementation was implemented using a pool defined from the multiprocessing library.

jit

First jit had to be investigated, apparently the numpy arrays being worked on was of different datatypes preventing jit from enabling nopython mode, going into object mode.

The fix was to go through every operation that should be run with jit and changing the datatypes of the numpy arrays, while making non-numpy arrays into numpy arrays. this fixed our issue with jit not going into nopython mode.

cuda

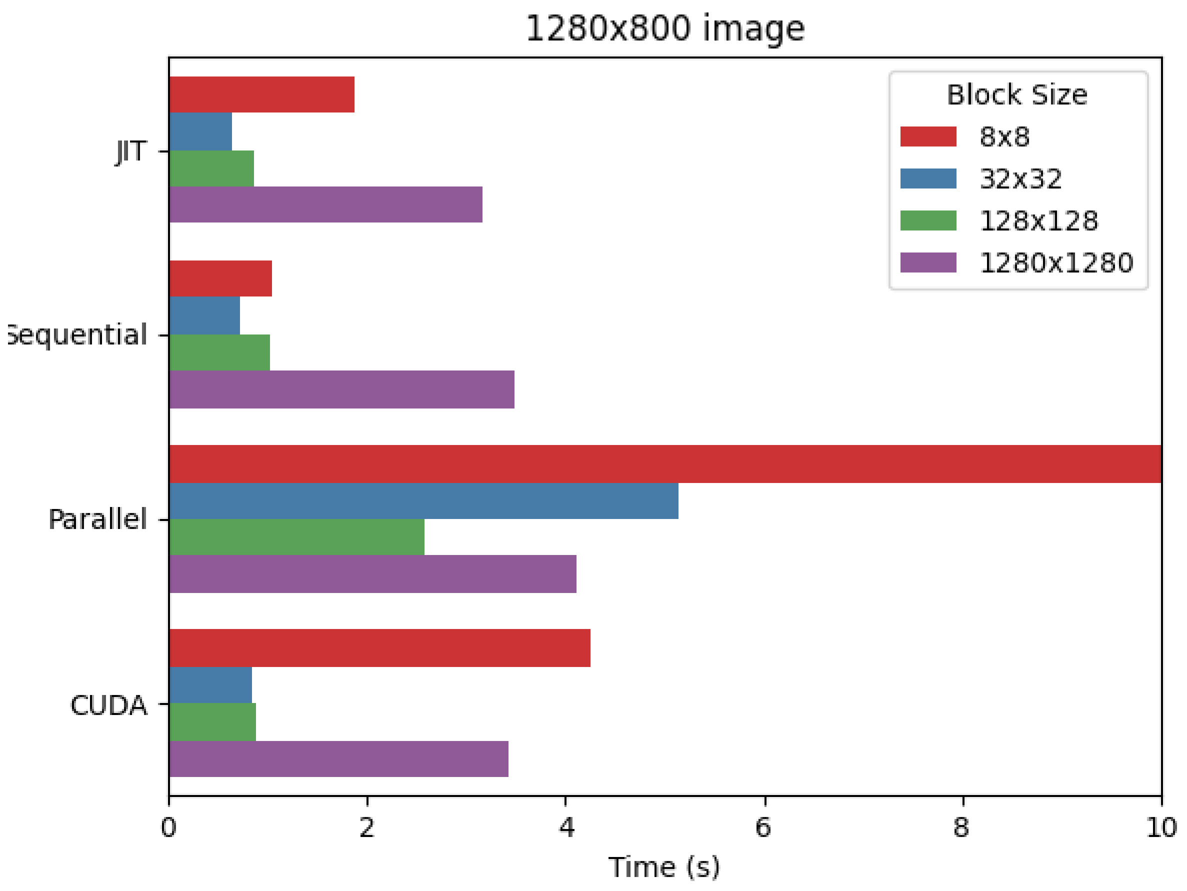
Then cuda was also an issue because it was weirdly fast, the suspicion here was that there should be so much communication cost that it should be significant overhead.

