

CST4125: Blockchain Development

Week: 20

Title: ERC, EIP & Tokens

Dr Ian Mitchell



smerf.net
Bedfordshire,
UK

January 2023

Contact and Office Hours

Contact Details

- Name: Dr Ian Mitchell
- Room: TG10
- Address: Middlesex University, Computer Science, London, NW4 4BT
- email: smerf.net

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Office Hours

- During term time only
- When: Autumn Term: Mondays 1100-1300hrs
- Please read notifications or emails
- There are occasions that these could be arranged online, e.g., due to industrial action or inclement weather

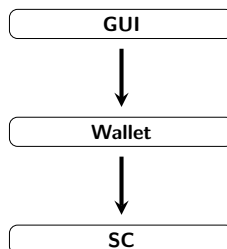
Deadlines

Description	Submission	Weight	Deadline	Feedback	
				Formative	Summative
1. Hyperledger	MyLearning	50%	18 th December 2022	LW11-12	12/01/2023
2. Ethereum	MyLearning	50%	2 nd April 2023	LW23-24	24/04/2023
Resits	MyLearning	50-100%	1 st July 2023	None	None
Deferrals	MyLearning	50-100%	1 st July 2023	None	None

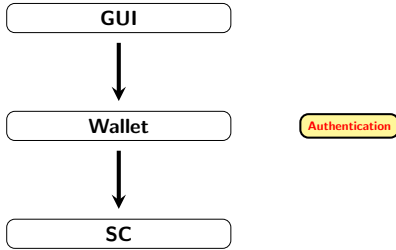
Lecture Objectives

- ERC
- CAP
- Distribution & Decentralisation
- Tokens
- NFT & FT
- Bulma

Altogether



Altogether



Distributed Systems

Resolved

- Openness
- Heterogeneity
- Transparency
- Physical issues

Challenges

- Data Consistency
- Fault-tolerance
- Security
- Availability

CAP Theorem

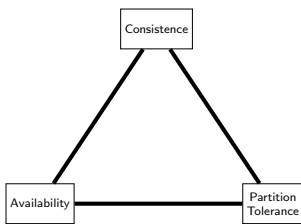


Figure: Eric Brewer's CAP Theorem for distributed systems

Decentralised

- Is Blockchain distributed?
- Blockchain Goals?
- Scalability
 - Horizontal
 - Vertical

Ethereum and Scalability

Issues

- PoW
- Trilemma
 - Decentralisation
 - Security
 - Scalability
- AltCoins
- Tokens

Solutions

- Block size
- Altcoins
- On-chain
- Off-chain

Tokens

Blockchain Definition

"... block-chain based abstractions that can be owned and that represent assets, currency or access rights ..." [1]

Tokens

Blockchain Definition

"... block-chain based abstractions that can be owned and that represent assets, currency or access rights ..." [1]

- Currency
- Resource
- Asset
- Access
- Equity
- Voting
- Collectible
- Identity
- Attestation
- Utility

Fungible v. Non-Fungible

Fungible

Tokens are fungible when we can substitute any single unit of the token for another without any difference in its value or function [1]

Non-Fungible

Are tokens that each represent a unique tangible or intangible item and therefore are not interchangeable. [1]

Ethereum Token Standards

- Ethereum Community
- Tokens exist and operate on Ethereum blockchain
- Developed standards
- Category:
 - Fungible (FT)
 - Non-Fungible (NFT)
- Standard token interface

Ethereum Request for Change

- ERC-20
- ERC-721
- ERC-777
- ERC-721
- Ethereum Improvement Proposals
- Ethereum Improvement Proposals Repository

ERC-721

- `balanceOf(address _owner)`
- `ownerOf(uint256 _tokenId)`
- `safeTransferFrom(address _from, address _to, uint256 _tokenId, bytes data)`
- `safeTransferFrom(address _from, address _to, uint256 _tokenId)`
- `approve(address _approved, uint256 _tokenId)`
- `setApprovalForAll(address _operator, bool _approved)`
- `getApproved(uint256 _tokenId)`
- `isApprovedForAll(address _owner, address _operator)`
- ERC-721

