Dynamic connexity & parameterised complexity

Kernelization algorithms: from static to dynamic graphs

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Outline

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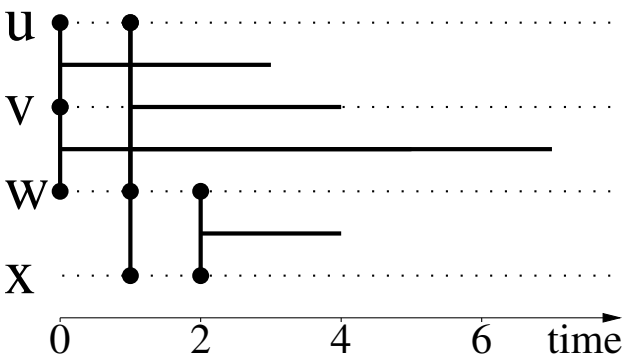
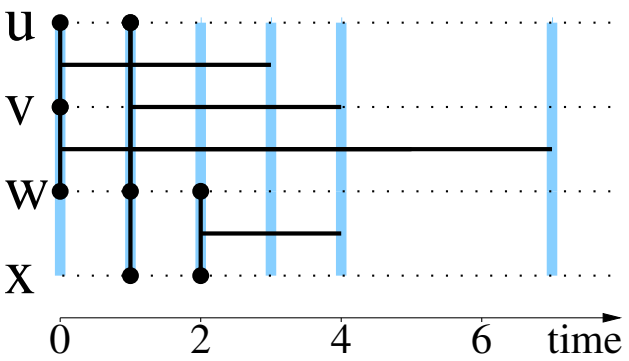
Graph-Likeness - Time intervals





Neighbourhood Reconstructibility

definition

A graph-like class Π of link streams is said to be ***neighbourhood reconstructible*** if there are two constants c, d and an algorithm A such that:

- A takes as input a link stream L, an integer k, and a subset of V_L, V', of size not greater than d ;
- A runs in polynomial time in $size(L)$;
- A decides whether or not L can be transformed, using a total of at most k edition operations and less than c edition operations in the vicinity of any vertex in V', into a link stream $L' \in \Pi$ such that all links of L' have exactly one end in V' .

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Heredity

Definition

A class of link streams is said to be ***hereditary*** if it is closed under vertex deletion.

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Problem Denomination: First prefix

First prefix: Describes the maximum number of cliques of size ≥ 2 allowed.

- ***d-***
- ****-*** (any)

Problem Denomination: Second prefix

Second prefix: Describes the maximum number of time intervals.

- ***If there is no second prefix:*** A single time interval, ie:

$$\exists b_c, e_c, \ \forall l \in E_L, \ l = (b_c, e_c, \_)$$

- ***-BI-*** Two neighbouring intervals, ie:

$$\exists (t_{c,i})_{i\in[0,2]}, \ \forall l \in E_L, \ \exists i < j, \ l = (t_{c,i}, t_{c,j}, \_)$$

- ***-MULTI-*** Any number of neighbouring intervals

$$\exists k, \ \exists (t_{c,i})_{i\in[0,k]}, \ \forall l \in E_L, \ \exists i < j, \ l = (t_{c,i}, t_{c,j}, \_)$$

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Problem Denomination: Stem

Stem: Describes whether or not we count isolated vertices when counting cliques.

- ***-Sparse-Split*** On each interval, the link stream is a certain number of cliques plus isolated vertices
- ***-Cluster*** On each interval, the link stream is a set of disjoint cliques

Problem Classification

Category	Link Stream Class	Graph-Like	Neighbourhood Reconstructible	Hereditary	Known Algorithm for the Editing Decision Problem
1	Sparse-Split	YES	YES	YES	QUADRATIC KERNEL (1)
	d-Sparse-Split	YES	YES	YES	QUADRATIC KERNEL (1)
	d-Cluster	YES	YES	YES	QUADRATIC KERNEL (1)
2	*-Sparse-Split	YES	UNLIKELY	YES	?
	*-Cluster	YES	UNLIKELY	YES	POSSIBLE FPT (2)
3	d-BI-Sparse-Split	NO	NA	YES	ONGOING RESEARCH (3)
	d-BI-Cluster	NO	NA	YES	?
	d-MULTI-Sparse-Split	NO	NA	YES	?
	d-MULTI-Cluster	NO	NA	YES	?
	*-BI-Sparse-Split	NO	NA	YES	?
	*-BI-Cluster	NO	NA	YES	?
	*-MULTI-Sparse-Split	NO	NA	YES	?
	*-MULTI-Cluster	NO	NA	YES	?

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Summary

- The Sparse-Split Link Stream Editing problem is FPT
- Many variations thereupon are also FPT