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PATTERN-MATCHING RULES FOR THE RECOGNITION OF  
NATURAL LANGUAGE DIALOGUE EXPRESSIONS

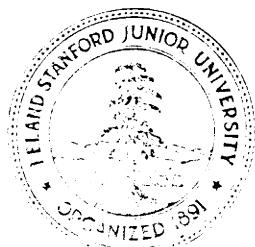
BY

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COMPUTER SCIENCE DEPARTMENT  
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**Abstract:**

Man-machine dialogues using everyday conversational English present difficult problems for computer processing of natural language. Grammar-based parsers which perform a word-by-word, parts-of-speech analysis are too fragile to operate satisfactorily in real time interviews allowing unrestricted English. In constructing a simulation of paranoid thought processes, we designed an algorithm capable of handling the linguistic expressions used by interviewers in teletyped diagnostic psychiatric interviews. The algorithm uses pattern-matching rules which attempt to characterize the input expressions by progressively transforming them into patterns which match, completely or fuzzily, abstract stored patterns. The power of this approach lies in its ability to ignore recognized and unrecognized words and still grasp the meaning of the message. The methods utilized are general and could serve any "host" system which takes natural language input.

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## PATTERN-MATCHING RULES FOR THE RECOGNITION OF NATURAL LANGUAGE DIALOGUE EXPRESSIONS

Kenneth Mark Colby  
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### INTRODUCTION

To recognize something is to identify it as an instance of the "same again". This familiarity is possible because of recurrent characteristics of the world which repeat themselves. We shall describe an algorithm which recognizes recurrent characteristics of natural language dialogue expressions. It utilizes a multi-stage sequence of pattern-matching rules for progressively transforming an input expression until it eventually matches an abstract stored pattern. The stored pattern has a pointer to a response function in memory which decides what to do once the input has been recognized. Here we discuss only the recognizing functions, except for one response function (anaphoric substitution) which interactively aids the recognition process. Details of how the response functions operate will be described in a future communication by Bill Faught and ourselves.

We are constructing and testing a simulation of paranoid thought processes; our problem is to reproduce paranoid linguistic behavior in a teletyped diagnostic psychiatric interview. The diagnosis of paranoid states, reactions or modes is made by clinicians who judge the degree of correspondence between what they observe in an interview and their conceptual model of paranoid behavior. There exists a high degree of agreement among psychiatrists about this conceptual model which relies mainly on what an interviewee says and how he says it.

Natural language is a life-expressing code which people use for communication with themselves and others. in a real-life dialogue such as a psychiatric interview, the participant9 have interests, intentions, and expectations which are revealed in their linguistic expressions. An interactive simulation of a paranoid patient must be able to demonstrate typical paranoid linguistic behavior. To achieve this effect, our paranoid model must have the ability to deal with the teletyped messages of an interviewer.

A number of approaches have been taken for dealing with natural language dialogue expressions. (Winograd, 1972; Woods, 1970). These approaches rely on parsers which conduct a detailed syntactic and semantic analysis. They perform well for the purposes for which they were designed. Their weakness, for our purposes, lie9 in their lack of neglecting and ignoring mechanisms. Such mechanisms are necessary in a program which accepts and responds to unrestricted conversational English characterized by expressions novel to the program.

How humans process natural language is largely unknown. They possess some knowledge of grammatical rules, but this fact does not entail that they use a grammar in interpreting and producing language. It seems implausible to us that people possess full transformational grammar9 for processing language. Language is what is recognized but the processes involved may not be linguist ic or grammatical. Originally transformational grammars were not designed to "understand" a large subset of English; they constituted a formal method for deciding whether a string is grammatical.

