.   -4!

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mirzo.zaynidinov@gmail.com

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1.

1.1.   *

1   ,

( ),
{StudentId, CourseId},
:
StudentId, CourseId
StudentId, CourseId, StudentName, GroupId, GroupName
StudentId, CourseId, StudentName, GroupId, GroupName, CourseName
StudentId, CourseId, StudentName, GroupId, GroupName, CourseName, Mark, LecturerId
StudentId, CourseId, StudentName, GroupId, GroupName, CourseName, Mark, LecturerId, GroupName, GroupFacultyId
StudentId, CourseId, StudentName, GroupId, GroupName, CourseName, Mark, LecturerId, GroupName, GroupFacultyId, GroupFacultyName, GroupFacultyDeanId
StudentId, CourseId, StudentName, GroupId, GroupName, CourseName, Mark, LecturerId, GroupName, GroupFacultyId, GroupFacultyName, GroupFacultyDeanId, LecturerName, LecturerFacultyId
StudentId, CourseId, StudentName, GroupId, GroupName, CourseName, Mark, LecturerId, GroupFacultyId, GroupFacultyName, GroupFacultyDeanId, LecturerName, LecturerFacultyId, LecturerFacultyName, LecturerFacultyDeanId

---

1.2. *

=> ; ; … .
.
(1, 2, …)
:
(SellerId, GoodId, PriceId, OrderId) => (SellerId, GoodId, PriceId);

(GoodId, PriceId).

.

, (--) .
.
, ( ).

(StudentId, StudentName, GroupId, GroupName, GroupFacultyId, GroupFacultyName, GroupFacultyDeanId, CourseId, CourseName, LecturerId, LecturerName, LecturerFacultyId, LecturerFacultyName, LecturerFacultyDeanId, Mark) => (StudentId, StudentName, GroupId, GroupName, GroupFacultyId, GroupFacultyName, GroupFacultyDeanId, CourseId, CourseName, LecturerId, LecturerName, LecturerFacultyId, LecturerFacultyName, LecturerFacultyDeanId, Mark).

2.

2.1.   *

      2,   ,
                :
        CourseId -> CourseName. CourseName
      CourseId.   .

(CourseId, CourseName)
(StudentId, StudentName, GroupId, GroupName, GroupFacultyId,
GroupFacultyName, GroupFacultyDeanId, CourseId, LecturerId, LecturerName,
LecturerFacultyId, LecturerFacultyName, LecturerFacultyDeanId, Mark)
      2   2   StudentId -> StudentName, GroupId,
GroupName. StudentName   StudentId.
          CourseId   GroupId,   ,
    GroupId, CourseId -> LecturerId,   ,
                (LecturerName, LecturerFacultyId,
LecturerFacultyName, LecturerFacultyDeanId).
(CourseId, CourseName)
(GroupId, CourseId, LecturerId, LecturerName, LecturerFacultyId,
LecturerFacultyName, LecturerFacultyDeanId)
(StudentId, StudentName, GroupId, GroupName, GroupFacultyId,
GroupFacultyName, GroupFacultyDeanId, CourseId, Mark)
      3   2   StudentId -> StudentName, GroupId,
GroupName. StudentName   StudentId.
          ,
(GroupName, GroupFacultyId, GroupFacultyName, GroupFacultyDeanId):
(CourseId, CourseName)   4,   - {CourseId}
(GroupId, CourseId, LecturerId, LecturerName, LecturerFacultyId,
LecturerFacultyName, LecturerFacultyDeanId)   5, 7, 10, 11,   {GroupId,
CourseId}
(StudentId, CourseId, Mark)   6,   - {StudentId, CourseId}
(StudentId, StudentName, GroupId, GroupName, GroupfacultyId,
GroupFacultyName, GroupFacultyDeanId)   1, 2, 3, 8, 9,   {StudentId}

2.2.   *

      ,   1.2.

(StudentId, StudentName, GroupId, GroupName, GroupFacultyId,
GroupFacultyName, GroupFacultyDeanId, CourseId, CourseName, LecturerId,
LecturerName, LecturerFacultyId, LecturerFacultyName, LecturerFacultyDeanId,
Mark) => (CourseId, CourseName); (GroupId, CourseId, LecturerId, LecturerName,
LecturerFacultyId, LecturerFacultyName, LecturerFacultyDeanId); (StudentId,
CourseId, Mark); (StudentId, StudentName, GroupId, GroupName, GroupfacultyId,
GroupFacultyName, GroupFacultyDeanId).

