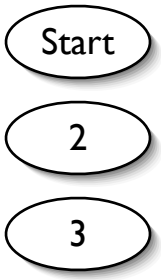
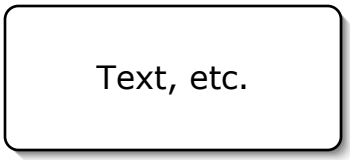
Legend:

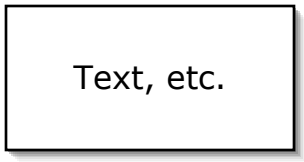
State markers:



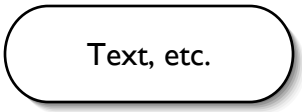
Main user visible content and interface:



Tree construction/ argumentation area:



Control:



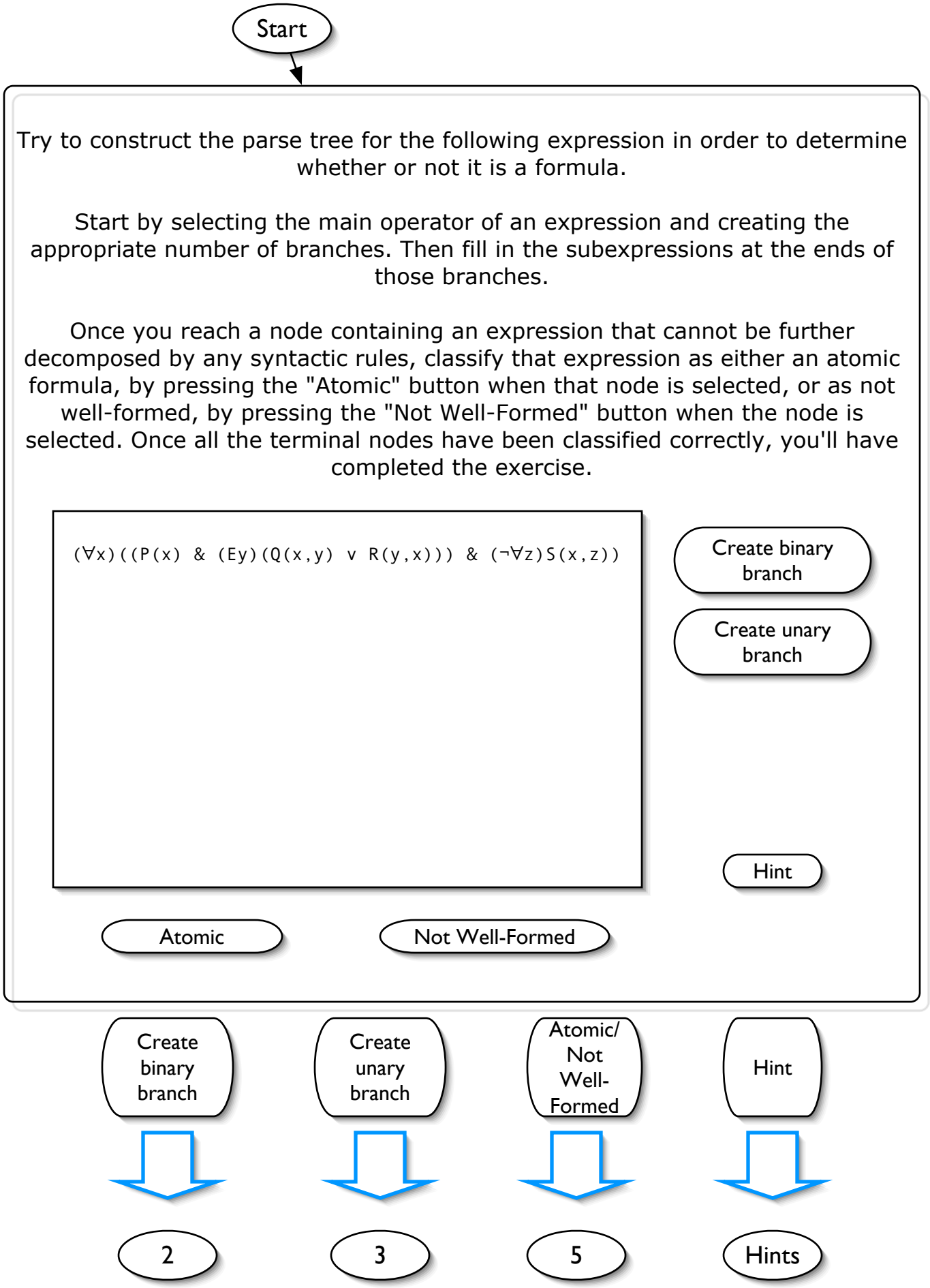
Correct move:

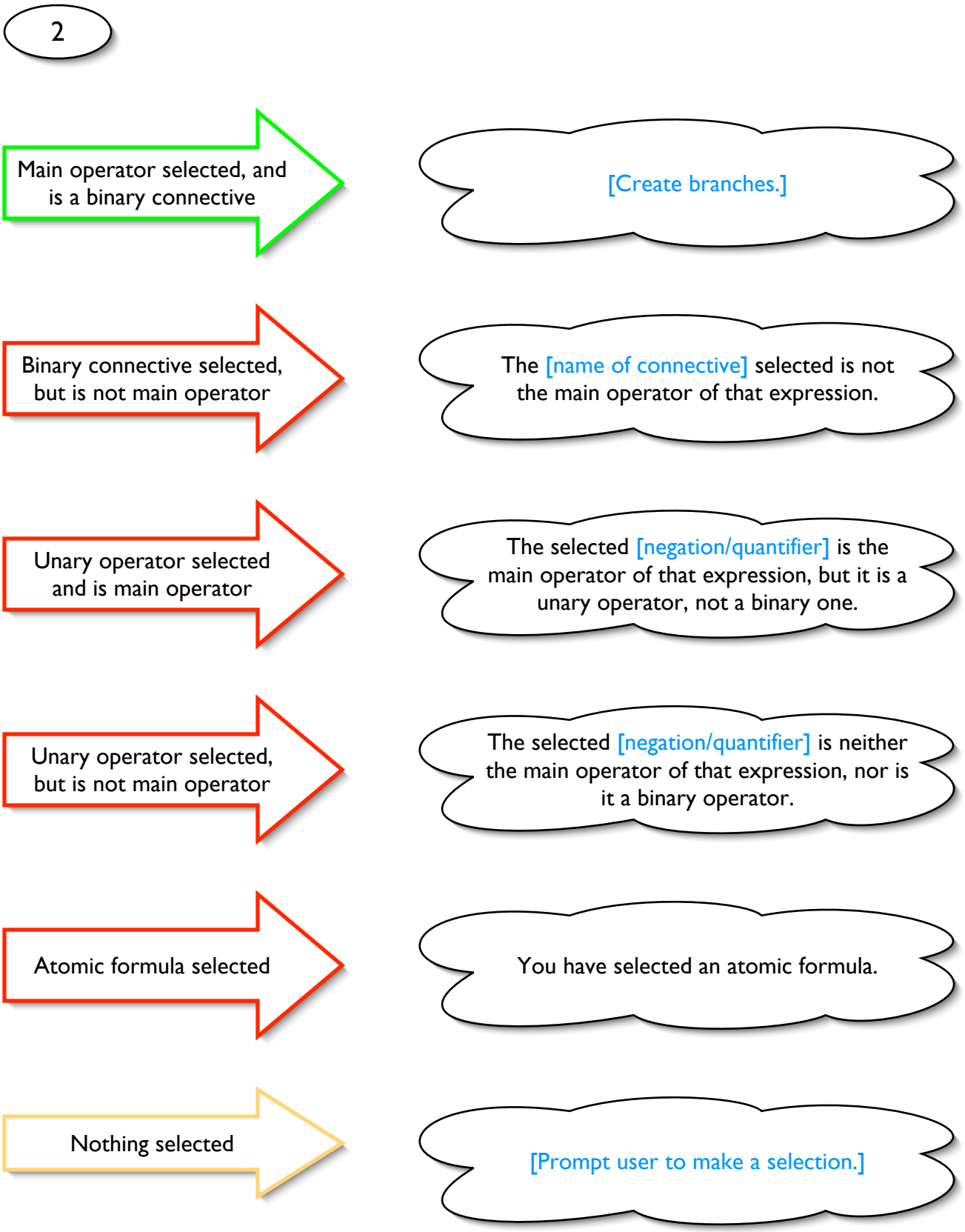
Incorrect move:

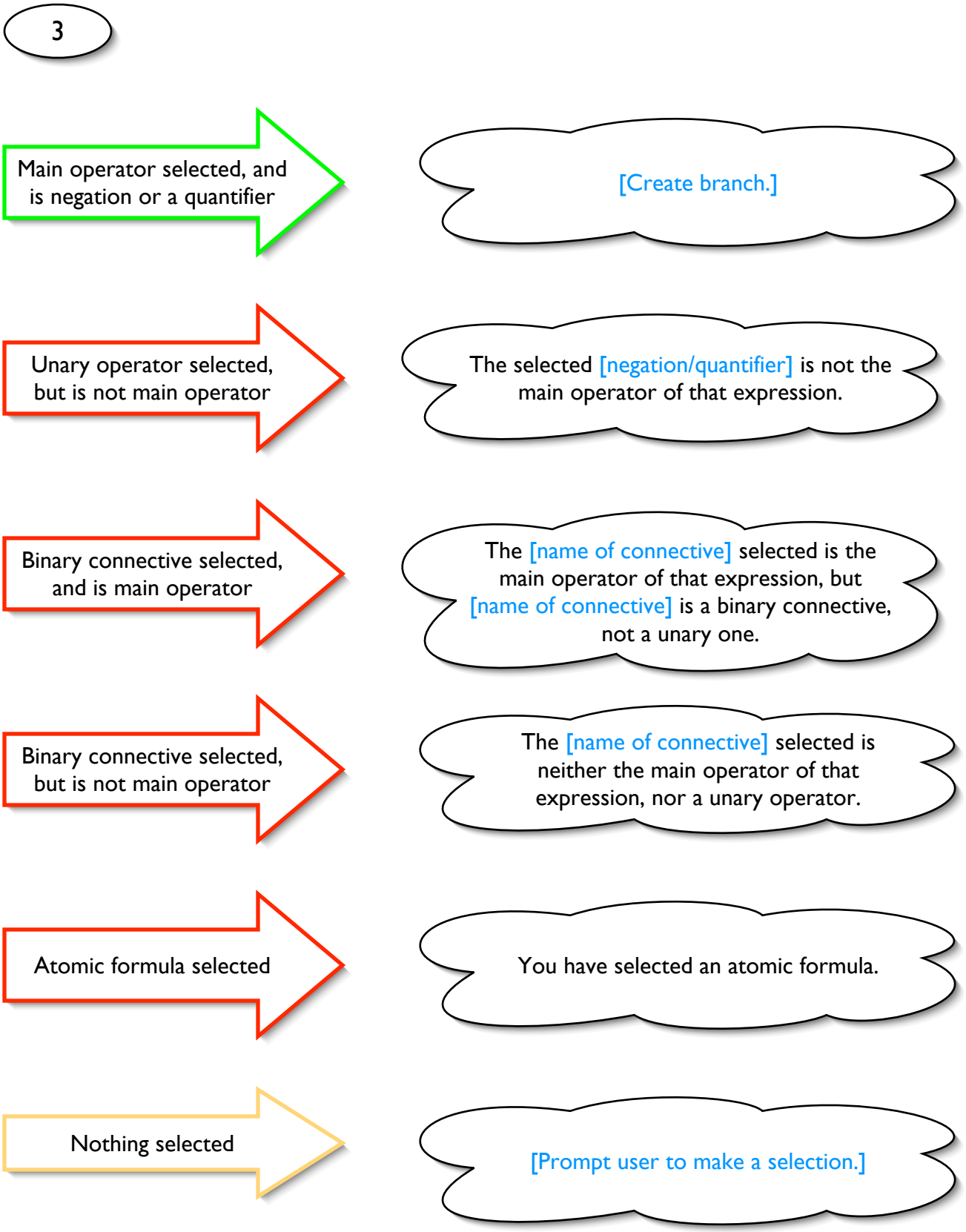
Incomplete move:

Navigational move:

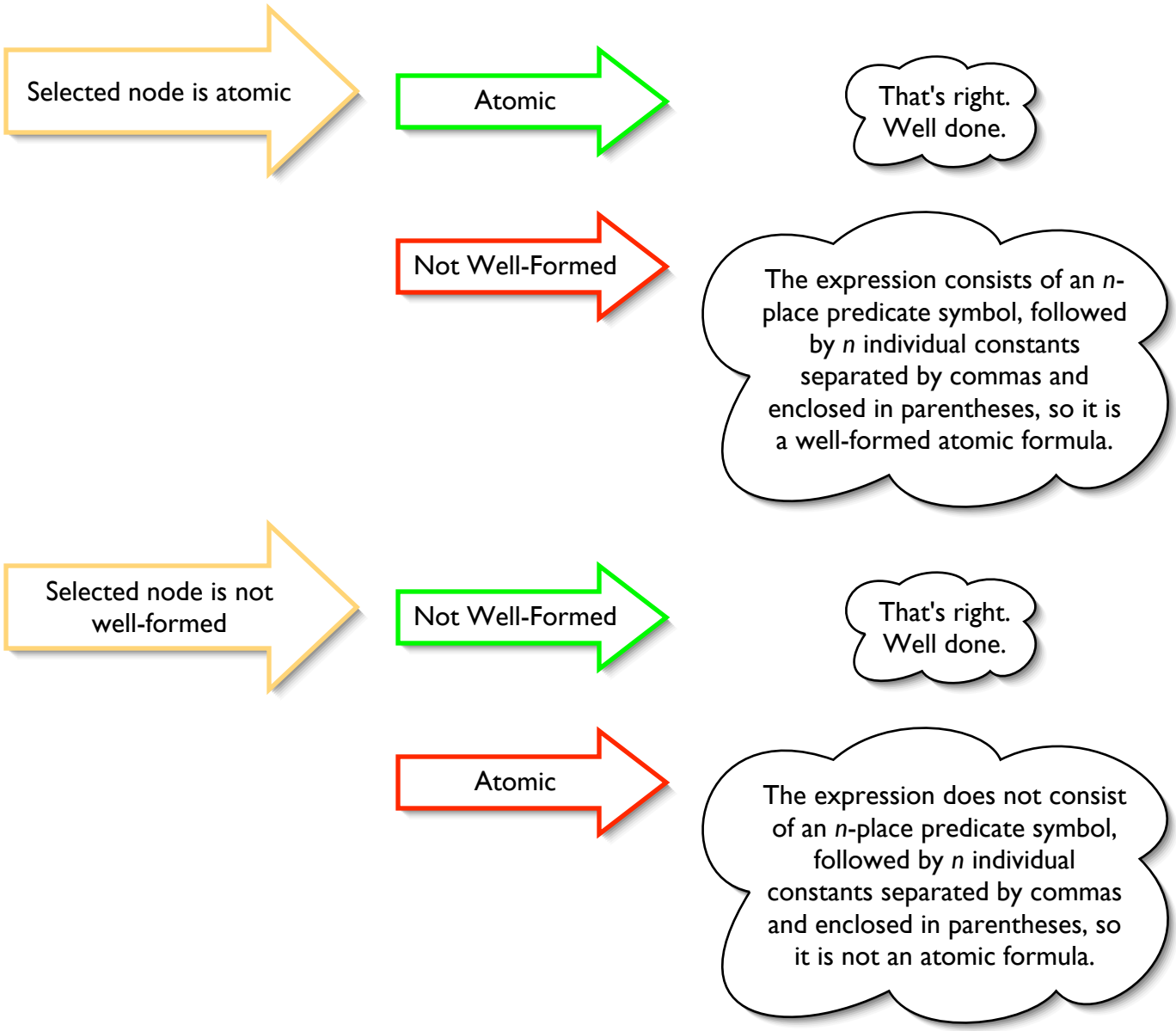
Feedback content:


Start
Try to construct the parse tree for the following expression in order to determine whether or not it is a formula.
Start by selecting the main operator of an expression and creating the appropriate number of branches. Then fill in the subexpressions at the ends of those branches.
Once you reach a node containing an expression that cannot be further decomposed by any syntactic rules, classify that expression as either an atomic formula, by pressing the "Atomic" button when that node is selected, or as not well-formed, by pressing the "Not Well-Formed" button when the node is selected. Once all the terminal nodes have been classified correctly, you'll have completed the exercise.
(∀x)((P(x) & (Ey)(Q(x,y) v R(y,x))) & (¬∀z)S(x,z))
Create binary branch
Create unary branch
Hint
Atomic
Not Well-Formed
Create binary branch
Create unary branch
Atomic/ Not Well-Formed
Hint
2
3
5
Hints


2
Main operator selected, and is a binary connective
[Create branches.]
Binary connective selected, but is not main operator
The [name of connective] selected is not the main operator of that expression.
Unary operator selected and is main operator
The selected [negation/quantifier] is the main operator of that expression, but it is a unary operator, not a binary one.
Unary operator selected, but is not main operator
The selected [negation/quantifier] is neither the main operator of that expression, nor is it a binary operator.
Atomic formula selected
You have selected an atomic formula.
Nothing selected
[Prompt user to make a selection.]

