ПМ.02 Разработка и администрирование баз данных
МДК.02.02 Технология разработки и защиты баз данных
Тема 2.1 Проектирование и реализация баз данных

Лекция 13.1

SELECT SQL: Соединения

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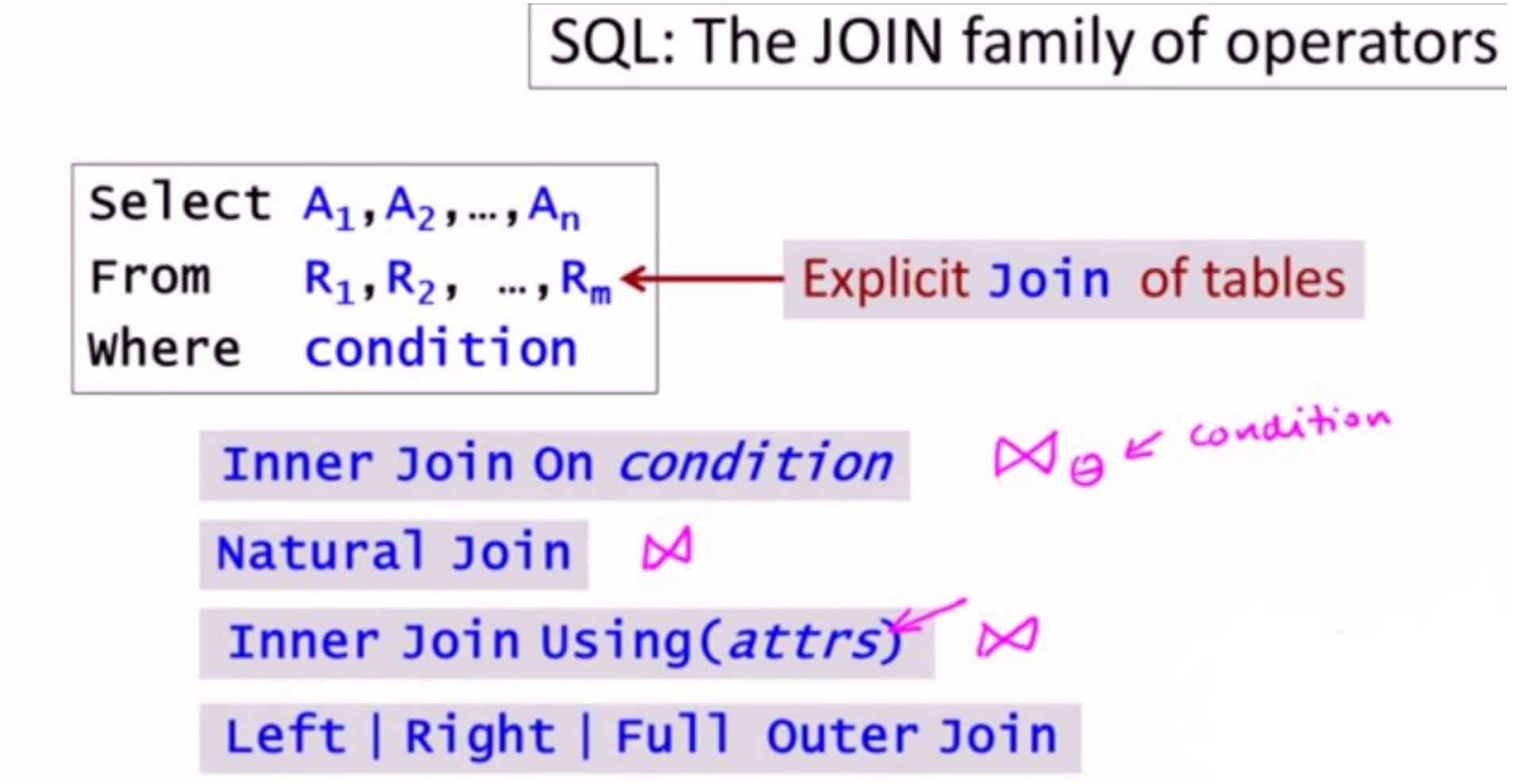
SQL

