Review

Binary Numbering systems:
The binary numbering system works much the same way as the decimal numbering system except that now we are in base 2 so we only have 2 digits (0, 1). The value of the number is still determined by the face value times the positional value, but since we are in base 2, the positional values are the powers of 2. Since the face values can only be 0 or 1, this means that the 0 or 1 is multiplied by the positional place in which it is found.
Example: binary number 1011011

1	0	1	1	0	1	1	Face value
2^6	2^5	2^4	2^3	2^2	2^1	2^0	Positional value
64	32	16	8	4	2	1	Resolved positional value

The positional values are first shown in the powers of 2 and then as the resolved number - in other words, 2 to the 6th is equal to 64.

Converting binary to decimal:
In the previous example to find the decimal equivalent for the number 1011011, we do the following:

$1 \times 2^6 = 1 \times 64 =$	64
$0 \times 2^5 = 0 \times 32 =$	0
$1 \times 2^4 = 1 \times 16 =$	16
$1 \times 2^3 = 1 \times 8 =$	8
$0 \times 2^2 = 0 \times 4 =$	0
$1 \times 2^1 = 1 \times 2 =$	2
$1 \times 2^0 = 1 \times 1 =$	1
	91

Converting decimal to binary:
Before doing this it is important that we review the decimal equivalent for the frequently used powers of 2:

$2^0 = 1$	$2^1 = 2$	$2^2 = 4$	$2^3 = 8$	$2^4 = 16$	$2^5 = 32$
$2^6 = 64$	$2^7 = 128$	$2^8 = 256$	$2^9 = 512$	$2^{10} = 1024$	etc.

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$1 \times 2^4 = 1 \times 16 =$	16
$1 \times 2^3 = 1 \times 8 =$	8
$0 \times 2^2 = 0 \times 4 =$	0
$1 \times 2^1 = 1 \times 2 =$	2
$1 \times 2^0 = 1 \times 1 =$	1
	91

Converting decimal to binary:
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$2^6 = 64$	$2^7 = 128$	$2^8 = 256$	$2^9 = 512$	$2^{10} = 1024$	etc.

To convert 91 from decimal to binary, you can follow the following steps:

1. Look at 91 and see what power of 2 can be taken from it. The highest power that can be subtracted is 2 to the 6th which is 64. Therefore we put a 1 in the 2 to the 6th position. Then we subtract: 91 - 64 = 27

1	____	____	____	____	____	____
2^6	2^5	2^4	2^3	2^2	2^1	2^0
64	32	16	8	4	2	1

2. Now we look at what is left, 27 and see if the next power of 2 (moving to the right) which is 2 to the 5th or 32 can be subtracted from 27. It can't, therefore we didn't use the 2 to the 5th position so we put a 0 in the 2 to the 5th position. Since we didn't use the 32, there is no subtraction.

1	0	____	____	____	____	____
2^6	2^5	2^4	2^3	2^2	2^1	2^0
64	32	16	8	4	2	1

3. Now we check to see if the next power of 2 (moving to the right) which is 2 to the 4th with the value of 16 can be subtracted from 27. It can, therefore we put a 1 in the 2 to the 4th position. Then we subtract: 27 - 16 = 11.

1	0	1	____	____	____	____
2^6	2^5	2^4	2^3	2^2	2^1	2^0
64	32	16	8	4	2	1

4. Now, we look at the next power of 2 which is 2 to the 3rd which resolves to 8 and check to see if 8 can be subtracted from 11. It can, therefore we put a 1 in the 2 to the 3rd position. Then we subtract 11 - 8 = 3

10	10

What we find is that when we run out of digits, we simply go to the next position - we call this putting down the 0 and carrying the 1.

Continuing along:

10	11	100	101	110	111	1000
+ 1	+ 1	+ 1	+ 1	+ 1	+ 1	+ 1
11	100	101	110	111	1000	1001

This means that when we count, we get the following:

Decimal	Binary
0	0
1	1
2	10
3	11
4	100
5	101
6	110
7	111
8	1000
9	1001
10	1010
11	1011
12	1100
13	1101

16	10000

Hexadecimal Numbering System:

The next numbering system is the hexadecimal numbering system. This is the base 16 numbering system, therefore there are 16 digits (0, 1, 2, 3, 4, 5, 6, 7, 8, 9, A, B, C, D, E, F). The letter A carries the same value as decimal 10, the letter B carries the same value as decimal 11, the letter C carries the same value as decimal 12, the letter D carries the same value as decimal 13, the letter E carries the same value as decimal 14, and the letter F carries the same value as decimal 15. Hexadecimal, like any other numbering system has the face value of digits and the positional value. The positional value is based on the powers of 16 since hexadecimal is the base 16 numbering system.

Example: Hexadecimal number A359

A	3	5	9	face value
16^3	16^2	16^1	16^0	positional value (powers of 16)
4096	256	16	1	resolved positional value

16 digits
0~9 ABCDEF

Converting hexadecimal to decimal:
To convert hexadecimal to its decimal equivalent, we multiply the face value times the positional value:

A x 16^3 =	10 x 4096 =	40960	(note A is equivalent to decimal 10)
3 x 16^2 =	3 x 256 =	768	
5 x 16^1 =	5 x 16 =	80	
9 x 16^0 =	9 x 1 =	9	
		41817	

The equivalent of hexadecimal A359 in decimal is 41817.

Converting decimal to hexadecimal:

16	10000

Hex	Dec		Hex	Dec
A	10		D	13
B	11		E	14
C	12		F	15

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$D6F_{16} = \_\_\_\_\_\__{10}$

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$9 \times 16^0 =$	$9 \times 1 =$	9	
		41817	

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Converting decimal to hexadecimal:

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Numbering Systems and Compute

www.pgrocer.net/Cis17/notes/numbers.h

16	10000

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		41817	

The equivalent of hexadecimal A359 in decimal is 41817.

Converting decimal to hexadecimal:

Hex Dec
A 10
B 11
C 12
D 13
E 14
F 15

$D6F_{16} = 3439_{10}$

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16	10000

Hexadecimal Numbering System:

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Example: Hexadecimal number A359

A	3	5	9	face value
16^3	16^2	16^1	16^0	positional value (powers of 16)
4096	256	16	1	resolved positional value

face $C9_{16} = 201_{10}$

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$A \times 16^3 =$	$10 \times 4096 =$	40960	(note A is equivalent to decimal 10)
$3 \times 16^2 =$	$3 \times 256 =$	768	
$5 \times 16^1 =$	$5 \times 16 =$	80	
$9 \times 16^0 =$	$9 \times 1 =$	9	
		41817	

The equivalent of hexadecimal A359 in decimal is 41817.

Converting decimal to hexadecimal:

16 10000

Hexadecimal Numbering System:

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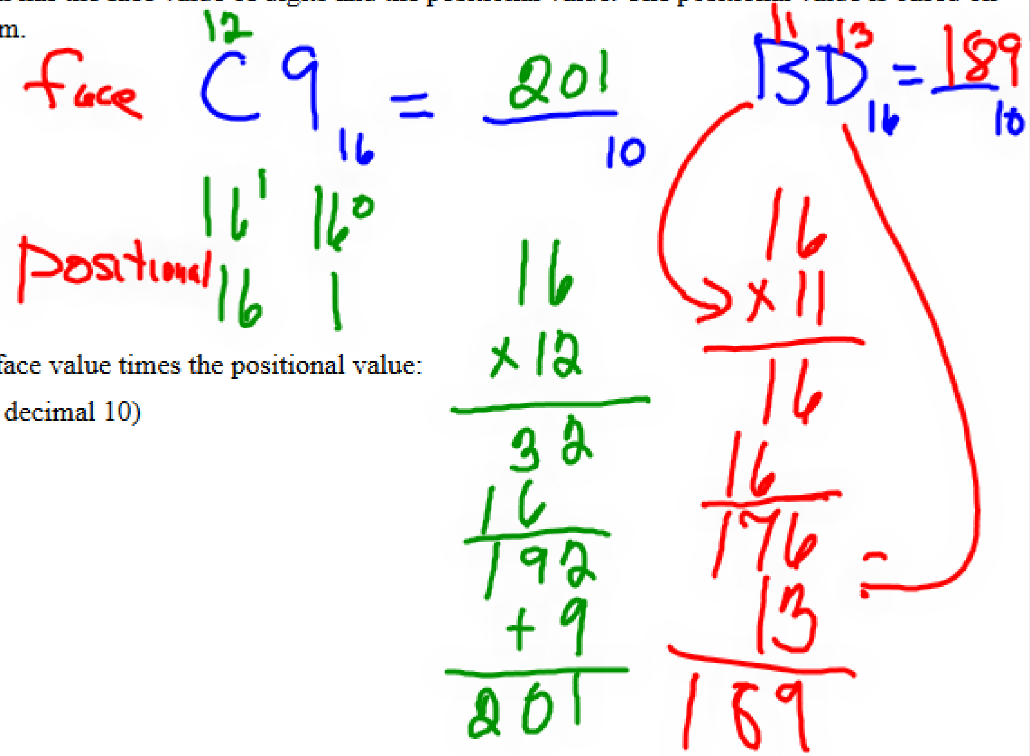

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		41817

The equivalent of hexadecimal A359 in decimal is 41817.

Converting decimal to hexadecimal:

The equivalent of hexadecimal A359 in decimal is 41817.

Converting decimal to hexadecimal:

Now we will take the decimal number 41817 and convert it back to hexadecimal. To do this, we will follow the same steps we used in converting decimal to binary with one change Ð this time we are concerned with multiplying by the face value (in binary this was not a concern because multiplying by 1 doesnÕt change anything).

The following are the decimal equivalents for some of the commonly used powers of 16:

$16^0 = 1$ $16^1 = 16$ $16^2 = 256$ $16^3 = 4096$ $16^4 = 65536$

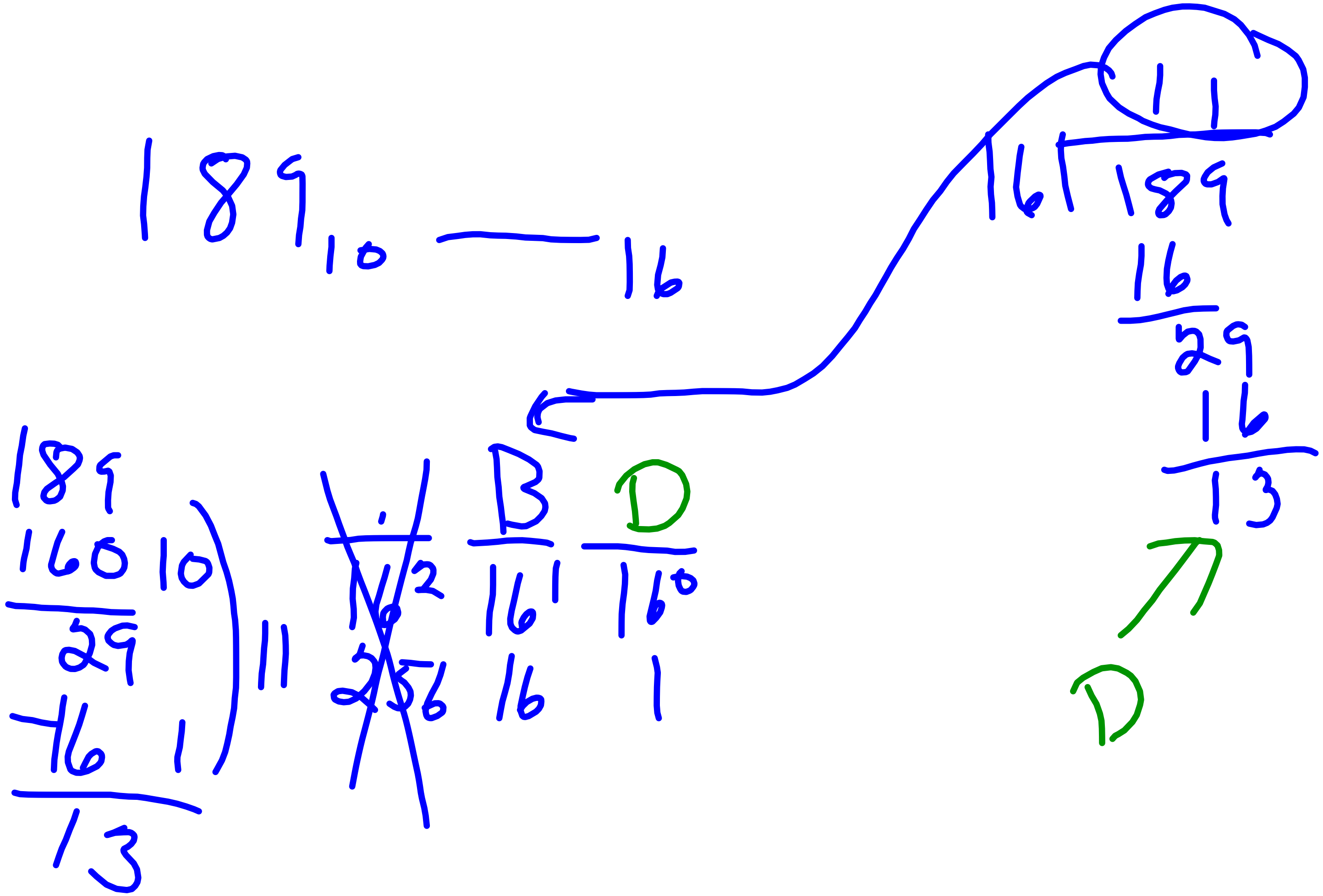
The following steps convert decimal 41817 to hexadecimal:

1. First we need to find out the highest base of 16 that can be subtracted from our number, 41817. Clearly 16 to the 4th which is equivalent to 65536 is too big. However, 16 to the 3rd which is equivalent to 4096 will work. Our next question is how many 16 to the 3rd s can be subtracted from 41817. Through trying different calculations, we discover that 10 x 4096 or 40960 is the most powers of 16 to the 3rd that we can subtract so we place A (the equivalent of 10) in the 16 to the 3rd position.
   We subtract: 41817 Ð 40960 = 857

