**CS 5200 Introduction to Database Management Homework #8**

Normalize the following relations when each one satisfies the specified functional dependencies. Decompose into BCNF if possible. If not, then decompose into 3NF. Show your work. In particular, show the list of all candidate keys of the original relation. To compute the candidate keys, use the discussion in [Candidate Keys and Normalization](http://www.ccs.neu.edu/home/kenb/10/fal/5200/resources/keynormal.html). In your decomposition show the attributes in each relation as well as the keys and embedded FDs.

1. The relation is ABCDE
   * E→D
   * D→E
   * ACD→B
2. The relation is ABCDE
   * A→C
   * BC→D
   * C→D
   * BD→A
   * A→D
3. The relation is ABCDEF
   * DF→C
   * BC→F
   * E→A
   * ABC→E
4. The relation is ABCDEF
   * BC→D
   * B→DF
   * CDF→B
5. The relation is ABCDEF
   * BE→A
   * BC→E
   * AEF→B
   * B→F
6. The relation is ABCDEFGH
   * DE→B
   * ACG→E
   * B→C
   * BCFG→E
7. The relation is ABCDEFGH
   * EH→F
   * H→A
   * BG→C

Normalize the following relations when each one satisfies the specified functional dependencies. Decompose into BCNF if possible. If not, then decompose into 3NF. Show your work. In particular, show the list of all candidate keys of the original relation. To compute the candidate keys, use the discussion in [Candidate Keys and Normalization](http://www.ccs.neu.edu/home/kenb/10/fal/5200/asst/resources/keynormal.html). In your decomposition show the attributes in each relation and the primary key of each relation.

1. The relation is ABCDE
   * E→D
   * D→E
   * ACD→B

|  |  |
| --- | --- |
| Neither |  |
| Right | B |
| Left | AC |
| Both | DE |

* + The core is AC
  + Closure of core is AC
  + Exterior attributes are DE
  + Keys: ACD, ACE
  + BCNF Normalization: ED (both E and D are unique), ABCD (ACD is unique)

1. The relation is ABCDE
   * A→C
   * BC→D
   * C→D
   * BD→A
   * A→D

The FD A→D is a consequence of A→C and C→D, so it was deleted. The FD BC→D is a consequence of C→D, so it was deleted.

|  |  |
| --- | --- |
| Neither | E |
| Right |  |
| Left | B |
| Both | ACD |

* + The core is BE
  + Closure of core is BE
  + Exterior attributes are ACD
  + Keys: BEA, BEC, BED
  + 3NF Normalization: AC (A is unique), BDA (BD is unique but A→D), CD (C is unique), BED (BED is unique).

1. The relation is ABCDEF
   * DF→C
   * BC→F
   * E→A
   * ABC→E

|  |  |
| --- | --- |
| Neither |  |
| Right |  |
| Left | BD |
| Both | ACEF |

* + The core is BD
  + Closure of core is BD
  + Exterior attributes are ACEF
  + Keys: BDAC, BDAF, BDCE, BDEF
  + 3NF Normalization: AE (E is unique), ABCE (ABC is unique but E→A), BCF (BC is unique), BDAC (BDAC is unique), DFC (DF is unique)

1. The relation is ABCDEF
   * BC→D
   * B→D
   * B→F
   * CDF→B

The FD BC→D is a consequence of C→D, so it was deleted.

|  |  |
| --- | --- |
| Neither | AE |
| Right |  |
| Left | C |
| Both | BDF |

* + The core is ACE
  + Closure of core is ACE
  + Exterior attributes are BDF
  + Keys: ACEB, ACEDF
  + 3NF Normalization: ACEB (ACEB is unique), BCDF (CDF is unique, but B→DF) BD (B is unique), BF (F is unique),

1. The relation is ABCDEF
   * BE→A
   * BC→E
   * AEF→B
   * B→F

|  |  |
| --- | --- |
| Neither | D |
| Right |  |
| Left | C |
| Both | ABEF |

* + The core is CD
  + Closure of core is CD
  + Exterior attributes are ABEF
  + Keys: CDB, CDAEF
  + 3NF Normalization: ABE (BE is unique), ABEF (AEF is unique but B→F and BE→A), BCD (BCD is unique), BCE (BC is unique), BF (B is unique)

1. The relation is ABCDEFGH
   * DE→B
   * ACG→E
   * B→C
   * BCFG→E

|  |  |
| --- | --- |
| Neither | H |
| Right |  |
| Left | ADFG |
| Both | BCE |

* + The core is ADFGH
  + Closure of core is ADFGH
  + Exterior attributes are BCE
  + Keys: ADFGHB, ADFGHC, ADFGHE
  + 3NF Normalization: ABDFGH (ABDFGH is unique), ACEG (ACG is unique), BC (B is unique), BCEFG (BCFG is unique but B→C), BDE (DE is unique)

1. The relation is ABCDEFGH
   * EH→F
   * H→A
   * BG→C

|  |  |
| --- | --- |
| Neither | D |
| Right | ACF |
| Left | BEGH |
| Both |  |

* + The core is BDEGH
  + Closure of core is ABCDEFGH
  + The core is the only key.
  + BCNF Normalization: AH (H is unique), BCG (BG is unique), BDEGH (BDEGH is unique), EFH (EH is unique)