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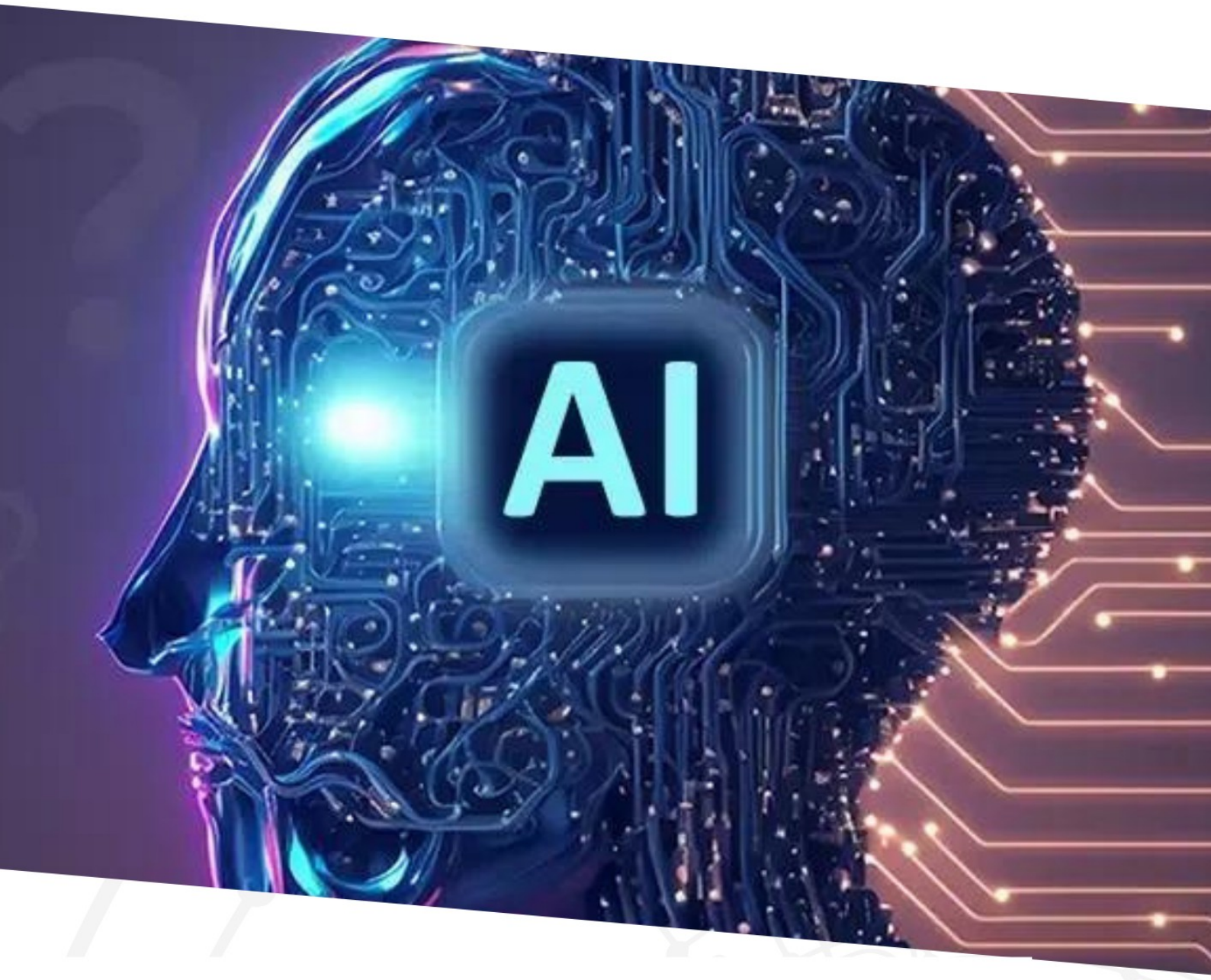

FINAL DELIVERY: NEGOTIATION MARKET

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1. Introduction

In this practice we have created a market using NetLogo, we decided to create a simulation model of a cryptocurrency market. The main objective was to evaluate the interaction protocols between agents. The agents are: buyers and sellers.

