

Practical 08

Aim- To study installation tools and basic blockchain concepts.

Theory-

Blockchain is a decentralized digital ledger technology that records data securely across a distributed network of computers (nodes) instead of relying on a single centralized authority. Unlike traditional databases managed by one organization, blockchain ensures **transparency, immutability, and trust** by replicating the same ledger across all participants in the network.

Data in blockchain is stored in **blocks**, where each block contains a collection of transactions, a timestamp, and a unique cryptographic hash. Each block is linked to the previous one, forming a continuous “chain.” This structure ensures that once information is added, it becomes extremely difficult to modify without altering all subsequent blocks, making tampering practically infeasible.

The **core principles** of blockchain are:

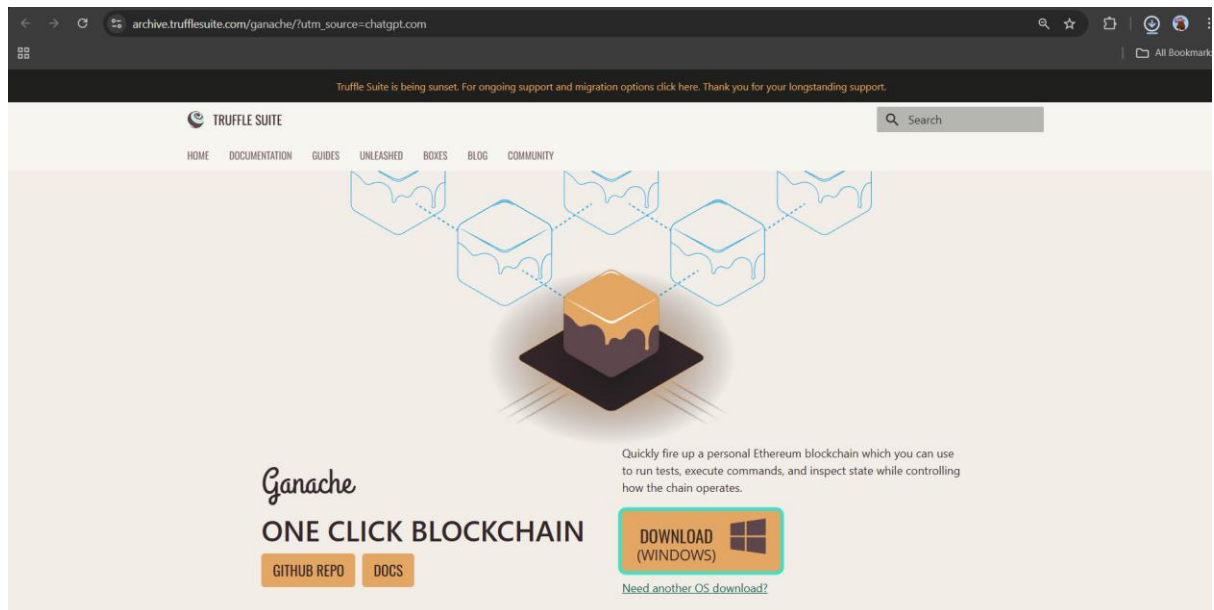
- **Decentralization** – No single entity controls the system, reducing risks of failure or manipulation.
- **Immutability** – Data, once written, cannot be changed or deleted.
- **Consensus Mechanisms** – Algorithms like Proof of Work (PoW), Proof of Stake (PoS), and Practical Byzantine Fault Tolerance (PBFT) help all nodes agree on the correct state of the ledger.
- **Cryptography** – Ensures security, integrity, and authentication of transactions.

To explore blockchain development, several tools and environments are commonly used:

1. **Ganache** – A local Ethereum blockchain simulator for testing smart contracts and transactions without using real cryptocurrency.
2. **Truffle Suite** – A framework that provides tools for writing, compiling, deploying, and testing smart contracts efficiently.
3. **MetaMask** – A crypto wallet and browser extension that manages keys/accounts and connects users to Ethereum-based decentralized applications (dApps).
4. **Remix IDE** – A browser-based platform for writing, debugging, and deploying Solidity smart contracts.
5. **Hyperledger Fabric** – A permissioned blockchain framework for enterprises that supports modular consensus, identity management, and private channels.

