

# **FX CONVERSION KATA**

# All Sprints - Backlog

Valuation in EUR, Products in EUR

Valuation in EUR, Products in USD

Valuation in EUR, Products with a company conversion rate

Valuation in EUR, Products in another exotic currency

Valuation in USD, Products in USD

Valuation in USD, Products in EUR

Valuation in USD, Products in another exotic currency

Valuation in USD, Products with a company conversion rate

...



[\*\*https://github.com/cyriux/ModellingFromFirstPrinciples\*\*](https://github.com/cyriux/ModellingFromFirstPrinciples)

# Sprint1 - Backlog

## Sprint 1 - Backlog

Valuation in EUR, Products in EUR  
Valuation in EUR, Products with a company conversion rate  
Valuation in EUR, Products in another exotic currency  
Valuation in USD, Products in USD  
Valuation in USD, Products in EUR  
Valuation in USD, Products in another exotic currency  
Valuation in USD, Products with a company conversion rate  
...

1

## Backlog / EUR everywhere

For an inventory valued in EUR, with only products with a unit price in EUR, the total value is:

$$V_{EUR} = \sum_{p \text{ in Inventory}} qty \cdot unitPrice_{EUR}$$

2

## Backlog / Products in USD

For an inventory valued in EUR, with products with a unit price in USD, the total value  $V$  is:

$$V_{EUR} = \sum_{\text{product in Inventory}} qty \cdot unitPrice_{USD} \cdot fx_{EURUSD}$$

3

## Backlog / Special rate CNY

For an inventory valued in EUR, with products with a unit price in Chinese Yuan currency, e.g. CNY/USD, the total value  $V$  is:

$$V_{EUR} = \sum_{\text{product in Inventory}} qty \cdot unitPrice_{CNY} \cdot fx_{EUR/CNY \text{ internal}}$$

Because we have a special negotiated fx rate EUR/CNY guaranteed by the bank.

## Backlog / Valuation in USD

For an inventory valued in USD, with only products with a unit price in USD, the total value is:

$$V_{USD} = \sum_{p \text{ in Inventory}} qty \cdot unitPrice_{USD}$$

## Backlog / Products in USD

For an inventory valued in USD, with products with a unit price in EUR, the total value  $V$  is:

$$V_{USD} = \sum_{\text{product in Inventory}} qty \cdot unitPrice_{EUR} / fx_{EURUSD}$$

Sprint1.PDF

<https://github.com/cyriux/ModellingFromFirstPrinciples>

# Backlog / EUR everywhere

For an inventory valued in EUR, with only products with a unit price in EUR, the total value is:

$$V_{EUR} = \sum_{p \text{ in Inventory}} qty . unitPrice_{EUR}$$

# Backlog / Products in USD

For an inventory valued in EUR, with products with a unit price in USD, the total value  $V$  is:

$$V_{EUR} = \sum_{\substack{\text{product in} \\ \text{Inventory}}} qty . unitPrice_{USD} * fx_{EUR/USD}$$



# Backlog / Special rate CNY

For an inventory valued in EUR, with products with a unit price in Chinese Yuan currency, e.g. CNY/USD, the total value  $V$  is:

$$V_{EUR} = \sum_{\substack{\text{product in} \\ \text{Inventory}}} qty . unitPrice_{CNY} * fx_{EUR/CNY \text{ internal}}$$

Because we have a special negotiated fx rate EUR/CNY guarantee by the bank  
<https://github.com/cyriux/ModellingFromFirstPrinciples>

# Backlog / Valuation in USD

For an inventory valued in USD, with only products with a unit price in USD, the total value is:

$$V_{USD} = \sum_{p \text{ in Inventory}} qty . unitPrice_{USD}$$

# Backlog / Products in USD

For an inventory valued in USD, with products with a unit price in EUR, the total value  $V$  is:

$$V_{USD} = \sum_{\substack{\text{product in} \\ \text{Inventory}}} qty . unitPrice_{EUR} / fx_{EUR/USD}$$



# “Reverse-engineer the formula” Game

Valuation in EUR, Products in EUR

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Valuation in USD, Products in USD

Valuation in USD, Products in EUR

Valuation in USD, Products in another exotic currency

Valuation in USD, Products with a company conversion rate

...

**Discuss. Criticise.**

**Ask questions.**

**Propose stuff / opportunities.**

# Sprint2 - Backlog

## Sprint 2 - Backlog

Valuation in EUR, Products in EUR  
Valuation in EUR, Products with a company conversion rate  
Valuation in EUR, Products in another exotic currency  
Valuation in USD, Products in USD  
Valuation in USD, Products in EUR  
Valuation in USD, Products in another exotic currency  
Valuation in USD, Products with a company conversion rate  
...

1

## Backlog / Exotic currency

For an inventory valued in EUR, with products with a unit price in exotic currencies, e.g. USD/SGD, the total value  $V$  is:

$$V_{EUR} = \sum_{\text{product in inventory}} qly \cdot unitPrice_{SGD} * fx_{USD/SGD} * fx_{EUR/USD}$$

2

## Backlog / USD Product exotic ccy

For an inventory valued in EUR, with products with a unit price in SGD, the total value  $V$  is:

$$V_{USD} = \sum_{\text{product in inventory}} qly \cdot unitPrice_{SGD} * fx_{EUR/SGD} / fx_{EUR/USD}$$

3

## Backlog / USD / Special rate CNY

For an inventory valued in USD, with products with a unit price in Chinese Yuan currency, the total value  $V$  is:

$$V_{USD} = \sum_{\text{product in inventory}} qly \cdot unitPrice_{CNY} * fx_{EUR/CNY internal} / fx_{EUR/USD}$$

Because we have a special negotiated fx rate EUR/CNY guaranteed by the bank.

