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::::::::::::::
lut_real.dat
::::::::::::::
                    7.8539816339744830962E-01
                    4.6364760900080611621E-01
                    2.4497866312686415417E-01
                    1.2435499454676143503E-01
                    6.2418809995957348474E-02
                    3.1239833430268276254E-02
                    1.5623728620476830803E-02
                    7.8123410601011112965E-03
                    3.9062301319669718276E-03
                    1.9531225164788186851E-03
                    9.7656218955931943040E-04
                    4.8828121119489827547E-04
                    2.4414062014936176402E-04
                    1.2207031189367020424E-04
                    6.1035156174208775022E-05
                    3.0517578115526096862E-05
                    1.5258789061315762107E-05
                    7.6293945311019702634E-06
                    3.8146972656064962829E-06
                    1.9073486328101870354E-06
                    9.5367431640596087942E-07
                    4.7683715820308885993E-07
                    2.3841857910155798249E-07
                    1.1920928955078068531E-07
                    5.9604644775390554414E-08
                    2.9802322387695303677E-08
                    1.4901161193847655147E-08
                    7.4505805969238279871E-09
                    3.7252902984619140453E-09
                    1.8626451492309570291E-09
                    9.3132257461547851536E-10
                    4.6566128730773925778E-10
                    2.3283064365386962890E-10
                    1.1641532182693481445E-10
                    5.8207660913467407226E-11
                    2.9103830456733703613E-11
                    1.4551915228366851807E-11
                    7.2759576141834259033E-12
                    3.6379788070917129517E-12
                    1.8189894035458564758E-12
                    9.0949470177292823792E-13
                    4.5474735088646411896E-13
                    2.2737367544323205948E-13
                    1.1368683772161602974E-13
                    5.6843418860808014870E-14
                    2.8421709430404007435E-14
                    1.4210854715202003717E-14
```

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                        7.1054273576010018587E-15
                        3.5527136788005009294E-15
                        1.7763568394002504647E-15
                        8.8817841970012523234E-16
                        4.4408920985006261617E-16
                        2.2204460492503130808E-16
                        1.1102230246251565404E-16
                        5.5511151231257827021E-17
                        2.7755575615628913511E-17
                        1.3877787807814456755E-17
                        6.9388939039072283776E-18
                        3.4694469519536141888E-18
                        1.7347234759768070944E-18
                        1.7347234759768070944E-18
                        1.7347234759768070944E-18
                        1.7347234759768070944E-18
                        1.7347234759768070944E-18
::::::::::::::
lut_comp.bat.out
::::::::::::::
nbits : 29  |A_delta| (max= 1.86e-09) |cos_delta| (max= 5.76e-10) |sin_delta| (max= 1.86e-09)
nbits : 30  |A_delta| (max= 9.31e-10) |cos_delta| (max= 3.51e-10) |sin_delta| (max= 9.31e-10)
nbits : 31  |A_delta| (max= 4.66e-10) |cos_delta| (max= 1.59e-10) |sin_delta| (max= 4.66e-10)
nbits : 32  |A_delta| (max= 2.33e-10) |cos_delta| (max= 5.49e-11) |sin_delta| (max= 2.33e-10)
nbits : 33  |A_delta| (max= 1.16e-10) |cos_delta| (max= 2.15e-11) |sin_delta| (max= 1.16e-10)
nbits : 34  |A_delta| (max= 5.82e-11) |cos_delta| (max= 2.15e-11) |sin_delta| (max= 5.82e-11)
nbits : 35  |A_delta| (max= 2.91e-11) |cos_delta| (max= 5.52e-12) |sin_delta| (max= 2.91e-11)
nbits : 36  |A_delta| (max= 1.46e-11) |cos_delta| (max= 2.82e-12) |sin_delta| (max= 1.46e-11)
nbits : 37  |A_delta| (max= 7.28e-12) |cos_delta| (max= 2.82e-12) |sin_delta| (max= 7.28e-12)
nbits : 38  |A_delta| (max= 3.64e-12) |cos_delta| (max= 1.19e-12) |sin_delta| (max= 3.64e-12)
nbits : 39  |A_delta| (max= 1.82e-12) |cos_delta| (max= 9.06e-13) |sin_delta| (max= 1.82e-12)
nbits : 40  |A_delta| (max= 9.09e-13) |cos_delta| (max= 3.77e-13) |sin_delta| (max= 9.09e-13)
nbits : 41  |A_delta| (max= 4.55e-13) |cos_delta| (max= 2.63e-13) |sin_delta| (max= 4.55e-13)
nbits : 42  |A_delta| (max= 2.27e-13) |cos_delta| (max= 1.02e-13) |sin_delta| (max= 2.27e-13)
