Why solana?

Until now, we've gone through the following -

1. What are blockchains, how do they work under the hood
2. Public and Private keys, how you can use them to `sign` transactions that miners use to `verify` and credit/debit balances

In today's class, we'll understand about one of the biggest use-case that blockchains like Solana/ETH solve for - Programs/Smart contracts.

Programs/Smart contracts

ETH was one of the first blockchains to introduce the `concept` of decentralized `state` / `programs`. These are popularly known as `smart contracts` on the ETH blockchain.

▶ Here is a simple ETH smart contract

▶ Here is a simple Node.js HTTP server that does something similar

HTTP Servers are deployed on cloud providers like `GCP, Azure`

Smart contracts/programs are deployed on the `blockchain`

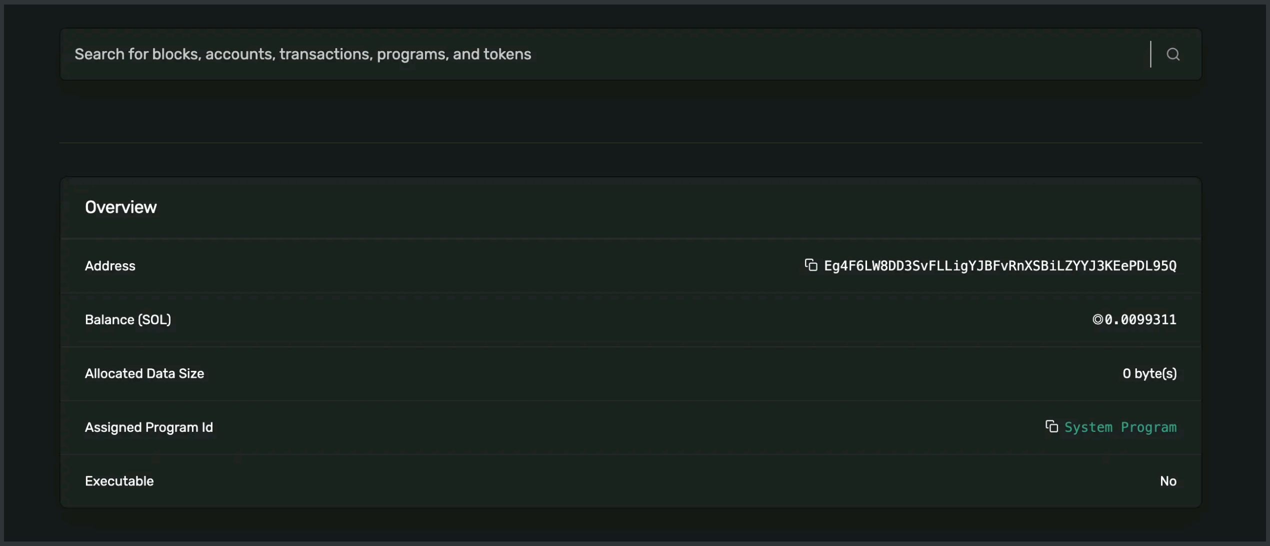
The way solana programs work is significantly different from other blockchains. Lets understand how.

Accounts on Solana

Accounts

On the Solana blockchain, an "account" is a fundamental data structure used to store various types of information.

1. **Data Storage**: Accounts on Solana are used to store data required by programs (smart contracts) or to maintain state
2. **Lamports**: Accounts hold a balance of Solana’s native cryptocurrency, lamports. Lamports are used to pay for transaction fees and to rent the space that the account occupies on the blockchain.

