Functional Dependency, Canonical Cover and Normalization

- **User** (**UserID**, 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 UserID 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

<u>Primary key</u>: UserID

<u>Function Dependency and Canonical Cover::</u>

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

<u>Normalization</u>: BCNF

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

Candidate Keys: Employer_ID

<u>Employer_ID could be the primary key in the Employer table,</u> since the employer could be a person and person's name can be duplicated.

Functional Dependency:

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

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 $Employer\_ID \rightarrow Description$*

    $G = \{ Employer\_ID \rightarrow Name, Employer\_ID \rightarrow Balance, Employer\_ID \rightarrow$
    $Membership\_StartTime, Employer\_ID \rightarrow EmployerStatus, Employer\_ID \rightarrow FrozenTime\}$
    $Employer\_ID+_G = \{Name, Balance, Membership\_StartTime, EmployerStatus, FrozenTime\}$
    Therefore, $Employer\_ID \rightarrow Description$ is not redundant

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

    $G = \{ Employer\_ID \rightarrow Description, Employer\_ID \rightarrow Balance, Employer\_ID \rightarrow$
    $Membership\_StartTime, Employer\_ID \rightarrow EmployerStatus, Employer\_ID \rightarrow FrozenTime\}$
    $Employer\_ID+_G = \{Description, Balance, Membership\_StartTime, EmployerStatus, FrozenTime \}$
    Therefore, $Employer\_ID \rightarrow Name$ is not redundant

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

$G = \{\, Employer\_ID \rightarrow Description, Employer\_ID \rightarrow Name, Employer\_ID \rightarrow$
$Membership\_StartTime, Employer\_ID \rightarrow EmployerStatus, Employer\_ID \rightarrow FrozenTime\}$
$Employer\_ID{+}_G = \{Description, Name, Membership\_StartTime, EmployerStatus, FrozenTime\,\}$
Therefore, $Employer\_ID \rightarrow Balance$ is not redundant

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

$G = \{\, Employer\_ID \rightarrow Description, Employer\_ID \rightarrow Name, Employer\_ID \rightarrow Balance, Employer\_ID \rightarrow$
$EmployerStatus, Employer\_ID \rightarrow FrozenTime\}$
$Employer\_ID{+}_G = \{Description, Name, Balance, EmployerStatus, FrozenTime\,\}$
Therefore, $Employer\_ID \rightarrow Membership\_StartTime$ is not redundant

    v.   *Remove* $Employer\_ID \rightarrow EmployerStatus$

$G = \{Employer\_ID \rightarrow Description, Employer\_ID \rightarrow Name, Employer\_ID \rightarrow Balance, Employer\_ID \rightarrow$
$Membership\_StartTime, Employer\_ID \rightarrow FrozenTime\}$
$Employer\_ID{+}_G = \{Description, Name, Balance, Membership\_StartTime, EmployerStatus\,\}$
$Employer\_ID \rightarrow EmployerStatus$ is not redundant

    vi.   *Remove* $Employer\_ID \rightarrow EmployerStatus$

$G = \{Employer\_ID \rightarrow Description, Employer\_ID \rightarrow Name, Employer\_ID \rightarrow Balance, Employer\_ID \rightarrow$
$Membership\_StartTime, Employer\_ID \rightarrow EmployerStatus\}$
$Employer\_ID{+}_G = \{Description, Name, Balance, Membership\_StartTime, FrozenTime\,\}$
$Employer\_ID \rightarrow EmployerStatus$ is not redundant

Normalization:

The primary key of Employer is "Employer_ID"

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

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

Summary

Primary key: Employer_ID

Function Dependency and Canonical Cover::

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

Normalization: BCNF

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

Candidate Keys: Candidate_ID

Functional Dependency:

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

Canonical Cover:

- Step 1: Split RHS to single attribute:

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

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

- Step 3: Remove redundant FDs.

