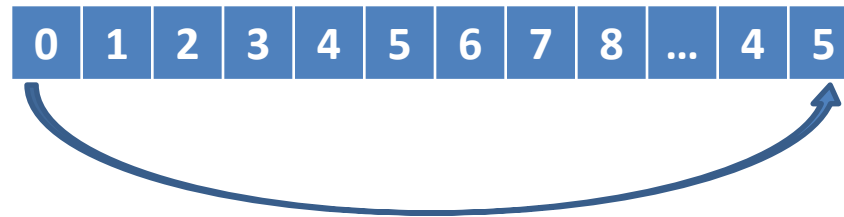


# Example Problem

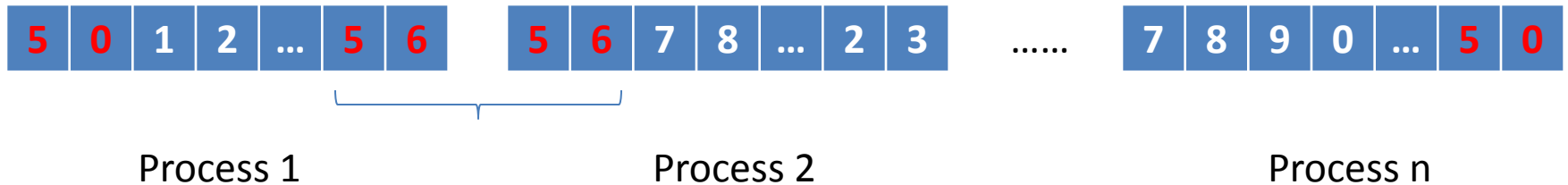


- A 1-D **periodic** array with  $N$  elements
- Initial value
  - C:  $cell(x)=x\%10$
  - Fortran:  $cell(x)=mod(x-1,10)$
- In each iteration, all elements are updated with the value of two adjacent elements:
  - $cell(x)_{i+1}=[cell(x-1)_i+cell(x+1)_i]\%10$
- Execute  $N_{iter}$  iterations
- The final outputs are the global maximum and average

# Sequential Program

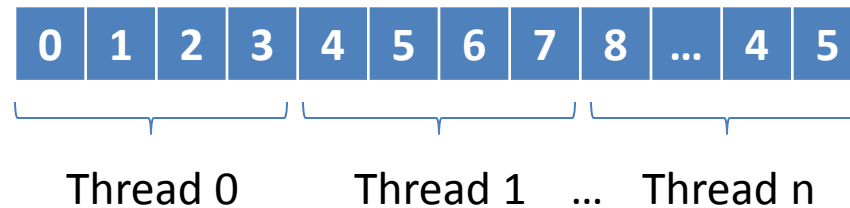
- Use an integer array to hold current values
- Use another integer array to hold the calculated values
- Swap the pointers at the end of each iteration
- No bugs in the serial program
- The result is used to check the correctness of the parallel programs

# MPI Program



- Divide the array among  $n$  processes
- Each process works on its local array
- Exchange boundary data with neighbor processes at the end of each iteration
- Ring topology

# OpenMP Program



- Each thread works on its own part of the global array
- All threads have access to the entire array, so no data exchange is necessary