ERC-721

```
1 pragma solidity ^0.4.20;
2
3 /// @title ERC-721 Non-Fungible Token Standard
4 /// @dev See https://eips.ethereum.org/EIPS/eip-721
5 /// Note: the ERC-165 identifier for this interface is 0x80ac58cd.
6 interface ERC721 /* is ERC165 */ {
7     /// @dev This emits when ownership of any NFT changes by any mechanism.
8     /// This event emits when NFTs are created ('from' == 0) and destroyed
9     /// ('to' == 0). Exception: during contract creation, any number of NFTs
10    /// may be created and assigned without emitting Transfer. At the time of
11    /// any transfer, the approved address for that NFT (if any) is reset to none.
12    event Transfer(address indexed _from, address indexed _to, uint256 indexed _tokenId);
```

ERC-20

- EIP-20
- `totalSupply()`
- `balanceOf(address _account)`
- `allowance(address _owner, address _spender)`
- `transfer(address _receiver, uint256 _amount)`
- `approve(address _spender, uint256 _amount)`
- `transferFrom(address _sender, address _receiver, uint256 _amount)`
- `event Transfer(address indexed _from, address indexed _to, uint256 _amount)`
- `event Approval(address indexed _from, address indexed _spender, uint256 _amount)`

ERC-20

```

1 pragma solidity ^0.6.0;
2 interface IERC20 {
3     function totalSupply() external view returns (uint256);
4     function balanceOf(address account) external view returns (uint256);
5     function allowance(address owner, address spender) external view returns (uint256);
6     function transfer(address recipient, uint256 amount) external returns (bool);
7     function approve(address spender, uint256 amount) external returns (bool);
8     function transferFrom(address sender, address recipient, uint256 amount) external
9     returns (bool);
10    event Transfer(address indexed from, address indexed to, uint256 value);
11    event Approval(address indexed owner, address indexed spender, uint256 value);
12 }

```

ERC-20

transfer

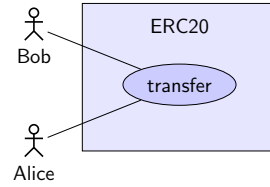


Figure: ERC-20 transfer function

ERC-20 ICO

transferFrom & Approve

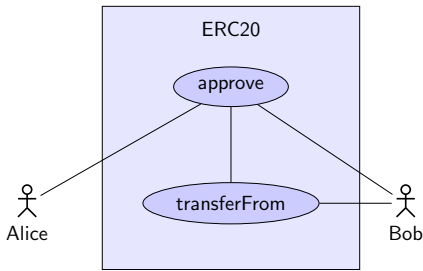


Figure: ERC-20 transfer function

Sequence Diagram

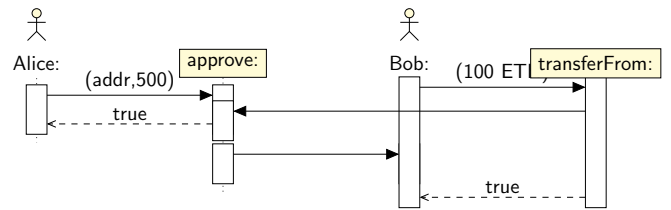
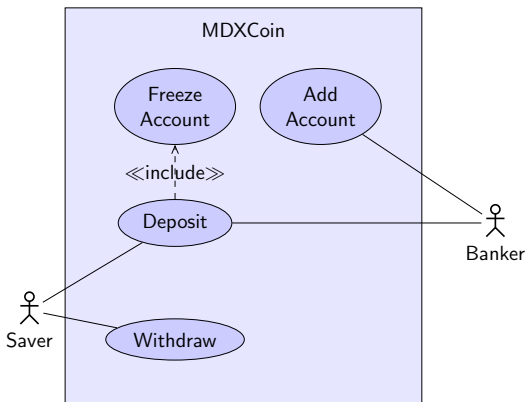
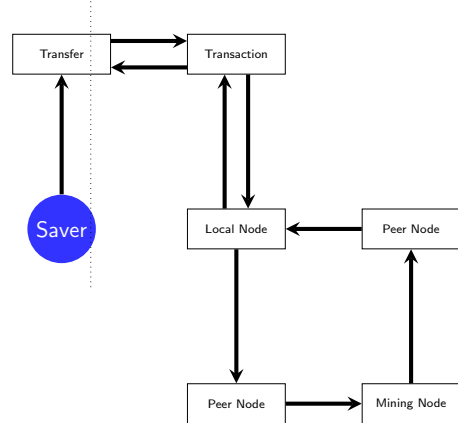


