Top Down Proof Demonstrations

Using predicates - SLD Resolution

Start from query and work backwards.

SLD Resolution - Lion loose at NUIG.

```
smarter(lion, lecturer).
chases(lion, lecturer).
chases(lion, nuig_student).
deadend(nuig_student).
caught(Y) ← chases(X,Y) ∧ smarter(X,Y).
caught(Y) ← chases(X,Y) ∧ deadend(Y).
```

Caught by lion:

SLD Resolution - Lion loose at NUIG.

```
smarter(lion, lecturer).
chases(lion, lecturer).
chases(lion, nuig_student).
deadend(nuig_student).
caught(Y) ← chases(X,Y) ∧ smarter(X,Y).
caught(Y) ← chases(X,Y) ∧ deadend(Y).

caught(X)?
```

Caught by lion:

SLD Resolution - Lion loose at NUIG.

```
smarter(lion, lecturer).
chases(lion, lecturer).
chases(lion, nuig_student).
deadend(nuig_student).
caught(Y) ← chases(X,Y) ∧ smarter(X,Y).
caught(Y) ← chases(X,Y) ∧ deadend(Y).

caught(X)?
yes(X) ← caught(X).
```

Caught by lion:

SLD Resolution - Lion loose at NUIG.

```
smarter(lion, lecturer).
chases(lion, lecturer).
chases(lion, nuig_student).
deadend(nuig_student).
caught(Y) ← chases(X,Y) ∧ smarter(X,Y).
caught(Y) ← chases(X,Y) ∧ deadend(Y).

caught(X)?
yes(X) ← caught(X).
    caught(Y′) ← chases(X′, Y′) ∧ smarter(X′, Y′).
    {Y′/X, X′/_}
yes(X) ← chases(X′, X) ∧ smarter(X′, X).
```

Caught by lion:

SLD Resolution - Lion loose at NUIG.

```
smarter(lion, lecturer).
chases(lion, lecturer).
chases(lion, nuig_student).
deadend(nuig_student).
caught(Y) ← chases(X,Y) ∧ smarter(X,Y).
caught(Y) ← chases(X,Y) ∧ deadend(Y).

caught(X)?
yes(X) ← caught(X).
    caught(Y′) ← chases(X′, Y′) ∧ smarter(X′, Y′).
    {Y′/X, X′/_}
yes(X) ← chases(X′, X) ∧ smarter(X′, X).
    chases(lion, lecturer).
    {X′/lion, X/lecturer}
yes(lecturer) ← smarter(lion, lecturer).
```

Caught by lion:

SLD Resolution - Lion loose at NUIG.

```
smarter(lion, lecturer).
chases(lion, lecturer).
chases(lion, nuig_student).
deadend(nuig_student).
caught(Y) ← chases(X,Y) ∧ smarter(X,Y).
caught(Y) ← chases(X,Y) ∧ deadend(Y).

caught(X)?
yes(X) ← caught(X).
    caught(Y′) ← chases(X′, Y′) ∧ smarter(X′, Y′).
    {Y′/X, X′/_}
yes(X) ← chases(X′, X) ∧ smarter(X′, X).
    chases(lion, lecturer).
    {X′/lion, X/lecturer}
yes(lecturer) ← smarter(lion, lecturer).
yes(lecturer) ←.
```

Caught by lion:

SLD Resolution - Lion loose at NUIG.

```
smarter(lion, lecturer).
chases(lion, lecturer).
chases(lion, nuig_student).
deadend(nuig_student).
caught(Y) ← chases(X,Y) ∧ smarter(X,Y).
caught(Y) ← chases(X,Y) ∧ deadend(Y).
```

Caught by lion:
lecturer

```
caught(X)?
yes(X) ← caught(X).
    caught(Y′) ← chases(X′, Y′) ∧ smarter(X′, Y′).
    {Y′/X, X′/_}
yes(X) ← chases(X′, X) ∧ smarter(X′, X).
    chases(lion, lecturer).
    {X′/lion, X/lecturer}
yes(lecturer) ← smarter(lion, lecturer).
yes(lecturer) ←.
```

SLD Resolution - Lion loose at NUIG.

```
smarter(lion, lecturer).
chases(lion, lecturer).
chases(lion, nuig_student).
deadend(nuig_student).
caught(Y) ← chases(X,Y) ∧ smarter(X,Y).
caught(Y) ← chases(X,Y) ∧ deadend(Y).
```

Caught by lion:
lecturer

```
caught(X)?
yes(X) ← caught(X).
    caught(Y′) ← chases(X′, Y′) ∧ smarter(X′, Y′).
    {Y′/X, X′/_}
yes(X) ← chases(X′, X) ∧ smarter(X′, X).
```

SLD Resolution - Lion loose at NUIG.

```
smarter(lion, lecturer).
chases(lion, lecturer).
chases(lion, nuig_student).
deadend(nuig_student).
caught(Y) ← chases(X,Y) ∧ smarter(X,Y).
caught(Y) ← chases(X,Y) ∧ deadend(Y).
```

Caught by lion:
lecturer

```
caught(X)?
yes(X) ← caught(X).
    caught(Y′) ← chases(X′, Y′) ∧ smarter(X′, Y′).
    {Y′/X, X′/_}
yes(X) ← chases(X′, X) ∧ smarter(X′, X).
    chases(lion, nuig_student).
    {X′/lion, X/nuig_student}
yes(nuig_student) ← smarter(lion, nuig_student).
```

SLD Resolution - Lion loose at NUIG.

```
smarter(lion, lecturer).
chases(lion, lecturer).
chases(lion, nuig_student).
deadend(nuig_student).
caught(Y) ← chases(X,Y) ∧ smarter(X,Y).
caught(Y) ← chases(X,Y) ∧ deadend(Y).

caught(X)?
yes(X) ← caught(X).
    caught(Y′) ← chases(X′, Y′) ∧ smarter(X′, Y′).
    {Y′/X, X′/_}
yes(X) ← chases(X′, X) ∧ smarter(X′, X).
    chases(lion, nuig_student).
    {X′/lion, X/nuig_student}
yes(nuig_student) ← smarter(lion, nuig_student).    FAIL!
```

