COLUMN ORIENTED COMPILATION OF VARIANT TABLES

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Disclaimer:
All work on my papers “Arc Consistency with Negative Variant Table” and “Column Oriented Compilation of Variant Tables” was performed privately during the last two years after transition into partial retirement.

It and the accompanying implementation are neither endorsed by SAP nor do they reflect ongoing SAP development.

Notwithstanding:
The motivation for this work lies in my past at SAP and is based on insights and experiences with the SAP product configurators. The terminology follows that used in conjunction with the SAP Variant Configurator and originates from roots in the manufacture of „variants“.

See paper(s) for references

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- Example product: T-Shirt
  - 4 colors, 3 sizes, 2 prints
  - 24 possible variants
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  - As a database table (e.g. pricing)

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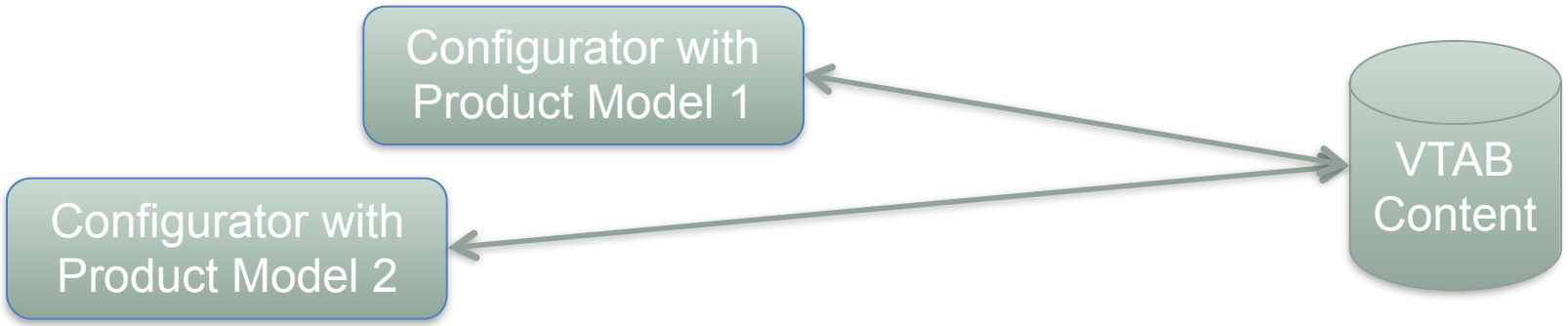

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In particular, support for arc-consistency (GAC algorithm)

- We want to “filter out” any values from any given domains that are not supported by a tuple in the VTAB

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- Decision diagrams: BDD/MDD/… [Knuth, Andersen et al.]
- Compression of VTABs into a small number of Cartesian products/cuboids, which I call *c-tuples* following [Katsirelos/Walsh]

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- Experimented with BDD approach using JavaBDD but ran into issues
  - Tool complex and tool not completely suited to task at hand
  - Missing natural heuristics as starting point
- Then explored a simple recursive VTAB decomposition
  - Yields a directed acyclic graph (DAG) which I call a Variant Decomposition Diagram (VDD)
  - Overriding development goals:
    - “Easy to implement”
    - fast lean development

Main Ideas of Decomposing a VTAB *T*

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MIB	Large	Black
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Columns reordered for ease of depiction:
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  - *R*(*T*,*j*,*x*): rest after removing *L*(*T*,*j*,*x*) and *B*(*T*,*j*,*x*)
- *L*(*T*,*j*,*x*) and *R*(*T*,*j*,*x*) in turn can be decomposed further

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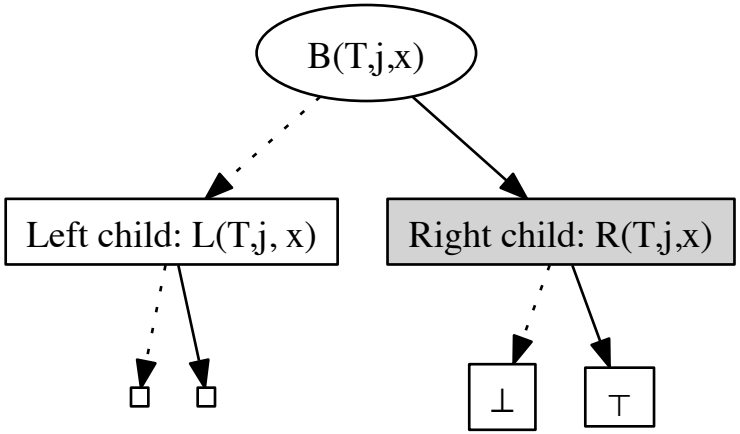
Basic Graph Structure of a VDD (Variant Decomposition Diagram)



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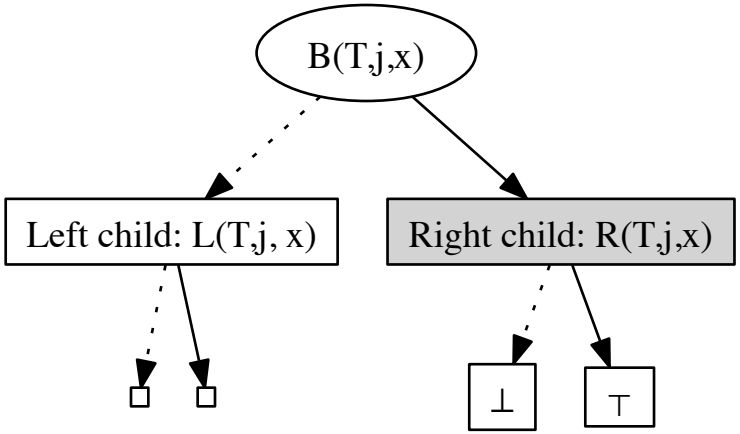

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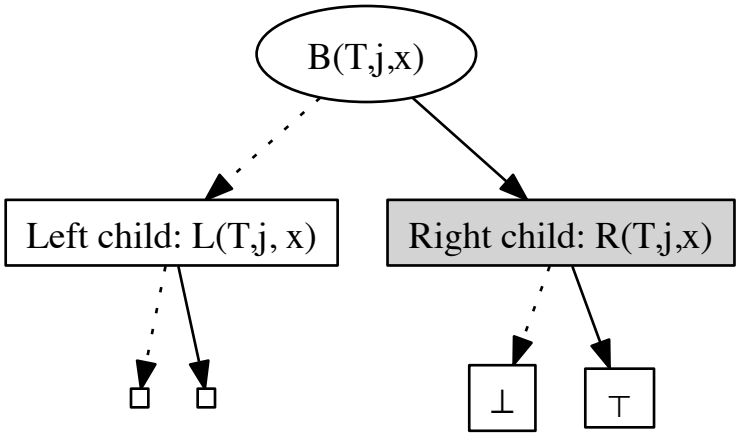

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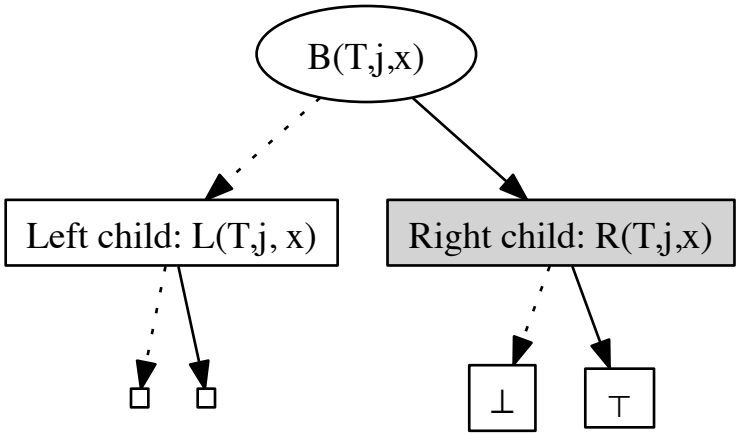

