CO450 Computer Architectures Week 5 Exercise Handout

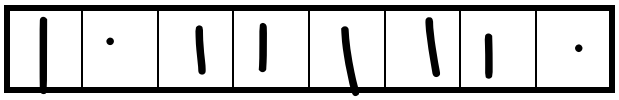
Signed Magnitude Notation

1. Represent the following decimal number in binary using Signed Magnitude Notation:

-62_{10}

128	64	32	16	8	4	2	1
2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0
1	**0**	**1**	**1**	**1**	**1**	**1**	**0**

The correct answer is:

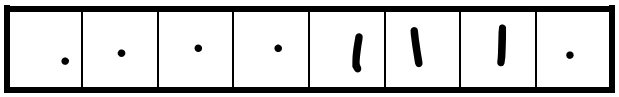


2. Represent the following decimal number in binary using Signed Magnitude Notation:

14_{10}

128	64	32	16	8	4	2	1
2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0
0	**0**	**0**	**0**	**1**	**1**	**1**	**0**

The correct answer is:

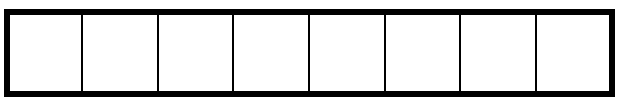


3. Represent the following decimal number in binary using Signed Magnitude Notation:

-103_{10}

128	64	32	16	8	4	2	1
2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0
1	**1**	**1**	**0**	**0**	**1**	**1**	**1**

The correct answer is:



Binary Excess Notation to Decimal

1. What is the decimal number that is represented by 10100010_2 in Excess Notation?

	128	64	32	16	8	4	2	1
	2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0
	1	**0**	**1**	**0**	**0**	**0**	**1**	**0**
Unsigned binary to decimal conversion using positional notation	**128 + 32 + 2 = 162_{10}**							
Unsigned decimal value minus Excess ($2^{(n-1)}$) Note: *n* = number of bits	**162 – 2^7 = 34_{10}**							

The correct answer is:

34_{10}

2. What is the decimal number that is represented by 01101100_2 in Excess Notation?

	128	64	32	16	8	4	2	1
	2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0
	0	**1**	**1**	**0**	**1**	**1**	**0**	**0**
Unsigned binary to decimal conversion using positional notation	**108**							
Unsigned decimal value minus Excess ($2^{(n-1)}$) Note: *n* = number of bits	**108-128=-20**							

The correct answer is:

-20

3. What is the decimal number that is represented by 11100111_2 in Excess Notation?

	128	64	32	16	8	4	2	1
	2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0
	1	1	1	·	·	1	1	1
Unsigned binary to decimal conversion using positional notation	231							
Unsigned decimal value minus Excess ($2^{(n-1)}$) Note: *n* = number of bits	$231-2^7$							

The correct answer is:

103

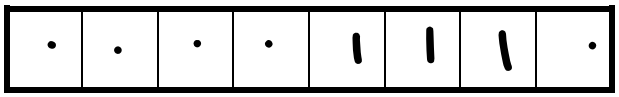
Decimal to Binary Excess Notation

1. What is the binary Excess Notation representation of the following decimal number:

-50_{10}

Decimal plus Excess ($2^{(n-1)}$) Note: *n* = number of bits	**-50+128=78**							
	128	64	32	16	8	4	2	1
	2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0
Convert Decimal with Excess to binary using positional notation	**0**	**0**	**0**	**0**	**1**	**1**	**1**	**0**

The correct answer is:

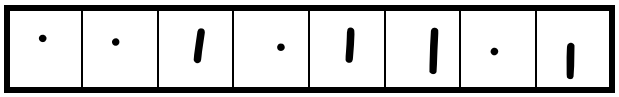


2. What is the binary Excess Notation representation of the following decimal number:

-83_{10}

Decimal plus Excess ($2^{(n-1)}$) Note: *n* = number of bits	**-83+128=45**							
	128	64	32	16	8	4	2	1
	2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0
Convert Decimal with Excess to binary using positional notation	**0**	**0**	**1**	**0**	**1**	**1**	**0**	**1**

The correct answer is:



Two's Complement

1. Convert 26_{10} to binary then use Two's Complement to convert the unsigned binary representation of 26_{10} in to the Two's Complemented binary representation for -26_{10}, what is the correct answer:

	128	64	32	16	8	4	2	1
	2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0
Positional notation used to convert decimal to binary	**0**	**0**	**0**	**1**	**1**	**0**	**1**	**0**
Flipped bits	**1**	**1**	**1**	**0**	**0**	**1**	**0**	**1**
One to add to the flipped bits above								**1**
Result of addition of flipped bits and one	**1**	**1**	**1**	**0**	**0**	**1**	**1**	**0**
Carry Bits							**1**	

The correct answer is:

2. Convert 118_{10} to binary then use Two's Complement to convert the unsigned binary representation of 118_{10} in to the Two's Complemented binary representation for -118_{10}, what is the correct answer:

	128	64	32	16	8	4	2	1
	2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0
Positional notation used to convert decimal to binary	**0**	**1**	**1**	**1**	**0**	**1**	**1**	**0**
Flipped bits	**1**	**0**	**0**	**0**	**1**	**0**	**0**	**1**
One to add to the flipped bits above								**1**
Result of addition of flipped bits and one	**1**	**0**	**0**	**0**	**1**	**0**	**1**	**0**
Carry Bits							**1**	

The correct answer is:

Two's Complement Binary Additions

1. Add the following numbers together using two's complement binary representation and then answer the questions below:

80_{10} + -33_{10} =

			128	64	32	16	8	4	2	1
			2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0
			0	**1**	**0**	**1**	**0**	**0**	**0**	**0**
+			**1**	**1**	**0**	**1**	**1**	**1**	**1**	**1**
			0	**0**	**1**	**0**	**1**	**1**	**1**	**1**
		1	1		1					

Did the calculation produce an overflow? NO

Did the calculation produce a carryout? YES

Would the calculation produce a correct result in an 8 bit system? YES

How many bits were carried to the left during the calculation? 3

2. Add the following numbers together using two's complement binary representation and then answer the questions below:

-104_{10} + -32_{10} =

			128	64	32	16	8	4	2	1
			2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0
			1	**0**	**0**	**1**	**1**	**0**	**0**	**0**
+			**1**	**1**	**1**	**0**	**0**	**0**	**0**	**0**
			0	**1**	**1**	**1**	**1**	**0**	**0**	**0**
		1								

Did the calculation produce an overflow? YES / NO

Did the calculation produce a carryout? YES / NO

Would the calculation produce a correct result in an 8 bit system? YES / NO

How many bits were carried to the left during the calculation? 1

3. Add the following numbers together using two's complement binary representation and then answer the questions below:

$73_{10} + 12_{10} =$

			128	64	32	16	8	4	2	1
			2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0
			0	1	0	0	1	0	0	1
+			0	0	0	0	1	1	0	0
			0	1	0	1	0	1	0	1
						1				

Did the calculation produce an overflow? YES / NO

Did the calculation produce a carryout? YES / NO

Would the calculation produce a correct result in an 8 bit system? YES / NO

How many bits were carried to the left during the calculation? 1

4. Add the following numbers together using two's complement binary representation and then answer the questions below:

$-11_{10} + -28_{10} =$

			128	64	32	16	8	4	2	1
			2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0
			1	1	1	1	0	1	0	1
+			1	1	1	0	0	1	0	0
			1	1	0	1	1	0	0	1
		1	1	1			1			

Did the calculation produce an overflow? YES / NO

Did the calculation produce a carryout? YES / NO

Would the calculation produce a correct result in an 8 bit system? YES / NO

How many bits were carried to the left during the calculation? 4

Decimal to Excess 50 Notation

1. Represent 15_{10} in excess 50 notation:

We have done this first one for you.

15_{10}	+	50_{10}	=	65_{10}

The correct answer is:

65_{10}

2. Represent -38_{10} in excess 50 notation:

-38	+	50_{10}	=	12

The correct answer is:

12

3. Represent 47_{10} in excess 50 notation:

47	+	50_{10}	=	97

The correct answer is:

97

4. Represent -50_{10} in excess 50 notation:

-50	+	50_{10}	=	0

The correct answer is:

0

Conversion of Decimal Numbers to SEEZMMMM Format

1. Convert -12,658$_{10}$ into the SEEZMMMM format:

We have done this first one for you.

S = signed magnitude notation	=	1
EE = Exponent Excess 50 notation	=	5 + 50 = 55
ZMMMM = Mantissa	=	12658
Normalise Mantissa	=	12658

The correct answer is:

15512658

2. Convert +0.05432$_{10}$ into the SEEZMMMM format:

S = signed magnitude notation	=	0
EE = Exponent Excess 50 notation	=	49
ZMMMM = Mantissa	=	5432
Normalise Mantissa	=	54320

The correct answer is:

04954320

3. Convert -105.678$_{10}$ into the SEEZMMMM format:

S = signed magnitude notation	=	1
EE = Exponent Excess 50 notation	=	53
ZMMMM = Mantissa	=	.10567
Normalise Mantissa	=	10568

The correct answer is:

1 53 10568

4. Convert -1,542.768$_{10}$ into the SEEZMMMM format:

S = signed magnitude notation	=	1
EE = Exponent Excess 50 notation	=	54
ZMMMM = Mantissa	=	1542768
Normalise Mantissa	=	15428

The correct answer is:

1 54 15428

Conversion of SEEZMMMM Format to Decimal Number

1. Convert 14667840 in the SEEZMMMM Format to a decimal number:

We have done this first one for you.

S = signed magnitude notation	=	1	=	-
EE = Exponent Excess 50 notation	=	46	=	10^{-4}
ZMMMM = Mantissa	=	67840	=	.6784 x 10^{-4} = 0.000067840

The correct answer is:

- 0.000067840

2. Convert 05617683 in the SEEZMMMM Format to a decimal number:

S = signed magnitude notation	=	0	=	+
EE = Exponent Excess 50 notation	=	56	=	6 x10⁶
ZMMMM = Mantissa	=	.17683	=	176830

The correct answer is:

176830.