A	____	____	____
16^3	16^2	16^1	16^0
4096	256	16	1

2. Now, we have established the first power of 16 that we can use. We now move over to 16 to the 2nd power which has the equivalent of 256 and ask how many times can 256 be subtracted from 857. Again, we try the calculations and discover 3 256s (768) can be subtracted from 857 which means we enter a 3 in the 16 to the 2nd position.
   We subtract: 857-768 = 89

A	3	____	____
16^3	16^2	16^1	16^0
4096	256	16	1



189₁₀ — 16
16 | 189
B D

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Ascii Table - ASCII character codes

www.asciitable.com

www.AsciiTable.com

ASCII | Scan Codes / EBCDIC | HTML Codes | Phonetic Alphabet | Unicode v4 | Dialing Codes | Voucher Code

ASCII Table and Description

ASCII stands for American Standard Code for Information Interchange. Computers can only understand numbers, so an ASCII code is the numerical representation of a character such as 'a' or '@' or an action of some sort. ASCII was developed a long time ago and now the non-printing characters are rarely used for their original purpose. Below is the ASCII character table and this includes descriptions of the first 32 non-printing characters. ASCII was actually designed for use with teletypes and so the descriptions are somewhat obscure. If someone says they want your CV however in ASCII format, all this means is they want 'plain' text with no formatting such as tabs, bold or underscoring - the raw format that any computer can understand. This is usually so they can easily import the file into their own applications without issues. Notepad.exe creates ASCII text, or in MS Word you can save a file as 'text only'

Dec	Hx	Oct	Char	Dec	Hx	Oct	Html	Chr	Dec	Hx	Oct	Html	Chr	Dec	Hx	Oct	Html	Chr
0	0	000	NUL (null)	32	20	040		Space	64	40	100	@	@	96	60	140	`	`
1	1	001	SOH (start of heading)	33	21	041	!	!	65	41	101	A	A	97	61	141	a	a
2	2	002	STX (start of text)	34	22	042	"	"	66	42	102	B	B	98	62	142	b	b
3	3	003	ETX (end of text)	35	23	043	#	#	67	43	103	C	C	99	63	143	c	c
4	4	004	EOT (end of transmission)	36	24	044	$	$	68	44	104	D	D	100	64	144	d	d
5	5	005	ENQ (enquiry)	37	25	045	%	%	69	45	105	E	E	101	65	145	e	e
6	6	006	ACK (acknowledge)	38	26	046	&	&	70	46	106	F	F	102	66	146	f	f
7	7	007	BEL (bell)	39	27	047	'	'	71	47	107	G	G	103	67	147	g	g
8	8	010	BS (backspace)	40	28	050	(	(	72	48	110	H	H	104	68	150	h	h
9	9	011	TAB (horizontal tab)	41	29	051	)	)	73	49	111	I	I	105	69	151	i	i
10	A	012	LF (NL line feed, new line)	42	2A	052	*	*	74	4A	112	J	J	106	6A	152	j	j
11	B	013	VT (vertical tab)	43	2B	053	+	+	75	4B	113	K	K	107	6B	153	k	k