4

Sprint2.PDF

<https://github.com/cyriux/ModellingFromFirstPrinciples>

# Backlog / Exotic currency

For an inventory valued in EUR, with products with a unit price in exotic currencies, e.g. USD/SGD, the total value  $V$  is:

$$V_{EUR} = \sum_{\substack{\text{product in} \\ \text{Inventory}}} qty . unitPrice_{SGD} * fx_{EUR/SGD}$$

# Backlog / USD Product exotic ccy

For an inventory valued in EUR, with products with a unit price in SGD, the total value V is:

$$V_{USD} = \sum_{\substack{\text{product in} \\ \text{Inventory}}} qty . unitPrice_{SGD} * fx_{EUR/SGD} / fx_{EUR/USD}$$

# Backlog / USD / Special rate CNY

For an inventory valued in USD, with products with a unit price in Chinese Yuan currency, the total value V is:

$$V_{USD} = \sum_{\substack{\text{product in} \\ \text{Inventory}}} qty . unitPrice_{CNY} * fx_{EUR/CNY \text{ internal}} / fx_{EUR/USD}$$

Because we have a special negotiated fx rate EUR/CNY guarantee by the bank

# Sprint 1+2 - Backlog

Valuation in EUR, Products in EUR

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Valuation in EUR, Products in another exotic currency

Valuation in USD, Products in USD

Valuation in USD, Products in EUR

Valuation in USD, Products in another exotic currency

Valuation in USD, Products with a company conversion rate

...

**Discuss. Criticise.**

**Ask questions.**

**Propose stuff / opportunities.**



# **“Reverse-engineer the formula” Game**

Valuation in EUR, Products in EUR

Valuation in EUR, Products with a company conversion rate

Valuation in EUR, Products in another exotic currency

Valuation in USD, Products in USD

Valuation in USD, Products in EUR

Valuation in USD, Products in another exotic currency

Valuation in USD, Products with a company conversion rate

## **Where do the formula come from?**

# **“Reverse-engineer the formula” Game**

Valuation in EUR, Products in EUR

Valuation in EUR, Products with a company conversion rate

Valuation in EUR, Products in another exotic currency

Valuation in USD, Products in USD

Valuation in USD, Products in EUR

Valuation in USD, Products in another exotic currency

Valuation in USD, Products with a company conversion rate

**Are they arbitrary? Are they all  
different? Any similarity that would  
make business sense?**

# Debrief

Valuation in EUR, Products in EUR

Valuation in EUR, Products with a company conversion rate

Valuation in EUR, Products in another exotic currency

Valuation in USD, Products in USD

Valuation in USD, Products in EUR

Valuation in USD, Products in another exotic currency

Valuation in USD, Products with a company conversion rate

**Are they arbitrary? Are they all different? Any similarity that would make business sense?**

# Browse the literature.

### Foreign Exchange (FX) Currency Pairs

### Currency Pair Notation

from (<http://forstraininggroup.com/an-overview-of-the-major-force-currency-pairs/>)

Forex currency pairs are often written by separating the three letter ISO 4217 currency code for each currency by a slash ("/"). For example, EUR/USD is the typical forex market notation for the currency pair consisting of European Union Euros for which the ISO code is EUR being quoted in U.S. Dollar terms for which the ISO code is USD.

Furthermore, each currency pair consists of a base currency that appears before the slash and a counter currency or quote currency that appears after the slash in the common market shorthand.

For the EUR/USD currency pair, the euro or EUR is the base currency in the pair, while the U.S. Dollar or USD is the counter currency in the pair that is being quoted relative to the base currency.

For example, an exchange rate quotation of 1.1500 for the EUR/USD currency pair means that each European Union Euro is worth 1.1500 U.S. Dollars. Hence, 10 million Euros could be exchanged for 11.5

million U.S. Dollars at that exchange rate.

## The Pecking Order in Currency Pairs

The prevailing forex market quotation convention gives precedence to certain currencies over others that affects whether they are usually quoted as the base currency or the counter currency in a currency pair.

This established priority ranking or "pecking order" for six of the most commonly traded currencies is as follows:

EUR > GBP > AUD > NZD > USD > CHF > JPY

According to this traditional pecking order, the foreign exchange market usually quotes the EUR/GBP and USD/CHF currency pairs in that order, rather than as GBP/EUR or CHF/USD. In the case of the EUR/GBP currency pair, the EUR appears first in the currency pair because it is situated higher in the aforementioned pecking order than the GBP.

Furthermore, most minor currencies are quoted as the counter currency in currency pairs with U.S. Dollars acting as the base currency. Examples are USD/SGD for the U.S. Dollar/Singapore Dollar exchange rate and USD/SEK for the U.S. Dollar Swedish Krona exchange rate.

### Liquidity in the Major, Minor and Exotic Currency Pairs

Forex pairs\_Liquidity/Participants in the forex market sometimes differ as to exactly which currency pairs they consider to be major, minor or exotic. Nevertheless, in most cases, these general categories describe currency pairs that respectively tend to be very liquid, quite liquid or relatively illiquid.

Furthermore, in the context of the currency market, the term "liquidity" refers to the degree to which forex market is able to handle a purchase or sale transaction without causing a substantial change in the exchange rate for the currency pair in question.

In practice, forex market liquidity tends to be a function of the number of market makers available to make quotations for a particular currency pair and their readiness to absorb large transactions without moving the exchange rate much.

The forex market for major currencies — such as the EUR, GBP, CHF, JPY, AUD, CAD and NZD — quoted against the USD tends to be very liquid, so the EUR/USD, GBP/USD, USD/CHF, USD/JPY, AUD/USD, USD/CAD and USD/JPY currency pairs are considered by most forex traders to be major currency pairs.