nbits : 43  |A_delta| (max= 1.14e-13) |cos_delta| (max= 2.20e-14) |sin_delta| (max= 1.14e-13)
nbits : 44  |A_delta| (max= 5.68e-14) |cos_delta| (max= 2.20e-14) |sin_delta| (max= 5.68e-14)
nbits : 45  |A_delta| (max= 2.84e-14) |cos_delta| (max= 8.33e-15) |sin_delta| (max= 2.84e-14)
nbits : 46  |A_delta| (max= 1.42e-14) |cos_delta| (max= 2.00e-15) |sin_delta| (max= 1.42e-14)
nbits : 47  |A_delta| (max= 7.11e-15) |cos_delta| (max= 2.00e-15) |sin_delta| (max= 7.11e-15)
nbits : 48  |A_delta| (max= 3.55e-15) |cos_delta| (max= 1.89e-15) |sin_delta| (max= 3.55e-15)
nbits : 49  |A_delta| (max= 1.78e-15) |cos_delta| (max= 5.55e-16) |sin_delta| (max= 1.78e-15)
nbits : 50  |A_delta| (max= 8.88e-16) |cos_delta| (max= 4.44e-16) |sin_delta| (max= 8.88e-16)
nbits : 51  |A_delta| (max= 4.44e-16) |cos_delta| (max= 2.22e-16) |sin_delta| (max= 4.44e-16)
nbits : 52  |A_delta| (max= 2.22e-16) |cos_delta| (max= 1.11e-16) |sin_delta| (max= 2.22e-16)
nbits : 53  |A_delta| (max= 1.11e-16) |cos_delta| (max= 1.11e-16) |sin_delta| (max= 1.11e-16)
nbits : 54  |A_delta| (max= 5.55e-17) |cos_delta| (max= 0.00e+00) |sin_delta| (max= 5.55e-17)
nbits : 55  |A_delta| (max= 2.78e-17) |cos_delta| (max= 0.00e+00) |sin_delta| (max= 2.78e-17)
nbits : 56  |A_delta| (max= 1.39e-17) |cos_delta| (max= 0.00e+00) |sin_delta| (max= 1.39e-17)
nbits : 57  |A_delta| (max= 6.94e-18) |cos_delta| (max= 0.00e+00) |sin_delta| (max= 6.94e-18)
nbits : 58  |A_delta| (max= 3.47e-18) |cos_delta| (max= 0.00e+00) |sin_delta| (max= 3.47e-18)
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nbits : 59  |A_delta| (max= 1.73e-18) |cos_delta| (max= 0.00e+00) |sin_delta| (max= 1.73e-18)
nbits : 60  |A_delta| (max= 8.67e-19) |cos_delta| (max= 0.00e+00) |sin_delta| (max= 8.67e-19)
::::::::::::::
lut_comp.out
::::::::::::::
./lut_comp 29
number of bits for fractional part : 29
sizeof(long long int) = 8
[  0] 7.8539816339744830962E-01 7.8539816339744827900e-01        421657428 00000000001921fb54 4.960468e-10 6.315863e-10
[  1] 4.6364760900080611621E-01 4.6364760900080609352e-01        248918914 00000000000ed63382 1.286868e-09 2.775531e-09
[  2] 2.4497866312686415417E-01 2.4497866312686414347e-01        131521918 000000000007d6dd7e 5.466124e-10 2.231266e-09
[  3] 1.2435499454676143503E-01 1.2435499454676143816e-01         66762579 000000000003fab753 6.222629e-10 5.003924e-09
[  4] 6.2418809995957348474E-02 6.2418809995957350023e-02         33510843 000000000001ff55bb 8.353672e-10 1.338326e-08
[  5] 3.1239833430268276254E-02 3.1239833430268277442e-02         16771757 000000000000ffeaad 1.610138e-09 5.154118e-08
[  6] 1.5623728620476830803E-02 1.5623728620476831294e-02          8387925 0000000000007ffd55 8.071138e-10 5.165948e-08
[  7] 7.8123410601011112965E-03 7.8123410601011111440e-03          4194218 0000000000003fffaa 1.247584e-09 1.596940e-07
[  8] 3.9062301319669718276E-03 3.9062301319669717574e-03          2097141 0000000000001ffff5 6.210636e-10 1.589931e-07
[  9] 1.9531225164788186851E-03 1.9531225164788187584e-03          1048574 0000000000000fffe 1.241769e-09 6.357866e-07
[ 10] 9.7656218955931943040E-04 9.7656218955931945944e-04           524287 00000000000007fff 1.552204e-09 1.589458e-06
[ 11] 4.8828121119489827547E-04 4.8828121119489828993e-04           262143 00000000000003fff 1.823840e-09 3.735225e-06
[ 12] 2.4414062014936176402E-04 2.4414062014936177124e-04           131071 00000000000001fff 1.857795e-09 7.609526e-06
[ 13] 1.2207031189367020424E-04 1.2207031189367020785e-04            65535 00000000000000fff 1.862039e-09 1.525382e-05
[ 14] 6.1035156174208775022E-05 6.1035156174208772594e-05            32767 000000000000007ff 1.862569e-09 3.051634e-05
[ 15] 3.0517578115526096862E-05 3.0517578115526095727e-05            16383 000000000000003ff 1.862636e-09 6.103485e-05
[ 16] 1.5258789061315762107E-05 1.5258789061315761542e-05             8191 000000000000001ff 1.862644e-09 1.220702e-04
[ 17] 7.6293945311019702634E-06 7.6293945311019699810e-06             4095 000000000000000fff 1.862645e-09 2.441406e-04
[ 18] 3.8146972656064962829E-06 3.8146972656064961418e-06             2047 000000000000007ff 1.862645e-09 4.882812e-04
[ 19] 1.9073486328101870354E-06 1.9073486328101869648e-06             1023 000000000000003ff 1.862645e-09 9.765625e-04
[ 20] 9.5367431640596087942E-07 9.5367431640596084413e-07              511 000000000000001ff 1.862645e-09 1.953125e-03
[ 21] 4.7683715820308885993E-07 4.7683715820308884228e-07              255 000000000000000ff 1.862645e-09 3.906250e-03
[ 22] 2.3841857910155798249E-07 2.3841857910155797367e-07              127 000000000000007f 1.862645e-09 7.812500e-03