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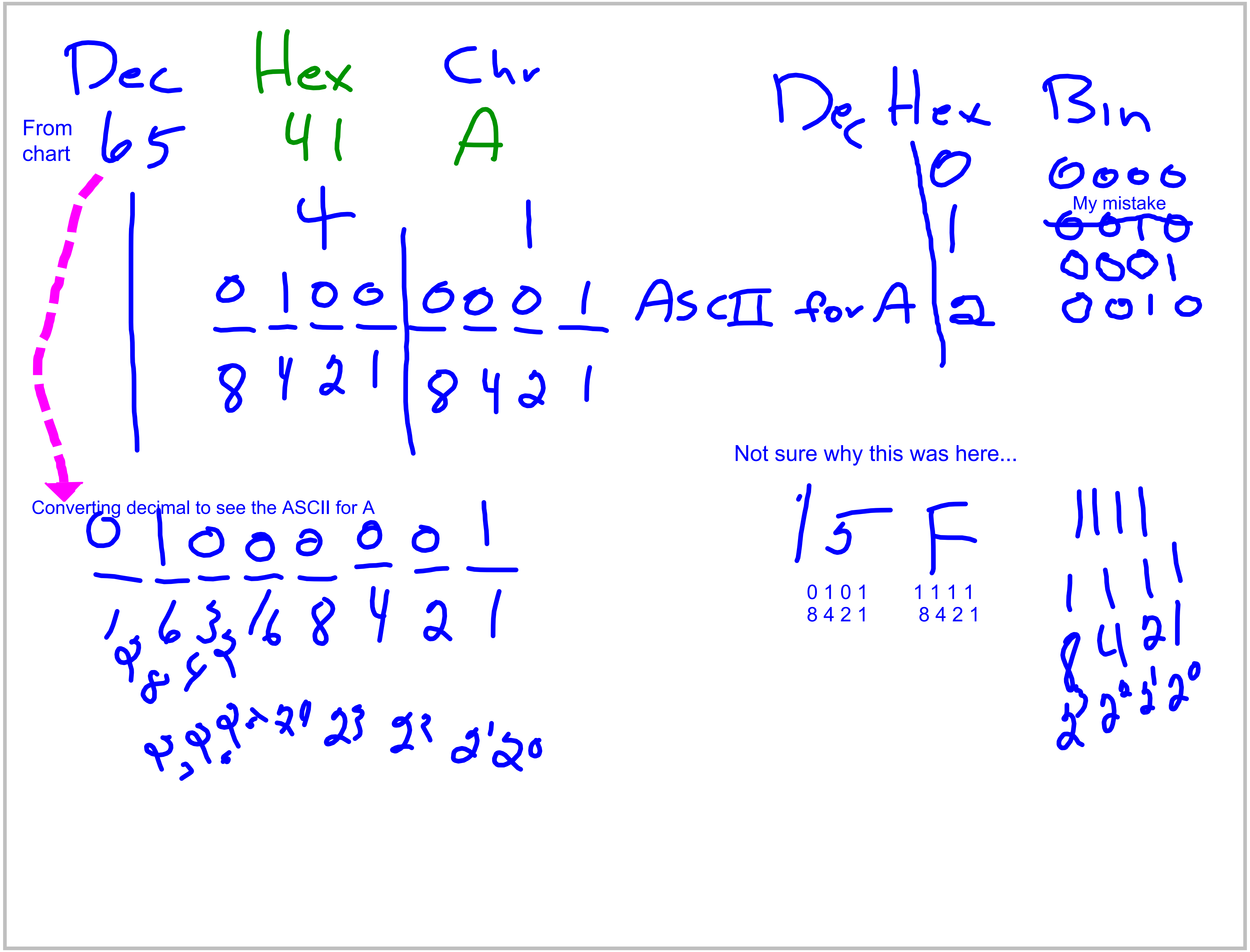
easily import the file into their own applications without issues. Notepad.exe creates ASCII text, or in MS Word you can save a file as 'text only'

Dec	Hx	Oct	Char		Dec	Hx	Oct	Html	Chr	Dec	Hx	Oct	Html	Chr	Dec	Hx	Oct	Html	Chr
0	0	000	NUL	(null)	32	20	040		Space	64	40	100	@	@	96	60	140	`	`
1	1	001	SOH	(start of heading)	33	21	041	!	!	65	41	101	A	A	97	61	141	a	a
2	2	002	STX	(start of text)	34	22	042	"	"	66	42	102	B	B	98	62	142	b	b
3	3	003	ETX	(end of text)	35	23	043	#	#	67	43	103	C	C	99	63	143	c	c
4	4	004	EOT	(end of transmission)	36	24	044	$	$	68	44	104	D	D	100	64	144	d	d
5	5	005	ENQ	(enquiry)	37	25	045	%	%	69	45	105	E	E	101	65	145	e	e
6	6	006	ACK	(acknowledge)	38	26	046	&	&	70	46	106	F	F	102	66	146	f	f
7	7	007	BEL	(bell)	39	27	047	'	'	71	47	107	G	G	103	67	147	g	g
8	8	010	BS	(backspace)	40	28	050	(	(	72	48	110	H	H	104	68	150	h	h
9	9	011	TAB	(horizontal tab)	41	29	051	)	)	73	49	111	I	I	105	69	151	i	i
10	A	012	LF	(NL line feed, new line)	42	2A	052	*	*	74	4A	112	J	J	106	6A	152	j	j
11	B	013	VT	(vertical tab)	43	2B	053	+	+	75	4B	113	K	K	107	6B	153	k	k
12	C	014	FF	(NP form feed, new page)	44	2C	054	,	,	76	4C	114	L	L	108	6C	154	l	l
13	D	015	CR	(carriage return)	45	2D	055	-	-	77	4D	115	M	M	109	6D	155	m	m
