Class-conditional independence as an assumption about the structure of a new environment

Presentation at the
ABC Mini Conference, 29 Nov 2012

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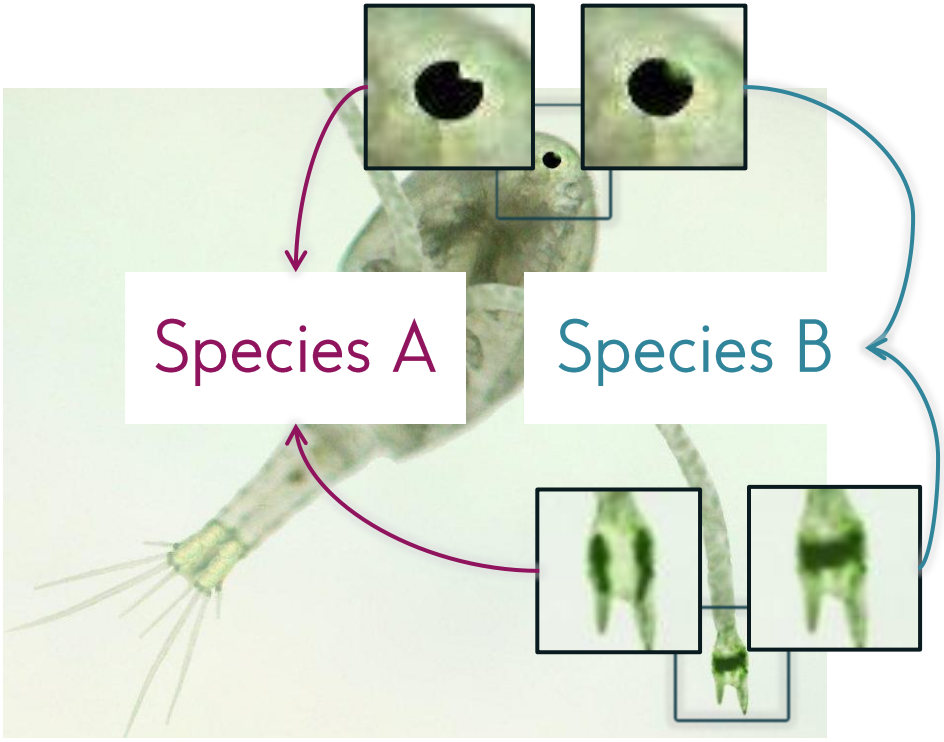
Assumption Explanation

Class-conditional independence of features

Classifications

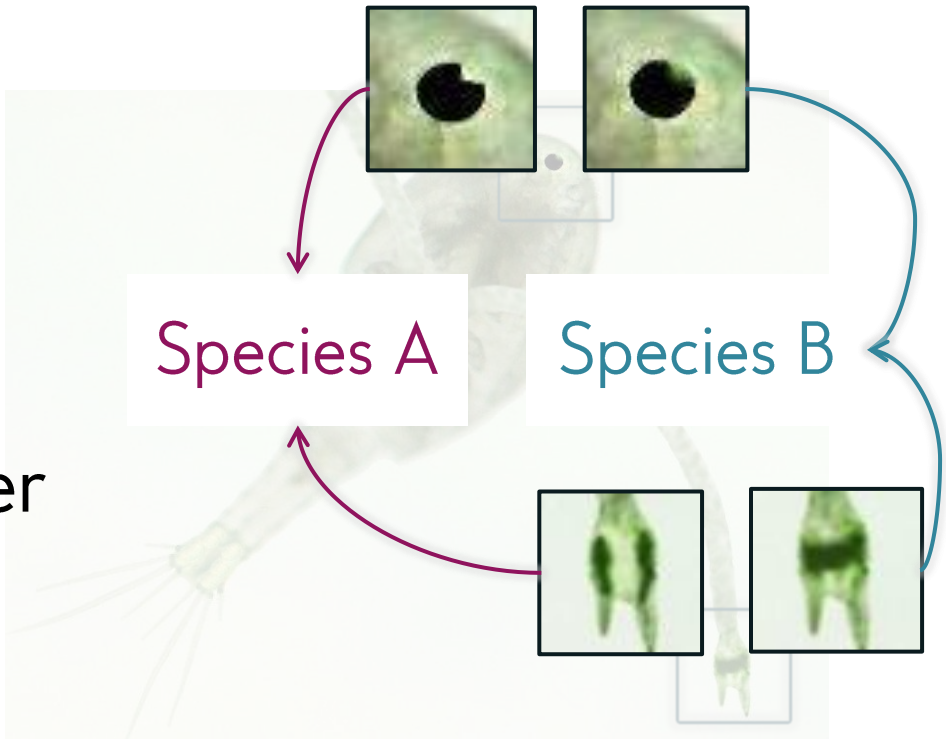
Assign an object with features by considering feature values to a category



