Using Decentralised Conflict-Abduction-Negation in Policy-making

Étienne Houzé[1,2], Ada Diaconescu[1], Jean-Louis Dessalles[1]

December 2021

[1]Télécom Paris
[2]EDF R&D

Problematic cases

Problematic cases

Example 1 : Autonomous Car Crash

An autonomous car crashes. Before setting up new regulations, one needs to fully understand the causal chain of events leading to the crash. However, knowledge is distributed among different people : driver, car manufacturer, local authorities...

Problematic cases

Example 1 : Autonomous Car Crash

An autonomous car crashes. Before setting up new regulations, one needs to fully understand the causal chain of events leading to the crash. However, knowledge is distributed among different people : driver, car manufacturer, local authorities...

Example 2 : Fake News on Social Media

A crime is perpetrated after a person read fake news on social media and decided to act on his/her own. What are the different responsibilities in this case, between the social media, the criminal, the original writer ?

Problematic cases

Example 1 : Autonomous Car Crash

An autonomous car crashes. Before setting up new regulations, one needs to fully understand the causal chain of events leading to the crash. However, knowledge is distributed among different people : driver, car manufacturer, local authorities...

Example 2 : Fake News on Social Media

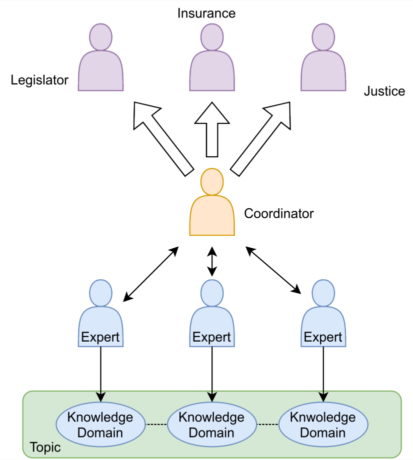
A crime is perpetrated after a person read fake news on social media and decided to act on his/her own. What are the different responsibilities in this case, between the social media, the criminal, the original writer ?

Can we provide a formal canvas for reasoning in these two cases ?

Problematic cases

Complex problems

In many real-world situations, a policy affects an entire topic, spanning over the knowledge of different experts. As such, to find relevant policies and causal chains, coordination and communication between these experts is required.



Insights from Smart Homes

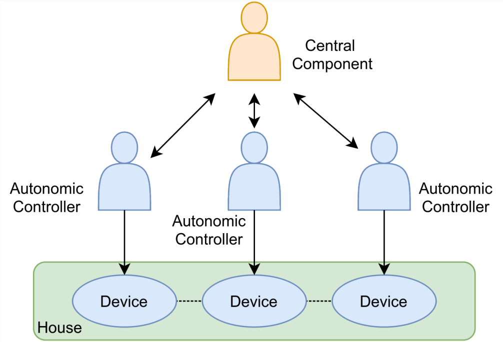
Insights from Smart Homes

What is a Smart Home?

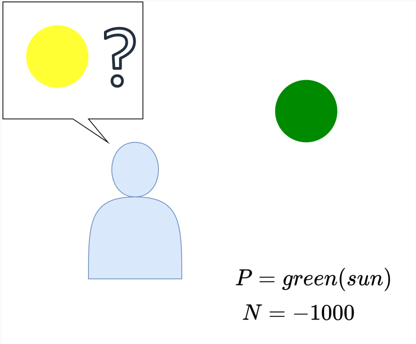
A Smart Home is a collection of connected devices located in the same house acting together towards the completion of various high-level goals, such as comfort, power efficiency, security[3].

Insights from Smart Homes

Parallel between Smart Home Systems and complex decisionary systems !



The D-CAN process



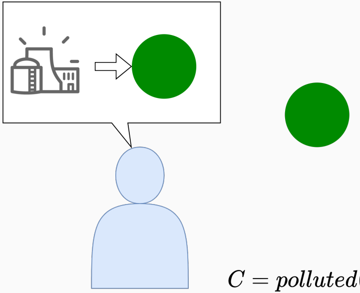
Conflict

At root of the process is a conflict, *i.e.* an proposition P that is realized while not expected/wished. A proposition is assigned a *necessity* N to convey intensity information.

