

HW 4: Unsigned Binary Addition

For each of the $\langle X, Y \rangle$ pairs below:

- Convert X and $Y \rightarrow$ binary
- Use binary addition, to compute the 8-bit **sum**
- Convert the **sum** \rightarrow hexadecimal
- Indicate whether the sum produces a carry
- Convert $X, Y, \text{sum} \rightarrow$ decimal (to check your work)

Where $\langle X, Y \rangle =$

- $\langle 0x4F, 0x6D \rangle$
- $\langle 0xC8, 0x2B \rangle$
- $\langle 0xA3, 0x95 \rangle$
- $\langle 0xB4, 0xE1 \rangle$

Example X1

$$\langle \mathbf{X}, \mathbf{Y} \rangle = \langle 0x\mathbf{9E}, 0x\mathbf{7A} \rangle$$

$$\langle \mathbf{X}, \mathbf{Y} \rangle = \langle 0b\mathbf{10011110}, 0b\mathbf{01111010} \rangle$$

$$\begin{array}{r} \mathbf{X} + \mathbf{Y} = \mathbf{10011110} \\ \quad \quad \mathbf{01111010} \\ \hline \end{array}$$

carry 

$$\begin{array}{ccccccc} & 1 & 1 & 1 & 1 & 1 & 1 & 0 \\ & 1 & 0 & 0 & 0 & 1 & 1 & 0 & 0 & 0 \end{array} \rightarrow 0x\mathbf{18} + 0x\mathbf{100}$$

$$\mathbf{X} = 9 \cdot 16 + 14 = 158$$

$$\mathbf{Y} = 7 \cdot 16 + 10 = 122$$

$$\mathbf{sum} = 1 \cdot 16 + 8 = 24$$

$$\mathbf{X} + \mathbf{Y} = 280 \neq 24$$

$$\mathbf{X} + \mathbf{Y} = 280 = 24 + 256$$

$$\mathbf{carry} = 1 \cdot 16^2 = 256$$

Example X2

$$\langle \textcolor{red}{X}, \textcolor{blue}{Y} \rangle = \langle 0x\textcolor{red}{B5}, 0x\textcolor{blue}{3C} \rangle$$

$$\langle \textcolor{red}{X}, \textcolor{blue}{Y} \rangle = \langle 0b\textcolor{red}{10110101}, 0b\textcolor{blue}{00111100} \rangle$$

$$\begin{array}{r} \textcolor{red}{X} + \textcolor{blue}{Y} = \textcolor{red}{10110101} \\ \quad \quad \quad \textcolor{blue}{00111100} \\ \hline \end{array}$$

carry 

$$\begin{array}{cccccccc} 0 & 0 & 1 & 1 & 1 & 1 & 0 & 0 & 0 \\ \textcolor{violet}{0} & \textcolor{green}{1} & \textcolor{green}{1} & \textcolor{green}{1} & \textcolor{green}{1} & \textcolor{green}{0} & \textcolor{green}{0} & \textcolor{green}{0} & \textcolor{green}{1} \end{array} \rightarrow 0x\textcolor{green}{F1} + 0x\textcolor{violet}{0}$$

$$\textcolor{red}{X} = \textcolor{red}{11} \cdot 16 + \textcolor{red}{5} = \textcolor{red}{181}$$

$$\textcolor{blue}{Y} = \textcolor{blue}{3} \cdot 16 + \textcolor{blue}{12} = \textcolor{blue}{60}$$

$$\textcolor{green}{sum} = \textcolor{green}{15} \cdot 16 + \textcolor{green}{1} = \textcolor{green}{241}$$

$$\textcolor{red}{X} + \textcolor{blue}{Y} = \textcolor{black}{241} = \textcolor{green}{241}$$

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#X2 X = 0xB5

Y = 0x3C

a) X = 0b10110101

Y = 0b00111100

b) X + Y = 10110101

00111100

0 0 1 1 1 1 0 0 0

11110001

c) sum = 0xF1

d) carry = 0

e) X = 11 · 16 + 5 = 181

Y = 3 · 16 + 12 = 60

sum = 15 · 16 + 1 = 241

X + Y = 241 = 241