

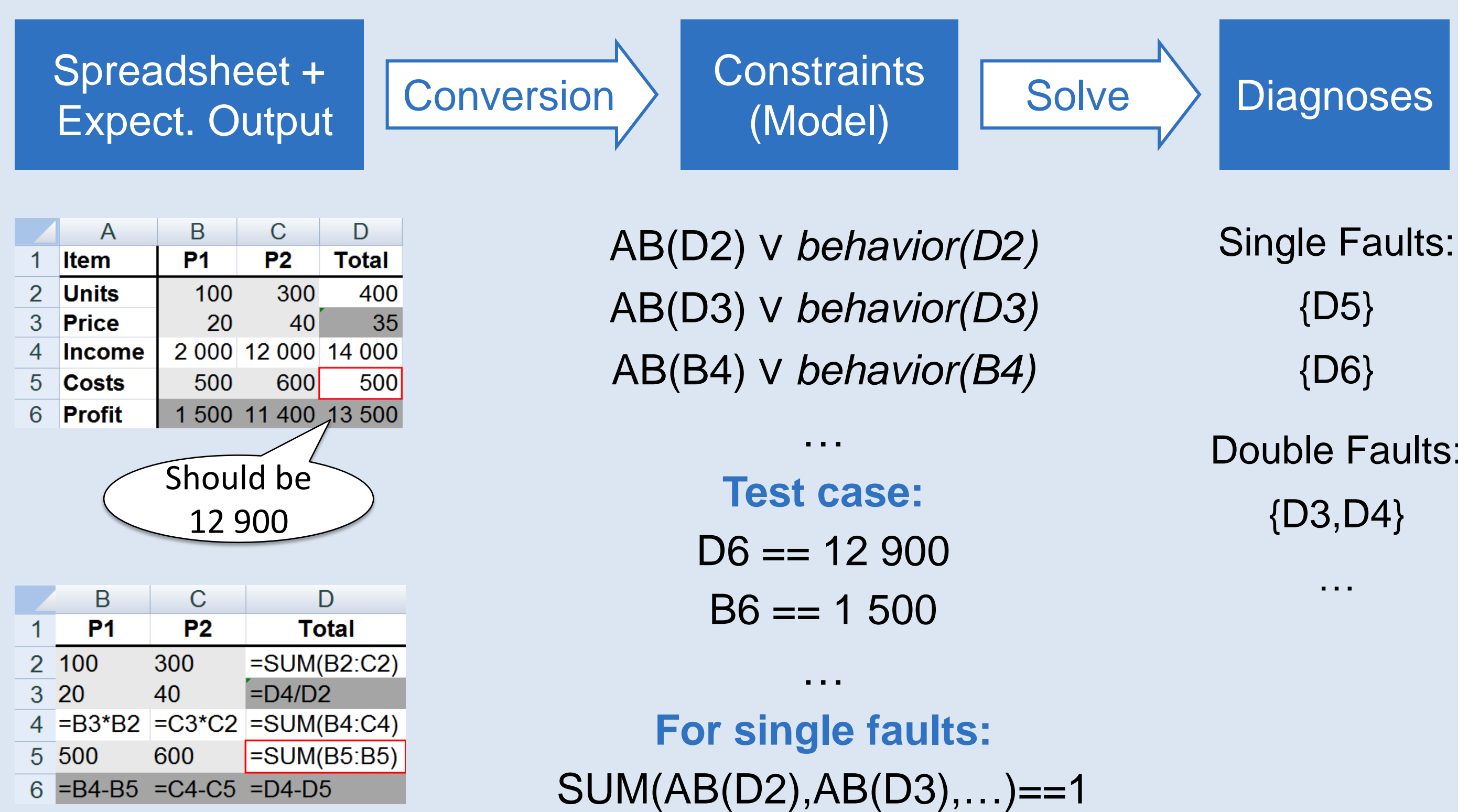
# Comparing Models for Spreadsheet Fault Localization

Birgit Hofer and Franz Wotawa

## Abstract

We present a novel dependency-based model that can be used in **Model-Based Software Debugging (MBSD)**. This model allows **improvements** of the **diagnostic accuracy** while keeping the **computation times short**. In an empirical evaluation, we show that **dependency-based models** of spreadsheets whose **value-based models** are often not solvable in an acceptable amount of time can be solved in less than one second. Furthermore, the amount of diagnoses is reduced by 15 % on average when using the novel dependency-based model instead of the original dependency-based model.

