

# Normalization Proofs

- Login\_info (username, password, mpin, UUID)
  - $FD = \{username \rightarrow \{password, mpin, UUID\}, \text{UUID} \rightarrow username\}$
  - Candidate key can be username or UUID.
  - Hence, Login\_info is in BCNF because the determining attributes are key.
  
- Customer (UUID, fname, lname, location, PIN, mobile\_no, email, DOB)
  - $FD = \{UUID \rightarrow \{fname, lname, location, PIN, mobile\_no, email, DOB\}\}$
  - Candidate key can be UUID or mobile\_no or email.
  - Hence, Customer is in BCNF because the determining attributes are key.
  
- Document (UUID, document)
  - Trivial FD only.
  - Candidate key can be {UUID, document}.
  - Hence, Document is in BCNF because the determining attributes are key.
  
- Pincodes (PIN, city, district, state)
  - $FD = \{PIN \rightarrow \{city, district, state\}\}$
  - Candidate key can be PIN.
  - Hence, Pincodes is in BCNF because the determining attributes are key.

- Account (account\_no, available\_balance, branch\_code, UUID, acc\_type)
  - FD = {account\_no → {available\_balance, branch\_code, UUID, acc\_type}}
  - Candidate key is account\_no.
  - Hence, Account is in BCNF because the determining attributes are key.
  
- Acc\_type (type\_name, interest\_rate)
  - FD = {type\_name → {interest\_rate}}
  - Candidate key is type\_name.
  - Hence, Acc\_type is in BCNF because the determining attributes are key.
  
- Loan\_application (loan\_app\_no, chosen\_term, loan\_amt, status, closed\_date, approved\_date, applied\_date, account\_no, loan\_ID)
  - FD = {loan\_app\_no → {chosen\_term, loan\_amt, status, closed\_date, approved\_date, applied\_date, account\_no, loan\_ID}}
  - Candidate key is loan\_app\_no.
  - Hence, Loan\_application is in BCNF because the determining attributes are key.
  
- Loan\_info (loan\_ID, min\_term, max\_term, delay\_penalty, loan\_type, min\_amt, max\_amt, interest\_rate, eligibility\_criteria)
  - FD = {loan\_ID → {min\_term, max\_term, delay\_penalty, loan\_type, min\_amt, max\_amt, interest\_rate, eligibility\_criteria}}
  - Candidate key is loan\_ID.
  - Hence, Loan\_info is in BCNF because the determining attributes are key.

- Loan\_repayment (loan\_app\_no, loan\_installment\_no, due\_date, due\_amt, settlement\_date)
  - FD = {{loan\_app\_no, loan\_installment\_no} → {due\_date, due\_amt, settlement\_date}}
  - Candidate key is {loan\_app\_no, loan\_installment\_no}.
  - Hence, Loan\_repayment is in BCNF because the determining attributes are key.
  
- Investment\_application (inv\_app\_no, annual\_duration, inv\_amt, status, approved\_date, profit, account\_no, inv\_ID)
  - FD = {inv\_app\_no → {annual\_duration, inv\_amt, status, approved\_date, profit, account\_no, inv\_ID}}
  - Candidate key is inv\_app\_no.
  - Hence, Investment\_application is in because the determining attributes are key.
  
- Investment\_info (inv\_ID, inv\_type, delay\_penalty)
  - FD = {inv\_ID → {inv\_type, delay\_penalty}, inv\_type → {inv\_ID}}
  - Candidate key is inv\_ID or inv\_type.
  - Hence, Investment\_info is in BCNF because the determining attributes are key.
  
- Investment\_payment (inv\_app\_no, inv\_installment\_no, due\_date, due\_amt, settlement\_date)
  - FD = {{inv\_app\_no, inv\_installment\_no} → {due\_date, due\_amt, settlement\_date}}
  - Candidate key is {inv\_app\_no, inv\_installment\_no}.
  - Hence, Investment\_payment is in BCNF because the determining attributes are key.
  