The simulation is based on the dynamics of buying and selling cryptocurrencies, taking into account budget restrictions and the availability of cryptocurrencies by sellers.

The motivation behind this model is to understand how the interaction between buyers and sellers affects the cryptocurrency market.

2. Specification of Interaction Protocols

To define the protocol between buyers and seller we have had to use some aspects developed in the second delivery: Message parsing.

To carry out the interaction between buyers and sellers using a protocol we have used messages, which have the relevant information to make the purchase and sale.

Through the function **`sendProtocol`** we manage to send messages between buyers and sellers. The message we send has the following structure:

```
let message (list protocol sender receiver content_type content)
```

The *illocutionary verbs (protocol)* that we have used for this protocol are:

- **REQUEST:** Used by buyers to request the information about the cryptocurrencies or to confirm the purchase.
- **INFORM:** Used by sellers to respond. It contains the information about the available cryptocurrencies or additional details, for example the tax value of the transaction.
- **CONFIRM:** Used by buyers or sellers. It is used to confirm a purchase.
- **DENY:** Rejection of a purchase request.

```
set REQUEST 0
set INFORM 1
set CONFIRM 2
set DENY 3
```

The different *content type* that we have created for this protocol are the following:

- **SHOW_REMAINING_COINS:** This content type is used when a buyer asks a seller to show the available cryptocurrencies. When a buyer wants to know what cryptocurrencies are available, they send a request with this type of content to the seller. The seller responds by providing the list of available cryptocurrencies.
- **BUY_COIN:** Indicates that the buyer is interested in purchasing a specific type of cryptocurrency. After receiving information about the available cryptocurrencies, the buyer can submit a purchase request specifying the index of the cryptocurrency they wish to purchase.
- **INFORM_TAX_ADDITION:** This type of content is used when the seller informs the buyer about adding taxes to transactions. If the seller decides to apply taxes to the transactions, he sends an information message to the buyer indicating the percentage of taxes that will be added to the cost of the cryptocurrency.
- **ALL_COIN_SOLD_OUT:** Indicates that the seller has exhausted all available cryptocurrency stock. When a seller runs out of cryptocurrencies to sell, he can send a message with this type of content to inform buyers that there is no longer any stock available.

```
set SHOW_REMAINING_COINS 0
set BUY_COIN 1
set INFORM_TAX_ADDITION 2
set ALL_COIN_SOLD_OUT 4
```

Within the message we send, the *content* is the specific content of the message, such as the index of the coin the buyer wants to purchase or the tax percentage applied.

3. Definition of Scenes

In this cryptocurrency market we find 2 different scenes:

- **Watch Price Scene (Scene 1):** In this scene, buyers are in the price-watching phase. In this state, buyers randomly generate the values of their tickets, which contain the price of each of the cryptocurrencies. These tickets are later used when buyers decide to purchase cryptocurrencies. Once they have their tickets they will change to the second scene.
- **Buy Crypto Scene (Scene 2):** In this scene, buyers are in the cryptocurrency purchasing phase. After having observed the prices in the previous scene, buyers make decisions based on their budget and purchasing capacity represented by the tickets. In this scene the actions carried out by the buyers are the following:
  - Sending requests to sellers to show available cryptocurrencies.
  - Receiving responses from sellers with information about cryptocurrencies and possibly taxes.
  - Make purchase or refusal decisions based on the responses received.

4. Explanation of the implementation

First of all, we declare the agents and the variables of our project. We have sellers and buyers. Each agent have their atributes.

```
breed [buyers buyer]
breed [sellers seller]

buyers-own [
  budget
  ticket
  scene
  state
  received_protocol
]

sellers-own [
  cryptocurrencies
  tax_percent
  received_protocol
]
```

4.1 Agent Procedure in Each Interaction

Buyers: generate random tickets and, depending on their budget, ask sellers for information about the available cryptocurrencies. Then, depending on the sellers response, they confirm or deny the purchase. Different states like INIT_STATE and WAITING_RESPONSE are handled to control the flow of interaction.

Sellers: respond to buyers requests by showing available cryptocurrencies or reporting additional taxes. They confirm or deny purchases based on the buyers response. Sellers also check the depletion of available cryptocurrencies.

