Assignment-5: Virtual Memory Management

15CS10001 and 15CS10053

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1 Design Documentation

The following global data structures have been used common to all page replacement algorithms:

1. **int *page_table** : Each page with its corresponding meta-data (mapped frame, valid-bit, modified bit, referenced bit) is stored as a 32-bit integer in the table.
2. **int *page_frame_table** : Bitmap to keep track of used page frames in memory.
3. **int *time_used** : Stores, for each page, the latest time it was accessed(R/W).
4. **int counter** : timer, incremented for each instruction.

Next, data structures specific to each page replacement algorithm:

1. **First In First Out**
   - *queue* $<$ *int* $>$ *myfifo* : maintains a fifo queue of incoming pages. First page to be mapped is the first to be replaced.
2. **Least Recently Used** : Uses *counter* and *time_used* for replacement.
3. **Second Chance** : Also uses *myfifo* queue

For generating the input page trace, following main data structures have been used:

1. **int timer**[] : Stores the latest time each page was accessed, used to update working set
2. **set** $<$ *int* $>$ **w_set** : STL set for implementing the working set

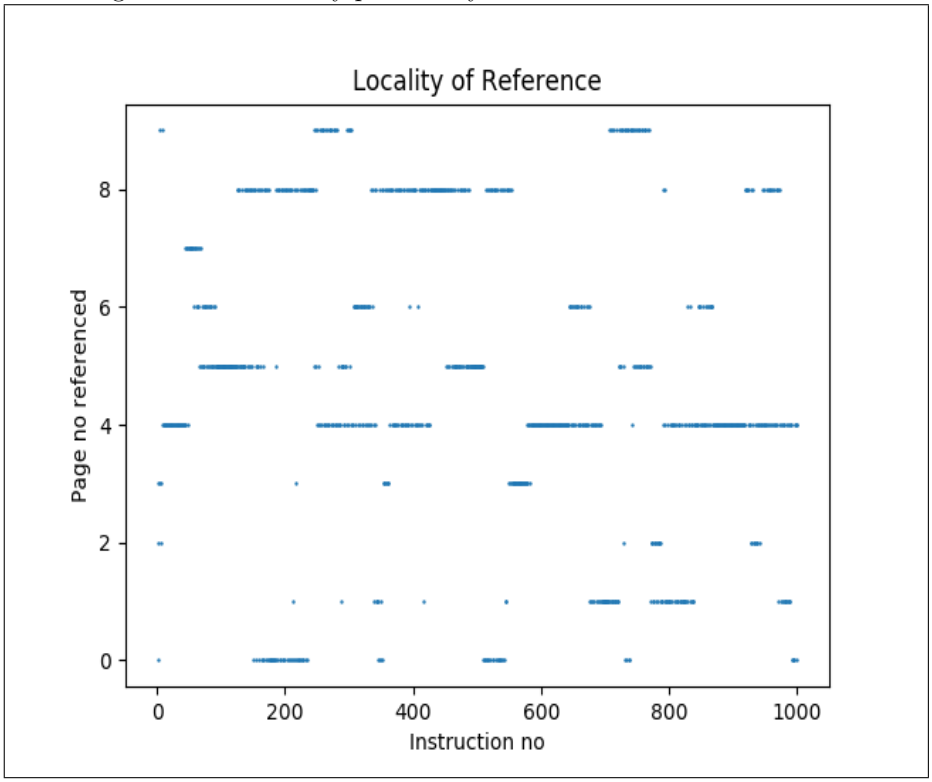
Following variables have been used for maintaining the statistics:

1. **int page_faults** : counts number of page faults
2. **int page_transfers** : counts numbers of page transfers from memory to disk and vice-versa
3. **long long cost** : Stores overall execution time as number of cycles.

Macro definitions used:

1. INTERRUPT : number of page faults for clearing the reference bits of all pages in case of NRU algortihm. Set to 10
2. READ_PROB : Probability that read operation occurs in the page trace file. Set to 0.7

Figure 1: Pages referenced for 1000 instructions when total pages are 10. Size of working set=5 and locality probability=0.95



2 Observations

Following were the statistics for 1 million references :-

1. **FIFO** :
   Number of page faults = 50427
   Number of page transfers = 99784
   Overall execution time in cycles = 325558000

2. **Random** :
   Number of page faults = 221
   Number of page transfers = 411
   Overall execution time in cycles = 2336000

3. **LRU** :
   Number of page faults = 48416
   Number of page transfers = 94945
   Overall execution time in cycles = 310035500

4. **NRU** :
   Number of page faults = 55966
   Number of page transfers = 106355
   Overall execution time in cycles = 348040500

5. **Second Chance** :
   Number of page faults = 72
   Number of page transfers = 98
   Overall execution time in cycles = 1322500