**6.16)**

1. EMP\_WORKS10 🡨(EMPLOYEE⨝Ssn=Essn( σHours>10(WORKS\_ON))  
   EMP\_WORKS10\_PRODX 🡨( σPname=’ProductX’(PROJECT)) ⨝Pnumber=Pno(EMP\_WORKS10)  
   RESULT 🡨( πFname,Lname(σDno=5(EMP\_WORKS10\_PRODX))

|  |  |
| --- | --- |
| **Fname** | **Lname** |
| John | Smith |
| Joyce | English |

1. EMP\_W\_DEP 🡨(EMPLOYEE⨝Ssn=Essn(DEPENDENT))  
   RESULT 🡨 (πFname,Lname(σFname=Dependent\_name(EMP\_W\_DEP))

|  |  |
| --- | --- |
| **Fname** | **Lname** |
|  |  |

1. WONG\_SSN 🡨 πSsn(σFname=’Franklin’,Lname=’Wong’(EMPLOYEE))  
   RESULT 🡨 πFname,Lname(EMPLOYEE⨝Superssn=Ssn(WONG\_SSN))

|  |  |
| --- | --- |
| **Fname** | **Lname** |
| John | Smith |
| Ramesh | Narayan |
| Joyce | English |

1. PROJ\_SUM\_HOURS 🡨ρ*R*(Pno,Total\_hours)(PnoℑSUM Hours(WORKS\_ON))  
   RESULT 🡨 πPname,Total\_hours(PROJ\_SUM\_HOURS⨝Pnumber=Pno(PROJECT))

|  |  |
| --- | --- |
| **Pname** | **Total\_hours** |
| ProductX | 52.5 |
| ProductY | 37.5 |
| ProductZ | 50.0 |
| Computerization | 55.0 |
| Reorganization | 25.0 |
| Newbenefits | 55.0 |

1. EMP\_PNOS 🡨 ρ*R*(Pno,Ssn)(πPno,Essn(WORKS\_ON))  
   ALL\_PNOS 🡨 ρ*R*(Pno)(πPnumber(PROJECT))  
   EMP\_ALL\_PNOS 🡨EMP\_PNOS ÷ ALL\_PNOS  
   RESULT 🡨 πFname,Lname(EMP\_ALL\_PNOS \* EMPLOYEE)

|  |  |
| --- | --- |
| **Fname** | **Lname** |
|  |  |

1. EMPS 🡨 πSsn(EMPLOYEE)  
   EMPS\_WORK 🡨 ρ*R*(Ssn)(πEssn(WORKS\_ON))  
   RESULT 🡨 πFname,Lname(EMPLOYEE \* (EMPS – EMPS\_WORK))

|  |  |
| --- | --- |
| **Fname** | **Lname** |
|  |  |

1. DEPT\_AVG 🡨 ρ*R*(Dnumber,Avg\_sal)(DnoℑAVG Salary(EMPLOYEE))  
   RESULT 🡨 πDname,Avg\_sal(DEPARTMENT \* DEPT\_AVG)

|  |  |
| --- | --- |
| **Dname** | **Avg\_sal** |
| Research | 33250 |
| Administration | 31000 |
| Headquarters | 55000 |

1. RESULT 🡨 ρ*R*(Avg\_sal)( ℑAVG Salary(σSex=’F’EMPLOYEE))

|  |
| --- |
| **Avg\_sal** |
| 31000 |

1. HOUSTON\_PROJ 🡨 ρ*R*(Pname,Pno,Plocation,Dnum)(σPlocation=’Houston’(PROJECT))  
   EMP\_HOUSTON\_PROJ 🡨 ρ*R*(Ssn)(πEssn(WORKS\_ON \* HOUSTON\_PROJ))

DEPT\_NOT\_HOUSTON 🡨 ρ*R*(Dno)(πDnumber(σDlocation<>’Houston’(DEPARTMENT)))

EMP\_NOT\_HOUSTON 🡨 πSsn(EMPLOYEE \* DEPT\_NOT\_HOUSTON)

RESULT 🡨 πFname,Lname,Address(EMPLOYEE \* (EMP\_HOUSTON\_PROJ – EMP\_NOT\_HOUSTON))

|  |  |  |
| --- | --- | --- |
| **Fname** | **Lname** | **Address** |
| Jennifer | Wallace | 291 Berry, Bellaire, TX |

