Backdoors and modulators

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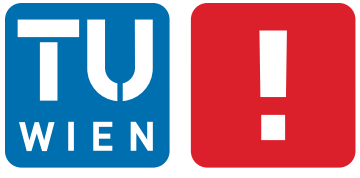
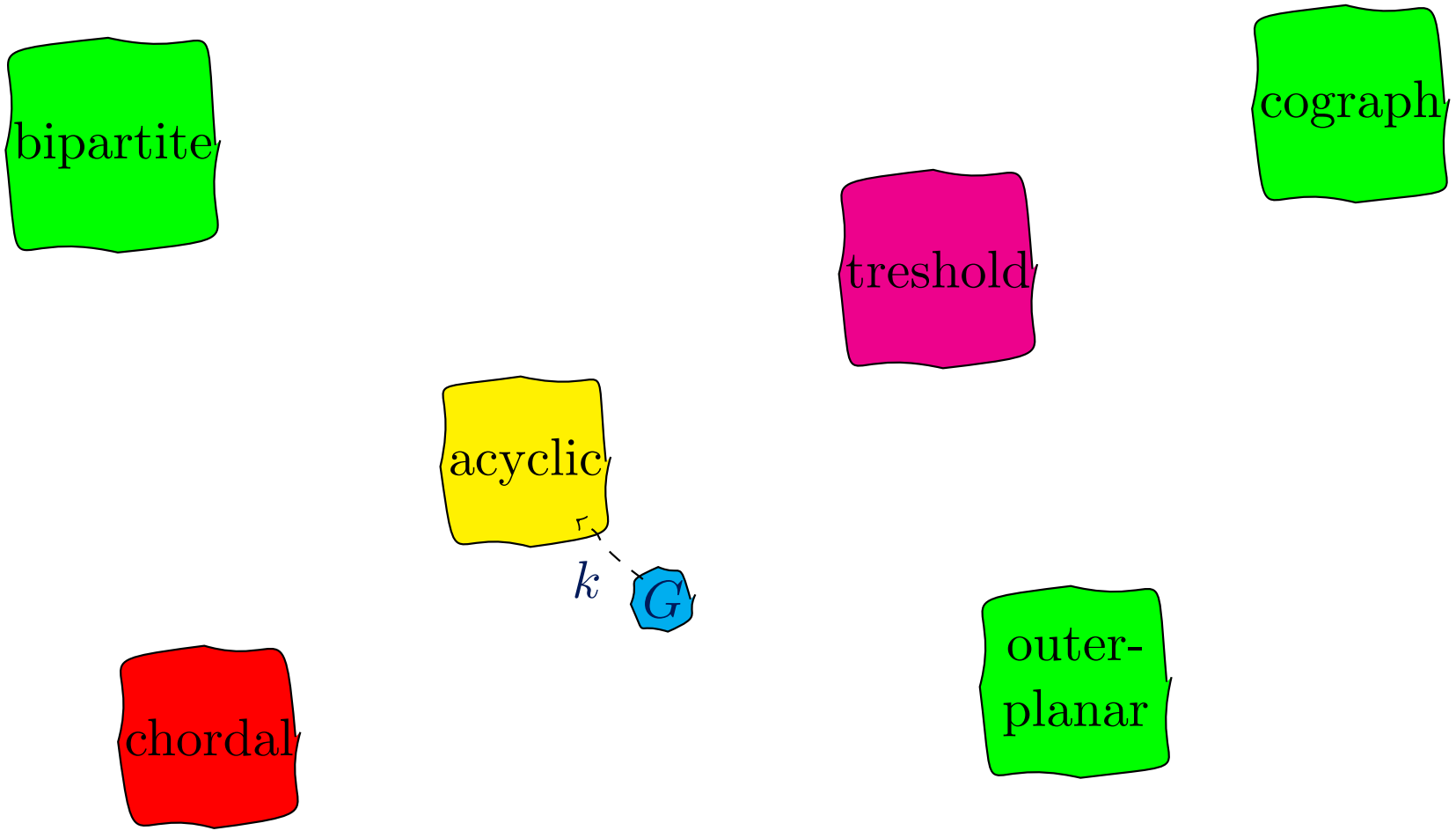
Retreat