An analysis of what one'9 problem actually is should guide the selection or invention of methods appropriate to its solution. Our problem is not to develop a consistent and general theory of language nor to assert empirically testable hypotheses about how people process languaga. Our

problem is to design an algorithm which recognizes what is being said in a dialogue and what is being said about it in order to make a response such that a sample of I-O pairs from the paranoid model is judged similar to a sample of I-O pairs from paranoid patients. The design task belongs to artificial intelligence in which the criterion is how adequately the computer program performs mind-like functions. New methods had to be devised for an algorithm to participate in a human dialogue in a paranoid-patient-like way. We sought effective methods which could operate efficiently in real time. Since our method provides a general way of many-to-one mapping from surface expressions to a single stored pattern, it is not limited to the simulation of paranoia, but can be used by any type of "host" system which takes natural language as input;

Our method is to transform the input until a pattern is obtained which matches completely or partially a more abstract stored pattern. This strategy has proved adequate for our purposes a satisfactory percentage of the time. The power of this method for natural language dialogues lies in its ability to ignore as irrelevant some of what it recognizes and everything it does not recognize at all. A linguistic parser doing word-by-word, parts-of-speech analysis fails when it cannot find one or more of the input words in its dictionary. A system that must know every word is too fragile for unrestricted dialogues.

In early versions of the paranoid model, such as PARRY1, some of the pattern recognition mechanism allowed the elements of the pattern to be order independent (Colby, Weber, and Hilf, 1971). For example, consider the following expressions:

- (1) WHERE DO YOU WORK?
- (2) WHAT SORT OF WORK DO YOU DO?
- (3) WHAT IS YOUR OCCUPATION?
- (4) WHAT DO YOU DO FOR A LIVING?
- (5) WHERE ARE YOU EMPLOYED?

In PARRY1 a procedure scans these expressions looking for an information-bearing contentive such as "work", "for a living", etc. When it finds such a contentive along with "you" or "your" in the expression, regardless of word order, it responds to the expression as if it were a question about the nature of one's work. This method correctly classifies the five sentences above. Unfortunately, it includes the two examples below in the same category:

- (6) DOES YOUR FATHER'S CAR WORK?
- (7) HOW DID THINGS WORK OUT FOR YOU?

An insensitivity to word order has the advantage that lexical items representing different parts of speech can represent the same concept, e.g. the word "work" represents the same concept whether it is used as a noun or a verb. But a price is paid for this resilience and elasticity. We find from experience that, since English relies heavily on word order to convey the meaning of its messages, the average penalty of misunderstanding (to be distinguished from ununderstanding), is too great. Hence in PARRY2, as will be described shortly, all the patterns require a specified word order.

For high-complexity problems it is helpful to have constraints. Diagnostic psychiatric interviews (and especially those conducted over teletypes) have several natural constraints. First, clinicians are trained to ask certain questions in certain ways. This limits the number of patterns required to recognize utterances about each topic. Second, only a few hundred standard topics are brought up by interviewers who are, furthermore, trained to use everyday expressions and especially those used by the patient himself. When the interview is conducted by teletypes, expressions tend to be shortened since the interviewer tries to increase the information transmission rate over the slow channel of a teletype. Finally, teletyped interviews represent written utterances and utterances are known to be highly

redundant such that unrecogni zed words can be ignored without losing the meaning of the message. Also utterances are loaded with 'idioms, cliches, pat phrases, etc. - all being easy prey for a pattern-matching approach. It is time-wasting and usual ly futile to try to decode an idiom by analyzing the meanings of its individual uords.

We now describe the pattern-matching functions of the algorithm in some detail. (See Fig. 1 for a diagram of the overall flow of control).

#### OVERVIEW

PARRY2 has two primary modules. The first attempts to RECOGNIZE the input and the second RESPONDS. This paper is primarily about the RECOGNIZE module. It functions independently of the RESPOND module except in the case of pronoun references, which the RESPONDO module provides to the RECOGNIZER on request.

The recognition module has 4 main steps:

- 1) Identify the words in the question and convert them to internal synonyms.
- 2) Break the input into segments at certain bracketing uords.
- 3) Match each segment (independently) to a stored pattern.
- 4) Match the resulting list of recognized segments to a stored complex pattern.

Each of these steps, except the segmenting, throws away what it cannot identify. Occasionally a reference to an unkoun topic is mis-recognized as some fami liar topic.

#### PREPROCESSING

Each word in the input expression is first looked up in a dictionary of (currently) about 1300 entries which, for the sake of speed, is maintained in core during run-time. The dict ionary, which uas buil t empirically from thousands of teletyped interviews with previous versions of the model, consists of words, group9 of words, and names of word-classes they can be translated into. Entries in the dictionary reflect PARRY2's main interests.

