Buyer-Seller Scenario

Consider a simple purchase scenario involving a buyer and a seller. The buyer desires to buy certain goods. The buyer can pay for the goods. The seller desires to sell certain goods, and to get paid.

- **Identify stakeholders, and their goals and capabilities**
  BUYER has the goal to acquire goods, $G_1 = G(\text{goods})$, and the capability to pay, pay.
  SELLER has the goal to get paid, $G_2 = G(\text{pay})$, and the capability to provide goods, goods.

- **Identify commitments and protocol**

  **Buyer analysis**
  
  ENTICE: The buyer has goal $G_1$ to acquire goods. To achieve $G_1$, buyer employs the ENTICE rule which yields the offer commitment $C_1 = C(\text{buyer, seller, goods, pay})$. Note that the buyer has the capability to bring about the consequent of this commitment, and the seller has the capability to bring about the antecedent. The buyer sends a message offer_to_buy to the seller.
  
  DELIVER: If the seller detaches $C_1$ by sending goods to the buyer, then the buyer employs the DELIVER (and DELIVERPRIME) rule to consider (and activate) the goal to pay, $G_3 = G(\text{pay})$. When the buyer satisfies this goal, the buyer sends disburse message to the seller. This satisfies seller’s goal $G_2(\text{pay})$.
  
  DETACH: If the seller makes an offer $C_2 = C(\text{seller, buyer, pay, goods})$, then the buyer employs the DETACH (and DETACHPRIME) rule to consider (and activate) the goal to pay, $G_3 = G(\text{pay})$. When the buyer satisfies this goal, the buyer sends disburse message to the seller.

  **Seller analysis**
  
  ENTICE: The seller has goal $G_2$ to get paid. To achieve $G_2$, seller employs the ENTICE rule which yields the offer commitment $C_2 = C(\text{seller, buyer, pay, goods})$. The seller sends a message offer_to_sell to the buyer.
  
  DELIVER: If the buyer detaches $C_2$ by paying the seller, then the seller employs the DELIVER (and DELIVERPRIME) rule to consider (and activate) the goal to send the goods, $G_4 = G(\text{goods})$. When the seller satisfies this goal, the seller sends ship message to the buyer. This satisfies buyer’s goal $G_1(\text{goods})$.
  
  DETACH: If the buyer makes an offer $C_1 = C(\text{buyer, seller, goods, pay})$, then the seller employs the DETACH (and DETACHPRIME) rule to consider (and activate) the goal to send goods, $G_4 = G(\text{goods})$. When the seller satisfies this goal, the seller sends a ship message to the buyer.
MAS Specification

\[ C_1 = \text{C(buyer, seller, goods, pay)} \]
\[ C_2 = \text{C(seller, buyer, pay, goods)} \]

\text{inform}[\text{offer\_to\_buy, transactionID}] \rightarrow \text{create}(C_1)
\text{inform}[\text{offer\_to\_sell, transactionID}] \rightarrow \text{create}(C_2)
\text{inform}[\text{disburse, transactionID}] \rightarrow \text{pay}
\text{inform}[\text{ship, transactionID}] \rightarrow \text{goods}

Buyer Agent specification

Name = buyer-agent
\[ G_1 = \text{G(goods)} \]
Capabilities = (pay)
ENTICE: \( \langle G_1^A, C_1^N \rangle \rightarrow \text{offer\_to\_buy} \)
DELIVER: \( \langle G_1^N, C_1^P \rangle \rightarrow \text{consider}(G_3) \)
DELIVERPRIME: \( \langle G_1^P, C_1^P \rangle \rightarrow \text{activate}(G_3) \)
DETACH: \( \langle G_1^N, C_2^C \rangle \rightarrow \text{consider}(G_3) \)
DETACHPRIME: \( \langle G_1^P, C_2^C \rangle \rightarrow \text{activate}(G_3) \)

Seller Agent specification

Name = seller-agent
\[ G_1 = \text{G(pay)} \]
Capabilities = (goods)
ENTICE: \( \langle G_2^A, C_2^N \rangle \rightarrow \text{offer\_to\_sell} \)
DELIVER: \( \langle G_2^N, C_2^P \rangle \rightarrow \text{consider}(G_4) \)
DELIVERPRIME: \( \langle G_2^P, C_2^P \rangle \rightarrow \text{activate}(G_4) \)
DETACH: \( \langle G_2^N, C_1^C \rangle \rightarrow \text{consider}(G_4) \)
DETACHPRIME: \( \langle G_2^P, C_1^C \rangle \rightarrow \text{activate}(G_4) \)

Agent Policies

The above analysis applied the goal-commitment alignment rules such as ENTICE, DETACH, and DELIVER, without any modification to our simple buyer-seller scenario. However, real-life scenarios often involve (private) agent policies, which require modified goal-commitment rules. For example, in the buyer-seller scenario, the buyer may have a policy to pay only after the seller sends the goods. In that case, the buyer will not employ DETACH rule at all. The buyer may have a variant of this policy in which the buyer pays before receiving the goods only if the amount is lesser than $500. In such a case, the DETACH rule would be modified to consider the payment amount. The payment amount would be a parameter of \( C_1 \)'s consequent (\( C_2 \)'s antecedent), and the \text{pay} message.
Implementation Details

The sample MAS implementation of the buyer-seller scenario consists of three files. JessAgent.java implements a Jade agent that uses Jess for reasoning. JessAgent can be instantiated with agent name argument. It reads a file agentname.clp from the current directory. The agents’ logical reasoning is done in Jess rules engine. Seller agent’s (specification) rules are encoded in seller-agent.clp file, whereas buyer agent’s rules are encoded in buyer-agent.clp file. The MAS (commitments and protocol) and agent specifications are coded in the Jess rules files. The goal and commitment structural rules are coded in structural.clp and included within seller.clp and buyer.clp.

To execute the agents, run this command:

```
java -cp \$JADE\_HOME/jade/lib/jade.jar:\$JESS\_HOME/lib/jess.jar:./
s:examples.JessAgent"(seller-agent)"
```

Jade includes a sniffer utility that builds a message sequence diagram as the sniffed agents exchange messages. You can use this utility to verify your implementation.

References

1. Jade Tutorial
2. Jess