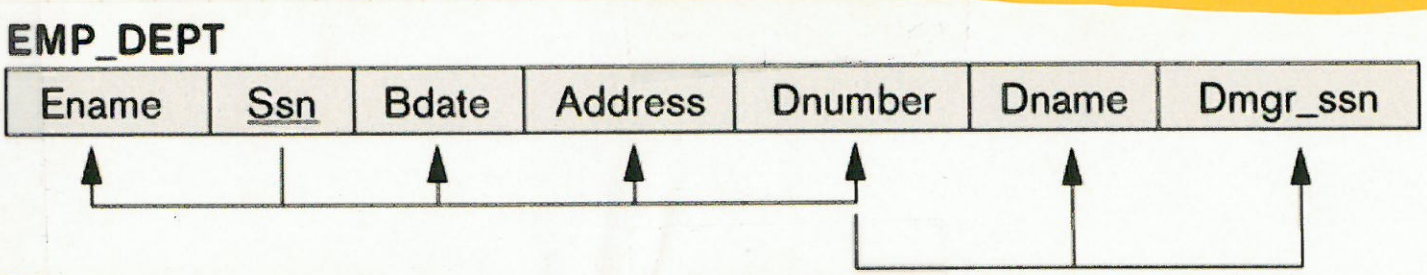
2NF, 3NF, BCNF

10/10

SSn	Ename	Dnum	Dname	Dmgr-SSn
123	Alice	1	CS	123
456	Bob	1	CS	123
789	Charlie	2	Eng	456



transitive dependency: FD $X \rightarrow Y$ in relational schema R

If attributes Z in R that is not a candidate key and not a subset of a key of R

but $X \rightarrow Z$ and $Z \rightarrow Y$

3NF: a relation R is 3NF
if 2NF
& no non-prime attribute of R
is transitively dependent on primary key

