Functional Dependency, Canonical Cover and Normalization

- **User (<u>UserID,</u>** Email, Address, Phone_number, Password, Username)

Candidate Keys: UserID

Since Email, Address and Phone_number can be changed by a user and Username can be null in our system, we defined the <u>UserID</u> be the primary key in the User table.

Functional Dependency:

$$F = \{UserID \rightarrow Email, UserID \rightarrow Address, UserID \rightarrow Phone\_number, UserID \rightarrow Password, UserID \rightarrow UserName\}$$

Canonical Cover:

- Step 1: Split RHS to single attribute: The RHS of User is already in this form.
- Step 2: Remove extraneous from LHS: The LHS of User is already in this form.
- Step 3: Remove redundant FDs.
  i. $Remove\ UserID \rightarrow Email$
  G = $\{ UserID \rightarrow Address, UserID \rightarrow Phone\_number, UserID \rightarrow Password, UserID \rightarrow UserName\}$
  $UserID+_G = \{Address, Phone\_number, Password, Username\}$
  Therefore, $UserID \rightarrow Email$ is not redundant
  ii. $Remove\ UserID \rightarrow Address$
  G = $\{ UserID \rightarrow Email, UserID \rightarrow Phone\_number, UserID \rightarrow Password, UserID \rightarrow UserName\}$
  $UserID+_G = \{Email, Phone\_number, Password, Username\}$
  Therefore, $UserID \rightarrow Address$ is not redundant
  iii. $Remove\ UserID \rightarrow Phone\_number$
  G = $\{UserID \rightarrow Address, UserID \rightarrow Email, UserID \rightarrow Password, UserID \rightarrow UserName\}$
  $UserID+_G = \{Email, Address, Password, Username\}$
  Therefore, $UserID \rightarrow Phone\_number$ is not redundant
  iv. $Remove\ UserID \rightarrow password$
  G = $\{UserID \rightarrow Address, UserID \rightarrow Email, UserID \rightarrow Phone\_number, UserID \rightarrow UserName\}$
  $UserID+_G = \{Email, Phone\_number, Address, Username\}$
  Therefore, $UserID \rightarrow Phone\_number$ is not redundant
  v. $Remove\ UserID \rightarrow UserName$
  G = $\{UserID \rightarrow Address, UserID \rightarrow Email, UserID \rightarrow Phone\_number, UserID \rightarrow Password\}$
  $UserID+_G = \{Email, Phone\_number, Address, Password\}$
  Therefore, $UserID \rightarrow UserName$ is not redundant

  Since there is no redundant FDs in F, F is Canonical Cover of itself.

Normalization:

The primary key of User is “UserID”

$F = \{UserID \rightarrow Email, UserID \rightarrow Address, UserID \rightarrow Phone\_number, UserID \rightarrow Password, UserID \rightarrow UserName\}$

Since LHS of all FDs is the primary key, User is in **BCNF**

Summary

Primary key: UserID

Function Dependency and Canonical Cover::

$F = \{UserID \rightarrow Email, UserID \rightarrow Address, UserID \rightarrow Phone\_number, UserID \rightarrow Password, UserID \rightarrow UserName\}$

Normalization: BCNF

- **Employer** (**Employer_ID**, Description, Name, Balance, Membership_StartTime)

Candidate Keys: Employer_ID

Employer_ID could be the primary key in the Employer table, since the employer could be a person and person’s name can be duplicated.

Functional Dependency:

$$F = \{Employer\_ID \rightarrow Description, Employer\_ID \rightarrow Name, Employer\_ID \rightarrow Balance, Employer\_ID \rightarrow Membership\_StartTime\}\}$$

Canonical Cover:

- Step 1: Split RHS to single attribute: The RHS of Employer is already in this form.
- Step 2: Remove extraneous from LHS: The LHS of Employer is already in this form.
- Step 3: Remove redundant FDs.
  i. $Remove\ Employer\_ID \rightarrow Description$

  G = $\{ Employer\_ID \rightarrow Name, Employer\_ID \rightarrow Balance, Employer\_ID \rightarrow Membership\_StartTime\}$

