Functional Dependencies, Canonical cover & Normalization

- **User** (<u>userName</u>, firstName, lastName, email, contactNumber, password)

Candidate keys:

userName, email.

userName $\subseteq$ User and userName $\rightarrow$ User

email $\subseteq$ User. email $\rightarrow$ User

We defined userName as primary key since email can be changed by a user.

Functional Dependencies:

F = {userName $\rightarrow$ firstName, userName $\rightarrow$ lastName, userName $\rightarrow$ email, userName $\rightarrow$ contactNumber, userName $\rightarrow$ password}

Canonical Cover:

$\Rightarrow$ Step 1: Making right hand side (RHS) a single attribute.

RHS is already a single attribute in all FDs.

$\Rightarrow$ Step 2: Having Left Hand Side in simple form.

userName $\rightarrow$ firstName (No left redundancy)

userName $\rightarrow$ lastName (No left redundancy)

userName $\rightarrow$ email (No left redundancy)

userName $\rightarrow$ contactNumber (No left redundancy)

userName $\rightarrow$ password (No left redundancy)

$\Rightarrow$ Step 3: Remove redundant FDs.

- For: userName $\rightarrow$ firstName

Let G = F – {userName $\rightarrow$ firstName}

G = {userName $\rightarrow$ lastName, userName $\rightarrow$ email, userName $\rightarrow$ contactNumber, userName $\rightarrow$ password}

$userName^{+}_{G}$ = {lastName, email, contactNumber, password}

Since firstName $\notin$ $userName^{+}_{G}$ so userName $\rightarrow$ firstName is not redundant.

- For: userName $\rightarrow$ lastName

Let G = F – {userName $\rightarrow$ lastName}

G = {userName $\rightarrow$ firstName, userName $\rightarrow$ email, userName $\rightarrow$ contactNumber, userName $\rightarrow$ password}

$userName^{+}_{G}$ = {firstName, email, contactNumber, password}

Since lastName $\notin$ $userName^{+}_{G}$ so userName $\rightarrow$ lastName is not redundant.

- For: userName $\rightarrow$ email

Let G = F – {userName $\rightarrow$ email}

G = {userName $\rightarrow$ firstName, userName $\rightarrow$ lastName, userName $\rightarrow$ contactNumber, userName $\rightarrow$ password}

$userName^{+}_{G}$ = {firstName, lastName, contactNumber, password}

Since email $\notin$ $userName^{+}_{G}$ so userName $\rightarrow$ email is not redundant.

- For: userName $\rightarrow$ contactNumber

Let G = F – {userName $\rightarrow$ contactNumber}

G = {userName $\rightarrow$ firstName, userName $\rightarrow$ lastName, userName $\rightarrow$ email, userName $\rightarrow$ password}

$userName^{+}_{G}$ = {firstName, lastName, email, password}

Since contactNumber $\notin$ $userName^{+}_{G}$ so userName $\rightarrow$ contactNumber is not redundant.

- For: userName $\rightarrow$ password

Let G = F – {userName $\rightarrow$ password}

G = {userName $\rightarrow$ firstName, userName $\rightarrow$ lastName, userName $\rightarrow$ email, userName $\rightarrow$ contactNumber}

$userName^{+}_{G}$ = {firstName, lastName, email, contactNumber}

Since password $\notin$ $userName^{+}_{G}$ so userName $\rightarrow$ password is not redundant.

Since there is no redundant Functional Dependencies in F so F is a Canonical Cover of itself.

Normalization

The primary key of User is "userName".

F = {userName $\rightarrow$ firstName, userName $\rightarrow$ lastName, userName $\rightarrow$ email, userName $\rightarrow$ contactNumber, userName $\rightarrow$ password}

Since LHS of all FDs in F is the primary key so User is in BCNF.

Summary

Primary Key: userName

Functional Dependencies: {userName $\rightarrow$ firstName, userName $\rightarrow$ lastName, userName $\rightarrow$ email, userName $\rightarrow$ contactNumber, userName $\rightarrow$ password}

Canonical Cover: {userName $\rightarrow$ firstName, userName $\rightarrow$ lastName, userName $\rightarrow$ email, userName $\rightarrow$ contactNumber, userName $\rightarrow$ password}

Normalization: BCNF

- **Employer** (<u>userName</u>, employerName, accStatus, category, balance)

Candidate key:

userName

userName $\subseteq$ Employer and userName $\rightarrow$ Employer

Functional Dependencies:

F = {userName $\rightarrow$ employerName, userName $\rightarrow$ accStatus, username $\rightarrow$ category, userName $\rightarrow$ balance}

Canonical Cover:

$\Rightarrow$ Step 1: Making RHS single attribute.