[ 23] 1.1920928955078068531E-07 1.1920928955078068090e-07               63 000000000000003f 1.862645e-09 1.562500e-02
[ 24] 5.9604644775390554414E-08 5.9604644775390552208e-08               31 000000000000001f 1.862645e-09 3.125000e-02
[ 25] 2.9802322387695303677E-08 2.9802322387695302574e-08               15 000000000000000f 1.862645e-09 6.250000e-02
[ 26] 1.4901161193847655147E-08 1.4901161193847654596e-08                7 0000000000000007 1.862645e-09 1.250000e-01
[ 27] 7.4505805969238279871E-09 7.4505805969238281250e-09                4 0000000000000004 0.000000e+00 0.000000e+00
[ 28] 3.7252902984619140453E-09 3.7252902984619140625e-09                2 0000000000000002 0.000000e+00 0.000000e+00
[ 29] 1.8626451492309570291E-09 1.8626451492309570312e-09                1 0000000000000001 0.000000e+00 0.000000e+00
[ 30] 9.3132257461547851536E-10 9.3132257461547851562e-10                0 0000000000000000 9.313226e-10 1.000000e+00
[ 31] 4.6566128730773925778E-10 4.6566128730773925781e-10                0 0000000000000000 4.656613e-10 1.000000e+00
[ 32] 2.3283064365386962890E-10 2.3283064365386962891e-10                0 0000000000000000 2.328306e-10 1.000000e+00
[ 33] 1.1641532182693481445E-10 1.1641532182693481445e-10                0 0000000000000000 1.164153e-10 1.000000e+00
[ 34] 5.8207660913467407226E-11 5.8207660913467407227e-11                0 0000000000000000 5.820766e-11 1.000000e+00
[ 35] 2.9103830456733703613E-11 2.9103830456733703613e-11                0 0000000000000000 2.910383e-11 1.000000e+00
[ 36] 1.4551915228366851807E-11 1.4551915228366851807e-11                0 0000000000000000 1.455192e-11 1.000000e+00
[ 37] 7.2759576141834259033E-12 7.2759576141834259033e-12                0 0000000000000000 7.275958e-12 1.000000e+00
[ 38] 3.6379788070917129517E-12 3.6379788070917129517e-12                0 0000000000000000 3.637979e-12 1.000000e+00
[ 39] 1.8189894035458564758E-12 1.8189894035458564758e-12                0 0000000000000000 1.818989e-12 1.000000e+00
[ 40] 9.0949470177292823792E-13 9.0949470177292823792e-13                0 0000000000000000 9.094947e-13 1.000000e+00
[ 41] 4.5474735088646411896E-13 4.5474735088646411896e-13                0 0000000000000000 4.547474e-13 1.000000e+00
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[ 42] 2.273736754432320594E-13 2.273736754432320594e-13                0 0000000000000000 2.273737e-13 1.000000e+00
[ 43] 1.136868377216160297E-13 1.136868377216160297e-13                0 0000000000000000 1.136868e-13 1.000000e+00
[ 44] 5.684341886080801487E-14 5.684341886080801487e-14                0 0000000000000000 5.684342e-14 1.000000e+00
[ 45] 2.842170943040400744E-14 2.842170943040400744e-14                0 0000000000000000 2.842171e-14 1.000000e+00
[ 46] 1.421085471520200372E-14 1.421085471520200372e-14                0 0000000000000000 1.421085e-14 1.000000e+00
[ 47] 7.105427357601001859E-15 7.105427357601001859e-15                0 0000000000000000 7.105427e-15 1.000000e+00
[ 48] 3.552713678800500929E-15 3.552713678800500929e-15                0 0000000000000000 3.552714e-15 1.000000e+00
[ 49] 1.776356839400250465E-15 1.776356839400250465e-15                0 0000000000000000 1.776357e-15 1.000000e+00
[ 50] 8.881784197001252323E-16 8.881784197001252323e-16                0 0000000000000000 8.881784e-16 1.000000e+00
[ 51] 4.440892098500626162E-16 4.440892098500626162e-16                0 0000000000000000 4.440892e-16 1.000000e+00
[ 52] 2.220446049250313081E-16 2.220446049250313081e-16                0 0000000000000000 2.220446e-16 1.000000e+00
[ 53] 1.110223024625156540E-16 1.110223024625156540e-16                0 0000000000000000 1.110223e-16 1.000000e+00
[ 54] 5.551115123125782702E-17 5.551115123125782702e-17                0 0000000000000000 5.551115e-17 1.000000e+00
[ 55] 2.775557561562891351E-17 2.775557561562891351e-17                0 0000000000000000 2.775558e-17 1.000000e+00
[ 56] 1.387778780781445675E-17 1.387778780781445675e-17                0 0000000000000000 1.387779e-17 1.000000e+00
[ 57] 6.938893903907228378E-18 6.938893903907228378e-18                0 0000000000000000 6.938894e-18 1.000000e+00
[ 58] 3.469446951953614189E-18 3.469446951953614189e-18                0 0000000000000000 3.469447e-18 1.000000e+00
[ 59] 1.734723475976807094E-18 1.734723475976807094e-18                0 0000000000000000 1.734723e-18 1.000000e+00
[ 60] 1.734723475976807094E-18 1.734723475976807094e-18                0 0000000000000000 1.734723e-18 1.000000e+00
[ 61] 1.734723475976807094E-18 1.734723475976807094e-18                0 0000000000000000 1.734723e-18 1.000000e+00
[ 62] 1.734723475976807094E-18 1.734723475976807094e-18                0 0000000000000000 1.734723e-18 1.000000e+00
[ 63] 1.734723475976807094E-18 1.734723475976807094e-18                0 0000000000000000 1.734723e-18 1.000000e+00


* A_delta
[ 0] A_real= 7.853981633974482790e-01 A_freal= 7.853981629014015198e-01 A_delta= 4.9604675922e-10
[ 1] A_real= 4.636476090008060935e-01 A_freal= 4.636476077139377594e-01 A_delta= 1.2868683341e-09
[ 2] A_real= 2.449786631268641435e-01 A_freal= 2.449786625802516937e-01 A_delta= 5.4661244975e-10
[ 3] A_real= 1.243549945467614382e-01 A_freal= 1.243549939244985580e-01 A_delta= 6.2226288011e-10
[ 4] A_real= 6.241880999595735002e-02 A_freal= 6.241880916059017181e-02 A_delta= 8.3536717821e-10
[ 5] A_real= 3.123983343026827744e-02 A_freal= 3.123983182013034821e-02 A_delta= 1.6101379292e-09
[ 6] A_real= 1.562372862047683129e-02 A_freal= 1.562372781336307526e-02 A_delta= 8.0711375604e-10
[ 7] A_real= 7.812341060101111144e-03 A_freal= 7.812339812517166138e-03 A_delta= 1.2475839450e-09
[ 8] A_real= 3.906230131966971757e-03 A_freal= 3.906229510903358459e-03 A_delta= 6.2106361330e-10
[ 9] A_real= 1.953122516478818758e-03 A_freal= 1.953121274709701538e-03 A_delta= 1.2417691172e-09
[10] A_real= 9.765621895593194594e-04 A_freal= 9.765606373548507690e-04 A_delta= 1.5522044687e-09
[11] A_real= 4.882812111948982899e-04 A_freal= 4.882793873548507690e-04 A_delta= 1.8238400475e-09
[12] A_real= 2.441406201493617712e-04 A_freal= 2.441387623548507690e-04 A_delta= 1.8577945110e-09
[13] A_real= 1.220703118936702078e-04 A_freal= 1.220684498548507690e-04 A_delta= 1.8620388194e-09
[14] A_real= 6.103515617420877259e-05 A_freal= 6.103329360485076904e-05 A_delta= 1.8625693580e-09
[15] A_real= 3.051757811552609572e-05 A_freal= 3.051571547985076904e-05 A_delta= 1.8626356753e-09
[16] A_real= 1.525878906131576154e-05 A_freal= 1.525692641735076904e-05 A_delta= 1.8626439650e-09
[17] A_real= 7.629394531101969981e-06 A_freal= 7.627531886100769043e-06 A_delta= 1.8626450012e-09
[18] A_real= 3.814697265606496142e-06 A_freal= 3.812834620475769043e-06 A_delta= 1.8626451307e-09
[19] A_real= 1.907348632810186965e-06 A_freal= 1.905485987663269043e-06 A_delta= 1.8626451469e-09
[20] A_real= 9.536743164059608441e-07 A_freal= 9.518116712570190430e-07 A_delta= 1.8626451489e-09
[21] A_real= 4.768371582030888423e-07 A_freal= 4.749745130538940430e-07 A_delta= 1.8626451492e-09
[22] A_real= 2.384185791015579737e-07 A_freal= 2.365559339523315430e-07 A_delta= 1.8626451492e-09
[23] A_real= 1.192092895507806809e-07 A_freal= 1.173466444015502930e-07 A_delta= 1.8626451492e-09
[24] A_real= 5.960464477539055221e-08 A_freal= 5.774199962615966797e-08 A_delta= 1.8626451492e-09
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[25] A_real= 2.9802322387695302574e-08 A_freal= 2.7939677238464355469e-08 A_delta= 1.8626451492e-09
[26] A_real= 1.4901161193847654596e-08 A_freal= 1.3038516044616699219e-08 A_delta= 1.8626451492e-09
[27] A_real= 7.4505805969238281250e-09 A_freal= 7.4505805969238281250e-09 A_delta= 0.0000000000e+00
[28] A_real= 3.7252902984619140625e-09 A_freal= 3.7252902984619140625e-09 A_delta= 0.0000000000e+00
[29] A_real= 1.8626451492309570312e-09 A_freal= 1.8626451492309570312e-09 A_delta= 0.0000000000e+00
[30] A_real= 9.3132257461547851562e-10 A_freal= 0.0000000000000000000e+00 A_delta= 9.3132257462e-10
[31] A_real= 4.6566128730773925781e-10 A_freal= 0.0000000000000000000e+00 A_delta= 4.6566128731e-10
[32] A_real= 2.3283064365386962891e-10 A_freal= 0.0000000000000000000e+00 A_delta= 2.3283064365e-10
[33] A_real= 1.1641532182693481445e-10 A_freal= 0.0000000000000000000e+00 A_delta= 1.1641532183e-10
[34] A_real= 5.8207660913467407227e-11 A_freal= 0.0000000000000000000e+00 A_delta= 5.8207660913e-11
[35] A_real= 2.9103830456733703613e-11 A_freal= 0.0000000000000000000e+00 A_delta= 2.9103830457e-11
[36] A_real= 1.4551915228366851807e-11 A_freal= 0.0000000000000000000e+00 A_delta= 1.4551915228e-11
[37] A_real= 7.2759576141834259033e-12 A_freal= 0.0000000000000000000e+00 A_delta= 7.2759576142e-12
[38] A_real= 3.6379788070917129517e-12 A_freal= 0.0000000000000000000e+00 A_delta= 3.6379788071e-12
[39] A_real= 1.8189894035458564758e-12 A_freal= 0.0000000000000000000e+00 A_delta= 1.8189894035e-12
[40] A_real= 9.0949470177292823792e-13 A_freal= 0.0000000000000000000e+00 A_delta= 9.0949470177e-13
[41] A_real= 4.5474735088646411896e-13 A_freal= 0.0000000000000000000e+00 A_delta= 4.5474735089e-13
[42] A_real= 2.2737367544323205948e-13 A_freal= 0.0000000000000000000e+00 A_delta= 2.2737367544e-13