The JOIN family of operators

Jennifer Widom

Структура оператора SELECT: соединения



Базовый пример: БД

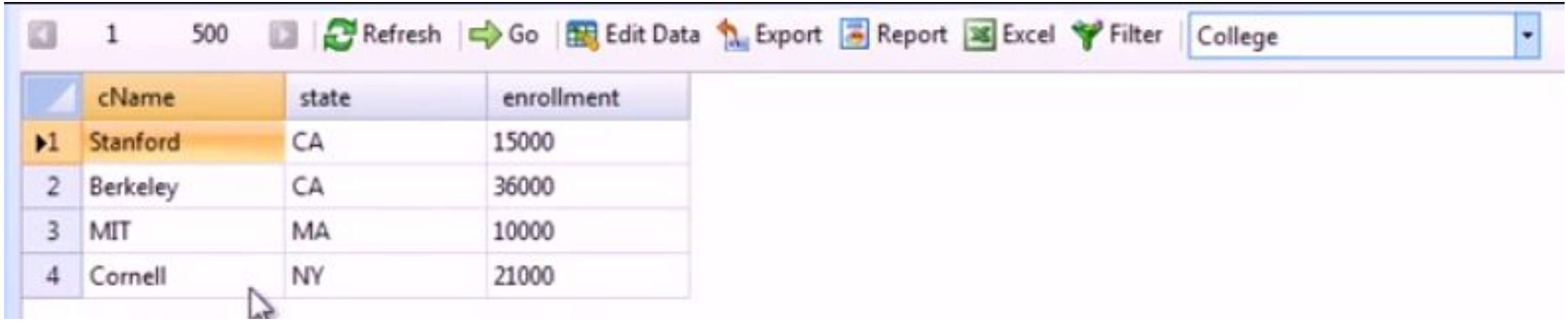
Demo: simple college admissions database

College(cName,state,enrollment)

Student(sID,sName,GPA,sizeHS)

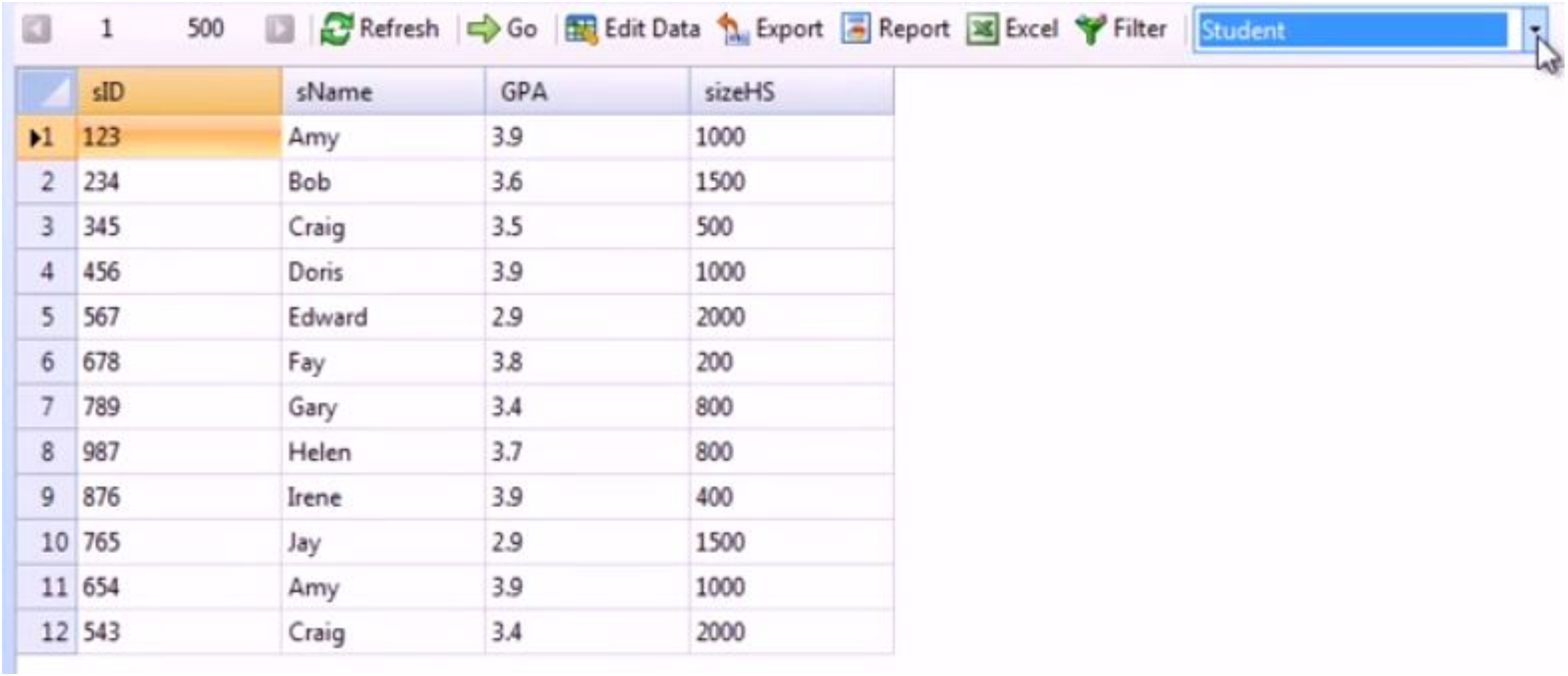
Apply(sID,cName,major,decision)