All the FDs have single attribute in the RHS.

$\Rightarrow$ Step 2: Having LHS in simple form.

{userName $\rightarrow$ employerName} (No left redundancy)

{userName $\rightarrow$ accStatus} (No left redundancy)

{userName $\rightarrow$ category} (No left redundancy)

{userName $\rightarrow$ balance} (No left redundancy)

$\Rightarrow$ Step 3: Removing redundant FDs

- For: userName $\rightarrow$ employerName

Let G = F – {userName $\rightarrow$ employerName}

G = {userName $\rightarrow$ accStatus, userName $\rightarrow$ category, userName $\rightarrow$ balance}

$userName^{+}_{G}$ = {accStatus, category, balance}

Since employerName $\notin$ $userName^{+}_{G}$ so userName $\rightarrow$ employer is not redundant.

- For: userName $\rightarrow$ accStatus

Let G = F – {userName $\rightarrow$ accStatus}

G = {userName $\rightarrow$ employerName, userName $\rightarrow$ category, userName $\rightarrow$ balance}

$userName^{+}_{G}$ = {employerName, category, balance}

Since accStatus $\notin$ $userName^{+}_{G}$ so userName $\rightarrow$ accStatus is not redundant.

- For: userName $\rightarrow$ category

Let G = F – {userName $\rightarrow$ category}

G = {userName $\rightarrow$ employerName, userName $\rightarrow$ accStatus, userName $\rightarrow$ balance}

$userName^{+}_{G}$ = {employerName, accStatus, balance}

Since category $\notin$ $userName^{+}_{G}$ so userName $\rightarrow$ category is not redundant.

- For: userName $\rightarrow$ balance

Let G = F – {userName $\rightarrow$ balance}

G = {userName $\rightarrow$ employerName, userName $\rightarrow$ accStatus}

$userName^{+}_{G}$ = {employerName, accStatus}

Since balance $\notin$ $userName^{+}_{G}$ so userName $\rightarrow$ balance is not redundant.

There are no redundant functional dependencies in F. So F is a canonical cover of itself.

Normalization

Primary Key: userName

F = {userName $\rightarrow$ employerName, userName $\rightarrow$ accStatus, userName $\rightarrow$ category, userName $\rightarrow$ balance}

Since LHS of all FD's in F is the primary key so Employer is in BCNF.

Summary

Primary Key: userName

Functional Dependencies: {userName $\rightarrow$ employerName, userName $\rightarrow$ accStatus, userName $\rightarrow$ category, userName $\rightarrow$ balance}

Canonical Cover: {userName $\rightarrow$ employerName, userName $\rightarrow$ accStatus, userName $\rightarrow$ category, userName $\rightarrow$ balance}

Normalization: BCNF

- **Applicant** (userName, category, accStatus, balance)

Candidate key:

userName

userName $\subseteq$ Applicant and userName $\rightarrow$ Applicant

Functional Dependencies:

F = {userName $\rightarrow$ category, userName $\rightarrow$ accStatus, userName $\rightarrow$ balance}

Canonical Cover:

$\Rightarrow$ Step 1: Making RHS single attribute.

All the FDs have single attribute in the RHS.

$\Rightarrow$ Step 2: Having LHS in simple form.

{userName $\rightarrow$ category} (No left redundancy)

{userName $\rightarrow$ accStatus} (No left redundancy)

{userName $\rightarrow$ balance} (No left redundancy)

$\Rightarrow$ Step 3: Removing redundant FDs

- For: userName $\rightarrow$ category

Let G = F – {userName $\rightarrow$ category}

G = {userName $\rightarrow$ accStatus, userName $\rightarrow$ balance}

$userName^{+}_{G}$ = {accStatus, balance}

Since category $\notin$ $userName^{+}_{G}$ so userName $\rightarrow$ category is not redundant.

