CME111 Programming Languages I

Week 11
Multidimensional Arrays

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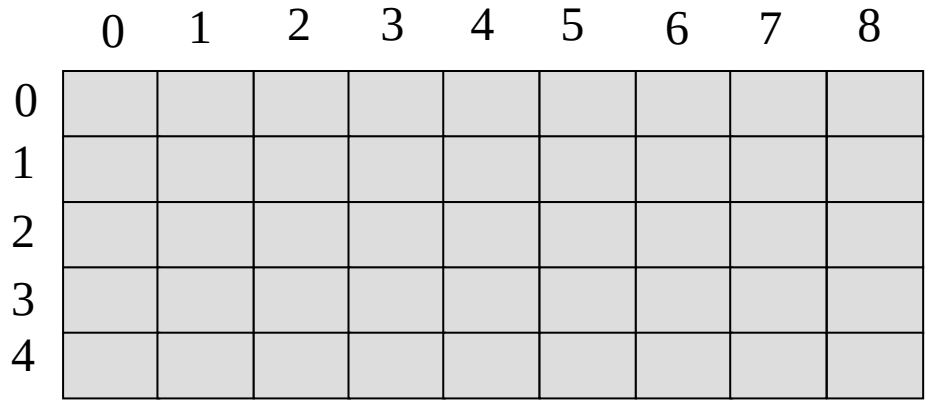
Multidimensional Arrays

- An array can have more than one-dimensional.
- For example we will use 2-dimensional array for 3x4 matrix.
- In three-dimensional Euclidean space x, y, z, we prefer a 3-dimensional array to store our points.
- We write M[i][j] to reach the elements in row i and column j.
  - For example, two-dimensional array (matrix) is defined as follows.
  - int M[5][9]; /* has 5 rows and 9 columns */
  - Conceptually, array M is similar to the following.



Reach 2-Dimensional Arrays

```
/* initialization */
for (i=0; i<5; i++){
  for (j=0; j<9; j++){
    M[i][j] = 0;
  }
}
```

```
/* Sum */
sum = 0;
for (i=0; i<5; i++){
  for (j=0; j<9; j++){
    sum += M[i][j];
  }
}
```

```
/* finding min and max */
min = M[0][0];
max = M[0][0];
for (i=0; i<5; i++){
  for (j=0; j<9; j++){
    if (M[i][j]<min) min=M[i][j];
    if (M[i][j]>max) max=M[i][j];
  }
}
printf("min: %d, max: %d\n", min, max);
```

Initialization of Multi-Dimensional Arrays

- Nested one-dimensional arrays can use used to assign initial values to the multi-dimensional arrays.

```
int M[5][9] = { {1, 1, 1, 1, 0, 1, 1, 1, 1},
                {0, 1, 0, 1, 0, 1, 0, 1, 0},
                {1, 0, 0, 1, 1, 1, 0, 0, 1},
                {0, 0, 0, 0, 1, 1, 1, 1, 1},
                {1, 1, 1, 1, 0, 0, 0, 1, 1}};
```

- If the first value is less than the rest, a multi-dimensional array element is filled with 0.

```
int M[5][9] = { {1, 1, 2, 1, 2, 0, 0, 1, 1},
                {0, 0, 0, 1, 1, 1, 1, 2, 1}};
        /* 2., 3. and 4. rows are filled with zero*/
```

Initialization of Multi-Dimensional Arrays

- If it is less than the number of elements of a row in the list contains, the remainder of the line is filled with 0.

```
int M[5][9] = { {1, 1, 0, 0, 1, 1, 1, 1, 1},
                {0, 1, 1, 2, 1, 1},
                {1, 1, 2, 2, 3}};

/* M[1][6], M[1][7], M[1][8] will be 0*/
/* M[2][5], M[2][6], M[2][7], M[2][8] will be 0*/
/* 3. and 4. rows will filled with 0 */
```

Higher Dimensional Arrays

- An array can be defined in any size.

```
int Cube[8][8][8];    /* a cube with size 8 */
int Prism[4][6][10]; /* a rectangular prism having
                       * dimensions 4x6x10
                       */
/* initialization can be done*/
float A[4][6][8] = {{{1, 2, 3}, {3, 4}}, {{3, 4}}};

Cube[2][3][4] = 2;
Prism[3][5][8] = 6;
A[0][0][4] = 3.34;
```