Базовый пример: таблица College



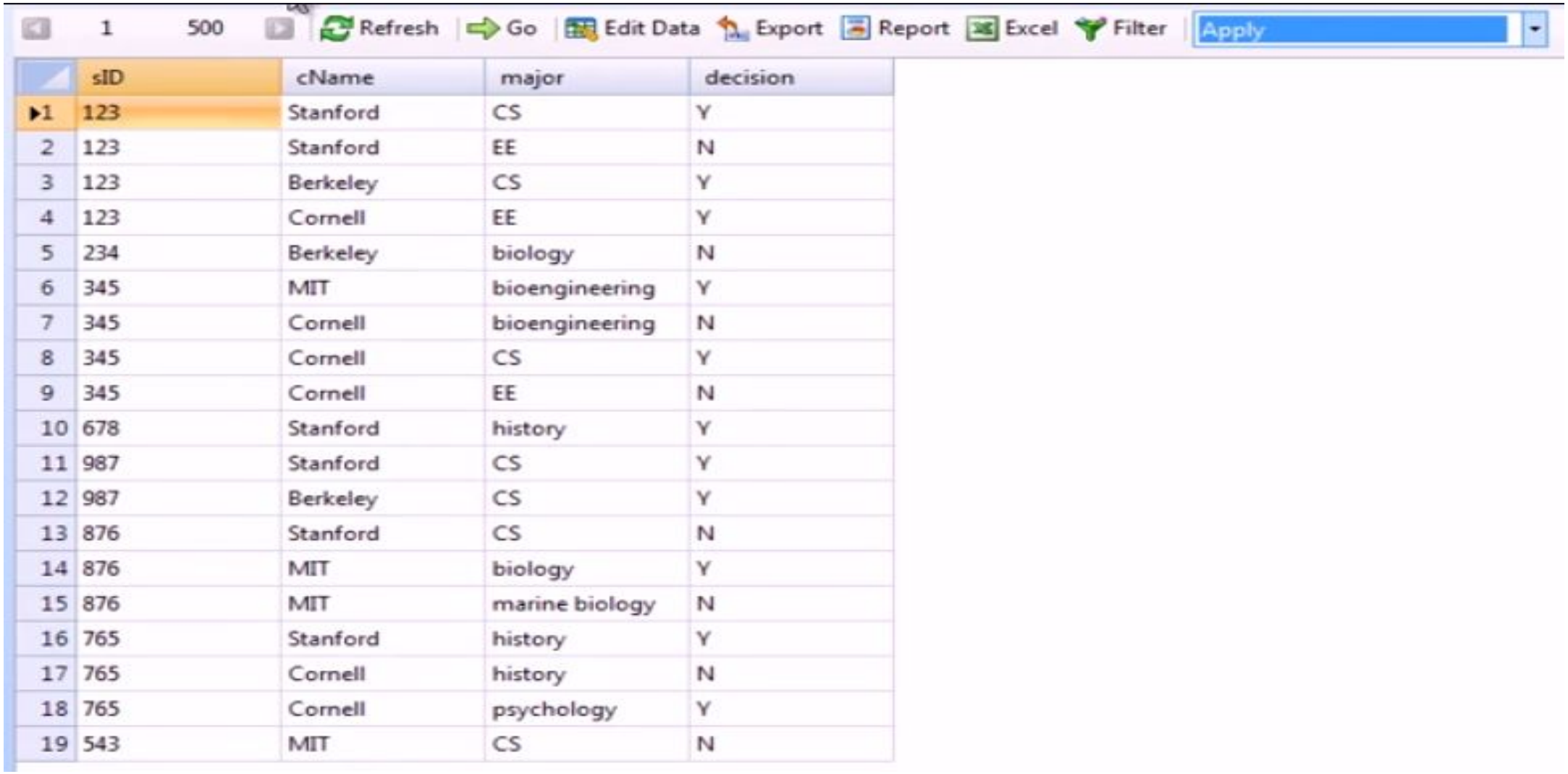
	cName	state	enrollment
▶1	Stanford	CA	15000
2	Berkeley	CA	36000
3	MIT	MA	10000
4	Cornell	NY	21000

Базовый пример: таблица Student



	sID	sName	GPA	sizeHS
1	123	Amy	3.9	1000
2	234	Bob	3.6	1500
3	345	Craig	3.5	500
4	456	Doris	3.9	1000
5	567	Edward	2.9	2000
6	678	Fay	3.8	200
7	789	Gary	3.4	800
8	987	Helen	3.7	800
9	876	Irene	3.9	400
10	765	Jay	2.9	1500
11	654	Amy	3.9	1000
12	543	Craig	3.4	2000

Базовый пример: таблица Apply



	sID	cName	major	decision
▶1	123	Stanford	CS	Y
2	123	Stanford	EE	N
3	123	Berkeley	CS	Y
4	123	Cornell	EE	Y
5	234	Berkeley	biology	N
6	345	MIT	bioengineering	Y
7	345	Cornell	bioengineering	N
8	345	Cornell	CS	Y
9	345	Cornell	EE	N
10	678	Stanford	history	Y
11	987	Stanford	CS	Y
12	987	Berkeley	CS	Y
13	876	Stanford	CS	N
14	876	MIT	biology	Y
15	876	MIT	marine biology	N
16	765	Stanford	history	Y
17	765	Cornell	history	N
18	765	Cornell	psychology	Y
19	543	MIT	CS	N

