

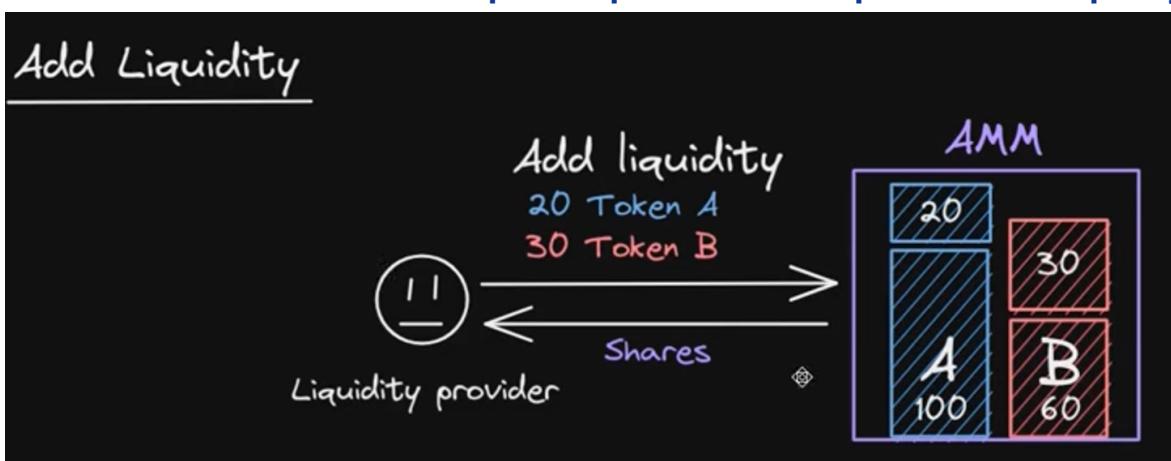
1 - Constant Sum AMM Math | DeFi

Constant Sum AMM Math | DeFi

- An Auto Market Maker is a decentralized exchange where the price of the token is determined by a Mathematical equation defined inside the contract
 - In Centralized exchanges, the price of the token is determined by the traders

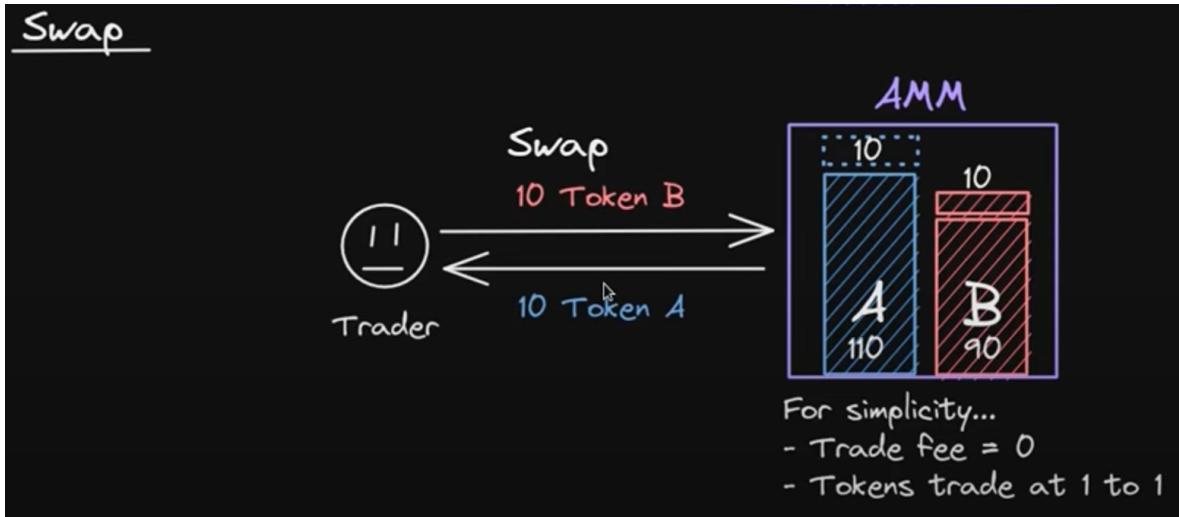
Auto Market Makers (AMMs) actions:

- Add Liquidity
- A user provides liquidity and receives some shares in exchange
 - Adding Liquidity means that a user (A Liquidity Provider) adds tokens to the AMM
 - When the AMM receives the tokens provided as liquidity, it updates its token's reserves accordingly to the number of tokens that were provided as liquidity
 - In exchange for the tokens provided as liquidity, the AMM mints new shares (Liquidity Provider tokens or LPs) to the user
 - These shares represent partial ownership of the total liquidity

