1. L_{20}

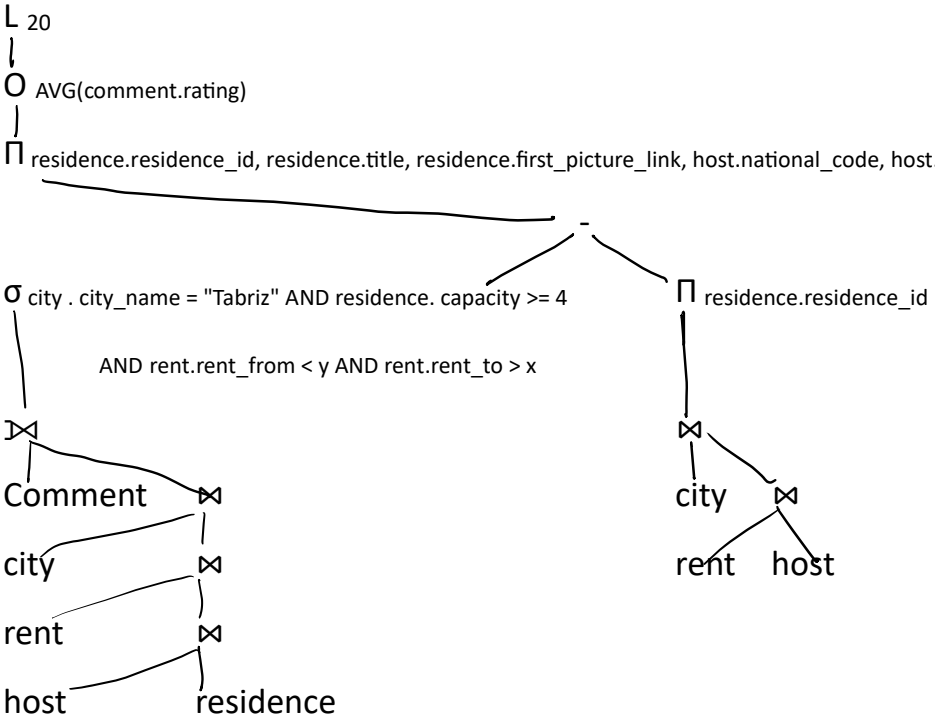
$O_{AVG(comment.rating)}$

$\Pi_{residence.residence\_id,\ residence.title,\ residence.first\_picture\_link,\ host.national\_code,\ host.first\_name,\ host.last\_name}$

$(\sigma_{city\ .\ city\_name = "Tabriz"\ AND\ residence.\ capacity >= 4\ AND\ rent.rent\_from < y\ AND\ rent.rent\_to > x}$

$(residence \bowtie_{residence.\ host\_id = host\ .\ national\_code} host \bowtie_{rent\ .\ residence\_id = residence.\ residence\_id} rent \bowtie_{city\ .\ city\_id = residence.city\_id} city \bowtie_{residence.residence\_id = comment.residence\_id} comment)$

- $\Pi_{residence.residence\_id}\ \sigma_{rent.rent\_from < y\ AND\ rent.rent\_to > x}\ (residence \bowtie_{residence\ .\ host\_id = host\ .\ national\_code} host \bowtie_{rent\ .\ residence\_id = residence\ .\ residence\_id} rent \bowtie_{city\ .\ city\_id = residence.\ city\_id} city))$



