1 Report of Homework 1

What I found in homework 1 is pretty simple: One must be cautious while operating two numerical values when they are beyond the accuracy "dynamic range" of the type. Under single precision on a x86 platform, such dynamic range is 10^{-7}, and under double precision it's 10^{-15} .
Note that although the range of these two types of value are much bigger; the word "dynamic" here means two values cannot be too apart from each other in terms of magnitude when applying an operand between them, otherwise the smaller one will be deemed as 0, or in another word, omitted.
Other than this, the computing results are totally fine(accurate), so one should feel eased to just use single precision valuses as long as "out-of-dynamic-range" problem do not occur during all steps of the computing process.
The numerical results of homework 1 is in Figure 1($x = 1$) and Figure 2($x = 10$) . "x" chosen here is 1. We can see that in this case, the "out-of-dynamic-range" problem only occurs when using single precison; although fluctuation in value is large, double precision handles that just well. When "x" si 10 where fluctuation is not as large, even single precision is usable.

```
0th term of Jn_fp32 without rescaling: -1.#IND000000000000
1th term of Jn_fp32 without rescaling: -1.#IND000000000000
2th term of Jn_fp32 without rescaling: -1.#IND000000000000
3th term of Jn_fp32 without rescaling: -1.#IND000000000000
4th term of Jn_fp32 without rescaling: -1.#IND000000000000
5th term of Jn_fp32 without rescaling: -1.#IND000000000000
6th term of Jn_fp32 without rescaling: -1.#IND000000000000
7th term of Jn_fp32 without rescaling: -1.#IND000000000000
8th term of Jn_fp32 without rescaling: -1.#IND000000000000
9th term of Jn_fp32 without rescaling: -1.#IND000000000000
10th term of Jn_fp32 without rescaling: -1.#IND000000000000
11th term of Jn_fp32 without rescaling: -1.#IND000000000000
12th term of Jn_fp32 without rescaling: -1.#IND000000000000
13th term of Jn_fp32 without rescaling: -1.#IND000000000000
14th term of Jn_fp32 without rescaling: -1.#IND000000000000
15th term of Jn_fp32 without rescaling: -1.#IND000000000000
16th term of Jn_fp32 without rescaling: -1.#IND000000000000
17th term of Jn_fp32 without rescaling: -1.#IND000000000000
0th term of Jn_fp32 with rescaling: 0.7651977539062500
1th term of Jn_fp32 with rescaling: 0.4400505721569061
2th term of Jn_fp32 with rescaling: 0.1149034947156906
3th term of Jn_fp32 with rescaling: 0.0195633545517921
4th term of Jn_fp32 with rescaling: 0.0024766388814896
5th term of Jn_fp32 with rescaling: 0.0002497577515896
6th term of Jn_fp32 with rescaling: 0.0000209383379115
7th term of Jn_fp32 with rescaling: 0.0000015023258584
8th term of Jn_fp32 with rescaling: 0.0000000942234308
9th term of Jn_fp32 with rescaling: 0.0000000052492495
10th term of Jn_fp32 with rescaling: 0.0000000002630615
11th term of Jn_fp32 with rescaling: 0.0000000000119801
12th term of Jn_fp32 with rescaling: 0.0000000000005000
13th term of Jn_fp32 with rescaling: 0.0000000000000193
14th term of Jn_fp32 with rescaling: 0.0000000000000007
15th term of Jn_fp32 with rescaling: 0.0000000000000000
16th term of Jn_fp32 with rescaling: 0.0000000000000000
17th term of Jn_fp32 with rescaling: 0.0000000000000000
0th term of Jn_fp64 without rescaling: 0.7651976865579667
1th term of Jn_fp64 without rescaling: 0.4400505857449336
2th term of Jn_fp64 without rescaling: 0.1149034849319005
3th term of Jn_fp64 without rescaling: 0.0195633539826684
4th term of Jn_fp64 without rescaling: 0.0024766389641100
5th term of Jn_fp64 without rescaling: 0.0002497577302112
6th term of Jn_fp64 without rescaling: 0.0000209383380024
7th term of Jn_fp64 without rescaling: 0.0000015023258174
8th term of Jn_fp64 without rescaling: 0.0000000942234417
9th term of Jn_fp64 without rescaling: 0.0000000052492502
10th term of Jn_fp64 without rescaling: 0.0000000002630615
11th term of Jn_fp64 without rescaling: 0.0000000000119801
12th term of Jn_fp64 without rescaling: 0.0000000000005000
13th term of Jn_fp64 without rescaling: 0.0000000000000193
14th term of Jn_fp64 without rescaling: 0.0000000000000007
15th term of Jn_fp64 without rescaling: 0.0000000000000000
16th term of Jn_fp64 without rescaling: 0.0000000000000000
17th term of Jn_fp64 without rescaling: 0.0000000000000000
0th term of Jn_fp64 with rescaling: 0.7651976865579666
1th term of Jn_fp64 with rescaling: 0.4400505857449335
2th term of Jn_fp64 with rescaling: 0.1149034849319005
3th term of Jn_fp64 with rescaling: 0.0195633539826684
4th term of Jn_fp64 with rescaling: 0.0024766389641100
5th term of Jn_fp64 with rescaling: 0.0002497577302112
6th term of Jn_fp64 with rescaling: 0.0000209383380024
7th term of Jn_fp64 with rescaling: 0.0000015023258174
8th term of Jn_fp64 with rescaling: 0.0000000942234417
9th term of Jn_fp64 with rescaling: 0.0000000052492502
10th term of Jn_fp64 with rescaling: 0.0000000002630615
11th term of Jn_fp64 with rescaling: 0.0000000000119801
12th term of Jn_fp64 with rescaling: 0.0000000000005000
13th term of Jn_fp64 with rescaling: 0.0000000000000193
14th term of Jn_fp64 with rescaling: 0.0000000000000007
15th term of Jn_fp64 with rescaling: 0.0000000000000000
16th term of Jn_fp64 with rescaling: 0.0000000000000000
17th term of Jn_fp64 with rescaling: 0.0000000000000000
```

