

# Reward Sharing

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## I. CONTEXT

BUY FROM DEX						
1	BOB	Buy 103 > Tax 3 > Pool = 3, balance = 100, total staked = 100				
2	ADAM	Buy 206 > Tax 6 > Pool = 9, balance = 200, total staked = 300				
3	CAROL	Buy 309 > Tax 9 > Pool = 18, balance = 300, total staked = 600				
4	ERIC	Buy 103 > Tax 3 > Pool = 21, balance = 100, total staked = 700				
FORMULA		Total buy: 103 + 206 + 309 + 103 = 700 + 21 = 721				
1	BOB	100 * 3/100	100 * 6/300	100 * 9/600	100 * 3/700	3.0 + 2.0 + 1.5 + 0.43 = 6.93
2	ADAM	0	200 * 6/300	200 * 9/600	200 * 3/700	0.0 + 4.0 + 3.0 + 0.86 = 7.86
3	CAROL	0	0	300 * 9/600	300 * 3/700	0.0 + 0.0 + 4.5 + 1.28 = 5.78
4	ERIC	0	0	0	100 * 3/700	0.0 + 0.0 + 0.0 + 0.43 = 0.43
					Total = 6.93 + 7.86 + 5.78 + 0.43 = 21 = pool size	
TRANSFER						
1	BOB	Buy 103 > Tax 3 > Pool = 3, balance = 100, total staked = 100				
2	ADAM	Buy 206 > Tax 6 > Pool = 9, balance = 200, total staked = 300				
3	BOB send 50 coins to ADAM => CONVERT TO BUY CASE: ADAM BUY 50 from BOB					
3.1	BOB	Balance = 100 – 50 = 50				
3.2	ADAM	Same BUY 50 from DEX > Tax = 1.46 > Pool = 10.46, balance = 200 + 48.54 = 248.54, total staked = 298.54				
FORMULA						
1	BOB	100 * 3/100	100 * 6/300	50 * 1.46/298.54	3.0 + 2.0 + 0.24 = 5.24	
2	ADAM	0	200 * 6/300	248.54 * 1.46/298.54	0.0 + 4.0 + 1.22 = 5.22	
					Total = 5.24 + 5.22 = 10.46 = pool size	
SELL TO DEX						
1	BOB	Buy 103 > Tax 3 > Pool = 3, balance = 100, total staked = 100				
2	ADAM	Buy 206 > Tax 6 > Pool = 9, balance = 200, total staked = 300				
3	BOB SELL 50 coins => CONVERT TO TRANSFER CASE: BOB TRANSFER to LP					
3.1	BOB	Sell 50 > Tax 1.5 > Pool 10.5, balance = 50, total staked = 250				
FORMULA						
1	BOB	100 * 3/100	100 * 6/300	50 * 1.5/250	3.0 + 2.0 + 0.3 = 5.3	
2	ADAM	0	200 * 6/300	200 * 1.5/250	0.0 + 4.0 + 1.2 = 5.2	
					Total = 5.3 + 5.2 = 10.5 = pool size	

## II. ALGORITHM

Global	<pre>// Global Variables l: uint = 0 // Portion map length r: map (uint -&gt; uint) // Portion reward mapping urc: map (address -&gt; uint) // User's reward accumulation up: map (address -&gt; uint) // User's portion reward offset ud: map (address -&gt; uint) // User's debt t: uint // Total staked pool: uint // Total pool reward distributed: uint // Distributed reward fee: uint // fee percent</pre>
Transfer (from_address, to_address, amount)	<pre># ----- # Token transfer function: transfer(from_address, to_address, amount) // Update portion anytime coin changes: buy, sell, transfer tp: address // tax payer  tax = fee * amount; after_tax = amount - tax; pool = pool + tax;  if (is_buy) {     t = t + after_tax;     tp = to_address;  } else if (is_transfer) {     t = t - tax;     tp = to_address;      urc[from_address] = urc[from_address] + get_portion_reward(from_address);     up[from_address] = 1 + 1;  } else {     t = t - amount;     tp = from_address;  }  // Update user offset and portion first urc[tp] = urc[tp] + get_portion_reward(tp); up[tp] = 1 + 1;  // Update reward portion r[l+1] = r[l] + tax / t; l = l + 1;  // Call native transfer super.transfer(from_address, address(this), tax); super.transfer(from_address, to_address, after_tax);</pre>
get_portion_reward (user_address)	<pre># ----- # Get user's portion reward amount function: get_portion_reward(user_address)</pre>

