

Set the range of the table. 1 to 1.6 corresponds to the first 12 pages of Babbage's 7 figure logarithms (6000 entries)

```
minlog = 1
1
maxlog = 1.600
1.6
```

Generate a table at large stepsize over the range. This can be compared to the table as a cross check and will be used to find a polynomial fit

```
Logtable = Table[{N[x, 40], N[Log[10, x], 40]}, {x, minlog, maxlog, 1 / 100}]
```

1.000	0
1.01000	0.004321373782642574275188178222937913219289
1.02000	0.008600171761917561048936692307945365975886
1.03000	0.01283722470517220517107119458023942439052
1.04000	0.01703333929878035484772184211580751113430
1.05000	0.02118929906993807279350526712325847591551
1.06000	0.02530586526477024084673118635174961946369
1.07000	0.02938377768520964083454123946143564612682
1.08000	0.03342375548694970231256149921433198113677
1.09000	0.03742649794062363520051330761387528664220
1.100	0.04139268515822504075019997124302424170670
1.11000	0.04532297878665743410347859279424475718310
1.12000	0.04921802267018161156717183749060830055633
1.13000	0.05307844348341972279522702860944818477838
1.14000	0.05690485133647259404510027373653765391945
1.15000	0.06069784035361168365403821752669652292932
1.16000	0.06445798922691847776032455241824104479067
1.17000	0.06818586174616164379656096445255904922999
1.18000	0.07188200730612538547439527925963726569493
1.19000	0.07554696139253075925238615292097322349114
1.200	0.07918124604762482772250569270410136273651
1.21000	0.08278537031645008150039994248604848341340
1.22000	0.08635983067474822909948740848181437603157
1.23000	0.08990511143939793180443975322329610873064
1.24000	0.09342168516223507009418188956740177584008
1.25000	0.09691001300805641435878331582652091969543
1.26000	0.1003705451175629005160109598273598386520
1.27000	0.1038037209559568642469874218272862585766
1.28000	0.1072099696478683664961722630714511873773
1.29000	0.1105897102992489637001160564843374680089
1.300	0.1139433523068367692065051579423284308297
1.31000	0.1172712956557642608100542706977385947802
1.32000	0.1205739312058498684727056639471256044432
1.33000	0.1238516409670857922485497343495655114347
1.34000	0.1271047983648076293628705239505616077178

Diffs[1]

```
{0.0000434271635244134203944256598, 0.0000434228221993613486334305086, 0.0000434184817394827512581537619,
  0.0000434141421445256141750837484, 0.0000434098034142380108270326842, 0.0000434054655483681021650888390,
  0.0000434011285466641366205741656, 0.0000433967924088744500770073922, 0.0000433924571347474658420725775}
```

Diffs[2]

```
{-4.341325052071760995151 × 10-9, -4.340459878597375276747 × 10-9,
  -4.339594957137083070013 × 10-9, -4.338730287603348051064 × 10-9, -4.337865869908661943845 × 10-9,
  -4.337001703965544514673 × 10-9, -4.336137789686543566773 × 10-9, -4.335274126984234934815 × 10-9}
```

Diffs[3]

```
{8.65173474385718405 × 10-13, 8.64921460292206733 × 10-13,
  8.64669533735018949 × 10-13, 8.64417694686107219 × 10-13,
  8.64165943117429172 × 10-13, 8.63914279000947900 × 10-13, 8.63662702308631959 × 10-13}
```

Diffs[4]

```
{-2.52014093511671 × 10-16, -2.51926557187784 × 10-16, -2.51839048911730 × 10-16,
  -2.51751568678047 × 10-16, -2.51664116481272 × 10-16, -2.51576692315941 × 10-16}
```

Diffs[5]

```
{8.7536323887 × 10-20, 8.7508276054 × 10-20, 8.7480233683 × 10-20, 8.7452196775 × 10-20, 8.7424165331 × 10-20}
```

Diffs[6]

```
{-2.804783 × 10-23, -2.804237 × 10-23, -2.803691 × 10-23, -2.803144 × 10-23}
```

Diffs[7]

```
{5.46 × 10-27, 5.46 × 10-27, 5.46 × 10-27}
```

Note how the higher order differences become very small. Hence we need a large number of digits in fixed point to retain adequate precision

Compute integer representations of the initial settings by scaling up by 10^{27} . The result column has 5 added to the 8th place so all results are automatically rounded to 7 digits. Negative differences are converted to 10's complement form. Note that because of the pipeline in the difference engine, earlier differences have to be taken from later rows of the table.

NumDigits = 27

27

```
Do[ Col[i] = If[Diffs[i][[4 - IntegerPart[i / 2]]] < 0, 10^NumDigits - FromDigits[
  RealDigits[Diffs[i][[4 - IntegerPart[i / 2]]], 10, NumDigits, -1][[1]]], FromDigits[
  RealDigits[Diffs[i][[4 - IntegerPart[i / 2]]], 10, NumDigits, -1][[1]]], {i, 0, 7}]
```

```
Col[0] = Col[0] + 5 * 10^(NumDigits - 8)
```

```
130325020149733084358878
```

```

Col[1]
43414142144525614175083

Col[2]
99999995660405042862916930

Col[3]
864669533735018

Col[4]
99999999999999748073442813

Col[5]
87508276

Col[6]
999999999999999999971953

Col[7]
5