Fix EMP_PEPT

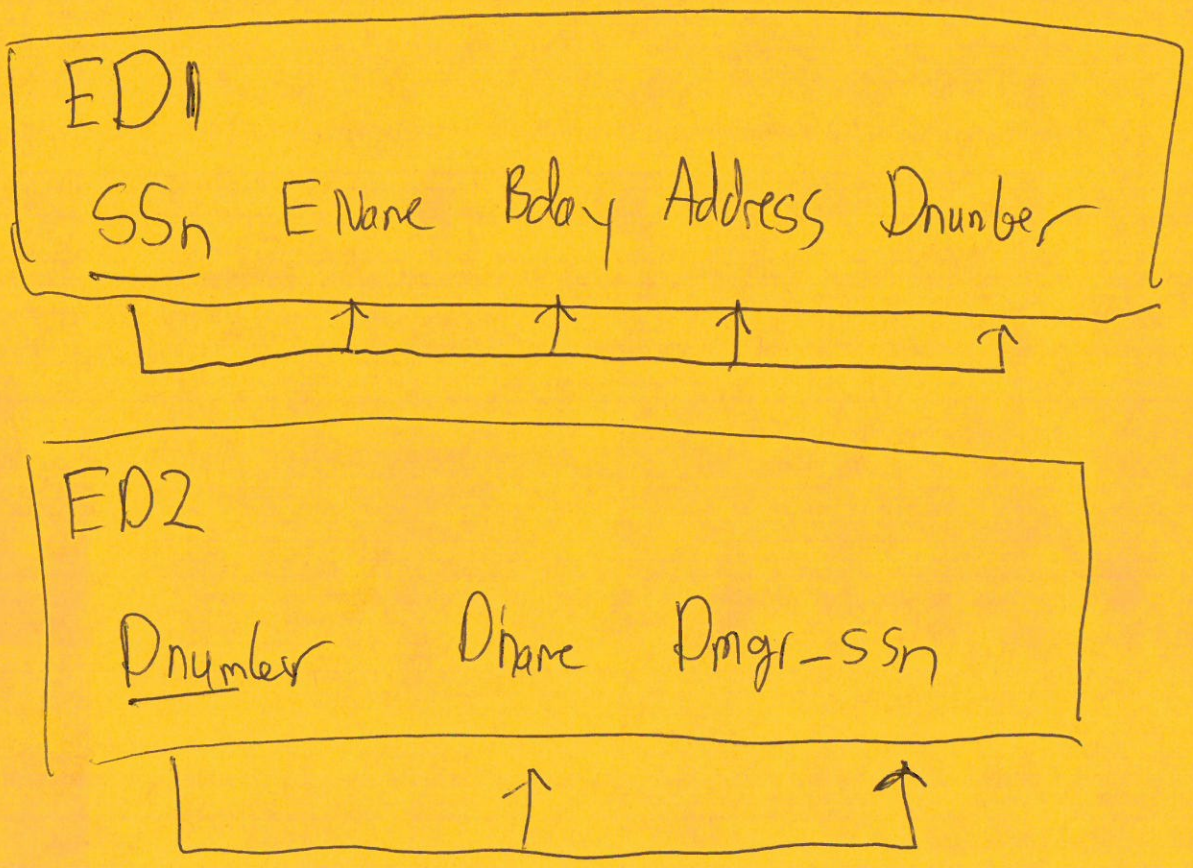


Table 14.1 Summary of Normal Forms Based on Primary Keys and Corresponding Normalization

Normal Form	Test	Remedy (Normalization)
First (1NF)	Relation should have no multivalued attributes or nested relations.	Form new relations for each multivalued attribute or nested relation.
Second (2NF)	For relations where primary key contains multiple attributes, no nonkey attribute should be functionally dependent on a part of the primary key.	Decompose and set up a new relation for each partial key with its dependent attribute(s). Make sure to keep a relation with the original primary key and any attributes that are fully functionally dependent on it.
Third (3NF)	Relation should not have a nonkey attribute functionally determined by another nonkey attribute (or by a set of nonkey attributes). That is, there should be no transitive dependency of a nonkey attribute on the primary key.	Decompose and set up a relation that includes the nonkey attribute(s) that functionally determine(s) other nonkey attribute(s).

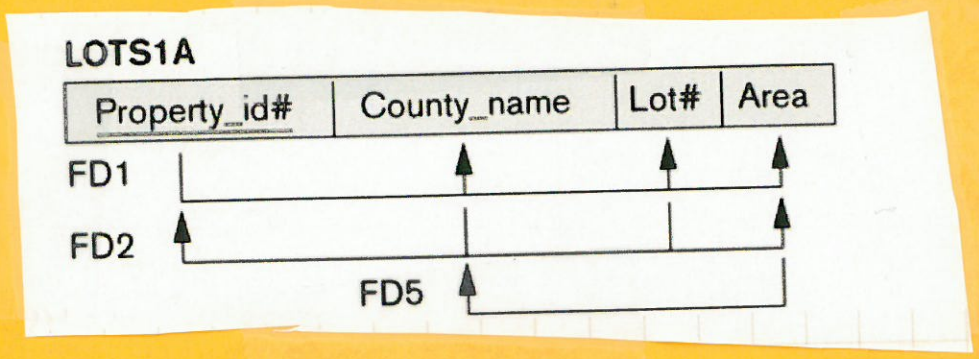
Definition. A relation schema R is in **second normal form (2NF)** if every nonprime attribute A in R is not partially dependent on *any* key of R.[12]

Therefore, we can state a **general alternative definition of 3NF** as follows:

Alternative Definition. A relation schema R is in 3NF if every nonprime attribute of R meets both of the following conditions:

- It is fully functionally dependent on every key of R.
- It is nontransitively dependent on every key of R.

BCNF



2 counties: {D, F}

→ {1.1, 1.2, --, 2.0}

→ {.1, .2, .3 - - -, .9}

BCNF: relation R is BCNF

if FD $X \rightarrow A \Rightarrow X$ is a superkey of R

TEACH

Student	Course	Instructor
Narayan	Database	Mark
Smith	Database	Navathe
Smith	Operating Systems	Ammar
Smith	Theory	Schulman
Wallace	Database	Mark
Wallace	Operating Systems	Ahamad
Wong	Database	Omiecinski
Zelaya	Database	Navathe
Narayan	Operating Systems	Ammar

FD1: {Student, Course} → Instructor

FD2: Instructor → Course