A Bibliography of Publications on Floating-Point Arithmetic

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Introduction

This is a bibliography of material on floating-point arithmetic that I came up with while doing research on a floating-point package of my own. I don’t claim it to be anywhere near complete. The material listed is only what I myself possess.

My main interest was in software based, binary floating-point arithmetic on a microprocessor, so you won’t find much material about the hardware used in floating-point arithmetic (e.g. adders, carry propagation schemes, higher radix
representation for multiplication and division, etc.) in this list. There is also not too much on non-binary floating-point arithmetic.

For most fields covered in this bibliography, the important or historically relevant articles should be included. There is also some material on integer arithmetic in this list as some of the methods used with integer arithmetic contain interesting ideas that may be useful in the realization of a floating-point arithmetic package.

Also, depending on the type of microprocessor used, one may need to implement integer multiplication and division for use in the floating-point package, so articles about this topic are included as well.

As I am German, there is a bit of material in German in this bibliography. However, English translations are provided for all non-English titles.

Thanks to the people who have helped me with previous versions of this document by sending me papers or additional references:

- Steven Sommars (sesv@research.bell-labs.com),
- Jim Kiernan (jmk@teak.cray.com),
- Warren Ferguson (ferguson@seas.smu.edu),
- Nhuan Doduc (ndoduc@framentec.fr),
- K. C. Ng (kwok.ng@eng.sun.com),
- Nelson H. F. Beebe (beebe@math.utah.edu).

Bibliography entries in the Books section are ordered alphabetically by author; ordering is by ascending year in the remaining sections.

**Warning:** it has yet not been possible to bring this citation list up-to-date with the entries in the BIBTEX files.

### Books, hardware oriented

[1670, 263, 1249, 1179, 3050, 3253, 1865, 813, 1128, 969, 1416, 815, 1302, 6710, 6711, 1511]

### Books, software oriented or theory

[1236, 445, 448, 449, 107, 1379, 2338, 879, 1017, 334, 2890, 2379, 2907, 2216, 302, 505, 6568]

### Books, machine specific

[2120, 3155, 3052, 2381, 1716, 1852, 2234, 1884, 2416]
1 Choice of base, floating point formats

1.1 Precision and Rounding

1.2 Determination of parameters of floating point arithmetic

1.3 IEEE standards for floating point arithmetic

1.4 Floating point arithmetic, general and implementation issues

1.5 Floating point packages

1.6 Floating point units
1.7 Test of floating point routines

2 Addition and Subtraction
[357, 1469]

2.1 Floating-point Summation
[307, 327, 344, 343, 546, 613, 651, 803, 1611, 2221, 2297]

2.2 Multiplication
[654, 1209, 1223, 1434, 1498, 1472, 1527, 1554, 1546, 1571, 1626, 1544, 1707]

2.3 Division

3 Elementary functions, general
[366, 379, 562, 624, 590, 1088, 1228, 1579, 1606, 1705, 1668, 1666, 1743, 1789, 6652, 1894, 2000, 2100, 2044, 2223, 6670, 2505, 2542, 2492, 2494, 2463, 2640, 2791, 2604, 2753, 2754, 2633, 3305, 3273]

3.1 Elementary functions, CORDIC and related algorithms
[175, 176, 231, 246, 355, 501, 528, 633, 625, 641, 706, 827, 1035, 1051, 1256, 1410, 1648, 1846, 1657, 1760, 1912, 2105, 2326, 2256, 2486, 2512, 2659, 2751, 2948, 2943, 3067, 3007, 3053]

3.2 Elementary functions, function approximation
[223, 224, 460, 599, 740, 739, 952, 990, 1126, 1949, 2241, 2133, 2628, 2725, 2726]

3.2.1 Polynomial evaluation
[241, 261, 286, 405, 1028, 1190, 2296]
3.3 Square root, general
[1049, 1150, 1438, 1551, 1602, 2510, 2620]

3.3.1 Square root, bit-oriented, iterative, and table methods of computation

3.3.2 Square root, Newton’s method
[144, 262, 284, 356, 329, 325, 365, 430, 406, 491, 496, 510, 572, 561, 555, 557, 676, 1288, 1278, 1356, 1536, 2279, 2957, 2885]

3.4 Sine and Cosine
[165, 1035, 987, 992, 1139, 1357, 1499, 1616, 1615, 1714, 1802, 1902, 2066, 2177, 2551, 2899, 2896, 2820, 2918, 3013]

3.5 Logarithm
[140, 253, 313, 664, 967, 1078, 1262, 1485, 2053, 2054, 2552, 2677]

3.6 Exponential function
[127, 390, 1146, 1320, 1474, 1697, 1796, 2415, 2553, 2940]

3.7 Arctangent
[129, 145, 191]

3.8 Other transcendental functions
[476, 588, 146, 993, 347, 257, 342, 2046, 1121, 2801, 2993]

4 Binary-decimal conversion
[174, 158, 206, 454, 552, 658, 1129, 1254, 1255, 1364, 1604, 1658, 1951, 1924, 2454, 2546, 2470, 2797]
5  **BCD arithmetic**

[648, 699, 749, 750, 751, 752, 753, 754, 755, 1341, 1449, 1654, 1592, 1986, 2589, 2898]

6  **Multiple precision arithmetic**

[274, 312, 391, 407, 607, 591, 922, 971, 1066, 1065, 1228, 1309, 1389, 1497, 2746, 2731, 2972, 3192]

7  **Conferences on computer arithmetic**

[6593, 6603, 6607, 6616, 6619, 6631, 6649, 6650, 6691, 6721, 6729, 6723, 6755]

8  **Additional contributions from Nelson H. F. Beebe**


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**Title word cross-reference**

#26 [5367].

\((2^n)^m\) [3726]. \((10^{31} - 1)/9\) [1925]. \(2^m\) [4267, 4288, 4469, 4478, 4385]. 
\((2^n + 1)\) [1048, 4700, 3838]. \((2^n - 1)\) [4903]. \((2^n-1,2^n+p,2^n+1)\) [6112]. \((2^n+1)\) [5932]. \((2^n \pm 1)\) [5394, 4062]. \((2m)\) [4350]. \((2n+3)\) [6334]. \((2n - (2p \pm 1))\) [4755]. \((d, r)\) [761]. \((\mathcal{R})\) [2846]. \((p)\) [4267, 4350]. \((x + y) * (x - y)\) [6448]. -2
\( \sqrt{x^2 + y^2} \) [5542]. \( T \) [6364]. \( \tan^{-1} x \) [355]. \( \theta(\log N) \) [2299]. \( \times [3992, 3843, 4056] \). \( w \) [4645]. \( X \) [1497, 2833, 430]. \( x^2 + ny^2 \) [3637]. \( x^n \) [5836, 3245]. \( y \) [4329]. \( Z \) [5216]. \( Z^2 \) [4931].