(Nelson et al., 2010; Meder & Nelson, 2012)

Class-conditional independence of features

If Species A
the relationship
between one feature
values and class
is independent of another
feature value



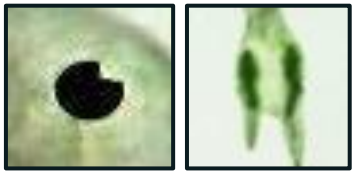
(Nelson et al., 2010; Meder & Nelson, 2012)

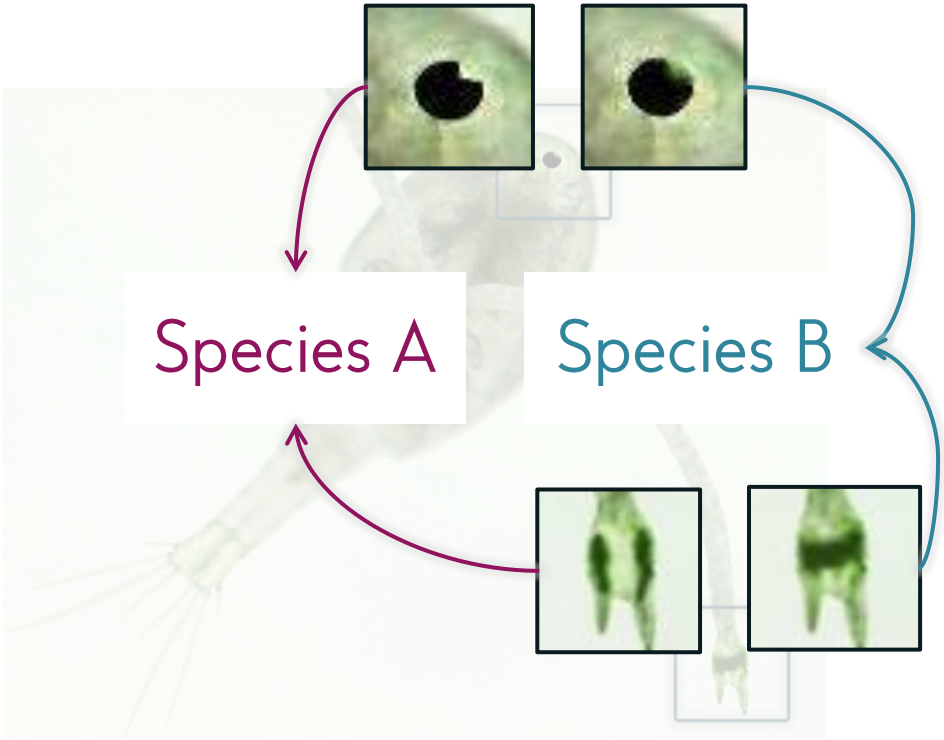
Assumption Explanation

Class-conditional independence of features


→ Species A


→ Species A


↛ Species B

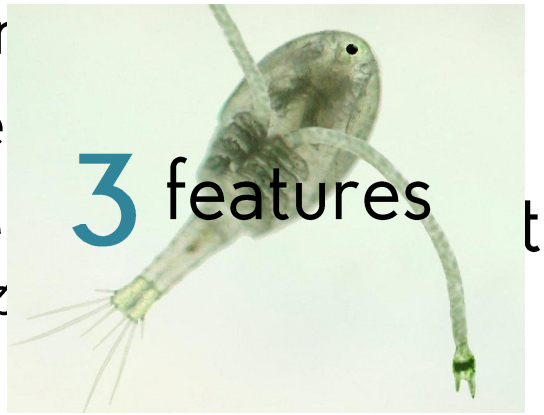


(Nelson et al., 2010; Meder & Nelson, 2012)

Assumption Why?

Class-conditional independence of features

- Facilitates performance of heuristics, e.g. FFT, TTB, Tallying
  (Katsikopoulos & Martignon, 2006)
- Deals with combinatorial explosion
  - Reductior
  - Inference
- Useful eve true
  (e.g. Domingos &

