

# The Snapshot Algorithm

Two rules:

- ▶ Marker sending Rule
- ▶ Marker receiving rule

The thing to remember is that the algorithm is channel based. The idea is to record the state of all the channels in the system as well as the states of the nodes.

# The Snapshot Algorithm

**function** MARKER SENDING RULE FOR PROCESS  $i$

Process  $i$  records its state

For each outgoing channel  $C$  on which a marker has not been sent,  $i$  sends a marker along  $C$  before  $i$  sends further messages along  $C$ .

**end function**

A process can decide at any time to initiate the algorithm by running the marker sending algorithm. The marker contains information about which node initiated the algorithm. This allows more than one copy of the algorithm to run at the same time.

# The Snapshot Algorithm

**function** MARKER RECEIVING RULE FOR PROCESS  $j$

On receiving a marker along Channel  $C$

**if**  $j$  has not recorded its state **then**

Record the state of  $C$  as the empty list and Follow the  
'Marker Sending Rule'

**else**

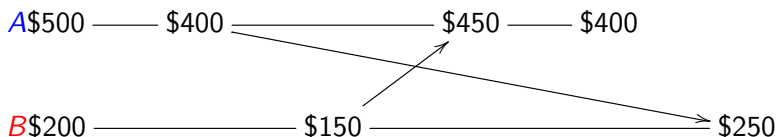
Record the state of  $C$  as the set of messages received  
along  $C$  after  $j$ 's state was recorded and before  $j$   
received the marker along  $C$ .

**end if**

**end function**

Algorithm terminates when each node is in a recording state and has recorded the state of all channels.

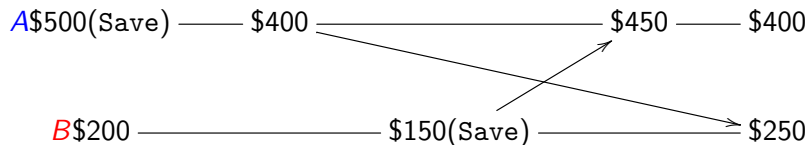
## We need to record global cuts



- ▶ A sends \$100 to B
- ▶ B sends \$50 to A

All is well and good money is preserved.

## We need to record global cuts

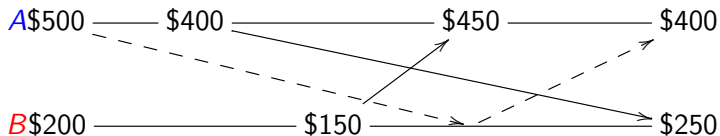


- ▶  $A$  saves the state \$500.
- ▶  $B$  starts to saves the state \$150 plus the receiving of \$100.

Total global money is  $\$500 + \$150 + \$100 = \$750$ . Too much money.

## The same scenario with the snapshot algorithm

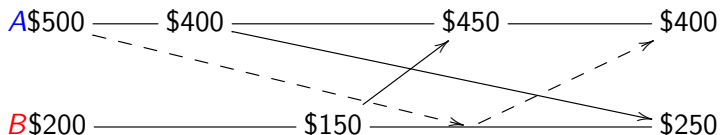
Let node *A* start the algorithm just before it sends its transfer.



Dotted lines correspond to marker messages.

## The same scenario with the snapshot algorithm

Let node  $A$  start the algorithm just before it sends its transfer.



First termination means

- ▶  $A$  state is recorded, when it sends the marker.
- ▶  $B$  state is recorded, when it receives the marker.
- ▶  $C_{AB}$  recorded as the empty set when  $A$  sends the marker.
- ▶  $C_{BA}$  is recorded when  $A$  receives the marker back from  $A$ . So we get the transfer of \$50 from  $B$  to  $A$ .

# Correctness

- ▶ Termination depends on the graph being strongly connected.
- ▶ The fact that you record a cut crucially depends on the communication begin FIFO.