The next lower tier of liquidity is shared by the minor currency pairs, which include the so-called cross currency exchange rates that do not

involve the U.S. Dollar. Some traders include the NZD/USD in this classification, while others place it among the major FX pairs since it remains popular among traders and tends to enjoy quite liquid markets as a result.

Trades of cross currency pairs typically experience less liquid trading conditions and wider spreads than those enjoyed for the forex major pairs. Cross exchange rates can be derived from the more liquid markets of their component

Highly liquid examples of U.S. Dollar include the EU currency pairs. Less liquid cross currency pairs include the AUD/JPY

from (<http://orderflowfree.com/2011/07/what-makes-a-currency-pair-liquid/>)

## GDP Of The Nations

How big the economy is of the countries is a much better determinant of how liquid a currency pair is. The bigger the GDP of the countries, the more liquid the currency pair. This means the reaction time the

Typically, the most liquid currency pairs will have the lowest spreads in normal market conditions. This is why you will almost always see the EUR/USD have a lower spread than the GBP/USD or the GBP/CHF. There is just a lot more financial flows occurring in EUR/USD than between GBP/USD or GBP/CHF.

## Ex-Interlata

<https://github.com/cyriux/ModellingFromFirstPrinciples>

# fx-literature.PDF

# **“Reverse-engineer the formula” Game**

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## **Where do the formula come from?**

# FINDINGS



**"Depends on the product"**

**EUR**  
product

$qty * price$

**non-EUR**  
product  
except MUR, IQD...

$qty * price * fx\ rate_{ccy/EUR}$

**MUR, IQD...**  
product

$qty * price * fx\ rate_{ccy/USD}$   
 $* fx\ rate_{USD/EUR}$

"Depends on the ~~product~~  
currency"

EUR  
product

qty \* price

non-EUR  
product  
except MUR, IQD...

qty \* price \* fx rate  
ccy/EUR

MUR, IQD...  
product

qty \* price \* fx rate  
ccy/USD  
\* fx rate  
USD/EUR

product

"Depends on the currency"

EUR  
product

non-EUR  
product  
except HKD, ZAR...

HKD, ZAR...  
product

qty \* price \* currency  
conversion

# **Reverse-engineer Mixed Responsibilities**

"Depends on the currency"

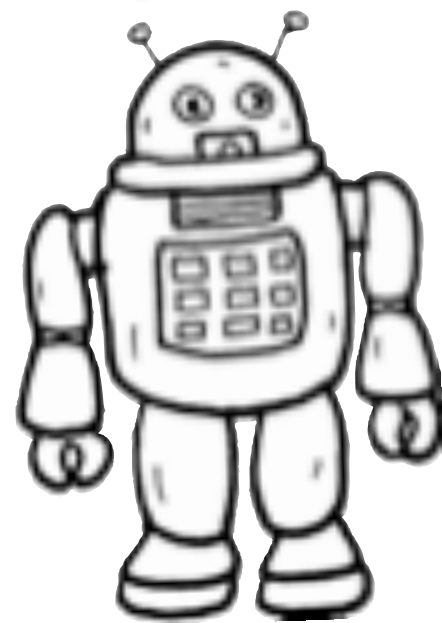
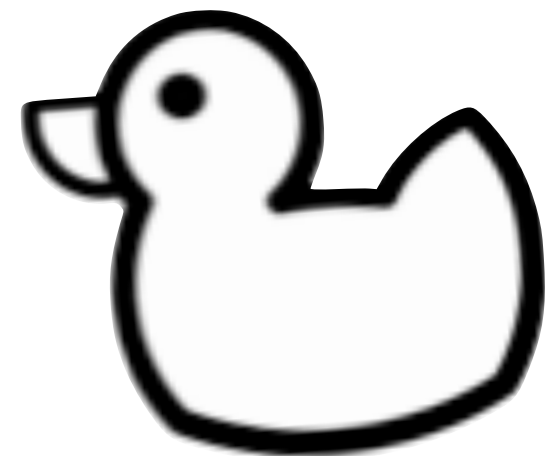
EUR  
product

non-EUR  
product  
except HKD, ZAR...

HKD, ZAR...  
product

qty \* price \* currency  
conversion

# Systematic



qty \* price \* currency

(See Currency  
Conversions business  
rules elsewhere)



**Could already  
refactor  
before the code!**

**As long as we have  
refactoring skills  
(e.g. developer)**

**SPOILER ALERT**

# Insights on currency pairs

Valuation in EUR, Products in EUR

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**Available rate, Reverse rate,  
degenerate case, favourite currency,  
Currency Pecking Order**