	<pre>// Get pending reward of user address portion = up[user_address]; if (portion == 0) portion = 1; return (r[1] - r[portion - 1]) * balanceOf(user_address);</pre>
get_max_reward (user_address)	<pre># ----- # Get user's max reward amount function: get_max_reward(user_address) // Get max reward of user address return get_portion_reward(user_address) + urc[user_address];</pre>
get_pending_reward (user_address)	<pre># ----- # Get user's pending reward amount function: get_pending_reward(user_address) // Get pending reward of user address total = get_max_reward(user_address); if (total &gt; ud[user_address]) return total - ud[user_address]; return 0;</pre>
withdraw_pending_reward (user_address)	<pre># ----- # Withdraw user's pending reward amount function: withdraw_pending_reward(user_address) // Withdraw reward reward = get_pending_reward(user_address); if (reward &gt; 0) {     distributed = distributed + reward;     ud[user_address] = ud[user_address] + reward;      ... do something with reward ... }</pre>

### III. JAVASCRIPT

```
export class AppService {
  // Native transfer
  balance: { [index: string]: number } = {};

  _transfer(from: string, to: string, amount: number): void {
    this.balance[from] -= amount;
    this.balance[to] += amount;
  }

  l: number = 0;
  r: { [index: number]: number } = {};
  urc: { [index: string]: number } = {};
  up: { [index: string]: number } = {};
  ud: { [index: string]: number } = {};
  t: number = 0;
  pool: number = 0;
  distributed: number = 0;
  fee: number = 3 / 103; // 2.9%

  // reset state
  reset(): void {
    this.r = {0: 0};
    this.l = 0;
  }
}
```

```

    this.unc = {};
    this.up = {};
    this.ud = {};
    this.t = 0;
    this.pool = 0;
    this.balance = {'bob': 0, 'adam': 0, 'carol': 0, 'eric': 0};
}

// Update reward in transfer action
token_transfer(type: string, from_address: string, to_address: string, amount: number):
void {
    console.log(`type: ${type}, from: ${from_address}, to: ${to_address}`);
    let tp: string;

    const tax: number = this.fee * amount;
    const after_tax: number = amount - tax;
    this.pool = this.pool + tax;

    if (type === 'buy') {
        this.t = this.t + after_tax;
        tp = to_address;
    } else if (type === 'transfer') {
        this.t = this.t - tax;
        tp = to_address;
    }

    this.unc[from_address] = (this.unc[from_address] ?? 0) +
this.get_portion_reward(from_address);
    this.up[from_address] = this.l + 1;

    } else {
        this.t = this.t - amount;
        tp = from_address;
    }

}

// Update user offset and portion first
this.unc[tp] = (this.unc[tp] ?? 0) + this.get_portion_reward(tp);
this.up[tp] = this.l + 1;

// Update reward portion
this.r[this.l + 1] = this.r[this.l] + tax/this.t;
this.l = this.l + 1;

// Call super native transfer
this._transfer(from_address, 'pool', tax);
this._transfer(from_address, to_address, after_tax);
}

// Get user portion reward function
get_portion_reward(user_address: string): number {
    let portion = (this.up[user_address] ?? 0);
    if(portion == 0) {
        portion = 1;
    }
    return (this.r[this.l] - this.r[portion - 1]) * this.balance[user_address];
}

// Get user max reward function
get_max_reward(user_address: string): number {
    return this.get_portion_reward(user_address) + (this.unc[user_address] ?? 0);
}

// Get user's pending reward amount function
get_pending_reward(user_address: string): number {