  $Employer\_ID +_G = \{Name, Balance, Membership\_StartTime\}$

  Therefore, $Employer\_ID \rightarrow Description$ is not redundant

  ii. $Remove\ Employer\_ID \rightarrow Name$

  G = $\{ Employer\_ID \rightarrow Description, Employer\_ID \rightarrow Balance, Employer\_ID \rightarrow Membership\_StartTime\}$

  $Employer\_ID +_G = \{Description, Balance, Membership\_StartTime\}$

  Therefore, $Employer\_ID \rightarrow Name$ is not redundant

  iii. $Remove\ Employer\_ID \rightarrow Balance$

  G = $\{ Employer\_ID \rightarrow Description, Employer\_ID \rightarrow Name, Employer\_ID \rightarrow Membership\_StartTime\}$

  $Employer\_ID +_G = \{Description, Name, Membership\_StartTime\}$

Therefore, $Employer\_ID \rightarrow Balance$ is not redundant

iv. $Remove\ Employer\_ID \rightarrow Membership\_StartTime$

G = { $Employer\_ID \rightarrow Description, Employer\_ID \rightarrow Name, Employer\_ID \rightarrow Balance$}

$Employer\_ID+_G=$ {$Description, Name, Balance$ }

Therefore, $Employer\_ID \rightarrow Membership\_StartTime$ is not redundant

Normalization:

The primary key of Employer is "Employer_ID"

$$F = \{Employer\_ID \rightarrow Description, Employer\_ID \rightarrow Name, Employer\_ID \rightarrow Balance, , Employer\_ID \rightarrow Membership\_StartTime\}$$

Since LHS of all FDs is the primary key, Employer is in **BCNF**

Summary

Primary key: Employer_ID

Function Dependency and Canonical Cover::

$$F = \{Employer\_ID \rightarrow Description, Employer\_ID \rightarrow Name, Employer\_ID \rightarrow Balance, Employer\_ID \rightarrow Membership\_StartTime\}$$

Normalization: BCNF

- **Candidate** (**Candidate_ID**, FirstName, LastName, Balance, Membership_StartTime)

Candidate Keys: Candidate_ID

Functional Dependency:

$$F = \{Candidate\_ID \rightarrow FirstName + LastName, Candidate\_ID \rightarrow Balance, Candidate\_ID \rightarrow Membership\_StartTime\}$$

Canonical Cover:

- Step 1: Split RHS to single attribute:

$$F = \{Candidate\_ID \rightarrow FirstName, Candidate\_ID \rightarrow LastName, Candidate\_ID \rightarrow Balance, Candidate\_ID \rightarrow Membership\_StartTime\}$$

- Step 2: Remove extraneous from LHS: The LHS of User is already in this form.
- Step 3: Remove redundant FDs.
  i. $Remove\ Candidate\_ID \rightarrow FirstName$

  G = { $Candidate\_ID \rightarrow LastName, Candidate\_ID \rightarrow Balance, Candidate\_ID \rightarrow Membership\_StartTime$}

  $Candidate\_ID+_G=$ {$LastName, Balance, Membership\_StartTime$ }

  Therefore, $Candidate\_ID \rightarrow FirstName$ is not redundant

  ii. $Remove\ Candidate\_ID \rightarrow LastName$

G = { $Candidate\_ID \rightarrow FirstName, Candidate\_ID \rightarrow Balance, Candidate\_ID \rightarrow Membership\_StartTime$}

$Candidate\_ID+_G = \{FirstName, Balance, Membership\_StartTime\}$

Therefore, $Candidate\_ID \rightarrow LastName$ is not redundant

iii. $Remove\ Candidate\_ID \rightarrow Balance$

G = { $Candidate\_ID \rightarrow FirstName, Candidate\_ID \rightarrow Balance, Candidate\_ID \rightarrow Membership\_StartTime$}

$Candidate\_ID+_G = \{CFirstName, LastName, Membership\_StartTime\}$

Therefore,$Candidate\_ID \rightarrow Balance$ is not redundant

iv. $Remove\ Candidate\_ID \rightarrow Membership\_StartTime$

G = { $Candidate\_ID \rightarrow FirstName, Candidate\_ID \rightarrow Balance, Candidate\_ID \rightarrow LastName$}