Caught by lion:
lecturer

SLD Resolution - Lion loose at NUIG.

```
smarter(lion, lecturer).
chases(lion, lecturer).
chases(lion, nuig_student).
deadend(nuig_student).
caught(Y) ← chases(X,Y) ∧ smarter(X,Y).
caught(Y) ← chases(X,Y) ∧ deadend(Y).
```

Caught by lion:
lecturer

```
caught(X)?
yes(X) ← caught(X).
    caught(Y′) ← chases(X′, Y′) ∧ smarter(X′, Y′).
    {Y′/X, X′/_}
yes(X) ← chases(X′, X) ∧ smarter(X′, X).
    chases(lion, nuig_student).
    {X′/lion, X/nuig_student}
yes(nuig_student) ← smarter(lion, nuig_student).
```

SLD Resolution - Lion loose at NUIG.

```
smarter(lion, lecturer).
chases(lion, lecturer).
chases(lion, nuig_student).
deadend(nuig_student).
caught(Y) ← chases(X,Y) ∧ smarter(X,Y).
caught(Y) ← chases(X,Y) ∧ deadend(Y).
```

Caught by lion:
lecturer

```
caught(X)?
yes(X) ← caught(X).
    caught(Y′) ← chases(X′, Y′) ∧ smarter(X′, Y′).
    {Y′/X, X′/_}
yes(X) ← chases(X′, X) ∧ smarter(X′, X).
```

SLD Resolution - Lion loose at NUIG.

```
smarter(lion, lecturer).
chases(lion, lecturer).
chases(lion, nuig_student).
deadend(nuig_student).
caught(Y) ← chases(X,Y) ∧ smarter(X,Y).
caught(Y) ← chases(X,Y) ∧ deadend(Y).

caught(X)?
yes(X) ← caught(X).
```

Caught by lion:
lecturer

SLD Resolution - Lion loose at NUIG.

```
smarter(lion, lecturer).
chases(lion, lecturer).
chases(lion, nuig_student).
deadend(nuig_student).
caught(Y) ← chases(X,Y) ∧ smarter(X,Y).
caught(Y) ← chases(X,Y) ∧ deadend(Y).

caught(X)?
yes(X) ← caught(X).
    caught(Y′) ← chases(X′, Y′) ∧ deadend(Y′).
    {Y′/X, X′/_}
yes(X) ← chases(X′, X) ∧ deadend(X).
```

Caught by lion:
lecturer

SLD Resolution - Lion loose at NUIG.

```
smarter(lion, lecturer).
chases(lion, lecturer).
chases(lion, nuig_student).
deadend(nuig_student).
caught(Y) ← chases(X,Y) ∧ smarter(X,Y).
caught(Y) ← chases(X,Y) ∧ deadend(Y).

caught(X)?
yes(X) ← caught(X).
    caught(Y′) ← chases(X′, Y′) ∧ deadend(Y′).
    {Y′/X, X′/_}
yes(X) ← chases(X′, X) ∧ deadend(X).
    chases(lion, lecturer).
    {X′/lion, X/lecturer}
yes(lecturer) ← deadend(lecturer).
```

Caught by lion:
lecturer

SLD Resolution - Lion loose at NUIG.

```
smarter(lion, lecturer).
chases(lion, lecturer).
chases(lion, nuig_student).
deadend(nuig_student).
caught(Y) ← chases(X,Y) ∧ smarter(X,Y).
caught(Y) ← chases(X,Y) ∧ deadend(Y).

caught(X)?
yes(X) ← caught(X).
    caught(Y′) ← chases(X′, Y′) ∧ deadend(Y′).
    {Y′/X, X′/_}
yes(X) ← chases(X′, X) ∧ deadend(X).
    chases(lion, lecturer).
    {X′/lion, X/lecturer}
yes(lecturer) ← deadend(lecturer).
```

FAIL!

Caught by lion:
lecturer

SLD Resolution - Lion loose at NUIG.

```
smarter(lion, lecturer).
chases(lion, lecturer).
chases(lion, nuig_student).
deadend(nuig_student).
caught(Y) ← chases(X,Y) ∧ smarter(X,Y).
caught(Y) ← chases(X,Y) ∧ deadend(Y).
```

Caught by lion:
lecturer

```
caught(X)?
yes(X) ← caught(X).
    caught(Y′) ← chases(X′, Y′) ∧ deadend(Y′).
    {Y′/X, X′/_}
yes(X) ← chases(X′, X) ∧ deadend(X).
    chases(lion, lecturer).
    {X′/lion, X/lecturer}
yes(lecturer) ← deadend(lecturer).
```

SLD Resolution - Lion loose at NUIG.

```
smarter(lion, lecturer).
chases(lion, lecturer).
chases(lion, nuig_student).
deadend(nuig_student).
caught(Y) ← chases(X,Y) ∧ smarter(X,Y).
caught(Y) ← chases(X,Y) ∧ deadend(Y).

caught(X)?
yes(X) ← caught(X).
    caught(Y′) ← chases(X′, Y′) ∧ deadend(Y′).
    {Y′/X, X′/_}
yes(X) ← chases(X′, X) ∧ deadend(X).
```