```

```

    const total = this.get_max_reward(user_address);
    if(total > (this.ud[user_address] ?? 0)) {
        return total - (this.ud[user_address] ?? 0);
    }
    return 0;
}

// Withdraw user's pending reward amount function
withdraw_pending_reward(user_address: string): void {
    const reward = this.get_pending_reward(user_address);
    if(reward > 0) {
        this.distributed += reward;
        this.ud[user_address] = (this.ud[user_address] ?? 0) + reward;
        console.log(`=> ${user_address} withdraw: ${reward}`);
    } else {
        console.log(`=> ${user_address} withdraw: empty`);
    }
}
}

```

#### IV. OUTPUT

```

const app = await NestFactory.createApplicationContext(AppModule);
const appService = app.get(AppService);

const printRewards = (isFull: boolean = false): void => {
    console.log(`Bob reward: ${appService.get_pending_reward('bob')}, balance:
    ${appService.balance['bob']}`);
    console.log(`Adam reward: ${appService.get_pending_reward('adam')}, balance:
    ${appService.balance['adam']}`);
    if(isFull) {
        console.log(`Carol reward: ${appService.get_pending_reward('carol')}, balance:
    ${appService.balance['carol']}`);
        console.log(`Eric reward: ${appService.get_pending_reward('eric')}, balance:
    ${appService.balance['eric']}`);
    }
}

const printPoolSizeAndStaked = (isDistributed: boolean = false): void => {
    console.log('Pool size:', appService.pool);
    console.log('Total staked:', appService.t);
    if(isDistributed) {
        console.log('Distributed size:', appService.distributed);
    }
}

// -----
appService.reset();
// Buy
console.log('---BUY---');
appService.token_transfer('buy', 'dex', 'bob', 103);
appService.token_transfer('buy', 'dex', 'adam', 206);
appService.token_transfer('buy', 'dex', 'carol', 309);
appService.token_transfer('buy', 'dex', 'eric', 103);
// Log
printPoolSizeAndStaked();
printRewards(true);

// -----
appService.reset();
// Transfer
console.log('---TRANSFER---');

```

```

appService.token_transfer('buy', 'dex', 'bob', 103);
appService.token_transfer('buy', 'dex', 'adam', 206);
appService.token_transfer('transfer', 'bob', 'adam', 50);
// Log
printPoolSizeAndStaked();
printRewards();

// -----
appService.reset();
// Sell
console.log('---SELL---');
appService.token_transfer('buy', 'dex', 'bob', 103);
appService.token_transfer('buy', 'dex', 'adam', 206);
appService.token_transfer('sell', 'bob', 'dex', 50);
// Log
printPoolSizeAndStaked();
printRewards();

// -----
appService.reset();
// Withdraw
console.log('---WITHDRAW---');
appService.token_transfer('buy', 'dex', 'bob', 103);
printRewards();
appService.withdraw_pending_reward('bob'); // = 3

appService.token_transfer('buy', 'dex', 'adam', 206);
printRewards();
appService.withdraw_pending_reward('bob'); // = 3 + 2 - 3 = 2
appService.withdraw_pending_reward('adam'); // = 4

appService.token_transfer('transfer', 'bob', 'adam', 50);
printRewards();
appService.withdraw_pending_reward('bob'); // = 3 + 2 + 0.24 - 5 = 0.24
appService.withdraw_pending_reward('adam'); // = 4 + 1.22 - 4 = 1.22
printPoolSizeAndStaked();

appService.token_transfer('sell', 'bob', 'dex', 50);
printRewards();
appService.withdraw_pending_reward('bob'); // = 0 (balance = 0)
appService.withdraw_pending_reward('adam'); // = 4 + 1.22 + 1.46 - 5.22 = 1.46
printPoolSizeAndStaked();

appService.token_transfer('buy', 'dex', 'adam', 206);
printRewards();
appService.withdraw_pending_reward('bob'); // = 0 (balance = 0)
appService.withdraw_pending_reward('adam'); // = 4 + 1.22 + 1.46 + 6 - 6.68 = 6
printPoolSizeAndStaked(true);

=====

---BUY---
type: buy, from: dex, to: bob
type: buy, from: dex, to: adam
type: buy, from: dex, to: carol
type: buy, from: dex, to: eric
Pool size: 21
Total staked: 700
Bob reward: 6.928571428571429, balance: 100
Adam reward: 7.857142857142857, balance: 200
Carol reward: 5.785714285714285, balance: 300
Eric reward: 0.42857142857142816, balance: 100