3.

3.1.   *

                3,   ,
                (   )   :
                    :   CourseName
        CourseId.
                    :   (LecturerName, LecturerfacultyId,
LecturerFacultyName, LecturerfacultyDeanId)   .

1) 3 10   11:
(GroupId, CourseId, LecturerId, LecturerName, LecturerFacultyId)
(LecturerFacultyId, LecturerfacultyName, LecturerFacultyDeanId)
2)   3 5.
(GroupId, CourseId, LecturerId)
(LecturerId, LecturerName, LecturerFacultyId)
(LecturerFacultyId, LecturerfacultyName, LecturerFacultyDeanId)
                    :   Mark
    .
                    :   (GroupFacultyId,
GroupFacultyName, GroupFacultyDeanId)   .

1)   8 9
(StudentId, StudentName, GroupId, GroupName, GroupfacultyId)
(GroupfacultyId, GroupFacultyName, GroupFacultyDeanId)
2)   2
(StudentId, StudentName, GroupId, GroupName)
(GroupId, GroupName, GroupfacultyId)
(GroupfacultyId, GroupFacultyName, GroupFacultyDeanId)

3.2.   *

            ,   1.2.

(CourseId, CourseName) => (CourseId, CourseName).
(GroupId, CourseId, LecturerId, LecturerName, LecturerFacultyId,
LecturerFacultyName, LecturerFacultyDeanId) => (GroupId, CourseId, LecturerId);
(LecturerId, LecturerName, LecturerFacultyId); (LecturerFacultyId,
LecturerfacultyName, LecturerFacultyDeanId).
(StudentId, CourseId, Mark) => (StudentId, CourseId, Mark).
(StudentId, StudentName, GroupId, GroupName, GroupfacultyId,
GroupFacultyName, GroupFacultyDeanId) => (StudentId, StudentName, GroupId,

GroupName); (GroupId, GroupName, GroupfacultyId); (GroupfacultyId, GroupFacultyName, GroupFacultyDeanId).

.1.   *

,   :

X -> Y, X   .   .

1)   (CourseId, CourseName).   {CourseId}.   3 4 (CourseId)   .   .

2)   (GroupId, CourseId, LecturerId).   {GroupId, CourseId}.   3 7 (GroupId, CourseId)   .   .

3)   (LecturerId, LecturerName, LecturerFacultyId). {LecturerId}.   3 5 (LecturerId)   .   .

4)   (LecturerFacultyId, LecturerfacultyName, LecturerFacultyDeanId).   {LecturerfacultyId} {LecturerFacultyName}.   3 10   11 (LecturerFacultyId) (LecturerFacultyName)   .   .

5)   (StudentId, CourseId, Mark).   {StudentId, CourseId}.   3 6 (StudentId, CourseId)   .   .

6)   (StudentId, StudentName, GroupId, GroupName). {StudentId}.   3 1 (StudentId)   .   .

7)   (GroupId, GroupName, GroupfacultyId).   {GroupId} {GroupName}.   3 2   3 (GroupId) (GroupName)   .

8)   (GroupfacultyId, GroupFacultyName, GroupFacultyDeanId).   {GroupfacultyId} {GroupFacultyName}.   3 8   9 (GroupFacultyId) (GroupFacultyName)   .   .

.2.   *

,   1.2.

(CourseId, CourseName) => (CourseId, CourseName).
(GroupId, CourseId, LecturerId) => (GroupId, CourseId, LecturerId).
(LecturerId, LecturerName, LecturerFacultyId) => (LecturerId, LecturerName, LecturerFacultyId).
(LecturerFacultyId, LecturerfacultyName, LecturerFacultyDeanId) => (LecturerFacultyId, LecturerfacultyName, LecturerFacultyDeanId).

