ME 766 Project Parallelization of SIMPLE Algorithm using MPI

By-

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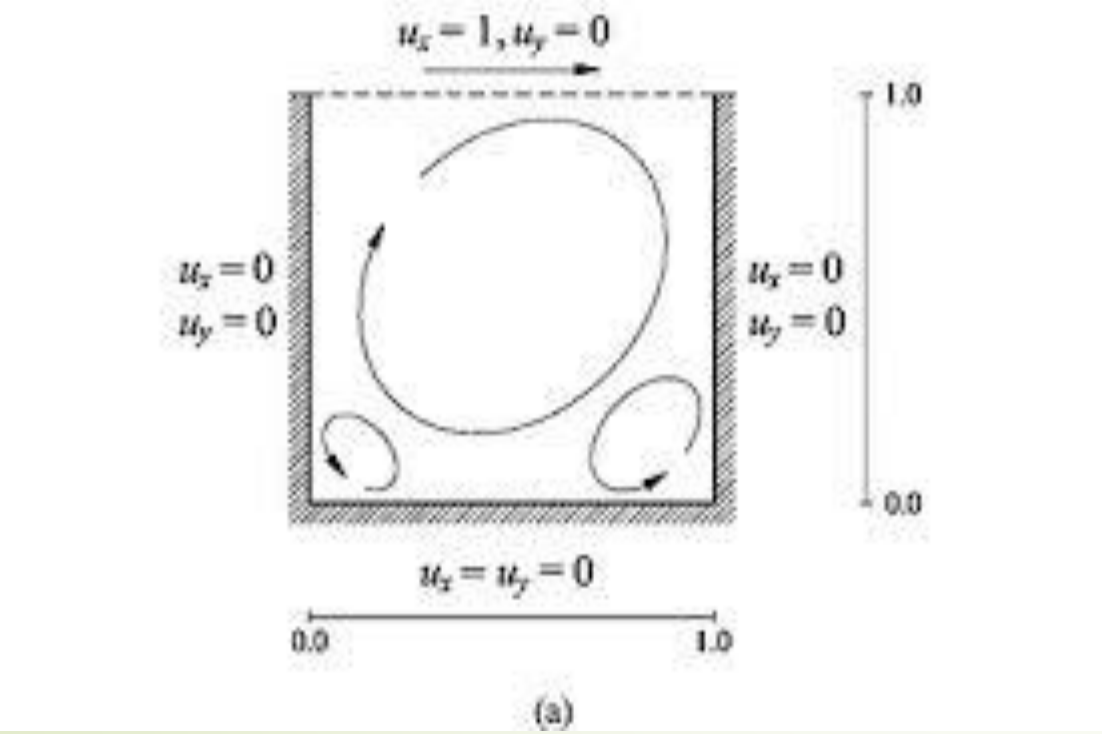
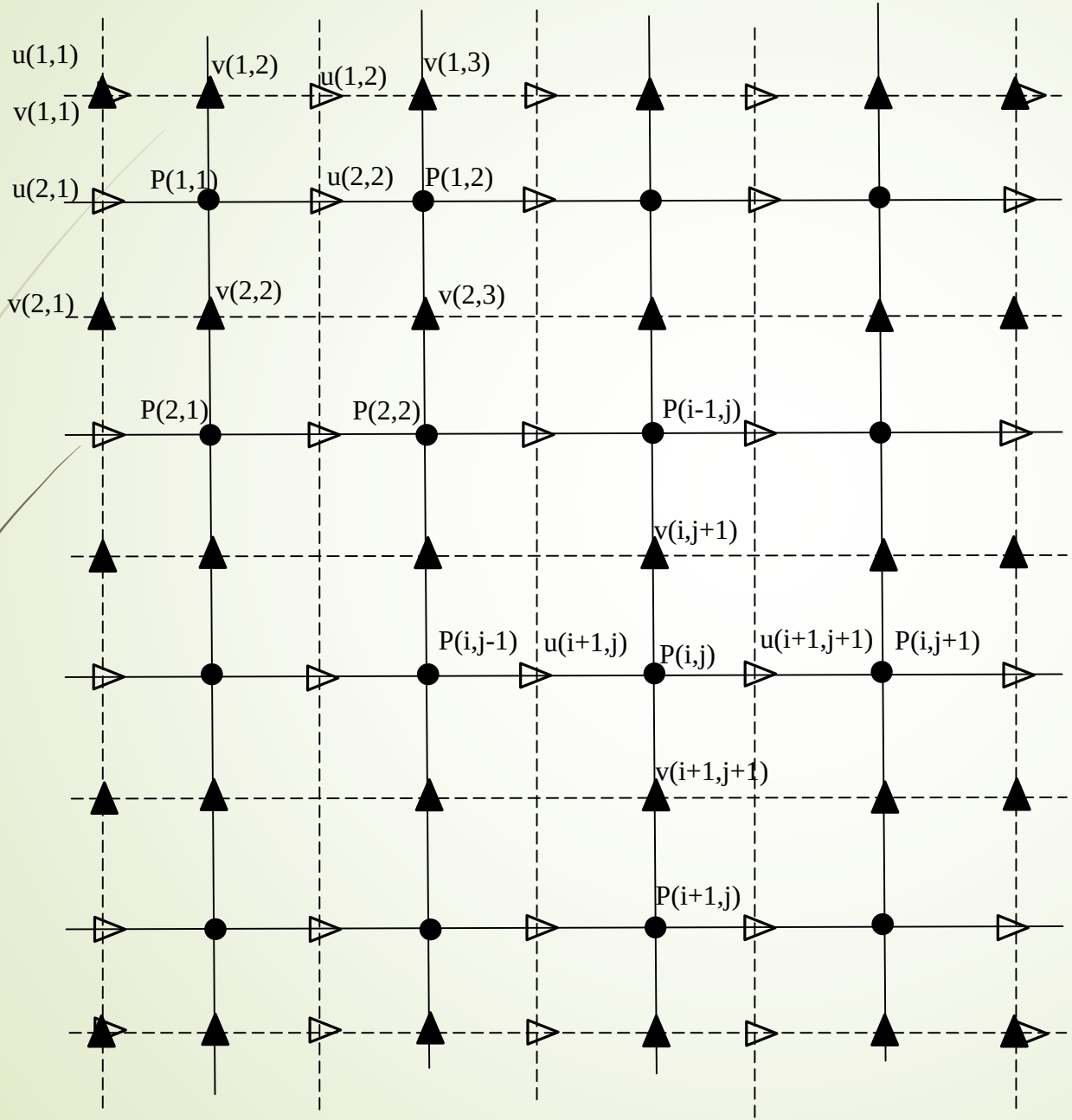
Problem Definition