# Insights on currency pairs



**Degenerate conversion**

# Insights on currency pairs



**Available rate**



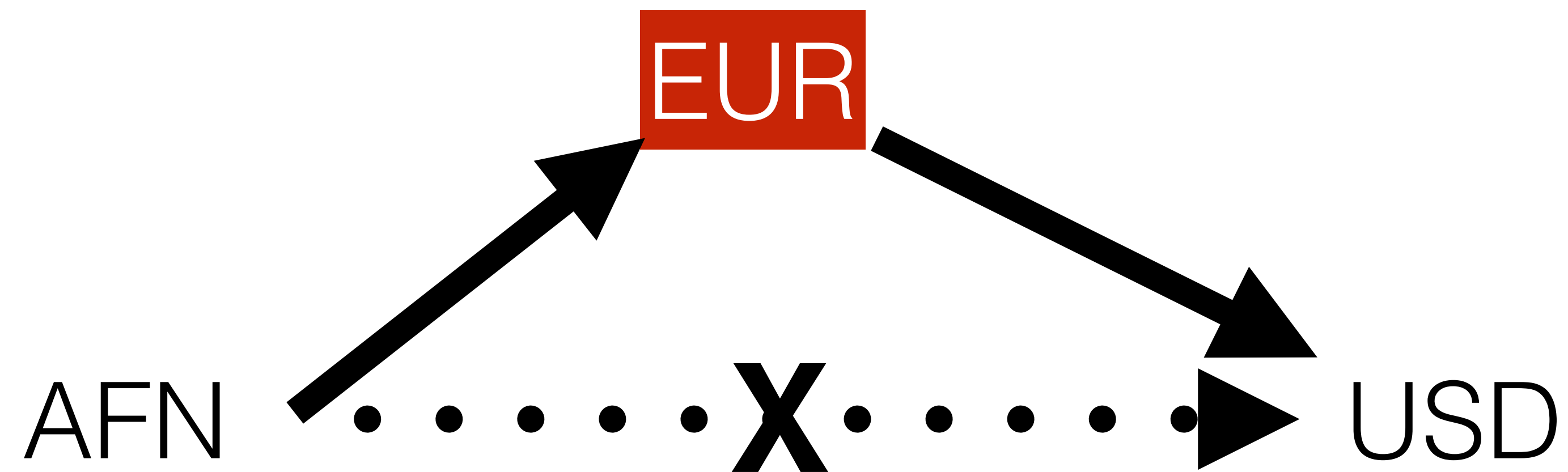
# Insights on currency pairs



**Reverse Available rate**

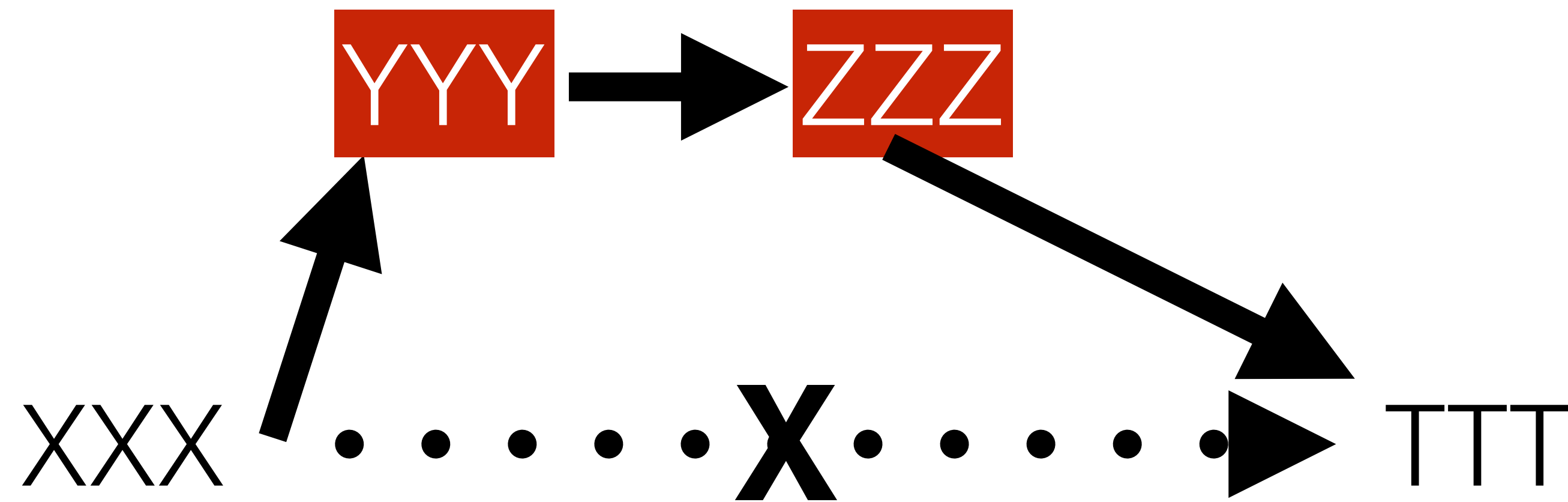
**What does the  
business tries to  
optimise for?**