Abduction

Negation

Conflict – Abduction – Negation [1]



$$C = polluted(air)$$
$$N = -1000$$

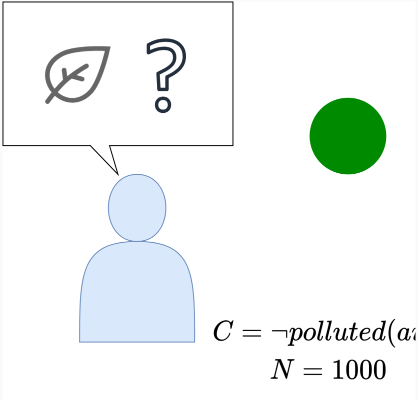
Conflict

Abduction

Observing a conflict (P, N), we propagate the conflict to a hypothetical cause C, creating the new conflict (C, N).

Negation

Conflict – Abduction – Negation [1]



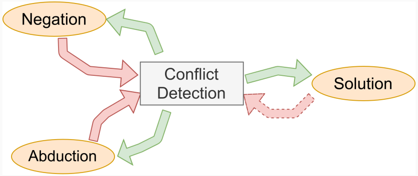
Conflict

Abduction

Negation

When confronted to a conflict (P, N), we can consider its negation $(\neg P, -N)$ as a conflict of the same intensity, thus propagating the reasoning to other branches.

Conflict – Abduction – Negation [1]



Conflict

Abduction

Negation

We iterate over these steps, propagating the conflict, until a solution is found, or the conflict is given up !

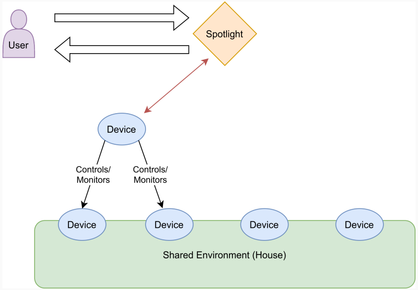
Decentralizing the process[2]

The Spotlight

Generic, no specialized knowledge. Analyzes the request and route it to the relevant component

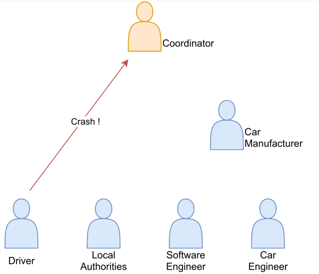
The Explanatory Component

Local Knowledge, specialized. Detects conflicts, uses abductive reasoning, "points finger" at the responsible.



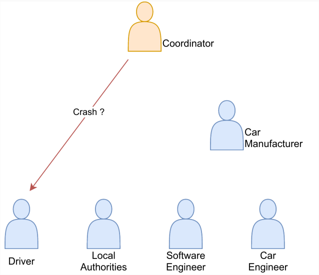
Illustrative Examples

Example 1 : The Car Crash



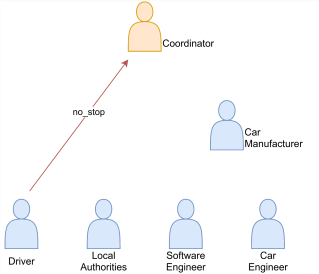
1. The driver reports her issue : the crash $P = crash$, $N = -100$

Example 1 : The Car Crash



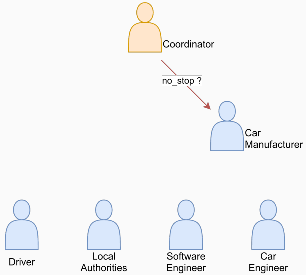
1. The driver reports her issue : the crash $P = \mathit{crash}$, $N = -100$
2. Coordinator returns the request, asking her to give more details

Example 1 : The Car Crash



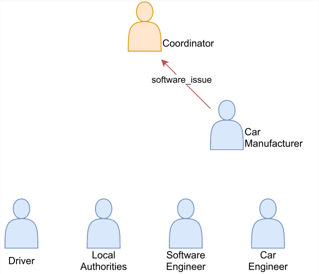
1. The driver reports her issue : the crash $P = crash, N = -100$
2. Coordinator returns the request, asking her to give more details
3. Answer : the car failed to stop at a sign. (abduction : $P = no\_stop$)

Example 1 : The Car Crash



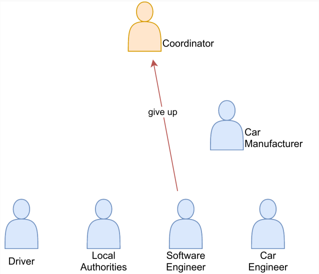
1. The driver reports her issue : the crash $P = crash$, $N = -100$
2. Coordinator returns the request, asking her to give more details
3. Answer : the car failed to stop at a sign. (abduction : $P = no\_stop$)
4. Coordinator transmits the request to the car manufacturer