Figure 1: Numerical values of Bessel function (x=1).

```
0th term of Jn_fp32 without rescaling: -0.2459359169006348
1th term of Jn_fp32 without rescaling: 0.0434730648994446
2th term of Jn_fp32 without rescaling: 0.2546305358409882
3th term of Jn_fp32 without rescaling: 0.0583791546523571
4th term of Jn_fp32 without rescaling: -0.2196030318737030
5th term of Jn_fp32 without rescaling: -0.2340615838766098
6th term of Jn_fp32 without rescaling: -0.0144585473462939
7th term of Jn_fp32 without rescaling: 0.2167113125324249
8th term of Jn_fp32 without rescaling: 0.3178543746471405
9th term of Jn_fp32 without rescaling: 0.2918557226657867
10th term of Jn_fp32 without rescaling: 0.2074858993291855
11th term of Jn_fp32 without rescaling: 0.1231160759925842
12th term of Jn_fp32 without rescaling: 0.0633694604039192
13th term of Jn_fp32 without rescaling: 0.0289706289768219
14th term of Jn_fp32 without rescaling: 0.0119541659951210
15th term of Jn_fp32 without rescaling: 0.0045010349713266
16th term of Jn_fp32 without rescaling: 0.0015489392681047
17th term of Jn_fp32 without rescaling: 0.0004555703490041
0th term of Jn_fp32 with rescaling: -0.2459359169006348
1th term of Jn_fp32 with rescaling: 0.0434730648994446
2th term of Jn_fp32 with rescaling: 0.2546305358409882
3th term of Jn_fp32 with rescaling: 0.0583791546523571
4th term of Jn_fp32 with rescaling: -0.2196030318737030
5th term of Jn_fp32 with rescaling: -0.2340615838766098
6th term of Jn_fp32 with rescaling: -0.0144585473462939
7th term of Jn_fp32 with rescaling: 0.2167113125324249
8th term of Jn_fp32 with rescaling: 0.3178543746471405
9th term of Jn_fp32 with rescaling: 0.2918557226657867
10th term of Jn_fp32 with rescaling: 0.2074858993291855
11th term of Jn_fp32 with rescaling: 0.1231160759925842
12th term of Jn_fp32 with rescaling: 0.0633694604039192
13th term of Jn_fp32 with rescaling: 0.0289706289768219
14th term of Jn_fp32 with rescaling: 0.0119541659951210
15th term of Jn_fp32 with rescaling: 0.0045010349713266
16th term of Jn_fp32 with rescaling: 0.0015489392681047
17th term of Jn_fp32 with rescaling: 0.0004555703490041
0th term of Jn_fp64 without rescaling: -0.2459359071205824
1th term of Jn_fp64 without rescaling: 0.0434730537714501
2th term of Jn_fp64 without rescaling: 0.2546305178748725
3th term of Jn_fp64 without rescaling: 0.0583791533784989
4th term of Jn_fp64 without rescaling: -0.2196030258477731
5th term of Jn_fp64 without rescaling: -0.2340615740567174
6th term of Jn_fp64 without rescaling: -0.0144585482089443
7th term of Jn_fp64 without rescaling: 0.2167113162059842
8th term of Jn_fp64 without rescaling: 0.3178543908973222
9th term of Jn_fp64 without rescaling: 0.2918557092297313
10th term of Jn_fp64 without rescaling: 0.2074858857161941
11th term of Jn_fp64 without rescaling: 0.1231160622026570
12th term of Jn_fp64 without rescaling: 0.0633694511296513
13th term of Jn_fp64 without rescaling: 0.0289706205085060
14th term of Jn_fp64 without rescaling: 0.0119541621924644
15th term of Jn_fp64 without rescaling: 0.0045010336303944
16th term of Jn_fp64 without rescaling: 0.0015489386987187
17th term of Jn_fp64 without rescaling: 0.0004555702055055
0th term of Jn_fp64 with rescaling: -0.2459359071205824
1th term of Jn_fp64 with rescaling: 0.0434730537714501
2th term of Jn_fp64 with rescaling: 0.2546305178748725
3th term of Jn_fp64 with rescaling: 0.0583791533784989
4th term of Jn_fp64 with rescaling: -0.2196030258477731
5th term of Jn_fp64 with rescaling: -0.2340615740567174
6th term of Jn_fp64 with rescaling: -0.0144585482089443
7th term of Jn_fp64 with rescaling: 0.2167113162059842
8th term of Jn_fp64 with rescaling: 0.3178543908973222
9th term of Jn_fp64 with rescaling: 0.2918557092297313
10th term of Jn_fp64 with rescaling: 0.2074858857161941
11th term of Jn_fp64 with rescaling: 0.1231160622026570
12th term of Jn_fp64 with rescaling: 0.0633694511296513
13th term of Jn_fp64 with rescaling: 0.0289706205085060
14th term of Jn_fp64 with rescaling: 0.0119541621924644
15th term of Jn_fp64 with rescaling: 0.0045010336303944
16th term of Jn_fp64 with rescaling: 0.0015489386987187
17th term of Jn_fp64 with rescaling: 0.0004555702055055
```

Figure 2: Numerical values of Bessel function (x=10).