CSE105

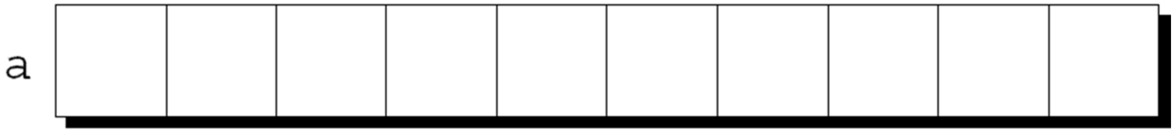
ARRAY (PART 1)

Scalar Variables versus Aggregate Variables

- So far, the only variables we’ve seen are ***scalar:*** capable of holding a single data item.
- C also supports ***aggregate*** variables, which can store collections of values.
- There are two kinds of aggregates in C: ***arrays*** and ***structures***.

One-Dimensional Arrays

- An ***array*** is a data structure containing a number of data values, all of which have the same type.
- These values, known as ***elements,*** can be individually selected by their position within the array.
- The simplest kind of array has just one dimension.
- The elements of a one-dimensional array `a` are conceptually arranged one after another in a single row (or column):



Defining Arrays

- When defining arrays, specify
  - Name
  - Type of array (Array can be defined over **any** type)
  - Number of elements

```
arrayType arrayName[ numberOfElements ];
```

  - Examples:

```
float grade[ 7 ];
int c[ 10 ];
```

- Defining multiple arrays of same type
  - Format similar to regular variables
  - Example:

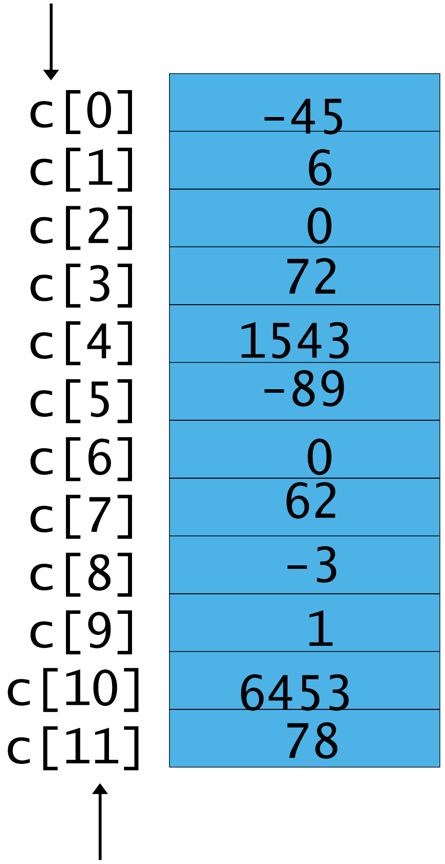
```
int b[ 100 ], x[ 27 ];
```

Array Elements

- To refer to an element, specify
  - Array name for the collection
  - Position number for the member
- Format:

  arrayname[*position number*]
  - First element at position 0
  - n element array named c:
    - c[0], c[1]...c[n – 1]

Name of array (Note that all elements of this array have the same name, c)



c[0]	-45
c[1]	6
c[2]	0
c[3]	72
c[4]	1543
c[5]	-89
c[6]	0
c[7]	62
c[8]	-3
c[9]	1
c[10]	6453
c[11]	78

Position number of the element within array c

One-Dimensional Arrays

- To declare an array, we must specify the *type* of the array's elements and the *number* of elements:

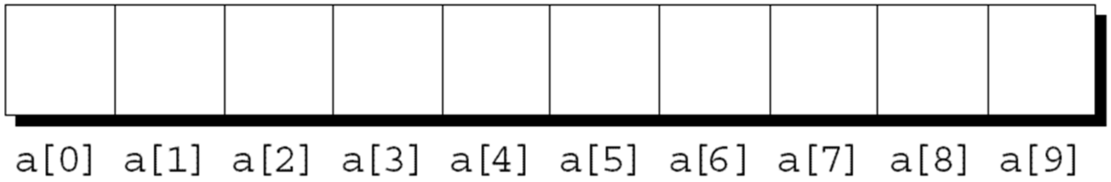
  ```
  int a[10];
  ```

- The elements may be of **any type**; the length of the array can be any (integer) constant expression.
- Using a macro to define the length of an array is an excellent practice:

  ```
  #define N 10
  …
  int a[N];
  ```

Array Subscripting

- To access an array element, write the array name followed by an integer value in square brackets.
- This is referred to as ***subscripting*** or ***indexing*** the array.
- The elements of an array of length *n* are indexed from 0 to *n* – 1.
- If `a` is an array of length 10, its elements are designated by `a[0]`, `a[1]`, …, `a[9]`:



Array Subscripting

- Expressions of the form `a[i]` are lvalues, so they can be used in the same way as ordinary variables:

```
a[0] = 1;
printf("%d\n", a[5]);
++a[i];
```

- In general, if an array contains elements of type *T*, then each element of the array is treated as if it were a variable of type *T*.