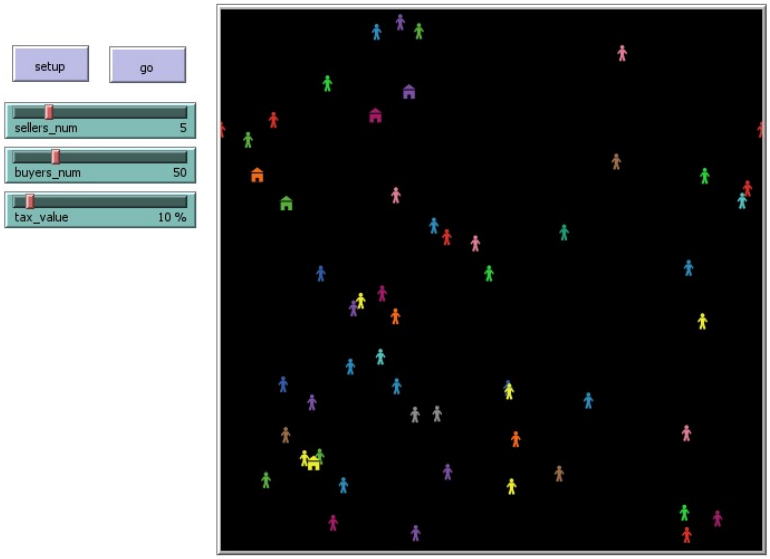
5. Experiments and Tests with the Market System

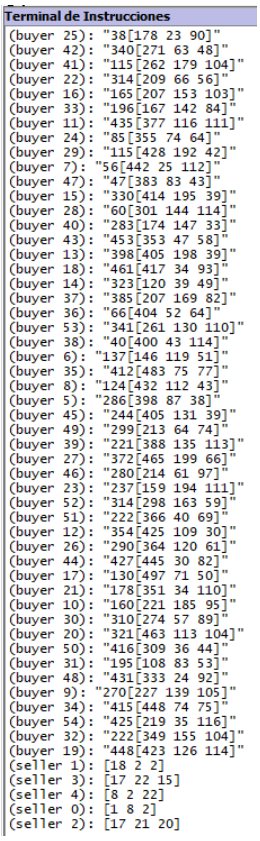
5.1: Variation in the Number of Sellers (sellers_num)

An increase in the number of sellers is expected to increase the supply of cryptocurrencies, which can affect competition and in this case, with fewer sellers, fewer opportunities to buy the cryptocurrency since once they are finished the market closes.

Evidence:

- Low Number of Sellers (sellers_num = 5): Observe the market dynamics with a small number of sellers.





- Moderate Number of Sellers (sellers_num = 10): Evaluate how a moderate number of sellers affects transactions and competition.
- High Number of Sellers (sellers_num = 20): Investigate how a significant increase in the number of sellers affects market dynamics.

Results:

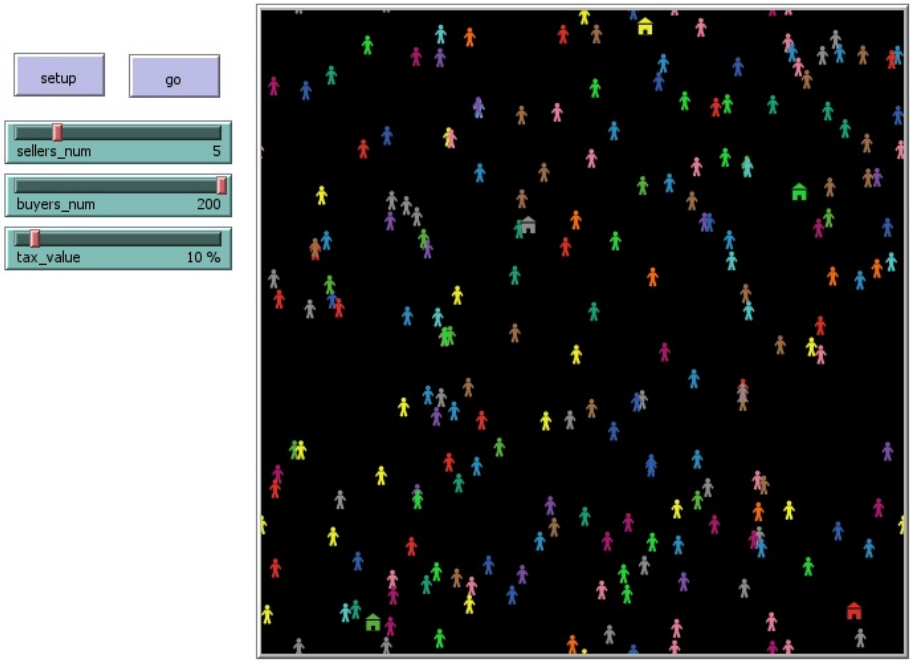
- With fewer sellers, competition may be low, and some buyers may have fewer options.
- With more sellers, competition can increase, and prices can become more competitive.
- When we increase the number of sellers a higher number of sales are made, because buyers have many more sellers from whom they can buy the cryptocurrency they want

