

Logical English as a Programming Language for Law and Ethics

A more human-friendly computer language for the future

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A more human-friendly computer language for the future

Logical English

- syntactic sugar for pure Prolog
- inspired in part by the language of well-written legal texts
- readable without any technical training in logic, computing or mathematics
- explainable
- incorporating deontic and other modalities
- not necessarily easy to write.

Prolog in many natural languages

<https://legalmachinelab.unibo.it/logicalenglish/p/subset.pl>

<https://legalmachinelab.unibo.it/logicalenglish/p/subset-prolog.pl>

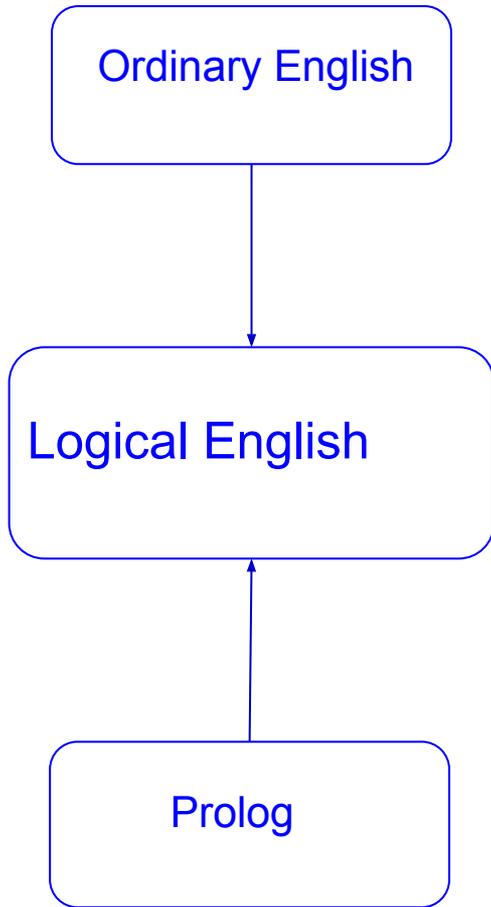
<https://legalmachinelab.unibo.it/logicalenglish/p/sousensemble.pl>

<https://legalmachinelab.unibo.it/logicalenglish/p/subconjunto.pl>

https://legalmachinelab.unibo.it/logicalenglish/p/cittadinanza_ita.pl

https://legalmachinelab.unibo.it/logicalenglish/p/cittadinanza_ita-scasp.pl

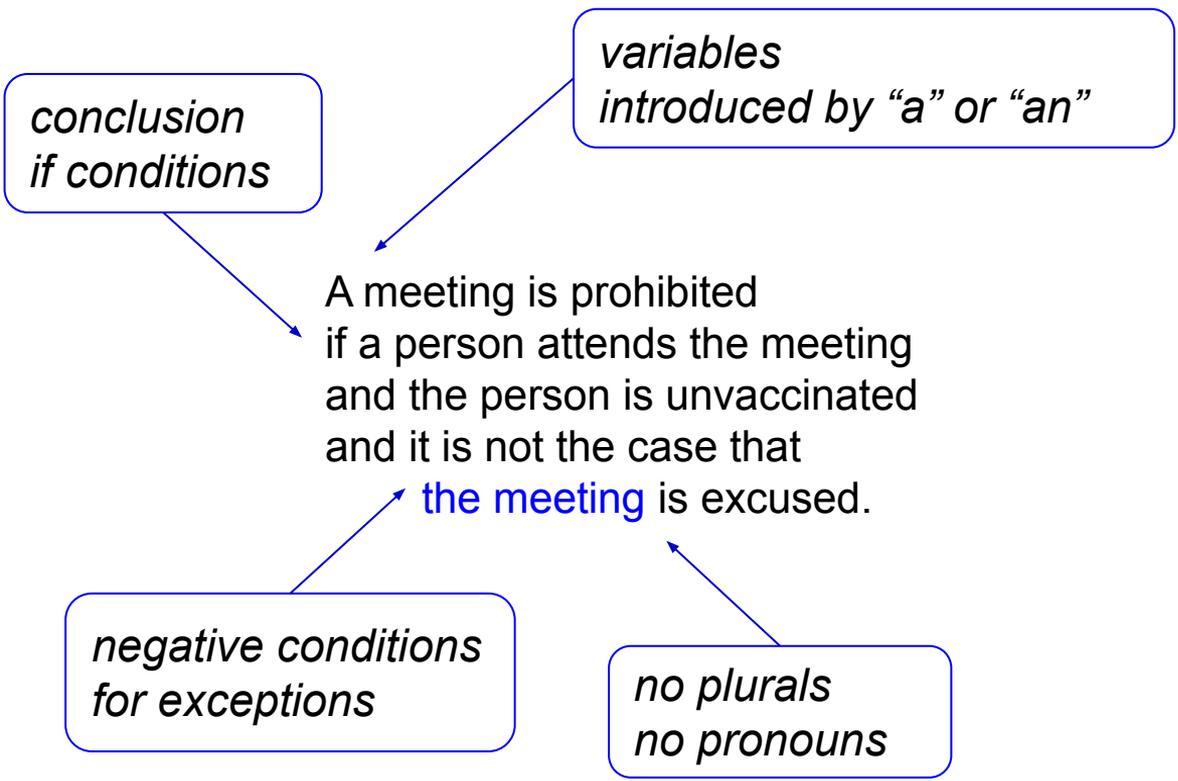
<https://legalmachinelab.unibo.it/logicalenglish/p/family-scasp.pl>