2. L_{20}

OS_{20}

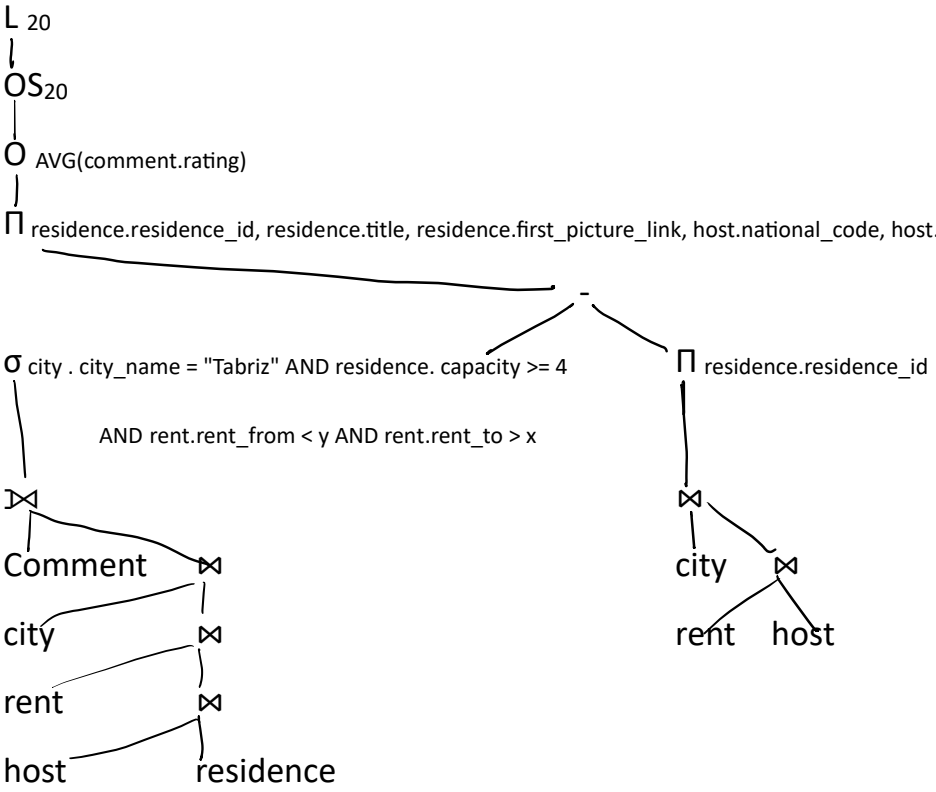
$O_{AVG(comment.rating)}$

$\Pi_{residence.residence\_id,\ residence.title,\ residence.first\_picture\_link,\ host.national\_code,\ host.first\_name,\ host.last\_name}$

$(\sigma_{city\ .\ city\_name = "Tabriz"\ AND\ residence.\ capacity >= 4\ AND\ rent.rent\_from < y\ AND\ rent.rent\_to > x}$

$(residence \bowtie_{residence.\ host\_id = host\ .\ national\_code} host \bowtie_{rent\ .\ residence\_id = residence.\ residence\_id} rent \bowtie_{city\ .\ city\_id = residence.city\_id} city \rtimes_{residence.residence\_id = comment.residence\_id} comment)$

- $\Pi_{residence.residence\_id}\ \sigma_{rent.rent\_from < y\ AND\ rent.rent\_to > x}(residence \bowtie_{residence\ .\ host\_id = host\ .\ national\_code} host \bowtie_{rent\ .\ residence\_id = residence\ .\ residence\_id} rent \bowtie_{city\ .\ city\_id = residence.\ city\_id} city))$



3. L_{20}

$O_{AVG(comment.rating)}$

$\Pi_{residence.residence\_id,\ residence.title,\ residence.first\_picture\_link,\ host.national\_code,\ host.first\_name,\ host.last\_name}$

$(\sigma_{city\ .\ city\_name = "Tabriz"\ AND\ residence.\ capacity >= 4\ AND\ rent.rent\_from < y\ AND\ rent.rent\_to > x}$

$(residence \bowtie_{residence.\ host\_id = host\ .\ national\_code} host \bowtie_{rent\ .\ residence\_id = residence.\ residence\_id} rent \bowtie_{city\ .\ city\_id = residence.city\_id} city \bowtie_{residence.residence\_id = comment.residence\_id} comment)$