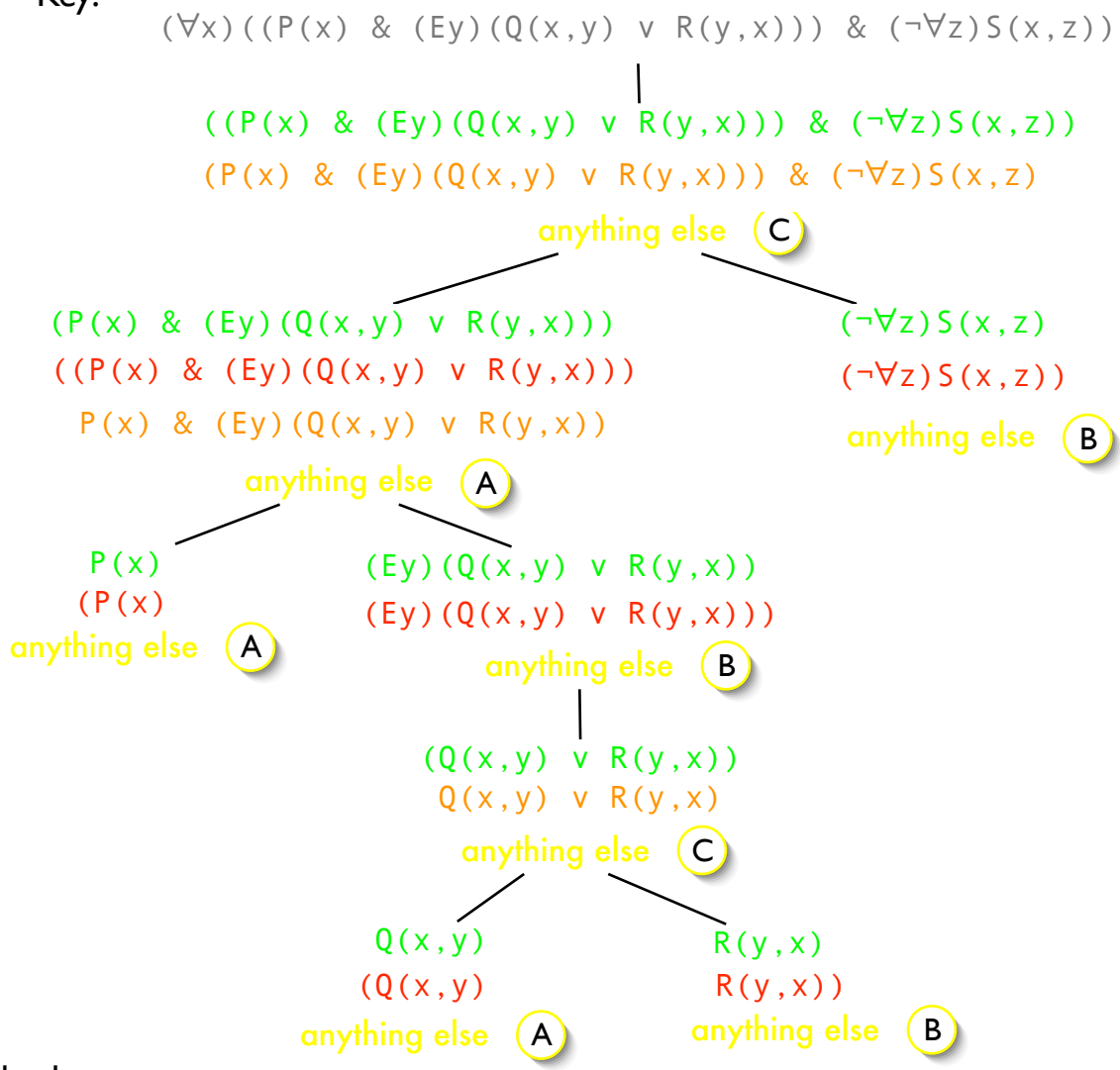

3
Main operator selected, and is negation or a quantifier
[Create branch.]
Unary operator selected, but is not main operator
The selected [negation/quantifier] is not the main operator of that expression.
Binary connective selected, and is main operator
The [name of connective] selected is the main operator of that expression, but [name of connective] is a binary connective, not a unary one.
Binary connective selected, but is not main operator
The [name of connective] selected is neither the main operator of that expression, nor a unary operator.
Atomic formula selected
You have selected an atomic formula.
Nothing selected
[Prompt user to make a selection.]

4


Selected node is atomic
Atomic
That's right. Well done.
Not Well-Formed