Caught by lion:
lecturer

SLD Resolution - Lion loose at NUIG.

```
smarter(lion, lecturer).
chases(lion, lecturer).
chases(lion, nuig_student).
deadend(nuig_student).
caught(Y) ← chases(X,Y) ∧ smarter(X,Y).
caught(Y) ← chases(X,Y) ∧ deadend(Y).

caught(X)?
yes(X) ← caught(X).
    caught(Y′) ← chases(X′, Y′) ∧ deadend(Y′).
    {Y′/X, X′/_}
yes(X) ← chases(X′, X) ∧ deadend(X).
    chases(lion, nuig_student).
    {X′/lion, X/nuig_student}
yes(nuig_student) ← deadend(nuig_student).
```

Caught by lion:
lecturer

SLD Resolution - Lion loose at NUIG.

```
smarter(lion, lecturer).
chases(lion, lecturer).
chases(lion, nuig_student).
deadend(nuig_student).
caught(Y) ← chases(X,Y) ∧ smarter(X,Y).
caught(Y) ← chases(X,Y) ∧ deadend(Y).

caught(X)?
yes(X) ← caught(X).
    caught(Y′) ← chases(X′, Y′) ∧ deadend(Y′).
    {Y′/X, X′/_}
yes(X) ← chases(X′, X) ∧ deadend(X).
    chases(lion, nuig_student).
    {X′/lion, X/nuig_student}
yes(nuig_student) ← deadend(nuig_student).
yes(nuig_student) ←
```

Caught by lion:
lecturer

SLD Resolution - Lion loose at NUIG.

```
smarter(lion, lecturer).
chases(lion, lecturer).
chases(lion, nuig_student).
deadend(nuig_student).
caught(Y) ← chases(X,Y) ∧ smarter(X,Y).
caught(Y) ← chases(X,Y) ∧ deadend(Y).

caught(X)?
yes(X) ← caught(X).
    caught(Y′) ← chases(X′, Y′) ∧ deadend(Y′).
    {Y′/X, X′/_}
yes(X) ← chases(X′, X) ∧ deadend(X).
    chases(lion, nuig_student).
    {X′/lion, X/nuig_student}
yes(nuig_student) ← deadend(nuig_student).
yes(nuig_student) ←
```

Caught by lion:
lecturer
nuig_student

Prolog trace

```
[trace] ?- caught(X).
Call:  (7) caught(_G312) ?  creep
Call:  (8) chases(_L191,_G312) ?  creep
Exit:  (8) chases(lion, lecturer) ?  creep
Call:  (8) smarter(lion, lecturer) ?  creep
Exit:  (8) smarter(lion, lecturer) ?  creep
Exit:  (7) caught(lecturer) ?  creep
X = lecturer ;
Redo:  (8) chases(_L191,_G312) ?  creep
Exit:  (8) chases(lion, nuig_student) ?  creep
Call:  (8) smarter(lion, nuig_student) ?  creep
Fail:  (8) smarter(lion, nuig_student) ?  creep
Redo:  (7) caught(_G312) ?  creep
Redo:  (7) caught(_G312) ?  creep
Call:  (8) chases(_L199, _G312) ?  creep
Exit:  (8) chases(lion, lecturer) ?  creep
Call:  (8) deadend(lecturer) ?  creep
Fail:  (8) deadend(lecturer) ?  creep
Redo:  (8) chases(_L199, _G312) ?  creep
Exit:  (8) chases(lion, nuig_student) ?  creep
Call:  (8) deadend(nuig_student) ?  creep
Exit:  (8) deadend(nuig_student) ?  creep
Exit:  (7) caught(nuig_student) ?  creep
X = nuig_student ;
No
```

SLD Resolution: `?-ancestor(X, liam)` - Recursive Example

```
parent(padhraic, liam).          parent(diarmuid, padhraic).
parent(brid, liam).              parent(maire, diarmuid).
ancestor(X,Y) ← parent(X,Y).     ancestor(X,Y) ← ancestor(Z,Y) ∧ parent (X,Z).
```

List of ancestors found:

SLD Resolution: `?-ancestor(X, liam)` - Recursive Example

```
parent(padhraic, liam).               parent(diarmuid, padhraic).
parent(brid, liam).                   parent(maire, diarmuid).
ancestor(X,Y) ← parent(X,Y).          ancestor(X,Y) ← ancestor(Z,Y) ∧ parent (X,Z).

yes(X) ← ancestor(X,liam).
```

List of ancestors found:

SLD Resolution: ?-ancestor(X, liam) - Recursive Example

```
parent(padhraic, liam).
parent(brid, liam).
ancestor(X,Y) ← parent(X,Y).
parent(diarmuid, padhraic).
parent(maire, diarmuid).
ancestor(X,Y) ← ancestor(Z,Y) ∧ parent (X,Z).
```

```
yes(X) ← ancestor(X,liam).
    ancestor(X′,Y′) ← parent(X′, Y′ )
    {X′/X, Y′/liam }
yes(X) ← parent(X, liam )
```

List of ancestors found:

SLD Resolution: ?-ancestor(X, liam) - Recursive Example

```
parent(padhraic, liam).          parent(diarmuid, padhraic).
parent(brid, liam).              parent(maire, diarmuid).
ancestor(X,Y) ← parent(X,Y).     ancestor(X,Y) ← ancestor(Z,Y) ∧ parent (X,Z).
```

```
yes(X) ← ancestor(X,liam).
    ancestor(X′,Y′) ← parent(X′, Y′ )
    {X′/X, Y′/liam }
yes(X) ← parent(X, liam )
    parent(padhraic,liam).
```

List of ancestors found:

SLD Resolution: `?-ancestor(X, liam)` - Recursive Example

```
parent(padhraic, liam).            parent(diarmuid, padhraic).
parent(brid, liam).                parent(maire, diarmuid).
ancestor(X,Y) ← parent(X,Y).       ancestor(X,Y) ← ancestor(Z,Y) ∧ parent (X,Z).
```

```
yes(X) ← ancestor(X,liam).
    ancestor(X′,Y′) ← parent(X′, Y′ )
    {X′/X, Y′/liam }
yes(X) ← parent(X, liam )
    parent(padhraic,liam).
yes(padhraic) ←
```

