Stochastic and distribution method before and after optimization evidence

I performed 5 tests when it was unoptimized and optimized then took the average of them all. These test results will be shown in the Figures below.

All tests were performed on the same hardware and conditions.

Unoptimized Stochastic Tests

Test 1 – 56.40

Test 2 – 58.38

Test 3 – 55.45

Test 4 – 59.01

Test 5 – 57.73

Average: 57.394 (Unoptimized)

Optimized Stochastic Tests

Test 1 – 50.97

Test 2 – 50.40

Test 3 – 50.78

Test 4 – 50.07

Test 5 – 50.44

Average: 50.532 (Optimized)

Time saved from optimization: 6.862

```
(venv) PS C:\Users\aaron\PycharmProjects\c2060506-csc1034-practical3-2022> python page_rank.py -m stochastic
The number of nodes is: 555
The number of edges is: 11849
Top 20 pages:
5.04     http://www.ncl.ac.uk/computing/about/
5.02     http://www.ncl.ac.uk/computing/
5.02     http://www.ncl.ac.uk/computing/news/
5.02     http://www.ncl.ac.uk/computing/current/
5.00     http://www.ncl.ac.uk/computing/sitemap/
4.99     http://www.ncl.ac.uk/computing/people/
4.99     http://www.ncl.ac.uk/computing/induction/
4.98     http://www.ncl.ac.uk/computing/undergraduate/
4.98     http://www.ncl.ac.uk/computing/outreach/
4.98     http://www.ncl.ac.uk/computing/visit/
4.98     http://www.ncl.ac.uk/computing/events/
4.98     http://www.ncl.ac.uk/computing/research/
4.96     http://www.ncl.ac.uk/computing/postgraduate/
0.92     http://www.ncl.ac.uk/computing/about/usb/
0.67     http://www.ncl.ac.uk/computing/people/seb/
0.67     http://www.ncl.ac.uk/computing/people/support/
0.66     http://www.ncl.ac.uk/computing/people/visiting/
0.66     http://www.ncl.ac.uk/computing/people/academic/
0.66     http://www.ncl.ac.uk/computing/people/research/
0.66     http://www.ncl.ac.uk/computing/people/professionalservices/
Calculation took 56.40 seconds.
```

Figure 2 – Unoptimized Stochastic test 1

```
(venv) PS C:\Users\aaron\PycharmProjects\c2060506-csc1034-practical3-2022> python page_rank.py -m stochastic
The number of nodes is: 555
The number of edges is: 11849
Top 20 pages:
5.03     http://www.ncl.ac.uk/computing/visit/
5.02     http://www.ncl.ac.uk/computing/sitemap/
5.02     http://www.ncl.ac.uk/computing/research/
5.01     http://www.ncl.ac.uk/computing/people/
5.00     http://www.ncl.ac.uk/computing/events/
5.00     http://www.ncl.ac.uk/computing/undergraduate/
5.00     http://www.ncl.ac.uk/computing/
4.99     http://www.ncl.ac.uk/computing/postgraduate/
4.99     http://www.ncl.ac.uk/computing/current/
4.98     http://www.ncl.ac.uk/computing/news/
4.97     http://www.ncl.ac.uk/computing/induction/
4.97     http://www.ncl.ac.uk/computing/outreach/
4.97     http://www.ncl.ac.uk/computing/about/
0.95     http://www.ncl.ac.uk/computing/about/usb/
0.68     http://www.ncl.ac.uk/computing/people/visiting/
0.68     http://www.ncl.ac.uk/computing/people/research/
0.67     http://www.ncl.ac.uk/computing/people/seb/
0.66     http://www.ncl.ac.uk/computing/people/professionalservices/
0.66     http://www.ncl.ac.uk/computing/people/support/
0.66     http://www.ncl.ac.uk/computing/people/academic/
Calculation took 58.38 seconds.
```