- For: userName $\rightarrow$ accStatus

Let G = F – {userName $\rightarrow$ accStatus}

G = {userName $\rightarrow$ category, userName $\rightarrow$ balance}

$userName^{+}_{G}$ = {category, balance}

Since accStatus $\notin$ $userName^{+}_{G}$ so userName $\rightarrow$ accStatus is not redundant

- For: userName $\rightarrow$ balance

Let G = F – {userName $\rightarrow$ balance}

G = {userName $\rightarrow$ category, userName $\rightarrow$ accStatus}

$userName^{+}_{G}$ = {category, accStatus}

Since balance $\notin$ $userName^{+}_{G}$ so userName $\rightarrow$ balance is not redundant

There are no redundant functional dependencies in F. So F is a canonical cover of itself.

Normalization

Primary Key: userName

F = {userName $\rightarrow$ category , userName $\rightarrow$ accStatus}

Since LHS of all FD's in F is the primary key so Applicant is in BCNF.

Summary

Primary Key: userName

Functional Dependencies: {userName $\rightarrow$ category, userName $\rightarrow$ accStatus}

Canonical Cover: {userName $\rightarrow$ category, userName $\rightarrow$ accStatus}

Normalization: BCNF

- **Admin** (userName)

Candidate Key: userName.

userName $\subseteq$ Admin and userName $\rightarrow$ Admin

Functional Dependencies: F = {}

Canonical Cover: F is a canonical cover of itself.

Normalization: BCNF

Summary

Primary Key: userName

Functional Dependencies: {}

Canonical Cover: {}

Normalization: BCNF

- **Job** (jobID, employerUserName, title, datePosted, description, category, jobStatus, empNeeded)

Candidate key:

jobID

jobID $\subseteq$ Job and jobID $\rightarrow$ Job

Functional Dependencies:

F = {jobID $\rightarrow$ employerUserName, jobID $\rightarrow$ title, jobID $\rightarrow$ datePosted, jobID $\rightarrow$ description, jobID $\rightarrow$ category, jobID $\rightarrow$ jobStatus, jobID $\rightarrow$ empNeeded}

Canonical Cover:

$\Rightarrow$ Step 1: Making RHS single attribute.

All the FDs have single attribute in the RHS.

$\Rightarrow$ Step 2: Having LHS in simple form.

{jobID $\rightarrow$ employerUserName} (No left redundancy)

{jobID $\rightarrow$ title} (No left redundancy)

jobID $\rightarrow$ datePosted} (No left redundancy)

{jobID $\rightarrow$ description} (No left redundancy)

{jobID $\rightarrow$ category} (No left redundancy)

{jobID → jobStatus} (No left redundancy)

{jobID → empNeeded} (No left redundancy)

⇒ Step 3: Removing redundant FDs

- For: jobID → employerUserName

Let G = F – {jobID → employerUserName}

G = {jobID → title, jobID → datePosted, jobID → description, jobID → category, jobID → jobStatus, jobID → empNeeded}

$jobID^+_G$ = {title, datePosted, description, category, jobStatus, empNeeded}

Since employerUserName ∉ $jobID^+_G$ so jobID → employerUserName is not redundant.

- For: jobID → title

Let G = F – {jobID → title}

G = {jobID → employerUserName, jobID → datePosted, jobID → description, jobID → category, jobID → jobStatus, jobID → empNeeded}

$jobID^+_G$ = {employerUserName, datePosted, description, category, jobStatus, empNeeded}

Since title ∉ $jobID^+_G$ so jobID → title is not redundant.

- For: jobID → datePosted

Let G = F – {jobID → datePosted}

G = {jobID → employerUserName, jobID → title, jobID → description, jobID → category, jobID → jobStatus, jobID → empNeeded}

$jobID^+_G$ = {employerUserName, title, description, category, jobStatus, empNeeded}

Since datePosted ∉ $jobID^+_G$ so jobID → datePosted is not redundant.

- For: jobID → description

Let G = F – {jobID → description}

G = {jobID → employerUserName, jobID → title, jobID → datePosted, jobID → category, jobID → jobStatus, jobID → empNeeded}

$jobID^+_G$ = {employerUserName, title, datePosted, category, jobStatus, empNeeded}

Since description $\notin$ jobID^+_G so jobID $\rightarrow$ description is not redundant.

