BCNF Normalization (Partial)

- Given: R = (R; F) where R = $ABCDEGHK$ and
  $F = \{ABH \rightarrow C,\ A \rightarrow DE,\ BGH \rightarrow K,\ K \rightarrow ADH,\ BH \rightarrow GE\}$
  - Step 1: Find a FD that violates BCNF
    Note $ABH \rightarrow C$, $(ABH)^+$ includes all attributes (BH is a key)
    $A \rightarrow DE$ violates BCNF since A is not a superkey ($A^+ = ADE$)
  - Step 2: Split R into:
    $R_1 = (ADE;\ F_1 = \{A \rightarrow DE\})$ *Remove DE - A*
    $R_2 = (ABCGHK;\ F_1 = \{ABH \rightarrow C,\ BGH \rightarrow K,\ K \rightarrow AH,\ BH \rightarrow G\})$
- Note 1: R_1 is in BCNF
- Note 2: Decomposition *is lossless* since A is a key of R_1.
- Note 3: FDs $K \rightarrow D$ and $BH \rightarrow E$ are not in F_1 or F_2.
  But both can be derived from $F_1 \cup F_2$
  ($E.g.$, $K \rightarrow A$ and $A \rightarrow D$ implies $K \rightarrow D$)
  Hence, decomposition *is dependency preserving*.

BCNF Decomposition Algorithm

***Input*:** **R** = (R; $\boldsymbol{F}$)

Decomp := **R**
while there is **S** = (S; $\boldsymbol{F}'$) $\in$ *Decomp* and **S** not in BCNF **do**
Find $X \rightarrow Y \in \boldsymbol{F}'$ that violates BCNF // *X isn't a superkey in* **S**
Replace **S** in *Decomp* with $\mathbf{S_1} = (XY;\ \boldsymbol{F}_1)$, $\mathbf{S_2} = (S - (Y - X);\ \boldsymbol{F}_2)$
// $\boldsymbol{F}_1$ = *all FDs of* $\boldsymbol{F}'$ *involving only attributes of XY*
// $\boldsymbol{F}_2$ = *all FDs of* $\boldsymbol{F}'$ *involving only attributes of* $S - (Y - X)$
end
return *Decomp*