## 1 Model-based Debugging



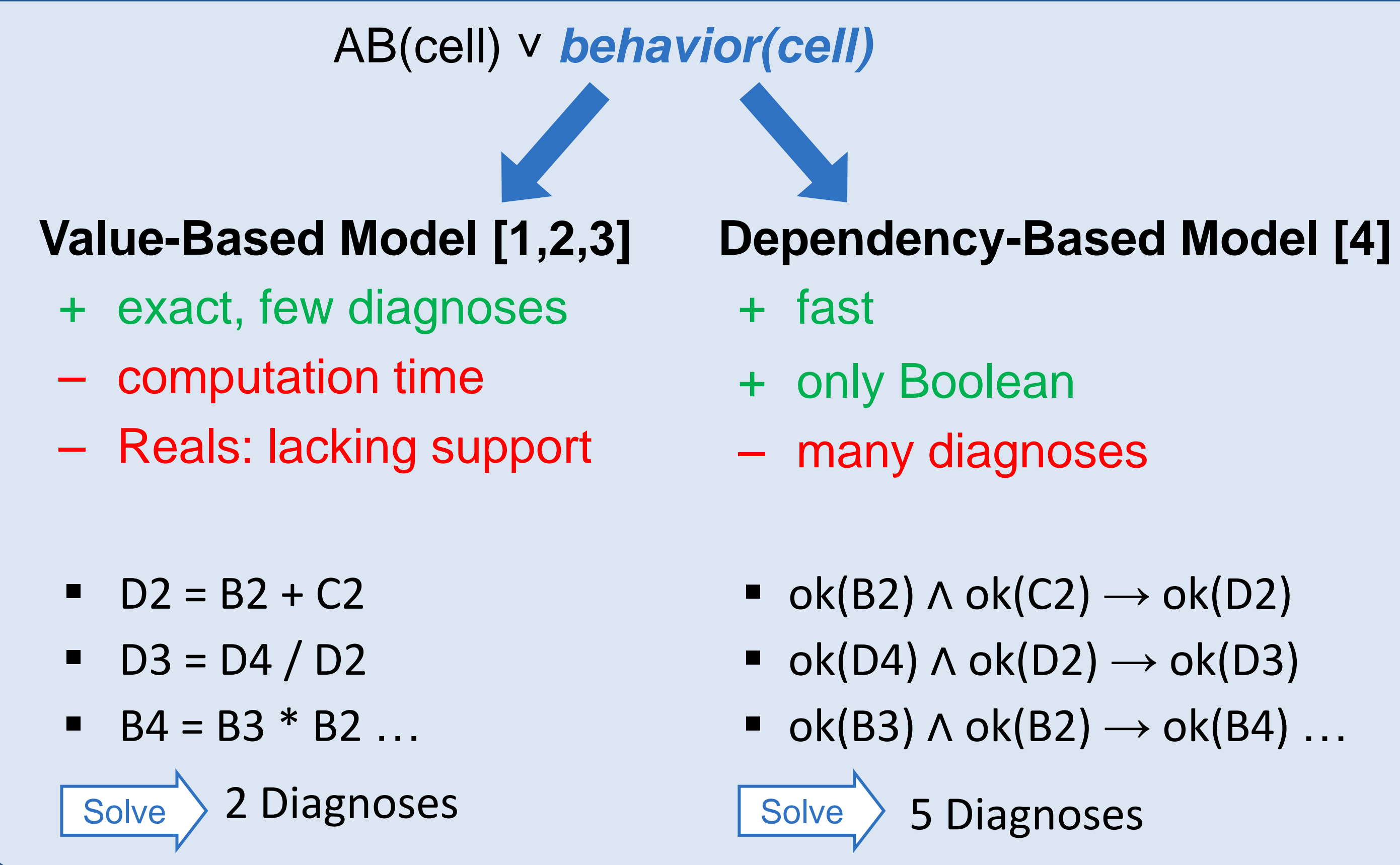
## 4 Coincidental Correctness (Fault Masking)

Functions and operations in spreadsheets where faults could be masked:

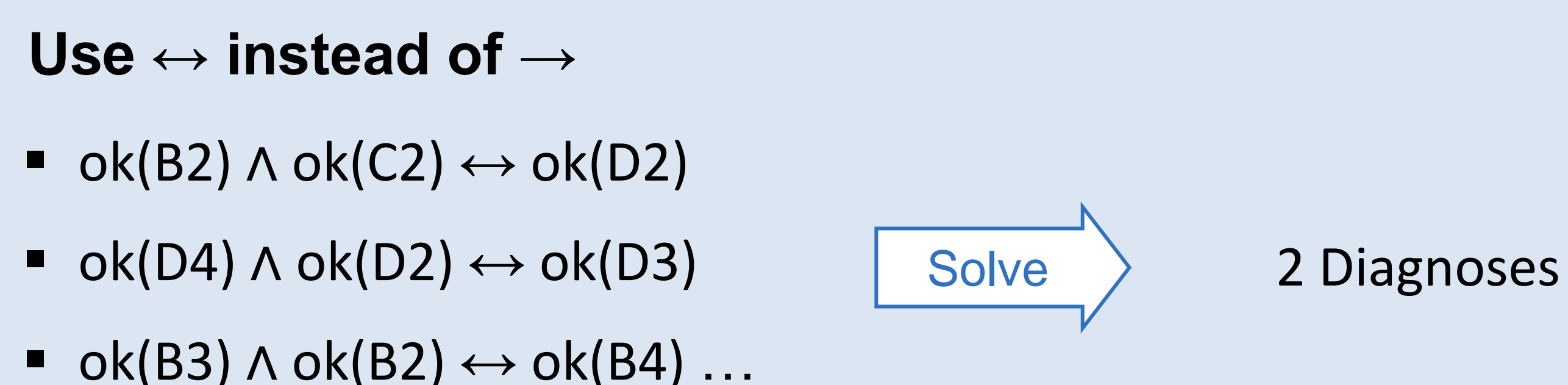
- Conditional like IF-function
- Abstraction function like MIN, MAX, COUNT
- Boolean
- Multiplication by zero
- Power with 0 or 1 as base number or 0 as exponent

Formulas containing any of these functions and/or operations must be modeled with  $\rightarrow$ , all other formulas can be modeled with  $\leftrightarrow$ .

## 2 Existing Behavior Models



## 3 Improving the Dependency-Based Model



## 5 Empirical Evaluation

Model	63 spreadsheets	31 spreadsheets
<b>Number of single fault diagnoses</b>		
Value-Based	4.0	-
Dependency-Based	13.2	45.0
Improved Dep.-Based	11.0	38.6
<b>Runtime</b>		
Value-Based	56,818.8 ms	> 20 minutes
Dependency-Based	32.0 ms	187.4 ms
Improved Dep.-Based	31.6 ms	164.8 ms

## 6 Conclusions

- Improved Dependency-Based Model:
- Still more diagnoses than value-based model
  - + 15 % less diagnoses than original dependency-based model
  - + Real time applicable
  - + Arbitrary solver (only Boolean needed)
  - + Debugging of spreadsheets containing Real numbers
  - + Correct/wrong info for output cells instead of concrete values

## References

- [1] R. Abreu, B. Hofer, A. Perez, and F. Wotawa: "Using constraints to diagnose faulty spreadsheets." *Software Quality Journal*, pp. 1–26, 2014.
- [2] D. Jannach and T. Schmitz, "Model-based diagnosis of spreadsheet programs - A constraint-based debugging approach." *Automated Software Engineering*, Springer, pp. 1-40, 2014.
- [3] S. Ausserlechner et al.: "The Right Choice Matters! SMT Solving Substantially Improves Model-Based Debugging of Spreadsheets." *QSIC 2013*: 139-148
- [4] F. Wotawa, "On the Relationship between Model-Based Debugging and Program Slicing." *Artificial Intelligence*, 135, 125–143, 2002.

## Acknowledgments

The research herein is partially conducted within the competence network Softnet Austria II ([www.soft-net.at](http://www.soft-net.at), COMET K-Projekt) and funded by the Austrian Federal Ministry of Economy, Family and Youth (bmwfj), the province of Styria, the Steirische Wirtschaftsförderungsgesellschaft mbH. (SFG), and the city of Vienna in terms of the center for innovation and technology (ZIT).

Contact: [bhofer@ist.tugraz.at](mailto:bhofer@ist.tugraz.at), [wotawa@ist.tugraz.at](mailto:wotawa@ist.tugraz.at)