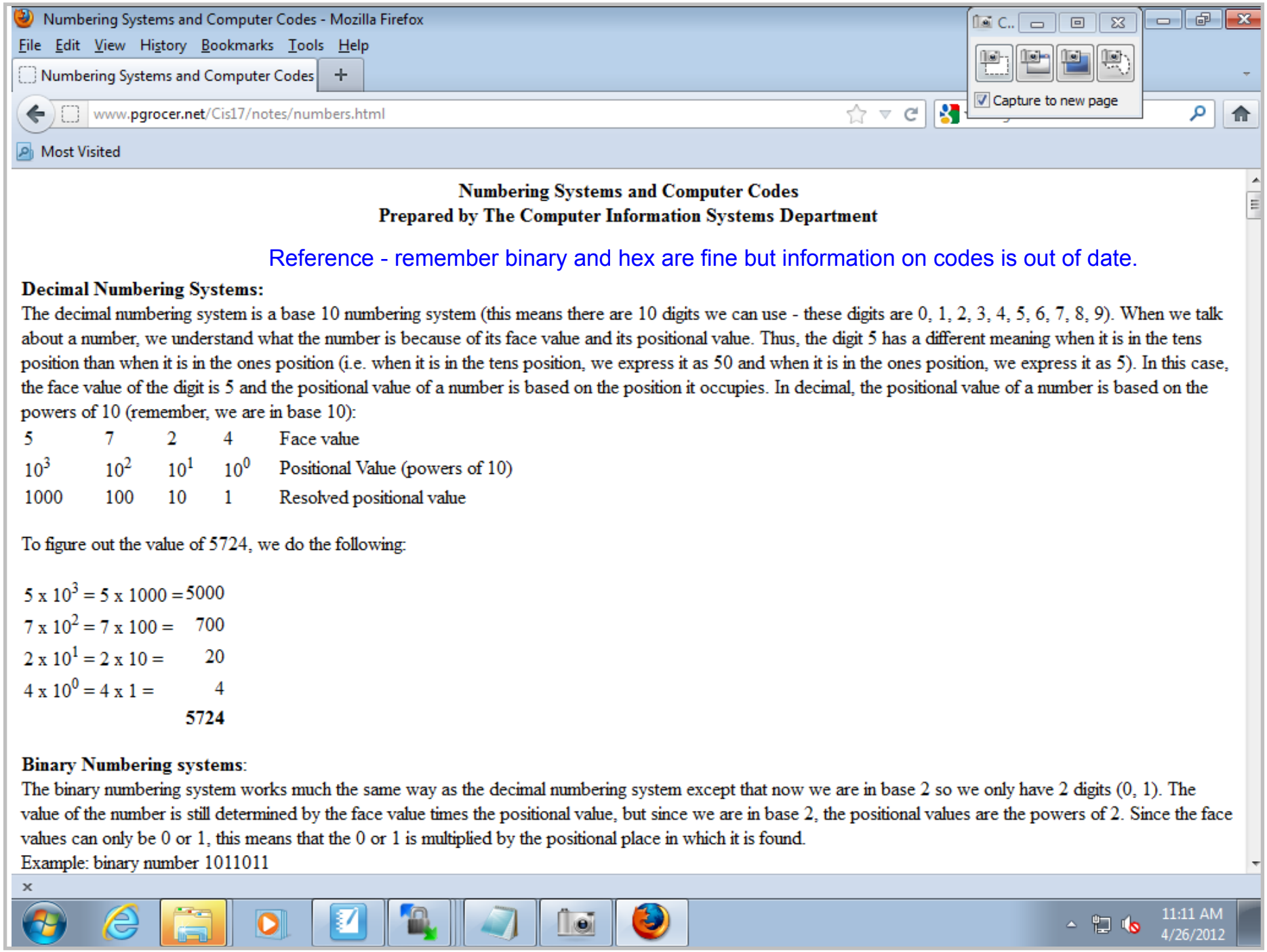


Numbering Systems and Computer Codes
Prepared by The Computer Information Systems Department

Reference - remember binary and hex are fine but information on codes is out of date.

Decimal Numbering Systems:

The decimal numbering system is a base 10 numbering system (this means there are 10 digits we can use - these digits are 0, 1, 2, 3, 4, 5, 6, 7, 8, 9). When we talk about a number, we understand what the number is because of its face value and its positional value. Thus, the digit 5 has a different meaning when it is in the tens position than when it is in the ones position (i.e. when it is in the tens position, we express it as 50 and when it is in the ones position, we express it as 5). In this case, the face value of the digit is 5 and the positional value of a number is based on the position it occupies. In decimal, the positional value of a number is based on the powers of 10 (remember, we are in base 10):

5	7	2	4	Face value
10^3	10^2	10^1	10^0	Positional Value (powers of 10)
1000	100	10	1	Resolved positional value

To figure out the value of 5724, we do the following:

$5 \times 10^3 = 5 \times 1000 = 5000$
$7 \times 10^2 = 7 \times 100 = 700$
$2 \times 10^1 = 2 \times 10 = 20$
$4 \times 10^0 = 4 \times 1 = 4$
5724