```

```

---TRANSFER---
type: buy, from: dex, to: bob
type: buy, from: dex, to: adam
type: transfer, from: bob, to: adam
Pool size: 10.45631067961165
Total staked: 298.54368932038835
Bob reward: 5.2439024390243905, balance: 50
Adam reward: 5.21240824058726, balance: 248.54368932038835
---SELL---
type: buy, from: dex, to: bob
type: buy, from: dex, to: adam
type: sell, from: bob, to: dex
Pool size: 10.45631067961165
Total staked: 250
Bob reward: 5.29126213592233, balance: 50
Adam reward: 5.165048543689322, balance: 200
---WITHDRAW---
type: buy, from: dex, to: bob
Bob reward: 3, balance: 100
Adam reward: 0, balance: 0
=> bob withdraw: 3
type: buy, from: dex, to: adam
Bob reward: 2, balance: 100
Adam reward: 4.000000000000001, balance: 200
=> bob withdraw: 2
=> adam withdraw: 4.000000000000001
type: transfer, from: bob, to: adam
Bob reward: 0.24390243902439046, balance: 50
Adam reward: 1.2124082405872594, balance: 248.54368932038835
=> bob withdraw: 0.24390243902439046
=> adam withdraw: 1.2124082405872594
Pool size: 10.45631067961165
Total staked: 298.54368932038835
type: sell, from: bob, to: dex
Bob reward: 0, balance: 0
Adam reward: 1.4563106796116507, balance: 248.54368932038835
=> bob withdraw: empty
=> adam withdraw: 1.4563106796116507
Pool size: 11.912621359223301
Total staked: 248.54368932038835
type: buy, from: dex, to: adam
Bob reward: 0, balance: 0
Adam reward: 6.000000000000002, balance: 448.54368932038835
=> bob withdraw: empty
=> adam withdraw: 6.000000000000002
Pool size: 17.9126213592233
Total staked: 448.54368932038835
Distributed size: 17.9126213592233

```

```

=====
Compiling your contracts...
=====
> Compiling ./src/active/TokenPresenter.sol
> Compiling ./src/active/utills/RewardSharing.sol
> Artifacts written to /var/folders/pv/_n9wn10539z4gq_17z945k300000gn/T/test--10423-4bK2A5isqI3Y
> Compiled successfully using:
  - solc: 0.8.4+commit.c7e474f2.Emscripten.clang

Contract: reflection.test
Owner: 0xF7e008130254b4bD272166dafaF52C65915D18e8
[ADD_LP] owner is adding liquidity of 100000 Reward1 and 100 BNB
BigNumber.toString does not accept any parameters; base-10 is assumed
[ADD_LP] owner is adding liquidity of 100000 N07 and 100 BNB
  initialize
    ✓ Verify init config (3769ms)
  logic
Owner: 0xF7e008130254b4bD272166dafaF52C65915D18e8
[ADD_LP] owner is adding liquidity of 100000 Reward1 and 100 BNB
[ADD_LP] owner is adding liquidity of 100000 N07 and 100 BNB
[BUY_EXACT_TOKENS] bob is buying worth of 103 Tokens
Estimated input: 0.103312825035437804
pool size: 3.0076
pool staked: 99.9924
pool distributed: 0.0
[bob]pendingReward: 3.0075999999999999999
[bob]tokenBalance: 99.9924
[bob]rewardBalance: 0.0
bob CLAIM
pool size: 3.0076
pool staked: 99.9924
pool distributed: 3.0075999999999999999
[bob]pendingReward: 0.0
[bob]tokenBalance: 99.9924
[bob]rewardBalance: 3.001587982910370198
[BUY_EXACT_TOKENS] adam is buying worth of 206 Tokens
Estimated input: 0.207254049949181209
[bob]pendingReward: 2.0050666666666666666
[bob]tokenBalance: 99.9924
[bob]rewardBalance: 3.001587982910370198
[adam]pendingReward: 4.0101333333333333333
[adam]tokenBalance: 199.9848
[adam]rewardBalance: 0.0
bob CLAIM
[bob]pendingReward: 0.0
[bob]tokenBalance: 99.9924
[bob]rewardBalance: 5.01073152988555529
[adam]pendingReward: 4.0101333333333333333
[adam]tokenBalance: 199.9848
[adam]rewardBalance: 0.0
pool size: 9.0228
pool staked: 299.9772
pool distributed: 5.0126666666666666666