(StudentId, CourseId, Mark) => (StudentId, CourseId, Mark).
(StudentId, StudentName, GroupId, GroupName) => (StudentId, StudentName, GroupId, GroupName).
(GroupId, GroupName, GroupfacultyId) => (GroupId, GroupName, GroupfacultyId).
(GroupfacultyId, GroupFacultyName, GroupFacultyDeanId) => (GroupfacultyId, GroupFacultyName, GroupFacultyDeanId).

4.

4.1.   *

                                                                              .

                        4   ,   X -> Y|Z, X –
                              ,
1)   (CourseId, CourseName).   -
                                                                                (.1),
                        4   .
2)   (GroupId, CourseId, LecturerId).
      (,   X -> Y|Z <=> X -> Z|Y,
                   ):
      GroupId -> CourseId|LecturerId   . (group_1, course_1, {lecture_1}),
(group_1, course_2, {lecture_2})   CourseId   LecturerId,
        GroupId -> CourseId|LecturerId
      CourseId -> GroupId|LecturerId   .(course_1, group_1, {lecture_1})
(course_1, group_2, {lecture_2})   GroupId   LecturerId,
        CourseId -> GroupId|LecturerId
      LecturerId -> GroupId|CourseId   .(lecture_1, group_1, {course_1})
(lecture_1, group_2, {course_2})   GroupId   CourseId,
        LecturerId -> GroupId|CourseId

                        ,   4   .
3)   (LecturerId, LecturerName, LecturerFacultyId).
                 -
      (.1),   4   .
4)   (LecturerFacultyId, LecturerfacultyName,
LecturerFacultyDeanId).   -
                                                              (.1),
    4   .
5)   (StudentId, CourseId, Mark).
(,   X -> Y|Z <=> X -> Z|Y,
             ):
      StudentId -> CourseId|Mark   . (student_1, course_1, {mark_1})
(student_1, course_2, {mark_2})   CourseId   Mark,

StudentId -> CourseId|Mark

CourseId -> StudentId|Mark   . (course_1, student_1, {mark_1})
(course_1, "student_2", {mark_2})   StudentId   Mark,
        CourseId -> StudentId|Mark

    Mark -> StudentId|CourseId   . (mark_1, student_1, {course_1})
(mark_1, student_1, {course_1, course_2})   StudentId
CourseId,   CourseId -> StudentId|Mark -

                                ,   4   .
6)   (StudentId, StudentName, GroupId, GroupName).
                                -
            (.1),   4   .
7)   (GroupId, GroupName, GroupfacultyId).
            -
        ,   4   .
8)   (GroupfacultyId, GroupFacultyName, GroupFacultyDeanId).
                        -
                        ,   4   .

                ,   1.2.

(CourseId, CourseName) => (CourseId, CourseName).
(GroupId, CourseId, LecturerId) => (GroupId, CourseId, LecturerId).
(LecturerId, LecturerName, LecturerFacultyId) => (LecturerId, LecturerName,
LecturerFacultyId).
(LecturerFacultyId, LecturerfacultyName, LecturerFacultyDeanId) =>
(LecturerFacultyId, LecturerfacultyName, LecturerFacultyDeanId).
(StudentId, CourseId, Mark) => (StudentId, CourseId, Mark).
(StudentId, StudentName, GroupId, GroupName) => (StudentId, StudentName,
GroupId, GroupName).
(GroupId, GroupName, GroupfacultyId) => (GroupId, GroupName, GroupfacultyId).
(GroupfacultyId, GroupFacultyName, GroupFacultyDeanId) => (GroupfacultyId,
GroupFacultyName, GroupFacultyDeanId).

5.

5.1.   *

                                                                .