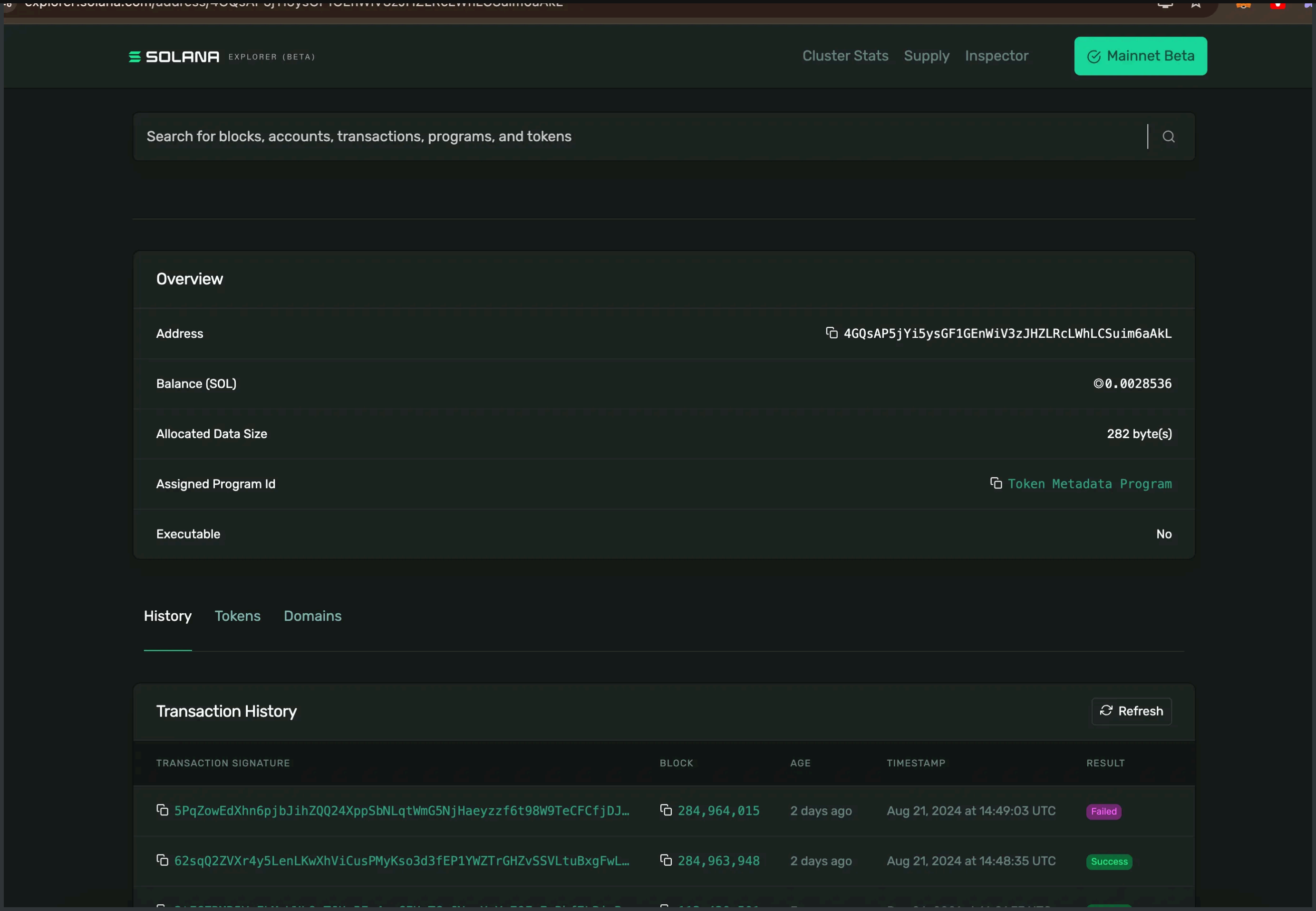

Search for blocks, accounts, transactions, programs, and tokens

Overview

Address	Eg4F6LW8DD3SvFLLigYJBFvRnXSBiLZYYJ3KEePDL95Q
Balance (SOL)	◎0.0099311
Allocated Data Size	0 byte(s)
Assigned Program Id	System Program
Executable	No

3. **Programs:** On Solana, programs are special accounts that contain executable code. These accounts are distinct from regular data accounts in that they are designed to be executed by the blockchain when triggered by a transaction.

Account with `data` and `lamports` but no data - https://explorer.solana.com/address/4GQsAP5jYi5ysGF1GEnWiV3zJHZLRcLWhLCSuim6aAkL



SOLANA EXPLORER (BETA) Cluster Stats Supply Inspector Mainnet Beta

Search for blocks, accounts, transactions, programs, and tokens

Overview

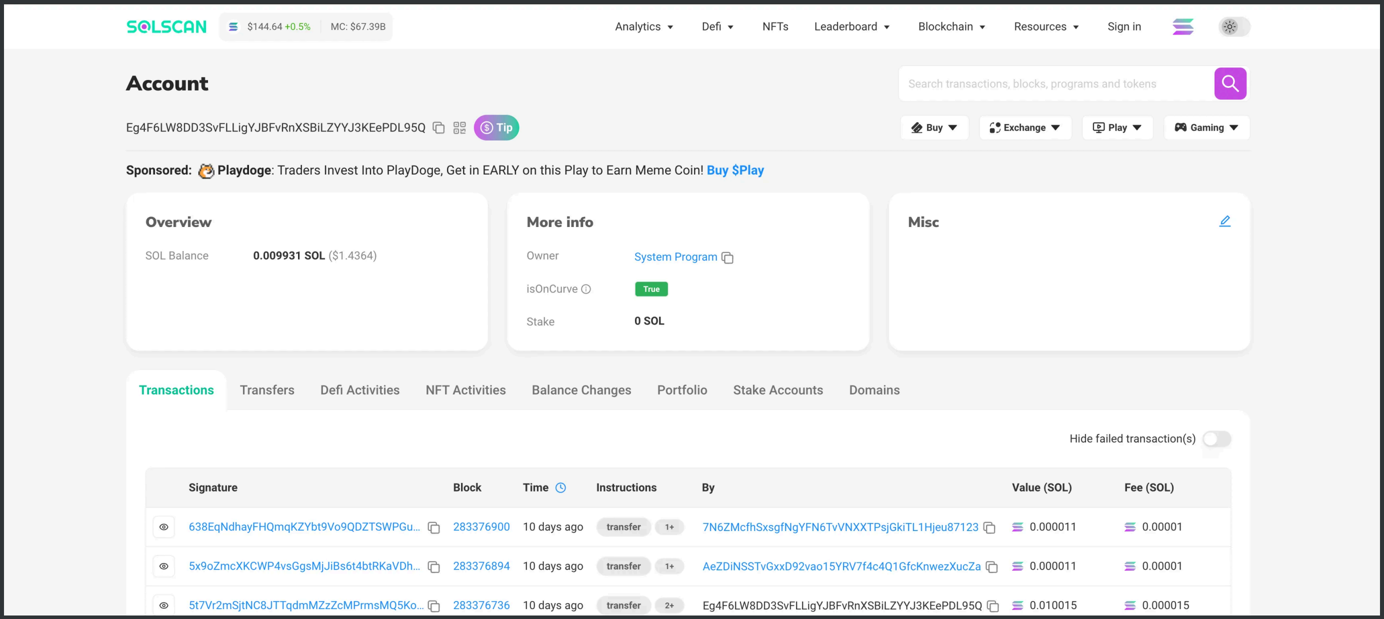
Address	4GQsAP5jYi5ysGF1GEnWiV3zJHZLRcLWhLCSuim6AkL
Balance (SOL)	◎0.0028536
Allocated Data Size	282 byte(s)
Assigned Program Id	Token Metadata Program
Executable	No