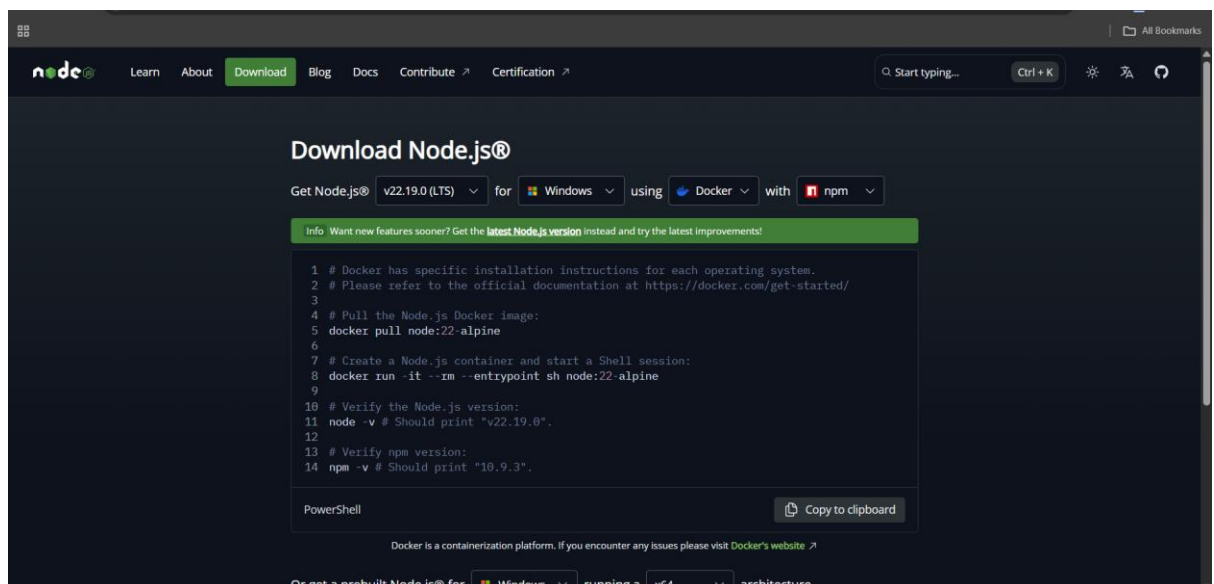
Installation Steps:

1. Ganache installation:



- Download from <https://trufflesuite.com/ganache>
- Install and launch the GUI/CLI.
- It will create a local Ethereum blockchain with test accounts and balances.

