Assignment 1

SCP8082721 - QUANTUM INFORMATION AND COMPUTING

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Exercise 2

- (a) Integer*2 can not add 2000000 and 1 since it can only represent integers from -32768 to 32767. Interestingly, if you add 1 to 32767 the printed result is -32768 and not Error: Arithmetic overflow, what I would expect to get.
- (b) Adding $\pi \cdot 10^{32}$ and $\sqrt{2} \cdot 10^{21}$
  - single precision result is 3.14159278E+32.
  - double precision result is 3.1415926536039354E+032.

Results exercise 3

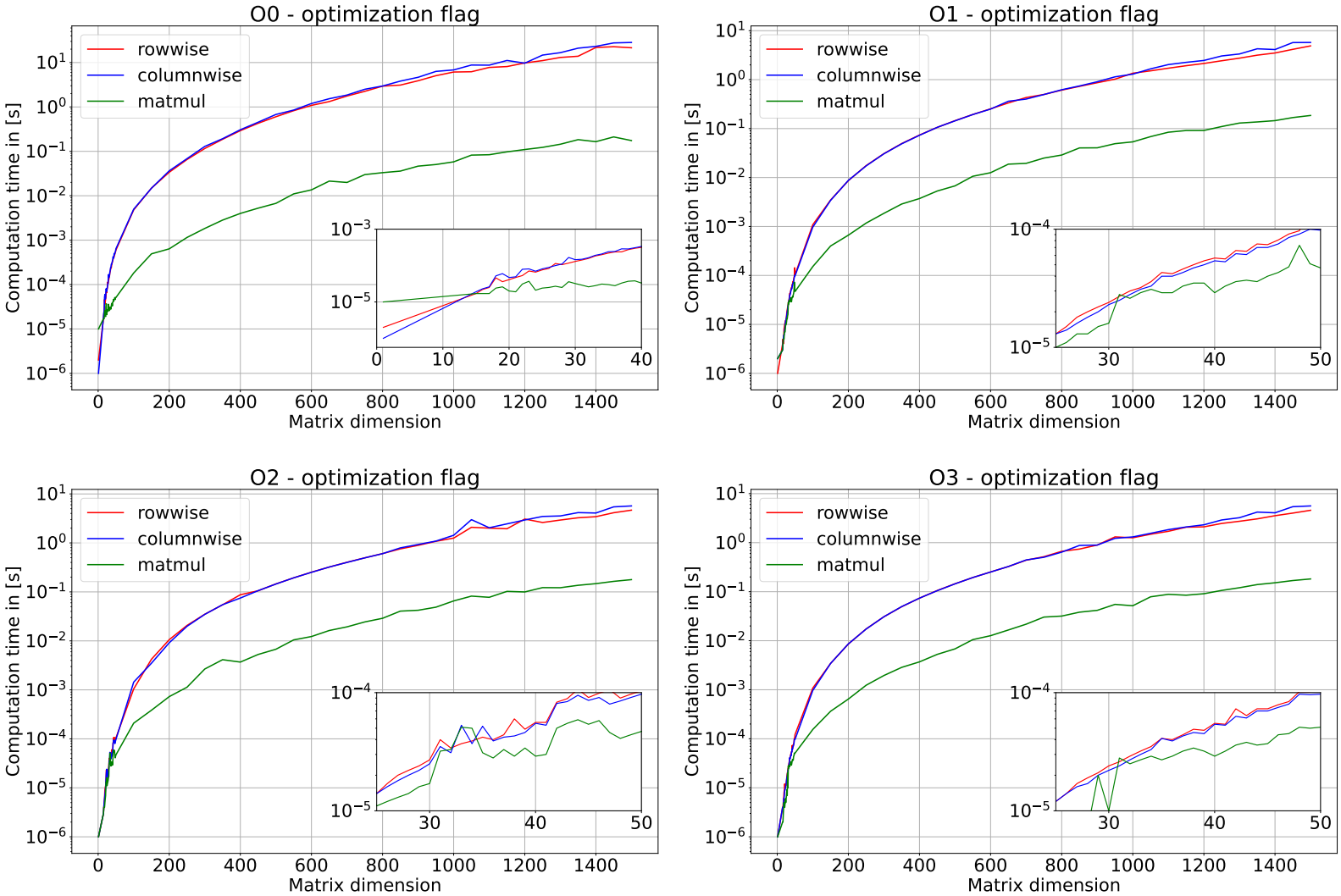

Figure: Some optimization flags. Note: The smaller plot is simply the big plot zoomed in onto the intersection point of the three lines.

Results exercise 3

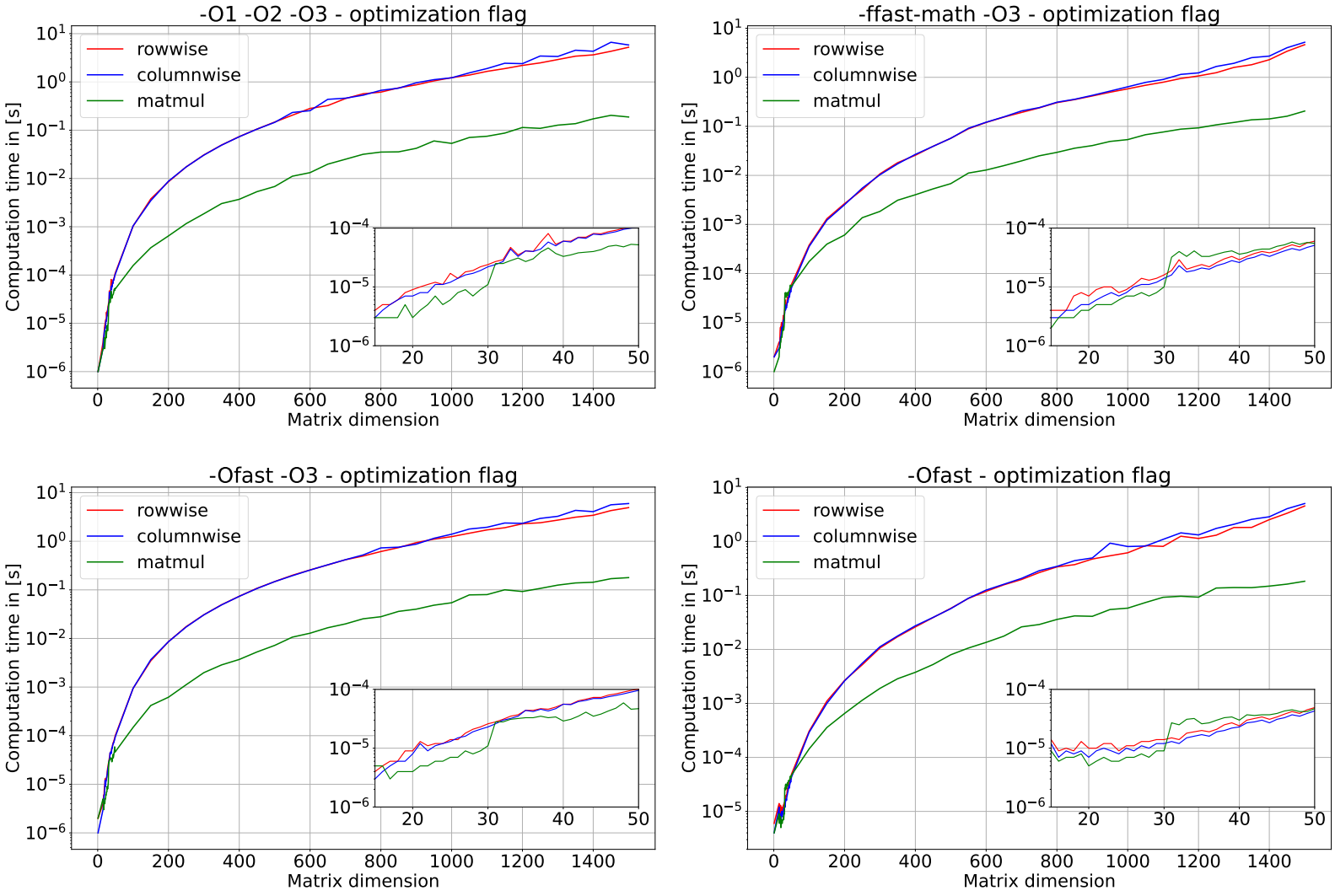

Figure: Some more optimization flags.