- Driven Cavity Problem
- U: X velocity
- V: Y velocity
- P: Pressure
- Aim: To find steady state velocity and pressure field
- SIMPLE algorithm with staggered grid used

SIMPLE Algorithm



- U, V and P separately parallelized
- Rows divided equally among all the processes
- Leftover rows distributed to the top few processes one per process
- Top and bottom rows of each process communicate using message passing

Comparison of Execution Time

Code Profile (gprof) and Miss Rate (valgrind)

% time	cumulative seconds	self seconds	calls	self ns/call	total ns/call	name
82.39	10.13	10.13				main
16.31	12.14	2.01	186049080	10.78	10.78	max
0.85	12.24	0.11	4757514	22.08	22.08	absolute
0.49	12.3	0.06				frame_dummy

Serial Code Miss Rate

L	refs:	98,368,186,853
L1	misses:	971
L2	misses:	948
I1	miss rate	0.00%
L2	miss rate	0.00%

MPI Code Miss Rate

I	refs:	17,574,579
L1	misses:	58,089
L2	misses:	6,153
L1	miss rate	0.33%
L2	miss rate	0.03%

OpenMP trial of SIMPLE Algorithm

- Attempted parallelization using OpenMP
- The code did not converge
- High level of Data dependencies and hence the algorithm has to be modified to make it compatible with shared memory parallelization

Thank You!