Figure 1 – Unoptimized Stochastic test 2

```
(venv) PS C:\Users\aaron\PycharmProjects\c2060506-csc1034-practical3-2022> python page_rank.py -m stochastic
The number of nodes is: 555
The number of edges is: 11849
Top 20 pages:
5.03     http://www.ncl.ac.uk/computing/news/
5.03     http://www.ncl.ac.uk/computing/postgraduate/
5.02     http://www.ncl.ac.uk/computing/events/
5.01     http://www.ncl.ac.uk/computing/induction/
5.00     http://www.ncl.ac.uk/computing/people/
5.00     http://www.ncl.ac.uk/computing/research/
5.00     http://www.ncl.ac.uk/computing/outreach/
5.00     http://www.ncl.ac.uk/computing/about/
4.98     http://www.ncl.ac.uk/computing/current/
4.98     http://www.ncl.ac.uk/computing/sitemap/
4.97     http://www.ncl.ac.uk/computing/
4.97     http://www.ncl.ac.uk/computing/undergraduate/
4.97     http://www.ncl.ac.uk/computing/visit/
0.94     http://www.ncl.ac.uk/computing/about/usb/
0.67     http://www.ncl.ac.uk/computing/people/professionalservices/
0.66     http://www.ncl.ac.uk/computing/people/seb/
0.66     http://www.ncl.ac.uk/computing/people/academic/
0.66     http://www.ncl.ac.uk/computing/people/support/
0.66     http://www.ncl.ac.uk/computing/people/research/
0.65     http://www.ncl.ac.uk/computing/people/visiting/
Calculation took 55.45 seconds.
```

Figure 4 – Unoptimized Stochastic test 3

```
(venv) PS C:\Users\aaron\PycharmProjects\c2060506-csc1034-practical3-2022> python page_rank.py -m stochastic
The number of nodes is: 555
The number of edges is: 11849
Top 20 pages:
5.01     http://www.ncl.ac.uk/computing/research/
5.01     http://www.ncl.ac.uk/computing/visit/
5.00     http://www.ncl.ac.uk/computing/undergraduate/
5.00     http://www.ncl.ac.uk/computing/events/
5.00     http://www.ncl.ac.uk/computing/sitemap/
5.00     http://www.ncl.ac.uk/computing/people/
5.00     http://www.ncl.ac.uk/computing/about/
4.99     http://www.ncl.ac.uk/computing/postgraduate/
4.98     http://www.ncl.ac.uk/computing/news/
4.96     http://www.ncl.ac.uk/computing/current/
4.96     http://www.ncl.ac.uk/computing/
4.96     http://www.ncl.ac.uk/computing/induction/
4.95     http://www.ncl.ac.uk/computing/outreach/
0.94     http://www.ncl.ac.uk/computing/about/usb/
0.67     http://www.ncl.ac.uk/computing/people/academic/
0.67     http://www.ncl.ac.uk/computing/people/visiting/
0.66     http://www.ncl.ac.uk/computing/people/research/
0.66     http://www.ncl.ac.uk/computing/people/professionalservices/
0.66     http://www.ncl.ac.uk/computing/people/seb/
0.65     http://www.ncl.ac.uk/computing/people/support/
Calculation took 59.01 seconds.
```

Figure 3 – Unoptimized Stochastic test 4

```
(venv) PS C:\Users\aaron\PycharmProjects\c2060506-csc1034-practical3-2022> python page_rank.py -m stochastic
The number of nodes is: 555
The number of edges is: 11849
Top 20 pages:
5.02    http://www.ncl.ac.uk/computing/sitemap/
5.01    http://www.ncl.ac.uk/computing/events/
5.00    http://www.ncl.ac.uk/computing/research/
5.00    http://www.ncl.ac.uk/computing/induction/
5.00    http://www.ncl.ac.uk/computing/news/
5.00    http://www.ncl.ac.uk/computing/postgraduate/
5.00    http://www.ncl.ac.uk/computing/outreach/
4.99    http://www.ncl.ac.uk/computing/current/
4.99    http://www.ncl.ac.uk/computing/undergraduate/
4.98    http://www.ncl.ac.uk/computing/
4.98    http://www.ncl.ac.uk/computing/about/
4.97    http://www.ncl.ac.uk/computing/people/
4.95    http://www.ncl.ac.uk/computing/visit/
0.94    http://www.ncl.ac.uk/computing/about/usb/
0.68    http://www.ncl.ac.uk/computing/people/professionalservices/
0.67    http://www.ncl.ac.uk/computing/people/academic/
0.67    http://www.ncl.ac.uk/computing/people/seb/
0.66    http://www.ncl.ac.uk/computing/people/support/
0.66    http://www.ncl.ac.uk/computing/people/research/
0.65    http://www.ncl.ac.uk/computing/people/visiting/
Calculation took 57.73 seconds.
```

