LENGUAJES Y CIENCIAS DE LA COMPUTACIÓN
UNIVERSIDAD DE MÁLAGA

4 Structured data types

1. Structs. The data type struct. Structs as parameters.
2. Arrays. array<>. Multidimensional arrays. Arrays as parameters
3. String of chars. string. string as parameters.
4. Examples

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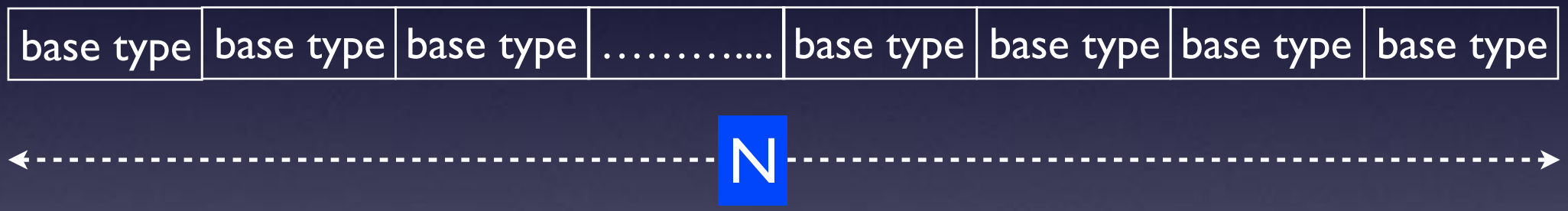
1st. year ETSII

4.2 Arrays

1. Structs. The data type struct. Structs as parameters.
2. **Arrays. array<>.** Multidimensional arrays. **array as parameter**
3. String of chars. string. string as parameter.
4. Examples

Arrays

N repetitions of a base type



The number N of elements is static, unchangeable

Syntax

```
array<int,100> ar;
```

base type

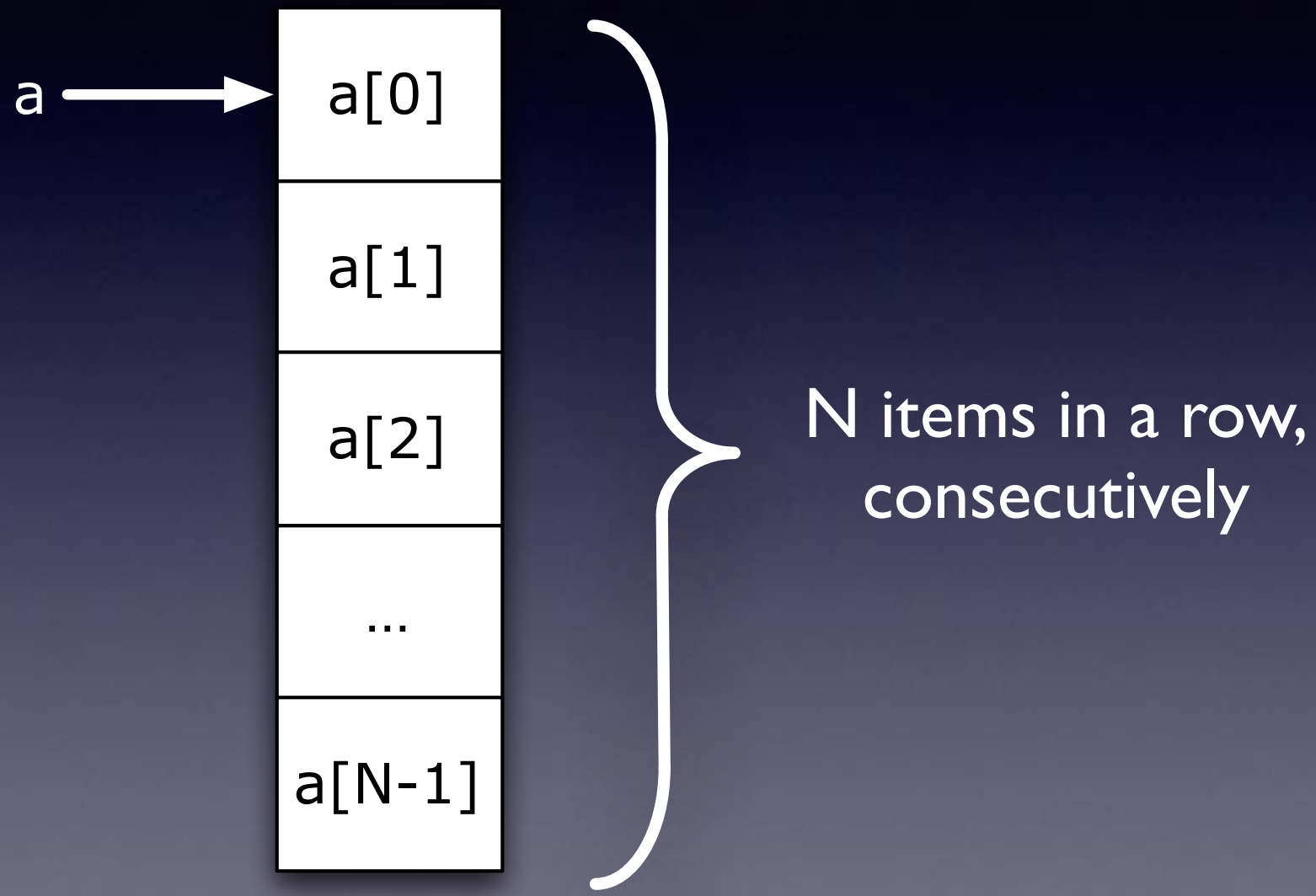
number of elements

```
array<float,3> vec;
```