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

face value

positional value

$10110_2 = \underline{22}_{10}$

$2^4\ 2^3\ 2^2\ 2^1\ 2^0$

$16\ 8\ 4\ 2\ 1$

$1 \times 2^4 = 1 \times 16 = 16$

$0 \times 2^3 = 0 \times 8 = 0$

$1 \times 2^2 = 1 \times 4 = 4$

$1 \times 2^1 = 1 \times 2 = 2$

$0 \times 2^0 = 0 \times 1 = 0$

22_{10}

10110

16 8 4 2 1

16

4

2

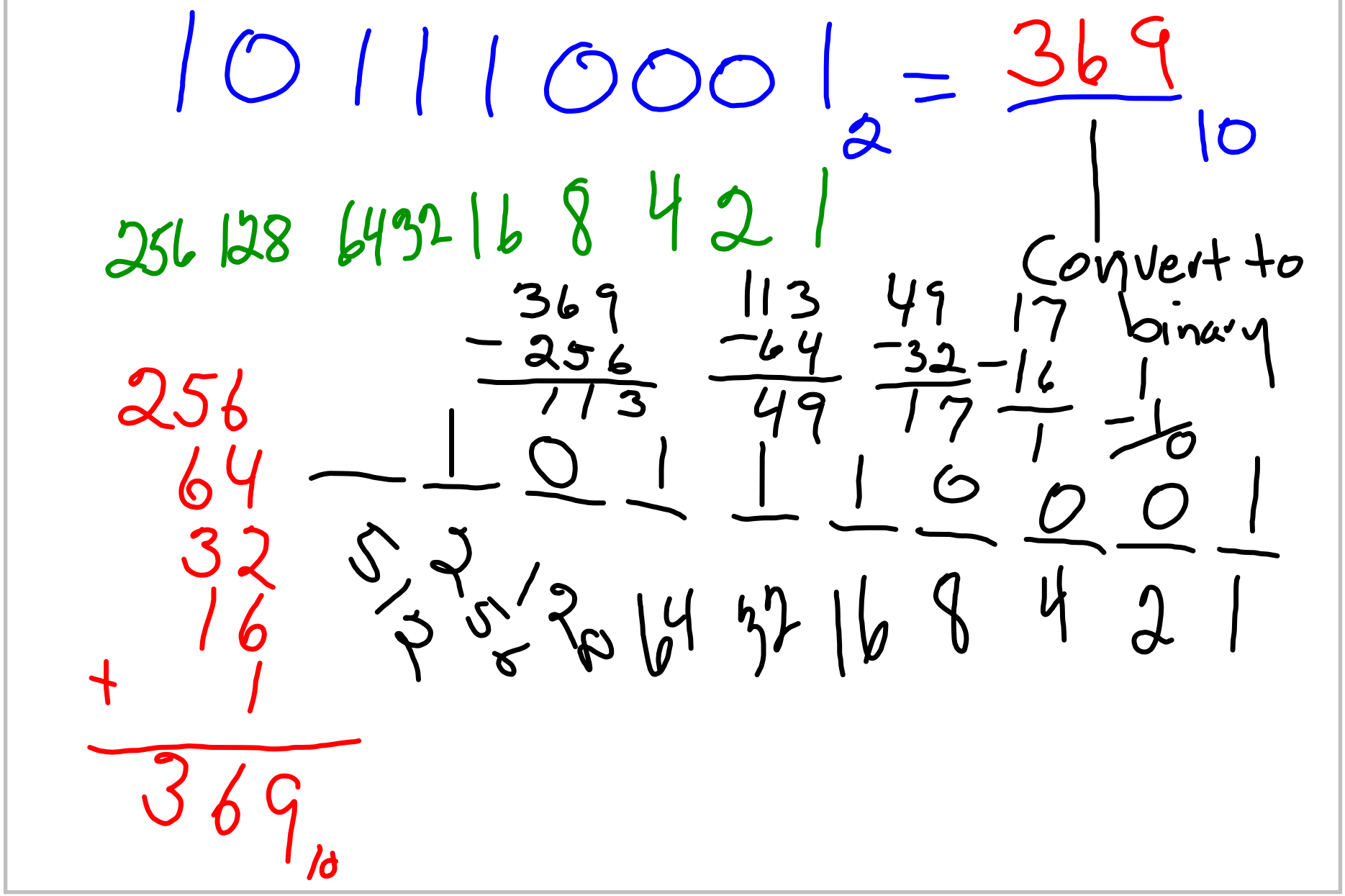
0

22 10

$$10111000_2 = \underline{369}_{10}$$

256 128 64 32 16 8 4 2 1

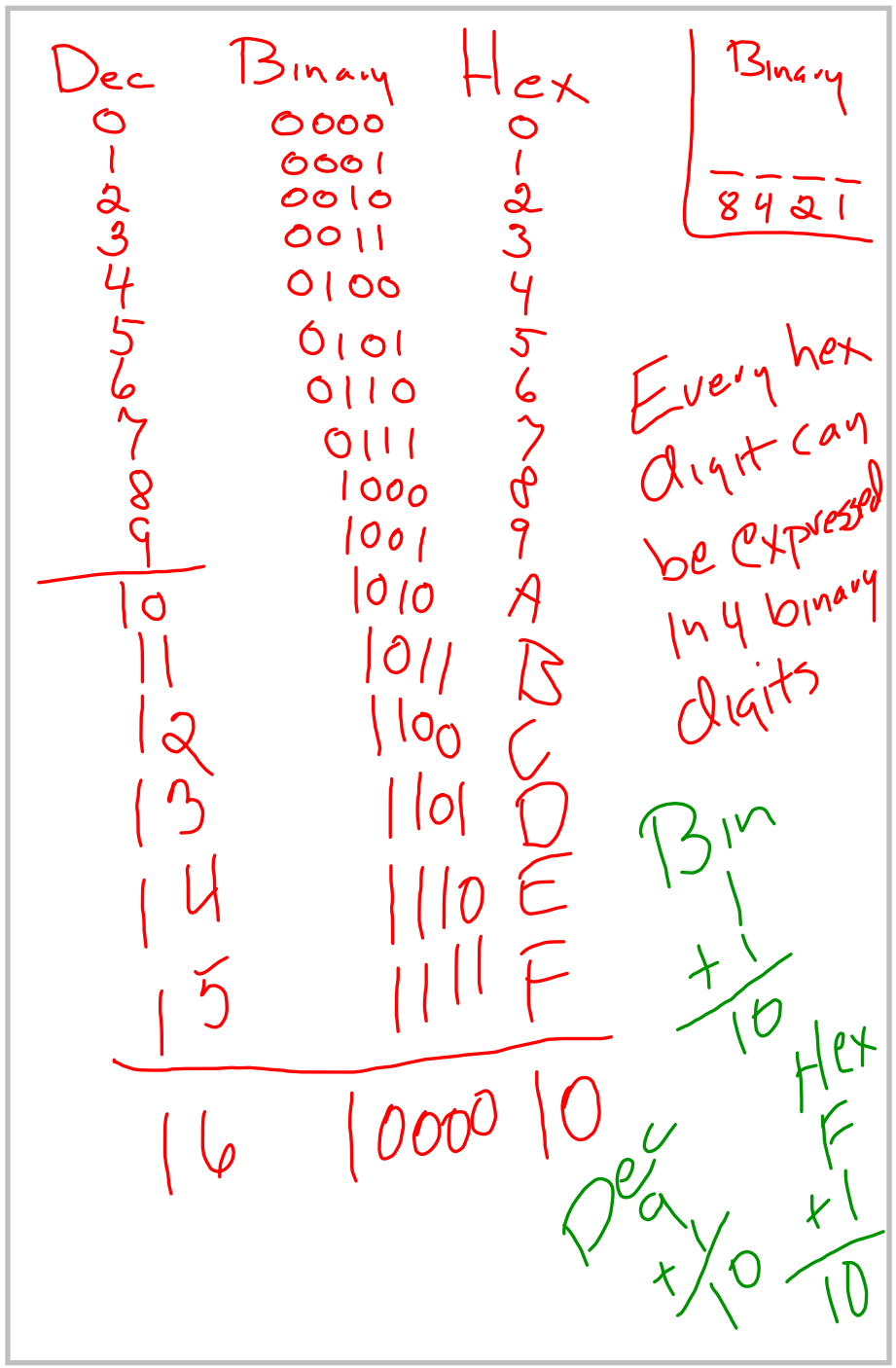
$$\begin{array}{r} 256 \\ 64 \\ 32 \\ 16 \\ + \quad 1 \\ \hline 369_{10} \end{array}$$