$Candidate\_ID+_G = \{CFirstName, LastName, Balance\}$

Therefore,$Candidate\_ID \rightarrow Membership\_StartTime$ is not redundant

Normalization:

The primary key of Candidate is "$Candidate\_ID$"

$$F = \{Candidate\_ID \rightarrow FirstName, Candidate\_ID \rightarrow LastName, Candidate\_ID \rightarrow Balance, Candidate\_ID \rightarrow Membership\}$$

Since LHS of all FDs is the primary key, Candidate is in **BCNF**

Summary

Primary key: Candidate_ID

Function Dependency and Canonical Cover:

$$F = \{Candidate\_ID \rightarrow FirstName, Candidate\_ID \rightarrow LastName, Candidate\_ID \rightarrow Balance, Candidate\_ID \rightarrow Membership\}$$

Normalization: BCNF

- **Admin** (**Admin_ID**, FirstName, LastName)

Candidate Keys: Admin_ID

Functional Dependency:

$$F = \{Admin\_ID \rightarrow FirstName + LastName\}$$

Canonical Cover:

- Step 1: Split RHS to single attribute:

$$F = \{Admin\_ID \rightarrow FirstName, Admin\_ID \rightarrow LastName\}$$

- Step 2: Remove extraneous from LHS: The LHS of Admin is already in this form.

- Step 3: Remove redundant FDs.
  i. $Remove\ Admin\_ID \rightarrow FirstName$

  G = { $Admin\_ID \rightarrow LastName$}

  $Admin\_ID+_G = \{LastName\}$

  Therefore, $Admin\_ID \rightarrow FirstName$ is not redundant

  ii. $Remove\ Admin\_ID \rightarrow LastName$

  G = { $Admin\_ID \rightarrow FirstName$}

  $Admin\_ID+_G = \{FirstName\}$

  Therefore, $Admin\_ID \rightarrow LastName$ is not redundant

Normalization:

The primary key of Admin is "$Admin\_ID$"

$$F = \{Admin\_ID \rightarrow FirstName, Admin\_ID \rightarrow LastName\}$$

Since LHS of all FDs is the primary key, Admin is in **BCNF**

Summary

Primary key: Admin_ID

Function Dependency and Canonical Cover:

$$F = \{Admin\_ID \rightarrow FirstName, Admin\_ID \rightarrow LastName\}$$

Normalization: BCNF

- **Job** (**Job_ID**, Vacancies, JobStatus, Title, Description, Post_Date, Location)

Candidate Keys: Job_ID

Functional Dependency:

$$F = \{Job\_ID \rightarrow Vacancies, Job\_ID \rightarrow JobStatus, Job\_ID \rightarrow Title, Job\_ID \rightarrow Description, Job\_ID \rightarrow Post\_Date, Job\_ID \rightarrow Location\}$$

Canonical Cover:

- Step 1: Split RHS to single attribute: The RHS of Job is already in this form
- Step 2: Remove extraneous from LHS: The LHS of Job is already in this form.
- Step 3: Remove redundant FDs.
  i. $Remove\ Job\_ID \rightarrow Vacancies$

  G = { $Job\_ID \rightarrow JobStatus, Job\_ID \rightarrow Title, Job\_ID \rightarrow Description, Job\_ID \rightarrow Post\_Date, Job\_ID \rightarrow Location$}

  $Job\_ID+_G = \{JobStatus, Title, Description, Post\_Date, Location\}$

  Therefore, $Job\_ID \rightarrow Vacancies$ is not redundant

ii. $Remove\ Job\_ID \rightarrow JobStatus$

G = $\{Job\_ID \rightarrow Vacancies, Job\_ID \rightarrow Title, Job\_ID \rightarrow Description, Job\_ID \rightarrow Post\_Date, Job\_ID \rightarrow Location\}$

$Job\_ID+_G = \{Vacancies, Title, Description, Post\_Date, Location\}$

Therefore, $Job\_ID \rightarrow JobStatus$ is not redundant

iii. $Remove\ Job\_ID \rightarrow Title$

G = $\{Job\_ID \rightarrow Vacancies, Job\_ID \rightarrow JobStatus, Job\_ID \rightarrow Description, Job\_ID \rightarrow Post\_Date, Job\_ID \rightarrow Location\}$

