Project Idea for GSoC 2018

SciPy

Extending scipy.integrate

General Info

Required knowledge and skills: Python, understanding of Cauchy Integral Formula, Cauchy Integral Theorem, Vector Calculus, Integration of multivariable functions along the curves in both real and complex plane.

Difficulty level: Medium to Hard

Mentors: Not available till date

Description

Integration of functions along various curves in both complex and real planes is necessary and a very important requirement in science and technology. For example, Cauchy Integral Formula can be used to calculate higher derivatives of complex functions. Similarly, integrals of functions along various in real plane are used in various of physics like electrodynamics, optics(especially wave optics).

The main aim of this project is to extend scipy.integrate so that the computations of the integrals described above becomes easy. The two classes that can be added to scipy.integrate are, **CIntegrate** and **RIntegrate**.

The list of methods that would be present in RIntegrate:

1. __*lintegrate*__: This method would perform the integration of real functions along the real curves passed as arguments. This method would be useful for the ones described below.
2. __*divergence*__: This method will help to calculate the divergence of functions of the form, L(x,y,z)i+M(x,y,z)j+N(x,y,z)k.
3. __*volintegrate*__: This method will compute the volume integral of a function of the form, L(x,y,z)i+M(x,y,z)j+N(x,y,z)k over a given volume V.
4. __*surfintegrate*__: This method will compute the surface integral of a function over a given surface S.

The list of methods that would be present in CIntegrate:

1. __*ndiff*__: This method would return the n-th derivate of complex functions at the points passed as arguments. This would require the use of Cauchy Integral Formula for high precision.
2. __*cintegrate*__: This method would compute the integral of complex functions along the complex curves passed as arguments.

Apart from the methods described we can use the following theorems:

1. Stokes Theorem
2. Gauss Theorem
3. Divergence Theorem

References:

1. http://home.iitk.ac.in/~psraj/mth101/lecture_notes/lecture32.pdf
2. http://home.iitk.ac.in/~psraj/mth101/lecture_notes/lecture33.pdf
3. http://home.iitk.ac.in/~psraj/mth101/lecture_notes/lecture34.pdf
4. http://home.iitk.ac.in/~psraj/mth101/lecture_notes/lecture35.pdf
5. http://home.iitk.ac.in/~psraj/mth101/lecture_notes/lecture36.pdf
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7. http://home.iitk.ac.in/~psraj/mth101/lecture_notes/lecture38.pdf
8. http://home.iitk.ac.in/~psraj/mth101/lecture_notes/lecture39.pdf
9. http://home.iitk.ac.in/~gp/MSO202Lect2.pdf
10. http://home.iitk.ac.in/~gp/MSO202Lect3.pdf

If any developer is interested in mentoring me as a student in this project then I would be keen to develop these ideas further.

Feedbacks are positively welcomed.

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