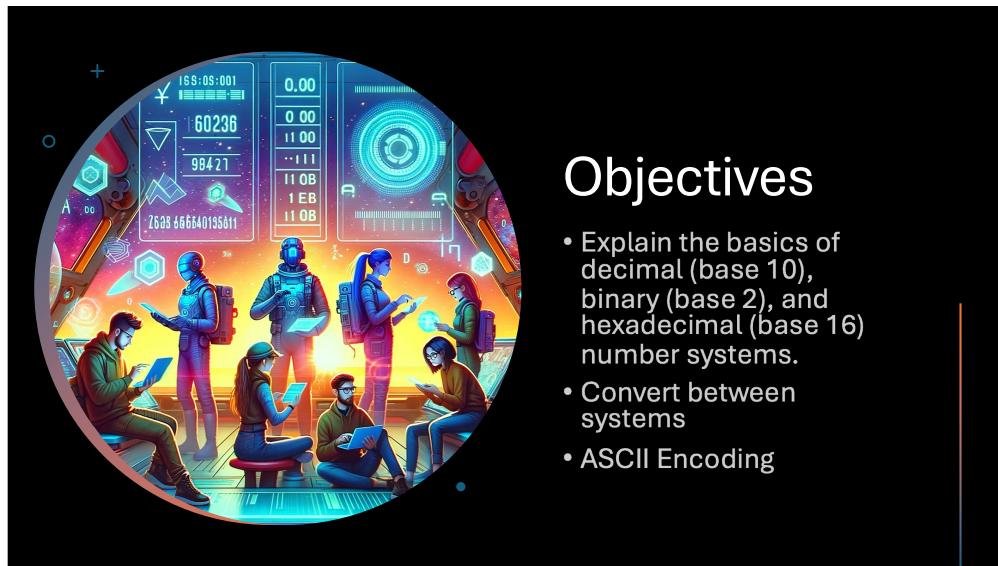
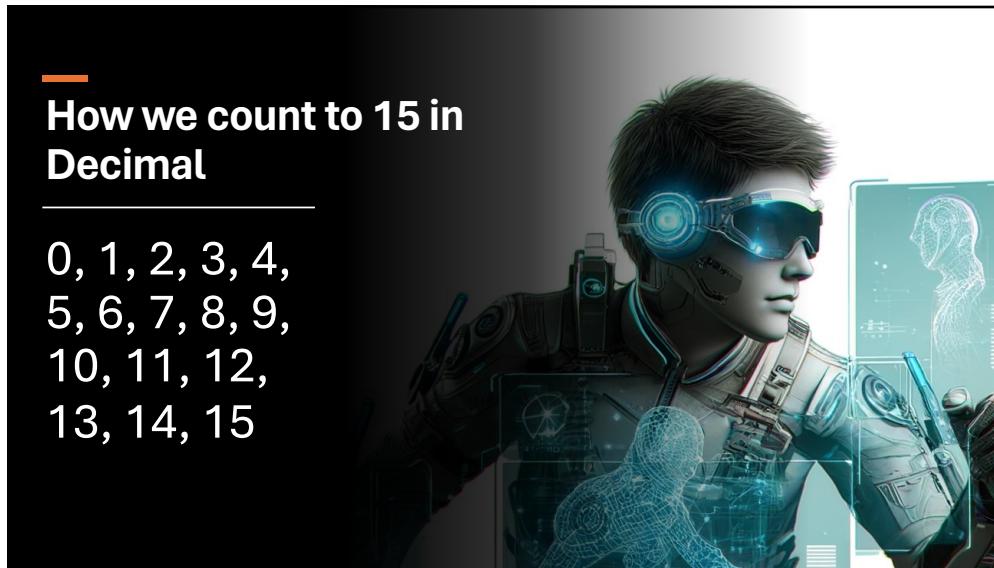




