Appendix C

Symbols Used

Mathematical Symbols Used

⌈⌉  CEIL, next higher integer
⌊⌋  FLOOR, next lower integer
≈  approximately equal
\(\hat{a}\)  much greater than
!  factorial
#  number of
log\(_y\) \(x\)  logarithm base \(y\) of \(x\)
log \(x\)  natural logarithm of \(x\), base \(e = 2.71828182846\)
\(\sum\)\(_k\) \(f(k)\)  sum of all \(f(k)\) for the integer \(k\)’s specified
\(\Theta\)  one of the comparison operators \(> \geq = \neq \leq \leq\)
\(\wedge\)  and, true if both sides are true
\(\lor\)  or, true if either side is true
\(\mid\)  where, precedes a conditional clause
\(-\)  set intersection
\(\cup\)  set union
\(-\)  set difference
\(\times\)  cartesian product
\(\subseteq\)  select tuples from a relation
\(\pi\)  project attributes from a relation
\(\bowtie\)  join two relations based on equality of the attributes \(a, b\)
\(\rightarrow\)  reference connection
\(\supset\)  ownership connection
\(\subset\)  subset connection
\(\subseteq\)  subset of
\(\in\)  member of
\(\forall\)  for all
\(\Rightarrow\)  becomes
\{\}  enclose a set
[\]  enclose a reference
Programming and Syntax Symbols As Used

In general we follow the convention of PL/1, a language originally developed by IBM to serve both scientific and commercial programming tasks. Some examples use Ada, a language sponsored by the US Defense department, COBOL, a widely used commercial language, and Pascal, a popular language for teaching.

\[ a + b \] addition
\[ a - b \] subtraction
\[ a * b \] multiplication
\[ a / b \] division
\[ \text{MOD}(a,b) \] modulo, integer remainder of division
\[ a ** b \] exponentiation, \( a \) to the power \( b \)
\[ a = b \] depending on context in PL/1, assignment or equality comparison
\[ a > b \] greater than comparison, true if \( a \) greater than \( b \)
\[ a \geq b \] greater or equal comparison, true if \( a \) greater or equal to \( b \)
\[ a \land b \] and, true if both \( a, b \) true (\& in PL/1)
\[ a \lor b \] or, true if either \( a, b \) true (| in PL/1)
\[ \neg c \] not, true if \( c \) false and vice versa (\# in Ada, PL/1)
\[ s || w \] catenation, string \( w \) appended to string \( s \) (\& in Ada)
\[ s | c \] where, do \( s \) if the predicate (conditional) clause \( c \) is true
\[ R \cup S \] union of relations \( R \) and \( S \)
\[ R \cap S \] intersection of relations \( R \) and \( S \)
\[ R \times S \] cross product of relations \( R \) and \( S \)
\[ R - S \] difference, remove tuples matching \( S \) from \( R \)
\[ \sum_{R.ex} \] select tuples of \( R \) according to expression \( ex \)
\[ \Pi_{R.a} \] projection of attributes \( a \) of \( R \)
\[ R.a \Join S.b \] Join \( R \) and \( S \), on equality of attribute values in \( a \) and \( b \)
\[ R.a \Join\Join S.b \] Outerjoin including all tuples
, field separator
:: key and goal fields separator
; statement separator
. termination of computational section
\[ ss, ... \] section \( ss \) may be repeated
[ ss ] section \( ss \) is optional
\{ ss/tt \} sections \( ss, tt \) are alternatives
:: is defined by
/* Note */ explanatory comments
\( a.b \) qualification of variable \( b \) by a higher-level variable \( a \), i.e., employee.name
"Word" character string constant
(underline) pseudo-alphabetic character without syntactic meaning used for legibility within variable names. (In COBOL – is used for this function.)
Variables Used in Performance Formulas

- **A**: average space required for attribute name  
  - Sec. 3-1-3

- **a**: number of different attributes in a file  
  - Sec. 3-1-1

- **a’**: average number of attributes in a record  
  - Sec. 3-1-1, 3-6-3

- **B**: blocksize  
  - Sec. 2-2

- **b**: blockcount  
  - Sec. 2-2-2

- **btt**: block transfer time = $B/t$  
  - Eq. 2-13

- **Bfr**: blocking factor $\approx B/R$  
  - Eqs. 2-5, 2-6, 2-7, 2-20

- **C**: Cost factors  
  - Sec. 5-4-6, 5-5-2

- **c**: computational overhead per record, when not negligible  
  - Sec. 2-3-4

- **D**: space required for data  
  - Eq. 5-1, Sec 5-3-3

- **d**: number of records that have been invalidated  
  - Sec. 3-1-3

- **f**: subscript denoting a fetch for a specific record  
  - Sec. 3-0-2

- **G**: space required for an interblock gap  
  - Sec. 2-2-3

- **h**: classification variable  
  - Sec. 5-4-3

- **i**: subscript denoting insertion of a record  
  - Sec. 3-0-2

- **j**: number of cylinders  
  - Sec. 2-2-1

- **K**: projection list  
  - Sec. 7-3-2

- **K**: Kilo or thousand (1024) times  

- **k**: number of tracks per cylinder  
  - Sec. 2-2-5, Table 2-1

- **L**: load frequency factors; selection list  
  - Sec. 5-1; 7-3-3

- **M**: multiprogramming factor  
  - Eq. 5-19

- **M**: Mega or million (1048576) times  

- **m**: number of available slots for records  
  - Sec. 3-5-1

- **n**: subscript denoting getting the next serial record  
  - Sec. 3-0-2

- **n**: number of records in a file  
  - Sec. 3-1-3

- **o**: number of records that overflow  
  - Secs. 3-1-3, 3-2-3, 3-3-3, 3-5-3

- **P**: space required for a pointer  
  - Sec. 2-3-3

- **p**: collision cost, also probability  
  - Eqs. 3-73, 3-74, 3-79, Fig. 3-23

- **q**: production demand by a file application  
  - Eq. 5-2, 5-4 to 5-6

- **R**: space required for a complete record; relation  
  - Sec. 3-0-2; 7-1-1

- **RW**: subscript indicating rewriting  
  - Sec. 2-3-6

- **r**: rotational latency time  
  - Eq. 2-3

- **SI**: storage space for index  
  - Eq. 3-52

- **s**: average seek time  
  - Eq. 2-2

- **s’**: effective seek time  
  - Eqs. 2-15, 2-16

- **T**: the time required for various operations; set of tuples  
  - Sec. 3-0-2; 7-3

- **T_{sort}**: the time required to sort a file  
  - Eq. 3-11

- **t**: transfer rate from a storage unit to processing memory  
  - Sec. 2-2-5

- **t’**: bulk transfer rate  
  - Eqs. 2-17, 2-18, 2-19

- **u**: subscript denoting an update of a record  
  - Sec. 3-0-2

- **u**: utilization  
  - Eqs. 5-3, 5-7 to 5-18, 5-20

- **uf**: utilization factor  
  - Eqs. 6-25, 6-29

- **V**: average space for value part of an attribute  
  - Sec. 3-1-3

- **v**: number of records updated  
  - Sec. 3-2-3

- **w**: wait time in queues  
  - Eq. 6-26

- **W**: wasted space due to gaps per record  
  - Eqs. 2-9, 2-10, 2-11, 2-21

- **x**: subscript denoting an exhaustive search  
  - Sec. 3-0-2

- **x**: number of levels in an index structure, master level  
  - Eq. 3-27, 3-49, 3-97

- **y**: subscript denoting a reorganization of a file  
  - Sec. 3-0-2

- **y**: fanout ratio  
  - Eq. 3-26, 3-48