The expression consists of an n-place predicate symbol, followed by n individual constants separated by commas and enclosed in parentheses, so it is a well-formed atomic formula.
Selected node is not well-formed
Not Well-Formed
That's right. Well done.
Atomic
The expression does not consist of an n-place predicate symbol, followed by n individual constants separated by commas and enclosed in parentheses, so it is not an atomic formula.

Feedback for entering expressions at nodes:

Key:



Feedback:

That's right!

Don't forget that the outermost parentheses are added by the application of a syntactic rule, so the outermost parentheses of an expression higher in the tree will not appear again in the branches below.

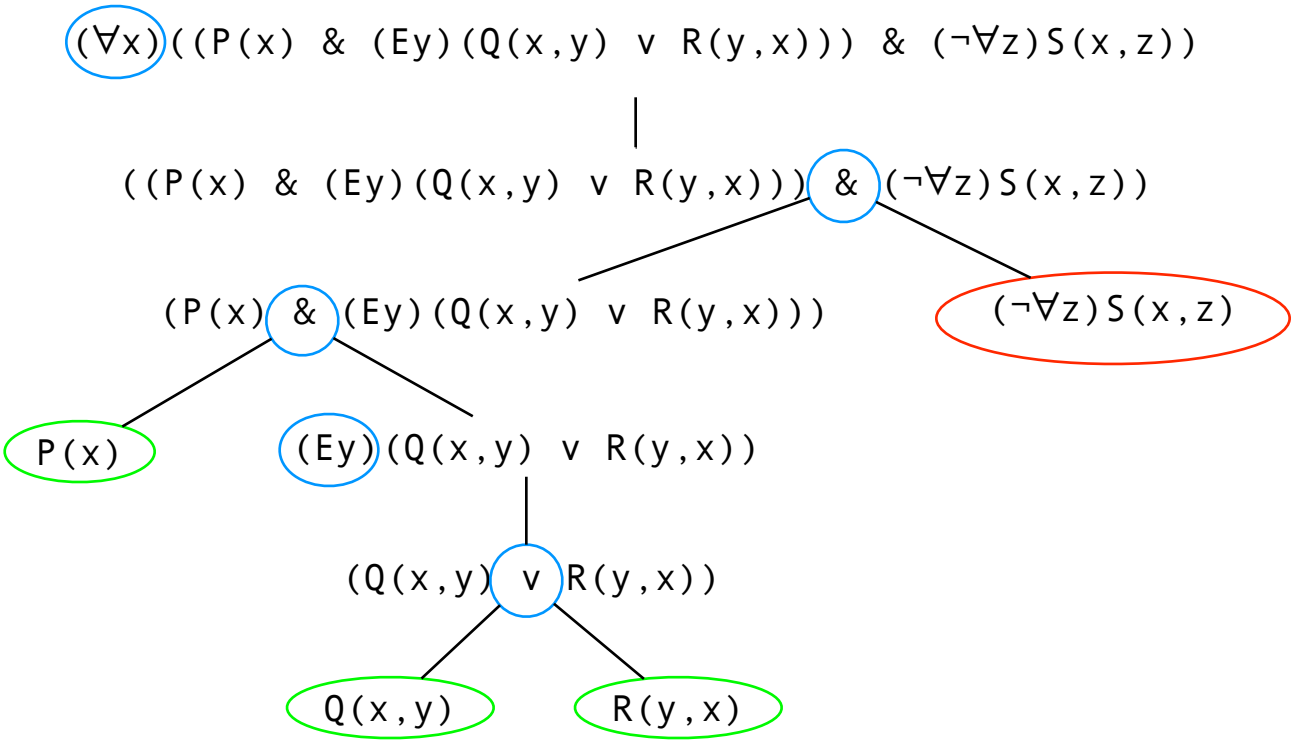
We never omit outermost parentheses in parse trees, but other than that you have the right formula.

