

## Question 1: (60%)

### Coding Logic

In this programming assignment you will be given a list of queries and a knowledge base in a file named `input.txt`. You will have to decide whether each query can be inferred from the knowledge base using GMP and forward-chaining. Your program should generate an outfile called `output.txt` which should contain the answer 'yes' or 'no' for each query on a separate line. Here we assume that 'no' means that the query cannot be inferred from the sentences provided in the knowledge base, which does not necessarily mean that one might be able to infer that the query is false (it could also be that you just don't have any knowledge about some of the elements of the query).

Your program must allow for variables (`x`, `y`, `z`, ...) and constants (`JOE`, `BILL`, ...). Variables will all be single-letter and lowercase. Constant symbols can be single or multiple letters and uppercase. Your program should also allow for predicates of the form `predicate(...)` which can take up to 1,000,000 arguments (variables and/or constants) separated by commas. Predicates will be multiple-letter lowercase strings followed by parentheses.

### Input format:

The first line will be the number of queries. The subsequent number of lines (depending of the number of queries) will all be queries you must solve. The remaining lines will be the contents of the knowledge base.

sample input:

```
3
evil(HOMEWORK)
cool(YOU)
evil(YOU)
lessfunthan(x, TV) ^ noun(x) -> evil(x)
lessfunthan(HOMEWORK, BEINGSICK)
lessfunthan(x, BEINGSICK) -> lessfunthan(x, TV)
finish(x, y) ^ noun(x) ^ evil(y) -> cool(x)
noun(x) ^ noun(y) -> finish(x, y)
noun(HOMEWORK)
noun(YOU)
```

notes:

1. white space should not be a factor. There can be any number of spaces between words or after words.
2. programs which do not read the format of the sample input will receive 0 credit.
3. `->` means implies, `!` means not, `^` means and, `|` means or.

**Output format:**

A list of 'yes' or 'no' dependent upon whether the query can be inferred from the knowledge base or not

sample output:

yes

yes

no

CAUTION: please follow these simple rules

- do not expect any command-line argument.
- make sure your code compiles on aludra.usc.edu using g++
- provide a Makefile or indicate in a README how to compile your code.
- your program should read one text file named "input.txt" which will contain a problem definition, and should write one text file named "output.txt" which will contain your solution.
- Assume unix text files (single LF at end of line, no CR).

**Question 2: (40%)**

1. Please draw a proof tree of backward chaining for the above sample input problem.
2. Translate the following sentences into first order logic, using a consistent vocabulary that you must define:
  - a. a ship that uses airguns and bombs is deadly
  - b. not every ship uses both airguns and bombs
  - c. bombs kill more than airguns