

1 Buffer Management

- (a) 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**

Least Recently Used (LRU)

A																Hit Rate
	B															
		C														
			D													$\frac{\quad}{14}$

Most Recently Used (MRU)

A																Hit Rate
	B															
		C														
			D													

CLOCK ("second chance LRU")

A																Hit Rate
	B															
		C														
			D													

- (b) 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 (remains pinned), D, G, D, unpin F, G, E, D, F**. Remember that unpinning does not contribute to the hit count!

Least Recently Used w/ Pinning

A																$\overline{13}$
	B															
		C														
			D													

Most Recently Used w/ Pinning

A																
	B															
		C														
			D													

- (c) Is MRU ever better than LRU?

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

- (e) 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?

2 Relational Algebra

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 names of the artists who have albums with a genre of either 'pop' or 'rock'.
- (b) Find the names of the artists who have albums of genre 'pop' and 'rock'.
- (c) Find the id of the artists who have albums of genre 'pop' or have spent over 10 weeks in the top 40.
- (d) Find the names of the artists who do not have any albums.