

Normalization

Company (CompanyID, Cname, Location)

Company $C(CIDCnL)$ - Functional Dependencies (FDs) $\{CID \rightarrow Cn, CID \rightarrow L\}$

(a) List all candidate keys for Company.

- $CIDCnL$ - all attributes are always a superkey
- $CIDL$ - can get attribute Cn through $CID \rightarrow Cn$
- $CIDCn$ - can get attribute L through $CID \rightarrow L$
- CID - can get attribute Cn through $CID \rightarrow Cn$, and then get attribute L through $CID \rightarrow L$
- Therefore the candidate key is: CID .

(b) Is Company in 3NF?

- $CID \rightarrow Cn$
 - (a) Is the right side a member of the left side? No.
 - (b) Is the left side a super key? Yes it is a candidate key.
 - (c) Is the right side a prime attribute? No.
- $CID \rightarrow L$
 - (a) Is the right side a member of the left side? No.
 - (b) Is the left side a super key? Yes it is a candidate key.
 - (c) Is the right side a prime attribute? No.

(c) Therefore Company relation is in 3NF

Department (DepartmentID, Dname, FK: CID)

Department $D(DIDCnCID)$ - FDs $\{DID \rightarrow Dn, CID \rightarrow DID\}$

(a) List all candidate keys for Department.

- $DIDCnCID$ - all attributes are always a superkey
- $DIDCID$ - can get attribute Dn through $DID \rightarrow Dn$
- $DnCID$ - can get attribute DID through $CID \rightarrow DID$
- Therefore the candidate keys are: $DIDCID$ and $DnCID$.

(b) Is Department in 3NF?

- $DIDCID \rightarrow Dn$
 - (a) Is the right side a member of the left side? No.
 - (b) Is the left side a super key? No.
 - (c) Is the right side a prime attribute? Yes it is part of the candidate key - $DnCID$.
- $CID \rightarrow DID$
 - (a) Is the right side a member of the left side? No.

- (b) Is the left side a super key? No.
- (c) Is the right side a prime attribute? Yes it is part of the candidate keys - *DIDCID*.

(c) Therefore Department is in 3NF.

Employee (EmployeeID, Fname, Minit, Lname, FK: CID, FK: DID)

Employee $E(EIDFnMLnCIDDDID)$ - FDs $\{EID \rightarrow Fn, EID \rightarrow M, EID \rightarrow Ln, FnLn \rightarrow EID, CIDDDID \rightarrow EID\}$

(a) List all candidate keys for Employee.

- *EIDFnMLnCIDDDID* - all attributes are always a superkey
- *EIDMLnCIDDDID* - can get attribute *Fn* through $EID \rightarrow Fn$
- *EIDFnLnCIDDDID* - can get attribute *M* through $EID \rightarrow M$
- *EIDFnMCIDDDID* - can get attribute *Ln* through $EID \rightarrow Ln$
- *FnMLnCIDDDID* - can get attribute *EID* through $FnLn \rightarrow EID$
- *FnMLnCIDDDID* - can get attribute *EID* through $CIDDDID \rightarrow EID$
- *EIDCIDDDID* - can get attribute *Fn* through $EID \rightarrow Fn$, then can get attribute *M* through $EID \rightarrow M$, and then can get attribute *Ln* through $EID \rightarrow Ln$
- Candidate keys for Employee are: *EIDCIDDDID* and *FnMLnCIDDDID*.

(b) Is Employee in 3NF?

- $EID \rightarrow Fn$
 - (a) Is the right side a member of the left side? No.
 - (b) Is the left side a super key? No.
 - (c) Is the right side a prime attribute? Yes it is part of the candidate key: *FnMLnCIDDDID*.
- $EID \rightarrow M$
 - (a) Is the right side a member of the left side? No.
 - (b) Is the left side a super key? No.
 - (c) Is the right side a prime attribute? Yes it is part of the candidate key: *FnMLnCIDDDID*.
- $EID \rightarrow Ln$
 - (a) Is the right side a member of the left side? No
 - (b) Is the left side a super key? No
 - (c) Is the right side a prime attribute? Yes it is part of the candidate key: *FnMLnCIDDDID*
- $FnLn \rightarrow EID$
 - (a) Is the right side a member of the left side? No.
 - (b) Is the left side a super key? No.

(c) Is the right side a prime attribute? Yes it is part of the candidate key:
EIDCIDDID.

- *CIDDID* \rightarrow *EID*

(a) Is the right side a member of the left side? No.

(b) Is the left side a super key? No.

