ENG10128 - Matemática Discreta 15/03/2011

Aula 4: Estimativa e medição de erros

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11 Inteiro em complemento de dois $\times$ real em ponto flutuante

Vamos comparar o que é necessário para realizar a mesma operação matemática utilizando inteiro em complemento de 2 e real em ponto flutuante.

Operação	Complemento de dois	Ponto flutuante - precisão reduzida
32	$\overbrace{0000}^{0}\overbrace{0000}^{0}\overbrace{0010}^{2}\overbrace{0000}^{0} = 0x0020$	$\underbrace{0}_{S}\underbrace{101\ 00}_{E}\underbrace{00\ 0000\ 0000}_{T} = 1,0000000000 \times 2^{101} = 0x5000$
$+$		
8	$\underline{\overbrace{0000}^{0}\overbrace{0000}^{0}\overbrace{0000}^{0}\overbrace{1000}^{8}} = 0x0008$	$\underbrace{0}_{S}\underbrace{\underline{100\ 10}}_{E}\underbrace{\underline{00\ 0000\ 0000}}_{T} = 1,0000000000 \times 2^{11} = 0x4800$
$=$		$= 1,0000000000 \times 2^{101} + 1,0000000000 \times 2^{11}$ $= 1,0000000000 \times 2^{101} + 0,0100000000 \times 2^{101}$
40	$\overbrace{0000}^{0}\overbrace{0000}^{0}\overbrace{0010}^{2}\overbrace{1000}^{8} = 0x0028$	$\underbrace{0}_{S}\underbrace{101\ 00}_{E}\underbrace{01\ 0000\ 0000}_{T} = 1,0100000000 \times 2^{101} = 0x5100$
2000	$\overbrace{0000}^{0}\overbrace{0111}^{7}\overbrace{1101}^{d}\overbrace{0000}^{0} = 0x07d0$	$\underbrace{0}_{S}\underbrace{110\ 01}_{E}\underbrace{11\ 1101\ 0000}_{T} = 1,1111010000 \times 2^{1010} = 0x67d0$
$+$		
1	$\underline{\overbrace{0000}^{0}\overbrace{0000}^{0}\overbrace{0000}^{0}\overbrace{0001}^{1}} = 0x0001$	$\underbrace{0}_{S}\underbrace{\underline{011\ 11}}_{E}\underbrace{\underline{00\ 0000\ 0000}}_{T} = 1,0000000000 \times 2^{0} = 0x3c00$
$=$		$= 1,1111010000 \times 2^{1010} + 1,0000000000 \times 2^{0}$ $= 1,1111010000 \times 2^{1010} + 0,00000000001 \times 2^{1010}$
2001	$\overbrace{0000}^{0}\overbrace{0111}^{7}\overbrace{1101}^{d}\overbrace{0001}^{1} = 0x07d1$	$\underbrace{0}_{S}\underbrace{110\ 01}_{E}\underbrace{11\ 1101\ 0000}_{T} = 0x67d0 = 2000$
110	$\overbrace{0000}^{0}\overbrace{0000}^{0}\overbrace{0110}^{6}\overbrace{1110}^{e} = 0x006e$	$\underbrace{0}_{S}\underbrace{101\ 01}_{E}\underbrace{10\ 1110\ 0000}_{T} = 1,1011100000 \times 2^{110} = 0x5ee0$
$+$		
-12	$\underline{\overbrace{1111}^{f}\overbrace{1111}^{f}\overbrace{1111}^{f}\overbrace{0100}^{4}} = 0xf4ff$	$\underbrace{1}_{S}\underbrace{\underline{100\ 10}}_{E}\underbrace{\underline{10\ 0000\ 0000}}_{T} = -1,1000000000 \times 2^{11} = 0xca00$
$=$		$= 1,1011100000 \times 2^{110} + -1,1000000000 \times 2^{11}$ $= 1,1011100000 \times 2^{110} + -0,0011000000 \times 2^{11}$ $= 01,1011100000 \times 2^{110} + 11,1101000000 \times 2^{110}$
98	$\overbrace{0000}^{0}\overbrace{0000}^{0}\overbrace{0110}^{6}\overbrace{0010}^{2} = 0x0062$	$\underbrace{0}_{S}\underbrace{101\ 01}_{E}\underbrace{10\ 0010\ 0000}_{T} = 1,1000100000 \times 2^{110} = 0x5620$

Operação	Complemento de dois	Ponto flutuante - precisão reduzida
91	$\overbrace{0000}^{0}\overbrace{0000}^{0}\overbrace{0101}^{5}\overbrace{1011}^{b} = 0x005b$	$\underbrace{0}_{S}\underbrace{101\ 01}_{E}\underbrace{01\ 1011\ 0000}_{T} = 1,0110110000 \times 2^{110} = 0x55b0$
*		
279	$\underline{\overbrace{0000}^{0}\overbrace{0001}^{1}\overbrace{0001}^{1}\overbrace{0111}^{7}} = 0x0117$	$\underbrace{0}_{S}\underbrace{110\ 00}_{E}\underbrace{00\ 0101\ 1100}_{T} = 1,0001011100 \times 2^{1000} = 0x605c$
=	0000 0000 0101 1011	$= 1,0110110000 \times 2^{110} \times 1,0001011100 \times 2^{1000}$
=	0000 0000 1011 011	$= (1,0110110000 \times 1,0001011100) \times (2^{1000} \times 2^{110})$
=	0000 0001 0110 11	$= (1,0110110000 \times 1,0001011100) \times 2^{1000+110}$
=	0000 0000 0000 0	$= (1,0110110000 \times 1,0001011100) \times 2^{1110}$
=	0000 0101 1011	
=	0000 0000 000	0000001,00010111
=	0000 0000 00	$\underline{000000001,011011}$
=	0000 0000 0	0000 0010 0010 111
=	0101 1011	0000 0100 0101 11
=	0000 000	0000 0000 0000 0
=	0000 00	0001 0001 0111
=	0000 0	0010 0010 111
=	0000	0000 0000 00
=	000	1000 1011 1
=	00	
=	0	$= 1,10001100101101 \times 2^{1110}$
25389	$\overbrace{0110}^{6}\overbrace{0011}^{3}\overbrace{0010}^{2}\overbrace{1101}^{d} = 0x632d$	$\underbrace{0}_{S}\underbrace{111\ 01}_{E}\underbrace{10\ 0011\ 0010}_{T} = 0x7632 = 25376$