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In [3]: #question 4

import numpy as np
from prettytable import PrettyTable

#a function based on the formula given, taking x as input
def f_x(x):
    return ((np.e**x)-1)/x

#create a table with PrettyTable library, create 3 columns: value of i, value of x, value of the calculation result
myTable = PrettyTable(['i','x','result','r_error'])

#initiate the value i as 0
i = 0
#give ans a arbitrary value
ans = 1
#set approximate value as 1 and previous approximate as 0
app_val = 1
prev_appr = 0

#repeat the calculation as long as the ans is not zero
while (ans != 0):
    x = 2**(-i)
    ans = f_x(x)
    #calculate the relative error based on the formula: |current approximation-previous approximation|/approximation value
    r_error = abs(ans-prev_appr)/app_val
    #add a row with related info to the table
    myTable.add_row([i,x,ans,r_error])
    #increment the value of i by 1
    i += 1
    #update previous approximation with current approximation value
    prev_appr = ans

# print out the table and last i value)
print(myTable)
print("value of i that give the function zero: ", i-1)

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i	x	result	r_error	
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0	1	1.718281828459045	1.718281828459045	
1	0.5	1.2974425414002564	0.4208392870587887	
2	0.25	1.1361016667509656	0.1613408746492908	
3	0.125	1.0651876245346106	0.070914042216355	
4	0.0625	1.0319113426857491	0.033276281848861444	
5	0.03125	1.0157890399712883	0.0161223027144608	
6	0.015625	1.0078533495478865	0.007935690423401809	
7	0.0078125	1.00391644242535	0.0039369071225365815	
8	0.00390625	1.001955670616951	0.001960771808398931	
9	0.001953125	1.0009771985934321	0.0009784720235188615	
10	0.0009765625	1.0004884402344487	0.0004887583589834321	
11	0.00048828125	1.0002441803662805	0.0002442598681682284	
12	0.000244140625	1.0001220802469106	0.0001221001193698612	
13	0.0001220703125	1.0000610376391705	6.104260774009163e-05	
14	6.103515625e-05	1.0000305182002194	3.051943895115983e-05	
15	3.0517578125e-05	1.0000152589418576	1.5259258361766115e-05	
16	1.52587890625e-05	1.000007629438187	7.629503670614213e-06	
17	7.62939453125e-06	1.0000038146972656	3.814740921370685e-06	
18	3.814697265625e-06	1.0000019073486328	1.9073486328125e-06	
19	1.9073486328125e-06	1.0000009536743164	9.5367431640625e-07	
20	9.5367431640625e-07	1.0000004768371582	4.76837158203125e-07	
21	4.76837158203125e-07	1.000000238418579	2.384185791015625e-07	
22	2.384185791015625e-07	1.0000001192092896	1.1920928955078125e-07	
23	1.1920928955078125e-07	1.0000000596046448	5.960464477539063e-08	
24	5.960464477539063e-08	1.0000000298023224	2.9802322387695312e-08	
25	2.9802322387695312e-08	1.0000000149011612	1.4901161193847656e-08	
26	1.4901161193847656e-08	1.0	1.4901161193847656e-08	
27	7.450580596923828e-09	1.0	0.0	
28	3.725290298461914e-09	1.0	0.0	
29	1.862645149230957e-09	1.0	0.0	
30	9.313225746154785e-10	1.0	0.0	
31	4.656612873077393e-10	1.0	0.0	
32	2.3283064365386963e-10	1.0	0.0	
33	1.1641532182693481e-10	1.0	0.0	
34	5.820766091346741e-11	1.0	0.0	
35	2.9103830456733704e-11	1.0	0.0	
36	1.4551915228366852e-11	1.0	0.0	

37	7.275957614183426e-12		1.0		0.0	
38	3.637978807091713e-12		1.0		0.0	
39	1.8189894035458565e-12		1.0		0.0	
40	9.094947017729282e-13		1.0		0.0	
41	4.547473508864641e-13		1.0		0.0	
42	2.2737367544323206e-13		1.0		0.0	
43	1.1368683772161603e-13		1.0		0.0	
44	5.684341886080802e-14		1.0		0.0	
45	2.842170943040401e-14		1.0		0.0	
46	1.4210854715202004e-14		1.0		0.0	
47	7.105427357601002e-15		1.0		0.0	
48	3.552713678800501e-15		1.0		0.0	
49	1.7763568394002505e-15		1.0		0.0	
50	8.881784197001252e-16		1.0		0.0	
51	4.440892098500626e-16		1.0		0.0	
52	2.220446049250313e-16		1.0		0.0	
53	1.1102230246251565e-16		0.0		1.0	

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value of i that give the function zero: 53