2. Truffle framework:



- Install Node.js first: <https://nodejs.org>
- Open terminal and install Truffle:

```
Command Prompt
Microsoft Windows [Version 10.0.26100.5074]
(c) Microsoft Corporation. All rights reserved.

C:\Users\>npm install -g truffle
npm warn deprecated rimraf@2.7.1: Rimraf versions prior to v4 are no longer supported
npm warn deprecated yaeti@0.0.6: Package no longer supported. Contact Support at https://www.npmjs.com/support for more info.
npm warn deprecated har-validator@5.1.5: this library is no longer supported
npm warn deprecated mkdirp-promise@5.0.1: This package is broken and no longer maintained. 'mkdirp' itself supports promises now, please switch to that.
npm warn deprecated memdown@1.4.1: Superseded by memory-level (https://github.com/Level/community#faq)
npm warn deprecated request@2.88.2: request has been deprecated, see https://github.com/request/request/issues/3142
npm warn deprecated inflight@1.0.6: This module is not supported, and leaks memory. Do not use it. Check out lru-cache if you want a good and tested way to coalesce async requests by a key value, which is much more comprehensive and powerful.
npm warn deprecated level-errors@2.0.1: Superseded by abstract-level (https://github.com/Level/community#faq)
npm warn deprecated deferred-level-down@5.3.0: Superseded by abstract-level (https://github.com/Level/community#faq)
npm warn deprecated encoding-down@6.3.0: Superseded by abstract-level (https://github.com/Level/community#faq)
npm warn deprecated levelup@4.4.0: Superseded by abstract-level (https://github.com/Level/community#faq)
npm warn deprecated glob@7.2.0: Glob versions prior to v9 are no longer supported
npm warn deprecated level-js@5.0.2: Superseded by browser-level (https://github.com/Level/community#faq)
npm warn deprecated level-packager@5.1.1: Superseded by abstract-level (https://github.com/Level/community#faq)
npm warn deprecated level-codec@9.0.2: Superseded by level-transcoder (https://github.com/Level/community#faq)
npm warn deprecated multibase@0.6.1: This module has been superseded by the multiformats module
npm warn deprecated multicodec@0.5.7: This module has been superseded by the multiformats module
npm warn deprecated apollo-server-errors@3.3.1: The 'apollo-server-errors' package is part of Apollo Server v2 and v3, which are now end-of-life (as of October 22nd 2023 and October 22nd 2024, respectively). This package's functionality is now found in the '@apollo/server' package. See https://www.apollographql.com/docs/apollo-server/previous-versions/ for more details.
npm warn deprecated apollo-server-types@3.8.0: The 'apollo-server-types' package is part of Apollo Server v2 and v3, which are now end-of-life (as of October 22nd 2023 and October 22nd 2024, respectively). This package's functionality is now found in the '@apollo/server' package. See https://www.apollographql.com/docs/apollo-server/previous-versions/ for more details.
npm warn deprecated apollo-datasource@3.3.2: The 'apollo-datasource' package is part of Apollo Server v2 and v3, which are now end-of-life (as of October 22nd 2023 and October 22nd 2024, respectively). See https://www.apollographql.com/docs/apollo-server/previous-versions/ for more details.
npm warn deprecated apollo-server-plugin-base@3.7.2: The 'apollo-server-plugin-base' package is part of Apollo Server v2 and v3, which are now end-of-life (as of October 22nd 2023 and October 22nd 2024, respectively). This package's functionality is now found in the '@apollo/server' package. See https://www.apollographql.com/docs/apollo-server/previous-versions/ for more details.
npm warn deprecated apollo-server-previous-versions@3.7.2: The 'apollo-server-previous-versions' package is part of Apollo Server v2 and v3, which are now end-of-life (as of October 22nd 2023 and October 22nd 2024, respectively). This package's functionality is now found in the '@apollo/server' package. See https://www.apollographql.com/docs/apollo-server/previous-versions/ for more details.
npm warn deprecated level-concat-iterator@3.1.0: Superseded by abstract-level (https://github.com/Level/community#faq)
npm warn deprecated apollo-server-express@3.13.0: The 'apollo-server-express' package is part of Apollo Server v2 and v3, which are now end-of-life (as of October 22nd 2023 and October 22nd 2024, respectively). This package's functionality is now found in the '@apollo/server' package. See https://www.apollographql.com/docs/apollo-server/previous-versions/ for more details.
