Chapter 14 – Normalization Examples
UTD CS-6360 Dr. Chris Irwin Davis

2NF, 3NF, and BCNF Normalization

- Normalization problems begin with a given relational schema and an associated set of Functional Dependencies (FD).
- For such problems you will be told to which level you are expected to normalize.
- Normalization problems must proceed in hierarchical order, each step must be completely normalized to that level before moving on to the next normal form.

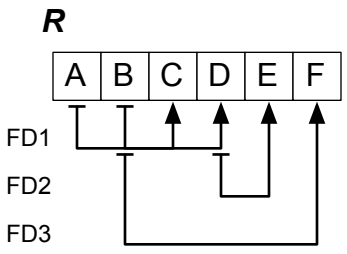
4NF, and 5NF Normalization

- Problems normalizing 4NF and 5NF will also include a small ER diagram to disambiguate the schema semantics, i.e. to determine whether 4NF normalization or 5NF normalization is warranted.
- Problems normalizing 4NF and 5NF may also include a data set which must be mapped onto the normalized schema.

Format of Given Information

- Normalization problems may be presented in either one of two different representations. One is a graphic representation of a relational schema and its associated FDs, the other is a text-based representation of a relational schema and its associated FDs. The following two examples are *two different ways to represent the exact same schema and FDs*. Exercises 14.24 and 14.25 in the textbook are given in text format.

  Graphic



  Text

  $R = \{A, B, C, D, E, F\}$
  $FD = \{\{A,B\} \rightarrow \{C,D\}, \{B\} \rightarrow \{F\}, \{D\} \rightarrow \{E\}\}$, Set notation, or shorthand…
  FD1 = AB → CD
  FD2 = D → E
  FD3 = B → F

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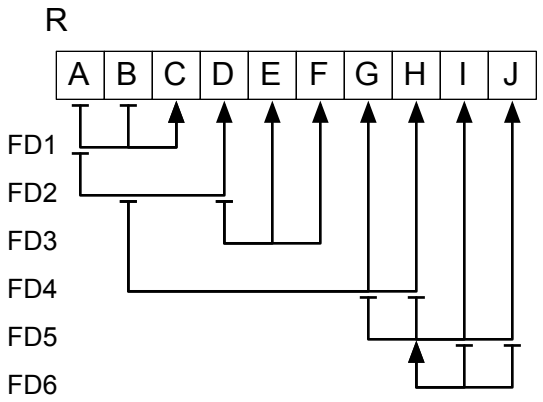
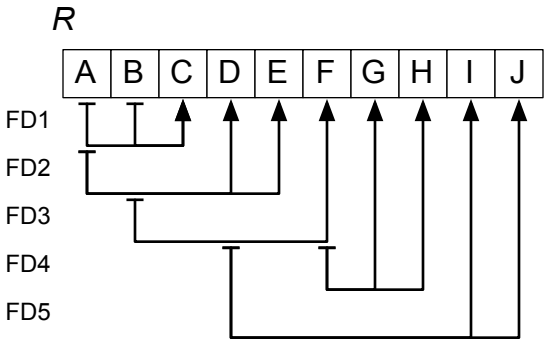
Consider each of the universal relation *R* below numbered 1–4, and each associated set of function dependencies. What is/are the key(s) for each *R*? Normalize/decompose each *R* into 2NF, then 3NF, and finally BCNF relations. Clearly indicate each step, label all FDs, and label the primary key (PK) for each new decomposed relation.

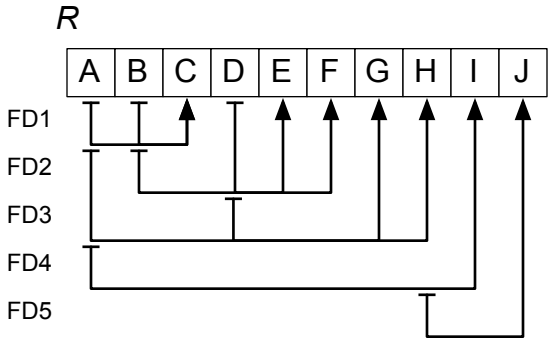
1)