Запрос 1.1: вывести список студентов и их специальность

```
1   select distinct sName, major
2   from Student, Apply
3   where Student.sID = Apply.sID;
```

Output

SQL: 1:select distinct sName, major from Student, Apply

	sName	major
▶1	Amy	CS
2	Amy	EE
3	Bob	biology
4	Craig	CS
5	Craig	EE
6	Craig	bioengineering
7	Fay	history
8	Helen	CS
9	Irene	CS
10	Irene	biology
11	Irene	marine biology
12	Jay	history

```
1   select distinct sName, major
2   from Student inner join Apply
3   on Student.sID = Apply.sID;
```

```
1   select distinct sName, major
2   from Student join Apply
3   on Student.sID = Apply.sID;
```

Запрос 1.2: вывести список студентов, их GPA и решение о зачислении в колледж Стенфорда на специальность CS при условии, что средняя школа имела менее 1000 обучающихся

```
1  select sname, GPA, decision
2  from Student, Apply
3  where Student.sID = Apply.sID
4    and sizeHS < 1000 and major = 'CS' and cname = 'Stanford';
```

Output

SQL: 1:select sname, GPA, decision from Student, Apply where Student.sID = Apply.sID and s...

	sName	GPA	decision
▶1	Helen	3.7	Y
2	Irene	3.9	N

```
1  select sName, GPA
2  from Student join Apply
3  on Student.sID = Apply.sID
4  where sizeHS < 1000 and major = 'CS' and cName = 'Stanford';
```

```
1  select sName, GPA
2  from Student join Apply
3  on Student.sID = Apply.sID
4  and sizeHS < 1000 and major = 'CS' and cName = 'Stanford';
```

Запрос 1.3: вывести список абитуриентов с указанием идентификатора, имени, GPA, колледжа, куда поданы документы, и количества обучающихся в нем

```
1  select Apply.sID, sName, GPA, Apply.cName, enrollment
2  from Apply, Student, College
3  where Apply.sID = Student.sID and Apply.cName = College.cName;
```

Output

SQL: 1:select Apply.sID, sName, GPA, Apply.cName, enrollment from Apply, Student,

	sid	sname	gpa	cname	enrollment
▶1	123	Amy	3.9	Stanford	15000
2	123	Amy	3.9	Cornell	21000
3	123	Amy	3.9	Berkeley	36000
4	123	Amy	3.9	Stanford	15000
5	234	Bob	3.6	Berkeley	36000
6	345	Craig	3.5	MIT	10000
7	345	Craig	3.5	Cornell	21000
8	345	Craig	3.5	Cornell	21000
9	345	Craig	3.5	Cornell	21000
10	543	Craig	3.4	MIT	10000
11	678	Fay	3.8	Stanford	15000
12	765	Jay	2.9	Cornell	21000
13	765	Jay	2.9	Stanford	15000

```
1  select Apply.sID, sName, GPA, Apply.cName, enrollment
2  from Apply join Student join College
3  on Apply.sID = Student.sID and Apply.cName = College.cName;
```

Output

Type	Info	Description
Error	1:select Apply.sID, sName, GPA, Apply.cName, en...	ERROR: 42601: syntax error at end of input
Summary	Total:1 Success:0 Failed:1	

```
1  select Apply.sID, sName, GPA, Apply.cName, enrollment
2  from (Apply join Student on Apply.sID = Student.sID) join College
3  on Apply.cName = College.cName;
```

Запрос 1.1 (модификация 1): вывести список студентов и их специальность

```
1   select distinct sName, major
2   from Student inner join Apply
3   on Student.sID = Apply.sID;
```

```
1   select distinct sName, major
2   from Student natural join Apply;
```

Output

SQL: 1:select distinct sName, major from Student natur

	sname	major
▶1	Helen	CS
2	Jay	history
3	Jay	psychology
4	Irene	CS
5	Craig	bioengineering
6	Irene	marine biology
7	Amy	EE
8	Craig	EE
9	Bob	biology
10	Craig	CS
11	Amy	CS
12	Irene	biology

```
1   select distinct sName, major
2   from Student join Apply
3   on Student.sID = Apply.sID;
```

Запрос 1.4: вывести полную информацию о студентах, название колледжа, специальность

```
1  select *
2  from Student natural join Apply;
```

Output

SQL: 1:select * from Student natural join Apply

	sid	sname	gpa	sizehs	cname	major	decision
▶1	123	Amy	3.9	1000	Cornell	EE	Y
2	123	Amy	3.9	1000	Berkeley	CS	Y
3	123	Amy	3.9	1000	Stanford	EE	N
4	123	Amy	3.9	1000	Stanford	CS	Y
5	234	Bob	3.6	1500	Berkeley	biology	N
6	345	Craig	3.5	500	Cornell	EE	N
7	345	Craig	3.5	500	Cornell	CS	Y
8	345	Craig	3.5	500	Cornell	bioengineering	N
9	345	Craig	3.5	500	MIT	bioengineering	Y
10	678	Fay	3.8	200	Stanford	history	Y
11	987	Helen	3.7	800	Berkeley	CS	Y
12	987	Helen	3.7	800	Stanford	CS	Y
13	876	Irene	3.9	400	MIT	marine biology	N