- For: jobID $\rightarrow$ category

Let G = F – {jobID $\rightarrow$ category}

G = {jobID $\rightarrow$ employerUserName, jobID $\rightarrow$ title, jobID $\rightarrow$ datePosted, jobID $\rightarrow$ description, jobID $\rightarrow$ jobStatus, jobID $\rightarrow$ empNeeded}

jobID^+_G = {employerUserName, title, datePosted, description, jobStatus, empNeeded}

Since category $\notin$ jobID^+_G so jobID $\rightarrow$ category is not redundant.

- For: jobID $\rightarrow$ jobStatus

Let G = F – {jobID $\rightarrow$ jobStatus}

G = {jobID $\rightarrow$ employerUserName, jobID $\rightarrow$ title, jobID $\rightarrow$ datePosted, jobID $\rightarrow$ description, jobID $\rightarrow$ category, jobID $\rightarrow$ empNeeded}

jobID^+_G = {employerUserName, title, datePosted, description, category, empNeeded}

Since jobStatus $\notin$ jobID^+_G so jobID $\rightarrow$ jobStatus is not redundant.

- For: jobID $\rightarrow$ empNeeded

Let G = F – {jobID $\rightarrow$ empNeeded}

G = {jobID $\rightarrow$ employerUserName, jobID $\rightarrow$ title, jobID $\rightarrow$ datePosted, jobID $\rightarrow$ description, jobID $\rightarrow$ category, jobID $\rightarrow$ jobStatus}

jobID^+_G = {employerUserName, title, datePosted, description, category, jobStatus}

Since empNeeded $\notin$ jobID^+_G so jobID $\rightarrow$ empNeeded is not redundant.

There are no redundant functional dependencies in F. So F is a canonical cover of itself.

Normalization

Primary Key: jobID

F = {jobID $\rightarrow$ employerUserName, jobID $\rightarrow$ title, jobID $\rightarrow$ datePosted, jobID $\rightarrow$ description, jobID $\rightarrow$ category, jobID $\rightarrow$ jobStatus, jobID $\rightarrow$ empNeeded}

Since LHS of all FD's in F is the primary key so Job is in BCNF.

Summary

Primary Key: jobID

Functional Dependencies: {jobID → employerUserName, jobID → title, jobID → datePosted, jobID → description, jobID → category, jobID → jobStatus, jobID → empNeeded}

Canonical Cover: {jobID → employerUserName, jobID → title, jobID → datePosted, jobID → description, jobID → category, jobID → jobStatus, jobID → empNeeded}

Normalization: BCNF

- **CreditCardInfo** (CCNumber, expireDate, userUserName, CCBNumber, defaultCard, auto_manual)

Candidate key:

{CCNumber, expireDate}

{CCNumber, expireDate} $\subseteq$ CreditCardInfo and {CCNumber, expireDate} → CreditCardInfo

Functional Dependencies:

F = {CCNumber, expireDate → userUserName, CCNumber, expireDate → CCBNumber, expireDate → defaultCard, expireDate → auto_manual}

Canonical Cover:

$\Rightarrow$ Step 1: Making RHS single attribute.

All the FDs have single attribute in the RHS.

$\Rightarrow$ Step 2: Having LHS in simple form.

$CCNumber^{+}$ = CCNumber.

$expireDate^{+}$ = expireDate.

CCNumber, expireDate → userUserName (No left redundancy)

CCNumber, expireDate → CCBNumber (No left redundancy)

CCNumber, expireDate → defaultCard (No left redundancy)

CCNumber, expireDate → auto_manual (No left redundancy)

⇒ Step 3: Removing redundant FDs

- For: CCNumber, expireDate → userUserName

Let G = F – {CCNumber, expireDate → userUserName}

G = {CCNumber, expireDate → CCBNumber, CCNumber, expireDate → defaultCard, CCNumber, expireDate → auto_manual}

$\{CCNumber, expireDate\}^{+}_{G}$ = {CCBNumber, defaultCard, auto_manual}

Since userUserName ∉ $\{CCNumber, expireDate\}^{+}_{G}$ so CCNumber, expireDate → userUserName is not redundant.

- For: CCNumber, expireDate → CCBNumber

Let G = F – {CCNumber, expireDate → CCBNumber}

G = {CCNumber, expireDate → userUserName, CCNumber, expireDate → defaultCard, CCNumber, expireDate → auto_manual}

$\{CCNumber, expireDate\}^{+}_{G}$ = {userUserName, defaultCard, auto_manual}

Since CCBNumber ∉ $\{CCNumber, expireDate\}^{+}_{G}$ so CCNumber, expireDate → CCBNumber is not redundant.

