

WHAT DO EXCEPTIONS HAVE IN COMMON?

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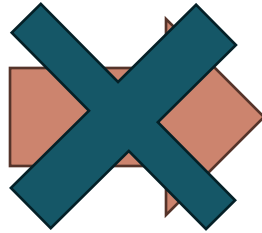
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DEFEASIBLE REASONING AND NON-MONOTONIC LOGICS

- **Defeasible reasoning** → a kind of reasoning which “fails to ‘preserve truth’ under all circumstances”
- Modelled through **non-monotonic logics** → adding new knowledge may lead to retracting some conclusions
 - Many approaches which rely on different intuitions and assumptions

BIRDS AND BEARS



Carnivora eat
meats. a
carnivoran.



Po is a panda
bear.

THE EXCEPTIONAL PATH

- What is an **exception**?
 - Starting definitions
 - Distinguishing exceptions
 - Sources of exceptions
- Relating **defeasibility** and **exceptions**
 - From universal to defeasible generalisations
 - A characterisation of exceptions
- Conclusions and criticalities



*WHAT IS AN
EXCEPTION?*

COMMON-SENSE DEFINITIONS OF “EXCEPTION”

- **Cambridge dictionary:** “someone or something that is not included in a rule, group, or list or that does not behave in the expected way”;
- **Oxford languages:** “a person or thing that is excluded from a general statement or does not follow a rule”;
- **Collins dictionary:** “An exception is a particular thing, person, or situation that is not included in a general statement, judgment, or rule.”



Two main concepts: some kind of **generalisation** and **an instance** or **individual** which **does not fit** to or is **excluded** from that generalisation.

EXCEPTIONS, COUNTER-EXAMPLES AND ERRORS

- **Counter-example**: the generalisation is falsified by the instance, e.g.:
The school can be reached only by bus or train, but Bob arrives by car.
- **Error**: the instance is faulty, e.g.:
Students have a unique ID card number, but Alice is registered with a wrong, non-unique number.
- **Exception**: both the generalisation and the instance are correct, e.g.:
Students have no salary, but Eve is a PhD student with a bursary



An exception is an **individual** justifiably **excluded** from a **generalisation**,
without causing a contradiction

SOURCES OF EXCEPTIONS

- **Incomplete** knowledge:
we need more knowledge to explain away all the exceptions.
- **Uncertain** knowledge:
there may be circumstances in which what we know does not apply.
- **Vague** knowledge
we cannot precisely fix the circumstances in which what we know applies.
- **Simplified** knowledge
we may understand that precisely speaking there are no exceptions, but for the sake of simplicity we accept some as such

DEFEASIBILITY AND EXCEPTIONS



UNIVERSAL AND DEFEASIBLE GENERALISATIONS

- A **universal generalisation** is formally represented through the **first-order logic** formula $\forall x(Px \rightarrow Qx)$, with the standard interpretation of “all the Ps are Qs”.
- A **defeasible generalisation** is formally represented as $\tilde{\forall}x(Px \rightarrow Qx)$ and it is interpreted as “a strict subset of the Ps is also a subset of the Qs”.
- The relation between universal and defeasible generalisations can be summarised as “ **$\tilde{\forall}$ -generalisation $\Leftrightarrow \forall$ -generalisation – exceptions**” where $\Leftrightarrow$ means an equivalence between the two formulations.

CHARACTERISING EXCEPTIONS

An **exception** is an individual belonging to a justified subset of the domain which if explicitly excluded from the scope of the quantifier of a false $\forall$ -generalisation transforms it into a true $\tilde{\forall}$ -generalisation.

The background features several thin, light brown lines that intersect to form various geometric shapes, including triangles and polygons, creating a modern, abstract design.

CONCLUSIONS

SUMMARY

What are exceptions:

common-sense definitions

counter-examples, errors and exceptions

sources of defeasibility

Defeasibility and exceptions:

two kinds of generalisations

the characterisation of exceptions

FUTURE WORK

- Developing further the framework
- Extending the comparison to other kinds of non-monotonic logics like preferential approaches and modal approaches
- Exploiting this analysis regarding the notions of exception and generalisation to refine our formal system

*THANK YOU FOR YOUR
ATTENTION!*

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