Tutorial

Programming & Data Structure: CS 11001

Section - 4/D

Department of Computer Science and Engineering

I.I.T. Kharagpur

Spring Semester: 2013 - 2014 (13.02.2014)

Download

Download the file tut130214.pdf from Programming & Data Structures ... of

http://cse.iitkgp.ac.in/~goutam

View the file using the command acroread & or xpdf &

Radix-Complement

A 3-digit radix-complement decimal (rcd or 10's complement) numeral is defined as follows:

- A numeral is a sequence of three decimal digits.
- A +ve numeral has 0, 1, 2, 3, or 4 as the most significant digit. The denotation is usual.

Radix-Complement

- A $-$ve numeral has 5, 6, 7, 8, or 9 as the most significant digit.
- If a number n is represented as a 3-digit rcd numeral, $-n$ is represented as $1000 - n$ in rcd.

Tutorial VI.1

Answer the following questions:

1. What is the value of rcd 729 in standard decimal?
2. What is the range of decimal numbers represented as 3-digit rcd?
3. What is the range of decimal numbers represented as n-digit rcd?
4. What is the range of decimal numbers represented as 3-digit radix-6, 6-complement numeral. Answer the same question for n-digits.
5. Answer the previous question for radix-2, 2's

complement numerals.

6. What will be the results of addition in 3-digit rcd in the following cases (all numbers are in rcd): (i) 123 + 234, (ii) 123 + 877, (iii) 403 + 311, (iv) 900 + 800, (v) 540 + 630

7. What will be the representation of 301 and 825 (3-digit rcds) as 6-digit rcds?

Tutorial VI.2

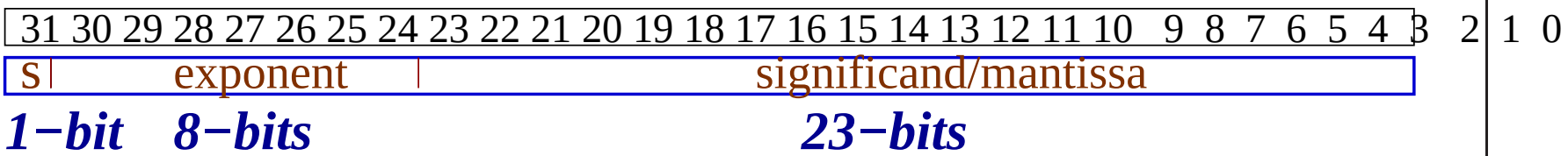
1. Convert the decimal numeral 1234 to a binary numeral.
2. Convert the unsigned binary numeral 0110 1001 to a decimal numeral.
3. Convert the unsigned binary numeral 1011 1010 0001 1110 to hexadecimal (Hex) and octal (Oct) numerals.
4. What is the range of unsigned integers that can be stored in 12-bits?

Tutorial VI.3

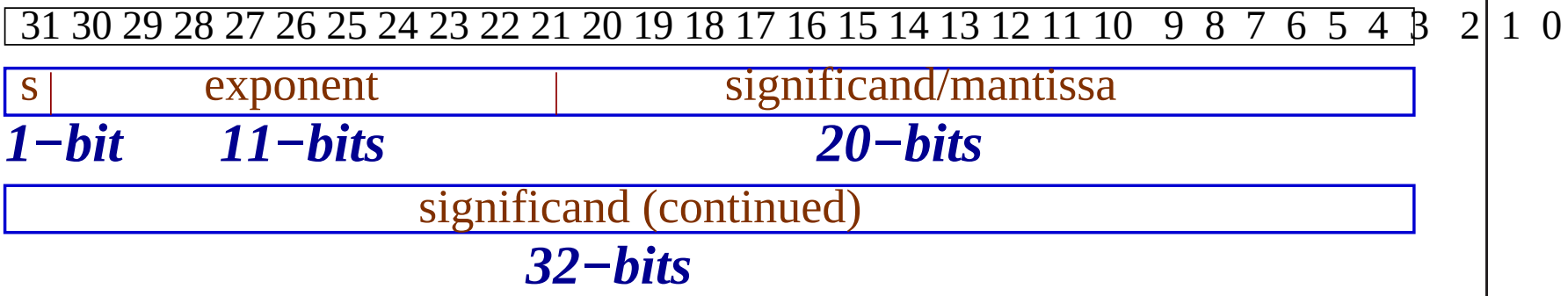
1. Convert the decimal numeral -234 to a binary numeral.
2. Convert the 2's complement binary numeral $1110\ 100$ to a decimal numeral.
3. Perform 2's complement addition in 4-bits, (i) $0011 + 0010$, (ii) $1101 + 1110$, (iii) $0011 + 1011$, (iv) $0100 + 0101$, (v) $1101 + 1010$.

Floating-point Number

What is IEEE 754 floating-point representation?



Single Precision



Double Precision

Single Precision Data

Fields		Data Type
Exponent	*Significand*	
0	0	0
0	nonzero	$\pm$ denormal number
1 - 254	anything	$\pm$ normalized number
255	0	$\pm\infty$
255	nonzero	NaN (not a number)

Double Precision Data

Fields		**Data Type**
Exponent	*Significand*	
0	0	0
0	nonzero	$\pm$ denormal number
1 - 2046	anything	$\pm$ normalized number
2047	0	$\pm\infty$
2047	nonzero	NaN (not a number)

Single Precision Normalized Number

Let the sign bit (31) be s, the exponent (30-23) be e and the mantissa (significand) (22-0) be m. The valid range of the exponent is 1 to 254 (if e is treated as an unsigned number).

- The exponent (e) is biased by 127 i.e. the actual value of the exponent is $e - 127$. This gives a range: $2^{1-127} = 2^{-126}$ to $2^{254-127} = 2^{127}$.

Single Precision Normalized Number

- The normalized significand is $1.m$ (binary dot). One is not present explicitly.
- The sign-bit s is 1 for a negative number and it is 0 for a positive number.
- The final value of a normalized number is

$$(-1)^s \times 1.m \times 2^{e-127}$$

Single Precision Denormal Number

The interpretation of a denormal number is different. The content of the exponent part (e) is zero and the significand part (m) is non-zero. The value of a denormal number is

$$(-1)^s \times 0.m \times 2^{-126}$$

There is no implicit one in the significand.

Tutorial VI.4

1. What is the representation of -27.75 in IEEE-754 single precision format?
2. What is the representation of $+27.7$?
3. What is the largest magnitude of a single precision normalized number?
4. What is the smallest magnitude of a single precision normalized number?
5. Answer the last two questions for denormal numbers.
6. What is the value stored as a result of $1.0/0.0$?

Tutorial VI.5

How do you print the bit pattern of a floating point number?

Tutorial VI.6

How do you print the exponent of a floating point number?

Tutorial VI.7

How do you print the significand of a floating point number?