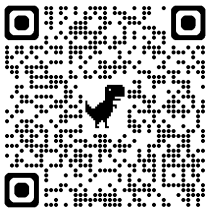
UNIVERSITY OF CALIFORNIA, BERKELEY
Department of Electrical Engineering and Computer Sciences
Computer Science Division

CS10 Fall 2025 **TA: Victoria**



SOLUTIONS

Discussion 3: Numeral Representation + Conditionals Continued

Instructions:

- If you're attending this section in-person, please log into iClicker!
- If you missed this discussion, fill out this entire worksheet, and upload it to the Gradescope assignment titled "Discussion 3" by next Discussion.

Group Activity / Question of the Day

- Ask the person to you – in front / right / left / behind / – What is one movie/TV show/musical album/video game that you've obsessed over in recent memory, and why did it speak to you so strongly?

Required (Pages 2 - 4):

Section I - Numeral Representation

Here is a conversion cheat sheet. Use this as your are working on the problems below:

Decimal	4-Bit Binary	Hexadecimal
0	0000	0
1	0001	1
2	0010	2
3	0011	3
4	0100	4
5	0101	5
6	0110	6
7	0111	7
8	1000	8
9	1001	9
10	1010	A
11	1011	B
12	1100	C
13	1101	D
14	1110	E
15	1111	F

1. What are the largest (single) digits in decimal, binary, and hexadecimal?
   Decimal: 9
   Binary: 1
   Hex: F (which represents 15)

2. How many digits do we have in base 10? What are they? What about binary (which is base 2)? What about hexadecimal?
   Decimal: 0, 1, 2, 3, 4, 5, 6, 7, 8, 9 = 10 digits
   Binary: 0, 1 = 2 digits
   Hex: 0, 1, 2, 3, 4, 5, 6, 7, 8, 9, A, B, C, D, E, F = 16 digits

3. How many digits do we have in base 3? What are they?
   3 digits = 0, 1, 2

4. If a numeral is valid in base 11, is it necessarily valid in base 3? *Hint: What are the digits in base 11, and are they the same in base 3?*
   Digits in base 11: 0,1, 2, 3, 4, 5, 6, 7, 8, 9, 10
   But digits 3 through 10 don't exist in base-3
   So it wouldn't necessarily be valid

5. 6. Circle the correct answer below to finish the statement:

   A Number-Representation System with a _____ base will generally use a numeral with fewer digits to represent the same number.

   ( ) Larger ( ) Smaller

   For example, to represent 15 in hexadecimal → F
   To represent 15 in binary → 11111

6. What's the value of 0b1101 in decimal?
   (8*1) + (4*1) + (2*0) + (1*1) = 13

7. Convert 1232 from decimal to binary.

2^{11}	2^{10}	2^9	2^8	2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0
2048	1024	512	256	128	64	32	16	8	4	2	1
0	**1**	**0**	**0**	**1**	**1**	**0**	**1**	**0**	**0**	**0**	**0**

1232 - 1024 = 208
208 - 128 = 80
80 - 64 = 16
16 - 16 = 0

Once, we reach 0, we are done. And, we add any remaining 0's to the right.

Answer = 10011010000

8. Convert 1232 from decimal to hexadecimal.

   Method 1

16^3	16^2	16^1	16^0
4096	256	16	1
0	**4**	**13**	**0**

1232 - (4 * 256) = 208
208 - (13 * 16) = 0

We stop once we reach 0, and 0 to any remaining boxes

How many times does 16 go into 208?
208 / 16 = 13
Floor division: We don't care about the remainder

We have to convert 13 to D ⟶ 4D0

Method 2

Divide by 16. Round down	Find the # mod 16	Result Digit
1232 / 16 = 77	1232 mod 16 = 0	0
77 / 16 = 4.8125 = 4	77 mod 16 = 13	D
4 / 16 = 0.25 = 0	4 mod 16 = 4	4

We read bottom up, so we get 4D0

We stop once we get to 0 when taking the floor

Method 3

Convert 1232 from decimal to hexadecimal. Option 3

2^{11}	2^{10}	2^9	2^8	2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0
2048	1024	512	256	128	64	32	16	8	4	2	1
0	**1**	**0**	**0**	**1**	**1**	**0**	**1**	**0**	**0**	**0**	**0**

Convert each group of four into the correct hexadecimal digit: 0100 1101 0000

0100 → (8 * 0) + (4 * 1) + (2 * 0) + (1 * 0) → 4
1101 → (8 * 1) + (4 * 1) + (2 * 0) + (1 * 1) → 13
0000 → (8 * 0) + (4 * 0) + (2 * 0) + (1 * 0) → 0

9. Convert 0b11010111 to hexadecimal.

   We can use the group method (method 3 from above) to convert directly to binary

   1101 ⟶ 13 ⟶ D
   0111 ⟶ 7

   So our answer is D7

10. Convert 0xA9 to binary and decimal.

    To decimal:

16^3	16^2	16^1	16^0
4096	256	16	1
		10	**9**

$$(16^1 * \underline{\mathbf{10}}) + (16^0 * \underline{\mathbf{9}})$$

$$= (16 * \underline{\mathbf{10}}) + (1 * \underline{\mathbf{9}}) = 169$$

To binary:

We can use the grouping method again

A in hex → 10 in decimal → 1010 in binary
9 in hex → 9 in decimal → 1001 in binary

Putting it altogether our answer in binary is → 10101001

Section II - Conditionals

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1. Create a predicate function called “take the bus?”. It should have three inputs: bus fare, your money, and the number of passengers. If the number of passengers is greater than or equal to 50, you should not be able to take the bus (return False). But, if the number of passengers is less than that and you have enough money to pay the bus fare, you can take the bus (return True). Fill out the code WITHOUT using Snap!

