Liquidity Tree Protocols With Pachira

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Outline

Who Am I

PACHIRA

Ian Moore, PhD

- Current:
  - Core Developer @ DeFiPy (2024-)
  - Syslabs Researcher (2022-)
  - Syscoin Foundation Advisor (2021-)
- Past:
  - Senior / Lead Data Scientist (2014-2020)
  - Adjunct Lecturer @ UofT (Biostats, 2010-2014)
  - Statistician (2009-2014)

Objectives

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Preamble

- Capital Efficiency
- CLMMs

Define our problem

- Define Stagnant Liquidity
- Stagnant Liquidity Problem

Present our Solution

- Liquidity Trees
- Simulation Results

What is Capital Efficiency?

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- Ability to maximize the utilization and productivity of capital within a DeFi ecosystem

$$\text{Capital Efficiency} = \frac{\text{Total Revenue}}{\text{Total Value Locked}}$$

- Lay Example:
  - Suppose we have a Uniswap V2 Liquidity Pool (LP)
  - Contains $\sim$ \$100K USD of Total Value Locked
  - On an arbitrary time interval, $\sim$ \$2-5K USD gets traded
  - These trades generate revenue on 0.3% swap fees
  - What about the remaining $\sim$ \$95-98K USD?
  - Poor capital efficiency
- This inactive capital is what's formally known as **Lazy Liquidity**

Solution: Concentrated Liquidity

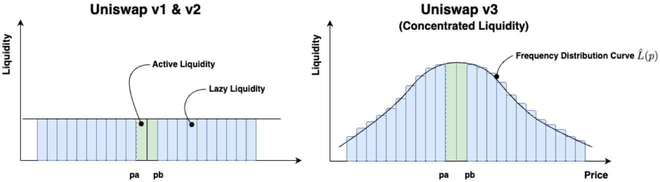

Figure: Liquidity Frequency Distributions trading between P_a and P_b: [RIGHT] Uniswap V1 & V2; [LEFT] Uniswap V3

Concentrated Liquidity Market Makers

Many DeFi protocols have applied the solution to this inefficiency using what's called a Concentrated Liquidity Market Maker (CLMM); well known CLMM protocols include:

- Uniswap V3 + forks:
  - Pancakeswap V3
  - Sushiswap V3
  - Quickswap V3
  - Apeswap V3
- Kyber Elastic
- Trader Joe v2
- Orca
- Raydium

Stagnant Liquidity Problem

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- Let $L(p)$ be our optimal liquidity frequency distribution, and $\hat{L}_{(MM)}(p)$ would our our market maker (MM) estimator
- Hence, we define stagnant liquidity as:

$$
\begin{aligned}
L_{(stagnant)} &= \int_{\mathbb{R}} \hat{L}_{(MM)}(p)dp - \int_{p_a}^{p_b} \hat{L}_{(MM)}(p)dp \\
&= L_{(total)} - \int_{p_a}^{p_b} \hat{L}_{(MM)}(p)dp
\end{aligned}
$$

Stagnant Liquidity Problem (2)

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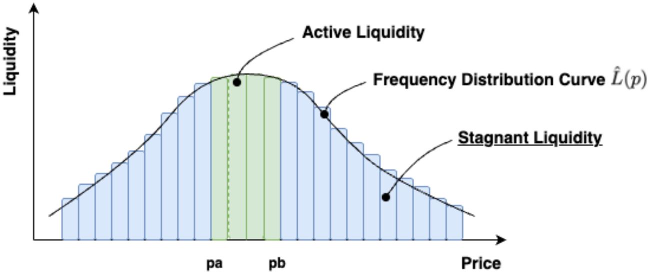

Figure: Optimized Liquidity Frequency Distribution (eg. Uniswap v3)

No matter what one does to address the lazy liquidity issue using CLMMs, there will always be a certain amount of stagnant liquidity remaining

Stagnant Liquidity Problem (3)

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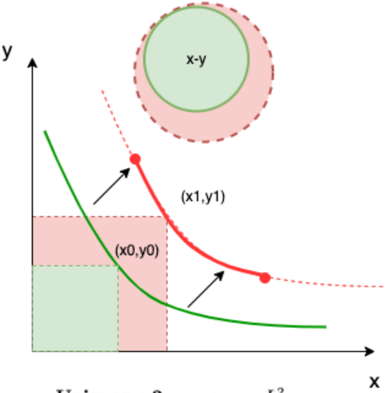
Problem?

