Rules for Reasoning about MVDs

•Use to identify the MVDs (e.g., from FD to MVD) which are necessary for the decomposition of a relation into 4NF

$V \bowtie W$ is $X \twoheadrightarrow Y$ with $X=V \cap W$ and $X \cup Y=W$

- $V \bowtie W$ implies that every instance of R can be losslessly decomposed into two relations $R_1=(V,F_1)$ and $R_2=(W,F_2)$
- $X \twoheadrightarrow Y$ implies that for every value of X are independent of the value of Y

$V \bowtie W$ is $X \twoheadrightarrow Y$ with $X=V \cap W$ and $X \cup Y=W$

- If $X \twoheadrightarrow Y$ then $X \twoheadrightarrow Z$ for $Z \subseteq X \cup Y$ (trivial)
- If $X \twoheadrightarrow Y$ and $Y \twoheadrightarrow Z$ then $X \twoheadrightarrow Z$ (transitivity of MVDs)
- If $X \twoheadrightarrow Y$ then $X \twoheadrightarrow Z$ for $Z = R - (X \cup Y)$ (complementation)
- If $X \rightarrow Y$ then $X \twoheadrightarrow Y$ (FD implication)

Algorithm for 4NF decomposition

Similar to BCNF decomposition:

Given **R** = (R, **D**) where **D** contains FDs and MVDs

- Take $X \twoheadrightarrow Y$ violates the 4NF condition
- Decompose **R** into $\mathbf{R_1}=(X,D_1)$ and $\mathbf{R_2}=(X \cup (R-Y),D_2)$ where the FDs in D_1 and D_2 are computed in the same way as in the BCNF decomposition, see note for the computation of the MVDs