.NET [4966].

/m [4771]. /spl [4771].

0.18-CMOS [5638]. '00 [6830, 6835, 2485]. '01 [6844]. '03 [6873]. '04 [6861, 6889]. '07 [6924, 6930, 6932, 6937]. '08 [6941, 2971, 5263].

8 ADDITIONAL CONTRIBUTIONS FROM NELSON H. F. BEEBE  

[6947, 6918]. 1st [6803]. 

2 [2121, 2462, 1683, 60, 62, 64, 4278, 3962, 6244, 3846, 4794, 506, 
1963, 3447, 4041, 4677, 2762, 2951]. 2-D [3447]. 2-Digit [4095]. 2- 
dimensional [2926]. 2.0 [3551]. 2.44 [3961, 4124]. 20 [2608, 2344]. 
[6840, 6841, 6843, 4735, 6845, 6851, 6852]. 2002 [6854, 6855, 6857, 6858, 
6859, 6866]. 2003 [6869, 6870, 6873, 6874]. 2004 [6880, 6881, 6883, 
6889, 6907, 4786]. 2005 [6897, 6898, 6900, 6903, 6909]. 2006 [6912, 6913, 
6916, 6920]. 2006Petrozavodsk [6967]. 2007 [6924, 6926, 6927, 6929, 
6932, 6934, 6944, 6939]. 2008 [6940, 6941, 5360, 6943, 6333, 5780, 
6400, 5410, 5621, 5431]. 2009 [6946, 6949, 6952, 6953, 5392]. 2010 [6962, 
6414, 6415, 6417, 6428, 6988, 6446]. 20th [6951, 6989, 6970, 6933]. 21-23 
[6949]. 2100 [2503]. 21064 [3279]. 21164 [324]. 21st [6957, 6886, 
6831, 6973]. 22 [319]. 22nd [6977]. 23-28 [6917]. 23nd [6981]. 23rd [6706, 
24th [6982, 6804, 6807, 6861, 6965]. 25-28 [6830]. 256 [6116]. 25th [6702, 
[1832]. 2nd [6961, 4491, 6589]. 2Sum [5983, 6081]. 

3 [3032, 5051, 2711, 5958]. 3-ps [5638]. 30-bit [2366]. 30-MFLOP [2191]. 
30-ns [3403]. 300 [4124, 1191]. 300-MHz [4124]. 300MHz [3961]. 312 [411]. 
3171 [2444]. 31st [6675]. 32 [5007, 2008]. 32-Bit [3645, 2258, 2528, 
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[3036, 3035]. 320C25 [3225]. 32b [2191]. 33 [2159]. 33rd [6785, 6836, 6730]. 34 
[489]. 34-MFLOP [2429]. 360 [398, 399, 481, 372, 373, 655, 418, 459, 1400, 
[4003, 3740, 4028, 4029]. 39th [6924, 6941]. 3CT [3319]. 3DNow 
[3846, 3962]. 3DTV [5627]. 3m [6179]. 3rd [6801, 6593, 6906]. 

4 [3329, 4701]. 4-2 [1130]. 4-Input [5230]. 4-Input/1-Output [5230]. 
4.4ns [3417]. 40 [2353]. 40-MFLOPS [2351, 2353]. 40-ns [622]. 400 [888]. 
4000 [490]. 400MHz [3843]. 40ns [621]. 41 [422]. 432 [1805]. 44th [6920]. 
45th [3689]. 48th [6903]. 4d [4583]. 4m [6179]. 4th [6603, 6830, 6725, 6852].


8 ADDITIONAL CONTRIBUTIONS FROM NELSON H. F. BEEBE

= [2740, 2741, 3281, 6590].

8 ADDITIONAL CONTRIBUTIONS FROM NELSON H. F. BEEBE

6876, 6892, 3405, 3415, 5416, 6737, 6726, 1495, 2231, 903, 5113, 4383, 1761, 6505, 6914, 1980, 6849, 6907.


ADDITIONAL CONTRIBUTIONS FROM NELSON H. F. BEEBE

8 ADDITIONAL CONTRIBUTIONS FROM NELSON H. F. BEEBE


Arithmetic [4244, 5672, 4881, 5363, 2621, 2150, 5750, 592, 841, 4725, 1463, 4091, 6485, 5895, 5993, 5157, 842, 6305, 3659, 3663, 4256, 3006, 2823, 1916, 5454, 3932, 4735, 1782, 6213, 1079, 2154, 2301, 6691, 4269, 3524, 6008, 6106, 6107, 6108, 6986, 1566, 653, 320, 321, 322, 535, 3953, 1004, 1256, 3814, 2838, 2653, 3683, 4458, 6324, 4120, 4274, 6114, 6222, 6327, 3686, 4616, 5181, 5287, 1927, 4756, 6115, 1096, 1263, 1368, 4465, 1097, 1264, 2031, 4277, 495, 1098, 1179, 1477, 1807, 6649, 1694, 1929, 2484, 3818, 6589, 6593, 6603, 6619, 6631, 1810, 1811, 2032, 6905, 6973, 5921, 6333, 5053, 5187, 324, 4066, 1372, 6663, 6116, 5288, 2847, 1932, 416, 5602, 5774, 6119, 1577, 3040, 5397, 6121, 1578, 5839, 6019, 6122].

Arithmetic [6123, 6451, 1696, 3967, 3545, 1375, 1935, 4132, 4759, 4912, 714, 717, 328, 3693, 4915, 20, 5464, 6721, 857, 4469, 4289, 799, 3697, 2042, 3048, 862, 1821, 2673, 3389, 6778, 1585, 4140, 5690, 3050, 6821, 3979, 4141, 4471, 1011, 1103, 1383, 1702, 2045, 2355, 6723, 5195, 6935, 5401, 5469, 5608, 5692, 5840, 3053, 3700, 723, 864, 3981, 865, 1012, 1013, 869, 1271, 1941, 4476, 5294, 5779, 6345, 5780, 3851, 6131, 872, 1828, 3702, 6796, 6134, 5066, 2049, 3985, 4302, 4482, 6026, 6138, 6348, 217, 268, 323, 3232, 3988, 2869, 6541, 1106, 4148, 270, 1109, 5614, 6143, 3233, 6144, 1833].