Запрос 1.4: вывести список идентификаторов студентов, подававших заявление на специальность

```
1  select distinct sID
2  from Student natural join Apply;
```

Output

SQL: 1:select distinct sID from Student natural join App

	sid
1	876
2	678
3	123
4	765
5	543
6	345
7	234
8	987

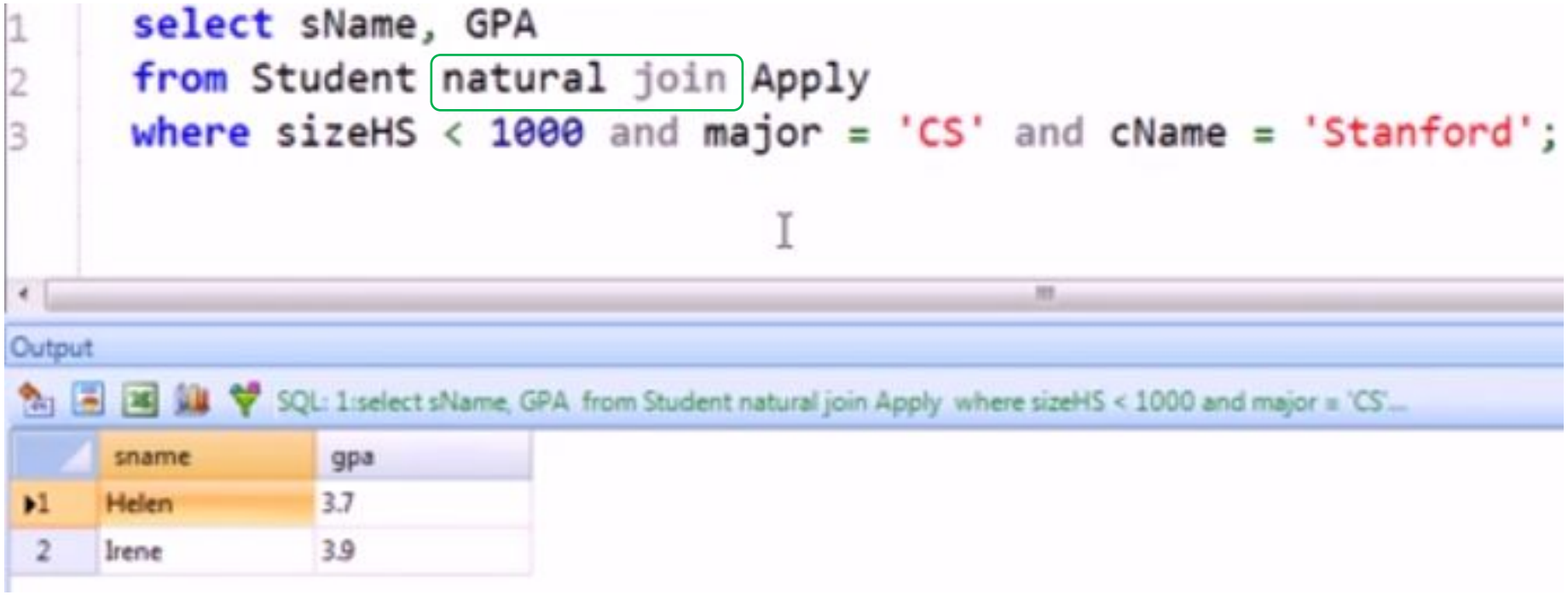
```
1  select distinct sID
2  from Student, Apply;
```

Output

Type	Info	Description
Error	1:select distinct sID from Student, Apply	ERROR: 42702: column reference "sid" is ambiguous
Summary	Total:1 Success:0 Failed:1	

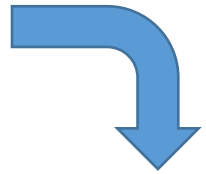
Запрос 1.2 (модификация 1): вывести список студентов, их GPA и решение о зачислении в колледж Стенфорда на специальность CS при условии, что средняя школа имела менее 1000 обучающихся

```
1   select sName, GPA
2   from Student join Apply
3   on Student.sID = Apply.sID
4   where sizeHS < 1000 and major = 'CS' and cName = 'Stanford';
```



Запрос 1.2 (модификация 2): вывести список студентов, их GPA и решение о зачислении в колледж Стенфорда на специальность CS при условии, что средняя школа имела менее 1000 обучающихся

```
1   select sName, GPA
2   from Student join Apply
3   on Student.sID = Apply.sID
4   where sizeHS < 1000 and major = 'CS' and cName = 'Stanford';
```



```
1   select sName, GPA
2   from Student join Apply using(sID)
3   where sizeHS < 1000 and major = 'CS' and cName = 'Stanford';
```

