NUMBERING SYSTEMS

Numbering Systems		
System	Base	Digits
Binary	2	0 1
Octal	8	0 1 2 3 4 5 6 7
Decimal	10	0 1 2 3 4 5 6 7 8 9
Hexadecimal	16	0 1 2 3 4 5 6 7 8 9 A B C D E F

Dec	Hex	Oct	Bin
0	0	000	00000000
1	1	001	00000001
2	2	002	00000010
3	3	003	00000011
4	4	004	00000100
5	5	005	00000101
6	6	006	00000110
7	7	007	00000111
8	8	010	00001000
9	9	011	00001001
10	A	012	00001010
11	B	013	00001011
12	C	014	00001100
13	D	015	00001101
14	E	016	00001110
15	F	017	00001111

Dec	Hex	Oct	Bin
16	10	020	00010000
17	11	021	00010001
18	12	022	00010010
19	13	023	00010011
20	14	024	00010100
21	15	025	00010101
22	16	026	00010110
23	17	027	00010111
24	18	030	00011000
25	19	031	00011001
26	1A	032	00011010
27	1B	033	00011011
28	1C	034	00011100
29	1D	035	00011101
30	1E	036	00011110
31	1F	037	00011111

Dec	Hex	Oct	Bin
32	20	040	00100000
33	21	041	00100001
34	22	042	00100010
35	23	043	00100011
36	24	044	00100100
37	25	045	00100101
38	26	046	00100110
39	27	047	00100111
40	28	050	00101000
41	29	051	00101001
42	2A	052	00101010
43	2B	053	00101011
44	2C	054	00101100
45	2D	055	00101101
46	2E	056	00101110
47	2F	057	00101111

Dec	Hex	Oct	Bin
48	30	060	00110000
49	31	061	00110001
50	32	062	00110010
51	33	063	00110011
52	34	064	00110100
53	35	065	00110101
54	36	066	00110110
55	37	067	00110111
56	38	070	00111000
57	39	071	00111001
58	3A	072	00111010
59	3B	073	00111011
60	3C	074	00111100
61	3D	075	00111101
62	3E	076	00111110
63	3F	077	00111111

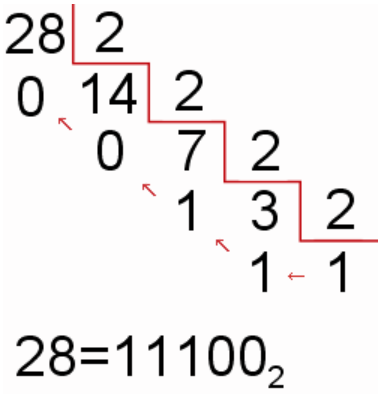
Dec	Hex	Oct	Bin
64	40	100	01000000
65	41	101	01000001
66	42	102	01000010
67	43	103	01000011
68	44	104	01000100
69	45	105	01000101
70	46	106	01000110
71	47	107	01000111
72	48	110	01001000
73	49	111	01001001
74	4A	112	01001010
75	4B	113	01001011
76	4C	114	01001100
77	4D	115	01001101
78	4E	116	01001110
79	4F	117	01001111

Dec	Hex	Oct	Bin
80	50	120	01010000
81	51	121	01010001
82	52	122	01010010
83	53	123	01010011
84	54	124	01010100
85	55	125	01010101
86	56	126	01010110
87	57	127	01010111
88	58	130	01011000
89	59	131	01011001
90	5A	132	01011010
91	5B	133	01011011
92	5C	134	01011100
93	5D	135	01011101
94	5E	136	01011110
95	5F	137	01011111

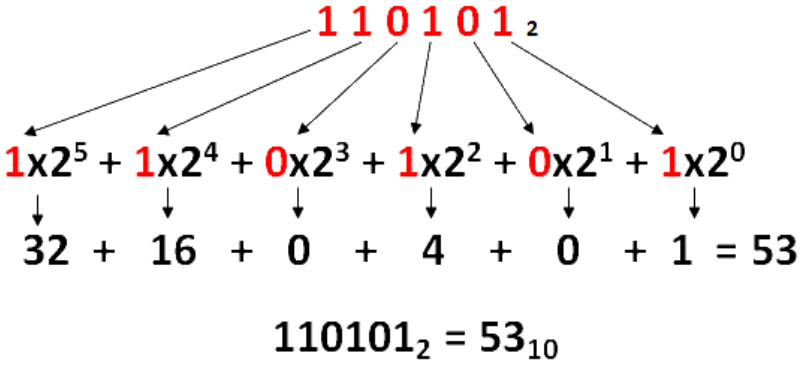
Dec	Hex	Oct	Bin
96	60	140	01100000
97	61	141	01100001
98	62	142	01100010
99	63	143	01100011
100	64	144	01100100
101	65	145	01100101
102	66	146	01100110
103	67	147	01100111
104	68	150	01101000
105	69	151	01101001
106	6A	152	01101010
107	6B	153	01101011
108	6C	154	01101100
109	6D	155	01101101
110	6E	156	01101110
111	6F	157	01101111