List of ancestors found:

SLD Resolution: `?-ancestor(X, liam)` - Recursive Example

```
parent(padhraic, liam).          parent(diarmuid, padhraic).
parent(brid, liam).              parent(maire, diarmuid).
ancestor(X,Y) ← parent(X,Y).     ancestor(X,Y) ← ancestor(Z,Y) ∧ parent (X,Z).

yes(X) ← ancestor(X,liam).
    ancestor(X′,Y′) ← parent(X′, Y′ )
    {X′/X, Y′/liam }
yes(X) ← parent(X, liam )
    parent(padhraic,liam).
yes(padhraic) ←
```

List of ancestors found:
padhraic

SLD Resolution: ?-ancestor(X, liam) - Recursive Example

```
parent(padhraic, liam).          parent(diarmuid, padhraic).
parent(brid, liam).              parent(maire, diarmuid).
ancestor(X,Y) ← parent(X,Y).     ancestor(X,Y) ← ancestor(Z,Y) ∧ parent (X,Z).
```

```
yes(X) ← ancestor(X,liam).
    ancestor(X′,Y′) ← parent(X′, Y′ )
    {X′/X, Y′/liam }
yes(X) ← parent(X, liam )
    parent(padhraic,liam).
```

List of ancestors found:
padhraic

SLD Resolution: `?-ancestor(X, liam)` - Recursive Example

```
parent(padhraic, liam).          parent(diarmuid, padhraic).
parent(brid, liam).              parent(maire, diarmuid).
ancestor(X,Y) ← parent(X,Y).     ancestor(X,Y) ← ancestor(Z,Y) ∧ parent (X,Z).
```

```
yes(X) ← ancestor(X,liam).
    ancestor(X′,Y′) ← parent(X′, Y′ )
    {X′/X, Y′/liam }
yes(X) ← parent(X, liam )
```

List of ancestors found:
padhraic

SLD Resolution: ?-ancestor(X, liam) - Recursive Example

```
parent(padhraic, liam).          parent(diarmuid, padhraic).
parent(brid, liam).              parent(maire, diarmuid).
ancestor(X,Y) ← parent(X,Y).     ancestor(X,Y) ← ancestor(Z,Y) ∧ parent (X,Z).
```

```
yes(X) ← ancestor(X,liam).
    ancestor(X′,Y′) ← parent(X′, Y′ )
    {X′/X, Y′/liam }
yes(X) ← parent(X, liam )
    parent(brid,liam).
```

List of ancestors found:
padhraic

SLD Resolution: `?-ancestor(X, liam)` - Recursive Example

```
parent(padhraic, liam).          parent(diarmuid, padhraic).
parent(brid, liam).              parent(maire, diarmuid).
ancestor(X,Y) ← parent(X,Y).     ancestor(X,Y) ← ancestor(Z,Y) ∧ parent (X,Z).

yes(X) ← ancestor(X,liam).
    ancestor(X',Y') ← parent(X', Y' )
    {X'/X, Y'/liam }
yes(X) ← parent(X, liam )
    parent(brid,liam).

yes(brid) ←
```

List of ancestors found:
padhraic

SLD Resolution: ?-ancestor(X, liam) - Recursive Example

```
parent(padhraic, liam).              parent(diarmuid, padhraic).
parent(brid, liam).                  parent(maire, diarmuid).
ancestor(X,Y) ← parent(X,Y).         ancestor(X,Y) ← ancestor(Z,Y) ∧ parent (X,Z).
```

```
yes(X) ← ancestor(X,liam).
    ancestor(X′,Y′) ← parent(X′, Y′ )
    {X′/X, Y′/liam }
yes(X) ← parent(X, liam )
    parent(brid,liam).
yes(brid) ←
```

List of ancestors found:
padhraic
brid

SLD Resolution: `?-ancestor(X, liam)` - Recursive Example

```
parent(padhraic, liam).           parent(diarmuid, padhraic).
parent(brid, liam).               parent(maire, diarmuid).
ancestor(X,Y) ← parent(X,Y).      ancestor(X,Y) ← ancestor(Z,Y) ∧ parent (X,Z).
```

```
yes(X) ← ancestor(X,liam).
    ancestor(X′,Y′) ← parent(X′, Y′ )
    {X′/X, Y′/liam }
yes(X) ← parent(X, liam )
    parent(brid,liam).
```

List of ancestors found:
padhraic
brid

SLD Resolution: `?-ancestor(X, liam)` - Recursive Example

```
parent(padhraic, liam).            parent(diarmuid, padhraic).
parent(brid, liam).                parent(maire, diarmuid).
ancestor(X,Y) ← parent(X,Y).       ancestor(X,Y) ← ancestor(Z,Y) ∧ parent (X,Z).
```

yes(X) ← ancestor(X,liam).

ancestor(X′,Y′) ← parent(X′, Y′)

{X′/X, Y′/liam }

yes(X) ← parent(X, liam)

List of ancestors found:
padhraic
brid

SLD Resolution: `?-ancestor(X, liam)` - Recursive Example

```
parent(padhraic, liam).                 parent(diarmuid, padhraic).
parent(brid, liam).                     parent(maire, diarmuid).
ancestor(X,Y) ← parent(X,Y).            ancestor(X,Y) ← ancestor(Z,Y) ∧ parent (X,Z).

yes(X) ← ancestor(X,liam).
```

List of ancestors found:
padhraic
brid

SLD Resolution: `?-ancestor(X, liam)` - Recursive Example

```
parent(padhraic, liam).
parent(brid, liam).
ancestor(X,Y) ← parent(X,Y).
```

```
parent(diarmuid, padhraic).
parent(maire, diarmuid).
ancestor(X,Y) ← ancestor(Z,Y) ∧ parent (X,Z).
```

```
yes(X) ← ancestor(X,liam).
    ancestor(X,Y′) ← ancestor(Z′, Y′ ) ∧ parent(X′,Z′)
    {X′/X,Y′/liam, Z′/_}
yes(X) ← ancestor(Z′, liam ) ∧ parent(X, Z′)
```