Output

SQL: 1:select sName, GPA from Student natural join Apply where sizeHS < 1000 and major = 'CS'...

	sname	gpa
▶1	Helen	3.7
2	Irene	3.9

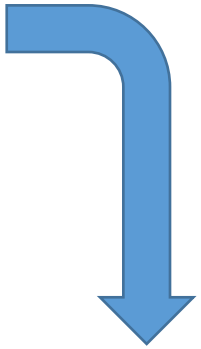
Запрос 1.5: вывести все пары студентов с одинаковым GPA

```
1   select S1.sID, S1.sName, S1.GPA, S2.sID, S2.sName, S2.GPA
2   from Student S1, Student S2
3   where S1.GPA = S2.GPA and S1.sID < S2.sID;
```

Output

SQL: 1:select S1.sID, S1.sName, S1.GPA, S2.sID, S2.sName, S2.GPA from Student S1, Student S2 ...

	sID	sName	GPA	sID1	sName1	GPA1
▶1	123	Amy	3.9	456	Doris	3.9
2	123	Amy	3.9	876	Irene	3.9
3	123	Amy	3.9	654	Amy	3.9
4	456	Doris	3.9	876	Irene	3.9
5	456	Doris	3.9	654	Amy	3.9
6	567	Edward	2.9	765	Jay	2.9
7	654	Amy	3.9	876	Irene	3.9
8	543	Craig	3.4	789	Gary	3.4



```
1   select S1.sID, S1.sName, S1.GPA, S2.sID, S2.sName, S2.GPA
2   from Student S1 join Student S2 using(GPA)
3   where S1.GPA = S2.GPA and S1.sID < S2.sID;
```

Запрос 1.5 (модификация 1): вывести все пары студентов с одинаковым GPA

```
1   select S1.sID, S1.sName, S1.GPA, S2.sID, S2.sName, S2.GPA
2   from Student S1 join Student S2 using(GPA)
3   where S1.GPA = S2.GPA and S1.sID < S2.sID;
```

```
1   select S1.sID, S1.sName, S1.GPA, S2.sID, S2.sName, S2.GPA
2   from Student S1 join Student S2 using(GPA)
3   on S1.sID < S2.sID;
```

Output

Type	Info	Description
Error	1:select S1.sID, S1.sName, S1.GPA, S2.sID, S2.sNa...	ERROR: 42601: syntax error at or near "on"
Summary	Total:1 Success:0 Failed:1	

Запрос 1.6: натуральное соединение таблицы с собой

```
1   select *
2   from Student S1 natural join Student S2;
```

Output

SQL: 1:select * from Student S1 natural join Student S2

	sid	sname	gpa	sizehs
▶1	123	Amy	3.9	1000
2	234	Bob	3.6	1500
3	345	Craig	3.5	500
4	456	Doris	3.9	1000
5	543	Craig	3.4	2000
6	567	Edward	2.9	2000
7	654	Amy	3.9	1000
8	678	Fay	3.8	200
9	765	Jay	2.9	1500
10	789	Gary	3.4	800
11	876	Irene	3.9	400
12	987	Helen	3.7	800

```
1   select *
2   from Student;
```

Output

SQL: 1:select * from Student

	sid	sname	gpa	sizehs
▶1	123	Amy	3.9	1000
2	234	Bob	3.6	1500
3	345	Craig	3.5	500
4	456	Doris	3.9	1000
5	567	Edward	2.9	2000
6	678	Fay	3.8	200
7	789	Gary	3.4	800
8	987	Helen	3.7	800
9	876	Irene	3.9	400
10	765	Jay	2.9	1500
11	654	Amy	3.9	1000
12	543	Craig	3.4	2000

Запрос 1.7: вывести список студентов, не подававших заявление на специальность

```
1  select sName, sID, cName, major
2  from Student inner join Apply using(sID);
```

Output

SQL: 1:select sName, sID, cName, major from Student inner join Apply us

	sname	sid	cname	major
▶1	Amy	123	Cornell	EE
2	Amy	123	Berkeley	CS
3	Amy	123	Stanford	EE
4	Amy	123	Stanford	CS
5	Bob	234	Berkeley	biology
6	Craig	345	Cornell	EE
7	Craig	345	Cornell	CS
8	Craig	345	Cornell	bioengineering
9	Craig	345	MIT	bioengineering
10	Fay	678	Stanford	history
11	Helen	987	Berkeley	CS
12	Helen	987	Stanford	CS
13	Irene	876	MIT	marine biology

```
1  select sName, sID, cName, major
2  from Student left outer join Apply using(sID);
```

