Université Paris Cité

Négociation Automatisée

Elise Bonzon

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Tous documents papiers autorisés

4 pages (recto-verso)

- Chaque exercice peut être résolu indépendamment des autres
- Vous pouvez répondre à chacun de ces exercice dans l'ordre que vous souhaitez dans votre copie, mais merci de regrouper entre elles les questions d'un même exercice
- **Toutes les réponses doivent être justifiées**
- Le barême est donné à titre indicatif, et peut être modifié
- N'oubliez pas d'essayer de répondre à toutes les questions simples. Ne restez pas bloqué sur les parties difficiles : continuez !

Exercice 1 (Game Theory - 5 points)
A prisoner's dilemma game, by Kim Swales

Two firms, A and B, serve the same market. They have a constant average costs of 2€ per unit. The firms can choose either a high price (10€) or a low price (5€) for their output.

- When both firms set a high price, the total demand is 10,000 units, which is split evenly between the two firms.
- When both set a low price, the total demand is 18,000, which is again split evenly.
- If one firm sets a low price and the second a high price, the low priced firm sells 15,000 units, whereas the high priced firm only 2,000 units.

Analyze the pricing decisions of the two firms as a non-co-operative game.

1. Define a strategic game, where the elements of each cell of the matrix are the two firms' profits.
2. What is (are) the pure strategy(ies) Nash Equilibrium(a) of this game ?
3. What is (are) the Pareto Optimum(a) of this game ?
4. Explain why this is an example of the prisoner's dilemma game. Is it an iterated dilemma ?

Exercice 2 (Combinatorial auctions question – 4 points)
Let an agent a_1 having the following monotonic preferences over a set of three items $\{a, b, c\}$:

- she prefers a over b
- having a and b together worth less than the sum of each individual valuations
- c does not worth anything, unless it is obtained with either a, b or both, in which case it allows to double the value of the bundle

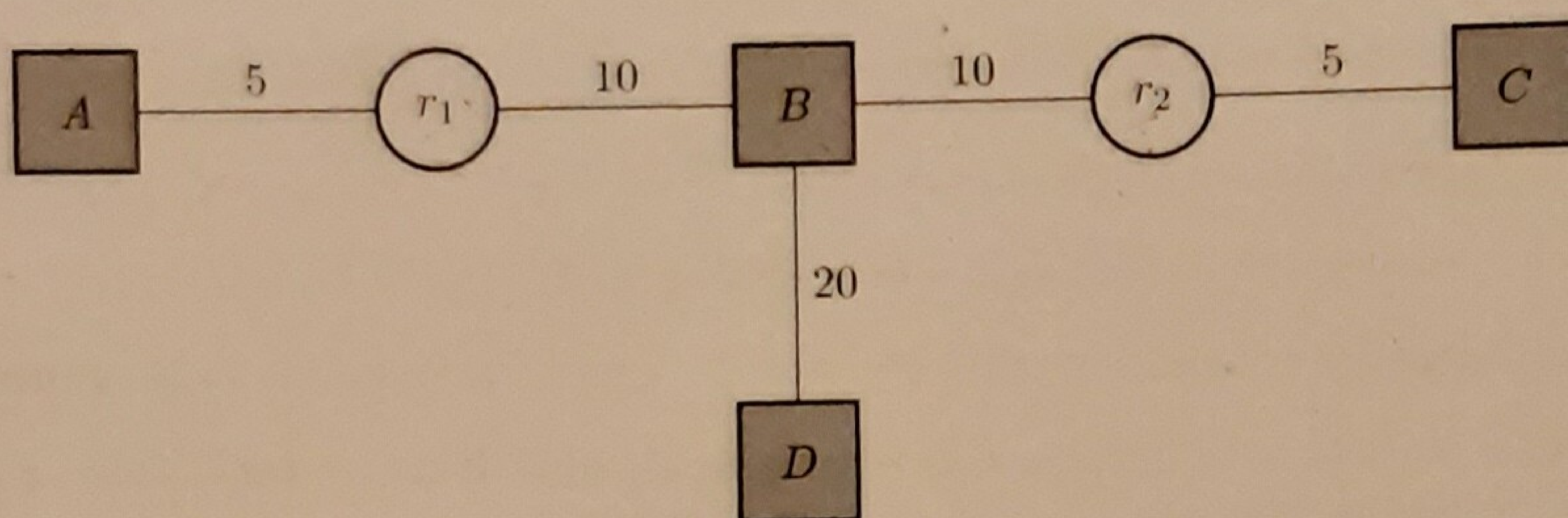
We assume that the utility of the agent is represented using three numerical values defined as follows : $0 < \alpha < \beta < \gamma$, such that $\alpha + \beta \underset{>}{\cancel{<}} \gamma$.

