Logic and Terminology

For Functional Dependencies
ARMSTRONG'S AXIOMS or RULES of DEDUCTION.

• Reasoning about FDs

• New Symbol: ⊨
  – ‘Double Turnstile’, ‘entails’

• \{FD_1, FD_2, ..., FD_3\} ⊨ FD_n means
  – Given the FDs on the Left, \{FD_1, FD_2, ..., FD_3\}
  – you can deduce the FD on the Right, FD_n
Program

- Introduce the rules of reasoning
- Give examples of what they mean.
- Later will prove them
- Show how to use them in reasoning.
Nature of Rules

• Rules are patterns
• With Xs, Ys, Zs, etc.
• Xs, Ys, Zs can be one or more attributes.
• Use by matching up the patterns to your particular problem
1. Reflexive Rule:

- if Y is subset of X then X $\rightarrow$ Y
- PNAME,PLOC $\rightarrow$ PNAME
- Pattern:
  - $X = \text{PNAME},\text{PLOC}$
  - $Y = \text{PNAME}$
- Use: if I need to get PNAME on RHS.
2. Augmentation Rule:

- \{X \rightarrow Y\} \models XZ \rightarrow YZ
- \{SSN \rightarrow ENAME\} \models SSN,PNAME \rightarrow ENAME,PNAME
- Pattern
  - X = SSN
  - Y = ENAME
  - Z = PNAME
- Use: Need to add PNAME to LHS.
3. Transitive Rule:

- \{X \rightarrow Y, Y \rightarrow Z\} \models X \rightarrow Z
- \{SSN \rightarrow DNUM, DNUM \rightarrow MSSN\} \models SSN \rightarrow MSSN
- Pattern:
  - X = SSN
  - Y = DNUM
  - Z = MSSN
- Use: to connect SSN & MSSN in 1 FD
4. Decomposition Rule:

- \( \{X \rightarrow YZ\} \models X \rightarrow Y \)
- \( \{PNO \rightarrow PNAME,PLOC\} \models PNO \rightarrow PNAME \)
- Pattern:
  - \( X = PNO \)
  - \( Y = PNAME \)
  - \( Z = PLOC \)
- Use: to get rid of attribs on RHS
5. Union Rule

- \{X \rightarrow Y, X \rightarrow Z\} \models X \rightarrow YZ

- \{\text{PNO} \rightarrow \text{PNAME}, \text{PNO} \rightarrow \text{PLOC}\} \models \text{PNO} \rightarrow \text{PNAME, PLOC}

- Pattern:
  - X = \text{PNO}
  - Y = \text{PNAME}
  - Z = \text{PLOC}

- Use: to combine attrs on RHS
6. Pseudotransitive Rule

- \{X \rightarrow Y, WY \rightarrow Z\} \models WX \rightarrow Z
- \{\text{ENAME} \rightarrow \text{SSN},
  \text{SSN},\text{PNO} \rightarrow \text{HOURS}\} \models
  \text{ENAME, PNO} \rightarrow \text{HOURS}
- Pattern:
  - X = \text{ENAME}
  - Y = \text{SSN}
  - W = \text{PNO}
  - Z = \text{HOURS}
- Use: basically useless, just mentioned because it is in the book.