History Tokens Domains

Transaction History Refresh

TRANSACTION SIGNATURE	BLOCK	AGE	TIMESTAMP	RESULT
5PqZowEdXhn6pjbJihZQQ24XppSbNLqtWmG5NjHaeyzzf6t98W9TeCFCfjDJ…	284,964,015	2 days ago	Aug 21, 2024 at 14:49:03 UTC	Failed
62sqQ2ZVXr4y5LenLKwXhViCusPMyKso3d3fEP1YWZTrGHZvSSVLtuBxgFwL…	284,963,948	2 days ago	Aug 21, 2024 at 14:48:35 UTC	Success

Account with lamports but no data - https://solscan.io/account/Eg4F6LW8DD3SvFLLigYJBFvRnXSBiLZYYJ3KEePDL95Q



SOLSCAN $144.64 +0.5% MC: $67.39B Analytics Defi NFTs Leaderboard Blockchain Resources Sign in

Account

Search transactions, blocks, programs and tokens

Eg4F6LW8DD3SvFLLigYJBFvRnXSBiLZYYJ3KEePDL95Q Tip

Buy Exchange Play Gaming

Sponsored: Playdoge: Traders Invest Into PlayDoge, Get in EARLY on this Play to Earn Meme Coin! Buy $Play

Overview

SOL Balance 0.009931 SOL ($1.4364)

More info

Owner System Program

isOnCurve True

Stake 0 SOL

Misc

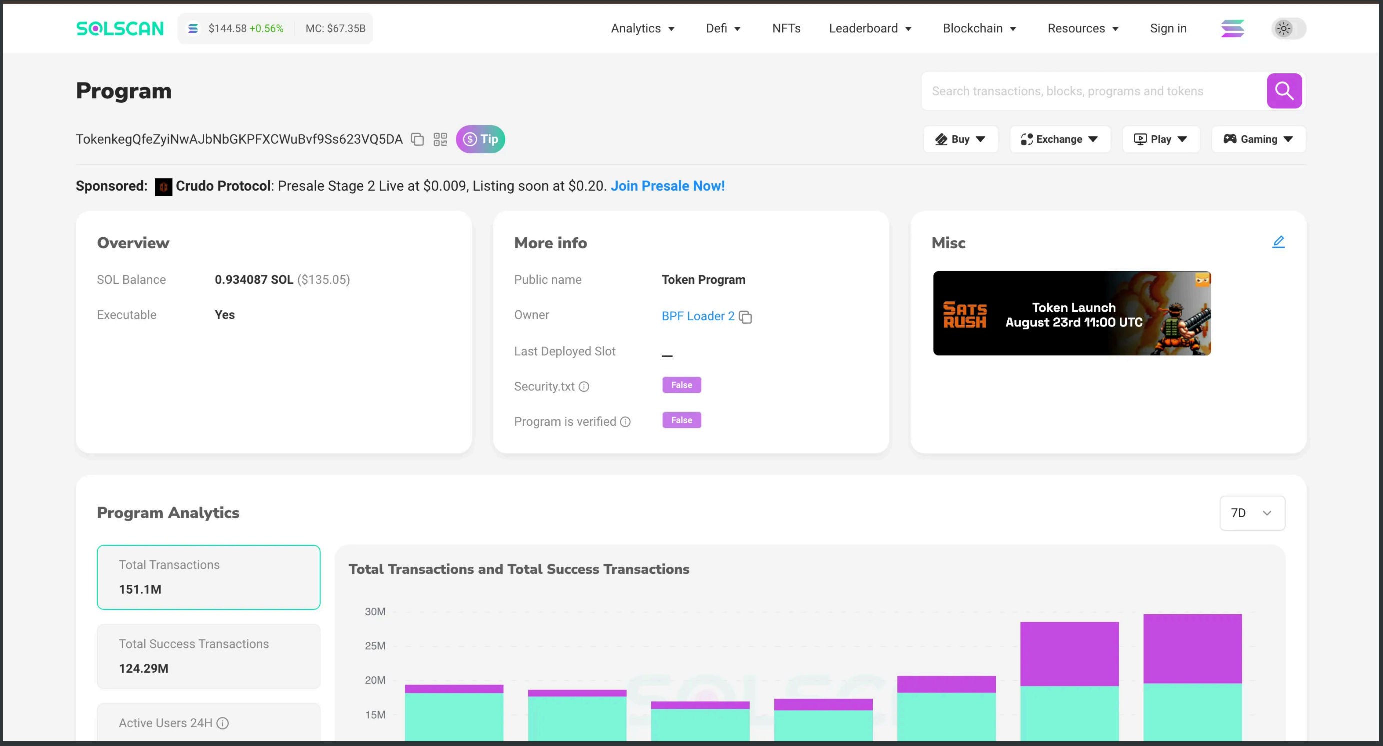
Transactions Transfers Defi Activities NFT Activities Balance Changes Portfolio Stake Accounts Domains

Hide failed transaction(s)

Signature	Block	Time	Instructions	By	Value (SOL)	Fee (SOL)
638EqNdhayFHQmqKZYbt9Vo9QDZTSWPGu...	283376900	10 days ago	transfer 1+	7N6ZMcfhSxsgfNgYFN6TvVNXXTPsjGkiTL1Hjeu87123	0.000011	0.00001
5x9oZmcXKCWP4vsGgsMjJiBs6t4btRKaVDh...	283376894	10 days ago	transfer 1+	AeZDiNSSTvGxxD92vao15YRV7f4c4Q1GfcKnwezXucZa	0.000011	0.00001
5t7Vr2mSjtNC8JTTqdmMZzZcMPrmsMQ5Ko...	283376736	10 days ago	transfer 2+	Eg4F6LW8DD3SvFLLigYJBFvRnXSBiLZYYJ3KEePDL95Q	0.010015	0.000015

Program

https://solscan.io/account/TokenkegQfeZyiNwAJbNbGKPFXCWuBvf9Ss623VQ5DA



Program

TokenkegQfeZyiNwAJbNbGKPFXCWuBvf9Ss623VQ5DA

Sponsored: **Crudo Protocol**: Presale Stage 2 Live at $0.009, Listing soon at $0.20. Join Presale Now!

