Graduate Operating Systems (Memory Management)

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

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

```c
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;
}

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;
}
```

Good or Bad Locality?
Paper “Multics”

- Multiplexed Information and Computing Service

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Paper “Multics”

- Paging

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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