CS W186 Fall 2019

Introduction to Database Systems Josh Hug

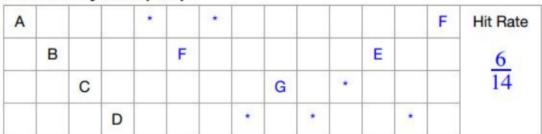
DIS 4

1 Buffer Management

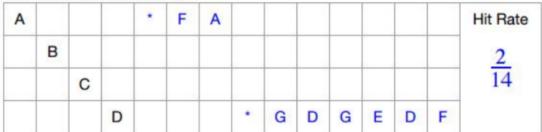
Fill in the following tables for the given buffer replacement policies. You have 4 buffer pages, with the access pattern **A B C D A F A D G D G E D F**

Diagrams are filled out from left to right columns, from least-recent to most-recent accesses. Each row represents a space for a page in memory.

Least Recently Used (LRU)



Most Recently Used (MRU)



Clock ("second chance LRU")



CS W186, Fall 2019, DIS 4

Red frame outline is where the clock hand points at the end of the access

Yellow frame outline is where the clock hand considered ejecting a page, but the bit was one

Red box means the second chance bit is zero

Green box means the second chance bit is one

Letters correspond to specific pages, whereas * denotes a hit

(a) Is MRU ever better than LRU?

Yes; MRU prevents sequential flooding during sequential scans

(b) Why would we use a clock replacement policy over LRU?

Efficiency (approximation of LRU; don't need to maintain entire ordering)

(c) Why would it be useful for a database management system to implement its own buffer replacement policy? Why shouldn't we just rely on the operating system?

The database management system knows its data access patterns, which allows it to optimize its buffer replacement policy for each case

CS W186, Fall 2019, DIS 4

2 Relational Algebra

Why do we care about relational algebra? Why do you think it might be useful?

Relational algebra are plans to execute queries; the many ways of writing the plans give the system room to design for optimizations. We will learn more about how to estimate the cost of the plan in the future.

Consider the schema:

```
Songs (song_id, song_name, album_id, weeks_in_top_40)

Artists(artist_id, artist_name, first_year_active)

Albums (album id, album name, artist id, year released, genre)
```

Write relational algebra expressions for the following queries:

(a) Find the name of the artists who have albums with a genre of either 'pop' or 'rock'.

```
π artists.artist_name (Artists ⋈(σ albums.genre = 'pop' ∨ albums.color = 'rock' Albums))
```

(b) Find the name of the artists who have albums of genre 'pop' and 'rock'.

```
π artists.artist_name ((σ albums.genre = 'pop' Albums) ⋈Artists) ∩ π artists.artist_name ((σ albums.genre = 'rock' Albums) ⋈Artists)
```

(c) Find the id of the artists who have albums of genre 'pop' or have spent over 10 weeks in the top 40.

```
\pi artists.artist_id (Artists \bowtie(\sigma albums.genre = 'pop' Albums)) \cup \pi albums.artist_id (Albums \bowtie(\sigma songs.weeks_in_top_40 > 10 Songs))
```

(d) Find the names of all artists who do not have any albums.

```
π artists.artist_name (Artists ⋈((π artists.artist_id Artists) - (π albums.artist_id Albums)))
```

CS W186, Fall 2019, DIS 4