

Normalization Proofs for Court Scheduling System

1. Court Relation

Attributes: { court_id, court_name, location, level, specialization }

Primary Key: court_id

Functional Dependencies:

- court_id \rightarrow court_name, location, level, specialization

Closure of court_id:

- court_id+ = { court_id, court_name, location, level, specialization }
- BCNF: All FDs have candidate key on LHS.

2. Judge Relation

Attributes: { judge_id, full_name, date_of_birth, specialization }

Primary Key: judge_id

FDs:

- judge_id \rightarrow full_name, date_of_birth, specialization

Closure: judge_id+ = { judge_id, full_name, date_of_birth, specialization }

BCNF: All FDs have candidate key on LHS.

3. Judge_History

Attributes: { judge_id, court_id, start_date, end_date }

Primary Key: { judge_id, court_id, start_date }

FDs:

- { judge_id, court_id, start_date } \rightarrow end_date

Closure: = All attributes

BCNF: All FDs have candidate key on LHS.

4. Lawyer

Attributes: { lawyer_id, full_name, bar_registration_number, lawyer_type }

Primary Key: lawyer_id

FDs:

- lawyer_id \rightarrow full_name, bar_registration_number, lawyer_type

Closure: lawyer_id+ = all attributes

BCNF: All FDs have candidate key on LHS.

5. Party

Attributes: { party_id, full_name, party_type }

Primary Key: party_id

FDs:

- $\text{party_id} \rightarrow \text{full_name}, \text{party_type}$
Closure: $\text{party_id}^+ = \text{all attributes}$
 BCNF: All FDs have candidate key on LHS.

6. Case

Attributes: { case_id, case_number, filing_date, case_type_id, court_id, is_undertrial, vulnerability_index, urgency_score, status, estimated_duration_blocks, parent_case_id }

Primary Key: case_id

FDs:

- $\text{case_id} \rightarrow \text{all other attributes}$
Closure: $\text{case_id}^+ = \text{all attributes}$
 BCNF: All FDs have candidate key on LHS.

7. Case_Type

Attributes: { case_type_id, type_name }

Primary Key: case_type_id

FDs:

- $\text{case_type_id} \rightarrow \text{type_name}$
Closure: $\text{case_type_id}^+ = \text{all}$
 BCNF: All FDs have candidate key on LHS.

8. Case_Parties

Attributes: { case_id, party_id }

Primary Key: { case_id, party_id }

FDs:

- No non-trivial FDs
 BCNF: All FDs have candidate key on LHS.

9. Case_Lawyer_Assignment

Attributes: { case_id, lawyer_id, start_date, end_date }

Primary Key: { case_id, lawyer_id, start_date }

FDs:

- $\{ \text{case_id}, \text{lawyer_id}, \text{start_date} \} \rightarrow \text{end_date}$
 BCNF: All FDs have candidate key on LHS.

10. Case_Document

Attributes: { doc_id, case_id, document_type, file_path_or_mongo_id, version, uploaded_at }

Primary Key: doc_id

FDs:

- doc_id → all other attributes
BCNF: All FDs have candidate key on LHS.

11. Case_Hearing

Attributes: { hearing_id, case_id, hearing_date, judge_id, outcome, remarks, hearing_mode }

Primary Key: hearing_id

FDs:

- hearing_id → all other attributes
BCNF: All FDs have candidate key on LHS.

12. Schedule_Log

Attributes: { schedule_id, case_id, judge_id, court_id, scheduled_date, start_time, end_time, created_at }

Primary Key: schedule_id

FDs:

- schedule_id → all other attributes
BCNF: All FDs have candidate key on LHS.

13. Court_Holidays

Attributes: { holiday_date, description }

Primary Key: holiday_date

FDs:

- holiday_date → description
BCNF: All FDs have candidate key on LHS.

14. Judge_Leave

Attributes: { judge_id, leave_date, reason }

Primary Key: { judge_id, leave_date }

FDs:

- { judge_id, leave_date } → reason
BCNF: All FDs have candidate key on LHS.

15. Case_Court_History

Attributes: { case_id, court_id, start_date, end_date }

Primary Key: { case_id, court_id, start_date }

FDs:

- { case_id, court_id, start_date } → end_date
BCNF: All FDs have candidate key on LHS.