

# Data representation

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# decimal refresher

$$\begin{array}{r} 5 \qquad \qquad \qquad 8 \qquad \qquad \qquad 0 \qquad \qquad \qquad 3 \qquad \qquad \qquad 6 \\ \hline 50000 \qquad + \qquad 8000 \qquad + \qquad 0 \qquad + \qquad 30 \qquad + \qquad 6 \end{array}$$

# decimal refresher

5		8		0		3		6
<hr/>								
50000	+	8000	+	0	+	30	+	6
<hr/>								
$5 \times 10000$	+	$8 \times 1000$	+	$0 \times 100$	+	$3 \times 10$	+	$6 \times 1$

# decimal refresher

5		8		0		3		6
<hr/>								
50000	+	8000	+	0	+	30	+	6
<hr/>								
$5 \times 10000$	+	$8 \times 1000$	+	$0 \times 100$	+	$3 \times 10$	+	$6 \times 1$
<hr/>								
$5 \times 10^4$	+	$8 \times 10^3$	+	$0 \times 10^2$	+	$3 \times 10^1$	+	$6 \times 10^0$

10110

# binary refresher

1		0		1		1		0
<hr/>								
$1 \times 2^4$	+	$0 \times 2^3$	+	$1 \times 2^2$	+	$1 \times 2^1$	+	$0 \times 2^0$

# binary refresher

1		0		1		1		0
<hr/>								
$1 \times 2^4$	+	$0 \times 2^3$	+	$1 \times 2^2$	+	$1 \times 2^1$	+	$0 \times 2^0$
<hr/>								
$1 \times 16$	+	$0 \times 8$	+	$1 \times 4$	+	$1 \times 2$	+	$0 \times 1$



# binary refresher

1		0		1		1		0
<hr/>								
$1 \times 2^4$	+	$0 \times 2^3$	+	$1 \times 2^2$	+	$1 \times 2^1$	+	$0 \times 2^0$
<hr/>								
$1 \times 16$	+	$0 \times 8$	+	$1 \times 4$	+	$1 \times 2$	+	$0 \times 1$
<hr/>								
16	+	0	+	4	+	2	+	0

# unsigned addition

$$0 + 0 = 0$$

$$0 + 1 = 1$$

$$1 + 0 = 1$$

$$1 + 1 = 10$$

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$$0 \ 0 \quad 0 \ 1 \ 0 \ 1 = 5$$

$$\text{ADD} \quad 0 \ 0 \quad 0 \ 1 \ 0 \ 1 = 5$$

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# unsigned addition

$$0 + 0 = 0$$

$$0 + 1 = 1$$

$$1 + 0 = 1$$

$$1 + 1 = 10$$

---

$$0 \ 0 \quad 0 \ 1 \ 0 \ 1 = 5$$

$$\text{ADD} \quad 0 \ 0 \quad 0 \ 1 \ 0 \ 1 = 5$$

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$$C = 0 \quad 0 \ 0 \quad 1 \ 0 \ 1 \ 0 = 10$$

## signed addition

$$0 \ 0 \quad 0 \ 1 \ 0 \ 1 \quad = +5$$

$$\text{ADD} \quad 1 \ 0 \quad 0 \ 1 \ 0 \ 1 \quad = -5$$

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## signed addition

$$0 \ 0 \ 0 \ 1 \ 0 \ 1 = +5$$

$$\text{ADD} \quad 1 \ 0 \ 0 \ 1 \ 0 \ 1 = -5$$

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$$C = 0 \quad 1 \ 0 \ 1 \ 0 \ 1 \ 0 = -10$$

## one's complement

NOT	0	0	0	1	0	1
-----	---	---	---	---	---	---

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# one's complement

NOT	0	0	0	1	0	1
<hr/>						
	1	1	1	0	1	0

# one's complement

NOT    0   0       0   1   0   1

---

1   1       1   0   1   0

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0   0       0   1   0   1

ADD   1   1       1   0   1   0

---



# one's complement

NOT	0	0	0	1	0	1
<hr/>						
	1	1	1	0	1	0
<hr/>						
	0	0	0	1	0	1
ADD	1	1	1	0	1	0
<hr/>						
C = 0	1	1	1	1	1	1

# one's complement

NOT	0	0	0	1	0	1
-----	---	---	---	---	---	---

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	1	1	1	0	1	0
--	---	---	---	---	---	---

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	0	0	0	1	0	1
--	---	---	---	---	---	---

ADD	1	1	1	0	1	0
-----	---	---	---	---	---	---

---

C = 0	1	1	1	1	1	1
-------	---	---	---	---	---	---

ADD	0	0	0	0	0	1
-----	---	---	---	---	---	---

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# one's complement

NOT	0	0	0	1	0	1
-----	---	---	---	---	---	---

---

	1	1	1	0	1	0
--	---	---	---	---	---	---

---

	0	0	0	1	0	1
--	---	---	---	---	---	---

ADD	1	1	1	0	1	0
-----	---	---	---	---	---	---

---

C = 0	1	1	1	1	1	1
-------	---	---	---	---	---	---

ADD	0	0	0	0	0	1
-----	---	---	---	---	---	---

---

C = 1	0	0	0	0	0	0
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