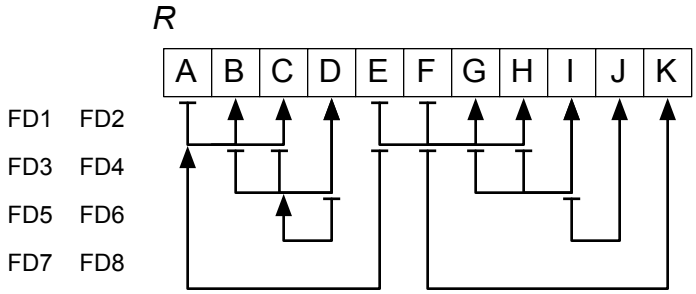
2) Textbook 7ed., Exercise 14.24 (p. 498)



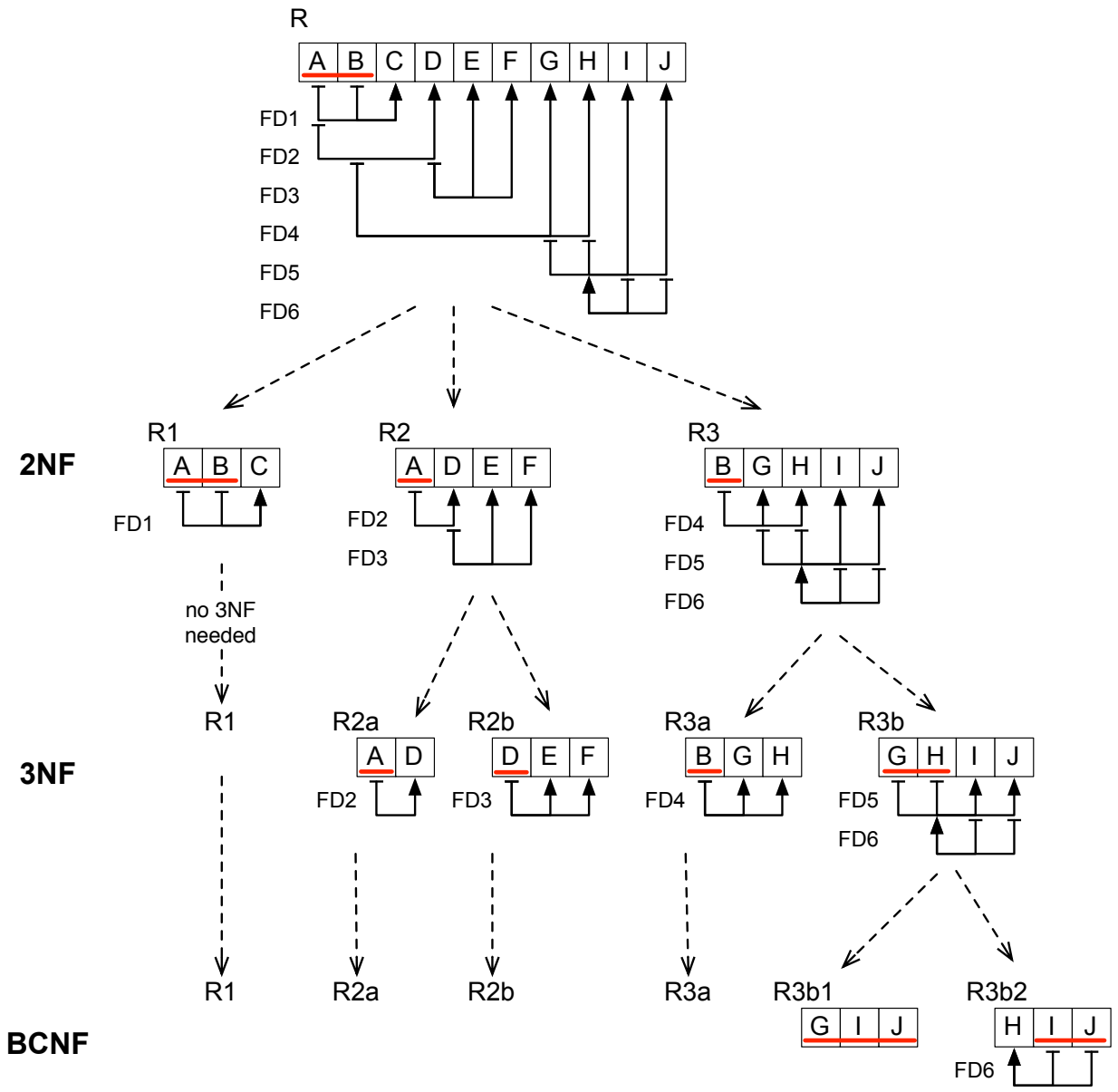
3) Textbook 7ed., Exercise 14.25 (p.498)