5.2: Variation in the Number of Buyers (buyers_num)

Changes in the number of buyers can influence demand and, therefore, market dynamics. Resulting in many buyers being left without the option to make purchases due to the scarcity of cryptocurrencies in the market.

Evidence:

- Low Number of Buyers (buyers_num = 10): Evaluate how a limited number of buyers affects interactions and demand.
- Moderate Number of Buyers (buyers_num = 100): Analyze how the presence of more buyers influences transactions and competition.
- High Number of Buyers (buyers_num = 200): Investigate the impact of a significant increase in the number of buyers in the market.



Results:

- Fewer buyers can lead to more limited transactions and possibly less variability in prices.
- More buyers can lead to greater competition and potentially increase variability in prices.
- When we increase the number of buyers, fewer sales are made, because buyers have fewer options to be able to communicate with a seller and if they do communicate, they may not have the cryptocurrency that the buyer could afford.

Results:

- Without taxes, a higher profitability for buyers is expected. Moderate taxes can affect purchasing decisions, while high taxes can discourage transactions.
- Very few sales are made because the buyers did not take into account that value of the purchase and sale tax, so they decide to reject the transaction and not buy any cryptocurrency. The final value leaves them without enough money to to be able to buy the cryptocurrency they wanted.

5.3: Tax Percentage Variation (tax_value)

Initially, when buyers are in the watch price coin scene, they receive the ticket with the prices of the cryptocurrencies, but that price is tax-free. Depending on how we configure the market, we can modify that a certain percentage of taxes is added to each transaction. This will cause the results of the number of purchases made to vary.

Evidence:

- *No Taxes (tax_value = 0):* Evaluate market dynamics when no taxes are applied to transactions.
- *Moderate Taxes (tax_value = 10):* Analyse how a moderate tax percentage affects transactions.
- *High Taxes (tax_value = 21):* Investigate the impact of a significant percentage of taxes on the profitability of transactions.

Results:

- Without taxes, a higher profitability for buyers is expected. Moderate taxes can affect purchasing decisions, while high taxes can discourage transactions.
- Very few sales are made because the buyers did not take into account that value of the purchase and sale tax, so they decide to reject the transaction and not buy any cryptocurrency. The final value leaves them without enough money to to be able to buy the cryptocurrency they wanted.

6. Comparison with reality

A very similar comparison is when a buyer from a bar goes to buy products in a wholesale store.

In these establishments they usually give us the price without IVA for products with a larger and more striking size, which gives the buyer false illusions about the price of the product, since later when they go to make the payment they add the percentage of IVA.

In many of these cases, the buyer, being at the checkout, decides to leave the product and not buy it due to the price increase generated by the tax.

This is a real example when they increase the taxes of the purchase and sale of products.

The bigger price (0,60€) is without taxes, and when we add IVA, the price change to (0,73€). This generates a notable increase in the price that buyers are sometimes not willing to pay.

7. Conclusions

In summary, the simulation of the cryptocurrency market effectively grasps how buyers and sellers interact, demonstrating that having clear rules and adjusting certain aspects is crucial. The way we design communication rules, using specific words and types of concrete information, helps buyers and sellers understand each other better. Additionally, through various tests, we learn important things, such as how the number of people in the market or taxes significantly impact what happens. This provides us with a solid foundation to continue exploring and improving our simulation in the future.