eosio.token
@owner: eosio.prods
@active: eosio.prods

alice: 100 EOS, 0 XYZ
-0 EOS

bob: 50 EOS, 0 XYZ

dan: 0 EOS, 25 XYZ

emily: 0 EOS, 50 XYZ

exchange: 0 EOS, 0 XYZ
+100 EOS

exchange
@owner: exowner.prods
@active: exowner.prods

@eosio.transfer: exchange@eosio.code

alice: 100 EOS, 0 XYZ

bob: 50 EOS, 0 XYZ

dan: 0 EOS, 25 XYZ

emily: 0 EOS, 50 XYZ

1. alice deposites into exchange

exchange::deposit
    eosio.token::transfer [“alice”,”exchange”,”100 EOS”]

eosio.token
@owner: eosio.prods
@active: eosio.prods

alice: 0 EOS, 0 XYZ
+100 EOS

bob: 50 EOS, 0 XYZ

dan: 0 EOS, 25 XYZ

emily: 0 EOS, 50 XYZ

exchange: 100 EOS, 0 XYZ
-0 EOS

exchange
@owner: exowner.prods
@active: exowner.prods

@eosio.transfer: exchange@eosio.code

alice: 100 EOS, 0 XYZ
0 EOS

bob: 50 EOS, 0 XYZ

dan: 0 EOS, 25 XYZ

emily: 0 EOS, 50 XYZ

2. alice withdrawl from exchange

exchange::withdrawl
    require_auth(to)
    eosio.token::transfer [“exchange”,”alice”,”100 EOS”]

1 - START

Users start with their respective balanaces in each token contract.

```
eosio.token - accounts

alice:
   balance: 100.0000 EOS

bob:
   balance: 50.0000 EOS

exchange:
    balance: 0.0000 EOS
```

```
usd.token - accounts

alice:
   balance: 250.00 USD

bob:
   balance: 150.00 USD

exchange:
    balance: 0.00 USD
```

2 - CREATE MARKET (QUOTE)

base : quote
EOS : USD

BID: base -> quote (EOS -> USD) **Sell**
ASK: quote -> base (USD -> EOS) **Bid**

ex:

```
push action exchange createmarket {
   "quote":"{"quantity":"1.00 USD","contract":"usd.token"}",
}
```

Creates market **usd** (no_pairs_yet/USD)

Limits
* Max deposits for coins with less than 8 decimal places get shorted by the difference in percision
* Market names can only contain 12 letters and symbols can be as long as 7 letters, meaning the sum of letters in a pair of market symbols can not exceed 12.

```
exchange - market

exchange:
   name: "usd"
   quote: {0.00 USD, "usd.token2"}
   base_map: [
               "eosusd": {0.0000 EOS, "eosio.token"}
        ]
```

```
market = exchange_markets.find("usd");
name eosusd = market->base_map.find("eosusd");
```

2 - ADD MARKET PAIR (BASE)

ex:

```
push action exchange addpair {
   "market_name": "usd"
   "base":"{"quantity":"0.0000 EOS","contract":"eosio.token"}",
}
```

Pairs EOS against USD (EOS/USD) in market **"usd"**

```
exchange - market

exchange:
   name: "usd"
   quote: {0.00 USD, "usd.token2"}
   base_map: [
               "eosusd": {0.0000 EOS, "eosio.token"}
               "librausd": {0.00 LIBRA, "libra.token"}
               "fedusd": {0.0000 FED, "fed.token"}
        ]
```

3 - DEPOSIT

Users can deposit any token for trading in a market pair. All deposits will be converted to 8 decimal places for conversion sake.

ex:

```
push action eosio.token transfer {"from": "alice", "to": "exchange", "quantity": "10.0000 EOS"} -p alice
push action usd.token    transfer {"from": "bob",   "to": "exchange", "quantity": "6.00 USD" } -p bob
```

Before

```
eosio.token - accounts

alice:
   balance: 100.0000 EOS

exchange:
   balance:    0.0000 EOS
```

```
usd.token - accounts

bob:
   balance: 150.00 USD

exchange:
   balance:    0.00 USD
```

After

```
eosio.token - accounts

alice:
   balance: 90.0000 EOS

exchange:
   balance: 10.0000 EOS
```

```
usd.token - accounts

bob:
   balance: 144.00 USD

exchange:
   balance:    6.00 USD
```

```
exchange - exaccounts

alice:
   balance: {10.00000000 EOS, eosio.token}
   balance: {2.000000000 EOS, eosio2}

bob:
   balance: {6.00000000 USD, usd.token}

exchange:
   balance: {0.00000000 EOS, eosio.token}
   balance: {0.00000000 USD,  usd.token}
```