All meetings with unvaccinated people are prohibited unless **they** are excused.

A meeting is prohibited if a person attends the meeting and the person is unvaccinated and it is not the case that **the meeting** is excused.

```
prohibited(M)  
:- attends(P, M),  
   unvaccinated(P),  
   not(excused(M)).
```



Deontic modalities (obligation, prohibition, permission) can be represented by meta (or higher-order) predicates

A person has an obligation **that** the person pays an amount
if the person attends a meeting
and the meeting is prohibited
and the fine for the person attending the meeting is the amount.

```
obligation(P, pays(P, A))  
:- attends(P, M),  
   prohibited(M),  
   fine(P, M, A).
```

Flood, M.D. and Goodenough, O.R., 2021. Contract as automaton: representing a simple financial agreement in computational form. *Artificial Intelligence and Law*, pp.1-26.

“Although the deontic approach reifies a number of key normative features, many expressions of formal law, such as statutes, regulations and the private rules of contract, typically do not use these normative formalisms in their natural language expressions.

Rather, such formal statements of law often substitute expressions of event and consequence for statements of obligation. That is, if certain rules are not respected, certain results—often unpleasant— will ensue.”

Deontic modalities (obligation, prohibition, permission) can be represented by specifying their consequences

A person has an obligation **that** the person pays an amount
if the person attends a meeting
and the meeting is prohibited
and the fine for the person attending the meeting is the amount.

An arrest warrant is issued for a person
if the person has an obligation that the person pays an amount
and it is not the case that
 the person pays the amount.

To be fully operational, the payment and arrest warrant events would need explicit temporal constraints.

Logical English on SWISH (online version of SWI Prolog)

```
19 A meeting is prohibited
20   if a person attends the meeting
21   and the person is unvaccinated
22   and it is not the case that
23     the meeting is excused.
24
25 A person has an obligation that the person pays an amount
26   if the person attends a meeting
27   and the meeting is prohibited
28   and the fine for the person attending the meeting is the amount.
29
30 An arrest warrant is issued for a person
31   if the person has an obligation that the person pays an amount
32   and it is not the case that
33     the person pays the amount.
34
35 scenario one is:
36
37   Boris attends christmas party.
38   Novak attends christmas party.
39   Novak is unvaccinated.
40   the fine for a person attending a meeting is £100
41   if the meeting is prohibited.
42 %   Novak pays £100.
43   Boris pays £1000.
```

 answer("query one with scenario one").

Query one with one: *a person* pays *an amount*

Answer: Boris pays £ 1000

true

 answer("query two with scenario one").

Query two with one: An arrest warrant is issued for *a person*

Answer: An arrest warrant is issued for Boris

true

Answer: An arrest warrant is issued for Novak

true

?- answer("query two with scenario one").