List of ancestors found:
padhraic
brid

SLD Resolution: `?-ancestor(X, liam)` - Recursive Example

```
parent(padhraic, liam).          parent(diarmuid, padhraic).
parent(brid, liam).              parent(maire, diarmuid).
ancestor(X,Y) ← parent(X,Y).     ancestor(X,Y) ← ancestor(Z,Y) ∧ parent (X,Z).

yes(X) ← ancestor(X,liam).
    ancestor(X,Y′) ← ancestor(Z′, Y′ ) ∧ parent(X′,Z′)
    {X′/X,Y′/liam, Z′/_}
yes(X) ← ancestor(Z′, liam ) ∧ parent(X, Z′)
    ancestor(X′,Y′) ← parent(X′, Y′ )
    {X′/Z′,Y′/liam}
yes(X) ← parent(Z′, liam ) ∧ parent(X,  Z′ )
```

List of ancestors found:
padhraic
brid

SLD Resolution: `?-ancestor(X, liam)` - Recursive Example

```
parent(padhraic, liam).          parent(diarmuid, padhraic).
parent(brid, liam).              parent(maire, diarmuid).
ancestor(X,Y) ← parent(X,Y).     ancestor(X,Y) ← ancestor(Z,Y) ∧ parent (X,Z).

yes(X) ← ancestor(X,liam).
    ancestor(X,Y′) ← ancestor(Z′, Y′ ) ∧ parent(X′,Z′)
    {X′/X,Y′/liam, Z′/_}
yes(X) ← ancestor(Z′, liam ) ∧ parent(X, Z′)
    ancestor(X′,Y′) ← parent(X′, Y′ )
    {X′/Z′,Y′/liam}
yes(X) ← parent(Z′, liam ) ∧ parent(X, Z′ )
    parent(padhraic,liam).
    {Z′/padhraic,X′/_}
yes(X) ← parent(X, padhraic ).
```

List of ancestors found:
padhraic
brid

SLD Resolution: `?-ancestor(X, liam)` - Recursive Example

```
parent(padhraic, liam).            parent(diarmuid, padhraic).
parent(brid, liam).                parent(maire, diarmuid).
ancestor(X,Y) ← parent(X,Y).       ancestor(X,Y) ← ancestor(Z,Y) ∧ parent (X,Z).
```

```
yes(X) ← ancestor(X,liam).
    ancestor(X,Y′) ← ancestor(Z′, Y′ ) ∧ parent(X′,Z′)
    {X′/X,Y′/liam, Z′/_}
yes(X) ← ancestor(Z′, liam ) ∧ parent(X, Z′)
    ancestor(X′,Y′) ← parent(X′, Y′ )
    {X′/Z′,Y′/liam}
yes(X) ← parent(Z′, liam ) ∧ parent(X,  Z′ )
    parent(padhraic,liam).
    {Z′/padhraic,X′/_}
yes(X) ← parent(X, padhraic ).
    parent(diarmuid, padhraic).
    {X/diarmuid}
yes(diarmuid) ← parent(diarmuid,padhraic).
```

List of ancestors found:
padhraic
brid

SLD Resolution: ?-ancestor(X, liam) - Recursive Example

```
parent(padhraic, liam).           parent(diarmuid, padhraic).
parent(brid, liam).               parent(maire, diarmuid).
ancestor(X,Y) ← parent(X,Y).      ancestor(X,Y) ← ancestor(Z,Y) ∧ parent (X,Z).

yes(X) ← ancestor(X,liam).
    ancestor(X,Y′) ← ancestor(Z′, Y′ ) ∧ parent(X′,Z′)
    {X′/X,Y′/liam, Z′/_}
yes(X) ← ancestor(Z′, liam ) ∧ parent(X, Z′)
    ancestor(X′,Y′) ← parent(X′, Y′ )
    {X′/Z′,Y′/liam}
yes(X) ← parent(Z′, liam ) ∧ parent(X,  Z′ )
    parent(padhraic,liam).
    {Z′/padhraic,X′/_}
yes(X) ← parent(X, padhraic ).
    parent(diarmuid, padhraic).
    {X/diarmuid}
yes(diarmuid) ← parent(diarmuid,padhraic).
yes(diarmuid) ←
```

List of ancestors found:
padhraic
brid

SLD Resolution: ?-ancestor(X, liam) - Recursive Example

```
parent(padhraic, liam).          parent(diarmuid, padhraic).
parent(brid, liam).              parent(maire, diarmuid).
ancestor(X,Y) ← parent(X,Y).     ancestor(X,Y) ← ancestor(Z,Y) ∧ parent (X,Z).

yes(X) ← ancestor(X,liam).
    ancestor(X,Y′) ← ancestor(Z′, Y′ ) ∧ parent(X′,Z′)
    {X′/X,Y′/liam, Z′/_}
yes(X) ← ancestor(Z′, liam ) ∧ parent(X, Z′)
    ancestor(X′,Y′) ← parent(X′, Y′ )
    {X′/Z′,Y′/liam}
yes(X) ← parent(Z′, liam ) ∧ parent(X,  Z′ )
    parent(padhraic,liam).
    {Z′/padhraic,X′/_}
yes(X) ← parent(X, padhraic ).
    parent(diarmuid, padhraic).
    {X/diarmuid}
yes(diarmuid) ← parent(diarmuid,padhraic).
yes(diarmuid) ←
```

