### 11.4, 2(d)

Number of runs = \(10,000,000 / 320 = 31250\)

Number of passes (excluding Pass 0) = \([\log_8 31250]\) = 5 (we have eight "input" buffers)

Number of blocks (32 pages each) we read per pass = \(10,000,000 / 32 = 312,500\)

Number of blocks (64 pages each) we write per pass = \(10,000,000 / 64 = 156,250\)

Total time taken by one pass = (average seek time + average rotational delay) *
number of blocks read and write +
transfer time for all pages

\[
= [(10 + 5) \times (312,500 + 156,250) + 2 \times 10,000,000] ms \\
= 2.7 \times 10^4 s
\]

Total time = 5 * 2.7 * 10^4 = 13.5 * 10^4 s ≈ 37.5 hours

### 12.4, 4

Number of pages of relation R = \(10,000 / 10 = 1000\) pages

Number of pages of relation S = \(2,000 / 10 = 200\) pages

Cost of joining R and S using hash join = \(3 \times (1000 + 200) = 3600\) pages

This cost will remain the same as long as the smaller relation (i.e. S) fits into the buffer pool.

We want \(B > \lceil \sqrt{200} \rceil\). If \(f = 1.2\), the minimum number of B is 16.

### 14.4, 2(d)

Cost metric is the number of I/O.

Number of pages containing tuples that meet the condition \(E.title = \text{’CFO’}\)

\[= 10,000 \times 10\% = 1,000\] pages.

Number of pages containing tuples that meet the condition \(E.title = \text{’CFO’} \text{ and } E.dname=’Toy’\)

\[= 10,000 \times 5\% = 500\] pages.

Use the B+ tree to find the first page that contains tuple with condition \(E.title = \text{’CFO’}\). Since the index is clustered, we will do a linear scan. The cost of the scan is 1,000 pages. The cost of the output is 500 pages. The total cost is 1,500 pages + \# I/O to traverse the B+-Tree from the root to the leaf.