

Spring 2009, CS255/455 Homework 1

1. Give the distance vectors and direction vectors for the following two loop nests. Assume a and b are different arrays.

```
do i = 2, n
  do j = 2, n-1
    a(i,j) = b(i,j) + a(i-1,j+1)
  end do
end do
```

```
do i = 2, n
  do j = 2, n-1
    a(i,j) = (a(i-1,j) + a(i+1,j) + a(i,j-1) + a(i,j+1))/4
  end do
end do
```

2. Describe the basic vectorization algorithm. Apply the basic vectorization algorithm to the following two loop nests, show your intermediate results after each step. In addition, for each loop check whether it is parallelizable, that is, whether its iterations can be executed in parallel, and give your reason.

```
do i = 1, n
  do j = 2, n
    a(i,j) = a(i,j-1) + c
  end do
end do
```

```
do i = 1, n
  do j = 1, n-1
    a(i,j) = a(i-1,j) + a(i-1,j+1)
  end do
end do
```

3. Given a loop as follows:

```
do i = 1, n
  do j = 1, n
    t = a(j,i) + a(j+1,i)
    a(j+1,i) = t + b(j)
    a(j+1,i) = a(j+1,i) + c(j)
  end do
end do
```

Can the following code transformation be applied to the loop to get additional parallelism? Show your reason and transformed result if necessary.

1. loop interchange
2. scalar expansion
3. array renaming

4. Build the control dependence graph for the following control flow graph.