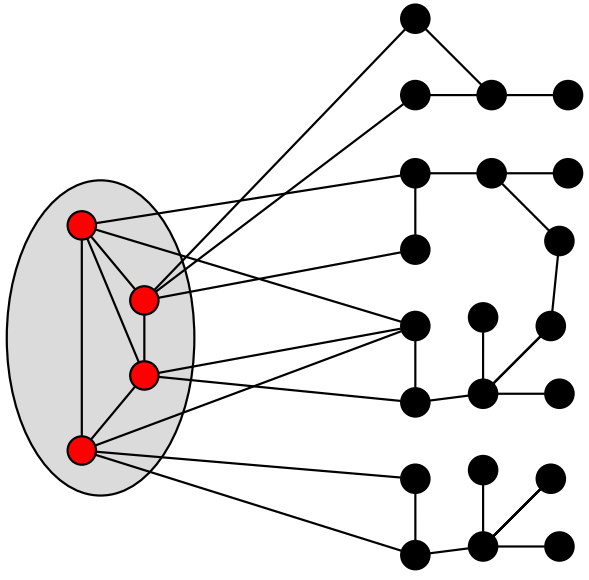
The islands of tractability

3-*colorability*



Modulators

to a graph class $\mathcal{H}$



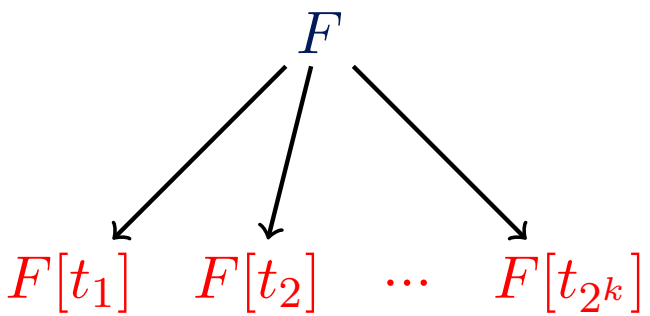
A graph with a small modulator to forests

- Finding size k modulators ($XP(n^k)$ if $\mathcal{H}$ is polynomially recognizable; aim for FPT)
- Using modulators (aim for FPT)

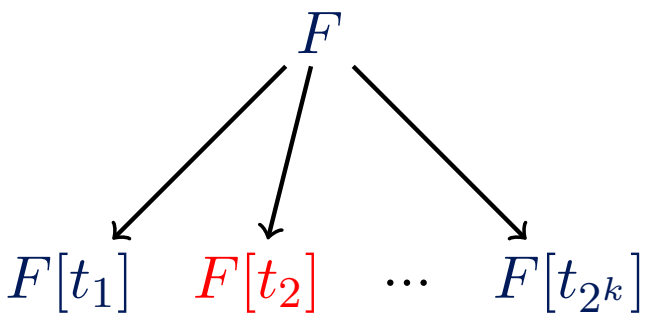
Backdoors

into a tractable class $\mathcal{H}$

Given a CNF formula F and set X of of k variables.
Let $t_1, \ldots, t_{2^k}$ be the truth assignments on X.



X is a strong backdoor if all the $F[t_i]$ belong to $\mathcal{H}$.



X is a weak backdoor if some $F[t_i]$ belongs to $\mathcal{H}$ and is satisfiable.

If we know a backdoor of size k, then we can decide F in time $2^k poly$.

Backdoors

complexity of BD detection

Base class	strong bd	weak bd	weak bd on r-CNF
Horn	FPT	$W[2]$-h	FPT
2CNF	FPT	$W[2]$-h	FPT
UP	$W[P]$-c	$W[P]$-c	$W[P]$-c
renamable Horn	$W[2]$-h	$W[2]$-h	$W[2]$-h
Acyclic	FPT-apx	$W[2]$-h	FPT
Treewidth[t]	FPT-apx	$W[2]$-h	FPT

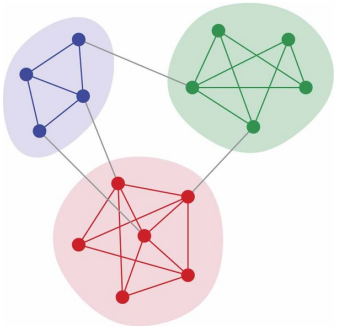
Relation to our work

FWF project "X-TRACT"