3. Convert 14275355 in the SEEZMMMM Format to a decimal number:

S = signed magnitude notation	=		=	
EE = Exponent Excess 50 notation	=		=	
ZMMMM = Mantissa	=		=	

The correct answer is:

-0.00000000

4. Convert 16144387 in the SEEZMMMM Format to a decimal number:

S = signed magnitude notation	=		=	
EE = Exponent Excess 50 notation	=		=	
ZMMMM = Mantissa	=		=	

The correct answer is:

— 4438700000

Conversion of Decimal Exponent to Excess 127 Binary

1. Represent an Exponent of -8_{10} in the Excess 127 format:

We have done this one for you.

Excess	127	=	0	1	1	1	1	1	1	1
Two's Complement Exponent	-8	=	1	1	1	1	1	0	0	0
Result of addition of excess and exponent			0	1	1	1	0	1	1	1
Carry's		*1*	*1*	*1*	*1*	*1*				

The correct answer is:

01110111_2	=	119_{10}

2. Represent an Exponent of -4_{10} in the Excess 127 format:

Excess	127	=	0	1	1	1	1	1	1	1
Two's Complement Exponent		=	1	1	1	1	1	1	0	0
Result of addition of excess and exponent			0	1	1	1	1	0	1	1
Carry's		*1*	*1*	*1*	*1*	*1*	*1*	*1*		

The correct answer is:

·1111.11	=	123

3. Represent an Exponent of 12_{10} in the Excess 127 format:

Excess	127	=	·	1	1	1	1	1	1	1
Two's Complement Exponent		=	·	·	·	·	1	1	·	·
Result of addition of excess and exponent			1	·	·	·	1	·	1	1
Carry's			1	1	1	1	1			

The correct answer is:

1···1·11	=	139

Conversion of IEEE 754 Single Precision Binary Float to Decimal

1. Convert the following IEEE 754 single precision binary float to decimal:

$01000011111000000000000000000000_2$

We have done this one for you.

Sign	0	=	+							
Excess		=	1	0	0	0	0	1	1	1
Convert excess binary unsigned to decimal and subtract excess 127 to get exponent		=	$135_{10} - 127_{10} = 8_{10}$							

Mantissa	$1.11000000000000000000000000000000_2$
Shift decimal point with exponent	$111000000.00000000000000000000000_2$
Convert shifted binary mantissa to decimal	$256_{10} + 128_{10} + 64_{10} = 448_{10}$
Add sign to converted decimal	$+448_{10}$

The correct answer is:

$+448_{10}$

2. Convert the following IEEE 754 single precision binary float to decimal:

$11000001111010000000000000000000_2$

Sign		=	—							
Excess		=	1	·	·	·	·	·	1	1
Convert excess binary unsigned to decimal and subtract excess 127 to get exponent		=	131 − 127 = 4							

Mantissa	1.1101
Shift decimal point with exponent	11101
Convert shifted binary mantissa to decimal	29
Add sign to converted decimal	−29

The correct answer is:

−29

3. Convert the following IEEE 754 single precision binary float to decimal:

$01000010110110000000000000000000_2$

Sign		=	+
Excess		=	1 . . . . 1 . 1
Convert excess binary unsigned to decimal and subtract excess 127 to get exponent		=	133 - 127 = 6

Mantissa	1.1011
Shift decimal point with exponent	1101100
Convert shifted binary mantissa to decimal	108
Add sign to converted decimal	

The correct answer is:

108

4. Convert the following IEEE 754 single precision binary float to decimal:

$01000010010011000000000000000000_2$

Sign		=	+
Excess		=	1 . . . . 1 . .
Convert excess binary unsigned to decimal and subtract excess 127 to get exponent		=	132 - 127 = 5

Mantissa	1.10011
Shift decimal point with exponent	110011
Convert shifted binary mantissa to decimal	51
Add sign to converted decimal	

The correct answer is:

51

The Answers

Signed Magnitude Notation

1. 10111110

2. 00001110

3. 11100111

Binary Excess Notation to Decimal

1. 34

2. -20

3. 103

Decimal to Binary Excess Notation

1. 01001110

2. 00101101

Two's Complement

1. 11100110

2. 10001010

Two's Complement Binary Additions

1. No, Yes, Yes, 3

2. Yes, Yes, No, 1

3. No, No, Yes, 1

4. No, Yes, Yes, 4

Decimal to Excess 50 Notation

1. 65

2. 12

3. 97

4. 0

Conversion of Decimal Numbers to SEEZMMMM Format

1. 15512658

2. 04954320

3. 15310568

4. 15415428

Conversion of SEEZMMMM Format to Decimal Number

1. - 0.000067840

2. +176,830

3. -0.0000000075355

4. -44,387,000,000

Conversion of Decimal Exponent to Excess 127 Binary

1. $01110111_2 = 119_{10}$

2. $01111011_2 = 123_{10}$

3. $10001011_2 = 139_{10}$

Conversion of IEEE 754 Single Precision Binary Float to Decimal

1. $+448_{10}$

2. -29_{10}

3. $+108_{10}$

4. $+51_{10}$