1. Is it possible to represent these preferences using OR bids ? If so, do it, otherwise explain why it is not possible.
2. Is it possible to represent these preferences using XOR bids ? If so, do it, otherwise explain why it is not possible.

Assume now that agent a_2 wants to have the majority of the objects, otherwise she is not interested. If she is satisfied, she obtains an utility of $2(\alpha + \beta)$, 0 otherwise.

3. Is it possible to represent these preferences using OR bids ? If so, do it, otherwise explain why it is not possible.
4. Is it possible to represent these preferences using XOR bids ? If so, do it, otherwise explain why it is not possible.

Exercice 3 (Negotiation in task-oriented domain – 6 points)
Let two robots r_1 and r_2. r_1 is equipped with a large wagon (capacity of 2kg), whereas r_2 is equipped with a smaller wagon (capacity of 1kg). Three 1kg gold nuggets have been found, one on each location A, B and C. These nuggets have to be transported on location D, but the transport has a cost for each robot. Note that a robot cannot exceed the capacity of his wagon (thus r_1 can take 2 nuggets at the same time, whereas r_2 can only take one). The situation is described on the following drawing, where the figures over the lines indicates the cost of the corresponding paths :



1. A task for a robot consists in transporting one or several nuggets from a location A, B or C to location D. Compute the cost of each task for each robot.
For example, to bring the nuggets from A to D, r_1 has to cover 5 to go from its location to A, then 5 back, then 10 to go to B, then 20 to go to D, so 40 total.

2. Assume that the initial allocation is such that r_1 has to bring nuggets from locations A and C to D, whereas r_2 has to bring nuggets from locations B and C to D. What are the set of the possible deals, and the utility associated to each of these deals for each agent ?

3. Determine the set of deals that are individual rational, and those Pareto optimal. Deduce the negotiation set.

4. Apply the monotonic concession protocol with Zeuthen strategy in order to find a deal between the robots.

Exercice 4 (A General Framework for ABN – 5 points)
We have $\mathcal{O} = \{o_1, o_2, o_3\}$, $\mathcal{T}_P = \langle \mathcal{A}_P, \mathcal{F}_P, \succeq_P, \mathcal{R}_P, \mathcal{D}_P \rangle$ and $\mathcal{T}_C = \langle \mathcal{A}_C, \mathcal{F}_C, \succeq_C, \mathcal{R}_C, \mathcal{D}_C \rangle$, with

- $\mathcal{A}_P = \{a,b,c,d\}$; $\mathcal{A}_C = \{a,b,c,d,e,f\}$
- $\mathcal{R}_P = \{(a,b),(b,a),(c,a),(c,d),(d,c)\}$; $\mathcal{R}_C = \{(a,b),(b,a),(c,a),(c,d),(d,c),(e,a),(e,b),(b,e),(f,d)\}$
- $\succeq_P = \succeq_C = \{(a,b),(d,c),(e,f)\}$;
- $\mathcal{F}_P(o_1) = \mathcal{F}_C(o_1) = \{a\}$, $\mathcal{F}_P(o_2) = \mathcal{F}_C(o_2) = \{b\}$, $\mathcal{F}_P(o_3) = \mathcal{F}_C(o_3) = \emptyset$;

1. Draw the argumentation graph of both agents (with respect to $\mathcal{R}_P$ and $\mathcal{R}_C$ respectively)
2. Draw the defeat graph of both agents (with respect to $\mathcal{D}_P$ and $\mathcal{D}_C$ respectively)
3. For each agent, give the sets of offers $\mathcal{O}_x$, for $x \in \{a,n,ns,r\}$, under the stable semantics.
4. Describe a possible ABN dialogue between agents P and C. If the agents have to update their theory during the dialogue, draw the new defeat graph.
   What is the outcome of the dialogue?