Examples▲

History▲

Solutions▲

The British Nationality Act

18 a person acquires British citizenship on a date
19 if the person is born in the UK on the date
20 and the date is after commencement
21 and an other person is the mother of the person
22 or the other person is the father of the person
23 and the other person is a British citizen on the date
24 or the other person is settled in the UK on the date,
25

```
acquires_British_citizenship_on(A, B) :-  
    is_born_in_on(A, the_UK, B),  
    is_after_commencement(B),  
    (  
        is_the_mother_of(C, A)  
    ;   is_the_father_of(C, A)  
    ),  
    (  
        is_a_British_citizen_on(C, B)  
    ;   is_settled_in_the_UK_on(C, B)  
    ).
```

?-

show prolog.

Examples▲

History▲

Solutions▲

table results

Run!

```
67
68 scenario harry is:
69
70 John is born in the UK on 2021-10-09.
71 2021-10-09 is after commencement.
72 Harry is the father of John.
73 Harry is settled in the UK on 2021-10-09.
74
75 query one is:
76
77 which person acquires British citizenship on which date.
78
```

Answer: John acquires British citizenship on 2021-10-9T0:0:0.0

true

Next 10 100 1,000 Stop

?- answer one with harry.

Examples▲ History▲ Solutions▲

table results **Run!**

```
67
68 scenario harry_says is:
69
70 John is born in the UK on 2021-10-09.
71 2021-10-09 is after commencement.
72 Harry says that Harry is the father of John.
73 Harry is settled in the UK on 2021-10-09.
74
75 query one is:
76
77 which person acquires British citizenship on which date.
78
```

The screenshot shows a logic programming interface. At the top, a text box contains the word "false" in red. Below it, a query is entered: "?- answer one with harry_says.". At the bottom of the interface, there are three buttons: "Examples▲", "History▲", and "Solutions▲". To the right of these buttons is a checkbox labeled "table results" and a blue button labeled "Run!".

```
54
55 scenario trust is:
56
57 John is born in the UK on 2021-10-09.
58 2021-10-09 is after commencement.
59 Harry says that Harry is the father of John.
60 Harry is settled in the UK on 2021-10-09.
61
62 a person X is the father of a person Y
63   if X says that X is the father of Y.
64
65 query one is:
66
67 which person acquires British citizenship on which date.
```

The screenshot shows a logic programming interface. At the top, a green box contains the answer: "Answer: John acquires British citizenship on 2021-10-9T0:0:0.0". Below this, the word "true" is displayed. A control bar contains buttons for "Next", "10", "100", "1,000", and "Stop". The main query area shows a query: "?- answer one with trust." with a red dashed box around the word "with". At the bottom, there are buttons for "Examples", "History", and "Solutions", along with a checkbox for "table results" and a blue "Run!" button.

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Contract as Automaton: The Computational Representation of Financial Agreements

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Table 2: A Streamlined Loan Agreement

Agreement

This loan agreement dated June 1, 2014, by and between Lender Bank Co. ("Lender") and Borrower Corp. (Borrower), will set out the terms under which Lender will extend credit in the principal amount of \$1,000 to Borrower with an un-compounded interest rate of 5% per annum, included in the specified payment structure.

1. The Loan:

At the request of Borrower, to be given on June 1, 2014, Lender will advance \$1000 to Borrower no later than June 2, 2014. If Borrower does not make such a request, this agreement will terminate.

2. Repayment:

Subject to the other terms of this agreement, Borrower will repay the loan in the following payments:

- (a) Payment 1, due June 1, 2015, in the amount of \$550, representing a payment of \$500 as half of the principal and interest in the amount of \$50.
- (b) Payment 2, due June 1, 2016, in the amount of \$525, representing a payment of \$500 as the remaining half of the principal and interest in the amount of \$25.

3. Representations and Warranties:

The Borrower represents and warrants, at the execution of this agreement, at the request for the advance of funds and at all times any repayment amount shall be outstanding, the Borrower's assets shall exceed its liabilities as determined under an application of the FASB rules of accounting.

4. Covenants:

The Borrower covenants that at the execution of this agreement, at the request for the advance of funds and at all times any repayment amount shall be outstanding it will make timely payment of all state and federal taxes as and when due.

5. Events of Default:

The Borrower will be in default under this agreement upon the occurrence of any of the following events or conditions, provided they shall remain uncured within a period of two days after notice is given to Borrower by Lender of their occurrence (such an uncured event an "Event of Default"):

- (a) Borrower shall fail to make timely payment of any amount due to Lender hereunder;
- (b) Any of the representation or warranties of Borrower under this agreement shall prove untrue;
- (c) Borrower shall fail to perform any of its covenants under this agreement;
- (d) Borrower shall file for bankruptcy or insolvency under any applicable federal or state law.

