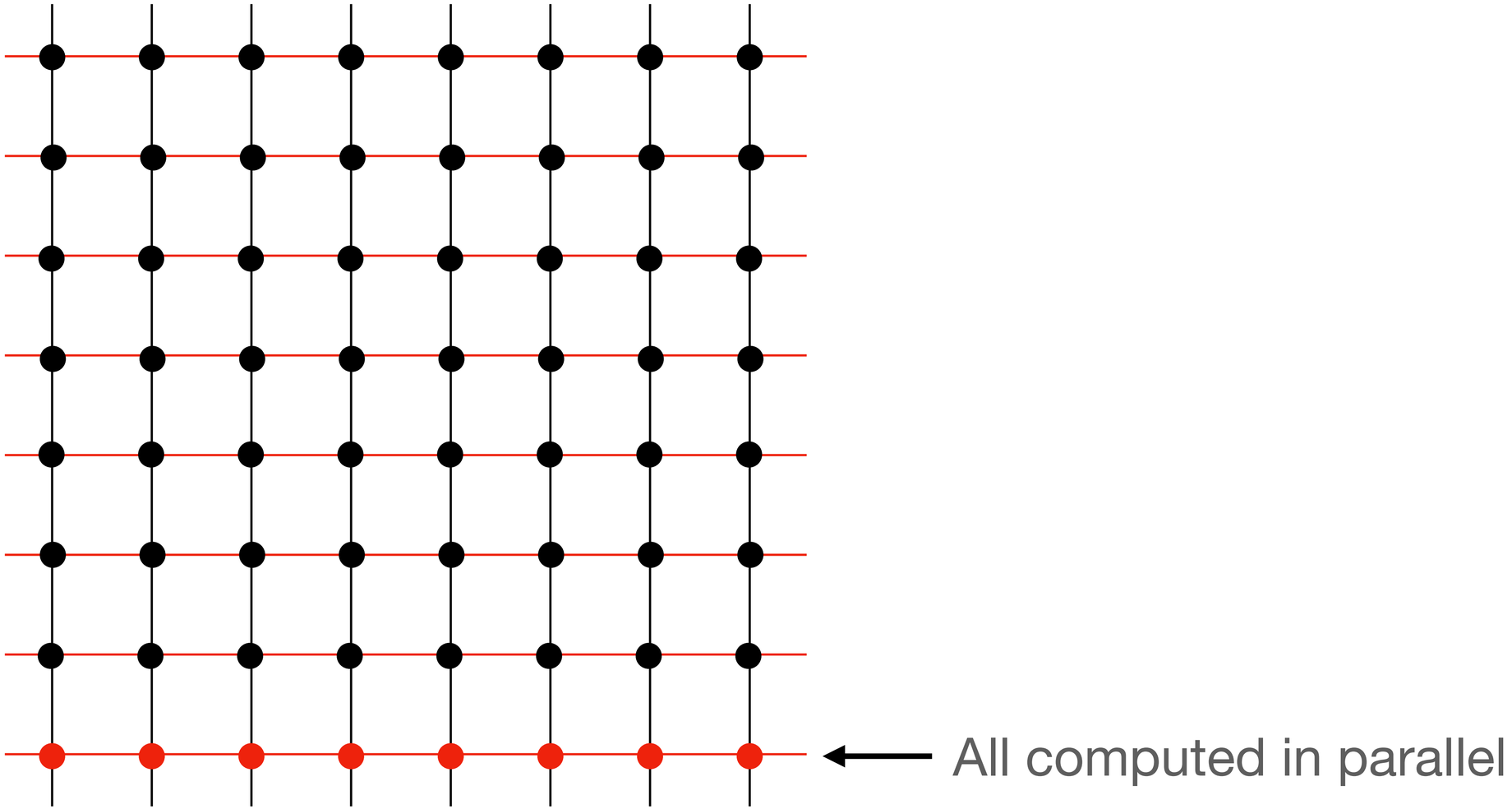
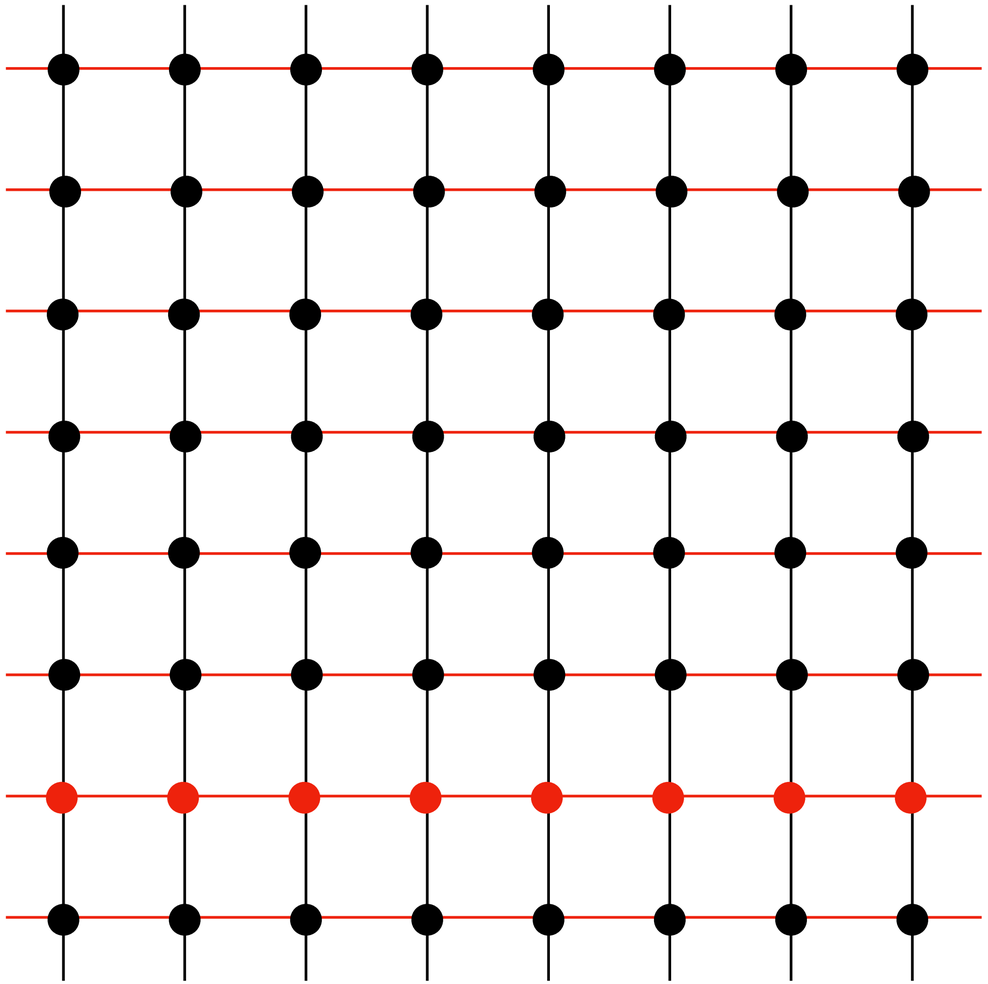
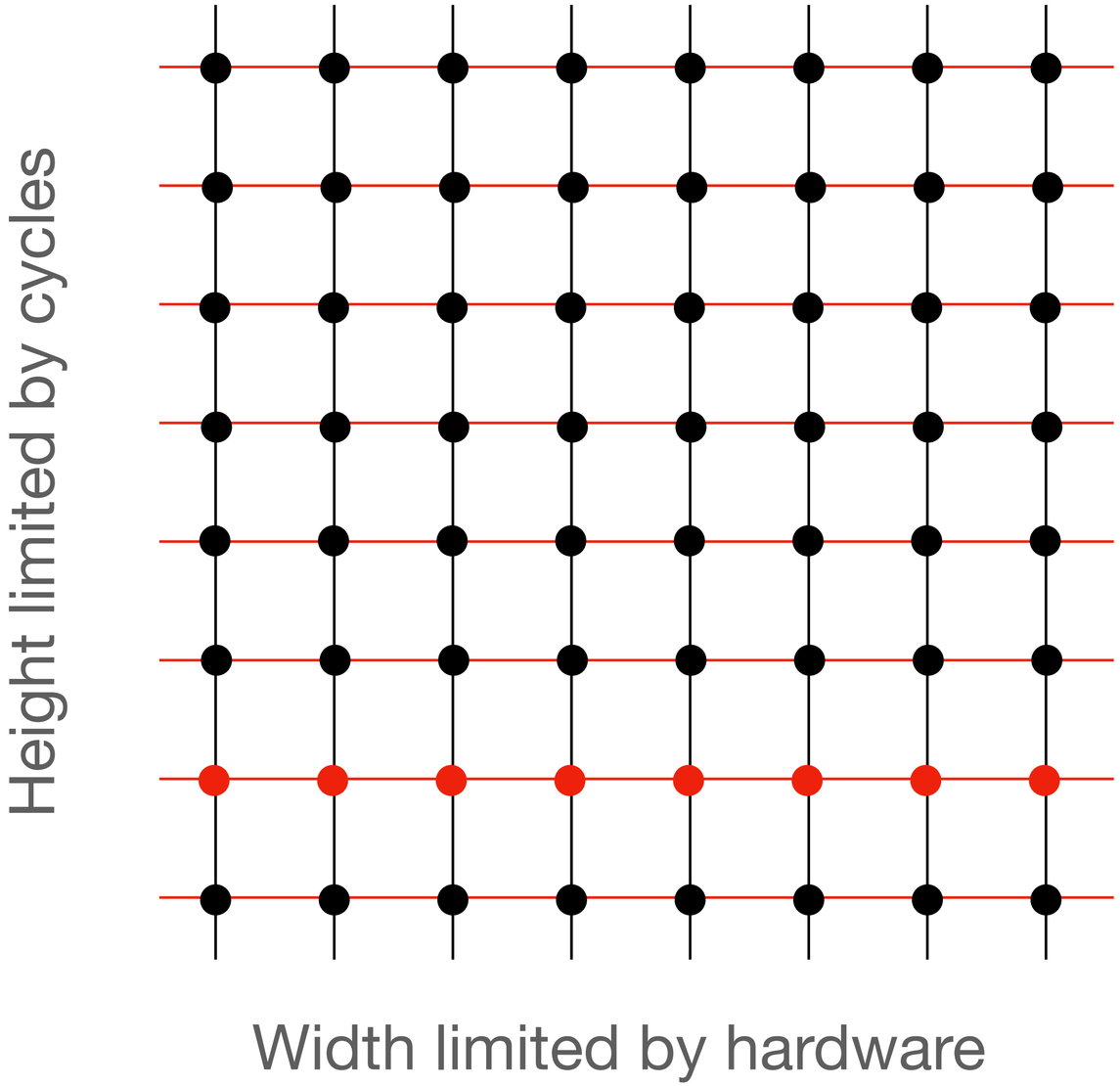

All computed in parallel



All computed in parallel
(in series with previous row)

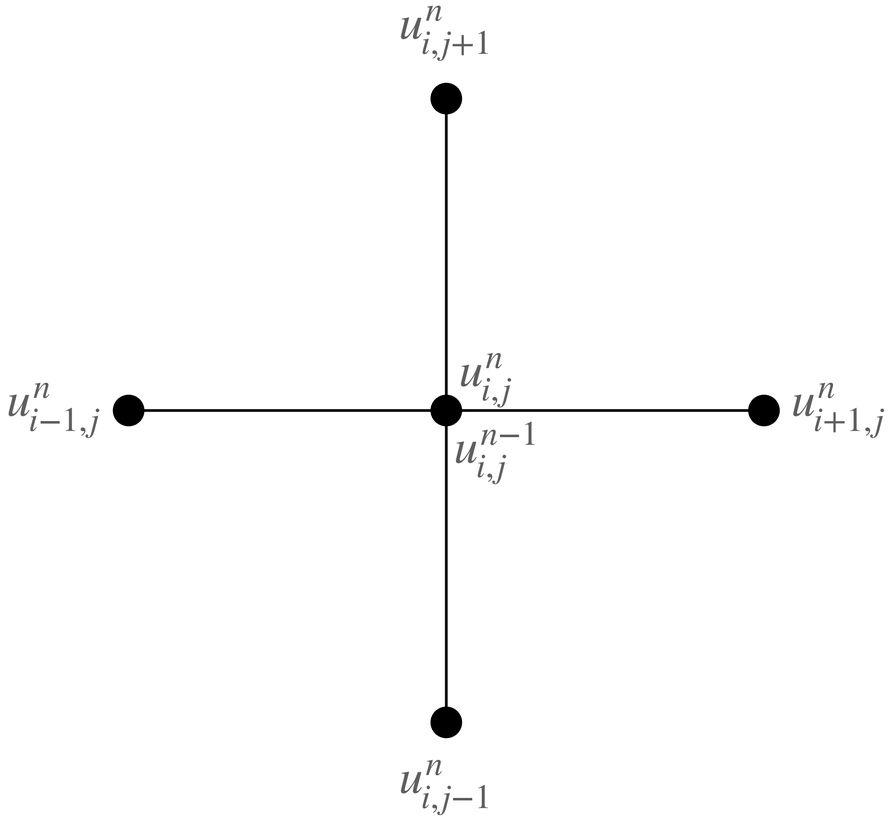

Height limited by cycles
Width limited by hardware

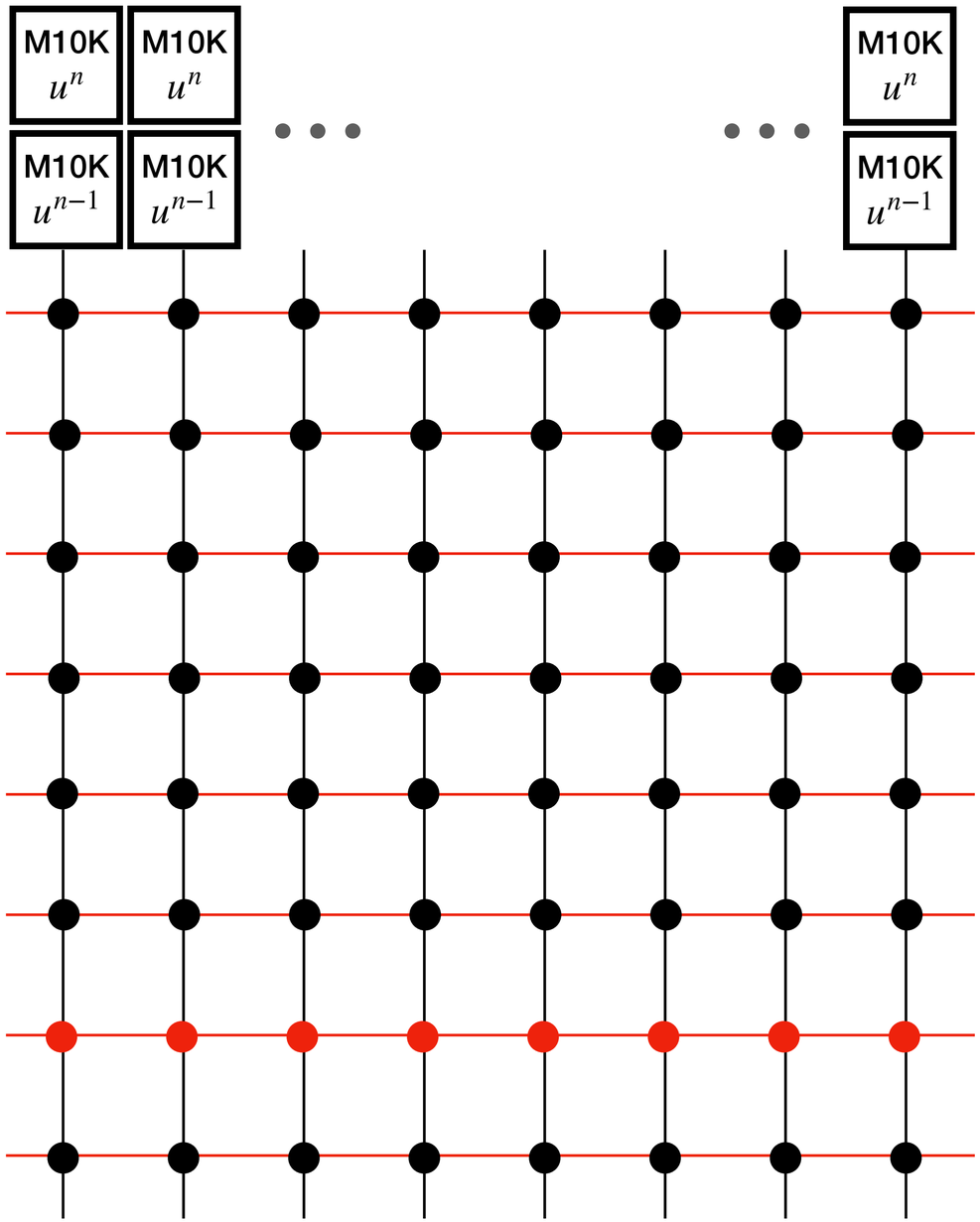
Compute Module

Inputs: $u_{i,j}^{n}$, $u_{i,j}^{n-1}$, $u_{i-1,j}$, $u_{i+1,j}$, $u_{i,j+1}$, $u_{i,j-1}$