Figure 5 – Unoptimized Stochastic test 5

```
(venv) PS C:\Users\aaron\PycharmProjects\c2060506-csc1034-practical3-2022> python page_rank.py -m stochastic
The number of nodes is: 555
The number of edges is: 11849
Top 20 pages:
5.03    http://www.ncl.ac.uk/computing/news/
5.02    http://www.ncl.ac.uk/computing/induction/
5.01    http://www.ncl.ac.uk/computing/sitemap/
5.01    http://www.ncl.ac.uk/computing/outreach/
5.01    http://www.ncl.ac.uk/computing/about/
5.00    http://www.ncl.ac.uk/computing/people/
4.98    http://www.ncl.ac.uk/computing/current/
4.98    http://www.ncl.ac.uk/computing/visit/
4.97    http://www.ncl.ac.uk/computing/events/
4.97    http://www.ncl.ac.uk/computing/
4.97    http://www.ncl.ac.uk/computing/research/
4.97    http://www.ncl.ac.uk/computing/undergraduate/
4.95    http://www.ncl.ac.uk/computing/postgraduate/
0.94    http://www.ncl.ac.uk/computing/about/usb/
0.68    http://www.ncl.ac.uk/computing/people/research/
0.66    http://www.ncl.ac.uk/computing/people/professionalservices/
0.66    http://www.ncl.ac.uk/computing/people/support/
0.66    http://www.ncl.ac.uk/computing/people/academic/
0.66    http://www.ncl.ac.uk/computing/people/visiting/
0.66    http://www.ncl.ac.uk/computing/people/seb/
Calculation took 50.97 seconds.
```

Figure 6 – Optimized Stochastic test 1

```
(venv) PS C:\Users\aaron\PycharmProjects\c2060506-csc1034-practical3-2022> python page_rank.py -m stochastic
The number of nodes is: 555
The number of edges is: 11849
Top 20 pages:
5.03    http://www.ncl.ac.uk/computing/postgraduate/
5.02    http://www.ncl.ac.uk/computing/events/
5.01    http://www.ncl.ac.uk/computing/outreach/
5.01    http://www.ncl.ac.uk/computing/undergraduate/
5.00    http://www.ncl.ac.uk/computing/
5.00    http://www.ncl.ac.uk/computing/induction/
5.00    http://www.ncl.ac.uk/computing/research/
4.99    http://www.ncl.ac.uk/computing/sitemap/
4.99    http://www.ncl.ac.uk/computing/about/
4.99    http://www.ncl.ac.uk/computing/current/
4.99    http://www.ncl.ac.uk/computing/visit/
4.97    http://www.ncl.ac.uk/computing/people/
4.97    http://www.ncl.ac.uk/computing/news/
0.93    http://www.ncl.ac.uk/computing/about/usb/
0.68    http://www.ncl.ac.uk/computing/people/visiting/
0.67    http://www.ncl.ac.uk/computing/people/academic/
0.66    http://www.ncl.ac.uk/computing/people/support/
0.66    http://www.ncl.ac.uk/computing/people/research/
0.66    http://www.ncl.ac.uk/computing/people/professionalservices/
0.66    http://www.ncl.ac.uk/computing/people/seb/
Calculation took 50.40 seconds.
```