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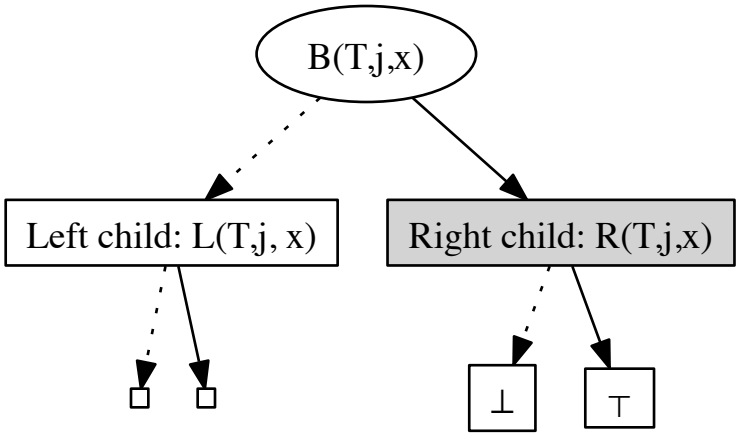
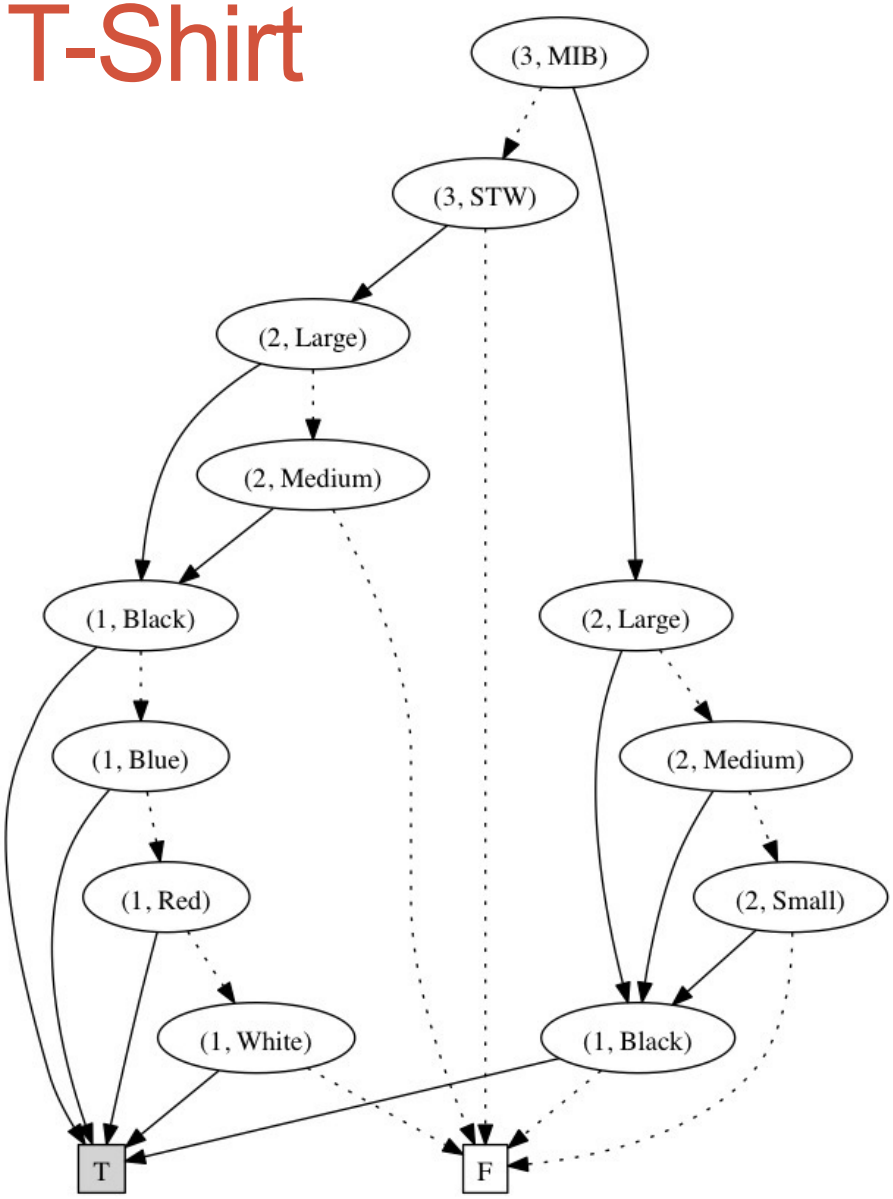
- Terminal nodes (sinks)
  - An empty *L*(•,*j*,*x*) is represented by the predefined sink (node) ⊥ (FALSE)
  - An empty *R*(•,*j*,*x*) is represented by the predefined sink (node) ⊤ (TRUE)



One VDD of VTAB T-Shirt



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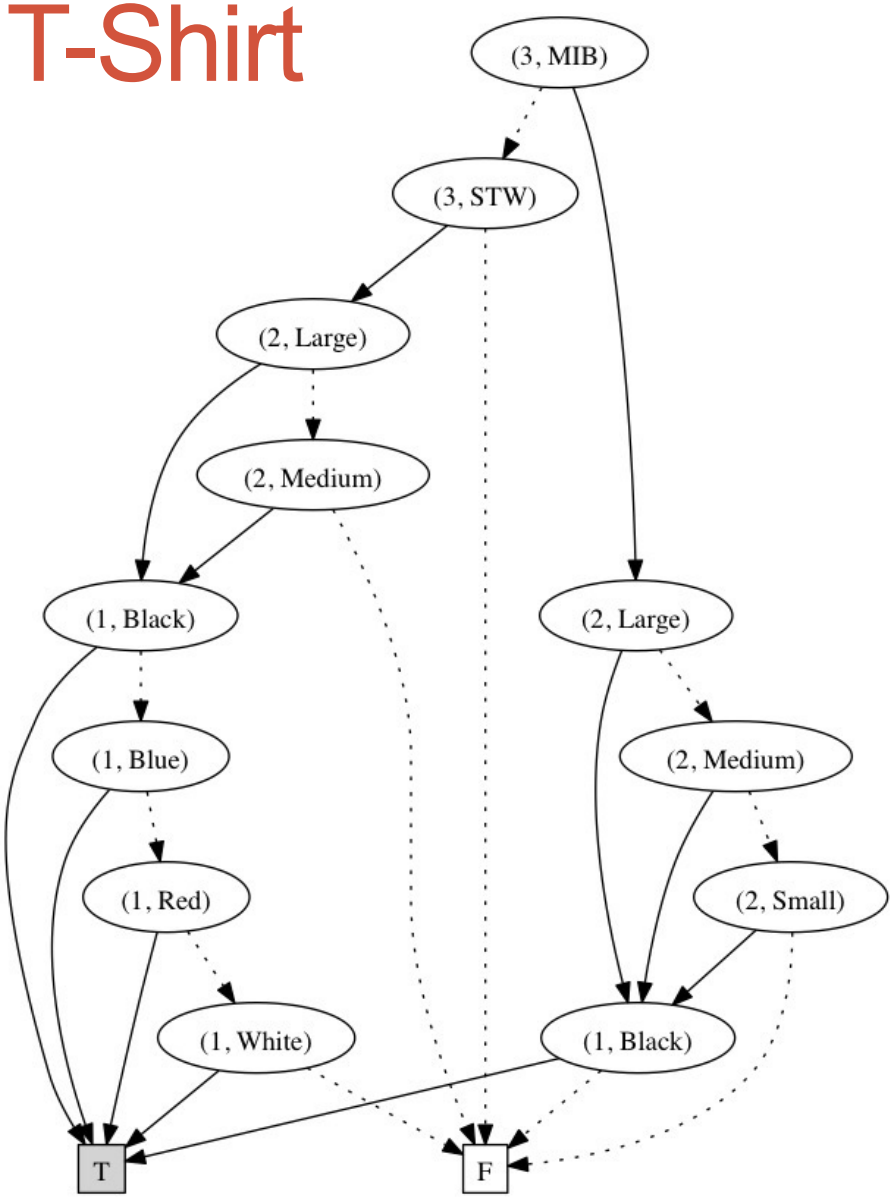
- Node label <(*j*, *x*)>



