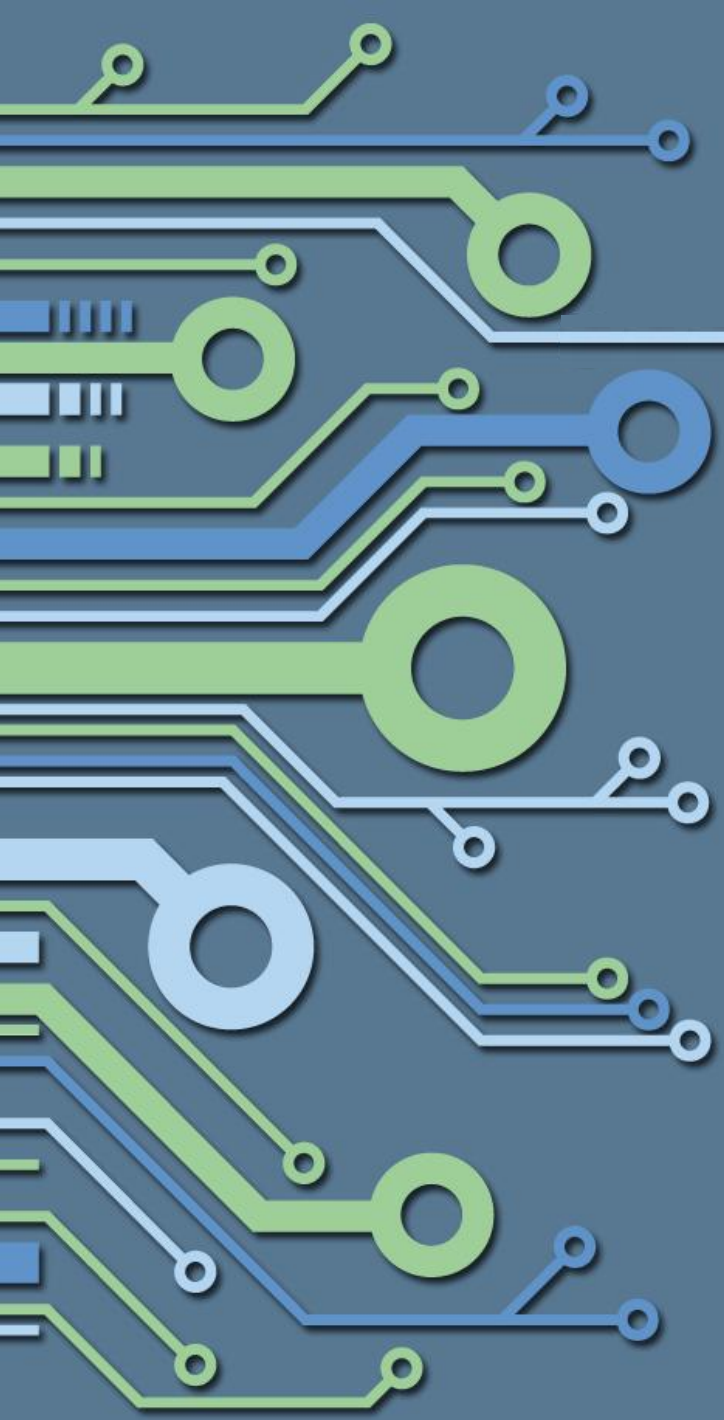


Chapter 1

DATA REPRESENTATION

Complements

Examples

- 10's C
  - 512790 = 487210
  - 14672.3 = 85327.7
- 7's C
  - 65172 = 12605

Examples

- 1's C
  - 011100 = 100011
- 2's C
  - 010101 = 101011
- 16's C
  - 59A1D = A65E3

Systems Used to Represent Negative Numbers

Signed-Magnitude Representation

- A number consists of a magnitude and a symbol indicating whether the magnitude is positive or negative.

Examples:

$+85 = 01010101_2$ $\quad -85 = 11010101_2$

$+127 = 01111111_2$ $\quad -127 = 11111111_2$

Systems Used to Represent Negative Numbers

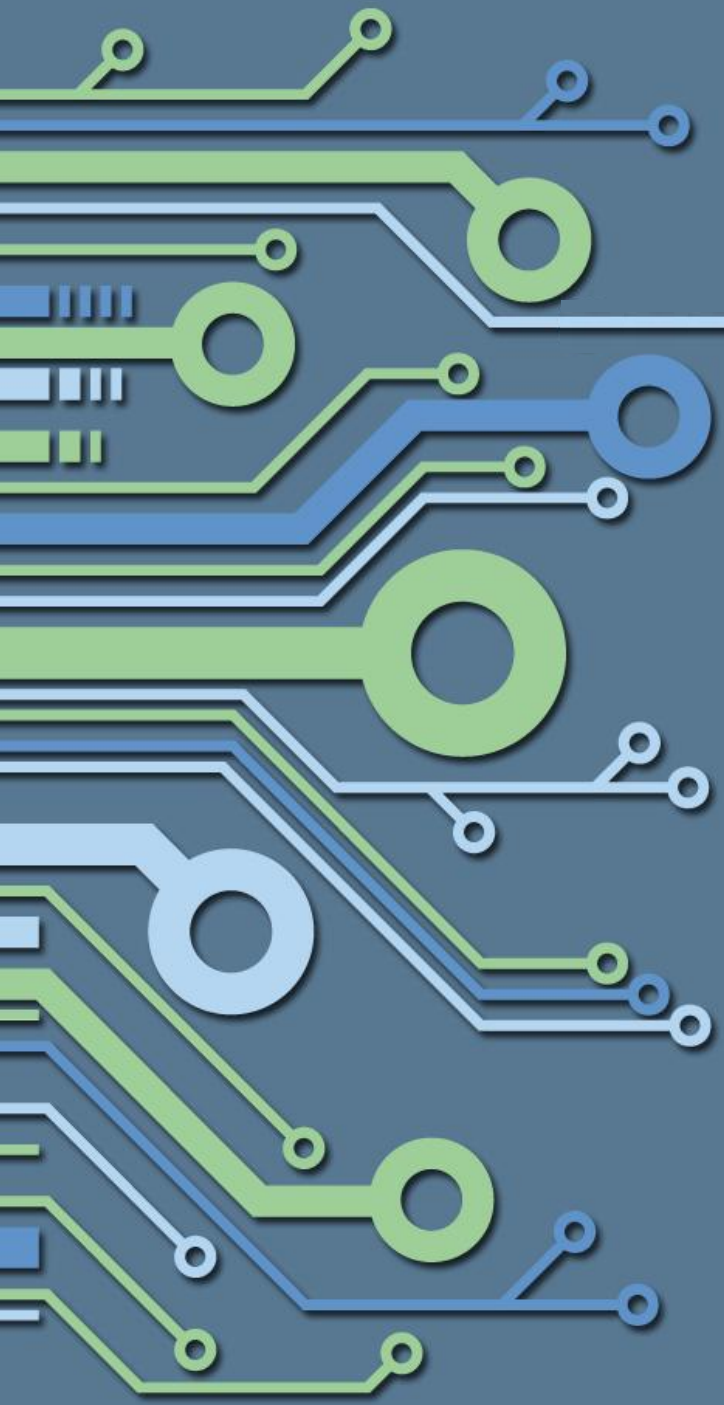
Signed-Complement System

- This system negates a number by taking its complement as defined by the system.

Examples:

$+85 = 01010101_2$ $\quad -85 = 10101010_2$ (1s)

$+127 = 01111111_2$ $\quad -127 = 10000001_2$ (2s)



Chapter 2

COMPUTER ARITHMETIC

Arithmetic in various Number Systems

- Addition of numbers in any number system
  - Add numbers starting at the least significant digit.
  - Perform addition on numbers of the same number base.
- Subtraction of numbers
  - Must use complements

Binary Addition

- To add binary numbers: (X + Y)
  - Get the SCR of the negative numbers
  - Add the two numbers
  - If the SCR used is:
    - 2's C: Discard end carry
    - 1's C: Add the end carry to the sum

Example: Binary Addition

- Add the following numbers. Use 8 bits to represent each number.
  - 6 + 13
  - 6 + (-13)
  - (-6) + 13
  - (-6) + (-13)

Example: Binary Addition

- 6 + 13 = 19

Example: Binary Addition

- 6 + 13 = 19

  0 0000110

Example: Binary Addition

- 6 + 13 = 19

```
  0 0000110
+ 0 0001101
```

Example: Binary Addition

- 6 + 13 = 19

```
  0 0000110
+ 0 0001101
---------
= 0 0010011
```

Example: Binary Addition

- 6 + 13 = 19

```
  0 0000110
+ 0 0001101
= 0 0010011
```

- 6 + (-13) = -7

```
  0 0000110
```

Example: Binary Addition

- 6 + 13 = 19

```
  0 0000110
+ 0 0001101
= 0 0010011
```

- 6 + (-13) = -7

```
  0 0000110
```

(1's)

Example: Binary Addition

- 6 + 13 = 19

```
  0 0000110
+ 0 0001101
= 0 0010011
```

- 6 + (-13) = -7

```
  0 0000110
+ 1 1110010  (1's)
```

Example: Binary Addition

- 6 + 13 = 19

```
  0 0000110
+ 0 0001101
= 0 0010011
```

- 6 + (-13) = -7

```
  0 0000110
+ 1 1110010   (1's)
= 1 1111000
```

Example: Binary Addition

- (-6) + 13 = 7

(2's)

