Dynamic Social Choice and Pronouns

Sumiyo Nishiguchi
Center for Language Studies, Otaru University of Commerce
nishiguchi@res.otaru-uc.ac.jp

Abstract

Dynamic social choice has been discussed from the perspective of dynamic change of preferences over time. Parkes and Procaccia (2013) discuss Markov decision processes while Freeman et al. (2017) present algorithm for fair allocation. Nishiguchi (2011, 2012a,b, 2016a,b, 2017b,a) have analyzed changing references of pronouns such as *she, he*, and *they* in texts in the setting of dynamic social choice. This paper presents refurbished view on pronoun resolution in dynamic setting.

1 Dynamic Social Choice for Pronoun Resolution

While the Centering Theory (Grosz and Sidner 1986, Grosz et al. n.d.) analyzes pronoun resolution in contraint-based decision theory, social choice theory has not been used in analyzing linguistic issues. Below I present a dynamic system for anaphora resolution building on Parkes and Procaccia (2013) and Freeman et al. (2017). The presented model is a modified version of Nishiguchi (2011, 2012a,b, 2016a,b, 2017b,a) which proposed anaphora resolution as social choice. In this view, contextual interpretation of pronouns such as *she, he, they*, and *it* is a social welfare function (SWF). The possible coreferential antecedent noun phrases such as *John, Mary, Tokyo, the station, books* are ranked with preferences.

(1) a. M =(S, A, P, T)

S: pronouns, A: antecedents, P: contextual interpretation, T: time

b. S= $\{\text{he}_1,...,\text{he}_m, \text{she}_1,...,\text{she}_n, \text{it}_1,...,\text{it}_o, \text{they}_1,...,\text{they}_p\}$

c. contextual interpretation P (SWF): $\text{S}\times\text{T} \rightarrow \text{A}$

The decision processes are not completely Markovian because pronoun reference incorporates discourse coherence. The salient entity in discourse tends to stay

referents for a couple of sentences. For example *Sarah* may stay referent of *she* in a few sentences but can be switched to someone else.

Consider a set of *n* pronouns *A* = $\{a_1, a_2, ..., a_n\}$ and a set of *m* possible alternatives, i.e., antecedents χ =$\{k_1, k_2, ..., k_m\}$. Let the dispersed and ordered time be *T* = $(t_1, t_2, ..., t_n)$. Every pronoun *a* sets its valuation $v_a^t(k_j) \in N$ for every alternative k_j. Thus the input at time *t* is a matrix V^t =$(v_a^t(k))a, j$. Let $v^t(k_j)$ denote the *j*-th column of matrix V^t, the vector of valuations for alternative k_j. For time *t*, a *Dynamic Social Choice Function (DSCF)* picks a set of alternatives C_t, from which a single alternative c_t is chosen arbitrary.

(2) $u_t(k) = \sum_{t'=1}^{t} v_k^{t'}(c_{t'})$

2 Example

In the following text taken from corpus, referents of pronouns such as *she* or *he* changes overtime. For example, the referent of the third person masculine pronoun *he* refers to *Aileen's husband* in $\sigma 1$ but *him* in $\sigma 2$ is coreferential with *Duke*.

(3) $\sigma 1$ There were ooh's and aah's when he_{x1} finished, and some unbridled laughter. Aileen_a was looking dubiously at her_{y1} husband_h but he_{x2} was in no mood to disapprove.

$\sigma 2$ He_{x3} winked at the Duke_d and called across to him_{x4}, 'What a grand thing, your Honour, to have a wedding without a minister!' The Duke_d did his_{x5} stately bow at that and then Donald_m was calling for another song.

$\sigma 3$ Some of the veterans_v were on the point of giving tongue but young $\text{Donald McCulloch}_m$ was on his_{x6} feet and moving into the middle of the ring, he_{x7} was full of himself_{x8}, sparkling with mischief but with an undertow of ardour.

$\sigma 4$ 'Duncan Ban MacIntyre_b wrote a song for his_{x9} wife Mary_r.

$\sigma 5$ I do not know if Alex_l used it to court his_{10} $Mary_r$ – he_{x11} must have used something —'The joke was unconscious but crowing laughter came from the young men_n beside the whisky jar. (BNC A0N1311-1315, *King Cameron*)

Therefore, disambiguation function changes between passages and dynamic resolution is called for.

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