Boyce-Codd Normal Form (BCNF)

- R is in BCNF if for every FD $\alpha \to \beta$:
    - $\alpha \to \beta$ is trivial (i.e., $\beta \subseteq \alpha$), or
    - α is a superkey for R (i.e., $\alpha \to R$)

- BCNF eliminates redundancy

Ex R:

α	β	γ
α_1	β_1	γ_1
α_1	β_1	γ_2

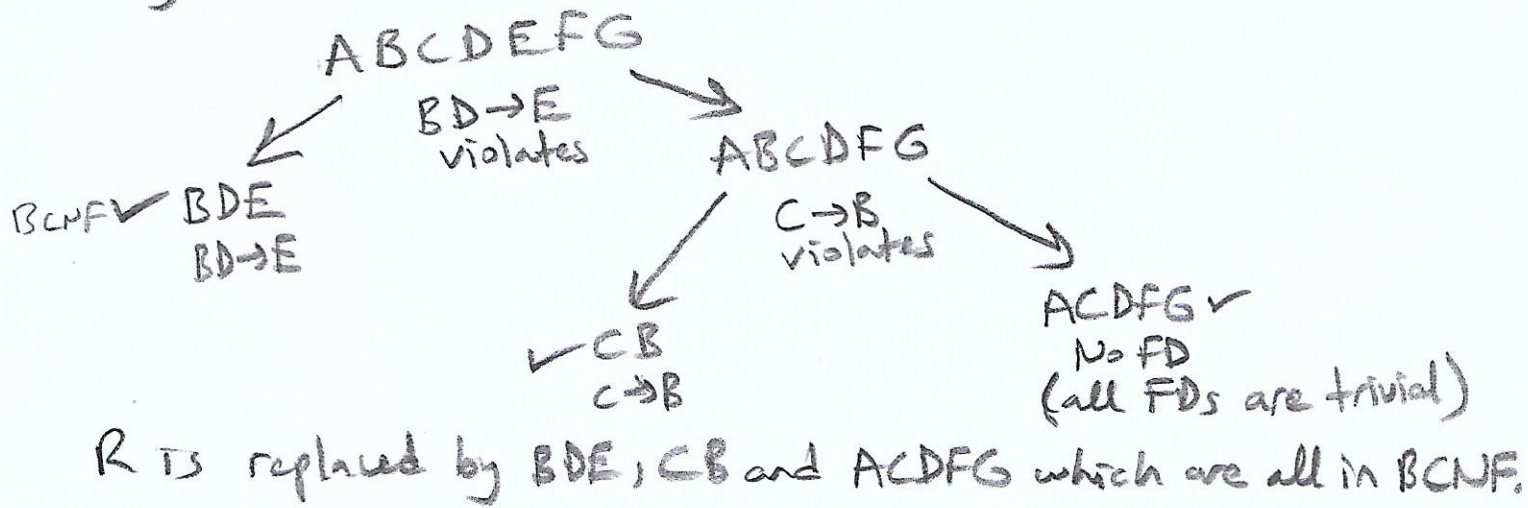redundancy

Given $\alpha \to \beta$

R is not in BCNF (α is not a superkey)

If R was in BCNF, such two tuples (leading to redundancy) would not exist.

BCNF Decomposition

- Suppose that R is not in BCNF. If $\alpha \rightarrow \beta$ violates BCNF, decompose R into: — $(\alpha \cup \beta)$, and
  — $(R - (\beta - \alpha))$

Ex: $R(\underline{A}, B, C, D, E, F, G)$ $CE \rightarrow A$, $BD \rightarrow E$, $C \rightarrow B$
     key   superkey

```
                    ABCDEFG
          BD→E  ╱            ╲
          violates              ABCDFG
BCNF ✓ BDE                   ╱  C→B  ╲
       BD→E               ╱   violates  ╲
                      ✓ CB              ACDFG ✓
                        C→B             No FD
                                        (all FDs are trivial)
```

R is replaced by BDE, CB and ACDFG which are all in BCNF.

- BCNF decomposition is not unique

Ex: $R(\underline{A}, B, C, D, E, F, G)$ $CE \rightarrow A$, $BD \rightarrow E$, $C \rightarrow B$

Alternative decomposition:

```
              ABCDEFG
       C→B  ╱         ╲
       violates          ACDEFG ✓
   ✓ CB                  CE→A
     C→B                   ↓
                        superkey
```

R is decomposed into CB and ACDEFG which are in BCNF.