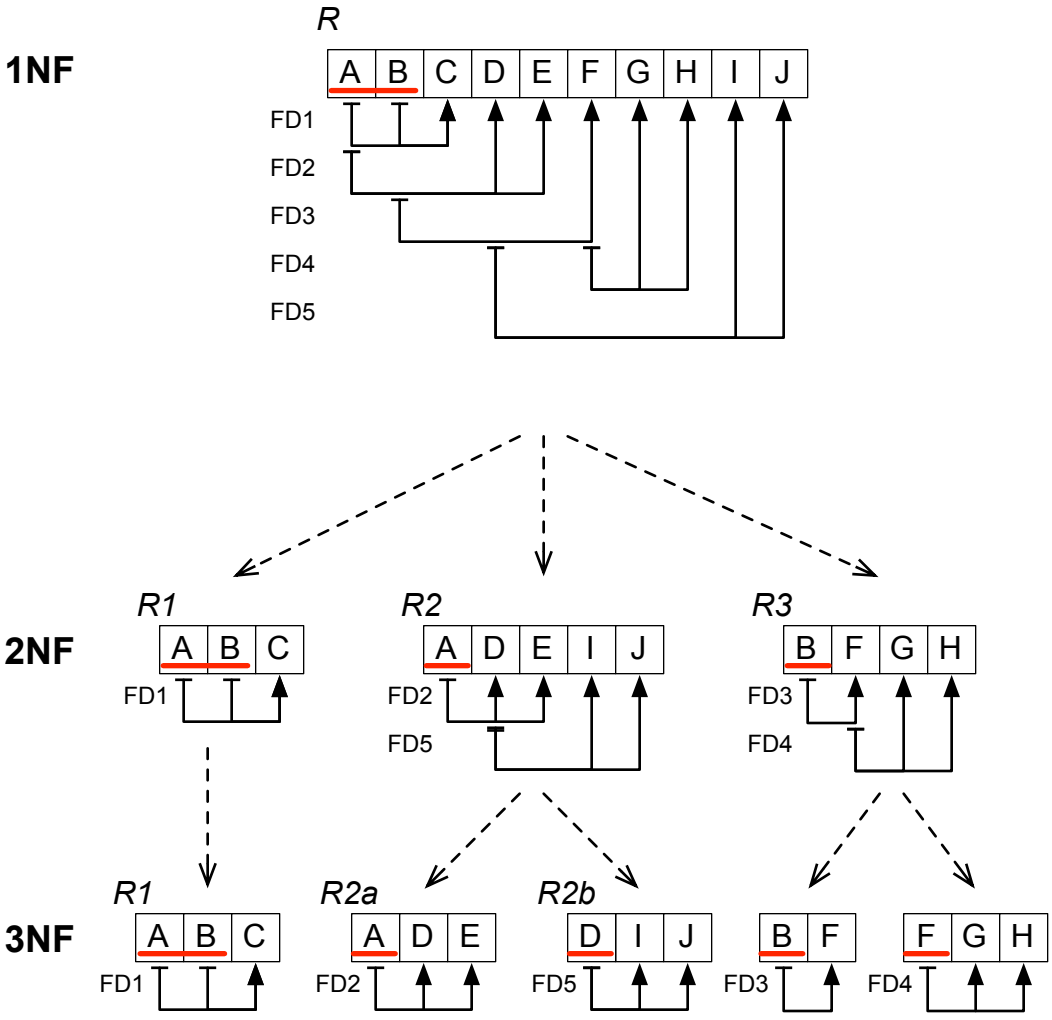
4)



