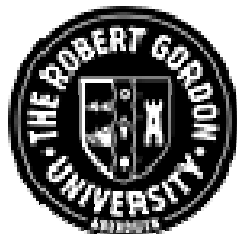


Learning Incident Causes

Amandine Orecchioni

Nirmalie Wiratunga, Stewart Massie,
Sutanu Chakraborti, Rahman Mukras



Outline

- Motivation
- Casebase Creation
- Structure Sentence Representation (SSR)
 - Sentence Decomposition (Link Grammar Parser)
 - Case Generalisation (WordNet)
- Evaluation
- Results
- Conclusion
- Future Work

Motivation

The pilot of the privately owned Ryan Aeronautical Navion B aircraft (registration C-FTRM, serial number NAV-4-2340B) departed Burlington, Ontario, under visual meteorological conditions, for a breakfast fly-in at Brantford, Ontario. An en route stop was made in Guelph, Ontario, to pick up a passenger. At approximately 1230 eastern standard time, the pilot and passenger boarded the aircraft and taxied for a departure from Brantford. The aircraft departed Runway 23 at the intersection of Taxiway Bravo and climbed on the runway heading. During the climb, the aircraft stalled and entered a spin. A single mayday call was heard on the Brantford Unicom frequency. The aircraft struck the ground in a nose down attitude, with the right wing striking first. The aircraft cartwheeled and came to rest 94 feet from the initial impact point. The occupants were fatally injured. There was no post-impact fire.

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Location

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Aircraft Type

Motivation

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Weather Conditions

Motivation

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Human Survival

Motivation

The pilot of the privately owned Ryan Aeronautical Navion B aircraft (registration C-FTRM, serial number NAV-4-2340B) departed Burlington, Ontario, under visual meteorological conditions, for a breakfast fly-in at Brantford, Ontario. An en route stop was made in Guelph, Ontario, to pick up a passenger. At approximately 1230 eastern standard time, the pilot and passenger boarded the aircraft and taxied for a departure from Brantford. The aircraft departed Runway 23 at the intersection of Taxiway Bravo and climbed on the runway heading. During the climb, the aircraft stalled and entered a spin. A single mayday call was heard on the Brantford Unicom frequency. The aircraft struck the ground in a nose down attitude, with the right wing striking first. The aircraft cartwheeled and came to rest 94 feet from the initial impact point. The occupants were fatally injured. There was no post-impact fire.



