(a)

for the matrix "A" to have a logarithm or so to say to have a convergence in the sum,

$$-\sum_{K=1}^{\infty} \frac{(I-A)^K}{K}$$

- "A" needs to be sufficiently close to I. Specifically if $\|I-A\| < 1$, then the series converges.
- If "A" is a real matrix, "A" must be invertible for it to have a real logarithm.

(b)

for large "n", using the Taylor expansion to compute $\log(A)$, the computational complexity is

$$O(\log(n)).$$

(c)

| Language | C++ | MATLAB | PYTHON |
|---|---|---|---|
| Source Code | Problem_4c.cpp | Problem_4c.m | Problem_4c.py |
| Printed result | Problem_4c_cpp .txt | Problem_4c_matlab .txt | Problem_4c_python .txt |

## (d)

| Language | Source code | |
|---|---|---|
| C++ | Problem_4d.cpp | |
| MATLAB | Problem_4d.m | Problem_4d_plot.m |
| PYTHON | Problem_4d.py | |

In the code, Problem_4d.cpp for n = 500 and n = 1000 and n = 2000, my command prompt shows the message "Segmentation Fault (Core dumped)", that's why I couldn't capture all the values of "t_cpp".

Therefore I plotted the t_matlab, t_python and predicted complexity from (b). in Problem_4d_plot.m