   Here is an example of how the function inputs would look:

- If (“number of passengers” >= 50)
  - report False
- Else if (“bus far” <= “your money”)
  - Report False
- Else
  - Report False

2. Fill out the truth table for the following expression:

a	b	c	a and (not b)	b and c=	(a and (not b)) or (b and c)
T	T	T	T and (F) = F	T and T = T	F or T = T
T	T	F	T and (not T) = F	T and F = F	F or F = F
T	F	T	T and (not F) = T	F and T = F	T or F = T
T	F	F	T and (not F) = T	F and F = F	T or F = T
F	T	T	F and (not T) = F	T and T = T	F or T = T
F	T	F	F and (not T) = F	T and F = F	F or F = F
F	F	T	F and (not F) = F	F and T = F	F or F = T
F	F	F	F and (not F)=F	F and F = F	F or F = T

Optional Extra Practice (Pages 5 - 6):

Optional Section I - Numeral Representation

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1. Convert 0xA0C to binary.

A → 10 → 1010
0 → 0 → 0000
C → 12 → 1100

Answer: 1010 0000 1100

2. What's the value of 0xCAFE in decimal?

C→ 12
A→ 10
F → 15
E → 14

$(16^3 * 12) + (16^2 * 10) + (16^1 * 15) + (16^0 * 14)$

= (4096 * 12) + (256 * 10) + (16 * 15) + (1 * 14)

= 51,966 in decimal

3. What's the value of 0x1011 in decimal?

$(2^3 * 1) + (2^2 * 0) + (2^1 * 1) + (2^0 * 1)$

= (8 * 1) + (4 * 0) + (2 * 1) + (1 * 1)

= 11 in decimal

4. Convert 164_7 to base-9.

First, we can convert 164_7 to decimal and then convert to base-9

Convert to decimal: $(7^2 * 1) + (7^1 * 6) + (7^0 * 4)$

= (49 * 1) + (7 * 6) + (1 * 4)

= 95

Convert 95 to base-9:

9^3	9^2	9^1	9^0
729	=81	=9	=1
0	1	1	5

95 - (81 * 1) = 1

14 - (9 * 1) = 5

5 - (1 * 5) = 0

So the answer in base-9 is → 115

5. Convert 164_9 to base-7.

Convert to decimal: $(9^2 * 1) + (9^1 * 6) + (9^0 * 4)$

$= (81 * 1) + (9 * 6) + (1 * 4)$

$= 139$

Convert 139 to base-7

7^3	7^2	7^1	7^0
343	=49	=7	=1
0	2	5	6

$139 - (49 * 2) = 41$

$41 - (7 * 5) = 6$

$6 - (1 * 6) = 0$

So the answer in base-7 is $\rightarrow$ 256

6. Fill in the blanks below:

Decimal	Binary	Hexadecimal
12	1100	C
5	101	5
11	1011	B
25	11001	19
17	10001	11
27	11011	1B
8	1000	8
14	1110	E
30	11110	1E
73	1001001	49

Optional Section II - Conditionals

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1. Fill out the truth table for the following expression:

a	b	c	b and (a≠c)	a and (not b)	Result
T	T	T	T and (T≠T) = T and F = F	T and (not T) = F	F or F = F
T	T	F	T and (T≠F) = T and T = T	T and (not T) = F	T or F = T
T	F	T	F and (T≠T) = F and F = F	T and (not F) = T	F or T = T
T	F	F	F and (T≠F) = F and T = F	T and (not F) = T	F or T = T
F	T	T	T and (F≠T) = T and T = T	F and (not T) = F	T or F = T
F	T	F	T and (F≠F) = T and F = F	F and (not T) = F	F or F = F
F	F	T	F and (F≠T) = F and T = F	F and (not F) = F	F or F = F
F	F	F	F and (F≠F) = F and F = F	F and (not F) = F	F or F = F

- Is this statement logically equivalent to? Why or why not?

To find if it's logically equivalent, we have to write a truth table out for the new expressions and compare the truth tables. If the truth tables are identical, then the statements are logically equivalent.

a	b	c	a and (not b)	b and c	Result
T	T	T	T and (not T) = F	T and T = T	F or T = T
T	T	F	T and (not T) = F	T and F = F	F or F = F
T	F	T	T and (not F) = T	F and T = F	T or F = T
T	F	F	T and (not F) = T	F and F = F	T or F = T
F	T	T	F and (not T) = F	T and T = T	F or T = T
F	T	F	F and (not T) = F	T and F = F	F or F = F
F	F	T	F and (not F) = F	F and T = F	F or F = F
F	F	F	F and (not F) = F	F and F = F	F or F = F

Since the results are not equivalent, then the two statements are NOT logically equivalent

2. A theme park has a thrill ride that only allows guests to ride if they meet specific access rules. Write a function named "can ride" that takes in three parameters — a, b, and c — and returns True if the guest is allowed to ride and False otherwise.
    a. Each guest has the following three boolean characteristics:
        i. True if the guest is an adult (18 or older), otherwise False.
        ii. True if the guest has a fast pass, otherwise False.
        iii. True if the guest is with a group, otherwise False.
    b. The park's rule for allowing guests on the ride is:
        i. A guest may ride if they are an adult or with a group,
        ii. or they do not have a fast pass unless they are also an adult.

For an extra challenge, write a single line expression using operations like AND, OR, etc.

Either function works from below because they are equivalent!: