

COMPUTER SYSTEMS ARCHITECTURE SEMINAR 0x00

SEMINAR SUPPORT NOTES

Cristian Rusu

CONVERSIONS, EX 1

				0x1111
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hex: 0x1111

binary:

base 4:

base 8:

base 10:

0 _{hex}	=	0 _{dec}	=	0 _{oct}	0	0	0	0
1 _{hex}	=	1 _{dec}	=	1 _{oct}	0	0	0	1
2 _{hex}	=	2 _{dec}	=	2 _{oct}	0	0	1	0
3 _{hex}	=	3 _{dec}	=	3 _{oct}	0	0	1	1
4 _{hex}	=	4 _{dec}	=	4 _{oct}	0	1	0	0
5 _{hex}	=	5 _{dec}	=	5 _{oct}	0	1	0	1
6 _{hex}	=	6 _{dec}	=	6 _{oct}	0	1	1	0
7 _{hex}	=	7 _{dec}	=	7 _{oct}	0	1	1	1
8 _{hex}	=	8 _{dec}	=	10 _{oct}	1	0	0	0
9 _{hex}	=	9 _{dec}	=	11 _{oct}	1	0	0	1
A _{hex}	=	10 _{dec}	=	12 _{oct}	1	0	1	0
B _{hex}	=	11 _{dec}	=	13 _{oct}	1	0	1	1
C _{hex}	=	12 _{dec}	=	14 _{oct}	1	1	0	0
D _{hex}	=	13 _{dec}	=	15 _{oct}	1	1	0	1
E _{hex}	=	14 _{dec}	=	16 _{oct}	1	1	1	0
F _{hex}	=	15 _{dec}	=	17 _{oct}	1	1	1	1

CONVERSIONS, EX 1

				0x1111
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hex: 0x1111

binary: 0001 0001 0001 0001

base 4:

base 8:

base 10:

0 _{hex}	=	0 _{dec}	=	0 _{oct}	0	0	0	0
1 _{hex}	=	1 _{dec}	=	1 _{oct}	0	0	0	1
2 _{hex}	=	2 _{dec}	=	2 _{oct}	0	0	1	0
3 _{hex}	=	3 _{dec}	=	3 _{oct}	0	0	1	1
4 _{hex}	=	4 _{dec}	=	4 _{oct}	0	1	0	0
5 _{hex}	=	5 _{dec}	=	5 _{oct}	0	1	0	1
6 _{hex}	=	6 _{dec}	=	6 _{oct}	0	1	1	0
7 _{hex}	=	7 _{dec}	=	7 _{oct}	0	1	1	1
8 _{hex}	=	8 _{dec}	=	10 _{oct}	1	0	0	0
9 _{hex}	=	9 _{dec}	=	11 _{oct}	1	0	0	1
A _{hex}	=	10 _{dec}	=	12 _{oct}	1	0	1	0
B _{hex}	=	11 _{dec}	=	13 _{oct}	1	0	1	1
C _{hex}	=	12 _{dec}	=	14 _{oct}	1	1	0	0
D _{hex}	=	13 _{dec}	=	15 _{oct}	1	1	0	1
E _{hex}	=	14 _{dec}	=	16 _{oct}	1	1	1	0
F _{hex}	=	15 _{dec}	=	17 _{oct}	1	1	1	1

CONVERSIONS, EX 1

				0x1111
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hex: 0x1111

binary: 0001 0001 0001 0001

base 4: 00 01 00 01 00 01 00 01

base 8:

base 10:

0 _{hex}	=	0 _{dec}	=	0 _{oct}	0	0	0	0
1 _{hex}	=	1 _{dec}	=	1 _{oct}	0	0	0	1
2 _{hex}	=	2 _{dec}	=	2 _{oct}	0	0	1	0
3 _{hex}	=	3 _{dec}	=	3 _{oct}	0	0	1	1
4 _{hex}	=	4 _{dec}	=	4 _{oct}	0	1	0	0
5 _{hex}	=	5 _{dec}	=	5 _{oct}	0	1	0	1
6 _{hex}	=	6 _{dec}	=	6 _{oct}	0	1	1	0
7 _{hex}	=	7 _{dec}	=	7 _{oct}	0	1	1	1
8 _{hex}	=	8 _{dec}	=	10 _{oct}	1	0	0	0
9 _{hex}	=	9 _{dec}	=	11 _{oct}	1	0	0	1
A _{hex}	=	10 _{dec}	=	12 _{oct}	1	0	1	0
B _{hex}	=	11 _{dec}	=	13 _{oct}	1	0	1	1
C _{hex}	=	12 _{dec}	=	14 _{oct}	1	1	0	0
D _{hex}	=	13 _{dec}	=	15 _{oct}	1	1	0	1
E _{hex}	=	14 _{dec}	=	16 _{oct}	1	1	1	0
F _{hex}	=	15 _{dec}	=	17 _{oct}	1	1	1	1

CONVERSIONS, EX 1

				0x1111
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hex: 0x1111

binary: 0001 0001 0001 0001

base 4: 00 01 00 01 00 01 00 01 = 01010101

base 8:

base 10:

0 _{hex}	=	0 _{dec}	=	0 _{oct}	0	0	0	0
1 _{hex}	=	1 _{dec}	=	1 _{oct}	0	0	0	1
2 _{hex}	=	2 _{dec}	=	2 _{oct}	0	0	1	0
3 _{hex}	=	3 _{dec}	=	3 _{oct}	0	0	1	1
4 _{hex}	=	4 _{dec}	=	4 _{oct}	0	1	0	0
5 _{hex}	=	5 _{dec}	=	5 _{oct}	0	1	0	1
6 _{hex}	=	6 _{dec}	=	6 _{oct}	0	1	1	0
7 _{hex}	=	7 _{dec}	=	7 _{oct}	0	1	1	1
8 _{hex}	=	8 _{dec}	=	10 _{oct}	1	0	0	0
9 _{hex}	=	9 _{dec}	=	11 _{oct}	1	0	0	1
A _{hex}	=	10 _{dec}	=	12 _{oct}	1	0	1	0
B _{hex}	=	11 _{dec}	=	13 _{oct}	1	0	1	1
C _{hex}	=	12 _{dec}	=	14 _{oct}	1	1	0	0
D _{hex}	=	13 _{dec}	=	15 _{oct}	1	1	0	1
E _{hex}	=	14 _{dec}	=	16 _{oct}	1	1	1	0
F _{hex}	=	15 _{dec}	=	17 _{oct}	1	1	1	1

CONVERSIONS, EX 1

				0x1111
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hex: 0x1111

binary: 0001 0001 0001 0001

base 4: 00 01 00 01 00 01 00 01 = 01010101

base 8: 0 001 000 100 010 001

base 10:

0 _{hex}	=	0 _{dec}	=	0 _{oct}	0	0	0	0
1 _{hex}	=	1 _{dec}	=	1 _{oct}	0	0	0	1
2 _{hex}	=	2 _{dec}	=	2 _{oct}	0	0	1	0
3 _{hex}	=	3 _{dec}	=	3 _{oct}	0	0	1	1
4 _{hex}	=	4 _{dec}	=	4 _{oct}	0	1	0	0
5 _{hex}	=	5 _{dec}	=	5 _{oct}	0	1	0	1
6 _{hex}	=	6 _{dec}	=	6 _{oct}	0	1	1	0
7 _{hex}	=	7 _{dec}	=	7 _{oct}	0	1	1	1
8 _{hex}	=	8 _{dec}	=	10 _{oct}	1	0	0	0
9 _{hex}	=	9 _{dec}	=	11 _{oct}	1	0	0	1
A _{hex}	=	10 _{dec}	=	12 _{oct}	1	0	1	0
B _{hex}	=	11 _{dec}	=	13 _{oct}	1	0	1	1
C _{hex}	=	12 _{dec}	=	14 _{oct}	1	1	0	0
D _{hex}	=	13 _{dec}	=	15 _{oct}	1	1	0	1
E _{hex}	=	14 _{dec}	=	16 _{oct}	1	1	1	0
F _{hex}	=	15 _{dec}	=	17 _{oct}	1	1	1	1

CONVERSIONS, EX 1

				0x1111
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hex: 0x1111

binary: 0001 0001 0001 0001

base 4: 00 01 00 01 00 01 00 01 = 01010101

base 8: 0 001 000 100 010 001 = 10421

base 10:

0 _{hex}	=	0 _{dec}	=	0 _{oct}	0	0	0	0
1 _{hex}	=	1 _{dec}	=	1 _{oct}	0	0	0	1
2 _{hex}	=	2 _{dec}	=	2 _{oct}	0	0	1	0
3 _{hex}	=	3 _{dec}	=	3 _{oct}	0	0	1	1
4 _{hex}	=	4 _{dec}	=	4 _{oct}	0	1	0	0
5 _{hex}	=	5 _{dec}	=	5 _{oct}	0	1	0	1
6 _{hex}	=	6 _{dec}	=	6 _{oct}	0	1	1	0
7 _{hex}	=	7 _{dec}	=	7 _{oct}	0	1	1	1
8 _{hex}	=	8 _{dec}	=	10 _{oct}	1	0	0	0
9 _{hex}	=	9 _{dec}	=	11 _{oct}	1	0	0	1
A _{hex}	=	10 _{dec}	=	12 _{oct}	1	0	1	0
B _{hex}	=	11 _{dec}	=	13 _{oct}	1	0	1	1
C _{hex}	=	12 _{dec}	=	14 _{oct}	1	1	0	0
D _{hex}	=	13 _{dec}	=	15 _{oct}	1	1	0	1
E _{hex}	=	14 _{dec}	=	16 _{oct}	1	1	1	0
F _{hex}	=	15 _{dec}	=	17 _{oct}	1	1	1	1

CONVERSIONS, EX 1

				0x1111
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hex: 0x1111

binary: 0001 0001 0001 0001

base 4: 00 01 00 01 00 01 00 01 = 01010101

base 8: 0 001 000 100 010 001 = 10421

base 10: 4369

0 _{hex}	=	0 _{dec}	=	0 _{oct}	0	0	0	0
1 _{hex}	=	1 _{dec}	=	1 _{oct}	0	0	0	1
2 _{hex}	=	2 _{dec}	=	2 _{oct}	0	0	1	0
3 _{hex}	=	3 _{dec}	=	3 _{oct}	0	0	1	1
4 _{hex}	=	4 _{dec}	=	4 _{oct}	0	1	0	0
5 _{hex}	=	5 _{dec}	=	5 _{oct}	0	1	0	1
6 _{hex}	=	6 _{dec}	=	6 _{oct}	0	1	1	0
7 _{hex}	=	7 _{dec}	=	7 _{oct}	0	1	1	1
8 _{hex}	=	8 _{dec}	=	10 _{oct}	1	0	0	0
9 _{hex}	=	9 _{dec}	=	11 _{oct}	1	0	0	1
A _{hex}	=	10 _{dec}	=	12 _{oct}	1	0	1	0
B _{hex}	=	11 _{dec}	=	13 _{oct}	1	0	1	1
C _{hex}	=	12 _{dec}	=	14 _{oct}	1	1	0	0
D _{hex}	=	13 _{dec}	=	15 _{oct}	1	1	0	1
E _{hex}	=	14 _{dec}	=	16 _{oct}	1	1	1	0
F _{hex}	=	15 _{dec}	=	17 _{oct}	1	1	1	1

CONVERSIONS, EX 1

1111 1111 0000 0000				
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binary: 1111 1111 0000 0000

hex:

base 4:

base 8:

base 10:

0 _{hex}	=	0 _{dec}	=	0 _{oct}	0	0	0	0
1 _{hex}	=	1 _{dec}	=	1 _{oct}	0	0	0	1
2 _{hex}	=	2 _{dec}	=	2 _{oct}	0	0	1	0
3 _{hex}	=	3 _{dec}	=	3 _{oct}	0	0	1	1
4 _{hex}	=	4 _{dec}	=	4 _{oct}	0	1	0	0
5 _{hex}	=	5 _{dec}	=	5 _{oct}	0	1	0	1
6 _{hex}	=	6 _{dec}	=	6 _{oct}	0	1	1	0
7 _{hex}	=	7 _{dec}	=	7 _{oct}	0	1	1	1
8 _{hex}	=	8 _{dec}	=	10 _{oct}	1	0	0	0
9 _{hex}	=	9 _{dec}	=	11 _{oct}	1	0	0	1
A _{hex}	=	10 _{dec}	=	12 _{oct}	1	0	1	0
B _{hex}	=	11 _{dec}	=	13 _{oct}	1	0	1	1
C _{hex}	=	12 _{dec}	=	14 _{oct}	1	1	0	0
D _{hex}	=	13 _{dec}	=	15 _{oct}	1	1	0	1
E _{hex}	=	14 _{dec}	=	16 _{oct}	1	1	1	0
F _{hex}	=	15 _{dec}	=	17 _{oct}	1	1	1	1

CONVERSIONS, EX 1

1111 1111 0000 0000				
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binary: 1111 1111 0000 0000

hex: 0xFF00

base 4:

base 8:

base 10:

0 _{hex}	=	0 _{dec}	=	0 _{oct}	0	0	0	0
1 _{hex}	=	1 _{dec}	=	1 _{oct}	0	0	0	1
2 _{hex}	=	2 _{dec}	=	2 _{oct}	0	0	1	0
3 _{hex}	=	3 _{dec}	=	3 _{oct}	0	0	1	1
4 _{hex}	=	4 _{dec}	=	4 _{oct}	0	1	0	0
5 _{hex}	=	5 _{dec}	=	5 _{oct}	0	1	0	1
6 _{hex}	=	6 _{dec}	=	6 _{oct}	0	1	1	0
7 _{hex}	=	7 _{dec}	=	7 _{oct}	0	1	1	1
8 _{hex}	=	8 _{dec}	=	10 _{oct}	1	0	0	0
9 _{hex}	=	9 _{dec}	=	11 _{oct}	1	0	0	1
A _{hex}	=	10 _{dec}	=	12 _{oct}	1	0	1	0
B _{hex}	=	11 _{dec}	=	13 _{oct}	1	0	1	1
C _{hex}	=	12 _{dec}	=	14 _{oct}	1	1	0	0
D _{hex}	=	13 _{dec}	=	15 _{oct}	1	1	0	1
E _{hex}	=	14 _{dec}	=	16 _{oct}	1	1	1	0
F _{hex}	=	15 _{dec}	=	17 _{oct}	1	1	1	1

CONVERSIONS, EX 1

1111 1111 0000 0000				
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binary: 1111 1111 0000 0000

hex: 0xFF00

base 4: 11 11 11 11 00 00 00 00

base 8:

base 10:

0 _{hex}	=	0 _{dec}	=	0 _{oct}	0	0	0	0
1 _{hex}	=	1 _{dec}	=	1 _{oct}	0	0	0	1
2 _{hex}	=	2 _{dec}	=	2 _{oct}	0	0	1	0
3 _{hex}	=	3 _{dec}	=	3 _{oct}	0	0	1	1
4 _{hex}	=	4 _{dec}	=	4 _{oct}	0	1	0	0
5 _{hex}	=	5 _{dec}	=	5 _{oct}	0	1	0	1
6 _{hex}	=	6 _{dec}	=	6 _{oct}	0	1	1	0
7 _{hex}	=	7 _{dec}	=	7 _{oct}	0	1	1	1
8 _{hex}	=	8 _{dec}	=	10 _{oct}	1	0	0	0
9 _{hex}	=	9 _{dec}	=	11 _{oct}	1	0	0	1
A _{hex}	=	10 _{dec}	=	12 _{oct}	1	0	1	0
B _{hex}	=	11 _{dec}	=	13 _{oct}	1	0	1	1
C _{hex}	=	12 _{dec}	=	14 _{oct}	1	1	0	0
D _{hex}	=	13 _{dec}	=	15 _{oct}	1	1	0	1
E _{hex}	=	14 _{dec}	=	16 _{oct}	1	1	1	0
F _{hex}	=	15 _{dec}	=	17 _{oct}	1	1	1	1

CONVERSIONS, EX 1

1111 1111 0000 0000				
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binary: 1111 1111 0000 0000

hex: 0xFF00

base 4: 11 11 11 11 00 00 00 00 = 33330000

base 8:

base 10:

0 _{hex}	=	0 _{dec}	=	0 _{oct}	0	0	0	0
1 _{hex}	=	1 _{dec}	=	1 _{oct}	0	0	0	1
2 _{hex}	=	2 _{dec}	=	2 _{oct}	0	0	1	0
3 _{hex}	=	3 _{dec}	=	3 _{oct}	0	0	1	1
4 _{hex}	=	4 _{dec}	=	4 _{oct}	0	1	0	0
5 _{hex}	=	5 _{dec}	=	5 _{oct}	0	1	0	1
6 _{hex}	=	6 _{dec}	=	6 _{oct}	0	1	1	0
7 _{hex}	=	7 _{dec}	=	7 _{oct}	0	1	1	1
8 _{hex}	=	8 _{dec}	=	10 _{oct}	1	0	0	0
9 _{hex}	=	9 _{dec}	=	11 _{oct}	1	0	0	1
A _{hex}	=	10 _{dec}	=	12 _{oct}	1	0	1	0
B _{hex}	=	11 _{dec}	=	13 _{oct}	1	0	1	1
C _{hex}	=	12 _{dec}	=	14 _{oct}	1	1	0	0
D _{hex}	=	13 _{dec}	=	15 _{oct}	1	1	0	1
E _{hex}	=	14 _{dec}	=	16 _{oct}	1	1	1	0
F _{hex}	=	15 _{dec}	=	17 _{oct}	1	1	1	1

CONVERSIONS, EX 1

1111 1111 0000 0000				
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binary: 1111 1111 0000 0000

hex: 0xFF00

base 4: 11 11 11 11 00 00 00 00 = 33330000

base 8: 1 111 111 100 000 000

base 10:

0 _{hex}	=	0 _{dec}	=	0 _{oct}	0	0	0	0
1 _{hex}	=	1 _{dec}	=	1 _{oct}	0	0	0	1
2 _{hex}	=	2 _{dec}	=	2 _{oct}	0	0	1	0
3 _{hex}	=	3 _{dec}	=	3 _{oct}	0	0	1	1
4 _{hex}	=	4 _{dec}	=	4 _{oct}	0	1	0	0
5 _{hex}	=	5 _{dec}	=	5 _{oct}	0	1	0	1
6 _{hex}	=	6 _{dec}	=	6 _{oct}	0	1	1	0
7 _{hex}	=	7 _{dec}	=	7 _{oct}	0	1	1	1
8 _{hex}	=	8 _{dec}	=	10 _{oct}	1	0	0	0
9 _{hex}	=	9 _{dec}	=	11 _{oct}	1	0	0	1
A _{hex}	=	10 _{dec}	=	12 _{oct}	1	0	1	0
B _{hex}	=	11 _{dec}	=	13 _{oct}	1	0	1	1
C _{hex}	=	12 _{dec}	=	14 _{oct}	1	1	0	0
D _{hex}	=	13 _{dec}	=	15 _{oct}	1	1	0	1
E _{hex}	=	14 _{dec}	=	16 _{oct}	1	1	1	0
F _{hex}	=	15 _{dec}	=	17 _{oct}	1	1	1	1

CONVERSIONS, EX 1

1111 1111 0000 0000				
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binary: 1111 1111 0000 0000

hex: 0xFF00

base 4: 11 11 11 11 00 00 00 00 = 33330000

base 8: 1 111 111 100 000 000 = 177400

base 10:

0 _{hex}	=	0 _{dec}	=	0 _{oct}	0	0	0	0
1 _{hex}	=	1 _{dec}	=	1 _{oct}	0	0	0	1
2 _{hex}	=	2 _{dec}	=	2 _{oct}	0	0	1	0
3 _{hex}	=	3 _{dec}	=	3 _{oct}	0	0	1	1
4 _{hex}	=	4 _{dec}	=	4 _{oct}	0	1	0	0
5 _{hex}	=	5 _{dec}	=	5 _{oct}	0	1	0	1
6 _{hex}	=	6 _{dec}	=	6 _{oct}	0	1	1	0
7 _{hex}	=	7 _{dec}	=	7 _{oct}	0	1	1	1
8 _{hex}	=	8 _{dec}	=	10 _{oct}	1	0	0	0
9 _{hex}	=	9 _{dec}	=	11 _{oct}	1	0	0	1
A _{hex}	=	10 _{dec}	=	12 _{oct}	1	0	1	0
B _{hex}	=	11 _{dec}	=	13 _{oct}	1	0	1	1
C _{hex}	=	12 _{dec}	=	14 _{oct}	1	1	0	0
D _{hex}	=	13 _{dec}	=	15 _{oct}	1	1	0	1
E _{hex}	=	14 _{dec}	=	16 _{oct}	1	1	1	0
F _{hex}	=	15 _{dec}	=	17 _{oct}	1	1	1	1

CONVERSIONS, EX 1

1111 1111 0000 0000				
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binary: 1111 1111 0000 0000

hex: 0xFF00

base 4: 11 11 11 11 00 00 00 00 = 33330000

base 8: 1 111 111 100 000 000 = 177400

base 10: 65280

0 _{hex}	=	0 _{dec}	=	0 _{oct}	0	0	0	0
1 _{hex}	=	1 _{dec}	=	1 _{oct}	0	0	0	1
2 _{hex}	=	2 _{dec}	=	2 _{oct}	0	0	1	0
3 _{hex}	=	3 _{dec}	=	3 _{oct}	0	0	1	1
4 _{hex}	=	4 _{dec}	=	4 _{oct}	0	1	0	0
5 _{hex}	=	5 _{dec}	=	5 _{oct}	0	1	0	1
6 _{hex}	=	6 _{dec}	=	6 _{oct}	0	1	1	0
7 _{hex}	=	7 _{dec}	=	7 _{oct}	0	1	1	1
8 _{hex}	=	8 _{dec}	=	10 _{oct}	1	0	0	0
9 _{hex}	=	9 _{dec}	=	11 _{oct}	1	0	0	1
A _{hex}	=	10 _{dec}	=	12 _{oct}	1	0	1	0
B _{hex}	=	11 _{dec}	=	13 _{oct}	1	0	1	1
C _{hex}	=	12 _{dec}	=	14 _{oct}	1	1	0	0
D _{hex}	=	13 _{dec}	=	15 _{oct}	1	1	0	1
E _{hex}	=	14 _{dec}	=	16 _{oct}	1	1	1	0
F _{hex}	=	15 _{dec}	=	17 _{oct}	1	1	1	1

CONVERSIONS, EX 2

				0xFEED
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hex: 0xFEED

binary:

base 4:

base 8:

base 10:

0 _{hex}	=	0 _{dec}	=	0 _{oct}	0	0	0	0
1 _{hex}	=	1 _{dec}	=	1 _{oct}	0	0	0	1
2 _{hex}	=	2 _{dec}	=	2 _{oct}	0	0	1	0
3 _{hex}	=	3 _{dec}	=	3 _{oct}	0	0	1	1
4 _{hex}	=	4 _{dec}	=	4 _{oct}	0	1	0	0
5 _{hex}	=	5 _{dec}	=	5 _{oct}	0	1	0	1
6 _{hex}	=	6 _{dec}	=	6 _{oct}	0	1	1	0
7 _{hex}	=	7 _{dec}	=	7 _{oct}	0	1	1	1
8 _{hex}	=	8 _{dec}	=	10 _{oct}	1	0	0	0
9 _{hex}	=	9 _{dec}	=	11 _{oct}	1	0	0	1
A _{hex}	=	10 _{dec}	=	12 _{oct}	1	0	1	0
B _{hex}	=	11 _{dec}	=	13 _{oct}	1	0	1	1
C _{hex}	=	12 _{dec}	=	14 _{oct}	1	1	0	0
D _{hex}	=	13 _{dec}	=	15 _{oct}	1	1	0	1
E _{hex}	=	14 _{dec}	=	16 _{oct}	1	1	1	0
F _{hex}	=	15 _{dec}	=	17 _{oct}	1	1	1	1

CONVERSIONS, EX 2

				0xFEED
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hex: 0xFEED

binary: 1111 1110 1110 1101

base 4:

base 8:

base 10:

0 _{hex}	=	0 _{dec}	=	0 _{oct}	0	0	0	0
1 _{hex}	=	1 _{dec}	=	1 _{oct}	0	0	0	1
2 _{hex}	=	2 _{dec}	=	2 _{oct}	0	0	1	0
3 _{hex}	=	3 _{dec}	=	3 _{oct}	0	0	1	1
4 _{hex}	=	4 _{dec}	=	4 _{oct}	0	1	0	0
5 _{hex}	=	5 _{dec}	=	5 _{oct}	0	1	0	1
6 _{hex}	=	6 _{dec}	=	6 _{oct}	0	1	1	0
7 _{hex}	=	7 _{dec}	=	7 _{oct}	0	1	1	1
8 _{hex}	=	8 _{dec}	=	10 _{oct}	1	0	0	0
9 _{hex}	=	9 _{dec}	=	11 _{oct}	1	0	0	1
A _{hex}	=	10 _{dec}	=	12 _{oct}	1	0	1	0
B _{hex}	=	11 _{dec}	=	13 _{oct}	1	0	1	1
C _{hex}	=	12 _{dec}	=	14 _{oct}	1	1	0	0
D _{hex}	=	13 _{dec}	=	15 _{oct}	1	1	0	1
E _{hex}	=	14 _{dec}	=	16 _{oct}	1	1	1	0
F _{hex}	=	15 _{dec}	=	17 _{oct}	1	1	1	1

CONVERSIONS, EX 2

				0xFEED
--	--	--	--	--------

hex: 0xFEED

binary: 1111 1110 1110 1101

base 4: 11 11 11 10 11 10 11 01

base 8:

base 10:

0 _{hex}	=	0 _{dec}	=	0 _{oct}	0	0	0	0
1 _{hex}	=	1 _{dec}	=	1 _{oct}	0	0	0	1
2 _{hex}	=	2 _{dec}	=	2 _{oct}	0	0	1	0
3 _{hex}	=	3 _{dec}	=	3 _{oct}	0	0	1	1
4 _{hex}	=	4 _{dec}	=	4 _{oct}	0	1	0	0
5 _{hex}	=	5 _{dec}	=	5 _{oct}	0	1	0	1
6 _{hex}	=	6 _{dec}	=	6 _{oct}	0	1	1	0
7 _{hex}	=	7 _{dec}	=	7 _{oct}	0	1	1	1
8 _{hex}	=	8 _{dec}	=	10 _{oct}	1	0	0	0
9 _{hex}	=	9 _{dec}	=	11 _{oct}	1	0	0	1
A _{hex}	=	10 _{dec}	=	12 _{oct}	1	0	1	0
B _{hex}	=	11 _{dec}	=	13 _{oct}	1	0	1	1
C _{hex}	=	12 _{dec}	=	14 _{oct}	1	1	0	0
D _{hex}	=	13 _{dec}	=	15 _{oct}	1	1	0	1
E _{hex}	=	14 _{dec}	=	16 _{oct}	1	1	1	0
F _{hex}	=	15 _{dec}	=	17 _{oct}	1	1	1	1

CONVERSIONS, EX 2

			0xFEED
--	--	--	--------

hex: 0xFEED

binary: 1111 1110 1110 1101

base 4: 11 11 11 10 11 10 11 01 = 33323231

base 8:

base 10:

0 _{hex}	=	0 _{dec}	=	0 _{oct}	0	0	0	0
1 _{hex}	=	1 _{dec}	=	1 _{oct}	0	0	0	1
2 _{hex}	=	2 _{dec}	=	2 _{oct}	0	0	1	0
3 _{hex}	=	3 _{dec}	=	3 _{oct}	0	0	1	1
4 _{hex}	=	4 _{dec}	=	4 _{oct}	0	1	0	0
5 _{hex}	=	5 _{dec}	=	5 _{oct}	0	1	0	1
6 _{hex}	=	6 _{dec}	=	6 _{oct}	0	1	1	0
7 _{hex}	=	7 _{dec}	=	7 _{oct}	0	1	1	1
8 _{hex}	=	8 _{dec}	=	10 _{oct}	1	0	0	0
9 _{hex}	=	9 _{dec}	=	11 _{oct}	1	0	0	1
A _{hex}	=	10 _{dec}	=	12 _{oct}	1	0	1	0
B _{hex}	=	11 _{dec}	=	13 _{oct}	1	0	1	1
C _{hex}	=	12 _{dec}	=	14 _{oct}	1	1	0	0
D _{hex}	=	13 _{dec}	=	15 _{oct}	1	1	0	1
E _{hex}	=	14 _{dec}	=	16 _{oct}	1	1	1	0
F _{hex}	=	15 _{dec}	=	17 _{oct}	1	1	1	1

CONVERSIONS, EX 2

				0xFEED
--	--	--	--	--------

hex: 0xFEED

binary: 1111 1110 1110 1101

base 4: 11 11 11 10 11 10 11 01 = 33323231

base 8: 1 111 111 011 101 101

base 10:

0 _{hex}	=	0 _{dec}	=	0 _{oct}	0	0	0	0
1 _{hex}	=	1 _{dec}	=	1 _{oct}	0	0	0	1
2 _{hex}	=	2 _{dec}	=	2 _{oct}	0	0	1	0
3 _{hex}	=	3 _{dec}	=	3 _{oct}	0	0	1	1
4 _{hex}	=	4 _{dec}	=	4 _{oct}	0	1	0	0
5 _{hex}	=	5 _{dec}	=	5 _{oct}	0	1	0	1
6 _{hex}	=	6 _{dec}	=	6 _{oct}	0	1	1	0
7 _{hex}	=	7 _{dec}	=	7 _{oct}	0	1	1	1
8 _{hex}	=	8 _{dec}	=	10 _{oct}	1	0	0	0
9 _{hex}	=	9 _{dec}	=	11 _{oct}	1	0	0	1
A _{hex}	=	10 _{dec}	=	12 _{oct}	1	0	1	0
B _{hex}	=	11 _{dec}	=	13 _{oct}	1	0	1	1
C _{hex}	=	12 _{dec}	=	14 _{oct}	1	1	0	0
D _{hex}	=	13 _{dec}	=	15 _{oct}	1	1	0	1
E _{hex}	=	14 _{dec}	=	16 _{oct}	1	1	1	0
F _{hex}	=	15 _{dec}	=	17 _{oct}	1	1	1	1

CONVERSIONS, EX 2

				0xFEED
--	--	--	--	--------

hex: 0xFEED

binary: 1111 1110 1110 1101

base 4: 11 11 11 10 11 10 11 01 = 33323231

base 8: 1 111 111 011 101 101 = 177355

base 10:

0 _{hex}	=	0 _{dec}	=	0 _{oct}	0	0	0	0
1 _{hex}	=	1 _{dec}	=	1 _{oct}	0	0	0	1
2 _{hex}	=	2 _{dec}	=	2 _{oct}	0	0	1	0
3 _{hex}	=	3 _{dec}	=	3 _{oct}	0	0	1	1
4 _{hex}	=	4 _{dec}	=	4 _{oct}	0	1	0	0
5 _{hex}	=	5 _{dec}	=	5 _{oct}	0	1	0	1
6 _{hex}	=	6 _{dec}	=	6 _{oct}	0	1	1	0
7 _{hex}	=	7 _{dec}	=	7 _{oct}	0	1	1	1
8 _{hex}	=	8 _{dec}	=	10 _{oct}	1	0	0	0
9 _{hex}	=	9 _{dec}	=	11 _{oct}	1	0	0	1
A _{hex}	=	10 _{dec}	=	12 _{oct}	1	0	1	0
B _{hex}	=	11 _{dec}	=	13 _{oct}	1	0	1	1
C _{hex}	=	12 _{dec}	=	14 _{oct}	1	1	0	0
D _{hex}	=	13 _{dec}	=	15 _{oct}	1	1	0	1
E _{hex}	=	14 _{dec}	=	16 _{oct}	1	1	1	0
F _{hex}	=	15 _{dec}	=	17 _{oct}	1	1	1	1