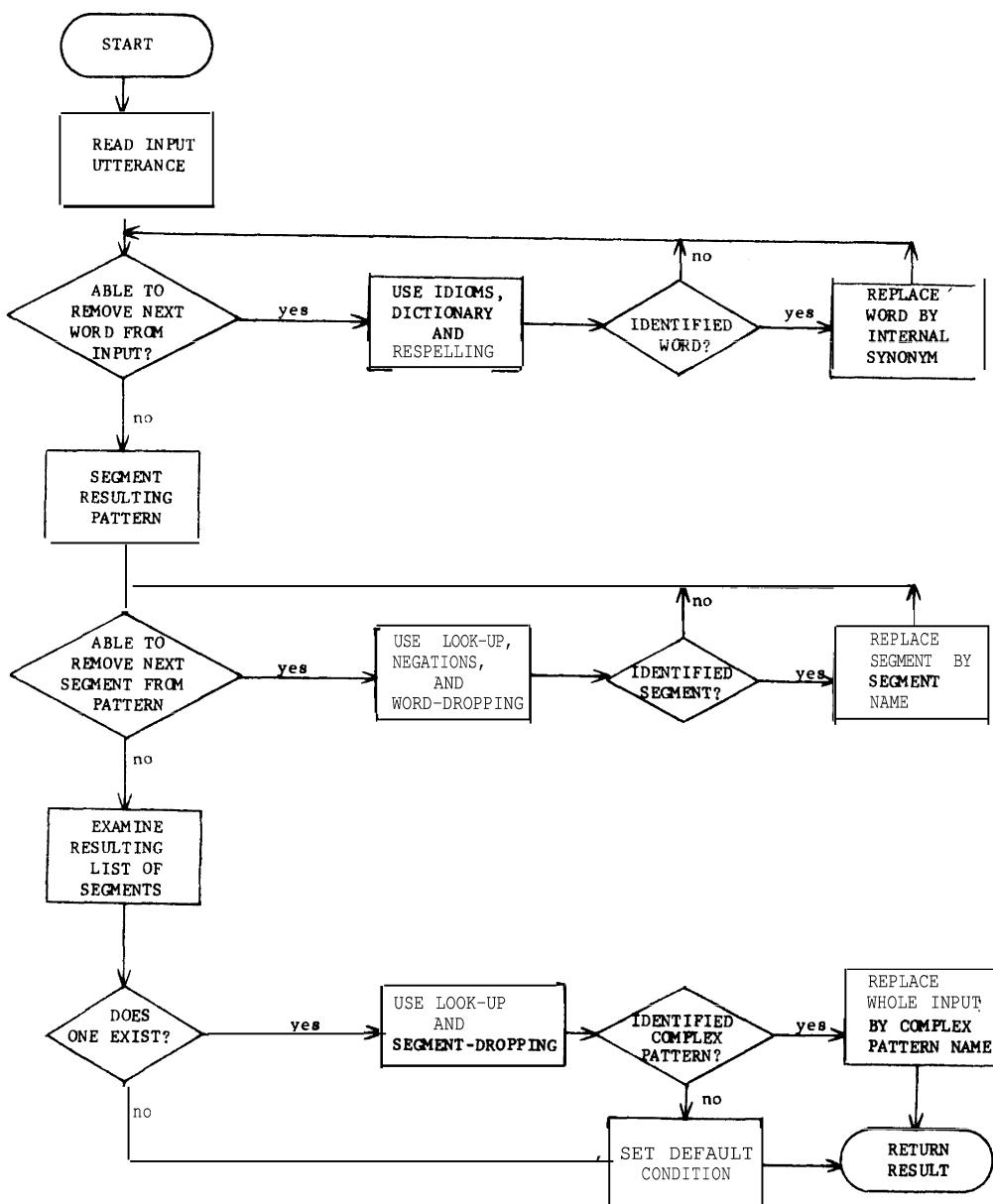


Figure 1  
Overall Flow Diagram of Language Recognizer

If a word in the input is not in the dictionary, it is checked to see if it ends with one of the common suffixes given in Fig. 2. If it does, the suffix is removed and the remaining word is looked up again. If it is still not in the dictionary, it is dropped from the pattern being formed. Thus if the input is:

WHAT IS YOUR CURRENT OCCUPATION?

and the word "current" is not in the dictionary, the pattern at this stage becomes:

(WHAT IS YOUR OCCUPATION)

