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MANIPAL IN`STITUTE OF TECHNOLOGY

(Constituent Institute of Manipal University)

SIXTH SEMESTER B.E. (CSE) DEGREE END SEMESTER EXAMINATION
MAY 2013
PARALLEL COMPUTER ARCHITECTURE AND PROGRAMMING (CSE 306)
DATE: 10-5-2013

TIME: 3 HOURS MAX.MARKS: 50

## Instructions to Candidates

- Answer **any five** full questions.

1A. With neat diagram explain the following Flynn's classification Schemes.
i. SIMD
ii. MIMD

1B. Why we need parallel computing?

1C. Consider the execution of a program of 20000 instructions by a linear pipelining processor. The clock rate of the pipelining is 25MHz. Pipeline has five stages and one instruction is issued per clock cycle. Neglect penalties due to branch instructions and out of sequence execution. Calculate
i. Speedup
iii. Efficiency
iv. Throughput

1D. Differentiate between static pipelining and Dynamic pipelining. (3+3+3+1)

2A. Consider a 4 stage pipeline processor specified by the following reservation table.

| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 |
|---|---|---|---|---|---|---|---|---|
| S1 | X | | X | | X | | | |
| S2 | | X | | X | | | | X |
| S3 | | | | | X | | X | |
| S4 | | | | | | X | | |

i. List the set of forbidden and permissible latencies and the collision vector.
ii. Draw the state diagram showing all possible cycles without causing the collision in the pipeline.
iii. List all the simple cycles from the state diagram.
iv. Identify greedy cycles among the simple cycles.
v. What is the MAL of this pipeline?
vi. What is the efficiency and throughput of this pipeline?

2B. Briefly explain name dependency with example.
2C. Explain how work groups and work dimensions are created in OpenCL by considering a 2 dimensional matrix. (6+2+2)

3A. Given 2 matrices

$$A = \begin{pmatrix} a11 & a12 \\ a21 & a22 \end{pmatrix} \quad B = \begin{pmatrix} b11 & b12 \\ b21 & b22 \end{pmatrix}$$

i. Show all memory allocation for SIMD matrix multiplication.
ii. Show all parallel SIMD operations carried out in each of the PE.
iii. Give Parallel algorithm for Matrix Multiplication.

3B. Sort the following numbers in descending order using odd-even transposition.

| P1 | P2 | P3 | P4 | P5 |
|---|---|---|---|---|
| 26 | 76 | 89 | 12 | 09 |

3C.

Stream A
add a,b,c
add d,b,e
mul f, a, e
add g,d,a
mul h ,g , f

Stream B
fadd a, b, c
fmul d, a, e
fmul f,d,f
add g,b ,d
mul f, g, f
fadd h, g , d

Show the instruction dependency and scheduling scheme which are done in simultaneous multithreading when 2 integer ALUs and 1 Floating point ALU are available. (4 +2 +4)

4A. Write MPI program to calculate the value of **pi** using m processes .
4B. Write the syntax of **standard send** primitive used in MPI. What is the role of tag and communicator in this primitive?
4C. With a neat diagram explain memory model used in OpenCL. (5+3+2)

5.i. Write an OpenCL program to read a MxN matrix. Replace each element by its equivalent binary value in another matrix and display the resultant matrix in main program.
ii. Write the kernel code which finds the binary of each element in parallel. (7.5 +2.5)

6A. Explain with example cache coherence problem in multiprocessors.
6B. What are cache coherence protocols? What are the 2 classes of protocols used in multiprocessors? Briefly explain any one protocol used in multiprocessors with example.
6C. Explain the 2 architectural approaches used for interprocessor communications in distributed memory multiprocessors. (2+5+3)