Overview

SOL Balance	**0.934087 SOL** ($135.05)
Executable	**Yes**

More info

Public name	**Token Program**
Owner	BPF Loader 2
Last Deployed Slot	—
Security.txt	False
Program is verified	False

Misc

SATS RUSH Token Launch August 23rd 11:00 UTC

Program Analytics

Total Transactions
151.1M

Total Success Transactions
124.29M

Active Users 24H

Total Transactions and Total Success Transactions

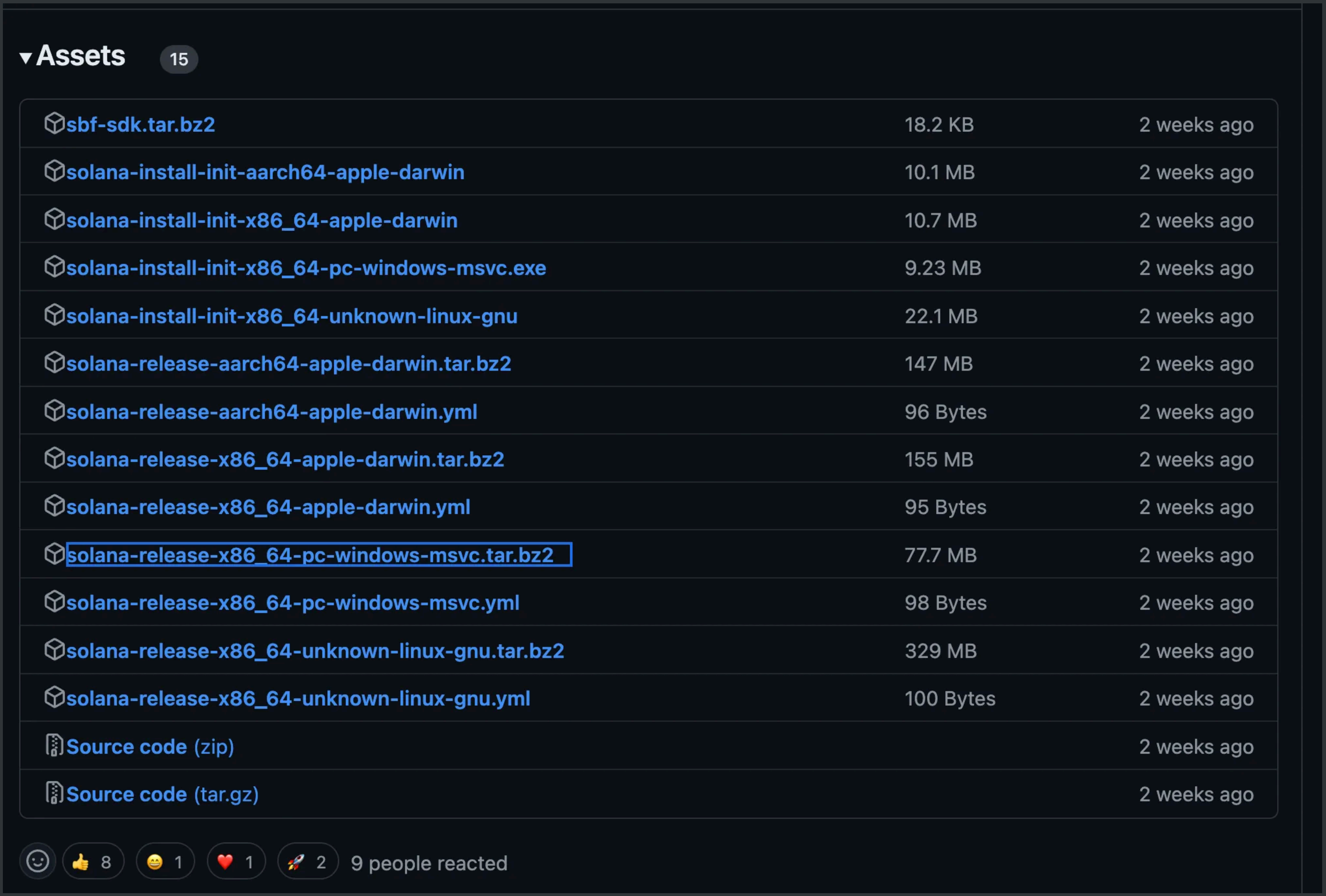
Install solana cli

You can install the solana cli locally by running the following command

```
sh -c "$(curl -sSfL https://release.anza.xyz/stable/install)"
```

For Windows people -

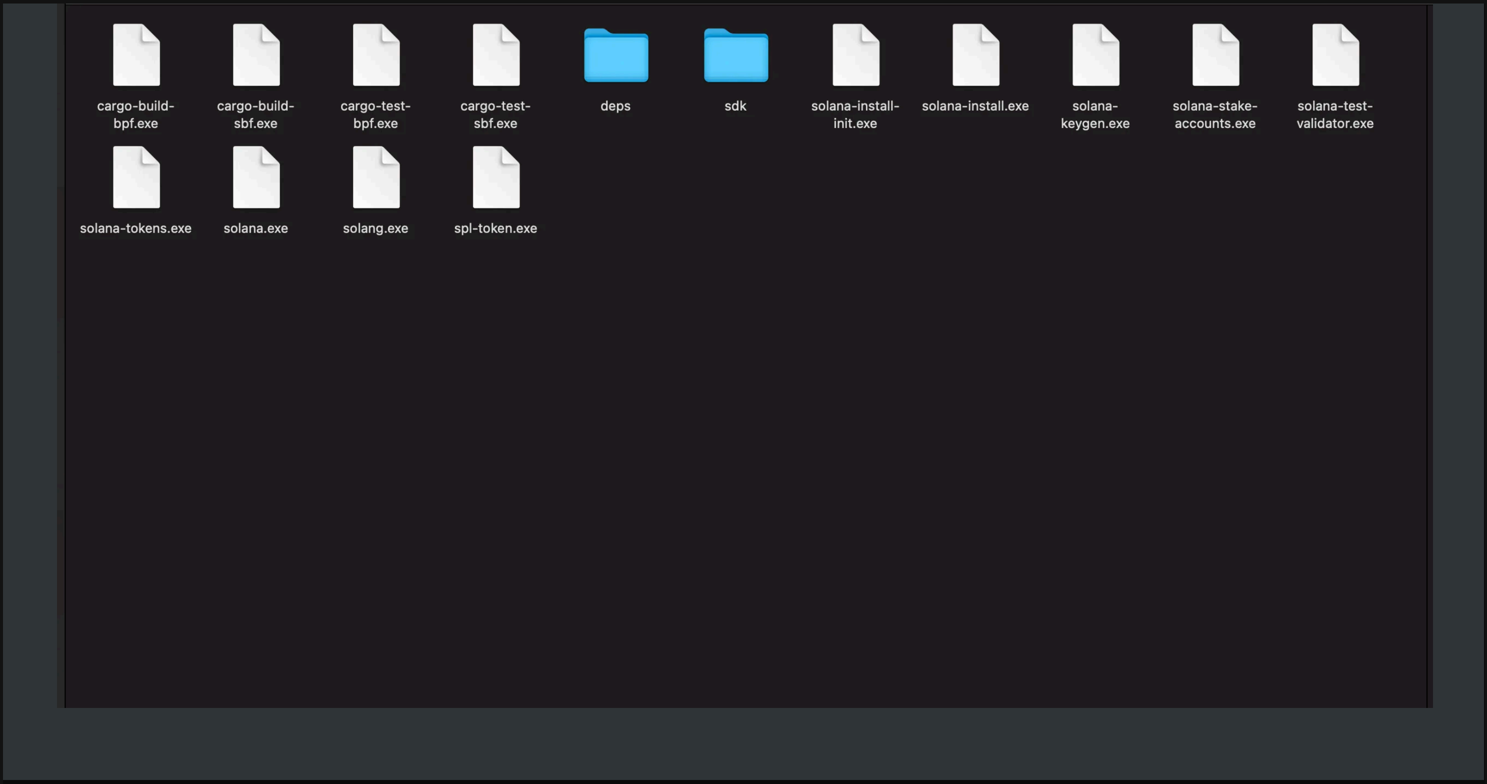
https://github.com/solana-labs/solana/releases



▾ Assets 15

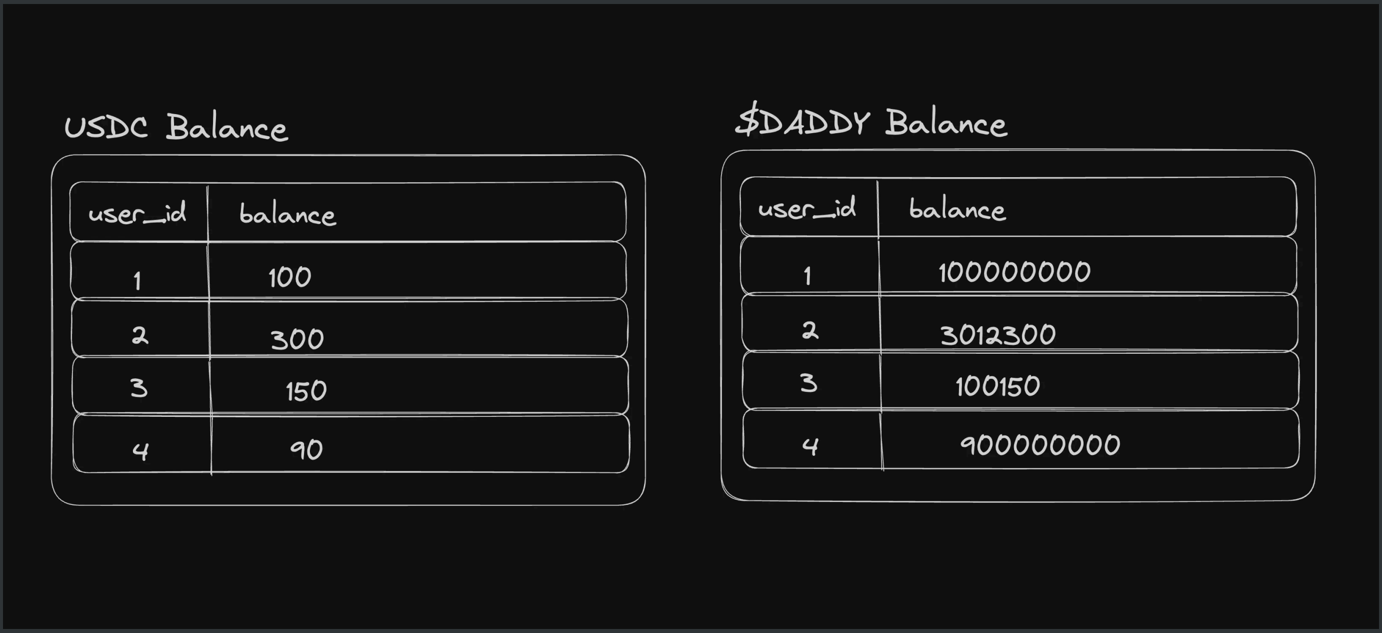
sbf-sdk.tar.bz2	18.2 KB	2 weeks ago
solana-install-init-aarch64-apple-darwin	10.1 MB	2 weeks ago
solana-install-init-x86_64-apple-darwin	10.7 MB	2 weeks ago
solana-install-init-x86_64-pc-windows-msvc.exe	9.23 MB	2 weeks ago
solana-install-init-x86_64-unknown-linux-gnu	22.1 MB	2 weeks ago
solana-release-aarch64-apple-darwin.tar.bz2	147 MB	2 weeks ago
solana-release-aarch64-apple-darwin.yml	96 Bytes	2 weeks ago
solana-release-x86_64-apple-darwin.tar.bz2	155 MB	2 weeks ago
solana-release-x86_64-apple-darwin.yml	95 Bytes	2 weeks ago
solana-release-x86_64-pc-windows-msvc.tar.bz2	77.7 MB	2 weeks ago
solana-release-x86_64-pc-windows-msvc.yml	98 Bytes	2 weeks ago
solana-release-x86_64-unknown-linux-gnu.tar.bz2	329 MB	2 weeks ago
solana-release-x86_64-unknown-linux-gnu.yml	100 Bytes	2 weeks ago
Source code (zip)		2 weeks ago
Source code (tar.gz)		2 weeks ago

Unzip and you should see all the .exe files


cargo-build-bpf.exe
cargo-build-sbf.exe
cargo-test-bpf.exe
cargo-test-sbf.exe
deps
sdk
solana-install-init.exe
solana-install.exe
solana-keygen.exe
solana-stake-accounts.exe
solana-test-validator.exe
solana-tokens.exe
solana.exe
solang.exe
spl-token.exe

Web2 Data model

In the web2 world, you store `data` in SQL/NoSQL databases. Here is an example of how you might create tables for a `token balance` app



USDC Balance

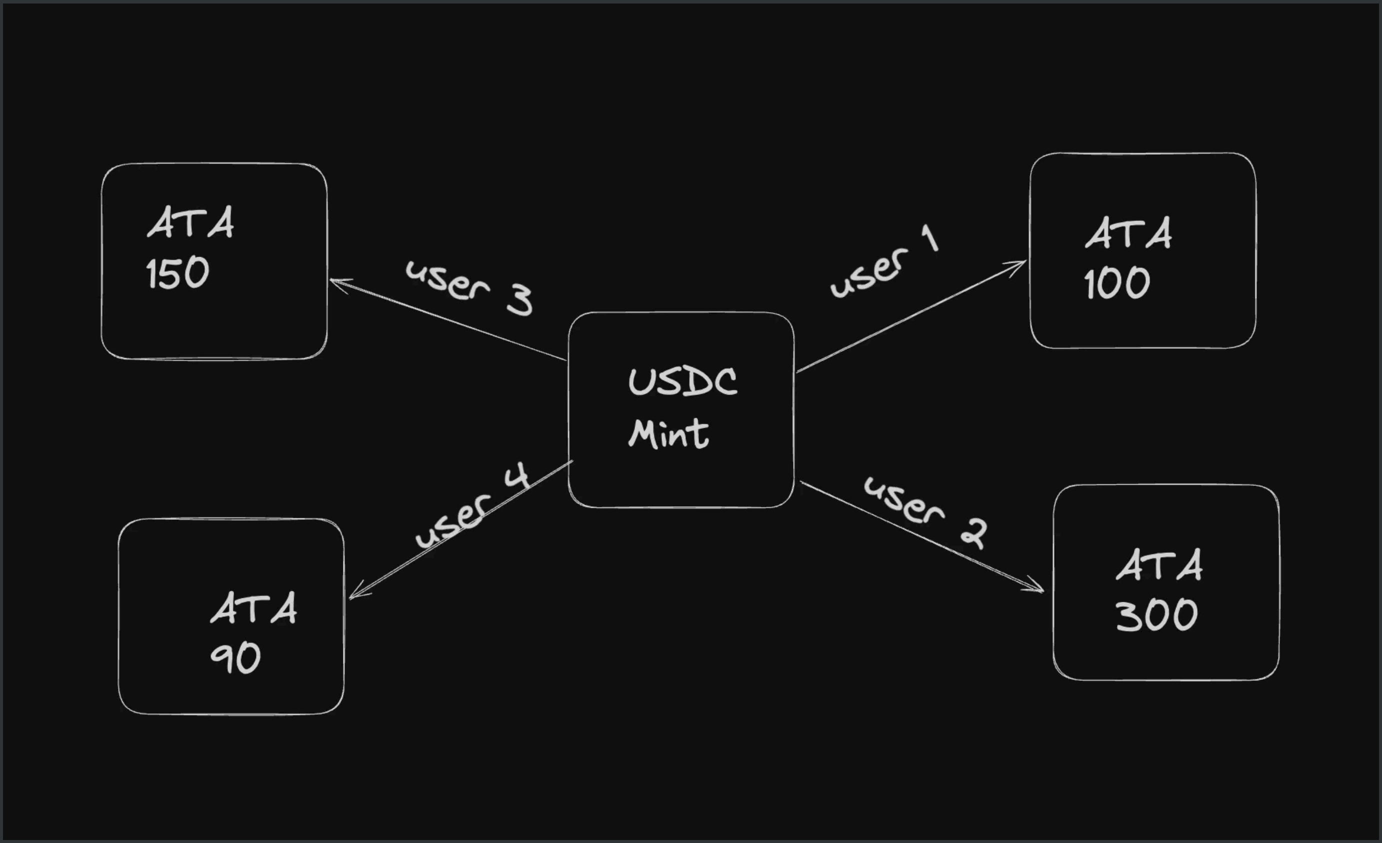
user_id	balance
1	100
2	300
3	150
4	90

$DADDY Balance

user_id	balance
1	100000000
2	3012300
3	100150
4	900000000

Data model on Solana

Solana stores all the data of the `same app` / `same program` in various accounts.