NULL-значения

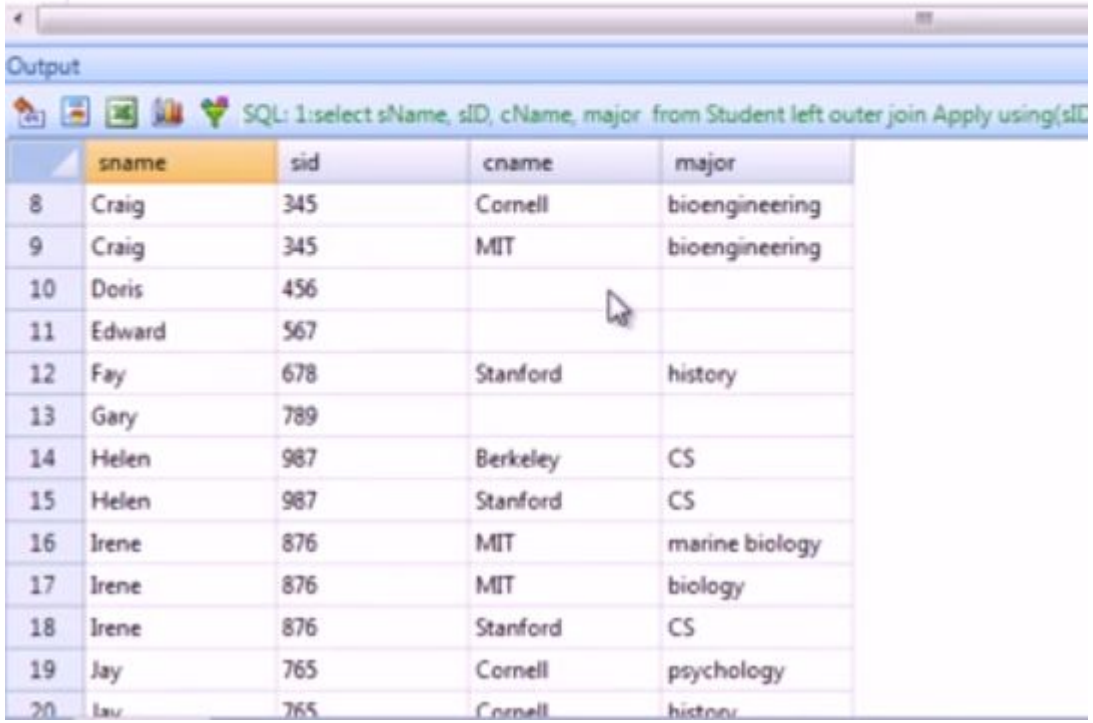
Output

SQL: 1:select sName, sID, cName, major from Student left outer join Apply using(sID

	sname	sid	cname	major
8	Craig	345	Cornell	bioengineering
9	Craig	345	MIT	bioengineering
10	Doris	456		
11	Edward	567		
12	Fay	678	Stanford	history
13	Gary	789		
14	Helen	987	Berkeley	CS
15	Helen	987	Stanford	CS
16	Irene	876	MIT	marine biology
17	Irene	876	MIT	biology
18	Irene	876	Stanford	CS
19	Jay	765	Cornell	psychology
20	Jay	765	Cornell	history

Запрос 1.7 (модификация 1): вывести список студентов, не подававших заявление на специальность

```
1  select sName, sID, cName, major
2  from Student left outer join Apply using(sID);
```



	sname	sid	cname	major
8	Craig	345	Cornell	bioengineering
9	Craig	345	MIT	bioengineering
10	Doris	456		
11	Edward	567		
12	Fay	678	Stanford	history
13	Gary	789		
14	Helen	987	Berkeley	CS
15	Helen	987	Stanford	CS
16	Irene	876	MIT	marine biology
17	Irene	876	MIT	biology
18	Irene	876	Stanford	CS
19	Jay	765	Cornell	psychology
20	Jay	765	Cornell	history

```
1  select sName, sID, cName, major
2  from Student left join Apply using(sID);
```

```
1  select sName, sID, cName, major
2  from Student natural left outer join Apply;
```

Запрос 1.7 (модификация 2): вывести список студентов, не подававших заявление на специальность

```
1  select sName, sID, cName, major
2  from Student natural left outer join Apply;
```

```
1  select sName, Student.sID, cName, major
2  from Student, Apply
3  where Student.sID = Apply.sID
4  union
5  select sName, sID, NULL, NULL
6  from Student
7  where sID not in (select sID from Apply);
```

Output

SQL: 1:select sName, Student.sID, cName, major from Student, Apply whe

	sname	sid	cname	major
15	Amy	654		
16	Helen	987	Stanford	CS
17	Fay	678	Stanford	history
18	Craig	345	Cornell	CS
19	Craig	345	Cornell	EE
20	Jay	765	Cornell	psychology
21	Jay	765	Stanford	history
22	Edward	567		
23	Jay	765	Cornell	history

Запрос 1.8 (вставка данных)

```
1  insert into Apply values (321, 'MIT', 'history', 'N');
2  insert into Apply values (321, 'MIT', 'psychology', 'Y');
```

