1. Get up and running

The dependencies for this project are matplotlib, network, and pygraphviz.
These should all be available on mds computers.

Alternatively, to install pygraphviz, install brew from https://brew.sh/ on your Linux/macOS machine and install pygraphviz by typing `brew install graphviz`

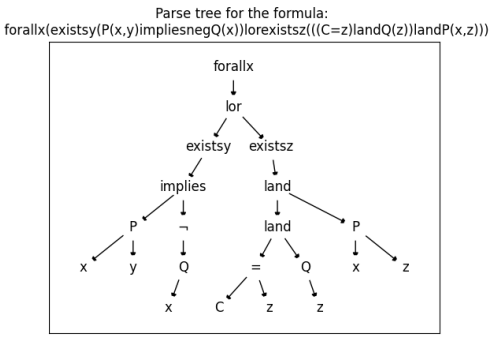
To run the parser first

1. cd into the directory containing parser.py
2. type `python parser.py <path to input file>`
    a. e.g. `python parser.py ./example.txt`

2. What to expect

There will be two outputs into the current directory both time-stamped in their name when created to avoid writing over old files:

1. A log file: “parse_log Fri Mar 6 04/28/50 2020.log”
    - A complete pre order traversal of the syntax tree
        - Or an incomplete one in the case of encountering an error
        - Note: no traversal will be given if the formula is found to be invalid before attempting to build the tree.
    - A list of error messages, shown recursively similar to how python gives error messages.
2. A PNG file: “parse_tree Fri Mar 6 04/28/50 2020.png”
    - Showing the parse tree for the formula, if it is valid.
    - And the original formula at the top.
3. A txt file: “grammar Fri Mar 6 04/28/51 2020.txt”, containing the grammar of this specific input file.



3. Parser.py file structure

The project consists of 2 classes, formula and userDefinedSyntax. 2 functions, log_error and formula_to_graph.

- userDefinedSyntax parses the desired input file,
    - finds any errors in variable/constant/predicate declarations explained further in section 4.
- Formula is a class with multiple formula objects as its ‘children’
    - it is essentially a recursive function in so far as the constructor,
    - each child object of the root formula object has a type and a value and optionally a child(ren).
    - but obviously not for individual atoms (in FOL it would be either a constant or a variable).
- log_error is a two-line function,

    - its sole purpose is to simplify the codebase to make logging errors more understandable.
- formula_to_graph takes an instance of the formula class and recursively expands on the object's children, adding the relevant nodes to the networkX graph declared globally.

4. Error checking

The parser should be able to parse any of your favourite FO formulae, I will quickly outline the kind of error checking the parser is doing:

- While parsing the input file
    - finds any errors in variable/constant/predicate declarations,
    - such as having non-alphanumeric/underscores names,
    - or a predicate declared with a non-numeric arity,
    - or if there are any duplicate name declarations in the file.
    - There are the suitable number of logical connectives

- While parsing the formula
    - Logical connectives have been negated
    - Predicates used in a formula that have not been declared in the syntax
    - Unexpected number of arguments given to a predicate.
    - Constants being used as arguments for predicates.
    - Attempting to quantify a constant

- Building the tree
    - Any uncaught errors in my understanding of the grammar of first order logic, or otherwise in the syntax or formula. This is clear as any node that is not a term (constant or variable) must have at least one child. The error log will reflect on the exact formula sub formula of the original input where the error was encountered.

5. Notes

- I was having a lot of problems with encoding backslashes in the python file with regex and otherwise, for this reason I strip all predicates, variable names qualifiers etc. of it. It was extremely unstable since it more often than not failed in string comparisons of two identical strings.
- I use pygraphviz to give the tree the hierarchical structure it has since the fixed positions I gave by doing an in-order traversal of the graph occasionally had overlapping edges when the plot was made on a low-resolution machine, where the root node had any more than 40 children
- At a few points I reference the different 'cases' of the formula given to the constructor

```
# case 1: ¬formula
# case 2: primative_formula
# case 3: quantifier variable formula
# case 4: Term
# case 5: formula connective formula
```

- These are outlined more in the grammar file, but for clarities sake:
    - A term is a variable or constant. A primitive formula is predicate function that takes any sequence of terms as a parameter (Constants are excluded later for more meaningful error messages; the length of the sequence is also checked).
    - Note: the grammar states formula -> (formula), this is allowed as all parentheses are stripped in my implementation, I did not realise the invalidity that it would make in your FOL grammar, and assumed that since it makes sense semantically it would take too much re-working of the formula class to find redundant braces for only certain cases.