  i. *Remove Candidate_ID → FirstName*

  $G = \{ Candidate\_ID \rightarrow LastName, Candidate\_ID \rightarrow Balance, Candidate\_ID \rightarrow$
  $Membership\_StartTime, Candidate\_ID \rightarrow CandidateStatus, Candidate\_ID \rightarrow FrozenTime\}$
  $Candidate\_ID+_G = \{LastName, Balance, Membership\_StartTime, CandidateStatus, FrozenTime \}$
  Therefore, $Candidate\_ID \rightarrow FirstName$ is not redundant

  ii. *Remove Candidate_ID → LastName*

  $G = \{ Candidate\_ID \rightarrow FirstName, Candidate\_ID \rightarrow Balance, Candidate\_ID \rightarrow$
  $Membership\_StartTime, Candidate\_ID \rightarrow CandidateStatus, Candidate\_ID \rightarrow FrozenTime\}$
  $Candidate\_ID+_G = \{FirstName, Balance, Membership\_StartTime, CandidateStatus, FrozenTime \}$
  Therefore, $Candidate\_ID \rightarrow LastName$ is not redundant

  iii. *Remove Candidate_ID → Balance*

  $G = \{ Candidate\_ID \rightarrow FirstName, Candidate\_ID \rightarrow Balance, Candidate\_ID \rightarrow$
  $Membership\_StartTime, Candidate\_ID \rightarrow CandidateStatus, Candidate\_ID \rightarrow FrozenTime\}$
  $Candidate\_ID+_G$
  $\qquad = \{CFirstName, LastName, Membership\_StartTime, CandidateStatus, FrozenTime\}$
  Therefore, $Candidate\_ID \rightarrow Balance$ is not redundant

  iv. *Remove Candidate_ID → Membership_StartTime*

  $G = \{ Candidate\_ID \rightarrow FirstName, Candidate\_ID \rightarrow Balance, Candidate\_ID \rightarrow$
  $LastName, Candidate\_ID \rightarrow CandidateStatus, Candidate\_ID \rightarrow FrozenTime\}$
  $Candidate\_ID+_G = \{CFirstName, LastName, Balance, CandidateStatus, FrozenTime\}$
  Therefore, $Candidate\_ID \rightarrow Membership\_StartTime$ is not redundant

  v. *Remove Candidate_ID → CandidateStatus*

  $G = \{ Candidate\_ID \rightarrow FirstName + LastName, Candidate\_ID \rightarrow Balance, Candidate\_ID \rightarrow$
  $Membership\_StartTime, Candidate\_ID \rightarrow FrozenTime\}$
  $Candidate\_ID+_G = \{CFirstName, LastName, Balance, Membership\_StartTime, FrozenTime\}$
  $Candidate\_ID \rightarrow CandidateStatus$ is not redundant

vi. $Remove\ Candidate\_ID \rightarrow FrozenTime$

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

$Membership\_StartTime, Candidate\_ID \rightarrow CandidateStatus\}$

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

$Candidate\_ID \rightarrow FrozenTime$ is not redundant

Normalization:

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

$$F = \{Candidate_{ID} \rightarrow FirstName + LastName, Candidate_{ID} \rightarrow Balance, Candidate_{ID}$$
$$\rightarrow Membership_{StartTime}, Candidate_{ID} \rightarrow CandidateStatus, Candidate_{ID} \rightarrow FrozenTime\}$$

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

Summary

<u>Primary key:</u> Candidate_ID

<u>Function Dependency and Canonical Cover:</u>

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

<u>Normalization:</u> BCNF

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

Candidate Keys: The PayMethod_ID 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** (**<u>Genre</u>**, 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 **<u>BCNF</u>**

Summary

Primary key: Genre

Function Dependency and Canonical Cover:

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

<u>Normalization</u>: BCNF

- **CandidateMembership** (<u>**Genre**</u>, 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 **<u>BCNF</u>**

Summary

<u>Primary key:</u> Genre

<u>Function Dependency and Canonical Cover:</u>

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

<u>Normalization</u>: BCNF

- **PadInformation** (AccountNumber, BranchNumber, InstituteNumber, <u>***PayMethod_ID***</u>)

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 → 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 → 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 → 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

<u>Primary key:</u> PayMethod_ID

<u>Function Dependency and Canonical Cover:</u>

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

<u>Normalization:</u> BCNF

- **JobCategory (<u>Genre</u>, 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