(c) Is the right side a prime attribute? Yes it is part of the candidate key:
EIDCIDDID.

(c) Therefore Employee is in 3NF.

Performance (SpeedTests & EID, FK: EID)

Performance *Pe*(*SteidEID*)

We do not believe that there are any functional dependencies between these two attributes because EID will not determine SpeedTests - they are there to determine how fast the system is running.

Payout (Paystub & EID, Ptotal, Dtotal, FK: EID)

Payout *Po*(*PseidPtDtEID*) - FDs $\{Pseid \rightarrow Pt, Pseid \rightarrow Dt, PtDt \rightarrow Pseid\}$

(a) List all the candidate keys for Payout.

- *PseidPtDtEID*- all attributes are always a super key
- *PseidDtEID* - can get attribute *Pt* through $Pseid \rightarrow Pt$
- *PseidPtEID* - can get attribute *Dt* through $Pseid \rightarrow Dt$
- *PtDtEID*- can get attribute *Pseid* through $PtDt \rightarrow Pseid$
- *PseidEID*- can get attribute *Pt* through $Pseid \rightarrow Pt$, and then get attribute *Dt* through $Pseid \rightarrow Dt$
- The candidate keys for Payout are: *PseidEID*, *PtDtEID*

(b) Is Payout in 3NF?

- *Pseid* \rightarrow *Pt*

(a) Is the right side a member of the left side? No.

(b) Is the left side a super key? No.

(c) Is the right side a prime attribute? Yes it is part of the candidate key:
PtDtEID.

- *Pseid* \rightarrow *Dt*

(a) Is the right side a member of the left side? No.

(b) Is the left side a super key? Yes it is a candidate key.

(c) Is the right side a prime attribute? Yes it is part of the candidate key:
PtDtEID.

- *PtDt* \rightarrow *Pseid*

(a) Is the right side a member of the left side? No.

- (b) Is the left side a super key? No.
- (c) Is the right side a prime attribute? Yes it is part of the candidate key:
PseidEID.

(c) Therefore Payout is in 3NF.

Salary (baseSalary & EID, Bonus, FK: EID)

Salary *S*(*BseidBoR*) - FDs $\{Bseid \rightarrow Bo, BoEID \rightarrow Bseid\}$

(a) List all candidate keys for Salary.

- *BseidBoEID* - all attributes are always a super key
- *BseidEID* - can get attribute *BoEID* through $Bs \rightarrow Bo$
- *BoEID* - can get attribute *Bseid* through $BoEID \rightarrow Bseid$
- The candidate key for Salary is *BseidEID*, *BoEID*.

(b) Is Salary in 3NF?

- $Bseid \rightarrow Bo$
 - (a) Is the right side a member of the left side? No
 - (b) Is the left side a super key? No.
 - (c) Is the right side a prime attribute? Yes it is part of the candidate key:*BoEID*.
- $BoEID \rightarrow Bseid$
 - (a) Is the right side a member of the left side? No
 - (b) Is the left side a super key? No.
 - (c) Is the right side a prime attribute? Yes it is part of the candidate key:*BseidEID*.

(c) Therefore Salary is in 3NF.

Leave (leaveID & EID, leavePay, fromDate, toDate, FK: EID)

Leave *L*(*LIDEIDLpFdTdEID*) - FDs $\{LIDEID \rightarrow Lp, LIDEID \rightarrow Fd, LIDEID \rightarrow Td, LIDEID \rightarrow EID\}$

(a) List all candidate keys for Leave.

- *LIDEIDLpFdTdEID* - all attributes are always a super key
- *LIDEIDFdTdEID* - can get attribute *Lp* through $LIDEID \rightarrow Lp$
- *LIDEIDLpTdEID* - can get attribute *Fd* through $LIDEID \rightarrow Fd$
- *LIDEIDLpFdEID* - can get attribute *Td* through $LIDEID \rightarrow Td$
- *LpFdTdEID* - can get attribute *LIDEID* through $LIDEID \rightarrow EID$
- *LIDR* - can get attribute *Lp* through $LID \rightarrow Lp$, then get attribute *Fd* through $LID \rightarrow Fd$, and then get attribute *Td* through $LID \rightarrow Td$
- The candidate keys in Leave are: *LIDEID*, *LpFdTdEID*.

(b) Is Leave in 3NF?