Output: $u_{i,j}^{n+1}$

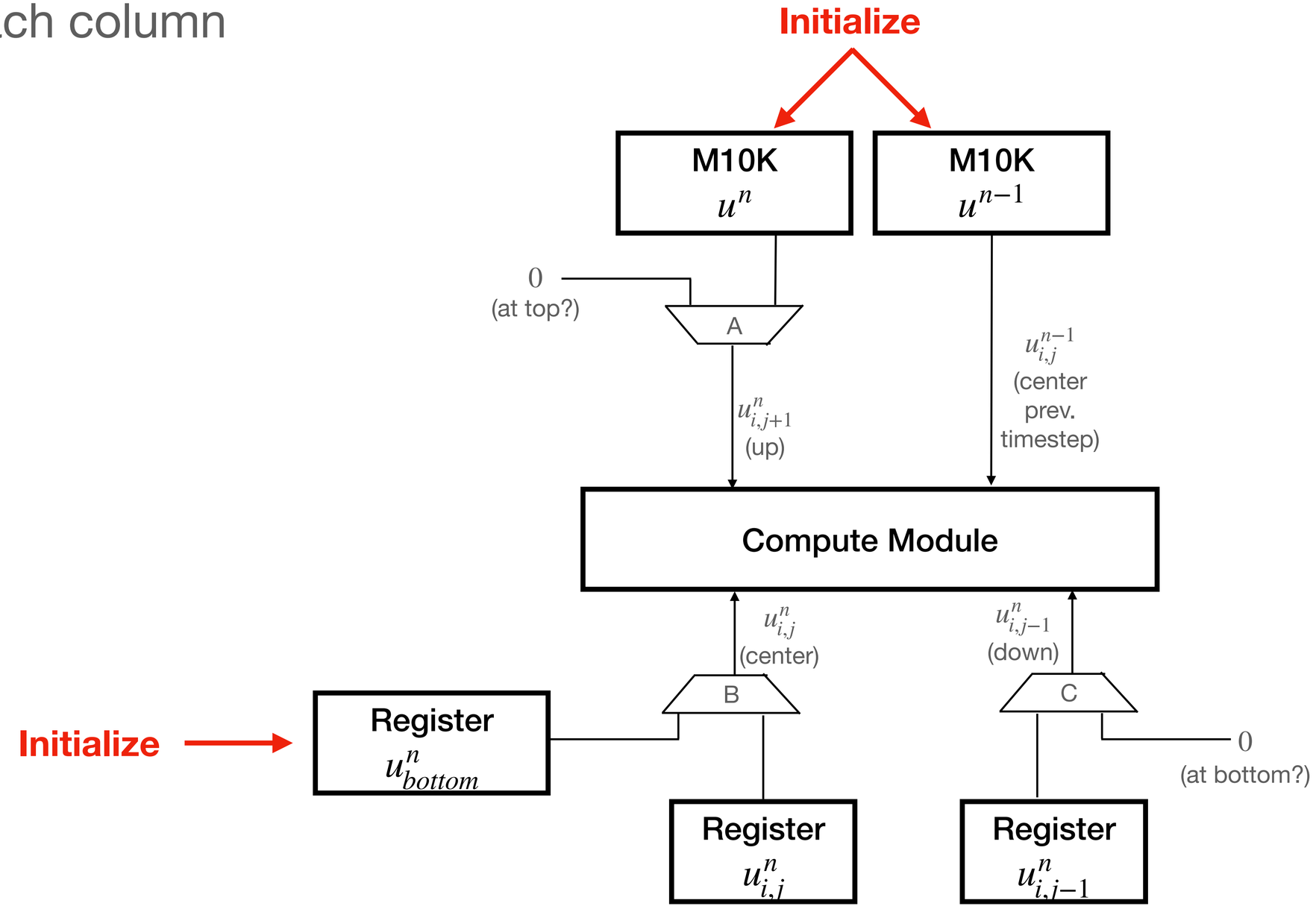
$$u_{i,j}^{n+1} = \left[1 - \frac{\eta \Delta t}{2}\right] \left\{ \rho \left[u_{i+1,j}^{n} + u_{i-1,j}^{n} + u_{i,j-1}^{n} + u_{i,j+1}^{n} - 4u_{i,j}^{n}\right] + 2u_{i,j}^{n} - \left[1 - \frac{\eta \Delta t}{2}\right] u_{i,j}^{n-1} \right\}$$



