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Finding the needle in the haystack: finding what matters in biomedical imaging

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Abstract:

In the context of medical imaging, searching for objects of interest is an ubiquitous problem encountered at scales ranging from centimeter to nanometer. If anything, the severity of the problem has only worsened with the advent of cheaper and ever more sophisticated imaging devices, capable of producing enormous amounts of data that must be analyzed automatically. And while established search paradigms are showing their limits, faster methods capable of dealing with larger quantities of data are now indispensable.

Towards this end, I will present a Bayesian formulation of the traditional "twenty questions" game, with the goal of locating objects in biomedical image data. By sequentially asking a knowledgeable oracle "questions" and considering that the received answers are noisy, the goal is to determine a policy, or sequence of questions, that reduces the uncertainty of a target location as much as possible. I will show that dynamic programming and information theory can be used to characterize an optimal policy when minimizing the expected entropy of the distribution of target locations and that a greedy, Bayes-optimal and simple to compute solution is attainable. I will then present embodiments of this concept in the context of real applications in biomedical image analysis and the impact that it can bring when dealing with real clinical cases.

Host: Fabrizio Montesi