To ards Efficient Team Formation for Cro dsourcing in Non-Cooperative Social Net orks

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Cro dsourcing has become a popular service computing paradigm for requesters to integrate the ubiquitous human-intelligence services for tasks that are difficult for computers but trivial for humans. This paper focuses on cro dsourcing comple tasks b team formation in social net orks (SNs) here a requester connects to a large number of orkers. A good indicator of efficient team collaboration is the social connection among orkers. Most previous social team formation approaches, ho ever, either assume that the requester can maintain information of all orkers and can directl communicate ith them to build teams, or assume that the orkers are cooperative and be illing to join the specific team built b the requester, both of hich are impractical in man real situations. To this end, this paper first models each orker as a selfish entit , here the requester prefers to hire ine pensive orkers that require less pa ment and orkers prefer to join the profitable teams here the can gain high revenue. Within the non-cooperative SNs, a distributed negotiation-based team formation mechanism is designed for the requester to decide hich orker to hire and for the orker to decide hich team to join and ho much should be paid for his skill service provision. The proposed social team formation approach can al a s build collaborative teams b allo ing team members to form a connected graph such that the can ork together efficientl . Finall , e conduct a set of e periments on real dataset of orkers to evaluate the effectiveness of our approach. The e perimental results sho that our approach can 1) preserving considerable social elfare b comparing the benchmark centrali ed approaches and 2) form the profitable teams ithin less negotiation time b comparing the traditional distributed approaches, making our approach a more economic option for real- orld applications.

Team formation, social net orks, cro dsourcing, multiagent, non-cooperative, negotiation

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$$v_{\kappa}(t)=\begin{cases} v_{\kappa}(\dfrac{Dl_{\kappa}+Wt_{\kappa}-t}{Dl_{\kappa}-It_{\kappa}})^{\delta}, & t \le Dl_{\kappa}+Wt_{\kappa} \\ 0 \qquad\qquad\qquad\quad , & t > Dl_{\kappa}+Wt_{\kappa} \end{cases}$$

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$$Ev(\kappa,\tau)=\frac{\int_{\tau+Wt_{\kappa}}^{Dl_{\kappa}+Wt_{\kappa}} v_{\kappa}(t)dt}{Dl_{\kappa}-\tau}$$

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$$Re(T_{\kappa})=\sum_{(a_i,s_j,p(a_i,s_j))\in Cont(\Omega_{\kappa},\kappa,P_{\kappa})} p(a_i,s_j)$$

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$$Ep(T_\kappa \otimes X, \tau) = Ep(T_\kappa, \tau) + (|X| - |rs_X|) \cdot th - (\sum_{s_j \in X} c(a_i, s_j) - \sum_{s_j \in rs_X} p(\cdot, s_j))$$

$$\begin{aligned} & Ep(T_\kappa \otimes X, \tau) + Ep(T_\kappa \otimes Y, \tau) \\ & = 2Ep(T_\kappa, \tau) + (|X| + |Y| - |rs_X| - |rs_Y|) \cdot th \\ & \quad - (\sum_{s_j \in X \cup Y} c(a_i, s_j) - \sum_{s_j \in rs_{Y \cup rs_X}} p(\cdot, s_j)) \\ & = Ep(T_\kappa, \tau) + Ep(T_\kappa \otimes Z, \tau) \end{aligned}$$

$$\begin{cases} Ep(T_\kappa \otimes Z) = Ep(T_\kappa \otimes \bigcup_{1 \le i \le n-1} X_i) + Ep(T_\kappa \otimes X_n) - Ep(T_\kappa) \\ Ep(T_\kappa \otimes \bigcup_{1 \le i \le n-1} X_i) = Ep(T_\kappa \otimes \bigcup_{1 \le i \le n-2} X_i) + Ep(T_\kappa \otimes X_{n-1}) - Ep(T_\kappa) \\ \vdots \\ Ep(T_\kappa \otimes \{X_1 \cup X_2\}) = Ep(T_\kappa \otimes X_1) + Ep(T_\kappa \otimes X_2) - Ep(T_\kappa) \end{cases} \quad (8)$$

