

Practical No 9

AIM: Memory Management Techniques

9.1.Simulate FIFO and LRU page replacement using page reference strings. Measure

9.2.Hit/miss ratios under different reference patterns.

9.3.Extend to include frames and memory constraints.

```
from collections import deque

def fifo_page_replacement(pages, frames):
    memory = deque()
    hits, misses = 0, 0

    print("\n--- FIFO Page Replacement ---")
    for page in pages:
        if page in memory:
            hits += 1
        else:
            misses += 1
            if len(memory) >= frames:
                memory.popleft() # Remove oldest page (FIFO)
            memory.append(page)
        print(f"Page: {page} -> Memory: {list(memory)}")

    print(f"\nFIFO Results: Hits = {hits}, Misses = {misses}, "
          f"Hit Ratio = {hits/len(pages):.2f}, Miss Ratio = {misses/len(pages):.2f}")

def lru_page_replacement(pages, frames):
    memory = deque()
    hits, misses = 0, 0

    print("\n--- LRU Page Replacement ---")
    for page in pages:
        if page in memory:
            hits += 1
            memory.remove(page) # Remove old position
            memory.append(page) # Move to most recently used
        else:
            misses += 1
            if len(memory) >= frames:
                memory.popleft() # Remove least recently used
            memory.append(page)
        print(f"Page: {page} -> Memory: {list(memory)}")

    print(f"\nLRU Results: Hits = {hits}, Misses = {misses}, "
          f"Hit Ratio = {hits/len(pages):.2f}, Miss Ratio = {misses/len(pages):.2f}")

if __name__ == "__main__":
    # Example page reference string
    reference_string = [7, 0, 1, 2, 0, 3, 0, 4, 2, 3, 0, 3, 2]
```

```
frames = 3
```

```
print("Reference String:", reference_string)
print("Frames:", frames)
```

```
fifo_page_replacement(reference_string, frames)
lru_page_replacement(reference_string, frames)
```

```
Reference String: [7, 0, 1, 2, 0, 3, 0, 4, 2, 3, 0, 3, 2]
Frames: 3
```

```
--- FIFO Page Replacement ---
```

```
Page: 7 -> Memory: [7]
Page: 0 -> Memory: [7, 0]
Page: 1 -> Memory: [7, 0, 1]
Page: 2 -> Memory: [0, 1, 2]
Page: 0 -> Memory: [0, 1, 2]
Page: 3 -> Memory: [1, 2, 3]
Page: 0 -> Memory: [2, 3, 0]
Page: 4 -> Memory: [3, 0, 4]
Page: 2 -> Memory: [0, 4, 2]
Page: 3 -> Memory: [4, 2, 3]
Page: 0 -> Memory: [2, 3, 0]
Page: 3 -> Memory: [2, 3, 0]
Page: 2 -> Memory: [2, 3, 0]
```

```
FIFO Results: Hits = 3, Misses = 10, Hit Ratio = 0.23, Miss Ratio = 0.77
```

```
--- LRU Page Replacement ---
```

```
Page: 7 -> Memory: [7]
Page: 0 -> Memory: [7, 0]
Page: 1 -> Memory: [7, 0, 1]
Page: 2 -> Memory: [0, 1, 2]
Page: 0 -> Memory: [1, 2, 0]
Page: 3 -> Memory: [2, 0, 3]
Page: 0 -> Memory: [2, 3, 0]
Page: 4 -> Memory: [3, 0, 4]
Page: 2 -> Memory: [0, 4, 2]
Page: 3 -> Memory: [4, 2, 3]
Page: 0 -> Memory: [2, 3, 0]
Page: 3 -> Memory: [2, 0, 3]
Page: 2 -> Memory: [0, 3, 2]
```

```
LRU Results: Hits = 4, Misses = 9, Hit Ratio = 0.31, Miss Ratio = 0.69
```

B.

```
from collections import deque
def fifo_page_replacement(pages, frames):
    memory = deque()
    hits, misses = 0, 0

    for page in pages:
        if page in memory:
            hits += 1
```

```

else:
    misses += 1
    if len(memory) >= frames:
        memory.popleft() # remove oldest
    memory.append(page)

hit_ratio = hits / len(pages)
miss_ratio = misses / len(pages)
return hits, misses, hit_ratio, miss_ratio

def lru_page_replacement(pages, frames):
    memory = []
    hits, misses = 0, 0
    for page in pages:
        if page in memory:
            hits += 1
            memory.remove(page) # move to most recently used
            memory.append(page)
        else:
            misses += 1
            if len(memory) >= frames:
                memory.pop(0) # remove least recently used
            memory.append(page)
    hit_ratio = hits / len(pages)
    miss_ratio = misses / len(pages)
    return hits, misses, hit_ratio, miss_ratio

# Example usage
if __name__ == "__main__":
    reference_string = [7, 0, 1, 2, 0, 3, 0, 4, 2, 3, 0, 3, 2]
    frames = 3

    print("Reference string:", reference_string)
    print("Frames:", frames)

    fifo_res = fifo_page_replacement(reference_string, frames)
    lru_res = lru_page_replacement(reference_string, frames)

    print("\nFIFO:")
    print(f"Hits: {fifo_res[0]}, Misses: {fifo_res[1]}, "
          f"Hit Ratio: {fifo_res[2]:.2f}, Miss Ratio: {fifo_res[3]:.2f}")

    print("\nLRU:")
    print(f"Hits: {lru_res[0]}, Misses: {lru_res[1]}, "
          f"Hit Ratio: {lru_res[2]:.2f}, Miss Ratio: {lru_res[3]:.2f}")

```

```

Reference string: [7, 0, 1, 2, 0, 3, 0, 4, 2, 3, 0, 3, 2]
Frames: 3

FIFO:
Hits: 3, Misses: 10, Hit Ratio: 0.23, Miss Ratio: 0.77

LRU:
Hits: 4, Misses: 9, Hit Ratio: 0.31, Miss Ratio: 0.69

```