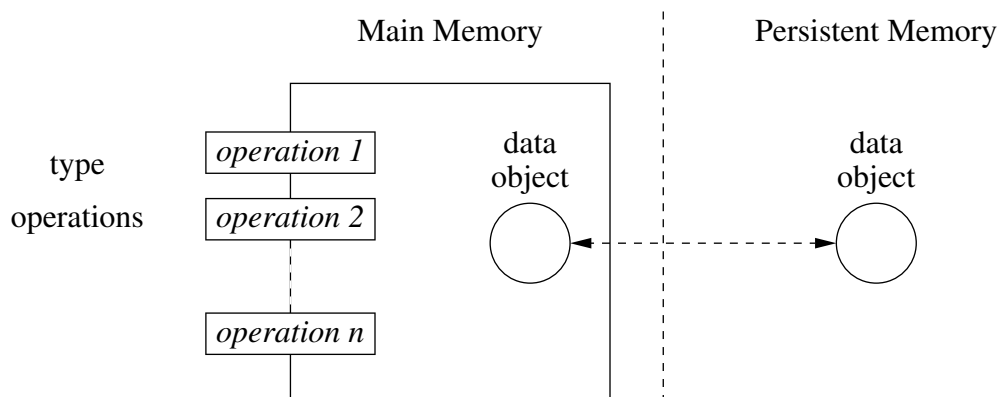


1993 Paper 5 Question 7

Concurrent Systems



The figure illustrates an object model which is used in a concurrent software system. We are concerned with how to implement atomic operations in the presence of concurrency and crashes.

In the descriptions given below, the term *client* indicates an external user of the system. A single-machine multiprocessor implementation should be assumed.

- (a) A data object exists in main memory only. Invocations of its type operations involve no writes to persistent memory and no output to clients. Concurrent processes may invoke the object.

How can the operations be made atomic? [8 marks]

- (b) A data object exists in persistent memory.

- (i) A single operation is invoked on it in response to a request from a client. The result of the invocation is output to the client.

How can the operation be made atomic? [4 marks]

- (ii) A client requests a high-level operation which comprises more than one of the type operations on the data object.

How can the high-level operation be made atomic? [8 marks]