CMPE 478: Parallel Processing
Homework 1, Spring 2007

Problem 1

Suppose you are given two-dimensional array `A[0..n-1,0..n-1]` array of integers. Develop parallel CREW algorithm which computes the following in logarithmic time.

$$B[i,j] := \sum_{k=i}^{min(i+w-1,n-1)} \sum_{s=j}^{min(j+w-1,n-1)} A[k,s]$$

for all (i,j) $0 \leq i,j \leq n-1$ Here, w is a specified window size. Develop a WORK EFFICIENT $O(logn)$ CREW PRAM algorithm which solves this problem. Write down the COMPLETE pseudo-code.

Problem 2

You are given integers in the range $[-log(n),\ldots,log(n)-1]$. Develop a parallel logarithmic CREW PRAM algorithm which will sort these integers using $O(n)$ total work.

Problem 3

Run the NAS benchmarks on the TR-GRID clusters and prepare a table with the following information for each run:

- problem name
- number of processors used
- time taken
- speedup
- total Mops
- operation

Problem 4

Implement the dot product operation for 32 bit floating point numbers using the Intel SIMD SSE extensions. Plot a graph showing speedup obtained for different vector sizes. Note: you can learn about Intel SIMD extensions by reading the tutorial at
`http://or1cedar.cps.intel.com/softwarecollege/CourseDetails.asp?courseID=23`
You can use the Intel compiler available on the TR-GRID or install one on your computer. You can compile your C++ code by giving the command:

```
icpc ex1.cc -Wno-deprecated
```

The following is an example program to get you started with the Intel SIMD extensions:

```
#include <iostream.h>
#include <fvec.h>

main()
{
  F32vec4 x(1.0,2.0,3.0,4.0);
  F32vec4 y(1.0,2.0,3.0,4.0);

  x = x + y ;

  cout << x << endl ;
}
```