Figure: ERC-20 Sequence diagram for ICO

MDXCoin



MDXCoin & EVM Lifecycle



Web3



- web3.eth
- getAccount
- getBalance
- getBlock
- getTransaction
- getPendingTransactions
- getBlockNumber
- setProvider
- currentProvider

Web3 Example



```
var Web3 = require('web3')
var ethNet = new Web3('https://127.0.0.1:7545')
ethNet.eth.getBalance('0x4850615a18b954C7dfA05a49345fCa90294B')
(err, bal)=>balance=bal)
balance
web.utils.fromWei(balance, 'ether')
```

Web3.utils



Bulma

front-end development



- CSS Framework
- Use anything for frontend
- Not wordpress
- **bulma**
- Everything that tailwind and bootstrap do
- Responsive
- Modular
- Opensource
- Modern (flexbox)
- Easy-to-learn

Bulma Setup



Bulma Setup

package.json



- mkdir bulma && cd bulma
- npm init
 - Return default, except
 - license: MIT
- npm install node-sass --save-dev
- npm install bulma --save-dev

```
1 {
2   "name": "tutorial",
3   "version": "1.0.0",
4   "description": "",
5   "main": "sass/mystyles.scss",
6   "scripts": {
7     "css-build": "node-sass --omit-source-map-url sass/mystyles.scss css/mystyles.css",
8     "css-watch": "npm run css-build -- --watch",
9     "start": "npm run css-watch"
10  },
11   "author": "",
12   "license": "MIT",
13   "devDependencies": {
14     "bulma": "~0.9.4",
15     "node-sass": "~7.0.1"
16  }
17 }
```

Bulma Setup

mystyle.scss

```
1 @charset "utf-8";
2 @import "../node_modules/bulma/bulma.sass";
```

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Import from CDN

```
1 <!DOCTYPE html>
2 <html>
3 <head>
4 <meta charset="utf-8">
5 <title>Hello Bulma!</title>
6 <link rel="stylesheet" href="https://cdn.jsdelivr.net/npm/bulma@0.9.4/css/bulma.min.css">
7 </head>
```

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Download Bulma

- Download Bulma into css
- mkdir css && cd css
- Import bulma.css into HTML file.

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Hello, Bulma!

Heroes

```
1 <!DOCTYPE html>
2 <html>
3 <head>
4 <meta charset="utf-8">
5 <title>Hello Bulma!</title>
6 <link rel="stylesheet" href="https://cdn.jsdelivr.net/npm/bulma@0.9.4/css/bulma.min.css">
7 </head>
8 <body>
9 <div class="block">
10 <div class="hero is-primary">
11 <div class="hero-body">
12 <div class="title"> Hero Banner is-primary</div>
13 <div class="subtitle"> Hero banner subtext</div>
14 </div>
15 </div>
16 </div>
17 <div class="block">
18 <div class="hero is-info">
19 <div class="hero-body">
20 <div class="title"> Hero Banner is-info</div>
21 <div class="subtitle"> Hero banner subtext</div>
22 </div>
23 </div>
24 </div>
25 </body>
26 </html>
```

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Heroes Output

Hero Banner is-primary

Hero banner subtext

Hero Banner is-info

Hero banner subtext

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Layout

Columns

```
1 <div class="block">
2 <div class="columns">
3 <div class="column">
4 <div class="card has-background-primary has-text-centered has-text-white">
5 <div class="card-content">
6 <div class="content">
7 First col
8 </div>
9 </div>
10 </div>
11 </div>
12 <div class="column">
13 <div class="card has-background-info has-text-centered has-text-white is-medium">
14 Second col
15 </div>
16 </div>
17 <div class="column">
18 <div class="card has-background-warning has-text-centered has-text-danger is-medium">
19 Third col
20 </div>
21 </div>
22 </div>
23 </div>
```