$Job\_ID+_G = \{Vacancies, JobStatus, Description, Post\_Date, Location\}$

Therefore, $Job\_ID \rightarrow Title$ is not redundant

iv. $Remove\ Job\_ID \rightarrow Description$

G = $\{Job\_ID \rightarrow Vacancies, Job\_ID \rightarrow JobStatus, Job\_ID \rightarrow Title, Job\_ID \rightarrow Post\_Date, Job\_ID \rightarrow Location\}$

$Job\_ID+_G = \{Vacancies, JobStatus, Title, Post\_Date, Location\}$

Therefore, $Job\_ID \rightarrow Description$ is not redundant

v. $Remove\ Job\_ID \rightarrow Post\_Date$

G = $\{Job\_ID \rightarrow Vacancies, Job\_ID \rightarrow JobStatus, Job\_ID \rightarrow Title, Job\_ID \rightarrow Location, Job\_ID \rightarrow Title, Job\_ID \rightarrow Description\}$

$Job\_ID+_G = \{Vacancies, JobStatus, Title, Description, Location\}$

Therefore, $Job\_ID \rightarrow Post\_Date$ is not redundant

vi. $Remove\ Job\_ID \rightarrow Location$

G = $\{Job\_ID \rightarrow Vacancies, Job\_ID \rightarrow JobStatus, Job\_ID \rightarrow Title, Job\_ID \rightarrow Post\_Date, Job\_ID \rightarrow Title, Job\_ID \rightarrow Description\}$

$Job\_ID+_G = \{Vacancies, JobStatus, Title, Description, Post\_Date\}$

Therefore, $Job_ID \rightarrow Location$is not redundant

Normalization:

The primary key of Job is "Job_ID"

$F = \{Job\_ID \rightarrow Vacancies, Job\_ID \rightarrow JobStatus, Job\_ID \rightarrow Title, Job\_ID \rightarrow Description, Job\_ID \rightarrow Post\_Date, Job\_ID \rightarrow Location\}$

Since LHS of all FDs is the primary key, Job is in **BCNF**

Summary

Primary key: Job_ID

Function Dependency and Canonical Cover:

$$F = \{Job\_ID \rightarrow Vacancies, Job\_ID \rightarrow JobStatus, Job\_ID \rightarrow Title, Job\_ID \rightarrow Description, Job\_ID \rightarrow Post\_Date, Job\_ID \rightarrow Location\}$$

Normalization: BCNF

- **Payment** (**Payment_ID,** Amount, PaymentCreateDate)

Candidate Keys: Payment_ID

Functional Dependency:

$$F = \{Payment\_ID \rightarrow Amount, Payment\_ID \rightarrow PaymentCreateDate\}$$

Canonical Cover:

- Step 1: Split RHS to single attribute: The RHS of Payment is already in this form
- Step 2: Remove extraneous from LHS: The LHS of Payment is already in this form.
- Step 3: Remove redundant FDs.
  i. $Remove\ Payment\_ID \rightarrow Amount$

     G = $\{ Payment\_ID \rightarrow PaymentCreateDate\}$

     $Payment\_ID+_G = \{PaymentCreateDate\}$

     Therefore, $Payment\_ID \rightarrow Amount$ is not redundant
  ii. $Remove\ Payment\_ID \rightarrow PaymentCreateDate$

     G = $\{ Payment\_ID \rightarrow Amount\}$

     $Payment\_ID+_G = \{Amount\}$

     Therefore, $Payment\_ID \rightarrow PaymentCreateDate$ is not redundant

Normalization:

The primary key of Payment is "$Payment\_ID$"

$$F = \{Payment\_ID \rightarrow Amount, Payment\_ID \rightarrow PaymentCreateDate\}$$

Since LHS of all FDs is the primary key, Payment is in **BCNF**

Summary

Primary key: Payment_ID

Function Dependency and Canonical Cover:

$$F = \{Payment\_ID \rightarrow Amount, Payment\_ID \rightarrow PaymentCreateDate\}$$

Normalization: BCNF

- **PayMenthod (<u>PayMethod_ID,</u>** Card_Number, CVV_Number, ExpireDate, DefaultCard, AutoManual)

Candidate Keys: The <u>PayMethod_ID</u> could be the primary key, since we assume different user can use same card to pay the bill and a car can pay for different orders.