- $LIDEID \rightarrow Lp$
 - (a) Is the right side a member of the left side? No.
 - (b) Is the left side a super key? No.
 - (c) Is the right side a prime attribute? Yes it is part of the candidate key:
 $LpFdTdEID$.
- $LIDEID \rightarrow Fd$
 - (a) Is the right side a member of the left side? No.
 - (b) Is the left side a super key? No.
 - (c) Is the right side a prime attribute? Yes it is part of the candidate key:
 $LpFdTdEID$.
- $LIDEID \rightarrow Td$
 - (a) Is the right side a member of the left side? No.
 - (b) Is the left side a super key? No.
 - (c) Is the right side a prime attribute? Yes it is part of the candidate key:
 $LpFdTdEID$.
- $EID \rightarrow LIDEID$
 - (a) Is the right side a member of the left side? No.
 - (b) Is the left side a super key? No.
 - (c) Is the right side a prime attribute? Yes it is part of the candidate key:
 $LIDEID$.

(c) Therefore Leave is in 3NF

Tax (StateTax & EID, FederalTax, FK: EID, FK: CID)

Tax $T(SxFxEIDCID)$ - FDs $\{Sxeid \rightarrow Fx, CID \rightarrow Sxeid, EID \rightarrow CID\}$ (Found online that state tax changes can have an affect on federal tax)

(a) List all the candidate keys for Tax.

- $SxeidFxEIDCID$ - all attributes are always a super key
- $SxeidEIDCID$ - can get attribute Fx through $Sxeid \rightarrow Fx$
- $FxEIDCID$ - can get attribute $Sxeid$ through $CID \rightarrow Sxeid$
- $SxeidFxEID$ - can get attribute CID through $EID \rightarrow CID$
- The candidate keys for Tax are: $SxeidEIDCID$, $FxEIDCID$, $SxeidFxEID$.

(b) Is Tax 3NF?

- $Sxeid \rightarrow Fx$
 - (a) Is the right side a member of the left side? No.
 - (b) Is the left side a super key? No.

(c) Is the right side a prime attribute? Yes it is part of the candidate key:
 $FxEIDCID, SxeidFx EID$.

- $CID \rightarrow Sxeid$

(a) Is the right side a member of the left side? No.

(b) Is the left side a super key? No.

(c) Is the right side a prime attribute? Yes it is part of the candidate key:
 $SxeidEIDCID, SxeidFx EID$.

- $EID \rightarrow CID$

(a) Is the right side a member of the left side? No.

(b) Is the left side a super key? No.

(c) Is the right side a prime attribute? Yes it is part of the candidate key:
 $SxeidEIDCID, FxEIDCID$.

(c) Therefore Tax is in 3NF.

Attendance (Absences & EID, Tardies, FK: EID)

Attendance $A(AbeidTaEID)$ - FDs $\{Abeid \rightarrow Ta, EID \rightarrow Abeid\}$

(a) List all the candidate keys for Attendance.

- $AbeidTaEID$ - all attributes will always be a super key
- $AbeidEID$ - can get attribute Ta through $Abeid \rightarrow Ta$
- $TaEID$ - can get attribute $Abeid$ through $EID \rightarrow Abeid$
- The candidate keys for Attendance are: $AbeidEID, TaEID$.

(b) Is Attendance in 3NF?

- $Abeid \rightarrow Ta$

(a) Is the right side a member of the left side? No.

(b) Is the left side a super key? No.

(c) Is the right side a prime attribute? Yes it is part of the candidate key:
 $TaEID$.

- $EID \rightarrow Abeid$

(a) Is the right side a member of the left side? No.

(b) Is the left side a super key? No.

(c) Is the right side a prime attribute? Yes it is part of the candidate key:
 $AbeidEID$.

(c) Therefore Attendance is in 3NF.

Benefits (Retirement & EID, Insurance, FK: EID)

Benefits $B(ReidIEID)$ - FDs $\{Reid \rightarrow I, EID \rightarrow Reid\}$

(a) List all the candidate keys for Benefits.

- $ReidIEID$ - all attributes will always be a super key
- $ReidEID$ - can get attribute I through $Reid \rightarrow I$
- $IEID$ - can get attribute $Reid$ through $EID \rightarrow Reid$
- The candidate key for Benefits is: $ReidEID, IEID$

(b) Is Benefits in 3NF?

- $Reid \rightarrow I$
 - (a) Is the right side a member of the left side? No.
 - (b) Is the left side a super key? No.
 - (c) Is the right side a prime attribute? Yes it is a part of the candidate key: $IEID$.
- $EID \rightarrow Reid$
 - (a) Is the right side a member of the left side? No.
 - (b) Is the left side a super key? No.
 - (c) Is the right side a prime attribute? Yes it is a part of the candidate key: $ReidEID$.

(c) Therefore Benefits is in 3NF.