14	E	016	SO	(shift out)	46	2E	056	.	.	78	4E	116	N	N	110	6E	156	n	n
15	F	017	SI	(shift in)	47	2F	057	/	/	79	4F	117	O	O	111	6F	157	o	o
16	10	020	DLE	(data link escape)	48	30	060	0	0	80	50	120	P	P	112	70	160	p	p
17	11	021	DC1	(device control 1)	49	31	061	1	1	81	51	121	Q	Q	113	71	161	q	q
18	12	022	DC2	(device control 2)	50	32	062	2	2	82	52	122	R	R	114	72	162	r	r
19	13	023	DC3	(device control 3)	51	33	063	3	3	83	53	123	S	S	115	73	163	s	s
20	14	024	DC4	(device control 4)	52	34	064	4	4	84	54	124	T	T	116	74	164	t	t
21	15	025	NAK	(negative acknowledge)	53	35	065	5	5	85	55	125	U	U	117	75	165	u	u
22	16	026	SYN	(synchronous idle)	54	36	066	6	6	86	56	126	V	V	118	76	166	v	v
23	17	027	ETB	(end of trans. block)	55	37	067	7	7	87	57	127	W	W	119	77	167	w	w
24	18	030	CAN	(cancel)	56	38	070	8	8	88	58	130	X	X	120	78	170	x	x
25	19	031	EM	(end of medium)	57	39	071	9	9	89	59	131	Y	Y	121	79	171	y	y
26	1A	032	SUB	(substitute)	58	3A	072	:	:	90	5A	132	Z	Z	122	7A	172	z	z
27	1B	033	ESC	(escape)	59	3B	073	;	;	91	5B	133	[	[	123	7B	173	{	{
28	1C	034	FS	(file separator)	60	3C	074	<	<	92	5C	134	\	\	124	7C	174			|
29	1D	035	GS	(group separator)	61	3D	075	=	=	93	5D	135	]	]	125	7D	175	}	}
30	1E	036	RS	(record separator)	62	3E	076	>	>	94	5E	136	^	^	126	7E	176	~	~
31	1F	037	US	(unit separator)	63	3F	077	?	?	95	5F	137	_	_	127	7F	177	&#127;	DEL