Functional Dependency:

$$F = \{PayMethod\_ID \rightarrow Card\_Number, PayMethod\_ID \rightarrow CVV\_Number, PayMethod\_ID \rightarrow ExpireDate, PayMethod\_ID \rightarrow DefaultCard, PayMethod\_ID \rightarrow AutoManual\}$$

Canonical Cover:

- Step 1: Split RHS to single attribute: The RHS of PayMenthod is already in this form
- Step 2: Remove extraneous from LHS: The LHS of PayMenthod is already in this form.
- Step 3: Remove redundant FDs.
  i. $Remove\ PayMethod\_ID \rightarrow Card\_Number$
  G = $\{PayMethod\_ID \rightarrow CVV\_Number, PayMethod\_ID \rightarrow ExpireDate, PayMethod\_ID \rightarrow DefaultCard, PayMethod\_ID \rightarrow AutoManual\}$
  $PayMethod\_ID+_G = \{CVV\_Number, ExpireDate, DefaultCard, AutoManual\}$
  Therefore, $PayMethod\_ID \rightarrow Card\_Number$ is not redundant
  ii. $Remove\ \ PayMethod\_ID \rightarrow CVV\_Number$
  G = $\{PayMethod\_ID \rightarrow Card\_Number, PayMethod\_ID \rightarrow ExpireDate, PayMethod\_ID \rightarrow DefaultCard, PayMethod\_ID \rightarrow AutoManual\}$
  $PayMethod\_ID+_G = \{Card\_Number, ExpireDate, DefaultCard, AutoManual\}$
  Therefore, $PayMethod\_ID \rightarrow CVV\_Number$ is not redundant
  iii. $Remove\ PayMethod\_ID \rightarrow ExpireDate$
  G = $\{PayMethod\_ID \rightarrow Card\_Number, PayMethod\_ID \rightarrow CVV\_Number, PayMethod\_ID \rightarrow DefaultCard, PayMethod\_ID \rightarrow AutoManual\}$
  $PayMethod\_ID+_G = \{Card\_Number, CVV\_Number, DefaultCard, AutoManual\}$
  Therefore, $PayMethod\_ID \rightarrow ExpireDate$ is not redundant
  iv. $Remove\ PayMethod\_ID \rightarrow DefaultCard$
  G = $\{PayMethod\_ID \rightarrow Card\_Number, PayMethod\_ID \rightarrow CVV\_Number, PayMethod\_ID \rightarrow ExpireDate, PayMethod\_ID \rightarrow AutoManual\}$
  $PayMethod\_ID+_G = \{Card\_Number, CVV\_Number, ExpireDate, AutoManual\}$
  Therefore, $PayMethod\_ID \rightarrow DefaultCard$ is not redundant
  v. $Remove\ PayMethod\_ID \rightarrow AutoManual$
  G = $\{PayMethod\_ID \rightarrow Card\_Number, PayMethod\_ID \rightarrow CVV\_Number, PayMethod\_ID \rightarrow ExpireDate, PayMethod\_ID \rightarrow DefaultCard\}$
  $PayMethod\_ID+_G = \{Card\_Number, CVV\_Number, ExpireDate, DefaultCard\}$

Therefore, $PayMethod\_ID \rightarrow AutoManual$ is not redundant

Normalization:

The primary key of PayMentod is "$PayMethod\_ID$"

$$F = \{PayMethod\_ID \rightarrow Card\_Number, PayMethod\_ID \rightarrow CVV\_Number, PayMethod\_ID \rightarrow ExpireDate, PayMethod\_ID \rightarrow DefaultCard, PayMethod\_ID \rightarrow AutoManual\}$$

Since LHS of all FDs is the primary key, PayMentod is in **BCNF**

Summary

Primary key: $PayMethod\_ID$

Function Dependency and Canonical Cover:

$$F = \{PayMethod\_ID \rightarrow Card\_Number, PayMethod\_ID \rightarrow CVV\_Number, PayMethod\_ID \rightarrow ExpireDate, PayMethod\_ID \rightarrow DefaultCard, PayMethod\_ID \rightarrow AutoManual\}$$