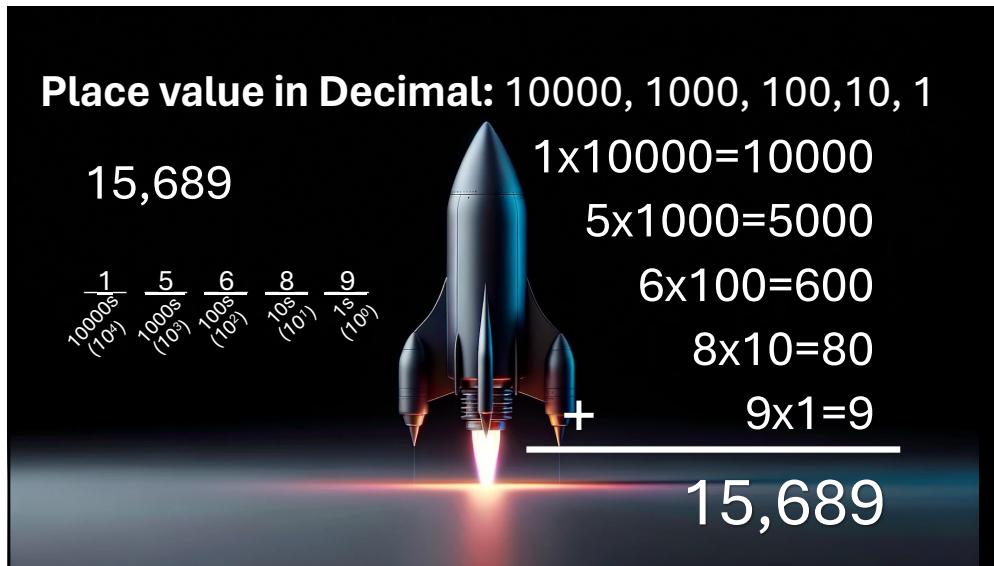
1



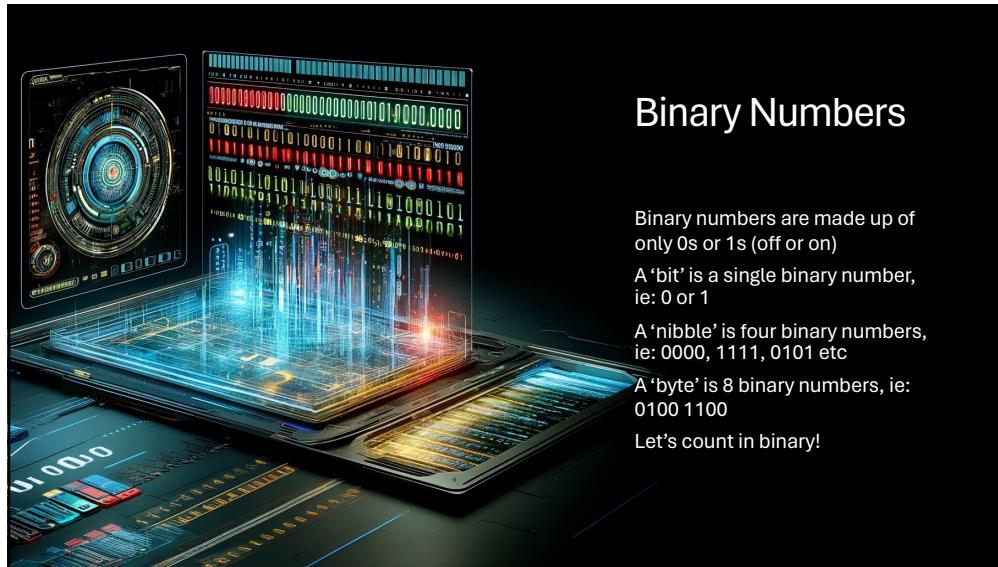
2



3



4



Binary Numbers

Binary numbers are made up of only 0s or 1s (off or on)

A 'bit' is a single binary number, ie: 0 or 1

A 'nibble' is four binary numbers, ie: 0000, 1111, 0101 etc

A 'byte' is 8 binary numbers, ie: 0100 1100

Let's count in binary!

5



How we count to 15 (dec) in binary

0000, 0001, 0010, 0011, 0100, 0101,
0110, 0111, 1000, 1001, 1010, 1011,
1100, 1101, 1110, 1111