List of ancestors found:
padhraic
brid
diarmuid

SLD Resolution: `?-ancestor(X, liam)` - Recursive Example

```
parent(padhraic, liam).          parent(diarmuid, padhraic).
parent(brid, liam).              parent(maire, diarmuid).
ancestor(X,Y) ← parent(X,Y).     ancestor(X,Y) ← ancestor(Z,Y) ∧ parent (X,Z).

yes(X) ← ancestor(X,liam).
    ancestor(X,Y′) ← ancestor(Z′, Y′ ) ∧ parent(X′,Z′)
    {X′/X,Y′/liam, Z′/_}
yes(X) ← ancestor(Z′, liam ) ∧ parent(X, Z′)
    ancestor(X′,Y′) ← parent(X′, Y′ )
    {X′/Z′,Y′/liam}
yes(X) ← parent(Z′, liam ) ∧ parent(X,  Z′ )
    parent(padhraic,liam).
    {Z′/padhraic,X′/_}
yes(X) ← parent(X, padhraic ).
    parent(diarmuid, padhraic).
    {X/diarmuid}
yes(diarmuid) ← parent(diarmuid,padhraic).
```

List of ancestors found:
padhraic
brid
diarmuid

SLD Resolution: `?-ancestor(X, liam)` - Recursive Example

```
parent(padhraic, liam).           parent(diarmuid, padhraic).
parent(brid, liam).               parent(maire, diarmuid).
ancestor(X,Y) ← parent(X,Y).      ancestor(X,Y) ← ancestor(Z,Y) ∧ parent (X,Z).

yes(X) ← ancestor(X,liam).
    ancestor(X,Y′) ← ancestor(Z′, Y′ ) ∧ parent(X′,Z′)
    {X′/X,Y′/liam, Z′/_}
yes(X) ← ancestor(Z′, liam ) ∧ parent(X, Z′)
    ancestor(X′,Y′) ← parent(X′, Y′ )
    {X′/Z′,Y′/liam}
yes(X) ← parent(Z′, liam ) ∧ parent(X,  Z′ )
    parent(padhraic,liam).
    {Z′/padhraic,X′/_}
yes(X) ← parent(X, padhraic ).
```

List of ancestors found:
padhraic
brid
diarmuid

SLD Resolution: `?-ancestor(X, liam)` - Recursive Example

```
parent(padhraic, liam).             parent(diarmuid, padhraic).
parent(brid, liam).                 parent(maire, diarmuid).
ancestor(X,Y) ← parent(X,Y).        ancestor(X,Y) ← ancestor(Z,Y) ∧ parent (X,Z).

yes(X) ← ancestor(X,liam).
    ancestor(X,Y′) ← ancestor(Z′, Y′ ) ∧ parent(X′,Z′)
    {X′/X,Y′/liam, Z′/_}
yes(X) ← ancestor(Z′, liam ) ∧ parent(X, Z′)
    ancestor(X′,Y′) ← parent(X′, Y′ )
    {X′/Z′,Y′/liam}
yes(X) ← parent(Z′, liam ) ∧ parent(X,  Z′ )
```

List of ancestors found:
padhraic
brid
diarmuid

SLD Resolution: `?-ancestor(X, liam)` - Recursive Example

```
parent(padhraic, liam).           parent(diarmuid, padhraic).
parent(brid, liam).               parent(maire, diarmuid).
ancestor(X,Y) ← parent(X,Y).      ancestor(X,Y) ← ancestor(Z,Y) ∧ parent (X,Z).

yes(X) ← ancestor(X,liam).
    ancestor(X,Y′) ← ancestor(Z′, Y′ ) ∧ parent(X′,Z′)
    {X′/X,Y′/liam, Z′/_}
yes(X) ← ancestor(Z′, liam ) ∧ parent(X, Z′)
    ancestor(X′,Y′) ← parent(X′, Y′ )
    {X′/Z′,Y′/liam}
yes(X) ← parent(Z′, liam ) ∧ parent(X,  Z′ )
    parent(brid,liam).
    {Z′/brid,X/_}
yes(X) ← parent(X,brid).
```

List of ancestors found:

padhraic
brid
diarmuid

SLD Resolution: `?-ancestor(X, liam)` - Recursive Example

```
parent(padhraic, liam).
parent(brid, liam).
ancestor(X,Y) ← parent(X,Y).
parent(diarmuid, padhraic).
parent(maire, diarmuid).
ancestor(X,Y) ← ancestor(Z,Y) ∧ parent (X,Z).

yes(X) ← ancestor(X,liam).
    ancestor(X,Y′) ← ancestor(Z′, Y′ ) ∧ parent(X′,Z′)
    {X′/X,Y′/liam, Z′/_}
yes(X) ← ancestor(Z′, liam ) ∧ parent(X, Z′)
    ancestor(X′,Y′) ← parent(X′, Y′ )
    {X′/Z′,Y′/liam}
yes(X) ← parent(Z′, liam ) ∧ parent(X,  Z′ )
    parent(brid,liam).
    {Z′/brid,X/_}
yes(X) ← parent(X,brid).

FAIL!
```

List of ancestors found:
padhraic
brid
diarmuid

SLD Resolution: `?-ancestor(X, liam)` - Recursive Example

```
parent(padhraic, liam).              parent(diarmuid, padhraic).
parent(brid, liam).                  parent(maire, diarmuid).
ancestor(X,Y) ← parent(X,Y).         ancestor(X,Y) ← ancestor(Z,Y) ∧ parent (X,Z).

yes(X) ← ancestor(X,liam).
    ancestor(X,Y′) ← ancestor(Z′, Y′ ) ∧ parent(X′,Z′)
    {X′/X,Y′/liam, Z′/_}
yes(X) ← ancestor(Z′, liam ) ∧ parent(X, Z′)
    ancestor(X′,Y′) ← parent(X′, Y′ )
    {X′/Z′,Y′/liam}
yes(X) ← parent(Z′, liam ) ∧ parent(X,  Z′ )
    parent(brid,liam).
    {Z′/brid,X/_}
yes(X) ← parent(X,brid).
```

