- CPSC 275: Introduction to Computer Systems

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Fall 2025

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Homework 25

NOTE: You are not required to hand in the following exercises, but you are strongly encouraged to complete them to strengthen your understanding of the concepts covered in class.

1. Consider the following function:

```
int sum_array_3d(int a[N][N][N])
{
    int i, j, k, sum = 0;

    for (i = 0; i < N; i++)
       for (j = 0; j < N; j++)
          for (k = 0; k < N; k++)
             sum += a[k][i][j];
    return sum;
}
```

Can you permute the loops so that the function scans the 3-d array `a` with a stride-1 reference pattern and thus has good spatial locality?

2. Given an array of `structs`:

```
#define N 1000

typedef struct {
   int vel[3];
   int acc[3];
} point;

point p[N];
```

the three functions shown below perform the same operation with varying degrees of spatial locality. Rank-order the functions with respect to the spatial locality enjoyed by each. Explain how you arrived at your ranking.

   A. The `clear1` function

```
void clear1(point *p, int n)
{
   int i, j;

   for (i = 0; i < n; i++) {
```

```
      for (j = 0; j < 3; j++)
         p[i].vel[j] = 0;
      for (j = 0; j < 3; j++)
         p[i].acc[j] = 0;
   }
}
```

B. The `clear2` function

```
void clear2(point *p, int n)
{
   int i, j;

   for (i = 0; i < n; i++) {
      for (j = 0; j < 3; j++) {
         p[i].vel[j] = 0;
         p[i].acc[j] = 0;
      }
   }
}
```

C. The `clear3` function

```
void clear3(point *p, int n)
{
   int i, j;

   for (j = 0; j < 3; j++) {
      for (i = 0; i < n; i++)
         p[i].vel[j] = 0;
      for (i = 0; i < n; i++)
         p[i].acc[j] = 0;
   }
}
```

- **Welcome: Sean**
  - LogOut