```

Now compute an actual table as a final cross check. These numbers should match exactly the beginning of Babbage's 7 figure table. Note that the calculation is pipelined in the same way the physical difference engine is

```

Do[Print[PaddedForm[
  FromDigits[Take[Take[IntegerDigits[Col[0] + 10^NumDigits], -NumDigits], 7]],
  6, NumberPadding -> "0"]]; Do[Col[i] = Col[i] + Col[i + 1], {i, 0, 6, 2}];
Do[Col[i] = Col[i] + Col[i + 1], {i, 1, 5, 2}], {j, 1, 500}]
0001303
0001737
0002171
0002605
0003039
0003473
0003907
0004341
0004775
0005208
0005642

```

0006076
0006510
0006943
0007377
0007810
0008244
0008677
0009111
0009544
0009977
0010411
0010844
0011277
0011710
0012143
0012576
0013009
0013442
0013875
0014308
0014741
0015174
0015607
0016039
0016472
0016905
0017337
0017770
0018202
0018635
0019067
0019499

0019932
0020364
0020796
0021228
0021661
0022093
0022525
0022957
0023389
0023821
0024253
0024685
0025116
0025548
0025980
0026411
0026843
0027275
0027706
0028138
0028569
0029001
0029432
0029863
0030295
0030726
0031157
0031588
0032019
0032451
0032882
0033313

0033744
0034174
0034605
0035036
0035467
0035898
0036328
0036759
0037190
0037620
0038051
0038481
0038912
0039342
0039772
0040203
0040633
0041063
0041493
0041924
0042354
0042784
0043214
0043644
0044074
0044504
0044933
0045363
0045793
0046223
0046652
0047082

0047512
0047941
0048371
0048800
0049229
0049659
0050088
0050517
0050947
0051376
0051805
0052234
0052663
0053092
0053521
0053950
0054379
0054808
0055237
0055666
0056094
0056523
0056952
0057380
0057809
0058237
0058666
0059094
0059523
0059951
0060380
0060808

0061236
0061664
0062092
0062520
0062949
0063377
0063805
0064232
0064660
0065088
0065516
0065944
0066372
0066799
0067227
0067654
0068082
0068510
0068937
0069364
0069792
0070219
0070647
0071074
0071501
0071928
0072355
0072782
0073209
0073637
0074063
0074490

0074917
0075344
0075771
0076198
0076624
0077051
0077478
0077904
0078331
0078757
0079184
0079610
0080037
0080463
0080889
0081316
0081742
0082168
0082594
0083020
0083446
0083872
0084298
0084724
0085150
0085576
0086002
0086427
0086853
0087279
0087704
0088130

0088556
0088981
0089407
0089832
0090257
0090683
0091108
0091533
0091958
0092384
0092809
0093234
0093659
0094084
0094509
0094934
0095359
0095784
0096208
0096633
0097058
0097483
0097907
0098332
0098756
0099181
0099605
0100030
0100454
0100878
0101303
0101727

0102151
0102575
0103000
0103424
0103848
0104272
0104696
0105120
0105543
0105967
0106391
0106815
0107239
0107662
0108086
0108510
0108933
0109357
0109780
0110204
0110627
0111050
0111474
0111897
0112320
0112743
0113166
0113589
0114013
0114436
0114859
0115281

0115704
0116127
0116550
0116973
0117396
0117818
0118241
0118664
0119086
0119509
0119931
0120354
0120776
0121198
0121621
0122043
0122465
0122887
0123310
0123732
0124154
0124576
0124998
0125420
0125842
0126263
0126685
0127107
0127529
0127951
0128372
0128794

0129215
0129637
0130058
0130480
0130901
0131323
0131744
0132165
0132587
0133008
0133429
0133850
0134271
0134692
0135113
0135534
0135955
0136376
0136797
0137218
0137639
0138059
0138480
0138901
0139321
0139742
0140162
0140583
0141003
0141424
0141844
0142264

0142685
0143105
0143525
0143945
0144365
0144785
0145205
0145625
0146045
0146465
0146885
0147305
0147725
0148144
0148564
0148984
0149403
0149823
0150243
0150662
0151082
0151501
0151920
0152340
0152759
0153178
0153598
0154017
0154436
0154855
0155274
0155693

0156112
0156531
0156950
0157369
0157788
0158206
0158625
0159044
0159462
0159881
0160300
0160718
0161137
0161555
0161973
0162392
0162810
0163229
0163647
0164065
0164483
0164901
0165319
0165737
0166155
0166573
0166991
0167409
0167827
0168245
0168663
0169080

0169498
0169916
0170333
0170751
0171168
0171586
0172003
0172421
0172838
0173256
0173673
0174090
0174507
0174924
0175342
0175759
0176176
0176593
0177010
0177427
0177844
0178260
0178677
0179094
0179511
0179927
0180344
0180761
0181177
0181594
0182010
0182427

0182843
0183259
0183676
0184092
0184508
0184925
0185341
0185757
0186173
0186589
0187005
0187421
0187837
0188253
0188669
0189084
0189500
0189916
0190332
0190747
0191163
0191578
0191994
0192409
0192825
0193240
0193656
0194071
0194486
0194902
0195317
0195732

0196147
0196562
0196977
0197392
0197807
0198222
0198637
0199052
0199467
0199882
0200296
0200711
0201126
0201540
0201955
0202369
0202784
0203198
0203613
0204027
0204442
0204856
0205270
0205684
0206099
0206513
0206927
0207341
0207755
0208169
0208583
0208997

0209411

0209824

0210238

0210652

0211066

0211479

0211893

0212307

0212720