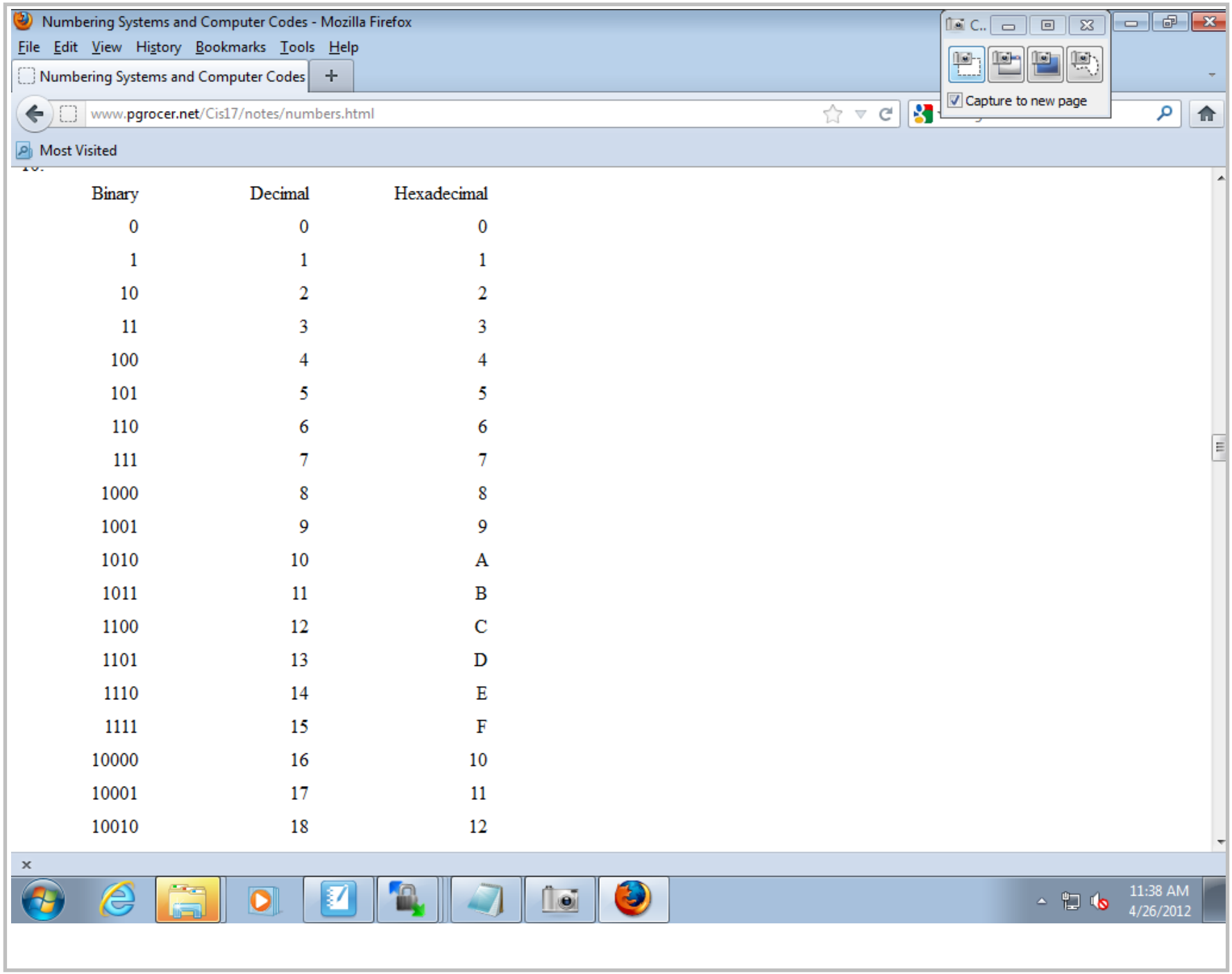

$10111000_2 = 369_{10}$
256 128 64 32 16 8 4 2 1
Convert to binary
369 − 256 = 113
113 − 64 = 49
49 − 32 = 17
17 − 16 = 1
1 − 1 = 0
1 0 1 1 1 0 0 0 1
256 + 64 + 32 + 16 + 1
369_{10}

