Solution

NDBI007: Practical class 2

Exercise 2.1: Primary Key Index (Solution)

- Blocking factor of primary file $b = \left\lfloor \frac{B}{R} \right\rfloor = \left\lfloor \frac{4 \bullet 2^{10}}{256} \right\rfloor = 16$
  - Number of blocks of primary file $n_B = 5{,}000{,}000 \div 16 = 312{,}500$
  - Blocking factor of primary key index $b_{ID} = \left\lfloor \frac{B}{R} \right\rfloor = \left\lfloor \frac{4 \bullet 2^{10}}{9} \right\rfloor = 455$

- Primary key index levels
  - The number of pages to index: 312,500, level size: $n_{PAGES,L=i} = \left\lceil \frac{n_{PAGES,L=i-1}}{b} \right\rceil = \left\lceil \frac{312{,}500}{455} \right\rceil = 687$
  - The number of pages to index: 687, level size: $\left\lceil \frac{687}{455} \right\rceil = 2$
  - The number of pages to index: 2, level size: $\left\lceil \frac{2}{455} \right\rceil = 1$

Exercise 2.2: Direct Index (Solution)

- Blocking factor $b_{FIRST\_NAME} = \left\lfloor \frac{B}{R} \right\rfloor = \left\lfloor \frac{4 \bullet 2^{10}}{24} \right\rfloor = 170$

- Direct index levels
  - Number of records in primary file: 5,000,000, level size: $\left\lceil \frac{5{,}000{,}000}{170} \right\rceil = 29{,}412$
  - Number of pages to address: 29,412, level size: $\left\lceil \frac{29{,}412}{170} \right\rceil = 174$
  - Number of pages to address: 174, level size: $\left\lceil \frac{174}{170} \right\rceil = 2$
  - Number of pages to address: 2, level size: $\left\lceil \frac{2}{170} \right\rceil = 1$

- The total size of index is $29{,}412 + 174 + 2 + 1 = 29{,}859$ so the space equals to $29{,}589 \bullet 4 \bullet 2^{10} \approx 115\ MB$
  - The size of this index is much larger than the size of the primary key index

Exercise 2.3: Indirect Index (Solution)

- First level blocking factor is $b_{SECOND\_NAME,FIRST\_LEVEL} = \left\lfloor \frac{B}{R} \right\rfloor = \left\lfloor \frac{4 \bullet 2^{10}}{30} \right\rfloor = 136$
- Other level blocking factor is $b_{SECOND\_NAME,OTHER\_LEVELS} = \left\lfloor \frac{B}{R} \right\rfloor = \left\lfloor \frac{4 \bullet 2^{10}}{29} \right\rfloor = 141$

- Indirect index levels
  - Number of records to address: 5,000,000, level size: $\left\lceil \frac{5{,}000{,}000}{136} \right\rceil = 36{,}765$
  - Number of pages to address: 36,765, level size: $\left\lceil \frac{36{,}765}{141} \right\rceil = 261$
  - Number of pages to address: 261, level size: $\left\lceil \frac{261}{141} \right\rceil = 2$
  - Number of pages to address: 2, level size: $\left\lceil \frac{2}{141} \right\rceil = 1$