

Please solve the following 4 exercises. 50% gives a passing grade.

## 1 Features

Extract the features from the following first-order logic formula:

$$p(f(X, f(a, b))) \rightarrow p(f(a, b))$$

Please consider at least two different kinds of features (for example path features and anti-unification features).

## 2 Skolemization

Consider the following TPTP first-order problem:

```
f of (a, axiom, ![X]. ?[Y]. (p(X, Y) => q(Y, X))).  
f of (c, conjecture, ?[X]. ![Y]. (~q(Y, X) & p(X, Y))).
```

Transform the problem to an equisatisfiable problem. When selecting the names of the Skolem functions/constants, try to use names that will be consistent across problems if this is possible (consistent skolemization).

### 3 Unification

Given a unary function symbol “ $\xi$ ” and a binary function symbol “ $\rightarrow$ ” find a solution to the following unification problem.

$$\xi(\beta) \approx \xi(\alpha \rightarrow \delta) \quad \beta \approx (\gamma \rightarrow \delta) \rightarrow \epsilon$$

Is the solution unique?

### 4 Premise Selection

Consider the premises characterized by the features and dependencies:

features:

a1 : f1 f2 f4 f6 : d1 d4

a2 : f3 f5 f6 : d2 d3

a3 : f2 f5 f6 : d1 d5

dependencies:

a1 : f1 f2 f4 f6 : d1 d4

a2 : f3 f5 f6 : d2 d3

a3 : f2 f5 f6 : d1 d5

And a conjecture characterized by the features f2 f6.

Use one of the simple premise selection methods (k-NN, Naive Bayes, or Sine) to order the available premises ( $a_{1..3}, d_{1-5}$ ).