Transaction vs Instruction

Transactions

A transaction in Solana is a bundle that includes one or more instructions. Transactions are used to submit operations or changes to the network. They can be simple, such as transferring SOL between accounts, or complex

Instructions

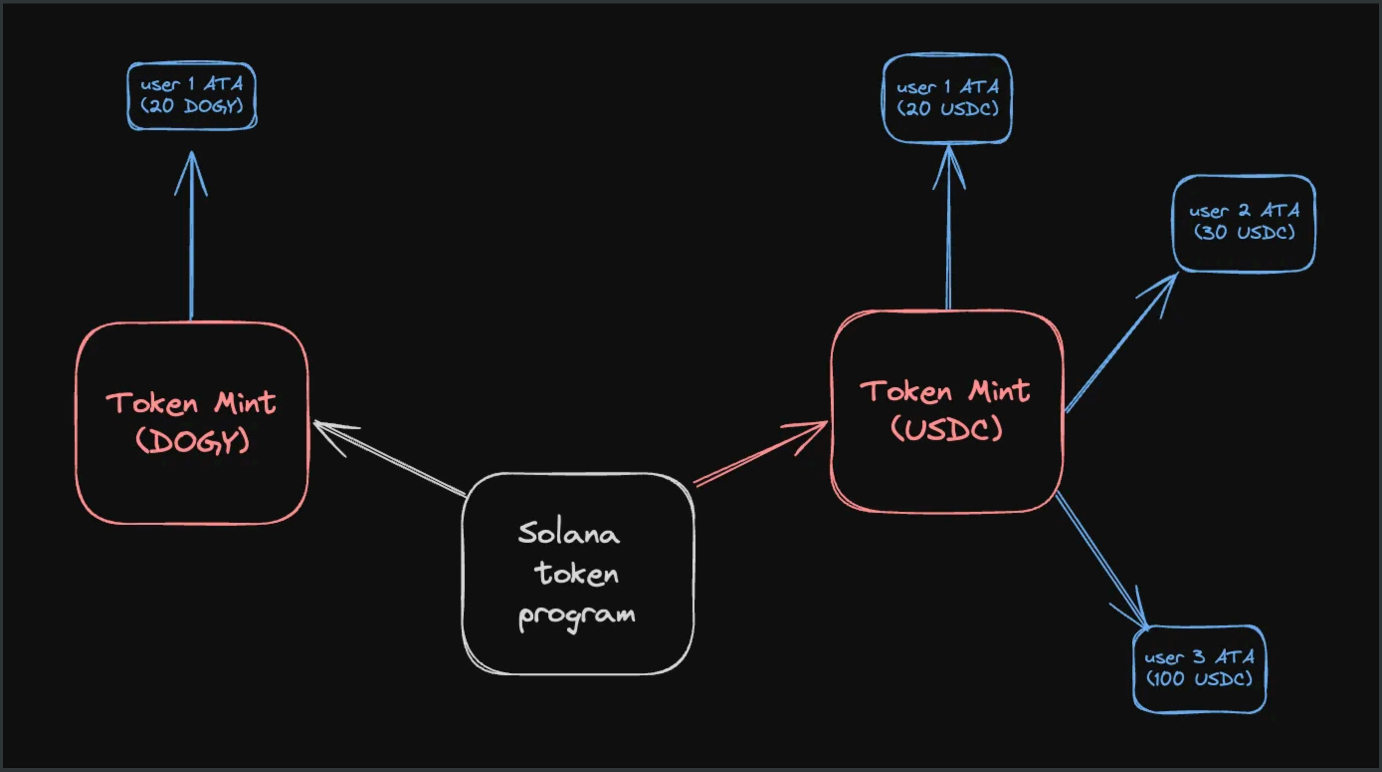
The core operations that the transaction will execute.

💡 There are more concepts like `recentBlockchash` and `signers` , `writeable` that we we will eventually get to.

How to create an account with some data

```
const solanaWeb3 = require('@solana/web3.js');
const fs = require("fs")
const { Keypair, Connection, SystemProgram, Transaction, sendAndConfirmTrc

// Connect to Solana devnet
const connection = new Connection(solanaWeb3.clusterApiUrl('devnet'), 'confi

// Generate a new keypair for the data account
const dataAccount = Keypair.generate();
const payer = Keypair.fromSecretKey(new Uint8Array(JSON.parse(fs.readFileSy

async function createAccount() {
  // Create a transaction to create and fund the account
  const tx = new Transaction().add(
    SystemProgram.createAccount({
      fromPubkey: payer.publicKey,
      newAccountPubkey: dataAccount.publicKey,
      lamports: await connection.getMinimumBalanceForRentExemption(1000
      space: 1000, // Space in bytes to allocate for data
      programId: SystemProgram.programId,
    })
  );

  // Send the transaction to the network
  const txId = await sendAndConfirmTransaction(connection, tx, [payer, dataA

  console.log(`Created account with transaction ID: ${txId}`);

}

createAccount();
```

Creating a token



Creating your own token (100x coin lets say) requires understanding the Token Program that is written by the engineers at Solana - https://github.com/solana-labs/solana-program-library

Specifically, the way to create a token requires you to

1. Create a token mint
2. Create an associated token account for this mint and for a specific user
3. Mint tokens to that user.