```



```

[BUY_EXACT_TOKENS] carol is buying worth of 309 Tokens
Estimated input: 0.312480734533329329
[BUY_EXACT_TOKENS] eric is buying worth of 103 Tokens
Estimated input: 0.104593129452477457
[bob]pendingReward: 1.933457142857142857
[bob]tokenBalance: 99.9924
[bob]rewardBalance: 5.01073152988555529
[adam]pendingReward: 7.877047619047619047
[adam]tokenBalance: 199.9848
[adam]rewardBalance: 0.0
[carol]pendingReward: 5.800371428571428571
[carol]tokenBalance: 299.9772
[carol]rewardBalance: 0.0
[eric]pendingReward: 0.429657142857142857
[eric]tokenBalance: 99.9924
[eric]rewardBalance: 0.0
pool size: 21.0532
pool staked: 699.9468
pool distributed: 5.012666666666666666
bob CLAIM
adam CLAIM
carol CLAIM
eric CLAIM
[bob]pendingReward: 0.0
[bob]tokenBalance: 99.9924
[bob]rewardBalance: 6.964093968644591065
[adam]pendingReward: 0.0
[adam]tokenBalance: 199.9848
[adam]rewardBalance: 7.956569325178487977
[carol]pendingReward: 0.0
[carol]tokenBalance: 299.9772
[carol]rewardBalance: 5.857311779031531119
[eric]pendingReward: 0.0
[eric]tokenBalance: 99.9924
[eric]rewardBalance: 0.433820380346272228
pool size: 21.0532
pool staked: 699.9468
pool distributed: 21.053199999999999998
    ✓ buy (11658ms)
Owner: 0xF7e008130254b4bD272166dafaF52C65915D18e8
[ADD_LP] owner is adding liquidity of 100000 Reward1 and 100 BNB
[ADD_LP] owner is adding liquidity of 100000 N07 and 100 BNB
[BUY_EXACT_TOKENS] bob is buying worth of 103 Tokens
Estimated input: 0.103312825035437804
[BUY_EXACT_TOKENS] adam is buying worth of 206 Tokens
Estimated input: 0.207266530150884673
[TRANSFER_TOKEN] From bob to adam for 50 tokens
[bob]pendingReward: 5.257171519318373168
[bob]tokenBalance: 49.9924
[bob]rewardBalance: 0.0
[adam]pendingReward: 5.225628480681626831
[adam]tokenBalance: 248.5248
[adam]rewardBalance: 0.0
pool size: 10.4828
pool staked: 298.5172
pool distributed: 0.0
    ✓ transfer (5505ms)
Owner: 0xF7e008130254b4bD272166dafaF52C65915D18e8