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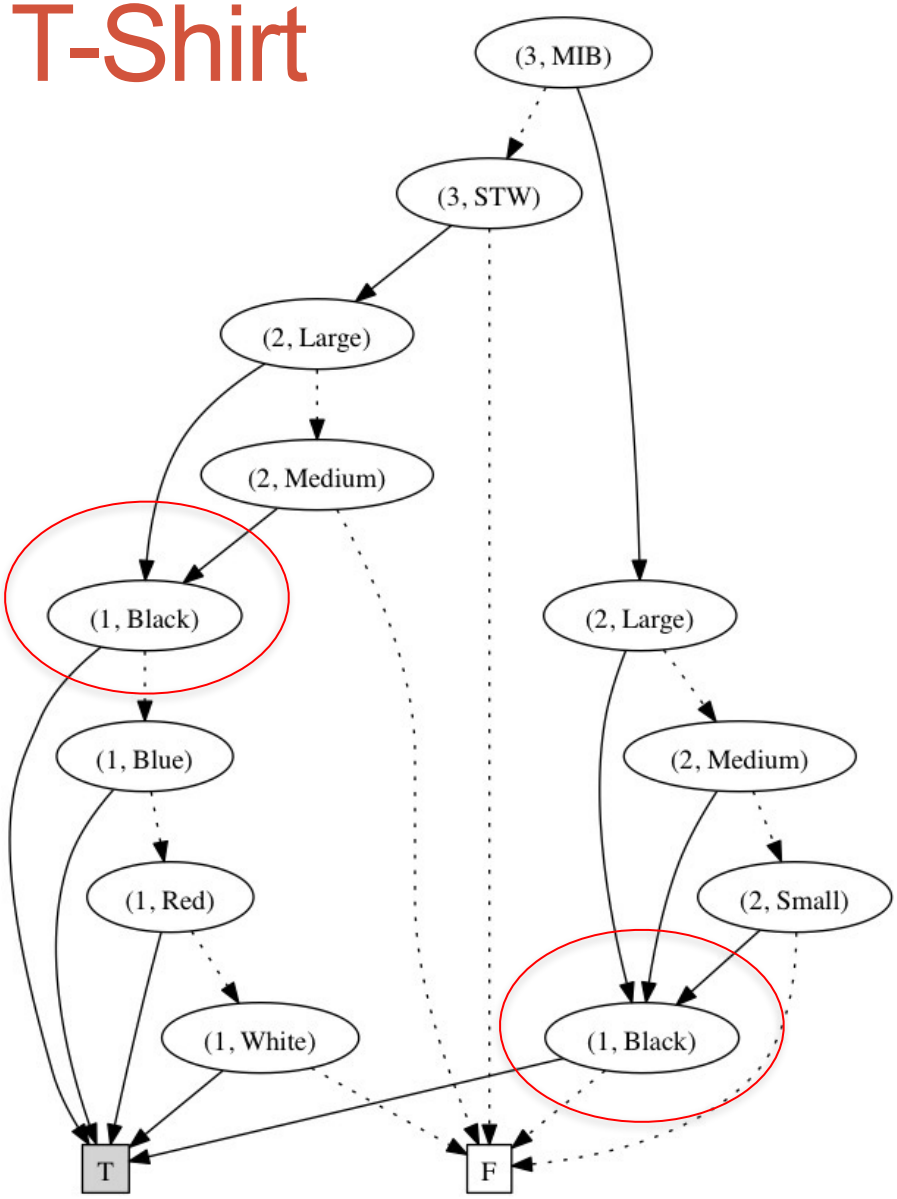

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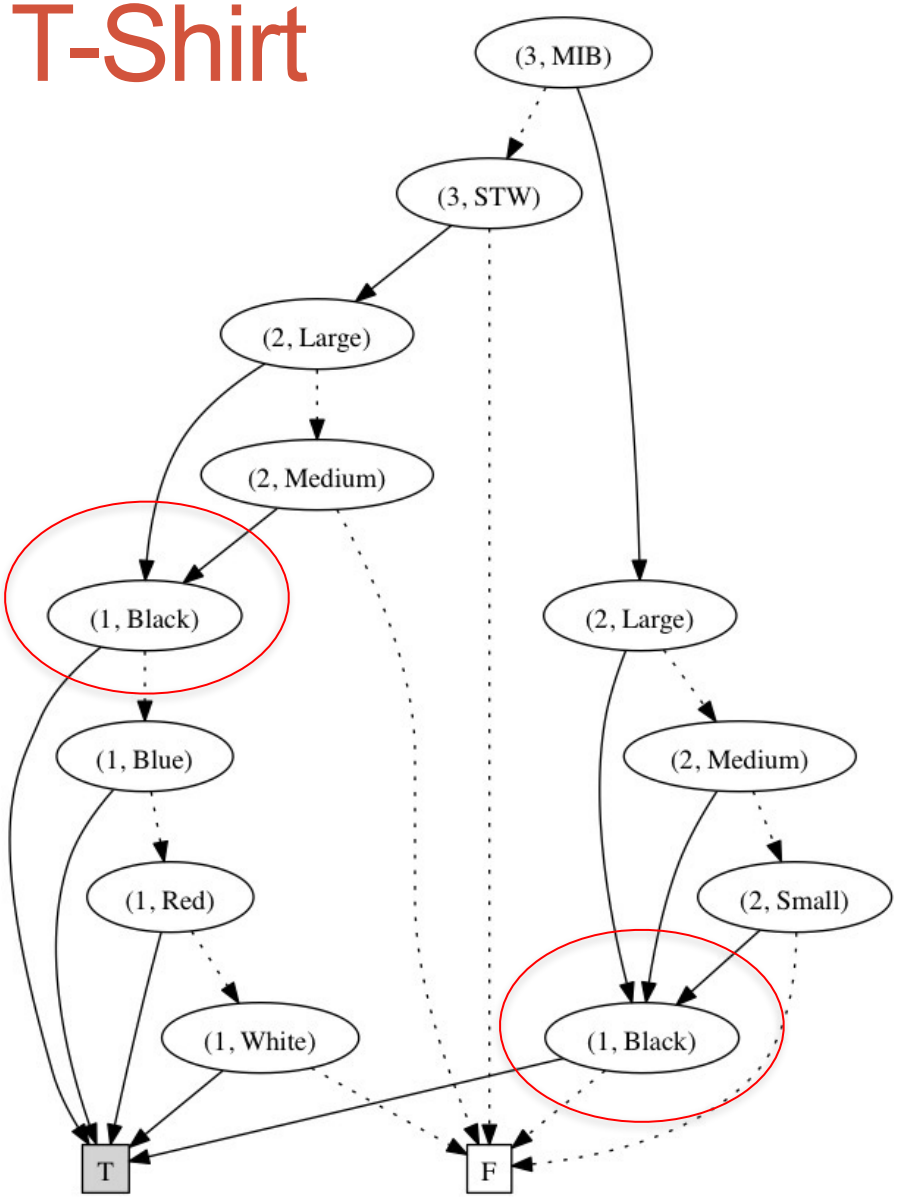