[43] A_real= 1.1368683772161602974e-13 A_freal= 0.0000000000000000000e+00 A_delta= 1.1368683772e-13
[44] A_real= 5.6843418860808014870e-14 A_freal= 0.0000000000000000000e+00 A_delta= 5.6843418861e-14
[45] A_real= 2.8421709430404007435e-14 A_freal= 0.0000000000000000000e+00 A_delta= 2.8421709430e-14
[46] A_real= 1.4210854715202003717e-14 A_freal= 0.0000000000000000000e+00 A_delta= 1.4210854715e-14
[47] A_real= 7.1054273576010018587e-15 A_freal= 0.0000000000000000000e+00 A_delta= 7.1054273576e-15
[48] A_real= 3.5527136788005009294e-15 A_freal= 0.0000000000000000000e+00 A_delta= 3.5527136788e-15
[49] A_real= 1.7763568394002504647e-15 A_freal= 0.0000000000000000000e+00 A_delta= 1.7763568394e-15
[50] A_real= 8.8817841970012523234e-16 A_freal= 0.0000000000000000000e+00 A_delta= 8.8817841970e-16
[51] A_real= 4.4408920985006261617e-16 A_freal= 0.0000000000000000000e+00 A_delta= 4.4408920985e-16
[52] A_real= 2.2204460492503130808e-16 A_freal= 0.0000000000000000000e+00 A_delta= 2.2204460493e-16
[53] A_real= 1.1102230246251565404e-16 A_freal= 0.0000000000000000000e+00 A_delta= 1.1102230246e-16
[54] A_real= 5.5511151231257827021e-17 A_freal= 0.0000000000000000000e+00 A_delta= 5.5511151231e-17
[55] A_real= 2.7755575615628913511e-17 A_freal= 0.0000000000000000000e+00 A_delta= 2.7755575616e-17
[56] A_real= 1.3877787807814456755e-17 A_freal= 0.0000000000000000000e+00 A_delta= 1.3877787808e-17
[57] A_real= 6.9388939039072283776e-18 A_freal= 0.0000000000000000000e+00 A_delta= 6.9388939039e-18
[58] A_real= 3.4694469519536141888e-18 A_freal= 0.0000000000000000000e+00 A_delta= 3.4694469520e-18
[59] A_real= 1.7347234759768070944e-18 A_freal= 0.0000000000000000000e+00 A_delta= 1.7347234760e-18
[60] A_real= 1.7347234759768070944e-18 A_freal= 0.0000000000000000000e+00 A_delta= 1.7347234760e-18
[61] A_real= 1.7347234759768070944e-18 A_freal= 0.0000000000000000000e+00 A_delta= 1.7347234760e-18
[62] A_real= 1.7347234759768070944e-18 A_freal= 0.0000000000000000000e+00 A_delta= 1.7347234760e-18
[63] A_real= 1.7347234759768070944e-18 A_freal= 0.0000000000000000000e+00 A_delta= 1.7347234760e-18


* cos_delta
[ 0] cos(A_real)=   7.0710678119e-01 cos(A_freal)=   7.0710678154e-01 cos_delta=  -3.5075797822e-10
[ 1] cos(A_real)=   8.9442719100e-01 cos(A_freal)=   8.9442719158e-01 cos_delta=  -5.7550508803e-10
[ 2] cos(A_real)=   9.7014250015e-01 cos(A_freal)=   9.7014250028e-01 cos_delta=  -1.3257306364e-10
[ 3] cos(A_real)=   9.9227787671e-01 cos(A_freal)=   9.9227787679e-01 cos_delta=  -7.7182260583e-11
[ 4] cos(A_real)=   9.9805257848e-01 cos(A_freal)=   9.9805257853e-01 cos_delta=  -5.2108761750e-11
[ 5] cos(A_real)=   9.9951207609e-01 cos(A_freal)=   9.9951207614e-01 cos_delta=  -5.0292214837e-11
[ 6] cos(A_real)=   9.9987795203e-01 cos(A_freal)=   9.9987795205e-01 cos_delta=  -1.2609580047e-11
[ 7] cos(A_real)=   9.9996948382e-01 cos(A_freal)=   9.9996948383e-01 cos_delta=  -9.7464258886e-12
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[ 8] cos(A_real)=   9.9999237069e-01 cos(A_freal)=   9.9999237070e-01 cos_delta=  -2.4260593534e-12
[ 9] cos(A_real)=   9.9999809266e-01 cos(A_freal)=   9.9999809266e-01 cos_delta=  -2.4252821973e-12
[10] cos(A_real)=   9.9999952316e-01 cos(A_freal)=   9.9999952316e-01 cos_delta=  -1.5157874955e-12
[11] cos(A_real)=   9.9999988079e-01 cos(A_freal)=   9.9999988079e-01 cos_delta=  -8.9050988805e-13
[12] cos(A_real)=   9.9999997020e-01 cos(A_freal)=   9.9999997020e-01 cos_delta=  -4.5352610556e-13
[13] cos(A_real)=   9.9999999255e-01 cos(A_freal)=   9.9999999255e-01 cos_delta=  -2.2726265314e-13
[14] cos(A_real)=   9.9999999814e-01 cos(A_freal)=   9.9999999814e-01 cos_delta=  -1.1368683772e-13
[15] cos(A_real)=   9.9999999953e-01 cos(A_freal)=   9.9999999953e-01 cos_delta=  -5.6843418861e-14
[16] cos(A_real)=   9.9999999988e-01 cos(A_freal)=   9.9999999988e-01 cos_delta=  -2.8421709430e-14
[17] cos(A_real)=   9.9999999997e-01 cos(A_freal)=   9.9999999997e-01 cos_delta=  -1.4210854715e-14
[18] cos(A_real)=   9.9999999999e-01 cos(A_freal)=   9.9999999999e-01 cos_delta=  -7.1054273576e-15
[19] cos(A_real)=   1.0000000000e+00 cos(A_freal)=   1.0000000000e+00 cos_delta=  -3.5527136788e-15
[20] cos(A_real)=   1.0000000000e+00 cos(A_freal)=   1.0000000000e+00 cos_delta=  -1.7763568394e-15
[21] cos(A_real)=   1.0000000000e+00 cos(A_freal)=   1.0000000000e+00 cos_delta=  -8.8817841970e-16
[22] cos(A_real)=   1.0000000000e+00 cos(A_freal)=   1.0000000000e+00 cos_delta=  -4.4408920985e-16
[23] cos(A_real)=   1.0000000000e+00 cos(A_freal)=   1.0000000000e+00 cos_delta=  -2.2204460493e-16