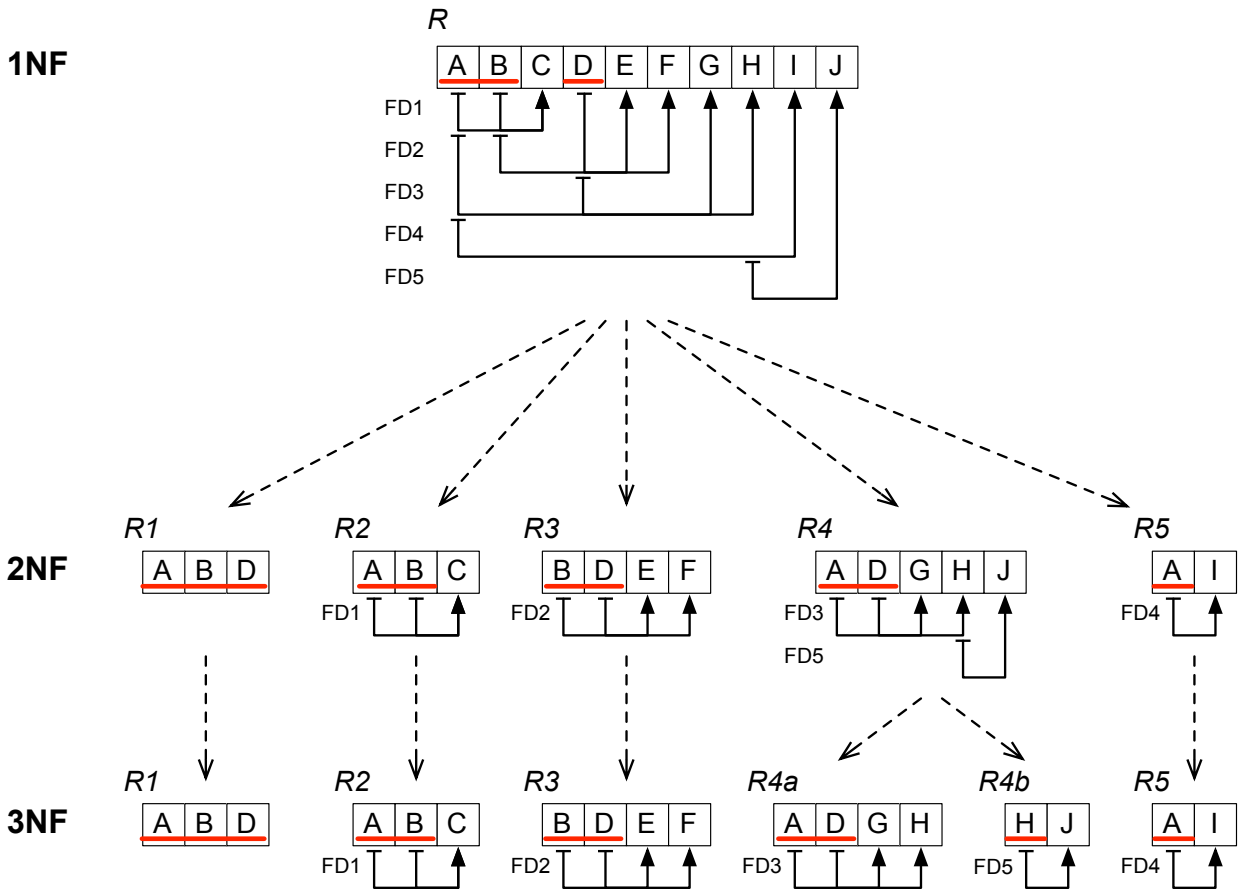
1)


R
A B C D E F G H I J
FD1
FD2
FD3
FD4
FD5
FD6
2NF
R1
A B C
FD1
R2
A D E F
FD2
FD3
R3
B G H I J
FD4
FD5
FD6
no 3NF needed
3NF
R1
R2a
A D
FD2
R2b
D E F
FD3
R3a
B G H
FD4
R3b
G H I J
FD5
FD6
BCNF
R1
R2a
R2b
R3a
R3b1
G I J
R3b2
H I J
FD6

