ANALOGY-EASSD ACQUISITION OF UTTERANCES RELATING TC TEMPORAL ASPECTS

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ABSTRACT

PLAS is an analogy-based language acquisition syston that can bo taught through examples. Tho primitives of its knowledge representation nro languago expressions and are learnt through interaction in tho vary same languago that is being learnt. This paper proposes extensions to cope with utterances relating to temporal aspects.

I INTRODUCTION

our approach to cope with the formidable complexity of doallng with Natural language as well as learning is to divide the effort into two stages. Tho first-stage system will begin with sensori-motor mechanisms rnd learn on interpreta-tionol machinery that enables comparatively primitive language processing* The second-stage system will start with such an interpretational machinery and loarn formal logic and grammar of the language that support complex performance.

We have described elsewhere [l,2,3,4] tho teachlng, language acquisition and understanding machinery of PLAS, a language acquisition system belonging to the first stage, PLAS is analogy-based and learns through examples, The primitives of its knowledge representation are not grammatical constructs but natural languago expressions thomselves. These primitives are learnt through interaction in the very same language that is being acquired (arguments for the above futures are available in [l to3]).

Though the language machinery of PLAS can cope, within its scope, with spatial as well as temporal aspects of the external world, its sonsorl-motor machinory cannot represent the temporal aspocts. Moreovor, though it can ler.rn to understand new phrases and sentences, its capability to acquire words is comparatlvoly limite. This paper proposes extensions to remove these limitations (call tho extended PLAS as PLAS.T).

II INTIAL KNOWLEDGE. TEACHING

The world of PLAS.T is a system of aspects (e.g. : tho meaning of YESTERDAY, Male 10) and aspoct-classes (o.g! the class of past events, tho class of males) of the exterml world, rnd utterances and uttoranco-classes i.e., language schemmes or simply schemes (o.g.: SCM1FCDY WI^TT SOMFfITKR* SOMETIME i.e.,*- WBJT - -•> of tho linguistic world.

PLAS.T starts with a system of sonsorl-motor aspects (A sonsorl-motor aspect Is nn aspect of tho external world that PLAS.T bocomos nware of through its sensing and manipulating capabilities. For example, a specific action such as walking, a specific agent.) and aspect-clnssos.

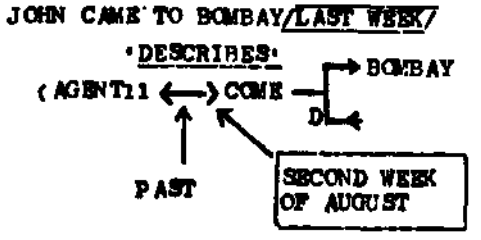
Since tho case structures nro clocor to tho structures loarnt by PLAS£4^ and Schank's CEN representation £ej is language-free, we propose to use *CW* to represent tho sensorl-motor knowledge given above. However, CDN will not be used to represent the aystorn of aspocts and aspect-elates at tho language lovol. Wo bollevo that a person's languago plays t key rolo in dotormining his modol of tho world and thus structuring his thought [7J .

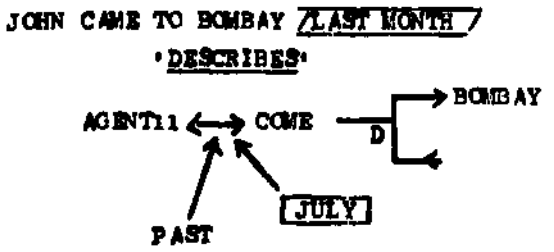
Utterances, sonsorl-motor aspocts and ospoct-classos are primltivoly rolatod by the toachor as in PLAS £lj by naming. For oxnmplo,

CKAIRI; CHAIR, ACIiAIR;*

•ft' stands for a CEN-representation of tho sensori-motor aspect-class corresponding to tho class of chairs. The example Informs tho system that CHAIR, A CHAIR are names of the aspect CHAIRi belonging to tho aspect-cla*s spool fled by a. All n-mo-uttorpneos need not be Introduced by naming. PLAS.T, using tho acquisition machlnory of PLAS and tho techniques dlscussod below, can learn them by analogy.