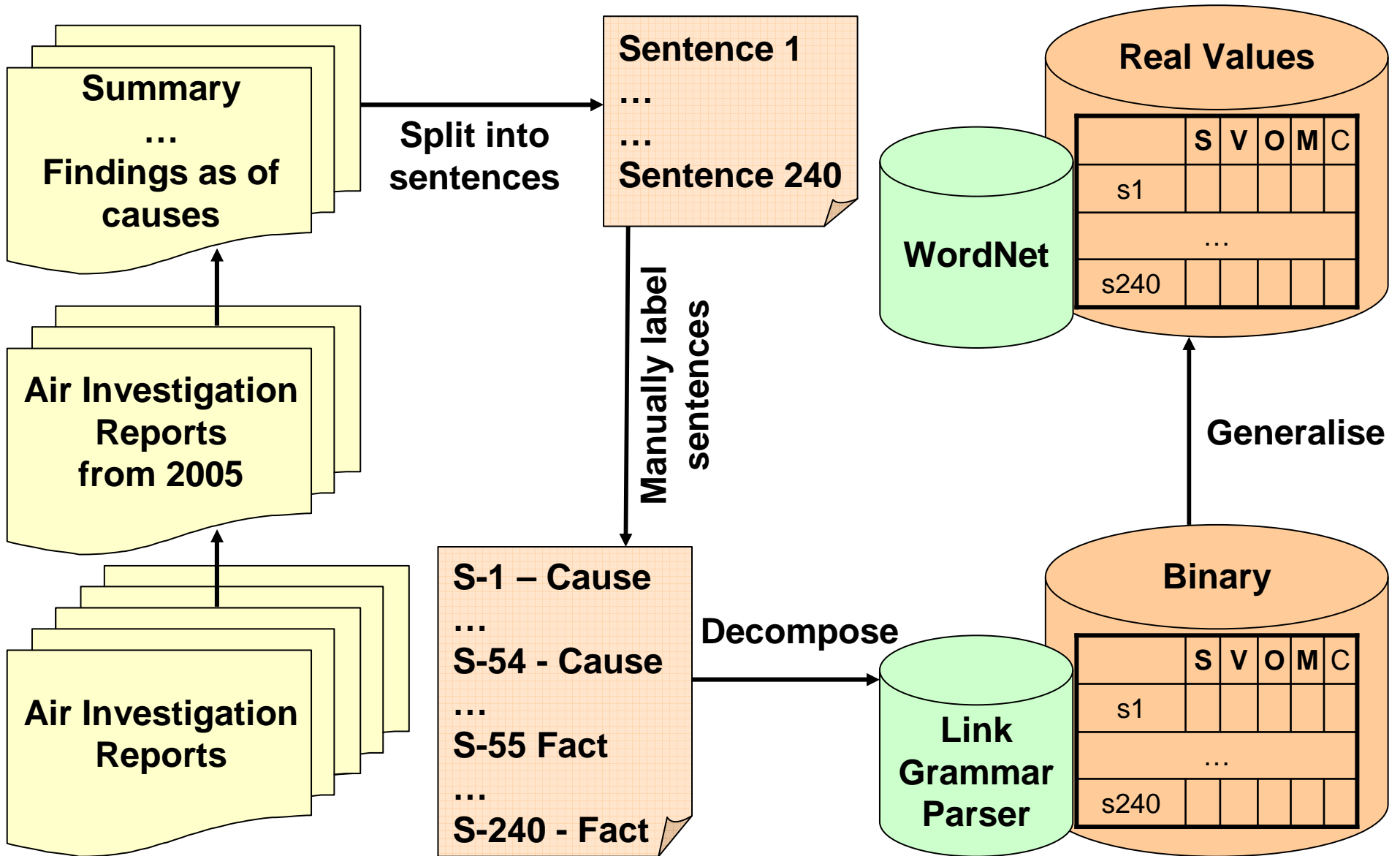
Incident Cause

Motivation

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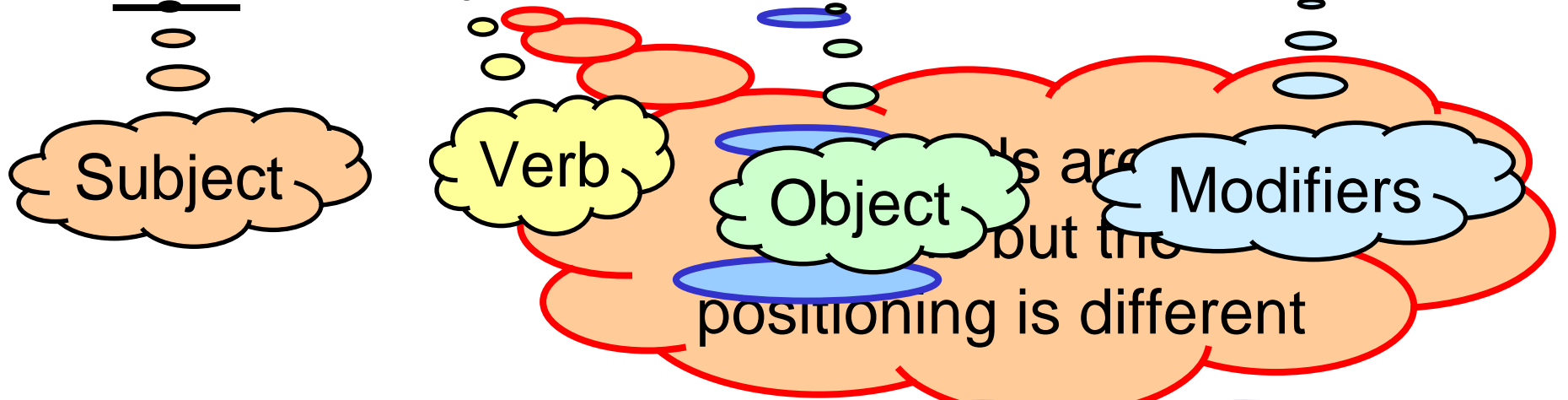
The aircraft stalled as part of the aerobatic display