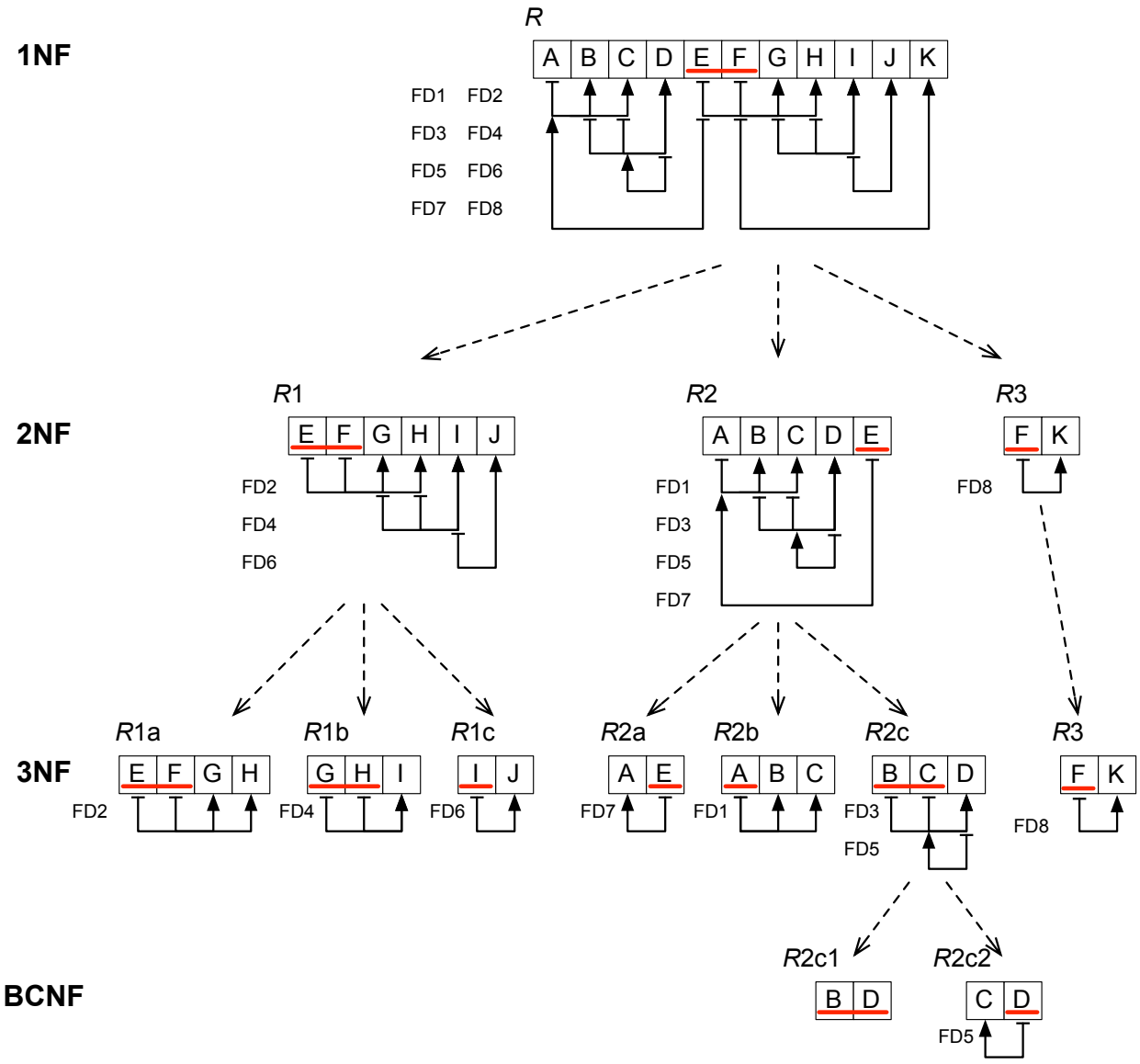
2) Textbook Exercise 15.24 (p.538)



3) Textbook Exercise 15.25 (p.538)



4)


1NF
R
A B C D E F G H I J K
FD1 FD2
FD3 FD4
FD5 FD6
FD7 FD8
2NF
R1
E F G H I J
FD2
FD4
FD6
R2
A B C D E
FD1
FD3
FD5
FD7
R3
F K
FD8
3NF
R1a
E F G H
FD2
R1b
G H I
FD4
R1c
I J
FD6
R2a
A E
FD7
R2b
A B C
FD1
R2c
B C D
FD3
FD5
R3
F K
FD8
BCNF
R2c1
B D
R2c2
C D
FD5