6

3

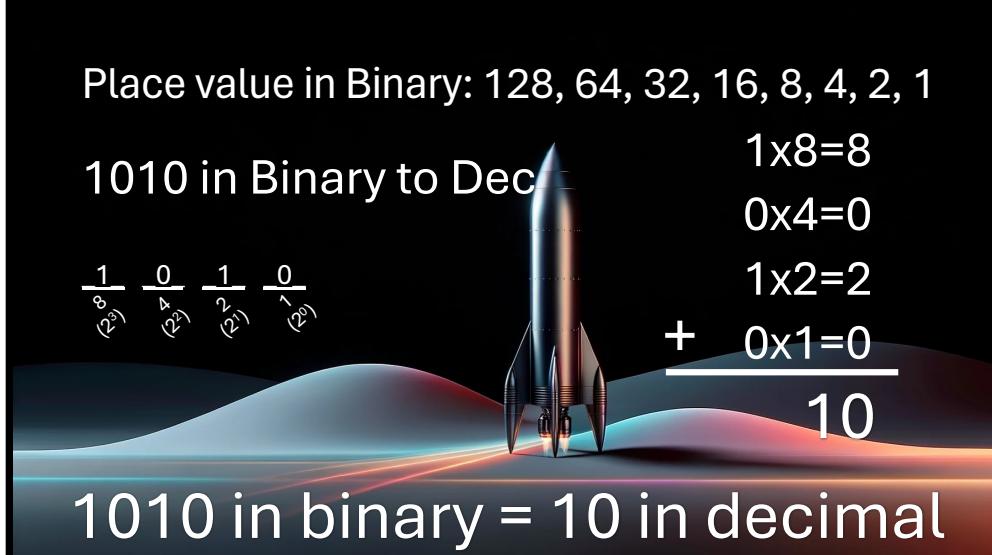
Place value in Binary: 128, 64, 32, 16, 8, 4, 2, 1

1010 in Binary to Dec

$$\begin{array}{r} \frac{1}{2^3} \quad \frac{0}{2^4} \quad \frac{1}{2^5} \quad \frac{0}{2^6} \\ + \end{array}$$

$$\begin{array}{r} 1 \times 8 = 8 \\ 0 \times 4 = 0 \\ 1 \times 2 = 2 \\ + 0 \times 1 = 0 \\ \hline 10 \end{array}$$

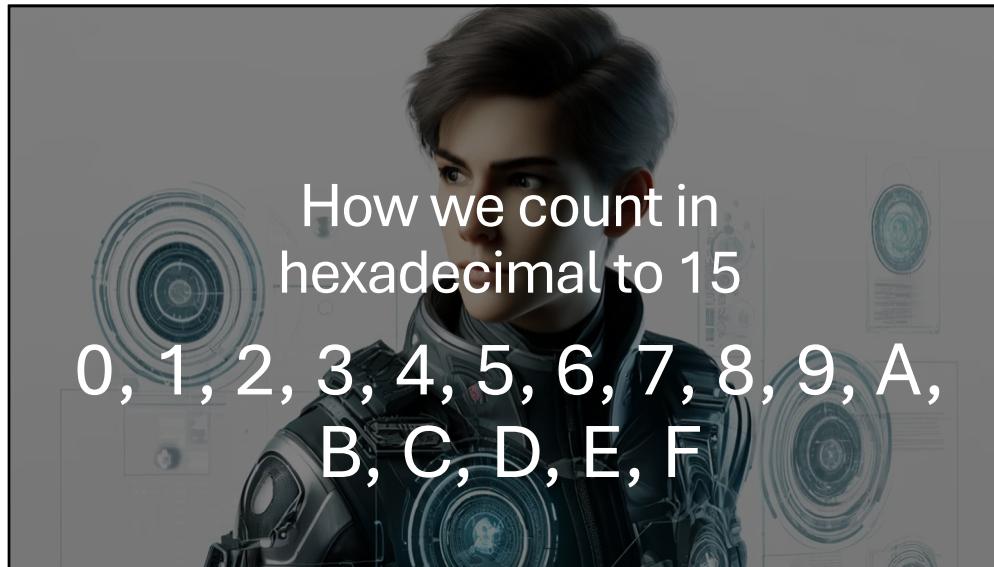
1010 in binary = 10 in decimal



7



8



How we count in
hexadecimal to 15

0, 1, 2, 3, 4, 5, 6, 7, 8, 9, A,
B, C, D, E, F

9

Background image of a rocket launching.