Binary base 2 — 0, 1

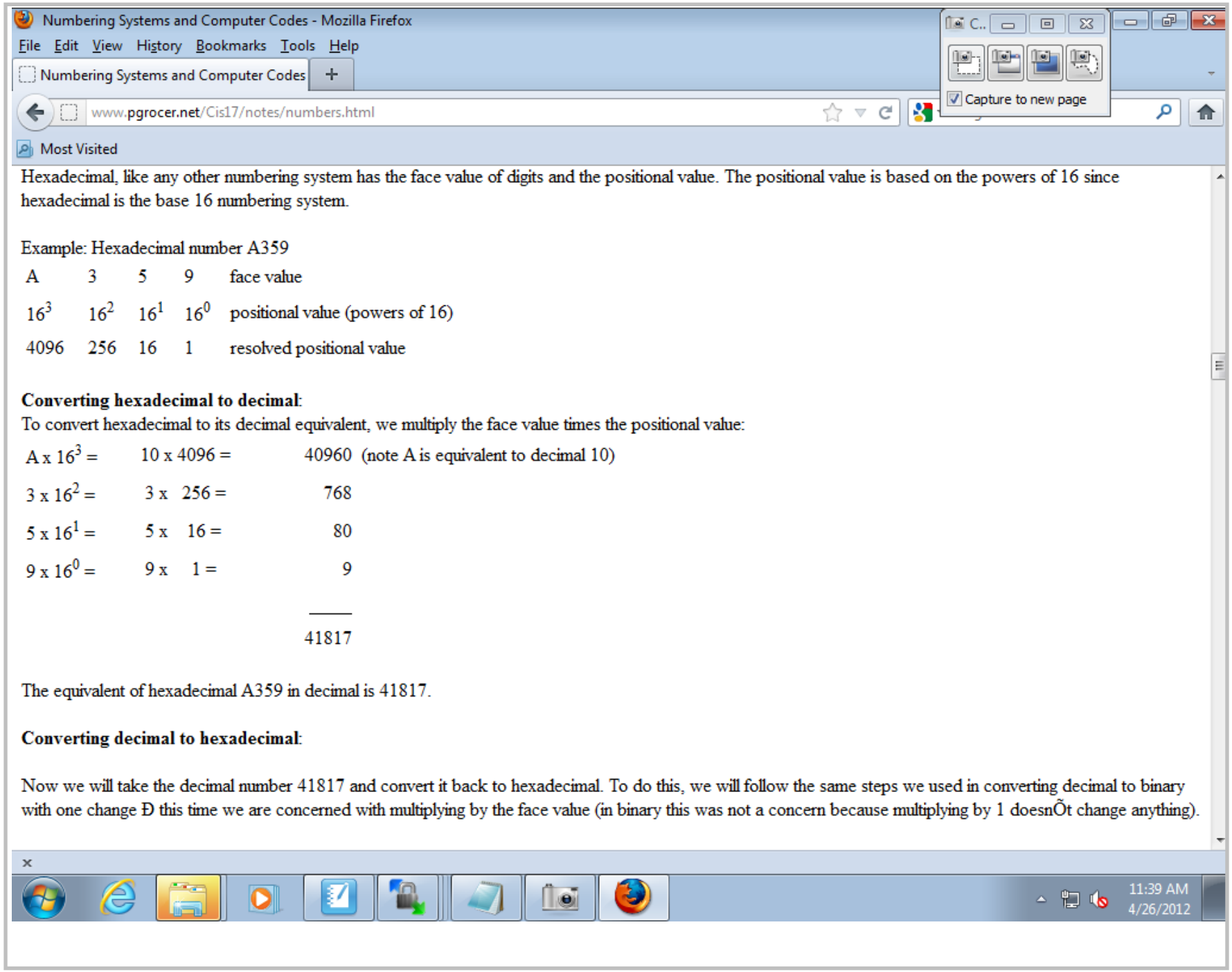
Decimal base 10 — 0–9

Hex
Hexadecimal base 16 — 0–9, A, B, C, D, E, F


Dec
Binary
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
8 1000 8
9 1001 9
10 1010 A
11 1011 B
12 1100 C
13 1101 D
14 1110 E
15 1111 F
16 10000 10
Binary
8 4 2 1
Every hex digit can be expressed in 4 binary digits
Bin
1
+1
10
Hex
F
+1
10
Dec
9
+1
10



Binary	Decimal	Hexadecimal
0	0	0
1	1	1
10	2	2
11	3	3
100	4	4
101	5	5
110	6	6
111	7	7
1000	8	8
1001	9	9
1010	10	A
1011	11	B
1100	12	C
1101	13	D
1110	14	E
1111	15	F
10000	16	10
10001	17	11
10010	18	12


Numbering Systems and Computer Codes - Mozilla Firefox
File Edit View History Bookmarks Tools Help
Numbering Systems and Computer Codes
www.pgrocer.net/Cis17/notes/numbers.html
Most Visited
Capture to new page
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
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:
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).
11:39 AM
4/26/2012

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Numbering Systems and Computer Codes

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

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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

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

$A359_{16} = 41817_{10}$

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).