Arithmetic [1399, 1610, 2069, 3726, 1025, 1284, 1853, 2070, 4169, 5933, 4173, 109, 5306, 2, 6789, 6524, 675, 2076, 2727, 193, 3422, 6369, 2731, 5086, 1405, 4340, 5088, 3854,
8 ADDITIONAL CONTRIBUTIONS FROM NELSON H. F. BEEBE


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[2746, 3867, 4669, 5505, 2232, 6495, 3744, 5092, 6496, 969, 1416, 2748, 761, 5093, 5094, 1417, 1418, 5422, 4533, 6526, 4039, 816, 511, 1133, 1134, 1301, 1302, 1303, 1640, 1874, 6710, 6711, 3122, 6754, 6755, 6978, 6979, 6980, 6987, 4192, 2414, 2415, 2552, 2553, 2940, 765, 1505, 1633, 4666, 1207, 2090, 172, 1867, 563, 5421, 898, 899, 251, 196, 540, 1728, 19, 22, 901, 1415, 1635]

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Asian [6764]. ASIC [6728, 6852, 6909, 5029, 6748, 6818, 5395, 3120, 2956].
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AWGN [5069]. Axiomatic [3101, 609]. Axiomatisierung [2636].
Axiomatization [1710, 2636, 2637]. Axiomatizations [1890, 2524]. AXP [3441].

B [321, 322, 244, 6267, 3199, 3570, 3403, 2895, 2386, 3417, 2224, 4368, 2776, 3459, 3342, 3526, 961, 2608].
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3968, 4129, 3218, 3690, 5056, 2677, 267, 2047, 5930, 242, 5402, 217]. Binary
[268, 4933, 1109, 6351, 166, 243, 3400, 244, 2054, 612, 659, 664, 1595, 4315, 245,
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1659, 6274, 5976, 921, 1992, 2583, 2589, 82, 4232, 3650, 6198, 4710, 2138, 6292,
5552, 1910, 6211, 5763, 209, 5379, 1254]. Binary-BCD [1255, 3028, 1262, 1812,
4280, 3217, 3547, 2853, 2668, 2856, 2495, 2357, 1191, 5699, 1, 4148, 1387, 1706,
218, 382, 3065, 4494, 4637, 668, 804, 3840, 5482, 1195, 6250, 2721, 3598, 6041,
4805, 1627, 5803, 2537, 1965, 5641, 2407, 1419, 1876, 3624, 5511, 5645, 3291,
3292, 2771, 3303, 5255, 5258, 772, 4548, 4687, 4688, 6502]. Binary-Coded-Decimal
[1558, 1566]. Binary-Coded-Ternary [5056, 1109]. Binary-Decimal [2470]. Binary-Integer
Binary-Integer-Residue-Complex [3840, 3291, 3292]. Binary-to-Decimal [2797, 5822, 141,
208, 1364, 243]. Binary-to-Multidigit [4951]. Binary/Ternary [5588, 5687, 6026, 6138].
Bipartite [4853, 5292, 3434, 3739, 4022]. Bipolar [2879]. Biquad [1827]. Biquinary
[782]. Birmingham [6734, 6664]. Birthday [6703]. Bis [57]. Bisect [3179, 6350, 3627,
3178, 3353]. Bisection-like [3353]. BIST [4678]. BIT [201, 212, 3645, 2986, 5544,
4873, 1158, 5358, 3912, 4878, 2815, 1552, 5898, 4446, 1561, 6315, 4267, 5386, 2836,
5180, 3210, 324, 5049, 2037, 4469, 2045, 2355, 4478, 5811, 4301, 6024, 4932, 545,
4498, 2377, 4502, 3843, 6461, 2896, 5082, 622, 5312, 4657, 1959, 3734, 4344,
4963, 5316, 2917, 1501, 1728, 1502, 5506, 1735, 2238, 2422, 3134, 6500, 1510,
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2271, 2135, 5347, 6505, 5270, 1903, 5020, 4872, 5352, 4713, 3349, 4585, 4090,
4884, 1916, 1554, 3008, 4890, 4891, 2309, 4742, 3015, 3946, 4609, 3519]. bit
[1362, 1563, 3365, 289, 4453, 6320, 5045, 2654, 3380, 1575, 2344, 2345, 2490,
3828, 2349, 2676, 2351, 2352, 2353, 2354, 2184, 2495, 2862, 4627, 5066, 5067,
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3597, 4806, 4809, 4810, 2410, 4361, 4041, 3126, 1877, 2942, 4046, 4823, 3878,
2429, 6264, 1434, 1982, 1218, 1653, 2775, 3140, 3881, 3882, 5813, 2254, 1891].
bit-complexity [1401]. bit-flip [5787]. Bit-Level [5989, 2815, 4498, 5707]. Bit-Manipulations
[6024]. bit-map [3134]. Bit-Parallel [5358, 5386, 4301, 5082, 5312, 5316, 5049, 2917,
4541, 4872, 4891, 3828, 4928, 3597, 3881, 3882], Bit-Pipelined [2355, 2184, 2495].
bit-reproducible [5818]. Bit-Sequential [1158, 1959, 1501, 1728, 1502, 2130, 2410]. Bit-Serial
[4873, 1561, 4267, 5386, 4469, 2045, 4932, 4502, 2836, 3210, 2135, 3519, 4810,
2942, 1653, 2254]. bit-slice [1903, 1218]. Bit-Sliced [5544, 4344]. bit-vector [5347]. Bit-Width
[5611, 4742, 5222]. Bits [4846, 4074, 409, 412, 2502, 5791, 6166, 1891]. bitwise
Oriented [4126]. butterfly [1709, 1671].