npm warn deprecated apollo-reporting-protobuf@3.4.0: The 'apollo-reporting-protobuf' package is part of Apollo Server v2 and v3, which are now end-of-life (as of October 22nd 2023 and October 22nd 2024, respectively). This package's functionality is now found in the '@apollo/usage-reporting-protobuf' package. See https://www.apollographql.com/docs/apollo-server/previous-versions/ for more details.
npm warn deprecated apollo-server-env@4.2.1: The 'apollo-server-env' package is part of Apollo Server v2 and v3, which are now end-of-life (as of October 22nd 2023 and October 22nd 2024, respectively). This package's functionality is now found in the '@apollo/usage-reporting-protobuf' package. See https://www.apollographql.com/docs/apollo-server/previous-versions/ for more details.
```

```
Command Prompt
npm warn deprecated @ensdomains/resolver@0.2.4: Please use @ensdomains/ens-contracts
npm warn deprecated @truffle/source-map-utils@1.3.119: Package no longer supported. Contact Support at https://www.npmjs.com/support for more info.
npm warn deprecated apollo-server-core@3.13.0: The 'apollo-server-core' package is part of Apollo Server v2 and v3, which are now end-of-life (as of October 22nd 2023 and October 22nd 2024, respectively). This package's functionality is now found in the '@apollo/server' package. See https://www.apollographql.com/docs/apollo-server/previous-versions/ for more details.
npm warn deprecated @truffle/abi-utils@1.0.3: Package no longer supported. Contact Support at https://www.npmjs.com/support for more info.
npm warn deprecated @truffle/provider@0.3.13: Package no longer supported. Contact Support at https://www.npmjs.com/support for more info.
npm warn deprecated @truffle/events@0.1.25: Package no longer supported. Contact Support at https://www.npmjs.com/support for more info.
npm warn deprecated uuid@3.4.0: Please upgrade to version 7 or higher. Older versions may use Math.random() in certain circumstances, which is known to be problematic. See https://v8.dev/blog/math-random for details.
npm warn deprecated level-concat-iterator@2.0.1: Superseded by abstract-level (https://github.com/Level/community#faq)
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npm warn deprecated level-concat-iterator@2.0.1: Superseded by abstract-level (https://github.com/Level/community#faq)
npm warn deprecated @truffle/code-utils@3.0.4: Package no longer supported. Contact Support at https://www.npmjs.com/support for more info.
npm warn deprecated @truffle/config@1.3.61: Package no longer supported. Contact Support at https://www.npmjs.com/support for more info.
npm warn deprecated @truffle/db-loader@0.2.36: Package no longer supported. Contact Support at https://www.npmjs.com/support for more info.
npm warn deprecated abstract-level-down@2.7.2: Superseded by abstract-level (https://github.com/Level/community#faq)
npm warn deprecated multicodec@1.0.4: This module has been superseded by the multiformats module
npm warn deprecated multibase@0.7.0: This module has been superseded by the multiformats module
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npm warn deprecated abstract-level-down@6.2.3: Superseded by abstract-level (https://github.com/Level/community#faq)
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npm warn deprecated abstract-level-down@6.2.3: Superseded by abstract-level (https://github.com/Level/community#faq)
npm warn deprecated @truffle/debugger@12.1.5: Package no longer supported. Contact Support at https://www.npmjs.com/support for more info.
npm warn deprecated @truffle/db@2.0.36: Package no longer supported. Contact Support at https://www.npmjs.com/support for more info.
npm warn deprecated @truffle/codec@0.17.3: Package no longer supported. Contact Support at https://www.npmjs.com/support for more info.

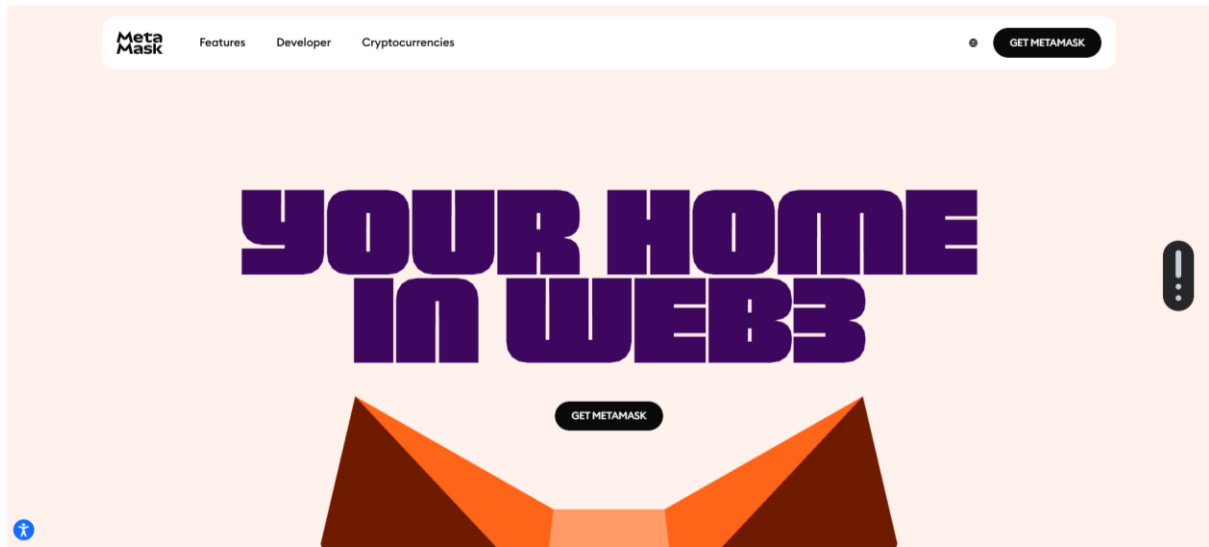
added 1174 packages in 2m

105 packages are looking for funding
  run `npm fund` for details
npm notice
npm notice New major version of npm available! 10.9.3 -> 11.5.2
npm notice Changelog: https://github.com/npm/cli/releases/tag/v11.5.2
npm notice To update run: npm install -g npm@11.5.2
npm notice
```