Figure 7 – Optimized Stochastic test 2

```
(venv) PS C:\Users\aaron\PycharmProjects\c2060506-csc1034-practical3-2022> python page_rank.py -m stochastic
The number of nodes is: 555
The number of edges is: 11849
Top 20 pages:
5.03    http://www.ncl.ac.uk/computing/events/
5.01    http://www.ncl.ac.uk/computing/sitemap/
5.00    http://www.ncl.ac.uk/computing/postgraduate/
5.00    http://www.ncl.ac.uk/computing/outreach/
5.00    http://www.ncl.ac.uk/computing/induction/
4.99    http://www.ncl.ac.uk/computing/about/
4.99    http://www.ncl.ac.uk/computing/visit/
4.99    http://www.ncl.ac.uk/computing/people/
4.99    http://www.ncl.ac.uk/computing/current/
4.98    http://www.ncl.ac.uk/computing/research/
4.98    http://www.ncl.ac.uk/computing/undergraduate/
4.98    http://www.ncl.ac.uk/computing/
4.97    http://www.ncl.ac.uk/computing/news/
0.94    http://www.ncl.ac.uk/computing/about/usb/
0.67    http://www.ncl.ac.uk/computing/people/professionalservices/
0.67    http://www.ncl.ac.uk/computing/people/support/
0.66    http://www.ncl.ac.uk/computing/people/visiting/
0.66    http://www.ncl.ac.uk/computing/people/research/
0.65    http://www.ncl.ac.uk/computing/people/seb/
0.64    http://www.ncl.ac.uk/computing/people/academic/
Calculation took 50.78 seconds.
```

Figure 8 – Optimized Stochastic test 3

```
(venv) PS C:\Users\aaron\PycharmProjects\c2060506-csc1034-practical3-2022> python page_rank.py -m stochastic
The number of nodes is: 555
The number of edges is: 11849
Top 20 pages:
5.02    http://www.ncl.ac.uk/computing/about/
5.00    http://www.ncl.ac.uk/computing/current/
5.00    http://www.ncl.ac.uk/computing/events/
5.00    http://www.ncl.ac.uk/computing/undergraduate/
5.00    http://www.ncl.ac.uk/computing/
5.00    http://www.ncl.ac.uk/computing/news/
5.00    http://www.ncl.ac.uk/computing/research/
4.99    http://www.ncl.ac.uk/computing/people/
4.98    http://www.ncl.ac.uk/computing/postgraduate/
4.97    http://www.ncl.ac.uk/computing/visit/
4.97    http://www.ncl.ac.uk/computing/sitemap/
4.97    http://www.ncl.ac.uk/computing/induction/
4.96    http://www.ncl.ac.uk/computing/outreach/
0.93    http://www.ncl.ac.uk/computing/about/usb/
0.68    http://www.ncl.ac.uk/computing/people/visiting/
0.66    http://www.ncl.ac.uk/computing/people/research/
0.66    http://www.ncl.ac.uk/computing/people/seb/
0.66    http://www.ncl.ac.uk/computing/people/support/
0.66    http://www.ncl.ac.uk/computing/people/professionalservices/
0.65    http://www.ncl.ac.uk/computing/people/academic/
Calculation took 50.07 seconds.
```

Figure 9 – Optimized Stochastic test 4

```
(venv) PS C:\Users\aaron\PycharmProjects\c2060506-csc1034-practical3-2022> python page_rank.py -m stochastic
The number of nodes is: 555
The number of edges is: 11849
Top 20 pages:
5.03    http://www.ncl.ac.uk/computing/news/
5.02    http://www.ncl.ac.uk/computing/about/
5.01    http://www.ncl.ac.uk/computing/current/
5.00    http://www.ncl.ac.uk/computing/events/
5.00    http://www.ncl.ac.uk/computing/people/
4.99    http://www.ncl.ac.uk/computing/visit/
4.99    http://www.ncl.ac.uk/computing/undergraduate/
4.99    http://www.ncl.ac.uk/computing/research/
4.98    http://www.ncl.ac.uk/computing/
4.98    http://www.ncl.ac.uk/computing/induction/
4.98    http://www.ncl.ac.uk/computing/sitemap/
4.97    http://www.ncl.ac.uk/computing/postgraduate/
4.95    http://www.ncl.ac.uk/computing/outreach/
0.93    http://www.ncl.ac.uk/computing/about/usb/
0.68    http://www.ncl.ac.uk/computing/people/visiting/
0.67    http://www.ncl.ac.uk/computing/people/professionalservices/
0.66    http://www.ncl.ac.uk/computing/people/academic/
0.66    http://www.ncl.ac.uk/computing/people/support/
0.66    http://www.ncl.ac.uk/computing/people/seb/
0.65    http://www.ncl.ac.uk/computing/people/research/
Calculation took 50.44 seconds.
```

Figure 10 – Optimized Stochastic test 5

I performed 5 tests when it was unoptimized and optimized then took the average of them all. These test results will be shown in the Figures below.

