Implementation

- I use `profile('info').FunctionTable(1).TotalTime` to get the running time.[1]
- To minimize the variance of the results, I run every function for 20 times and calculate the average of them.

Analysis

When $n \gg 1$,

$$\mathcal{T}(\text{For}) > \mathcal{T}(\text{MAT}) > \mathcal{T}(\text{FFT}) > \mathcal{T}(\text{GPU}).$$

The inequality holds by the following facts:

1. $\mathcal{O}(\text{FOR}) = n^2$.
2. MATLAB has a optimization for matrix multiplication. Thus $\mathcal{O}(\text{MAT}) < n^2$ (may be $n^{1.4}$).[2]
3. $\mathcal{O}(\text{FFT}) = \mathcal{O}(\text{GPU}) = n\log(n)$.

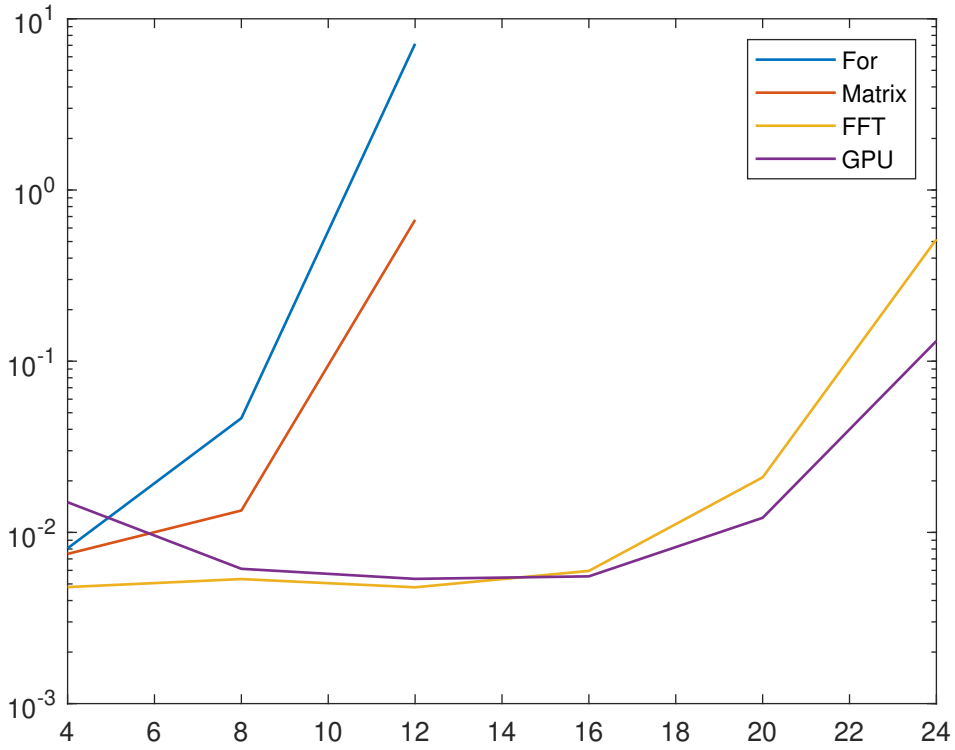

Figure 1: Running time of different types of FFT

[1] I refer to https://stackoverflow.com/questions/30125908.
[2] Basic Linear Algebra Subprograms,Wikipedia.