

ELEC60004/70068 Machine Reasoning
Tutorial 3 – Knowledge Representation

1.

Some villagers have found a witch (or so they think) and want to burn her. Consider the following statements of Sir Bedevere.

For anything, if it is a woman and it burns, then it is a witch.
For anything, if it is made of wood, then it burns.
For anything, if it floats, then it is made of wood.
For any two things, if the first thing floats, and it weighs the same as the second thing, then the second thing floats.

Express these four statements as formulas of First Order Predicate Logic, and translate them into clausal form.

Consider the following facts:

By observation, *the girl is a woman.*
By observation, *the duck floats.*
By experiment, *the duck weighs the same as the girl.*

Express these facts in clausal form. Explain why existential quantifiers have not been used.

Prove, using resolution and showing the unifiers, that *the girl is a witch* [and so the villagers should, in fact, burn her (Burn her! Burn her! etc.)].

2.

In Isleworth Crown Court, the barristers for prosecution and defence establish and accept the following arguments:

If a psychiatrist says someone is a nutter, then they are not of-sound-mind.

If anyone is of-sound-mind, then they are responsible for their actions.

If anyone is not of-sound-mind, then they are not responsible for their actions.

If someone burns their flat down and is responsible, then they are guilty of arson.

If someone burns their flat down and is not responsible, then they are guilty-but-insane.

Express these five arguments as formulas of First Order Predicate Logic, and translate them into clausal form.

A judge admits the following facts:

Sigmund is a psychiatrist.

g burnt her flat down.

Sigmund says g is a nutter.

Express these facts in clausal form.

As the jury, using proof-by-refutation and the resolution rule (showing the unifiers), prove that: *g is guilty-but-insane.*

3.

In *Bill, The Galactic Hero*, Bill is accused of being AWOL from the space troopers. The presiding judge makes the following statements:

If anyone is in the space troopers, they must be on duty.

If anyone has been on planet Helior for a year, they must have slept.

If anyone is on duty and has slept, they must have slept on duty.

If anyone sleeps on duty, they must be guilty.

Express these four statements as formulas of First Order Predicate Logic, and translate them into clausal form.

The judge accepts the following facts:

Bill is in the space troopers.

Bill has been on planet Helior for a year.

Express these facts in clausal form.

Prove, using resolution and showing the unifiers, that *Bill is guilty*.

4.

The ISN research group has a saying that:

If it looks like a thesis and it smells like a thesis, then it is a thesis.

It is also rumoured that:

If it passes the flick test, then it looks like a thesis.

If it passes the sniff test, then it smells like a thesis.

If one document passes the sniff test, and a second document weighs the same as the first document, then the second document passes the sniff test.

Express these four statements as formulas of First Order Predicate Logic, and translate them into clausal form.

Consider the following facts:

*Brendan's document passes the flick test.*¹

*Lloyd's document passes the sniff test.*²

Lloyd's document weighs the same as Brendan's document.

Express these facts in clausal form.

Prove, using resolution and showing the unifiers, that *Brendan's document is a thesis*.

¹ A document passes the flick test if the supervisor riffles through the pages and observes an adequate number of equations, graphs and fivers stapled to the pages.

² A document passes the sniff test if the supervisor opens it at a random page and inhales that unique aroma of printer ink, debt and desperation.