List of ancestors found:

padhraic
brid
diarmuid

SLD Resolution: `?-ancestor(X, liam)` - Recursive Example

```
parent(padhraic, liam).
parent(brid, liam).
ancestor(X,Y) ← parent(X,Y).

parent(diarmuid, padhraic).
parent(maire, diarmuid).
ancestor(X,Y) ← ancestor(Z,Y) ∧ parent (X,Z).
```

```
yes(X) ← ancestor(X,liam).
    ancestor(X,Y′) ← ancestor(Z′, Y′ ) ∧ parent(X′,Z′)
    {X′/X,Y′/liam, Z′/_}
yes(X) ← ancestor(Z′, liam ) ∧ parent(X, Z′)
    ancestor(X′,Y′) ← parent(X′, Y′ )
    {X′/Z′,Y′/liam}
yes(X) ← parent(Z′, liam ) ∧ parent(X,  Z′ )
```

List of ancestors found:
padhraic
brid
diarmuid

SLD Resolution: `?-ancestor(X, liam)` - Recursive Example

```
parent(padhraic, liam).          parent(diarmuid, padhraic).
parent(brid, liam).              parent(maire, diarmuid).
ancestor(X,Y) ← parent(X,Y).     ancestor(X,Y) ← ancestor(Z,Y) ∧ parent (X,Z).
```

```
yes(X) ← ancestor(X,liam).
    ancestor(X,Y′) ← ancestor(Z′, Y′ ) ∧ parent(X′,Z′)
    {X′/X,Y′/liam, Z′/_}
yes(X) ← ancestor(Z′, liam ) ∧ parent(X, Z′)
```

List of ancestors found:
padhraic
brid
diarmuid

SLD Resolution: ?-ancestor(X, liam) - Recursive Example

```
parent(padhraic, liam).            parent(diarmuid, padhraic).
parent(brid, liam).                parent(maire, diarmuid).
ancestor(X,Y) ← parent(X,Y).       ancestor(X,Y) ← ancestor(Z,Y) ∧ parent (X,Z).

yes(X) ← ancestor(X,liam).
    ancestor(X,Y′) ← ancestor(Z′, Y′ ) ∧ parent(X′,Z′)
    {X′/X,Y′/liam, Z′/_}
yes(X) ← ancestor(Z′, liam ) ∧ parent(X, Z′)
    ancestor(X,Y′) ← ancestor(W′,Y′) ∧ parent(X′,W′)
    {X′/Z′,Y′/liam, W′/_}
yes(X) ← ancestor(W′, liam) ∧ parent(Z′, W′) ∧ parent(X,Z′)
```

List of ancestors found:
padhraic
brid
diarmuid

SLD Resolution: `?-ancestor(X, liam)` - Recursive Example

```
parent(padhraic, liam).
parent(brid, liam).
ancestor(X,Y) ← parent(X,Y).

parent(diarmuid, padhraic).
parent(maire, diarmuid).
ancestor(X,Y) ← ancestor(Z,Y) ∧ parent (X,Z).

yes(X) ← ancestor(X,liam).
    ancestor(X,Y′) ← ancestor(Z′, Y′ ) ∧ parent(X′,Z′)
    {X′/X,Y′/liam, Z′/_}
yes(X) ← ancestor(Z′, liam ) ∧ parent(X, Z′)
    ancestor(X,Y′) ← ancestor(W′,Y′) ∧ parent(X′,W′)
    {X′/Z′,Y′/liam, W′/_}
yes(X) ← ancestor(W′, liam) ∧ parent(Z′, W′) ∧ parent(X,Z′)
    ancestor(X′,Y′) ← parent(X′,Y′)
    {X′/W′,Y′/liam,Z′/_}
yes(X) ← parent(W′, liam) ∧ parent(Z′, W′) ∧ parent(X,Z′)
```

List of ancestors found:
padhraic
brid
diarmuid

SLD Resolution: `?-ancestor(X, liam)` - Recursive Example

```
parent(padhraic, liam).              parent(diarmuid, padhraic).
parent(brid, liam).                  parent(maire, diarmuid).
ancestor(X,Y) ← parent(X,Y).         ancestor(X,Y) ← ancestor(Z,Y) ∧ parent (X,Z).

yes(X) ← ancestor(X,liam).
    ancestor(X,Y′) ← ancestor(Z′, Y′ ) ∧ parent(X′,Z′)
    {X′/X,Y′/liam, Z′/_}
yes(X) ← ancestor(Z′, liam ) ∧ parent(X, Z′)
    ancestor(X,Y′) ← ancestor(W′,Y′) ∧ parent(X′,W′)
    {X′/Z′,Y′/liam, W′/_}
yes(X) ← ancestor(W′, liam) ∧ parent(Z′, W′) ∧ parent(X,Z′)
    ancestor(X′,Y′) ← parent(X′,Y′)
    {X′/W′,Y′/liam,Z′/_}
yes(X) ← parent(W′, liam) ∧ parent(Z′, W′) ∧ parent(X,Z′)
    parent(padhraic, liam).
    {W′/padhraic, Z′/_, X/_}
yes(X) ← parent(Z′,padhraic) ∧ parent(X,Z′).
```