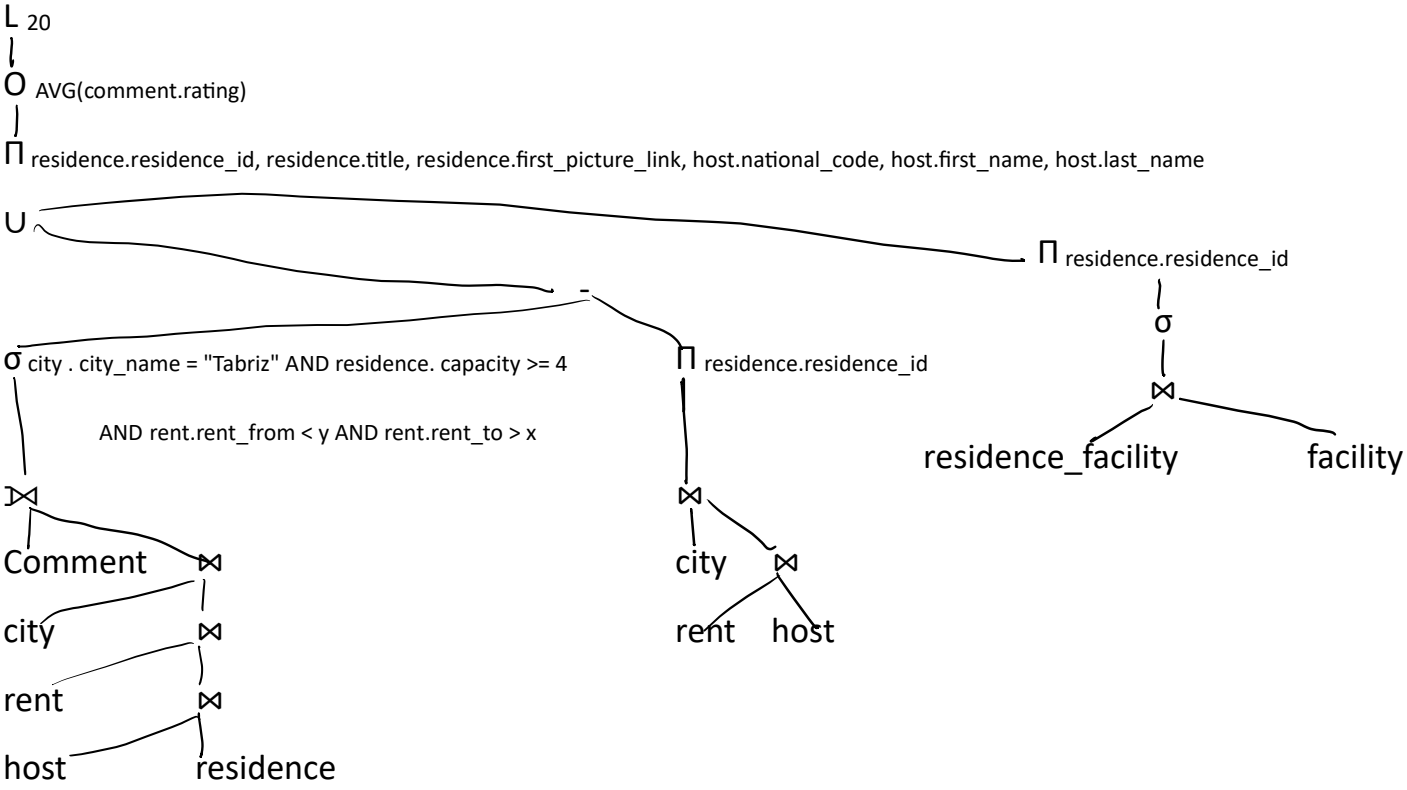
- $\Pi_{residence.residence\_id}\ \sigma_{rent.rent\_from < y\ AND\ rent.rent\_to > x}(residence \bowtie_{residence\ .\ host\_id = host\ .\ national\_code} host \bowtie_{rent\ .\ residence\_id = residence\ .\ residence\_id} rent \bowtie_{city\ .\ city\_id = residence.\ city\_id} city))$

$\cup$

$(\Pi_{residence.residence\_id}$

$\sigma_{residence\_facility.residence\_id = r.residence\_id\ AND(facility.facility\_name = 'free\ internet\ access'\ OR\ facility.facility\_name = 'dedicated\ parking'}$

$(residence\_facility \bowtie_{residence\_facility.residence\_facility\_id = facility.facility\_id} facility))$