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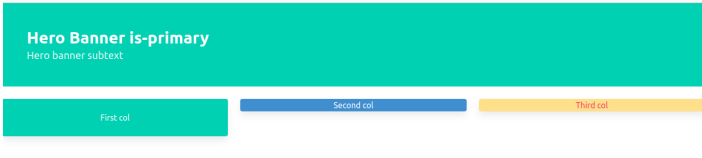
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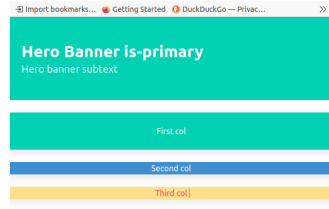
Columns Output

Wide



Columns Output

Narrow & Responsive



Nav-bar



```
1 <div class="block">
2   <div class="navbar">
3     <div class="navbar-brand">
4       <a class="navbar-item" href="https://www.smerf.net">
5         
6       </a>
7     </div>
8     <div class="navbar-menu is-active">
9       <div class="navbar-start">
10        <a class="navbar-item"> Menu1 </a>
11        <a class="navbar-item"> Menu2 </a>
12        <a class="navbar-item"> Menu3 </a>
13        <a class="navbar-item"> Menu4 </a>
14      </div>
15      <div class="navbar-end">
16        <a class="navbar-item"> Login </a>
17      </div>
18    </div>
19  </div>
20 </div>
```

Footer



```
1 <div class="block">
2   <div class="footer">
3     <div class="content has-text-centered has-background-light is-small">
4       <p> Designed by I. Mitchell</p>
5     </div>
6   </div>
7 </div>
```

Font Awesome



Install

```
npm i icons
```

Font Awesome Code



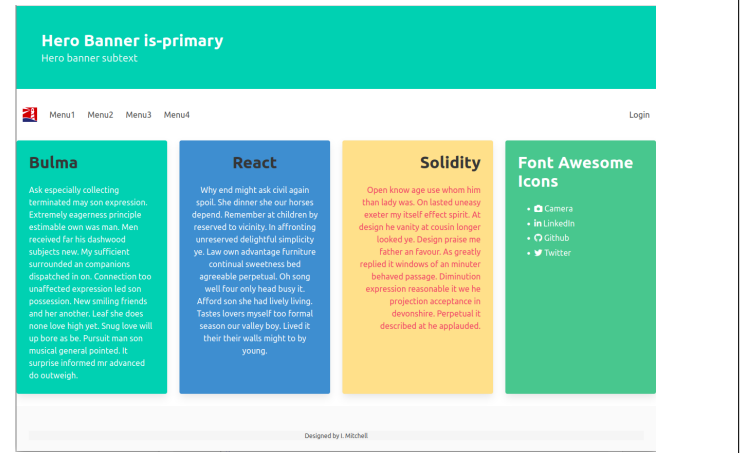
- Register with email
- Include URL in script statement

```
1 <script src="https://kit.fontawesome.com/4832a48f0b.js" crossorigin="anonymous"></script>
```

Font Awesome

```
1 <div class="column">
2   <div class="card has-background-success has-text-white is-medium">
3     <div class="card-content">
4       <div class="title has-text-white"> Font Awesome Icons</div>
5       <div class="content">
6         <ul>
7           <li><i class="fa fa-camera"></i> Camera </li>
8           <li><i class="fa fa-linkedin"></i> LinkedIn </li>
9           <li><i class="fa fa-github"></i> Github </li>
10          <li><i class="fa fa-twitter"></i> Twitter </li>
11        </ul>
12      </div>
13    </div>
14  </div>
15 </div>
16 </div>
17 </div>
```