All tests were performed on the same hardware and conditions.

<u>Unoptimized Distribution Tests</u>

Test 1 – 0.08

Test 2 – 0.08

Test 3 – 0.08

Test 4 – 0.08

Test 5 – 0.08

Average: 0.08 (Unoptimized)

<u>Optimized Distribution Tests</u>

Test 1 – 0.07

Test 2 – 0.07

Test 3 – 0.07

Test 4 – 0.07

Test 5 – 0.07

Average: 0.07 (Optimized)

Time saved from optimization:

```
(venv) PS C:\Users\aaron\PycharmProjects\c2060506-csc1034-practical3-2022> python page_rank.py --method=distribution --number=20
The number of nodes is: 555
The number of edges is: 11849
Top 20 pages:
4.99    http://www.ncl.ac.uk/computing/
4.99    http://www.ncl.ac.uk/computing/induction/
4.99    http://www.ncl.ac.uk/computing/people/
4.99    http://www.ncl.ac.uk/computing/research/
4.99    http://www.ncl.ac.uk/computing/postgraduate/
4.99    http://www.ncl.ac.uk/computing/current/
4.99    http://www.ncl.ac.uk/computing/events/
4.99    http://www.ncl.ac.uk/computing/outreach/
4.99    http://www.ncl.ac.uk/computing/sitemap/
4.99    http://www.ncl.ac.uk/computing/news/
4.99    http://www.ncl.ac.uk/computing/visit/
4.99    http://www.ncl.ac.uk/computing/undergraduate/
4.99    http://www.ncl.ac.uk/computing/about/
0.94    http://www.ncl.ac.uk/computing/about/usb/
0.66    http://www.ncl.ac.uk/computing/people/academic/
0.66    http://www.ncl.ac.uk/computing/people/visiting/
0.66    http://www.ncl.ac.uk/computing/people/seb/
0.66    http://www.ncl.ac.uk/computing/people/research/
0.66    http://www.ncl.ac.uk/computing/people/support/
0.66    http://www.ncl.ac.uk/computing/people/professionalservices/
Calculation took 0.08 seconds.
```

Figure 11 - Unoptimized distribution test 1

```
(venv) PS C:\Users\aaron\PycharmProjects\c2060506-csc1034-practical3-2022> python page_rank.py --method=distribution --number=20
The number of nodes is: 555
The number of edges is: 11849
Top 20 pages:
4.99    http://www.ncl.ac.uk/computing/
4.99    http://www.ncl.ac.uk/computing/induction/
4.99    http://www.ncl.ac.uk/computing/people/
4.99    http://www.ncl.ac.uk/computing/research/
4.99    http://www.ncl.ac.uk/computing/postgraduate/
4.99    http://www.ncl.ac.uk/computing/current/
4.99    http://www.ncl.ac.uk/computing/events/
4.99    http://www.ncl.ac.uk/computing/outreach/
4.99    http://www.ncl.ac.uk/computing/sitemap/
4.99    http://www.ncl.ac.uk/computing/news/
4.99    http://www.ncl.ac.uk/computing/visit/
4.99    http://www.ncl.ac.uk/computing/undergraduate/
4.99    http://www.ncl.ac.uk/computing/about/
0.94    http://www.ncl.ac.uk/computing/about/usb/
0.66    http://www.ncl.ac.uk/computing/people/academic/
0.66    http://www.ncl.ac.uk/computing/people/visiting/
0.66    http://www.ncl.ac.uk/computing/people/seb/
0.66    http://www.ncl.ac.uk/computing/people/research/
0.66    http://www.ncl.ac.uk/computing/people/support/
0.66    http://www.ncl.ac.uk/computing/people/professionalservices/
Calculation took 0.08 seconds.
```