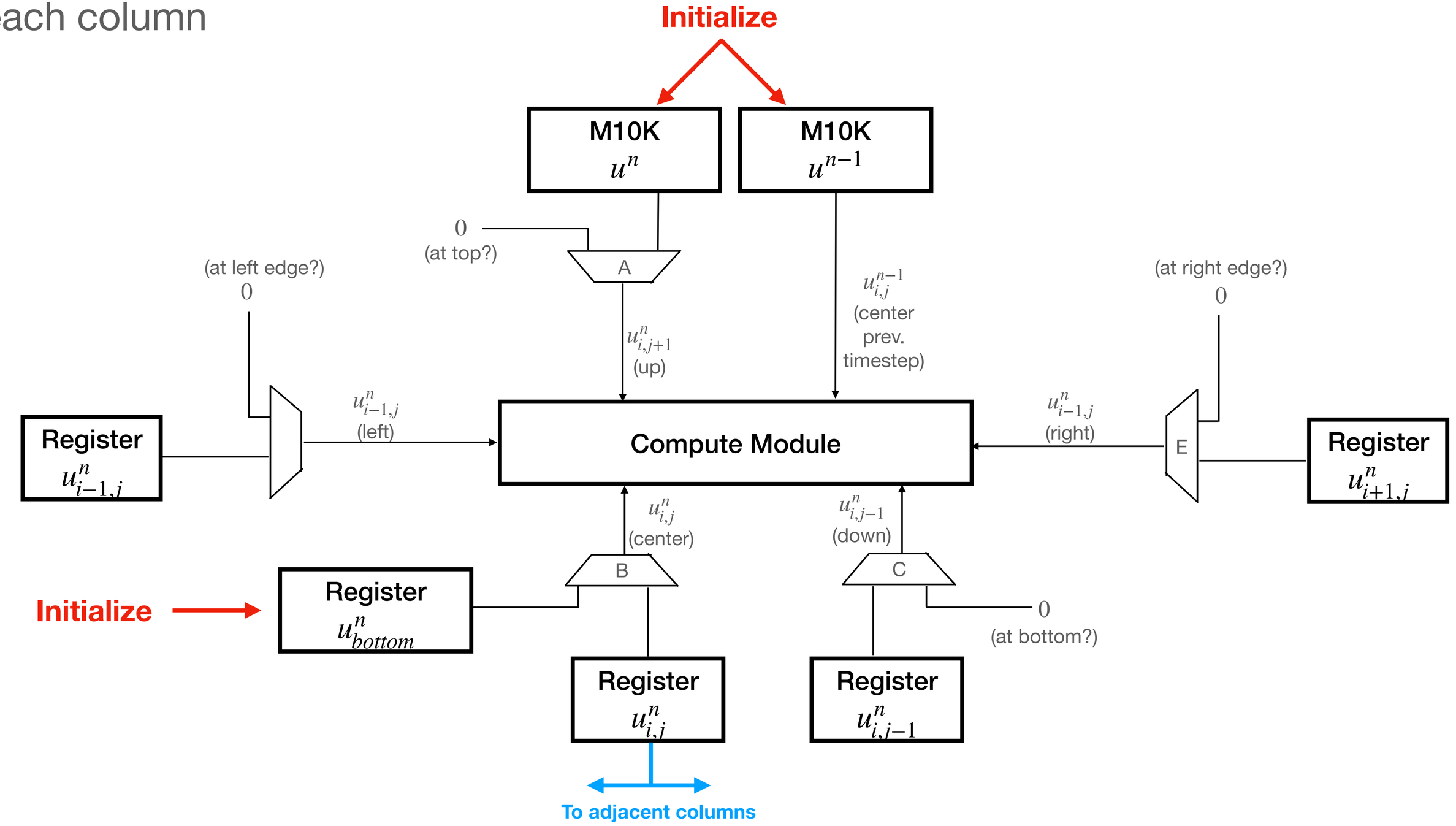


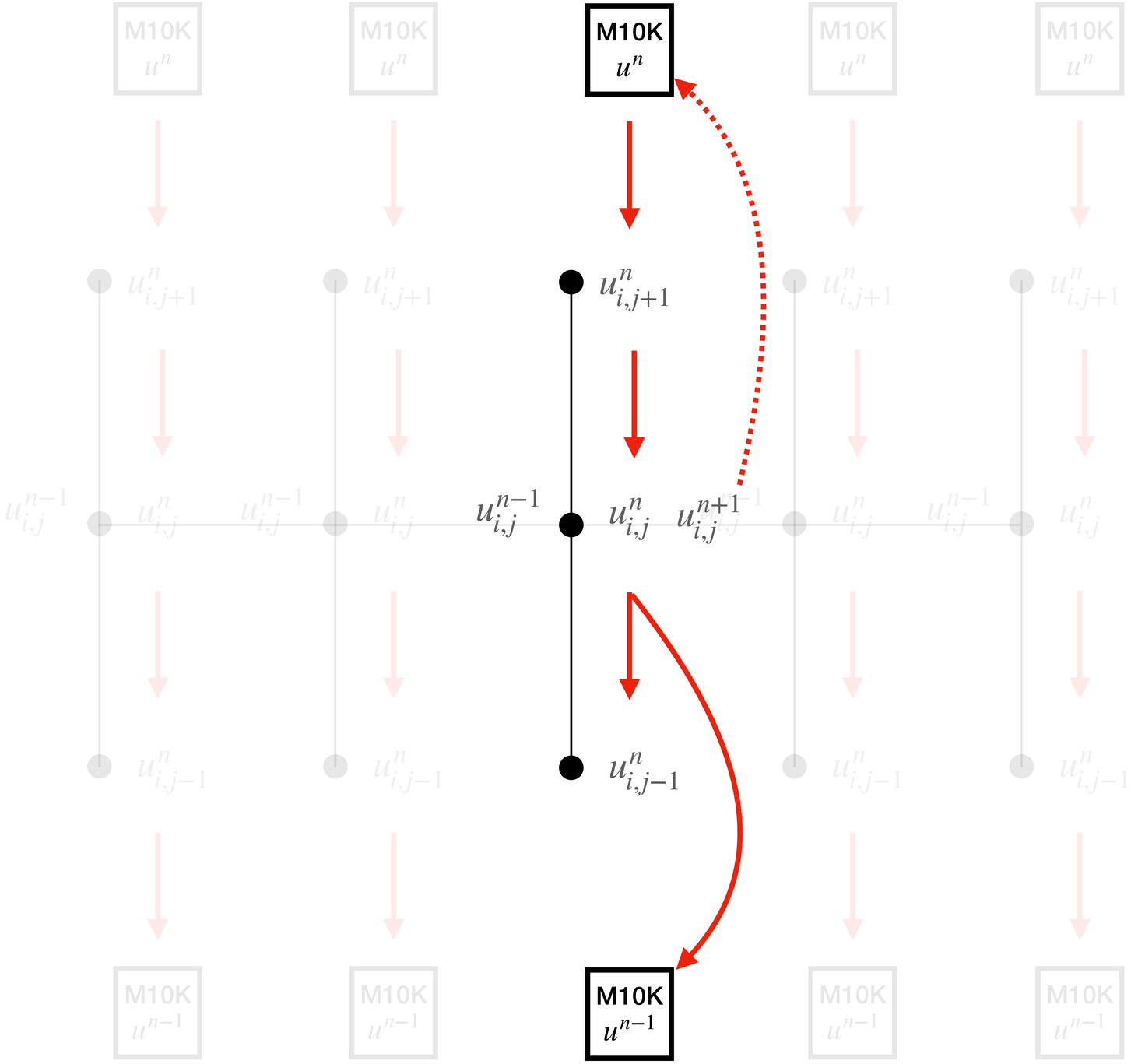
Two M10k blocks for each column

For each column

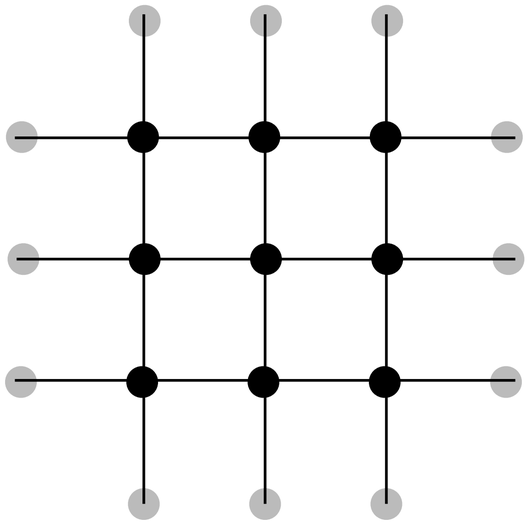


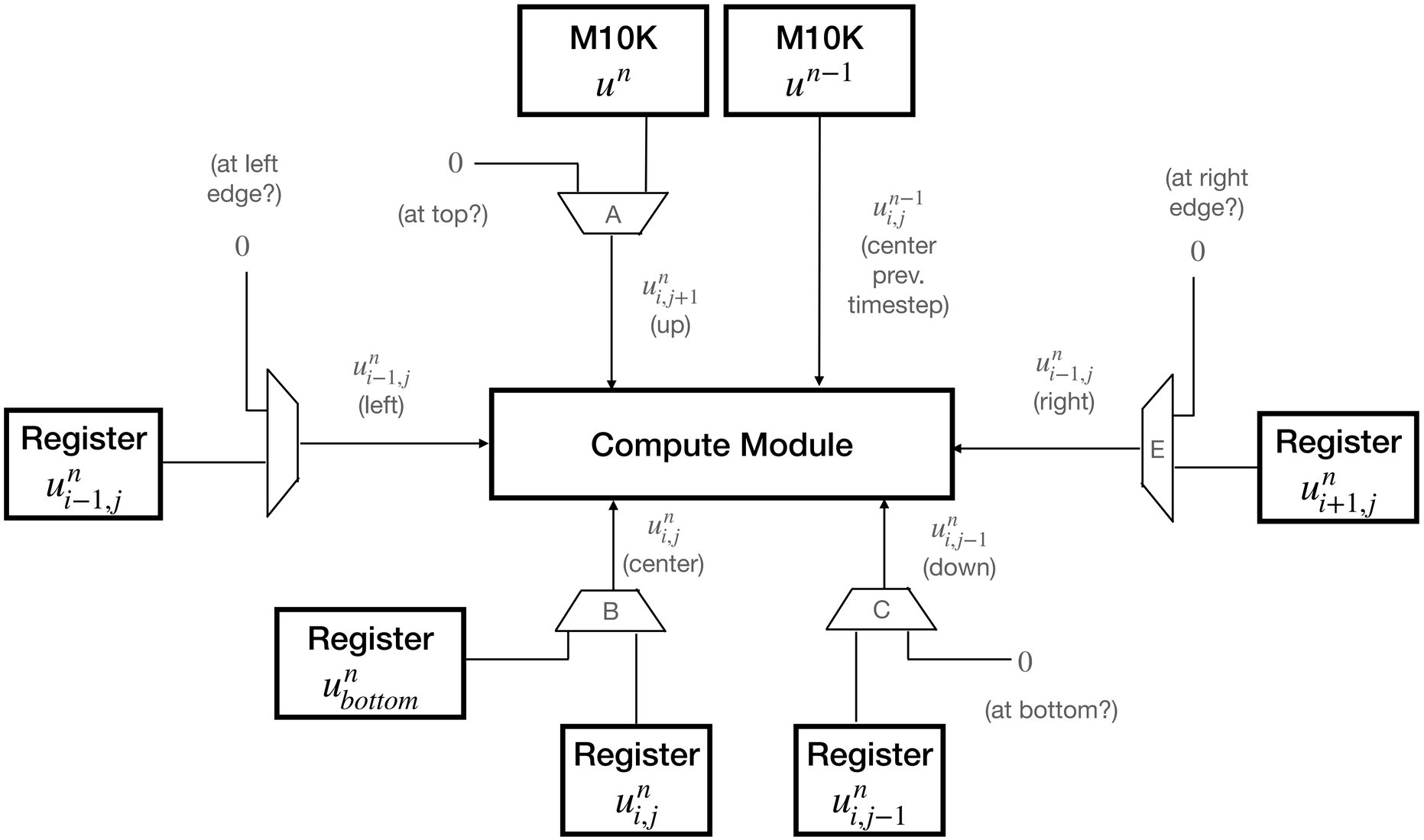
For each column



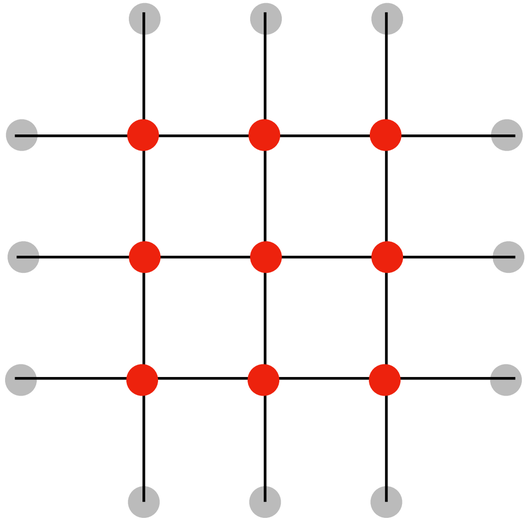

M10K
u^n
$u^n_{i,j+1}$
$u^{n-1}_{i,j}$
$u^n_{i,j}$
$u^{n+1}_{i,j}$
$u^n_{i,j-1}$
M10K
u^{n-1}

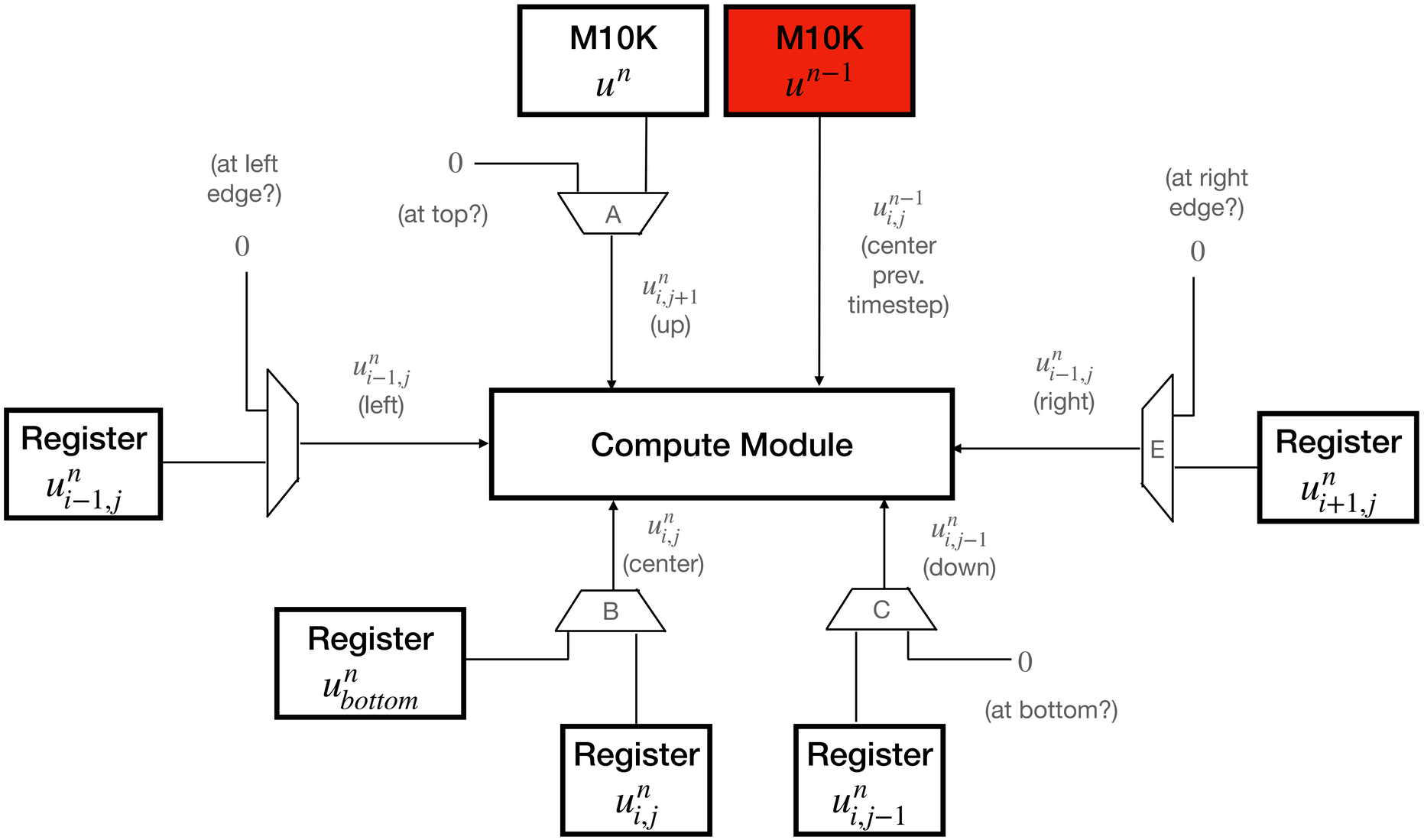
Updating a 3x3 drum



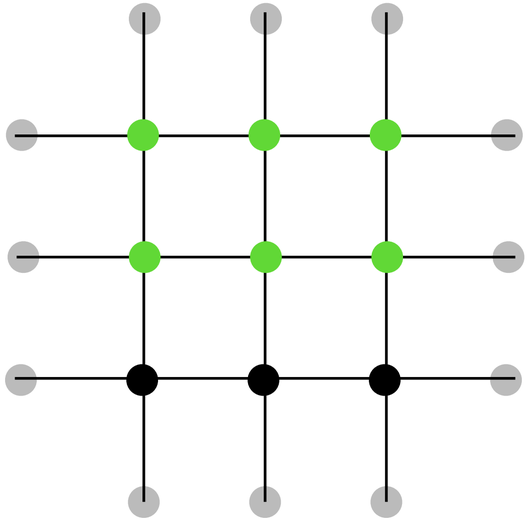


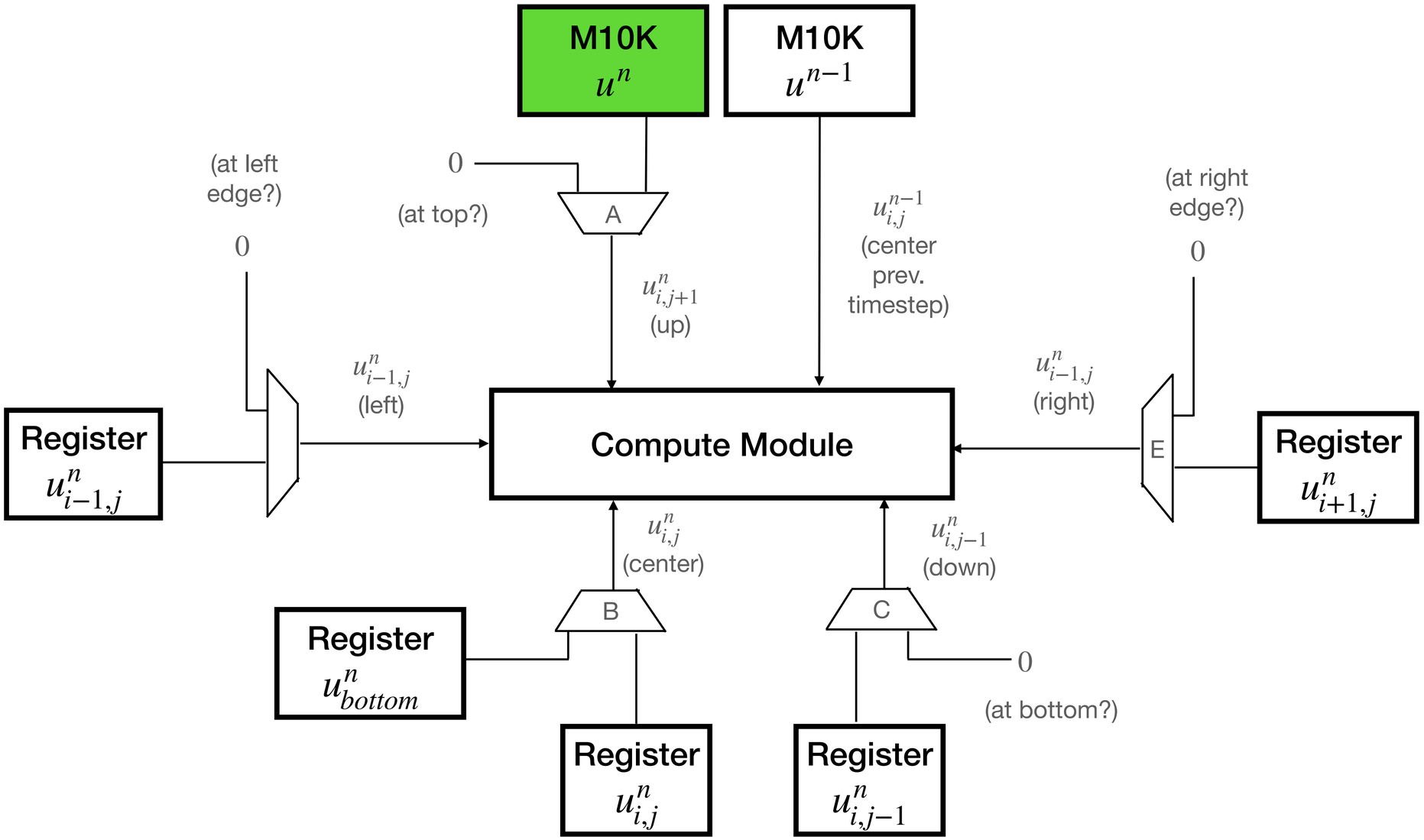
Initialize the $n-1$ states of each node (write M10K memory)



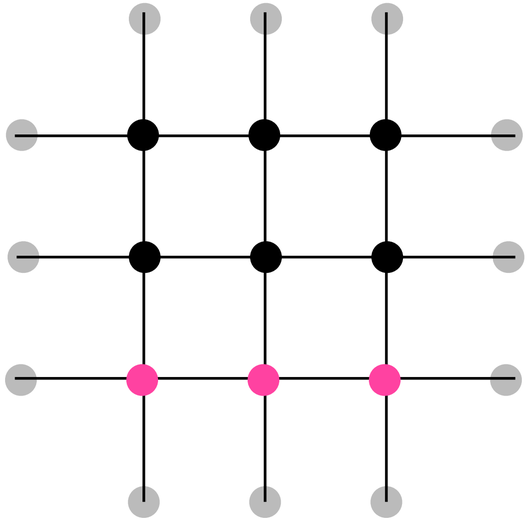


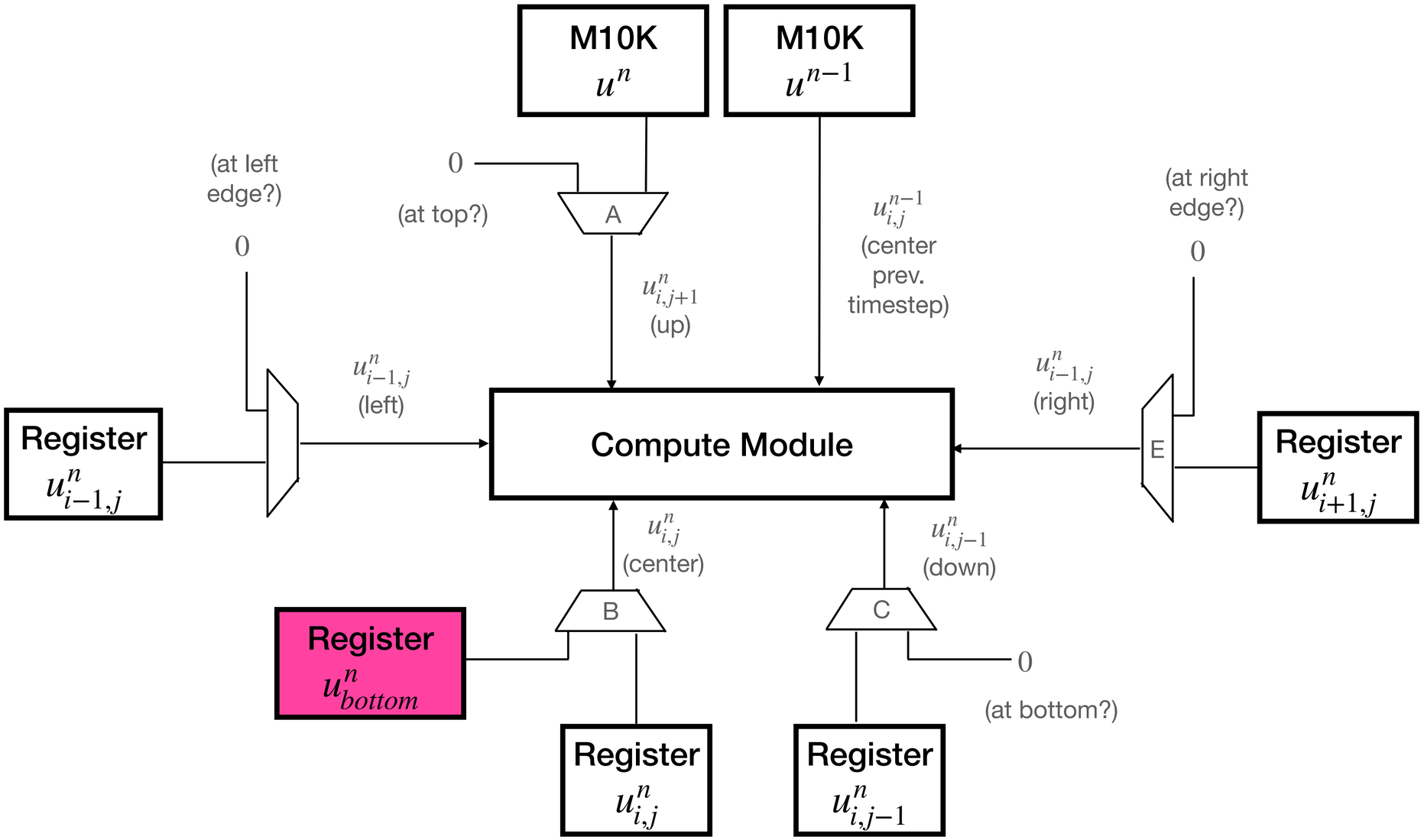
Initialize the n states of each node not in bottom row (write M10K memory)