A default will be cured by the Borrower (i) remedying the potential event of default and (ii) giving effective notice of such remedy to the Lender. In the event of multiple events of default, the first

to occur shall take precedence for the purposes of specifying outcomes under this agreement.

6. Acceleration on Default

Upon the occurrence of an Event of Default all outstanding payments under this agreement will become immediately due and payable, including both principal and interest amounts, without further notice, presentment, or demand to the Borrower.

7. Choice of Law:

This agreement will be subject to the laws of the State of New York applicable to contracts entered into and performed wholly within that state.

8. Amendments and Waivers:

Any purported amendment to, or waiver of rights under, this agreement will only be effective if set forth in writing and executed by both parties.

9. Courts and Litigation:

Any legal action brought to enforce, interpret or otherwise deal with this agreement must be brought in the state courts of the State of New York located in New York County, and each of the parties agrees to the jurisdiction of such courts over both the parties themselves and over the subject matter of such a proceeding, and waives any claim that such a court may be an inconvenient forum.

10. Time of the Essence; No Pre-Payment

Timely performance is required for any action to be taken under this agreement, and, except as may otherwise be specifically provided herein, failure to take such action on the day specified will constitute a binding failure to take such action. Payments shall only be made on or after the dates specified in Section 2 or on or after such other date as may be required under Section 6; pre-payments made on earlier dates shall not be accepted.

11. Notices

Notices provided for in this agreement will be given by an email to the email addresses set out below and will be effective upon receipt.

[Lender email here]

[Borrower email here]

Accepted and agreed:

LENDER BANK CO.

BORROWER CORP.

By: _____

By: _____

Title: _____

Title: _____

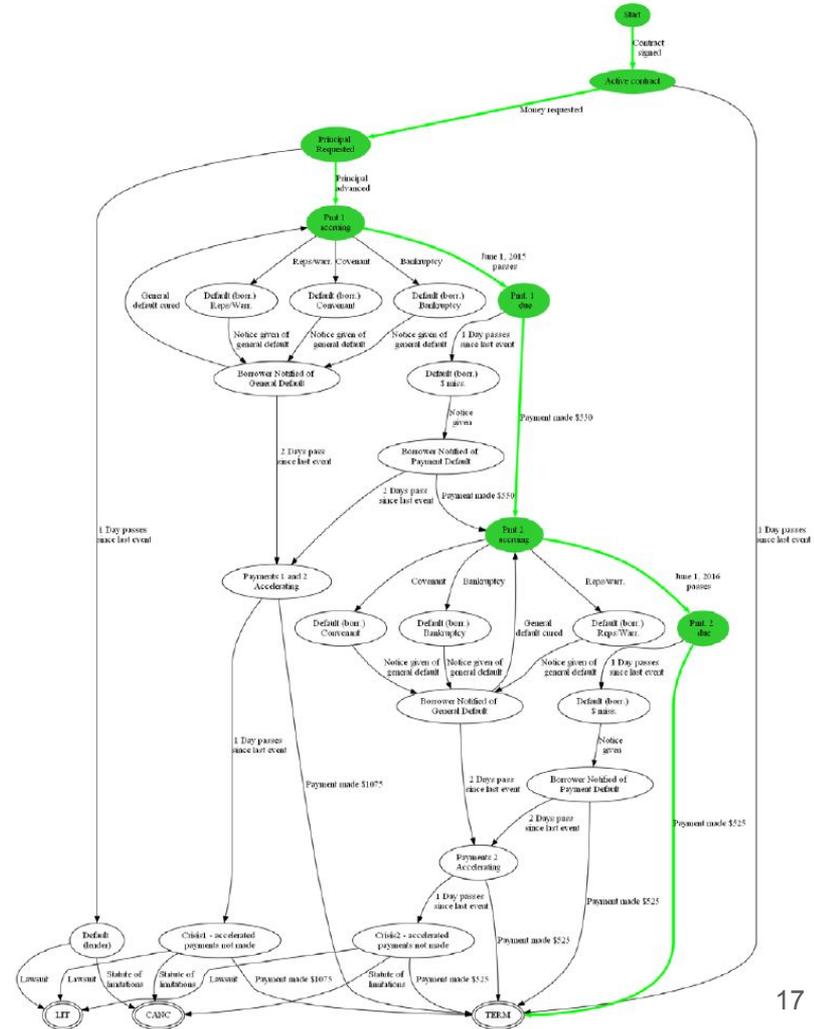
[NOTE: Statute of Limitations on debt obligations in NY is 6 years]

Draft of July 23, 2014

The loan agreement as a Discrete Finite Automaton

Key Messages

- Financial contracts are structured internally as state-transition systems.
- Discrete finite automata (DFA) are an adequate formalism to represent this structure as finite sets of states, events, and transitions.