Figure 12 - Unoptimized distribution test 2

```
(venv) PS C:\Users\aaron\PycharmProjects\c2060506-csc1034-practical3-2022> python page_rank.py --method=distribution --number=20
The number of nodes is: 555
The number of edges is: 11849
Top 20 pages:
4.99    http://www.ncl.ac.uk/computing/
4.99    http://www.ncl.ac.uk/computing/induction/
4.99    http://www.ncl.ac.uk/computing/people/
4.99    http://www.ncl.ac.uk/computing/research/
4.99    http://www.ncl.ac.uk/computing/postgraduate/
4.99    http://www.ncl.ac.uk/computing/current/
4.99    http://www.ncl.ac.uk/computing/events/
4.99    http://www.ncl.ac.uk/computing/outreach/
4.99    http://www.ncl.ac.uk/computing/sitemap/
4.99    http://www.ncl.ac.uk/computing/news/
4.99    http://www.ncl.ac.uk/computing/visit/
4.99    http://www.ncl.ac.uk/computing/undergraduate/
4.99    http://www.ncl.ac.uk/computing/about/
0.94    http://www.ncl.ac.uk/computing/about/usb/
0.66    http://www.ncl.ac.uk/computing/people/academic/
0.66    http://www.ncl.ac.uk/computing/people/visiting/
0.66    http://www.ncl.ac.uk/computing/people/seb/
0.66    http://www.ncl.ac.uk/computing/people/research/
0.66    http://www.ncl.ac.uk/computing/people/support/
0.66    http://www.ncl.ac.uk/computing/people/professionalservices/
Calculation took 0.08 seconds.
```

Figure 13 - Unoptimized distribution test 3

```
(venv) PS C:\Users\aaron\PycharmProjects\c2060506-csc1034-practical3-2022> python page_rank.py --method=distribution --number=20
The number of nodes is: 555
The number of edges is: 11849
Top 20 pages:
4.99    http://www.ncl.ac.uk/computing/
4.99    http://www.ncl.ac.uk/computing/induction/
4.99    http://www.ncl.ac.uk/computing/people/
4.99    http://www.ncl.ac.uk/computing/research/
4.99    http://www.ncl.ac.uk/computing/postgraduate/
4.99    http://www.ncl.ac.uk/computing/current/
4.99    http://www.ncl.ac.uk/computing/events/
4.99    http://www.ncl.ac.uk/computing/outreach/
4.99    http://www.ncl.ac.uk/computing/sitemap/
4.99    http://www.ncl.ac.uk/computing/news/
4.99    http://www.ncl.ac.uk/computing/visit/
4.99    http://www.ncl.ac.uk/computing/undergraduate/
4.99    http://www.ncl.ac.uk/computing/about/
0.94    http://www.ncl.ac.uk/computing/about/usb/
0.66    http://www.ncl.ac.uk/computing/people/academic/
0.66    http://www.ncl.ac.uk/computing/people/visiting/
0.66    http://www.ncl.ac.uk/computing/people/seb/
0.66    http://www.ncl.ac.uk/computing/people/research/
0.66    http://www.ncl.ac.uk/computing/people/support/
0.66    http://www.ncl.ac.uk/computing/people/professionalservices/
Calculation took 0.08 seconds.
```

Figure 14 - Unoptimized distribution test 4

(venv) PS C:\Users\aaron\PycharmProjects\c2060506-csc1034-practical3-2022> python page_rank.py --method=distribution --number=20
The number of nodes is: 555
The number of edges is: 11849
Top 20 pages:
4.99   http://www.ncl.ac.uk/computing/
4.99   http://www.ncl.ac.uk/computing/induction/
4.99   http://www.ncl.ac.uk/computing/people/
4.99   http://www.ncl.ac.uk/computing/research/
4.99   http://www.ncl.ac.uk/computing/postgraduate/
4.99   http://www.ncl.ac.uk/computing/current/
4.99   http://www.ncl.ac.uk/computing/events/
4.99   http://www.ncl.ac.uk/computing/outreach/
4.99   http://www.ncl.ac.uk/computing/sitemap/
4.99   http://www.ncl.ac.uk/computing/news/
4.99   http://www.ncl.ac.uk/computing/visit/
4.99   http://www.ncl.ac.uk/computing/undergraduate/
4.99   http://www.ncl.ac.uk/computing/about/
0.94   http://www.ncl.ac.uk/computing/about/usb/
0.66   http://www.ncl.ac.uk/computing/people/academic/
0.66   http://www.ncl.ac.uk/computing/people/visiting/
0.66   http://www.ncl.ac.uk/computing/people/seb/
0.66   http://www.ncl.ac.uk/computing/people/research/
0.66   http://www.ncl.ac.uk/computing/people/support/
0.66   http://www.ncl.ac.uk/computing/people/professionalservices/
Calculation took 0.08 seconds.

