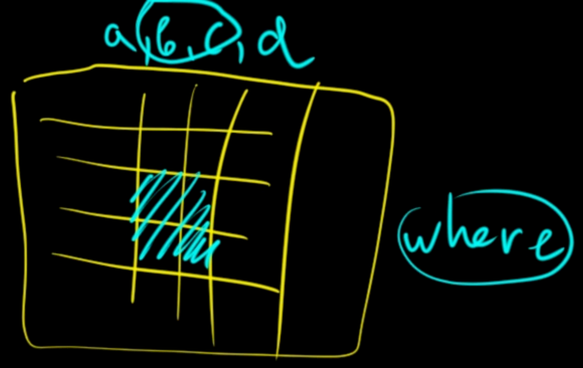



| id | group |
|---|---|
| | FS7 |
| | <null> |

null / string

normalization

| id | name | dob | groupp |
|---|---|---|---|
| 2 | Alex | 1976 | FS4 |
| 1 | Jim | 1973 | FS3 |
| 3 | Alex | 1975 | FS5 |
| 5 | JACK | 1999 | FS5 |
| 8 | MArie | 1977 | <null> |

startdak

teacher name

FS5-online

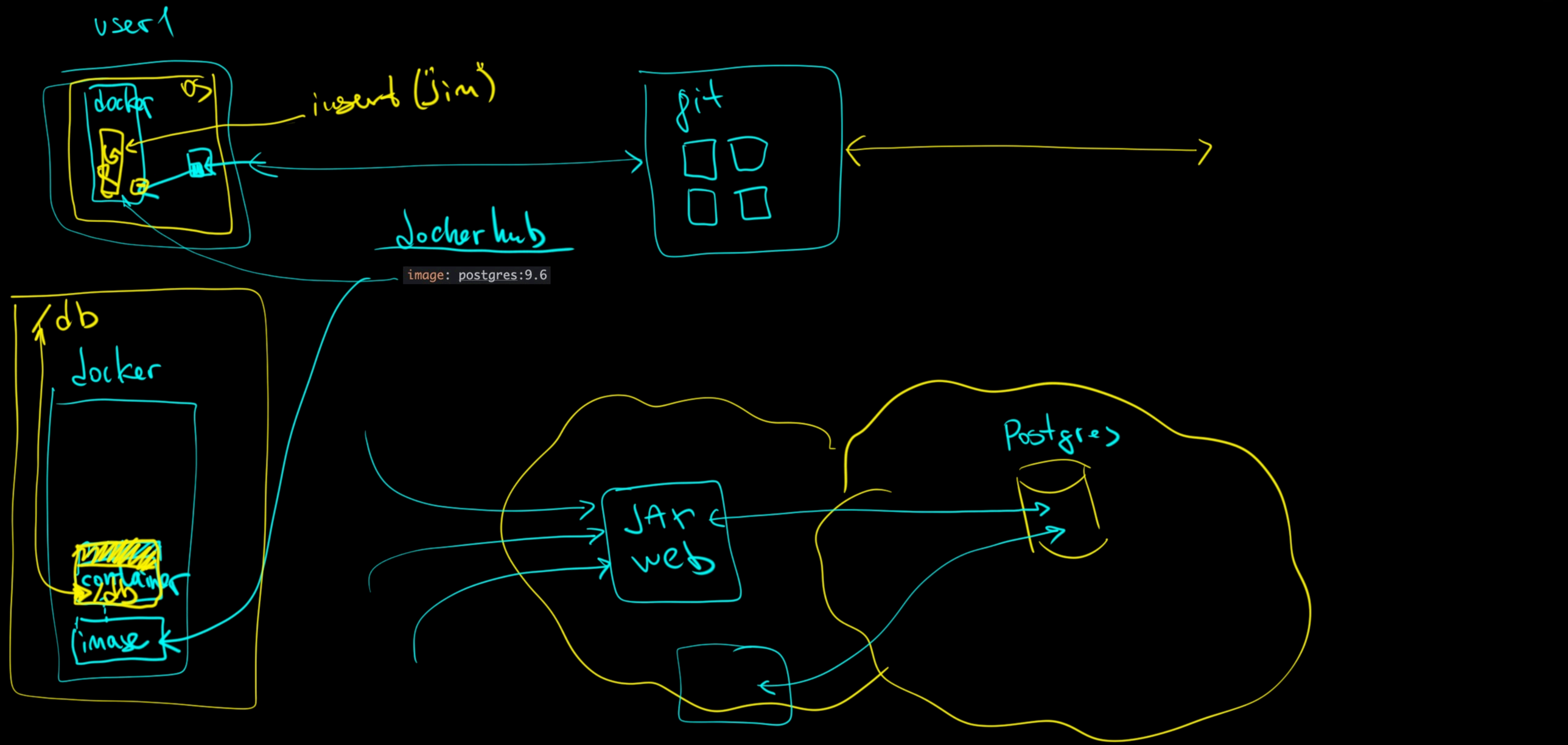
9 sergio

2000 FS3 FS7

entity #1

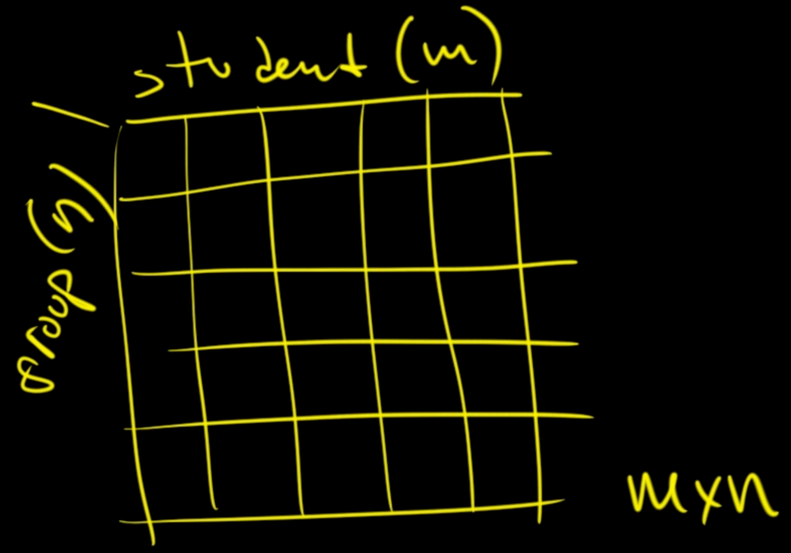
entity #2

new data → col >> tab ?


user 1
docker
insert ("Jim")
git
docker hub
image: postgres:9.6
db
docker
container
db
image
JAR
web
Postgres

m n

```
select * from student, groupp;
```




cartesian product

student × groupp

List(1,2) × List(A,B,C)

(1,A)
(1,B)
(1,C)
(2,A)
(2,B)
(2,C)
(3,A)
(3,B)
(3,C)

ANSI SQL 92

ISO

| id | name | dob | group_id |
|---|---|---|---|
| 9 | Jim | 1942 | 1 |
| 10 | Jack | 1981 | 2 |
| 11 | Mary | 2000 | 3 |
| 12 | Helen | 2002 | 5 |
| 13 | Nate | 2001 | 5 |
| 14 | Jacky | 2002 | 5 |
| 15 | Olha | 2011 | <null> |