Overview of Casebase Creation



Structure Sentence Representation

The passenger rescued the pilot from the aircraft
The pilot rescued the passenger from the aircraft



Different sentences but same bag-of-words (BOW) representation

Sentence Decomposition

- Link Grammar Parser [Sleator 2001]
 - Syntactic structure
 - Part of speech
 - Constituent tree

```
+-----Xp-----+
|               |
+-----Wd-----+ |               |
|               | |               |
+-----Ds-----+ |               |
|               | |               |
+-----Ss-----+ |               |
|               | |               |
+-----Pg*b----+ |               |
|               | |               |
+-----K-----+ |               |
|               | |               |
+-----AN-----+ |               |
|               | |               |
+-----AN-----+ |               |
|               | |               |
LEFT-WALL the helicopter.n was.v carrying.v out lake.n water.n sampling.g .
```

Constituent tree:

```
(S (NP The helicopter)
  (VP was
    (VP carrying
      (PRT out)
      (NP lake water sampling)))
  .)
```

Structure Sentence Representation (SSR)

Sentences	SSR Representation															Class				
	S						V						O				M			
	pilot	passenger	helicopter	runway	edge	lights	rescued	was	carrying	out	were	of	order	passenger	pilot	lake	water	sampling	aircraft	y
s1="The <u>pilot</u> rescued the passenger from the aircraft"	1	0	0	0	0	0	1	0	0	0	0	0	0	1	0	0	0	0	1	fact
s2="The <u>passenger</u> rescued the pilot"	0	1	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	fact
s3="The <u>runway edge lights</u> were out of order"	0	0	0	1	1	1	0	0	0	1	1	1	1	0	0	0	0	0	0	cause
s4="The <u>helicopter</u> was carrying out lake water sampling"	0	0	1	0	0	0	0	1	1	1	0	0	0	0	0	1	1	1	0	fact

Vocabulary of the subject constituents

Structure Sentence Representation (SSR)

Sentences	SSR Representation															Class					
	S					V					O						M				
	pilot	passenger	helicopter	runway	edge	lights	rescued	was	carrying	out	were	of	order	passenger	pilot	lake	water	sampling	aircraft	y	
s1="The pilot rescued the passenger from the aircraft"	1	0	0	0	0	0	1	0	0	0	0	0	0	0	1	0	0	0	0	1	fact
s2="The passenger rescued the pilot"	0	1	0	0	0	0	1	0	0	0	0	0	0	0	0	1	0	0	0	0	fact
s3="The runway edge lights were out of order"	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	se
s4="The helicopter was carrying out lake water sampling"	0	0	1	0	0	0	0	0	1	1	0	0	0	0	0	0	1	1	0	0	fact

Each constituent contains fewer words than the entire sentence

Structure Sentence Representation (SSR)

A structured representation means more sparseness

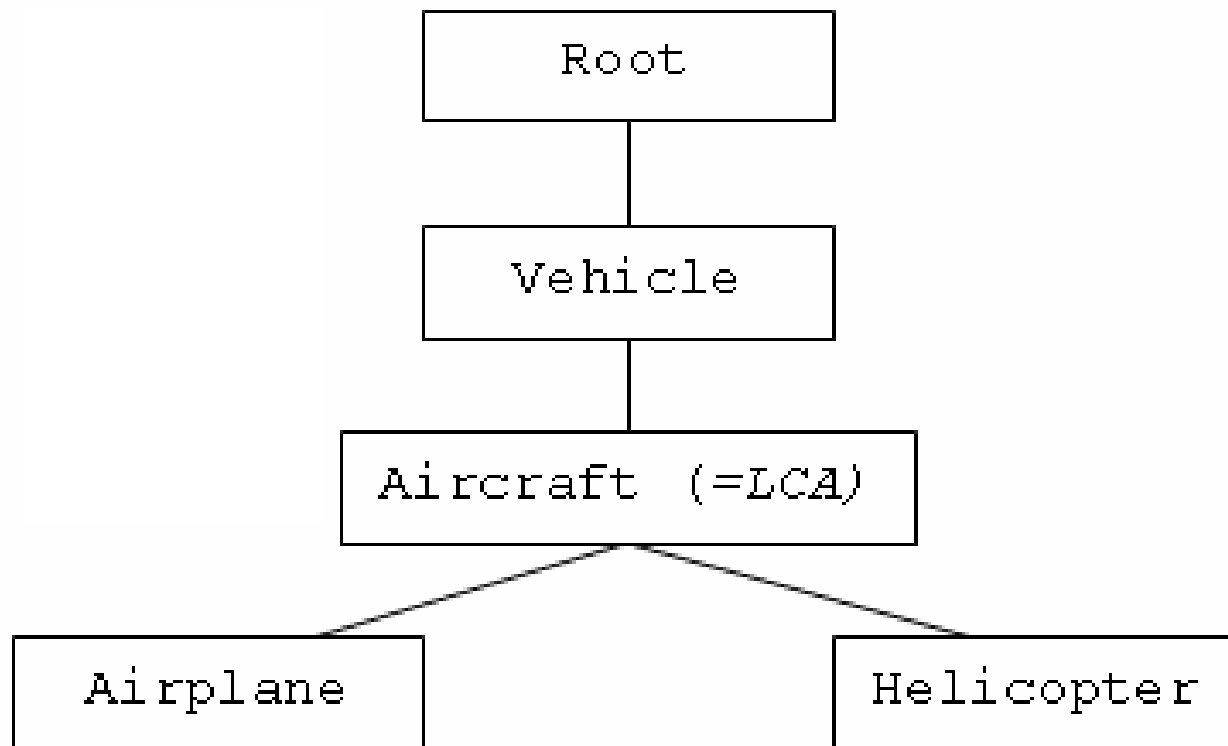
Sentences	prot	passenger	helicopter	runway	edge	lights	were	out	of	order	per	ing	fact		
s1="The pilot rescued the passenger from the aircraft"	1	0	0	0	0	0	0	1	0	0	0	0	0	1	fact
s2="The passenger rescued the pilot"	0	1	0	0	0	0	0	0	0	0	0	0	0	0	fact
s3="The runway edge lights were out of order"	0	0	0	1	1	1	0	0	0	1	1	1	1	0	cause
s4="The helicopter was carrying out lake water sampling"	0	0	1	0	0	0	0	1	1	1	0	0	0	0	fact

Structure Sentence Representation (SSR)

Sentences	SSR Representation															Class				
	S					V					O					M	y			
	pilot	passenger	helicopter	runway	edge	lights	rescued	was	carrying	out	were	of	order	passenger	pilot	lake		water	sampling	aircraft
s1="The pilot rescued the passenger from the aircraft"	1	0	0	0	0	0	1	0	0	0	0	0	0	1	0	0	0	0	1	fact
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s3="The runway edge lights were out of order"	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	fact
s4="The helicopter was carrying out lake water sampling"	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	fact

Boost value of absent words highly similar to present words

WordNet [Fellbaum 1998]



Case Generalisation

S1 = “The seaplane tipped to the right”

Subject	
Weather	0
Water	0
Seaplane	1
Runway	0
Pilot	0
Passenger	0
Engine	0
Biplane	0.86
Aircraft	0.8

For each feature $F=0$

- calculate similarity with present features
- If similarity is greater than 0.8
- Then boost F

$$\text{Similarity}(\text{Seaplane}, \text{Weather}) = 0.25$$

Evaluation

- Binary sentence classification: *cause/fact*
- Classification accuracy with:
 - Bow
 - Each SSR constituents independently (subject, verb, object, modifiers)
 - All SSR constituents combined
- Influence of Feature Generalisation

Results

- Overall accuracy between 74% and 84%
- SSR performs better than BOW
- Verb is poor at identifying facts, but good at identifying causes
- Object performs poorly
- All constituents, individually or combined, benefit from generalisation

Conclusion

- Sentence structure helps preserving meaning
- Sentence constituents perform better combined
- A constituent may be better at identifying a specific class
- Case generalisation is beneficial

Future Work

- Performance on a balanced dataset
- Transferability on a different domain
- SSR ability to identify other reports
comparison factors
- Compare WordNet based generalisation
with co-occurrence based generalisation
- Evaluate a combination of both
approaches

Thank You