The character data type

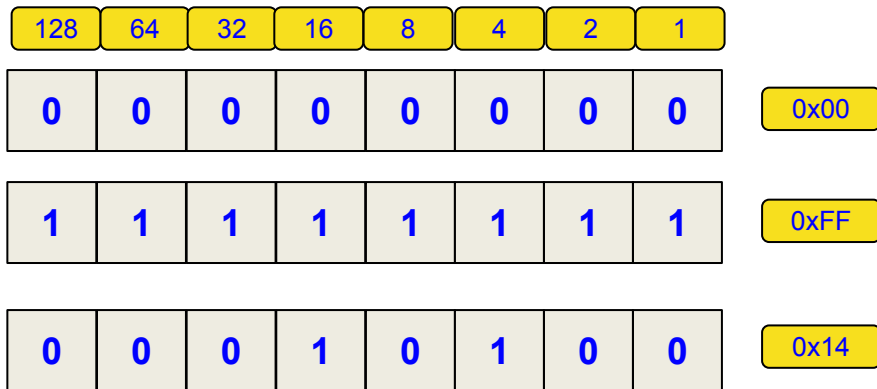By: Yehia M. Abu Eita

Outlines

- **The unsigned character**

- **The signed character**

- **Two's complement (method 1)**

- **Two's complement (method 2)**

The unsigned character

- The character data type may be **unsigned** or **signed**.

- The **unsigned character** has the following properties:

    - **Size in memory: 1 byte**.

    - **Minimum value: 0**.

    - **Maximum value: 255**.

```
unsigned char x = 20;
OR
unsigned  char x = 0x14;
```
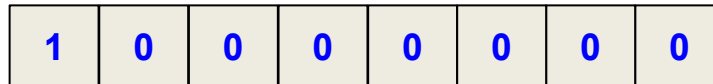
128	64	32	16	8	4	2	1

0	0	0	0	0	0	0	0	0x00

1	1	1	1	1	1	1	1	0xFF

0	0	0	1	0	1	0	0	0x14

The signed character

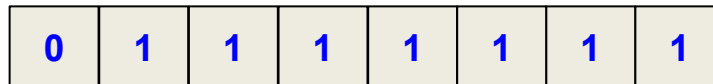- The **signed character** has the following properties:

  – **Size in memory: 1 byte**.

  – **Minimum value: -128**.

  – **Maximum value: +127**.

```
signed char x = -20;
// use the 2's complement
to convert
```
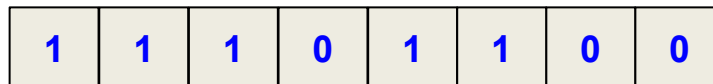

Sign Bit

| 128 | 64 | 32 | 16 | 8 | 4 | 2 | 1 |

| 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | -0x80

| 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0x7F

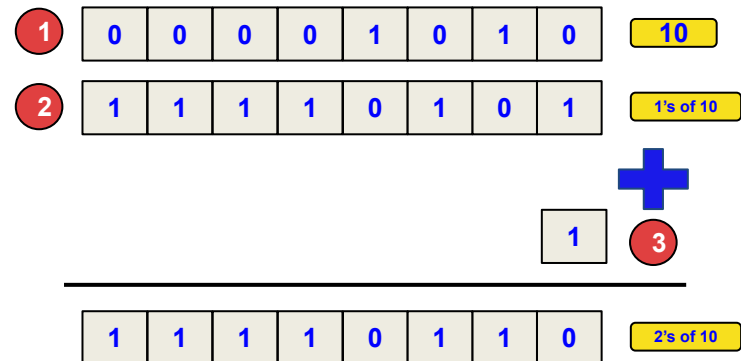| 1 | 1 | 1 | 0 | 1 | 1 | 0 | 0 | -0x14

Two's complement (method 1)

- The **signed character** is converted into a suitable form in the memory.

- The CPU uses the 2's complement method.

- Three steps are made to get the 2's complement of a number:

  - **Convert to binary form.**

  - **Get 1's complement (Flip all bits).**

  - **Make binary addition with 1.**

1	0	0	0	0	1	0	1	0	**10**

2	1	1	1	1	0	1	0	1	**1's of 10**

$$+$$

							1	**3**

	1	1	1	1	0	1	1	0	**2's of 10**

Two's complement (method 2)

- Another simple method to get the 2's complement
  - **Convert to binary form.**
  - **Start moving from the least significant bit (LSB), from the right to the left.**
  - **After the first 1 you found, flip all bits.**

1	0	0	0	0	1	0	1	0	**10**

| 2 | 0 | 0 | 0 | 0 | 1 | 0 | 1 | 0 |

| 3 | 1 | 1 | 1 | 1 | 0 | 1 | 1 | 0 | **2's of 10** |
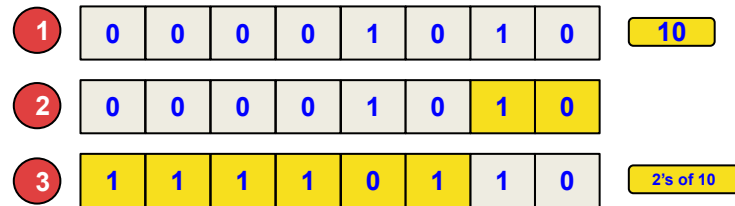
Summary

- **You have learned about the unsigned character, its size, range, memory representation and declaration.**

- **You have learned about the signed character, its size, range, memory representation and declaration.**

- **You have learned two methods to get the two's complement of any negative number to get its representation in the memory.**