Missouri University of Science & Technology — Department of Computer Science
Fall 2018 — **CS 2300: Databases**

Solutions to Homework 2

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Problem 1

1. (a) This is allowed because ESsn must be unique and there are no duplicates when this is added. In addition it doesn't already exist(Key Constraint), The key is not Null(Entity integrity) and it doesn't reference non existent primary keys(referential integrity).

   (b) This is allowed because Pnumber must be unique and there are no duplicates when this is added. In addition it doesn't already exist(Key Constraint), The key is not Null(Entity integrity) and it doesn't reference non existent primary keys(referential integrity).

   (c) This is NOT allowed because there are duplicate Dnumbers. This could be rectified by changing Production's DNumber to 3 (violates key constraint).

   (d) This is NOT allowed because Pno is a key and it must not be Null, otherwise there would be no way of knowing which Pno it corresponds to. This can be fixed by changing null to a valid Pno (Null is not in the domain of a Key) (entity integrity constraint violation).

   (e) This is allowed because no duplicates are introduced with the keys Essn and Dependend_name. In addition it doesn't already exist(Key Constraint), The key is not Null(Entity integrity) and it doesn't reference non existent primary keys(referential integrity).

   (f) This is allowed because it doesn't violate referential integrity (nothing references any of the attributes in WORKS_ON.

   (g) This is not allowed because it violates referential integrity. In department the Mgr_ssn references this ssn which is going to be deleted. To fix this, we must propogate these deletions/changes in DEPARTMENT by changing the Mgr_ssn's that equal "987654321" and the WORKS_ON tuples that have Essn = "987654321" and the DEPENDENT's that have Essn = "987654321" and the Super_ssn's that are equal to this ssn.

   (h) This also violates referential integrity because there is an attribute Pnumber in tuples in WORKS_ON that reference a PROJECT with Pnumber of 1. This could be fixed by not removing this project or removing/changing the WORKS_ON tuples that reference it.

   (i) This modification is allowed because the changing of Mgr_ssn references a valid Ssn that exists, and mgr_start_date doesn't reference anything.

   (j) This is allowed because super_ssn references a valid key(it was added in a).

   (k) This is allowed because it exists and wont violate any of the constraints.

Problem 2

1. Relational algebra expressions using the relational operators discussed in class.

   (a) Product = $\sigma_{Pname="ProductX"}(PROJECT)$
   ProductXNumber = $\Pi_{Pnumber}(ProductX)$
   WorksOnProdX = $WORKS\_ON \bowtie_{Pnumber=Pno} ProductXNumber$
   5hrsOnProdX = $\sigma_{Hours>5}(WorksOnProdX)$
   EOnProdX = $5hrsOnProdX \bowtie_{Essn=Ssn} EMPLOYEE$
   D5OnProdX = $\sigma_{Dno=5}(EOnProdX)$

   (b) DependentNameSSN = $\Pi_{Essn,Dependent\_name}(DEPENDENT)$
   DependentWEmploy = $EMPLOYEE \bowtie_{Essn=Ssn} DependentNameSSN$
   SameName = $\sigma_{Lname=Dependent\_name}(DependentWEmploy)$

   (c) FWong = $\sigma_{Fname="Franklin"\&Lname="Wong}(EMPLOYEE)$
   FWongSsn = $\Pi_{Ssn}(FWong)$
   Supervised = $FWongSsn \bowtie_{Ssn=Super_ssn} EMPLOYEE$
   Names = $\Pi_{Fname,Lname}(Supervised)$

   (d) HoursPerProj = $PnoF_{SumHours}(WORKS_ON)$
   NamesHours = $PROJECT \bowtie_{Pnumber=Pno} (HoursPerProj)$

   (e) ProjNums = $\Pi_{Pnumber}(PROJECT)$
   Projects = $\rho_{Pno}(ProjNums)$
   EmployeeProj = $\Pi_{Essn,Pno}(WORKS\_ON)$
   WorkOnAll = $EmployeeProj \div Projects$

   (f) AllEmploy = $\Pi_{Ssn}(EMPLOYEE)$
   EmployOnProj = $\Pi_{Essn}(WORKS\_ON)$
   DontWorkOnProj = AllEmploy - EmployOnProj

   (g) AvgSal = Dno $F_{Average\ Salary}(EMPLOYEE)$
   DepNameNo = $\Pi_{Dname,Dnumber}(DEPARTMENT)$
   NameAvgSal = $DepNameNo \bowtie_{Dnumber=Dno} AvgSal$

   (h) Females = $\sigma_{Sex="F"}(EMPLOYEE)$
   AvgSalary=$F_{Average\ Salary}(Females)$

Problem 3

In ORDER, Cust# is a foreign key to a CUSTOMER attribute, Cust#.
In ORDER_ITEM, Order# is a foreign key to an ORDER attribute Order#. and Item# is a foreign key to an ITEM attribute ITEM#.
In SHIPMENT, Order# is a foreign key to an ORDER attribute Order#. and Warehouse# is a foreign key to a WAREHOUSE attribute Warehouse#