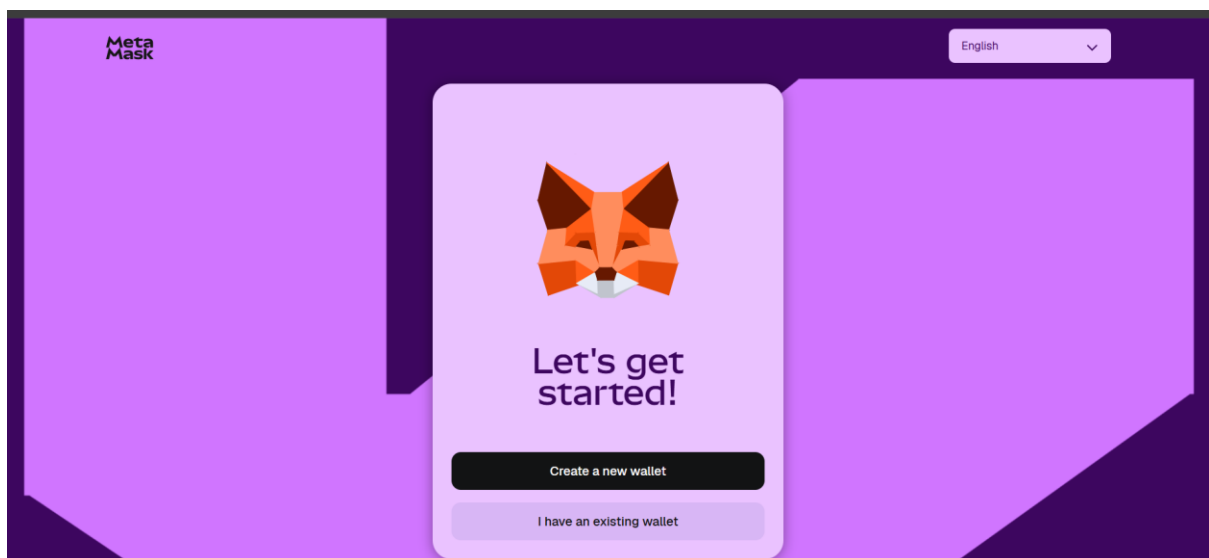
- Verify installation:

```
C:\Users\>truffle version
Truffle v5.11.5 (core: 5.11.5)
Ganache v7.9.1
Solidity v0.5.16 (solc-js)
Node v22.19.0
Web3.js v1.10.0
```