When does an Event of Default occur?

5. Events of Default:

on day D0

The Borrower will be in default under this agreement upon the occurrence of any of the following events or conditions, provided they shall remain uncured within a period of two days after notice is given to Borrower by Lender of their occurrence (such an uncured event an “Event of Default”):

on day D0

- (a) Borrower shall fail to make timely payment of any amount due to Lender hereunder;
- (b) Any of the representation or warranties of Borrower under this agreement shall prove untrue;
- (c) Borrower shall fail to perform any of its covenants under this agreement;
- (d) Borrower shall file for bankruptcy or insolvency under any applicable federal or state law.

When does an Event of Default occur?

5. Events of Default:

if

on day D0

The Borrower will be in default under this agreement upon the occurrence of any of the following events or conditions, provided they shall remain uncured within a period of two days after notice is given to Borrower by Lender of their occurrence (such an uncured event an “Event of Default”):

on day D1

on day D0

- (a) Borrower shall fail to make timely payment of any amount due to Lender hereunder;
- (b) Any of the representation or warranties of Borrower under this agreement shall prove untrue;
- (c) Borrower shall fail to perform any of its covenants under this agreement;
- (d) Borrower shall file for bankruptcy or insolvency under any applicable federal or state law.

When does an Event of Default occur?

5. Events of Default:

if

on day D0

The Borrower will be in default under this agreement upon the occurrence of any of the following events or conditions, provided they shall remain uncured within a period of two days after notice is given to Borrower by Lender of their occurrence (such an uncured event an “Event of Default”):

on day D1

on day D0

- (a) Borrower shall fail to make timely payment of any amount due to Lender hereunder;
- (b) Any of the representation or warranties of Borrower under this agreement shall prove untrue;
- (c) Borrower shall fail to perform any of its covenants under this agreement;
- (d) Borrower shall file for bankruptcy or insolvency under any applicable federal or state law.

A default will be cured by the Borrower

- (i) remedying the potential event of default and
- (ii) giving effective notice of such remedy to the Lender.

When does an Event of Default occur?

5. Events of Default:

if

on day D0

The Borrower will be in default under this agreement upon the occurrence of any of the following events or conditions, provided they shall remain uncured within a period of two days after notice is given to Borrower by Lender of their occurrence

(such an uncured event an “Event of Default”):

on D2 = D1 + 2

on day D1

on day D0

- (a) Borrower shall fail to make timely payment of any amount due to Lender hereunder;
- (b) Any of the representation or warranties of Borrower under this agreement shall prove untrue;
- (c) Borrower shall fail to perform any of its covenants under this agreement;
- (d) Borrower shall file for bankruptcy or insolvency under any applicable federal or state law.

A default will be cured by the Borrower

- (i) remedying the potential event of default and
- (ii) giving effective notice of such remedy to the Lender.

When does an Event of Default occur?

5. Events of Default:

if

on day D0

The Borrower will be in default under this agreement upon the occurrence of any of the following events or conditions, provided they shall remain uncured within a period of two days after notice is given to Borrower by Lender of their occurrence

(such an uncured event an “Event of Default”):

on D2 = D1 + 2

on D0 or D2?

on day D1

on day D0

- (a) Borrower shall fail to make timely payment of any amount due to Lender hereunder;
- (b) Any of the representation or warranties of Borrower under this agreement shall prove untrue;
- (c) Borrower shall fail to perform any of its covenants under this agreement;
- (d) Borrower shall file for bankruptcy or insolvency under any applicable federal or state law.

6. Acceleration on Default. Upon the occurrence of an Event of Default all outstanding payments under this agreement will become immediately due and payable, including both principal and interest amounts, without further notice, presentment, or demand to the Borrower.

