ADVANCED FEATURE SELECTION FOR POWER SYSTEM SECURITY ASSESSMENT

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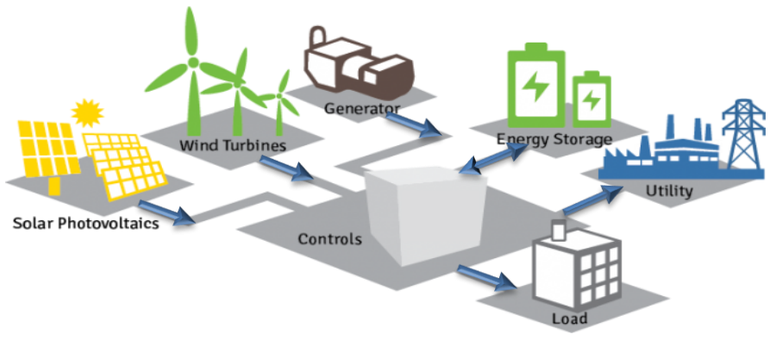
The new "dynamic" reality challenges

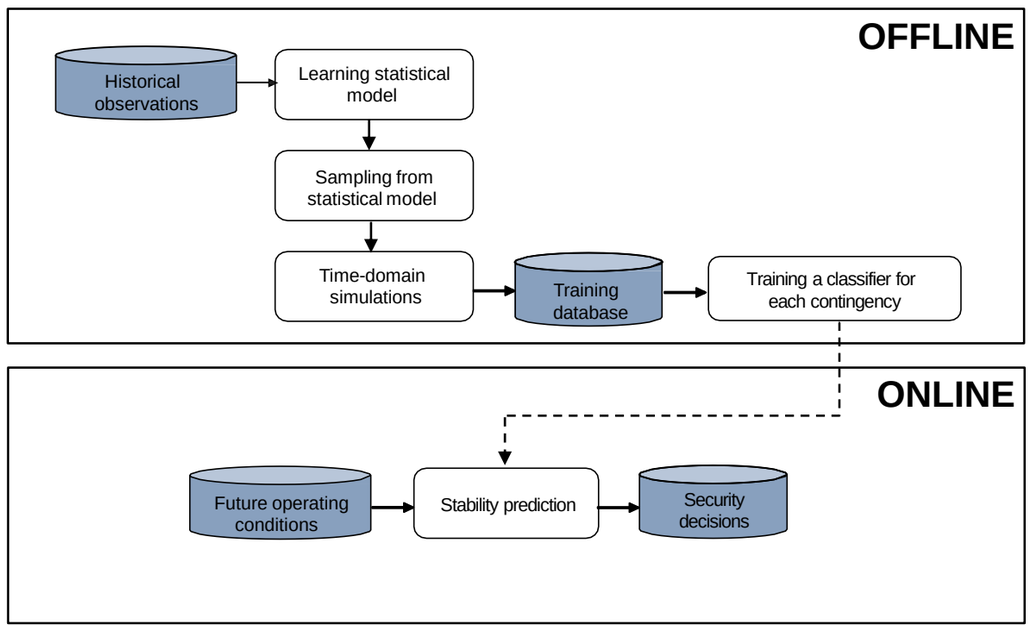
Grid operators face a new dynamic reality [1] due to:
- More renewable energy sources
- More flexible devices



→ High uncertainty in real-time operation

→ **ONLINE DYNAMIC SECURITY ASSESSMENT** for continuous grid monitoring and assessment

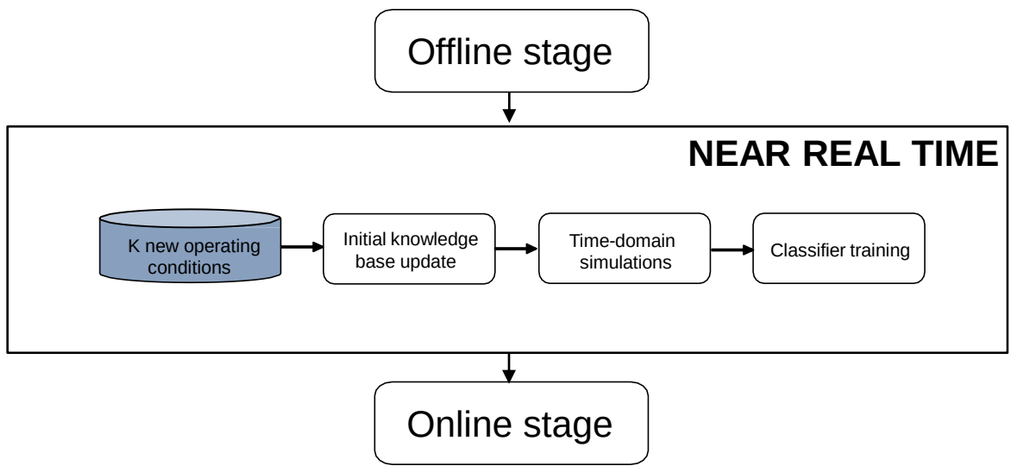
The concept of "preparing offline"



Challenge I : Inaccurate online predictions

Reasons for inaccurate online classification decisions [2]:
- Online operating conditions are different from those included in the knowledge base
- Forced outage of lines and transformers