# Insights on currency pairs



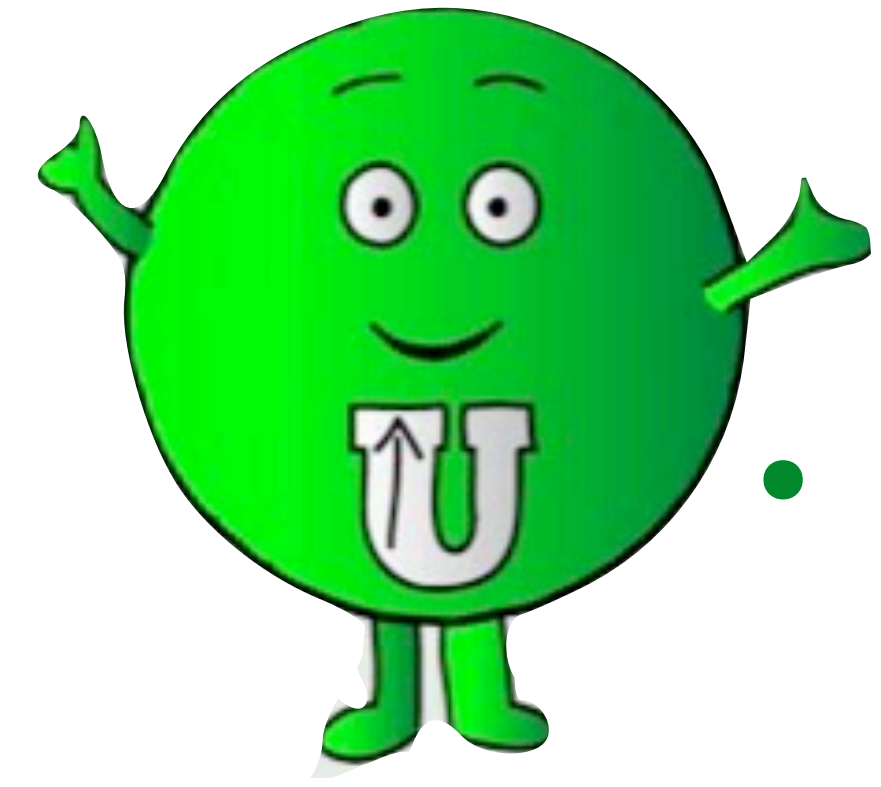
**Pivot currency**

# Insights on currency pairs



**Pivot currencies**

# Insights on currency pairs



- Available currency pairs rates

- Reverse currency pairs rates



- Pivot: Own currency > EUR >  
Company fx rate > USD >  
exotic



# Insights on currency pairs

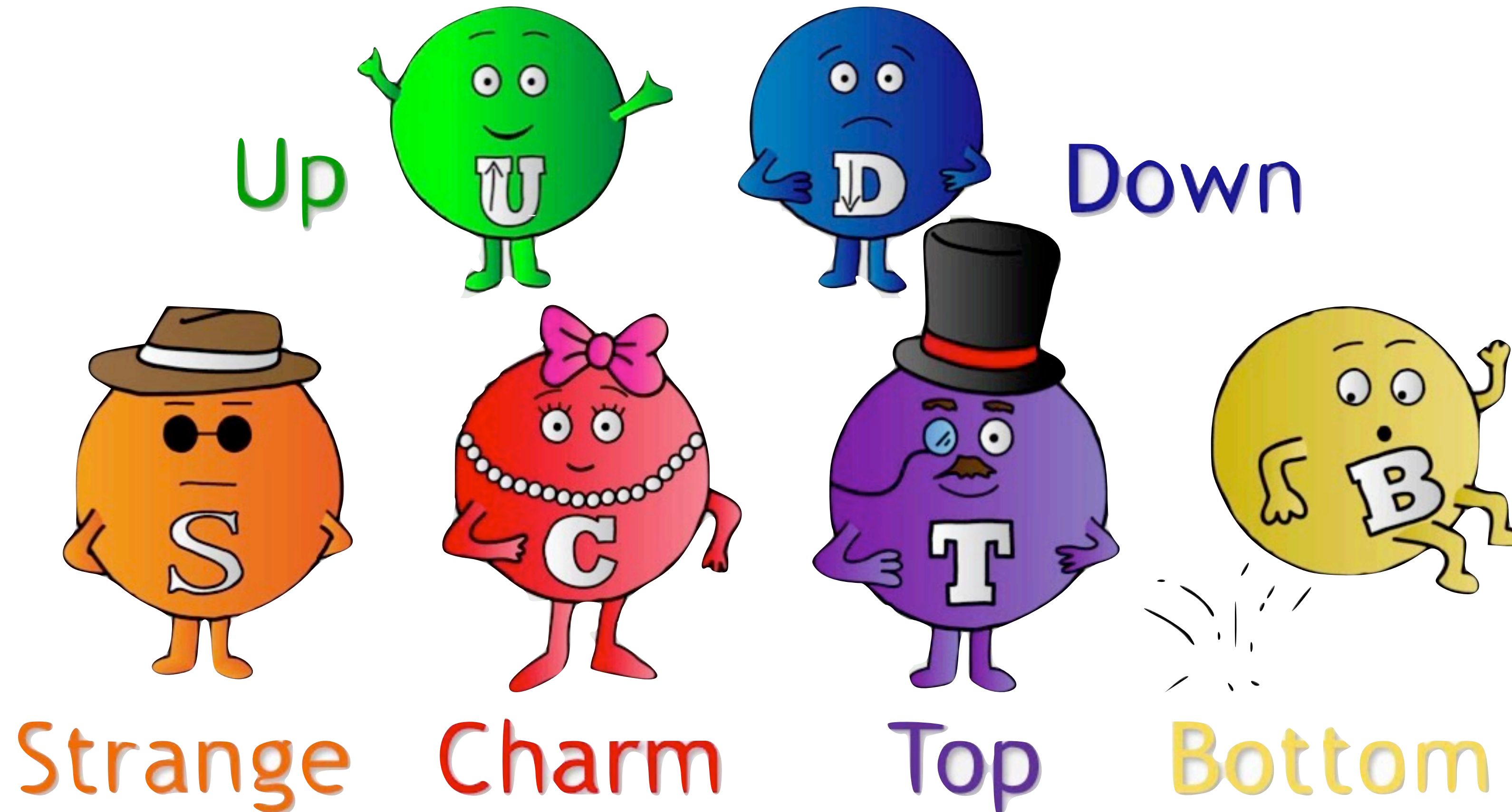
```
private FxRate availableRate(final CurrencyPair pair) {  
    if (pair.isDegenerate()) {  
        return FxRate.fxRate(1., "Degenerate"); // e.g. EUR/EUR  
    }  
    final Double directRate = rates.get(pair);  
    if (directRate != null) {  
        return FxRate.fxRate(directRate, pair.toString());  
    }  
    final Double reverseRate = rates.get(pair.reverse());  
    if (reverseRate != null) {  
        return FxRate.fxRate(1. / reverseRate, "1/(" + pair.toString() + ")");  
    }  
    return FxRate.noFxRate(pair + " Not Available");  
}
```

**List<Currency> dominance = asList(EUR, CNY, USD);**

```
private FxRate resolveFxRate(CurrencyPair pair) {  
    FxRate rate = availableRate(pair); // zero pivot  
    if (rate.hasRate()) {  
        return rate;  
    }  
    for (Currency pivot : dominance) { // one pivot at a time  
        final FxRate rate1 = availableRate(pair.splitBase(pivot));  
        final FxRate rate2 = availableRate(pair.splitCounter(pivot));  
        if (rate1.hasRate() && rate2.hasRate()) {  
            return FxRate.fxRate(rate1.getRate() * rate2.getRate(),  
                rate1.getDescription() + " * " + rate2.getDescription());  
        }  
    } // could generalize to 2 pivots etc.  
    return FxRate.noFxRate(pair + " Not Available, even through " + dominance);  
}
```