- Insurance\_application (ins\_app\_no, chosen\_premium\_amt, status, approved\_date, end\_date, ins\_ID, account\_no)

- FD = {ins\_app\_no → {chosen\_premium\_amt, status, approved\_date, end\_date, ins\_ID, account\_no}}
  - Candidate key is ins\_app\_no.
  - Hence, Insurance\_application is in BCNF because the determining attributes are key.
- Insurance\_info (ins\_ID, annual\_pay\_period, ins\_type, delay\_penalty, ins\_term, coverage\_amt, premium\_amt, eligibility\_criteria)
- FD = {ins\_ID → {annual\_pay\_period, ins\_type, delay\_penalty, ins\_term, coverage\_amt, premium\_amt, eligibility\_criteria }}
  - Candidate key is ins\_ID.
  - Hence, Insurance\_info is in BCNF because the determining attributes are key.
- Insurance\_record (ins\_app\_no, ins\_installment\_no, due\_date, due\_amt, settlement\_date)
- FD = {{ins\_app\_no, ins\_installment\_no} → {due\_date, due\_amt, settlement\_date}}
  - Candidate key is {ins\_app\_no, ins\_installment\_no}.
  - Hence, Insurance\_Record is in BCNF because the determining attributes are key.
- Service (service\_ID, service\_name)
- FD = {service\_ID → service\_name  
service\_name → service\_ID}
  - Candidate key is service\_ID or service\_name.
  - Hence, Service is in BCNF because the determining attributes are key.
- Service\_request (req\_ID, req\_date, status, additional\_notes, account\_no, service\_ID)
- FD = {req\_ID → {req\_date, status, additional\_notes, account\_no, service\_ID}}

- Candidate key is req\_ID.
  - Hence, Service\_request is in BCNF because the determining attributes are key.
- FD\_info (FD\_ID, interest\_rate, tenure\_yrs, min\_amt, description)
- FD = {FD\_ID → {interest\_rate, tenure\_yrs, min\_amt, description}}
  - interest\_rate → FD\_ID, tenure\_yrs → FD\_ID
  - Candidate key is FD\_ID or interest\_rate or tenure\_yrs.
  - Hence, FD\_info is in BCNF because the determining attributes are key.
- Fixed\_deposit (FD\_no, dep\_amt, maturity\_date, maturity\_amt, opened\_date, account\_no, FD\_ID)
- FD = {FD\_no → {dep\_amt, maturity\_date, maturity\_amt, opened\_date, account\_no, FD\_ID}}
  - Candidate key is FD\_no.
  - Hence, Fixed\_deposit is in BCNF because the determining attributes are key.
- Transaction (transaction\_ID, amount, transaction\_type, date, mode, receiver\_acc\_no, payer\_acc\_no)
- FD = {transaction\_ID → {amount, transaction\_type, date, mode, receiver\_acc\_no, payer\_acc\_no}}
  - Candidate key is transaction\_ID.
  - Hence, Transaction is in BCNF because the determining attributes are key.
- Branch (branch\_code, branch\_name, location, PIN)
- FD = {branch\_code → {branch\_name, location, PIN}}
  - Candidate key is branch\_code.
  - Hence, Branch is in BCNF because the determining attributes are key.

- Employee (emp\_ID, emp\_password, fname, lname, join\_date, salary, email, mobile\_no, dep\_no, branch\_code)
  - FD = {emp\_ID → {emp\_password, fname, lname, join\_date, salary, email, mobile\_no, dep\_no, branch\_code}}
  - Candidate key is emp\_ID.
  - Hence, Employee is in BCNF because the determining attributes are key.
  
- Department (dep\_no, dep\_name)
  - FD = {dep\_no → dep\_name, dep\_name → dep\_no}
  - Candidate key is dep\_no.
  - Hence, Department is in BCNF because the determining attributes are key.
  
- Operates\_in (branch\_code, dep\_no, mgr\_ID)
  - FD = {{branch\_code, dep\_no} → mgr\_ID}
  - Candidate key is {branch\_code, dep\_no}.
  - Hence, Operates\_in is in BCNF because the determining attributes are key.