List of ancestors found:
padhraic
brid
diarmuid

SLD Resolution: ?-ancestor(X, liam) - Recursive Example

```
parent(padhraic, liam).          parent(diarmuid, padhraic).
parent(brid, liam).              parent(maire, diarmuid).
ancestor(X,Y) ← parent(X,Y).     ancestor(X,Y) ← ancestor(Z,Y) ∧ parent (X,Z).

yes(X) ← ancestor(X,liam).
    ancestor(X,Y′) ← ancestor(Z′, Y′ ) ∧ parent(X′,Z′)
    {X′/X,Y′/liam, Z′/_}
yes(X) ← ancestor(Z′, liam ) ∧ parent(X, Z′)
    ancestor(X,Y′) ← ancestor(W′,Y′) ∧ parent(X′,W′)
    {X′/Z′,Y′/liam, W′/_}
yes(X) ← ancestor(W′, liam) ∧ parent(Z′, W′) ∧ parent(X,Z′)
    ancestor(X′,Y′) ← parent(X′,Y′)
    {X′/W′,Y′/liam,Z′/_}
yes(X) ← parent(W′, liam) ∧ parent(Z′, W′) ∧ parent(X,Z′)
    parent(padhraic, liam).
    {W′/padhraic, Z′/_, X/_}
yes(X) ← parent(Z′,padhraic) ∧ parent(X,Z′).
    parent(diarmuid, padhraic).
    {Z′/diarmuid, X/_}
yes(X) ← parent(X,diarmuid).
```

List of ancestors found:

padhraic
brid
diarmuid

SLD Resolution: `?-ancestor(X, liam)` - Recursive Example

```
parent(padhraic, liam).              parent(diarmuid, padhraic).
parent(brid, liam).                  parent(maire, diarmuid).
ancestor(X,Y) ← parent(X,Y).         ancestor(X,Y) ← ancestor(Z,Y) ∧ parent (X,Z).

yes(X) ← ancestor(X,liam).
    ancestor(X,Y′) ← ancestor(Z′, Y′ ) ∧ parent(X′,Z′)
    {X′/X,Y′/liam, Z′/_}
yes(X) ← ancestor(Z′, liam ) ∧ parent(X, Z′)
    ancestor(X,Y′) ← ancestor(W′,Y′) ∧ parent(X′,W′)
    {X′/Z′,Y′/liam, W′/_}
yes(X) ← ancestor(W′, liam) ∧ parent(Z′, W′) ∧ parent(X,Z′)
    ancestor(X′,Y′) ← parent(X′,Y′)
    {X′/W′,Y′/liam,Z′/_}
yes(X) ← parent(W′, liam) ∧ parent(Z′, W′) ∧ parent(X,Z′)
    parent(padhraic, liam).
    {W′/padhraic, Z′/_, X/_}
yes(X) ← parent(Z′,padhraic) ∧ parent(X,Z′).
    parent(diarmuid, padhraic).
    {Z′/diarmuid, X/_}
yes(X) ← parent(X,diarmuid).
    parent(maire, diarmuid).      {X/maire}
yes(maire) ← parent(maire,diarmuid).
```

List of ancestors found:
padhraic
brid
diarmuid

SLD Resolution: ?-ancestor(X, liam) - Recursive Example

```
parent(padhraic, liam).           parent(diarmuid, padhraic).
parent(brid, liam).               parent(maire, diarmuid).
ancestor(X,Y) ← parent(X,Y).      ancestor(X,Y) ← ancestor(Z,Y) ∧ parent (X,Z).

yes(X) ← ancestor(X,liam).
    ancestor(X,Y′) ← ancestor(Z′, Y′ ) ∧ parent(X′,Z′)
    {X′/X,Y′/liam, Z′/_}
yes(X) ← ancestor(Z′, liam ) ∧ parent(X, Z′)
    ancestor(X,Y′) ← ancestor(W′,Y′) ∧ parent(X′,W′)
    {X′/Z′,Y′/liam, W′/_}
yes(X) ← ancestor(W′, liam) ∧ parent(Z′, W′) ∧ parent(X,Z′)
    ancestor(X′,Y′) ← parent(X′,Y′)
    {X′/W′,Y′/liam,Z′/_}
yes(X) ← parent(W′, liam) ∧ parent(Z′, W′) ∧ parent(X,Z′)
    parent(padhraic, liam).
    {W′/padhraic, Z′/_, X/_}
yes(X) ← parent(Z′,padhraic) ∧ parent(X,Z′).
    parent(diarmuid, padhraic).
    {Z′/diarmuid, X/_}
yes(X) ← parent(X,diarmuid).
    parent(maire, diarmuid).      {X/maire}
yes(maire) ← parent(maire,diarmuid).
yes(maire) ←
```

List of ancestors found:
padhraic
brid
diarmuid

SLD Resolution: ?-ancestor(X, liam) - Recursive Example

```
parent(padhraic, liam).            parent(diarmuid, padhraic).
parent(brid, liam).                parent(maire, diarmuid).
ancestor(X,Y) ← parent(X,Y).       ancestor(X,Y) ← ancestor(Z,Y) ∧ parent (X,Z).

yes(X) ← ancestor(X,liam).
    ancestor(X,Y′) ← ancestor(Z′, Y′ ) ∧ parent(X′,Z′)
    {X′/X,Y′/liam, Z′/_}
yes(X) ← ancestor(Z′, liam ) ∧ parent(X, Z′)
    ancestor(X,Y′) ← ancestor(W′,Y′) ∧ parent(X′,W′)
    {X′/Z′,Y′/liam, W′/_}
yes(X) ← ancestor(W′, liam) ∧ parent(Z′, W′) ∧ parent(X,Z′)
    ancestor(X′,Y′) ← parent(X′,Y′)
    {X′/W′,Y′/liam,Z′/_}
yes(X) ← parent(W′, liam) ∧ parent(Z′, W′) ∧ parent(X,Z′)
    parent(padhraic, liam).
    {W′/padhraic, Z′/_, X/_}
yes(X) ← parent(Z′,padhraic) ∧ parent(X,Z′).
    parent(diarmuid, padhraic).
    {Z′/diarmuid, X/_}
yes(X) ← parent(X,diarmuid).
    parent(maire, diarmuid).        {X/maire}
yes(maire) ← parent(maire,diarmuid).
yes(maire) ←
```

List of ancestors found:

padhraic
brid
diarmuid
maire