Ay190 – Worksheet 6

Xiangcheng Ma

Date: January 23, 2014

Discrete Fourier Transform

(a) The function `dft(x)` that computes discrete Fourier transform is achieved in module "`dft.py`". To test this function, I uniformly generate 30 point in $[-2,2]$ for a Gaussian function

$$f(x) = \frac{1}{\sqrt{2\pi}} e^{-\frac{x^2}{2}}, \tag{1}$$

and calculate the discrete Fourier transform using my function and the `np.fft.fft` function. The results are listed in Table 1. Their results are consistent within my output accuracy, i.e., 10^{-9}.

(b) For 100 calculations, the accumulated time versus N^2 are plotted in Figure 1. It shows basically a linear relation.

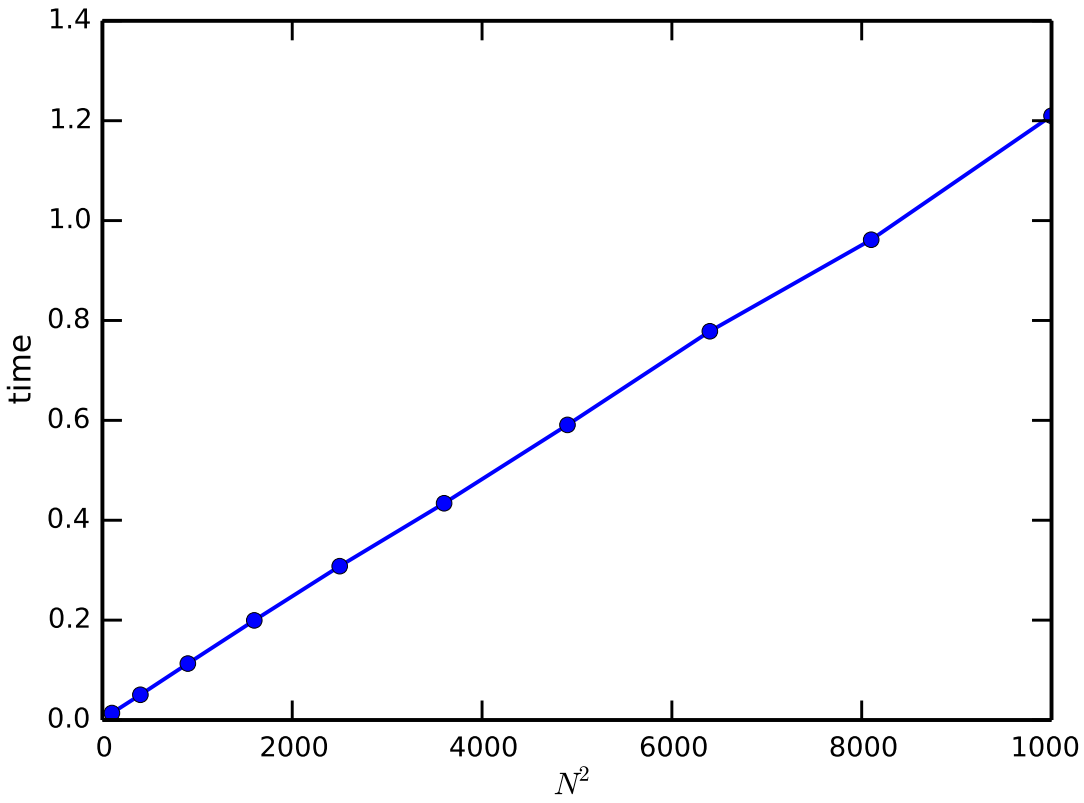

Figure 1: Computer time for `dft(x)` function.

(c) For 100 calculations, the accumulated time versus $N\log(N)$ are plotted in Figure 2. Although some scatter exists, the relation is in general linear.