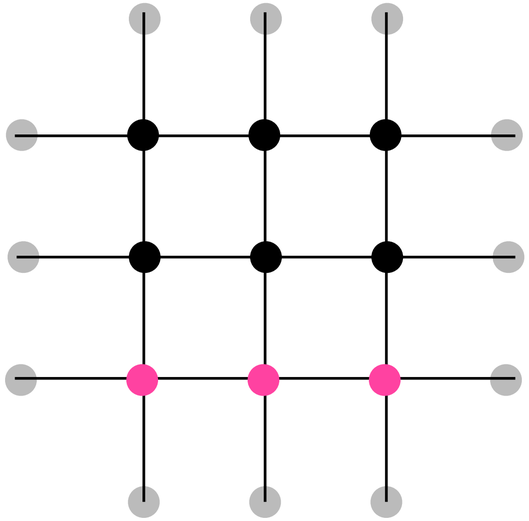


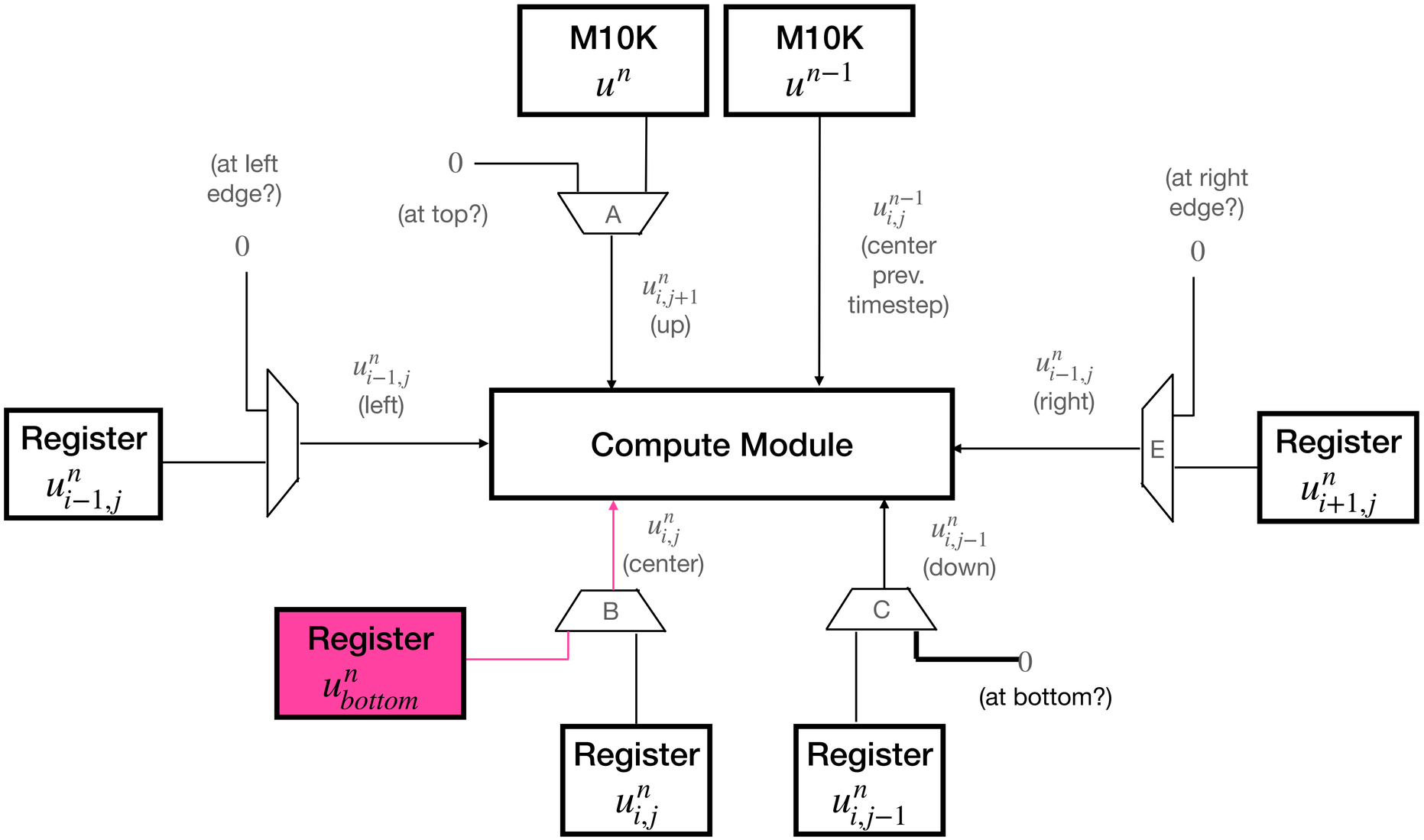
Initialize registers which hold the amplitudes of the bottom notes u^n_{bottom}



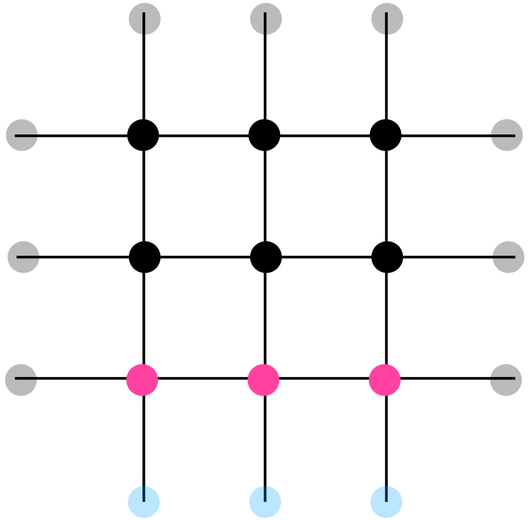


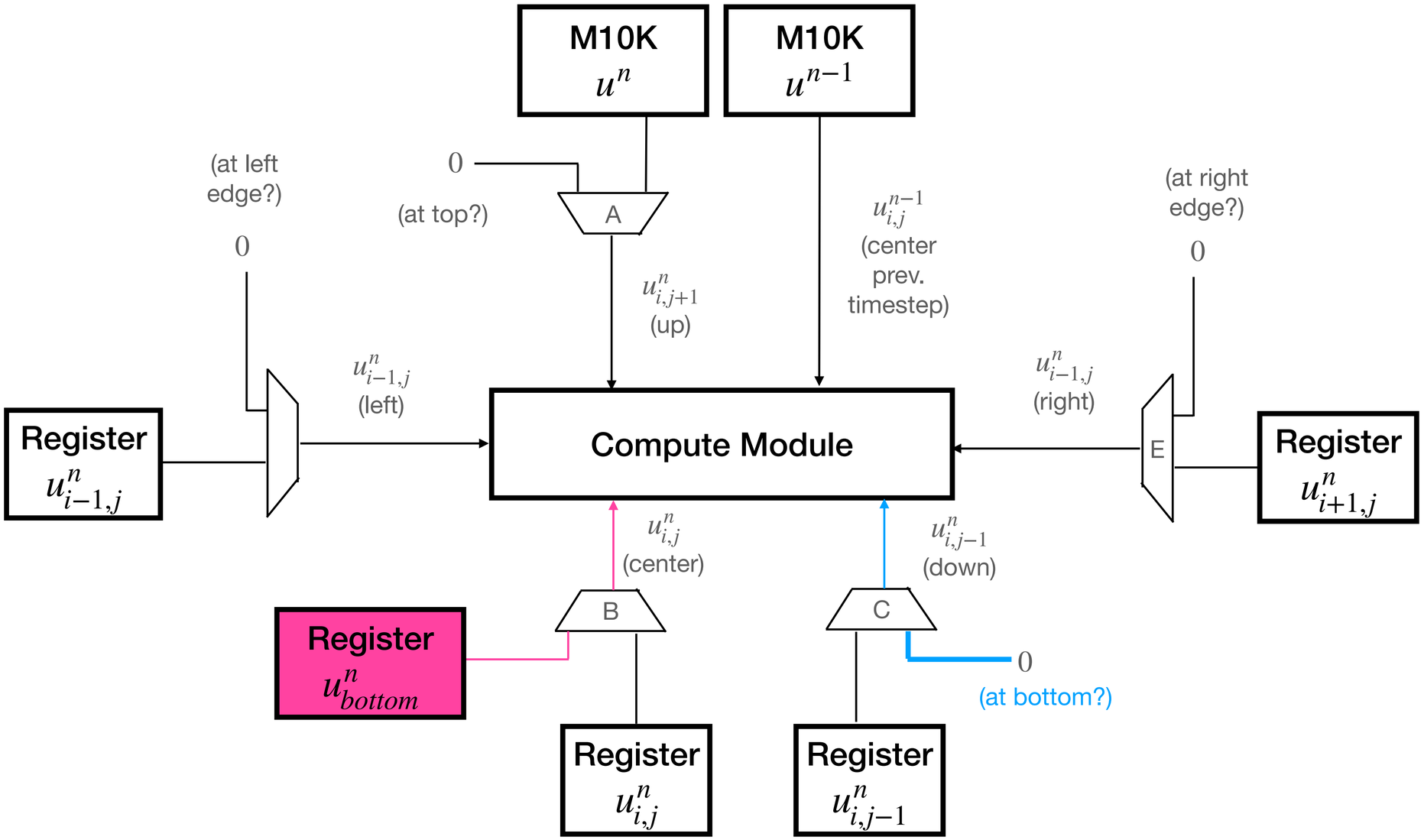
Start by updating the bottom row of the drum.



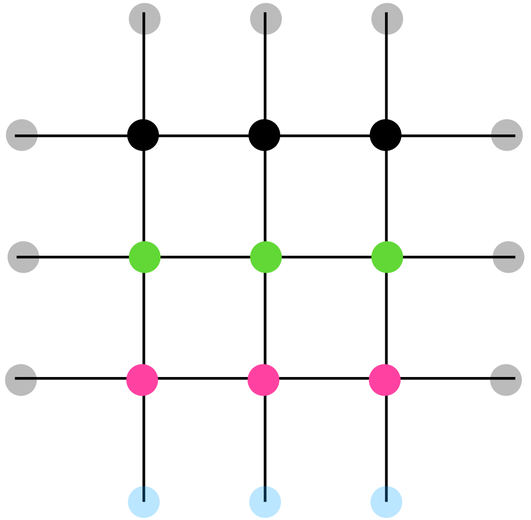


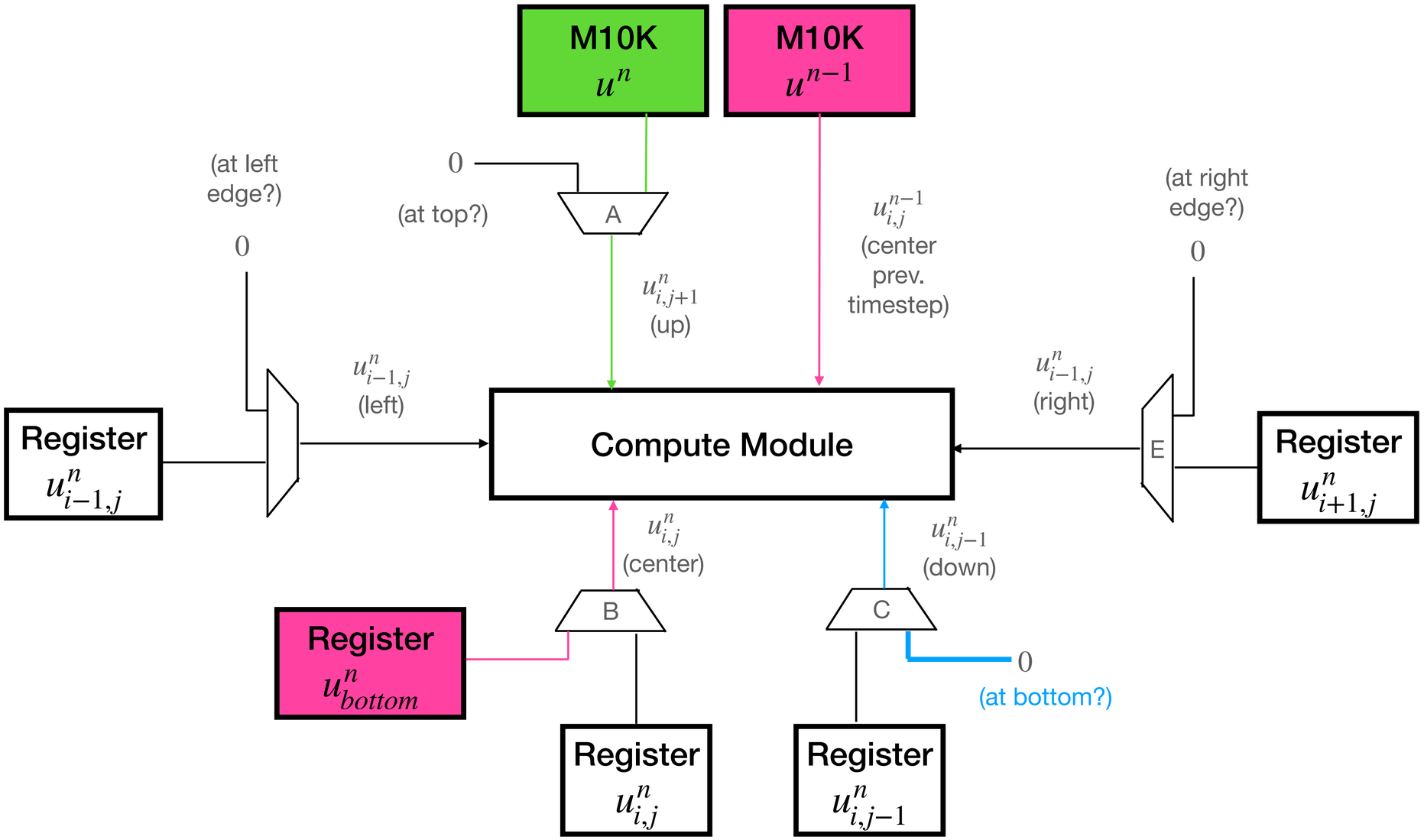
0 is multiplexed in for the “down” nodes since we are at an edge