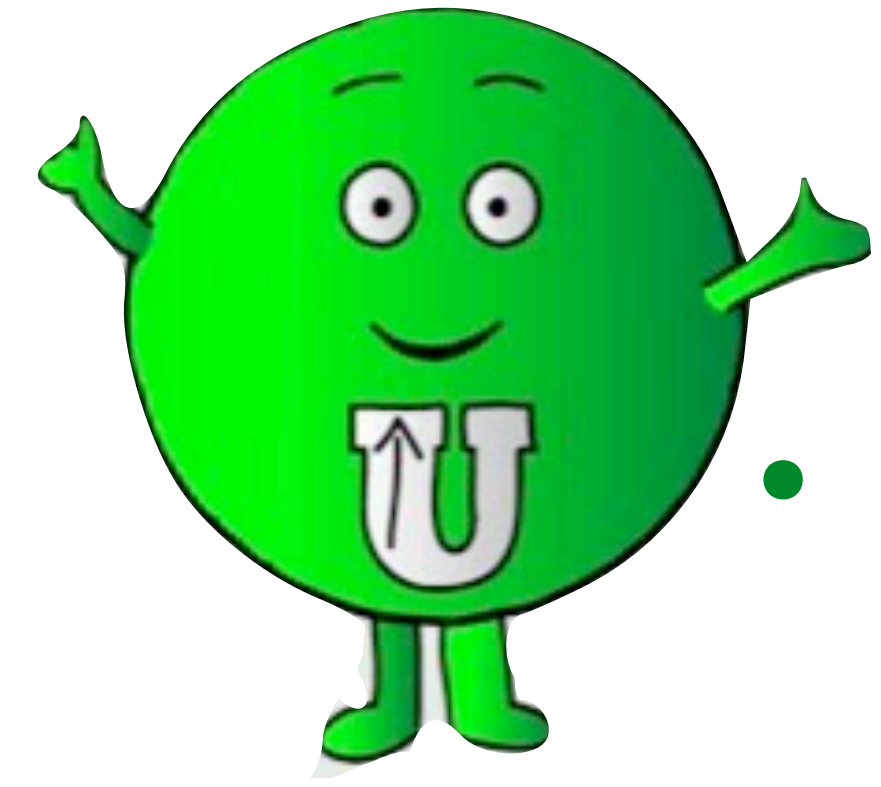


# A Finite Set of Quarks





# A Finite Set of Quarks

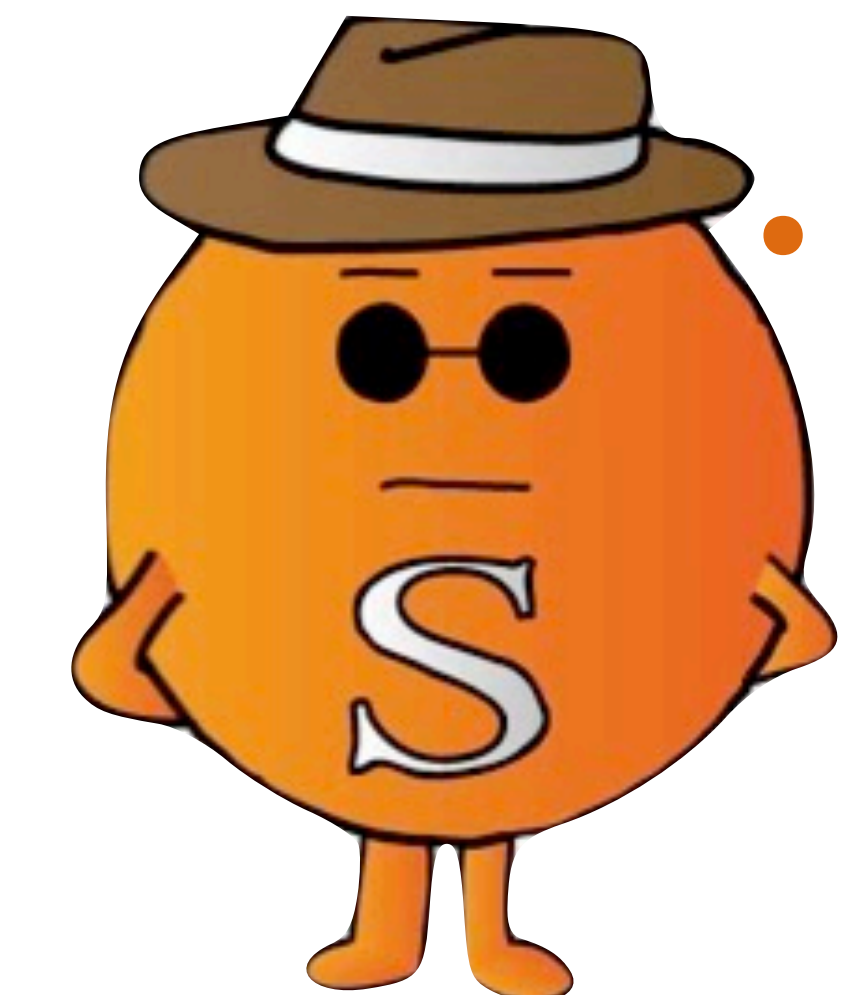


- Available currency pairs rates

