

## Exercise 1: Data Dependence Analysis

July 7th, 2014

### 1. Introducing data dependence

- (a) What is the condition of a data dependence exist from a statement  $s_1$  to  $s_2$ ?
  
- (b) What is the meaning of true, anti, and output dependences?
  
- (c) What is the safety constraint of a reordering transformation?

### 2. Loop dependence

- (a) What is the meaning of an iteration vector  $I=(3,5,7)$ ? What is the meaning of relating two iteration vectors  $I$  and  $J$  as  $I < J$ ?
  
- (b) What is the iteration space of a loop nest?
  
- (c) What is the distance vector of a loop dependence from iteration  $I$  of  $s_1$  to iteration  $J$  of  $s_2$ ?
  
- (d) What is the relation between dependence distance and direction?
  
- (e) What is the safety constraint of loop reordering transformations?

### 3. Level of loop dependence

- (a) What is the meaning of loop carried/independent dependences?
  
- (b) What is the level of a loop dependence?

4. Given the following loop nest,

```
do J = 3, N-1, 1
S1:  RX(J,J) = RX(J,J) * 2
    do I = 2, N-1, 1
S2:    RX(I,J) = (RX(I,J-1) + RX(I-1,J)) / 2
    enddo
enddo
```

- (a) What are the iteration vectors for S1 and S2?
  
- (b) What is the iteration space of the loop nest?
  
- (c) What are the systems of dependence testing equations between the array references?
  
- (d) Solve the equations. What are the resulting distance/direction vectors?
  
- (e) Draw a dependence graph for the give code.
  
- (f) For each dependence, is it anti, output, or true ?
  
- (g) For each dependence, what is its loop carrying level?