1. DEPT\_MANG 🡨 ρ*R*(Ssn)(πMgrssn(DEPARTMENT))  
   EMP\_W\_DEP 🡨 ρ*R*(Ssn)(πEssn(DEPENDENT))  
   RESULT🡨 πFname,Lname(EMPLOYEE \* (DEPT\_MANG – EMP\_W\_DEP))

|  |  |
| --- | --- |
| **Fname** | **Lname** |
| James | Borg |

**6.17)**

1. DEPART🡨Flight\_numberℑMIN Leg\_number(FLIGHT\_LEG)  
   ARRIVE🡨 Flight\_numberℑMAX Leg\_number(FLIGHT\_LEG)

DEPART\_AIRPORT🡨 πFlight\_number,Departure\_airport\_code(DEPART \* FLIGHT\_LEG)  
ARRIVE\_AIRPORT🡨 πFlight\_number,Arrival\_airport\_code(ARRIVE \* FLIGHT\_LEG)  
RESULT 🡨(DEPART \* ARRIVE)

1. DEPART\_HOUSTON 🡨 σ­­­­­­Departure\_airport\_code=’IAH’(FLIGHT\_LEG)  
   ARRIVE\_LA 🡨 σArrival\_airport\_code=’LAX’(FLIGHT\_LEG)  
   RESULT 🡨 πFlight\_number,Weekdays(FLIGHT \* (DEPART\_HOUSTON \* ARRIVE\_LA))
2. DEPART\_HOUSTON 🡨 σ­­­­­­Departure\_airport\_code=’IAH’(FLIGHT\_LEG)  
   ARRIVE\_LA 🡨 σArrival\_airport\_code=’LAX’(FLIGHT\_LEG)  
   RESULT 🡨 πFlight\_number,Departure\_airport\_code,Scheduled\_departure\_time,Arrival\_airport\_code,Scheduled\_arrival\_time, Weekdays(FLIGHT \* (DEPART\_HOUSTON \* ARRIVE\_LA))
3. RESULT 🡨 σFlight\_number=’CO197’(FARE)
4. RESULT 🡨 πNumber\_of\_available\_seats)( σFlight\_number=’CO197’ AND Date=’2009-10-09’)(LEG\_INSTANCE))

**6.18)**

1. LOST\_TRIBE 🡨 σTitle=’The Lost Tribe’(BOOK)  
   SHARPSTOWN 🡨 σBranch\_name=’Sharpstown’(LIBRARY\_BRANCH)  
   RESULT 🡨 πNo\_of\_copies((LOST\_TRIBE \* BOOK\_COPIES) \* SHARPSTOWN)
2. LOST\_TRIBE 🡨 σTitle=’The Lost Tribe’(BOOK)  
   RESULT🡨 πTitle,Brance\_name,No\_of\_copies((LOST\_TRIBE \* BOOK\_COPIES) \* LIBRARY\_BRANCH)
3. LOANED 🡨 πCard\_no(BOOK\_LOANS)  
   MEMBERS🡨 πCard\_no(BORROWER)  
   RESULT 🡨 πName(BORROWER \* (MEMBERS – LOANED)

This relational algebra is assuming that you can sign-up to be a borrower but not have borrowed a book and that after books are returned the entry is removed from BOOK\_LOAN.

1. SHARPSTOWN 🡨 σBranch\_name=’Sharpstown’)(LIBRARY\_BRANCH)  
   DUE\_TODAY 🡨 σDue\_date=’2017-03-22’(BOOK\_LOANS)  
   DUE\_TODAY\_SHARPSTOWN 🡨((SHARPSTOWN \* DUE\_TODAY) \* BOOK)  
   RESULT 🡨 πTitle,Name,Address(DUE\_TODAY\_SHARPSTOWN \* BORROWER)  
     