Place value in Hexadecimal: 65536, 4096, 256, 16, 1

5AC3 in Hex to Dec

$$\begin{array}{r} \frac{5}{(16^4)} \quad \frac{A}{(16^3)} \quad \frac{C}{(16^2)} \quad \frac{3}{(16^1)} \\ \hline \end{array}$$

$$\begin{array}{r} 5 \times 4096 = 20480 \\ 10 \times 256 = 2560 \\ 12 \times 16 = 192 \\ + \quad 3 \times 1 = 3 \\ \hline 23,235 \end{array}$$

5AC3 in Hex = 23,235 in decimal

10



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Decimal – Binary - Hexadecimal

Decimal	Bits “Nibble”	Hex
0	0000	0
1	0001	1
2	0010	2
3	0011	3
4	0100	4
5	0101	5
6	0110	6
7	0111	7

Decimal	Bits “Nibble”	Hex
8	1000	8
9	1001	9
10	1010	A
11	1011	B
12	1100	C
13	1101	D
14	1110	E
15	1111	F

12

Decimal to Binary Conversion

1. Divide the decimal number by 2.
2. Multiply the remainder by 2. Record the digit.
3. Repeat.
4. Read the recorded digits in reverse.



13

Example:

Convert decimal 13 to binary:

$$13 \div 2 = 6.5$$

$$0.5 \times 2 = 1$$

$$6 \div 2 = 3$$

$$0 \times 2 = 0$$

$$3 \div 2 = 1.5$$

$$0.5 \times 2 = 1$$

$$1 \div 2 = 0.5$$

$$0.5 \times 2 = 1$$

Decimal 13 = 1101 in binary

Decimal to Hexadecimal Conversion

1. Divide the number by 16.
2. Multiply the remainder by 16. Record the digit.
3. Repeat.
4. Read the recorded digits in reverse.



14

Example:

Convert decimal 5000 to hex:

$$5000 \div 16 = 312.5$$

$$0.5 \times 16 = 8$$

$$312 \div 16 = 19.5$$

$$.5 \times 16 = 8$$

$$19 \div 16 = 1.1875$$

$$.1875 \times 16 = 3$$

$$1 \div 16 = 0.0625$$

$$0.0625 \times 16 = 1$$

Decimal 5000 = 1388 in hexadecimal

Hexadecimal to Binary Conversion



Convert 0x2F3 to binary:

2 = 0010
F = 1111
3 = 0011

$0x2F3 = 0010\ 1111\ 0011$

Hex	Bits - "Nibble"
0	0000
1	0001
2	0010
3	0011
4	0100
5	0101
6	0110
7	0111
8	1000
9	1001
10	A
11	B
12	C
13	D
14	E
15	F

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Binary to Hex Conversion



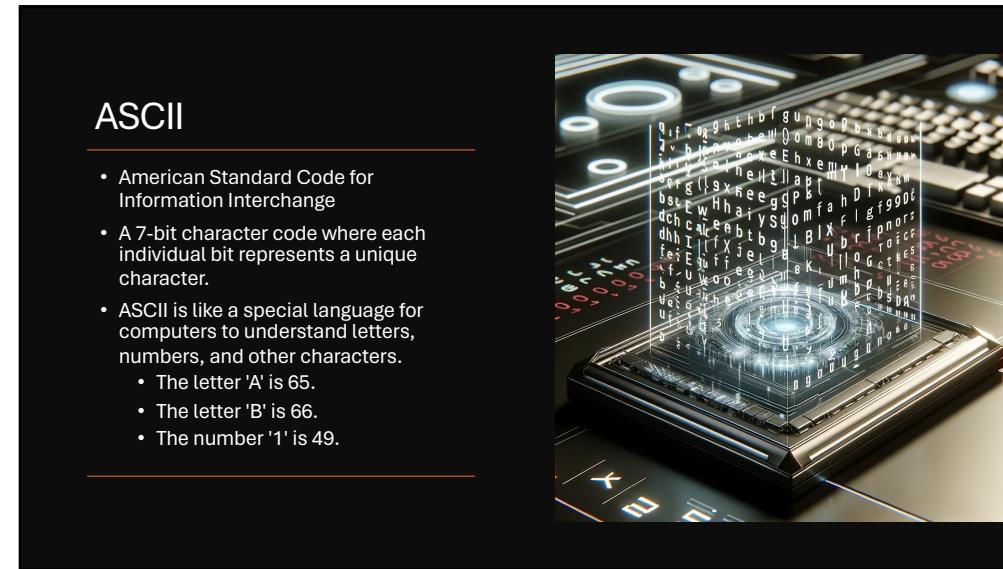
Convert 0xF38 to binary:

2F3 to binary =
1111 = F
0011 = 3
1000 = 8

$0xF38 = 1111\ 0011\ 1000$

Hex	Bits - "Nibble"
0	0000
1	0001
2	0010
3	0011
4	0100
5	0101
6	0110
7	0111
8	1000
9	1001
10	A
11	B
12	C
13	D
14	E
15	F

16



ASCII

- American Standard Code for Information Interchange
- A 7-bit character code where each individual bit represents a unique character.
- ASCII is like a special language for computers to understand letters, numbers, and other characters.
 - The letter 'A' is 65.
 - The letter 'B' is 66.
 - The number '1' is 49.