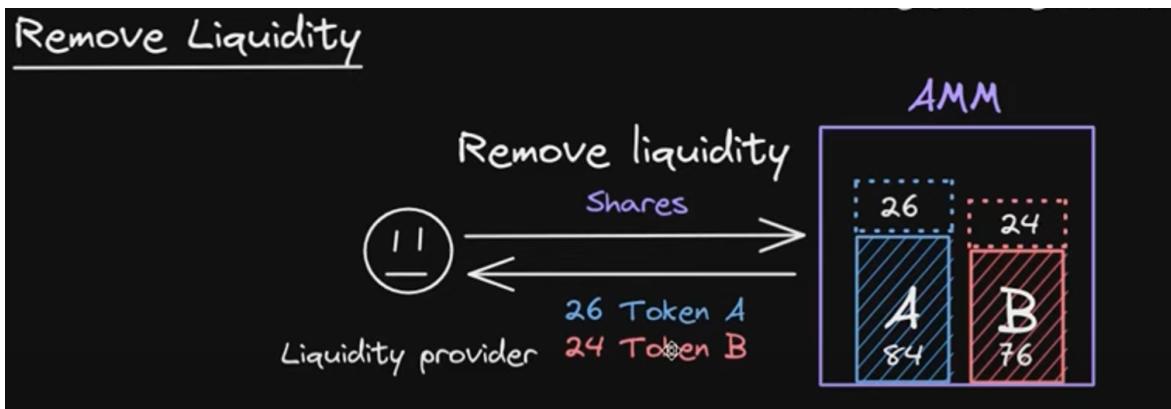


- Make Swaps
- A swap is when a user trades tokens
 - When a user makes a swap, the AMM calculates the number of tokens to give out in exchange for the number of tokens that the user is giving in

- As part of the calculus, the AMM updates the total number of tokens it holds based on the input and output number of tokens that were issued during the swap



- Remove Liquidity
- Removing liquidity is withdrawing the equivalent amount of tokens in exchange for shares (LPs - Liquidity Provider tokens)
 - When a user removes its liquidity, it means that the user is returning its shares to the AMM, the AMM burns those shares and makes the calculus to determine the appropriate amount of tokens to return for those shares
 - The same amount of tokens that went in it'll be the number of tokens that goes out
 - The total number of each token might vary depending on the reserves of the AMM at the moment of removing the liquidity.



What is a Constant Sum AMM?

- A Constant Sum AMM is an AMM where the price of tokens are determined by the equation:

$$X + Y = K$$

X = Amount of Token A in the AMM
 Y = Amount of Token B in the AMM

- When a user trades in this AMM, the constant K must remain the same, even though the number of tokens X or tokens Y may change

How many tokens to return in a trade?

Swap - How many token to return in a trade?

Trade from Token A to Token B

Before the trade

$$X + Y = K$$

After the trade

$$X + dx + Y - dy = K$$

$$X + dx + Y - dy = X + Y$$

$$dx - dy = 0$$

Amount of token out = Amount of token in $dx = dy$

Amount of token out = Amount of token in

$$dx = dy$$

Example

Token in = Token A = 100

How many Token B to return?

Token out = Token B = 100

$$dx = 100$$

$$dx = dy$$

$$dy = 100$$

How many shares to mint when Adding Liquidity?

- Increase in liquidity is proportional to increase in total shares

Add liquidity - How many shares to mint?

Increase in liquidity is proportional to increase in total shares

a = Amount in
 L = Total liquidity before new liquidity is added
 s = Amount of shares to mint
 T = Total shares before mint

$$\frac{L + a}{L} = \frac{T + s}{T} \rightarrow s = \frac{aT}{L}$$

$a = dx + dy$

$L = X + Y$

$$s = \frac{(dx + dy)T}{X + Y}$$

How many tokens to receive when Removing Liquidity?

- The number of tokens that will be withdrawn from the AMM will be proportional to the shares that will be burn

Remove liquidity - How many tokens to withdraw?

Withdraw tokens proportional to shares

a = Amount out

L = Total liquidity

s = Amount of shares to burn

T = Total shares

$$\frac{a}{L} = \frac{s}{T}$$

$$a = \frac{Ls}{T}$$

$$a = dx + dy$$

$$L = x + y$$

$$dx + dy = \frac{(x + y)s}{T}$$

$$= \frac{x s}{T} + \frac{y s}{T}$$

$$dx = \frac{x s}{T}$$

$$dy = \frac{y s}{T}$$

14.34 • Remove liquidity - How many tokens to withdraw? >

Resources

[🔗 https://www.youtube.com/watch?v=-Jhgcf...](https://www.youtube.com/watch?v=-Jhgcf...)