Output

Type	Info	Description
Success	1:insert into Apply values (321, 'MIT', 'history', 'N')	1 rows affected
Success	2:insert into Apply values (321, 'MIT', 'psychology'...	1 rows affected
Summary	Total:2 Success:2 Failed:0	

1 500 Refresh Go Edit Data Export Report Excel Filter apply

	sid	cname	major	decision
▶1	123	Stanford	CS	Y
2	123	Stanford	EE	N
3	123	Berkeley	CS	Y
4	123	Cornell	EE	Y
5	234	Berkeley	biology	N
6	345	MIT	bioengineering	Y
7	345	Cornell	bioengineering	N
8	345	Cornell	CS	Y
9	345	Cornell	EE	N
10	678	Stanford	history	Y
11	987	Stanford	CS	Y
12	987	Berkeley	CS	Y
13	876	Stanford	CS	N
14	876	MIT	biology	Y
15	876	MIT	marine biology	N
16	765	Stanford	history	Y
17	765	Cornell	history	N
18	765	Cornell	psychology	Y
19	543	MIT	CS	N
20	321	MIT	history	N
21	321	MIT	psychology	Y

Запрос 1.9: вывести список студентов, подававших заявление на специальность

```
1  select sName, sID, cName, major
2  from Apply natural left outer join Student;
```

Output

SQL: 1:select sName, sID, cName, major from Apply natural left outer join Stud

	sname	sid	cname	major
10	Fay	678	Stanford	history
11	Helen	987	Stanford	CS
12	Helen	987	Berkeley	CS
13	Irene	876	Stanford	CS
14	Irene	876	MIT	biology
15	Irene	876	MIT	marine biology
16	Jay	765	Stanford	history
17	Jay	765	Cornell	history
18	Jay	765	Cornell	psychology
19	Craig	543	MIT	CS
20		321	MIT	history
21		321	MIT	psychology

Запрос 1.10: вывести список всех студентов, подававших и не подававших заявление на специальность

```
1   select sName, sID, cName, major
2   from Student full outer join Apply using(sID);
```

	sname	sid	cname	major
1	Amy	123	Stanford	CS
2	Amy	123	Stanford	EE
3	Amy	123	Berkeley	CS
4	Amy	123	Cornell	EE
5	Bob	234	Berkeley	biology
6		321	MIT	psychology
7		321	MIT	history
8	Craig	345	Cornell	CS
9	Craig	345	Cornell	EE
10	Craig	345	MIT	bioengineering
11	Craig	345	Cornell	bioengineering
12	Doris	456		
13	Craig	543	MIT	CS

	sname	sid	cname	major
14	Edward	567		
15	Amy	654		
16	Fay	678	Stanford	history
17	Jay	765	Stanford	history
18	Jay	765	Cornell	history
19	Jay	765	Cornell	psychology
20	Gary	789		
21	Irene	876	MIT	biology
22	Irene	876	MIT	marine biology
23	Irene	876	Stanford	CS
24	Helen	987	Stanford	CS
25	Helen	987	Berkeley	CS

Запрос 1.10 (модификация 1): вывести список всех студентов, подававших и не подававших заявление на специальность

```
1  select sName, sID, cName, major
2  from Student left outer join Apply using(sID)
3  union
4  select sName, sID, cName, major
5  from Student right outer join Apply using(sID);
```

Output

SQL: 1:select sName, sID, cName, major from Student left outer join Apply using(sID)

	sname	sid	cname	major
▶1	Craig	345	MIT	bioengineering
2	Amy	123	Cornell	EE
3	Gary	789		
4	Bob	234	Berkeley	biology
5	Irene	876	MIT	biology
6	Doris	456		
7		321	MIT	psychology
8	Irene	876	MIT	marine biology
9	Craig	543	MIT	CS
10	Irene	876	Stanford	CS

Запрос 1.10 (модификация 2): вывести список всех студентов, подававших и не подававших заявление на специальность

```
1   select sName, Student.sID, cName, major
2   from Student, Apply
3   where Student.sID = Apply.sID
4   union
5   select sName, sID, NULL, NULL
6   from Student
7   where sID not in (select sID from Apply)
8   union
9   select NULL, sID, cName, major
10  from Apply
11  where sID not in (select sID from Student);
```

Output

SQL: 1:select sName, Student.sID, cName, major from Student, Apply where

	sname	sid	cname	major
▶1	Craig	345	MIT	bioengineering
2	Amy	123	Cornell	EE
3	Gary	789		
4	Bob	234	Berkeley	biology

Список источников

1. http://www.sql.ru/docs/sql/u_sql/ - Martin Gruber. Understanding SQL (главы 3-5, 7, 8, 9, 10, 11, 12, 13, 14)
2. https://class.stanford.edu/courses/DB/SQL/SelfPaced/about - Databases: SQL (parts:

✔ The JOIN family operators

СПАСИБО ЗА ВНИМАНИЕ