| 16 | Alex | 1975 | 6 |
| 17 | Alex | 1975 | 4 |
| 18 | Tom | 2020 | 7 |
| 19 | Bill | 2015 | <null> |

| id | name | start |
|---|---|---|
| 1 | FS1 | 2023-03-01 |
| 2 | FS2 | 2023-04-01 |
| 3 | FS3 | 2023-05-01 |
| 4 | FS4 | 2023-06-01 |
| 5 | FS5 | 2023-07-01 |
| 6 | FS6 | 2023-08-01 |
| 7 | FS7 | 2023-09-01 |
| 8 | FS8 | 2024-05-09 |

f(s,g) => bool

```
select *
from student s
join groupp g on s.group_id = g.id;
```

=

```
select * from student s, group g
where s.group = g.id
```

| s.id | s.name | dob | group_id | g.id | g.name | start |
|---|---|---|---|---|---|---|
| 9 | Jim | 1942 | 1 | 1 | FS1 | 2023-03-01 |
| 10 | Jack | 1981 | 2 | 2 | FS2 | 2023-04-01 |
| 11 | Mary | 2000 | 3 | 3 | FS3 | 2023-05-01 |
| 17 | Alex | 1975 | 4 | 4 | FS4 | 2023-06-01 |
| 14 | Jacky | 2002 | 5 | 5 | FS5 | 2023-07-01 |
| 13 | Nate | 2001 | 5 | 5 | FS5 | 2023-07-01 |
| 12 | Helen | 2002 | 5 | 5 | FS5 | 2023-07-01 |
| 16 | Alex | 1975 | 6 | 6 | FS6 | 2023-08-01 |
| 18 | Tom | 2020 | 7 | 7 | FS7 | 2023-09-01 |

