

# Lecture 3

Friday, April 3, 2020 2:32 PM

General Questions and issues from remote teaching

- Lab
- Lecture
- Quiz
- Reading Report

## Part 1 - Complements

Radix	Diminished Radix Complement	Radix Complement
Decimal	9's complement	10's complement
Binary	1's complement	2's complement

## Part 2 - Addition and Subtraction

Addition and Subtraction in Decimal, Hexadecimal, & Binary  
Subtracting by adding the radix complement

Week 1 Quiz Published

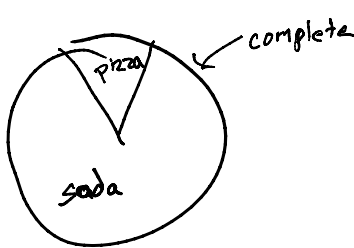
End of lecture questions

## Part 3 - Optional Video Game, Factorio

Socializing while practicing physical distancing  
693 Hours played, since release on Steam  
Practice 3 core concepts of Engineering and Computer Science

Hierarchy	Use Small things to build bigger things
Regularity	Each structure should be uniform in construction, avoiding special tweaks
Modularity	Each structure should have well defined interfaces, making it reusable

Part 1 - Complements (not thoroughly described in the Textbook 4:04)



Decimal

$$\begin{array}{r} 37 \\ + 62 \\ \hline 99 \end{array}$$

2 digit 9's comp.

$$\begin{array}{r} 37 \\ + 63 \\ \hline 100 \end{array}$$

2 digit 10's comp.

Question 1: What is the 2-digit 9's complement of 31? What is the 4-digit 9's complement of 31?

$$\begin{array}{r} 31 \\ + 68 \\ \hline 99 \end{array}$$

2-digit 9's comp.

$$\begin{array}{r} 31 \\ + 9968 \\ \hline 9999 \end{array}$$

4-digit 9's comp.

Question 2: What is the 2-digit 10's complement of 31? What is the 5-digit 10's complement of 31?

$$\begin{array}{r} 31 \\ + 69 \\ \hline 100 \end{array}$$

2-digit 10's comp.

$$\begin{array}{r} 31 \\ + 9969 \\ \hline 10000 \end{array}$$

5-digit 10's comp.

Question 3: What is the 8-digit 1's complement of 30? What is the 16-digit 1's complement of 30?

$$\begin{array}{r} 30 \\ 11110110 \\ + 11100001 \\ \hline 11110111 \end{array}$$

8-digit 1's complement

$$\begin{array}{r} 30 \\ 00011110 \\ + 11100001 \\ \hline 11110111 \end{array}$$

16-digit 1's complement

Question 4: What is the 8-digit 2's complement of 30? What is the 16-digit 2's complement of 30?

$$\begin{array}{r} 30 \\ 00011110 \\ + 1 \\ \hline 00011111 \end{array}$$

8-digit 2's complement

$$\begin{array}{r} 30 \\ 00011110 \\ + 1 \\ \hline 00011111 \end{array}$$

16-digit 2's complement

Question 5: Represent 21 using an 8-bit binary number using the 2's complement number system.

$$\begin{array}{r} 21 \\ 00010101 \\ + 11101010 \\ \hline 11111111 \end{array}$$

8-bit 2's complement

$$\begin{array}{r} 21 \\ 00000000 \\ + 11101010 \\ \hline 11101010 \end{array}$$

16-bit 2's complement

Question 6: Represent -21 using an 8-bit binary number using the 2's complement number system.

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$(0001\ 0101)_2 \rightarrow 21 \rightarrow 1110\ 1011$   
 $1's \rightarrow 1111\ 1111$   
 $2's \rightarrow 1111\ 1111 + 1110\ 1011$

Question 7: Represent -13 using an 8-bit binary number using the 2's complement number system.

$1110\ 1011 \rightarrow -21$   
 $13 \rightarrow 01101 \rightarrow 10010 \rightarrow 10011$   
 $2's \rightarrow 10011$   
 $5 \rightarrow 2 + 13$   
 $-13$

Question 8: Represent -13 using an 8-bit binary number using the sign/magnitude number system.

$\begin{array}{c} 1 \\ \hline 1\ 1\ 0\ 1 \\ \hline \text{Sign} \quad \text{Magnitude} \end{array} = -13$

Question 1: Do the following subtraction problem in decimal, show all work (including carries/borrows).

$\begin{array}{r} 33 \\ -11 \\ \hline 22 \end{array}$   
 $\begin{array}{r} 22 \\ -11 \\ \hline 11 \end{array}$   
 $\begin{array}{r} 33 \\ +10's \text{ comp } 17 \\ \hline 50 \end{array}$   
 $\begin{array}{r} 33 \\ +83 \\ \hline 116 \end{array}$   
 $\begin{array}{r} 17 \\ -33 \\ \hline -16 \end{array}$   
 $\begin{array}{r} 17 \\ +67 \\ \hline 84 \end{array}$   
 $\begin{array}{r} 17 \\ +16 \\ \hline 33 \end{array}$   
 $\begin{array}{r} 33 \\ +16 \\ \hline 49 \end{array}$

Question 2: Do the following subtraction problem in hexadecimal, show all work (including carries/borrows).

$\begin{array}{r} 33 \\ -11 \\ \hline 22 \end{array}$   
 $\begin{array}{r} 22 \\ -11 \\ \hline 11 \end{array}$   
 $\begin{array}{r} 33 \\ +10's \text{ comp } 17 \\ \hline 50 \end{array}$   
 $\begin{array}{r} 33 \\ +83 \\ \hline 116 \end{array}$

Question 3: Do the following subtraction problem in hexadecimal, show all work (including carries/borrows).

$\begin{array}{r} 33 \\ -1E \\ \hline 17 \end{array}$   
 $\begin{array}{r} 11\ 1100 \\ -01\ 0111 \\ \hline 10\ 1000 \end{array}$   
 $\begin{array}{r} 10\ 1000 \\ +1001\ 2's \\ \hline 10\ 1001 \end{array}$   
 $\begin{array}{r} 11\ 1100 \\ +101001 \\ \hline 11\ 00101 \end{array}$