CS4130/5130 Homework 4

Due Friday, April 4 @ 1PM.

(50 points)

1. For the Fortran loop nest (column-major order) below, do the following.

```
DO J = 1, N, 2
  DO I = 1, N
      A(I+1,  2*J) = A(I, 2*J) + B(J,I) + 10.
      A(I,    2*J+1) = A(I-1, 2*J) + B(J,I+1)
  ENDDO
ENDDO
```

   (a) (5 points) Draw the dependence graph and annotate each edge with its distance vector.

   (b) (5 points) What are the reference groups with respect to loop I and loop J.

   (c) (5 points) What are the loop costs for loop I and J? Is loop interchange legal? Will loop interchange improve the locality of the nest?

   (d) (20 points) We are going to apply scalar replacement on the loop nest. What is the pruned dependence graph? What are the generators? Show the code after scalar replacement.

2. (15 points) Consider the following Fortran loop nest:

```
   DO K = 1, 100
      DO J = 1, 100
S1       B(1, J, K) = A(1, J-1, K)
         DO I = 1, 100
S2          A(I+1, J, K) = B(I, 100-J, K) + C
         ENDDO
      ENDDO
   ENDDO
```

   Does statement S_2 depend on statement S_1? Does statement S_1 depend on statement S_2? Given the dependence type, direction vector, and array variable involved for each dependence that exists. Vectorize this loop based on the *AdvancedVectorization* algorithm in the notes. (Please note that the first subscripts in both references of S_1 are one not I).