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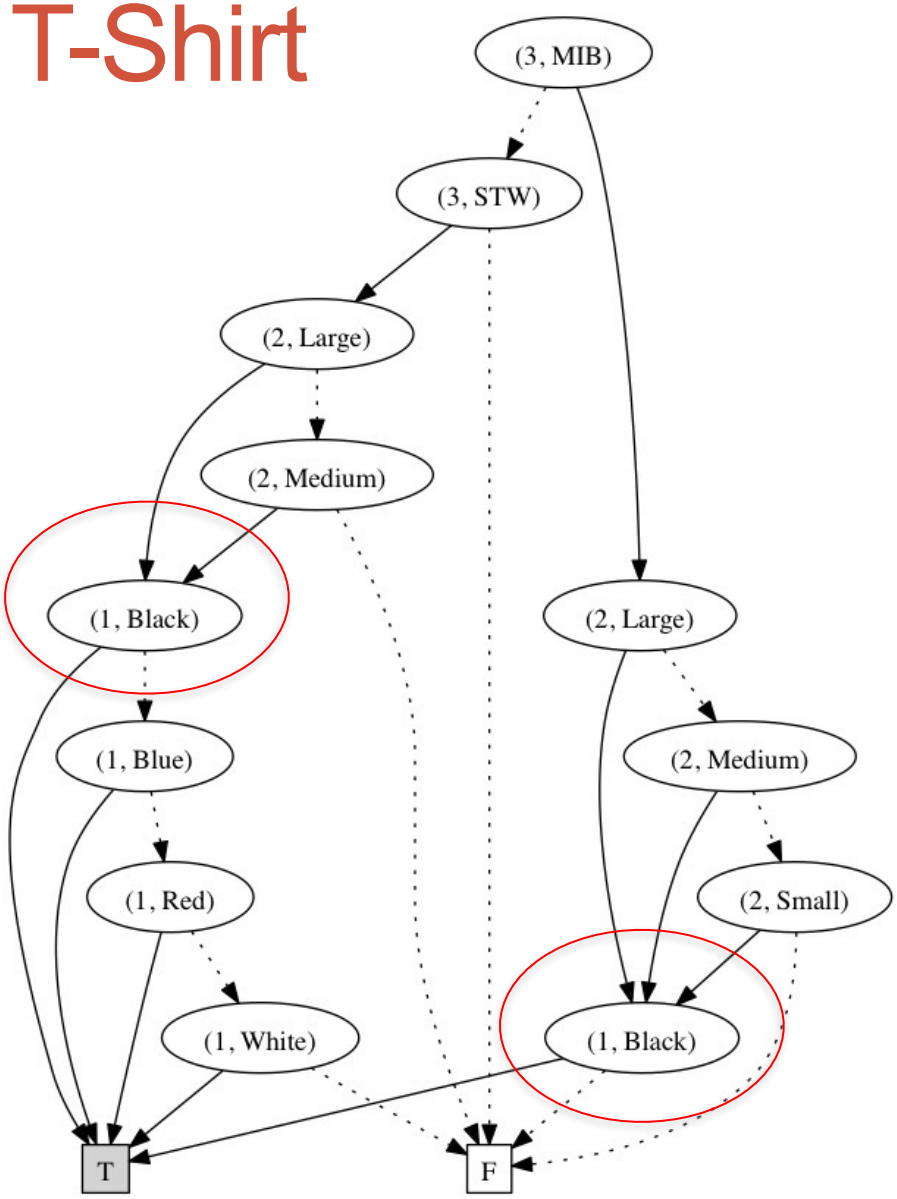
- Results in a DAG (usually not a tree)
- With care could be interpreted as a ZDD (Zero-Supressed-DD) [Knuth]



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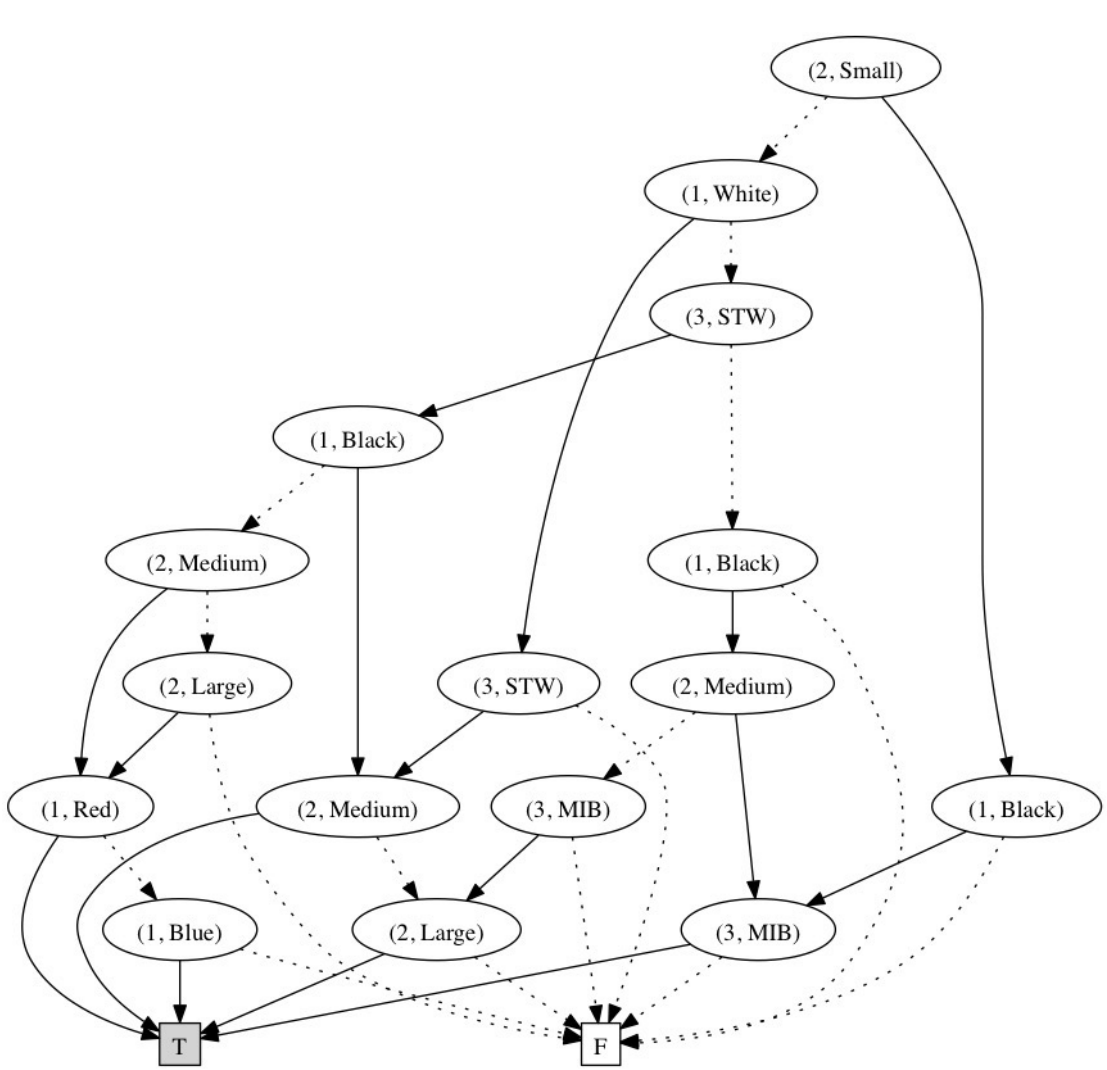
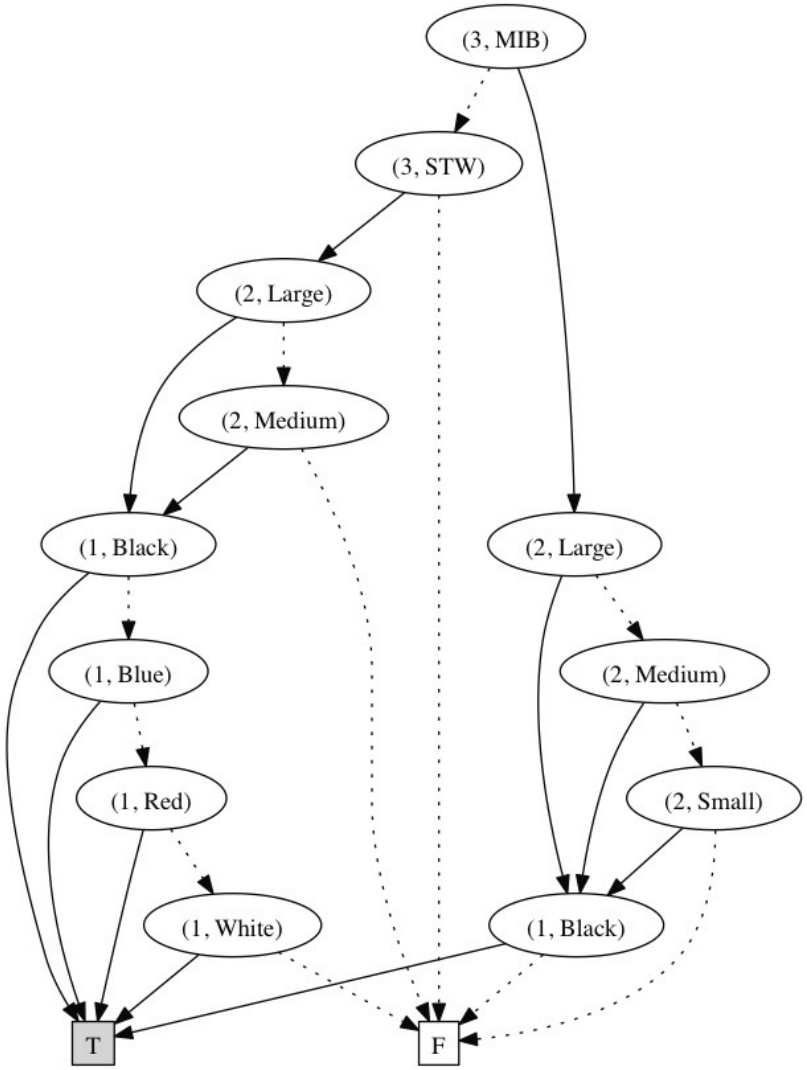
- Assumes VTAB is sorted
- My results are obtained with also sorting the columns by number of distinct occurring values (row with most values last – *Print*, *Size*, *Color* in t-shirt example)

