Solution

NDBI007: Practical class 2

Exercise 2.1: Primary Key Index (Solution)

- Blocking factor of primary file $b = \left\lfloor \dfrac{B}{R} \right\rfloor = \left\lfloor \dfrac{4 \bullet 2^{10}}{256} \right\rfloor = 16$

  - Number of blocks of primary file $n_B = 5{,}000{,}000 \div 16 = 312{,}500$

  - Blocking factor of primary key index $b_{ID} = \left\lfloor \dfrac{B}{R} \right\rfloor = \left\lfloor \dfrac{4 \bullet 2^{10}}{9} \right\rfloor = 455$

- Primary key index levels

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

  - The number of pages to index: 687, level size: $\left\lceil \dfrac{687}{455} \right\rceil = 2$

  - The number of pages to index: 2, level size: $\left\lceil \dfrac{2}{455} \right\rceil = 1$

Exercise 2.2: Direct Index (Solution)

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

- Direct index levels

  - Number of records in primary file: 5,000,000, level size: $\left\lceil \dfrac{5,000,000}{170} \right\rceil = 29,412$

  - Number of pages to address: 29,412, level size: $\left\lceil \dfrac{29,412}{170} \right\rceil = 174$

  - Number of pages to address: 174, level size: $\left\lceil \dfrac{174}{170} \right\rceil = 2$

  - Number of pages to address: 2, level size: $\left\lceil \dfrac{2}{170} \right\rceil = 1$

- The total size of index is $29,412 + 174 + 2 + 1 = 29,589$ 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 $b_{SECOND\_NAME, FIRST\_LEVEL} = \left\lfloor \dfrac{B}{R} \right\rfloor = \left\lfloor \dfrac{4 \bullet 2^{10}}{30} \right\rfloor = 136$

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

- Indirect index levels

  - Number of records to address: 5,000,000, level size: $\left\lceil \dfrac{5,000,000}{136} \right\rceil = 36,765$

  - Number of pages to address: 36,765, level size: $\left\lceil \dfrac{36,765}{141} \right\rceil = 261$

  - Number of pages to address: 261, level size: $\left\lceil \dfrac{261}{141} \right\rceil = 2$

  - Number of pages to address: 2, level size: $\left\lceil \dfrac{2}{141} \right\rceil = 1$