Normalization: BCNF

- **EmployerMembership** (**Genre**, MonthlyFee, MaxJobPost)

Candidate Keys: Genre

Functional Dependency:

$$F = \{Genre \rightarrow MonthlyFee, Genre \rightarrow MaxJobPost\}$$

Canonical Cover:

- Step 1: Split RHS to single attribute: The RHS of EmployerMembership is already in this form
- Step 2: Remove extraneous from LHS: The LHS of EmployerMembership is already in this form.
- Step 3: Remove redundant FDs.
  i. $Remove\ Genre \rightarrow MonthlyFee$

     G = { $Genre \rightarrow MaxJobPost$}

     $Genre+_G = \{MaxJobPost\}$

     Therefore, $Genre \rightarrow MonthlyFee$ is not redundant
  ii. $Remove\ \ Genre \rightarrow MaxJobPost$

     G = { $Genre \rightarrow MonthlyFee$}

     $Genre+_G = \{MonthlyFee\}$

     Therefore, $Genre \rightarrow MaxJobPost$ is not redundant

Normalization:

The primary key of EmployerMembership is "$Genre$"

$$F = \{Genre \rightarrow MonthlyFee, Genre \rightarrow MaxJobPost\}$$

Since LHS of all FDs is the primary key, EmployerMembership is in **BCNF**

Summary

Primary key: Genre

Function Dependency and Canonical Cover:

$$F = \{Genre \rightarrow MonthlyFee, Genre \rightarrow MaxJobPost\}$$

Normalization: BCNF

- **CandidateMembership** (**Genre**, MonthlyFee, MaxJobApply)

Candidate Keys: Genre

Functional Dependency:

$$F = \{Genre \rightarrow MonthlyFee, Genre \rightarrow MaxJobApply\}$$

Canonical Cover:

- Step 1: Split RHS to single attribute: The RHS of CandidateMembership is already in this form
- Step 2: Remove extraneous from LHS: The LHS of CandidateMembership is already in this form.
- Step 3: Remove redundant FDs.

iii. $Remove\ Genre \rightarrow MonthlyFee$

G = { $Genre \rightarrow MaxJobApply$}

$Genre+_G = \{MaxJobApply\}$

Therefore, $Genre \rightarrow MonthlyFee$ is not redundant

iv. $Remove\ \ Genre \rightarrow MaxJobApply$

G = { $Genre \rightarrow MonthlyFee$}

$Genre+_G = \{MonthlyFee\}$

Therefore, $Genre \rightarrow MaxJobApply$ is not redundant

Normalization:

The primary key of CandidateMembership is "$Genre$"

$$F = \{Genre \rightarrow MonthlyFee, Genre \rightarrow MaxJobApply\}$$

Since LHS of all FDs is the primary key, CandidateMembership is in **BCNF**

Summary

Primary key: Genre

Function Dependency and Canonical Cover:

$$F = \{Genre \rightarrow MonthlyFee, Genre \rightarrow MaxJobApply\}$$

Normalization: BCNF

- **PadInformation** (AccountNumber, BranchNumber, InstituteNumber, ***PayMethod_ID***)

Candidate Keys: Since it's a weak entity, so the primary key is PayMethod_ID

Functional Dependency:

$$F = \{PayMethod\_ID \rightarrow AccountNumber, PayMethod\_ID \rightarrow BranchNumber, PayMethod\_ID \rightarrow InstituteNumber\}$$

Canonical Cover:

- Step 1: Split RHS to single attribute: The RHS of PadInformation is already in this form
- Step 2: Remove extraneous from LHS: The LHS of PadInformation is already in this form.
- Step 3: Remove redundant FDs.
  i. $Remove\ PayMethod\_ID \rightarrow AccountNumber$
  G = $\{ PayMethod\_ID \rightarrow BranchNumber, PayMethod\_ID \rightarrow InstituteNumber\}$
  $PayMethod\_ID +_G = \{ BranchNumber, InstituteNumber\}$
  Therefore, $PayMethod\_ID \rightarrow AccountNumber$ is not redundant
  ii. $Remove\ PayMethod\_ID \rightarrow BranchNumber$
  G = $\{PayMethod\_ID \rightarrow AccountNumber, PayMethod\_ID \rightarrow InstituteNumber\}$
  $Genre +_G = \{AccountNumber, InstituteNumber\}$
  Therefore, $PayMethod\_ID \rightarrow BranchNumber$ is not redundant
  iii. $Remove\ PayMethod\_ID \rightarrow InstituteNumber$
  G = $\{PayMethod\_ID \rightarrow AccountNumber, PayMethod\_ID \rightarrow BranchNumber\}$
  $Genre +_G = \{AccountNumber, BranchNumber\}$
  Therefore, $PayMethod\_ID \rightarrow InstituteNumber$ is not redundant

Normalization:

The primary key of PadInformation is "$PayMethod\_ID$"

$$F = \{PayMethod\_ID \rightarrow AccountNumber, PayMethod\_ID \rightarrow BranchNumber, PayMethod\_ID \rightarrow InstituteNumber\}$$

Since LHS of all FDs is the primary key, PadInformation is in **BCNF**

Summary

Primary key: PayMethod_ID

Function Dependency and Canonical Cover:

$$F = \{PayMethod\_ID \rightarrow AccountNumber, PayMethod\_ID \rightarrow BranchNumber, PayMethod\_ID \rightarrow InstituteNumber\}$$

Normalization: BCNF

- **JobCategory** (**Genre**, Name)

Candidate Keys: Genre

Functional Dependency:

$$F = \{Genre \rightarrow Name\}$$

Canonical Cover:

- Step 1: Split RHS to single attribute: The RHS of JobCategory is already in this form
- Step 2: Remove extraneous from LHS: The LHS of JobCategory is already in this form.
- Step 3: Remove redundant FDs. There is no redundant.

Normalization:

The primary key of JobCategory is "$Genre$"

$$F = \{Genre \rightarrow Name\}$$

Since LHS of all FDs is the primary key, JobCategory is in **BCNF**

Summary

Primary key: Genre

Function Dependency and Canonical Cover:

$$F = \{Genre \rightarrow Name\}$$

Normalization: BCNF

- **Application** (ApplicationStatus, ApplicationDate, **Job_ID, Candidate_ID**)

Candidate Keys: (Job_ID, Candidate_ID)

Functional Dependency:

$$F = \{Job\_ID, Candidate\_ID \rightarrow ApplicationStatus, Job\_ID, Candidate\_ID \rightarrow ApplicationDate\}$$

Canonical Cover:

- Step 1: Split RHS to single attribute: The RHS of Application is already in this form
- Step 2: Remove extraneous from LHS:

$Job\_ID^{+} = Job\_ID$

$Candidate\_ID^{+} = Candidate\_ID$

So, there is no left redundant.

- Step 3: Remove redundant FDs.
  i. $Remove\ Job\_ID, Candidate\_ID \rightarrow ApplicationStatus$

  G = $\{Job\_ID, Candidate\_ID \rightarrow ApplicationDate\}$

  $Remove\ Job\_ID, Candidate\_ID +_{G} = \{ApplicationDate\}$

  Therefore, $Job\_ID, Candidate\_ID \rightarrow ApplicationStatus$ is not redundant

  ii. $Remove\ Job\_ID, Candidate\_ID \rightarrow ApplicationDate$

  G = $\{Job\_ID, Candidate\_ID \rightarrow ApplicationStatus\}$

  $Remove\ Job\_ID, Candidate\_ID +_{G} = \{ApplicationStatus\}$

  Therefore, $Job\_ID, Candidate\_ID \rightarrow ApplicationDate$ is not redundant

Normalization:

The primary key of Application is "$Genre$"

$$F = \{Job\_ID, Candidate\_ID \rightarrow ApplicationStatus, Job\_ID, Candidate\_ID \rightarrow ApplicationDate\}$$

Since LHS of all FDs is the primary key, Application is in **BCNF**

Summary

Primary key: Genre

Function Dependency and Canonical Cover:

$$F = \{Job\_ID, Candidate\_ID \rightarrow ApplicationStatus, Job\_ID, Candidate\_ID \rightarrow ApplicationDate\}$$

Normalization: BCNF