28 the borrower defaults on a date D_2
29 if the borrower has an obligation
30 and the borrower fails on a date D_0 to fulfil the obligation
31 and the Lender notifies the borrower on a date D_1
32 that the borrower fails on D_0 to fulfil the obligation
33 and D_2 is 2 days after D_1
34 and it is not the case that
35 the borrower cures the failure of the obligation on or before D_2 .

36
37 the borrower cures the failure of an obligation on or before a date D_3
38 if the obligation is
39 that the borrower pays an amount to the Lender on a date D_0
40 and the borrower pays the amount to the Lender on a date D_1
41 and the borrower notifies the Lender on a date D_2
42 that the borrower pays the amount to the Lender on D_1
43 and D_1 is on or before D_3
44 and D_2 is on or before D_3 .

28 the borrower defaults on a date D_2
29 if the borrower has an obligation
30 and the borrower fails on a date D_0 to fulfil the obligation
31 and the Lender notifies the borrower on a date D_1
32 that the borrower fails on D_0 to fulfil the obligation
33 and D_2 is 2 days after D_1
34 and it is not the case that
35 the borrower cures the failure of the obligation on or before D_2 .

36
37 the borrower cures the failure of an obligation on or before a date D
38 if the obligation is
39 that the borrower pays an amount to the Lender on an other date
40 and the borrower pays the amount to the Lender on a new payment date
41 and the borrower notifies the Lender on a notification date
42 that the borrower pays the amount to the Lender on the new payment date
43 and the new payment date is on or before D
44 and the notification date is on or before D .

52 scenario payment is:

53 the lender notifies the borrower on 2016-06-04

54 that the borrower fails on 2016-06-01 to fulfil obligation2.

55 the borrower pays 525 to the lender on 2016-06-05.

56 the borrower notifies the lender on 2016-06-06

57 that the borrower pays 525 to the lender on 2016-06-06.

58

59 query defaults is:

60 which person defaults on which day.

Query defaults with payment: *a borrower* defaults on *a date*

Answer: the borrower defaults on 2016-6-6T0:0:0.0

true

?-

answer defaults with payment.

Prospects for the Future

- All computer languages should be readable without training.
- But learning to write will be harder than learning to read.
- Learning to write well will be much harder.
- We need a corpus of well-written examples.
- Legal applications are a good place to start.

SWISH implementation of LE at
<https://logicalenglish.logicalcontracts.com/>

Some other examples

```

1 :- module('subset+http://tests.com', []).
2
3 en("the target language is: prolog.
4
5 the templates are:
6   *a set* is a subset of *a set*,
7   *a thing* is a set,
8   *a thing* belongs to *a set*.
9
10 the knowledge base subset includes:
11
12 a set A is a subset of a set B
13   if set A is a set
14   and set B is a set
15   and for all cases in which
16   a thing belongs to set A
17   it is the case that
18   the thing belongs to set B.
19
20 scenario one is:
21   family one is a set.
22   family two is a set.
23   Bob belongs to family one.
24   Alice belongs to family one.
25
26   Alice belongs to family two.
27
28 query one is:
29   which first family is a subset of which second family.
30
31 scenario two is:
32   [Alice, Bob] is a set.
33   [Alice] is a set.
34
35   a thing belongs to a set

```

answer one with one.

Query one with one: **a set* is a subset of *a set**

Answer: *family one is a subset of family one*

true

Answer: *family two is a subset of family one*

true

Answer: *family two is a subset of family two*

true

answer two with two.

Query two with two: **a set* is a subset of *a set**

Answer: *[Alice,Bob] is a subset of [Alice,Bob]*

true

Next 10 100 1,000 Stop

show prolog.

```

is_a_subset_of(A, B) :-
  is_a_set(A),
  is_a_set(B),
  forall(belongs_to(C, A), belongs_to(C, B)).
query(null, true).
query(one, is_a_subset_of(_, _)).
query(two, is_a_subset_of(_, _)).
example(null, []).
example(one, [scenario([is_a_set(family_one):-true), (is_a_set(family_two):-true), (belongs_to('Bob', family_one):-true), (belongs_to('Alice', family_one):-true), (belongs_to('Alice', family_two):-true)]]).
example(two, [scenario([is_a_set(['Alice', 'Bob']):-true), (is_a_set(['Alice']):-true), (belongs_to('Alice', ['Alice', 'Bob']):-true), (belongs_to('Bob', ['Alice', 'Bob']):-true)]]).
true

```

?- show prolog.

Examples History Solutions

table results Run!

```
11
12 un ensemble A est un sous-ensemble d'un ensemble B
13   si l'ensemble A est un ensemble
14   et l'ensemble B est un ensemble
15   et pour tous Les cas où
16     une chose appartient à L'ensemble A
17     c'est Le cas que
18     La chose appartient à L'ensemble B.
19
20 Le scénario un est:
21   La famille un est un ensemble.
22   La famille deux est un ensemble.
23   Bob appartient à La famille un.
24   Alice appartient à La famille un.
25
26   Alice appartient à La famille deux.
27
28 La question un est:
29   quelle premier famille est un sous-ensemble d' quelle seconde famille.
30
31 Le scénario deux est:
32   [Alice, Bob] est un ensemble.
33   [Alice] est un ensemble.
34
```

répondre deux avec un.

La question deux avec un: *an ensemble* est un sous-ensemble d *an ensemble*

La réponse: La famille un est un sous-ensemble d La famille un

true 1

La réponse: La famille deux est un sous-ensemble d La famille un

true 2

La réponse: La famille deux est un sous-ensemble d La famille deux

true 3

répondre deux avec deux.

La question deux avec deux: *an ensemble* est un sous-ensemble d *an ensemble*

La réponse: [Alice,Bob] est un sous-ensemble d [Alice,Bob]

true 1

La réponse: [Alice] est un sous-ensemble d [Alice,Bob]

true 2

La réponse: [Alice] est un sous-ensemble d [Alice]

true 3

?- répondre deux avec deux.

Examples History Solutions table results Run!

12 un conjunto A es un subconjunto de un conjunto B
13 si el conjunto A es un conjunto
14 y el conjunto B es un conjunto
15 y for all cases in which
16 una cosa pertenece a el conjunto A
17 it is the case that
18 La cosa pertenece a el conjunto B.
19
20 escenario uno es:
21 familia uno es un conjunto.
22 familia dos es un conjunto.
23 Roberto pertenece a La familia uno.
24 Alicia pertenece a La familia uno.
25
26 Alicia pertenece a La familia dos.
27
28 La pregunta uno es:
29 which first familia es un subconjunto de which second familia.
30
31 escenario dos es:
32 [Alicia, Roberto] es un conjunto.
33 [Alicia] es un conjunto.
34
35 una cosa pertenece a un conjunto
36 if la cosa is in el conjunto.
37
38 La pregunta dos es:
39 which conjunto es un subconjunto de which other conjunto.
40

responde dos con uno.

La pregunta dos con uno: *a conjunto* es un subconjunto de *a conjunto*

La respuesta: familia uno es un subconjunto de familia uno

true

La respuesta: familia uno es un subconjunto de familia dos

true

La respuesta: familia dos es un subconjunto de familia uno

true

La respuesta: familia dos es un subconjunto de familia dos

true

responde dos con dos.

La pregunta dos con dos: *a conjunto* es un subconjunto de *a conjunto*

La respuesta: [Alicia,Roberto] es un subconjunto de [Alicia,Roberto]

true

La respuesta: [Alicia] es un subconjunto de [Alicia,Roberto]

true

La respuesta: [Alicia] es un subconjunto de [Alicia]

true

?- responde dos con dos.

Examples▲

History▲

Solutions▲

16 La base di conoscenza cittadinanzaaita include:
17
18 una persona A ha la cittadinanza italiana
19 se una persona B è genitore di La persona A
20 e La persona B ha la cittadinanza italiana.
21
22 una persona A è genitore di una persona B
23 se La persona A è padre di La persona B.
24
25 una persona A è genitore di una persona B
26 se La persona A è madre di La persona B.
27
28 scenario giuseppe è:
29 felice è padre di giuseppe.
30 tatiana è madre di giuseppe.
31 felice ha la cittadinanza italiana.
32 tatiana ha la cittadinanza italiana.
33
34 domanda uno è:
35 quale persona ha la cittadinanza italiana.
36

 answer(uno, with(giuseppe), le(E), R).

