PRINCE OF SONGKLA UNIVERSITY
FACULTY OF ENGINEERING

Final Examination: Semester 2 **Academic Year**: 2007-2008

Date:19 February 2008 **Time**: 9.00-12.00 (3 hours)

Subject Number: 240-573 **Room**: R200

Subject Title: Special Topic in Computer System Design Engineering II (Parallel Computing)

Exam Duration: 3 hours

This paper has 12 pages, 5 questions and 180 marks (25%).

Authorised Materials:

- Writing instruments (e.g. pens, pencils).
- Textbooks, a notebook, handouts, and dictionaries are permitted.

Instructions to Students:

- Scan all the questions before answering so that you can manage your time better.
- Attempt all questions in English.
- Write your name and ID on every page.
- Any unreadable part will be considered wrong.

When drawing diagrams or coding, use good layout, and short comments, marks will not be deducted for minor syntax errors.

Cheating in this examination

Lowest punishment: Failed in this subject and courses dropped for next semester.

Highest punishment: Expelled.

Name_____ ID_____

Question 1 (46 marks; 46 minutes)

a) Compare Static and Dynamic Load Balancing? (4 marks)

Static Load Balancing	Dynamic Load Balancing

b) When do we use *Domain Decomposition* and when do we use *Functional Decomposition*? (4 marks)

Domain Decomposition	Functional Decomposition

c) Explain how *Agglomeration* can improve performance and also some pictures to help with the explanation. (4 marks)

Name_____ ID_____

d) What are the performance matrices and how important are they? (4 marks)

e) What are important caveats that apply to automatic parallelization? (4 marks)

f) What is the limitation of Amdahl's Law and what are the effects of Amdahl's law? (4 marks)

g) Explain the following picture of the execution of parallel processes and th three states. (6 marks)

h) What and why do we need to identify when we are in the process o understanding the problem and the program which is the first step in developin parallel software? (6 marks)

Question 2 (36 marks; 36 minutes)

Tell if the following statement true or false.

2.1 ___T__ With too small number processors used, the communication and synchronization overhead will dominate

2.2 ___T__ In MPI programming, the goal is often to create one agglomerated task per processor.

2.3 ___F__ When granularity is increased, parallelism is increased and communication is also increased.

2.4 ___T__ The tasks use the same information should be grouped together to reduce communication.

2.5 ___F__ Execution time decreases as number of processors decreases.

2.6 ___T__ Manually developing parallel codes is a time consuming, complex, error-prone and iterative process.

2.7 ___T__ Loops are the most frequent target for automatic parallelization.

2.8 ___F__ If you are beginning with an existing serial code and have no time or budget constraints, then automatic parallelization may be the answer.

2.9 ___T__ Pipelining and parallelism can be used to increase throughput.

2.10___F__ Cost-effectiveness means the shortest execution time.

2.11___T__ A good factor for measuring the cost-effectiveness is utilization.

2.12___T__ The utilization corresponds to the Gigaflops/cost of the purchasing price.

2.13___T__ Performance/Cost ratio is the ratio of the speed to the purchasing price.

2.14___F__ Efficiency is the measure of the entire time for which a processor is employed.

2.15___F__ Amdahl's law ignores parallel overhead and often underestimates achievable speedup.

2.16___T__ Amdahl Effect states that for any fixed number of processors, speedup is usually an increasing function of the problem size.

2.17___F__ When a number of processors increases, the efficiency will increase.

2.18___T__ The parallel overhead depends on both the number of processors used and the problem size.

2.19___F__ The speedup/efficiency will decrease if the problem size increases keeping the number of processors fixed.

2.20___T__ The parallel overhead depends on both the number of processors used and the problem size.

2.21___T__ In a scalable system, we can keep the speedup/efficiency fixed by increasing both the size of problem and number of processor.

2.22___T__ A scalable system maintains efficiency as processors are added

2.23___F__ For a given problem size, as the number of processors increases, the efficiency also increases.

Name_____ID_____

2.24___F__ A big Isoefficiency function indicates that the parallel system is highly scalable.

2.25___T__ Load balance increases the application performance and system utilization.

2.26___T__ If an application causes a lot of memory paging, then the size of the free available memory is a good indicator of processor load.

2.27___T__ In Heuristic Static Load Balancing, the faster processors will then be assigned with more tasks.

2.28 ___T__ In Heuristic Static Load Balancing, we find a module pair with most inter-module communication and assign them to the same processor.

2.29 ___T__ In Load Balancing, when the traffic is heavy, information exchange should be stopped.

2.30 ___F__ In Load Balancing, it is common to consider moving an old process that is in execution for a long period of time rather than a new process.

2.31 ___T__ In Load Balancing Transfer Policy, we should migrate processes that communicate frequently with the intended destination processor to reduce communications load.

2.32 ___F__ In Load Balancing Transfer Policy, migrating the most locally demanding process will not reduce the local load.

2.33 ___F__ Under heavy load conditions, the sender initiated load transfer performs better, where as the receiver initiated load transfer performs better under lower load conditions.

2.34 ___F__ Randomization polling works well on a heterogeneous system.

2.35 ___T__ Task transfer should not disrupt the communication locality.

2.36 ___F__ Reducing the number of tasks transferred is more important than reducing the size of the task transfer.

Question 3 (28 marks; 28 minutes)

Answer the following questions and also use some pictures to help with explanation of the load balancing techniques.

a) What is *load balancing*? (4 marks)

Name_____ ID_____

b) Bin Packing (4 marks)

c) Randomization (4 marks)

d) Pressure Model (4 marks)

e) Manager-Worker (6 marks)

f) What are three dynamic load balancing factors? (3 marks)

g) When can Load balancing be initiated? (3 marks)

Question 4 (30 marks; 30 minutes)

Demonstrate how to sort the following array using 5 processors in parallel using the Parallel Quick Sort:

83, 66, 67, 5, 70, 98, 54, 50, 12, 47, 72, 65, 54, 75, 91, 15, 64, 21, 9, 88, 66, 22, 33, 42

Name_____ ID_____

Question 5 (40 marks; 40 minutes)

From the following algorithms to write parallel pseudo code using the MPI operations which might speed up the execution.

For i = 1 to m

For j = 1 to n

For k = 1 to 5

Do

$F[i,j,k] = A[i] + b[j]^k$

When A and B are 1D arrays and F is a 3D array.

Name_____ ID_____