$$B6E_{16} = 2926_{10}$$

256 16 1

$\times 11 \quad \times 6 \quad \times 14$

$256 \quad 96 \quad 14$

256

256

2816

2816

96

14

2926

$B6E_{16} = 2926_{10}$

256 16 1

$\times 11 \quad \times 6 \quad \times 14$

$256 \quad 96 \quad 14$

256

2816

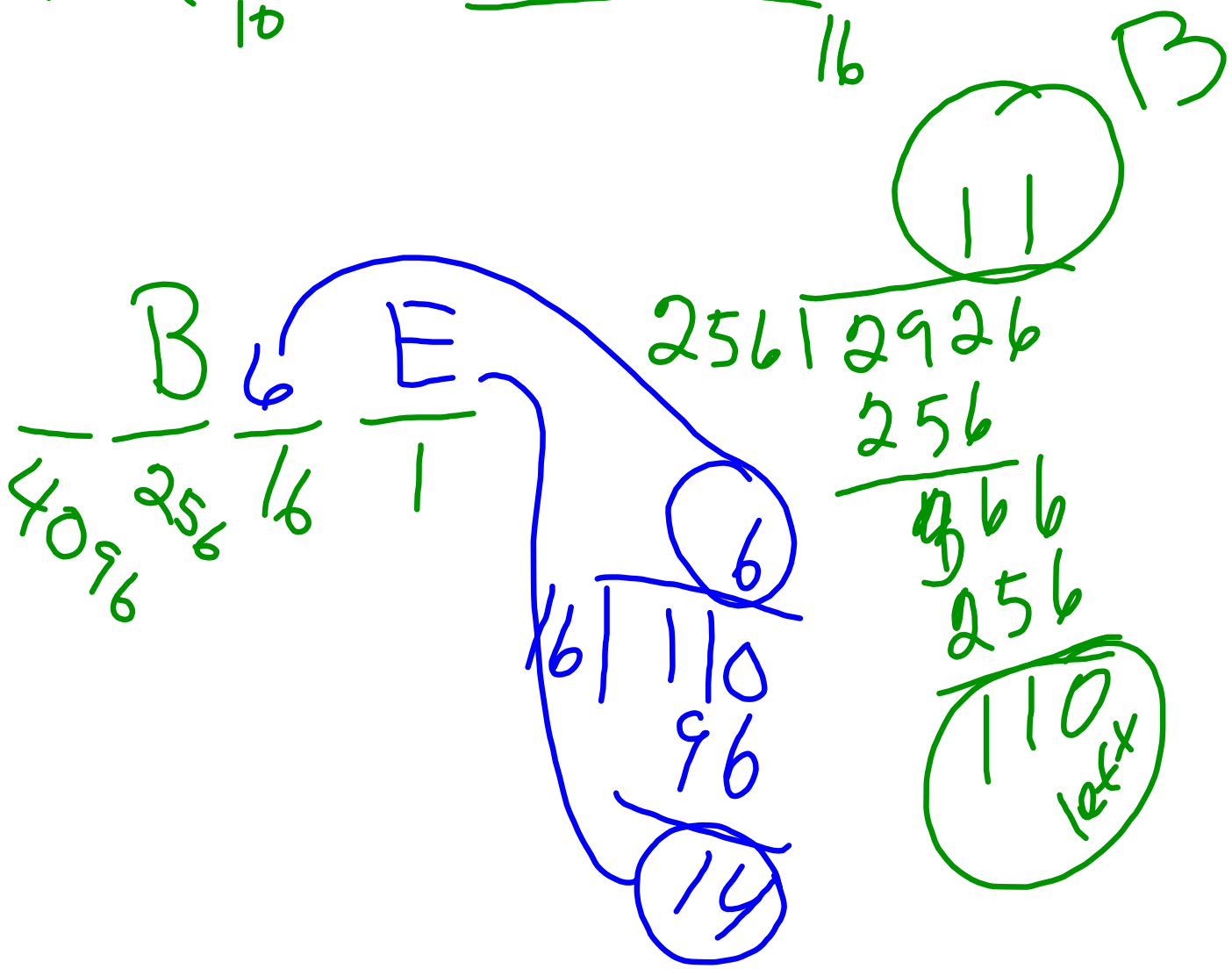