`dft(x)`	`np.fft.fft(x)`
6.971632500+0.000000000*i*	6.971632500+0.000000000*i*
-2.489146792-0.261619870*i*	-2.489146792-0.261619870*i*
-0.042808965-0.009099326*i*	-0.042808965-0.009099326*i*
-0.058058048-0.018864203*i*	-0.058058048-0.018864203*i*
-0.032299210-0.014380535*i*	-0.032299210-0.014380535*i*
-0.019552499-0.011288641*i*	-0.019552499-0.011288641*i*
-0.012453261-0.009047824*i*	-0.012453261-0.009047824*i*
-0.008147322-0.007335881*i*	-0.008147322-0.007335881*i*
-0.005370869-0.005964954*i*	-0.005370869-0.005964954*i*
-0.003503690-0.004822416*i*	-0.003503690-0.004822416*i*
-0.002215366-0.003837127*i*	-0.002215366-0.003837127*i*
-0.001318619-0.002961667*i*	-0.001318619-0.002961667*i*
-0.000702697-0.002162678*i*	-0.000702697-0.002162678*i*
-0.000300840-0.001415339*i*	-0.000300840-0.001415339*i*
-0.000073574-0.000700006*i*	-0.000073574-0.000700006*i*
0.000000000-0.000000000*i*	0.000000000-0.000000000*i*
-0.000073574+0.000700006*i*	-0.000073574+0.000700006*i*
-0.000300840+0.001415339*i*	-0.000300840+0.001415339*i*
-0.000702697+0.002162678*i*	-0.000702697+0.002162678*i*
-0.001318619+0.002961667*i*	-0.001318619+0.002961667*i*
-0.002215366+0.003837127*i*	-0.002215366+0.003837127*i*
-0.003503690+0.004822416*i*	-0.003503690+0.004822416*i*
-0.005370869+0.005964954*i*	-0.005370869+0.005964954*i*
-0.008147322+0.007335881*i*	-0.008147322+0.007335881*i*
-0.012453261+0.009047824*i*	-0.012453261+0.009047824*i*
-0.019552499+0.011288641*i*	-0.019552499+0.011288641*i*
-0.032299210+0.014380535*i*	-0.032299210+0.014380535*i*
-0.058058048+0.018864203*i*	-0.058058048+0.018864203*i*
-0.042808965+0.009099326*i*	-0.042808965+0.009099326*i*
-2.489146792+0.261619870*i*	-2.489146792+0.261619870*i*

Table 1: Discrete Fourier Tranform

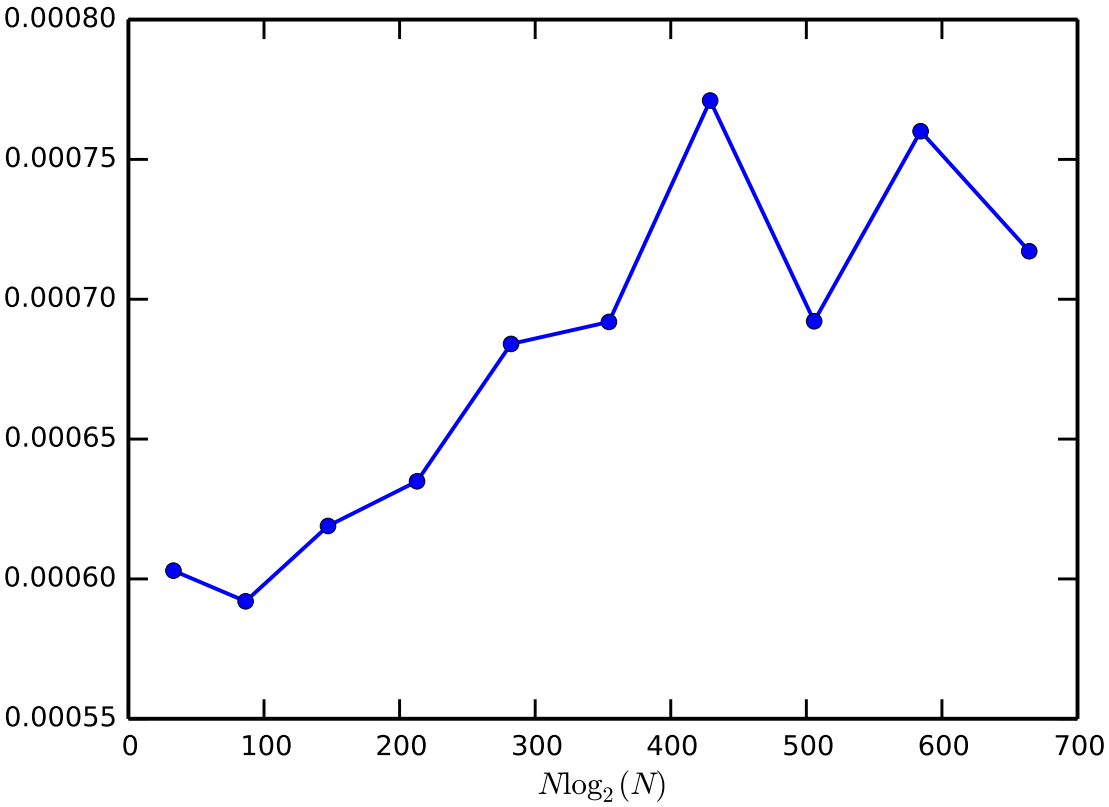

Figure 2: Computer time for `dft(x)` function.