LEFT

RIGHT

ISO.... f(s,g) => bool

LEFT 100%

```
select s.name, g.name, g.start
from student s
left outer join groupp g on s.group_id = g.id;
```

| s.name | g.name | start |
|---|---|---|
| Jim | FS1 | 2023-03-01 |
| Jack | FS2 | 2023-04-01 |
| Mary | FS3 | 2023-05-01 |
| Alex | FS4 | 2023-06-01 |
| Jacky | FS5 | 2023-07-01 |
| Nate | FS5 | 2023-07-01 |
| Helen | FS5 | 2023-07-01 |
| Alex | FS6 | 2023-08-01 |
| Tom | FS7 | 2023-09-01 |
| Bill | <null> | <null> |
| Olha | <null> | <null> |

```
select s.name, g.name, g.start
from student s
right outer join groupp g on s.group_id = g.id;
```

| s.name | g.name | start |
|---|---|---|
| Jim | FS1 | 2023-03-01 |
| Jack | FS2 | 2023-04-01 |
| Mary | FS3 | 2023-05-01 |
| Alex | FS4 | 2023-06-01 |
| Jacky | FS5 | 2023-07-01 |
| Nate | FS5 | 2023-07-01 |
| Helen | FS5 | 2023-07-01 |
| Alex | FS6 | 2023-08-01 |
| Tom | FS7 | 2023-09-01 |
| <null> | FS8 | 2024-05-09 |

```
select s.name, g.name, g.start
from student s
full outer join groupp g on s.group_id = g.id;
```

| s.name | g.name | start |
|---|---|---|
| Jim | FS1 | 2023-03-01 |
| Jack | FS2 | 2023-04-01 |
| Mary | FS3 | 2023-05-01 |
| Alex | FS4 | 2023-06-01 |
| Jacky | FS5 | 2023-07-01 |
| Nate | FS5 | 2023-07-01 |
| Helen | FS5 | 2023-07-01 |
| Alex | FS6 | 2023-08-01 |
| Tom | FS7 | 2023-09-01 |
| <null> | FS8 | 2024-05-09 |
| Bill | <null> | <null> |
| Olha | <null> | <null> |

```
select s.name, g.name, g.start
from student s
inner join groupp g on s.group_id = g.id;
```

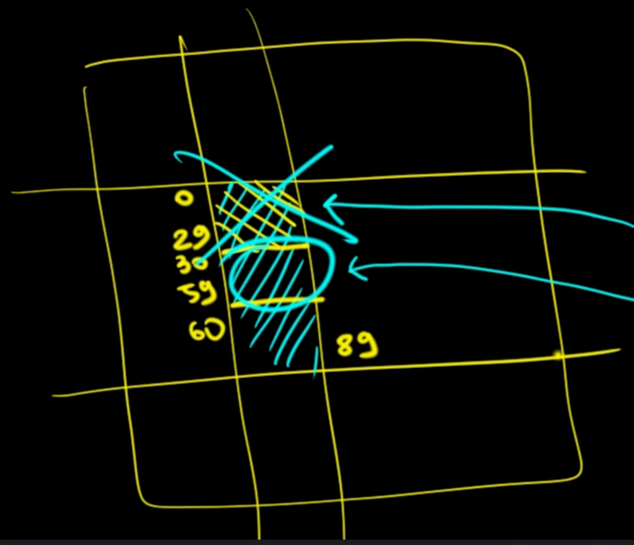
| s.name | g.name | start |
|---|---|---|
| Jim | FS1 | 2023-03-01 |
| Jack | FS2 | 2023-04-01 |
| Mary | FS3 | 2023-05-01 |
| Alex | FS4 | 2023-06-01 |
| Jacky | FS5 | 2023-07-01 |
| Nate | FS5 | 2023-07-01 |
| Helen | FS5 | 2023-07-01 |
| Alex | FS6 | 2023-08-01 |
| Tom | FS7 | 2023-09-01 |

```
select s.name, g.name, g.start
from student s
cross join groupp g
```

S x g = 88 rows

| s.name | g.name | start |
|---|---|---|
| Jim | FS1 | 2023-03-01 |
| Jack | FS1 | 2023-03-01 |
| Mary | FS1 | 2023-03-01 |
| Helen | FS1 | 2023-03-01 |
| Nate | FS1 | 2023-03-01 |
| Jacky | FS1 | 2023-03-01 |
| Olha | FS1 | 2023-03-01 |
| Alex | FS1 | 2023-03-01 |
| Alex | FS1 | 2023-03-01 |
| Tom | FS1 | 2023-03-01 |
| Bill | FS1 | 2023-03-01 |
| Jim | FS2 | 2023-04-01 |
| Jack | FS2 | 2023-04-01 |
| Mary | FS2 | 2023-04-01 |
| Helen | FS2 | 2023-04-01 |

```
alter table student
    add constraint student_fk1
        foreign key (group_id) references groupp(id);
```




OFFSET 30 ≡ skip
LIMIT 30 ≡ take

```
select s.name, g.name, g.start
from student s
inner join groupp g on s.group_id = g.id
offset 2
limit 2
```

~~noSQL~~ non-relational database

- no PRIMARY KEY
- no FOREIGN KEY
- no UNIQUE

Pagination : N size

OFFSET (N-1)*size
LIMIT size

```
select * from groupp;
```