Source: www.LookupTables.com

Extended ASCII Codes


Dec Hex Chr
From chart
65 41 A
4 1
0100 0001
8421 8421
ASCII for A
Dec Hex Bin
0 0000
1 0001
2 0010
My mistake
Not sure why this was here...
15 F
0 1 0 1
8 4 2 1
1 1 1 1
8 4 2 1
1111
8421
Converting decimal to see the ASCII for A
0 1 0 0 0 0 0 1
8 4 2 1

	Dec	Hex	ASCII
A	65	41	01000001
B	66	42	01000010
C	67	43	01000011
Z	90	5A	01011010

010 Capital letter

type   which

4   2
0100   0010
8421   8421

01011010
128 64 32 16 8 4 2 1

5A
0101   1010
8421   8421

10

Note that for Z I need 5 places to show which.

1 1 0 1 0
16 8 4 2 1

16,8,2 have a one in that position so I add them to get a which of 26 for the letter Z.

	Dec	Hex	ASCII
A	65	41	01000001
B	66	42	01000010
C	67	43	01000011
	90	5A	01011010
a	97	61	0110 0001
b	98	62	0110 0010
z	122	7A	0111 1010

type

61

0110 0001
8421 8421

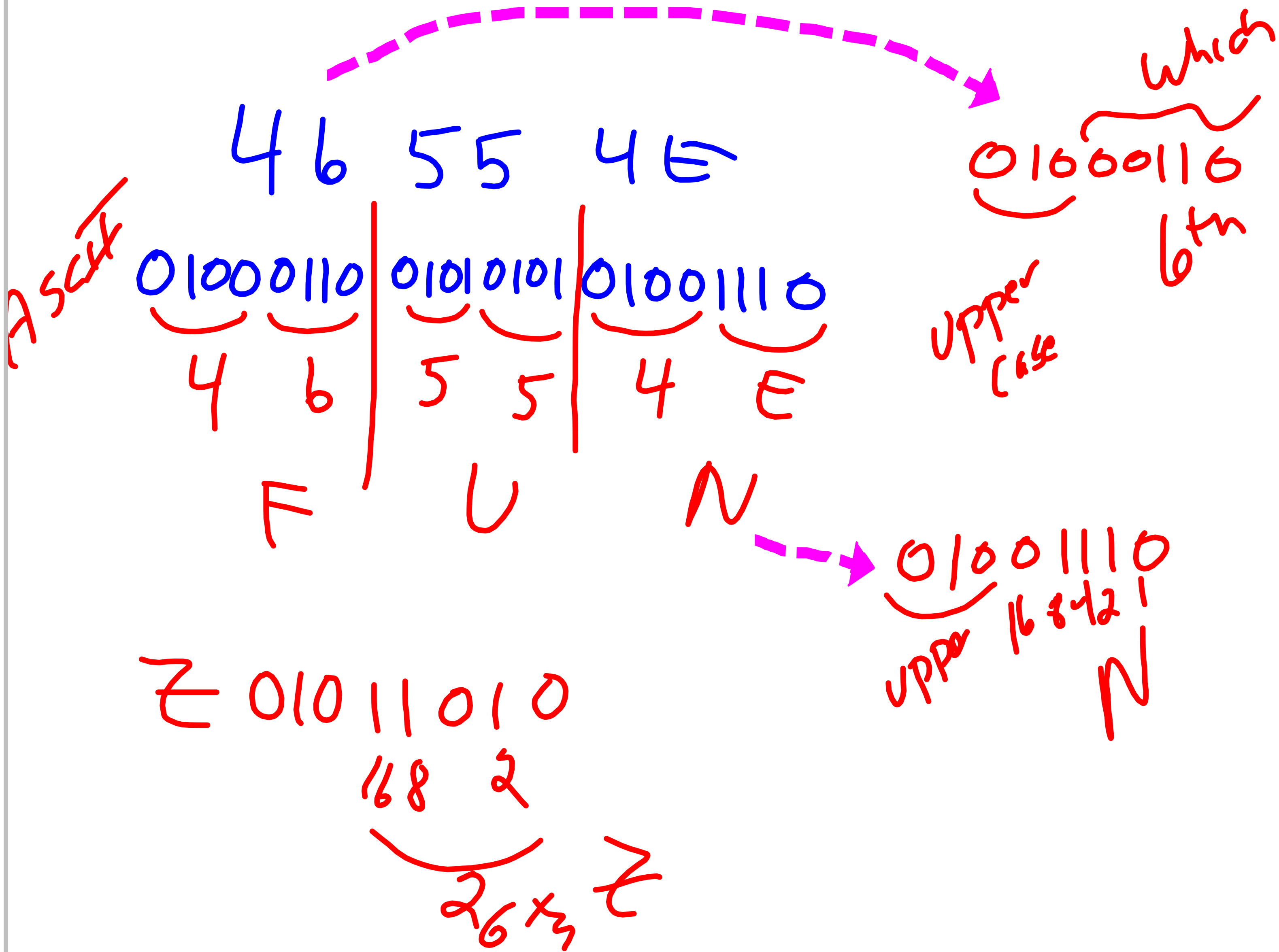
011 lower case

7A

0111 1010
8421 8421

I continued on with FUN and fun in the next three slides. I hope they are right! If you find a stupid error of mine, please let me know.

FUN



65	41	101	A	A	97	61	141	a	a
66	42	102	B	B	98	62	142	b	b
67	43	103	C	C	99	63	143	c	c
68	44	104	D	D	100	64	144	d	d
69	45	105	E	E	101	65	145	e	e
70	46	106	F	F	102	66	146	f	f
71	47	107	G	G	103	67	147	g	g
72	48	110	H	H	104	68	150	h	h
73	49	111	I	I	105	69	151	i	i
74	4A	112	J	J	106	6A	152	j	j
75	4B	113	K	K	107	6B	153	k	k
76	4C	114	L	L	108	6C	154	l	l
77	4D	115	M	M	109	6D	155	m	m
78	4E	116	N	N	110	6E	156	n	n
79	4F	117	O	O	111	6F	157	o	o
80	50	120	P	P	112	70	160	p	p
81	51	121	Q	Q	113	71	161	q	q
82	52	122	R	R	114	72	162	r	r
83	53	123	S	S	115	73	163	s	s
84	54	124	T	T	116	74	164	t	t
85	55	125	U	U	117	75	165	u	u
86	56	126	V	V	118	76	166	v	v
87	57	127	W	W	119	77	167	w	w
88	58	130	X	X	120	78	170	x	x
89	59	131	Y	Y	121	79	171	y	y
90	5A	132	Z	Z	122	7A	172	z	z

FUN
F is 70 in dec and 46 in hex
first translating the decimal
1 1 1 use or put 1 in 64, 4, 2 which is 70
128 64 32 16 8 4 2 1
0 1 0 0 0 1 1 0 so it is 01000110
128 64 32 16 8 4 2 1
next translating the hex
4 is 6 is
0 1 0 0 0 1 1 0 so F is 01000110 (same result)
8 4 2 1 8 4 2 1

f is 102 in dec and 66 in hex
first translating the decimal
1 1 1 1 use or put 1 in 64,32, 4, 2 which is 102
128 64 32 16 8 4 2 1
0 1 1 0 0 1 1 0 so it is 01100110
128 64 32 16 8 4 2 1
next translating the hex
6 is 6 is
0 1 1 0 0 1 1 0
8 4 2 1 8 4 2 1 so f is 01100110 (same result)

Note F is 01000110 and f is 01100110 the which part which is the right most 5 digits are the same but the type in the first three digits is 010 for F and 011 for f. Upper case letters have 010 and lower case letters have 011.

