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Speaker: Pamphile T. Roy

SciPy's updates around QMC and... SA

Pamphile T. Roy
Quansight, proy@quansight.com
Matt Haberland
California Polytechnic State University, San Luis Obispo, USA,

SciPy version 1.7.0 made Quasi Monte Carlo (QMC) available to millions of users [1]. Since then, the QMC module has steadily improved: with every new version we are adding more features and resolving bugs [2]. The QMC module includes the following functionalities:

- Sobol' and Halton sequences (scrambled and unscrambled),
- Sobol' can use variable bits, with $bits \in [0, 64]$,
- Poisson disk sampling,
- Latin Hypercube Sampling (centred, strength 1 or 2),
- Multinominal and Multivariate normal sampler,
- QMC integer sampling,
- Discrepancy measures (C^2, wrap around, star-L_2, mixed),
- Optimize a sample by maximizing the C^2 discrepancy or performing Lloyd-Max iterations,
- QMC Integration.

The first important usage in another widely used library we have seen is Optuna: a hyperparameter optimization framework. With their 3.0 major release, users are able to use *Sobol'* and *Halton* sequences. Additionally SALib: a sensitivity analysis framework; replaced its custom *Sobol'* code.

The team is also actively working on reworking SciPy's distribution interface which would natively allow to use QMC for sampling.

The next SciPy release (version 1.11) will introduce a Sensitivity Analysis (SA) method: *Sobol'* indices. This is a major milestone for the whole community and we hope it will

[1] 1 million download per day on average. Source: pypistats.org
[2] 1000 Pull Requests/Issues closed per year.

make SA more discoverable. The team is also actively working on an overhaul of SciPy's distribution interface, which will enable users to use QMC methods to sample from all SciPy distributions.

In this presentation, I will showcase these new developments and invite experts to help us push the boundaries of QMC and SA in SciPy.