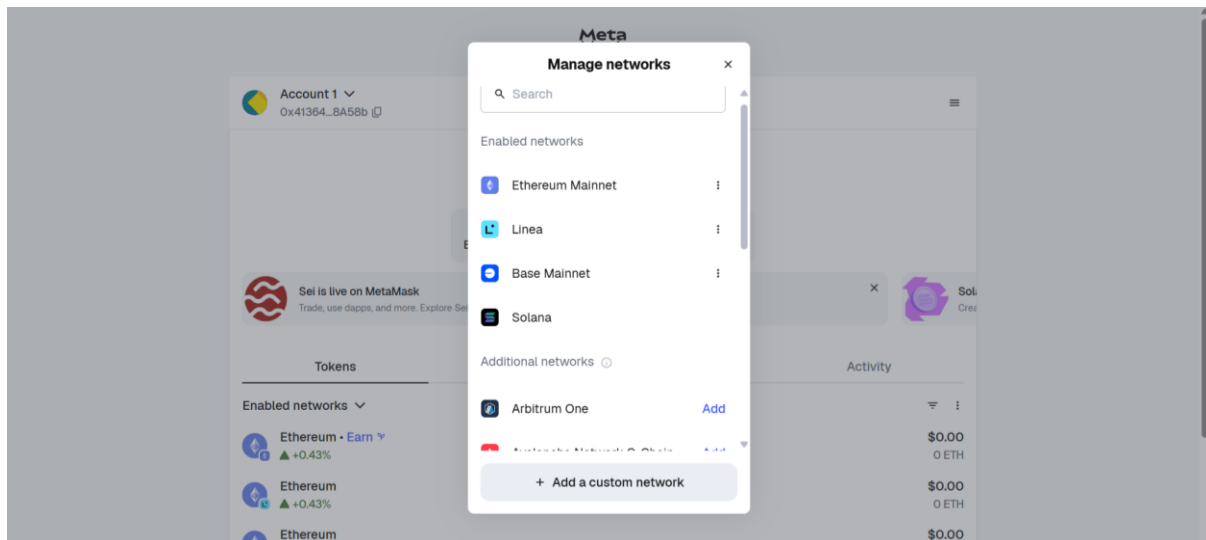
3. MetaMask



- Add MetaMask extension to Chrome/Firefox.
- Create a new wallet and store seed phrases safely.