T-Shirt: VDDs for Heuristics h_1 and h_2





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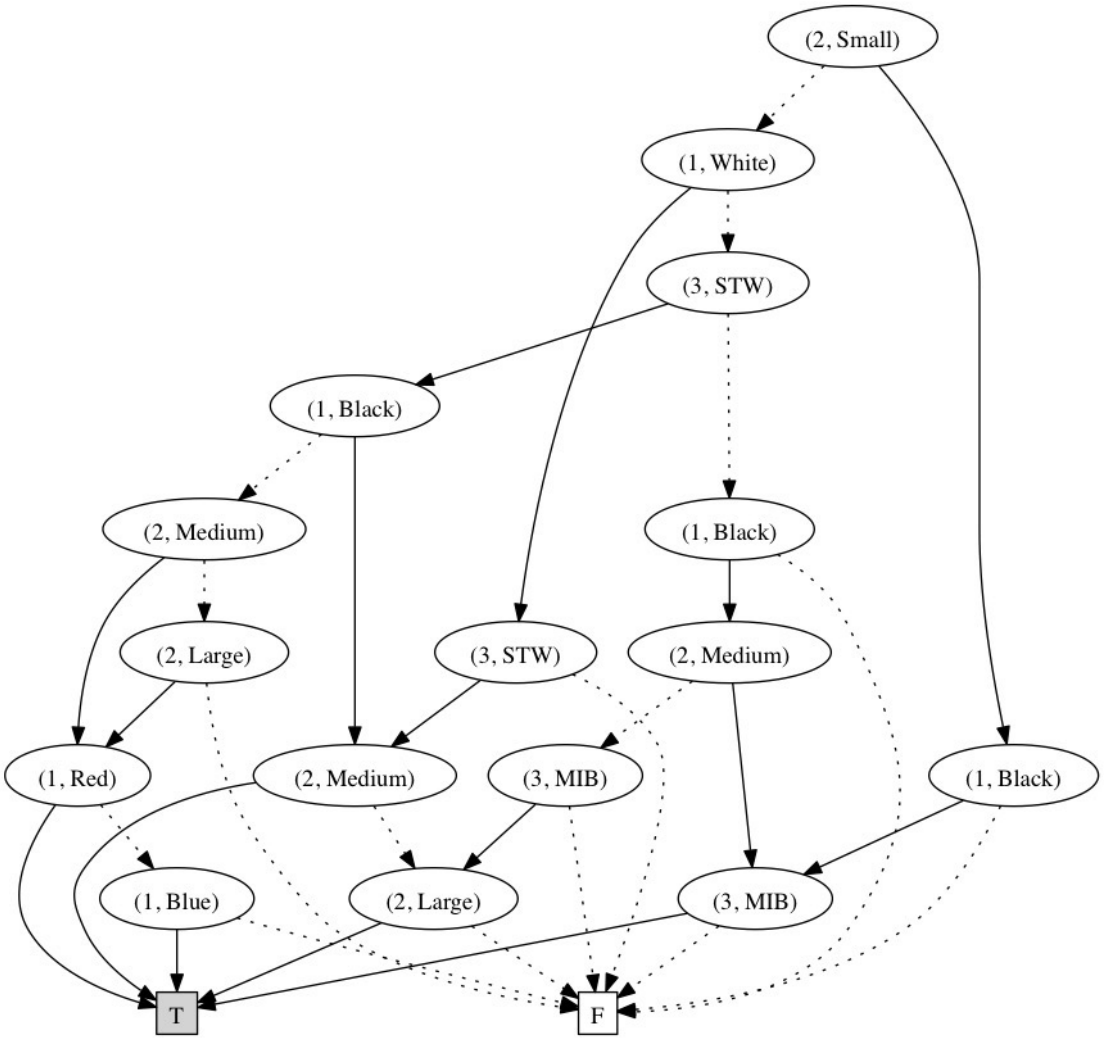
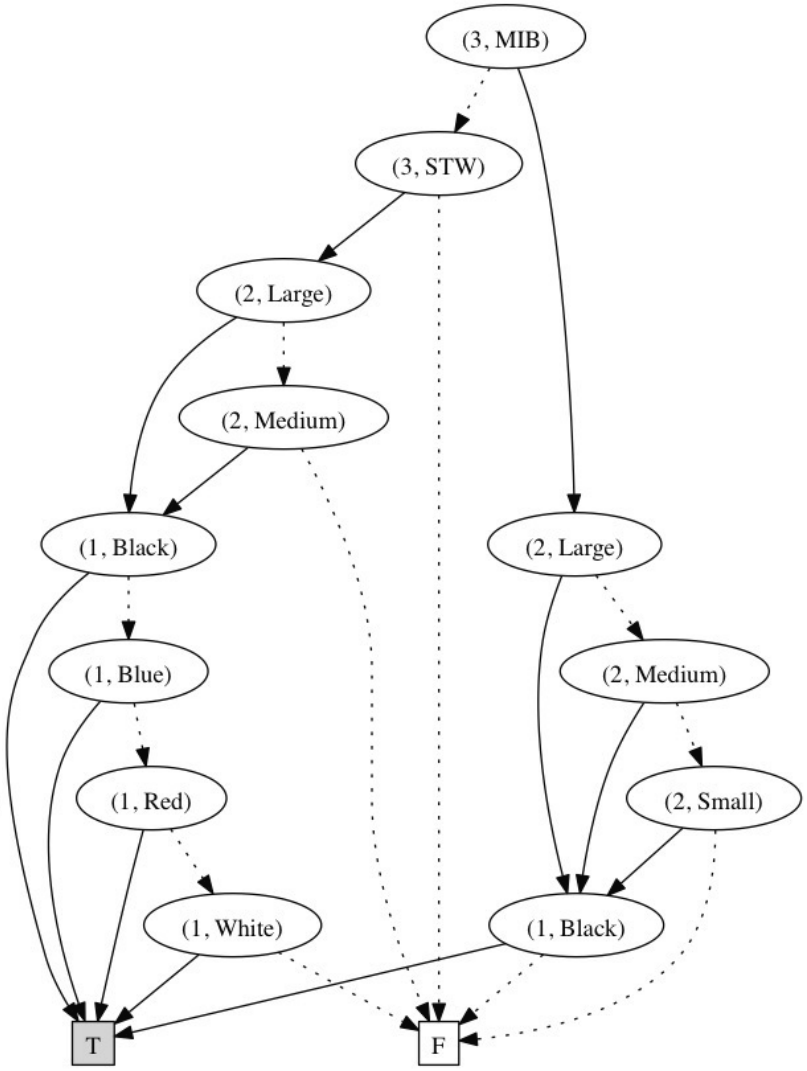


h_1: 16 nodes



h_2: 12 nodes

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- Overall h_2 clearly outperforms h_1

