Competitive Sourcing for Internet Commerce

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ICDCS'98

Outline

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Safeguarding and Charging for Information on the Internet

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ICDE'98

Introduction

- **Internet commerce**
  - many possible suppliers for the customer's goal
    - ⇨**minimize the expense**
    - ⇨**maximize the probability of success by deadlines**
  - competitive sourcing problem
    - ⇨**CNN response to a fast-breaking story in Europe**
      - →*price, reliability, time-critical, conjunct*
    - ⇨**customers need a request strategy**
      - →*a plan of which suppliers to contact and when they should be contacted*
    - ⇨**differences with economics**
      - →*real-time, more parties per trans., reliability*

Introduction

- **Goal**
  - provide algorithms for determining optimal ordering strategies, under certain conditions
    - ⇨**each supplier charge a different price, and have a unique reliability**
    - ⇨**customers may face hard deadlines**
    - ⇨**customers may require conjunctions of all goods**
    - ⇨**suppliers may require customers to pay at the time the order is placed**
  - comparison
    - ⇨**inventory and backlogging are also charged**
    - ⇨**optimal ordering is determined at the start**

Framework

- **Definition**
  - supplier: (i,j)
    - ⇨**i: the input, j: the ranking of the supplier for i**
  - utility gain: $U \geq 0$
  - charge: $C_{i,j}$
  - delivery profiles: suppliers' performance
    - ⇨**the probability that the request for (i,j) will be satisfied at or before t time units: $Sat_{i,j}(t)$**
      - →*t is assumed to be a discrete value*
    - ⇨**supplier's reliability: $R_{i,j}=Sat_{i,j}(\infty)$**
      - →*a customer's prior experiences*
      - →*average statistics*

Framework

- **Assumption**
  - the customer knows U and $C_{i,j}$
  - the customer can pay the costs for the requests
  - delivery time is independent between suppliers
    - ⇨**a supplier for multiple inputs is treated as aliases**
  - requests will be answered in the order received
- **Consideration**
  - whether the customer faces a deadline
  - the number of suppliers for each input
  - the number of inputs for the conjunction

One Input

- **One supplier: yes or no?**
  - no deadline
    - ⇨**the request strategy: by the supplier's reliability**
    - ⇨**expected utility gain=(U*$R_{1,1}$)-$C_{1,1}$**
      - → *>0: place the order right away*
  - has deadline
    - ⇨**expected utility gain=(U*$Sat_{1,1}$(D))-$C_{1,1}$**
- **Multiple suppliers: which supplier first? when?**
  - no deadline
    - ⇨**serial approach: only positive, sorting, waiting**
    - ⇨**expected utility gain=(U*$R_{1,j}$)-$C_{1,j}$**

One Input

- **Multiple suppliers**
  - has deadline
    - ⇨**parallel approach: make redundant requests**
    - ⇨**an assignment of a request time to each supplier**
      - → *RT(i,j): the time point at which (i,j) is contacted*
    - ⇨**number of distinct strategies: $|S|^D$**
      - → *multiple suppliers for each time point: $D^{|S|}$*

$$U*(1-\prod_{(1,j)\in S, RT(1,j)<D}(1-Sat_{1,j}(D-RT(1,j)))$$
$$-\sum_{(1,j)\in S, RT(1,j)<D}(C_{1,j}*\prod_{(1,k)\in S}(1-Sat_{1,k}(RT(1,j)-RT(1,k))))$$

One Input

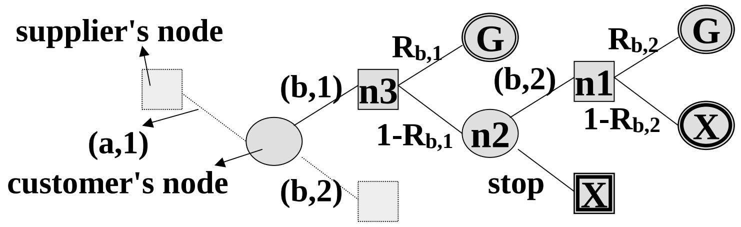
- **Example 1.**
  - two supplier: (1,1), (1,2)
  - deadline: D=3
  - delivery profiles: $Sat_{1,1}(t)=0.2t$, $Sat_{1,2}(t)=0.5t$
    - ⇨**strategy1: <u>RT(1,1)=1, RT(1,2)=3</u>**
      - → $U*(1-(1-Sat_{1,1}(3-1)))-C_{1,1}*1=0.4U-C_{1,1}$
    - ⇨**strategy2: <u>RT(1,1)=3, RT(1,2)=2</u>**
      - → $U*(1-(1-Sat_{1,2}(3-2)))-C_{1,2}*1=0.5U-C_{1,2}$
    - ⇨**strategy3: <u>RT(1,1)=1, RT(1,2)=2</u>**
      - → $U*(1-(1-Sat_{1,1}(3-1))\ (1-Sat_{1,2}(3-2)))-C_{1,1}*1+ C_{1,2}*(1-Sat_{1,1}(RT(1,2)-RT(1,1)))\ =0.7U-C_{1,1}-0.8C_{1,2}$

Multiple Inputs

- **No deadline: which input/supplier first?**
  - serial approach: decision tree representation
    - ⇨**customer's node: make a request**
      - → *stop, change supplier, change input*
    - ⇨**supplier's node: control the outcome**
      - → *send the goods or not (based on* $R_{i,j}$*)*
    - ⇨**enumerate all the possible paths: top-down**
    - ⇨**evaluate the expected utility gain: bottom-up**
      - → *leaf: expected utility gain as one-input case*
        - » positive if the full conjunction is obtained
      - → *customer's node: select the maximum*
      - → *supplier's node: weighting summation*

Multiple Inputs

- **Example 2.**
  - two inputs of a conjunction: a, b
  - three suppliers: (a,1), (b,1), (b,2)
    - ⇨ **n1** $=R_{b,2}*(U-C_{a,1}-C_{b,1}-C_{b,2})+(1-R_{b,2})*(-C_{a,1}-C_{b,1}-C_{b,2})=(R_{b,2}*U)-C_{a,1}-C_{b,1}-C_{b,2}$
    - ⇨ **n2** $=Max(-C_{a,1}-C_{b,1}, (R_{b,2}*U)-C_{a,1}-C_{b,1}-C_{b,2})$
    - ⇨ **n3** $=R_{b,1}*(U-C_{a,1}-C_{b,1})+(1-R_{b,1})*$**n2**



Multiple Inputs

- **Has deadline: which? when?**
  - trigger approach: Bayes net representation
  - trigger example
    - ⇨ **contact (b,1) at time 5 if a has been received**

Id	Supplier	Time	a	b
T_3	(b,1)	5	1	0

  - T_X=(t,DV)
    - ⇨ **t: time point to apply the trigger**
    - ⇨ **DV: document vector to keep the condition of T_x**
      - → *maximal number of triggers:* $2^{|G|}$
      - → *number of distinct strategies:* $(2^{2^{|G|}})^{D*|S|}$

Multiple Inputs

- **Bayes net construction: CPT**
  - status nodes: i@t, where t≤deadline, for each i
    - ⇨**whether input i has been received or not**
  - a goal node: G=AND(i@deadline), for each i
    - ⇨**whether the goal G is achieved or not**
  - trigger nodes: $T_x=(t_x,DV)$
    - ⇨**whether the trigger T_x is fired or not**
    - ⇨**T_x=AND(i@t, T_y), where i∈DV and t= t_x, t_y<t_x**

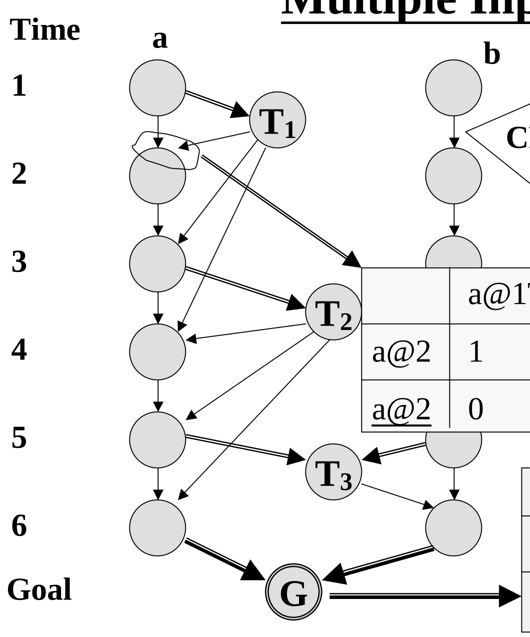
	a@5b@5	a@5$\underline{\text{b@5}}$	$\underline{\text{a@5}}$b@5	$\underline{\text{a@5b@5}}$
T_3	0	1	0	0
$\underline{T}_3$	1	0	1	1

Multiple Inputs

- **Example 3.**
  - two inputs of a conjunction: a, b
  - three supplier: (a,1), (a,2), (b,1)
  - deadline: D=6
  - delivery profiles: $Sat_{a,1}(t)=Sat_{a,2}(t)$= {0.2(t=1), 0.4(t=2), 0.6(t=3), 0*}, $Sat_{b,1}(t)$={0.5(t=1), 0*}

Id	**Supplier**	**Time**	**a**	**b**
T_1	(a,1)	1	0	0
T_2	(a,2)	3	0	0
T_3	(b,1)	5	1	0

Multiple Inputs



	b@1	$\underline{\text{b@1}}$
b@2	1	0
$\underline{\text{b@2}}$	0	1

	a@1T_1	a@1$\underline{T}_1$	$\underline{\text{a@1}}T_1$	$\underline{\text{a@1}T}_1$
a@2	1	1	0.2	0
$\underline{\text{a@2}}$	0	0	0.8	1

	a@6b@6	other
G	1	0
$\underline{\text{G}}$	0	1

Conclusion

- **Contribution**
  - the representation of request strategy
  - expected utility gain calculation
- **Discussion**
  - if the payment is due at delivery...
  - aliases for different inputs may degrade the performance of this supplier…
  - Does it manipulate the conjunctions well?
    - ⇨**disjunctive trigger: more than one trigger is used**
  - how to combine multiple delivery profiles?
    - ⇨**two separate suppliers are contacted...(a@4)**