- For: CCNumber, expireDate → defaultCard

Let G = F – {CCNumber, expireDate → defaultCard}

G = {CCNumber, expireDate → userUserName, CCNumber, expireDate → CCBNumber, CCNumber, expireDate → auto_manual}

$\{CCNumber, expireDate\}^{+}_{G}$ = {userUserName, CCBNumber, auto_manual}

Since defaultCard ∉ $\{CCNumber, expireDate\}^{+}_{G}$ so CCNumber, expireDate → defaultCard is not redundant.

- For: CCNumber, expireDate → auto_manual

Let G = F – {CCNumber, expireDate → auto_manual}

G = {CCNumber, expireDate → userUserName, CCNumber, expireDate → CCBNumber, CCNumber, expireDate → defaultCard}

$\{CCNumber, expireDate\}^{+}_{G}$ = {userUserName, CCBNumber, defaultCard}

Since auto_manual $\notin$ {CCNumber, expireDate}$^{+}_{G}$ so CCNumber, expireDate $\rightarrow$ auto_manual is not redundant.

There are no redundant functional dependencies in F. So, F is a canonical cover of itself.

Normalization

Primary Key: CCNumber, expireDate

F = {CCNumber, expireDate $\rightarrow$ userUserName, CCNumber, expireDate $\rightarrow$ CCBNumber, expireDate $\rightarrow$ defaultCard, expireDate $\rightarrow$ auto_manual}

Since LHS of all FD's in F is the primary key so CreditCardInfo is in BCNF.

Summary

Primary Key: CCNumber, expireDate

Functional Dependencies: {CCNumber, expireDate $\rightarrow$ userUserName, CCNumber, expireDate $\rightarrow$ CCBNumber}

Canonical Cover: {CCNumber, expireDate $\rightarrow$ userUserName, CCNumber, expireDate $\rightarrow$ CCBNumber}

Normalization: BCNF

- **PADInfo** (accountNumber, instituteNumber, branchNumber, defaultAccount, auto_manual)

Candidate key:

accountNumber

accountNumber $\subseteq$ PADInfo and accountNumber $\rightarrow$ PADInfo

Functional Dependencies:

F = {accountNumber $\rightarrow$ instituteNumber, accountNumber $\rightarrow$ branchNumber, accountNumber $\rightarrow$ defaultAccount, accountNumber $\rightarrow$ auto_manual}

Canonical Cover:

$\Rightarrow$ Step 1: Making RHS single attribute.

All the FDs have single attribute in the RHS.

$\Rightarrow$ Step 2: Having LHS in simple form.

{accountNumber $\rightarrow$ instituteNumber} (No left redundancy)

{accountNumber $\rightarrow$ branchNumber} (No left redundancy)

{accountNumber $\rightarrow$ defaultAccount} (No left redundancy)

{accountNumber $\rightarrow$ auto_manual} (No left redundancy)

$\Rightarrow$ Step 3: Removing redundant FDs

- For: accountNumber $\rightarrow$ instituteNumber

Let G = F – {accountNumber $\rightarrow$ instituteNumber}

G = {accountNumber $\rightarrow$ userUserName, accountNumber $\rightarrow$ branchNumber, accountNumber $\rightarrow$ defaultAccount, accountNumber $\rightarrow$ auto_manual}

$accountNumber^{+}_{G}$ = {branchNumber, defaultAccount, auto_manual}

Since instituteNumber $\notin$ $accountNumber^{+}_{G}$ so accountNumber $\rightarrow$ instituteNumber is not redundant.

- For: accountNumber $\rightarrow$ branchNumber

Let G = F – {accountNumber $\rightarrow$ branchNumber}

G = accountNumber $\rightarrow$ instituteNumber, accountNumber $\rightarrow$ defaultAccount, accountNumber $\rightarrow$ auto_manual}

$accountNumber^{+}_{G}$ = {instituteNumber, defaultAccount, auto_manual}

Since branchNumber $\notin$ $accountNumber^{+}_{G}$ so accountNumber $\rightarrow$ branchNumber is not redundant.

- For: accountNumber $\rightarrow$ defaultAccount

Let G = F – {accountNumber → defaultAccount }

G = {accountNumber → instituteNumber, accountNumber → branchNumber, accountNumber → auto_manual}

$accountNumber^{+}_{G}$ = {instituteNumber, brachNumber, auto_manual}

Since defaultAccount ∉ $accountNumber^{+}_{G}$ so accountNumber → defaultAccount is not redundant.

