Tribhuvan University

Institute of Science and Technology

Evaluating Impact of Pruned Metadata on Low Inter-reference Recency Set (LIRS) Page Replacement Policy

Dissertation

Submitted to:

Central Department of Computer Science and Information Technology
Kirtipur, Kathmandu, Nepal

In Partial Fulfillment of the Requirements for the Degree Of
Master of Science in Computer Science and Information Technology

Submitted By

Dipak Prashad Bhatt

July, 2014

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Supervisor's Recommendation

We here by recommend that the dissertation prepared under our supervision by **Mr. Dipak Prashad Bhatt** entitled **"Evaluating Impact of Pruned Metadata on LIRS Page Replacement Policy"** be accepted as fulfilling in partial requirements for the degree of Master of Science in Computer Science and Information Technology. In my best knowledge this is an original work in computer science.

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LETTER OF APPROVAL

We certify that we have read this dissertation work and in our opinion it is satisfactory on the scope and quality as a dissertation in the partial fulfillment for the requirement of Master of Science in Computer Science and Information Technology.

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I have done my best to complete this research work but there may be some errors as well. Thus, suggestions regarding the error of this dissertation will always be welcomed.

Dipak Prashad Bhatt
Kathmandu, Nepal

Abstract

To combat the problem of growing performance gap between system and rapidly improving CPU performance, virtual memory system has been becoming increasingly important for all memory management system. Virtual memory system needs an efficient page replacement algorithm to decide which page to be swapped out at page fault. Least Recently Used (LRU) is the one, which captures locality of reference but does not exploit frequency effectively. To minimize the deficiencies presented in LRU *Jiang and Zhang* [7] proposed a LIRS algorithm which aims at maintaining two key pieces of data access history- the recency and IRR. In this algorithm, the metadata of all accessed blocks in recent past are not maintained on the cache. And the pruning operation is performed to minimize space overhead. Due to such pruning operation, the algorithm can store only one history information of accessed block and cannot work always correct because of the constraint timing scope.

This dissertation, lets us to exploit the impact of pruned metadata on LIRS algorithm by maintaining metadata about all pages accessed in the past.

When workload has high reference locality, Derived LIRS has significantly superior performance than LIRS in terms of hit rate. Derived LIRS has higher hit rate up to 32.22% in comparison to LIRS. This is because Derived LIRS employs several history information items whereas the LIRS scheme uses only one history information item. However, Revised LIRS shows poorer performance on same traces due to the dominance of unused blocks in the cache.

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List of Abbreviations

2Q	-	Two Queues
ARC	-	Adaptive Replacement Cache
AFPR	-	Adaptive Fuzzy Page Replacement
CAR	-	Clock with Adaptive Replacement
CLOCK Pro	-	Clock with Pro
CPU	-	Central Processing Unit
EELRU	-	Early Eviction Least Recently Used
FINUFO	-	First In Not Used First Out
FIFO	-	First In First Out
FPR	-	Fuzzy Page Replacement
HIR	-	High Inter-reference Recency
HIRS	-	High Inter-reference Recency Set
IRG	-	Inter- Reference Gap
IRR	-	Inter- Reference Recency
LFU	-	Least Frequently Used
LIR	-	Low Inter-reference Recency
LIRS	-	Low Inter-reference Recency Set
LRFU	-	Least Recently Frequently Used
LRU	-	Least Recently Used
MMU	-	Memory Management Unit
MQ	-	Multi Queue
MRU	-	Most Recently Used
NRU	-	Not Recently Used
OS	-	Operating System
TLB	-	Translation Look-aside Buffer