→ New stage near real-time operation for **UPDATING** the classifier

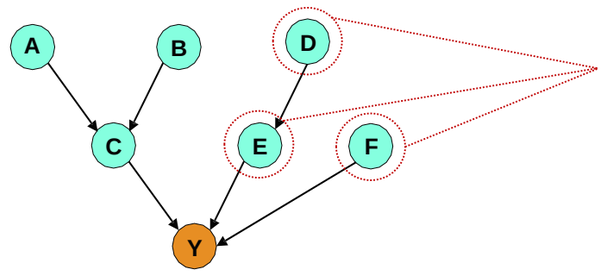


Challenge II : High computational time

The growing scale of power systems increases:
- Number of active contingencies
- Number of measurable parameters

→ The classifier update is computationally **EXPENSIVE** for near real-time operation

→ **FEATURE SELECTION** for dimension reduction of attributes [3]

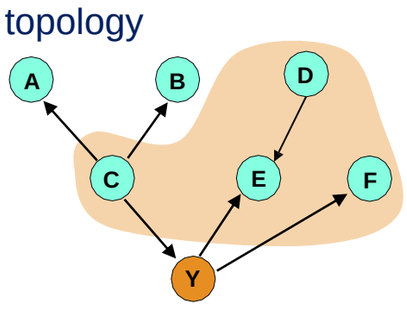


Existing Feature Selection techniques:
- Filter: low accuracy at low computation cost
- Wrapper: high accuracy at high computation cost

Markov Blanket based Feature Selection

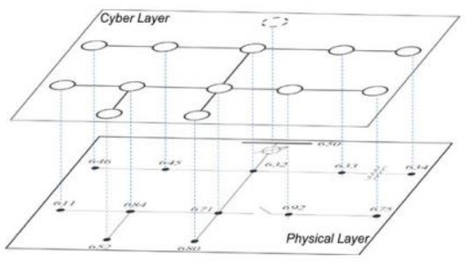
Need of fast algorithms with high predictive accuracy performances:

→ **MARKOV BLANKET** based Feature Selection algorithms
Advantage: Taking into account the knowledge of the network topology

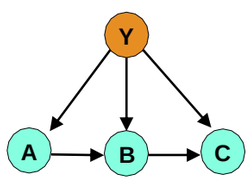


Markov Blanket of Y is given by its parents, children and spouses

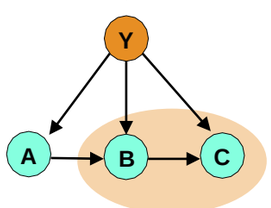
→ Our approach (MB TAN)



Graphical model of the power network based on probability distribution



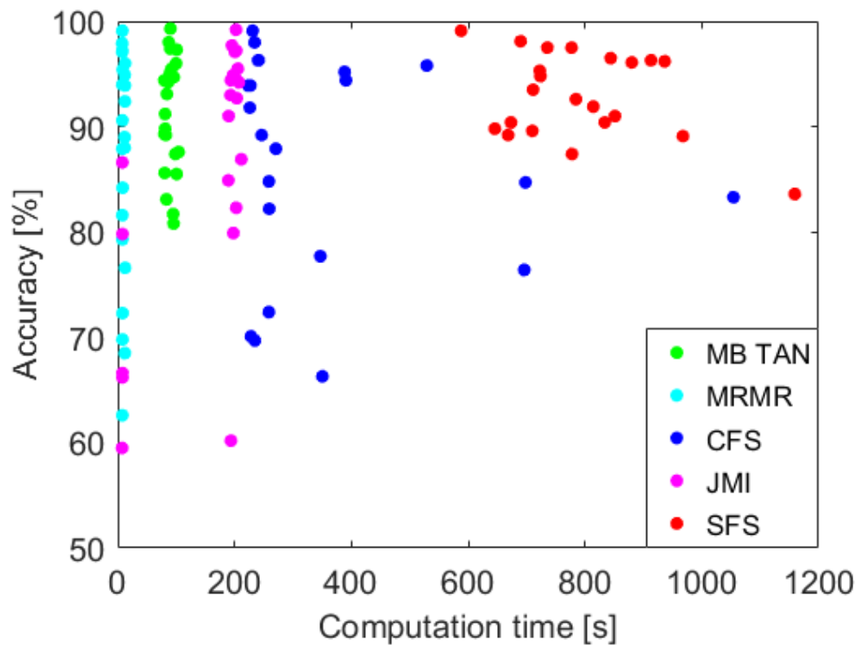
Probability distribution approximation through Tree Augmented Naïve Bayes structure



Approximate Markov Blanket identification

Case study: IEEE 68 bus system

Tests over 22 contingencies considering dynamic stability



Advantages of the MB TAN approach:
- The best trade-off between accuracy performances and computational costs
- Time scheduling of the classifier update is easier because the computational time is almost constant over all contingencies

REFERENCES

[1] P. Panciatici, G. Bareux and L. Wehenkel, "Operating in the Fog: Security Management Under Uncertainty," in IEEE Power and Energy Magazine, vol. 10, no. 5, pp. 40-49, Sept.-Oct. 2012.

[2] I. Konstantelos, G. Jamgotchian, S. H. Tindemans, P. Duchesne, S. Cole, C. Merckx , G. Strbac and P. Panciatici, "Implementation of a Massively Parallel Dynamic Security Assessment Platform for Large-Scale Grids," in IEEE Transactions on Smart Grid, vol. 8, no. 3, pp. 1417-1426, May 2017.

[3] I. Guyon and A. Elisseeff, "An Introduction to Variable and Feature Selection," J. Mach. Learn. Res., vol. 3, pp. 1157–1182, Mar. 2003. [Online]. Available: http://dl.acm.org/citation.cfm?id=944919.944968.