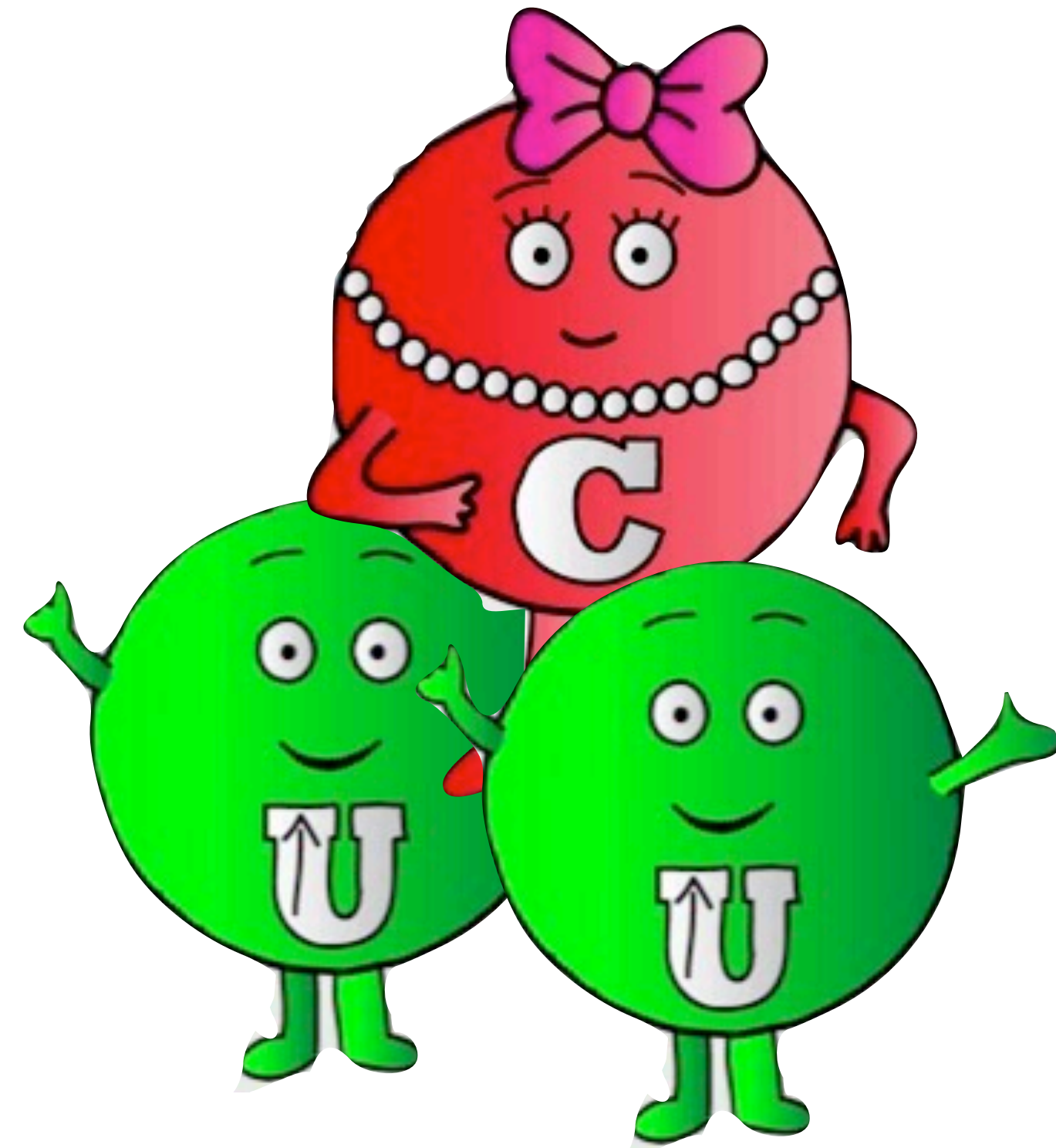
- Reverse currency pairs rates



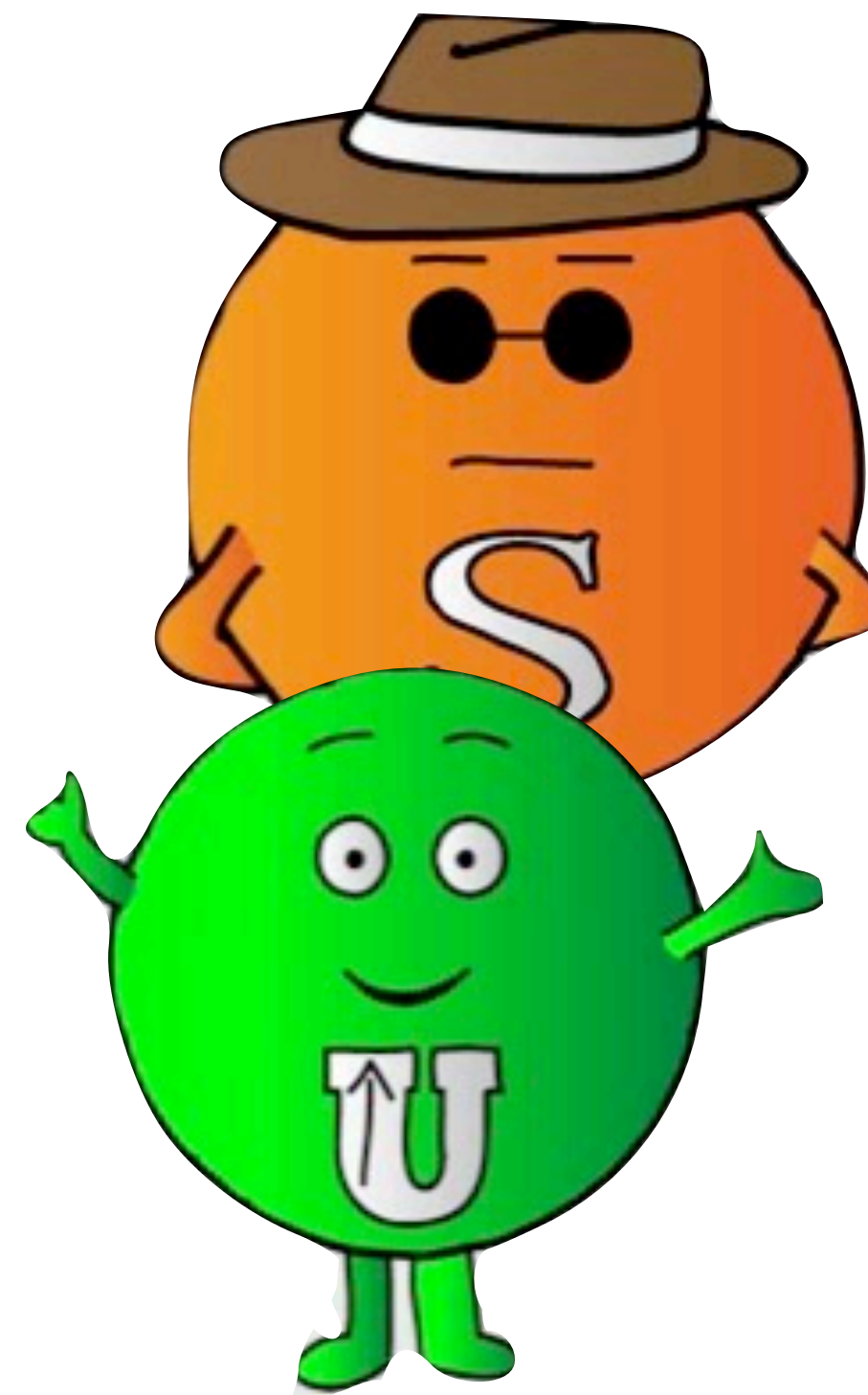
- Precedence: Own currency > EUR > Company fx rate > USD > exotic