Example: Binary Addition

- (-6) + 13 = 7

  1 1111010 (2's)

6 = 0 0000110

Example: Binary Addition

- (-6) + 13 = 7

```
  1 1111010  (2's)
+ 0 0001101
-----------
```

6 = 0 0000110

Example: Binary Addition

- (-6) + 13 = 7

```
   1 1111010  (2's)
+  0 0001101
-----------
=10 0000111
```

6 = 0 0000110

Example: Binary Addition

- (-6) + 13 = 7

```
   1 1111010  (2's)
+  0 0001101
-------------
=10 0000111
```

6 = 0 0000110

Example: Binary Addition

- (-6) + 13 = 7

  1 1111010 (2's)

  \+ 0 0001101

  =10 0000111

- (-6) + (-13) = -19

  1 1111010 (2's)

6 = 0 0000110

Example: Binary Addition

- (-6) + 13 = 7

```
  1 1111010  (2's)
+ 0 0001101
-------------
=10 0000111
```

- (-6) + (-13) = -19

```
    1 1111010  (2's)
+   1 1110011  (2's)
--------------------
```

6 = 0 0000110

Example: Binary Addition

- (-6) + 13 = 7

```
  1 1111010  (2's)
+ 0 0001101
-------------
=10 0000111
```

- (-6) + (-13) = -19

```
    1 1111010  (2's)
+   1 1110011  (2's)
-------------
=  11 1101101
```

6 = 0 0000110

Example: Binary Addition

- (-6) + 13 = 7

```
  1 1111010  (2's)
+ 0 0001101
-------------
=10 0000111
```

- (-6) + (-13) = -19

```
  1 1111010  (2's)
+ 1 1110011  (2's)
-------------
= 11 1101101
```

6 = 0 0000110

Examples: Addition

- $(999.5 + 281.6)_{10}$

$$\begin{array}{rr} & {\scriptstyle 1\ \ 1\ 1} \\ & 999.5 \\ + & 281.6 \\ \hline & 1281.1 \end{array}$$

Examples: Addition

- $(999.5 + 281.6)_{10}$

```
  1 1 1
    999.5
+   281.6
-------
   1281.1
```

- $(110.11 + 101010.11)_2$

```
  1 1 1  1  1
    110.11
+ 101010.11
-----------
 110001.10
```

Examples: Addition

- $(355.45 + 240.664)_8$

$$\begin{array}{rr} & 355.45 \\ + & 240.664 \\ \hline = & \end{array}$$

Examples: Addition

- $(355.45 + 240.664)_8$

$$\begin{array}{rr} & {\scriptstyle 1} \\ & 355.45 \\ + & 240.664 \\ \hline = & \quad 4 \end{array}$$

Examples: Addition

- $(355.45 + 240.664)_8$

$$\begin{array}{rr} & {\scriptstyle 1} \\ & 355.45 \\ + & 240.664 \\ \hline = & 34 \end{array}$$

Examples: Addition

- $(355.45 + 240.664)_8$

$$\begin{array}{rr} & {\scriptstyle 1\ \ 1} \\ & 355.45 \\ + & 240.664 \\ \hline = & 6.334 \end{array}$$

Examples: Addition

- $(355.45 + 240.664)_8$

$$\begin{array}{rr} & {\scriptstyle 1\quad 1\quad 1} \\ & 355.45 \\ + & 240.664 \\ \hline = & 616.334 \end{array}$$

Examples: Addition

- $(355.45 + 240.664)_8$

$$\begin{array}{rr} & {\scriptstyle 1\ \ 1\ \ 1\ \ } \\ & 355.45 \\ + & 240.664 \\ \hline = & 616.334 \end{array}$$

- $(A0C.D + E72.9)_{16}$

$$\begin{array}{rr} & A0C.D \\ + & E72.9 \\ \hline = & \end{array}$$

Examples: Addition

- $(355.45 + 240.664)_8$

$$\begin{array}{rr} & {\scriptstyle 1\ \ 1\ \ 1} \\ & 355.45 \\ + & 240.664 \\ \hline = & 616.334 \end{array}$$

- $(A0C.D + E72.9)_{16}$

$$\begin{array}{rr} & {\scriptstyle 1} \\ & A0C.D \\ + & E72.9 \\ \hline = & .6 \end{array}$$

Examples: Addition

- $(355.45 + 240.664)_8$

$$\begin{array}{r} {\scriptstyle 1\ \ 1\ \ 1} \\ 355.45 \\ +\ 240.664 \\ \hline = \ 616.334 \end{array}$$

- $(A0C.D + E72.9)_{16}$

$$\begin{array}{r} {\scriptstyle 1} \\ A0C.D \\ +\ E72.9 \\ \hline = \ 187F.6 \end{array}$$