{X1,X2,...,Xn}　　　　　X_i –

1)　　　　　　　　　(CourseId, CourseName).　o　　　　　　　　　　　　　-
　　　　　　　　　　　　　　　3　　　　　　　　　　　　.
　　　　　5　　.
2)　　　　　　　　(GroupId, CourseId, LecturerId).
　*{{GroupId}, {CourseId}, {LecturerId}}　　　　　　　(group_1, course_1,
lecture_1) (group_2, course_2, lecture_2)　　　　　　　　　GroupId:
(group_1), (group_2); CourseId: (course_1), (course_2); LecturerId: (lecture_1),
(lecture_2),　　　　　　　GroupId　CourseId　　　　　　　　(group_2,
course_1)　　　　　　.　　　　　{{GroupId}, {CourseId}, {LecturerId}}
　*{{GroupId, CourseId}, {CourseId, LecturerId}, {GroupId, LecturerId}}
　　　　(group_1, course_1, lecture_1) (group_2, course_2, lecture_1)
　　　　　(GroupId, CourseId): (group_1, course_1), (group_2,
course_2); (CourseId, LecturerId): (course_1, lecture_1), (course_2, lecture_1);
(GroupId, LecturerId): (group_1, lecture_1), (group_2, lecture_1),
(GroupId, LecturerId)　(CourseId, LecturerId)　　　　　　　　(group_1,
lecture_1, course_2)　　　　　　　.　　　　　{{GroupId, CourseId}, {CourseId,
LecturerId}, {GroupId, LecturerId}}　　　.
　　　　　　　　　　,　　　　　　　　　　　5　　.
3)　　　　　　(LecturerId, LecturerName, LecturerFacultyId).　o
　　　　　-　　　　　　　　　　　　3　　　　　　　　　.
　　　　　5　　.
4)　　　　　　(LecturerFacultyId, LecturerfacultyName,
LecturerFacultyDeanId).　o　　　　　　　　　-
　　　　3　　　　　　　.　　　　　　　　5　　.
5)　　　　　(StudentId, CourseId, Mark).　　　　　:
　*{{StudentId}, {CourseId}, {Mark}}　　　　.　(student_1, course_1, mark_1)
(student_2, course_2, mark_2)　　　　　　　StudentId: (student_1),
(student_2); CourseId: (course_1), (course_2); Mark: (mark_1), (mark_2)
　　　　StudentId　CourseId　　　　　(student_2, course_1),
　　　.　　{{StudentId}, {CourseId}, {Mark}}　　　.
　*{{StudentId, CourseId}, {CourseId, Mark}, {StudentId, Mark}}　　　.
(student_1, course_1, mark_1) (student_2, course_2, mark_1)
　　　(StudentId, CourseId): (student_1, course_1), (student_2, course_2);
(CourseId, Mark): (course_1, mark_1), (course_2, mark_1); (StudentId, Mark):
(student_1, mark_1), (student_2, mark_1),　　　　　(StudentId, Mark)
(CourseId, Mark)　　　　　(student_1, mark_1, course_2)
　.　　{{StudentId, CourseId}, {CourseId, Mark}, {StudentId, Mark}}　　.
　　　　　,　　　　　5　　.
6)　　　　　(StudentId, StudentName, GroupId, GroupName).　o
　　　-　　　　　　　　　　　3
　.　　　　　　5　　.
7)　　　　　(GroupId, GroupName, GroupfacultyId).　o
　　　-　　　　　　　3　　　　.
　　　5　　.
8)　　　　　(GroupfacultyId, GroupFacultyName, GroupFacultyDeanId).
　o　　　　　　-　　　　　　　3

5.2.   *

          ,   1.2.

(CourseId, CourseName) => (CourseId, CourseName).
(GroupId, CourseId, LecturerId) => (GroupId, CourseId, LecturerId).
(LecturerId, LecturerName, LecturerFacultyId) => (LecturerId, LecturerName, LecturerFacultyId).
(LecturerFacultyId, LecturerfacultyName, LecturerFacultyDeanId) => (LecturerFacultyId, LecturerfacultyName, LecturerFacultyDeanId).
(StudentId, CourseId, Mark) => (StudentId, CourseId, Mark).
(StudentId, StudentName, GroupId, GroupName) => (StudentId, StudentName, GroupId, GroupName).
(GroupId, GroupName, GroupfacultyId) => (GroupId, GroupName, GroupfacultyId).
(GroupfacultyId, GroupFacultyName, GroupFacultyDeanId) => (GroupfacultyId, GroupFacultyName, GroupFacultyDeanId).

6.