Array Subscripting

- Many programs contain `for` loops whose job is to perform some operation on every element in an array.
- Examples of typical operations on an array `a` of length `N`:

```
for (i = 0; i < N; i++)
  a[i] = 0;             /* clears a */

for (i = 0; i < N; i++)
  scanf("%d", &a[i]);   /* reads data into a */

for (i = 0; i < N; i++)
  sum += a[i];          /* sums the elements of a */
```

Array Subscripting

- C doesn’t require that subscript bounds be checked; if a subscript goes out of range, the program’s behavior is undefined.
- **A common mistake**: forgetting that an array with *n* elements is indexed from 0 to *n* – 1, not 1 to *n*:

  ```
  int a[10], i;

  for (i = 1; i <= 10; i++)
    a[i] = 0;
  ```

  With some compilers, this innocent-looking `for` statement causes an infinite loop.

Array Subscripting

- An array subscript may be any integer expression:

```
a[i+j*10] = 0;
```

- The expression can even have side effects:

```
i = 0;
while (i < N)
  a[i++] = 0;
```

Using Arrays: Averaging Grades

```
float grade[7], total=0;
/* initialize grades somehow */
total = grade[0] + grade[1] + grade[2] + grade[3] +
        grade[4] + grade[5] + grade[6];
printf(“average = %f\n”, total/7.0);
```

Or,

```
For (int i=0; i<7; i++)
    total+= grade[i];
printf(“average = %f\n”, total/7.0);
```

Actually, we can use arrays efficiently with loops

Program: Reversing a Series of Numbers

- The `reverse.c` program prompts the user to enter a series of numbers, then writes the numbers in reverse order:

```
Enter 10 numbers: 34 82 49 102 7 94 23 11 50 31
In reverse order: 31 50 11 23 94 7 102 49 82 34
```

- The program stores the numbers in an array as they’re read, then goes through the array backwards, printing the elements one by one.

reverse.c

```
/* Reverses a series of numbers */

#include <stdio.h>

int main(void)
{
  int a[10], i, N=10;

  printf("Enter %d numbers: ", N);
  for (i = 0; i < N; i++)
    scanf("%d", &a[i]);

  printf("In reverse order:");
  for (i = N - 1; i >= 0; i--)
    printf(" %d", a[i]);
  printf("\n");

  return 0;
}
```

Array Initialization

- An array, like any other variable, can be given an initial value at the time it's declared.
- The most common form of ***array initializer*** is a list of constant expressions enclosed in braces and separated by commas:

```
int a[10] = {1, 2, 3, 4, 5, 6, 7, 8, 9, 10};
```

Array Initialization

- If the initializer is shorter than the array, the remaining elements of the array are given the value 0:

  ```
  int a[10] = {1, 2, 3, 4, 5, 6};
  /* initial value of a is {1,2,3,4,5,6,0,0,0,0} */
  ```

- Using this feature, we can easily initialize an array to all zeros:

  ```
  int a[10] = {0};
  /* initial value of a is {0,0,0,0,0,0,0,0,0,0} */
  ```

  There's a single 0 inside the braces because it's illegal for an initializer to be completely empty.

- It's also illegal for an initializer to be longer than the array it initializes.

Array Initialization

- If an initializer is present, the length of the array may be omitted:

```
int a[] = {1, 2, 3, 4, 5, 6, 7, 8, 9, 10};
```

- The compiler uses the length of the initializer to determine how long the array is.

Static Array Sizes

- The size of array should be static; no dynamic array in C
  - The following is wrong:

```
int x;
scanf(“%d”, &x);
int temp[x];
```

You should use dynamic memory allocation like `malloc()` for dynamically-sized arrays

C Does Not Check Array Bounds

```
double grade[7];
int i = 9;
grade[i] = 3.5; /* Is i out-of-range? If so, any error message ?*/
```

- You should check it for yourself if not sure

```
if (0 <= i && i < 7)
   /* OK to access grade[i] */
else
   printf(“Array Index %d out-of-range.\n”, i);
```

Program: Checking a Number for Repeated Digits

- The `repdigit.c` program checks whether any of the digits in a number appear more than once.
- After the user enters a number, the program prints either `Repeated digit` or `No repeated digit`:

```
Enter a number: 28212
Repeated digit
```

- The number 28212 has a repeated digit (2); a number like 9357 doesn’t.

Program: Checking a Number for Repeated Digits

- The program uses an array of 10 Integer values to keep track of which digits appear in a number.
- Initially, every element of the `digit_seen` array is 0.
- When given a number **`n`**, the program examines `n`'s digits one at a time, storing the current digit in a variable named `digit`.
  - If `digit_seen[digit]` is >1, then `digit` appears at least twice in `n`.
  - If `digit_seen[digit]` is 0, then `digit` has not been seen before.

repdigit.c

```c
/* Checks numbers for repeated digits */

#include <stdio.h>

int main(void)
{
  int digit_seen[10] = {0};
  int digit;
  long n;

  printf("Enter a number: ");
  scanf("%ld", &n);
  while (n > 0) {
      digit = n % 10;
      digit_seen[digit]++;
      n /= 10;
  }
```

Try This

- Create an integer array of 20 elements.
- Initialize the array with 0.
- Insert 5 numbers in an array from keyboard
- Detect whether the array is sorted in descending/ascending order.
- Insert a number at the end of the array
- Insert a number at the beginning of the array
- Delete the first number from the array.
- Delete lowest element from the array.

Try This

- Search a number from the array.
- Find the highest and lowest number from array (with their position)
- Factorial of n = n*(n-1)*…… 3*2*1
- Fibonacci sequence n = 0 1 1 2 3 5 … … … nth term
- Minimal Element Sort