Theories are one of the most important tools of science. Although psychologists discussed problems of theory in their discipline for a long time, weak theories are still widespread in most subfields. One possible reason for this is that psychologists lack the tools to systematically assess the quality of their theories.

Previously a computational model for formal theory evaluation based on the concept of explanatory coherence was developed (Thagard, 1989, <doi:10.1017/S0140525X00057046>). However, there are possible improvements to this model and it is not available in software that psychologists typically use. Therefore, a new implementation of explanatory coherence based on the Ising model is available in this R-package.

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computeIMEC

Computes the Ising model of explanatory coherence.

Description

Computes IMEC based on previously specified explanatory relations.

Usage

computeIMEC(
  matrix,  
  evidence, 
  phenomena, 
  theory1, 
  theory2 = character(), 
  analytic = TRUE, 
  analogy = numeric()
)

Arguments

- **matrix**: matrix of explanatory relations.
- **evidence**: vector of evidence for phenomena.
- **phenomena**: vector of phenomena should be the same length as evidence.
- **theory1**: vector of propositions in theory1.
- **theory2**: vector of propositions in theory2.
- **analytic**: whether the result should be calculated analytically or (for large networks) estimated using Metropolis-Hastings algorithm enhanced with Coupling from the past.
- **analogy**: this argument is only for purposes of adding analogy in the future and should currently not be used.

Value

returns an IMEC object which contains the explanatory coherence of the propositions, the explanatory relations, the evidence, and the phenomena.
Examples

# simple example comparing two hypotheses one of them with more explanatory breadth##
T1 <- c(“H1”, “H2”)
Phenomena <- c(“E1”, “E2”)
Thresholds <- c(2,2)
explanations <- initializeNetwork(Phenomena, T1)
explanations <- explain(“H1”, “E1”, explanations)
explanations <- explain(“H1”, “E2”, explanations)
explanations <- explain(“H2”, “E2”, explanations)
explanations <- contradict("H1", "H2", explanations)
coherence <- computeIMEC(explanations, Thresholds, Phenomena, T1)
summary(coherence)
plot(coherence)

contradict

Description

Sets a contradictory relation between a set of propositions and a phenomenon. If more than one proposition is used the edge weight will be reduced accordingly.

Usage

contradict(Explanation, Explanandum, matrix, weight = 4)

Arguments

Explanation Vector of explanations that explain the explanandum
Explanandum A proposition or phenomenon that is explained
Matrix of explanatory relations that is modified
weight Strength of connection (i.e., strength of contradiction)

Examples

# simple example comparing two hypotheses one of them with more explanatory breadth##
T1 <- c("H1", "H2")
Phenomena <- c("E1", "E2")
Thresholds <- c(2,2)
explanations <- initializeNetwork(Phenomena, T1)
explanations <- explain("H1", "E1", explanations)
explanations <- explain("H1", "E2", explanations)
explanations <- explain("H2", "E2", explanations)
explanations <- contradict("H1", "H2", explanations)
coherence <- computeIMEC(explanations, Thresholds, Phenomena, T1)
summary(coherence)
plot(coherence)
**Description**

Sets an explanatory relation between a set of propositions and a phenomenon. If more than one proposition is used the edge weight will be reduced accordingly.

**Usage**

```
explain(Explanation, Explanandum, matrix, weight = 1)
```

**Arguments**

- **Explanation**: Vector of Explanations that explain the Explanandum
- **Explanandum**: A proposition or phenomenon that is explained
- **matrix**: Matrix of Explanatory relations that is modified
- **weight**: Strength of connection (i.e., quality of explanation)

**Value**

Returns the explanatory matrix with the edge weights modified according to the specified explanation

**Examples**

```
# simple example comparing two hypotheses one of them with more explanatory breadth
T1 <- c("H1", "H2")
Phenomena <- c("E1", "E2")
Thresholds <- c(2,2)
explanations <- initializeNetwork(Phenomena, T1)
explanations <- explain("H1", "E1", explanations)
explanations <- explain("H1", "E2", explanations)
explanations <- explain("H2", "E2", explanations)
contradict("H1", "H2", explanations)
coherence <- computeIMEC(explanations, Thresholds, Phenomena, T1)
summary(coherence)
pplot(coherence)
```
Description

This package computes the Ising Model of Explanatory Coherence for theory comparison and theory appraisal.

Construct Explanary Network

initializeNetwork constructs an initial empty explanatory network Explain and Contradict specify explanatory relations.

Calculate IMEC

computeIMEC computes the Ising model of explanatory coherence and returns an object of class IMEC. Use summary to summarize the result and plot to plot the explanatory relations.

initializeNetwork Initialize the explanatory network

Description

This function initializes the network in which explanatory relations can be stored later.

Usage

initializeNetwork(phenomena, theory1, theory2 = character())

Arguments

phenomena Vector of phenomena that are explained
theory1 Vector of propositions included in theory 1
theory2 Vector of propositions included in theory 2 (only set manually if theory comparison is intended)

Value

An empty edge matrix (all edges 0)
Examples

# simple example comparing two hypotheses one of them with more explanatory breadth#
T1 <- c("H1", "H2")
Phenomena <- c("E1", "E2")
Thresholds <- c(2,2)
explanations <- initializeNetwork(Phenomena, T1)
explanations <- explain("H1", "E1", explanations)
explanations <- explain("H1", "E2", explanations)
explanations <- explain("H2", "E2", explanations)
explanations <- contradict("H1", "H2", explanations)
coherence <- computeIMEC(explanations, Thresholds, Phenomena, T1)
summary(coherence)
plot(coherence)

plot.IMEC

Plots the explanatory relations

Description

Plot the explanatory relations between data and phenomena. A window will open where you can drag the nodes in the intended position. Then press enter to plot the network.

Usage

## S3 method for class 'IMEC'
plot(x, nodesize = 10, ...)

Arguments

x Object of the class IMEC as returned by computeIMEC
nodesize size of vertices in the plotted network
... other parameters passed on to S3 method.

Examples

# simple example comparing two hypotheses one of them with more explanatory breadth#
T1 <- c("H1", "H2")
Phenomena <- c("E1", "E2")
Thresholds <- c(2,2)
explanations <- initializeNetwork(Phenomena, T1)
explanations <- explain("H1", "E1", explanations)
explanations <- explain("H1", "E2", explanations)
explanations <- explain("H2", "E2", explanations)
explanations <- contradict("H1", "H2", explanations)
coherence <- computeIMEC(explanations, Thresholds, Phenomena, T1)
summary(coherence)
plot(coherence)
Summary of an IMEC object.

Usage

```r
## S3 method for class 'IMEC'
summary(object, ...)
```

Arguments

- `object`: IMEC object.
- `...`: other parameters passed on from S3 method.

Examples

```r
# simple example comparing two hypotheses one of them with more explanatory breadth
T1 <- c("H1", "H2")
Phenomena <- c("E1", "E2")
Thresholds <- c(2,2)
explanations <- initializeNetwork(Phenomena, T1)
explanations <- explain("H1", "E1", explanations)
explanations <- explain("H1", "E2", explanations)
explanations <- explain("H2", "E2", explanations)
explanations <- contradict("H1", "H2", explanations)
coherence <- computeIMEC(explanations, Thresholds, Phenomena, T1)
summary(coherence)
plot(coherence)
```
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