4. L_{20}

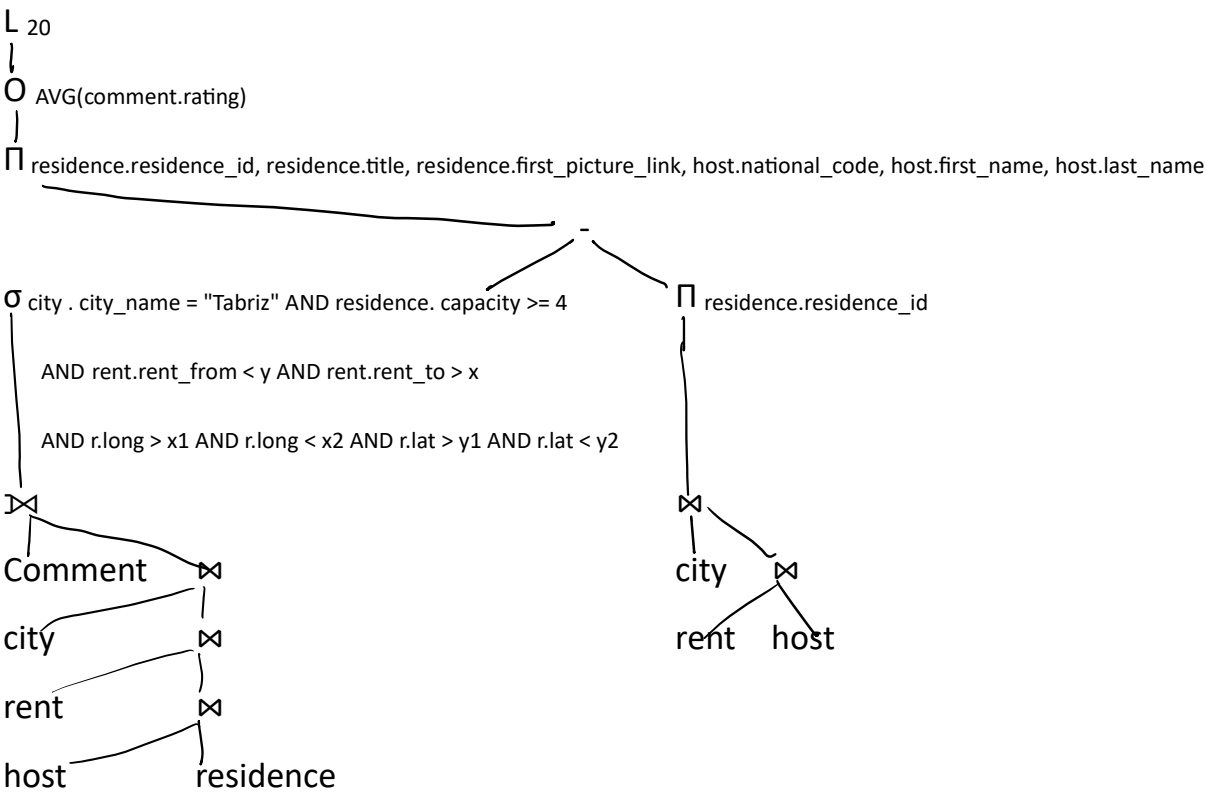
$O_{AVG(comment.rating)}$

$\Pi_{residence.residence\_id,\ residence.title,\ residence.first\_picture\_link,\ host.national\_code,\ host.first\_name,\ host.last\_name}$

$\sigma_{city\ .\ city\_name = "Tabriz"\ AND\ residence.\ capacity >= 4\ AND\ rent.rent\_from < y\ AND\ rent.rent\_to > x\ AND\ r.long > x1\ AND\ r.long < x2\ AND\ r.lat > y1\ AND\ r.lat < y2}$

$(residence \bowtie_{residence.\ host\_id = host\ .\ national\_code} host \bowtie_{rent\ .\ residence\_id = residence.\ residence\_id} rent \bowtie_{city\ .\ city\_id = residence.city\_id} city \bowtie_{residence.residence\_id = comment.residence\_id} comment)$

- $\Pi_{residence.residence\_id}\ \sigma_{rent.rent\_from < y\ AND\ rent.rent\_to > x}(residence \bowtie_{residence\ .\ host\_id = host\ .\ national\_code} host \bowtie_{rent\ .\ residence\_id = residence\ .\ residence\_id} rent \bowtie_{city\ .\ city\_id = residence.\ city\_id} city)$



5. L_{20}

$O_{residence.price:ASC}$

$\Pi_{residence.residence\_id,\ residence.title,\ residence.first\_picture\_link,\ host.national\_code,\ host.first\_name,\ host.last\_name}$

$(\sigma_{city\ .\ city\_name\ =\ "Tabriz"\ AND\ residence.\ capacity\ >=\ 4\ AND\ rent.rent\_from\ <\ y\ AND\ rent.rent\_to\ >\ x}$

$(residence \bowtie_{residence.\ host\_id\ =\ host\ .\ national\_code} host \bowtie_{rent\ .\ residence\_id\ =\ residence.\ residence\_id} rent \bowtie_{city\ .\ city\_id\ =\ residence.city\_id} city \bowtie_{residence.residence\_id\ =\ comment.residence\_id} comment)$