```

```

[ADD_LP] owner is adding liquidity of 100000 Reward1 and 100 BNB
[ADD_LP] owner is adding liquidity of 100000 N07 and 100 BNB
[BUY_EXACT_TOKENS] bob is buying worth of 103 Tokens
Estimated input: 0.103312825035437804
[BUY_EXACT_TOKENS] adam is buying worth of 206 Tokens
Estimated input: 0.207266530150884673
[SELL] bob is selling 50 tokens
BNB snapshot: 999997.277441221110303483
Estimated output: 0.050185008455145256
[bob]pendingReward: 5.304648911447390668
[bob]tokenBalance: 49.9924
[bob]rewardBalance: 0.0
[adam]pendingReward: 5.178151088552609331
[adam]tokenBalance: 199.9848
[adam]rewardBalance: 0.0
pool size: 10.4828
pool staked: 249.9772
pool distributed: 0.0
    ✓ sell (5705ms)
Owner: 0xF7e008130254b4bD272166dafaF52C65915D18e8
[ADD_LP] owner is adding liquidity of 100000 Reward1 and 100 BNB
[ADD_LP] owner is adding liquidity of 100000 N07 and 100 BNB
[BUY_EXACT_TOKENS] bob is buying worth of 103 Tokens
Estimated input: 0.103312825035437804
[BUY_EXACT_TOKENS] adam is buying worth of 206 Tokens
Estimated input: 0.207266530150884673
[TRANSFER_TOKEN] From bob to adam for 50 tokens
[SELL] bob is selling 49.9924 tokens
BNB snapshot: 999997.205517334021242901
Estimated output: 0.050177384149600891
[BUY_EXACT_TOKENS] adam is buying worth of 206 Tokens
Estimated input: 0.207923245680291133
[bob]pendingReward: 5.257171519318373168
[bob]tokenBalance: 0.0
[bob]rewardBalance: 0.0
[adam]pendingReward: 12.700606560681626831
[adam]tokenBalance: 448.5096
[adam]rewardBalance: 0.0
pool size: 17.95777808
pool staked: 448.5096
pool distributed: 0.0
bob CLAIM
adam CLAIM
[bob]pendingReward: 0.0
[bob]tokenBalance: 0.0
[bob]rewardBalance: 5.284859663537046342
[adam]pendingReward: 0.0
[adam]tokenBalance: 448.5096
[adam]rewardBalance: 12.762892311784533734
pool size: 17.95777808
pool staked: 448.5096
pool distributed: 17.957778079999999999
    ✓ combine (7705ms)
Owner: 0xF7e008130254b4bD272166dafaF52C65915D18e8
[ADD_LP] owner is adding liquidity of 100000 Reward1 and 100 BNB
[ADD_LP] owner is adding liquidity of 100000 N07 and 100 BNB
[ADD_LP] owner is adding liquidity of 100000 Reward2 and 100 BNB
[BUY_EXACT_TOKENS] bob is buying worth of 103 Tokens

```

```
Estimated input: 0.103312825035437804
[BUY_EXACT_TOKENS] adam is buying worth of 206 Tokens
Estimated input: 0.207266530150884673
[TRANSFER_TOKEN] From bob to adam for 50 tokens
[SELL] bob is selling 43.9772 tokens
BNB snapshot: 999997.121232725040114541
Estimated output: 0.044142583271503352
[BUY_EXACT_TOKENS] adam is buying worth of 206 Tokens
Estimated input: 0.207958306302054554
bob CLAIM
adam CLAIM
POOL: 0
[bob]pendingReward: 0.0
[bob]tokenBalance: 0.0
[bob]rewardBalance: 5.396289108422247945
[adam]pendingReward: 0.0
[adam]tokenBalance: 421.5288
[adam]rewardBalance: 12.475359590232993053
pool size: 17.78213424
pool staked: 454.5248
pool distributed: 17.782134239999999999
POOL: 1
[bob]pendingReward: 0.0
[bob]tokenBalance: 0.0
[bob]rewardBalance: 10.671317769274254885
[adam]pendingReward: 0.0
[adam]tokenBalance: 421.5288
[adam]rewardBalance: 25.054443800364667268
pool size: 35.56426848
pool staked: 438.0268
pool distributed: 35.564268479999999999
    ✓ 2 pools (16454ms)
```

6 passing (2m)