Artificial Digestion

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It seems presumptuous for AI to attempt to simulate human cognition when no one yet understands how the cognitive system operates. Therefore we at the Institute of Computer Ecology have decided to instead simulate a human system that *is* well understood – the gastro-intestinal system.

Artificial Digestion (AD) is the study of symbolic computer models of the human GI system. Our prototype is called TUMMY (*T*he Brown *U*niversity Si*M*ulation of Hu*M*an DY*g*estion).[1] Input to the program is symbolic, and takes the form of a high-level English language description. Here is a typical example that our system can handle:

Soup du jour[2]

Smoked trout in a light horseradish sauce
Mondavi fumé blanc 1975

Boneless braised duck, garnished with kumquats,
in a delightful raspberry vinegar
Broccoli *Pilaf rice*
Cols du val cabernet sauvignon 1973

Zabaglione
Fromage et fruits
Grand Marnier *Cafe au lait*

It should be noted that this is not a contrived example designed just for our system. Rather, it is one of about 50 real-world data points that were especially collected by the author and his colleagues from well-known New York restaurants.[3] This example produces the following output:

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[1] We are indebted to our colleague J. Sauvage for this ingenious and witty acronym.

[2] Cream of asparagus.

[3] The collection of data was supported by the National Science Foundation under grant number TR-889-11Q.

Energy: 25730 kJ
Fat: 0.46 kg
Waste products:[4]
Solid: 0.22 kg
Liquid: 0.92 L
Gas: 0.41 L

Needless to say, TUMMY has been designed to handle abnormal inputs as well. For example, if fed *Five-day-old poached whiting* TUMMY's output is *Vomits: 0.48 L.*[5] This is of course in accordance with the well-known programming maxim "Garbage in, garbage out". In addition, when subjected to stress and a poor diet, TUMMY will develop an ulcer. However, it can be cured by typing *Tagamet*[6] to the program four times a day for about a month.

Clearly, there are many practical applications for Artificial Digestion. Interest has already been expressed in commercial use of TUMMY and its successors in such diverse areas as diabetic research, reviewing restaurants, test-marketing new food products, and vicarious eating for gluttons under medical advice to limit their intake. We are confident that five years from now, while AI is still floundering, AD will be an important, flourishing science.

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[4]We have been dismayed by the number of smutty little jokes that this aspect of our program has engendered among our otherwise respectable colleagues. The reader should remember that this is Science.

[5]See previous footnote.

[6]"Tagamet" is a trademark[7] of the SmithKline Beckman Corporation.

[7]"Trademark" is a trademark of the U.S. Trademarks Office.

Conference Report

Workshop on the Psychological Reality of Lisp

Yale University, 11–12 March 1981

Report by R.M. Duck-Lewis

The first Workshop on the Psychological Reality of Lisp was recently held at Yale University under the sponsorship of the Sloan Foundation, with about twenty invited participants. The Workshop was conceived and organized by Roger Schank.

The program consisted of informal presentations by some of the participants, each followed by long and often lively discussion. A brief description of the program follows:

Roger Schank opened the workshop with an overview of his own research, in which an NLU program is treated as a literal theory of human language understanding. He had slowly begun to realize, he said, that this approach could only make sense if one made the additional assumption that there was an underlying mental reality to Lisp, and he therefore began research to find proof of this reality. He became aware of other researchers doing the same, and convened this workshop to promote an interchange of ideas on the topic.

James Roderickson: "Evidence for the mental reality of cons cells". Roderickson described a series of experiments he and his colleagues had performed in an attempt to show that human memory representations are based on cons cells and pointers. Subjects were given simple list-manipulation problems, and reaction times in choosing the correct answer from an array of four choices were measured. The results were in accord with the prediction that time taken on a problem would be proportional to the number of Lisp conses that would be required to do the problem. One surprise was that in some cases a subject would take longer than predicted; it was assumed that this was due to garbage collection of used cons cells, and these data points were therefore not included in the analysis.

Norma Tinstein: "Evidence for the mental reality of pointers". After the lunch break, Roderickson's colleague Tinstein continued the report on the abovementioned experiments. Given the reality of cons cells, it was then necessary to show the reality of pointers. This was investigated indirectly, through a study of the problems of broken lists, dangling pointers, and circular lists. For example, a subject would be asked to perform a ***replaca*** or ***replacd*** which would result in a circular list. When asked to say what the list was, subjects would go into an infinite loop, which, in one extreme case, could only be halted by a blow from the experimenter. Regrettably, the subject was hospitalized for two days, and the university's Human Experimental Subjects Review Board terminated the experiments before adequate data could be generated.

