

Код:

```
class Faculty:

    def __init__(self, id, name):

        self.id = id

        self.name = name

        self.departments = [] # Связь один-ко-многим с кафедрами


class Department:

    def __init__(self, id, name, faculty_id):

        self.id = id

        self.name = name

        self.faculty_id = faculty_id # Ссылка на факультет


class Professor:

    def __init__(self, id, name, salary):

        self.id = id

        self.name = name

        self.salary = salary

        self.departments = [] # Связь многие-ко-многим с кафедрами


class ProfessorDepartment:

    def __init__(self, professor_id, department_id):

        self.professor_id = professor_id

        self.department_id = department_id # Связь многие-ко-многим


# Факультеты
faculty1 = Faculty(1, "IU")
faculty2 = Faculty(2, "RK")


# Кафедры
department1 = Department(1, "Кафедра U5", faculty1.id)
department2 = Department(2, "RK9", faculty2.id)
department3 = Department(3, "IU4", faculty1.id)
```

```
# Добавляем кафедры к факультетам
```

```
faculty1.departments.extend([department1, department3])
```

```
faculty2.departments.append(department2)
```

```
# Преподаватели
```

```
professor1 = Professor(1, "Ivanov", 50000)
```

```
professor2 = Professor(2, "Petrov", 55000)
```

```
professor3 = Professor(3, "Sidorov", 60000)
```

```
professor4 = Professor(4, "Smirnov", 58000)
```

```
# Установка связей многие-ко-многим между преподавателями и кафедрами
```

```
professor_department_relations = [
```

```
    ProfessorDepartment(professor1.id, department1.id),
```

```
    ProfessorDepartment(professor1.id, department3.id),
```

```
    ProfessorDepartment(professor2.id, department1.id),
```

```
    ProfessorDepartment(professor3.id, department2.id),
```

```
    ProfessorDepartment(professor4.id, department3.id)
```

```
]
```

```
# Связываем преподавателей с их кафедрами
```

```
department_by_id = {dept.id: dept for dept in [department1, department2, department3]}
```

```
professor_by_id = {prof.id: prof for prof in [professor1, professor2, professor3, professor4]}
```

```
for relation in professor_department_relations:
```

```
    professor_by_id[relation.professor_id].departments.append(department_by_id[relation.department_id])
```

```
print("Запрос 1: Список всех связанных Преподавателей и Кафедр, отсортированный по Кафедрам")
```

```
departments_with_professors = {dept.name: [] for dept in [department1, department2, department3]}
```

```
for relation in professor_department_relations:
```

```
    dept_name = department_by_id[relation.department_id].name
```

```
    prof_name = professor_by_id[relation.professor_id].name
```

```
    departments_with_professors[dept_name].append(prof_name)
```

```
for dept_name, profs in sorted(departments_with_professors.items()):
```

```
    print(f"Department: {dept_name}")
```

```
    for prof_name in profs:
```

```
        print(f" - Professor: {prof_name}")
```

```
print("\nЗапрос 2: Список Кафедр с суммарной зарплатой Преподавателей в каждом отделе,  
отсортированный по суммарной зарплате")
```

```
salary_by_department = {dept.name: 0 for dept in [department1, department2, department3]}
```

```
for relation in professor_department_relations:
```

```
    prof = professor_by_id[relation.professor_id]
```

```
    dept_name = department_by_id[relation.department_id].name
```

```
    salary_by_department[dept_name] += prof.salary
```

```
for dept_name, total_salary in sorted(salary_by_department.items(), key=lambda x: x[1], reverse=True):
```

```
    print(f"Department: {dept_name}, Total Salary: {total_salary}")
```

```
print("\nЗапрос 3: Список всех Кафедр, у которых в названии присутствует слово «Кафедра», и  
список работающих в них Преподавателей.")
```

```
print("Checking departments:")
```

```
for dept in [department1, department2, department3]:
```

```
    print(f"Department: {dept.name}")
```

```
departments_with_keyword = {
```

```
dept.id: dept.name for dept in [department1, department2, department3] if "Кафедра" in dept.name
}
```

```
print("\nDepartments containing 'Кафедра' in the name:")
```

```
for dept_id, dept_name in departments_with_keyword.items():
```

```
    print(f"Department: {dept_name}")
```

```
result = {}
```

```
for dept_id, dept_name in departments_with_keyword.items():
```

```
    result[dept_name] = [
```

```
        professor_by_id[relation.professor_id].name
```

```
        for relation in professor_department_relations if relation.department_id == dept_id
```

```
    ]
```

```
for dept_name, profs in result.items():
```

```
    print(f"Department: {dept_name}")
```

```
    for prof_name in profs:
```

```
        print(f" - Professor: {prof_name}")
```

Результаты работы:

Запрос 1: Список всех связанных Преподавателей и Кафедр, отсортированный по Кафедам

Department: IU4

- Professor: Ivanov

- Professor: Smirnov

Department: RK9

- Professor: Sidorov

Department: Кафедра U5

- Professor: Ivanov

- Professor: Petrov

Запрос 2: Список Кафедр с суммарной зарплатой Преподавателей в каждом отделе, отсортированный по суммарной зарплате

Department: IU4, Total Salary: 108000

Department: Кафедра U5, Total Salary: 105000

Department: RK9, Total Salary: 60000

Запрос 3: Список всех Кафедр, у которых в названии присутствует слово «Кафедра», и список работающих в них Преподавателей.

Checking departments:

Department: Кафедра U5

Department: RK9

Department: IU4

Departments containing 'Кафедра' in the name:

Department: Кафедра U5

Department: Кафедра U5

- Professor: Ivanov

- Professor: Petrov