- For: accountNumber → auto_manual

Let G = F – {accountNumber → auto_manual}

G = {accountNumber → instituteNumber, accountNumber → branchNumber, accountNumber → defaultAccount}

$accountNumber^{+}_{G}$ = {instituteNumber, brachNumber, defaultAccount}

Since auto_manual ∉ $accountNumber^{+}_{G}$ so accountNumber → auto_manual is not redundant.

There are no redundant FD. So, F is a canonical cover of itself.

Normalization

Primary Key: accountNumber

F = {accountNumber → instituteNumber, accountNumber → branchNumber, accountNumber → defaultAccount, accountNumber → auto_manual}

Since LHS of all FD's in F is the primary key so PADInfo is in BCNF.

Summary

Primary Key: accountNumber

Functional Dependencies: {accountNumber → instituteNumber, accountNumber → branchNumber, accountNumber → defaultAccount, accountNumber → auto_manual}

Canonical Cover: {accountNumber → instituteNumber, accountNumber → branchNumber, accountNumber → defaultAccount, accountNumber → auto_manual}

Normalization: BCNF

- **Application** (<u>applicantUserName</u>, <u>jobID</u>, applicationStatus, applicationDate)

Candidate key:

{applicantUserName, jobID}

{applicantUserName, jobID} $\subseteq$ Apply and {applicantUserName, jobID} $\rightarrow$ Apply

Functional Dependencies:

F = {applicantUserName, jobID $\rightarrow$ applicationStatus, applicantUserName, jobID $\rightarrow$ applicationDate}

Canonical Cover:

$\Rightarrow$ Step 1: Making RHS single attribute.

All the FDs have single attribute in the RHS.

$\Rightarrow$ Step 2: Having LHS in simple form.

applicantUserName $^{+}$ = applicantUserName.

jobID^{+} = jobID.

{applicantUserName, jobID} $\rightarrow$ applicationStatus (No left redundancy)

{applicantUserName, jobID} $\rightarrow$ applicationDate (No left redundancy)

$\Rightarrow$ Step 3: Removing redundant FDs

- For: {applicantUserName, jobID} $\rightarrow$ applicationStatus

Let G = F – {applicantUserName, jobID $\rightarrow$ applicationStatus}

G = {applicantUserName, jobID $\rightarrow$ applicationDate}

{applicantUserName, jobID}$^{+}_{G}$ = {applicationDate}

Since applicationStatus $\notin$ {applicantUserName, jobID}$^{+}_{G}$ so applicantUserName, jobID $\rightarrow$ applicationStatus is not redundant.

- For: {applicantUserName, jobID} $\rightarrow$ applicationDate

Let G = F – {applicantUserName, jobID $\rightarrow$ applicationDate}

G = {applicantUserName, jobID → applicationStatus}

$\{applicantUserName, jobID\}^+_G$ = {applicationStatus}

Since applicationDate ∉ $\{applicantUserName, jobID\}^+_G$ so applicantUserName, jobID → applicationDate is not redundant.

There are no redundant functional dependencies in F. So, F is a canonical cover of itself.

Normalization

Primary Key: applicantUserName, jobID

F = {applicantUserName, jobID → applicationStatus, applicantUserName, jobID → applicationDate}

Since LHS of all FD's in F is the primary key so Apply is in BCNF.

Summary

Primary Key: applicantUserName, jobID

Functional Dependencies: {applicantUserName, jobID → applicationStatus, applicantUserName, jobID → applicationDate}

Canonical Cover: {applicantUserName, jobID → applicationStatus, applicantUserName, jobID → applicationDate}

Normalization: BCNF

- **EmployerCC** (employerUserName**,** CCNumber**)**

Candidate key:

{CCNumber}

{CCNumber} ⊆ EmployerCC and {CCNumber} → EmployerCC

Functional Dependencies:

F = {CCNumber → employerUserName}

Canonical Cover:

$\Rightarrow$ Step 1: Making RHS single attribute.

All the FDs have single attribute in the RHS.

$\Rightarrow$ Step 2: Having LHS in simple form.

LHS of all FDs are in simple form.