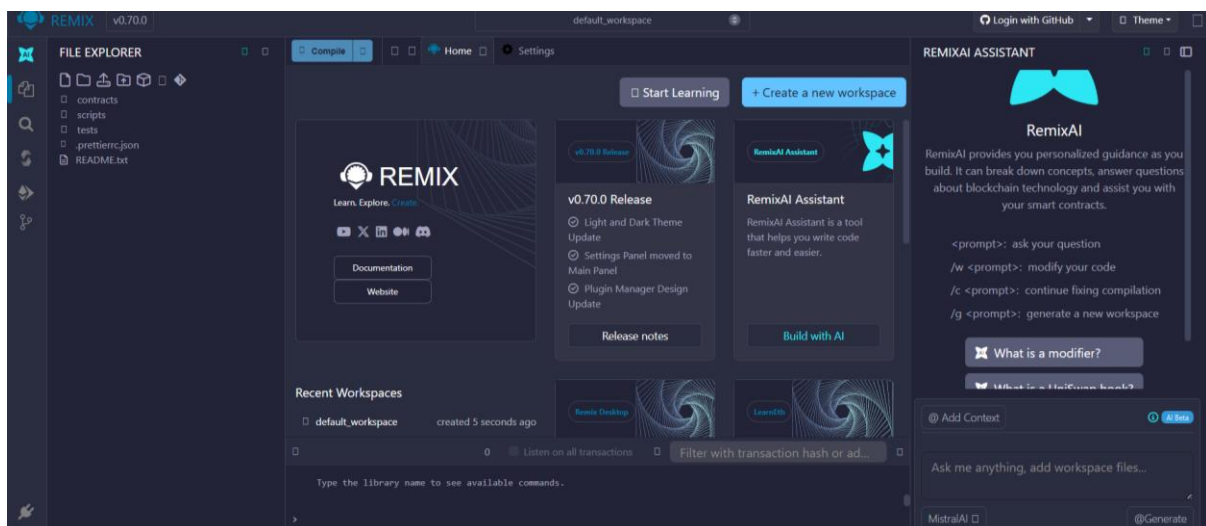


- Connect it to Ganache or test networks like Ropsten/Goerli.



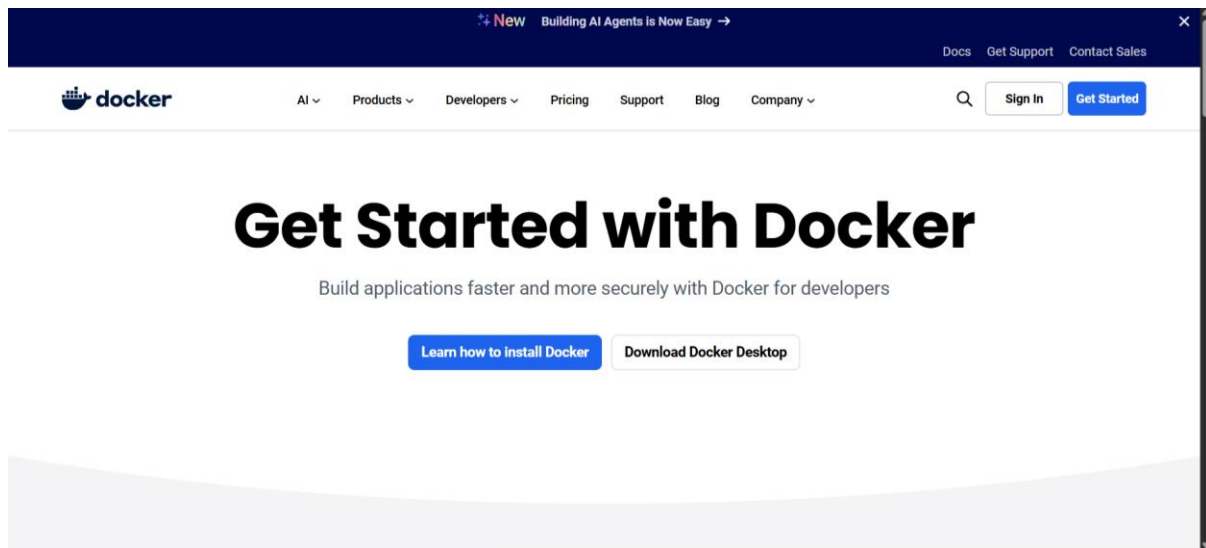
4. Remix IDE

- Open <https://remix.ethereum.org> in the browser.



- Start writing and deploying Solidity smart contracts.

5. Hyperledger fabric



- Install Docker and cURL.
- Download Fabric binaries:
- `curl -sSL https://bit.ly/2ysbOFE | bash -s`
- Set up a local Fabric network and test chaincode.

Conclusion- In this practical, we studied basic blockchain concepts and explored important installation tools like Ganache, Truffle, MetaMask, Remix IDE, and Hyperledger. These tools form the foundation for blockchain development by providing a local environment for testing, deploying, and interacting with smart contracts and decentralized applications. Understanding these tools and concepts helps in building practical blockchain solutions and prepares us for more advanced experiments in consensus mechanisms, transaction processing, and blockchain integration with machine learning.