



Lecture 10

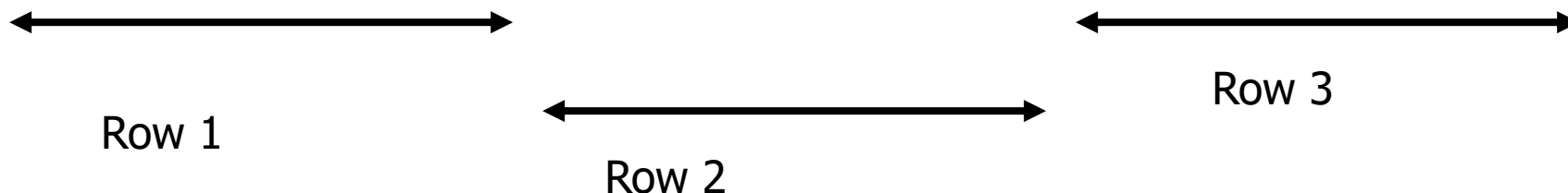
**Arrays: Multidimensional array layout,
types of arrays, element selector design,
Design Issues**

Layout of Multidimensional arrays

- Address computation
 - row-major layout
 - rows appear side by side
 - column-major layout
 - columns appear side by side

Row major array layout (in C)

11	3	4	6	-1	1	4	9	-2	7	4	12
----	---	---	---	----	---	---	---	----	---	---	----



Address computation of an element $M[i][j]$

let the size of the matrix be $m \times n$

the type of all elements is same (Let w be the width of the type)

$$\text{address of } M[i][j] = (i \times n + j) \times w$$

Row major array layout (in Pascal)

var M: array[3..5][2..5] of integer

11	3	4	6	-1	1	4	9	-2	7	4	12
----	---	---	---	----	---	---	---	----	---	---	----

base



Row 3



Row 4



Row 5

Address computation of an element $M[i][j]$

subranges $[low1..high1]$ and $[low2..high2]$

the type of all elements is same (say w be the width)

address of $M[i][j] = ??$

Compute the address of A[9][4]

- Var A: array[6..10][3..6] of integer;
- Layout: row major form

Array values and initialization

- Array initialization is done while array declaration

```
int A[] = { 20, -1, 10, -19, 30 }
```

- Size is computed at compile time as is 5. Accordingly 5 contiguous memory locations are allocated for A.

Type signature of an array data type



- Is described by the size of the array and the type of each element
- Example 1
 - `typedef int ARRAY[20];`
 - Type of the data type ARRAY can be described as an expression `array(20, int)`
- Example 2
 - `typedef int matrix[15][20];`
 - Type of the data type matrix can be described as an expression `array(15, array(20,int))`

Design Issues

- What should be the type of the subscripts?
- Whether an expression can be an index of an array element?
- When should the index value be checked to be in permissible limits?
- When can the relative address be computed?
- What should be the layout form for multidimensional arrays?
- Can array be initialized when they have their storage allocated?

Array categories

Name the categories with respect to the subscript binding and storage allocation of arrays you have used.

- Static array
- Fixed stack-dynamic array
- Stack-dynamic array
- Fixed heap-dynamic array