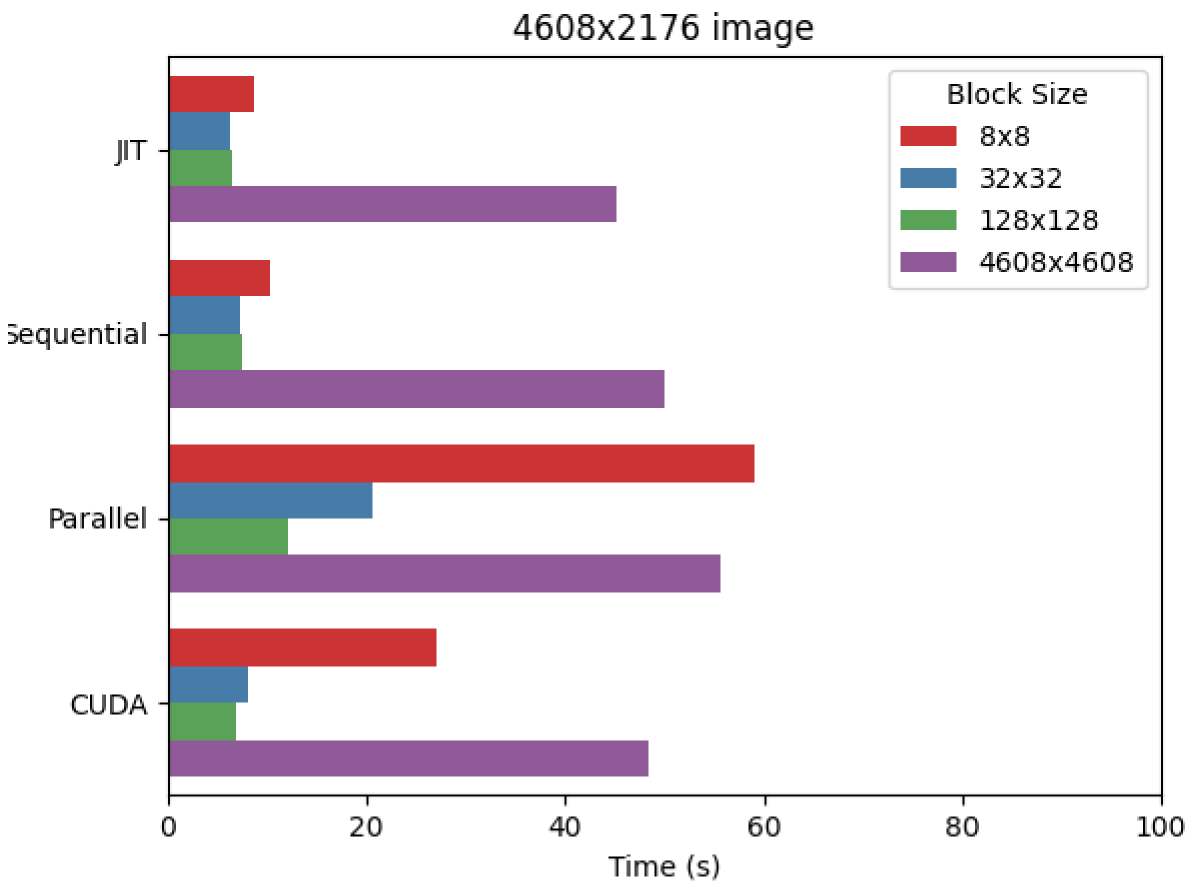
The cuda implementation was tested and apparently the first time it was tested it was not utilizing the GPU, rather the program was running on a cpu. fixing it was a matter of two things;

first every single tensor should have a device assigned to it

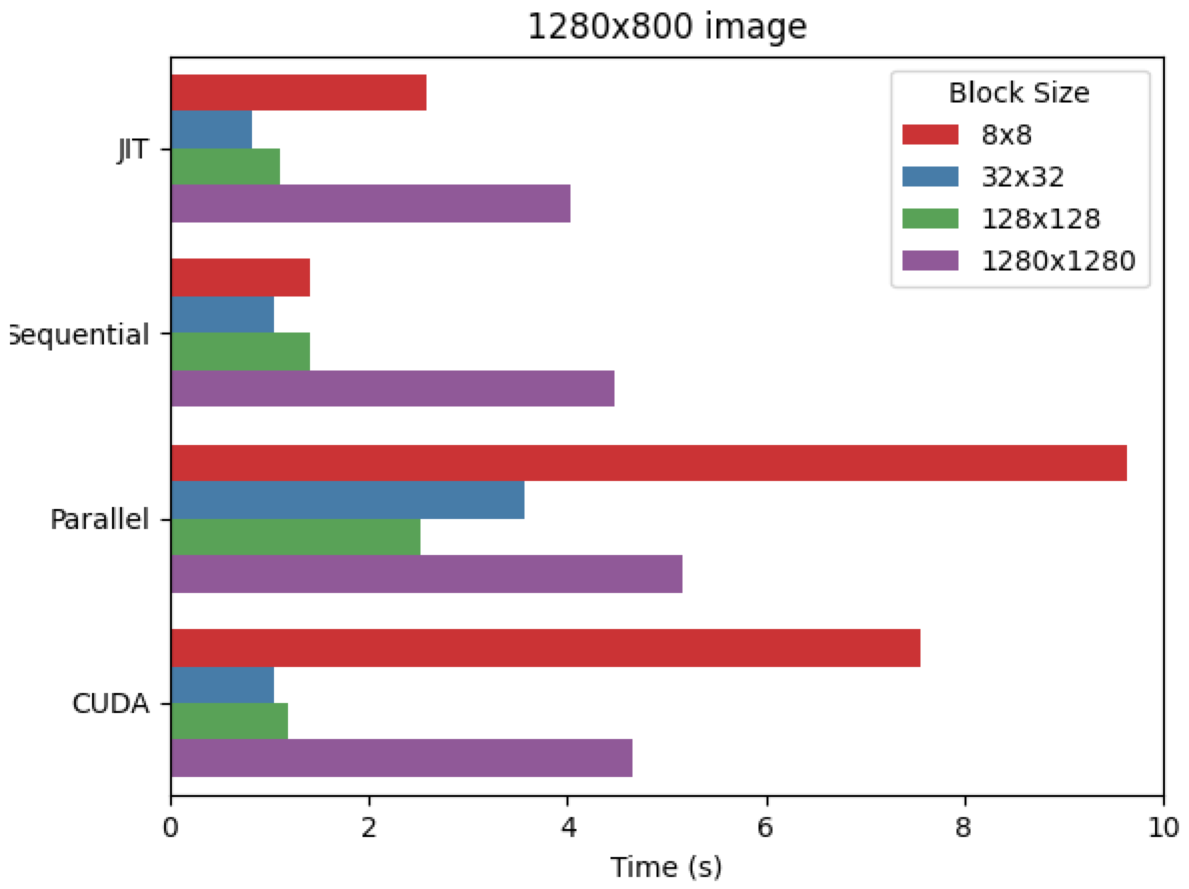
Second the tensors were defined in the multiply and hadamard functions which means that for every loop in the function, the program would create new tensors for the dct and the quantization matrices. these tensors could have been defined once at the beginning of the program, thus generating a significant performance improvement.

