Contents

Chapter 1

Functional Dependency

1.1 Relation

Definition 1.1. A *relation* is an ordered pair (*S*,*R*), where S is an n-tuple of names of attributes, and R is a set of n-tuples with values for the attributes as described by S.

Given $T \in R$ and $S = (s_1, s_2, ...s_n)$, we denote the value for attribute s_1 in T as $T(s_1)$.

1.2 Functional Dependency

Definition 1.2. Given R and $S = (X, Y)$, we say that X determines Y, denoted $X \to Y$, if $T_1(X) = T_2(X)$ implies $T_1(Y) = T_2(Y)$ for any $T_1, T_2 \in R$, and we call this a *functional dependency*.

1.3 Armstrong's Axioms

1. *Reflexivity*: if $Y \subseteq X$ then $X \to Y$
2. *Augmentation*: if $X \to Y$ then $XZ \to YZ$ for any Z
3. *Transitivity*: if $X \to Y$ and $Y \to Z$ then $X \to Z$

1.4 Closure

Definition 1.3. The *closure* of a set F of functional dependencies, denoted $F+$, is the set of all functional dependencies that can be inferred from those in F.

1.5 Minimal Cover

Definition 1.4. The *minimal cover* G of a set F of functional dependencies, is the smallest set such that $G+ = F+$.

Chapter 2

Normal Forms

2.1 First Normal Form (1NF)

Definition 2.1. A *superkey* of a relation S, R is a set of attributes X such that $t_1(X) = t_2(X)$ if and only if $t_1 = t_2$. Such attributes are said to be *prime*.

A superkey is said to be *minimal* if it has the least number of attributes required to meet this condition. Such a minimal superkey is called a candidate key.

Definition 2.2. A set of relations is in *First Normal Form* if every relation has a minimal superkey.

2.2 Second Normal Form (2NF)

Definition 2.3. A *partial dependency* is a dependency of a non-prime attribute on a proper subset of a candidate key.

Definition 2.4. A set of relations is in *Second Normal Form* if it is in 1NF and it contains no partial dependencies.

2.3 Third Normal Form (3NF)

Definition 2.5. A *trivial dependency* is a dependency $X \to Y$ where $Y \subseteq X$.

Definition 2.6. A *transitive dependency* is a dependency inferred from the transitive axiom. If $X \to Y$ is a transitive dependency, we say Y is *transitively dependent* on X, otherwise Y is *directly dependent* on X.

Definition 2.7. A set of relations is in *Third Normal Form* if it is in 2NF and all functional dependencies $X \to Y$ are trivial, or X is a superkey, or all attributes $a \in (X - Y)$ are prime.

2.4 Boyce-Codd Normal Form (BCNF)

Definition 2.8. A set of relations is in *Boyce-Codd Normal Form* if it is in 2NF and all functional dependencies $X \to Y$ are trivial or X is a superkey.

Appendix A

Entity Relational Diagrams

Entity Relational Diagrams are a visual diagramming language for describing entities using relational vocabulary.