A For a binary branch, the left-hand subexpression will always consist of that portion of the original expression between the leftmost outer parenthesis and the connective that was added by the application of the syntactic rule.

B For a binary branch, the right-hand subexpression will always consist of that portion of the original expression between the rightmost outer parenthesis and the connective that was added by the application of the syntactic rule.

C For a unary branch corresponding to an application of one of the quantifier rules, the subexpression will always consist of the original expression minus the outermost quantifier that was added by the application of the syntactic rule.

Solution:



Atomic terminal nodes are circled in green, and non-well-formed nodes in red. Additionally, the main connective of each expression is circled in blue.

Recall that **all** terminal nodes must be classified correctly by the user before the activity is complete.

For reference:

Operator Name	Symbol	Type
Conjunction	&	Binary
Disjunction	v	Binary
Conditional	→	Binary
Negation	¬	Unary
Universal Quantifier	(∀x)	Unary
Existential Quantifier	(∃x)	Unary

Hints

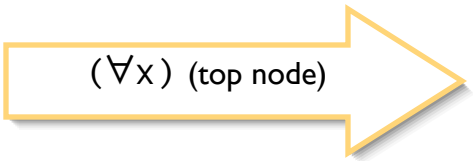
Click here to get help on how to construct the tree.

Click here to view the syntactic rules
and parse tree rules.

Links should be to the following files, respectively:

parsetreeconstruction5help.gif
parsetreeconstruction5hint.gif

The latter is already done, but I'll wait on the help images until after the interface has been finalized.



Start by selecting the main operator of the formula.

If the leftmost symbol of the expression is a negation, then that is the main connective, and if the expression has a quantifier at its far left, then that is the main operator. If not, look for a binary connective with a parenthesis to either side (a right parenthesis on its left, and a left parenthesis on its right).

In this expression, the universal quantifier is the main operator.

Click here to highlight the operator.

((P(x) & (Ey)(Q(x,y) v R(y,x))) & (¬∀z)S(x,z))

textbox

The expression that should go at the end of a unary branch corresponding to the application of one of the syntactic rules for the quantifiers is just the portion of the original expression remaining after the quantifier is removed.

For this branch, the parent expression is
(∀x)((P(x) & (Ey)(Q(x,y) v R(y,x))) & (¬∀z)S(x,z)),
so the expression that should go at the end of this branch is the portion of the expression remaining after removing the quantifier.

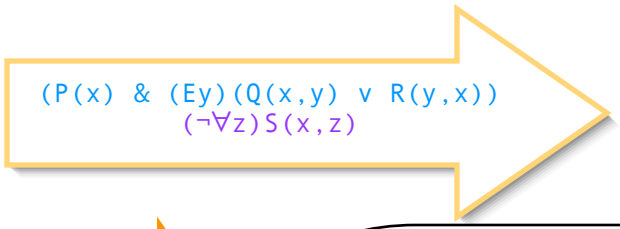
The expression you should enter here is
((P(x) & (Ey)(Q(x,y) v R(y,x))) & (¬∀z)S(x,z)).

&

If multiple connectives occur in an expression, the one with highest scope will be enclosed in only a single set of parentheses. If an occurrence has only a single unmatched parenthesis of either kind to one side, that is the occurrence to select.

In this expression, the rightmost conjunction is the main connective.

Click here to highlight the connective



textbox

The expression that should go at the end of a binary branch is just that portion of the parent expression that comes between the outermost parenthesis on the same side as the branch and the connective itself.

For this branch, the parent expression is
((P(x) & (Ey)(Q(x,y) v R(y,x))) & (¬∀z)S(x,z)), so
the expression that should go at the end of this branch is the portion of that between the [left/right] outer parenthesis and the conjunction.

The expression you should enter here is
(P(x) & (Ey)(Q(x,y) v R(y,x))
(¬∀z)S(x,z).

