Locality of Reference

• Temporal
  – Recently referenced items are likely to be reused

• Spatial
  – Items with nearby addresses tend to be referenced close together in time

• Data
  – Walking through an array or a matrix
  – Referencing sum in each iteration

• Instructions
  – Reference instructions in sequence
  – Loops

```
sum = 0;
for (i = 0; i < n; i++)
  sum += a[i];
return sum;
```
Good or Bad Locality?

```
int sum_array_rows(int a[M][N])
{
    int i, j, sum = 0;
    for (i = 0; i < M; i++)
        for (j = 0; j < N; j++)
            sum += a[i][j];
    return sum;
}

int sum_array_cols(int a[M][N])
{
    int i, j, sum = 0;
    for (j = 0; j < N; j++)
        for (i = 0; i < M; i++)
            sum += a[i][j];
    return sum;
}
```

Good or Bad Locality?

```
int sum_array_3d(int a[M][N][N])
{
    int i, j, k, sum = 0;
    for (i = 0; i < M; i++)
        for (j = 0; j < N; j++)
            for (k = 0; k < N; k++)
                sum += a[k][i][j];
    return sum;
}
```
Paper “Multics”

- Multiplexed Information and Computing Service
Paper “Multics”

- What is the motivation behind segmentation?
- What is the motivation behind paging?
- Demand paging
- Machine independence
- Descriptor segment (DS)
- Descriptor base register (DBR)
- Segment descriptor word (SDW)
- Segmentation fault
- Page fault