6.   ERM   PDM *
                1920x1080.   — ERM.   — PDM.
                   ,   /   /   ,
     .   (   )   .

🖼️ Screenshot 2024-10-07 at 03.29.48 - Firdavs Zaynidinov.jpg

7. SQL
       ,   SQL –   ,

7.1. DDL *

create table GroupFaculty (

```sql
  GroupfacultyId int not null primary key,
  GroupFacultyName varchar(50) not null unique,
  GroupFacultyDeanId int not null
);
create table GROUPS (
  GroupId int not null primary key,
  GroupName varchar(10) not null unique,
  GroupfacultyId int not null,
  constraint GroupFacultyFk foreign key (GroupfacultyId) references GroupFaculty
(GroupfacultyId)
);
create table Student (
  StudentId int not null primary key,
  StudentName varchar(100) not null,
  GroupId int not null,
  GroupName varchar(10) not null,
  constraint StudentsGroupIdFk foreign key (GroupId) references GroupS (GroupId)
);
create table LectureFaculty(
  LecturerFacultyId int not null primary key,
  LecturerfacultyName varchar(50) not null unique,
  LecturerFacultyDeanId  int not null
);
create table Lecture (
  LecturerId int not null primary key,
  LecturerName varchar(100) not null,
  LecturerFacultyId int not null,
  constraint LecturerFacultyIdFk foreign key (LecturerFacultyId) references
LectureFaculty (LecturerFacultyId)
);
create table Course (
  CourseId int not null primary key,
  CourseName varchar(50) not null
);
create table Syllabus (
  GroupId int not null,
  CourseId int not null,
  LecturerId int not null,
  constraint SyllabusPk primary key (CourseId, GroupId),
  constraint SyllabusCourseIdFk foreign key (CourseId) references Course (CourseId),
  constraint SyllabusLecturerIdFk foreign key (LecturerId) references Lecture
(LecturerId),
  constraint SyllabusGroupIdFk foreign key (GroupId) references GroupS (GroupId)
);
create table Mark (
  StudentId int not null,
```

```
    CourseId int not null,
    Mark varchar(2) not null,
    constraint primaryMark primary key (StudentId, CourseId),
    constraint MarksStudentFk foreign key (StudentId) references Student (StudentId),
    constraint MarksSyllabusFk foreign key (CourseId) references Course (CourseId)
);
```

7.2. DML *

                  .   2-3   ,
                      .
       ,   .

```
insert into GroupFaculty (GroupFacultyId, GroupFacultyName, GroupFacultyDeanId)
values (1, '          1', 1),
    (2, '          2', 2),
    (3, '          3', 3);
insert into Groups (GroupId, GroupName, GroupFacultyId)
values (1, '  3136', 1),
    (2, '  3237', 1),
    (3, 'N3338', 2),
    (4, 'N4150', 2),
    (5, 'I3160', 3),
    (6, 'I3345', 3);
insert into Student (StudentId, StudentName, GroupId, GroupName)
values (1, '          1', 1, '  3136'),
    (2, '          2', 1, '  3136'),
    (3, '          3', 2, '  3237'),
    (4, '          4', 3, '  3338'),
    (5, '          5', 4, 'N4150'),
    (6, '          6', 4, 'N4150'),
    (7, '          7', 5, 'I3160'),
    (8, '          8', 5, 'I3160'),
    (9, '          9', 6, 'I3345');
insert into LectureFaculty (LecturerFacultyId, LecturerFacultyName,
LecturerFacultyDeanId)
values (1, '          1', 1),
    (2, '          2', 2),
    (3, '          3', 3);
insert into Lecture (LecturerId, LecturerName, LecturerFacultyId)
values (1, '          1', 1),
    (2, '          2', 1),
    (3, '          3', 2),
    (4, '          4', 2),
    (5, '          5', 3),
```

```
      (6, '          6', 3);
insert into Course (CourseId, CourseName)
values (1, '      1'),
      (2, '      2'),
      (3, '      3'),
      (4, '      4');
insert into Syllabus (GroupId, CourseId, LecturerId)
values (1, 1, 1),
      (2, 2, 2),
      (3, 3, 3),
      (4, 4, 4),
      (5, 1, 5),
      (6, 2, 6),
      (1, 3, 1),
      (2, 4, 2);
insert into Mark (StudentId, CourseId, Mark)
values (1, 1, 'D'),
      (2, 2, 'FX'),
      (3, 3, 'E'),
      (4, 4, 'D'),
      (5, 1, 'C'),
      (6, 2, 'A'),
      (7, 3, 'B'),
      (8, 4, 'B'),
      (9, 1, 'a');
```