8 ADDITIONAL CONTRIBUTIONS FROM NELSON H. F. BEEBE

561, 624, 6624, 5802, 171, 3859, 813, 1632, 1864, 6878, 967, 390, 761, 2933, 686, 815, 5506, 2751, 1039, 1911, 3173, 3352, 4589, 4727, 4929, 3802, 2298, 70, 5033, 5369, 3937, 2305, 6640, 6762, 4607, 1171, 1246, 1172, 1693, 1262, 798, 1178, 5773, 2487, 6665, 2043, 2672, 4296, 865, 1012, 6453, 1490, 4515, 3096, 1204, 1293, 5804, 195, 3271, 2230, 2231, 4974, 4975, 4357, 4358, 4531, 118, 5423, 4986, 2764, 2421, 3133, 5867, 1429, 1430, 519, 2565, 521, 1886, 2578, 2593, 1579, 2512, 6939, 6742, 1743, 964.

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Compute-Bound [2921, 2741, 2920].

Computed [2747, 2210].


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6424, 6536, 2273, 3902, 4233, 4572, 4710, 3491, 1454, 1670, 3165, 361, 4874, 2278, 2451, 4236, 5986, 5354, 5148, 5356, 4875, 1068, 3788, 6914, 6429, 1677, 2997, 315, 2998, 5032, 5366, 6885, 6212, 2464, 3008, 2154, 4739, 3667, 1354, 1556, 1089, 5569, 5570, 5765, 3670, 3015, 5905, 3946, 851, 3364, 4107, 1794, 6103, 1360, 1249, 853, 370, 4751, 413, 5578, 1253, 447, 3684, 3956, 6324, 1926, 4464, 5586, 5587, 4908, 5186, 588, 494, 1179, 6692, 6580, 6656.

Design

Design

Designed

Desirable

Desynchronization

Details

Detect

Detectable

Detecting

Detection

Determinants

Determine

Determining

Determinism

Deterministic

Deutschland

Developed

Developers

Developing

Development

Desk-Calculator
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division [2064, 2894, 431, 4001, 3414, 3586, 4004, 4795, 4649, 2905, 4801, 4342, 4659, 117, 148, 3856, 3857, 1031, 751, 3274, 3108, 3109, 3438, 4814, 6468, 3448, 3745, 2412, 2413, 275, 4191, 4192, 1135, 1422, 5104, 1404, 2417, 3877, 4198, 4681, 4832, 4833, 1216, 2110, 2775, 2778, 4834, 4684, 4393, 4202, 1943, 244, 1719, 1434].


DMT [4692]. DNA [4465]. DNA-based [4465]. DNS [5182, 5183].

Do [4573, 1375, 4253, 5835, 3366, 3042, 4284, 1288]. Document [6034].

Documentation [5923, 562]. Documents [3771]. Does [5882, 2462, 2].


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Dot-Product [6423, 6339, 3226, 6368]. dot-products [5590].

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[3281]. Konvertierung [1924]. Konvertierungs Routinen [2424]. Konvolutionssumme
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[1288]. KY [6872]. Kyoto [6987, 3129].

L [1440, 6483, 1621, 4695, 4874, 4887, 2332, 4936]. L-U [2332]. L
[24, 1622]. l.s.d [2102]. label [2968]. Laboratories [69, 89, 2692].
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[6746, 6808, 6894]. Lagrange [5012]. Lahey [3771]. Lake [6931, 6952]. Lakes
[6881, 6940, 6808, 6824]. Lancaster [6696]. Lanczos [3942, 5074]. Land
[6143]. Language [6698, 6882, 2796, 1677, 1348, 4242, 4243, 4244, 1467, 4106,
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Modula-3 [3032, 2711] · Modular [1048, 6503, 3643, 4216, 4859, 5340, 5737, 5265, 5980, 1530, 3898, 2135, 5348, 5146, 5987, 4576, 5150, 5151, 3352, 5155, 2621, 5750, 5028, 6305, 3805, 5998, 6213, 2632, 4103, 4260, 5766, 6315, 5907, 6317, 6442, 3367, 5044, 2837, 5178, 3538, 5589, 1180, 5591, 6116, 3040, 5292, 4288, 5466, 3051, 4475, 3984, 4301, 6139, 270, 3717, 5073, 5478, 1842, 2511, 5948, 736, 3419, 3727, 4959, 4334, 2724, 5956, 4015, 5229, 4182, 6376, 5502, 816, 1133, 2938, 3123, 5242, 4367, 2772, 4378, 4379, 1436, 5868, 6528, 5260, 6057, 3778, 4225, 6505, 5145, 6203, 5277, 3798, 3009, 6487, 3941, 2611, 4119, 4460, 5390] · modular [3957, 4621, 4914, 4139, 4303, 4483, 1274, 4782, 4784, 5220, 5633, 6260, 2752, 2939, 4676, 5112, 3135, 3761, 5256, 4997, 6529, 4841]. Modular-Multiplication [2511] · modulation [4138, 4057] · Modulator [119, 3906].

Module [3771, 1455, 1079, 2631, 2369, 3415, 3100, 4352, 3454, 4219, 2273, 1234, 2302, 2881, 4661, 5647] · Modules [1528, 4412, 4482, 3415, 4774, 3267] · Moduli [5869, 5879, 3816, 6317, 1691, 4755, 6112, 6324, 5185, 889, 5234, 4051, 4379, 3314, 3315, 4843, 1226, 1662, 4572, 4710, 5145, 3916, 4580, 2863, 4652, 1858, 1958, 4972, 4033, 4034, 4055, 2774].

Modulo [4549, 4700, 5540, 6082, 780, 642, 838, 5832, 5374, 4612, 4903, 6324, 5586, 3934, 6334, 1268, 4134, 5932, 4932, 4940, 5225, 3908, 3423, 4324, 1860, 170, 5490, 4667, 4536, 4376, 6401, 972, 4062, 2574, 3891, 4733, 4885, 4892, 1257, 3838, 1856, 4651, 4520, 2925, 5507, 2570].

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545, 3565, 382, 734, 4500, 2513, 5948, 2719, 2720, 3924, 221, 2397, 3429, 1497, 6812, 1863, 4665, 758, 2746, 3867, 4669, 5093, 5094, 5424, 6054, 435, 2422, 1309, 5966, 3134, 912, 2719, 2720, 2904, 193, 221, 2397, 3429, 1497, 6812, 1863, 4665, 758, 2746, 3867, 4669, 5093, 5094, 304, 2548, 2937, 5170, 798, 6447. multiple [2179, 2180, 3224, 6515, 553, 4498, 4499, 5850, 3590, 4177, 2532, 2533, 4356, 1968, 274, 4191, 4983, 5508, 2243, 1310, 5250, 4058, 4546, 1064, 4786].