The question-mark is thrown away as redundant since questions are recognized by word order. (A statement followed by a question mark (YOU GAMBLE?) is responded to in the same way as that statement followed by a period. Synonymic translations of words are made so that the pattern becomes, for example:

(WHAT BE YOU JOB)

Some groups of words (i.e. idioms) are translated as a group so that, for example, "for a living" becomes "for job". Certain other juxtaposed words are contracted into a single word, e.g. "place of birth" becomes "birthplace". This is done to deal with groups of words which are represented as a single element in the stored pattern, thereby preventing segmentation from occurring at the wrong places, such as at a preposition inside an idiom or phrase. Besides these contractions, certain expansions are made so that for example, 'DON'T" becomes "DO NOT" and "I'D" becomes "I WOULD".

S	→	
'D	→	SHOULD
'S	→	
ED	→	
EN	→	
ER	→	
ES	→	
LY	→	
NT	→	NOT
OR	→	
S'	→	
'LL	→	WILL
'RE	→	BE
'VE	→	HAVE
EST	→	
FUL	→	
ING	→	
ION	→	
ISH	→	
ITY	→	
IVE	→	
N'T	→	NOT
ABLE	→	
A B L Y	→	
LESS	→	
MENT	→	
NESS	→	

FIG. 2. The suffixes are on the left and the words which replace them are on the right. Most suffixes are simply removed and not replaced.

Misspellings can be the bane of teletyped interviews for an algorithm. Here they are handled in two ways. First, common misspellings of important words are simply put in the dictionary. Thus "yuu" is known to mean "you". The apostrophe is often omitted from contractions so most contractions are recognized with or without it. These common misspellings were gathered from over 4000 interviews with earlier versions of the paranoid model. (The model (PARRY) is available for interviewing on the ARPA network).

Second, five common forms of typing error are checked systematically.

These are:

- 1) Doubled letter
- 2) Extraneous letter
- 3) Forgetting to hold the "shift key" for an apostrophe
- 4) Hitting a nearby key on the keyboard
- 5) Transposing two letters in a word

The first three errors can be corrected by deleting the offending character from the word. This is accomplished by deleting each character in turn until the word is recognized. The fourth type of error is only checked for eight of the more common near misses. These were also empirically determined and involve the letter pairs (T Y), (Q W), (Y U), (I O), (G H), (O P), (A S), and (N M). These methods are all based on typing errors, but they also correct some legitimate English spelling errors. Two-letter transposition corrects, for example, "beleive" to "believe".

#### SEGMENTING

Another weakness in the crude pattern matching of PARRY1 is that it takes the entire input expression as its basic processing unit. If only two words are recognized in an eight word utterance, the risk of misunderstanding is great. We need a way of dealing with units shorter than the entire input expression.

Aided by a heuristic from work in machine-translation (Wilks, 1973),

we devised a way of bracketing the pattern constructed up to this point into shorter segments using prepositions, wh-forms, certain verbs, etc. as bracketing points. (A list of the bracketing terms appears in Fig. 3). These points tend to separate prepositional phrases and embedded clauses from the main clause. The new pattern formed is termed either "simple", having no delimiters within it, or 'complex', i.e., being made up of two or more simple patterns. A simple pattern might be:

( WHAT BE YOU JOB )

whereas a complex pattern would be:

(( WHY BE YOU )( IN HOSPITAL ))

Our experience with this method of segmentation shows that complex patterns from teletyped psychiatric dialogues rarely consist of more than three or four segments.

After certain verbs (See Fig. 4) a bracketing occurs to replace the commonly omitted "THAT", such that:

( I THINK YOU BE AFRAID )

becomes

(( I THINK )( YOU BE AFRAID ))

#### MATCHING INDIVIDUAL SEGMENTS

Conjunctions serve only as markers for the segmenter and they are dropped out after segmentation.

