V I R T U A L M E M O R Y T E C H N I Q U E S

F O R

S M A L L C O M P U T E R S

John Nguyen Thanh THUY, B.E. (Hons.)

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To my wife

Catherine-Nuong

DECLARATION

This thesis contains no material which has been accepted for the award of any other degree or diploma in any University, and to the best of my knowledge and belief it contains no material previously published or written by another person, except where due reference is made in the text of the thesis.

J.N.T. THUY

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SUMMARY

This thesis describes an investigation into a cost - effective method of expanding main memory of a computer. The method used is known as Virtual Memory which has the significant advantage of being transparent to programmers. Special attention is paid to small computers in a single - user environment. This is the focus of the study.

Basically this thesis consists of four main parts. Part 1 (Chapter 1 and 2) is a literature survey of the virtual memory concept for the last 15 years since it came to existence. Part 2 (Chapter 3, 4, 5 and 6) presents the results of the investigation in 3 main areas: Replacement algorithms, Prediction methods and the Prevention of Pushes. In Part 3 (Chapter 7,8), mathematical models of the virtual memory system are derived. An evaluation is made on all the techniques investigated using the suggested models. Part 4 (Chapter 9 and 10), discusses possible extensions of this project for future study which includes: Program restructuring and the expansion of the Virtual Address Space. Proper conclusions are then drawn.

Appendices contain the Listing and Flow Charts of the Simulation Program. Tables of Back-up numerical results are also included.

KEYWORDS AND SYMBOLS

- virtual memory	:	virtual storage.
- auxiliary memory	:	external storage, backing store.
- a page	:	a block: a group of words.
- page fault	:	page exception, translation exception.
- pre-paging	:	lookahead, predictive loading.
- a push	:	a write back, a paging-out, a transfer of data from main memory to backing store.
- a pull	:	a paging-in; a transfer of data from backing store to main memory.
- page frame	:	space in main memory for one page.
- fault rate	:	ratio of page faults and total number of references expressed in percentage.
- reference pattern	:	a sequence of page references in a program.
- address space	:	maximum range in which the CPU is capable of addressing. In V.M. System, it is called Virtual Address Space.

P : page size

M : main memory size

C : No. of page frames in main memory

F : total number of page faults of a program

f : fault rate

T : average access time

n : number of references executed in a program

t_1 : access time of main memory

t_s : settling time of disk head or tape head

t_t : data transfering time per work of disk or tape

α : co-efficient of page transfers

R : ratio of Pushes over Pulls

HR : Hit Rate

HR = 1-f

HR% = 100%-f%

Note: The term "memory" in this thesis is meant to be "main memory". For example -
memory size : main memory size