Exercise 1

a)

In the main experiment, we run the pointer chasing with a certain size of vector and a certain stride. This certain size is from 256 integers (1024 bytes) to N = 512*1024*1024(max size) integers. The stride is from 1 to n/2. (e.g., If n=256, s id from 1 to 128).

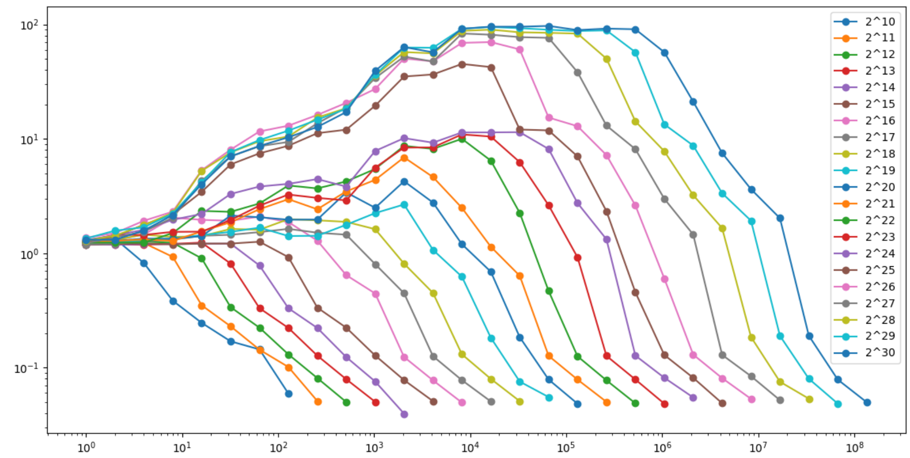
The time that empty experiment takes won't be affected by the cache size because it won't visit any memory. At the same time, the time every loop takes can be different with different n and s. So, we should calculate time these loop takes and eliminate their effects.

For each n, we can keep the total amount of pointer chasing loops invariant.

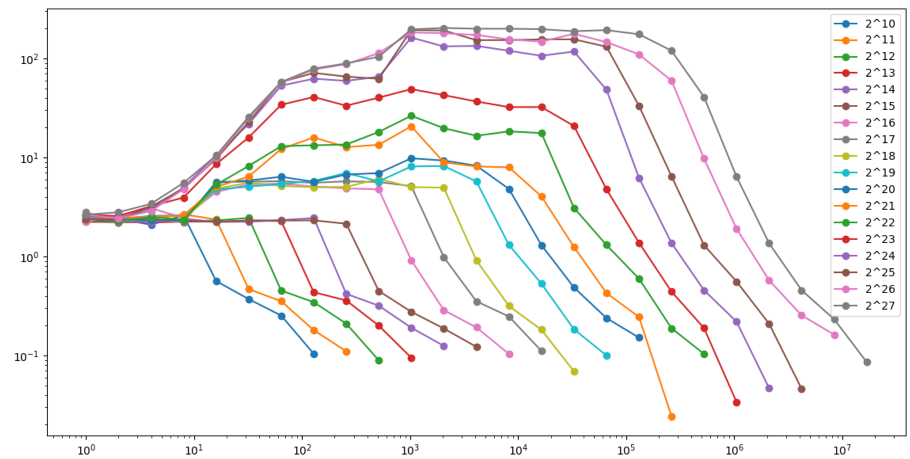
b)

See result_a.txt and result_b.txt

c)



(figure a) First laptop with L1: 480KB*10, L2: 1280KB*10, L3: 24MB*1



(figure b) Second laptop with L1: 48KB*4, L2: 1280KB*4, L3: 8MB*1 d)

Comparing the total bytes of the vector (show in the legend) with the size of caches, we can find 3 obvious gaps among these lines in figure (b). They correspond to the size of L1, L2 and L3 cache.

The first gap is between 2^15 and 2^16, which corresponds to L1 cache (48KB).

The second gap is between 2^15 and 2^16, which corresponds to L2 cache (48KB).

The third gap is between 2^22 and 2^23, which corresponds to L3 cache (8MB).

In figure (a), there is an obvious gap between 2^24 and 2^25, which corresponds to L3 cache (24MB).

At the data points that take the longest time, we have to visit the main memory. Therefore, the time it takes is close to the speed of main memory (about 100ns).