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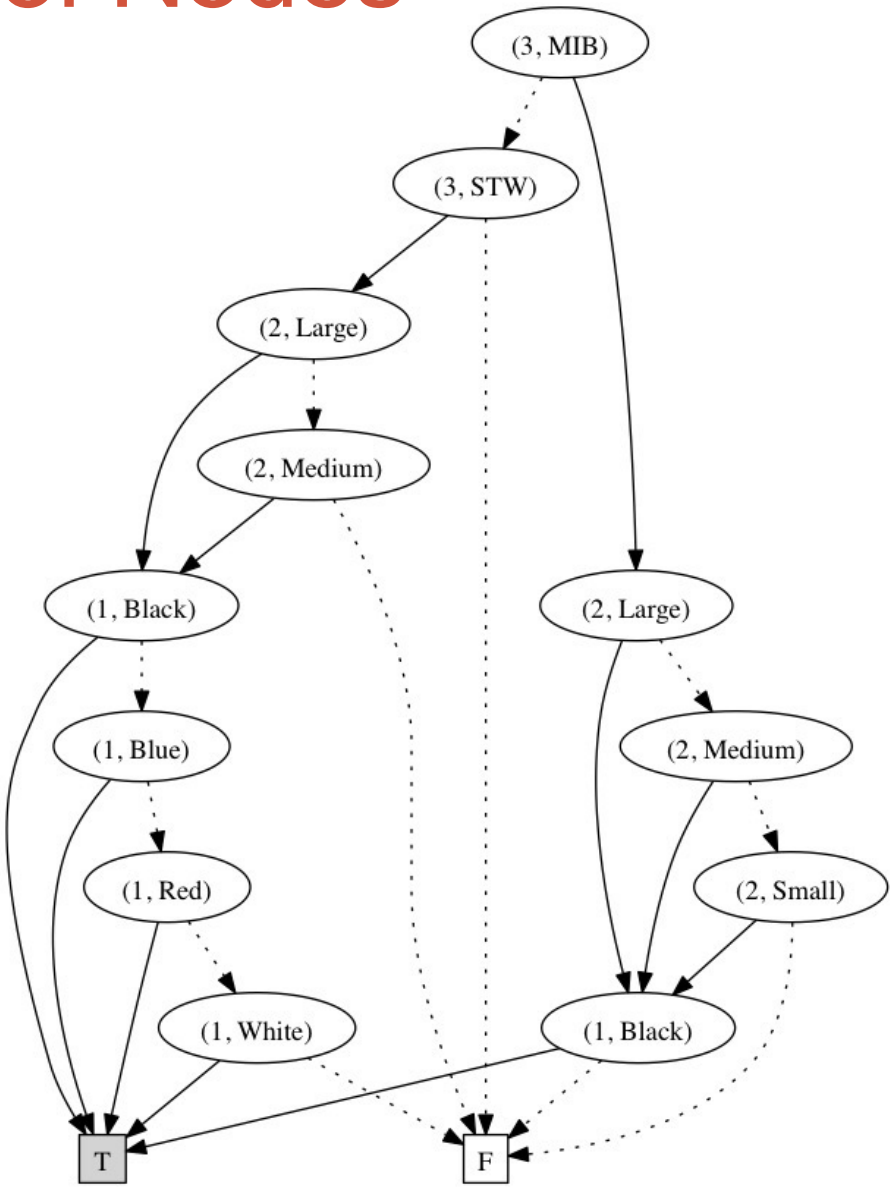
  - Includes real-valued continuous intervals
  - But, in particular, allow nodes labeled with discrete sets

h_2^*: h_2 with Merging of Nodes



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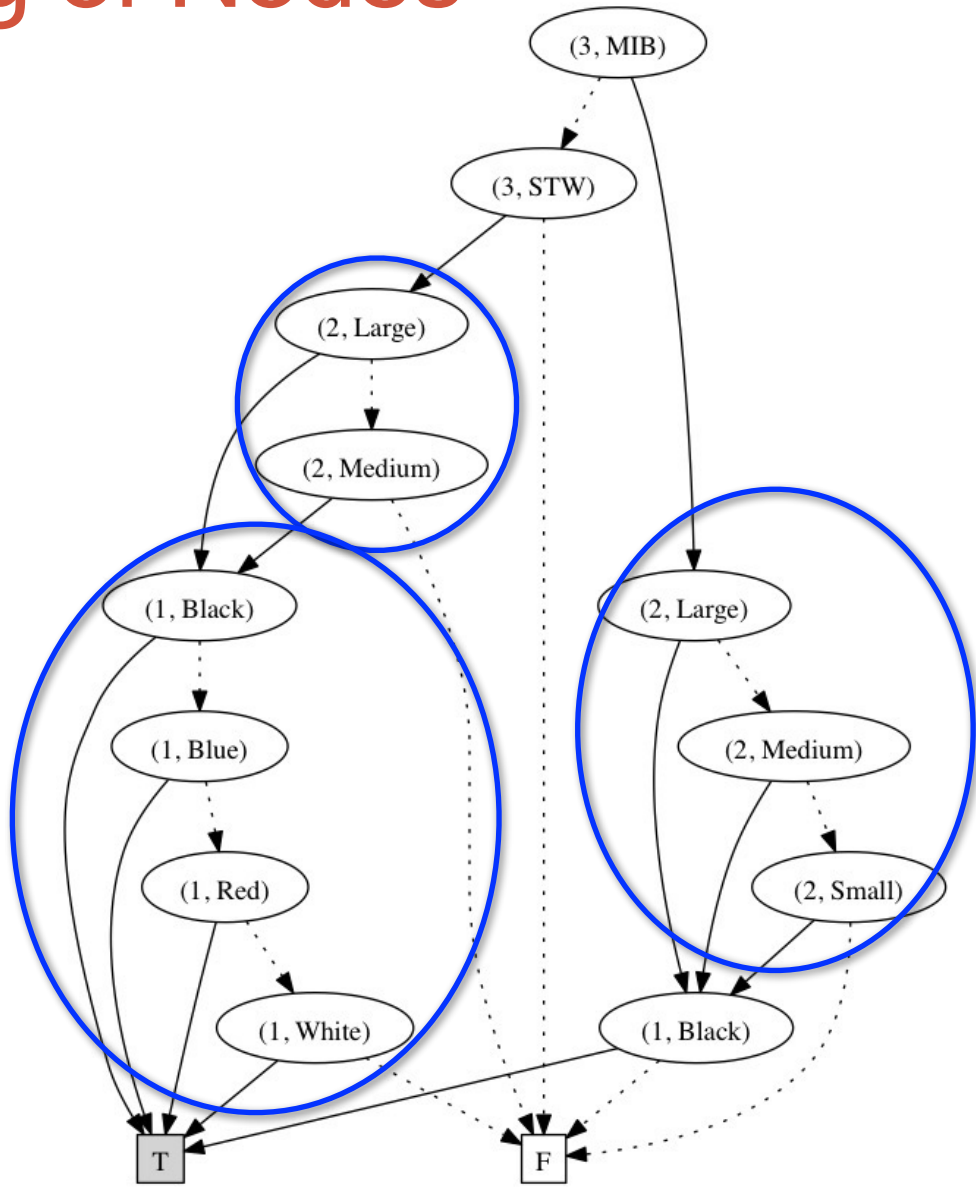
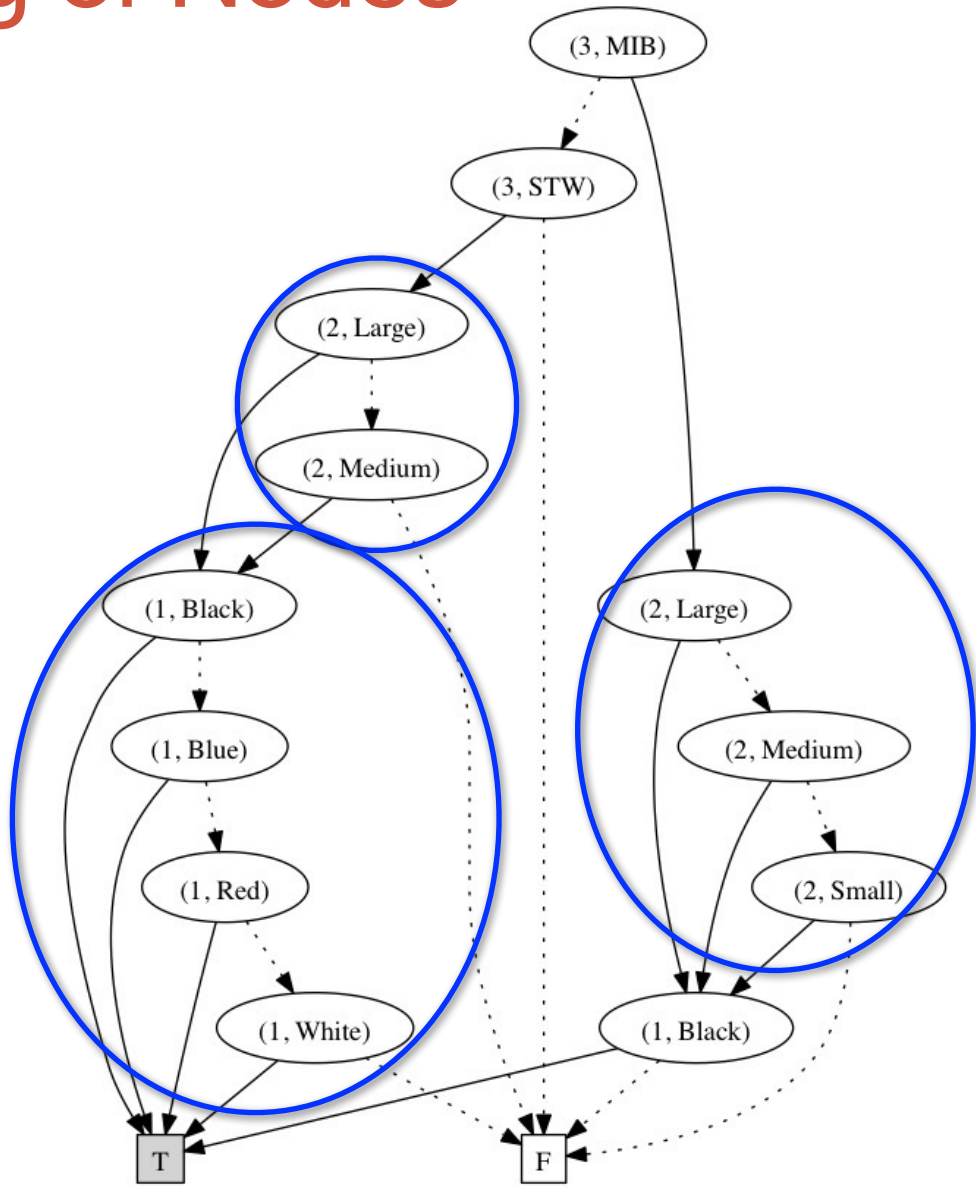
- Idea: Merge nodes representing a disjunction into one set-labeled node