Figure 15 - Unoptimized distribution test 5

```
(venv) PS C:\Users\aaron\PycharmProjects\c2060506-csc1034-practical3-2022> python page_rank.py --method=distribution --number=20
The number of nodes is: 555
The number of edges is: 11849
Top 20 pages:
4.99    http://www.ncl.ac.uk/computing/
4.99    http://www.ncl.ac.uk/computing/induction/
4.99    http://www.ncl.ac.uk/computing/people/
4.99    http://www.ncl.ac.uk/computing/research/
4.99    http://www.ncl.ac.uk/computing/postgraduate/
4.99    http://www.ncl.ac.uk/computing/current/
4.99    http://www.ncl.ac.uk/computing/events/
4.99    http://www.ncl.ac.uk/computing/outreach/
4.99    http://www.ncl.ac.uk/computing/sitemap/
4.99    http://www.ncl.ac.uk/computing/news/
4.99    http://www.ncl.ac.uk/computing/visit/
4.99    http://www.ncl.ac.uk/computing/undergraduate/
4.99    http://www.ncl.ac.uk/computing/about/
0.94    http://www.ncl.ac.uk/computing/about/usb/
0.66    http://www.ncl.ac.uk/computing/people/academic/
0.66    http://www.ncl.ac.uk/computing/people/visiting/
0.66    http://www.ncl.ac.uk/computing/people/seb/
0.66    http://www.ncl.ac.uk/computing/people/research/
0.66    http://www.ncl.ac.uk/computing/people/support/
0.66    http://www.ncl.ac.uk/computing/people/professionalservices/
Calculation took 0.07 seconds.
```

Figure 16 - Optimized distribution test 1

```
(venv) PS C:\Users\aaron\PycharmProjects\c2060506-csc1034-practical3-2022> python page_rank.py --method=distribution --number=20
The number of nodes is: 555
The number of edges is: 11849
Top 20 pages:
4.99    http://www.ncl.ac.uk/computing/
4.99    http://www.ncl.ac.uk/computing/induction/
4.99    http://www.ncl.ac.uk/computing/people/
4.99    http://www.ncl.ac.uk/computing/research/
4.99    http://www.ncl.ac.uk/computing/postgraduate/
4.99    http://www.ncl.ac.uk/computing/current/
4.99    http://www.ncl.ac.uk/computing/events/
4.99    http://www.ncl.ac.uk/computing/outreach/
4.99    http://www.ncl.ac.uk/computing/sitemap/
4.99    http://www.ncl.ac.uk/computing/news/
4.99    http://www.ncl.ac.uk/computing/visit/
4.99    http://www.ncl.ac.uk/computing/undergraduate/
4.99    http://www.ncl.ac.uk/computing/about/
0.94    http://www.ncl.ac.uk/computing/about/usb/
0.66    http://www.ncl.ac.uk/computing/people/academic/
0.66    http://www.ncl.ac.uk/computing/people/visiting/
0.66    http://www.ncl.ac.uk/computing/people/seb/
0.66    http://www.ncl.ac.uk/computing/people/research/
0.66    http://www.ncl.ac.uk/computing/people/support/
0.66    http://www.ncl.ac.uk/computing/people/professionalservices/
Calculation took 0.07 seconds.
```