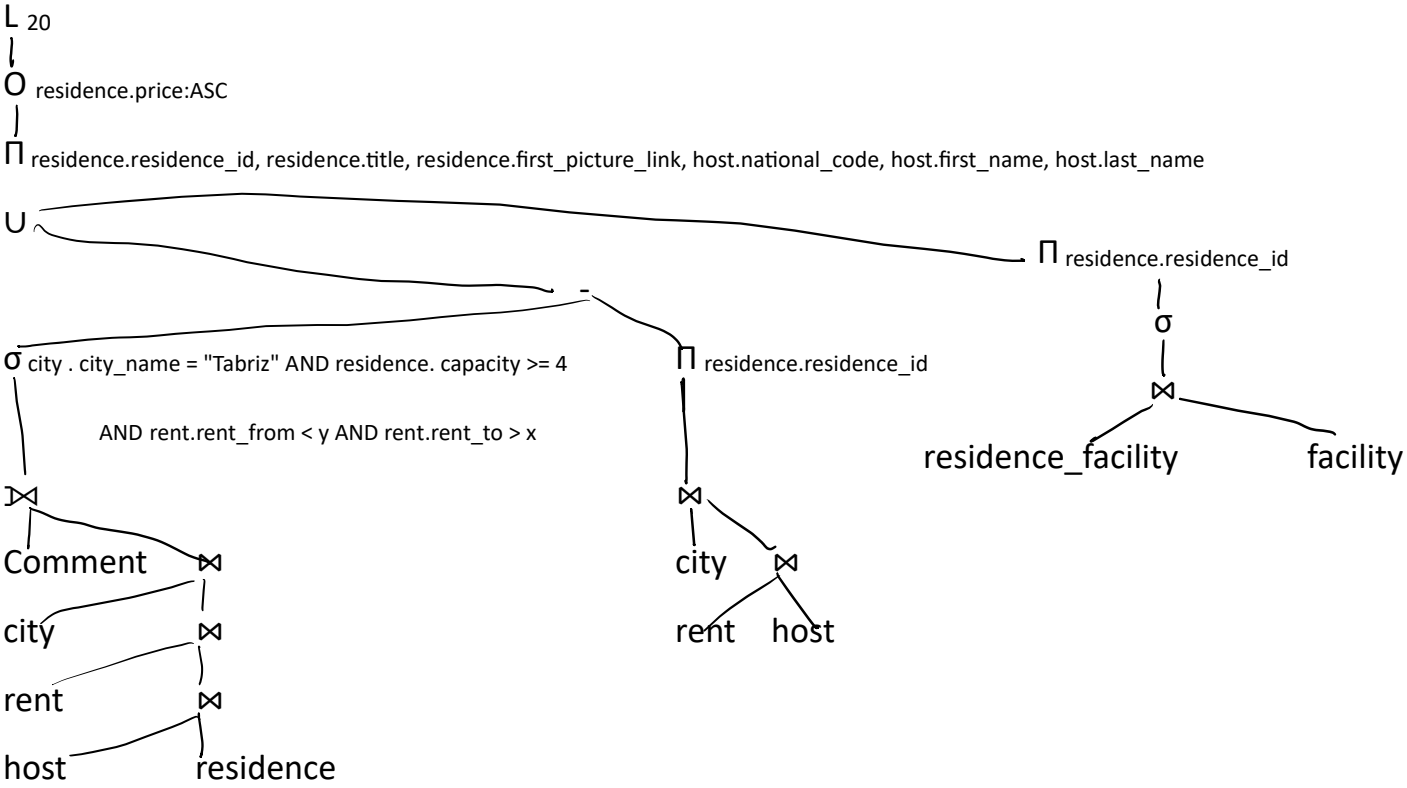
- $\Pi_{residence.residence\_id}\ \sigma_{rent.rent\_from\ <\ y\ AND\ rent.rent\_to\ >\ x}(residence \bowtie_{residence\ .\ host\_id\ =\ host\ .\ national\_code} host \bowtie_{rent\ .\ residence\_id\ =\ residence\ .\ residence\_id} rent \bowtie_{city\ .\ city\_id\ =\ residence.\ city\_id} city))$

$\cup$

$(\Pi_{residence.residence\_id}$

$\sigma_{residence\_facility.residence\_id\ =\ r.residence\_id\ AND(facility.facility\_name\ =\ 'free\ internet\ access'\ OR\ facility.facility\_name\ =\ 'dedicated\ parking'}$

$(residence\_facility \bowtie_{residence\_facility.residence\_facility\_id\ =\ facility.facility\_id} facility))$

