



March 29-31, 2013

## J: Satisfaction Guaranteed

Consider a very simple programming language, with only three types of statements:

```
if <boolean expression> then <statement list> fi
if <boolean expression> then <statement list> else <statement list> fi
checkpoint
```

All keywords are required to consist of all lower case letters. A *<statement list>* is obviously just a list of one or more statements, and an entire program is a single *<statement list>*.

A *<boolean expression>* consists of:

Variables: a single capital letter

Operators: unary ~ (NOT), binary & (AND), binary | (OR).

Precedence: ~ > & > |

Parentheses

NO Spaces

*<BE>* → ~*<BE>* or *<BE>&<BE>* or *<BE>|<BE>* or (*<BE>*) or [A-Z]

Given a syntactically correct program in this simple language, what values must the boolean variables hold in order to satisfy each of the checkpoints?

### Input

Input will be a single syntactically correct program in this simple language. Keywords are guaranteed to be in all lower case, and boolean variables are guaranteed to each be a single upper case letter. White space (space, tab or newline) is guaranteed to separate keywords, and surround expressions. Expressions will not contain whitespace. Every *<statement list>* will contain at least one statement. The input program will not use more than 20 of the available variables, and will not contain more than 5,000 statements. No Boolean expression will be longer than 128 characters.

### Output

For each *checkpoint*, in the order they appear, output a single line, consisting of '>' followed by either a list of variables, or the word 'unreachable'. If the *checkpoint* is reachable, output a list of variables, in alphabetical order, with an upper case letter if it must be true, or a lower case letter if it must be false to reach the *checkpoint*. Omit the variable if it can be either. If the *checkpoint* is not reachable, then output the word 'unreachable', entirely in lower case. Do not print any spaces, and do not print any blank lines between lines of output.



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<b>Sample Input</b>	<b>Sample Output</b>
<pre>if A then   checkpoint   if ~A then     checkpoint   fi else   checkpoint fi if (A&amp;B)   (~A&amp;~B) then   checkpoint fi if A ~A then checkpoint fi if B then   if ~A then checkpoint fi fi</pre>	<pre>&gt;A &gt;unreachable &gt;a &gt; &gt; &gt;aB</pre>