The Serial Model of Attack trees

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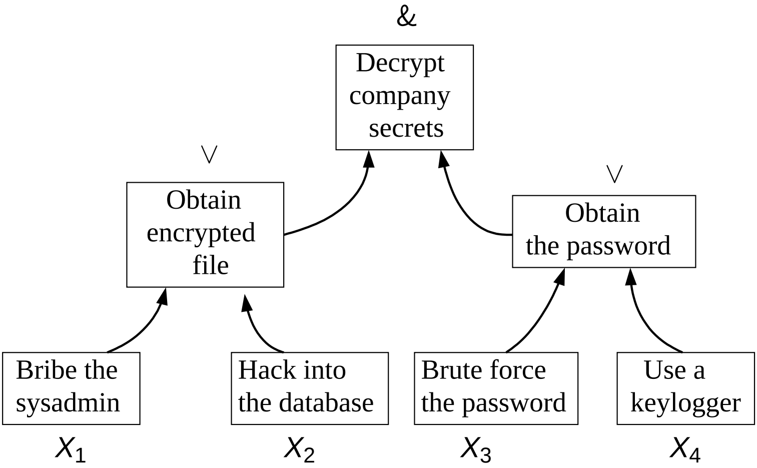
Attack trees

- Model for adversary behavior in attacking a system
- One central root goal
- Recursively down into subattacks
  - & nodes - all subattacks need to succeed
  - $\vee$ nodes - one of the subattacks needs to succeed
- Can be used to estimate many different parameters

Attack tree - Example



History

- Used since the 70-es for failiure and threat analysis
- Made famous by Bruce Schreiner in ’99
- Buldas, Laud, Priisalu, Saarepera, Willemson - ’06
  - Financial analysis
  - Gains of root threat g
  - Two parameters – expenses e_i and success probability p_i.
  - Attacks made in parallel

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  - Aivo is working on optimization and an approximate solver
- However - not good enough!

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- a "dirty hack" – consider subsets of attacks
- "Modeling cost-sensitive terrorist behavior"

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  - Fix an order of attacks
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- Basically - the classic model of economic decision theory!
  - Less likely to be flawed

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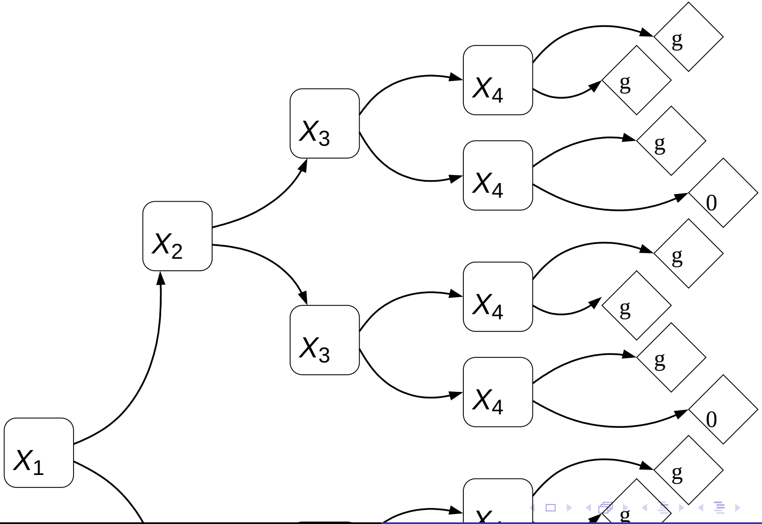
Decision tree - Example



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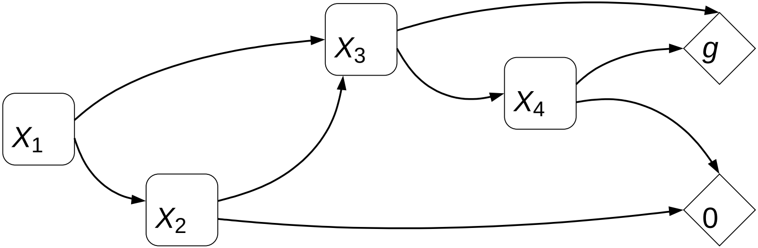
- Final model: Binary Decision Diagrams
  - Structurally, anyways

Binary Decision Diagrams



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- There are orders with exponential complexity
- Real life more likely to imply orders of the first kind
- Orders of the second kind can be strictly better

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- Strictly better outcome than parallel model
  - For any order – we can use the "good" order with $O(n)$ complexity
  - Can be used as an upper bound for that case as well

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  - Recurring subattacks
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- Finding a good attack order
- Sensitivity analysis for parameters e_i and p_i
- Analysis of how to best strenghten the system

Thank you!

Questions? Comments?