The teacher can also associate a linguistic and a sensori-motor representations of on ovont by the oxtro-lingulstlc marker 'DESCRIBES' which simulates the oxtra-lingulstic behaviour viz., simultaneously pointing to, and describing, a situation. For Example,





(For lack of space, 'COME' has not boon described fully, and structures of tho linguistic representation wore not shown). Applying tho rule that any difference in tho linguistic representantion of two ovonts relates to tho difference in their sensori-motor roprosontntions, PLAS.T can associato LAST MCNTO with JULY and LAST WESC with SECOND WEEK OF AUGUST. Using anothor rule, PLAS.T can relate the only non-understandable unit in a linguistic roprosontntion with tho only ono in tho sonsori-motor roprosontntion that has not been reintod to any unit in tho former. For example, the boxod units glvon below:

JOHN IS /TALL/ 'DESCRIBES'

AGENT11 ⇄ /TALL/

Next, linguistic represontntions of two ovonts can be rolatod by tho teachor using the extra-linguistic markers, nnmely 'IS-A-RECOLLECTION-OF' and 'IS-AN-IMAGINATION-OF'. For example,

JILL DROPPED THE DOLL YESTERDAY
'IS-A-RECOLLECTION-OF' JILL DROPS THE DOLL

JILL WILL BE AT BOMBAY IS-AN-IMAGINATION-OF JILL IS AT BOMBAY.

• IS-A-RBCCLLECTION-OF' simulatos tho oxtm-llnguietlc moans employed by a lnnpjuago community to onablo tho henror to recollect a past ovont and associaciato with its roprosontntion tho present one. Tho other marker simulates tho extra-linguistic means that enable tho hoofer to imagine a now situation and relate its representation with tho present one. With tho holp of such associations between statements, nnd tho analogy-based capability of PLAS to transform utterances (details in [1,2,4]). PLAS.T can convert tho tense of a statement.

Teaching PLAS.T a text is as in PLAS [1,2,4] except that tho extra-linguistic markers described above can also bo used in addition to tho ones already available in PLAS.

III UNDERSTANDING AND KNOWLEDGE REPRESENTATION

In PLAS.T a sensori-motor aspect is represented by a Picture Producer node, Action node, Picture Aider node, Action Aider node or a conceptualization [5] . An interpretation of an utterance is an aspect (at either the sensori-motor or the language level). The semantic category of an utterance is represented by a sensori-motor aspect-class (and not by a language level aspect-class to avoid complexity).

The surface-structure of a phrase or a sentence consists of the underlying schema and the surface-structures of its fillers. For example, that of JOHN BRUSHES HIS TEETH DAILY is: (— BRUSHES — —, JOHN, (HIS —, TEETH)). The aspect-class structure of an utterance (i.e., a phrase or a sentence) consists of the aspect-class of the utterance and the aspect-class structures of its fillers. The aspect-structure of an utterance consists of the aspect of the utterance and the aspect-structures of its fillers. The surface, aspect-class and aspect structure of a word is respectively the word itself, its aspect-class and aspect.

To understand an utterance, PLAS.T has to obtain its three structures (details of the understanding process are in [1,2,4]).

When an utterance is successfully understood, the utterance and its structures are integrated into the knowledge net of PLAS.T. The knowledge net called LBA-net is a Language Based (because the primitives are language expressions) Associative network [3] . It supports the following associative information retrieval.

1. Aspects represented by an utterance;

2. Utterances representing an aspect;

3. Aspect-class-structures associated with an utterance and vice versa;

4. Aspect-class-structures associated with an aspect and vice versa;

5. Fillers of a variable of a schema;

6. Utterances that can be segmented through a schema;

7. Language schemas segmenting an utterance.

These associative functions constitute the interface between the understanding process and the knowledge net (details in [3]).

IV COMMENTS

The acquired competence of PLAS.T can be tested as in PLAS [1,2,4]. If its response is incorrect, the teacher presently has to switch PLAS.T to the state of the latest correct response and modify his teaching sequence. Extensions to enable the system to debug its knowledge through question-answering have been discussed in [4]. Though some of the learning principles discussed above rely on the concept of 'near miss', the generalization techniques of PLAS which PLAS.T inherits do not require examples of 'near miss' type. Since neither PLAS nor PLAS.T is designed to learn a grammar, and the knowledge representation does not employ the usual grammatical and semantic primitives, the computational machinery of PLAS.T is bound to be unconventional.

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