65	41	101	A	A	97	61	141	a	a
66	42	102	B	B	98	62	142	b	b
67	43	103	C	C	99	63	143	c	c
68	44	104	D	D	100	64	144	d	d
69	45	105	E	E	101	65	145	e	e
70	46	106	F	F	102	66	146	f	f
71	47	107	G	G	103	67	147	g	g
72	48	110	H	H	104	68	150	h	h
73	49	111	I	I	105	69	151	i	i
74	4A	112	J	J	106	6A	152	j	j
75	4B	113	K	K	107	6B	153	k	k
76	4C	114	L	L	108	6C	154	l	l
77	4D	115	M	M	109	6D	155	m	m
78	4E	116	N	N	110	6E	156	n	n
79	4F	117	O	O	111	6F	157	o	o
80	50	120	P	P	112	70	160	p	p
81	51	121	Q	Q	113	71	161	q	q
82	52	122	R	R	114	72	162	r	r
83	53	123	S	S	115	73	163	s	s
84	54	124	T	T	116	74	164	t	t
85	55	125	U	U	117	75	165	u	u
86	56	126	V	V	118	76	166	v	v
87	57	127	W	W	119	77	167	w	w
88	58	130	X	X	120	78	170	x	x
89	59	131	Y	Y	121	79	171	y	y
90	5A	132	Z	Z	122	7A	172	z	z

FUN

U is 85 in dec and 55 in hex

first translating the decimal

1 1 1 0 1 use or put 1 in 64, 16, 4, 1 which is 85

128 64 32 16 8 4 2 1

0 1 0 1 0 1 0 1 so U is 01010101

128 64 32 16 8 4 2 1

next translating the hex

5 is 5 is

0 1 0 1 0 1 0 1 so U is 01010101 (same result)

8 4 2 1 8 4 2 1

u is 117 in dec and 75 in hex

first translating the decimal

1 1 1 0 1 0 1 put 1 in 64,32, 16, 4, 1 which is 117

128 64 32 16 8 4 2 1

0 1 1 1 0 1 0 1 so u is 01110101

128 64 32 16 8 4 2 1

next translating the hex

7 is 5 is

0 1 1 1 0 1 0 1

8 4 2 1 8 4 2 1 so u is 01110101 (same result)

Note U is 01010101 and u is 01110101 the which part which i
the right most 5 digits are the same but the type in the first thr
digits is 010 for U and 011 for u. Upper case letters have 010
and lower case letters have 011.

65	41	101	A	A	97	61	141	a	a
66	42	102	B	B	98	62	142	b	b
67	43	103	C	C	99	63	143	c	c
68	44	104	D	D	100	64	144	d	d
69	45	105	E	E	101	65	145	e	e
70	46	106	F	F	102	66	146	f	f
71	47	107	G	G	103	67	147	g	g
72	48	110	H	H	104	68	150	h	h
73	49	111	I	I	105	69	151	i	i
74	4A	112	J	J	106	6A	152	j	j
75	4B	113	K	K	107	6B	153	k	k
76	4C	114	L	L	108	6C	154	l	l
77	4D	115	M	M	109	6D	155	m	m
78	4E	116	N	N	110	6E	156	n	n
79	4F	117	O	O	111	6F	157	o	o
80	50	120	P	P	112	70	160	p	p
81	51	121	Q	Q	113	71	161	q	q
82	52	122	R	R	114	72	162	r	r
83	53	123	S	S	115	73	163	s	s
84	54	124	T	T	116	74	164	t	t
85	55	125	U	U	117	75	165	u	u
86	56	126	V	V	118	76	166	v	v
87	57	127	W	W	119	77	167	w	w
88	58	130	X	X	120	78	170	x	x
89	59	131	Y	Y	121	79	171	y	y
90	5A	132	Z	Z	122	7A	172	z	z

FUN

N is 78 in dec and 4E in hex
first translating the decimal
1 1 1 1 use or put 1 in 64,8,4,2 which is 78
128 64 32 16 8 4 2 1
0 1 0 0 1 1 1 0 so N is 01001110
128 64 32 16 8 4 2 1
next translating the hex
4 is E is (which is 14 dec)
0 1 0 0 1 1 1 0 so N is 01001110 (same result)
8 4 2 1 8 4 2 1

n is 110 in dec and 6E in hex
first translating the decimal
1 1 1 1 1 put 1 in 64,32,8,4,2 which is 110
128 64 32 16 8 4 2 1
0 1 1 0 1 1 1 0 so n is 01101110
128 64 32 16 8 4 2 1
next translating the hex
6 is E is
0 1 1 0 1 1 1 0
8 4 2 1 8 4 2 1 so n is 01101110 (same result)

Note N is 01001110 and n is 01101110 the which part which is the right most 5 digits are the same but the type in the first thre digits is 010 for N and 011 for n. Upper case letters have 010 and lower case letters have 011.