A COMPARISON OF SEQUENTIAL AND ASSOCIATE COMPUTING OF PRIORITY QUEUES*

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A comparison of priority queues on four ifferent types of computer memories are made by sing a model to determine the total time to do mparable tasks. The four types of memories mpared are random access (RAM), associate (AM), hybrid consisting of an associate memory and a ndom access memory (AM/RAM), and the hybrid mory with an auxiliary memory having the pability to perform Lewin's Associate algorithm], (AM/RAM/AML).

The model used for the comparisons is an tension of the MIX model developed by Knuth [1]. e MIX model was extended to include the four pes of memories and the instruction set expanded include instructions for the memories added. This del allows direct comparisons to be made of the fferent architectures and different software gorithms in performing the same tasks.

A variety of priority queues are compared, cluding those based on primary keys; primary d secondary keys; primary, secondary, and rtiary keys; first in, first out (FIFO); and st in, first out (LIFO). This research attempted select an effective way to program each priority queue and to use an appropriate linear storage structure for each type of memory. Comparisons of the various memory types for each of the priority queues are based on the total model time to perform a "composite node cycle." A "composite node cycle" is adding a node (entry) to and deleting a node (entry) from a priority queue. A different program (algorithm) is used for the composite node cycle for each memory type and priority queue. Since the measurement used in the comparisons is total model time, the overhead time as well as the times to perform the required operations are included in the measurement used for comparison.

Because the major interest in this research was comparing random access memories to associative type memories, a concept called the "breakeven bit width" was developed and is used for tradeoff comparisons. First, the number of memory cycles allowed in each of the associative memory types is found such that the total model time for each composite node cycle is equal for both the RAM and the AM type. Using this value and the AM processing bit width, the maximum number of bits

*his paper does not necessarily represent the views of the Air Force.

allowed per word for the link field and search keys is determined for each AM type and composite node cycle. The AM processing bit width is the number of bits compared per word simultaneously across all words in one AM memory cycle and is a model parameter which can vary from one bit, commonly found in AMs today, to the number of bits in an AM word. If the number of bits used in an AM require less than the allowed number of memory cycles for equality between the RAM and AM, then the AM requires less processing time than the RAM and vice-versa. A breakeven bit width was found for each combination of composite node cycle (priority queue) and AM type for various parameter settings. Several graphs of the results are in [2].

The results of the research show an interaction between priority queues, memory types, AM processing bit width, and to some extent other parameters. One can state, in a general way, that the AM/RAM/AML is much superior to the RAM and the RAM is better than the AM and AM/RAM for processing priority queues using primary, secondary and/or tertiary keys.

References

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3. Lewin, M.H., "Retrieval of Order Lists from a Content Addressed Memory," RCA Review, Vol. 23: 215-229, June 1962.