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Multiple-modulus [1911]. Multiple-Precision [833, 922, 1065, 1066, 1155, 5746, 4434, 2422, 3192].

Multiple-Precision-arithmetic [3004]. Multiple-Radix [5565].

Multiple-Radix [5565].

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5845, 4942, 4644, 4830]. Multiply-Add-Fused [5203, 5204, 5205, 4772, 4672].
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[5727, 3146, 6009]. mystery [2095].

NAF [4645]. Names [4282, 3415]. N.A.N [6435, 6540]. Nancy [6912],
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Perfect [1558]. Nearest [6481, 6010, 6011, 5608, 5692, 5318, 5417, 5799].
Nears [3670]. nebst [561]. Necessary [4418, 3980, 738, 3450, 4195]. Need
[1663, 1375, 5240, 3759, 5768]. Needed [1251, 3415, 3420, 509, 757, 5087].
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[1899]. NS32532 [2127, 2169]. NS32532-NS32580 [2127]. NS32580 [2127].
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Optical [1559]. Optical [2960, 2141, 2329, 2176, 1600, 2370].
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Optimations [3892, 3363, 4104, 4519, 4389, 4568, 5625, 6036]. optimize [5696, 6173]. Optimized [4690, 3634, 6277, 6433, 5458, 4113, 6339, 6026, 6138, 5939, 2706, 6247, 6364, 5796, 5501, 6497, 3588, 5626, 4813, 3176].
Optimizing [5279, 5998, 485, 2307, 1797, 6105, 5837, 5184, 2497, 4929, 3235, 4791, 3283, 4054, 5652, 1452, 4440, 4143, 2758, 4195, 2559].
Optimum [823, 3466, 315, 5063, 2103, 2667, 1891]. Options [935, 1001, 2080, 2255].
Optoelectronic [4101, 6524, 3709]. Oracle [6530]. Oracle-free [6530].
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[2727, 2728, 3091, 3593, 6369, 5416, 2731, 2911, 1721, 2527, 3094, 4802, 5488, 5309, 6325, 6253, 2218, 960, 2225, 962, 3097, 2226, 4519, 5489, 2227, 2738, 4816, 1495, 6168, 1629, 432, 1630, 6169, 5636, 3860, 4966, 1498, 4020, 2539, 1413, 1724, 4811, 4968, 2228, 4028, 4354, 4665, 4969, 5637, 4526, 4971, 2921, 1725, 5501, 5719, 2540, 3616, 3617, 2232, 5806, 6052, 3281, 5960, 5961, 6379, 1969, 1970, 1638, 2933, 5807, 2546, 4816, 815, 1297].

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[5814, 6405, 5438, 5519, 5001, 5260, 5123, 6406, 5563, 5751, 5892, 4538, 6178, 4197, 2415, 2552, 2553, 2940, 4984, 4985, 1424, 5425, 1738, 5105, 5426, 2763, 3452, 2765, 6470, 3288, 6175, 1308, 469, 4987, 5724, 6396, 3759, 3132, 6058, 6263, 2245, 3876, 6472, 199, 6183, 1427, 1650, 2561, 4993, 5114, 5252, 5253, 5434, 5435, 5512, 5515, 6264, 1510, 1314, 1982, 5649, 2949, 2950, 5811, 200, 3139, 2248, 2600, 4199, 5968, 1746, 4384, 5117, 2569, 771, 2958, 1655, 3462, 5259, 5652, 4061, 917, 1890, 6501]. Point

[5814, 6405, 5438, 5519, 5001, 5260, 5123, 6406, 5563, 5751, 5892, 4538, 6178, 4197, 2415, 2552, 2553, 2940, 4984, 4985, 1424, 5425, 1738, 5105, 5426, 2763, 3452, 2765, 6470, 3288, 6175, 1308, 469, 4987, 5724, 6396, 3759, 3132, 6058, 6263, 2245, 3876, 6472, 199, 6183, 1427, 1650, 2561, 4993, 5114, 5252, 5253, 5434, 5435, 5512, 5515, 6264, 1510, 1314, 1982, 5649, 2949, 2950, 5811, 200, 3139, 2248, 2600, 4199, 5968, 1746, 4384, 5117, 2569, 771, 2958, 1655, 3462, 5259, 5652, 4061, 917, 1890, 6501].