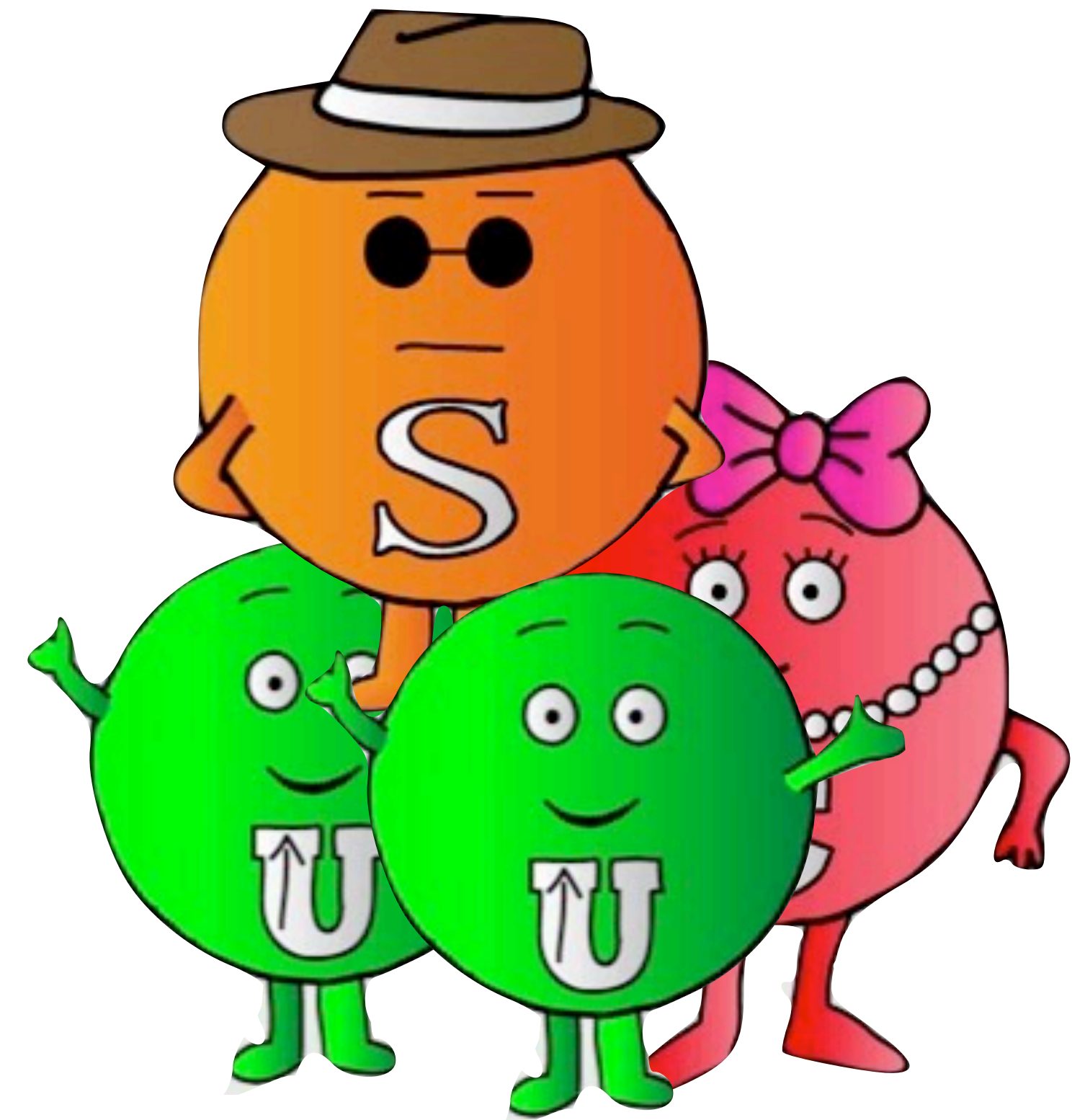
# Recompose into large variety of behaviours



**Direct rate**



**Company rate**



**Exotic rate**