h_2^*: h_2 with Merging of Nodes

- Idea: Merge nodes representing a disjunction into one set-labeled node
- Column order plays a role



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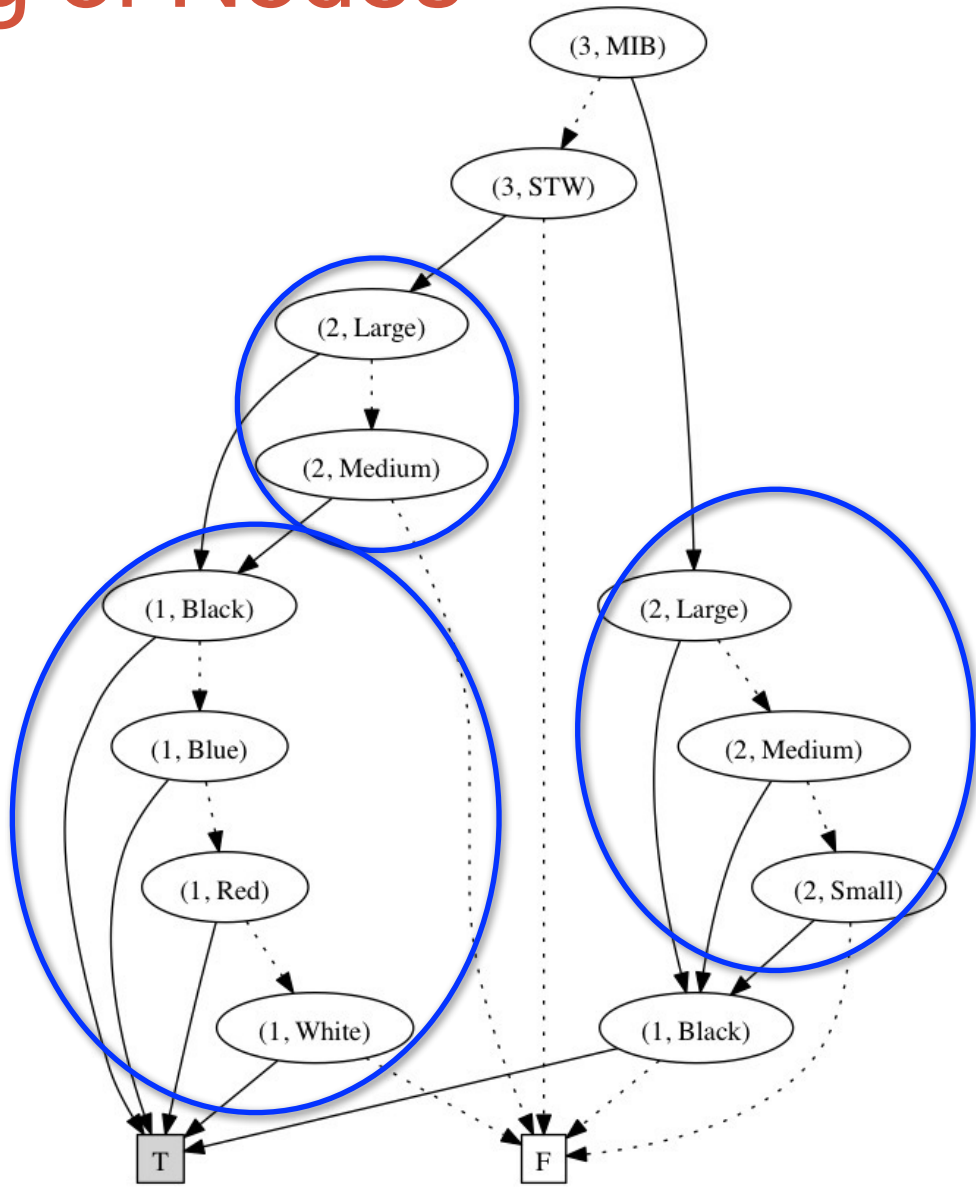