Point

[5814, 6405, 5438, 5519, 5001, 5260, 5123, 6406, 5563, 5751, 5892, 4538, 6178, 4197, 2415, 2552, 2553, 2940, 4984, 4985, 1424, 5425, 1738, 5105, 5426, 2763, 3452, 2765, 6470, 3288, 6175, 1308, 469, 4987, 5724, 6396, 3759, 3132, 6058, 6263, 2245, 3876, 6472, 199, 6183, 1427, 1650, 2561, 4993, 5114, 5252, 5253, 5434, 5435, 5512, 5515, 6264, 1510, 1314, 1982, 5649, 2949, 2950, 5811, 200, 3139, 2248, 2600, 4199, 5968, 1746, 4384, 5117, 2569, 771, 2958, 1655, 3462, 5259, 5652, 4061, 917, 1890, 6501].
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1563, 2316, 234, 163, 289, 2649, 3810, 2320, 1799, 4268, 4751, 3811, 2477, 3949,
3019, 3950, 3676, 3526, 5686, 3951, 4455, 4613, 6319, 3681, 5043, 2834, 2835].
point [3193, 3528, 4114, 6221, 1005, 3022, 3371, 3529, 1254, 1366, 4905, 1176,
1923, 3531, 2165, 3372, 1367, 1259, 3198, 3029, 3957, 2166, 3377, 5391, 4463,
2839, 2480, 3030, 1261, 2654, 5182, 5183, 1693, 2841, 6225, 6331, 6445, 5587,
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1576, 3216, 5838, 6017, 6120, 6229, 2334, 185, 2034, 3966, 3544, 6233, 2173,
2849, 3041, 3217, 2175, 2340, 2341, 2176, 3042, 1934, 601, 2038]. point
[2039, 3385, 3547, 3548, 4131, 4133, 5604, 4622, 2853, 3219, 3387, 3550, 3220,
5925, 603, 452, 716, 2344, 2345, 3221, 3222, 2346, 2347, 718, 719, 1186, 240,
4917, 2491, 2181, 2043, 1584, 293, 498, 4766, 4767, 2676, 1187, 1188, 2351, 2353,
2354, 2858, 1700, 1823, 1483, 1701, 5468, 3556, 3829, 4294, 3054, 3228, 1936,
4770, 5470, 4474, 866, 2862, 3391, 5196, 801, 868, 942, 1942, 5927, 4143, 5929,
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6454, 3832, 3833, 5696, 5067, 6027, 331, 727, 2362, 2683, 2866, 3056, 4481, 5699,
5935, 5841, 5785, 6492, 4774]. point [3707, 4308, 4487, 333, 4489, 3836, 4775,
502, 547, 657, 5474, 1706, 5207, 3563, 5475, 5787, 1590, 5209, 5210, 4150, 5845,
4777, 6354, 2193, 1838, 1018, 1944, 1274, 1708, 2879, 3570, 549, 614, 729, 730,
382, 3572, 662, 663, 948, 550, 5846, 2195, 4779, 1945, 1946, 949, 880, 3065, 6030,
3066, 1393, 2506, 4494, 4637, 5620, 5941, 3068, 2197, 2060, 6516, 6151, 2698,
4942, 2198, 5212, 3074, 1597, 6460, 3077, 1598, 1599, 669, 2508, 2199, 5621,
5707, 3407, 5214, 4785, 4944, 5216, 5217, 5218, 5299, 5411, 2509, 1948, 3842,
4946, 5301, 301, 1843, 2201, 2380, 2383, 2385, 2704, 3580]. point [5851, 1396,
3843, 2063, 2892, 2893, 888, 5485, 5302, 2386, 2387, 953, 4163, 3247, 4644, 2897,
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556, 4795, 5222, 5713, 6038, 459, 4165, 3085, 3086, 5223, 5414, 5952, 5714, 954,
4168, 4010, 4171, 5627, 737, 955, 3728, 4011, 4650, 3261, 4798, 619, 1287, 1953,
5628, 5487, 2209, 192, 674, 958, 2210, 2906, 2211, 3730, 2212, 2213, 2524, 3263,
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745, 5798, 6044, 5493, 5494, 5716, 6047, 5634, 3856, 3857, 4018, 1296, 4809, 4521,
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748, 1962, 2225, 2538, 2087, 6548, 4810, 5862, 752, 683, 684, 3109, 3740, 4029,
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4357, 4358, 4531, 4976, 4977, 4978, 5095, 5096, 5097, 5098, 5099, 5100, 5235,
5236, 5237, 5238, 5322, 5323, 5324, 5325, 5326, 2750, 2934, 1733, 1419, 2236,
274, 1420, 1973, 1974, 4672, 3620, 4041, 357, 305, 4190, 4674, 817, 2758, 2759,


5637, 224, 3753, 5424, 5428, 6397, 4991, 5259, 6474, 4078, 4079, 4711, 3496, 4089, 5827, 6486, 5899, 3933, 4595, 3512, 3595, 1250, 3810, 5768, 4110, 4753, 5583, 3817, 2857, 3830, 4155, 3713, 4952, 4001, 4647, 4505, 5627, 4814, 3621, 4195, 2555, 2557, 3134, 4381, 3300]. Power-Delay [3050, 4052].


**Precise** [2115, 3767, 2594, 5904, 3536, 3963, 4759, 6357, 3269, 4974, 4975, 4379, 5027, 2170, 6036, 5328, 5329, 4296, 4142]. Precision [6047, 5655, 5970, 3465, 4551, 6268, 3771, 1443, 3642, 4857, 6280, 4697, 6281, 6282, 700, 833, 922, 1064, 1065, 1066, 1155, 1227, 4867, 5267, 5542, 6084, 6290, 5349, 5270, 6293, 3492, 3493, 362, 5555, 6296, 6297, 6427, 5556, 5746, 6087, 1541, 284, 1345, 1543, 5749, 207, 3350, 6204, 4434, 4435, 4587, 6431, 591, 4439, 3355, 5455, 5567, 6213, 5999, 931, 407, 4893, 5160, 5459, 6437, 4265, 4452, 5575, 4750, 854, 6441, 4752, 6323, 4274, 6222, 6327, 6328, 6224, 10, 2167, 3958, 4122, 4123, 4756, 4907, 5186, 1475, 1804, 1928, 77, 1098, 3211, 324, 4467, 3214, 3382, 5597, 6118].

**Precise** [5924, 6121, 6336, 6019, 6122, 1696, 3968, 5604, 3694, 6338, 329, 5467, 1702, 1824, 4920, 4922, 5469, 3700, 330, 5694, 6022, 6135, 5403, 6456, 2049, 4304, 4632, 4930, 6025, 6137, 5842, 5203, 5205, 6028, 1389, 6143, 3396, 2499, 6458, 3565, 6145, 4786, 2055, 2194, 4156, 665, 1275, 1837, 5619, 5943, 6154, 734, 6155, 6156, 6362, 343, 344, 3080, 5708, 6033, 6461, 5791, 3246, 5077, 1282, 4957, 2719, 2720, 191, 4511, 193, 6369, 2731, 3246, 221, 4516, 4517, 679, 742, 4345, 3429, 5569, 6165, 6374, 682, 1497, 1863, 4352, 3436, 4184, 2228, 2229, 5501, 2746, 3118, 3867].