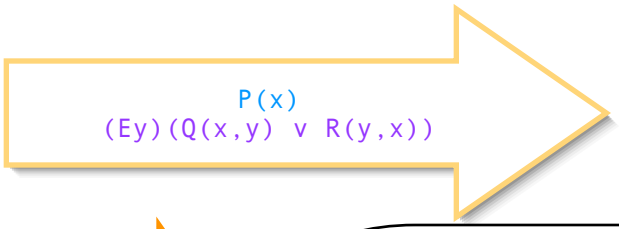
operator

If multiple connectives occur in an expression, the one with highest scope will be enclosed in only a single set of parentheses. If an occurrence has only a single unmatched parenthesis of either kind to one side, that is the occurrence to select.

If an expression contains no connectives and no quantifiers (a let parenthesis followed by a quantifier symbol, a term, and a right parenthesis), then that expression cannot be further decomposed according to the syntactic rules, and should be classified as either atomic or not well-formed.

In this expression, the conjunction is the main connective.
Click here to highlight the connective

The syntactic rules do not permit a negation symbol and a quantifier symbol to appear immediately adjacent to one another in any well-formed expression, so (¬∀z)S(x,z) is not well-formed.



textbox

The expression that should go at the end of a binary branch is just that portion of the parent expression that comes between the outermost parenthesis on the same side as the branch and the connective itself.

For this branch, the parent expression is `(P(x) & (Ey)(Q(x,y) v R(y,x)))`, so the expression that should go at the end of this branch is the portion of that between the [left/right] outer parenthesis and the conjunction.

The expression you should enter here is
`P(x)`
`(Ey)(Q(x,y) v R(y,x))`.

operator

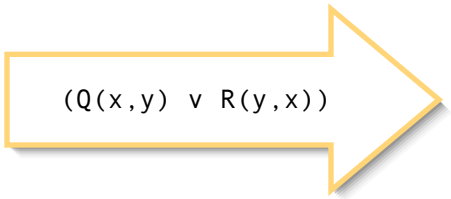
If an expression contains no connectives and no quantifier symbols, then that expression cannot be further decomposed according to the syntactic rules, and should be classified as either atomic or not well-formed.

If an expression has a quantifier at its far left, with no parenthesis to the left of the quantifier's left parenthesis, then the quantifier is the main operator for the expression.

Since P(x) consists of a predicate letter followed by a single term enclosed in parentheses, it is a well-formed atomic formula.

In this expression, the quantifier is the main connective.

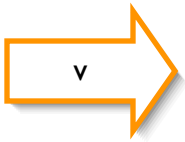
Click here to highlight the connective



The expression that should go at the end of a unary branch corresponding to the application of one of the syntactic rules for the quantifiers is just the portion of the original expression remaining after the quantifier is removed.

For this branch, the parent expression is `(Ey)(Q(x,y) v R(y,x))`, so the expression that should go at the end of this branch is the portion of the expression remaining after removing the quantifier.

The expression you should enter here is `(Q(x,y) v R(y,x))`.

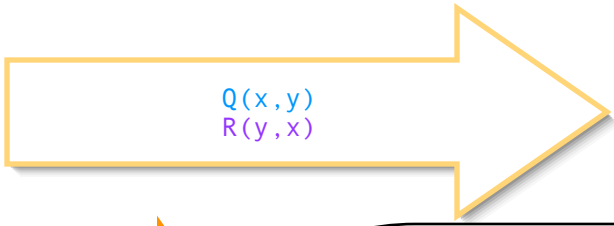


If only a single binary connective occurs in an expression, then as long as the expression is enclosed in parentheses, that binary connective is the one to select.

This expression is enclosed in parentheses, and the only binary connective it contains is a single occurrence of disjunction.

In this expression, the disjunction is the main connective.

Click here to highlight the connective.



textbox

The expression that should go at the end of a binary branch is just that portion of the parent expression that comes between the outermost parenthesis on the same side as the branch and the connective itself.

For this branch, the parent expression is (Q(x,y) v R(y,x)), so the expression that should go at the end of this branch is the portion of that between the [left/right] outer parenthesis and the conjunction.

The expression you should enter here is
Q(x,y)
R(y,x).

operator

If an expression contains no connectives and no quantifier symbols, then that expression cannot be further decomposed according to the syntactic rules, and should be classified as either atomic or not well-formed.

Since Q(x,y)/R(y,x) consists of a predicate letter, followed by two terms enclosed in parentheses and separated by a comma, it is a well-formed atomic formula.