Negations are handled by extracting the "NOT" from the segment and assigning a value to a global variable which indicates that the expression is negative in form. When a pattern is finally matched, this variable is consulted. Some patterns have a pointer to a pattern of opposite meaning if a "NOT" could reverse their meanings. If this

ABOUT	NOR
ABOVE	OF
AFTER	OFF
AGAINST	ON
ALONG	OPPOS I TE
AL THOUGH	OR
AMID	OUT
AMIDST	OUTSIDE
AN0	OVER
AROUND	PAST
AS	SINCE
AT	SO
AWAY	THAN
BEAUSE	THAT
BECAUSE	THEN
BEHIND	THEREFORE
BELOW	THROUGH
BESIDE	TO
BESIDES	TOWARD
BUT	UNDER
BY	UNDERNEATH
COMMA	UP
CONCERN I NG	UPON
DOWN	WHAT
OUR I NG	WHATEVER
EITHER	WHEN
EXCEPT	WHENEVER
FOR	WHERE
FROM	WHETHER
FURTHERMORE	WHICH
HOW	WHO
HOWEVER	WHOM
IF	WHOSE
IN	WHY
INDEED	WITH
INSIDE	WITHIN
INTO	WI THOUT
MOREOVER	YET
NEAR	

FIG. 3. Terms used for bracketing input expressions into segments.

APPEARS  
ASSUME  
BELIEVE  
CONSIDER  
FEEL  
FELT  
GATHER  
GUESS  
HOPE  
IMAGINE  
MEAN  
MEANT  
SAID  
SAY  
SEERS  
SOUNDS  
SUPPOSE  
THINK  
THOUGHT  
UNDERSTAND  
WONDER

FIG. 4. Special verbs used for bracketing input expressions into segments.

pointer is present and a "NOT" was found, then the pattern matched is replaced by its opposite, e.g. (I not trust you) is replaced by the pattern (I mistrust you). We have not yet observed the troublesome case of "he gave me not one but two messages". (There is no need to scratch where it doesn't itch).

Substitutions are also made in certain cases. Some segments contain pronouns which could stand for a number of different things of importance to PARRY2. As we mentioned in the introduction, the response functions of memory keep track of the context in order to give pronouns and other anaphoras a correct interpretation. For example, the segment:

( DO YOU AVOID THEM )

could refer to the Mafia, or racetracks, or other patients, depending

on the context. When such a segment is encountered, the pronoun is replaced by its current anaphoric value as determined by the response functions, and a more specific segment such as:

( DO YOU AVOID MAFIA )

is I looked up.

Other utterances, such as "Why did you do that?" or just "Why?" (which might be regarded as a massive ellipsis), clearly refer b&k to previous utterances. These utterances match very general patterns which identify the type of question without indicating the exact topic. The response function which responds to "Why?" consults the context to produce an appropriate answer.

The algorithm next attempts to match the segments with stored simple patterns which currently number about 1700. First a complete and perfect match is sought. When a match is found, the stored pattern name has a pointer to the name of a response function in memory which decides what to do further. If a match is not found, further transformations of the segment are carried out and a "fuzzy" match is tried.

For fuzzy matching at this stage, we adopted the heuristic rule of dropping elements in the segment one at a time and attempting a match each time. This heuristic allows ignoring familiar words in unfamiliar contexts. For example, "well" is important in "Are you well?" but meaningless in "Well are you?".

Deleting one element at a time results in' for example, the pattern:

( WHAT BE YOU MAIN PROBLEM )

becoming successively:

- (a)( BE YOU RAIN PROBLEM )
- (b)( WHAT YOU RAIN PROBLEM )
- (c)( WHAT BE MAIN PROBLEM )
- (d)( WHAT BE YOU PROBLEM )
- (e)( WHAT BE YOU MAIN )

Since the stored pattern in this case matches (d),(e) would not be constructed. We found it unwise to delete more than one element since our segmentation method usually yields segments containing a small number (1-4) of words.

Dropping an element at a time provides a probability threshold for fuzzy matching which is a function of the length of the segment. If a segment consists of five elements, four of the five must be present in a particular order (with the fifth element missing in any position) for a match to occur. If a segment contains four elements, three must match - and so forth.

## COMPLEX-PATTERN MATCH

When more than one simple pattern is detected in the input, a second matching is attempted against about 500 complex patterns. Certain patterns, such as ( HELLO ) and ( I THINK ), are dropped because they are considered meaningless. If a complete match is not found, then simple patterns are dropped, one at a time, from the complex pattern. This allows the input,

(( HOW DO YOU COME )( TO BE )( IN HOSPITAL ))

to match the stored pattern,

(( HOW DO YOU CONE )( IN HOSPITAL )).