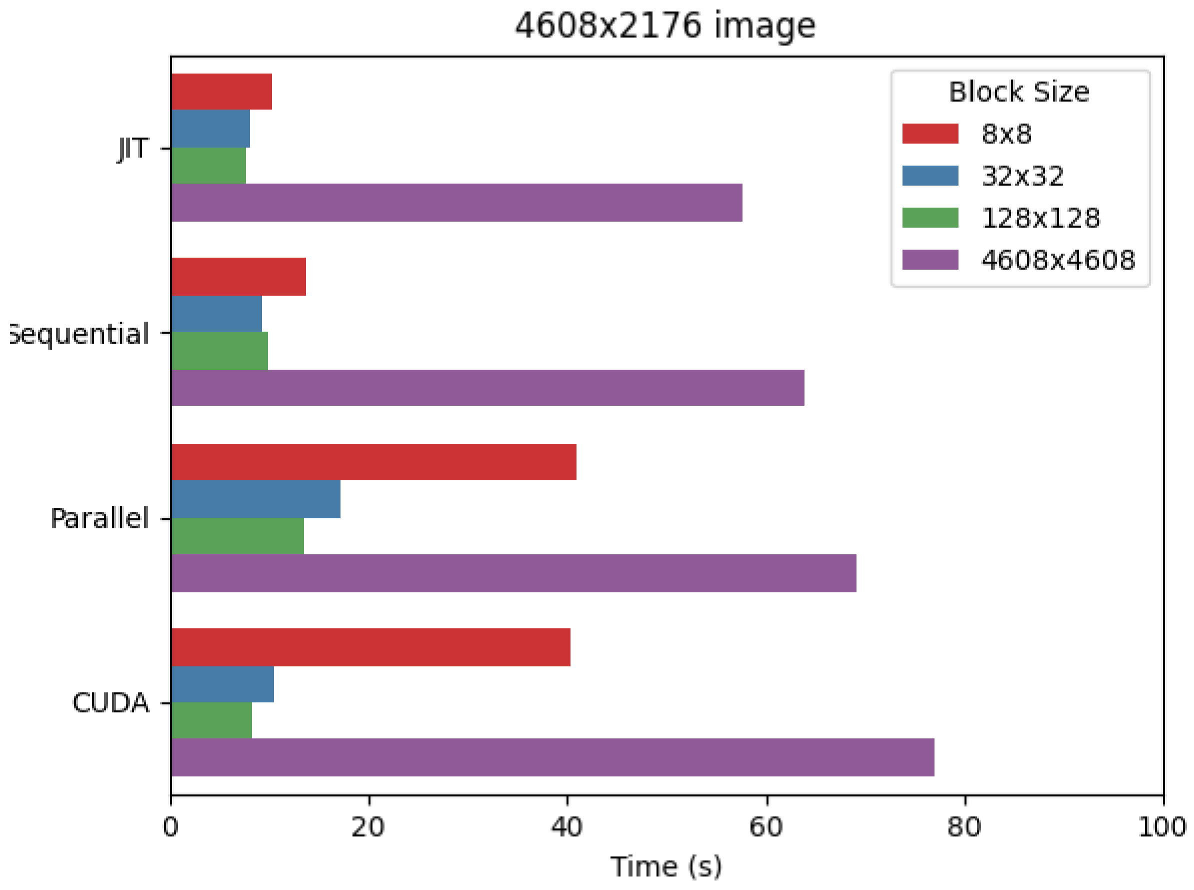
Results with a Geforce GTX 1080 GPU over the PCI-Express bus + 6 core cpu





Results with a Nvidia Quadro m3000m integrated GPU + 4 core cpu


1280x800 image
JIT
Sequential
Parallel
CUDA
Block Size
8x8
32x32
128x128
1280x1280
0
2
4
6
8
10
Time (s)


4608x2176 image
JIT
Sequential
Parallel
CUDA
Block Size
8x8
32x32
128x128
4608x4608
0
20
40
60
80
100
Time (s)