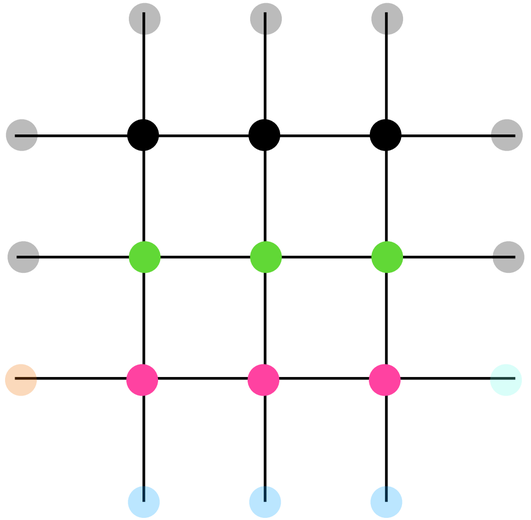


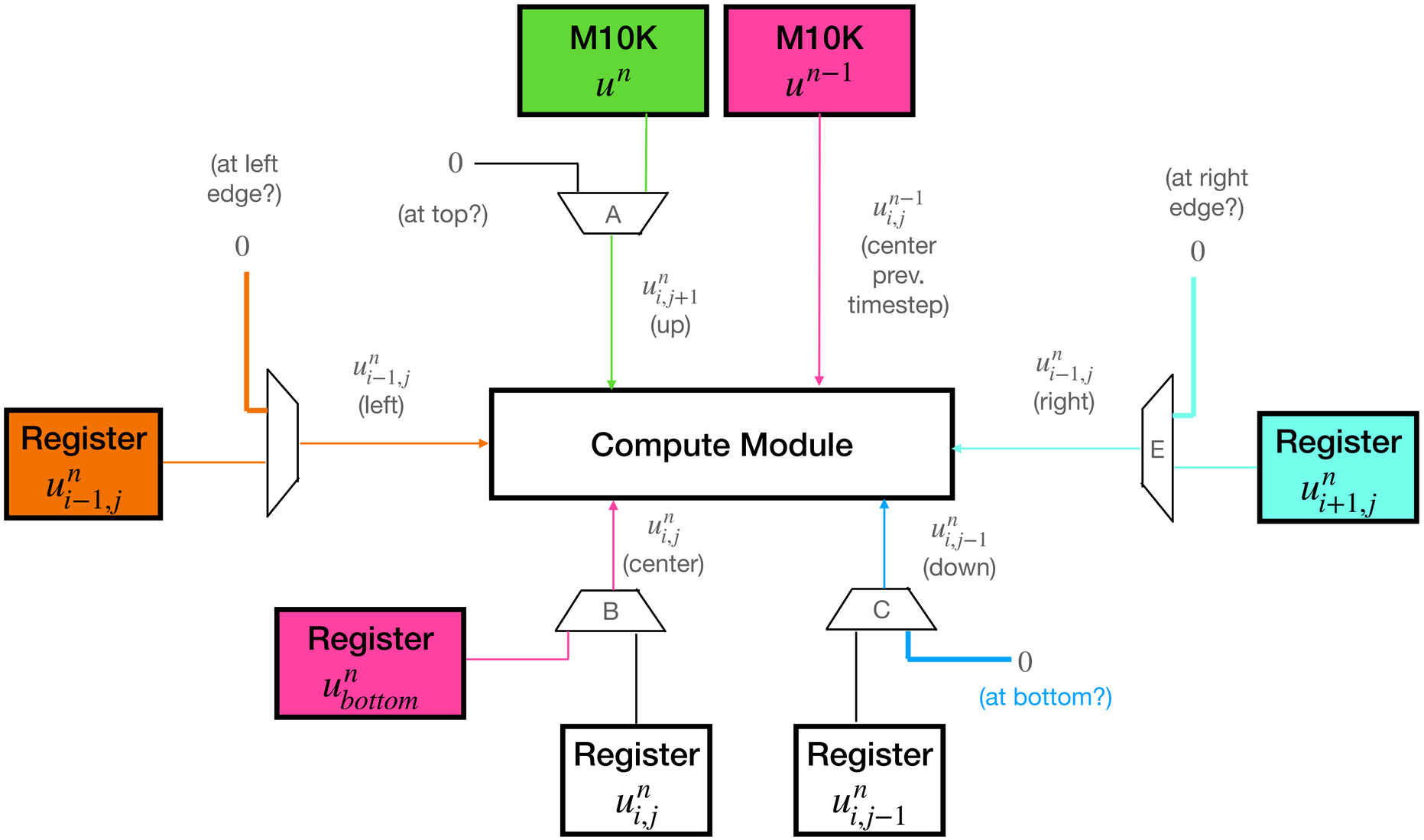
The “up” node and the $n-1$ state of center node are read from M10K memory



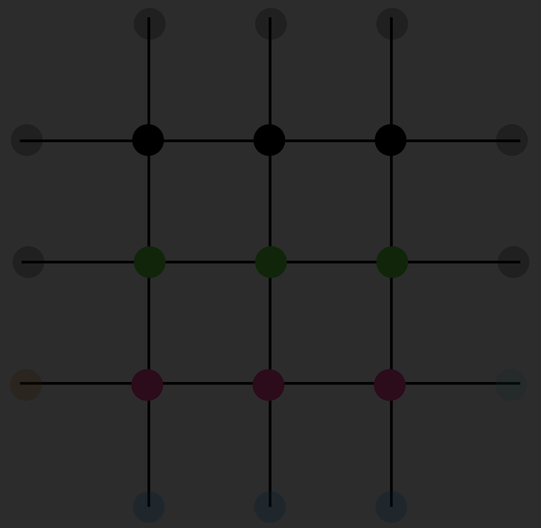


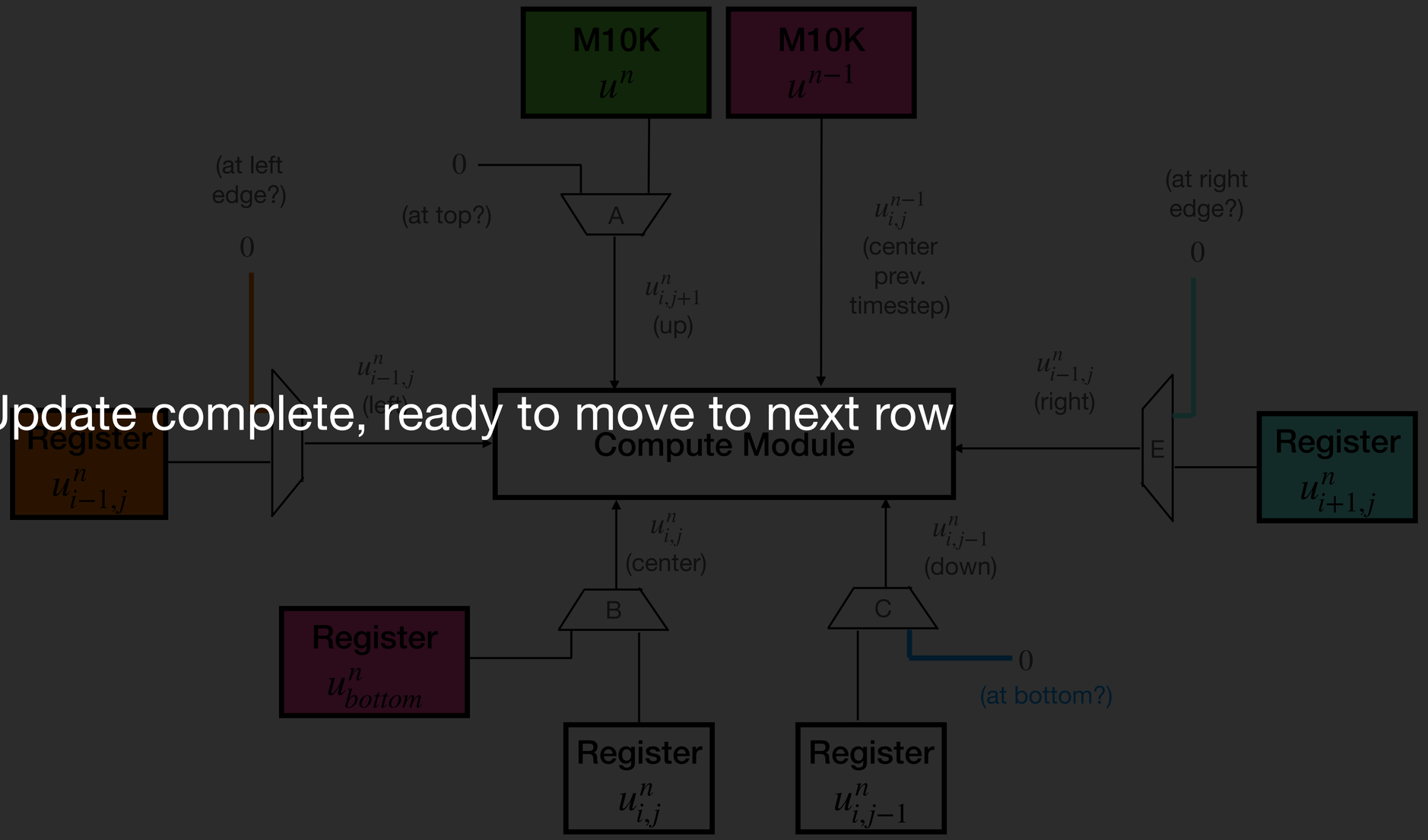
The “left” and “right” nodes are either the u^n_{bottom} registers from the adjacent columns, or 0



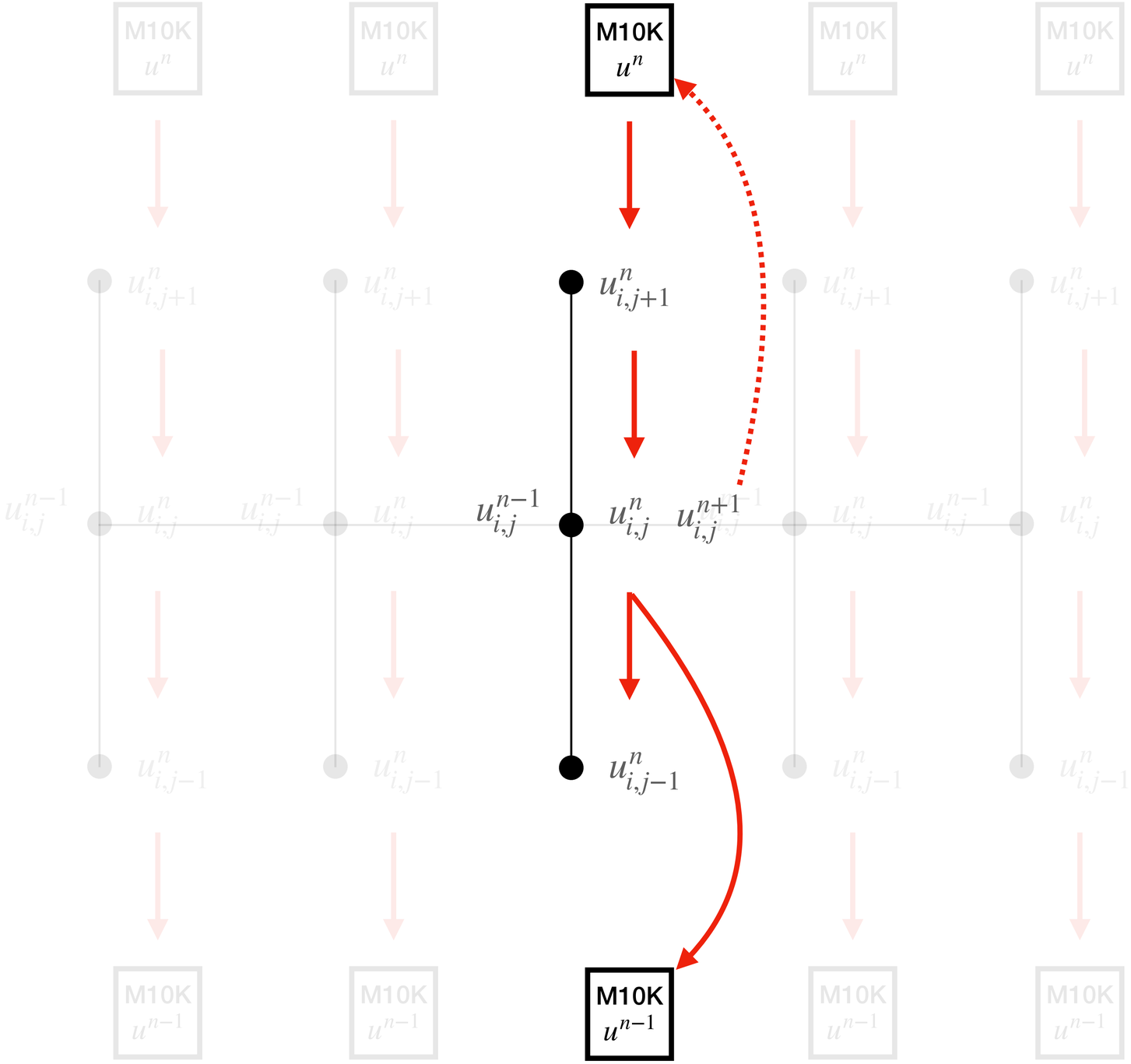


The “left” and “right” nodes are either the u^n_{bottom} registers from the adjacent columns, or 0





Update complete, ready to move to next row

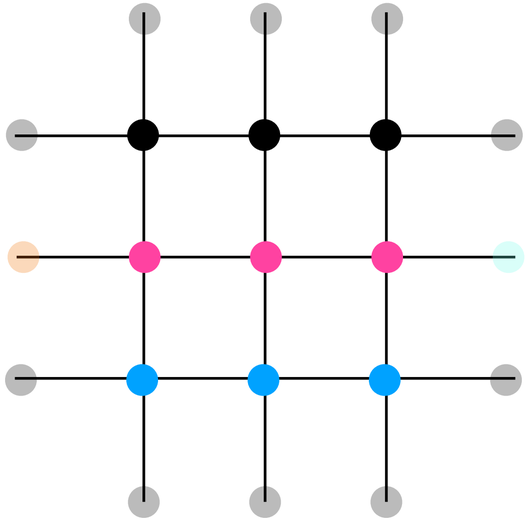

M10K
u^n
$u^n_{i,j+1}$
$u^{n-1}_{i,j}$
$u^n_{i,j}$
$u^{n+1}_{i,j}$
$u^n_{i,j-1}$
M10K
u^{n-1}