Figure 17 - Optimized distribution test 2

```
(venv) PS C:\Users\aaron\PycharmProjects\c2060506-csc1034-practical3-2022> python page_rank.py --method=distribution --number=20
The number of nodes is: 555
The number of edges is: 11849
Top 20 pages:
4.99    http://www.ncl.ac.uk/computing/
4.99    http://www.ncl.ac.uk/computing/induction/
4.99    http://www.ncl.ac.uk/computing/people/
4.99    http://www.ncl.ac.uk/computing/research/
4.99    http://www.ncl.ac.uk/computing/postgraduate/
4.99    http://www.ncl.ac.uk/computing/current/
4.99    http://www.ncl.ac.uk/computing/events/
4.99    http://www.ncl.ac.uk/computing/outreach/
4.99    http://www.ncl.ac.uk/computing/sitemap/
4.99    http://www.ncl.ac.uk/computing/news/
4.99    http://www.ncl.ac.uk/computing/visit/
4.99    http://www.ncl.ac.uk/computing/undergraduate/
4.99    http://www.ncl.ac.uk/computing/about/
0.94    http://www.ncl.ac.uk/computing/about/usb/
0.66    http://www.ncl.ac.uk/computing/people/academic/
0.66    http://www.ncl.ac.uk/computing/people/visiting/
0.66    http://www.ncl.ac.uk/computing/people/seb/
0.66    http://www.ncl.ac.uk/computing/people/research/
0.66    http://www.ncl.ac.uk/computing/people/support/
0.66    http://www.ncl.ac.uk/computing/people/professionalservices/
Calculation took 0.07 seconds.
```

Figure 18 - Optimized distribution test 3

```
(venv) PS C:\Users\aaron\PycharmProjects\c2060506-csc1034-practical3-2022> python page_rank.py --method=distribution --number=20
The number of nodes is: 555
The number of edges is: 11849
Top 20 pages:
4.99    http://www.ncl.ac.uk/computing/
4.99    http://www.ncl.ac.uk/computing/induction/
4.99    http://www.ncl.ac.uk/computing/people/
4.99    http://www.ncl.ac.uk/computing/research/
4.99    http://www.ncl.ac.uk/computing/postgraduate/
4.99    http://www.ncl.ac.uk/computing/current/
4.99    http://www.ncl.ac.uk/computing/events/
4.99    http://www.ncl.ac.uk/computing/outreach/
4.99    http://www.ncl.ac.uk/computing/sitemap/
4.99    http://www.ncl.ac.uk/computing/news/
4.99    http://www.ncl.ac.uk/computing/visit/
4.99    http://www.ncl.ac.uk/computing/undergraduate/
4.99    http://www.ncl.ac.uk/computing/about/
0.94    http://www.ncl.ac.uk/computing/about/usb/
0.66    http://www.ncl.ac.uk/computing/people/academic/
0.66    http://www.ncl.ac.uk/computing/people/visiting/
0.66    http://www.ncl.ac.uk/computing/people/seb/
0.66    http://www.ncl.ac.uk/computing/people/research/
0.66    http://www.ncl.ac.uk/computing/people/support/
0.66    http://www.ncl.ac.uk/computing/people/professionalservices/
Calculation took 0.07 seconds.
```

Figure 19 - Optimized distribution test 4

```
(venv) PS C:\Users\aaron\PycharmProjects\c2060506-csc1034-practical3-2022> python page_rank.py --method=distribution --number=20
The number of nodes is: 555
The number of edges is: 11849
Top 20 pages:
4.99    http://www.ncl.ac.uk/computing/
4.99    http://www.ncl.ac.uk/computing/induction/
4.99    http://www.ncl.ac.uk/computing/people/
4.99    http://www.ncl.ac.uk/computing/research/
4.99    http://www.ncl.ac.uk/computing/postgraduate/
4.99    http://www.ncl.ac.uk/computing/current/
4.99    http://www.ncl.ac.uk/computing/events/
4.99    http://www.ncl.ac.uk/computing/outreach/
4.99    http://www.ncl.ac.uk/computing/sitemap/
4.99    http://www.ncl.ac.uk/computing/news/
4.99    http://www.ncl.ac.uk/computing/visit/
4.99    http://www.ncl.ac.uk/computing/undergraduate/
4.99    http://www.ncl.ac.uk/computing/about/
0.94    http://www.ncl.ac.uk/computing/about/usb/
0.66    http://www.ncl.ac.uk/computing/people/academic/
0.66    http://www.ncl.ac.uk/computing/people/visiting/
0.66    http://www.ncl.ac.uk/computing/people/seb/
0.66    http://www.ncl.ac.uk/computing/people/research/
0.66    http://www.ncl.ac.uk/computing/people/support/
0.66    http://www.ncl.ac.uk/computing/people/professionalservices/
Calculation took 0.07 seconds.
(venv) PS C:\Users\aaron\PycharmProjects\c2060506-csc1034-practical3-2022>
```

Figure 20 - Optimized distribution test 5