[24] cos(A_real)=   1.0000000000e+00 cos(A_freal)=   1.0000000000e+00 cos_delta=  -1.1102230246e-16
[25] cos(A_real)=   1.0000000000e+00 cos(A_freal)=   1.0000000000e+00 cos_delta=   0.0000000000e+00
[26] cos(A_real)=   1.0000000000e+00 cos(A_freal)=   1.0000000000e+00 cos_delta=   0.0000000000e+00
[27] cos(A_real)=   1.0000000000e+00 cos(A_freal)=   1.0000000000e+00 cos_delta=   0.0000000000e+00
[28] cos(A_real)=   1.0000000000e+00 cos(A_freal)=   1.0000000000e+00 cos_delta=   0.0000000000e+00
[29] cos(A_real)=   1.0000000000e+00 cos(A_freal)=   1.0000000000e+00 cos_delta=   0.0000000000e+00
[30] cos(A_real)=   1.0000000000e+00 cos(A_freal)=   1.0000000000e+00 cos_delta=   0.0000000000e+00
[31] cos(A_real)=   1.0000000000e+00 cos(A_freal)=   1.0000000000e+00 cos_delta=   0.0000000000e+00
[32] cos(A_real)=   1.0000000000e+00 cos(A_freal)=   1.0000000000e+00 cos_delta=   0.0000000000e+00
[33] cos(A_real)=   1.0000000000e+00 cos(A_freal)=   1.0000000000e+00 cos_delta=   0.0000000000e+00
[34] cos(A_real)=   1.0000000000e+00 cos(A_freal)=   1.0000000000e+00 cos_delta=   0.0000000000e+00
[35] cos(A_real)=   1.0000000000e+00 cos(A_freal)=   1.0000000000e+00 cos_delta=   0.0000000000e+00
[36] cos(A_real)=   1.0000000000e+00 cos(A_freal)=   1.0000000000e+00 cos_delta=   0.0000000000e+00
[37] cos(A_real)=   1.0000000000e+00 cos(A_freal)=   1.0000000000e+00 cos_delta=   0.0000000000e+00
[38] cos(A_real)=   1.0000000000e+00 cos(A_freal)=   1.0000000000e+00 cos_delta=   0.0000000000e+00
[39] cos(A_real)=   1.0000000000e+00 cos(A_freal)=   1.0000000000e+00 cos_delta=   0.0000000000e+00
[40] cos(A_real)=   1.0000000000e+00 cos(A_freal)=   1.0000000000e+00 cos_delta=   0.0000000000e+00
[41] cos(A_real)=   1.0000000000e+00 cos(A_freal)=   1.0000000000e+00 cos_delta=   0.0000000000e+00
[42] cos(A_real)=   1.0000000000e+00 cos(A_freal)=   1.0000000000e+00 cos_delta=   0.0000000000e+00
[43] cos(A_real)=   1.0000000000e+00 cos(A_freal)=   1.0000000000e+00 cos_delta=   0.0000000000e+00
[44] cos(A_real)=   1.0000000000e+00 cos(A_freal)=   1.0000000000e+00 cos_delta=   0.0000000000e+00
[45] cos(A_real)=   1.0000000000e+00 cos(A_freal)=   1.0000000000e+00 cos_delta=   0.0000000000e+00
[46] cos(A_real)=   1.0000000000e+00 cos(A_freal)=   1.0000000000e+00 cos_delta=   0.0000000000e+00
[47] cos(A_real)=   1.0000000000e+00 cos(A_freal)=   1.0000000000e+00 cos_delta=   0.0000000000e+00
[48] cos(A_real)=   1.0000000000e+00 cos(A_freal)=   1.0000000000e+00 cos_delta=   0.0000000000e+00
[49] cos(A_real)=   1.0000000000e+00 cos(A_freal)=   1.0000000000e+00 cos_delta=   0.0000000000e+00
[50] cos(A_real)=   1.0000000000e+00 cos(A_freal)=   1.0000000000e+00 cos_delta=   0.0000000000e+00
[51] cos(A_real)=   1.0000000000e+00 cos(A_freal)=   1.0000000000e+00 cos_delta=   0.0000000000e+00
[52] cos(A_real)=   1.0000000000e+00 cos(A_freal)=   1.0000000000e+00 cos_delta=   0.0000000000e+00
[53] cos(A_real)=   1.0000000000e+00 cos(A_freal)=   1.0000000000e+00 cos_delta=   0.0000000000e+00
[54] cos(A_real)=   1.0000000000e+00 cos(A_freal)=   1.0000000000e+00 cos_delta=   0.0000000000e+00
[55] cos(A_real)=   1.0000000000e+00 cos(A_freal)=   1.0000000000e+00 cos_delta=   0.0000000000e+00
[56] cos(A_real)=   1.0000000000e+00 cos(A_freal)=   1.0000000000e+00 cos_delta=   0.0000000000e+00
[57] cos(A_real)=   1.0000000000e+00 cos(A_freal)=   1.0000000000e+00 cos_delta=   0.0000000000e+00
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[58] cos(A_real)=   1.0000000000e+00 cos(A_freal)=   1.0000000000e+00 cos_delta=   0.0000000000e+00
[59] cos(A_real)=   1.0000000000e+00 cos(A_freal)=   1.0000000000e+00 cos_delta=   0.0000000000e+00
[60] cos(A_real)=   1.0000000000e+00 cos(A_freal)=   1.0000000000e+00 cos_delta=   0.0000000000e+00
[61] cos(A_real)=   1.0000000000e+00 cos(A_freal)=   1.0000000000e+00 cos_delta=   0.0000000000e+00
[62] cos(A_real)=   1.0000000000e+00 cos(A_freal)=   1.0000000000e+00 cos_delta=   0.0000000000e+00
[63] cos(A_real)=   1.0000000000e+00 cos(A_freal)=   1.0000000000e+00 cos_delta=   0.0000000000e+00


* sin_delta
[ 0] sin(A_real)=   7.0710678119e-01 sin(A_freal)=   7.0710678084e-01 sin_delta=   3.5075797822e-10
[ 1] sin(A_real)=   4.4721359550e-01 sin(A_freal)=   4.4721359435e-01 sin_delta=   1.1510100650e-09
[ 2] sin(A_real)=   2.4253562504e-01 sin(A_freal)=   2.4253562451e-01 sin_delta=   5.3029197700e-10
[ 3] sin(A_real)=   1.2403473459e-01 sin(A_freal)=   1.2403473397e-01 sin_delta=   6.1745768221e-10
[ 4] sin(A_real)=   6.2378286155e-02 sin(A_freal)=   6.2378285321e-02 sin_delta=   8.3374036147e-10
