1. Data

I did four experiments instead of three. I added a cache version of mydig.py. The result of the four experiments are shown in the following table. The data is the average of 10 runs.

Websites	mydig.py (no cache)	mydig.py (cache)	vmns2.cs.stony brook.edu.	google-public-dns-a.google.com.
google.com	158.54	18.02	4.29	7.83
youtube.com	157.33	17.16	4.38	5.83
facebook.com	149.83	14.66	5.41	5.6
baidu.com	481.67	48.02	5.85	6.03
wikipedia.org	181.4	20.16	5.34	5.33
reddit.com	154.99	14.56	5.55	5.75
yahoo.com	163.95	17.04	5.71	5.84
google.co.in	330.46	34.43	5.68	5.76
qq.com	530.92	46.67	6.05	5.6
taobao.com	217.87	22.05	4.92	5.04
amazon.com	152.11	15.21	6.54	5.98
tmall.com	218.58	21.17	5.8	13.86
twitter.com	155.45	14.81	5.21	5.82
google.co.jp	501.6	56.97	5.84	6.19
instagram.com	167.4	15.62	7.12	6.55
live.com	222	21.57	5.12	5.11
sohu.com	464.18	47.39	5.37	6.02
vk.com	849.95	81.81	4.92	5.84
sina.com.cn	645.02	71.91	4.59	5.79
jd.com	563.32	92.19	4.08	4.99

The IP of vmns2.cs.stonybrook.edu. is 130.245.9.242.
The IP of google-public-dns-a.google.com. is 8.8.8.8.

2. Visualization

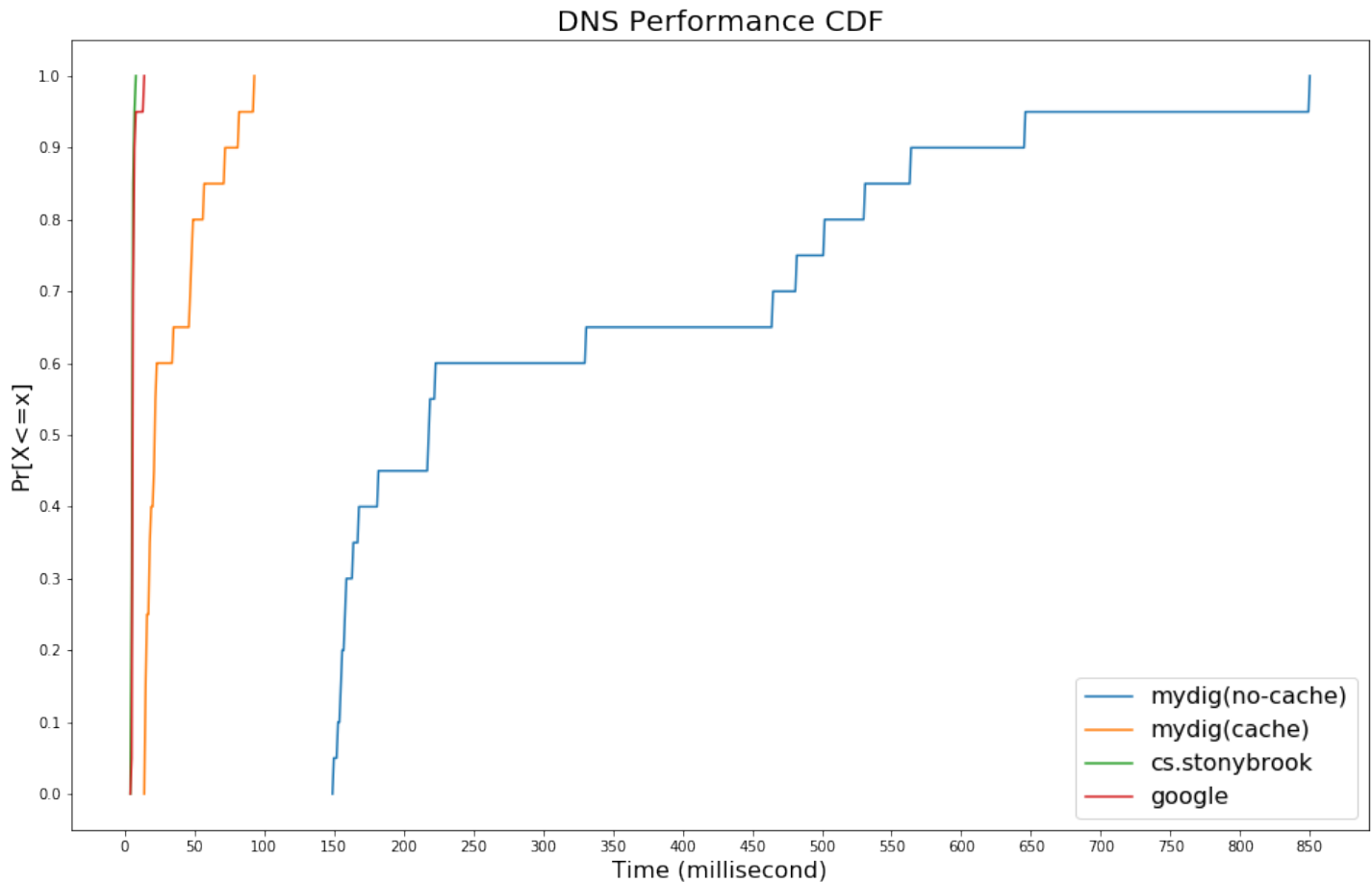Below is the **CDF** of the performance data.

Figure 1: CDF of DNS performance

3. Explanation

The DNS server of cs.stonybrook.edu and google perform very well, their time usage is mainly in the (4,6) millisecond range. I think it is because the they have cached the popular website. So, the packet travels to the DNS server and directly comes back.

Figure 2 and figure 3 prove they use cache to enhance time performance. I use www.ictbox.com as my example. It is a very **unpopular** website and the **DNS server do NOT have the cache until I make the query.**

Input-1: dig www.ictbox.com
Input-2: dig www.ictbox.com
Output-1: 389 msec
Output-2: 6 msec

Figure 2: First dig www.ictbox.com

Figure 3: Second dig www.ictbox.com. A lot faster because the first dig is cached

The first dig cost as much as 389 msec and the **second dig only cost 6 msec**. I believe this is because of the **caching mechanism**. Therefore, I also implemented a cache version. In the cache version of mydig, the first dig cost much time, but the following nine queries cost nearly ZERO time. This cache mechanism speeds up the time performance to a large extent.