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## CRITICAL PATH MEASUREMENT ON THE FLY

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An algorithm is given which will determine the length (in real time) of the critical path of a simulation written for Time Warp. It assumes message transmit time is zero, each object is on its own node, and an amusing assumption for queries. We assume there is a copy of the query section of each object on each node (which currently is true), and that saved states instantly appear on all the nodes.

## NEW DATA STRUCTURES:

A new field "cputime" is added to both the saved states and the message headers. This field cputime contains the earliest real time that the message or saved state could have been created under the assumptions above (with infinitely many processors).

## INITIALIZATION:

Messages created by the config file should have cputime set to zero. The initial saved states should have their cputime set to the amount of real time it takes to run the init section of the object.

## BEFORE EVENTS AND QUERIES:

We can determine the earliest real time that a given event or query section can start by taking the maximum (saved state -> cputime, input message(s) -> cputime). We "set" our real time clock to this value and run the event or query section.

## AT MESSAGE SEND TIME:

Simply transfer the time on the real time clock to message-header-field "cputime" when the message is created. We do this for each of the message types: event messages, query messages and query reply messages.

#### AT QUERY REPLY RECIEVE TIME:

The real time clock must be increased to the cputime of the query reply message. Note that this increase in real time can be strictly longer than the real time needed to run the correct query section. Indeed, we may have to wait for the correct saved state to be created. (Hence the simulator has to something different about timing queries.)

#### AFTER EVENTS AND QUERIES:

After the completion of the event section, the new saved state's cputime is assigned the value of the real time clock. No change in the cputime of any saved state is changed at the end of a query section. This amount of real time has already been charged to object which called the query (see at query reply time). This views query messages as a request for the (correct) saved state of the queried object, which instantly appears. Then the query section of the queried object is run on the querying node.

#### THE CRITICAL PATH TIME:

It is the maximum "cputime" of all the saved states.