CS 698L Semester 2019–2020-I: Assignment 2

23rd August 2019

Due Your assignment is due by Sep 1 2019 11:59 PM IST.

General Policies

- You should do this assignment ALONE.
- Do not plagiarize or turn in solutions from other sources. You will be PENALIZED if caught.
- We MAY check your submission(s) with plagiarism checkers.

Submission

- Submission will be through Canvas.
- Submit a PDF file with name "<roll-no>.pdf". You are encouraged to use LaTeX typesetting system for generating the PDF file.
- Submitting your assignments late will mean losing points automatically. You will lose 10% for each day that you miss, for up to three days.
- For late submissions, email your submission to the instructor.

Problem 1 **[10 points]**

Consider the following code:

```
for i = 1, N-2
  for j = i+1, i+N-2
    A(i, i-j) = A(i, i-j-1) - A(i+1, i-j) + A(i-1, i-j-1)
```

List all flow, anti, and output dependences, if any.

Problem 2 **[70 points]**

Consider the following code:

```
int i, j, t;
for (t = 0; t < 1024; t++) {
  for (i = 0; i < 1024; i++) {
    for (j = 1; j < 2048 - i; j++) {
      S(t, i, j);
    }
  }
}
```

The data dependences for the loop are given to be (0,1,-1), (0,0,1), and (1,-1,0).

(a) Which loops, if any, are valid to unroll? Why?

(b) What are valid permutations of the loop? Why?

(c) What tiling is valid, if any?

(d) Show valid code for the *tji* permutation of the loop. For this part and the next one, assume all permutations are valid.

(e) Show a 2-way i-unrolled form (i.e., unroll-jam) for the *tij* form.

Problem 3

[70 points]

Consider the following code:

```
int i, j, t, k;
for (t = 0; t < 1024; t++) {
  for (i = t; i < 1024; i++) {
    for (j = t; j < i; j++) {
      for (k = 1; k < j; k++) {
        S(t, i, j, k);
      }
    }
  }
}
```

The data dependences for the loop are given to be (1,0,-1,1), (1,-1,0,1), and (0,1,0,-1).

(a) Which loops, if any, are valid to unroll? Why?

(b) What are valid permutations of the loop? Why?

(c) What tiling is valid, if any?

(d) Which loops, if any, are parallel?

(e) Show code for the *tikj* form of the code. For this part, ignore the above dependences and assume *tikj* permutation is allowed.

Problem 4

[50 points]

Consider the following code:

```
#define N 1024
double A[N][N];
int t,i,j;
for (t = 0; t < N; t++) {
  for (i = 1; i < N-1; i++) {
    for (j = 1; j < N-1; j++) {
      A[i][j] = 0.2*(A[i-1][j] + A[i][j] + A[i+1][j] + A[i][j-1] + A[i][j+1]);
    }
  }
}
```

(a) List all data dependences, stating the kind of dependence and the distance vector.

(b) What permutations (if any) are valid? Why?

(c) Which loops (if any) are valid to unroll? Why?

(d) What tiling (if any) is valid? Why?