Martin Hammond, a speech therapist from New York, spoke for half an hour on "The psychological ontogeny of sibilant speech impediments" before anyone realized that he was talking about the psychological reality of a different type of lisp; whereupon he was removed from the workshop by security guards.

Ellen Johnson: "MAClisp or Stanford Lisp?". Johnson considered the question of which of the many dialects of Lisp now in use was closest to the mental Lisp. At present, only intuition and anecdotal evidence are available, but the indications are that MAClisp is closer to real life. Matters considered include whether taking the car and cdr of nil result in an error, or yield a value of nil, and whether the default number base is octal or decimal. The cardinality of the chiral phalanges is considered significant in the second question.

H. Toucan: "A mental model of errors in Lisp programming". According to Toucan, the three most common errors in Lisp programs are (1) an incorrect number of arguments to a function; (2) trying to take the car or cdr of an atom; and (3) attempting to evaluate an unbound atom that should have been quoted but wasn't. Toucan described a model of the human mind as the execution of a Lisp program in which mental errors are explained as instances of these Lisp programming errors. For example, the oft-studied "tip-of-the-tongue" phenomenon, when one is unable to complete the retrieval of a word from the mental lexicon, is caused by a type 3 error: a missing quote mark at the time when the word is initially entered in the lexicon. A surprising consequence of the model is that the human mind has a $44\frac{1}{2}$-bit address space.

The final conference session was an evaluation of the workshop, and discussion of future plans. It was decided that another workshop should be held in two years. In the meantime, an elected committee would look into the possibility of organizing a formal society, possibly known as the Association for the Reality of Artificial Intelligence. In addition, Academic Press had expressed an interest in publishing a journal tentatively named *Cognitive Programming*; a committee to liaise with the publisher was elected.

The social program was just as successful as the rest of the workshop. Instead of the usual boring conference banquet, Schank organized a game of touch football (Home vs Visitors), which the Yale team won 14-9.

An AI system with something for everyone

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It has often been suggested that the real test of AI will come only when the various theories and systems produced over the last few years are combined into a completely general integrated system. Such a system has now been built at Brown University, and is described in this report.

The system combines modern theories of scene analysis, discourse comprehension, problem solving, language generation, robotics and knowledge representation. In principle, the program is domain independant. However its knowledge is so far limited to the intersection of the domains that the component programs were designed to deel with. It therefore presently can only deal with the inventory control of blocks in international terrorism.

For the sake of concreteness, let us show how the system processes one particular sentence:

How many red blocks should you pick up?

Our input is in the form of American Sign Language, which the user performs in front of a high-resolution video camera. We take the input and translate it into Montague's intensional logic, thus:

$\lambda x \lambda y \lambda u \lambda z \lambda w[w\ u\ y$ should $x\ z]$(you)(blocks)(red)(pick−up)(how−many)

This is passed to the speech act module, which uses bottom-up knowledge to infer that this utterence takes place in the context of a conversation about how many red blocks ought to be picked up, and brings in the world knowledge, a partitioned semantic network appropriate to this situation.

Problem solving components then take over to move the robot arm around the table to see how many red blocks are present. Each block on the table is picked up and held by the arm in front of a colorimeter. The system then compares the number of red blocks found with its frame-based knowledge of social norms to decide what number of red blocks is the optimal number to pick up, in this case two.

This information is represented as the binary number 10, and passed to the language generator, which formulates it into an English sentence by selecting the appropriate discourse rule to express the answer. In this case, the rule is:

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FORMAT (14H THE ANSWER IS, X, I4, 1H./)
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Our future work will include extending the system to operate on a second question, and also do optical recognition of Chinese characters.

If you can believe ten impossible things before breakfast, then you should join

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- That there is a hole in the Earth at the North Pole from which UFOs come.
- That π equals precisely 3.000.
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- That Billy Joe Wilson (Hoopla, Miss.) has successfully squared the circle.
- That Harry Truman is still president, and doing a fine job.
- That π equals precisely 22/7.

Several other important counterfactual beliefs are presently being studied, including Reagan/Thatcher economics; that the moon landings were done in a Hollywood special effects studio; and all current theories in Artificial Intelligence. These will be the subject of a forthcoming Papal Bull.

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