Optimal Liquidity Pool Graphs

The inception of Bitcoin marked the creation of the first fully decentralized cryptocurrency relying on blockchain technology. Almost a decade later, Ethereum introduced the concept of smart contracts, which allowed for most parts of the financial system to be rebuilt in a decentralized manner using the blockchain. Decentralized Finance (DeFi) is the umbrella term for these financial applications running on the blockchain (mainly Ethereum), and their usage has been growing dramatically.

Decentralized exchanges (Uniswap, Sushiswap, Curve, etc.) are notable DeFi applications. They allow for transactions to take place on the blockchain without an intermediary. Most decentralized exchanges replace traditional order books with an automated market maker mechanism, whereby the liquidity of two cryptocurrencies is aggregated in what is referred to as a liquidity pool. This liquidity pool then facilitates trading between the pool's two cryptocurrencies. The exchange ratio is controlled by an algorithm and generally depends on the amount of reserved liquidity, as well as the ratio of the reserves. The larger a pol's reserves, the lower a trade's price slippage.

In the absence of a liquidity pool between cryptocurrencies X and Z, a trader can exchange the two cryptocurrencies by routing their trade through a set of liquidity pools. Assume there exists a liquidity pool between cryptocurrency X and cryptocurrency Y ($X \rightleftharpoons Y$), as well as a pool between cryptocurrency Y and cryptocurrency Z ($Y \rightleftharpoons Z$). Then the trader can first exchange X for Y in pool $X \rightleftharpoons Y$ and then Y for Z in pool $Y \rightleftharpoons Z$. When routing, the trader pays a transaction fee in every pool, thus making their trade more expensive.

We want to find the optimal liquidity pool graph, i.e., the graph ensuring that collectively traders are offered the best exchange ratio for their trades. In particular, we will study the balance between creating only a few pools, reducing the price slippage incurred by traders, and ensuring that the resulting graph offers short paths between all cryptocurrencies such that the trader's transaction fees are low.

Requirements: An interest and experience with graph theory is a plus. We will have weekly meetings to discuss open questions and determine the next steps.

Interested? Please contact us for more details!

Contact

- Lioba Heimbach: hlioba@ethz.ch, ETZ G95

- Judith Beestermöller: jbeesterm@ethz.ch, ETZ G94