- Given the estimate of our optimized MM liquidity frequency distribution (eg. $\hat{L}_{(CLMM)}(p)$)
- How do we increase trading volume on stagnated liquidity outside of the active liquidity band $[p_a, p_b]$?
- Stagnant Liquidity Problem

Solution

- Instead of adjusting the price curve as individual LPs using CLMMs, we address the problem via a network of LPs called Liquidity Trees
- Not mutually exclusive, hence complimentary to CLMMs
- Can implement both Liquidity Trees and CLMMs together (shall discuss)

Price Curve: Uniswap v3



$$\textbf{Uniswap v2:} \quad x_0 * y_0 = L_0^2$$
$$\textbf{Uniswap v3:} \quad x_1 * x_1 = L_1^2$$

$$L_1 > L_0$$

Figure: Graphical illustration on how depth is virtually increased using Uniswap v3

Indexing Problem: Posed

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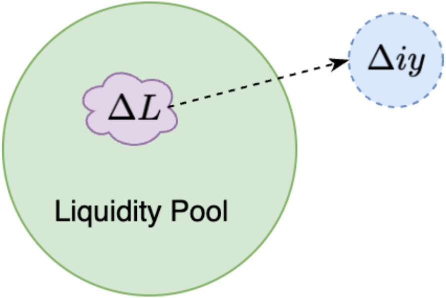
CPT Indexing Problem

- Given a position ΔL, what is the indexed value in only one of the two pairing assets (x,y)



Let's Include a new Dimension ...

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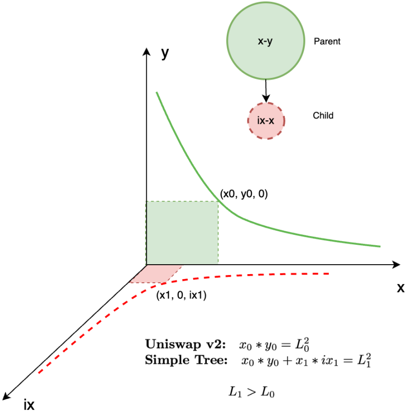

Figure: Include a new dimension (ix); liquidity ΔL gets indexed to Δix, and new market is formed on ix-x plane

How does this Work?

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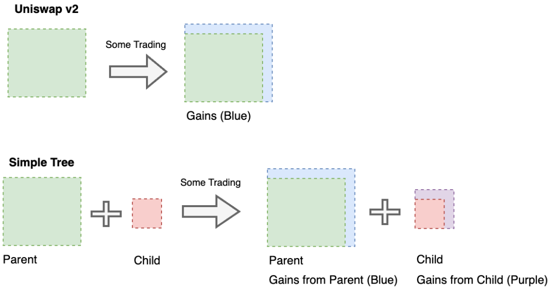

Figure: Boxes represent liquidity under CPT curve; creating a new market out of indexed liquidity indexed liquidity is a way to address the stagnant liquidity problem; in short we've leveraged some of the green, got red and made some extra purple

Full Tree

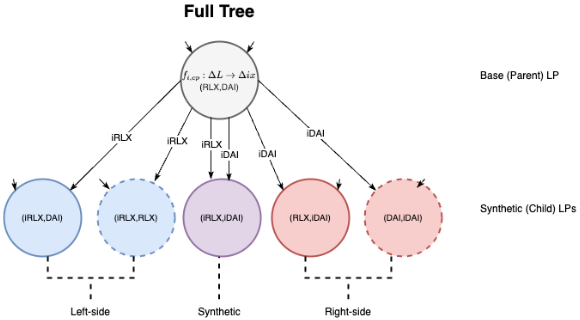

Figure: Full CPT liquidity tree represented as a computational tree structure comprised of left-sided, right-sided and synthetic pools

Liquidity Trees can be represented as computational graphs where nodes are denoted as DEX operations and arcs are denoted as indexed capital transitioning between the parent node and the child

Sub Trees

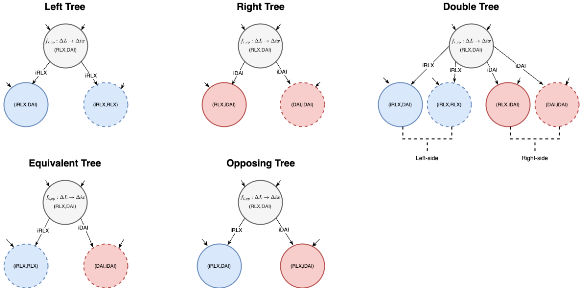

Figure: Sub-trees comprised of: (TOP LEFT) left tree; (TOP CENTER) right tree; (TOP RIGHT) double tree; (BOTTOM LEFT) equivalent tree; (BOTTOM CENTER) opposing Tree

Left Tree

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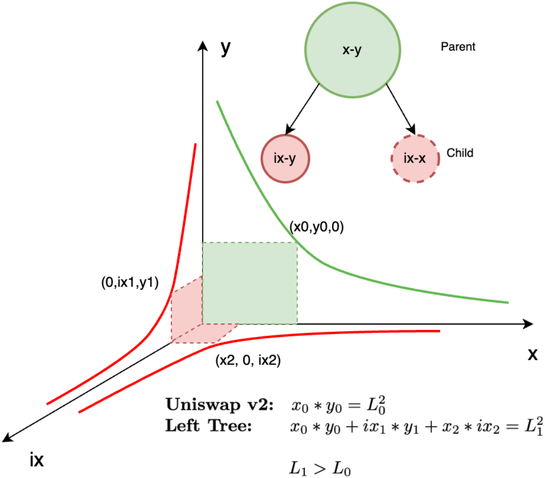
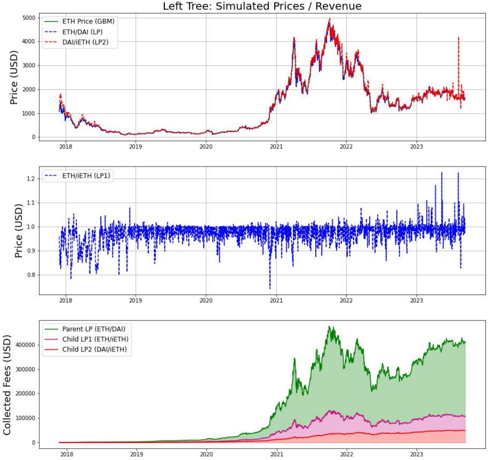