   This relational algebra is using today’s actual date (03/22/2017) as the Due\_date of today and the date format is assumed from 6.17) e).
2. LOAN\_COUNT 🡨 ρ*R*(Brancg\_id,Loan\_count)(Branch\_idℑCOUNT Book\_id(BOOK\_LOANS))  
   RESULT 🡨 πBranch\_name, Loan\_count(LOAN\_COUNT \* LIBRARY\_BRANCH)
3. LOAN\_COUNT 🡨 ρ*R*(Card\_no,Loan\_count)(Card\_noℑCOUNT Book\_id(BOOK\_LOANS))  
   LOAN\_COUNT\_5 🡨 σLoan\_count>5­(LOAN\_COUNT)  
   RESULT 🡨 πName,Address,Loan\_count(BORROWER \* LOAN\_COUNT\_5)
4. CENTRAL 🡨 σBranch\_name=’Central’(LIBRARY\_BRANCH)  
   KING 🡨 σAuthor\_name=’Stephen King’(BOOK\_AUTHORS)  
   KING\_BOOKS 🡨KING \* BOOK  
   RESULT🡨 πTitle,No\_of\_copies((BOOK\_COPIES \* CENTRAL) \* KING\_BOOKS)

**6.21)**

1. SMITH🡨 πSsn(σName=’John Smith’(STUDENT))  
   SMITH\_COURSES 🡨SMITH \* ENROLL  
   SMITH\_COURSE\_COUNT 🡨 ρ*R*(Quarter,Course\_count)(QuarterℑCOUNT Course#(SMITH\_COURSES))  
   RESULT 🡨 πCourse\_count(σQuarter=’W09’(SMITH\_COURSE\_COUNT))
2. CS\_COURSES 🡨 σDept=’CS’(COURSE)  
   CS\_COURSES\_BOOKS 🡨((CS\_COURSES \* BOOK\_ADOPTION) \* TEXT)  
   CS\_BOOKS\_COUNT 🡨 ρ*R*(Course#,Book\_title,Book\_Count)(Course#,Book\_titleℑCOUNT Book\_isbn(CS\_COURSES\_BOOKS))  
   CS\_BOOKS\_COUNT\_INFO 🡨CS\_BOOKS\_COUNT \* TEXT  
   RESULT 🡨 πCourse#,Book\_isbn,Book\_title(σBook\_count>2(CS\_BOOKS\_COUNT\_INFO)
3. NOT\_PEARSON 🡨 σPublisher<>’Pearson Publishing’(TEXT)  
   NOT\_PEARSON\_DEPT 🡨 πDept((PEARSON \* BOOK\_ADOPTION) \* COURSE)  
   ALL\_DEPT 🡨 πDept(BOOK\_ADOPTION \* COURSE)  
   RESULT 🡨ALL\_DEPT – NOT\_PEARSON\_DEPT

**6.23)**

1. JANE 🡨 σName=’Jane Doe’(SALESPERSON)  
   RESULT🡨 πSerial#,Manufacturer,Sale\_price((JANE \* SALE) \* CAR)
2. CAR\_W\_OPTIONS 🡨 πSerial#,Model(CAR \* OPTION)  
   ALL\_CARS 🡨 πSerial#,Model(CAR)  
   RESULT 🡨ALL\_CARS – CAR\_W\_OPTIONS
3. The left outer join (SALESPERSON ⟕ SALE) will result in any SALESPERSON that didn’t make a sale to be padded for Serial\_no, Date, Sale\_price.  
     
     
   EXAMPLE:

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Salesperson\_id | Name | Phone | Serial\_no | Date | Sale\_price |
| 1 | John Smith | 4445556666 | 01 | 2016-04-10 | 30000 |
| 2 | Jane Doe | 2223334444 | NULL | NULL | NULL |

1. SALESPERSON\_SALE 🡨 πSerial\_no(SALESPERSON \* SALE)  
   CAR\_W\_OPTIONS 🡨 πSerial\_no(CAR \* OPTION)  
   RESULT 🡨SALESPERSON\_SALE ∩ CAR\_W\_OPTIONS  
     
   English: List all the Cars that were sold that had options.

**6.32)**

1. RESULT 🡨 πFname,Lname(σDno= (EMPLOYEE)) (πDno(σSalary=  (EMPLOYEE)))  
    (ℑMAX Salary(EMPLOYEE))
2. RESULT 🡨 πFname,Lname(σSuperssn= (EMPLOYEE))  
    (πSsn(σSuperssn=’888665555’(EMPLOYEE)))
3. RESULT 🡨 πFname,Lname(σSalary>=1000 +  (EMPLOYEE))  
    (πSalary(σSalary= (EMPLOYEE)))  
    (ℑMIN Salary(EMPLOYEE))