17

Hx Oct Char	Hx Oct Html Chr	Hx Oct Html Chr	Hx Oct Html Chr
0 000 MUL (null)	20 040 Space	40 100 @ Ø	60 140 ` `
1 001 SOH (start of heading)	21 041 ! !	41 101 A a	61 141 a a
2 002 STX (start of text)	22 042 " "	42 102 B B	62 142 b b
3 003 ETX (end of text)	23 043 # #	43 103 C C	63 143 c c
4 004 EOT (end of transmission)	24 044 $ \$	44 104 D D	64 144 d d
5 005 ENQ (enquiry)	25 045 % %	45 105 E E	65 145 e e
6 006 ACK (acknowledge)	26 046 & &	46 106 F F	66 146 f f
7 007 BEL (bell)	27 047 ' '	47 107 G G	67 147 g g
8 010 BS (backspace)	28 050 ((48 110 H H	68 150 h h
9 011 TAB (horizontal tab)	29 051))	49 111 I I	69 151 i i
A 012 LF (NL line feed, new line)	2A 052 * *	4A 112 J J	6A 152 j j
B 013 VT (vertical tab)	2B 053 + +	4B 113 K K	6B 153 k k
C 014 FF (NP form feed, new page)	2C 054 , ,	4C 114 L L	6C 154 l l
D 015 CR (carriage return)	2D 055 - -	4D 115 M M	6D 155 m m
E 016 SO (shift out)	2E 056 . .	4E 116 N N	6E 156 n n
F 017 SI (shift in)	2F 057 / /	4F 117 O O	6F 157 o o
10 020 DLE (data link escape)	30 060 0 0	50 120 P P	70 160 p p
11 021 DC1 (device control 1)	31 061 1 1	51 121 Q Q	71 161 q q
12 022 DC2 (device control 2)	32 062 2 2	52 122 R R	72 162 r r
13 023 DC3 (device control 3)	33 063 3 3	53 123 S S	73 163 s s
14 024 DC4 (device control 4)	34 064 4 4	54 124 T T	74 164 t t
15 025 NAK (negative acknowledge)	35 065 5 5	55 125 U U	75 165 u u
16 026 SYN (synchronous idle)	36 066 6 6	56 126 V V	76 166 v v
17 027 ETB (end of trans. block)	37 067 7 7	57 127 W W	77 167 w w
18 030 CAN (cancel)	38 070 8 8	58 130 X X	78 170 x x
19 031 EM (end of medium)	39 071 9 9	59 131 Y Y	79 171 y y
1A 032 SUB (substitute)	3A 072 : :	5A 132 Z Z	7A 172 z z
1B 033 ESC (escape)	3B 073 ; ;	5B 133 [[7B 173 { [
1C 034 FS (file separator)	3C 074 < <	5C 134 \ \	7C 174 | \
1D 035 GS (group separator)	3D 075 = =	5D 135]]	7D 175 }]
1E 036 RS (record separator)	3E 076 > >	5E 136 ^ ^	7E 176 ~ ~
1F 037 US (unit separator)	3F 077 ? ?	5F 137 _ _	7F 177 DEL

