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Computer-Aided Normalizing and Unpacking: Some Interesting Machine-Processable Transformations of Legal Rules

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Publication Information & Recommended Citation

Allen, Layman E., co-author. "Computer-Aided Normalizing and Unpacking: Some Interesting Machine-Processable Transformations of Legal Rules." C. S. Saxon, co-author. In *Computing Power and Legal Reasoning*, edited by C. Walter, 495-572. St. Paul: West Pub. Co., 1985.

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Computing Power and Legal Reasoning

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West Publishing Company

St. Paul New York San Francisco Los Angeles

**COMPUTER AIDED NORMALIZING AND UNPACKING: SOME
INTERESTING MACHINE-PROCESSABLE TRANSFORMATIONS
OF LEGAL RULES**

by

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ABSTRACT

One way of dealing with an important aspect of the natural language barrier that researchers in artificial intelligence have been wrestling with for more than two decades is to normalize the expression of the logical structure of legal rules.

The computer program, **NORMALIZER**, will enable a legal analyst to automatically generate Normalized Versions of legal rules and Outlines of them from Parenthesized Logical Expressions of their structure and Marked Versions of the Original Text of the rules. In brief:

Parenthesized Logical Expression & Marked Version ==> Outline & Normalized Version.

The Parenthesized Logical Expression of a Normalized rule is a statement that expresses the logical structure of the rule in brief notation. The Marked Version of the Original Text of a rule divides that text into constituent sentences and associates a short name with each of them. The short names of the sentences in the Marked Version are used in the Parenthesized Logical Expression to represent those sentences. In the Parenthesized Logical Expression, the logical structure of the Normalized rule is presented in a single dimension -- horizontally. In the Outline of the Normalized rule, the logical structure is presented in two dimensions -- both horizontally and vertically. In the Outline, short names are used to represent the constituent sentences, but in the Normalized Version the short names are replaced by the sentences themselves. In the Normalized Version, the logical structure of the rule is presented in two dimensions -horizontally and vertically -- by means of defined (and signalled) structural terminology.

Unpacking the logical structure of a Normalized rule into progressively more basic structural terms is done automatically by part of **NORMALIZER**. A completely unpacked rule (an elementary normalized one) will be expressed in terms of three of the four basic structural terms (**AND OR NOT** and **IF-THEN**) and will be in the form of a conjunction of elementary norms. Although some drafters may prefer to use advanced Normalized Versions, probably the most frequently used ones will be clear Normalized Versions and basic Normalized Versions.

In using **NORMALIZER** a legal analyst must first specify the Parenthesized Logical Expression and Marked Version of the legal rule being normalized, and then **NORMALIZER** can be used to generate the Outline and Normalized Version of the rule. Thus, the interpretation of the Original Text is a result of the expertise of the human analyst, while the formatting of the expression of that interpretation is done automatically by the program. The program can also automatically generate equivalent Normalized Versions that are expressed in logically more basic form (and also the reverse).

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INTRODUCTION

The NORMALIZER computer program is currently being developed to transform legal norms as they are expressed initially into various normalized forms. Doing such transformations manually is extremely tedious. NORMALIZER is designed to free the analyst from the routine housekeeping chores associated with the task of normalizing statutes, regulations and other legal materials. To the extent that it succeeds in doing that well, an analyst can devote his/her efforts to more interesting and difficult judgmental matters. Because alternative ways of expressing a given statement in normalized form can be generated automatically and quickly by NORMALIZER, an analyst can easily produce many alternative versions to consider and choose from. This will be a tremendous advantage in tailoring the expression of a norm so that it appropriately fits each individual context.

Having legal materials expressed in such form will permit an even more profound change from a reader's point of view. It will enable individual readers to each choose that form of the expression of a set of ideas that each prefers and can most easily understand. Those readers that are thoroughly familiar with the defined structural language of normalization will likely prefer a condensed normalized form that uses higher-level definitions extensively. On the other hand, those just becoming familiar with defined structural terminology will likely prefer a more extended version that uses only more basic structural terminology. The condensed versions will not be abstracts of the more extended versions. Each will express the complete set of ideas involved. A reader will be able to choose the versions that s/he can read and understand most easily. Over time, each reader will be learning and moving in the direction of coping effectively with the more condensed versions.

The capability to easily generate various equivalent, but different, normalized forms of legal rules introduces the possibility of drastic change in both the production and use of legal documents.

The current capabilities of the NORMALIZER program and the implications of normalization will be exhibited in this paper mainly by an in-depth consideration of one particular example. The example is one that was discovered and first normalized manually by Bruce Brakel, a student in the senior author's seminar on Symbolic Logic and Legal Communication at the University of Michigan Law School. The presenting of this example also provides an opportunity to illustrate the process of transforming an existing rule into normalized form.

PROCESS OF TRANSFORMING AN EXISTING RULE INTO NORMALIZED FORM

A long sentence in the Residential Housing Lease of the University of Michigan is the example used to illustrate (1) some of the present capabilities of the existing NORMALIZER program as well as some of the planned capabilities, (2) some of the implications of normalization, and (3) something about the process of transforming an existing statute, regulation or other legal rule into normalized form. It specifies the conditions under which the University may terminate the lease. The

Present Version of it reads as follows:

UNIVERSITY LEASE TERMINATION CLAUSE: Present Version

The University may terminate this lease when the Lessee, having made application and executed this lease in advance of enrollment, is not eligible to enroll or fails to enroll in the University or leaves the University at any time prior to the expiration of this lease, or for violation of any of the provisions of this lease, or for violation of any University regulation relative to Residence Halls or for health reasons. by providing the student with written notice of this termination 30 days prior to the effective time of termination, unless life, limb, or property could be jeopardized, the Lessee engages in the sale or purchase of controlled substances in violation of federal, state or local law, or the Lessee is no longer enrolled as a student or the Lessee engages in the use or possession of firearms, explosives, inflammable liquids, fireworks, or other dangerous weapons within the building, or turns in a false fire alarm in which cases a maximum of 24 hours notice will be sufficient.

The five steps in the process of transforming the Present Version of a norm into its various normalized versions are the following:

1. Use the Present Version to specify the constituent sentences of the Present Version to construct the Marked Version.
2. Use the Marked Version to construct the Structure of the Present Version by replacing the constituent sentences with their abbreviations.
3. Use the Marked Version to specify the constituent sentences of the normalized versions and make the Detailed Marked Version.
4. Use the Marked Version, the Structure of the Present Version, and the Detailed Marked Version to specify and construct the Structure of the Normalized Versions.
5. Finally, the Detailed Marked Version and Structure of the Normalized Versions are used as inputs to the NORMALIZER program to automatically produce the various Normalized Versions.

This process is summarized in Figure 1.

A. Constructing the Marked Version

The first step in converting the Present Version of this statement into a normalized form is for the analyst to identify and name the constituent sentences of the Present Version. At the same time, the analyst also identifies the structural terminology used in the Present Version to logically relate the constituent sentences to each other. The analyst edits the Present Version to produce the Marked Version of the statement by marking the boundaries of the constituent sentences with square brackets and giving each of them a short name that is placed at the beginning the sentence and followed by a colon. There should be a high degree of agreement among native speakers of English in arriving at the Marked Version of a statement. In this case, the Marked Version of the termination clause above is as follows:

SUMMARY OF PROCESS OF NORMALIZING A LEGAL RULE

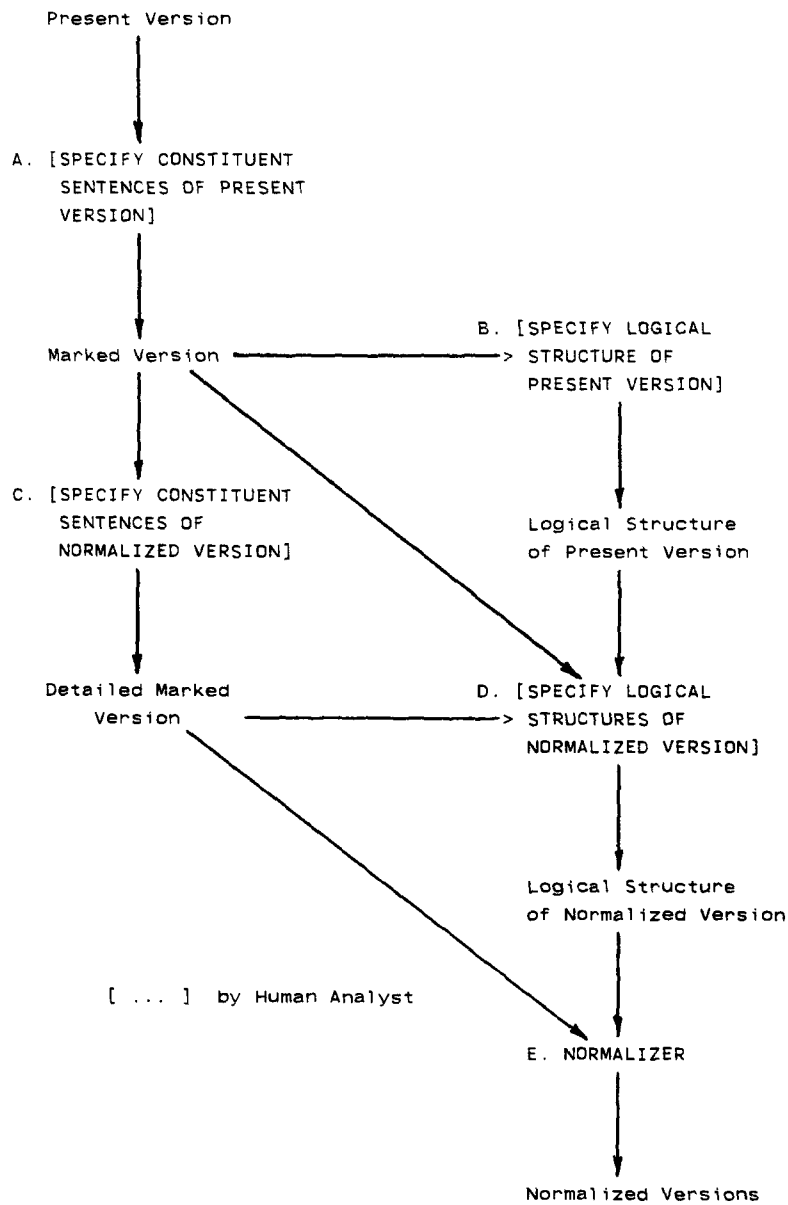


Figure 1

UNIVERSITY LEASE TERMINATION CLAUSE: Marked Version

[a: the University may terminate this lease] when [b: the Lessee, having made application and executed this lease in advance of enrollment, is not eligible to enroll or fails to enroll in the University or leaves the University at any time prior to the expiration of this lease, or for violation of any of the provisions of this lease, or for violation of any University regulation relative to Residence Halls or for health reasons], [a.2: by providing the student with written notice of this termination 30 days prior to the effective time of termination], unless [c: life, limb, or property could be jeopardized], [d: the Lessee engages in the sale or purchase of controlled substances in violation of federal, state or local law], or [e: the Lessee is no longer enrolled as a student] or [f: the Lessee engages in the use or possession of firearms, explosives, inflammable liquids, fireworks, or other dangerous weapons within the building, or turns in a false fire alarm] in which cases [g: a maximum of 24 hours notice will be sufficient].

B. Constructing the Logical Structure of the Present Version

The second step in the process of transforming a norm into normalized form is to specify the Logical Structure of the Present Version of the norm (the Present Version in abbreviated form). Examination of the above Marked Version to separate it into complete sentences that are connected by structural terminology indicates that the Logical Structure of the Present Version is as follows:

UNIVERSITY LEASE TERMINATION CLAUSE:

Logical Structure of the Present Version

a when b, a.2, unless c, d, or e or f, in which cases g.

Notice that a.2 is a nonsentence-part that is associated with sentence a. Notice also that in sentence b, although the first part of it, namely:

the Lessee, having made application and executed this lease in advance of enrollment, is not eligible to enroll or fails to enroll in the University

is a complete sentence, that part cannot be separated from what follows, because none of the remaining parts are complete sentences. However, at the next stage of the analysis, a stage that is clearly quite a bit more artful than producing the Marked Version, the analyst may decide to add to the text and create some complete sentences out of some of these parts to form constituent sentences of Normalized Versions.

C. Constructing the Detailed Marked Version

The third step in transforming a rule into normalized form is to convert the Marked Version into a Detailed Marked Version. This step is the more difficult one; it is more artful and thus more

subject to disagreement between different analysts. In the Detailed Marked Version the analyst must specify and name the constituent sentences of the various Normalized Versions. This is in contrast to the Marked Version where the constituent sentences of the Present Version were named and specified. The Detailed Marked Version is specified by editing the Marked Version, indicating additions by corner brackets < > and deletions by curly brackets { }. In specifying in the Detailed Marked Version what shall be the constituent sentences of the Normalized Versions, the analyst needs to decide which sentence parts of the Present Version need to be expanded into full sentences so that (1) all questions about all ambiguities detected may be expressed in terms of those constituent sentences, and (2) all alternative structural interpretations may be expressed in terms of those sentences. Clearly, this is the difficult part that requires practice and experience to do well. This part must be done by a human analyst. There is little hope that NORMALIZER (or, we think, any other such program) will ever make these kinds of judgments satisfactorily.

In making decisions about modifying the Marked Version, the analyst will want to examine carefully both the Logical Structure of the Present Version and the constituent sentences of the Present Version to decide just what the Present Version is asserting. Often, there is some ambiguity with respect to how parts of sentences should be interpreted as being related to each other, as well as how complete sentences should be interpreted as being related to each other.

For example, consider the following sentences that are implicitly imbedded in sentence b:

- b1 the Lessee has applied for and executed this lease in
 advance of enrollment
- b2 the Lessee is not eligible to enroll in the University
- b3 the Lessee fails to enroll in the University
- b4 the Lessee leaves the University at any time prior to
 the expiration of this lease
- b5 the Lessee violates any of the provisions of this lease
- b6 the Lessee violates any University regulation relative
 to Residence Halls
- b7 there are health reasons for terminating this lease

The wording of the sentences above were obtained by the following insertions to and deletions from the text of the Present Version.

< ... > indicates additions

{ ... } indicates deletions

- b1 the Lessee {having made application} <has applied for>
 and executed this lease in advance of enrollment
- b2 <the Lessee> is not eligible to enroll in the
 University
- b3 <the Lessee> fails to enroll in the University

- b4 <the Lessee> leaves the University at any time prior to the expiration of this lease
- b5 {for violation of} <the Lessee violates> any of the provisions of this lease
- b6 {for violation of} <the Lessee violates> any University regulation relative to Residence Halls
- b7 {for} <there are> health reasons <for terminating this lease>

Using these complete sentences to construct interpretations of this termination clause, there is a question about the most appropriate way to interpret the present language with respect to the logical relationships expressed.

Q1. Which interpretation is most appropriate?

- A) (b1 AND b2) OR b3 ... b7.
- B) (b1 AND (b2 OR b3)) OR b4 ... b7.
- C) (b1 AND (b2 OR b3 OR b4)) OR b5 ... b7.
- D) (b1 AND (b2 OR b3 OR b4 OR b5)) OR b6 OR b7.
- E) (b1 AND (b2 OR b3 OR b4 OR b5 OR b6)) OR b7.
- F) b1 AND (b2 OR b3 OR b4 OR b5 OR b6 OR b7).

(There are other questions about ambiguities in the structure, but these will be considered later.)

These same alternative interpretations can be expressed, although somewhat less explicitly from a logical point of view, perhaps more clearly (even though longer) to readers not comfortable with abbreviated notation.

- A) The University may terminate this lease
 1. when the Lessee,
 - A. having made application and executed this lease in advance of enrollment, is not eligible to enroll or
 - B. fails to enroll in the University or
 - C. leaves the University at any time prior to the expiration of this lease, or
 2. for violation of any of the provisions of this lease, or
 3. for violation of any University regulation relative to Residence Halls or
 4. for health reasons,
 by providing the student with written notice of this termination 30 days prior to the effective time of termination,
- B) The University may terminate this lease
 1. when the Lessee,

- A. having made application and executed this lease in advance of enrollment,
 - 1. is not eligible to enroll or
 - 2. fails to enroll in the University or
 - B. leaves the University at any time prior to the expiration of this lease, or
 - 2. for violation of any of the provisions of this lease, or
 - 3. for violation of any University regulation relative to Residence Halls or
 - 4. for health reasons,
- by providing the student with written notice of this termination 30 days prior to the effective time of termination,
- C) The University may terminate this lease
- 1. when the Lessee, having made application and executed this lease in advance of enrollment,
 - A. is not eligible to enroll or
 - B. fails to enroll in the University or
 - C. leaves the University at any time prior to the expiration of this lease, or
 - 2. for violation of any of the provisions of this lease, or
 - 3. for violation of any University regulation relative to Residence Halls or
 - 4. for health reasons,
- by providing the student with written notice of this termination 30 days prior to the effective time of termination,
- D) The University may terminate this lease
- 1. when the Lessee, having made application and executed this lease in advance of enrollment,
 - A. is not eligible to enroll or
 - B. fails to enroll in the University or
 - C. leaves the University at any time prior to the expiration of this lease, or
 - D. for violation of any of the provisions of this lease, or
 - 2. for violation of any University regulation relative to Residence Halls or
 - 3. for health reasons,
- by providing the student with written notice of this termination 30 days prior to the effective time of termination,
- E) The University may terminate this lease
- 1. when the Lessee, having made application and executed this lease in advance of enrollment,
 - A. is not eligible to enroll or
 - B. fails to enroll in the University or
 - C. leaves the University at any time prior to the expiration of this lease, or
 - D. for violation of any of the provisions of

- this lease, or
- E. for violation of any University regulation
relative to Residence Halls or
2. for health reasons,
- by providing the student with written notice of this
termination 30 days prior to the effective time of
termination,
- F) The University may terminate this lease when the Lessee,
having made application and executed this lease in advance
of enrollment,
1. is not eligible to enroll or
 2. fails to enroll in the University or
 3. leaves the University at any time prior to
the expiration of this lease, or
 4. for violation of any of the provisions of
this lease, or
 5. for violation of any University regulation
relative to Residence Halls or
 6. for health reasons.
- by providing the student with written notice of this
termination 30 days prior to the effective time of
termination.

When the alternative interpretations are presented in this form with the full text available to the analyst's eyes, it is apparent that interpretations D, E, and F are untenable. The reason is that the text just does not make grammatical sense when related in the manner that these interpretations relate it. Interpretation D does not make sense, because its 1.D. part (... when the Lessee, having made application and executed this lease in advance of enrollment, ... for violation of any of the provisions of this lease, or ...) does not make grammatical sense when connected to the beginning and ending parts of interpretation D, because the part that follows 'when' in 1.D. is not a complete sentence. Similarly, E does not make sense, because its 1.D. and 1.E. parts do not make grammatical sense, and E does not make sense, because its 4, 5, and 6, parts do not make grammatical sense when connected to its beginning and ending parts.

Some features of the two modes of presenting alternative interpretations above deserve some emphasis. It is handy to present alternatives in the abbreviated form; their brevity makes the logical structure more apparent and easier to compare. In the case of these two examples, the parts in the first that were abbreviated were all alike (they were all complete sentences), while the parts of the second were a mixture of complete sentences and parts of sentences. Probably the most important thing to notice is that it is extremely useful to look at the full textual expression of an interpretation to judge whether it makes sense.

Thus, each mode has its advantages. But each has limitations when used alone. So, it is useful to move back and forth between the abbreviated modes (handy for easily perceiving logical structure) and full-text modes (essential for judging whether the interpretation makes sense). It requires some experience in doing this manually to fully appreciate what a difference NORMALIZER makes in producing automatically the full-text versions to check.

Our specification of the constituent sentences of the normalized versions to be considered in this paper resulted in the following Detailed Marked Version:

UNIVERSITY LEASE TERMINATION CLAUSE:

Detailed Marked Version

< ... > indicates additions

{ ... } indicates deletions

[a: the University may terminate this lease] when [b1: the Lessee {, having made application}<has applied for> and executed this lease in advance of enrollment], [b2: <the Lessee> is not eligible to enroll in the University] or [b3: <the Lessee> fails to enroll in the University] or [b4: <the Lessee> leaves the University at any time prior to the expiration of this lease], or [b5: {for violation of}<the Lessee violates> any of the provisions of this lease], or [b6: {for violation of}<the Lessee violates> any University regulation relative to Residence Halls] or [b7: {for} <there are> health reasons <for terminating this lease>], [a2: {by providing}<the University provides> the {student}<Lessee> with written notice of {this} <the> termination 30 days prior to the effective time of termination] unless [c: life, limb, or property could be jeopardized <by continuation of the lease>]. [d: the Lessee engages in the sale or purchase of controlled substances in violation of federal, state or local law], or [e: the Lessee is no longer enrolled as a student] or [f1: the Lessee engages in the use or possession of firearms, explosives, inflammable liquids, fireworks, or other dangerous weapons within the building], or [f2: <the Lessee> turns in a false fire alarm] in which cases [g: {a maximum of 24 hours notice will be sufficient}<the University provides the Lessee with notice of the termination a minimum of 24 hours prior to the effective time of termination].

To permit in the alternative interpretations the representation of the sentence combinations, [a a2] and [a g]:

- a the University may terminate this lease
- a2 the University provides the Lessee with written notice of the termination 30 days prior to the effective time of termination

- a the University may terminate this lease
- g the University provides the Lessee with notice of the termination a minimum of 24 hours prior to the effective time of termination

the following pair of sentences were also added to the list of constituent sentences of the normalized versions:

[a3: the University may terminate this lease by providing the Lessee with written notice of the termination 30 days prior to the effective time of termination]

[a4: the University may terminate this lease by providing the Lessee with notice of the termination a minimum of 24 hours prior to the effective time of termination]

D. Constructing the Logical Structure of the Normalized Versions

The fourth step in transforming a norm into normalized form is to specify the Logical Structures of the Normalized Versions that will relate the constituent sentences of the Normalized Versions. These are specified for each Normalized Version by what is here called the Parenthesized Logical Expression. In constructing the Parenthesized Logical Expression, the analyst uses as input the Detailed Marked Version (to get the constituent sentences of the Normalized Version), the Marked Version (to get the constituent sentences of the Present Version), and the Logical Structure of the Present Version. The latter two are used to determine what the Present Version asserts so that the sentences of the Normalized Version can be related by the Logical Structure being constructed in such a way that the Normalized Version will assert the same set of ideas.

E. Producing the Normalized Version Automatically by NORMALIZER

When the analyst has completed these four tasks, NORMALIZER can take over to produce the various Normalized Versions. Thus, the process of normalizing a rule is not as easy as A B C. It is, however, from the analyst's point of view as easy as A B C D, where the D part is a worthy challenge.

To produce a Normalized Version, NORMALIZER needs two things as input: (1) a Parenthesized Logical Expression and (2) the Detailed Marked Version plus any additional constituent sentences used in the Parenthesized Logical Expression.

We are now ready to illustrate how NORMALIZER can be used to construct various alternative Normalized Versions of an interpretation of a rule. The UNIVERSITY LEASE TERMINATION CLAUSE is the provision that will be considered in some extensive detail.

INTERPRETING THE UNIVERSITY LEASE TERMINATION CLAUSE

In interpreting any legal rule for purposes of expressing it in normalized form, the expression of alternative interpretations will be in terms of the constituent sentences of the Normalized Version specified in constructing the Detailed Marked Version. Thus, specifying the constituent sentences of the Detailed Marked Version is done by the analyst with some tentative idea in mind of what the various final Normalized Versions will be. The analyst must also have in mind the questions about structural ambiguities in the Present Version that need to be asked for purposes of determining the most appropriate interpretation for expression in normalized form. Often there will be interaction between the process of constructing the Detailed Marked Version and the process of interpreting the legal rule. The more experienced an analyst becomes, the less likely it is that there will need to be

significant changes made as a result of such interaction. But, the results of each process should be regarded as being tentative and open to change in light of what is discovered in the other.

In determining the questions to be asked for purposes of resolving structural ambiguities in the Present Version of a legal rule, the analyst uses as input the same three elements used to determine the Logical Structure of various Normalized Versions. These are:

1. the Present Version of the legal rule.
2. the Logical Structure of the Present Version, and
3. the Detailed Marked Version of the legal rule.

The ambiguities in the UNIVERSITY LEASE TERMINATION CLAUSE are of two types -- those between sentences and those within sentences. Questions about both of these types of ambiguities are most easily expressed in abbreviated form by statements that are about the structure between complete sentences.

Questions about between-sentence ambiguity of the Present Version involve the Logical Structure of the Present Version. Recall that it is as follows:

a when b. a.2, unless c, d, or e or f. in which cases g.

Recall also that sentence a and nonsentence-part a.2, although split in the Present Version, are really two parts of the same constituent sentence of the Present Version -- namely, the sentence a3. This combining of a and a.2 into a3 results in a Logical Structure of the Present Version as follows:

a3 when b, unless c, d, or e or f, in which cases g.

The questions about between-sentence ambiguity of the Present Version are as follows:

Q1. Which interpretation is most appropriate?

- A) (a3 when b), unless c ... g.
- B) a3 when (b, unless c ---) --- .

In alternative A 'unless' is the main connective, while in alternative B 'when' is the main connective. The placement of the right parentheses in B is shown as being indefinite. Just where it is placed will be pursued in later questions. The '...' in A represents an ellipsis that is not empty, while the '---' in B represents an ellipsis that may be either empty or not empty.

Q2. Which interpretation is most appropriate?

- A) (... unless c ---) or ... g.
- B) ... unless (c, [or] d ---), --- .

In alternative A 'or' is the main connective, while in alternative B 'unless' is the main connective. The '[or]' in B is an implicit one between c and d, in contrast to the explicit ones that follow d and e. The 'or's in square brackets always indicate implicit ones, while a naked 'or' like the one in A may indicate either an implicit 'or' or an explicit one.

Q3. Which interpretation is most appropriate?

- A) ... (c, ... or f), in which cases g.
 B) ... or (... f, in which cases g).

In alternative A 'in which cases' is the main connective, while in alternative B 'or' is the main connective.

Q4. Which interpretation is most appropriate?

- A) --- (... unless c). [or] (d, ... f), in which cases g.
 B) --- (... unless c, [or] d), or (e or f). in which cases g.
 C) ... unless (c, ... f), in which cases g.

This question deals with the scope of the term 'unless'. Does it apply only to sentence c (Alternative A)? Does it apply to just sentences c and d (Alternative B)? Or does it apply to all the sentences c through f (Alternative C)? The possible alternative interpretations of C

- C1) ... ((c. [or] d). or e) or f)
 C2) ... ((c. [or] (d, or e)) or f)
 C3) ... ((c. [or] d), or (e or f))
 C4) ... (c, [or] ((d, or e) or f))
 C5) ... (c, [or] (d, or (e or f)))

are not asked, because each of them is logically equivalent to the other (by virtue of the associativity of 'or'). If an analyst were to try to comprehensively enumerate all possible parenthesizations of the Present Version of this termination clause, the task would quickly be recognized to be unmanageable. This is easily seen by the following:

1. If a legal rule has three constituent sentences (a, b, and c) and two logical connectives (O and O), then there are just two alternative parenthesizations:

aO(bOc) and (aOb)Oc

which would require just one question with two alternatives to distinguish, namely:

- Q1. Which interpretation is most appropriate?
 A) aO(bOc).
 B) (aOb)Oc.

2. If a legal rule has four constituent sentences (a, b, c, and d) and three logical connectives (O, O, and O), then there are just five alternative parenthesizations:

aO(bO(cOd)), aO((bOc)Od), (aOb)O(cOd),
 (aO(bOc))Od, and ((aOb)Oc)Od

which would require just three questions with a minimum number of alternatives for each question, namely:

- Q1. Which interpretation is most appropriate?
 A) aO(b ... d).
 B) (aOb)O(cOd).

C) (a ... c)Od.

Q2. Which interpretation is most appropriate?

A) bO(cOd).

B) (bOc)Od.

Q3. Which interpretation is most appropriate?

A) aO(bOc).

B) (aOb)Oc.

3. If there are five sentences and four connectives, there are 14 alternative parenthesizations distinguishable by nine questions with a minimum number of alternatives for each question.
4. If there are six sentences and five connectives, there are 42 alternative parenthesizations distinguishable by 27 questions with a minimum number of alternatives for each question.
5. If there are seven sentences and six connectives, there are 132 alternative parenthesizations distinguishable by 81 questions with a minimum number of alternatives for each question.

In the case of the Present Version of this termination clause there are the 132 alternatives with 81 questions required to distinguish between the 132 alternatives, four of which are specified above. Because of the associativity of the 'or' in the Present Version of this termination clause and the relationship between the terms 'unless' and 'in which cases' used in it, many of these 132 alternatives are equivalent. Nevertheless, an unmanageably large number of questions must be asked in order to be comprehensive in asking about all alternatives possible. Therefore, there will not be included here the other 77 questions dealing with how the logical relationship between the seven constituent sentences of the Present Version of this termination clause is most appropriately interpreted in light of the six structural terms used in the Present Version to relate them, namely:

'when', 'unless', '[or]', 'or', 'or', and 'in which cases'.

Q82. Which interpretation is most appropriate for the term 'when'?

A) IF b THEN a3.

B) (IF b THEN a3) AND (IF NOT b THEN NOT a3).

Unlike the first four questions (and the 77 not asked), which were about where parentheses should be inserted to indicate how groups of sentences are most appropriately related to each other, this question deals with how the natural-language structural terminology used in the Present Version is most appropriately interpreted. The various possible interpretations are indicated by defined between-sentence structural terminology used in Normalized Versions. The four basic defined between-sentence terms are:

IF THEN
AND
NOT and
OR.

The definitions of the four basic between-sentence structural terms are:

IF x THEN y.

The truth of y is deducible from the truth of x, and the truth of x is logically relevant to and necessary for the truth of y.

- x AND y. Both x and y are true.
- NOT x. The negation of x is false when x is true.
- x OR y. At least one of the two of x and y are true.

The defined terms are expressed entirely in CAPITAL letters.

This question (Q82) deals with whether the specified situations permitting termination of the lease with 30 days written notice are the only situations permitting such termination (Alternative B) or whether there may be other situations permitting such termination (Alternative A).

Q83. Which interpretation is most appropriate for the term 'unless'?

- A) --- (--- b) UNLESS (c ---) ---.
- B) --- (--- b) UNLESS.2 (c ---) ---.

Notice that the alternative interpretations for this question are not expressed in terms of the four basic defined terms. A is in terms of the defined (nonbasic) term 'UNLESS', while B is in terms of the defined (nonbasic) term UNLESS.2. Both of them, in turn are defined in terms of the four basic terms as follows:

x UNLESS y. =df IF NOT y THEN x.

x UNLESS.2 y. =df (IF NOT y THEN x) AND (IF y THEN NOT x).

Thus, by unpacking the 'UNLESS' and 'UNLESS.2' of alternatives A and B, the following equivalent alternatives can be obtained.

- A') IF NOT (c ---) THEN (a3 ---).
- B') ((IF NOT (c ---) THEN (a3 ---)) AND (IF (c ---) THEN NOT (a3 ---)))

Q84. Which interpretation is most appropriate for the term 'in which cases' in the context where it follows the text 'unless c, ... or f'?

- A) (... unless c ... f), AND (IF (c ... f) THEN g).
- B) (... unless c ... f), AND (IF (c ... f) THEN g BUT OTHERWISE NOT).

This question focuses on whether the situations specified in the lease that allow the university to terminate the lease with 24 hours notice are the only situations that allow for termination on such short notice. Alternative A leaves open the possibility that there may be other situations leading to that result, while Alternative B indicates that the situations specified are the only ones that permit termination on 24 hours notice.

The 'BUT OTHERWISE NOT' in Alternative B, like the 'UNLESS' and 'UNLESS.2' of Q83, can also be unpacked so that Alternative B is expressed in basic structural terms. The term 'BUT OTHERWISE NOT' in its defined sense will always immediately follow an IF-THEN sentence and add to that IF-THEN sentence. So, 'BUT OTHERWISE NOT' is defined in the context of an IF-THEN sentence as follows:

IF x THEN y
BUT OTHERWISE NOT. =df IF x THEN y AND
IF NOT x THEN NOT y.

Therefore, the equivalent to Alternative B expressed in basic structural terms would be:

B') (... unless c ... f), AND
 ((IF (c ... f) THEN g) AND (IF NOT (c ... f) THEN NOT g)).

Q85. Which interpretation is most appropriate?

- A) (b1 AND b2) OR b3 ... b7
- B) (b1 AND (b2 OR b3)) OR b4 ... b7
- C) (b1 AND (b2 OR b3 OR b4)) OR b5 ... b7
- D) (b1 AND (b2 OR b3 OR b4 OR b5)) OR b6 OR b7
- E) (b1 AND (b2 OR b3 OR b4 OR b5 OR b6)) OR b7
- F) b1 AND (b2 OR b3 OR b4 OR b5 OR b6 OR b7)

Unlike the questions Q1-Q4 and Q82-Q84 that dealt with between-sentence ambiguity, this question deals with within-sentence ambiguity. It deals with how the parts of sentence b should be parenthesized to indicate the most appropriate relationships between them. The question, however, is stated in terms of logical relationships between complete sentences that are derived from the nonsentence-parts of the Present Version of the UNIVERSITY LEASE TERMINATION CLAUSE. These alternative interpretations are expressed in terms of logical structure between parts of sentences in the more detailed discussion of this in the section above on The Process of Normalizing a Legal Rule.

Q86. Which interpretation is most appropriate?

- A) ... (f1 OR f2) in which cases g.
- B) ... (f1 in which cases g) OR ... (f2 in which cases g).

This question is also one about within-sentence ambiguity of the Present Version, expressed here as a between-sentence ambiguity with respect to what elements the 'OR' connects. In A it connects f1 to f2, while in B it connects (f1 ... g) to (f2 ... g).

The answers that an analyst gives to the questions about the ambiguity of the provision being examined determines the analyst's structural interpretation of that provision. Those answers must be supplied before NORMALIZER can generate the various different equivalent Normalized Versions of the provision.

We will specify a set of answers (and some reasons why the alternatives selected were the ones chosen) to show how the answers determine the structural interpretation of the lease.

Q1	A	Q82	A
Q2	B	Q83	A
Q3	A	Q84	B
Q4	C	Q85	B
		Q86	A

To Q1, Alternative A is more appropriate because it asserts that some conditional result occurs unless condition c is met, while Alternative B declares the rather implausible assertion that condition b occurs unless condition c is met. The structure determined by this answer to Q1 is:

(a3 when b), unless c ... g.

To Q2, Alternative B is more appropriate because the contents of c through f each specify a situation for which 24 hours notice will be sufficient to terminate the lease, and thus an exception to the situations for which 30 days notice is sufficient. Alternative A indicates that at least one of the sentences d through f is not such an exception, while Alternative B allows the possibility for each to be such an exception. The contents of the sentences c through f appear to describe situations in which the University would require the capacity to terminate a lease on 24 hours notice. The structure determined by this answer along with the answer to Q1 is:

(a3 when b), unless (c, d ---) ---.

To Q3, Alternative A is more appropriate because, similar to the reason given for Q2, the content of sentences c through f each specify a situation for which 24 hours should be sufficient to terminate the lease, and thus they should be grouped together (as required by Alternative A) and not split up (as required by Alternative B). The structure determined by this answer along with the answers to Q1 and Q2 is:

(a3 when b), unless (c, d, or e or f) in which cases g.

To Q4, Alternative C is most appropriate, again for the reason given for the choice in Q2. The structure determined by this answer along with the answers to Q1-Q3 is the same as the structure specified above for Q3. Because of the particular answers specified here for Q1-Q3, the answer given for Q4 does not further specify the structure. However, a different pattern of answers to Q1-Q3 might well have resulted in the answer to Q4 further specifying the structure.

To Q82, Alternative A is more appropriate because Alternative B indicates that the situations specified in this sentence are the only ones for which 30-day written notice is sufficient. Elsewhere in the lease other situations for terminating are specified. The structure determined by the answer to this question along with the answers to questions Q1-Q4 is:

(IF b THEN a3), unless (c, d, or e or f) in which cases g.

To Q83, Alternative A is more appropriate because the additional part of the stronger Alternative B would preclude the University from terminating the lease with 30 days notice if one of the conditions c through f were met, even though the condition for such termination (condition b) was met. The structure determined by the answer to this question along with the answers to questions Q1-Q82 is:

(IF b THEN a3) UNLESS (c, d, or e or f) in which cases g.

To Q84, Alternative B is more appropriate because the situations specified in this clause are the only ones for which 24-hours notice is sufficient to terminate the lease. Alternative A leaves open the possibility that there may be other situations qualifying for termination on such short notice. The structure determined by the answer to this question along with the answers to questions Q1-Q83 is:

((IF b THEN a3) UNLESS (c, d, or e or f)) AND
(IF c, d, or e or f THEN g BUT OTHERWISE NOT).

To Q85, Alternative B is most appropriate because of the content of b1 and the difference in the contents of b2 and b3 from the contents of b4, b5, b6, and b7. The execution of the lease before enrollment (b1) should only make a difference in the cases where the Lessee is not eligible to enroll (b2) or fails to enroll (b3), but should not make a difference where the Lessee leaves the University (b4), violates a provision of the lease (b5), or violates a University regulation with respect to Residence Halls (b6), or there are health reasons (b7). The structure determined by the answer to

this question along with the answers to questions Q1-Q84 is:

((IF ((b1 AND (b2 OR b3)) OR b4 OR b5 OR b6 OR b7)
THEN a3) UNLESS (c, d, or e or f)) AND
(IF c, d, or e or f THEN g BUT OTHERWISE NOT).

To Q86, Alternative A is more appropriate because f1 and f2 express alternative conditions for which termination on 24-hours notice is sufficient, rather than that at least one of them is sufficient for such termination (but not specifying which one). The structure determined by the answer to this question along with the answers to questions Q1-Q85 is:

((IF ((b1 AND (b2 OR b3)) OR b4 OR b5 OR b6 OR b7)
THEN a3) UNLESS (c, d, or e or f1 OR f2)) AND
(IF c, d, or e or f1 OR f2 THEN g BUT OTHERWISE NOT).

When the natural-language 'or's of this interpretation are replaced by defined 'OR's, and the 'g' is replaced by 'a4' (which explicitly mentions that the University may terminate the lease with the 24-hour notice), the result is the interpretation that will be used by NORMALIZER to generate a set of equivalent normalized interpretations of the UNIVERSITY LEASE TERMINATION CLAUSE. It is as follows:

((IF ((b1 AND (b2 OR b3)) OR b4 OR b5 OR b6 OR b7)
THEN a3) UNLESS (c OR d OR e OR f1 OR f2)) AND
(IF c OR d OR e OR f1 OR f2 THEN a4 BUT OTHERWISE NOT).

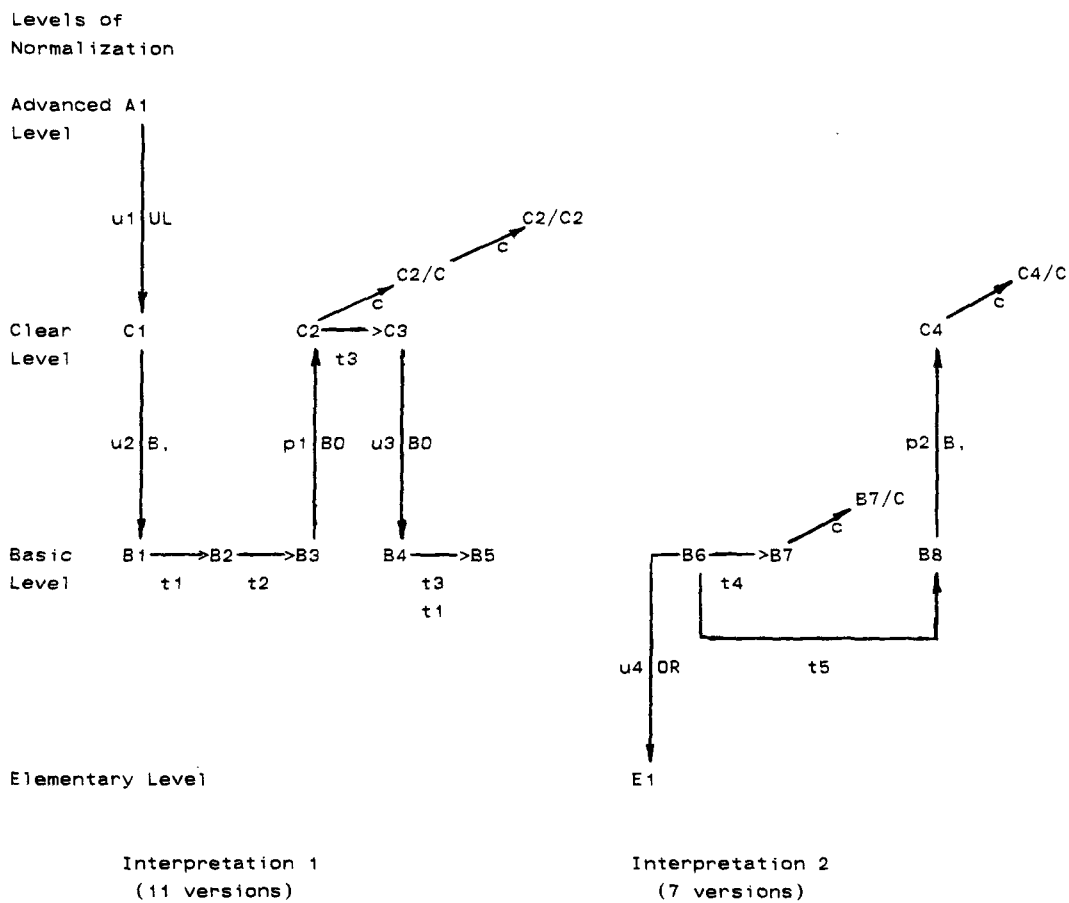
All that remains to be done before NORMALIZER can be put to work to generate the normalized versions of the termination clause is to transform the above expression of the logical structure of the clause into a Parenthesized Logical Expression by replacing the capitalized logical words with notational abbreviations. The resulting transformation and the outputs from NORMALIZER are presented in the next section.

USING NORMALIZER TO GENERATE NORMALIZED VERSIONS OF A LEGAL RULE

Once an interpretation of a legal rule is determined and expressed in the notation that NORMALIZER accepts, many different Normalized Versions of that interpretation can be generated automatically. A total of 18 different Normalized Versions will be generated below to illustrate what the present version of NORMALIZER can do. Examples of Normalized Versions at all four different levels of normalization are included: the elementary level, the basic level, the clear level, and the advanced level. The 18 different Normalized Versions to be generated and the transformations that occur from one to the next are summarized in Figure 2.

The notation used in Parenthesized Logical Expressions to represent the defined logical terminology of the Normalized Versions is as follows:

SUMMARY OF INTERPRETATIONS OF UNIVERSITY HOUSING
LEASE TERMINATION CLAUSE



Interpretation 1
(11 versions)

Interpretation 2
(7 versions)

Key to Kinds of Transformations

- u1. UL>i: $x \text{ UL } y \text{ -----} \rightarrow Ny > x.$
- u2. B,o>i: $x > y \text{ B,} \text{ -----} \rightarrow (x > y) \& (Nx > Ny).$
- t1. &o>i: $x \& y \text{ -----} \rightarrow y \& x.$
- t2. &o>i: $(x > y) \& (x > z) \text{ -----} \rightarrow x > (y \& z).$
- p1. &oB0i: $(x > y) \& (Nx > z) \text{ -----} \rightarrow x > y \text{ B0 } z.$
- t3. >o>i: $x > (y.1 \text{ } y.2) \text{ -----} \rightarrow x > (y1 > y2).$
- u3. B0o>i: $x > y \text{ B0 } z \text{ -----} \rightarrow (x > y) \& (Nx > z).$
- t4. &o>Vi: $(x > z) \& (y > z) \text{ -----} \rightarrow (x \vee y) > z.$
- t5. >&o>i: $(x \& y) > z \text{ -----} \rightarrow x > (y > z).$
- p2. &oB,i: $(x > y) \& (Nx > Ny) \text{ -----} \rightarrow x > y \text{ B,}.$
- u4. >Vo>i: $(x \vee y) > z \text{ -----} \rightarrow (x > z) \& (y > z).$

Figure 2

Notation	Defined Logical Expression
&	AND)))
N	NOT)))
>	IF - THEN Elementary)))
V	OR Basic)))
BO	BUT OTHERWISE))
B.	BUT OTHERWISE NOT))
EQ	IF AND ONLY IF Clear))
UL	UNLESS)
U2	UNLESS.2)
U+	UNLESS.2+)
U-	UNLESS.2-)
UD	UNLESS.2d Advanced)
:	:

When this notation is substituted for the defined logical terminology in the interpretation arrived at by the pattern of answers to the nine structural questions asked, the resulting Parenthesized Logical Expression is the following:

$$((b1\&(b2Vb3)Vb4Vb5Vb6Vb7>a3) \text{ UL } (cVdVeVf1Vf2)) \ \& \ (cVdVeVf1Vf2>a4B,)$$

(The spaces in the expression are informal punctuation to make it easier to read.)

This expression is the one labeled A1 on Figure 2 ('A' to indicate that it will result in an "advanced" Normalized Version when processed by NORMALIZER). From A1, NORMALIZER will be able to "unpack" the 'UL' (UNLESS) to get the second expression on Figure 2, namely: C1. (The 'C' in 'C1' indicates that the expression will result in a "clear" Normalized Version when it is processed by NORMALIZER.) The expression C1 is:

$$(nc\&\&\&\&nf1\&nf2 > ((b1\&(b2Vb3)Vb4Vb5Vb6Vb7>a3) \ \& \ (cVdVeVf1Vf2>a4B,))$$

The 'B,' (BUT OTHERWISE NOT) in C1, in turn, can be "unpacked" by NORMALIZER to produce B1 in Figure 2. (The 'B' in 'B1' indicates that the expression will result in a "basic" Normalized Version. The expression B1 is:

$$(nc\&\&\&\&nf1\&nf2 > ((b1\&(b2Vb3)Vb4Vb5Vb6Vb7>a3) \ \& \ ((cVdVeVf1Vf2>a4) \ \& \ (nc\&\&\&\&nf1\&nf2>Na4)))$$

Similarly, by

1. packing BO (BUT OTHERWISE)
2. unpacking BO
3. packing B,
4. unpacking OR, and
5. five other logical transformations

the other 15 expressions in Figure 2 can be generated by NORMALIZER. (We are now saying that these can be generated by NORMALIZER, because by the time that this paper is presented at the workshop in Houston in August, NORMALIZER will have such capability. At present the authors

have generated these alternative expressions "manually" on an IBM personal computer, and NORMALIZER generated the Normalized Versions from the expressions.)

An input file to NORMALIZER called ULEASE.INPUT is constructed from three types of information:

1. the first, each beginning on a separate line, the 18 expressions, A1 ... E1,
2. the second, the Detailed Marked Version of the UNIVERSITY LEASE TERMINATION CLAUSE, and
3. finally, the list of constituent sentences of all the various Normalized Versions of the UNIVERSITY LEASE TERMINATION CLAUSE.

The contents of the ULEASE.INPUT file is as follows:

```
(1)
(((b1&(b2Vb3))Vb4Vb5Vb6Vb7>a3) UL (cVdVeVf1Vf2)) & (cVdVeVf1Vf2>a4B.)

(2)
(Nc&Nd&Ne&Nf1&Nf2 > (((b1&(b2Vb3))Vb4Vb5Vb6Vb7>a3))) & (cVdVeVf1Vf2>a4B.)

(3)
(Nc&Nd&Ne&Nf1&Nf2 > ((b1&(b2Vb3))Vb4Vb5Vb6Vb7>a3)) &
((cVdVeVf1Vf2>a4) & (Nc&Nd&Ne&Nf1&Nf2>Na4))

(4)
((cVdVeVf1Vf2>a4) & (nc&nd&ne&nf1&nf2>Na4)) &
(nc&nd&ne&nf1&nf2>((b1&(b2Vb3))Vb4Vb5Vb6Vb7>a3))

(5)
(cVdVeVf1Vf2>a4) & (nc&nd&ne&nf1&nf2 > (Na4&((b1&(b2Vb3))Vb4Vb5Vb6Vb7>a3)))

(6)
cVdVeVf1Vf2 > a4 B0 (Na4 & (((b1&(b2Vb3))Vb4Vb5Vb6Vb7>a3)))

(7)
(q>a4B0(Na4&(s>a3))) A& (qEQcVdVeVf1Vf2) B& (sEQ(b1&(b2Vb3))Vb4Vb5Vb6Vb7)

(8)
(q>a4B0(Na4&(s>a3))) A& ((qEQcVdVeVf1Vf2) B& (sEQrVb4Vb5Vb6Vb7) B& (rEQb1&(b2Vb3)))

(9)
cVdVeVf1Vf2 > (g>a) B0 (N(g>a) & (((b1&(b2Vb3))Vb4Vb5Vb6Vb7>(a2>a))))

(10)
(cVdVeVf1Vf2>(g>a)) &
(nc&nd&ne&nf1&nf2 > (N(g>a)&(((b1&(b2Vb3))Vb4Vb5Vb6Vb7>(a2>a))))

(11)
(nc&nd&ne&nf1&nf2 > (((b1&(b2Vb3))Vb4Vb5Vb6Vb7)&a2)>a) &
(((cVdVeVf1Vf2)&g>a)&((nc&nd&ne&nf1&nf2)>N(g>a)))
```

- (12)
 (((b1&(b2Vb3))Vb4Vb5Vb6Vb7)&a2)>a) & ((cVdVeVf1Vf2)&g>a) &
 ((nc&nd&ne&nf1&nf2)>N(g>a))
- (13)
 (((b1&(b2Vb3))Vb4Vb5Vb6Vb7)&a2)V((cVdVeVf1Vf2)&g) > a) &
 ((nc&nd&ne&nf1&nf2)>N(g>a))
- (14)
 ((s&a2)V(q&g) > a) &
 ((nq>N(g>a)) A& ((sEQ(b1&(b2Vb3))Vb4Vb5Vb6Vb7) B& (qEQcVdVeVf1Vf2))
- (15)
 (((b1&(b2Vb3))Vb4Vb5Vb6Vb7)&a2)>a) & ((cVdVeVf1Vf2)>(g>a)) &
 ((nc&nd&ne&nf1&nf2)>N(g>a))
- (16)
 (((b1&(b2Vb3))Vb4Vb5Vb6Vb7)&a2) > a) & (cVdVeVf1Vf2 > (g>a) E.)
- (17)
 ((s&a2>a) & (q>(g>a)E,)) A& ((sEQ(b1&(b2Vb3))Vb4Vb5Vb6Vb7) B& (qEQcVdVeVf1Vf2))
- (18)
 (b1&b2&a2>a)&(b1&b3&a2>a)&(b4&a2>a)&(b5&a2>a)&(b6&a2>a)&(b7&a2>a)&
 (c&g>a)&(d&g>a)&(e&g>a)&(f1&g>a)&(f2&g>a) & (nc&nd&ne&nf1&nf2>N(g>a))

RESIDENCE HALLS LEASE: Detailed Marked Version

< ... > indicates additions

{ ... } deletions

[a: the University may terminate this lease] when [b1: the Lessee {, having made application}<has applied for> and executed this lease in advance of enrollment], [b2: <the Lessee> is not eligible to enroll in the University] or [b3: <the Lessee> fails to enroll in the University] or [b4: <the Lessee> leaves the University at any time prior to the expiration of this lease], or [b5: {for violation of}<the Lessee violates> any of the provisions of this lease], or [b6: {for violation of}<the Lessee violates> any University regulation relative to Residence Halls] or b7: {for} <there are> health reasons <for terminating this lease>], [a2: {by providing}<the University provides> the {student}<Lessee> with written notice of {this}<the> termination 30 days prior to the effective time of termination] unless [c: life, limb, or property could be jeopardized <by continuation of the lease>], [d: the Lessee engages in the sale or purchase of controlled substances in violation of federal, state or local law], or [e: the Lessee is no longer enrolled as a student] or [f1: the Lessee engages in the use or possession of firearms, explosives, inflammable liquids, fireworks, or other dangerous weapons within the building], or [f2: <the Lessee> turns in a false fire alarm] in which cases [g: {a maximum of 24 hours notice will be sufficient}<the University provides the Lessee with notice of the termination a minimum of 24 hours prior to the effective time of termination]

The additions and deletions for sentences a ... g above are almost entirely merely appropriate ones to convert partial sentences into complete sentences. The sole exception is in g where the

drafter's use of 'maximum' was changed to 'minimum'. It appeared to us to be clear that the drafter meant something different from what was stated. The constituent sentences of the various Normalized Versions that are in the Detailed Marked Version above plus additional ones that are later determined to be needed are listed below.

CONSTITUENT SENTENCES

1. [a: the University may terminate this lease]. AND
2. [b1: the Lessee has applied for and executed this lease in advance of enrollment].
3. [b2: the Lessee is not eligible to enroll in the University].
4. [b3: the Lessee fails to enroll in the University].
5. [b4: the Lessee leaves the University at any time prior to the expiration of this lease].
6. [b5: the Lessee violates any of the provisions of this lease].
7. [b6: the Lessee violates any University regulation relative to Residence Halls].
8. [b7: there are health reasons for terminating this lease].
9. [a2: the University provides the Lessee with written notice of the termination 30 days prior to the effective time of termination].
10. [c: life, limb, or property could be jeopardized by continuation of the lease].
11. [d: the Lessee engages in the sale or purchase of controlled substances in violation of federal, state or local law].
12. [e: the Lessee is no longer enrolled as a student].
13. [f1: the Lessee engages in the use or possession of firearms, explosives, inflammable liquids, fireworks, or other dangerous weapons within the building].
14. [f2: the Lessee turns in a false fire alarm].
15. [g: the University provides the Lessee with notice of the termination a minimum of 24 hours prior to the effective time of termination]
16. [q: an adequate set of conditions for terminating a lease with 24 hours notice is met]
17. [r: an adequate set of conditions for terminating a lease executed prior to enrollment is met]
18. [s: an adequate set of conditions for terminating a lease with 30 days written notice is met]
19. [a3: the University may terminate this lease by providing the Lessee with written notice of the termination 30 days prior to the effective time of termination]
20. [a4: the University may terminate this lease by providing the Lessee with notice of the termination a minimum of 24 hours prior to the effective time of termination].

21. [na: the University shall NOT terminate this lease],
22. [nb1: the Lessee has NOT applied for and executed this lease in advance of enrollment],
23. [nb2: the Lessee is eligible to enroll in the University].
24. [nb3: the Lessee does NOT fail to enroll in the University],
25. [nb4: the Lessee does NOT leave the University at any time prior to the expiration of this lease],
26. [nb5: the Lessee does NOT violate any of the provisions of this lease].
27. [nb6: the Lessee does NOT violate any University regulation relative to Residence Halls],
28. [nb7: there are NOT any health reasons for terminating this lease],
29. [na2: the University does NOT provide the Lessee with written notice of the termination 30 days prior to the effective time of termination],
30. [nc: life, limb, or property could NOT be jeopardized by continuation of the lease],
31. [nd: the Lessee does NOT engage in the sale or purchase of controlled substances in violation of federal, state or local law],
32. [ne: the Lessee is still enrolled as a student],
33. [nf1: the Lessee does NOT engage in the use or possession of firearms, explosives, inflammable liquids, fireworks, or other dangerous weapons within the building],
34. [nf2: the Lessee does NOT turn in a false fire alarm],
35. [ng: the University does NOT provide the Lessee with notice of the termination a minimum of 24 hours prior to the effective time of termination]
36. [na3: the University shall NOT terminate this lease by providing the Lessee with written notice of the termination 30 days prior to the effective time of termination]
37. [na4: the University shall NOT terminate this lease by providing the Lessee with notice of the termination a minimum of 24 hours prior to the effective time of termination].
38. [nq: an adequate set of conditions for terminating a lease with 24 hours notice is NOT met]
39. [nr: an adequate set of conditions for terminating a lease executed prior to enrollment is NOT met]
40. [ns: an adequate set of conditions for terminating a lease with 30 days written notice is NOT met]

With this ULEASE.INPUT file and an appropriate SYMBOL TABLE FILE, which is required by NORMALIZER, we are ready to show an example of how NORMALIZER generates a Normalized Version of a legal rule from its Parenthesized Logical Expression and the ULEASE.INPUT file. A sample run of NORMALIZER for expression A1 follows (with inputs from the analyst in capital

letters):

```

Sample Run of NORMALIZER           [authors' comments]

#RUN NORMALIZER INPUT=ULEASE.INPUT OUTPUT=-00

#Execution begins
Name of the symbol table file:
SYMBOL.TABLE.FILE                 [furnishes name of
                                   file]

Expression:
READ                               [tells NORMALIZER
                                   to read the expres-
                                   sion from a file]

File name (with line range):
ULEASE.INPUT(1)                   [tells NORMALIZER
                                   where expression
                                   to be read is
                                   located]

1. A. IF
   1) A. b1, AND                   [output from
                                   NORMALIZER for
                                   use by analyst
                                   to check whether
                                   the outline is
                                   correct or not]
   B. 1) b2, OR
      2) b3, OR
   2) b4, OR
   3) b5, OR
   4) b6, OR
   5) b7,
   THEN
   6. a3,
   UNLESS
   B. 1) c, OR
      2) d, OR
      3) e, OR
      4) f1, OR
      5) f2, AND

2. IF
   A) c, OR
   B) d, OR
   C) e, OR
   D) f1, OR
   E) f2,
   THEN
   F. a4,
   BUT OTHERWISE, NOT.

Expression:
STOP                               [outline was OK,
                                   so no new
                                   expression is
                                   needed]

Type of output: n=none, i=indented, l=labeled (indented),
b=both (i and l), u=unindented

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B                                     [selects type
                                     of output!]

#Execution terminated

#COPY -OO                             [makes a copy of
                                     output file on
                                     analyst's device]

1. A. IF
    1) A. b1, AND
       B. 1) b2, OR
          2) b3, OR
    2) b4, OR
    3) b5, OR
    4) b6, OR
    5) b7,
    THEN
    6. a3,
    UNLESS
    B. 1) c, OR
       2) d, OR
       3) e, OR
       4) f1, OR
       5) f2, AND
2. IF
    A) c, OR
    B) d, OR
    C) e, OR
    D) f1, OR
    E) f2,
    THEN
    F. a4,
    BUT OTHERWISE, NOT.

                                     [copy of the
                                     indented, unlabeled
                                     Normalized Version]

1. A. IF
    1) A. the Lessee has applied for and executed this lease in
       advance of enrollment, AND
       B. 1) the Lessee is not eligible to enroll in the
          University, OR
          2) the Lessee fails to enroll in the University, OR
    2) the Lessee leaves the University at any time prior to
       the expiration of this lease, OR
    3) the Lessee violates any of the provisions of this lease,
       OR
    4) the Lessee violates any University regulation relative
       to Residence Halls, OR
    5) there are health reasons for terminating this lease,
    THEN
    6. the University may terminate this lease by providing the
       Lessee with written notice of the termination 30 days
       prior to the effective time of termination,
    UNLESS
```

- B. 1) life, limb, or property could be jeopardized by continuation of the lease, OR
- 2) the Lessee engages in the sale or purchase of controlled substances in violation of federal, state or local law, OR
- 3) the Lessee is no longer enrolled as a student, OR
- 4) the Lessee engages in the use or possession of firearms, explosives, inflammable liquids, fireworks, or other dangerous weapons within the building, OR
- 5) the Lessee turns in a false fire alarm, AND

2. IF

- A) life, limb, or property could be jeopardized by continuation of the lease, OR
 - B) the Lessee engages in the sale or purchase of controlled substances in violation of federal, state or local law, OR
 - C) the Lessee is no longer enrolled as a student, OR
 - D) the Lessee engages in the use or possession of firearms, explosives, inflammable liquids, fireworks, or other dangerous weapons within the building, OR
 - E) the Lessee turns in a false fire alarm,
- THEN
- F. the University may terminate this lease by providing the Lessee with notice of the termination a minimum of 24 hours prior to the effective time of termination,
- BUT OTHERWISE, NOT.

[copy of the
indented, labeled
Normalized Version]

1. A. IF

- 1) A. [b1: the Lessee has applied for and executed this lease in advance of enrollment], AND
 - B. 1) [b2: the Lessee is not eligible to enroll in the University], OR
 - 2) [b3: the Lessee fails to enroll in the University], OR
 - 2) [b4: the Lessee leaves the University at any time prior to the expiration of this lease], OR
 - 3) [b5: the Lessee violates any of the provisions of this lease], OR
 - 4) [b6: the Lessee violates any University regulation relative to Residence Halls], OR
 - 5) [b7: there are health reasons for terminating this lease],
- THEN
- 6. [a3: the University may terminate this lease by providing the Lessee with written notice of the termination 30 days prior to the effective time of termination].

UNLESS

- B. 1) [c: life, limb, or property could be jeopardized by continuation of the lease], OR
- 2) [d: the Lessee engages in the sale or purchase of controlled substances in violation of federal, state or

```

        local law], OR
    3) [e: the Lessee is no longer enrolled as a student], OR
    4) [f1: the Lessee engages in the use or possession of
        firearms, explosives, inflammable liquids, fireworks, or
        other dangerous weapons within the building], OR
    5) [f2: the Lessee turns in a false fire alarm], AND
2. IF
  A) [c: life, limb, or property could be jeopardized by
      continuation of the lease], OR
  B) [d: the Lessee engages in the sale or purchase of
      controlled substances in violation of federal, state or
      local law], OR
  C) [e: the Lessee is no longer enrolled as a student], OR
  D) [f1: the Lessee engages in the use or possession of
      firearms, explosives, inflammable liquids, fireworks, or
      other dangerous weapons within the building], OR
  E) [f2: the Lessee turns in a false fire alarm],
  THEN
  F. [a4: the University may terminate this lease by providing
      the Lessee with notice of the termination a minimum of 24
      hours prior to the effective time of termination],
  BUT OTHERWISE, NOT.

```

This computer run produced the above two Normalized Versions resulting from expression A1. The labeled version may be used by the analyst as an intermediate output for purposes of checking whether or not the Normalized Version says exactly what the analyst wants it to say. If changes need to be made, it is handy to have the short name of the sentence readily available. There is still another output possible that some users may prefer. This is the unindented version which, even though it is also structurally unambiguous, is less clear than the indented versions. The following unindented Normalized Version is easily obtained by another run of NORMALIZER:

[unindented version]

```

(1) (1A) IF (1A1A) the Lessee has applied for and executed this lease in
advance of enrollment, AND (1A1B1) the Lessee is not eligible to enroll in the
University, OR (1A1B2) the Lessee fails to enroll in the University, OR (1A2)
the Lessee leaves the University at any time prior to the expiration of this
lease, OR (1A3) the Lessee violates any of the provisions of this lease, OR
(1A4) the Lessee violates any University regulation relative to Residence
Halls, OR (1A5) there are health reasons for terminating this lease, THEN
(1A6) the University may terminate this lease by providing the Lessee with
written notice of the termination 30 days prior to the effective time of
termination, UNLESS (1B) (1B1) life, limb, or property could be jeopardized by
continuation of the lease, OR (1B2) the Lessee engages in the sale or purchase
of controlled substances in violation of federal, state or local law, OR (1B3)
the Lessee is no longer enrolled as a student, OR (1B4) the Lessee engages in
the use or possession of firearms, explosives, inflammable liquids, fireworks,
or other dangerous weapons within the building, OR (1B5) the Lessee turns in a
false fire alarm, AND (2) (IF (2A) life, limb, or property could be
jeopardized by continuation of the lease, OR (2B) the Lessee engages in the
sale or purchase of controlled substances in violation of federal, state or
local law, OR (2C) the Lessee is no longer enrolled as a student, OR (2D) the
Lessee engages in the use or possession of firearms, explosives, inflammable

```


liquids, fireworks, or other dangerous weapons within the building, OR (2E) the Lessee turns in a false fire alarm, THEN (2F) the University may terminate this lease by providing the Lessee with notice of the termination a minimum of 24 hours prior to the effective time of termination, BUT OTHERWISE, NOT).

These forms of the A1 version of the UNIVERSITY LEASE TERMINATION CLAUSE are advanced Normalized Versions of it, because they contain the defined structural term, 'UNLESS'. Some users for reasons of taste may prefer an equivalent Normalized Version at some other level (clear, basic, or elementary) or a different one at the same level. NORMALIZER can automatically generate many alternatives from which to choose.

For example, NORMALIZER can "unpack" the 'UNLESS' in A1 to obtain the clear expression C1 from which a clear Normalized Version would be generated. We speak of a transformation as being an "unpacking" transformation when it moves down in level, away from the advanced level and toward the elementary level. Similarly, we speak of a transformation as being a "packing" transformation when it moves up in level, toward the advanced level and away from the elementary level. Transformations with results that are at the same level, we refer to simply as transformations. Each transformation is given an o-i (out-in) name that indicates the structural term(s) that is/are coming out and the one(s) that is/are going in (in the order in which they would be arranged if the starting and ending expressions were rearranged in Polish prefix form). The full name of the transformation rule that unpacks the 'UL' in A1 from its

x UNLESS y

form into its logically equivalent

IF NOT y THEN x

form, is u1.ULo>i. Its short name is u1. The formal statement of this transformation rule is:

u1.ULo>i: x UL y -----> Ny > x.

Doing a u1 transformation on A1 results in the following clear expression, C1:

(Nc&Nd&Ne&Nf1&Nf2 > (((b1&(b2Vb3))Vb4Vb5Vb6Vb7>a3))) &
(cVdVeVf1Vf2>a4B,)

which can then be used by NORMALIZER to automatically produce the following:

Clear Normalized Version Generated from C1

1. IF
 - A. IT IS NOT SO THAT
c, AND
 - B. IT IS NOT SO THAT
d, AND
 - C. IT IS NOT SO THAT
e, AND
 - D. IT IS NOT SO THAT
f1, AND
 - E. IT IS NOT SO THAT
f2,
- THEN

F. IF
1) A. b1, AND
E. 1) b2, OR
2) b3, OR
2) b4, OR
3) b5, OR
4) b6, OR
5) b7,
THEN
6. a3. AND

2. IF
A) c, OR
B) d, OR
C) e, OR
D) f1, OR
E) f2,
THEN
F. a4,
BUT OTHERWISE, NOT.

1. IF
A. IT IS NOT SO THAT
life, limb, or property could be jeopardized by
continuation of the lease, AND
B. IT IS NOT SO THAT
the Lessee engages in the sale or purchase of controlled
substances in violation of federal, state or local law, AND
C. IT IS NOT SO THAT
the Lessee is no longer enrolled as a student, AND
D. IT IS NOT SO THAT
the Lessee engages in the use or possession of firearms,
explosives, inflammable liquids, fireworks, or other
dangerous weapons within the building, AND
E. IT IS NOT SO THAT
the Lessee turns in a false fire alarm,
THEN
F. IF
1) A. the Lessee has applied for and executed this lease in
advance of enrollment, AND
B. 1) the Lessee is NOT eligible to enroll in the
University, OR
2) the Lessee fails to enroll in the University, OR
2) the Lessee leaves the University at any time prior to
the expiration of this lease, OR
3) the Lessee violates any of the provisions of this lease,
OR
4) the Lessee violates any University regulation relative
to Residence Halls, OR
5) there are health reasons for terminating this lease,
THEN
6. the University may terminate this lease by providing the
Lessee with written notice of the termination 30 days
prior to the effective time of termination, AND

2. IF

- A) life, limb, or property could be jeopardized by continuation of the lease, OR
 - B) the Lessee engages in the sale or purchase of controlled substances in violation of federal, state or local law, OR
 - C) the Lessee is no longer enrolled as a student, OR
 - D) the Lessee engages in the use or possession of firearms, explosives, inflammable liquids, fireworks, or other dangerous weapons within the building, OR
 - E) the Lessee turns in a false fire alarm.
- THEN
- F. the University may terminate this lease by providing the Lessee with notice of the termination a minimum of 24 hours prior to the effective time of termination,
- BUT OTHERWISE, NOT.

The outline of this Normalized Version of the termination clause presents the logical structure of the provision in abbreviated form. An even more human-friendly summary of the logical relationships is presented in what we call an "arrow diagram". The following abbreviations are used in arrow diagrams:

- >- x ----> y. for IF x THEN y.

- Nx. for NOT x. (or IT IS NOT SO THAT x.)

- x - y. for x AND y. (antecedent)
- x for x AND y. (consequent)
- |
- y.

- x - for x OR y.
- | |
- y -

- >- x ----> y for IF x THEN y
- o BUT OTHERWISE NOT.
- |
- > N.

- >- x ----> y for IF x THEN y
- o BUT OTHERWISE z.
- |
- > z.

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1. IF
 - A. IT IS NOT SO THAT
 life, limb, or property could be jeopardized by
 continuation of the lease, AND
 - B. IT IS NOT SO THAT
 the Lessee engages in the sale or purchase of controlled
 substances in violation of federal, state or local law, AND
 - C. IT IS NOT SO THAT
 the Lessee is no longer enrolled as a student, AND
 - D. IT IS NOT SO THAT
 the Lessee engages in the use or possession of firearms,
 explosives, inflammable liquids, fireworks, or other
 dangerous weapons within the building, AND
 - E. IT IS NOT SO THAT
 the Lessee turns in a false fire alarm,
THEN
 - F. IF
 - 1) A. the Lessee has applied for and executed this lease in
 advance of enrollment, AND
 - B. 1) the Lessee is not eligible to enroll in the
 University, OR
 - 2) the Lessee fails to enroll in the University, OR
 - 2) the Lessee leaves the University at any time prior to
 the expiration of this lease, OR
 - 3) the Lessee violates any of the provisions of this lease,
 OR
 - 4) the Lessee violates any University regulation relative
 to Residence Halls, OR
 - 5) there are health reasons for terminating this lease,
THEN
 6. the University may terminate this lease by providing the
 Lessee with written notice of the termination 30 days
 prior to the effective time of termination, AND
2. IF
 - A) life, limb, or property could be jeopardized by
 continuation of the lease, OR
 - B) the Lessee engages in the sale or purchase of controlled
 substances in violation of federal, state or local law, OR
 - C) the Lessee is no longer enrolled as a student, OR
 - D) the Lessee engages in the use or possession of firearms,
 explosives, inflammable liquids, fireworks, or other
 dangerous weapons within the building, OR
 - E) the Lessee turns in a false fire alarm,
THEN
 - F. the University may terminate this lease by providing the
 Lessee with notice of the termination a minimum of 24
 hours prior to the effective time of termination, AND
3. IF
 - A. IT IS NOT SO THAT
 life, limb, or property could be jeopardized by
 continuation of the lease, AND
 - B. IT IS NOT SO THAT
 the Lessee engages in the sale or purchase of controlled

- substances in violation of federal, state or local law, AND
- C. IT IS NOT SO THAT
the Lessee is no longer enrolled as a student, AND
- D. IT IS NOT SO THAT
the Lessee engages in the use or possession of firearms,
explosives, inflammable liquids, fireworks, or other
dangerous weapons within the building, AND
- E. IT IS NOT SO THAT
the Lessee turns in a false fire alarm,
- THEN
- F. IT IS NOT SO THAT
the University may terminate this lease by providing the
Lessee with notice of the termination a minimum of 24
hours prior to the effective time of termination.

This Normalized Version of the termination clause generated from B1 is a basic version, because it contains only the defined structural terms AND, IF-THEN, NOT, and OR. The particular form of 'NOT' that it contains is the phrase 'IT IS NOT SO THAT' preceding whatever sentence is being negated. For example, in the outline the sentence 'IT IS NOT SO THAT c' is generated from the 'Nc' part of the expression B1. It is possible to have this same idea expressed by an imbedded 'NOT' rather than by the sentence prefix 'IT IS NOT SO THAT'. However, to obtain the imbedded-NOT version, it is necessary for the analyst to construct a variant of B1 in which the 'N's are replaced by 'n's. This B1' variant will be:

$$((nc\&\&ne\&\&nf1\&\&nf2 > ((b1\&(b2Vb3))Vb4Vb5Vb6Vb7>a3)) \& \\ ((cVdVeVf1Vf2>a4) \& (nc\&\&ne\&\&nf1\&\&nf2>Na4))$$

Since in B1' 'nc' replaces 'Nc' of B1, 'nd' replaces 'Nd', etc., the analyst needs to add to the list of constituent sentences of the various Normalized Versions the negations of 'c', 'd', etc. that contain imbedded 'NOT's. These are the sentences for which 'nc', 'nd', etc., are the short names.

Notice however, that in B1' 'Na4' is not replaced by 'na4'. The reason for this is that in some sentences an imbedded 'NOT' in that sentence does not express the same idea as that sentence with a sentence-prefix 'IT IS NOT SO THAT'. The sentence a4 is such a sentence; 'Na4' does not express the same idea as 'na4'. This is a subtle, but centrally important difference. Consider both of them carefully.

- Na4: IT IS NOT SO THAT
the University may terminate this lease by providing the Lessee with notice of the termination a minimum of 24 hours prior to the effective time of termination.
- na4: the University shall NOT terminate this lease by providing the Lessee with notice of the termination a minimum of 24 hours prior to the effective time of termination.

Consider also:

- na4': the University may NOT terminate this lease by providing the Lessee with notice of the termination a minimum of 24 hours prior to the effective time of termination.

The na4' sentence is ambiguous. Most of the time the phrase 'may NOT' is intended to indicate an obligation to refrain from doing something. However, occasionally it is meant to indicate permission to refrain. That is the reason for changing the 'may' to a 'shall' in na4 -- to indicate unambiguously that an obligation to refrain is what is intended.

The sentence a4 at first glance seems to merely extend a permission to the University to terminate the lease. So, on this superficial interpretation, the negation of that would be an obligation to refrain from terminating the lease, that is -- no permission to terminate. Hence, na4 would seem to adequately represent the negation of a4.

However, upon closer analysis it is evident that a4 is not merely referring to what the University is permitted to do. It is also referring to what the University is (by the lease) empowered to do. What the sentence a4:

the University may terminate this lease

in this context means is:

the university has the legal power to terminate
this lease and is permitted to exercise that power.

Thus, na4, which indicates merely the negation of the permission to terminate is unsatisfactory as an expression as the negation of a4. The negation of a4 is the negation of the combination that a4 represents -- a power and a permission. What na4 seems to state is that the University is obligated not to exercise its power to terminate, implying that it still has the power to terminate. But what is probably intended in these circumstances is that the University will not have the power to terminate. Thus Na4, which negates the power part of a4 as well as the permission part, is required.

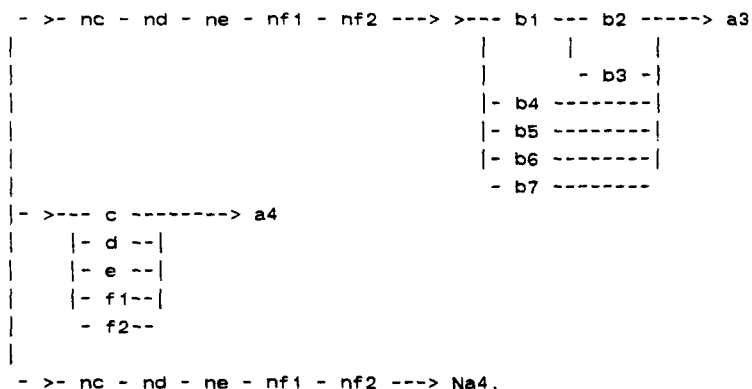
This use of the term 'may' in a4 is just one example of the pervasive structural ambiguities that are involved with the use of the terms 'may' and 'shall' for purposes of expressing legal rules. Their widespread use is particularly unfortunate, because the resulting ambiguities are virtually universally, inadvertent ones, rather than uncertainties that are introduced as a matter of deliberate choice.

The Normalized Version generated by NORMALIZER from B1' is still a basic one, and it removes the awkward sentence-prefix 'IT IS NOT SO THAT' in favor of an imbedded 'NOT'.

Basic Normalized Version Generated from B1'

- 1. IF
 - A. nc, AND
 - B. nd, AND
 - C. ne, AND
 - D. nf1, AND
 - E. nf2,
 - THEN
 - F. IF
 - 1) A. b1, AND
 - B. 1) b2, OR
 - 2) b3, OR
 - 2) b4, OR
 - 3) b5, OR

- 4) b6, OR
 - 5) b7,
 - THEN
 - 6. a3, AND
2. IF
- A) c, OR
 - B) d, OR
 - C) e, OR
 - D) f1, OR
 - E) f2,
 - THEN
 - F. a4, AND
3. IF
- A. nc, AND
 - B. nd, AND
 - C. ne, AND
 - D. nf1, AND
 - E. nf2,
 - THEN
 - F. IT IS NOT SO THAT
 - a4.



1. IF
- A. life, limb, or property could NOT be jeopardized by continuation of the lease, AND
 - B. the Lessee does NOT engage in the sale or purchase of controlled substances in violation of federal, state or local law, AND
 - C. the Lessee is still enrolled as a student, AND
 - D. the Lessee does NOT engage in the use or possession of firearms, explosives, inflammable liquids, fireworks, or other dangerous weapons within the building, AND
 - E. the Lessee does NOT turn in a false fire alarm,
 - THEN
 - F. IF

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- 1) A. the Lessee has applied for and executed this lease in advance of enrollment, AND
 - B. 1) the Lessee is not eligible to enroll in the University, OR
 - 2) the Lessee fails to enroll in the University, OR
 - 2) the Lessee leaves the University at any time prior to the expiration of this lease, OR
 - 3) the Lessee violates any of the provisions of this lease, OR
 - 4) the Lessee violates any University regulation relative to Residence Halls, OR
 - 5) there are health reasons for terminating this lease,
THEN
 - 6. the University may terminate this lease by providing the Lessee with written notice of the termination 30 days prior to the effective time of termination, AND
2. IF
- A) life, limb, or property could be jeopardized by continuation of the lease, OR
 - B) the Lessee engages in the sale or purchase of controlled substances in violation of federal, state or local law, OR
 - C) the Lessee is no longer enrolled as a student, OR
 - D) the Lessee engages in the use or possession of firearms, explosives, inflammable liquids, fireworks, or other dangerous weapons within the building, OR
 - E) the Lessee turns in a false fire alarm,
THEN
 - F. the University may terminate this lease by providing the Lessee with notice of the termination a minimum of 24 hours prior to the effective time of termination, AND
3. IF
- A. life, limb, or property could NOT be jeopardized by continuation of the lease, AND
 - B. the Lessee does NOT engage in the sale or purchase of controlled substances in violation of federal, state or local law, AND
 - C. the Lessee is still enrolled as a student, AND
 - D. the Lessee does NOT engage in the use or possession of firearms, explosives, inflammable liquids, fireworks, or other dangerous weapons within the building, AND
 - E. the Lessee does NOT turn in a false fire alarm,
THEN
 - F. IT IS NOT SO THAT
the University may terminate this lease by providing the Lessee with notice of the termination a minimum of 24 hours prior to the effective time of termination.

The next transformations to be considered are ones at the same level; they do not involve unpacking or packing. This pair of transformations at the same level is useful for putting the *Normalized Version* into a form in which it can be packed into a clear version that contains 'BUT OTHERWISE'.

The first transformation is one called t_1 . It is a simple transformation in which conjuncts are reversed. The formal statement of this transformation rule is

$$t_1: \quad x \ \& \ y \quad \text{----} \> \quad y \ \& \ x.$$

Doing a t_1 transformation on B1' results in the following basic expression, B2:

$$((c \vee d \vee e \vee f_1 \vee f_2 > a_4) \ \& \ (nc \ \& \ nd \ \& \ ne \ \& \ nf_1 \ \& \ nf_2 > Na_4)) \ \& \ (nc \ \& \ nd \ \& \ ne \ \& \ nf_1 \ \& \ nf_2 > ((b_1 \ \& \ (b_2 \vee b_3)) \vee b_4 \vee b_5 \vee b_6 \vee b_7 > a_3))$$

The basic Normalized Version of the termination clause that NORMALIZER would generate from B2 would differ from that generated from B1' only in that its first conjunct would appear after the combination of its second and third conjuncts. Because it involves such a slight difference, it is not reproduced here.

The second transformation is one called t_2 . It transforms a conjunction of conditionals with a common antecedent into a conditional with a conjunctive consequent. As with all of the rest of these transformations, the resulting expression is logically equivalent to the starting expression upon which the transformation is made. The formal statement of this transformation rule is

$$t_2: \quad (x > y) \ \& \ (x > z) \quad \text{----} \> \quad x > (y \ \& \ z).$$

Doing a t_2 transformation on B2 results in the following basic expression, B3:

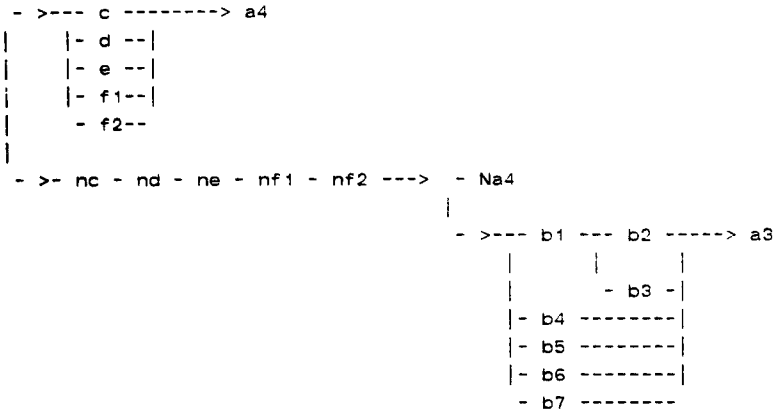
$$(c \vee d \vee e \vee f_1 \vee f_2 > a_4) \ \& \ (nc \ \& \ nd \ \& \ ne \ \& \ nf_1 \ \& \ nf_2 > (Na_4 \ \& \ ((b_1 \ \& \ (b_2 \vee b_3)) \vee b_4 \vee b_5 \vee b_6 \vee b_7 > a_3)))$$

The Normalized Version generated by NORMALIZER from B3, which is still a basic one, is in a form ready to be packed into a compact clear version containing a 'BUT OTHERWISE' term.

Basic Normalized Version Generated from B3

1. IF
 - A) c, OR
 - B) d, OR
 - C) e, OR
 - D) f₁, OR
 - E) f₂,
 THEN
 - F. a₄, AND
2. IF
 - A. nc, AND
 - B. nd, AND
 - C. ne, AND
 - D. nf₁, AND
 - E. nf₂,
 THEN
 - F. IT IS NOT SO THAT
 - a₄, AND
 - G. IF
 - 1) A. b₁, AND
 - B. 1) b₂, OR
 - 2) b₃, OR

- 2) b4, OR
- 3) b5, OR
- 4) b6, OR
- 5) b7.
- THEN
- 6. a3.



1. IF
 - A) life, limb, or property could be jeopardized by continuation of the lease, OR
 - B) the Lessee engages in the sale or purchase of controlled substances in violation of federal, state or local law, OR
 - C) the Lessee is no longer enrolled as a student, OR
 - D) the Lessee engages in the use or possession of firearms, explosives, inflammable liquids, fireworks, or other dangerous weapons within the building, OR
 - E) the Lessee turns in a false fire alarm,
 - THEN
 - F. the University may terminate this lease by providing the Lessee with notice of the termination a minimum of 24 hours prior to the effective time of termination, AND
2. IF
 - A. life, limb, or property could NOT be jeopardized by continuation of the lease, AND
 - B. the Lessee does NOT engage in the sale or purchase of controlled substances in violation of federal, state or local law, AND
 - C. the Lessee is still enrolled as a student, AND
 - D. the Lessee does NOT engage in the use or possession of firearms, explosives, inflammable liquids, fireworks, or other dangerous weapons within the building, AND
 - E. the Lessee does NOT turn in a false fire alarm,
 - THEN
 - F. IT IS NOT SO THAT

the University may terminate this lease by providing the Lessee with notice of the termination a minimum of 24 hours prior to the effective time of termination, AND

G. IF

- 1) A. the Lessee has applied for and executed this lease in advance of enrollment, AND
 - B. 1) the Lessee is not eligible to enroll in the University, OR
 - 2) the Lessee fails to enroll in the University, OR
- 2) the Lessee leaves the University at any time prior to the expiration of this lease, OR
- 3) the Lessee violates any of the provisions of this lease, OR
- 4) the Lessee violates any University regulation relative to Residence Halls, OR
- 5) there are health reasons for terminating this lease, THEN
6. the University may terminate this lease by providing the Lessee with written notice of the termination 30 days prior to the effective time of termination.

The packing of B3 into a clear version containing a BUT OTHERWISE is achieved by the p1.&oBOi rule. It transforms the conjunction of a pair of conditionals, the second of which has an antecedent that is the negation of the antecedent of the first, into into an 'IF ... THEN ... BUT OTHERWISE ...' type statement. The formal statement of this transformation rule is

p1.&oBOi: $(x > y) \& (Nx > z) \text{ ----> } x > y \text{ BO } z.$

Doing a p1 transformation on B3 results in the following clear expression, C2:

$cVdVeVf1Vf2 > a4 \text{ BO } (Na4 \& (((b1\&(b2Vb3))Vb4Vb5Vb6Vb7)>a3))$

The Normalized Version generated by NORMALIZER from C2, which is a clear one, is the following:

Clear Normalized Version Generated from C2

```

IF
1) c, OR
2) d, OR
3) e, OR
4) f1, OR
5) f2,
THEN
6. a4,
BUT OTHERWISE,
7. IT IS NOT SO THAT
  a4, AND
8. IF
  A) 1. b1, AND
     2. A) b2, OR
        B) b3, OR
  B) b4, OR

```


THEN

F. the University may terminate this lease by providing the Lessee with written notice of the termination 30 days prior to the effective time of termination.

The sets of conditions in this provision leading to termination with 30 days written notice (that is, b1, b2, ... b7) and termination with 24 hours notice (that is, c, d, ... f2) are approaching a level of complexity where additional clarity can be achieved by "chunking" the sets of conditions into manageable units and captioning them. A chunked version of C2 at the first layer can be obtained from the following clear expression, C2/C, which the analyst must construct. It is not generated automatically by NORMALIZER.

(q>a4BO(Na4&(s>a3))) A& (qEQcVdVeVf1Vf2) B&
(sEQ(b1&(b2Vb3))Vb4Vb5Vb6Vb7)

The chunked Normalized Version generated by NORMALIZER from C2/C, which is still a clear one, is the following:

Clear Chunked Normalized Version Generated from C2/C

1. IF
 - A. q,
 - THEN
 - B. a4,
 - BUT OTHERWISE,
 - C. IT IS NOT SO THAT
 - a4, AND
 - D. IF
 1. s,
 - THEN
 2. a3.

2. A. q,
- IF AND ONLY IF
 - 1) c, OR
 - 2) d, OR
 - 3) e, OR
 - 4) f1, OR
 - 5) f2.
- B. s,
- IF AND ONLY IF
 - 1) A. b1, AND
 - B. 1) b2, OR
 - 2) b3, OR
 - 2) b4, OR
 - 3) b5, OR
 - 4) b6, OR
 - 5) b7.

- substances in violation of federal, state or local law, OR
 - 3) the Lessee is no longer enrolled as a student, OR
 - 4) the Lessee engages in the use or possession of firearms, explosives, inflammable liquids, fireworks, or other dangerous weapons within the building, OR
 - 5) the Lessee turns in a false fire alarm.
- B. WITH 30-DAY WRITTEN NOTICE
- An adequate set of conditions for terminating a lease with 30 days written notice is met, IF AND ONLY IF
- 1) A. the Lessee has applied for and executed this lease in advance of enrollment, AND
 - B. 1) the Lessee is not eligible to enroll in the University, OR
 - 2) the Lessee fails to enroll in the University, OR
 - 2) the Lessee leaves the University at any time prior to the expiration of this lease, OR
 - 3) the Lessee violates any of the provisions of this lease, OR
 - 4) the Lessee violates any University regulation relative to Residence Halls, OR
 - 5) there are health reasons for terminating this lease.

Such a chunked Normalized Version has two parts: (1) the normalized part and (2) the definitions part. Since the normalized part is so much simpler than its unchunked counterpart, its structure is more apparent and easier to understand.

A second and extremely important feature of chunked versions that contributes to easier understanding is the systematic captioning that is possible in such versions. In the normalization part, the content of the caption is determined by the content of the results of that part. In the definitions part, the content of the caption is determined by the concept being defined. These systematic captions, not only make such provisions easier to read and understand, but also they facilitate access to such provisions when information retrieval functions are being performed. These captions, of course, are furnished by the analyst; they are not done automatically by NORMALIZER.

This clear chunked Normalized Version is in our judgment the easiest to understand of all the versions presented here of this first interpretation of the termination clause. It can be chunked to a second layer deep, but the added chunking does not (we think) contribute to further ease of understanding. To get a Normalized Version chunked at the second layer, the analyst needs to construct the following expression, C2/C2:

```
(q>a4BO(Na4&(s>a3))) A& ((qEQcVdVeVf1Vf2) B&
(sEQrVb4Vb5Vb6Vb7) B& (rEQb1&(b2Vb3)))
```

The second layer chunked Normalized Version generated by NORMALIZER from C2/C2, which is still a clear one, is the following:

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Clear Chunked Normalized Version Generated from C2/C2

1. IF
A. q,
THEN
B. a4,
BUT OTHERWISE,
C. IT IS NOT SO THAT
a4, AND
D. IF
1. s,,
THEN
2. a3.

2. A. q,
IF AND ONLY IF
1) c, OR
2) d, OR
3) e, OR
4) f1, OR
5) f2.
B. s,
IF AND ONLY IF
1) r, OR
2) b4, OR
3) b5, OR
4) b6, OR
5) b7.
C. r,
IF AND ONLY IF
1. b1, AND
2. A) b2. OR
B) b3.

```

>- q ----> a4
  |
  --> - Na4
      |
      - >- s ----> a3.
  
```

```

- q <----> - c --
|           |- d --|
|           |- e --|
|           |- f1 -|
|           - f2.-
|
- s <----> - r --
|           |- b4 -|
|           |- b5 -|
|           |- b6 -|
|           - b7 -
|
- r <----> b1 --- b2 -
|           |       |
|           - b3.-
  
```

1. TERMINATION OF LEASE, NOTICE REQUIRED

IF

A. an adequate set of conditions for terminating a lease with 24 hours notice is met,

THEN

B. the University may terminate this lease by providing the Lessee with notice of the termination a minimum of 24 hours prior to the effective time of termination,

BUT OTHERWISE,

C. IT IS NOT SO THAT

the University may terminate this lease by providing the Lessee with notice of the termination a minimum of 24 hours prior to the effective time of termination, AND

D. IF

1. an adequate set of conditions for terminating a lease with 30 days written notice is met,

THEN

2. the University may terminate this lease by providing the Lessee with written notice of the termination 30 days prior to the effective time of termination.

2. REQUIREMENTS FOR TERMINATION OF LEASE

A. WITH 24-HOUR NOTICE

An adequate set of conditions for terminating a lease with 24 hours notice is met,

IF AND ONLY IF

1) life, limb, or property could be jeopardized by continuation of the lease, OR

- 2) the Lessee engages in the sale or purchase of controlled substances in violation of federal, state or local law, OR
 - 3) the Lessee is no longer enrolled as a student, OR
 - 4) the Lessee engages in the use or possession of firearms, explosives, inflammable liquids, fireworks, or other dangerous weapons within the building, OR
 - 5) the Lessee turns in a false fire alarm.
- B. WITH 30-DAY WRITTEN NOTICE
- An adequate set of conditions for terminating a lease with 30 days written notice is met,
- IF AND ONLY IF
- 1) an adequate set of conditions for terminating a lease executed prior to enrollment is met, OR
 - 2) the Lessee leaves the University at any time prior to the expiration of this lease, OR
 - 3) the Lessee violates any of the provisions of this lease, OR
 - 4) the Lessee violates any University regulation relative to Residence Halls, OR
 - 5) there are health reasons for terminating this lease.
- C. LEASE EXECUTED PRIOR TO ENROLLMENT
- An adequate set of conditions for terminating a lease executed prior to enrollment is met,
- IF AND ONLY IF
1. the Lessee has applied for and executed this lease in advance of enrollment, AND
 2. A) the Lessee is not eligible to enroll in the University, OR
 - B) the Lessee fails to enroll in the University.

In this example the sets of conditions are not sufficiently complex to warrant the second layer of chunking. In other examples the sets of conditions may be sufficiently more complex that added chunking will make understanding easier. Clearly, the judgment on this is a matter of taste that will vary from one drafter to another.

In the seven examples of Normalized Versions of the termination clause presented so far, the capabilities of NORMALIZER have been demonstrated. It was also promised that some of the implications of normalizing a legal rule would be considered. Some delivery on that promise is now possible. One of the important implications of getting rules stated in normalized form is that a reader can perceive more easily just what is being said. In the case of this termination clause, a careful consideration of any one of the Normalized Versions makes it apparent that the drafters of this provisions really do not intend exactly what they have written. They have written (roughly paraphrased):

The University may terminate with 30 days written notice
when
sufficient conditions are met
unless
stronger conditions are met
in which cases
the University may terminate with 24 hours notice.

A natural language 'x unless y' has many different interpretations, but each of them includes the following:

IF NOT y THEN x.

Thus, in using the term 'unless' in this termination clause, the drafters have made the absence of the stronger conditions a requirement before the sufficient conditions can lead to the University's power to terminate the lease with 30 days written notice. They really did not mean that! What was intended, it seems clear is:

The University may terminate with 30 days written notice
when
sufficient conditions are met
and
the University may terminate with 24 hours notice
when
stronger conditions are met.

If this is what was intended, then a second interpretation of the termination clause is necessary. This second interpretation results in a Normalized Version that is (in our judgment) still easier to understand than the clear chunked C2/C Normalized Version of Interpretation 1.

We will move toward this easier-to-understand Normalized Version of Interpretation 2 in a step-by-step manner that will include presentation of three more Normalized Versions of Interpretation 1. This will permit an easily-perceived comparison of Interpretation 1 with Interpretation 2 and show clearly the relationship between the two.

There is imbedded in the result a4 of expression C2 a condition that can be exported by means of the $t3.>o>>i$ transformation. The formal statement of this transformation is

$$t3.>o>>i: \quad x > (y.1 \ y.2) \ \text{-----} \> \ x > (y1 > y2).$$

If C2 is transformed by $t3$, the result is another clear expression, C3:

$$cVdVeVf1Vf2 > (g>a) \ \text{BO} \ (N(g>a) \ \& \ ((b1\&(b2Vb3))Vb4Vb5Vb6Vb7)>(a2>a))$$

The Normalized Version generated by NORMALIZER from C3, which is still a clear one, is the following:

Clear Normalized Version Generated from C3

```
IF
1) c, OR
2) d, OR
3) e, OR
4) f1, OR
5) f2,
THEN
6. IF
   A. g,
   THEN
   B. a,
```



```

BUT OTHERWISE,
7. IT IS NOT SO THAT
  IF
    A. the University provides the Lessee with notice of the
      termination a minimum of 24 hours prior to the effective
      time of termination,
    THEN
      B. the University may terminate this lease, AND
8. IF
  A) 1. the Lessee has applied for and executed this lease in
      advance of enrollment, AND
      2. A) the Lessee is not eligible to enroll in the
          University, OR
          B) the Lessee fails to enroll in the University, OR
  B) the Lessee leaves the University at any time prior to the
      expiration of this lease, OR
  C) the Lessee violates any of the provisions of this lease,
      OR
  D) the Lessee violates any University regulation relative to
      Residence Halls, OR
  E) there are health reasons for terminating this lease,
    THEN
  F. IF
    1. the University provides the Lessee with written notice
      of the termination 30 days prior to the effective time
      of termination,
    THEN
    2. the University may terminate this lease.
  
```

In this clear Normalized Version of C3, the a4 of C2 has been replaced by g>a, that is

a4: The University may terminate this lease by providing the Lessee with notice of the termination a minimum of 24 hours prior to the effective time of termination.

is replaced by

IF g: the University provides the Lessee with notice of the termination a minimum of 24 hours prior to the effective time of termination,

THEN a: the University may terminate this lease.

Unpacking the 'BUT OTHERWISE' of this Normalized Version, results in a basic Normalized Version that is just one step removed from one that can be easily compared with a basic Normalized Version of Interpretation 2. The unpacking is done by the u3.BOo&i transformation. The formal statement of it is

$$u3.BOo\&i: \quad x > y \text{ BO } z \quad \text{---->} \quad (x > y) \& (N_x > z).$$

It is the reverse of the p1.&oBOi transformation. When C3 is transformed by u3, the result is expression B4:

$$(c \vee d \vee e \vee f_1 \vee f_2 > (g > a)) \quad \& \quad (nc \& nd \& ne \& nf_1 \& nf_2 > (N(g > a) \& ((b_1 \& (b_2 \vee b_3)) \vee b_4 \vee b_5 \vee b_6 \vee b_7) > (a_2 > a))))$$

The Normalized Version generated by NORMALIZER from B4, which is a basic one, is the following:

Basic Normalized Version Generated from B4

1. IF
 - A) c, OR
 - B) d, OR
 - C) e, OR
 - D) f1, OR
 - E) f2,
 THEN
 - F. IF
 1. g,
 THEN
 2. a, AND
2. IF
 - A. nc, AND
 - B. nd, AND
 - C. ne, AND
 - D. nf1, AND
 - E. nf2,
 THEN
 - F. IT IS NOT SO THAT
 - IF
 1. g,
 THEN
 2. a, AND
 - G. IF
 - 1) A. b1, AND
 - B. 1) b2, OR
 - 2) b3, OR
 - 2) b4, OR
 - 3) b5, OR
 - 4) b6, OR
 - 5) b7,
 THEN
 6. IF
 - A. a2,
 THEN
 - B. a.


```

- >--- c -----> >- g ----> a
|
| | - d --|
| | - e --|
| | - f1--|
| | - f2--|
|
- >- nc - nd - ne - nf1 - nf2 ----> - N>- g ----> a
|
| - >--- b1 --- b2 ----> >- a2 ----> a.
|
| | - b3 -|
| | - b4 -----|
| | - b5 -----|
| | - b6 -----|
| | - b7 -----|

```

1. IF
 - A) life, limb, or property could be jeopardized by continuation of the lease, OR
 - B) the Lessee engages in the sale or purchase of controlled substances in violation of federal, state or local law, OR
 - C) the Lessee is no longer enrolled as a student, OR
 - D) the Lessee engages in the use or possession of firearms, explosives, inflammable liquids, fireworks, or other dangerous weapons within the building, OR
 - E) the Lessee turns in a false fire alarm,

THEN

 - F. IF
 1. the University provides the Lessee with notice of the termination a minimum of 24 hours prior to the effective time of termination,

THEN

 2. the University may terminate this lease, AND
2. IF
 - A. life, limb, or property could NOT be jeopardized by continuation of the lease, AND
 - B. the Lessee does NOT engage in the sale or purchase of controlled substances in violation of federal, state or local law, AND
 - C. the Lessee is still enrolled as a student, AND
 - D. the Lessee does NOT engage in the use or possession of firearms, explosives, inflammable liquids, fireworks, or other dangerous weapons within the building, AND
 - E. the Lessee does NOT turn in a false fire alarm,

THEN

 - F. IT IS NOT SO THAT
 - IF
 1. the University provides the Lessee with notice of the termination a minimum of 24 hours prior to the effective time of termination,

THEN

- 2. the University may terminate this lease. AND
- G. IF
 - 1) A. the Lessee has applied for and executed this lease in advance of enrollment, AND
 - B. 1) the Lessee is not eligible to enroll in the University, OR
 - 2) the Lessee fails to enroll in the University, OR
 - 2) the Lessee leaves the University at any time prior to the expiration of this lease, OR
 - 3) the Lessee violates any of the provisions of this lease, OR
 - 4) the Lessee violates any University regulation relative to Residence Halls, OR
 - 5) there are health reasons for terminating this lease,
 - THEN
 - 6. IF
 - A. the University provides the Lessee with written notice of the termination 30 days prior to the effective time of termination,
 - THEN
 - B. the University may terminate this lease.

If B4 is transformed first by t3 and then by t1, the result is the expression B5:

$$((nc \& nd \& ne \& nf1 \& nf2 > ((b1 \& (b2 \vee b3)) \vee b4 \vee b5 \vee b6 \vee b7) \& a2) > a) \& ((c \vee d \vee e \vee f1 \vee f2) \& g > a) \& ((nc \& nd \& ne \& nf1 \& nf2) > N(g > a))$$

The Normalized Version generated by NORMALIZER from B5, which is a basic one, is the following:

Basic Normalized Version Generated from B5

- 1. IF
 - A. nc, AND
 - B. nd, AND
 - C. ne, AND
 - D. nf1, AND
 - E. nf2,
 - THEN
 - F. IF
 - 1. A) 1. b1, AND
 - 2. A) b2, OR
 - B) b3, OR
 - B) b4, OR
 - C) b5, OR
 - D) b6, OR
 - E) b7, AND
 - 2. a2,
 - THEN
 - 3. a, AND
- 2. IF
 - A. 1) c, OR
 - 2) d, OR

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University, OR
B) the Lessee fails to enroll in the University,
OR
B) the Lessee leaves the University at any time prior to
the expiration of this lease, OR
C) the Lessee violates any of the provisions of this
lease, OR
D) the Lessee violates any University regulation relative
to Residence Halls, OR
E) there are health reasons for terminating this lease, AND
2. the University provides the Lessee with written notice
of the termination 30 days prior to the effective time
of termination,
THEN
3. the University may terminate this lease, AND
2. IF
A. 1) life, limb, or property could be jeopardized by
continuation of the lease, OR
2) the Lessee engages in the sale or purchase of controlled
substances in violation of federal, state or local law,
OR
3) the Lessee is no longer enrolled as a student, OR
4) the Lessee engages in the use or possession of firearms,
explosives, inflammable liquids, fireworks, or other
dangerous weapons within the building, OR
5) the Lessee turns in a false fire alarm, AND
B. the University provides the Lessee with notice of the
termination a minimum of 24 hours prior to the effective
time of termination,
THEN
C. the University may terminate this lease, AND
3. IF
A. life, limb, or property could NOT be jeopardized by
continuation of the lease, AND
B. the Lessee does NOT engage in the sale or purchase of
controlled substances in violation of federal, state or
local law, AND
C. the Lessee is still enrolled as a student, AND
D. the Lessee does NOT engage in the use or possession of
firearms, explosives, inflammable liquids, fireworks, or
other dangerous weapons within the building, AND
E. the Lessee does NOT turn in a false fire alarm,
THEN
F. IT IS NOT SO THAT
IF
1. the University provides the Lessee with notice of the
termination a minimum of 24 hours prior to the
effective time of termination,
THEN
2. the University may terminate this lease.

The logical form of this basic Normalized Version is as follows:

(IF nc ... nf2 THEN IF b1 ... b7 AND a2 THEN a) AND
 (IF c ... f2 AND g THEN a) AND
 (IF nc ... nf2 THEN NOT(IF g THEN a)).

that is

```
IF no strong condition is met
THEN IF a sufficient condition is met AND the University
      provides 30 days written notice
      THEN the University may terminate this lease AND
IF a strong condition is met AND
  the University provides 24 hours notice
THEN the University may terminate this lease AND
IF no strong condition is met
THEN IT IS NOT SO THAT
  IF the University provides 24 hours notice
  THEN the University may terminate this lease.
```

The drafters surely did not intend to make the absence of meeting any of the strong conditions a prerequisite to the University's having the power to terminate the lease on 30 days written notice when one of the sufficient conditions is met. The change in logical form to omit this prerequisite would delete nc ...nf2 as the antecedent of the first conjunct, resulting in:

(IF b1 ... b7 AND a2 THEN a) AND
 (IF c ... f2 AND g THEN a) AND
 (IF nc ... nf2 THEN NOT(IF g THEN a)).

By deleting 'nc ... nf2>' from B5 the analyst can obtain the expression B6:

(((b1&(b2Vb3))Vb4Vb5Vb6Vb7)&a2)>a) & ((cVdVeVf1Vf2)&g>a) &
 ((nc&nd&ne&nf1&nf2)>N(g>a))

The Normalized Version generated by NORMALIZER from B6, which is a basic one, is the following:

Basic Normalized Version Generated from B6

1. IF
 - A. 1) A. b1, AND
 - B. 1) b2, OR
 - 2) b3, OR
 - 2) b4, OR
 - 3) b5, OR
 - 4) b6, OR
 - 5) b7, AND
 - B. a2,
- THEN
- C. a, AND
2. IF
 - A. 1) c, OR
 - 2) d, OR
 - 3) e, OR
 - 4) f1, OR

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```

    5) f2, AND
    B. g,
    THEN
    C. a, AND
3. IF
    A. nc, AND
    B. nd, AND
    C. ne, AND
    D. nf1, AND
    E. nf2,
    THEN
    F. IT IS NOT SO THAT
        IF
            1. g,
            THEN
                2. a.

```

```

- >--- b1 --- b2 --- a2 ----> a
|   |           |           |
|   |           |   - b3 - |
|   |   - b4 - - - - - |
|   |   - b5 - - - - - |
|   |   - b6 - - - - - |
|   |   - b7 - - - - - |
|   |           |           |
| - >--- c --- g ----> a
|   |   - d - - | |
|   |   - e - - |
|   |   - f1 - - |
|   |   - f2 - - |
|   |           |           |
- >- nc - nd - ne - nf1 - nf2 ----> N>- g ----> a.

```

```

1. IF
    A. 1) A. the Lessee has applied for and executed this lease in
        advance of enrollment, AND
        B. 1) the Lessee is not eligible to enroll in the
            University, OR
            2) the Lessee fails to enroll in the University, OR
        2) the Lessee leaves the University at any time prior to
            the expiration of this lease, OR
        3) the Lessee violates any of the provisions of this lease,
            OR
        4) the Lessee violates any University regulation relative
            to Residence Halls, OR
        5) there are health reasons for terminating this lease, AND
    B. the University provides the Lessee with written notice of
        the termination 30 days prior to the effective time of
        termination,
    THEN
    C. the University may terminate this lease, AND

```


1. IF
 - A) 1. A) 1. the Lessee has applied for and executed this lease in advance of enrollment, AND
 2. A) the Lessee is not eligible to enroll in the University. OR
 - B) the Lessee fails to enroll in the University. OR
 - B) the Lessee leaves the University at any time prior to the expiration of this lease. OR
 - C) the Lessee violates any of the provisions of this lease. OR
 - D) the Lessee violates any University regulation relative to Residence Halls. OR
 - E) there are health reasons for terminating this lease. AND
 2. the University provides the Lessee with written notice of the termination 30 days prior to the effective time of termination. OR
- B) 1. A) life, limb, or property could be jeopardized by continuation of the lease. OR
 - B) the Lessee engages in the sale or purchase of controlled substances in violation of federal, state or local law. OR
 - C) the Lessee is no longer enrolled as a student. OR
 - D) the Lessee engages in the use or possession of firearms, explosives, inflammable liquids, fireworks, or other dangerous weapons within the building. OR
 - E) the Lessee turns in a false fire alarm. AND
2. the University provides the Lessee with notice of the termination a minimum of 24 hours prior to the effective time of termination.

THEN

- C. the University may terminate this lease. AND

2. IF

- A. life, limb, or property could NOT be jeopardized by continuation of the lease. AND
- B. the Lessee does NOT engage in the sale or purchase of controlled substances in violation of federal, state or local law. AND
- C. the Lessee is still enrolled as a student. AND
- D. the Lessee does NOT engage in the use or possession of firearms, explosives, inflammable liquids, fireworks, or other dangerous weapons within the building. AND
- E. the Lessee does NOT turn in a false fire alarm.

THEN

F. IT IS NOT SO THAT

IF

1. the University provides the Lessee with notice of the termination a minimum of 24 hours prior to the effective time of termination.

THEN

2. the University may terminate this lease.

This Normalized Version can be made easier to understand if the analyst chunks it. The expression that will produce the chunked version is B7/C:

((s&a2)V(q&g) > a) & (nq>N(g>a)) A&
 ((sEQ(b1&(b2Vb3))Vb4Vb5Vb6Vb7) B& (qEQcVdVeVf1Vf2))

The Normalized Version generated by NORMALIZER from B7/C, which is a basic chunked one, is the following:

Basic Chunked Normalized Version Generated from B7/C

- 1. A. IF
 - 1) A. s, AND
 - B. a2, OR
 - 2) A. q, AND
 - B. g,
 - THEN
 - 3. a, AND
 - B. IF
 - 1. nq,
 - THEN
 - 2. IT IS NOT SO THAT
 - IF
 - A. g,
 - THEN
 - B. a.
-
- 2. A. s,
 - IF AND ONLY IF
 - 1) A. b1, AND
 - B. 1) b2, OR
 - 2) b3, OR
 - 2) b4, OR
 - 3) b5, OR
 - 4) b6, OR
 - 5) b7.
 - B. q,
 - IF AND ONLY IF
 - 1) c, OR
 - 2) d, OR
 - 3) e, OR
 - 4) f1, OR
 - 5) f2.

```

- >--- s - a2 -----> a
|   |   |
|   - q - g --
|
- >- nq ----> N>- g ----> a.

- q <----> - c --
|           |- d --|
|           |- e --|
|           |- f1 -|
|           - f2.-
|
- s <----> - b1 --- b2 -
|           |         |
|           |         ~ b3 -|
|           |- b4 -----|
|           |- b5 -----|
|           |- b6 -----|
|           - b7.-----

```

1. TERMINATION OF LEASE, NOTICE REQUIRED

A. IF

- 1) A. an adequate set of conditions for terminating a lease with 30 days written notice is met, AND
 - B. the University provides the Lessee with written notice of the termination 30 days prior to the effective time of termination, OR
- 2) A. an adequate set of conditions for terminating a lease with 24 hours notice is met, AND
 - B. the University provides the Lessee with notice of the termination a minimum of 24 hours prior to the effective time of termination,

THEN

3. the University may terminate this lease, AND

B. IF

1. an adequate set of conditions for terminating a lease with 24 hours notice is NOT met,

THEN

2. IT IS NOT SO THAT

IF

- A. the University provides the Lessee with notice of the termination a minimum of 24 hours prior to the effective time of termination,

THEN

B. the University may terminate this lease.

2. REQUIREMENTS FOR TERMINATION OF LEASE

A. WITH 30-DAY WRITTEN NOTICE

An adequate set of conditions for terminating a lease with 30 days written notice is met,

IF AND ONLY IF

- 1) A. the Lessee has applied for and executed this lease in advance of enrollment, AND
 - B. 1) the Lessee is not eligible to enroll in the University, OR
 - 2) the Lessee fails to enroll in the University, OR
 - 2) the Lessee leaves the University at any time prior to the expiration of this lease, OR
 - 3) the Lessee violates any of the provisions of this lease, OR
 - 4) the Lessee violates any University regulation relative to Residence Halls, OR
 - 5) there are health reasons for terminating this lease.
- B. WITH 24-HOUR NOTICE
- An adequate set of conditions for terminating a lease with 24 hours notice is met,
- IF AND ONLY IF
- 1) life, limb, or property could be jeopardized by continuation of the lease, OR
 - 2) the Lessee engages in the sale or purchase of controlled substances in violation of federal, state or local law, OR
 - 3) the Lessee is no longer enrolled as a student, OR
 - 4) the Lessee engages in the use or possession of firearms, explosives, inflammable liquids, fireworks, or other dangerous weapons within the building, OR
 - 5) the Lessee turns in a false fire alarm.

In addition to this chunked Normalized Version at the basic level, there is an even easier chunked version at the clear level. To get to this one, a different transformation needs to be applied to B6 to get another basic expression, which is, in turn, packed into a 'BUT OTHERWISE NOT' Normalized Version and then chunked. This other transformation $t5.>\&o>i$ converts a conditional with a conjunctive antecedent to a conditional with a conditional consequent. Stated formally it is

$$t5.>\&o>i: \quad (x \& y) > z \quad \text{-----} > \quad x > (y > z).$$

When NORMALIZER applies $t5$ to B6, the result is the expression B8:

$$(((b1\&(b2Vb3))Vb4Vb5Vb6Vb7)\&a2)>a) \& ((cVdVeVf1Vf2)>(g>a)) \& ((nc\&nd\&ne\&nf1\&nf2)>N(g>a))$$

The Normalized Version generated by NORMALIZER from B8, which is a basic one, is the following:

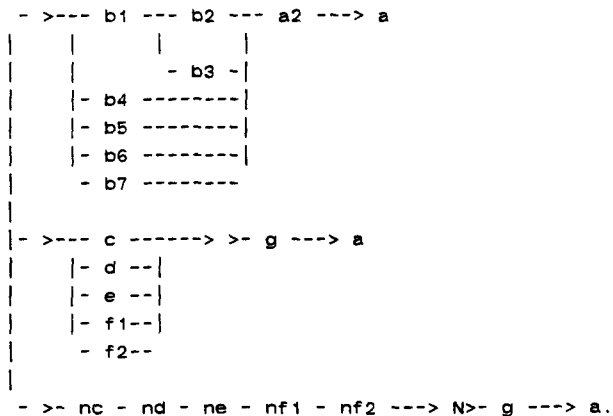
Basic Normalized Version Generated from B8

- 1. IF
 - A. 1) A. b1, AND
 - B. 1) b2, OR
 - 2) b3, OR
 - 2) b4, OR
 - 3) b5, OR
 - 4) b6, OR
 - 5) b7, AND

```

B. a2,
THEN
C. a, AND
2. IF
A) c, OR
B) d, OR
C) e, OR
D) f1, OR
E) f2,
THEN
F. IF
  1. g,
  THEN
  2. a, AND
3. IF
A. nc, AND
B. nd, AND
C. ne, AND
D. nf1, AND
E. nf2,
THEN
F. IT IS NOT SO THAT
  IF
  1. g,
  THEN
  2. a.

```



```

. IF
A. 1) A. the Lessee has applied for and executed this lease in
  advance of enrollment, AND
  B. 1) the Lessee is not eligible to enroll in the
  University, OR
  2) the Lessee fails to enroll in the University, OR
  2) the Lessee leaves the University at any time prior to

```

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- the expiration of this lease, OR
- 3) the Lessee violates any of the provisions of this lease, OR
- 4) the Lessee violates any University regulation relative to Residence Halls, OR
- 5) there are health reasons for terminating this lease, AND
- B. the University provides the Lessee with written notice of the termination 30 days prior to the effective time of termination,
- THEN
- C. the University may terminate this lease, AND
- 2. IF
- A) life, limb, or property could be jeopardized by continuation of the lease, OR
- B) the Lessee engages in the sale or purchase of controlled substances in violation of federal, state or local law, OR
- C) the Lessee is no longer enrolled as a student, OR
- D) the Lessee engages in the use or possession of firearms, explosives, inflammable liquids, fireworks, or other dangerous weapons within the building, OR
- E) the Lessee turns in a false fire alarm,
- THEN
- F. IF
- 1. the University provides the Lessee with notice of the termination a minimum of 24 hours prior to the effective time of termination,
- THEN
- 2. the University may terminate this lease, AND
- 3. IF
- A. life, limb, or property could NOT be jeopardized by continuation of the lease, AND
- B. the Lessee does NOT engage in the sale or purchase of controlled substances in violation of federal, state or local law, AND
- C. the Lessee is still enrolled as a student, AND
- D. the Lessee does NOT engage in the use or possession of firearms, explosives, inflammable liquids, fireworks, or other dangerous weapons within the building, AND
- E. the Lessee does NOT turn in a false fire alarm,
- THEN
- F. IT IS NOT SO THAT
- IF
- 1. the University provides the Lessee with notice of the termination a minimum of 24 hours prior to the effective time of termination,
- THEN
- 2. the University may terminate this lease.

The packing transformation that produces a 'B,' expression is p2.&oB,i. Its formal statement is

$$p2.\&oB,i: \quad (x > y) \& (Nx > Ny) \quad \text{-----}> \quad x > y \text{ B},.$$

B. 1) the Lessee is not eligible to enroll in the University, OR
 2) the Lessee fails to enroll in the University, OR
 2) the Lessee leaves the University at any time prior to the expiration of this lease, OR
 3) the Lessee violates any of the provisions of this lease, OR
 4) the Lessee violates any University regulation relative to Residence Halls, OR
 5) there are health reasons for terminating this lease, AND
 B. the University provides the Lessee with written notice of the termination 30 days prior to the effective time of termination,
 THEN
 C. the University may terminate this lease, AND
 2. IF
 A) life, limb, or property could be jeopardized by continuation of the lease, OR
 B) the Lessee engages in the sale or purchase of controlled substances in violation of federal, state or local law, OR
 C) the Lessee is no longer enrolled as a student, OR
 D) the Lessee engages in the use or possession of firearms, explosives, inflammable liquids, fireworks, or other dangerous weapons within the building, OR
 E) the Lessee turns in a false fire alarm,
 THEN
 F. IF
 1. the University provides the Lessee with notice of the termination a minimum of 24 hours prior to the effective time of termination,
 THEN
 2. the University may terminate this lease,
 BUT OTHERWISE, NOT.

When the analyst chunks C4, the result is the expression C4/C:

((s&a2>a) & (q>(g>a)B,)) A&
 ((sEQ(b1&(b2Vb3))Vb4Vb5Vb6Vb7) B& (qEQcVdVeVf1Vf2))

The Normalized Version generated by NORMALIZER from C4/C, which is a clear chunked one, is the following:

Clear Chunked Normalized Version Generated from C4/C

1. A. IF
 1. s, AND
 2. a2,
 THEN
 3. a, AND
 B. IF
 1. q,
 THEN
 2. IF

A. g,
 THEN
 B. a,
 BUT OTHERWISE, NOT.

2. A. s,
 IF AND ONLY IF
 1) A. b1, AND
 B. 1) b2, OR
 2) b3, OR
 2) b4, OR
 3) b5, OR
 4) b6, OR
 5) b7.
- B. q,
 IF AND ONLY IF
 1) c, OR
 2) d, OR
 3) e, OR
 4) f1, OR
 5) f2.

```
- >--- s - a2 -----> a
|
- >- q -----> >- g ----> a
  |
  o
  |
  --> N.
```

```
- q <---> - c --
|           | - d --|
|           | - e --|
|           | - f1 -|
|           - f2.-
|
- s <---> - b1 --- b2 -
|           |         |
|           | - b3 -|
| - b4 -----|
| - b5 -----|
| - b6 -----|
| - b7.-----|
```

1. TERMINATION OF LEASE, NOTICE REQUIRED

A. IF

1. an adequate set of conditions for terminating a lease with 30 days written notice is met, AND
2. the University provides the Lessee with written notice of the termination 30 days prior to the effective time of termination,

- THEN
3. the University may terminate this lease, AND
- B. IF
1. an adequate set of conditions for terminating a lease with 24 hours notice is met,
- THEN
2. IF
- A. the University provides the Lessee with notice of the termination a minimum of 24 hours prior to the effective time of termination,
- THEN
- B. the University may terminate this lease,
- BUT OTHERWISE, NOT.
2. REQUIREMENTS FOR TERMINATION OF LEASE
- A. WITH 30-DAY WRITTEN NOTICE
- An adequate set of conditions for terminating a lease with 30 days written notice is met.
- IF AND ONLY IF
- 1) A. the Lessee has applied for and executed this lease in advance of enrollment, AND
- B. 1) the Lessee is not eligible to enroll in the University, OR
- 2) the Lessee fails to enroll in the University, OR
- 2) the Lessee leaves the University at any time prior to the expiration of this lease, OR
- 3) the Lessee violates any of the provisions of this lease, OR
- 4) the Lessee violates any University regulation relative to Residence Halls, OR
- 5) there are health reasons for terminating this lease.
- B. WITH 24-HOUR NOTICE
- An adequate set of conditions for terminating a lease with 24 hours notice is met.
- IF AND ONLY IF
- 1) life, limb, or property could be jeopardized by continuation of the lease, OR
- 2) the Lessee engages in the sale or purchase of controlled substances in violation of federal, state or local law, OR
- 3) the Lessee is no longer enrolled as a student, OR
- 4) the Lessee engages in the use or possession of firearms, explosives, inflammable liquids, fireworks, or other dangerous weapons within the building, OR
- 5) the Lessee turns in a false fire alarm.

This clear chunked Normalized version of Interpretation 2 is what we believe to be the clearest and easiest to understand version of what the drafters of the UNIVERSITY LEASE TERMINATION CLAUSE intended.

For some inexperienced readers the 'BUT OTHERWISE, NOT' in this chunked version may be too cryptic. The delightful thing about having NORMALIZER available is that a slightly more detailed version is available automatically and easily. The 'BUT OTHERWISE, NOT' is quickly

transformed into:

- ```

3. IT IS NOT SO THAT
 IF
 A. the University provides the Lessee with notice of the
 termination a minimum of 24 hours prior to the
 effective time of termination.
 THEN
 B. the University may terminate this lease.

```

There is one more Normalized Version that is of some interest. This is the version at the elementary level, in which the only between-sentence defined structural terms used are AND, NOT, and IF-THEN. At the elementary level, the Normalized Version is a conjunction of elementary norms. Elementary norms are conditional statements that have (1) a result that is either a simple sentence or its negation and (2) an antecedent that is either a simple sentence or its negation or the conjunction of such sentences. These elementary norms are closely parallel to the Horn clauses of the programming language PROLOG, which has been adopted by Japanese computer research scientists as the official language for the heralded "Fifth-Generation" project. This language is significant in that it purports to be not only a high-level computer programming language, but also an effective problem-solving system. This link between the elementary norms of normalized legal drafting and the Horn clauses of PROLOG may turn out to be significant in future problem-solving efforts involving normalized statements.

Statements of complex legal rules at the elementary level, however, are so repetitive that no sensible drafter would ever use this mode of expression.

To get a Parenthesized Logical Expression of Interpretation 2 at the elementary level, NORMALIZER must unpack the 'OR' in the basic Normalized Version of B6. The transformation that does the unpacking is  $u4.>Vo&i$ . Formally stated it is

$$u4.>Vo&i: \quad (x \vee y) > z \quad \text{---->} \quad (x > z) \& (y > z).$$

When NORMALIZER applies  $u4$  to B6, the result is the expression E1:

```

(b1&b2&a2>a) & (b1&b3&a2>a) & (b4&a2>a) & (b5&a2>a) & (b6&a2>a) &
(b7&a2>a) & (c&g>a) & (d&g>a) & (e&g>a) & (f1&g>a) & (f2&g>a) &
(nc&nd&ne&nf1&nf2>N(g>a))

```

The elementary Normalized Version generated by NORMALIZER from E1 is the following:

Elementary Normalized Version Generated from E1

- ```

1. IF
  A. b1, AND
  B. b2, AND
  C. a2,
  THEN
  D. a, AND
2. IF
  A. b1, AND
  B. b3, AND
  C. a2,
  THEN

```

- D. a, AND
- 3. IF
 - A. b4, AND
 - B. a2,
 - THEN
 - C. a, AND
- 4. IF
 - A. b5, AND
 - B. a2,
 - THEN
 - C. a, AND
- 5. IF
 - A. b6, AND
 - B. a2,
 - THEN
 - C. a, AND
- 6. IF
 - A. b7, AND
 - B. a2,
 - THEN
 - C. a, AND
- 7. IF
 - A. c, AND
 - B. g,
 - THEN
 - C. a, AND
- 8. IF
 - A. d, AND
 - B. g,
 - THEN
 - C. a, AND
- 9. IF
 - A. e, AND
 - B. g,
 - THEN
 - C. a, AND
- 10. IF
 - A. f1, AND
 - B. g,
 - THEN
 - C. a, AND
- 11. IF
 - A. f2, AND
 - B. g,
 - THEN
 - C. a, AND
- 12. IF
 - A. nc, AND
 - B. nd, AND
 - C. ne, AND
 - D. nf1, AND
 - E. nf2,
 - THEN

F. IT IS NOT SO THAT
 IF
 1. g.
 THEN
 2. a.

```

- >- b1 - b2 - a2 ----> a
|
- >- b1 - b3 - a2 ----> a
|
- >- b4 - a2 ----> a
|
- >- b5 - a2 ----> a
|
- >- b6 - a2 ----> a
|
- >- b7 - a2 ----> a
|
- >- c - g ----> a
|
- >- d - g ----> a
|
- >- e - g ----> a
|
- >- f1 - g ----> a
|
- >- f2 - g ----> a
|
- >- nc - nd - ne - nf1 - nf2 ----> N>- g ----> a.
  
```

1. IF
 - A. the Lessee has applied for and executed this lease in advance of enrollment, AND
 - B. the Lessee is not eligible to enroll in the University, AND
 - C. the University provides the Lessee with written notice of the termination 30 days prior to the effective time of termination,

THEN

 - D. the University may terminate this lease, AND
2. IF
 - A. the Lessee has applied for and executed this lease in advance of enrollment, AND
 - B. the Lessee fails to enroll in the University, AND
 - C. the University provides the Lessee with written notice of the termination 30 days prior to the effective time of termination,

THEN

 - D. the University may terminate this lease, AND
3. IF
 - A. the Lessee leaves the University at any time prior to the

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expiration of this lease, AND

B. the University provides the Lessee with written notice of the termination 30 days prior to the effective time of termination.

THEN

C. the University may terminate this lease, AND

4. IF

A. the Lessee violates any of the provisions of this lease, AND

B. the University provides the Lessee with written notice of the termination 30 days prior to the effective time of termination.

THEN

C. the University may terminate this lease, AND

5. IF

A. the Lessee violates any University regulation relative to Residence Halls, AND

B. the University provides the Lessee with written notice of the termination 30 days prior to the effective time of termination.

THEN

C. the University may terminate this lease, AND

6. IF

A. there are health reasons for terminating this lease, AND

B. the University provides the Lessee with written notice of the termination 30 days prior to the effective time of termination.

THEN

C. the University may terminate this lease, AND

7. IF

A. life, limb, or property could be jeopardized by continuation of the lease, AND

B. the University provides the Lessee with notice of the termination a minimum of 24 hours prior to the effective time of termination.

THEN

C. the University may terminate this lease, AND

8. IF

A. the Lessee engages in the sale or purchase of controlled substances in violation of federal, state or local law, AND

B. the University provides the Lessee with notice of the termination a minimum of 24 hours prior to the effective time of termination.

THEN

C. the University may terminate this lease, AND

9. IF

A. the Lessee is no longer enrolled as a student, AND

B. the University provides the Lessee with notice of the termination a minimum of 24 hours prior to the effective time of termination.

THEN

C. the University may terminate this lease, AND

10. IF

- A. the Lessee engages in the use or possession of firearms, explosives, inflammable liquids, fireworks, or other dangerous weapons within the building, AND
 - B. the University provides the Lessee with notice of the termination a minimum of 24 hours prior to the effective time of termination,
- THEN
- C. the University may terminate this lease, AND
11. IF
- A. the Lessee turns in a false fire alarm, AND
 - B. the University provides the Lessee with notice of the termination a minimum of 24 hours prior to the effective time of termination,
- THEN
- C. the University may terminate this lease, AND
12. IF
- A. life, limb, or property could NOT be jeopardized by continuation of the lease, AND
 - B. the Lessee does NOT engage in the sale or purchase of controlled substances in violation of federal, state or local law, AND
 - C. the Lessee is still enrolled as a student, AND
 - D. the Lessee does NOT engage in the use or possession of firearms, explosives, inflammable liquids, fireworks, or other dangerous weapons within the building, AND
 - E. the Lessee does NOT turn in a false fire alarm,
- THEN
- F. IT IS NOT SO THAT
- IF
- 1. the University provides the Lessee with notice of the termination a minimum of 24 hours prior to the effective time of termination,
- THEN
- 2. the University may terminate this lease.

CONCLUSION

The capability of NORMALIZER to automatically generate a wide variety of Normalized Versions of a legal rule has certainly been exemplified in copious detail. The fact that NORMALIZER makes this so easy for an analyst to do encourages the exploration of alternatives that otherwise just might not be considered. The effort to construct a Normalized Version uncovers a multitude of structural ambiguities that an analyst then has the opportunity to resolve (if s/he wishes to do so).

In this paper, NORMALIZER has been used from the viewpoint of the producer of a legal document. The same capability may have even more important significance for the users of legal documents. A form of electronic publishing far more flexible than any that has been considered to date may be practical. In one important respect a reader can choose the form of a document that is most convenient for him/her to read. There can be control exercised over the compactness or extensiveness of the document by choosing the level of normalization and thus specifying the terms used to express the logical structure of the document.

The future evolution of NORMALIZER will be in the direction of specifying within-sentence defined structural terms at both the clear and complex levels of normalization along with additional between-sentence terms at the complex level. The within-sentence clear level terms will include deontic and Hohfeldian concepts. There will also be additional between-level and within-level transformation rules specified for deriving equivalent normalizations.

The transformation of bodies of legal rules into normalized form is the first step toward one approach for getting legal knowledge into a suitable form for use in knowledge-based expert legal systems. Many of these will undoubtedly be computer-based, but there may also be a place for expert systems in the form of logically well-designed loose-leaf services.