4 - PLACEORDER

Users can place orders with their **exaccount** balance within a **market**.

example (EOS/USD market):

alice sells 2.0000 EOS @ 3.6 USD each

```
push action exchange trade {
   "trader": "alice",
   "order_type": "BID",
   "price": "{"quantity": "3.60 USD", "contract": "usd.token"}",
   "volume": "{quantity": "2.0000 EOS", "contract": "eosio.token" }"
} -p alice
```

bob buys 1.5555 EOS @ 3.6 USD each (1.5555 EOS * 3.6 USD/EOS = 5.5988 USD)

```
push action exchange trade {
   "trader": "bob",
   "order_type": "ASK",
   "price": "{"quantity": "3.60 USD", "contract": "usd.token"}",
   "volume": "{"quantity": "1.5555 EOS", "contract": "eosio.token"},
} -p bob
```

Before

```
exchange - exaccounts

alice:
   balance: {10.00000000 EOS, eosio.token}

bob:
   balance: {6.00000000 USD, usd.token}

exchange:
   balance: {0.00000000 EOS, eosio.token}
   balance: {0.00000000 USD, usd.token}
```

After

```
exchange - exaccounts

alice:
   balance: {8.00000000 EOS, eosio.token}

bob:
   balance: {0.40120000 USD, usd.token}

exchange:
   balance: {2.00000000 EOS, eosio.token}
   balance: {5.59880000 USD, usd.token}
```

exchange - bidorders
scope: eosusd { EOS eosio.token, usd.token}

id	Trader	Price (USD)	Volume (EOS)	type
0	alice	3.60000000	2.00000000	eosio.token
1	alice	3.6		eosio2

exchange - askorders
scope: eosusd

id	Trader	Price (USD)	Volume (EOS)
0	bob	3.60000000	1.55550000

5 - EXECUTE TRADE

ex: partial fill single order

1. Take the **best bid order** and **best ask order** and generate a trade with the following properties:
   volume traded = the minimum volume between both the best bid and best ask orders
   volume base = 1.55550000 EOS
   volume quote = 5.59880000 USD

   spread = (3.6 USD - 3.6 USD) = 0
   price = 3.6 USD

2. Update Order books
   remove order with minimum volume (**bob ask**)
   update volume (**alice bid)**
   alice bid volume = (2.0000 EOS - 1.5555 EOS) = 0.4445 EOS

send bid: 1.5555 EOS -> bob
send ask: 5.5988 USD -> alice

Before

```
exchange - exaccounts

alice:
   balance: {8.00000000 EOS, eosio.token}
   balance: {0.00000000 USD, usd.token}

bob:
   balance: {0.00000000 EOS, eosio.token}
   balance: {0.40120000 USD, usd.token}

exchange:
   balance: {2.00000000 EOS, eosio.token}
   balance: {5.59880000 USD, usd.token}
```

After

```
exchange - exaccounts

alice:
   balance: {8.00000000 EOS, eosio.token}
   balance: {5.59880000 USD, usd.token}

bob:
   balance: {1.55550000 EOS, eosio.token}
   balance: {0.40120000 USD, usd.token}

exchange:
   balance: {0.44450000 EOS, eosio.token}
   balance: {0.00000000 USD, usd.token}
```

exchange - bidorders
scope: eosusd

id	Trader	Price (USD)	Volume (EOS)
0	alice	3.60000000	0.44450000

exchange - askorders
scope: eosusd

id	Trader	Price (USD)	Volume (EOS)

6 - CANCEL

ex:

```
push action exchange cancel {
   "trader": "alice",
   "market": "eosusd",
   "order_type": "BID",
   "id": "0"
} -p alice
```

Before

```
exchange - exaccounts

alice:
   balance: {8.00000000 EOS, eosio.token}
   balance: {5.59880000 USD, usd.token}

bob:
   balance: {1.55550000 EOS, eosio.token}
   balance: {0.40120000 USD, usd.token}

exchange:
   balance: {0.44450000 EOS, eosio.token}
   balance: {0.00000000 USD, usd.token}
```

exchange - bidorders
scope: eosusd

id	Trader	Price (USD)	Volume (EOS)
0	alice	3.60000000	0.44450000

exchange - askorders
scope: eosusd

id	Trader	Price (USD)	Volume (EOS)

After

```
exchange - exaccounts

alice:
   balance: {8.44450000 EOS, eosio.token}
   balance: {5.59880000 USD, usd.token}

bob:
   balance: {1.55550000 EOS, eosio.token}
   balance: {0.40120000 USD, usd.token}

exchange:
   balance: {0.00000000 EOS, eosio.token}
   balance: {0.00000000 USD, usd.token}
```

exchange - bidorders
scope: eosusd

id	Trader	Price (USD)	Volume (EOS)

exchange - askorders
scope: eosusd

id	Trader	Price (USD)	Volume (EOS)