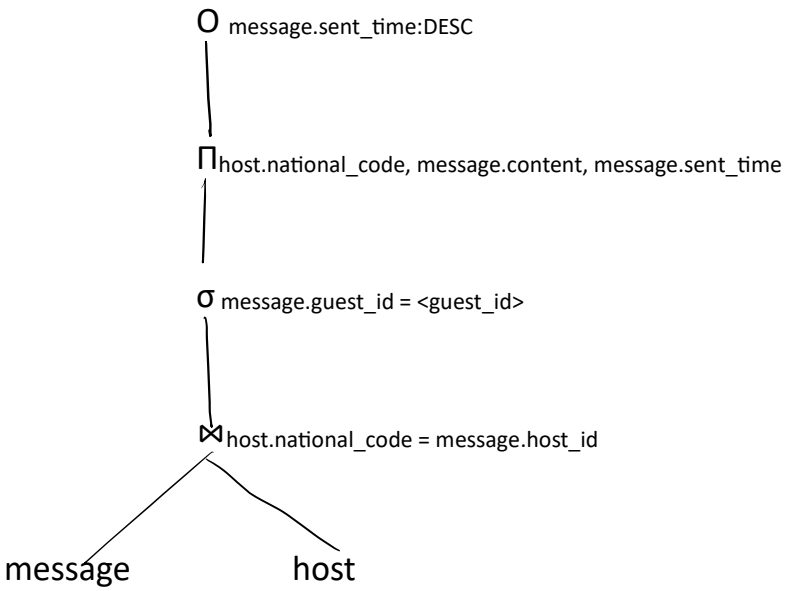


6. O message.sent_time:DESC

   Π host.national_code, message.content, message.sent_time

   σ message.guest_id = <guest_id>

   (message ⋈ host.national_code = message.host_id host)

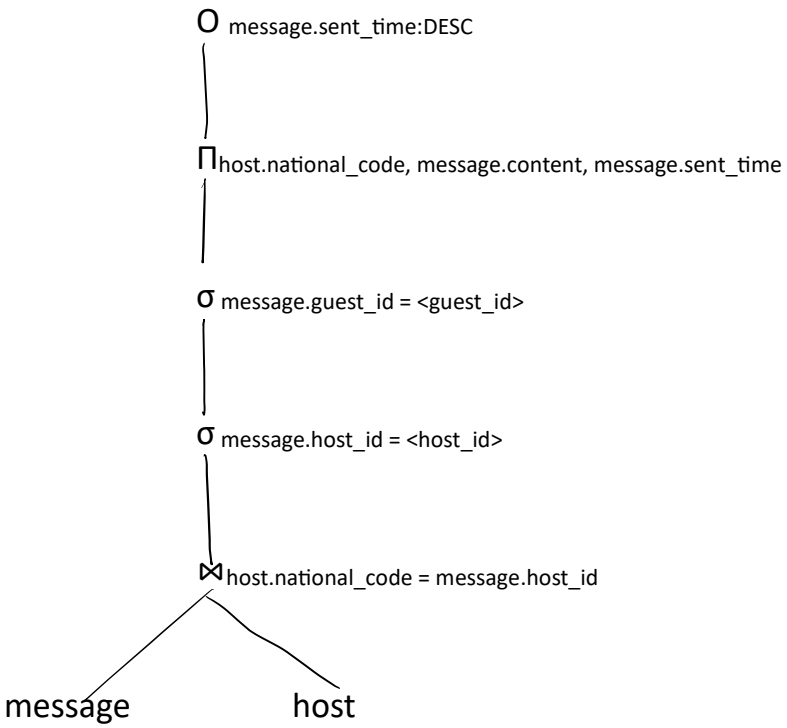


7. O message.sent_time:DESC

   Π host.national_code, message.content, message.sent_time

   σ message.guest_id = <guest_id> AND message.host_id = <host_id>

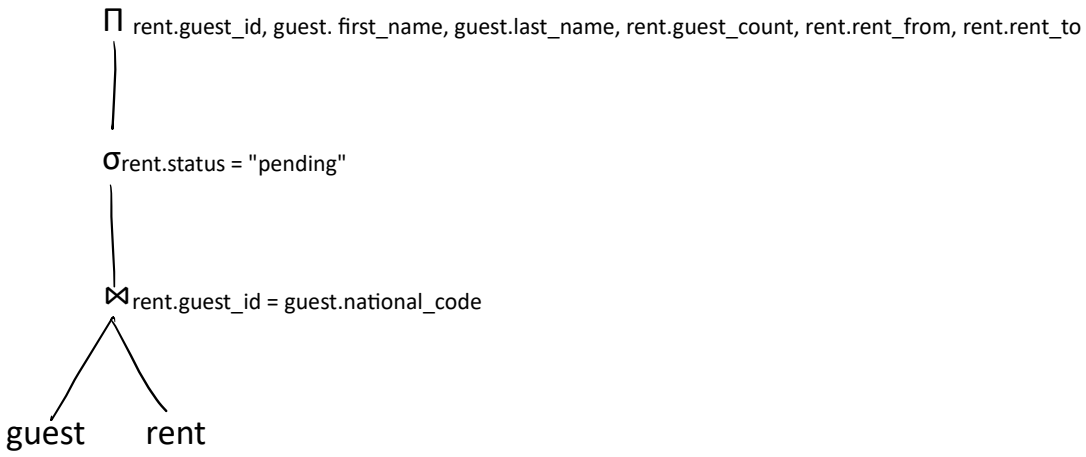
   (message ⋈ host.national_code = message.host_id host)