[ 5] sin(A_real)=   3.1234752378e-02 sin(A_freal)=   3.1234750768e-02 sin_delta=   1.6093523042e-09
[ 6] sin(A_real)=   1.5623093001e-02 sin(A_freal)=   1.5623092194e-02 sin_delta=   8.0701524977e-10
[ 7] sin(A_real)=   7.8122615923e-03 sin(A_freal)=   7.8122603448e-03 sin_delta=   1.2475458739e-09
[ 8] sin(A_real)=   3.9062201980e-03 sin(A_freal)=   3.9062195770e-03 sin_delta=   6.2105887490e-10
[ 9] sin(A_real)=   1.9531212747e-03 sin(A_freal)=   1.9531200330e-03 sin_delta=   1.2417667487e-09
[10] sin(A_real)=   9.7656203434e-04 sin(A_freal)=   9.7656048214e-04 sin_delta=   1.5522037285e-09
[11] sin(A_real)=   4.8828119179e-04 sin(A_freal)=   4.8827936795e-04 sin_delta=   1.8238398301e-09
[12] sin(A_real)=   2.4414061772e-04 sin(A_freal)=   2.4413875993e-04 sin_delta=   1.8577944556e-09
[13] sin(A_real)=   1.2207031159e-04 sin(A_freal)=   1.2206844955e-04 sin_delta=   1.8620388056e-09
[14] sin(A_real)=   6.1035156136e-05 sin(A_freal)=   6.1033293567e-05 sin_delta=   1.8625693545e-09
[15] sin(A_real)=   3.0517578111e-05 sin(A_freal)=   3.0515715475e-05 sin_delta=   1.8626356745e-09
[16] sin(A_real)=   1.5258789061e-05 sin(A_freal)=   1.5256926417e-05 sin_delta=   1.8626439648e-09
[17] sin(A_real)=   7.6293945310e-06 sin(A_freal)=   7.6275318860e-06 sin_delta=   1.8626450011e-09
[18] sin(A_real)=   3.8146972656e-06 sin(A_freal)=   3.8128346205e-06 sin_delta=   1.8626451307e-09
[19] sin(A_real)=   1.9073486328e-06 sin(A_freal)=   1.9054859877e-06 sin_delta=   1.8626451469e-09
[20] sin(A_real)=   9.5367431641e-07 sin(A_freal)=   9.5181167126e-07 sin_delta=   1.8626451489e-09
[21] sin(A_real)=   4.7683715820e-07 sin(A_freal)=   4.7497451305e-07 sin_delta=   1.8626451492e-09
[22] sin(A_real)=   2.3841857910e-07 sin(A_freal)=   2.3655593395e-07 sin_delta=   1.8626451492e-09
[23] sin(A_real)=   1.1920928955e-07 sin(A_freal)=   1.1734664440e-07 sin_delta=   1.8626451492e-09
[24] sin(A_real)=   5.9604644775e-08 sin(A_freal)=   5.7741999626e-08 sin_delta=   1.8626451492e-09
[25] sin(A_real)=   2.9802322388e-08 sin(A_freal)=   2.7939677238e-08 sin_delta=   1.8626451492e-09
[26] sin(A_real)=   1.4901161194e-08 sin(A_freal)=   1.3038516045e-08 sin_delta=   1.8626451492e-09
[27] sin(A_real)=   7.4505805969e-09 sin(A_freal)=   7.4505805969e-09 sin_delta=   0.0000000000e+00
[28] sin(A_real)=   3.7252902985e-09 sin(A_freal)=   3.7252902985e-09 sin_delta=   0.0000000000e+00
[29] sin(A_real)=   1.8626451492e-09 sin(A_freal)=   1.8626451492e-09 sin_delta=   0.0000000000e+00
[30] sin(A_real)=   9.3132257462e-10 sin(A_freal)=   0.0000000000e+00 sin_delta=   9.3132257462e-10
[31] sin(A_real)=   4.6566128731e-10 sin(A_freal)=   0.0000000000e+00 sin_delta=   4.6566128731e-10
[32] sin(A_real)=   2.3283064365e-10 sin(A_freal)=   0.0000000000e+00 sin_delta=   2.3283064365e-10
[33] sin(A_real)=   1.1641532183e-10 sin(A_freal)=   0.0000000000e+00 sin_delta=   1.1641532183e-10
[34] sin(A_real)=   5.8207660913e-11 sin(A_freal)=   0.0000000000e+00 sin_delta=   5.8207660913e-11
[35] sin(A_real)=   2.9103830457e-11 sin(A_freal)=   0.0000000000e+00 sin_delta=   2.9103830457e-11
[36] sin(A_real)=   1.4551915228e-11 sin(A_freal)=   0.0000000000e+00 sin_delta=   1.4551915228e-11
[37] sin(A_real)=   7.2759576142e-12 sin(A_freal)=   0.0000000000e+00 sin_delta=   7.2759576142e-12
[38] sin(A_real)=   3.6379788071e-12 sin(A_freal)=   0.0000000000e+00 sin_delta=   3.6379788071e-12
[39] sin(A_real)=   1.8189894035e-12 sin(A_freal)=   0.0000000000e+00 sin_delta=   1.8189894035e-12
[40] sin(A_real)=   9.0949470177e-13 sin(A_freal)=   0.0000000000e+00 sin_delta=   9.0949470177e-13
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[41] sin(A_real)=   4.5474735089e-13 sin(A_freal)=   0.0000000000e+00 sin_delta=   4.5474735089e-13
[42] sin(A_real)=   2.2737367544e-13 sin(A_freal)=   0.0000000000e+00 sin_delta=   2.2737367544e-13
[43] sin(A_real)=   1.1368683772e-13 sin(A_freal)=   0.0000000000e+00 sin_delta=   1.1368683772e-13
[44] sin(A_real)=   5.6843418861e-14 sin(A_freal)=   0.0000000000e+00 sin_delta=   5.6843418861e-14
[45] sin(A_real)=   2.8421709430e-14 sin(A_freal)=   0.0000000000e+00 sin_delta=   2.8421709430e-14
[46] sin(A_real)=   1.4210854715e-14 sin(A_freal)=   0.0000000000e+00 sin_delta=   1.4210854715e-14
[47] sin(A_real)=   7.1054273576e-15 sin(A_freal)=   0.0000000000e+00 sin_delta=   7.1054273576e-15
[48] sin(A_real)=   3.5527136788e-15 sin(A_freal)=   0.0000000000e+00 sin_delta=   3.5527136788e-15
[49] sin(A_real)=   1.7763568394e-15 sin(A_freal)=   0.0000000000e+00 sin_delta=   1.7763568394e-15
