

## A Decision Tree Flow to Boolean Logic **Optimization**

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Logical minimization tools can't deal well with a big number of inputs. Machine Learning methods such as

Decision Trees (DT) can provide better results compared to traditional tools.

METHODOLOGY

Using a data set with 100 benchmarks composed by incomplete truth tables from the IWLS 2020 contest, simplification results from C5.0 and Scikit-Learn (both DT tools) were compared Espresso's ones.

- Parsing PLA to Decision Tree inputs
- EQN format (intermediate)
- C5.0 SPAXM





learn unknown Boolean functions

Goal

Evaluate DT-based methods to

## **Proposed Learning Flow** Train PLA Espresso Espresso was not able to end its optimization for Pre-processing larger benchmarks C5.0 SK SOP POS SOP SPAXM DISCUSSION AND CONCLUSION Figure of Merit: (# of Nodes)/Acc C5.0 SOP **C5.0 POS** SPAXM SK SOP Espresso

Fig. 1: SOP + POS and XOR + MUX (SPAXM)

SPAXM: to improve the final results. Sum of Products (SOP) and Product of Sums (POS) combined were in а single circuit.

10.21 0.75 0.81 1.58 14.08

Decision Trees can reach accuracy and number of nodes similar to Espresso for incomplete truth tables.

- DTs showed to be a faster alternative
- C5.0 SPAXM had a slight improvement compared to SOP and POS.
- SK reached the best accuracy, but the number of inputs had to be considerably higher to do so.

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**Next Steps:** 

Explore the proposed flow to fast logic minimization

Extend the proposed flow englobing the synthesis steps

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