7 - WITHDRAW

ex:

```
push action withdraw {"from": "alice", "quantity": "5.59 USD"} -p alice
```

Before

```
exchange - exaccounts

alice:
   balance: {8.44450000 EOS, eosio.token}
   balance: {5.59880000 USD, usd.token}

bob:
   balance: {1.55550000 EOS, eosio.token}
   balance: {0.40120000 USD, usd.token}

exchange:
   balance: {0.00000000 EOS, eosio.token}
   balance: {0.00000000 USD, usd.token}
```

```
usd.token - accounts

alice:
   balance: 250.00 USD

bob:
   balance: 144.00 USD

exchange:
   balance: 6.00 USD
```

After

```
exchange - exaccounts

alice:
   balance: {8.44450000 EOS, eosio.token}
   balance: {0.00880000 USD, usd.token}

bob:
   balance: {1.55550000 EOS, eosio.token}
   balance: {0.40120000 USD, usd.token}

exchange:
   balance: {0.00000000 EOS, eosio.token}
   balance: {0.00000000 USD, usd.token}
```

```
usd.token - accounts

alice:
   balance: 255.59 USD

bob:
   balance: 144.00 USD

exchange:
   balance: 0.41 USD
```

5 - EXECUTE TRADE

ex: overlapping partial orders

exchange - bidorders
scope: eosusd

id	Trader	Price (USD)	Volume (EOS)	
0	alice	3.60000000	1.00000000	Best Bid Order
1	alice	3.70000000	2.50000000	
2	alice	4.00000000	5.00000000	

exchange - aksorders
scope: eosusd

id	Trader	Price (USD)	Volume (EOS)	
0	bob	3.30000000	10.00000000	
1	bob	3.40000000	5.00000000	
2	bob	3.80000000	4.00000000	Best Ask

spread = (3.6 USD - 3.8 USD) = -0.2
price = earliest price submitted (lowest price?) = 3.6 USD

1. Take the **best bid order** and **best ask order** and generate a trade with the following properties:
   volume traded = the minimum volume between both the best bid and best ask orders
   volume base = 1.00000000 EOS (bid id:0)
   volume quote = 1.00000000 EOS * 3.8 USD/EOS = 3.8 USD (ask id:1)

2. Update Order books
   remove order with minimum volume (**alice bid**)
   update volume (**bob ask)**
   bob ask volume = (4.0000 EOS - 1.0000 EOS) = 3.0000 EOS

send bid: 1.0000 EOS -> bob
send ask: 3.8000 USD -> alice

exchange - bidorders
scope: eosusd

id	Trader	Price (USD)	Volume (EOS)	
~~0~~	~~alice~~	~~3.60000000~~	~~1.00000000~~	Remove Order
1	alice	3.70000000	2.50000000	Best Bid Order
2	alice	4.00000000	5.00000000	

exchange - aksorders
scope: eosusd

id	Trader	Price (USD)	Volume (EOS)	
0	bob	3.30000000	10.00000000	
1	bob	3.40000000	5.00000000	
2	bob	3.80000000	3.00000000	Updated Best Ask

spread = (3.7 USD - 3.8 USD) = -0.1
price = earliest price submitted (lowest price?) = 3.7 USD

1. Take the **best bid order** and **best ask order** and generate a trade with the following properties:
   volume traded = the minimum volume between both the best bid and best ask orders
   volume base = 2.50000000 EOS (bid id:1)
   volume quote = 2.50000000 EOS * 3.7 USD/EOS = 9.25 USD (ask id:1)

2. Update Order books
   remove order with minimum volume (**alice bid**)
   update volume (**bob ask)**
   bob ask volume = (3.0000 EOS - 2.5000 EOS) = 0.5000 EOS

send bid: 2.5000 EOS -> bob
send ask: 9.2500 USD -> alice

exchange - bidorders
scope: eosusd

id	Trader	Price (USD)	Volume (EOS)	
~~0~~	~~alice~~	~~3.60000000~~	~~1.00000000~~	Remove Order
~~1~~	~~alice~~	~~3.70000000~~	~~2.50000000~~	Best Bid Order
2	alice	4.00000000	5.00000000	

exchange - aksorders
scope: eosusd

id	Trader	Price (USD)	Volume (EOS)	
0	bob	3.30000000	10.00000000	
1	bob	3.40000000	5.00000000	
2	bob	3.80000000	0.50000000	Updated Best Ask