

ALL of the homeworks and project writeups in this course must be written using latex. See the template latex file (cs560-template.tex) at <http://www.cs.colostate.edu/~cs560/Spring2012/assignments.php>. Homework assignments are to be completed individually. Homeworks need to be submitted electronically via RamCT AND by email to cs560@cs.colostate.edu by 11:59pm on the due date. For this homework submit a tar ball with all of the latex source and a Makefile to build the writeup pdf. Total points: 100

1. [60 points] Data dependence analysis

For each of the below loops show the memory data dependence relation with all of the inequalities and equalities for all of the flow, anti, and output dependences. This is equivalent to setting up the memory data dependence problem. Then enter that into the omega calculator and also show the simplified omega calculator output.

(a)

```
for(int i=0; i<N; ++i)
  for(int j=0; j<N; ++j)
    for(int k=0; k<N; ++k)
      A[i][k] = B[i][j] * C[j][k];
```

(b)

```
for(int i=0; i<N; ++i)
  for(int j=i; j<N; ++j)
    A[j] = A[2i+1];
```

(c)

```
for(int i=0; i<N; ++i)
  for(int j=0; j<i; ++j)
    for(int k=i; k<N; ++k)
      A[i][j] = A[i][j-4] * A[k][i-1];
```

(d)

```
for(int i=0; i<100; ++i)
  x[i+100] = 2*x[i]
```

2. [10 points] Exact data dependence analysis

For the following loop, set up the EXACT data dependence analysis problem for the flow data dependence. Show the initial set of constraints and then show the simplified data dependence relation from omega.

```
for(int i=0; i<N; ++i)
    for(int j=i; j<N; ++j)
        A[j] = A[j-1];
```

3. [30 points] Transformation and Code Generation in omega
Start with the ORIGINAL version of the loop at lines 207 and 208 in smithWaterman.c from HW0 and express its iteration space as a set in the omega calculator. Then specify permutation and skewing as a single relation or as a composition of two relations. Finally generate the transformed loop bounds with the omega calculator. Show all of the omega set and relation definitions as well as how you call codegen and the output loop bounds and statement macro call.