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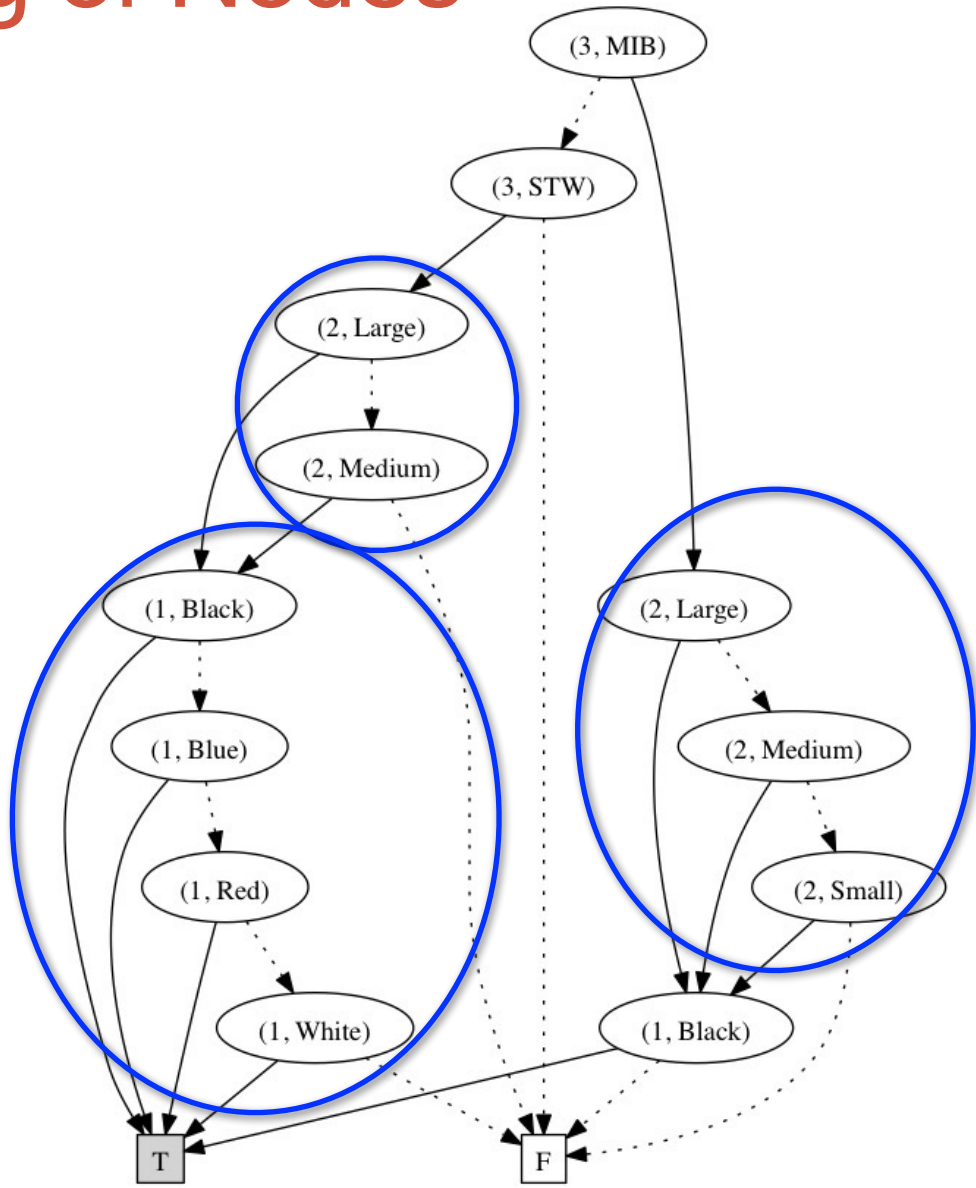
- I refer to h_2 with the stated column order heuristic and merging as h_2^*
- The results from querying a VDD may now be c-tuples. A final additional intersection with given a given run-time restriction R is needed



Visual Comparison of h_2^* and MDD for the T-shirt

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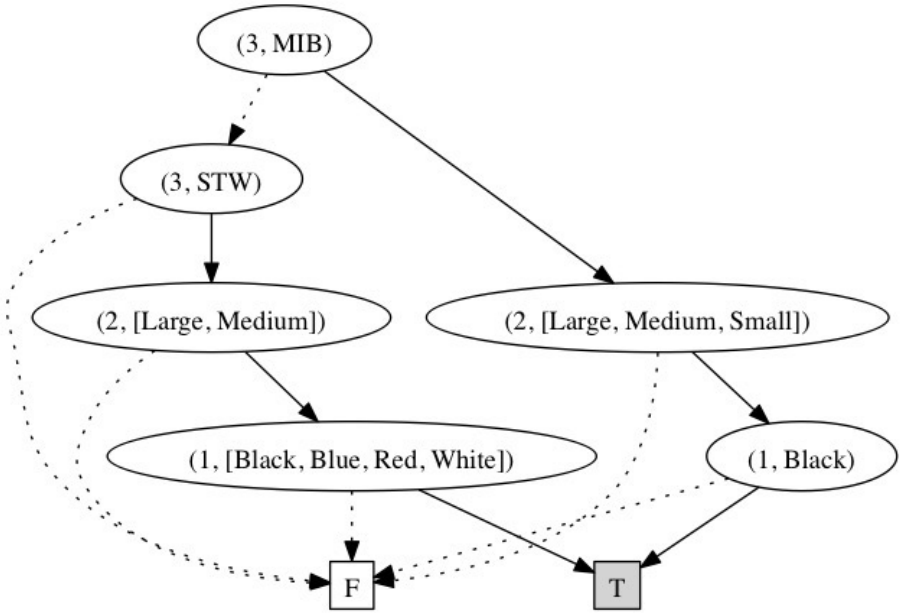

VDD for t-shirt for h_2^*

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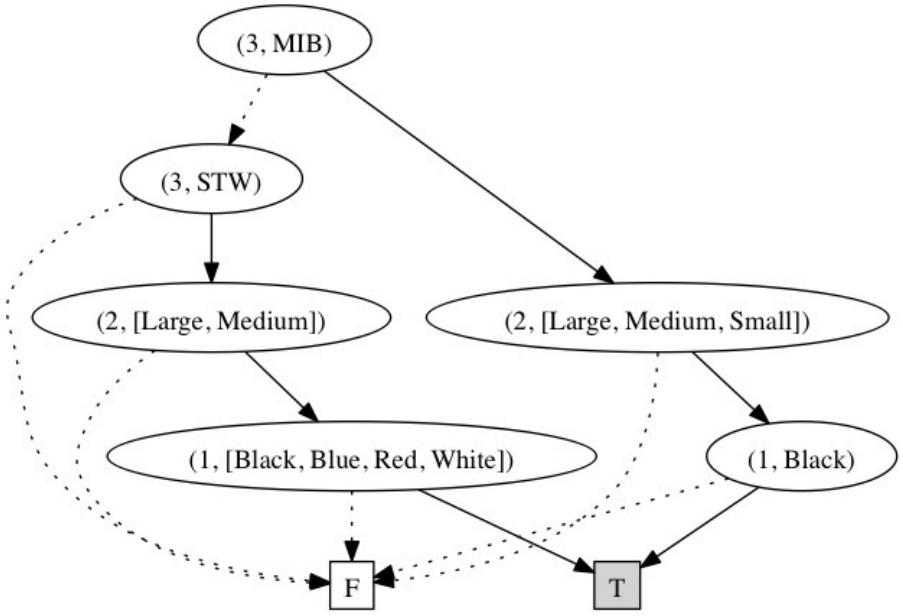

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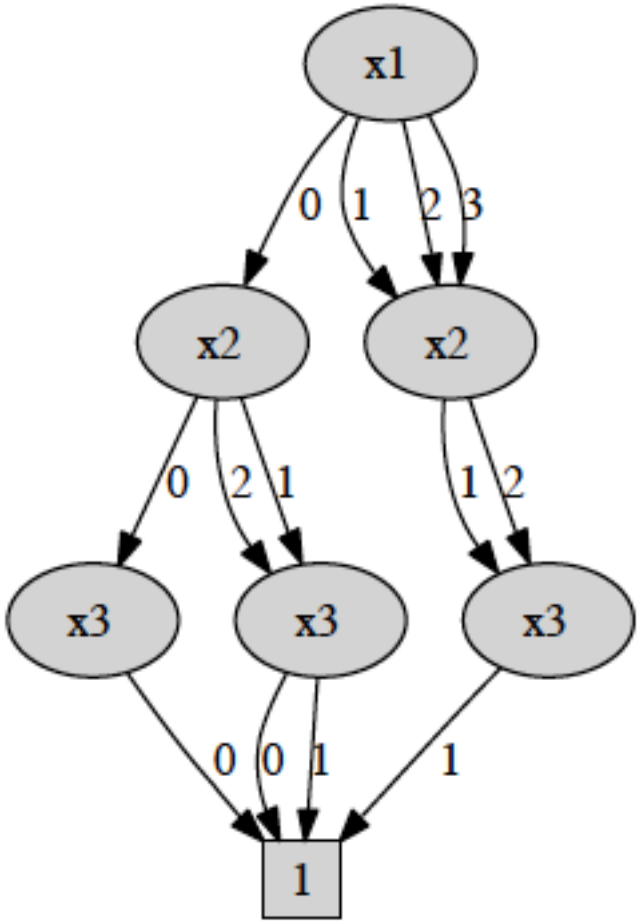

MDD for t-shirt [Andersen et al.]
(same number of nodes)

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Arity/ distinct values (*s*) biggest VTAB: 10/152

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Summary performance (number of nodes)

- h_2 outperformed h_1 for: 143 VTABS
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Summary performance (number of nodes)

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- h_2 equal to h_1 for: 71 VTABS
- h_2 beaten by h_1 for: 24 VTABS

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  - h_2/h_2^* is a very simple/ very fast compilation technique for VTABs
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- Outlook
  - Formal analysis and application to wider test bed is future work
  - Objective run-time measurements still missing

Thank You