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Biobrick Chain Recommendations for Genetic Circuit Design

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Abstract

Synthetic biology databases have collected numerous biobricks to accelerate genetic circuit design. However, selecting biobricks is a tough task. Here, we leverage the fact that these manually designed circuits can provide underlying knowledge to support biobrick selection. We propose to design a recommendation system based on the analysis of available genetic circuits, which can narrow down the biobrick selection range and provide candidate biobricks for users to choose. A recommendation strategy based on a Markov model is established to tackle this issue. Furthermore, a biobrick chain recommendation algorithm Sira is proposed that applies a dynamic programming process on a layered state transition graph to obtain the top k recommendation results. In addition, a weighted filtering strategy, WFSira, is proposed to augment the performance of Sira. The experimental results on the Registry of Standard Biological Parts show that Sira outperforms other algorithms significantly for biobrick recommendations, with approximately 30% improvement in terms of recall rate. It is also able to make biobrick chain recommendations. WFSira can further improve the recall rate of Sira by an average of 7.5% for the top 5 recommendations.

Keywords: Recommendation, Biobrick Chain, Markov, Genetic Circuit

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