$u^{n+1}_{bottom} \rightarrow u^{n}_{bottom}$

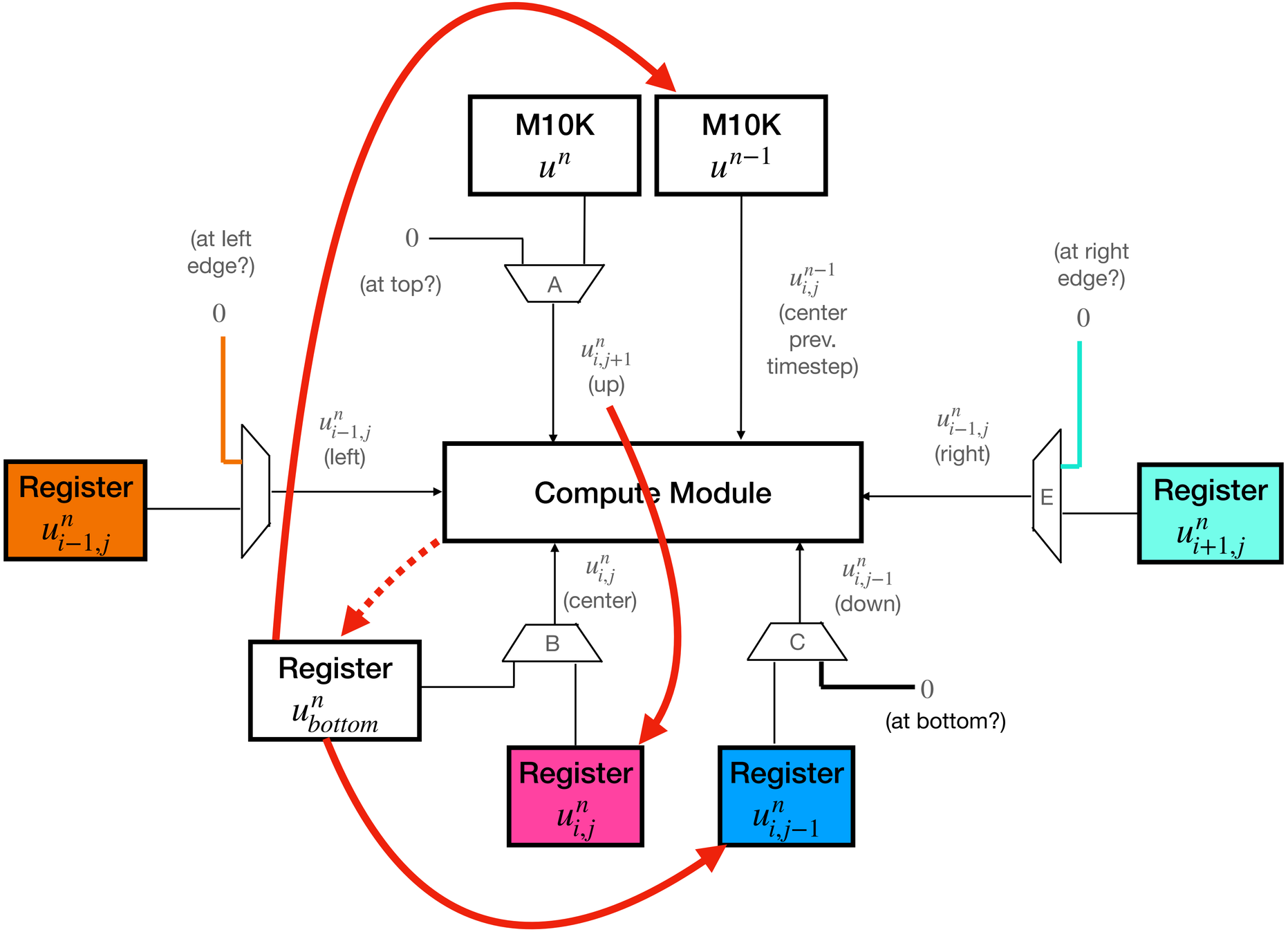
$u^{n}_{bottom} \rightarrow u^{n}_{i,j-1}$

$u^{n}_{bottom} \rightarrow$ M10k n-1

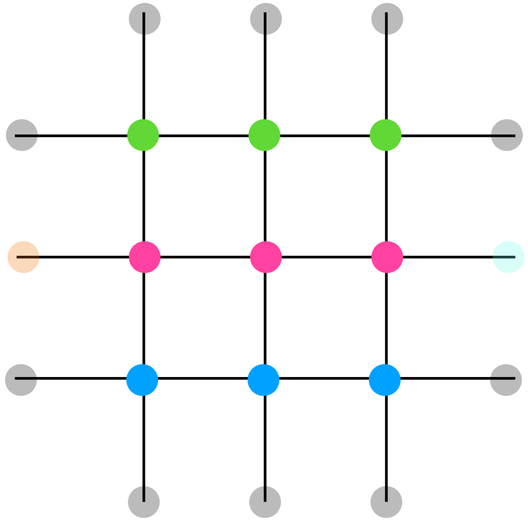
$u^{n}_{i,j+1} \rightarrow u^{n}_{i,j}$

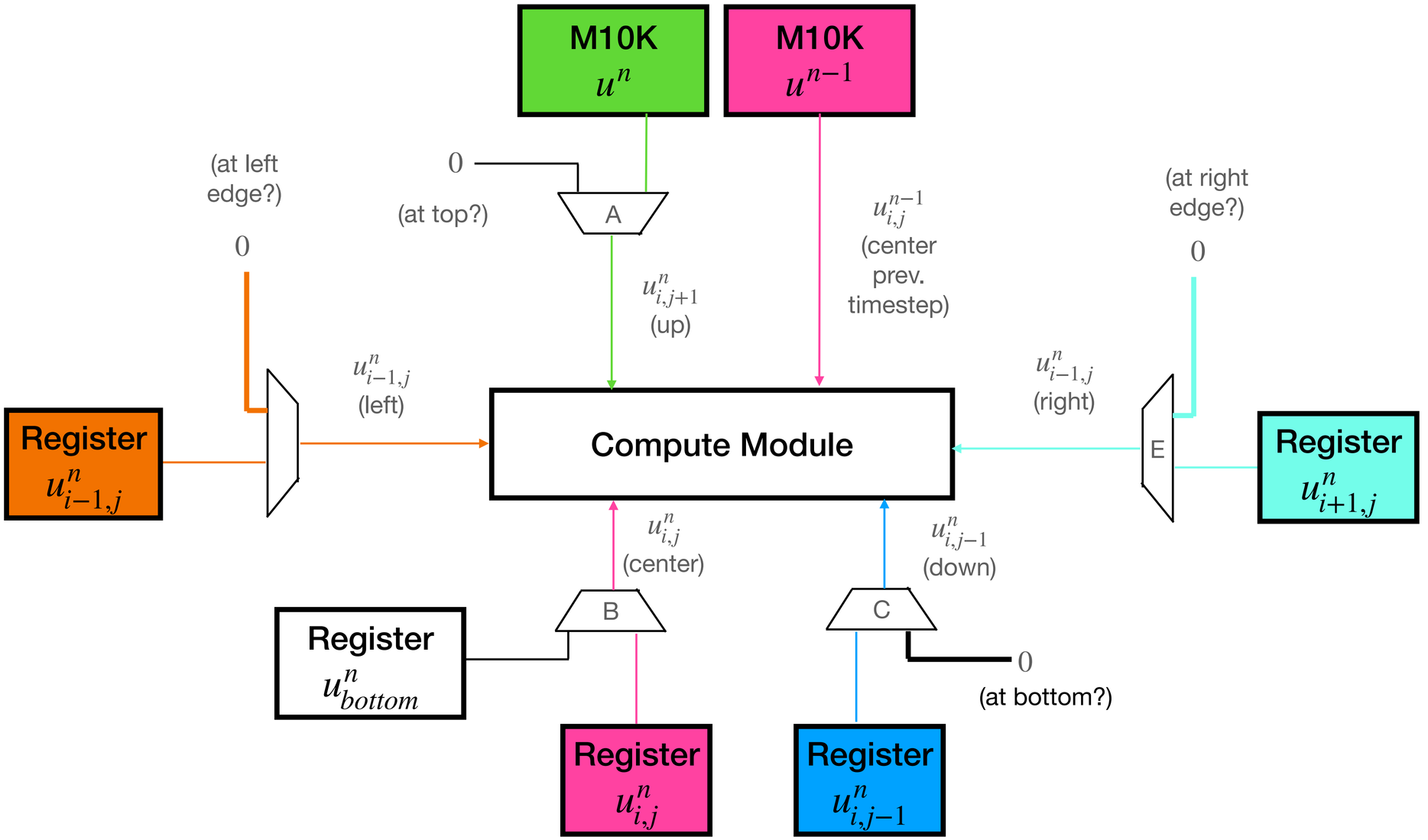


(happens in parallel across all columns, so left/right values update when each column updates)

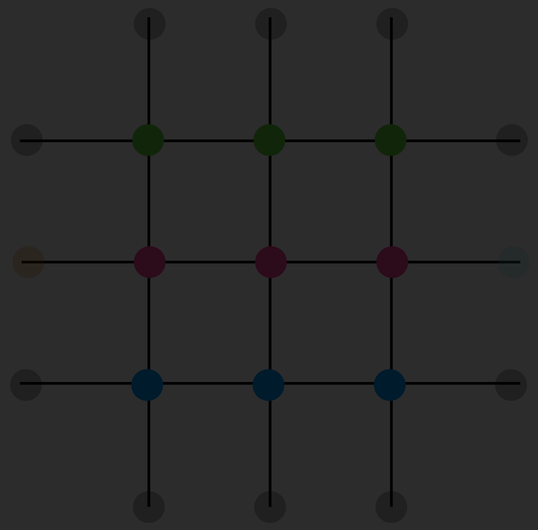


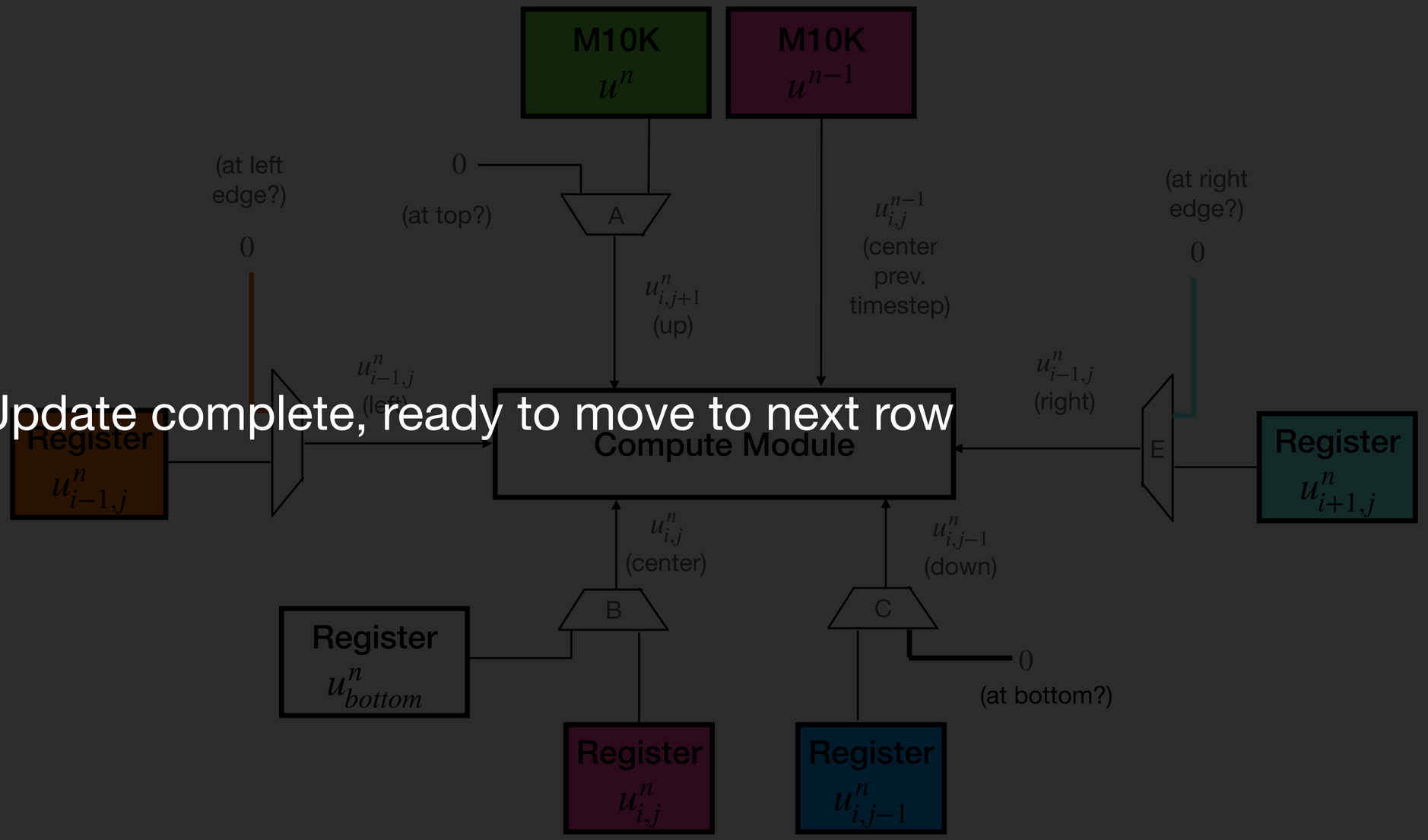
The “up” node and the $n-1$ state of center node are read from M10K memory





The “up” node and the $n-1$ state of center node are read from M10K memory





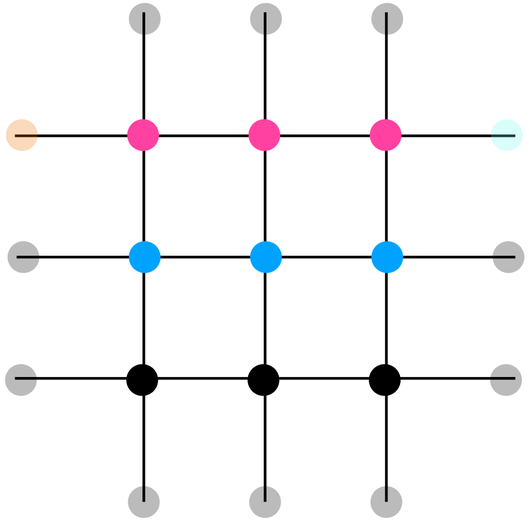
Update complete, ready to move to next row