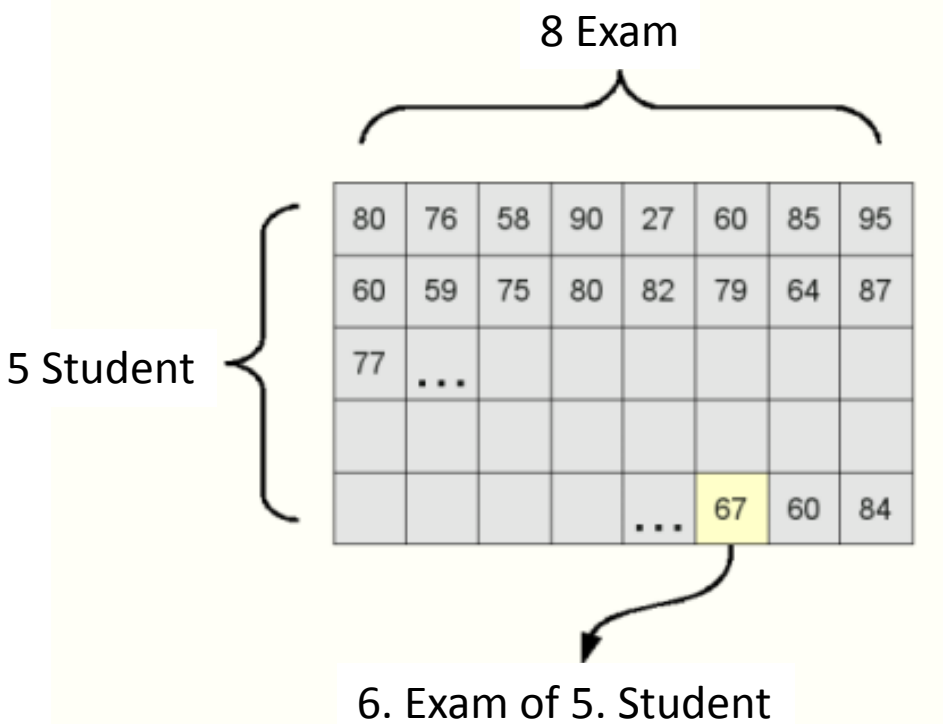
Multidimensional Arrays

- 8 tests are applied for 5-person group of students.
- Let's use 2-dimensional array to store their results.

```
#include<stdio.h>
int main( void ) {
        // Creating 5x8 matrix.
        int student_table[ 5 ][ 8 ];
        int i, j;
        for( i = 0; i < 5; i++ ) {
                for( j = 0; j < 8; j++ ) {
                        printf( "%d no. student's ", ( i + 1 ) );
                        printf( "%d no. exam> ", ( j + 1 ) );
                        // We take value as the one-dimensional array.
                        scanf( "%d", &student_table[ i ][ j ] );
                }
        }
        return 0;
}
```

Multidimensional Arrays

- Run this program, imagine we assign different values to the students. To put this into a visual form, it consists of a table as follows:



- According to the table, 1. student seems to have taken 80, 76, 58, 90, 27, 60, 85 and 95 points. Or we understand that the 5. student takes the 67 from 6. exam. Similarly the necessary values assigned to other cells and related student's exam notes is being held in memory.

Example: Sum of Two Matrices

```
#include <stdio.h>
#define SAT 2
#define SUT 3

int main(){
   int a[SAT][SUT] = {5, 3, 7,  0, 1, 2};

   int b[SAT][SUT] = {1, 2, 3,  4, 5, 6};
   int c[SAT][SUT];
   int i, j;

   puts("A Matrix:");
   for(i=0; i<SAT; i++){
      for(j=0; j<SUT; j++)
         printf("%4d",a[i][j]);
      printf("\n");
   }
```

Example: Sum of Two Matrices

```
    puts("B Matrix:");
    for(i=0; i<SAT; i++){
        for(j=0; j<SUT; j++)
            printf("%4d",b[i][j]);
        printf("\n");
    }
    puts("\nC Matrix:");
    for(i=0; i<SAT; i++){
         for(j=0; j<SUT; j++){
             c[i][j] = a[i][j] + b[i][j];
             printf("%4d",c[i][j]);
         }
         printf("\n");
    }
  return 0;
}
```

Example: Symmetric Matrix

```
#include <stdio.h>
#include <conio.h>
 int main(){
     int a[100][100];
    int symmetry =1;
    int x, y, i, j;
     printf("Row size of matrix > ");
    scanf("%d", &x);
    printf("Column size of matrix > ");
    scanf("%d", &y);
     printf("Enter matrix values > ");
     for(i=0; i<x; i++) {
        for(j=0; j<y; j++) {
            printf("\n Value [%d] [%d] --> ", i+1, j+1);
            scanf("%d", &a[i][j]);
        }
    }
```

Example: Symmetric Matrix

```
    //NOTE: if a[i][j]==a[j][i] this matrix is symmetric.
    for(i=0; i<x; i++){
      for(j=0; j<y; j++){
           if(a[i][j]!=a[j][i])
                symmetry=0;
                break;
           }
      }
   }
    if(symmetry ==1)
       printf("\n Matrix is symmetric.\n");
    else
       printf("\n Matrix is not symmetric\n");

   return 0;
}
```

Example: Array to Matrix Conversion

```
#include <stdio.h>
#include <stdlib.h>
 int main(){
    int dizi[100];
    int a[100][100];
    int i, j, n, x, sat, sut;
    printf(«How many elements does your array contain? > ");
    scanf("%d", &n);
     for(x=0; x<n; x++){
        printf(«Enter [%d]. element > ",x+1);
        scanf("%d",&dizi[x]);
    }
    printf("\n Enter matrix row count > ");
    scanf("%d", &sat);
    printf(" Enter matrix column count > ");
    scanf("%d",&sut);
```

Example: Array to Matrix Conversion

```
if(n%sat==0 && n%sut==0){
        x=0;
        for(i=0; i<sat; i++){
            for (j=0; j<sut; j++){
                a[i][j]=dizi[x];
                x++;
            }
        }
        printf("\n\n MATRIX > \n");
        for(i=0; i<sat; i++){
            for(j=0; j<sut; j++)
                printf("%3d", a[i][j]);
            printf("\n");
        }
    } else
            printf("ERROR! Number of Array Elements can be full divided by row or column");
     return 0;
}
```

References

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