$\Rightarrow$ Step 3: Removing redundant FDs

- For: {CCNumber $\rightarrow$ employerUserName}

Let G = F – {CCNumber $\rightarrow$ employerUserName}

G = {}

Since employerUserName $\notin$ {CCNumber}$^{+}_{G}$ so CCNumber $\rightarrow$ employerUserName is not redundant.

Normalization

Primary Key: CCNumber

F = {CCNumber $\rightarrow$ employerUserName}

Since LHS of all FD's in F is the primary key so Apply is in BCNF.

Summary

Primary Key: CCNumber

Functional Dependencies: {CCNumber $\rightarrow$ employerUserName}

Canonical Cover: {CCNumber $\rightarrow$ employerUserName}

Normalization: BCNF

- **EmployerPAD** (employerUserName**,** accountNumber**)**

Candidate key:

{accountNumber}

{accountNumber} $\subseteq$ EmployerPAD and {accountNumber} $\rightarrow$ EmployerPAD

Functional Dependencies:

F = {accountNumber → employerUserName}

Canonical Cover:

⇒ Step 1: Making RHS single attribute.

All the FDs have single attribute in the RHS.

⇒ Step 2: Having LHS in simple form.

LHS of all FDs are in simple form.

⇒ Step 3: Removing redundant FDs

- For: {accountNumber → employerUserName}

Let G = F – {accountNumber → employerUserName}

G = {}

Since employerUserName ∉ $\{accountNumber\}^{+}_{G}$ so accountNumber → employerUserName is not redundant.

Normalization

Primary Key: accountNumber

F = {accountNumber → employerUserName}

Since LHS of all FD's in F is the primary key so Apply is in BCNF.

Summary

Primary Key: accountNumber

Functional Dependencies: {accountNumber → employerUserName}

Canonical Cover: {accountNumber → employerUserName}

Normalization: BCNF

- **ApplicantCC** (applicantUserName**,** CCNumber**)**

Candidate key:

{CCNumber}

{CCNumber} $\subseteq$ ApplicantCC and {CCNumber} $\rightarrow$ ApplicantCC

Functional Dependencies:

F = {CCNumber $\rightarrow$ applicantUserName}

Canonical Cover:

$\Rightarrow$ Step 1: Making RHS single attribute.

All the FDs have single attribute in the RHS.

$\Rightarrow$ Step 2: Having LHS in simple form.

LHS of all FDs are in simple form.

$\Rightarrow$ Step 3: Removing redundant FDs

- For: {CCNumber $\rightarrow$ applicantUserName}

Let G = F – {CCNumber $\rightarrow$ applicantUserName}

G = {}

Since applicantUserName $\notin$ $\{CCNumber\}^{+}_{G}$ so CCNumber $\rightarrow$ applicantUserName is not redundant.

Normalization

Primary Key: CCNumber

F = {CCNumber $\rightarrow$ applicantUserName}

Since LHS of all FD's in F is the primary key so Apply is in BCNF.

Summary

Primary Key: CCNumber

Functional Dependencies: {CCNumber $\rightarrow$ applicantUserName}

Canonical Cover: {CCNumber $\rightarrow$ applicantUserName}

Normalization: BCNF

- **EmployerPAD** (applicantUserName**,** accountNumber**)**

Candidate key:

{accountNumber}

{accountNumber} $\subseteq$ ApplicantPAD and {accountNumber} $\rightarrow$ ApplicantPAD

Functional Dependencies:

F = {accountNumber $\rightarrow$ applicantUserName}

Canonical Cover:

$\Rightarrow$ Step 1: Making RHS single attribute.

All the FDs have single attribute in the RHS.

$\Rightarrow$ Step 2: Having LHS in simple form.

LHS of all FDs are in simple form.

$\Rightarrow$ Step 3: Removing redundant FDs

- For: {accountNumber $\rightarrow$ applicantUserName}

Let G = F – {accountNumber $\rightarrow$ applicantUserName}

G = {}

Since applicantUserName $\notin$ {accountNumber}$^{+}_{G}$ so accountNumber $\rightarrow$ applicantUserName is not redundant.

Normalization

Primary Key: accountNumber

F = {accountNumber $\rightarrow$ applicantUserName}

Since LHS of all FD's in F is the primary key so Apply is in BCNF.

Summary

Primary Key: accountNumber

Functional Dependencies: {accountNumber $\rightarrow$ applicantUserName}

Canonical Cover: {accountNumber → applicantUserName}

Normalization: BCNF