$u_{i,j}^{n+1} \rightarrow$ M10k n

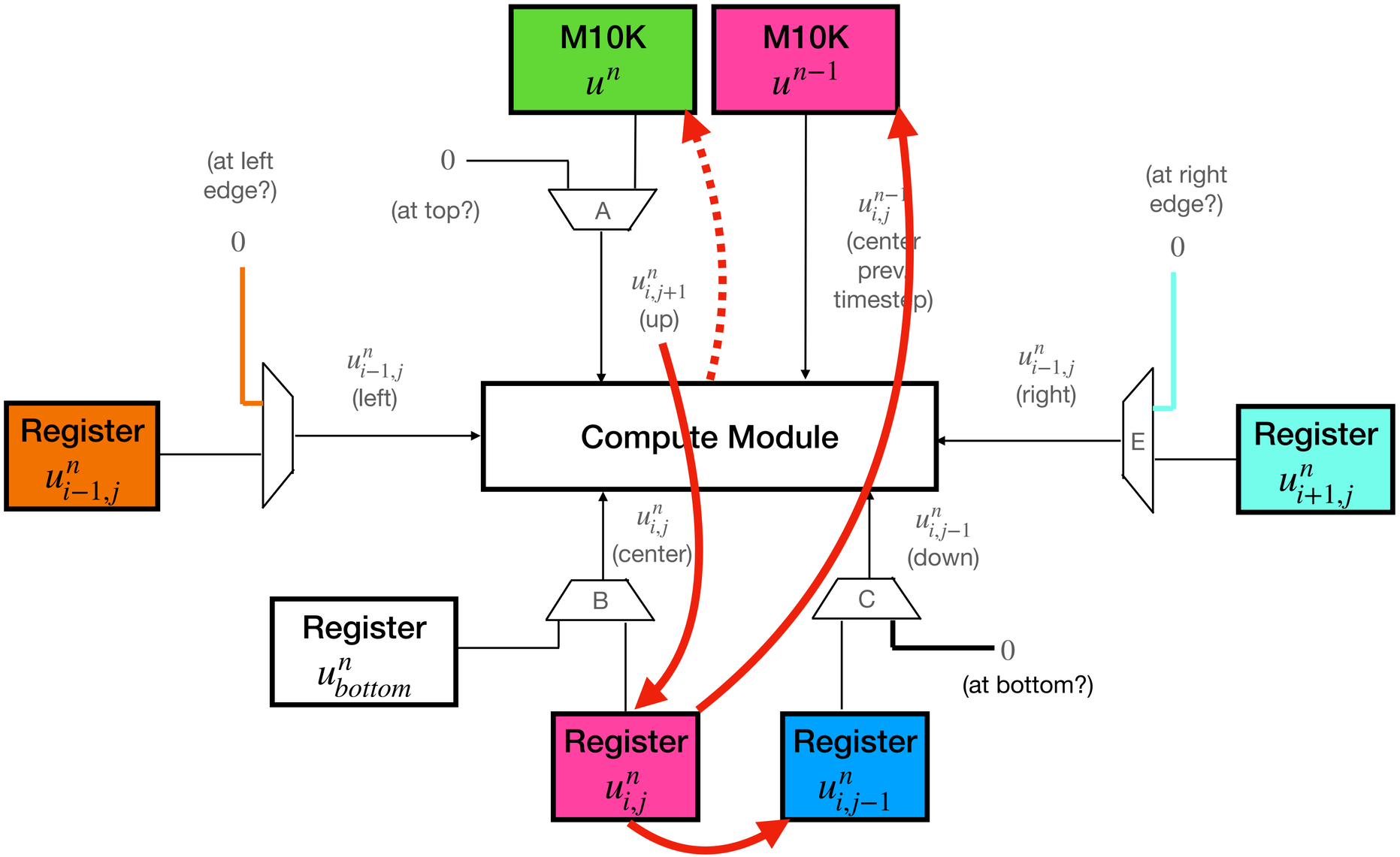
$u_{i,j+1}^{n} \rightarrow u_{i,j}^{n}$

$u_{i,j}^{n} \rightarrow u_{i,j-1}^{n}$

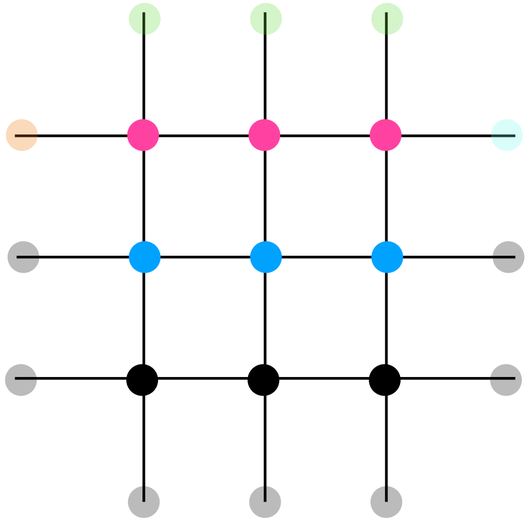
$u_{i,j-1}^{n} \rightarrow$ M10k n-1

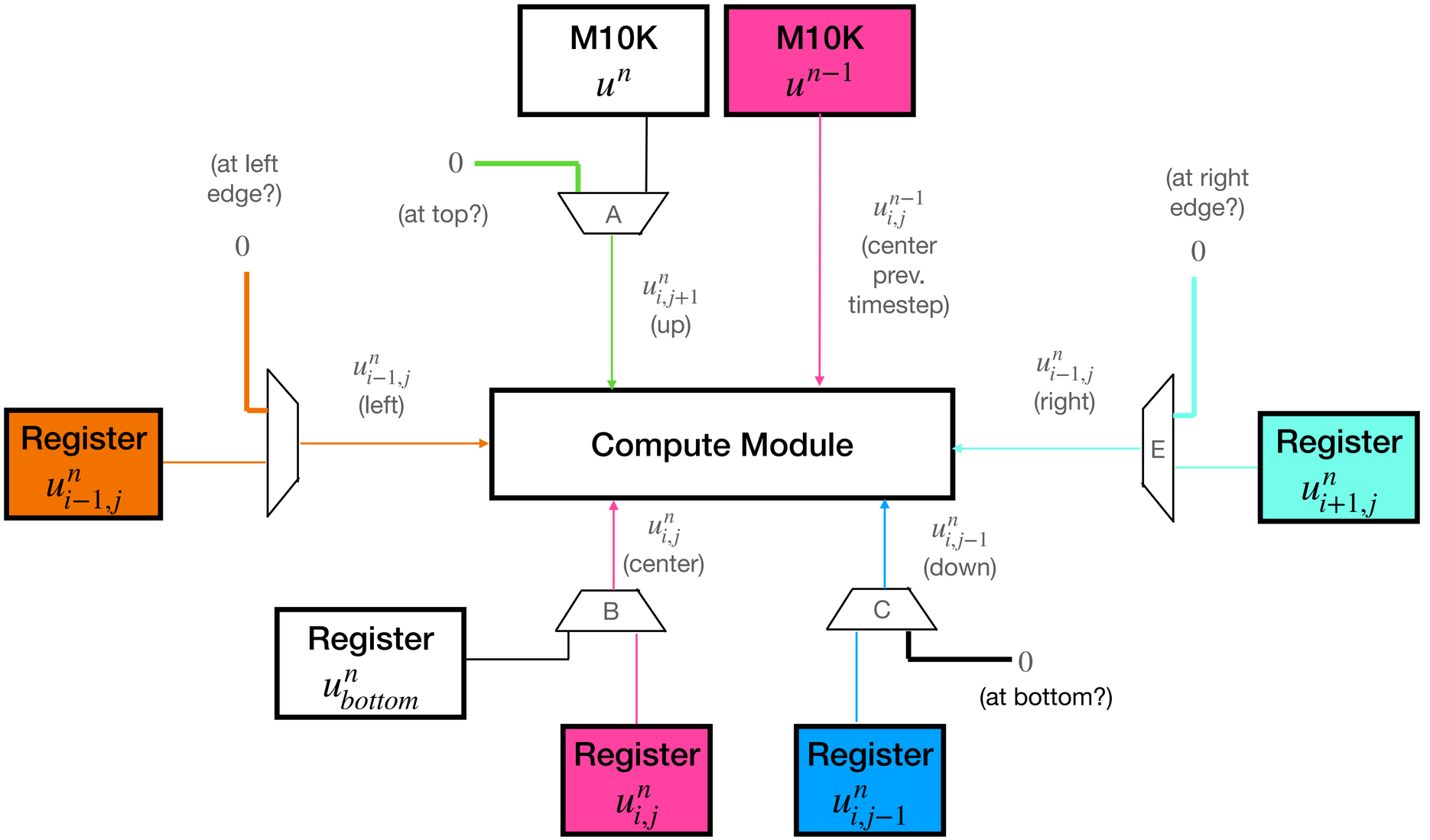


This is how information moves for *most* of the rows of the drum. The only other special-case row is the top

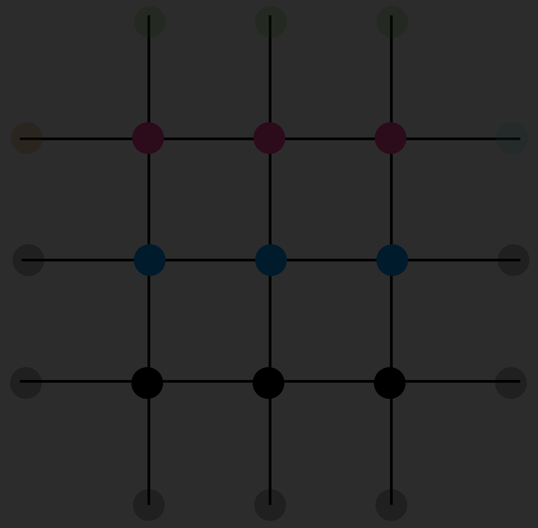


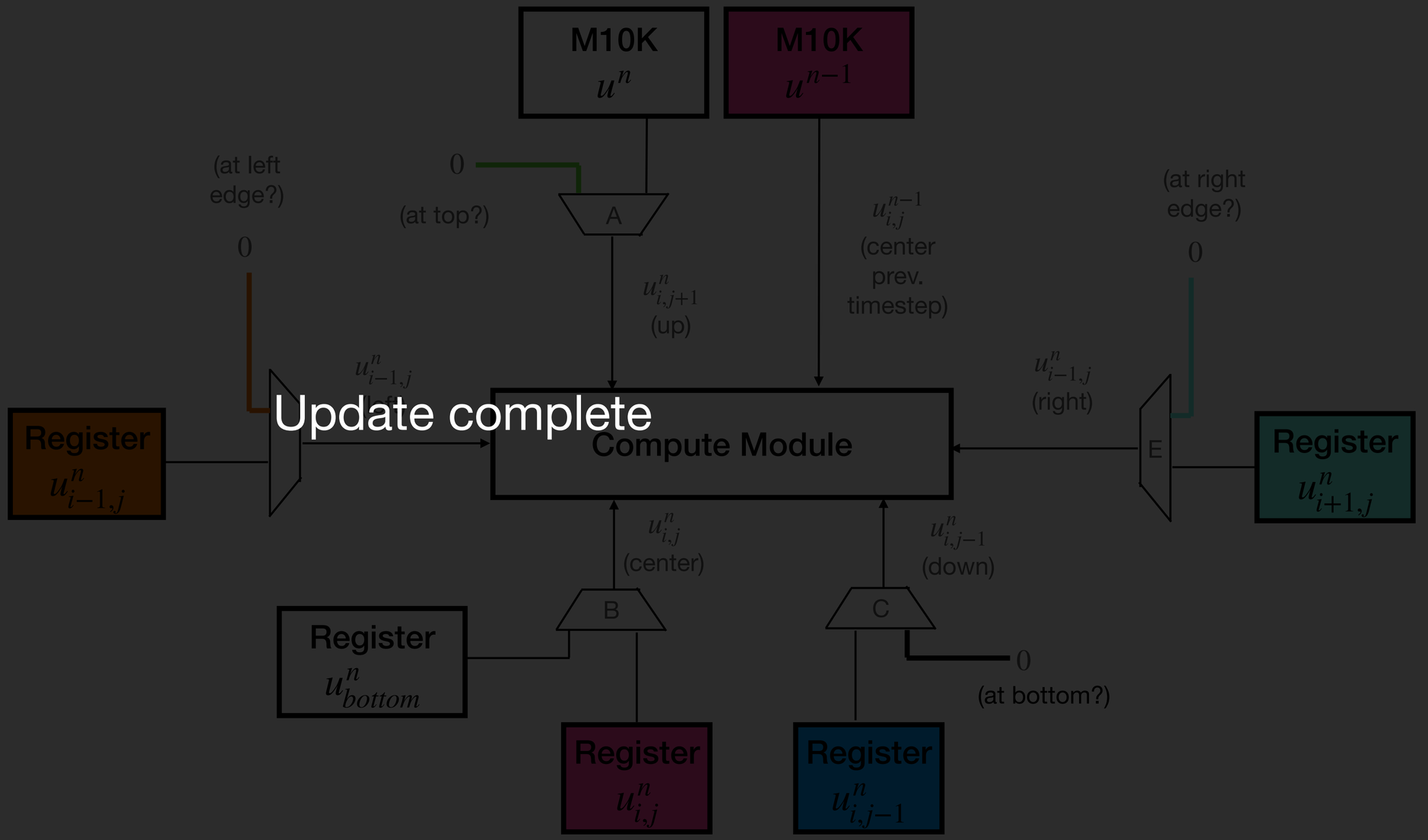
0 is multiplexed in for the “up node, the $n-1$ state of center node is read from M10K memory





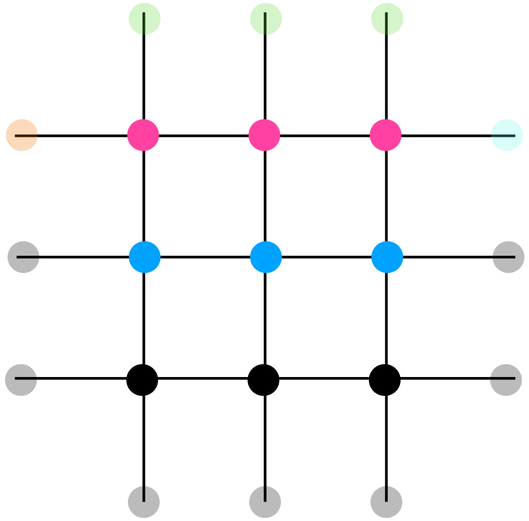
0 is multiplexed in for the “up node, the $n-1$ state of center node is read from M10K memory