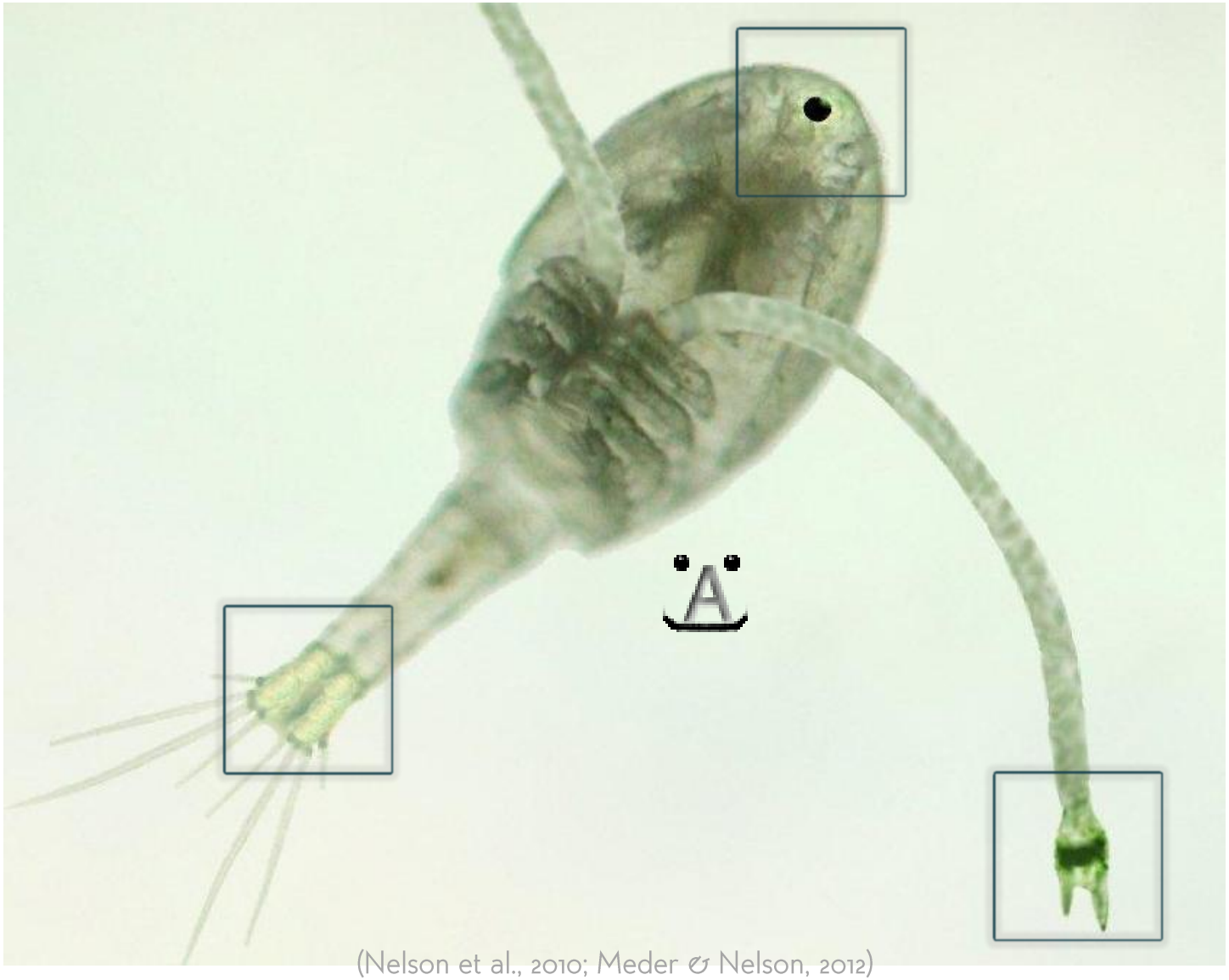


Hypothesis Assumptions

- People approach unknown environments assuming class-conditional independence of features
  - initial belief
  - initial learning strategy

- Specific categorization decisions early in learning

Experiment Task

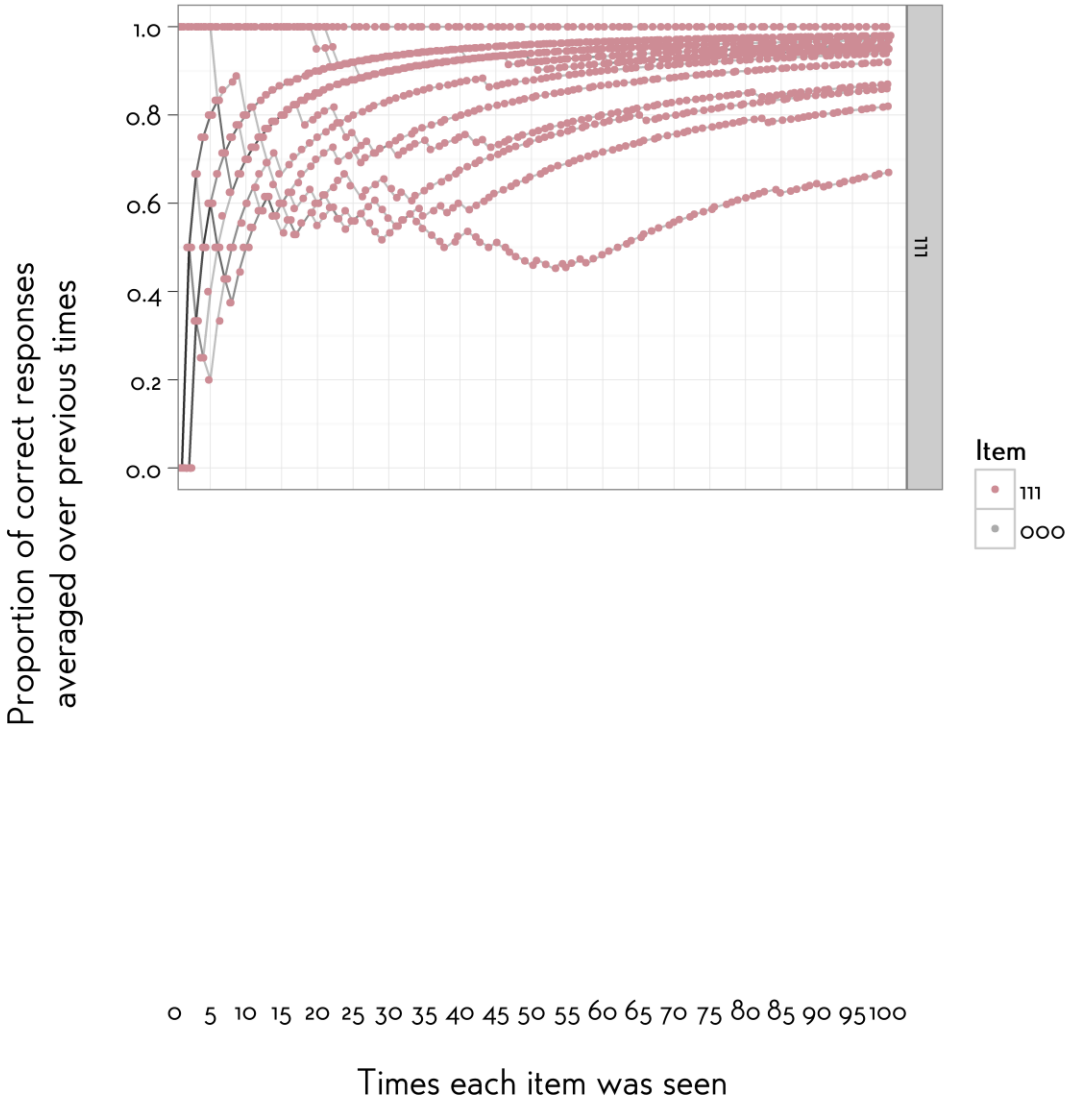


(Nelson et al., 2010; Meder & Nelson, 2012)

Experiment Environment

- Limited maximum accuracy
  - Naive Bayes Classifier
    - with class-conditional feature assumption
  - Fast-and-Frugal-Tree Classifiers
    - Different construction methods
- Which strategies are used here?

Data Glance



Item 111

Actual Environment: A

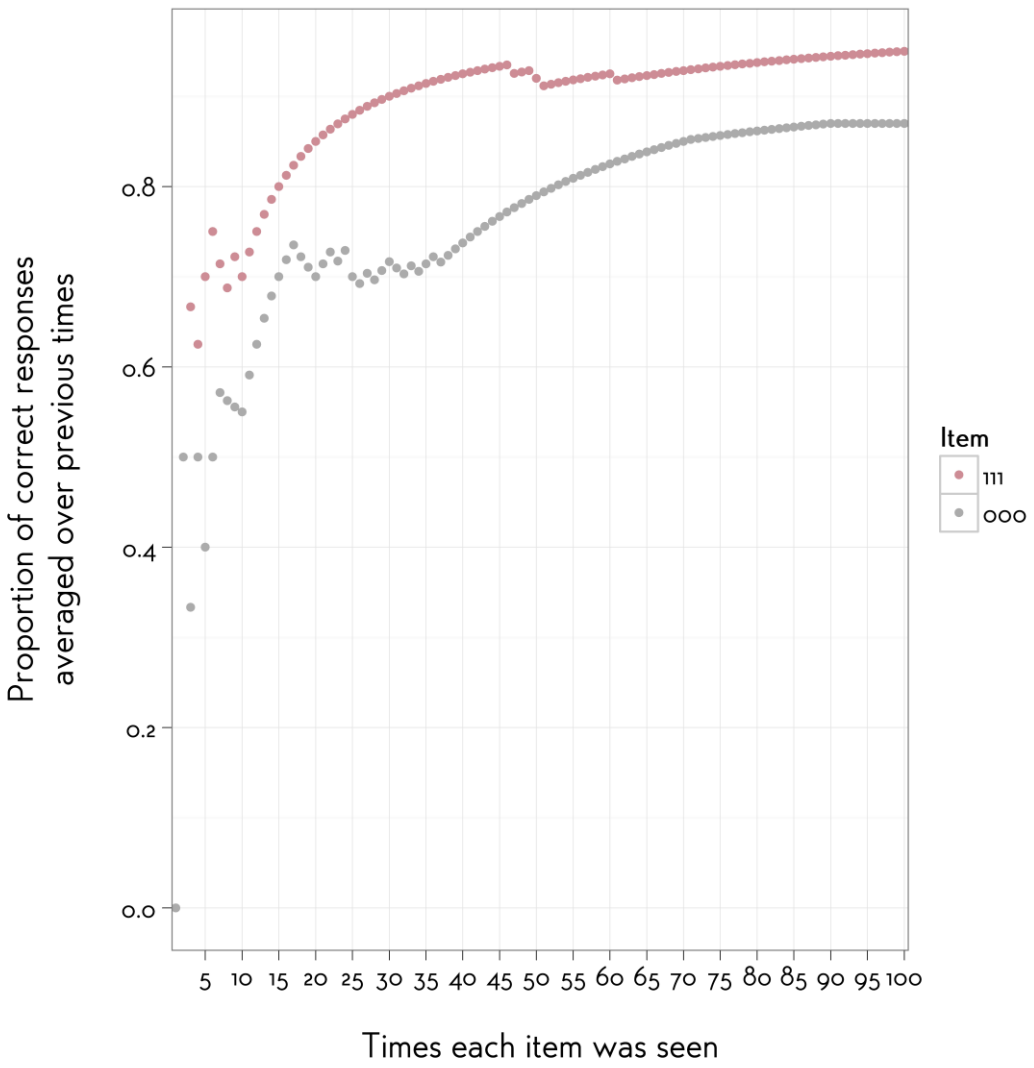
Assuming class-conditional indep.: A

Item 000

Actual Environment: A

Assuming class-conditional indep.: B

Data Glance



Item 111

Actual Environment: A

Assuming class-conditional indep.: A

Item 000

Actual Environment: A

Assuming class-conditional indep.: B

Summary so far

- Reasonable to have assumptions
- Learning contra-intuitive environments is possible
- Initial response pattern more variable for contradictory item (ooo)

Thank you.

Issues we are thinking about

- Information encoding
  how could the learning process work
- Datasets
  to check if assumption yields low decision error
