Scientific Computing Lab 05

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Problem 1:

Output:

```
part (a): accurate value = 0.19225935773279607 and Gaussian Quadrature approximate =
0.19226870637091759
part (b): accurate value = -0.17682002012178924 and Gaussian Quadrature approximate =
-0.17681898945491187
part (c): accurate value = 0.088755284435257 and Gaussian Quadrature approximate =
0.08926301565713288
```

Problem 2:

We can consider, following definition of function given that $w_j < 0$

$$f(x) = \begin{cases} 0 & x < x_{j-1} \\ 0 & x > x_{j+1} \\ \sin \frac{x - x_{j-1}}{x_j - x_{j-1}} \frac{\pi}{2} & x_{j-1} \le x \le x_j \\ \sin \frac{x_{j+1} - x}{x_{j+1} - x_j} \frac{\pi}{2} & x_j \le x \le x_{j+1} \end{cases}$$

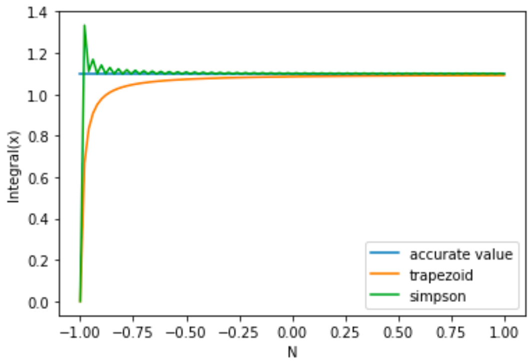
Consider $x_{n+1} = b$ and $x_{-1} = a$

Problem 3:

Output:

```
Accurate value = 1.0986122886681098
trapezoidal approximate = 1.3333333333333333
simpson approximate = 1.3333333333333333
Gaussian Quadrature approx = 1.0909090909090908

accurate value = 1.0986122886681098
Trapezoid approximate = 1.0919752503144537
Simpson approximate = 1.0986122939305363
```



Problem 4:

Output:

```
Accurate value = 0.6931471805599453
simpson approximate = 0.6931545306545307
Gaussian Q. approximate = 0.693121693121693
```

Problem 5:

For n=2 we are given a closed and open Newton-Cotes formula. We see that second case of approximation is better:

```
1st case for f(x) = sin(x) , error = 0.0001644957389245194
2nd case for f(x) = sin(x) , error = 0.00014439414802319694
1st case for f(x) = cos(x) , error = 0.00030110743037536913
2nd case for f(x) = cos(x) , error = 0.000264311715043708
1st case for f(x) = 1/(x+1) , error = 0.0012972638844990225
2nd case for f(x) = 1/(x+1) , error = 0.001083688496453239
```

Problem 6:

Output:

```
Accurate value = -C (Catalans Constant) = -0.915966
Gaussian Q. n=1 approximate = -0.25663098184519656
Gaussian Q. n=2 approximate = -0.7601832504223041
Gaussian Q. n=3 approximate = -0.8381514607952754
Gaussian Q. n=4 approximate = -0.8665745118193433
Gaussian Q. n=5 approximate = -0.8830329610520602
```