8. Π rent.guest_id, guest. first_name, guest.last_name, rent.guest_count, rent.rent_from, rent.rent_to

σ rent.status = "pending"

(guest ⋈ rent.guest_id = guest.national_code rent)

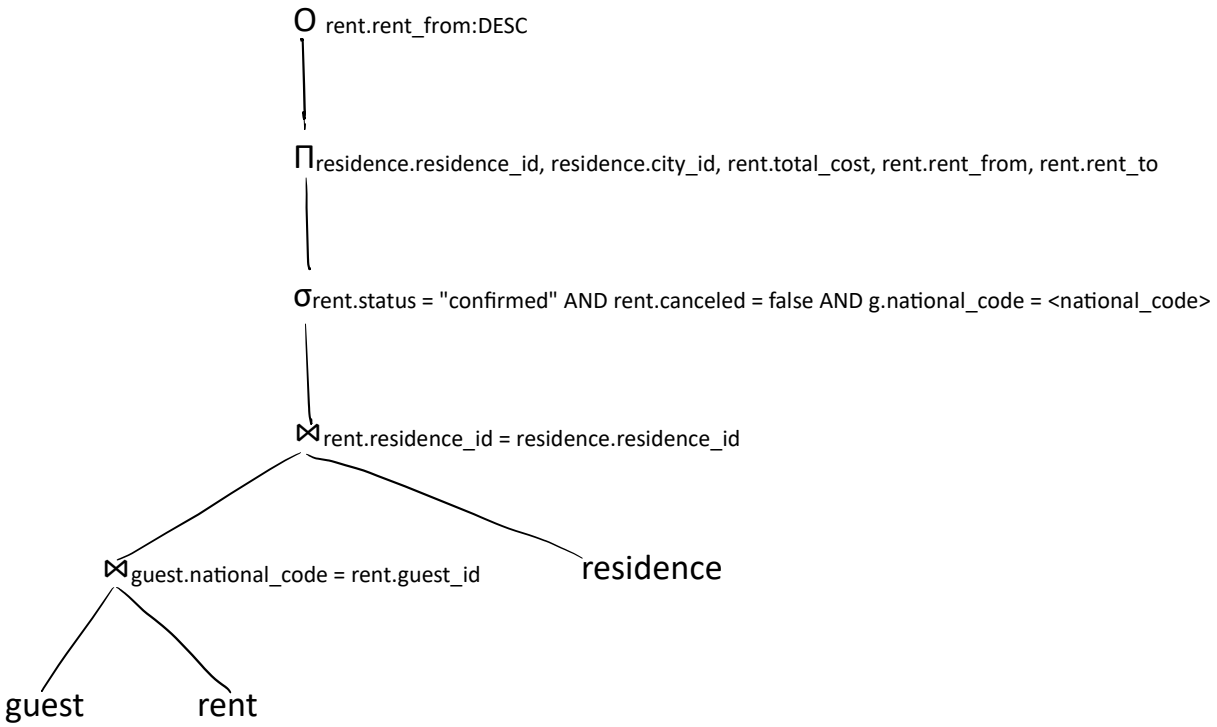


9. O rent.rent_from:DESC

Π residence.residence_id, residence.city_id, rent.total_cost, rent.rent_from, rent.rent_to

σ rent.status = "confirmed" AND rent.canceled = false AND g.national_code = <national_code>

(guest ⋈ guest.national_code = rent.guest_id rent ⋈ rent.residence_id = residence.residence_id residence)