Dec	Hex	Oct	Bin
112	70	160	01110000
113	71	161	01110001
114	72	162	01110010
115	73	163	01110011
116	74	164	01110100
117	75	165	01110101
118	76	166	01110110
119	77	167	01110111
120	78	170	01111000
121	79	171	01111001
122	7A	172	01111010
123	7B	173	01111011
124	7C	174	01111100
125	7D	175	01111101
126	7E	176	01111110
127	7F	177	01111111

Converting decimal to binary



Converting binary to decimal

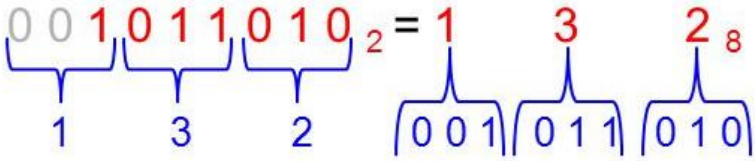


Converting between binary, octal, and hexadecimal numbers

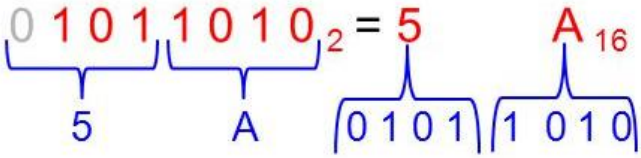
Because binary, octal, and hex number systems are all powers of two (which is the reason we use them) there is a relationship that we can exploit to make conversion easier.

$$1\,0\,1\,1\,0\,1\,0_{\,2} = 132_{\,8} = 5A_{\,H}$$

To convert directly between binary and octal, group the binary bits into sets of 3 (because $2^3 = 8$). You may need to pad with leading zeros.



To convert directly between binary and hexadecimal number systems, group the binary bits into sets of 4 (because $2^4 = 16$). You may need to pad with leading zeros.



Exercises

1. Convert C5C1 from base 16 to base 2.
2. Convert 238 from base 10 to base 2.
3. Convert 1010 0010 1011 1001 from binary to hexadecimal.
4. Convert 0 from base 8 to binary.
5. Convert 0111 0110 1011 1011 from binary to base 16.
6. Convert 0100 0100 1000 0011 from binary to base 16.
7. Convert 0001 1101 1101 1111 from base 2 to hexadecimal.
8. Convert 53 from base 8 to base 2.
9. Convert 1101 1111 from base 2 to decimal.
10. Convert 0100 0110 1101 0111 from binary to base 16.
11. Convert 101 100 001 from binary to base 8.
12. Convert 0110 0100 1000 1101 from binary to base 16.
13. Convert 44 from base 8 to binary.
14. Convert 9ABF from base 16 to base 2.
15. Convert 1100 1111 from base 2 to base 10.
16. Convert 10B2 from base 16 to binary.
17. Convert A1ED from base 16 to binary.
18. Convert 1010 0001 1111 1100 from base 2 to base 16.
19. Convert 77 from base 8 to binary.
20. Convert 1000 1111 from binary to decimal.
21. Convert 0011 1101 from base 2 to base 10.
22. Convert 57 from base 8 to binary.
23. Convert 0100 0100 1011 0100 from binary to hexadecimal.
24. Convert 0110 0110 from binary to base 10.
25. Convert 31 from octal to binary.
26. Convert 1110 1101 from base 2 to base 10.
27. Convert EC2C from base 16 to base 2.
28. Convert 208 from base 10 to binary.
29. Convert 1 from base 10 to binary.
30. Convert 101 from base 2 to base 8.

Solution to exercises

1. 1100 0101 1100 0001.
2. 1110 1110.
3. A2B9.
4. 0.
5. 76BB.
6. 4483.
7. 1DDF.
8. 101 011.
9. 223.
10. 46D7.
11. 541.
12. 648D.
13. 100 100.
14. 1001 1010 1011 1111.
15. 207.
16. 0001 0000 1011 0010.
17. 1010 0001 1110 1101.
18. A1FC.
19. 111 111.
20. 143.
21. 61.
22. 101 111.
23. 44B4.
24. 102.
25. 011 001.
26. 237.
27. 1110 1100 0010 1100.
28. 1101 0000.
29. 0001.
30. 5.