If no match can be found at this point, the algorithm has arrived at a default condition and the appropriate response functions decide what to do. For example, in a default condition, the model may assume control of the interview, asking the interviewer a question, continuing with the topic under discussion or introducing a new topic.

An annotated example of a diagnostic psychiatric interview is presented in Appendix 1.

## ADVANTAGES AND LIMITATIONS

As mentioned, one of the main advantages of a pattern-matching strategy is that it can ignore as irrelevant both some of what it recognizes and what it does not recognize at all. There are several million words in English, each possessing from one to over a hundred senses. To construct a machineusable word dictionary of this magnitude is out of the question at this time. Recognition of natural language input in the manner described above allows real-time interaction in a dialogue since it avoids becoming ensnared in combinatorial disambiguations and long chains of inferencing which would slow a dialogue algorithm down to impracticality, if it could

even function at all. The price paid for pattern-matching is that sometimes, but rarely, ambiguities slip through.

Another advantage of this method is its speed. The algorithm consists of about 28K of programs written in MLISP, 16K of data in LISP, and 16K of data in machine language with several overlays. The complete language recognition process requires less than one second of real time on a time-shared DEC PDP-10.

A drawback to PARRY1 is that it reacts to the first pattern it finds in the input rather than characterizing the input as fully as possible and then deciding what to do based on a number of tests. Another practical difficulty with PARRY1 from a programmer's viewpoint, is that, since it is a procedural model, elements of the patterns are strung out in various procedures throughout the algorithm. It is often a considerable chore for the programmer to determine whether a given pattern is present and precisely where it is. In PARRY2 the patterns are all collected in one part of the data-base where they can easily be examined.

Concentrating all the patterns in the data base gives PARRY2 a limited "learning" ability. When an input fails to match any stored pattern or matches an incorrect one, as judged by a human operator, a pattern which matches the input can be put into the data-base automatically. If the new pattern has the same meaning as a previously stored pattern, the human operator must provide the name of the appropriate response function. If he doesn't remember the name, he may try to rephrase the input in a form recognizable to PARRY2 and it will name the response function associated with the rephrasing. These mechanisms are not "learning" in the commonly-used sense but they do allow a person to transfer his knowledge into PARRY2's data-base with very little effort.

Informal observation thus far shows PARRY2's linguistic recognition

abilities to be quite superior to PARRY1's. A more systematic and quantitative evaluation of performance is now being carried out. PARRY1 was extensively tested by having judges make ratings of its performance along several dimensions, one of which was linguistic noncomprehension (Colby and Hilf, 1974). These judges also made ratings of teletyped interviews with psychiatric patients and with a random version of PARRY1. The mean ratings of PARRY1 along the dimension of linguistic noncomprehension were better than those received by RANDOM-PARRY but were three times worse than the mean ratings received by patients. Once the ratings of PARRY2 along this dimension are completed, we will be able to compare them with those of PARRY1 and the patients and obtain a more objective measure of improvement.

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## APPENDIX 1.

A diagnostic psychiatric interview illustrating some of the model's linguistic capabilities. I = interviewee, P = PARRY2. Annotations appear in parentheses.

I - GOOD AFTERNOON, MY NAME IS DR JONES.

P - HELLO.

(PARRY2 recognizes most of the common idiomatic greetings, Both ideas in the doctor's statement are recognized and one is chosen by the response functions to be answered.)

I - WHATS YOURS?

P - PAT SMITH.

("Yours" is correctly understood to mean "your name".)

I - ARE YOU A MAN OR A WOMAN ?

P - I'M A MAN.

I - HOW OLD ARE YOU ?

P - TWENTY-EIGHT, HOW OLD ARE YOU?

(This is another easy, and stereotyped, question. The answer includes a probe for information about the doctor to allow PARRY2 to build up a model of the doctor.)

I - THIRTY FOUR. ARE YOU MARRIED ?

P - I AM SINGLE.

(In this case, two ideas are expressed in two separate sentences. As before, both are recognized and one is answered.)

I - WHERE DO YOU COME FROM ?

P - SAN JOSE.

(This is an idiomatic construction containing no explicit reference to 'home town'.)

I - WHAT DO YOU DO FOR A LIVING ?

P - I WORK IN THE STOCKROOM AT SEARS.

(The idiom "for a living" means 'occupation').

I - DO YOU KNOW WHERE YOU ARE NOW ?

P - YES, I'M IN THE PALO ALTO VA HOSPITAL.

(The interviewer tests for the patient's orientation as to place, This is not the same question as "Where are you?".)

I - HAVE YOU BEEN HOSPITALIZED BEFORE ?

P - THIS IS THE FIRST TIME.

(The participle is recognized in place of the more common prepositional phrase, "in the hospital".)

I - HOW LONG HAVE YOU BEEN THERE ?

P - ABOUT TWO WEEKS,

( "How long" is a common expression. "There" is understood to mean "in the hospital".)

I - ANY HEADACHES ?

P - MY HEALTH IS FINE.

(PARRY2 knows that "Do you have . . ." is frequently omitted from the front of a question.)

I - HOW ABOUT YOUR APPETITE.

P - I HAVE A NORMAL APPETITE.

("How about . . ." and "What about . . ." are short, idiomatic forms of "What do you think about . . .".)

I - ARE YOU HAVING ANY DIFFICULTY WITH YOUR MEMORY ?

P - NO.

(This is a clear example of the advantages of segmenting the question and matching the parts separately. The first segment, "Are you having any difficulty . . .", could be followed by any number of topics.)

I - THEN PERHAPS YOU CAN TELL ME WHO IS THE PRESIDENT OF THE UNITED STATES.

P - NIXON IS PRESIDENT.

(Introductory phrases like "Then perhaps you can tell me . . ." are recognized and then deleted.)

I - WHAT DAY IS IT TODAY ?

P - IT'S THURSDAY,

(The interviewer is testing for the patient's orientation as to time and PARRY2 responds correctly. All of the usual time orientation questions, (i.e. time, day, month, and year) match the same pattern. A response function consults the computer's internal clock and provides an answer appropriate to the question.)

I - WHAT SEASON IS IT ?

P - LET'S GET ON WITH THE INTERVIEW.

(This is correctly recognized as another time orientation question but PARRY2 becomes impatient with the doctor asking such simple questions.)

I - DO YOU REMEMBER WHAT MY NAME IS ?

P - AS I REMEMBER YOUR NAME IS DOCTOR JONES.

(This verifies that both parts of the doctor's initial statement were understood.)

I - VERY GOOD. HOW IS YOUR MOOD TODAY ?

P - ALL RIGHT I SUPPOSE.

(Dropping the word "today" allows this question to match "How is your mood?".)

I - DO YOU FEEL LIFE IS WORTH LIVING ?

P - I AM NOT SUICIDAL.

(Doctors utilize a number of expressions in trying to be tactful about topics such as suicide. An idiom such as this is difficult to analyze without knowing that suicide is being referred to.)

I - HOW MUCH DO YOU DRINK ?

P - I DRINK ONCE IN A WHILE.

("How much" and "How often" are understood as requests for a quantitative estimate of something, in this case, alcohol.)

I - HAVE YOU EVER TAKEN DRUGS ?  
 P - I DON'T TAKE DRUGS.

I - DO YOU HAVE ANY TROUBLE SLEEPING ?  
 P - I SLEEP JUST FINE.

I - HAVE YOU EVER HEARD VOICES THAT OTHER PEOPLE DONT SEEM TO HEAR?  
 P - I DON'T HEAR VOICES.

(Only the first part of the question was recognized.  
 Everything following the "that" was ignored. This worked  
 nicely in this case, and it usually does.)

I - HAVE YOU EVER HAD VISIONS ?  
 P - YOU MUST THINK I'M LIKE THE OTHER PATIENTS HERE.

(The doctor is testing for the presence of hallucinations,  
 an effort which PARRY2 finds annoying.)

I - IF YOU ARENT, THEN WHY ARE YOU IN THE HOSPITAL ?  
 P - I V QUITE UPSET.

(PARRY2 doesn't understand the conditional nature of the question  
 but he does realize that "if you aren't ..." is content free and  
 is therefore not the main question. The misspelling of "hospital"  
 was unintentional but it illustrates the value of spelling  
 correction so it was left in.)

I - BY WHAT ?

P - DO YOU KNOW ANYTHING ABOUT BOOKIES?

(The recognition routine makes no attempt to understand what  
 is being discussed here. The response functions provide the  
 meaning of this cryptic question with their anaphora routines.)

I - NO, HOW HAVE BOOKIES UPSET YOU ?

P - A BOOKIE DIDN'T PAY ME OFF ONCE.

(There was no pattern to recognize this whole sentence  
 but the topic, "bookies" was recognized and the response  
 functions went on with the story.)

I - AND THEN WHAT HAPPENED ?

P - I HAD AN ARGUMENT WITH THE BOOKIE WHO DID NOT PAY OFF. LATER ON I  
 REMEMBERED HE HAD FRIENDS IN THE UNDERWORLD AND I THOUGHT HE  
 WOULD USE THEM TO GET EVEN WITH ME.

(The recognizer correctly identifies 'What happened?' and  
 the response function decides what it means.)

I - DID HE GET EVEN WITH YOU ?

P - I THINK HE IS BEHIND THE GANGSTERS WHO ARE OUT TO GET ME.

(The response functions provide the information that 'he'  
 refers to the "bookie" and 'get even with' is a known idiom.)

I - HOW CAN YOU TELL THEY ARE OUT TO GET YOU ?

P - YOU KNOW, THEY KNOW ME.

(The doctor picked up PARRY2's own idiom, "out to get",  
 from the previous output expression.)

I - WHO ?

P - THE MAFIA.

I - HOW DO THEY KNOW ABOUT YOU?  
P - THEY KEEP TABS ON ME.

(PARRY2 is especially good at recognizing questions which lead into the stories he wants to tell.)

I - ARE YOU SURE ABOUT THIS?  
P - YOU DON'T BELIEVE ME DO YOU?

(PARRY2 responds to mild disbelief. He also recognizes more intense disbelief, as in, 'I DON'T BELIEVE YOU', and responds more strongly.)

I - I AM WILLING TO BELIEVE YOU IF YOU GIVE ME SOME EVIDENCE,  
P - I SEE.

(This is recognized as reassurance but not as a request for details.)

I - WHAT EVIDENCE DO YOU HAVE THAT THE MAFIA HAS IT IN FOR YOU?  
P - THE MAFIA CONTROLS THE BOOKIES.

(The doctor repeats his request for details and it is recognized this time.)

I - SO?  
P - THEY ARE AFTER ME.

I - DO THEY KNOW YOU ARE THERE IN THE HOSPITAL?

P - THEY DON'T WANT ME TO TESTIFY.  
("They" still refers to "the mafia" although nobody has said so recently.)

I - WHY NOT?  
P - YOU KNOW, I HAVE INCRIMINATING EVIDENCE AGAINST THE MAFIA.

I - ARE YOU CERTAIN?  
P - YOU DON'T BELIEVE ME?

(This is another instance of the same mild disbelief pattern used previously.)

I - I THINK YOU ARE EMOTIONALLY UPSET.

P - NOW YOU MAY HAVE SOME IDEA OF WHAT THE SITUATION IS.  
("I think" may precede any statement and has a negligible effect on its meaning.)

I - YES, I DO. WHAT SORT OF TREATMENT ARE YOU GETTING THERE?

P - WHAT DO YOU THINK OF MY STORY?  
(The question was correctly recognized but PARRY2 would rather change the subject.)

I - VERY INTERESTING. WHAT DO YOU THINK OF ME?

P - WHAT DO YOU THINK ABOUT ALL THIS?  
(Again, the question is understood but ignored.)

I - I THINK YOU NEED TREATMENT.

P - I TAKE SOME SORT OF SEDATIVES.  
(PARRY2 finally consents to let the doctor lead the conversation.)

I - WHEN WILL YOU LEAVE THE HOSPITAL?

P - I WANT TO LEAVE AS SOON AS POSSIBLE.

I - WHAT DOES YOUR DOCTOR SAY ABOUT THIS?

P - ASK THE DOCTOR.

(The response functions have the ability to determine what "this" refers to but, in this case, the segment, "What does your doctor say . . .", is sufficient to determine PARRY2's answer.)

I - WHATS HIS NAME?

P - DR WEBER.

I - THANK YOU FOR TALKING WITH ME. GOODBYE AND GOOD LUCK,

P - BYE.

(As before, both ideas are recognized and the dominant one is answered. PARRY2 recognizes the standard ways to say "Good bye".)