2816

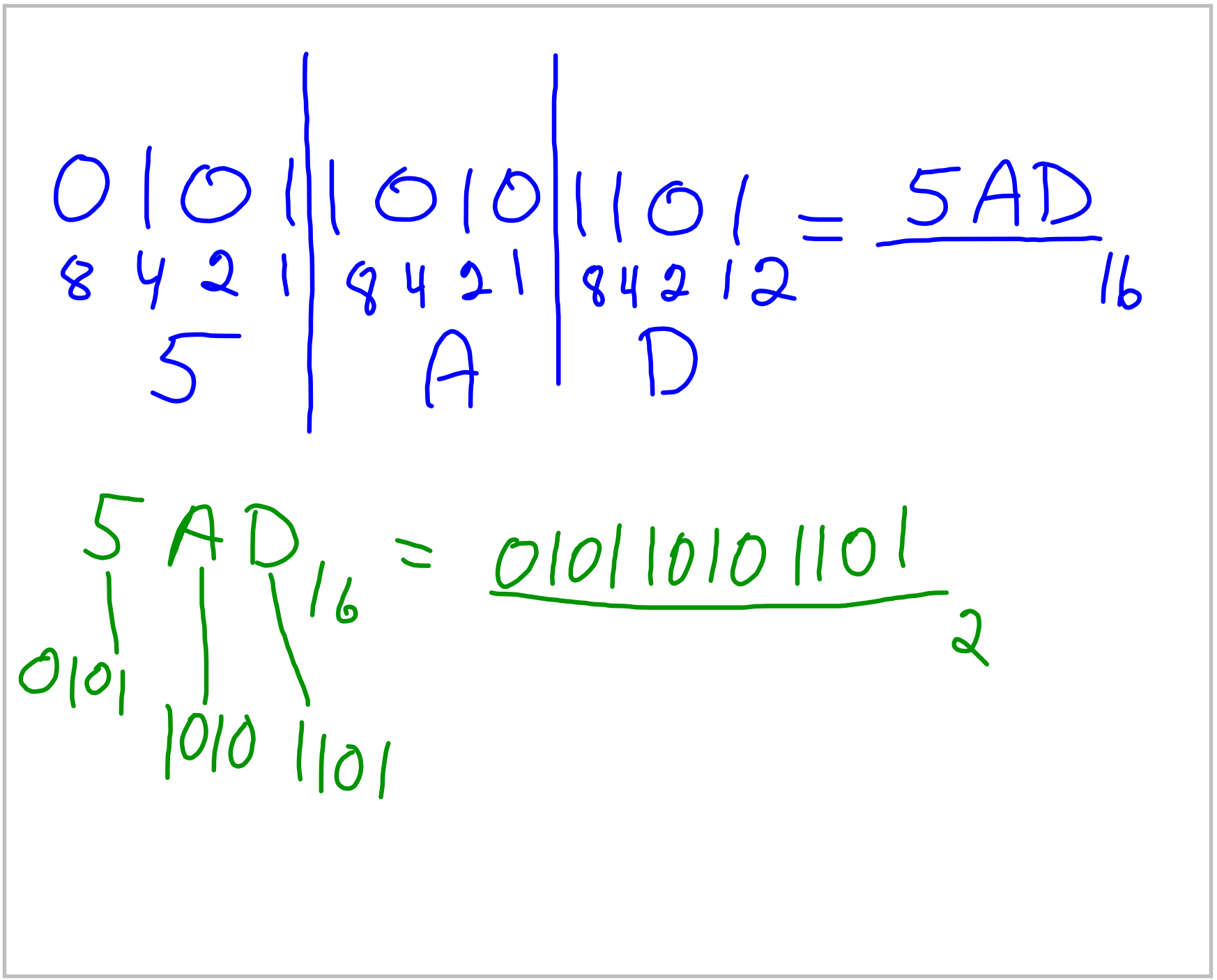
96

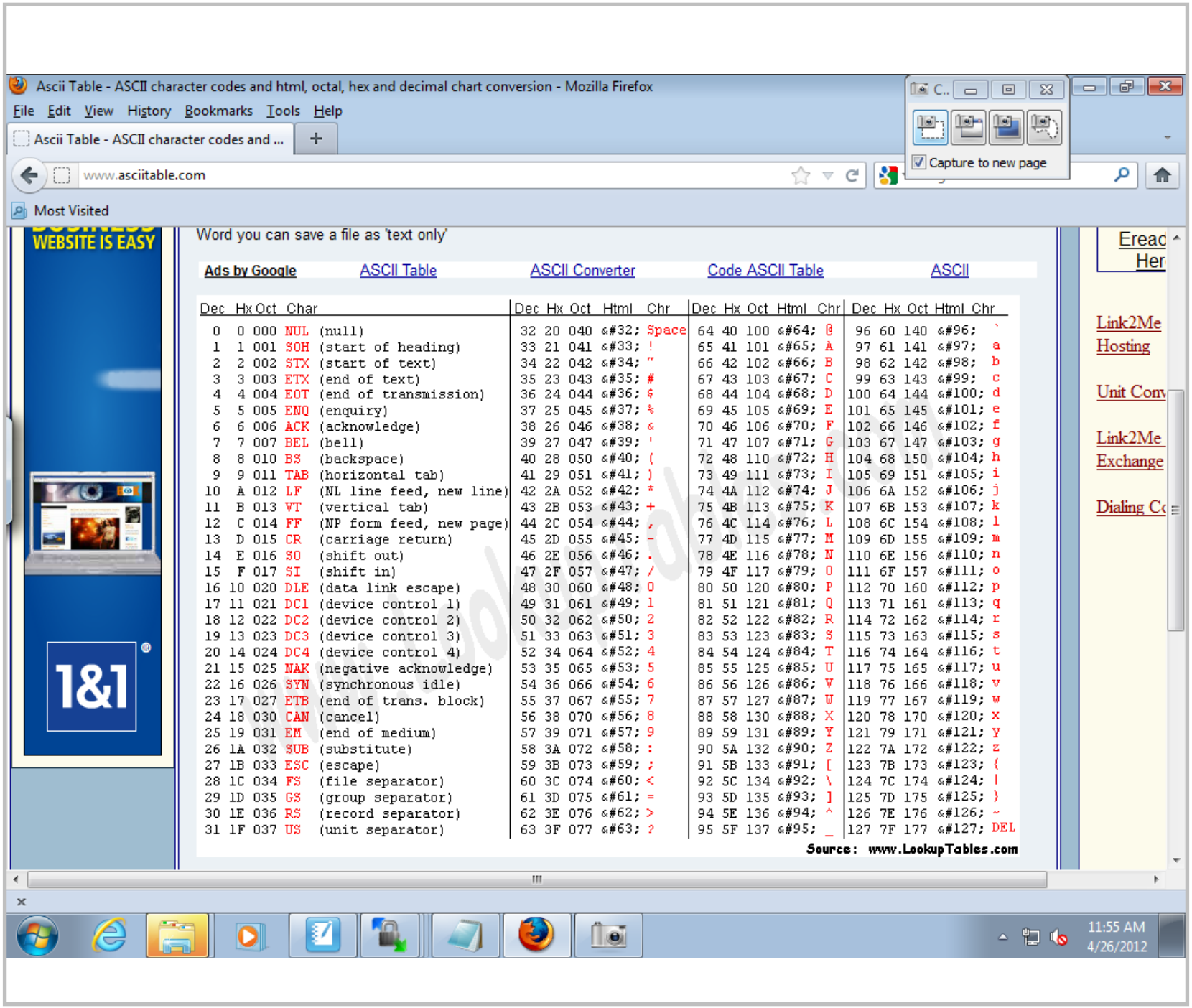
14

2926

$2926_{10} = \underline{BbE}_{16}$




0101 | 1010 | 1101 = 5AD
8421 | 8421 | 8421 2
5 | A | D
5AD16 = 010110101101
0101
1010
1101
2



Title: Apr 26-11:55 AM (14 of 18)