Example 1 : The Car Crash



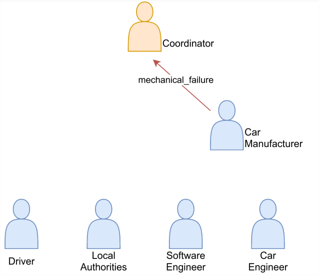
1. The driver reports her issue : the crash $P = crash$, $N = -100$
2. Coordinator returns the request, asking her to give more details
3. Answer : the car failed to stop at a sign. (abduction : $P = no\_stop$)
4. Coordinator transmits the request to the car manufacturer
5. Car manufacturer finds a possible cause might be an issue with the software. (abduction : $P = software\_issue$)

Example 1 : The Car Crash



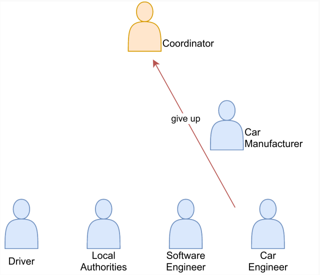
1. The driver reports her issue : the crash $P = crash, N = -100$
2. Coordinator returns the request, asking her to give more details
3. Answer : the car failed to stop at a sign. (abduction : $P = no\_stop$)
4. Coordinator transmits the request to the car manufacturer
5. Car manufacturer finds a possible cause might be an issue with the software. (abduction : $P = software\_issue$)
6. After testing, software engineer finds no issue in the software (give up)

Example 1 : The Car Crash



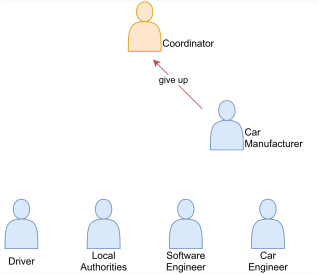
1. The driver reports her issue : the crash $P = crash, N = -100$
2. Coordinator returns the request, asking her to give more details
3. Answer : the car failed to stop at a sign. (abduction : $P = no\_stop$)
4. Coordinator transmits the request to the car manufacturer
5. Car manufacturer finds a possible cause might be an issue with the software. (abduction : $P = software\_issue$)
6. After testing, software engineer finds no issue in the software (give up)
7. Car manufacturer proposes another solution : possible mechanical failure (abduction : $P = mechanical\_failure$)

Example 1 : The Car Crash



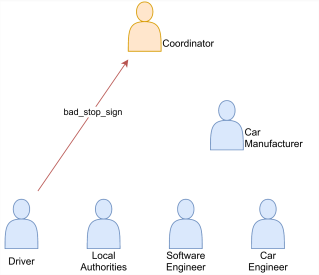
1. The driver reports her issue : the crash $P = crash$, $N = -100$
2. Coordinator returns the request, asking her to give more details
3. Answer : the car failed to stop at a sign. (abduction : $P = no\_stop$)
4. Coordinator transmits the request to the car manufacturer
5. Car manufacturer finds a possible cause might be an issue with the software. (abduction : $P = software\_issue$)
6. After testing, software engineer finds no issue in the software (give up)
7. Car manufacturer proposes another solution : possible mechanical failure (abduction : $P = mechanical\_failure$)
8. Car engineer clearly states there is no defect (give up)

Example 1 : The Car Crash



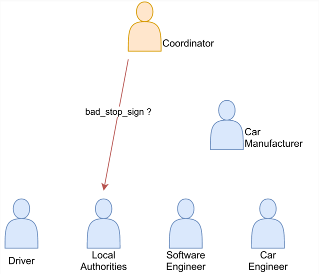
1. The driver reports her issue : the crash $P = crash$, $N = -100$
2. Coordinator returns the request, asking her to give more details
3. Answer : the car failed to stop at a sign. (abduction : $P = no\_stop$)
4. Coordinator transmits the request to the car manufacturer
5. Car manufacturer finds a possible cause might be an issue with the software. (abduction : $P = software\_issue$)
6. After testing, software engineer finds no issue in the software (give up)
7. Car manufacturer proposes another solution : possible mechanical failure (abduction : $P = mechanical\_failure$)
8. Car engineer clearly states there is no defect (give up)
9. Car manufacturer returns with no further hypothesis (give up)

Example 1 : The Car Crash



1. The driver reports her issue : the crash $P = crash$, $N = -100$
2. Coordinator returns the request, asking her to give more details
3. Answer : the car failed to stop at a sign. (abduction : $P = no\_stop$)
4. Coordinator transmits the request to the car manufacturer
5. Car manufacturer finds a possible cause might be an issue with the software. (abduction : $P = software\_issue$)
6. After testing, software engineer finds no issue in the software (give up)
7. Car manufacturer proposes another solution : possible mechanical failure (abduction : $P = mechanical\_failure$)
8. Car engineer clearly states there is no defect (give up)
9. Car manufacturer returns with no further hypothesis (give up)
10. Back to the driver : maybe the Stop sign was damaged (abduction : $P = bad\_stop\_sign$)