$$Er(a_i, T_{\kappa^*}, \tau) = \frac{Sr(T_{\kappa^*}, \tau)\sum_{(a_i, s_j, p(a_i, s_j)) \in Cont(\Omega_{\kappa^*}, \kappa^*, P_{\kappa^*})} p(a_i, s_j)}{Wt_{\kappa^*}}$$

$$Er(a_i, T_\kappa, ns, \tau) = \frac{Sr(T_\kappa, \tau)\sum_{s_j \in ns} c(a_i, s_j)}{Wt_\kappa}$$

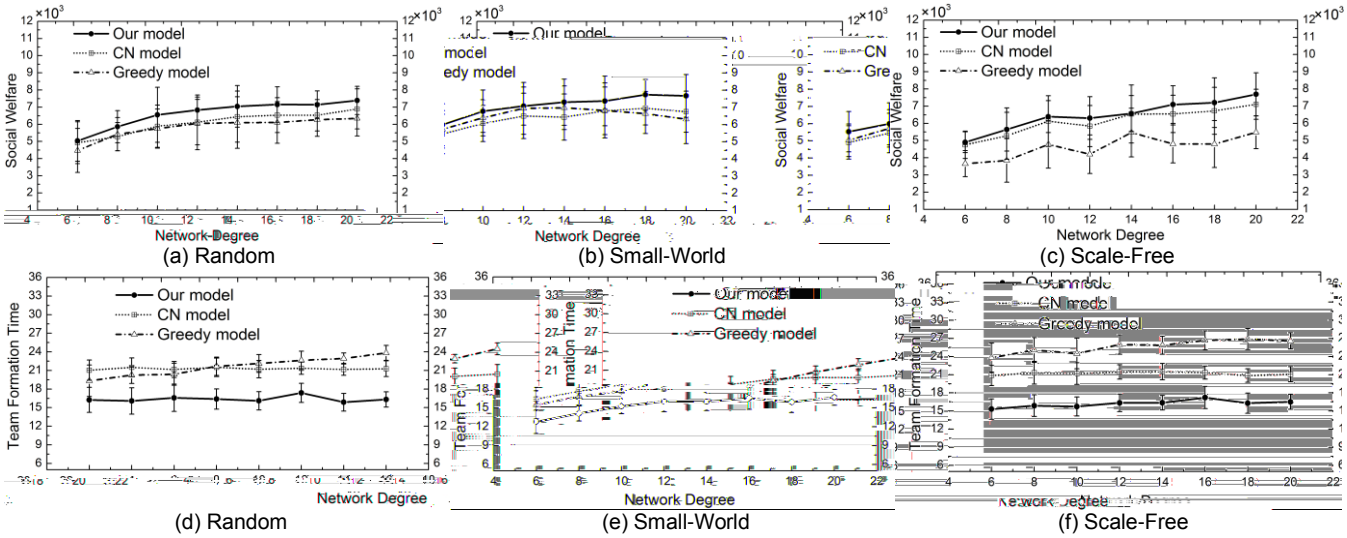

Fig. 1. The effect of net ork degree on different social team formation models social elfare (a c) and team formation time (d f).

$$SW = \sum_{i=1}^{n} profit(Ia_{\kappa_i}) = \sum_{\kappa \in CT} (v_{\kappa}(ct_{\kappa}) - Re(T_{\kappa}))$$

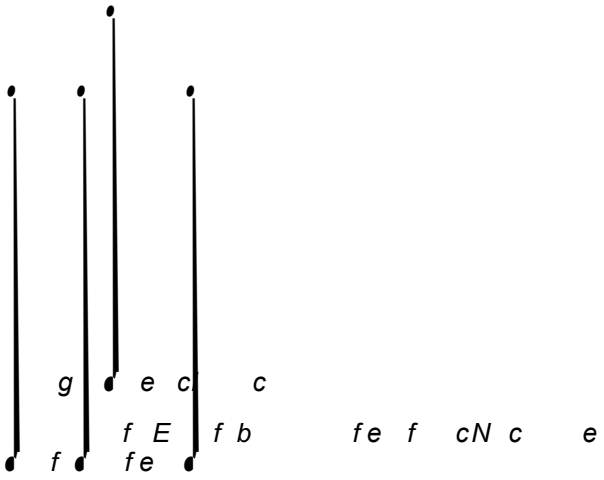

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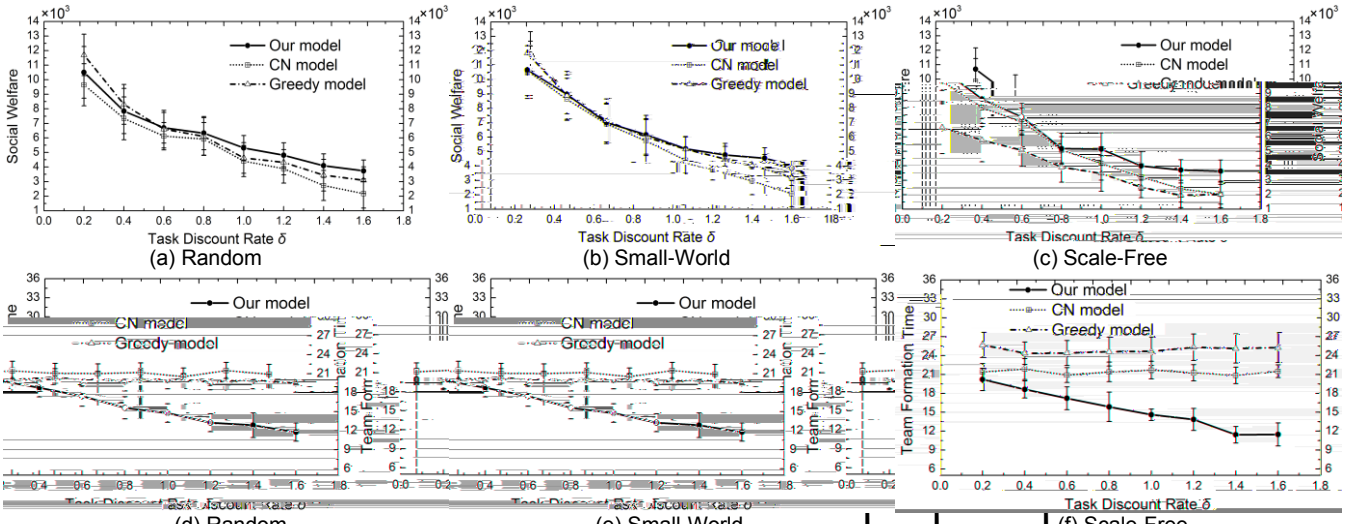
Table 3 The properties of net orks

Propert / Net ork	Net ork Degree											
	=6			=10			=14			=18		
		gc	*c*		*gc*	*c*		*gc*	*c*		*gc*	*c*
Random	7.0	4.0	0.007	5.1	3.3	0.011	4.9	3.0	0.015	4.0	2.7	0.019
Small-World	7.5	4.5	0.22	5.2	3.5	0.24	5. 0	3.1	0.25	4.0	2.8	0.26
Scale-Free	6.0	3.5	0.03	5.0	2.9	0.035	4.0	2.7	0.045	4.0	2.5	0.053



(a) Random (b) Small-World (c) Scale-Free

(d) Random (e) Small-World (f) Scale-Free

Fig. 2. The effect of task discount rate on different social team formation models social elfare (a c) and team formation time (d f).

f b f e l fe f cN c

e f f fe

S R R S R