Precision [4669, 5093, 5094, 304, 5422, 4039, 5327, 356, 5424, 174, 1882, 4045, 5243, 6392, 1039, 1309, 5966, 5114, 5512, 5515, 5649, 4384, 971, 5812, 5969, 6554, 438, 6405, 6475, 5518, 6476, 6477, 6406, 5965, 6178, 4587, 3313, 693, 5816, 979, 280, 2973, 4409, 5666, 5736, 5876, 6480, 5444, 4861, 6283, 3899, 4077, 4227, 4228, 4565, 834, 923, 5446, 4707, 3489, 2276, 3784, 1234, 363, 364, 5747, 5359, 5557, 4087, 4431, 4880, 3797, 4090, 6096, 4248, 4249, 2010, 1550, 1679, 5032, 3004, 5761, 6432, 2013, 3806, 3933, 4594, 707, 4098, 6539, 3187, 5170, 4607, 5768, 3950, 6111, 6218]. precision [6219, 1253, 3679, 6319, 9, 5182, 5183, 600, 415, 798, 1476, 2661, 856, 6226, 5590, 6447, 1816, 6449, 6450, 5839, 2039, 2179, 2180, 3043, 1378, 1586, 2678, 5693, 607, 6237, 5201, 5699, 5785, 5786, 3707, 4486, 333, 2870, 3563, 382, 731, 4779, 4636, 5406, 6358, 6544, 4943, 2884, 5074, 6153, 553, 2375, 669, 4498, 4499, 4500, 5850, 2513, 5485, 4791, 6449, 4650, 4177, 1289, 5087, 2217, 1291, 6161, 1205, 1960, 5798, 6044, 5492, 2086, 5496, 3098, 5862, 4661, 683, 3275,
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produce [6515, 4644]. produced [3126]. producing [4170]. Product [6757, 777, 5880, 6423, 6084, 5272, 3788, 1342, 2997, 4889, 4747, 5382, 6440, 4753, 6443, 6336, 6339, 5399, 3226, 6126, 1847, 4792, 4793, 4956, 6368, 1411, 1868, 5806, 6052, 2564, 3466, 1442, 5341, 5273, 1907, 3496, 2813, 3002, 3506, 6513, 3948, 4456, 1478, 3044, 3045, 3046, 3047, 3055, 5609, 5785, 3588, 5716, 760, 1869, 2941, 1646, 5119, 5437, 5333].

Production [6620]. productivity [6851].


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[5869, 6503, 4853, 4854, 6276, 6421, 1322, 1324, 3777, 4216, 4860, 474, 4383, 4931, 3997, 109, 1961, 6048, 683, 1506, 4828, 1889, 1753, 3780, 2136, 3496, 5747, 2298, 3951, 4455,
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6360, 2885, 2701, 5219, 6247, 1115, 5624, 5711, 3845, 555, 3418, 1487, 5083,
1955, 3393, 4298, 5701, 2871, 5702, 6543, 3396, 2369, 1591, 3403, 6360, 2885,
2701, 5219, 6247, 1115, 5624, 5711, 3845, 555, 3418, 1487, 5083, 1955, 3393,
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3845, 555, 3418, 1487, 5083, 1955, 3393, 4298, 5701, 2871, 5702, 6543, 3396,
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3418, 1487, 5083, 1955, 3393, 4298, 5701, 2871, 5702, 6543, 3396, 2369, 1591,
3403, 6360, 2885, 2701, 5219, 6247, 1115, 5624, 5711, 3845, 555, 3418, 1487,
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5711, 3845, 555, 3418, 1487, 5083, 1955, 3393, 4298, 5701, 2871, 5702, 6543,
3396, 2369, 1591, 3403, 6360, 2885, 2701, 5219, 6247, 1115, 5624, 5711, 3845,
555, 3418, 1487, 5083, 1955, 3393, 4298, 5701, 2871, 5702, 6543, 3396, 2369,
1591, 3403, 6360, 2885, 2701, 5219, 6247, 1115, 5624, 5711, 3845, 555, 3418,
1487, 5083, 1955, 3393, 4298, 5701, 2871, 5702, 6543, 3396, 2369, 1591, 3403,
6360, 2885, 2701, 5219, 6247, 1115, 5624, 5711, 3845, 555, 3418, 1487, 5083,
1955, 3393, 4298, 5701, 2871, 5702, 6543, 3396, 2369, 1591, 3403, 6360, 2885,
2701, 5219, 6247, 1115, 5624, 5711, 3845, 555, 3418, 1487, 5083, 1955, 3393,
4298, 5701, 2871, 5702, 6543, 3396, 2369, 1591, 3403, 6360, 2885, 2701, 5219,
6247, 1115, 5624, 5711, 3845, 555, 3418, 1487, 5083, 1955, 3393, 4298, 5701,
2871, 5702, 6543, 3396, 2369, 1591, 3403, 6360, 2885, 2701, 5219, 6247, 1115,
5624, 5711, 3845, 555, 3418, 1487, 5083, 1955, 3393, 4298, 5701, 2871, 5702,
6543, 3396, 2369, 1591, 3403, 6360, 2885, 2701, 5219, 6247, 1115, 5624, 5711,
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SC'06 [6911]. SC2002 [6860]. SC22 [5052, 5053, 5054].

Scalable [5763, 4887, 4904, 5591, 4795, 6169, 4350, 5502, 4367, 4372, 5117, 6528, 4841, 5001, 5260, 5859, 4676]. Scalar [1894, 5262, 4203, 6268, 5011, 2591, 5744, 5383, 4462, 5606, 5942, 4644, 4329, 4503, 4645, 4349, 4522, 4391, 5131, 5132, 3329, 6209, 2175, 2340, 2341, 2043, 1942, 2359, 6041, 2941, 5116, 6283]. Scalars [4522, 4780]. Scale [6557, 1771, 5754, 5566, 1371, 6765, 6162, 5420, 906, 2751, 6551, 3575, 6624, 6174]. scale-dependent [6174]. scalable [3878].

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tactics
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Taipei
Taiwan
take
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Takes
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tale
Talk
talks
Tall
Tall-Skinny
Tampa
Tanaka
Tang
Tangent
Tapered
Tapia
Tar
Target
Targeting
targets
Task
Taub
Taylor
TC
TC2
TC2/WG
TCCA
TDC
Teaching
Tech.
technical
Technique
techniques/floating
Technologies
Technology
techniques
Teil
telco
Telecommunications
teleoperator
Telephone
Telephony
Tempe
Ten
ten-thousandfold
ten
Tender
Tensor
TensorFlow
Tenth
Terabytes
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[1268, 665, 1116, 4012, 4174, 1224, 1937, 1939, 5108].
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them
[1221, 121, 4412, 3672, 5778, 879, 883, 1625, 3613, 2753, 2754, 4538,
3320, 6201, 27, 1915, 3193, 5392, 2333, 1831, 680, 4187, 2407, 354, 762,
1972, 2938, 5107, 3129]. them [6009]. Theorem [4552, 6770, 6854, 6841,
3910, 453, 4330, 4524, 524, 2272, 3500, 5043, 5507].
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[6286, 3408]. therefore [5209]. Thereof [6124]. Things [4075, 6549]. Third
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[7, 5135, 782, 3934, 4096, 846, 6112, 6012, 889, 1856, 4515, 170, 4020, 2097,
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[233, 1010, 6464, 5559, 3625]. thresholding [3432]. Throughput
[5442, 6195, 6127, 6131, 4924, 5489, 6375, 1144, 3491, 3284]. throughputs
[6313]. Thumb
[4330]. Thyrite
[101]. TI
[903, 3125, 4369, 4370]. TI-89
[4369, 4370]. TI-89/TI-92
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[2948]. tidal [3320]. Ties
[6481]. Tight
[6123, 6518, 5626, 4649, 5642, 3649, 3630].
tti
[1688, 619]. Tiling
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Sinha:1989:FPA