Uniswap v2: $x_0 * y_0 = L_0^2$

Left Tree: $x_0 * y_0 + ix_1 * y_1 + x_2 * ix_2 = L_1^2$

$L_1 > L_0$

Left Tree: Simulated Price / Revenue (1)



Left Tree: Simulated Price / Revenue (2)

Metric	Totals		
Revenue (LP) / LP Liquidity	19.4%		
Revenue (LP+LP1+LP2) / LP Liquidity	26.3%		
Revenue Boost (Indexed Liquidity)	35.61%		
Percentage Indexed	7.51%		
	Sub-totals		
	LP (ETH-DAI)	**LP1 (iETH-ETH)**	**LP2 (iETH-DAI)**
Liquidity	$1,559,145	$71,961	$162,118
Revenue	$302,140	$57,927	$49,673
Revenue / Liquidity	19.4%	80.5%	30.64%

Table: Metrics harvested from Left-tree simulation using ETH & DAI (Jan 2018 to Oct 2023)

In Summary

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Stagnant Liquidity Problem

- Defined stagnant liquidity problem and how it can be addressed

Liquidity Trees: A new DeFi Primitive

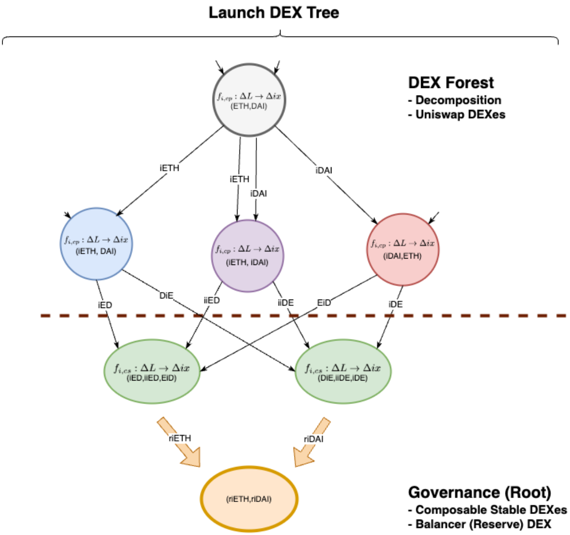
- New DeFi primitive, which we call Liquidity Trees
- Utilizes fully collateralized liquidity, and can be represented as undirected graphs or algebraically in $\mathbb{R}^n$
- Simulations support our reasoning

Pachira Token Launch

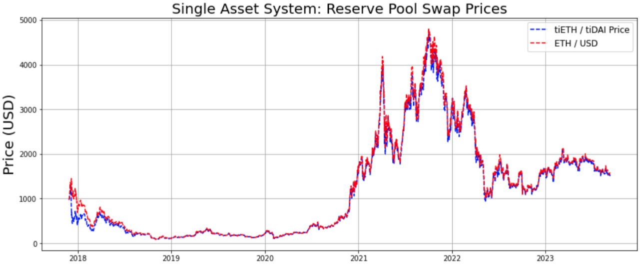
- Combining Liquidity Trees with a governance system for Pachira token launch

Thank you!

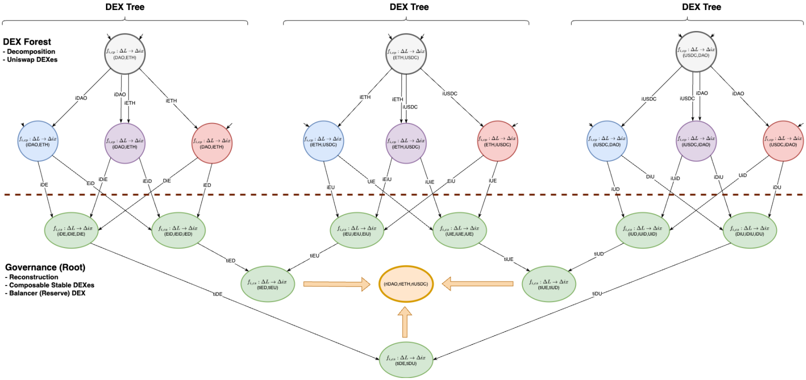
Appendix 1: Pachira Token Launch



Appendix 2: Reserve Swap Prices



Appendix 3: Pachira Token Launch



Appendix 4: Reserve Swap Prices