CONVERSIONS, EX 2

				0xFEED
--	--	--	--	--------

hex: 0xFEED

binary: 1111 1110 1110 1101

base 4: 11 11 11 10 11 10 11 01 = 33323231

base 8: 1 111 111 011 101 101 = 177355

base 10: -275

0 _{hex}	=	0 _{dec}	=	0 _{oct}	0	0	0	0
1 _{hex}	=	1 _{dec}	=	1 _{oct}	0	0	0	1
2 _{hex}	=	2 _{dec}	=	2 _{oct}	0	0	1	0
3 _{hex}	=	3 _{dec}	=	3 _{oct}	0	0	1	1
4 _{hex}	=	4 _{dec}	=	4 _{oct}	0	1	0	0
5 _{hex}	=	5 _{dec}	=	5 _{oct}	0	1	0	1
6 _{hex}	=	6 _{dec}	=	6 _{oct}	0	1	1	0
7 _{hex}	=	7 _{dec}	=	7 _{oct}	0	1	1	1
8 _{hex}	=	8 _{dec}	=	10 _{oct}	1	0	0	0
9 _{hex}	=	9 _{dec}	=	11 _{oct}	1	0	0	1
A _{hex}	=	10 _{dec}	=	12 _{oct}	1	0	1	0
B _{hex}	=	11 _{dec}	=	13 _{oct}	1	0	1	1
C _{hex}	=	12 _{dec}	=	14 _{oct}	1	1	0	0
D _{hex}	=	13 _{dec}	=	15 _{oct}	1	1	0	1
E _{hex}	=	14 _{dec}	=	16 _{oct}	1	1	1	0
F _{hex}	=	15 _{dec}	=	17 _{oct}	1	1	1	1

CONVERSIONS, EX 2

1111 1111 0000 0000				
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binary: 1111 1111 0000 0000

hex:

base 4:

base 8:

base 10:

0 _{hex}	=	0 _{dec}	=	0 _{oct}	0	0	0	0
1 _{hex}	=	1 _{dec}	=	1 _{oct}	0	0	0	1
2 _{hex}	=	2 _{dec}	=	2 _{oct}	0	0	1	0
3 _{hex}	=	3 _{dec}	=	3 _{oct}	0	0	1	1
4 _{hex}	=	4 _{dec}	=	4 _{oct}	0	1	0	0
5 _{hex}	=	5 _{dec}	=	5 _{oct}	0	1	0	1
6 _{hex}	=	6 _{dec}	=	6 _{oct}	0	1	1	0
7 _{hex}	=	7 _{dec}	=	7 _{oct}	0	1	1	1
8 _{hex}	=	8 _{dec}	=	10 _{oct}	1	0	0	0
9 _{hex}	=	9 _{dec}	=	11 _{oct}	1	0	0	1
A _{hex}	=	10 _{dec}	=	12 _{oct}	1	0	1	0
B _{hex}	=	11 _{dec}	=	13 _{oct}	1	0	1	1
C _{hex}	=	12 _{dec}	=	14 _{oct}	1	1	0	0
D _{hex}	=	13 _{dec}	=	15 _{oct}	1	1	0	1
E _{hex}	=	14 _{dec}	=	16 _{oct}	1	1	1	0
F _{hex}	=	15 _{dec}	=	17 _{oct}	1	1	1	1

CONVERSIONS, EX 2

1111 1111 0000 0000				
---------------------	--	--	--	--

binary: 1111 1111 0000 0000

hex: 0xFF00

base 4:

base 8:

base 10:

0 _{hex}	=	0 _{dec}	=	0 _{oct}	0	0	0	0
1 _{hex}	=	1 _{dec}	=	1 _{oct}	0	0	0	1
2 _{hex}	=	2 _{dec}	=	2 _{oct}	0	0	1	0
3 _{hex}	=	3 _{dec}	=	3 _{oct}	0	0	1	1
4 _{hex}	=	4 _{dec}	=	4 _{oct}	0	1	0	0
5 _{hex}	=	5 _{dec}	=	5 _{oct}	0	1	0	1
6 _{hex}	=	6 _{dec}	=	6 _{oct}	0	1	1	0
7 _{hex}	=	7 _{dec}	=	7 _{oct}	0	1	1	1
8 _{hex}	=	8 _{dec}	=	10 _{oct}	1	0	0	0
9 _{hex}	=	9 _{dec}	=	11 _{oct}	1	0	0	1
A _{hex}	=	10 _{dec}	=	12 _{oct}	1	0	1	0
B _{hex}	=	11 _{dec}	=	13 _{oct}	1	0	1	1
C _{hex}	=	12 _{dec}	=	14 _{oct}	1	1	0	0
D _{hex}	=	13 _{dec}	=	15 _{oct}	1	1	0	1
E _{hex}	=	14 _{dec}	=	16 _{oct}	1	1	1	0
F _{hex}	=	15 _{dec}	=	17 _{oct}	1	1	1	1

CONVERSIONS, EX 2

1111 1111 0000 0000				
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binary: 1111 1111 0000 0000

hex: 0xFF00

base 4: 11 11 11 11 00 00 00 00

base 8:

base 10:

0 _{hex}	=	0 _{dec}	=	0 _{oct}	0	0	0	0
1 _{hex}	=	1 _{dec}	=	1 _{oct}	0	0	0	1
2 _{hex}	=	2 _{dec}	=	2 _{oct}	0	0	1	0
3 _{hex}	=	3 _{dec}	=	3 _{oct}	0	0	1	1
4 _{hex}	=	4 _{dec}	=	4 _{oct}	0	1	0	0
5 _{hex}	=	5 _{dec}	=	5 _{oct}	0	1	0	1
6 _{hex}	=	6 _{dec}	=	6 _{oct}	0	1	1	0
7 _{hex}	=	7 _{dec}	=	7 _{oct}	0	1	1	1
8 _{hex}	=	8 _{dec}	=	10 _{oct}	1	0	0	0
9 _{hex}	=	9 _{dec}	=	11 _{oct}	1	0	0	1
A _{hex}	=	10 _{dec}	=	12 _{oct}	1	0	1	0
B _{hex}	=	11 _{dec}	=	13 _{oct}	1	0	1	1
C _{hex}	=	12 _{dec}	=	14 _{oct}	1	1	0	0
D _{hex}	=	13 _{dec}	=	15 _{oct}	1	1	0	1
E _{hex}	=	14 _{dec}	=	16 _{oct}	1	1	1	0
F _{hex}	=	15 _{dec}	=	17 _{oct}	1	1	1	1

CONVERSIONS, EX 2

1111 1111 0000 0000				
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binary: 1111 1111 0000 0000

hex: 0xFF00

base 4: 11 11 11 11 00 00 00 00 = 33330000

base 8:

base 10:

0 _{hex}	=	0 _{dec}	=	0 _{oct}	0	0	0	0
1 _{hex}	=	1 _{dec}	=	1 _{oct}	0	0	0	1
2 _{hex}	=	2 _{dec}	=	2 _{oct}	0	0	1	0
3 _{hex}	=	3 _{dec}	=	3 _{oct}	0	0	1	1
4 _{hex}	=	4 _{dec}	=	4 _{oct}	0	1	0	0
5 _{hex}	=	5 _{dec}	=	5 _{oct}	0	1	0	1
6 _{hex}	=	6 _{dec}	=	6 _{oct}	0	1	1	0
7 _{hex}	=	7 _{dec}	=	7 _{oct}	0	1	1	1
8 _{hex}	=	8 _{dec}	=	10 _{oct}	1	0	0	0
9 _{hex}	=	9 _{dec}	=	11 _{oct}	1	0	0	1
A _{hex}	=	10 _{dec}	=	12 _{oct}	1	0	1	0
B _{hex}	=	11 _{dec}	=	13 _{oct}	1	0	1	1
C _{hex}	=	12 _{dec}	=	14 _{oct}	1	1	0	0
D _{hex}	=	13 _{dec}	=	15 _{oct}	1	1	0	1
E _{hex}	=	14 _{dec}	=	16 _{oct}	1	1	1	0
F _{hex}	=	15 _{dec}	=	17 _{oct}	1	1	1	1

CONVERSIONS, EX 2

1111 1111 0000 0000				
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binary: 1111 1111 0000 0000

hex: 0xFF00

base 4: 11 11 11 11 00 00 00 00 = 33330000

base 8: 1 111 111 100 000 000

base 10:

0 _{hex}	=	0 _{dec}	=	0 _{oct}	0	0	0	0
1 _{hex}	=	1 _{dec}	=	1 _{oct}	0	0	0	1
2 _{hex}	=	2 _{dec}	=	2 _{oct}	0	0	1	0
3 _{hex}	=	3 _{dec}	=	3 _{oct}	0	0	1	1
4 _{hex}	=	4 _{dec}	=	4 _{oct}	0	1	0	0
5 _{hex}	=	5 _{dec}	=	5 _{oct}	0	1	0	1
6 _{hex}	=	6 _{dec}	=	6 _{oct}	0	1	1	0
7 _{hex}	=	7 _{dec}	=	7 _{oct}	0	1	1	1
8 _{hex}	=	8 _{dec}	=	10 _{oct}	1	0	0	0
9 _{hex}	=	9 _{dec}	=	11 _{oct}	1	0	0	1
A _{hex}	=	10 _{dec}	=	12 _{oct}	1	0	1	0
B _{hex}	=	11 _{dec}	=	13 _{oct}	1	0	1	1
C _{hex}	=	12 _{dec}	=	14 _{oct}	1	1	0	0
D _{hex}	=	13 _{dec}	=	15 _{oct}	1	1	0	1
E _{hex}	=	14 _{dec}	=	16 _{oct}	1	1	1	0
F _{hex}	=	15 _{dec}	=	17 _{oct}	1	1	1	1

CONVERSIONS, EX 2

1111 1111 0000 0000				
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binary: 1111 1111 0000 0000

hex: 0xFF00

base 4: 11 11 11 11 00 00 00 00 = 33330000

base 8: 1 111 111 100 000 000 = 177400

base 10:

0 _{hex}	=	0 _{dec}	=	0 _{oct}	0	0	0	0
1 _{hex}	=	1 _{dec}	=	1 _{oct}	0	0	0	1
2 _{hex}	=	2 _{dec}	=	2 _{oct}	0	0	1	0
3 _{hex}	=	3 _{dec}	=	3 _{oct}	0	0	1	1
4 _{hex}	=	4 _{dec}	=	4 _{oct}	0	1	0	0
5 _{hex}	=	5 _{dec}	=	5 _{oct}	0	1	0	1
6 _{hex}	=	6 _{dec}	=	6 _{oct}	0	1	1	0
7 _{hex}	=	7 _{dec}	=	7 _{oct}	0	1	1	1
8 _{hex}	=	8 _{dec}	=	10 _{oct}	1	0	0	0
9 _{hex}	=	9 _{dec}	=	11 _{oct}	1	0	0	1
A _{hex}	=	10 _{dec}	=	12 _{oct}	1	0	1	0
B _{hex}	=	11 _{dec}	=	13 _{oct}	1	0	1	1
C _{hex}	=	12 _{dec}	=	14 _{oct}	1	1	0	0
D _{hex}	=	13 _{dec}	=	15 _{oct}	1	1	0	1
E _{hex}	=	14 _{dec}	=	16 _{oct}	1	1	1	0
F _{hex}	=	15 _{dec}	=	17 _{oct}	1	1	1	1

CONVERSIONS, EX 2

1111 1111 0000 0000				
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binary: 1111 1111 0000 0000

hex: 0xFF00

base 4: 11 11 11 11 00 00 00 00 = 33330000

base 8: 1 111 111 100 000 000 = 177400

base 10: -256

0 _{hex}	=	0 _{dec}	=	0 _{oct}	0	0	0	0
1 _{hex}	=	1 _{dec}	=	1 _{oct}	0	0	0	1
2 _{hex}	=	2 _{dec}	=	2 _{oct}	0	0	1	0
3 _{hex}	=	3 _{dec}	=	3 _{oct}	0	0	1	1
4 _{hex}	=	4 _{dec}	=	4 _{oct}	0	1	0	0
5 _{hex}	=	5 _{dec}	=	5 _{oct}	0	1	0	1
6 _{hex}	=	6 _{dec}	=	6 _{oct}	0	1	1	0
7 _{hex}	=	7 _{dec}	=	7 _{oct}	0	1	1	1
8 _{hex}	=	8 _{dec}	=	10 _{oct}	1	0	0	0
9 _{hex}	=	9 _{dec}	=	11 _{oct}	1	0	0	1
A _{hex}	=	10 _{dec}	=	12 _{oct}	1	0	1	0
B _{hex}	=	11 _{dec}	=	13 _{oct}	1	0	1	1
C _{hex}	=	12 _{dec}	=	14 _{oct}	1	1	0	0
D _{hex}	=	13 _{dec}	=	15 _{oct}	1	1	0	1
E _{hex}	=	14 _{dec}	=	16 _{oct}	1	1	1	0
F _{hex}	=	15 _{dec}	=	17 _{oct}	1	1	1	1

BINARY OPERATIONS, EX. 3

$$\begin{array}{r|l} 0101\ 1100\ 1111\ 0011 & \\ 1111\ 1111\ 0000\ 0000 & + \\ \hline \end{array}$$

$$\begin{array}{r|l} 1111\ 1111\ 1111\ 1111 & \\ 0000\ 0000\ 0000\ 0001 & + \\ \hline \end{array}$$

- what are the operands/result (decimal/binary)?

BINARY OPERATIONS, EX. 3

$$\begin{array}{r|l} 0101\ 1100\ 1111\ 0011 & \\ 1111\ 1111\ 0000\ 0000 & + \\ \hline 1\ 0101\ 1011\ 1111\ 0011 & \end{array}$$

$$\begin{array}{r|l} 1111\ 1111\ 1111\ 1111 & \\ 0000\ 0000\ 0000\ 0001 & + \\ \hline 1\ 0000\ 0000\ 0000\ 0000 & \end{array}$$

- **what are the operands/result (decimal/binary)?**
 - left: 23795 and -256, result 23539
 - right: -1 and +1

BINARY OPERATIONS, EX. 3

$$\begin{array}{r|l} 1111 & 1111 & 1111 & 1111 \\ 1000 & 0000 & 0000 & 0000 \\ \hline & + & & \end{array}$$

$$\begin{array}{r|l} 1000 & 0000 & 0000 & 0000 \\ 0000 & 0000 & 0000 & 0001 \\ \hline & + & & \end{array}$$

- what are the operands/result (decimal/binary)?

BINARY OPERATIONS, EX. 3

$$\begin{array}{r|l} 1111 & 1111 & 1111 & 1111 \\ 1000 & 0000 & 0000 & 0000 \\ \hline 1 & 0111 & 1111 & 1111 \\ 1111 & & & \end{array} \quad +$$

$$\begin{array}{r|l} 1000 & 0000 & 0000 & 0000 \\ 0000 & 0000 & 0000 & 0001 \\ \hline 1000 & 0000 & 0000 & 0001 \end{array} \quad +$$

- **what are the operands/result (decimal/binary)?**
 - left: -1 and -32 768
 - right: -32 768 and +1

BINARY OPERATIONS, EX. 4

$$\begin{array}{r|l} 0101 & 1100 & 1111 & 0011 \\ 0101 & 1100 & 1111 & 0011 \\ \hline \end{array} \quad \text{AND}$$

X	Y	X AND Y
0	0	0
0	1	0
1	0	0
1	1	1

$$\begin{array}{r|l} 1101 & 1100 & 1111 & 0011 \\ 1101 & 1100 & 1111 & 0011 \\ \hline \end{array} \quad \text{XOR}$$

X	Y	X XOR Y
0	0	0
0	1	1
1	0	1
1	1	0

BINARY OPERATIONS, EX. 4

$$\begin{array}{r|l} 0101 & 1100 & 1111 & 0011 \\ 0101 & 1100 & 1111 & 0011 \\ \hline 0101 & 1100 & 1111 & 0011 \end{array} \quad \text{AND}$$

X	Y	X AND Y
0	0	0
0	1	0
1	0	0
1	1	1

$$\begin{array}{r|l} 1101 & 1100 & 1111 & 0011 \\ 1101 & 1100 & 1111 & 0011 \\ \hline 0000 & 0000 & 0000 & 0000 \end{array} \quad \text{XOR}$$

X	Y	X XOR Y
0	0	0
0	1	1
1	0	1
1	1	0

BINARY OPERATIONS, EX. 4

0000 0000 1111 1111	AND
0000 0001 0000 0000	

1100 0110 1001 1110	XOR
1001 1111 0110 1100	
1100 0110 1001 1110	XOR

X	Y	X AND Y
0	0	0
0	1	0
1	0	0
1	1	1

X	Y	X XOR Y
0	0	0
0	1	1
1	0	1
1	1	0

BINARY OPERATIONS, EX. 4

0000 0000 1111 1111

0000 0001 0000 0000

0000 0000 0000 0000

AND

1100 0110 1001 1110

1001 1111 0110 1100

1100 0110 1001 1110

1001 1111 0110 1100

XOR

XOR

X	Y	X AND Y
0	0	0
0	1	0
1	0	0
1	1	1

X	Y	X XOR Y
0	0	0
0	1	1
1	0	1
1	1	0

SHORT QUESTIONS, EX 5

- a) $2^N - 1$
- b) $2N-1 - 1$ and $-2N-1$
- c) approximately $\log_2 x$, exactly $\text{ceil}(\log_2 (x+1))$
- d) $4k$
- e) $\text{ceil}(k / 4)$
- f) $\text{ceil}(k \log_2 10)$

BINARY FIXED-POINT, EX 6

...	2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0		2^{-1}	2^{-2}	2^{-3}	2^{-4}	2^{-5}	2^{-6}	2^{-7}	...
-----	-------	-------	-------	-------	-------	-------	-------	-------	--	----------	----------	----------	----------	----------	----------	----------	-----

- $\frac{1}{2} = 0.5$
 - $\frac{1}{4} = 0.25$
 - $\frac{1}{8} = 0.125$
 - $\frac{1}{16} = 0.0625$
 - ...
-
- **Compute the representations for**

(a) 101.101;

(b) 111.001;

(c) 1110.00111;

(a) 3.75;

(b) 12.3125;

(c) 3.078125;

BINARY FIXED-POINT, EX 6

...	2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0		2^{-1}	2^{-2}	2^{-3}	2^{-4}	2^{-5}	2^{-6}	2^{-7}	...
-----	-------	-------	-------	-------	-------	-------	-------	-------	--	----------	----------	----------	----------	----------	----------	----------	-----

- $\frac{1}{2} = 0.5$
 - $\frac{1}{4} = 0.25$
 - $\frac{1}{8} = 0.125$
 - $\frac{1}{16} = 0.0625$
 - ...
-
- **Compute the representations for**

(a) 101.101; **5.625**

(b) 111.001;

(c) 1110.00111;

(a) 3.75; **11.11**

(b) 12.3125;

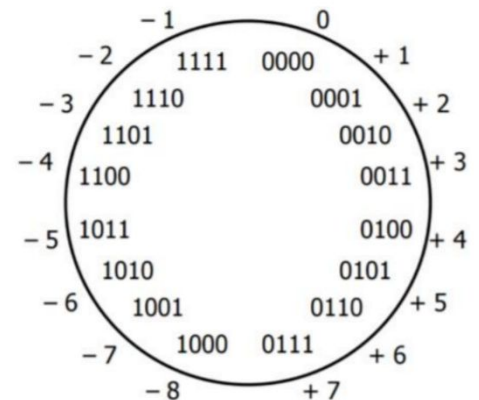
(c) 3.078125;

TWO'S COMPLEMENT, EX. 7

bit b_i :	1	1	1	1	0	0	0	1
2^i :	-2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0

$$x = -b_{N-1}2^{N-1} + \sum_{i=0}^{N-2} b_i 2^i$$

- to represent a negative number, we take the positive value of the number, invert its bits, and add one
- why does this procedure work?
 - we start from the fact that we use modular arithmetic
 - we fix the setting and work on 8 bits

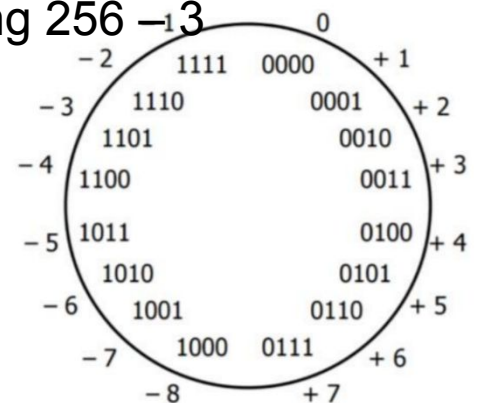


TWO'S COMPLEMENT, EX. 7

bit b_i :	1	1	1	1	0	0	0	1
2^i :	-2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0

$$x = -b_{N-1}2^{N-1} + \sum_{i=0}^{N-2} b_i 2^i$$

- to represent a negative number, we take the positive value of the number, invert its bits, and add one
- why does this procedure work?
 - we start from the fact that we use modular arithmetic
 - we fix the setting and work on 8 bits
 - therefore, subtracting 3 is equivalent to adding $256 - 3$
 - $-3 \equiv 256 - 3 =$

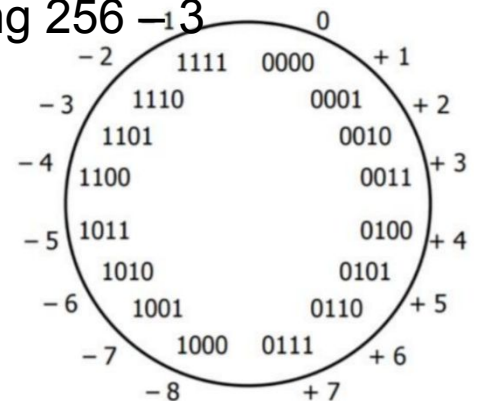


TWO'S COMPLEMENT, EX. 7

bit b_i :	1	1	1	1	0	0	0	1
2^i :	-2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0

$$x = -b_{N-1}2^{N-1} + \sum_{i=0}^{N-2} b_i 2^i$$

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- why does this procedure work?
 - we start from the fact that we use modular arithmetic
 - we fix the setting and work on 8 bits
 - therefore, subtracting 3 is equivalent to adding $256 - 3$
 - $-3 \equiv 256 - 3 = 1\ 0000\ 0000 - 0000\ 0011$

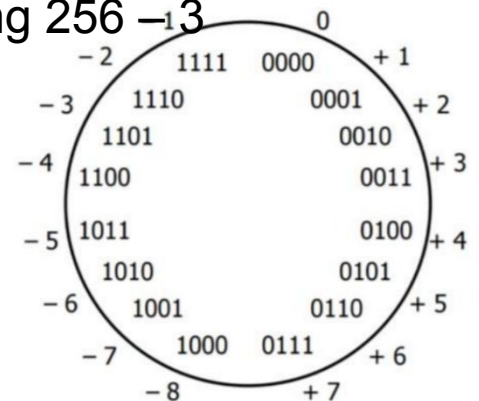


TWO'S COMPLEMENT, EX. 7

bit b_i :	1	1	1	1	0	0	0	1
2^i :	-2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0

$$x = -b_{N-1}2^{N-1} + \sum_{i=0}^{N-2} b_i 2^i$$

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 $= 1 + 1111\ 1111 - 0000\ 0011$

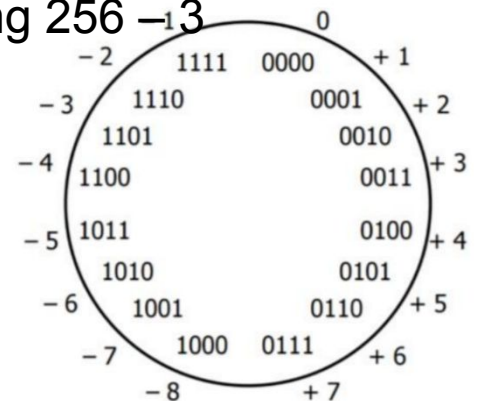


TWO'S COMPLEMENT, EX. 7

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2^i :	-2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0

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 - therefore, subtracting 3 is equivalent to adding $256 - 3$
 - $-3 \equiv 256 - 3 = 1\ 0000\ 0000 - 0000\ 0011$
 $= 1 + 1111\ 1111 - 0000\ 0011$
 $= 1 + (3 \text{ with the bits inverted})$



TWO'S COMPLEMENT, EX. 7

bit b_i :	1	1	1	1	0	0	0	1
2^i :	-2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0

$$x = -b_{N-1}2^{N-1} + \sum_{i=0}^{N-2} b_i 2^i$$

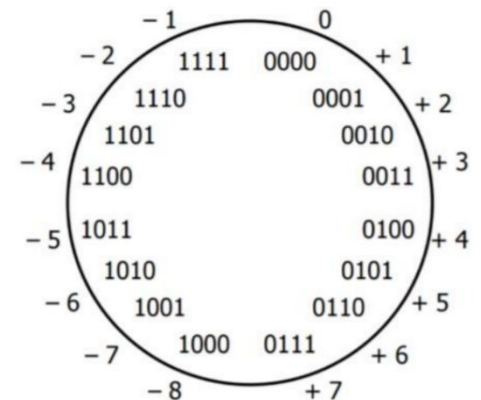
- to represent a negative number, we take the positive value of the number, invert its bits, and add one
- why does this procedure work?

$$-\left(-2^N + \sum_{i=0}^{N-1} b_i 2^i\right) =$$

=

=

=



TWO'S COMPLEMENT, EX. 7

bit b_i :	1	1	1	1	0	0	0	1
2^i :	-2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0

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- why does this procedure work?

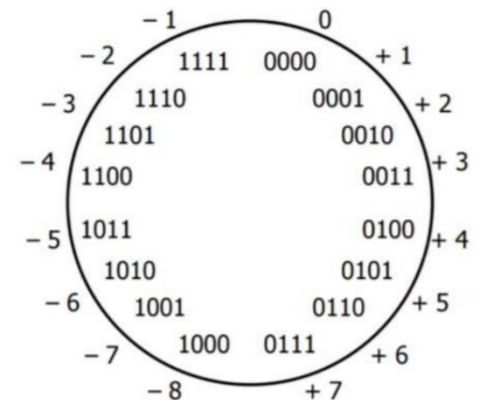
$$- \left(-2^N + \sum_{i=0}^{N-1} b_i 2^i \right) =$$

$$2^{N+1} = \sum_{i=0}^N 2^i + 1$$

=

=

=



TWO'S COMPLEMENT, EX. 7

bit b_i :	1	1	1	1	0	0	0	1
2^i :	-2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0

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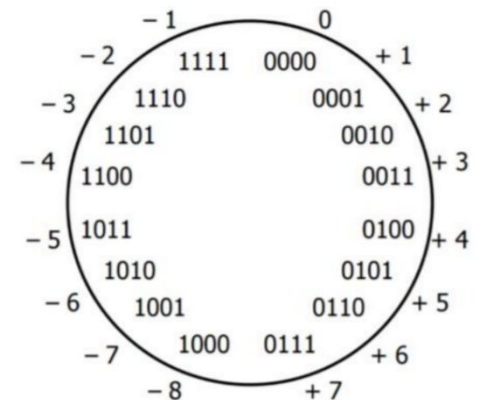
$$-\left(-2^N + \sum_{i=0}^{N-1} b_i 2^i\right) = 2^N - \sum_{i=0}^{N-1} b_i 2^i$$

$$2^{N+1} = \sum_{i=0}^N 2^i + 1$$

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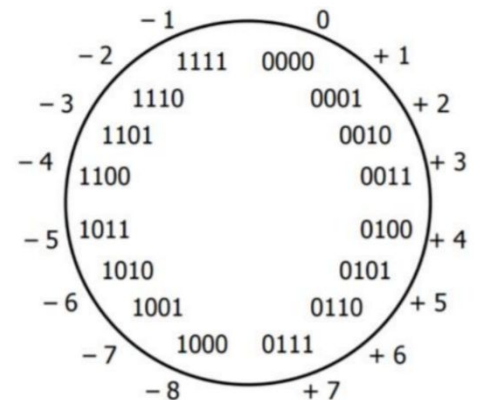
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$$\begin{aligned}
 - \left(-2^N + \sum_{i=0}^{N-1} b_i 2^i \right) &= 2^N - \sum_{i=0}^{N-1} b_i 2^i \\
 2^{N+1} &= \sum_{i=0}^N 2^i + 1 - \sum_{i=0}^{N-1} b_i 2^i \\
 &= \\
 &=
 \end{aligned}$$



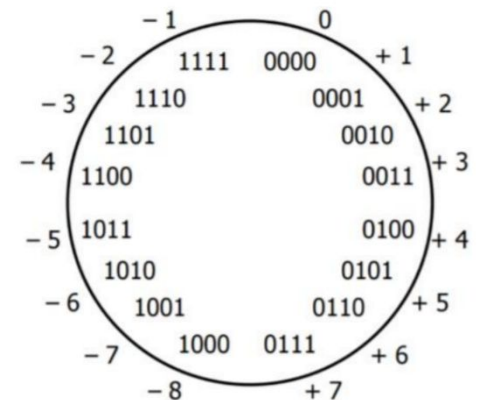
TWO'S COMPLEMENT, EX. 7

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$$\begin{aligned}
 - \left(-2^N + \sum_{i=0}^{N-1} b_i 2^i \right) &= 2^N - \sum_{i=0}^{N-1} b_i 2^i \\
 2^{N+1} &= \sum_{i=0}^N 2^i + 1 \\
 &= \sum_{i=0}^{N-1} 2^i + 1 - \sum_{i=0}^{N-1} b_i 2^i \\
 &= \sum_{i=0}^{N-1} (1 - b_i) 2^i + 1 \\
 &=
 \end{aligned}$$



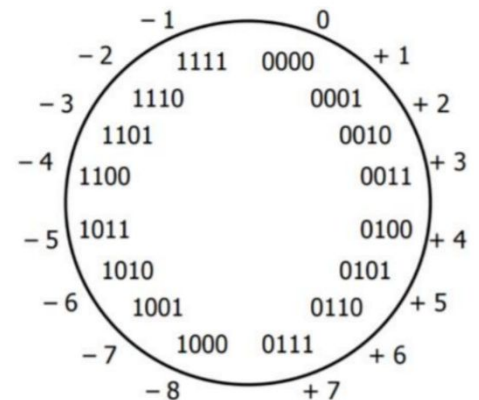
TWO'S COMPLEMENT, EX. 7

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$$\begin{aligned}
 - \left(-2^N + \sum_{i=0}^{N-1} b_i 2^i \right) &= 2^N - \sum_{i=0}^{N-1} b_i 2^i \\
 2^{N+1} &= \sum_{i=0}^N 2^i + 1 \\
 &= \sum_{i=0}^{N-1} 2^i + 1 - \sum_{i=0}^{N-1} b_i 2^i \\
 &= \sum_{i=0}^{N-1} (1 - b_i) 2^i + 1 \\
 &= (\text{inversed bits}) + 1
 \end{aligned}$$



INTEGER LOGARITHM, EX. 9

bit b_i :	0	1	1	1	0	0	0	1
2^i :	2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0

- show that $\lfloor \log_2 x \rfloor = i_{\max}$
- we start from the binary representation and apply the logarithm

$$x = \sum_{i=0}^{N-1} b_i 2^i$$

$$\log_2 x = \log_2 \left(\sum_{i=0}^{N-1} b_i 2^i \right)$$

=

=

=

INTEGER LOGARITHM, EX. 9

bit b_i :	0	1	1	1	0	0	0	1
2^i :	2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0

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$$x = \sum_{i=0}^{N-1} b_i 2^i$$

$$\log_2 x = \log_2 \left(\sum_{i=0}^{N-1} b_i 2^i \right)$$

$$= \log_2 \left(2^{i_{\max}} \left(\sum_{i=0}^{N-1} b_i \frac{2^i}{2^{i_{\max}}} \right) \right)$$

=

=

INTEGER LOGARITHM, EX. 9

bit b_i :	0	1	1	1	0	0	0	1
2^i :	2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0

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$$= \log_2 \left(2^{i_{\max}} \left(\sum_{i=0}^{N-1} b_i \frac{2^i}{2^{i_{\max}}} \right) \right)$$

$$= \log_2 2^{i_{\max}} + \log_2 \left(\left(\sum_{i=0}^{N-1} b_i \frac{2^i}{2^{i_{\max}}} \right) \right)$$

=

INTEGER LOGARITHM, EX. 9

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$$= \log_2 \left(2^{i_{\max}} \left(\sum_{i=0}^{N-1} b_i \frac{2^i}{2^{i_{\max}}} \right) \right)$$

$$= \log_2 2^{i_{\max}} + \log_2 \left(\left(\sum_{i=0}^{N-1} b_i \frac{2^i}{2^{i_{\max}}} \right) \right)$$

$$= i_{\max} + C, \quad C < 1$$

