

Using Attribution-based Explainability to Guide Deep Molecular Optimization

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De novo molecular design is an optimization task where the objective is to find candidate molecules with desired properties. This task is however challenging given the size of the drug-like chemical space. The recently proposed Genetic expert guided learning (GEG) [1] framework has demonstrated impressive performances on several de novo molecular design tasks. Despite the displayed state-of-the-art results, the proposed system relies on an expert-designed Genetic expert. Although hand-crafted experts allow to navigate the chemical space efficiently, designing such experts requires a significant amount of effort and might contain inherent biases which can potentially slow down convergence or even lead to suboptimal solutions. In this research, we propose a novel genetic expert which is free of design rules and can generate new molecules by combining extracted molecular fragments. Fragments are obtained by using an additional graph convolutional neural network [2] which computes attributions [3] for each atom for a given molecule. Molecular substructures which contribute positively to the task score are kept and combined to propose novel molecules. We experimentally demonstrate that our attribution-based genetic expert is competitive on most tasks and even outperforms the previous state-of-the-art expert-designed genetic expert [4] when evaluating proposed candidate molecules is limited. Furthermore, we empirically show that combining several experts that share a fixed sampling budget at each optimization round either improves or maintains the overall performance of the framework.

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