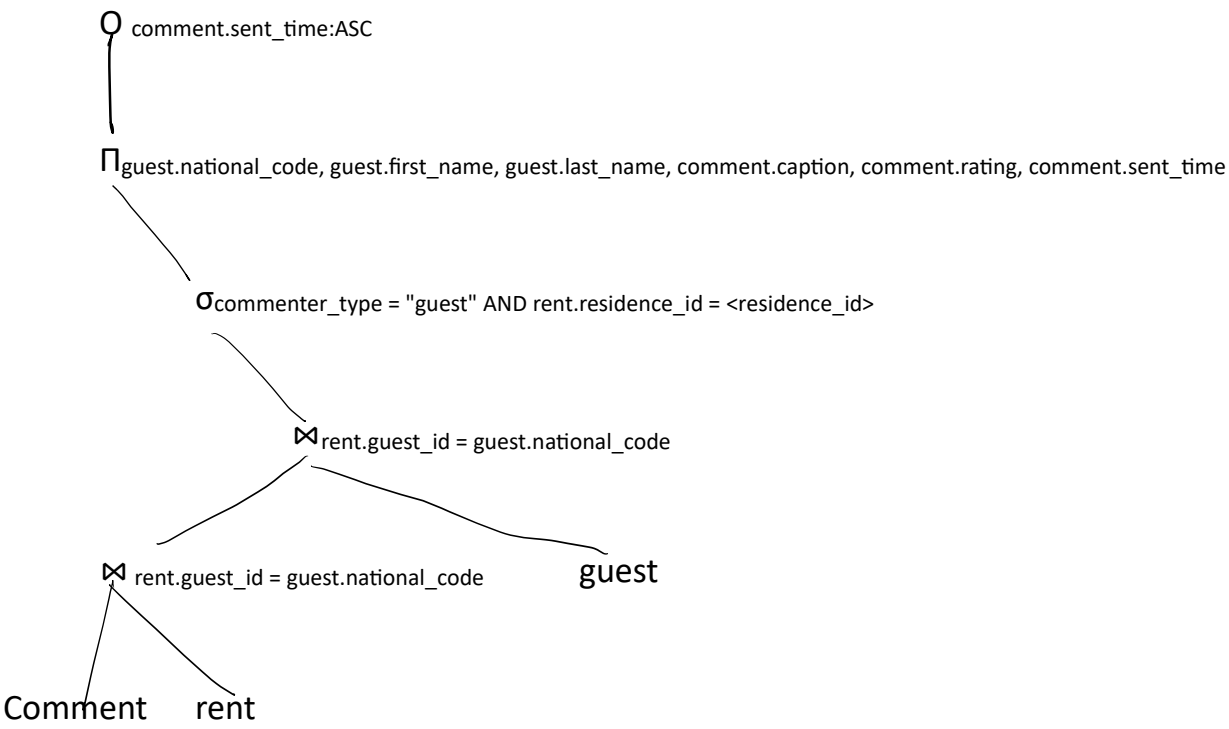


10. O comment.sent_time:ASC

Π guest.national_code, guest.first_name, guest.last_name, comment.caption, comment.rating, comment.sent_time

σ commenter_type = "guest" AND rent.residence_id = <residence_id>

(comment ⋈ comment.rent_id = rent.rent_id rent ⋈ rent.guest_id = guest.national_code guest)



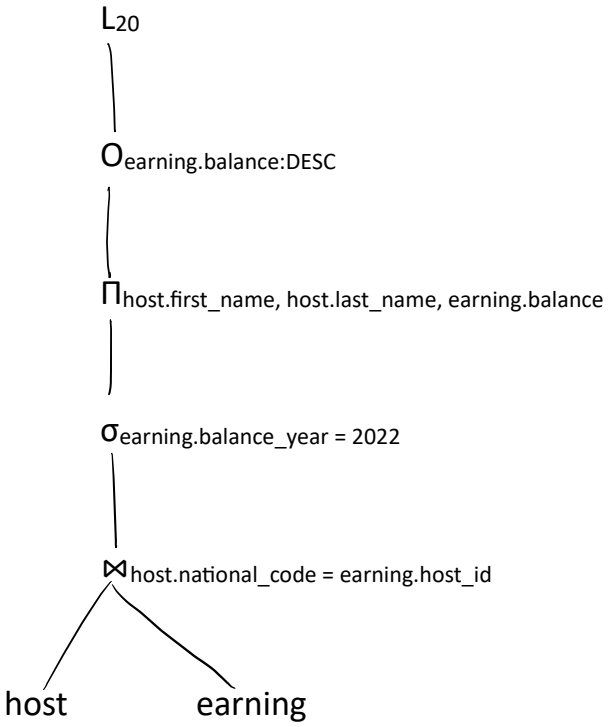
11. L_{20}

$O_{\text{earning.balance:DESC}}$

$\Pi_{\text{host.first\_name, host.last\_name, earning.balance}}$

$\sigma_{\text{earning.balance\_year = 2022}}$

$(\text{host} \bowtie_{\text{host.national\_code = earning.host\_id}} \text{earning})$



برای دیتابیس پنج ایندکس ساخته شده که به شرح زیر است:

city(city_name)

residence(capacity)

rent(rent_from)

rent(rent_to)

comment(rating)

علت گذاشتن ایندکس روی تمامی این ستون ها، پرکاربرد بودن این ستون هاست. یعنی تعداد استفاده آنها برای عبارت های WHERE و یا ORDER بیش از سایر ستون ها بود و همچنین احتمال استفاده آنها در سایر دستورات آینده ی دیتابیس بیشتر است.