ASCII

A = hex 41_{16} B = 42_{16}

A = 01000001

B = 01000010

C = 01000011 = 43_{16}

D = 01000100 = 44_{16}

49_{hex} I = 01001001

$4A$ J = 01001010

$4F$ O = 01001111

50_{16} P = 01010000

$5A$ Z = 01011010

hex ASCII

41 = A = 01000001

61 = a = 01100001

30 = 0 = 00110000

31 = 1 = 00110001

$A = 65_{10}$

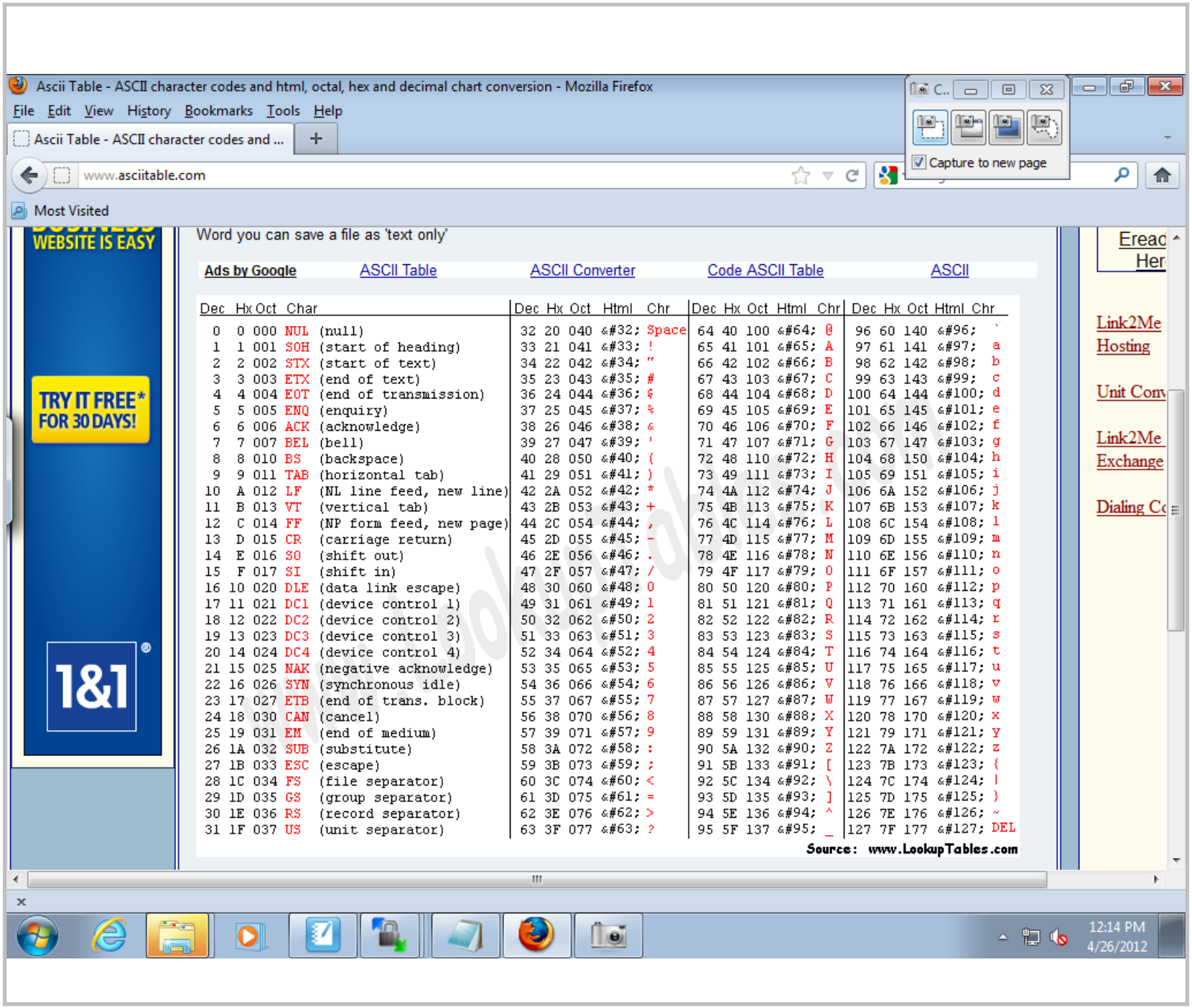
$41_{16} = 01000001$

0	1	0	0	0	0	0	1
128	64	32	16	8	4	2	1

$B = 66_{10}$

$42_{16} = 01000010$

0	1	0	0	0	0	1	0
128	64	32	16	8	4	2	1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Ads by Google
ASCII Table
ASCII Converter
Code ASCII Table
ASCII
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
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