L05: Extraneous Attributes (Supplementary Slides)

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Extraneous Attributes

• There may be extraneous/redundant attributes on the LHS of a dependency
  - Let $\alpha \rightarrow \beta$ be a functional dependency in $F$. Attribute $A$ is extraneous in $\alpha$ if $F$ logically implies $F' = (F - \{\alpha \rightarrow \beta\}) \cup \{(\alpha - A) \rightarrow \beta\}$

  - To test if attribute $A$ is extraneous in $\alpha$ is extraneous in:
    1. compute $({\alpha} - A)^+$ using the dependencies in $F$
    2. check that $({\alpha} - A)^+$ contains $A$; if it does, $A$ is extraneous

  - Example:

    $F = \{\{A\} \rightarrow \{B\}, \{B\} \rightarrow \{C\}, \{A,C\} \rightarrow \{D\}\}$ can be simplified to $F' = \{\{A\} \rightarrow \{B\}, \{B\} \rightarrow \{C\}, \{A\} \rightarrow \{D\}\}$

    Because: Compute $\left(\{A,C\} - C\right)^+ = A^+$ using the dependencies in $F$

    $A^+ = \{A,B,C,D\}$ contains $C$

    Thus, $C$ in $\{A,C\} \rightarrow \{D\}$ is extraneous, and $F$ can be simplified to $F'$
Extraneous Attributes

- There may be extraneous/redundant attributes on the RHS of a dependency
  - Let $\alpha \rightarrow \beta$ be a functional dependency in $F$. Attribute $A$ is extraneous in $\beta$ if
    \[ F' = (F - \{\alpha \rightarrow \beta \}) \cup \{\alpha \rightarrow (\beta - A)\} \] logically implies $F$

- To test if attribute $A$ is extraneous in $\beta$: 
  1. compute $\alpha^+$ using only the dependencies in $F'$
  2. check that $\alpha^+$ contains $A$; if it does, $A$ is extraneous

- Example:
  \[ F = \{\{A\} \rightarrow \{B\}, \{B\} \rightarrow \{C\}, \{A\} \rightarrow \{C,D\}\} \] can be simplified to
  \[ F' = \{\{A\} \rightarrow \{B\}, \{B\} \rightarrow \{C\}, \{A\} \rightarrow \{D\}\} \]
  Because: Compute $A^+$ using $F'$
  \[ A^+ = \{A,B,C,D\} \text{ contains C} \]
  Thus, C in $\{A\} \rightarrow \{C,D\}$ is extraneous, and $F$ can be simplified to $F'$