float
float
float

how are arrays laid out in RAM?

```
array<int,N> a;
```



Arrays

- The size of an array, once declared, can't be modified

…and types
typedef 'ing

```
const int N = 3;
const int NPER = 55;

typedef  array<float,N> TVector;
typedef  array<int,NPER> TAges;
```

new names,
easier to read

access to the elements

- `a[0]` is the first element
- Typically

```
for (int i=0; i < N; i++)
  cout << a[i] << endl;
```

.size() == N

- `a[0]` is the first element
- Typically

```
for (int i=0; i < a.size(); i++)
  cout << a[i] << endl;
```

declaring arrays

Quick {{initialisation}}

```
typedef array<float,3> TVector;

TVector v = {{3, 5, -2}}; // quick init
TVector v = {{1,2}}; // first 2 initialised
```

Exercices

- Define an array to contain:

1. A polynomial of up to 10 real coefficients
2. The rainfalls in a year, day to day
3. The temperature and rainfall for every day of a given week

Exercices

Define the interface (prototype) of:

1. a function that returns the value of TPoly at a given **x**
2. a function that returns the derivative of a TPoly

if

array<int,N> a;

N a const previously defined

traversing the whole array

```
for (int i=0; i<N; i++) {

}
```

array<> can be treated as ‘simple’ vars

```
array <int,3> a, b;
```

✔ `a = b`

✔ `a == b`

✔ `a > b`

etc

example

```
#include <iostream>
#include <array>
using namespace std;
// dont't do this, use typedefs
const int N = 3;

void printArr(array<int, N> a);

int main()
{
    array<int, 3> a, b;
    b = (array<int,3>){{0,0,0}}; // better with
                                 // typedefs, isn't it

    a = b;
    if (a == b)
        printArr(a);
    ++a[1];
    if (a > b)
        printArr(a);

    return 0;
}

void printArr(array<int, N> a)
{
    for (int i = 0; i < a.size(); ++i)
        cout << a[i] << ", ";
    cout << endl;

}
```

```
0, 0, 0,
0, 1, 0,
```

2.1 Arrays typedef

typedef 'ing is quite **useful** with **array<>**

```
const int N = 3;
const int NPER = 55;

typedef  array<float,N> TVector;
typedef  array<int,NPER> TAges;
```

sending and receiving array<>

typedef

```
array<int,3> sumv(array<int,3> a, array<int,3> b)
{
    array<int,3> r;
    for (int i = 0; i < a.size(); ++i) {
        r[i] = a[i] + b[i];
    }
    return r;
}
```

better with…

typedef array<int,3> TVec;

```
TVec sumv(TVec a, TVec b)
{
    TVec r;
    for (int i = 0; i < a.size(); ++i) {
        r[i] = a[i] + b[i];
    }
    return r;
}
```

example

typedef

Sum all the elements of an array of integers and return the result

```
int sumarr(array <int,N> a)
{
    int result = 0;
    for ( int i = 0; i < N; ++i )
        result += a[i];
    return result;
}
```

example

typedef

the same with .size()

```
int sumarr(TVec a)
{
    int result = 0;
    for (int i = 0; i < a.size(); ++i )
        result += a[i];
    return result;
}
```

Example

$$r\mathbf{a} = \{ra_i\}$$

- Build a function that multiplies a vector by a number

```
TVec prod(TVec a, float v)
```

```
TVec prod(TVec a, float r)
{
    TVec res;
    for (int i = 0; i < a.size(); i++)
        res[i] = a[i] * r;
    return res;
}
```

Example

$$\text{prodEsc}(\mathbf{a}, \mathbf{b}) = \mathbf{a} \cdot \mathbf{b} = \sum_{i=0}^{N-1} a_i b_i$$

- Build the Scalar Product function:

```
float prodEsc(TVec a, TVec b)
```

```
float prodEsc(TVec a, TVec b)
{
    int prod = 0;
    for (int i = 0; i < a.size(); i++)
        prod += a[i] * b[i];
    return prod;
}
```

exercises

Given the array:

typedef **array<int,N> TVec;**

(N a const),

```
const int N = 3;
typedef array<int,N> TVec;

void resetArr(TVec& a);
void printArr(TVec a);
void readArr(TVec& a);
TVec readArr();
int sumArr(TVec a);
bool isIn(TVec a, int x);
int indexOf(TVec a, int x);
int count(TVec a, int x);
bool anyReps(TVec a);
int findPosFirstMax(TVec a);
```

1. make all its values be 0
2. print all of its values sep by spaces
3. read all of its values from keyboard
4. add up all of its values
5. guess wether an value **x** is in the array
6. find the first position in it of a given **x**
7. count the times an element appears
8. guess if any element is repeated
9. find the index of the first time the max values is