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TheLastMetric: ML for statistically rigorous observing strategy optimization

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Most applications of ML in astronomy pertain to classification, regression, or emulation, however, ML has the potential to address whole new categories of problems in astronomical big data. This presentation uses ML in a statistically principled approach to observing strategy selection, which encompasses the frequency and duration of visits to each portion of the sky and impacts the degree to which the resulting data can be employed toward any scientific objective, let alone the net effect on many diverse science goals. Aiming to homogenize the units of observing strategy metrics across different science cases and minimize analysis model-dependence, we introduce TheLastMetric, a variational approximation to the lower bound of mutual information between a physical parameter of interest and anticipated data, a measure of the potentially recoverable information, under a given observing strategy. We demonstrate TheLastMetric in the context of photometric redshifts (photo-zs) from the upcoming Legacy Survey of Space and Time (LSST) on the Vera C. Rubin Observatory, showing qualitative agreement with traditional photo-z metrics and improved discriminatory power without assuming a photo-z estimation model. In combination with evaluations on other physical parameters of interest, TheLastMetric isolates the subjective assessment of relative priority of a science goal from the units-dependent sensitivity of its metric, enhancing the transparency and objectivity of the decision-making process. We thus recommend the broad adoption of TheLastMetric as an appropriate and effective paradigm for community-wide observing strategy optimization.

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