[50] sin(A_real)=   8.8817841970e-16 sin(A_freal)=   0.0000000000e+00 sin_delta=   8.8817841970e-16
[51] sin(A_real)=   4.4408920985e-16 sin(A_freal)=   0.0000000000e+00 sin_delta=   4.4408920985e-16
[52] sin(A_real)=   2.2204460493e-16 sin(A_freal)=   0.0000000000e+00 sin_delta=   2.2204460493e-16
[53] sin(A_real)=   1.1102230246e-16 sin(A_freal)=   0.0000000000e+00 sin_delta=   1.1102230246e-16
[54] sin(A_real)=   5.5511151231e-17 sin(A_freal)=   0.0000000000e+00 sin_delta=   5.5511151231e-17
[55] sin(A_real)=   2.7755575616e-17 sin(A_freal)=   0.0000000000e+00 sin_delta=   2.7755575616e-17
[56] sin(A_real)=   1.3877787808e-17 sin(A_freal)=   0.0000000000e+00 sin_delta=   1.3877787808e-17
[57] sin(A_real)=   6.9388939039e-18 sin(A_freal)=   0.0000000000e+00 sin_delta=   6.9388939039e-18
[58] sin(A_real)=   3.4694469520e-18 sin(A_freal)=   0.0000000000e+00 sin_delta=   3.4694469520e-18
[59] sin(A_real)=   1.7347234760e-18 sin(A_freal)=   0.0000000000e+00 sin_delta=   1.7347234760e-18
[60] sin(A_real)=   1.7347234760e-18 sin(A_freal)=   0.0000000000e+00 sin_delta=   1.7347234760e-18
[61] sin(A_real)=   1.7347234760e-18 sin(A_freal)=   0.0000000000e+00 sin_delta=   1.7347234760e-18
[62] sin(A_real)=   1.7347234760e-18 sin(A_freal)=   0.0000000000e+00 sin_delta=   1.7347234760e-18
[63] sin(A_real)=   1.7347234760e-18 sin(A_freal)=   0.0000000000e+00 sin_delta=   1.7347234760e-18


* fractional bits = 29
|A_delta|   (min= 0.00e+00 avg= 6.64e-10 max= 1.86e-09)
|cos_delta| (min= 0.00e+00 avg= 1.98e-11 max= 5.76e-10)
|sin_delta| (min= 0.00e+00 avg= 6.59e-10 max= 1.86e-09)
::::::::::::::
lut_conv.out
::::::::::::::
gcc -c -g -I/home/young/include lut_conv.c
gcc lut_conv.o -o lut_conv -lm
./lut_conv 29
number of bits for fractional part : 29
sizeof(long long int) = 8
col #1 : index i
col #2 : number in string
col #3 : double type data
col #4 : fixed point integer
col #5 : hexadecimal number
col #6 : error
col #7 : normalized err
[  0] 7.8539816339744830962E-01 7.8539816339744827900e-01        421657428 00000000001921fb54 4.960468e-10 6.315863e-10
[  1] 4.6364760900080611621E-01 4.6364760900080609352e-01        248918914 00000000000ed63382 1.286868e-09 2.775531e-09
[  2] 2.4497866312686415417E-01 2.4497866312686414347e-01        131521918 000000000007d6dd7e 5.466124e-10 2.231266e-09
[  3] 1.2435499454676143503E-01 1.2435499454676143816e-01         66762579 000000000003fab753 6.222629e-10 5.003924e-09
[  4] 6.2418809995957348474E-02 6.2418809995957350023e-02         33510843 000000000001ff55bb 8.353672e-10 1.338326e-08
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[  9] 1.9531225164788186851E-03 1.9531225164788187584e-03        1048574 0000000000000fffe 1.241769e-09 6.357866e-07
[ 10] 9.7656218955931943040E-04 9.7656218955931945944e-04         524287 00000000000007fff 1.552204e-09 1.589458e-06
[ 11] 4.8828121119489827547E-04 4.8828121119489828993e-04         262143 00000000000003fff 1.823840e-09 3.735225e-06
[ 12] 2.4414062014936176402E-04 2.4414062014936177124e-04         131071 00000000000001fff 1.857795e-09 7.609526e-06
[ 13] 1.2207031189367020424E-04 1.2207031189367020785e-04          65535 00000000000000fff 1.862039e-09 1.525382e-05
[ 14] 6.1035156174208775022E-05 6.1035156174208772594e-05          32767 00000000000007fff 1.862569e-09 3.051634e-05
[ 15] 3.0517578115526096862E-05 3.0517578115526095727e-05          16383 00000000000003fff 1.862636e-09 6.103485e-05
[ 16] 1.5258789061315762107E-05 1.5258789061315761542e-05           8191 00000000000001fff 1.862644e-09 1.220702e-04
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[ 19] 1.9073486328101870354E-06 1.9073486328101869648e-06           1023 00000000000003ff 1.862645e-09 9.765625e-04
[ 20] 9.5367431640596087942E-07 9.5367431640596084413e-07            511 00000000000001ff 1.862645e-09 1.953125e-03
[ 21] 4.7683715820308885993E-07 4.7683715820308884228e-07            255 00000000000000ff 1.862645e-09 3.906250e-03
[ 22] 2.3841857910155798249E-07 2.3841857910155797367e-07            127 000000000000007f 1.862645e-09 7.812500e-03
[ 23] 1.1920928955078068531E-07 1.1920928955078068090e-07             63 000000000000003f 1.862645e-09 1.562500e-02
[ 24] 5.9604644775390554414E-08 5.9604644775390552208e-08             31 000000000000001f 1.862645e-09 3.125000e-02
[ 25] 2.9802322387695303677E-08 2.9802322387695302574e-08             15 000000000000000f 1.862645e-09 6.250000e-02
[ 26] 1.4901161193847655147E-08 1.4901161193847654596e-08              7 0000000000000007 1.862645e-09 1.250000e-01
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