Results exercise 3

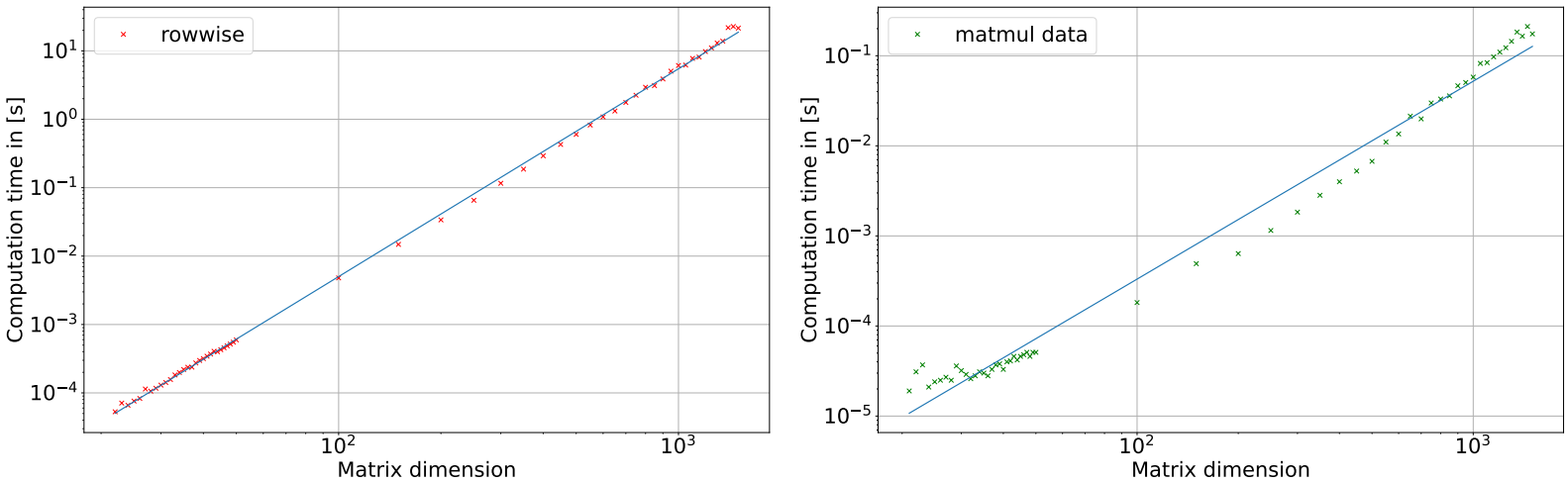

Figure: Doing a time complexity analysis on the unoptimized results (-O0): matmul gives $\mathcal{O}(n^{2.2})$ and the explicit calculation scales as $\mathcal{O}(n^{3.0})$.

Some thoughts on Exercise 3

- I used GCC (Gnu Compiler Collection) to find out which optimization flags exist and what they each do. [1]
- For very small matrix sizes (up to n = 10 roughly), the explicit calculation is faster. From some point (for the best optimization flags at roughly 100, for the less aggressive optimization O1 - O3 between n = 20 and n = 40) the intrinsic becomes much faster. At n = 1400 it is almost two orders of magnitude faster even for the best optimization flags.
- -Ofast is the best flag of the ones I tried out.

[1] https://gcc.gnu.org/onlinedocs/gcc/Optimize-Options.html (accessed 27.10.2022)