Backdoors which "disconnect" instance into several islands of tractability

- great for CSPs, but also works well on SAT and graphs

Using "community structure" to solve SAT instances

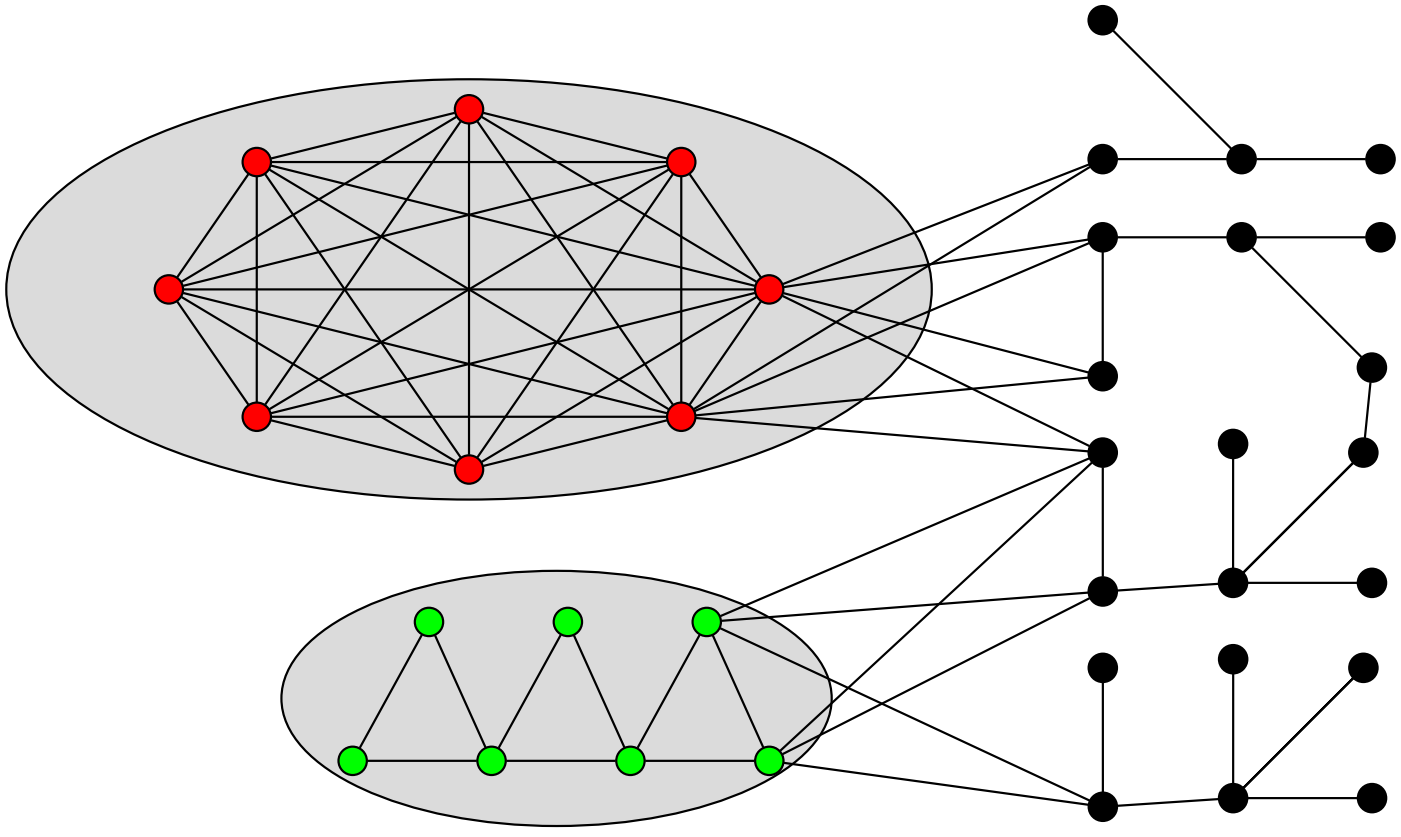


- real-world SAT instances seem to have community structure
- a more restricted notion is required to have rigorous algorithmic results

Well-structured modulators

FWF project "X-TRACT"

Basic idea: what if the graph has a large but well-structured modulator to $\mathcal{H}$?



A graph with a 2-well-structured modulator to forests