E =

• It is the case that: **giuseppe ha la cittadinanza italiana** as proved by [KB Text](#)
because

- It is the case that: **felice è genitore di giuseppe** as proved by [KB Text](#)
because
 - It is the case that: **felice è padre di giuseppe** as proved by *hypothesis in scenario*
- It is the case that: **felice ha la cittadinanza italiana** as proved by *hypothesis in scenario*,

R = true

E =

• It is the case that: **giuseppe ha la cittadinanza italiana** as proved by [KB Text](#)
because

- It is the case that: **tatiana è genitore di giuseppe** as proved by [KB Text](#)
because
 - It is the case that: **tatiana è madre di giuseppe** as proved by *hypothesis in scenario*
- It is the case that: **tatiana ha la cittadinanza italiana** as proved by *hypothesis in scenario*,

R = true

Next 10 100 1.000 Stop
Examples History Solutions

ta

The event calculus for reasoning about time

14 a fluent holds at a time T_2
15 if an event happens at a time T_1
16 and the event initiates the fluent at T_1
17 and T_1 is before T_2
18 and it is not the case that
19 an other event happens at a time T
20 and the other event terminates the fluent at T
21 and T_1 is on or before T
22 and T is before T_2 .

23
24 switch up initiates light at each time.
25 switch down initiates dark at each time.
26 switch up terminates dark at each time.
27 switch down terminates light at each time.

28
29 switch up happens at 1.
30 switch down happens at 4.

Answer: Light holds at 2

true

Answer: Light holds at 3

true

Answer: Light holds at 4

true

Answer: dark holds at 5

true

Answer: dark holds at 6

true

Next

10

100

1,000

Stop

?-

answer two with switching.

Examples▲

History▲

Solutions▲

```
10
11 the knowledge base simple RPS includes:
12     scissors beats paper.
13     paper beats rock.
14     rock beats scissors.
15
16 a first player gets a prize
17     if the first player inputs a first choice and an amount X
18     and a second player inputs a second choice and an amount Y
19     and the first player is different from the second player
20     and the first choice beats the second choice
21     and the prize is X+Y.
22
23 the game is a draw
24     if a first player inputs a first choice and an amount X
25     and a second player inputs the first choice and an amount Y
26     and the first player is different from the second player.
27
28 a player gets an amount
29     if the game is a draw
30     and the player inputs a choice and the amount.
31
32 scenario mb is:
33     miguel inputs scissors and 100.
34     bob inputs paper and 1000.
35
36 query gets is:
37     which person gets which amount.
```

 answer gets with mb.

Query gets with mb: *a person* gets *an amount*

Answer: miguel gets 1100

true

false

?- answer gets with mb.

```

12  scissors beats paper.
13  paper beats rock.
14  rock beats scissors.
15
16  a first player gets a prize
17  if the first player inputs a first choice and an amount X
18  and a second player inputs a second choice and an amount Y
19  and the first player is different from the second player
20  and the first choice beats the second choice
21  and the prize is X+Y.
22
23  the game is a draw
24  if a first player inputs a first choice and an amount X
25  and a second player inputs the first choice and an amount Y
26  and the first player is different from the second player.
27
28  a player gets an amount
29  if the game is a draw
30  and the player inputs a choice and the amount.
31
32  scenario mbj is:
33  miguel inputs paper and 100.
34  bob inputs paper and 1000.
35  % jacinto inputs paper and 1000.
36
37  query gets is:
38  which person gets which amount.
39
40  query draw is:
41  the game is a draw.

```

answer(gets, with(mbj), le(Explanations), R).

Explanations =

It is the case that: **miguel gets 100** as proved by [KB Text](#)
because

- It is the case that: **the game is a draw** as proved by [KB Text](#)
because
 - It is the case that: **miguel inputs paper and 100** as proved by *hypothesis in scenario*
 - It is the case that: **bob inputs paper and 1000** as proved by *hypothesis in scenario*

R = true

Explanations =

It is the case that: **bob gets 1000** as proved by [KB Text](#)
because

- It is the case that: **the game is a draw** as proved by [KB Text](#)
because
 - It is the case that: **miguel inputs paper and 100** as proved by *hypothesis in scenario*
 - It is the case that: **bob inputs paper and 1000** as proved by *hypothesis in scenario*

R = true

Next 10 100 1,000 Stop

?- answer(gets, with(mbj), Le(Explanations), R).

Examples History Solutions

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