Sit:1989:MFP


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Vassiliadis:1989:SMF


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Vulchanov:1989:SCR


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Wang:1989:ADF


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Chen:1990:DIH


Chren:1990:NRN


Ciminiera:1990:HRS


Clinger:1990:HRF


Codenotti:1990:ATT


Cosnard:1990:STF

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Cyrix:1990:FCU


Darley:1990:TFC


Darley:1990:TFP


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insert k <-- 0 after assertion, and also delete k <-- 0 from Table 6.

2. Table 9 (page 125):
   for -1:USER"();
   substitute -1:USER"0);
   and delete the comment.

3. Table 10 (page 125):
   for fill(-k, "0")
   substitute fill(-k-1, "0")


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Teetz:1990:SNS


Tricker:1990:ERP


Tricker:1990:ERSa


Tricker:1990:ERSb


vanderVorst:1990:CBP

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Vuillemin:1990:ERC

Wallis:1990:IFP

Weber:1990:EHP

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- branch and bound algorithms for global optimization,
- constraint propagation,
- solution sets of linear systems,
- hardware and software systems for interval computations, and
- fuzzy logic.

Actual applications described in the book include:
• economic input-output models,
• quality control in manufacturing design,
• a computer-assisted proof in quantum mechanics,
• medical expert systems,
• and others.

A realistic view of interval computations is taken: the articles indicate when and how overestimation and other challenges can be overcome. An introductory chapter explains the content of the papers in terminology accessible to mathematically literate graduate students. The style of the individual, refereed contributions has been made uniform and understandable, and there is an extensive book-wide index. Audience: Valuable to students and researchers interested in automatic result verification. Detailed information, including contents, contributors, and an order form can be found:

• on Kluwer homepage http://www.wkap.nl, or

The information on the Interval Computations homepage is basically a mirror image of the Kluwer one (the only difference is that the fonts are fancier).

Schulte:1995:HDA


Schulte:1995:PSI

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Ito:1996:SRI


Jayasuriya:1996:MAU


Jessani:1996:FPU


Jullien:1996:VDS


Kahan:1996:BEC


Kahan:1996:DNS


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Kraemer:1996:CNI


Kreinovich:1996:CCI


Ley:1996:PDU


Li:1996:NNR


Lions:1996:AFF

Industry immediately started to investigate the failure. From the report: "The internal SRI software exception was caused during execution of a data conversion from 64-bit floating point to 16-bit signed integer value. The floating point number which was converted had a value greater than what could be represented by a 16-bit signed integer. This resulted in an Operand Error. The data conversion instructions (in Ada code) were not protected from causing an Operand Error, although other conversions of comparable variables in the same place in the code were protected."

Lo:1996:CBC


Louca:1996:IIS


Lozier:1996:EBL


Luther:1996:CAG


MacDonald:1996:NSS


Mayer:1996:SEI


Mikov:1996:LSA


Miner:1996:VIC


Moler:1996:CCF


Mraz:1996:ELB


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Blinn:1997:JBC


Bomar:1997:RNA


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Doring:1997:DAL


Drmac:1997:IJR


Drolshagen:1997:PES


EC:1997:IER


Edelman:1997:MPD


Even:1997:DIC

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Harrison:1997:FPV


Hasan:1997:DA


Hekstra:1997:FRL


Hiasat:1997:DIR


Hix:1997:CTV


Holmes:1997:CAP

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that of Ariane 4, which results in considerably higher horizontal velocity values.”.


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Batten:2000:NAD


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Parker:2000:MCAb


Parks:2000:NTT


Philippsen:2000:CNJ


Pillai:2000:LPA


Ploog:2000:MPB

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result. Interval arithmetic is an improvement on this, but still not an ideal solution because if the final interval is larger than desired, there is no simple way to restart the computation at higher precision. By contrast, in XR no precision level is set in advance, and no computation takes place until a final request takes place for some output. Despite this, programming with XR is no different from MPFP, except for the declaration of critical variables as type ‘XR’.

The main aim is to produce a usably efficient implementation, which can be easily interfaced with existing C++ code. This contrasts with previous implementations in functional languages (Haskell, Miranda etc.), which, although theoretically important, seem to be rather too slow for real use. This code is designed as an add-on to Victor Shoup’s arbitrary-precision arithmetic package NTL, and implements a new type XR, to complement NTL’s ZZ and RR integer and real types.

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\[
p(n) = \frac{2}{\pi} \int_0^\infty \frac{\sin(x)}{x} x^{n+1} \, dx,
\]
and that function is always a rational number. Its values are
\[
p(n) = 1, \frac{3}{4}, \frac{2}{3}, \frac{115}{192}, \frac{11}{20}, \frac{5887}{11520}, \frac{151}{315}, \frac{259723}{573440}, \ldots
\]
for \( n = 1 \) to 8.


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- branch and bound algorithms for global optimization,
- constraint propagation,
- solution sets of linear systems,
- hardware and software systems for interval computations, and
- fuzzy logic.

Actual applications described in the book include:

- economic input-output models,
- quality control in manufacturing design,
- a computer-assisted proof in quantum mechanics,
- medical expert systems,
- and others.

A realistic view of interval computations is taken: the articles indicate when and how overestimation and other challenges can be overcome. An introductory chapter explains the content of the papers in terminology accessible to mathematically literate graduate students. The style of
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the individual, refereed contributions has been made uniform and understandable, and there is an extensive book-wide index. Audience: Valuable to students and researchers interested in automatic result verification. Detailed information, including contents, contributors, and an order form can be found:

- on Kluwer homepage http://www.wkap.nl, or

The information on the Interval Computations homepage is basically a mirror image of the Kluwer one (the only difference is that the fonts are fancier).


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