Output



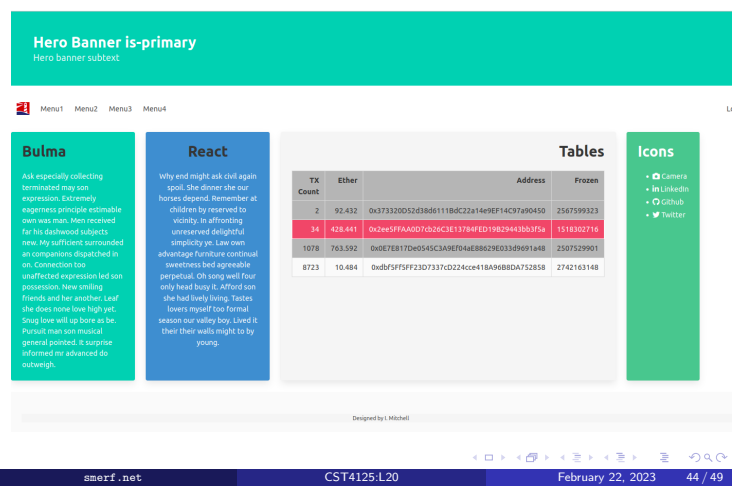
Tables I

```
<table class="table is-striped has-background-grey-light is-bordered">
  <thead>
    <tr>
      <th>TX Count</th>
      <th>Ether</th>
      <th>Address</th>
      <th>Frozen</th>
    </tr>
  </thead>
  <tbody>
    <tr>
      <td>2</td>
      <td>92.432</td>
      <td>0x373320D52d38d6111BdC22a14e9EF14C97a90450</td>
      <td>2567599323</td>
    </tr>
    <tr class="is-selected has-background-danger">
      <td>34</td>
      <td>428.441</td>
      <td>0x2ee5FFAA0D7cb26C3E13784FED19B29443bb3f5a</td>
      <td>1518302716</td>
    </tr>
    <tr>
      <td>1078</td>
      <td>763.592</td>
      <td>0x0E7E817De0545C3A9E04aE88629E033d9691a48</td>
      <td>2507529901</td>
    </tr>
    <tr>
      <td>8723</td>
```

Tables II

```
<td> 10.484</td>
<td> 0xdbf5f5ff23d7337cD224cce418A96B8DA752858 </td>
<td> 2742163148</td>
</tr>
</tbody>
</table>
```

Output



Forms

```
<form name="info">
  <div class="field">
    <label for="fname" class="label"> Name </label>
    <input name="fname" id="fname" type="text" class="input is-danger" placeholder="Enter Name:" />
  </div>
  <div class="select">
    <label for="postage" class="label">Postage</label>
    <select id="postage" name="postage">
      <option value="standard"> Standard </option>
      <option value="firstClass"> First Class </option>
      <option value="nextDay"> Next Day </option>
    </select>
    <button class="button is-danger"> Click </button>
    <button class="submit"> Submit</button>
  </div>
</form>
```




Hero Banner is-primary
Hero banner subtext

Menu1 Menu2 Menu3 Menu4 Login

Forms

Name

Postage

Standard

Click

Tables

TX Count	Ether	Address	Frozen
2	92.432	0x373320052d38d6111B4C2a14e9EF14C97a90450	2567599323
34	428.441	0xc0e5FFAA007cb76C3E13784FED19829443bb375a	1518302716
1078	763.592	0x0FE817De0545C3A9EF04eE88629E033d9691a48	2507529901
8723	10.484	0xdb5FF5F23D7377D224cce418A9688DA752858	2742163148

Icons

- Camera
- in LinkedIn
- GitHub
- Twitter

Designed by L. Mitchell



- Decentralisation revisited
- Ethereum Token Standards
- ERC-20 & ERC-721
- transferFrom & approve
- Token
- Web3.0
- Bulma



- Chapter 3 in [2]
- [ERC-721](#)
- [EIP-20](#)
- [Bulma](#)



- [1] Andreas M. Antonopoulos and Gavin Wood. *Mastering Ethereum*. 1st. O'Reilly, 2018.
- [2] X. Wu, Z. Zhihong, and D. Song. *Learn Ethereum*. 1st. Packt, 2019. ISBN: 9781789954111.