NAME:_____Student Number:_____

CSE4/529 **MidTerm I** Fall, 2016

This exam is *closed book/notes/neighbors/etc.* Answer all questions on these exam pages. No code or pseudo-code is necessary – just a precise and concise explanation and justification. *Unsupported work will receive no credit.*

Q1 of 5 (5 pts) Fill in the following table using Θ notation. While no explanation is required, if you feel it necessary to include an explanation or comment, please provide such information in the space provided below the table.

Model	Communication Diameter	Bisection Width	Degree of Network
Mesh of size *n*			
Hypercube of size *n*			
K_n			
Star of size *n*			

K_n is to defined to be a set of *n* processors where every processor P_i is directly connected to every processor P_j for all $1 \le i \le n$, $1 \le j \le n$, and $i \ne j$.

For a definition of a *star of size n*, please refer to Q2.

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Q2 of 5 (9 pts) Define a *star of size n* to be a set of *n* processors, labeled P_0, $P_1,\ldots,P_{n-1}$, where processor P_0 is connected to every processor P_i, $1 \le i \le n-1$. That is, there are only *n*-1 communication links in a *star of size n*.

Justify your answers to each of the following.

A. Give an asymptotically optimal algorithm to find the minimum of a set of *n* pieces of data, initially distributed 1 per processor in an arbitrary fashion.
B. Give an asymptotically optimal algorithm to compute the parallel prefix of a set of *n* pieces of data, initially distributed 1 per processor in an arbitrary fashion.
C. Give an asymptotically optimal algorithm to sort of a set of *n* pieces of data, initially distributed 1 per processor in an arbitrary fashion.

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Q3 of 5 (10 pts) Given *n* integers arbitrarily and evenly distributed amongst the processors of the following architectures, determine the sum of these *n* values. Define your architecture such that your solution is asymptotically-optimal and cost-optimal.

i) PRAM
ii) Linear Array
iii) Hypercube
iv) Star

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Q4 of 5 (6 pts) Given a pyramid of size *n*, with a 0 or 1 stored in every base processor, give an algorithm that will determine for every processor, the number of base processors in its subtree that have a 1 in it. Note that this is equivalent to each processor knowing the sum of the 1's in the base of its subtree. Discuss the optimality of the running time of your algorithm.

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Extra Credit (1 pt) From what institution did Prof. Miller receive his Ph.D.?

Extra Credit (1 pt) How many books has Prof. Miller co-authored?