- Theoretical reasons
  for using the assumption
- Heuristics
  what heuristics work when class-conditional independence does not hold?

References

Domingos et al (1997) On the optimality of the simple Bayesian classifier under zero-one loss Machine Learning 29 (2-3) 103-130 doi: 10.1023/A:1007413511361

Katsikopoulos et al (2006) Naive heuristics for paired comparisons: Some results on their relative accuracy Journal Of Mathematical Psychology 50 (5) 488-494 doi: 10.1016/j.jmp.2006.06.001

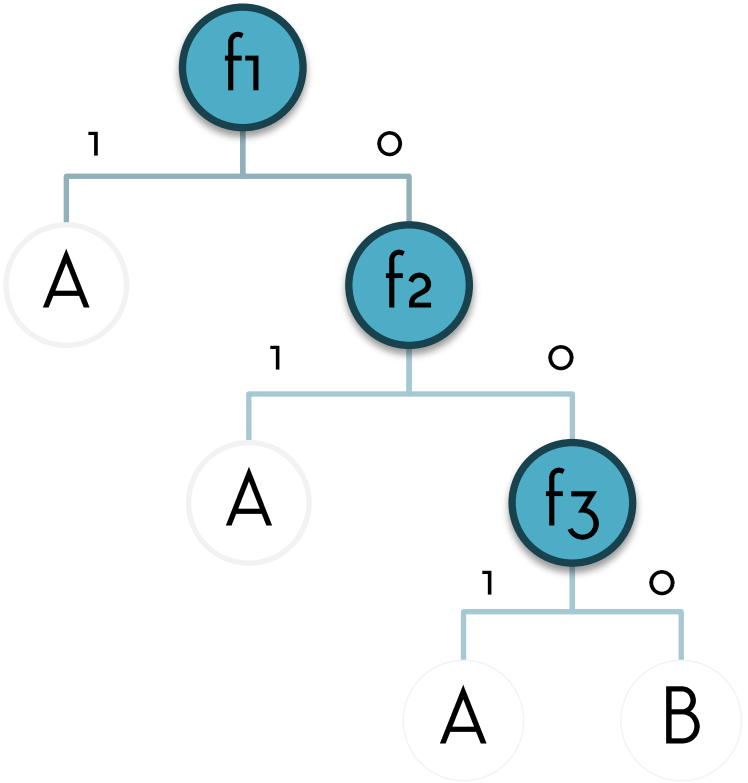
Fast & Frugal Trees in this Environment

Validities

Features f1f2f3	for A	for B
1xx	0.78	0.22
0xx	0.56	0.44
x1x	0.78	0.22
x0x	0.56	0.44
xx1	0.78	0.22
xx0	0.56	0.44