Source: www.asciitable.com

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Hx	Oct	Html	Chr	Hx	Oct	Html	Chr	Hx	Oct	Html	Chr
20	040	 	Space	40	100	@	Ø	60	140	`	`
21	041	!	!	41	101	A	A	61	141	a	a
22	042	"	"	42	102	B	B	62	142	b	b
23	043	#	#	43	103	C	C	63	143	c	c
24	044	$	\$	44	104	D	D	64	144	d	d
25	045	%	%	45	105	E	E	65	145	e	e
26	046	&	&	46	106	F	F	66	146	f	f
27	047	'	'	47	107	G	G	67	147	g	g
28	050	({	48	110	H	H	68	150	h	h
29	051)	}	49	111	I	I	69	151	i	i
2A	052	*	*	4A	112	J	J	6A	152	j	j
2B	053	+	+	4B	113	K	K	6B	153	k	k
2C	054	,	,	4C	114	L	L	6C	154	l	l
2D	055	-	-	4D	115	M	M	6D	155	m	m
2E	056	.	.	4E	116	N	N	6E	156	n	n
2F	057	/	/	4F	117	O	O	6F	157	o	o
30	060	0	0	50	120	P	P	70	160	p	p
31	061	1	1	51	121	Q	Q	71	161	q	q
32	062	2	2	52	122	R	R	72	162	r	r
33	063	3	3	53	123	S	S	73	163	s	s
34	064	4	4	54	124	T	T	74	164	t	t
35	065	5	5	55	125	U	U	75	165	u	u
36	066	6	6	56	126	V	V	76	166	v	v
37	067	7	7	57	127	W	W	77	167	w	w
38	070	8	8	58	130	X	X	78	170	x	x
39	071	9	9	59	131	Y	Y	79	171	y	y
3A	072	:	:	5A	132	Z	Z	7A	172	z	z
3B	073	;	:	5B	133	[[7B	173	{	{
3C	074	<	<	5C	134	\	\	7C	174	|	
3D	075	=	=	5D	135]]	7D	175	}	}
3E	076	>	>	5E	136	^	^	7E	176	~	~
3F	077	?	?	5F	137	_	_	7F	177		DEL

Source: www.asciitable.com

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20

Hx	Oct	Char	Hx	Oct	Html	Chr	Hx	Oct	Html	Chr	Hx	Oct	Html	Chr
0	000	MUI (null)	20	040	 	Space	40	100	@	Ø	60	140	`	
1	001	SOH (start of heading)	21	041	!	!	41	101	A	A	61	141	a	à
2	002	STX (start of text)	22	042	"	"	42	102	B	B	62	142	b	à
3	003	ETX (end of text)	23	043	#	#	43	103	C	C	63	143	c	à
4	004	EOT (end of transmission)	24	044	$	\$	44	104	D	D	64	144	d	à
5	005	ENQ (enquiry)	25	045	%	à	45	105	E	E	65	145	e	è
6	006	ACK (acknowledge)	26	046	&	à	46	106	F	F	66	146	f	à
7	007	BEL (bell)	27	047	'	'	47	107	G	G	67	147	g	à
			28	050	((48	110	H	H	68	150	h	à
			29	051))	49	111	I	I	69	151	i	à
			2A	052	*	*	4A	112	J	J	6A	152	j	à
			2B	053	+	+	4B	113	K	K	6B	153	k	à
			2C	054	,	,	4C	114	L	L	6C	154	l	x2
			2D	055	-	-	4D	115	M	M	6D	155	m	
			2E	056	.	.	4E	116	N	N	6E	156	n	n
			2F	057	/	/	4F	117	O	O	6F	157	o	ò
			30	060	0	0	50	120	P	P	70	160	p	p
			31	061	1	1	51	121	Q	Q	71	161	q	q
			32	062	2	2	52	122	R	R	72	162	r	r
			33	063	3	3	53	123	S	S	73	163	s	s
			34	064	4	4	54	124	T	T	74	164	t	t
			35	065	5	5	55	125	U	U	75	165	u	ù
			36	066	6	6	56	126	V	V	76	166	v	v
			37	067	7	7	57	127	W	W	77	167	w	w
			38	070	8	8	58	130	X	X	78	170	x	x
			39	071	9	9	59	131	Y	Y	79	171	y	y
			3A	072	:	:	5A	132	Z	Z	7A	172	z	z
			3B	073	;	:	5B	133	[[7B	173	{	{
			3C	074	<	<	5C	134	\	\	7C	174	|	
			3D	075	=	=	5D	135]]	7D	175	}	}
			3E	076	>	>	5E	136	^	^	7E	176	~	~
			3F	077	?	?	5F	137	_	_	7F	177		DEL

Source: www.asciitable.com

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Decimal to ASCII:

72 101 108 108 111

Review

- We learned the basics of decimal (base 10), binary (base 2), and hexadecimal (base 16) number systems.
- We learned how to convert between systems
- We learned about ASCII Encoding



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