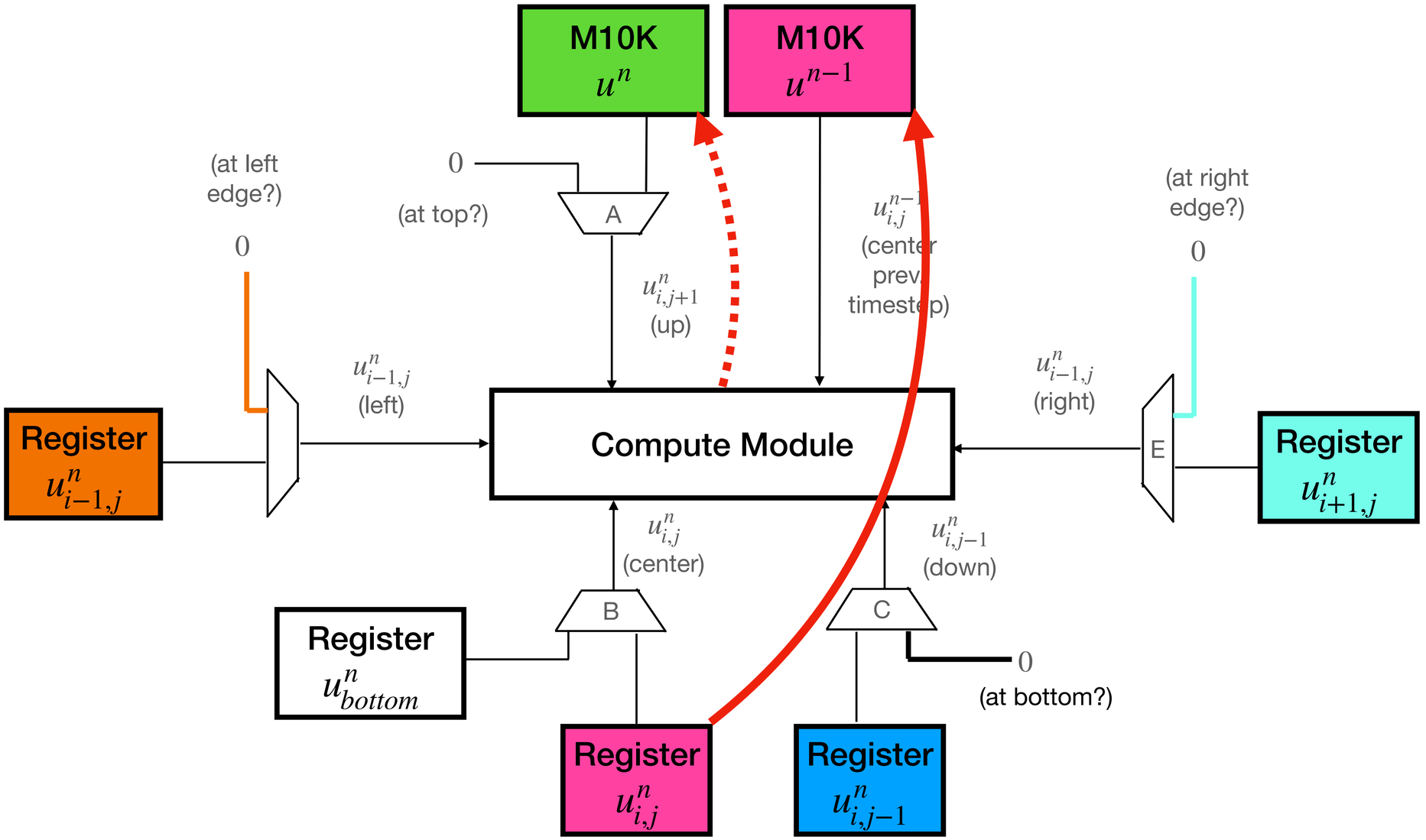




$u_{i,j}^{n+1}$ → M10k n

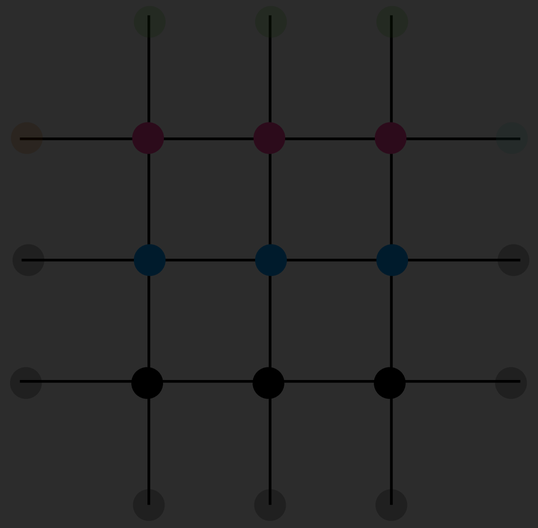
$u_{i,j}^{n}$ → M10k n-1

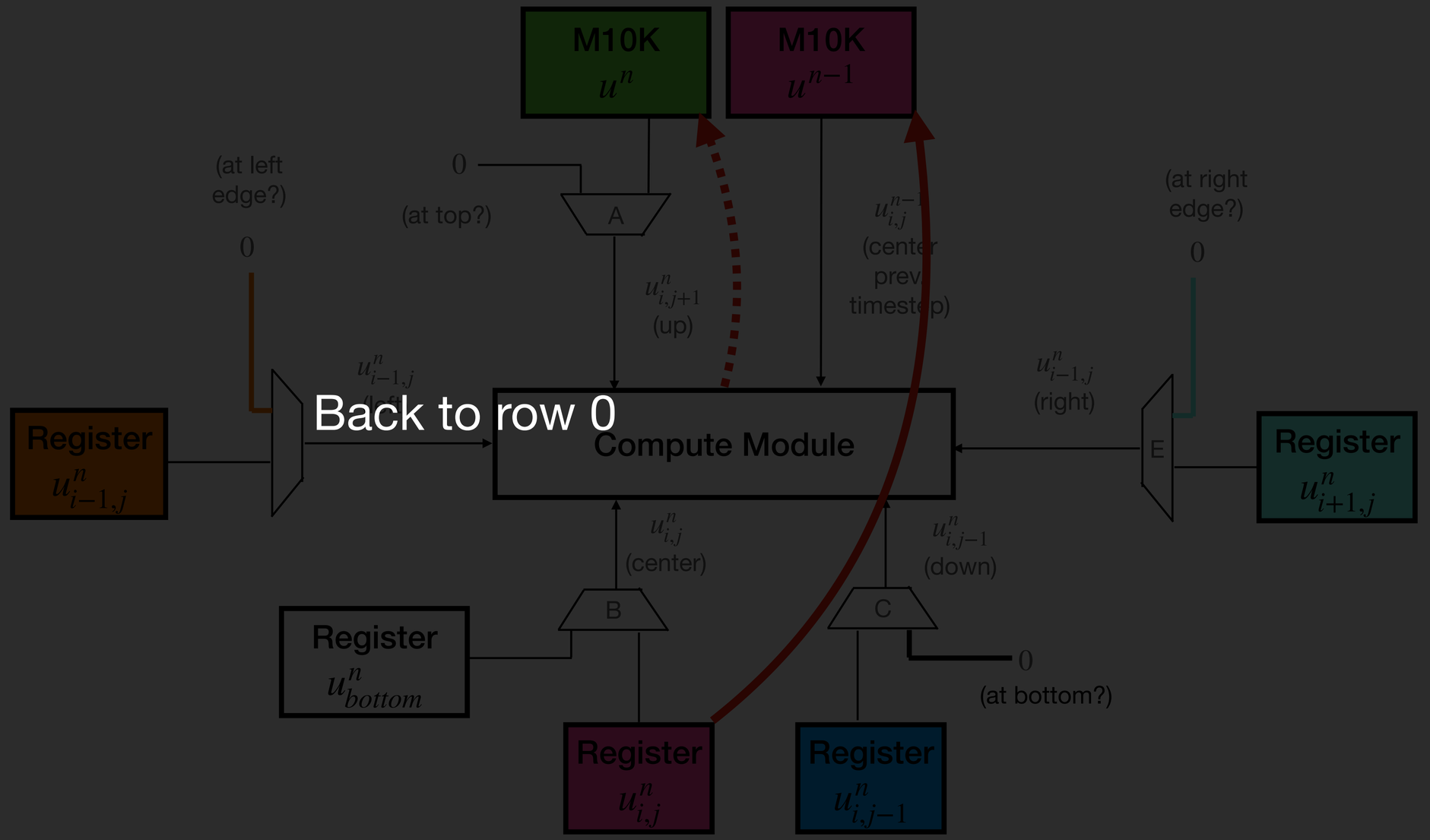




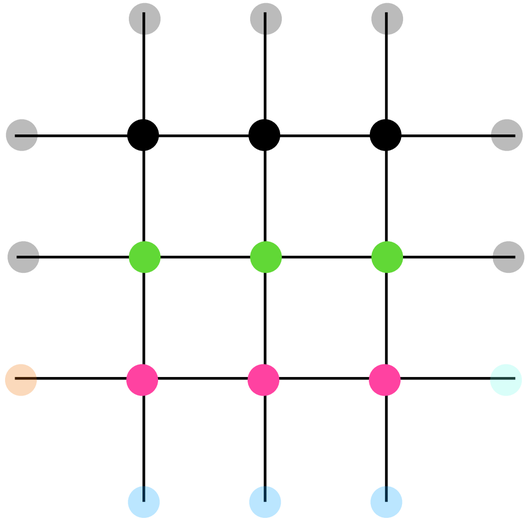
$u_{i,j}^{n+1}$ → M10k n

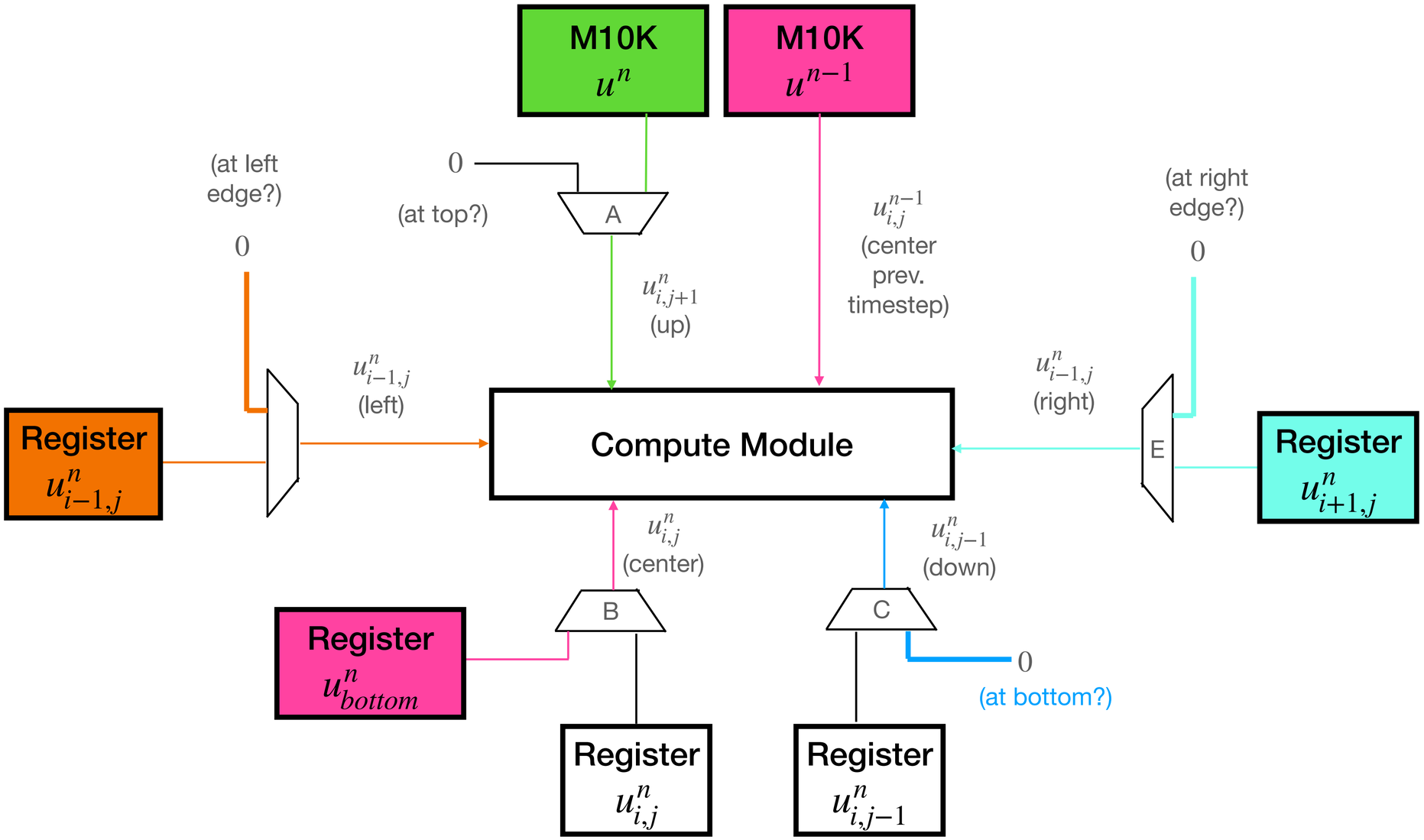
$u_{i,j}^{n}$ → M10k n-1

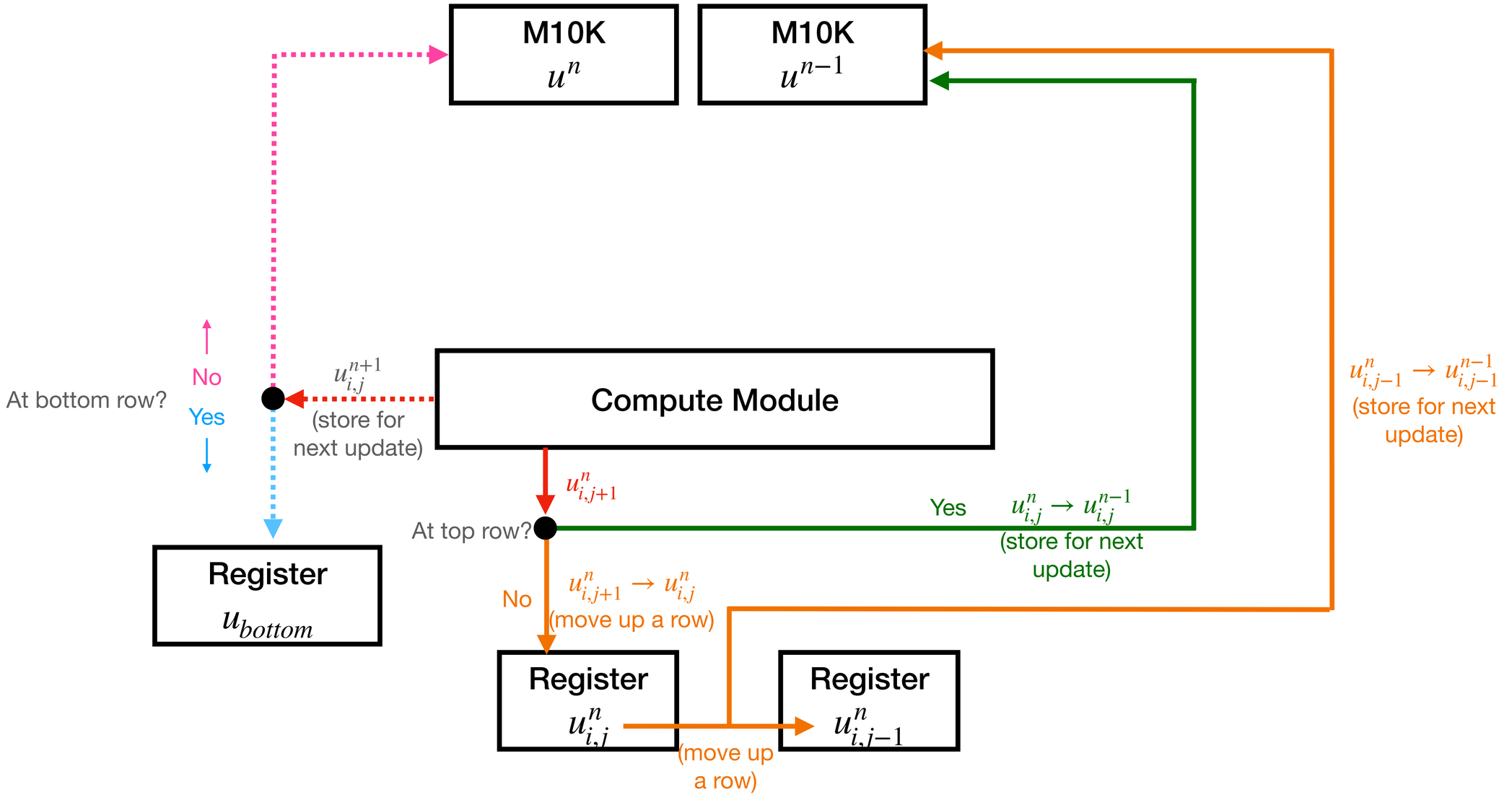




The “left” and “right” nodes are either the u^n_{bottom} registers from the adjacent columns, or 0







Solid line: pipelining information
Dotted line: moving new information