Example 1 : The Car Crash



1. The driver reports her issue : the crash $P = crash$, $N = -100$
2. Coordinator returns the request, asking her to give more details
3. Answer : the car failed to stop at a sign. (abduction : $P = no\_stop$)
4. Coordinator transmits the request to the car manufacturer
5. Car manufacturer finds a possible cause might be an issue with the software. (abduction : $P = software\_issue$)
6. After testing, software engineer finds no issue in the software (give up)
7. Car manufacturer proposes another solution : possible mechanical failure (abduction : $P = mechanical\_failure$)
8. Car engineer clearly states there is no defect (give up)
9. Car manufacturer returns with no further hypothesis (give up)
10. Back to the driver : maybe the Stop sign was damaged (abduction : $P = bad\_stop\_sign$)
11. Go to the local authorities...

Example 2 : Fake News Consequences

1. The initial conflict is the crime ($P = crime, N = -100$)

Example 2 : Fake News Consequences

1. The initial conflict is the crime ($P = crime, N = -100$)
2. Faced with accusation, she tells about her readings on the social media. (abduction :$P = social\_media\_news, N = -90$)

Example 2 : Fake News Consequences

1. The initial conflict is the crime ($P = crime, N = -100$)
2. Faced with accusation, she tells about her readings on the social media. (abduction :$P = social\_media\_news, N = -90$)
3. Social media denies responsibility (given-up)

Example 2 : Fake News Consequences

1. The initial conflict is the crime ($P = crime, N = -100$)
2. Faced with accusation, she tells about her readings on the social media. (abduction :$P = social\_media\_news, N = -90$)
3. Social media denies responsibility (given-up)
4. Request again, but with more intensity ($P = social\_media\_news$, $\mathrm{N} = -130$)

Example 2 : Fake News Consequences

1. The initial conflict is the crime ($P = crime, N = -100$)
2. Faced with accusation, she tells about her readings on the social media. (abduction :$P = social\_media\_news, N = -90$)
3. Social media denies responsibility (given-up)
4. Request again, but with more intensity ($P = social\_media\_news, \mathrm{N} = -130$)
5. This time, social media finds something (abduction :$P = group\_1\_news$)

Example 2 : Fake News Consequences

1. The initial conflict is the crime ($P = crime, N = -100$)
2. Faced with accusation, she tells about her readings on the social media. (abduction :$P = social\_media\_news, N = -90$)
3. Social media denies responsibility (given-up)
4. Request again, but with more intensity ($P = social\_media\_news$, $\mathrm{N} = -130$)
5. This time, social media finds something (abduction :$P = group\_1\_news$)
6. The investigation goes on to the original writer of the news

Example 2 : Fake News Consequences

1. The initial conflict is the crime ($P = crime, N = -100$)
2. Faced with accusation, she tells about her readings on the social media. (abduction :$P = social\_media\_news, N = -90$)
3. Social media denies responsibility (given-up)
4. Request again, but with more intensity ($P = social\_media\_news, \mathrm{N} = -130$)
5. This time, social media finds something (abduction :$P = group\_1\_news$)
6. The investigation goes on to the original writer of the news
7. ...

Conclusion

Conclusion

- The D-CAN process enables inter-agent communication in Smart Homes.
- This process can be transferred to policy-making situations where different experts must cooperate.
- It provides a formal canvas to enable discussion and model interactions between these experts.
- Limits : Human agents can deceive, make mistakes, hide the truth !

Thank you !

References

Jean-Louis Dessalles.
A Cognitive Approach to Relevant Argument Generation.
In Matteo Baldoni, Cristina Baroglio, and Floris Bex, editors, *Principles and Practice of Multi-Agent Systems, LNAI 9935*, pages 3–15. Springer, 2016.

Étienne Houzé, Jean-Louis Dessalles, Ada Diaconescu, David Menga, and Mathieu Schumann.
A Decentralized Explanatory System for Intelligent Cyber-Physical Systems.
In *Proceedings of SAI Intelligent Systems Conference*, pages 719–738. Springer, 2021.

Vincent Ricquebourg, David Menga, David Durand, Bruno Marhic, Laurent Delahoche, and Christophe Loge.
The smart home concept : our immediate future.
In *2006 1st IEEE international conference on e-learning in industrial electronics*, pages 23–28. IEEE, 2006.