Token mint

It's like a bank that has the athority to create more coins. It can also have the authority to freeze coins .

Associated token account

Before you can ask other people to send you a token, you need to create an `associated token account` for that token and your public key

Reference - https://spl.solana.com/token

▶ Create a new cli wallet

▶ Set the RPC url

▶ Airdrop yourself some SOL

▶ Check your balance

▶ Create token mint

▶ Verify token mint on chain

▶ Check the supply of the token

▶ Create an associated token account

▶ Mint some tokens to yourself

▶ Check your balances in the explorer

▶ Import the token in Phantom and see the balances

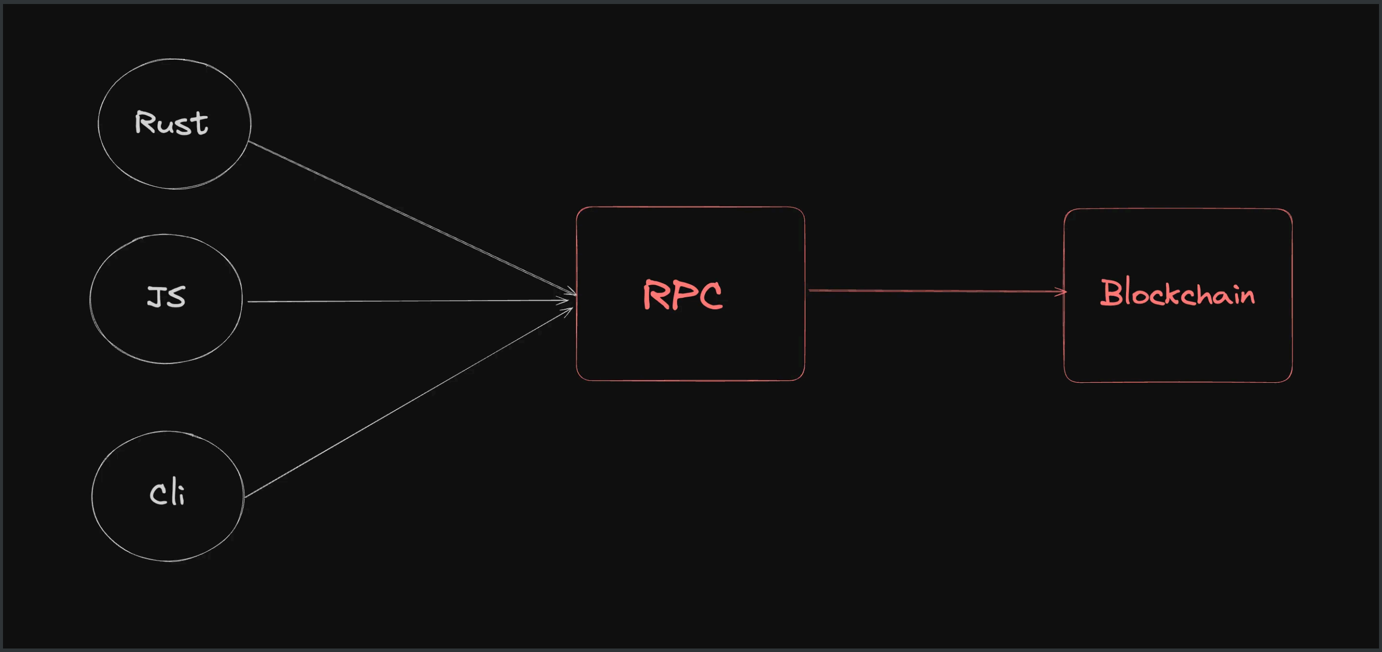
Equivalent code in JS

- ▶ Create a new cli wallet
- ▶ Set the RPC url
- ▶ Create an empty JS file
- ▶ Install dependencies
- ▶ Write a function to airdrop yourself some solana
- ▶ Check your balance
- ▶ Create token mint
- ▶ Verify token mint on chain
- ▶ Create an associated token account, mint some tokens
- ▶ Check your balances in the explorer
- ▶ Import the token in Phantom and see the balances

Equivalent code in rust/python/go

Solana has libraries similar to `@solana/web3.js` in Rust, Python that would let you do the same thing.

In the end, they all are sending requests to an RPC server.



PDAs

When you created an `associated token account` , you actually created a PDA - https://github.com/solana-labs/solana-program-library/blob/master/associated-token-account/program/src/lib.rs#L71

JS - https://github.com/solana-labs/solana-program-library/blob/ab830053c59c9c35bc3a727703aacf40c1215132/token/js/src/state/mint.ts#L171

Token-22 program

Ref - https://spl.solana.com/token-2022

A token program on the Solana blockchain, defining a common implementation for fungible and non-fungible tokens.

The Token-2022 Program, also known as Token Extensions, is a superset of the functionality provided by the Token Program.

▶ Create token mint

▶ Create an associated token account

▶ Mint the tokens

Token-22 with metadata

https://cdn.100xdevs.com/metadata.json

▶ Create a token with metadata enabled

▶ Create metadata

▶ Create ATA

▶ Mint

▶ Check out the token in your wallet

Assignment

1. Show all the tokens that the user has in our web based wallet
2. Create a token launchpad website that lets users launch tokens (take things like decimals, freeze athority as inputs from the user)