Tree: Max(val+,val-):

39 % accuracy



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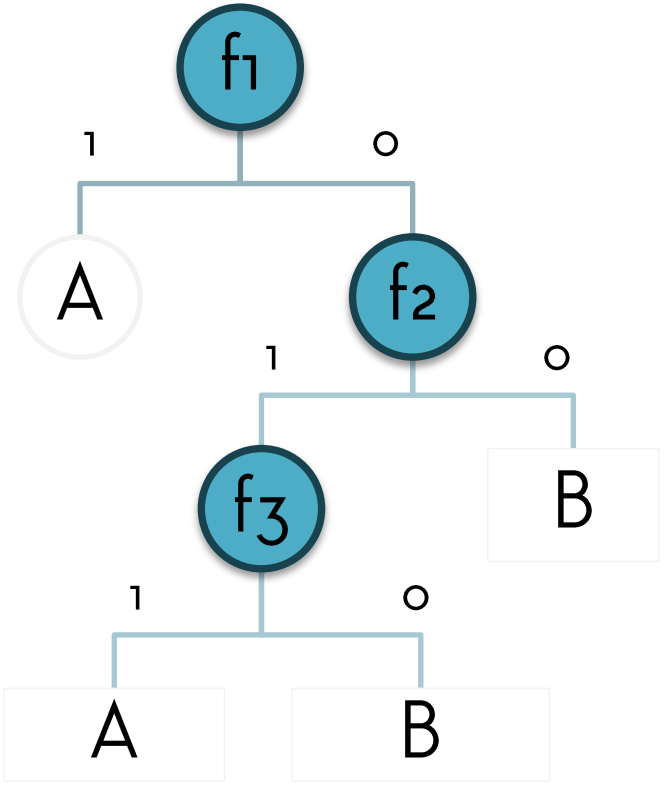
Tree: ZigZag(val+,val-):
61 % accuracy



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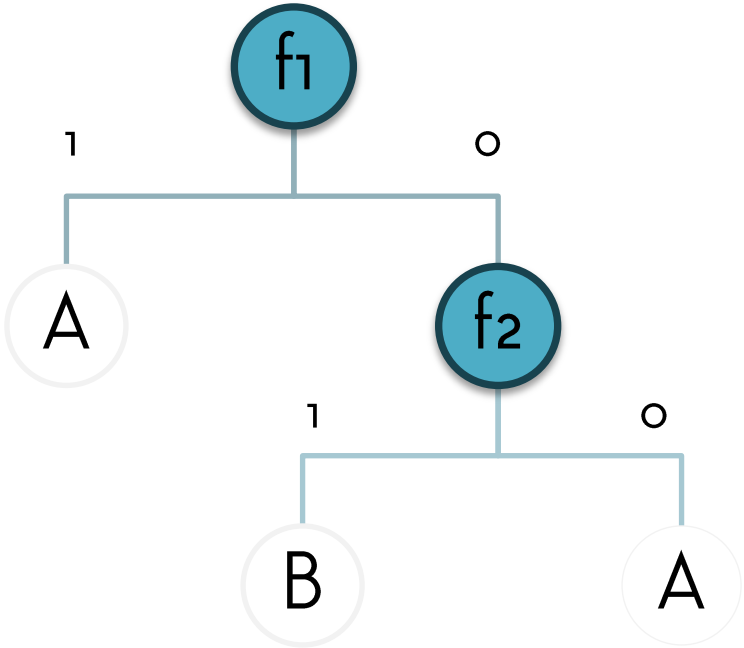
Tree:

78 % accuracy



Motivation What?