

Gene Module Decomposition

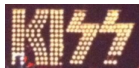
Madison Cooley

Casey S. Greene, Davis Issac, Milton Pividori, Blair D. Sullivan

Parameterized algorithms for identifying gene co-expression modules via
weighted clique decomposition

University of Utah | SIAM ACDA21

Modules



GENE SIMMONS
FAMILY JEWELS

TRICK @ TREAT

Modules

KISS



GENE SIMMONS
FAMILY JEWELS



TRICK OR TREAT



Modules

KISS



Musician Gene

GENE SIMMONS
FAMILY JEWELS



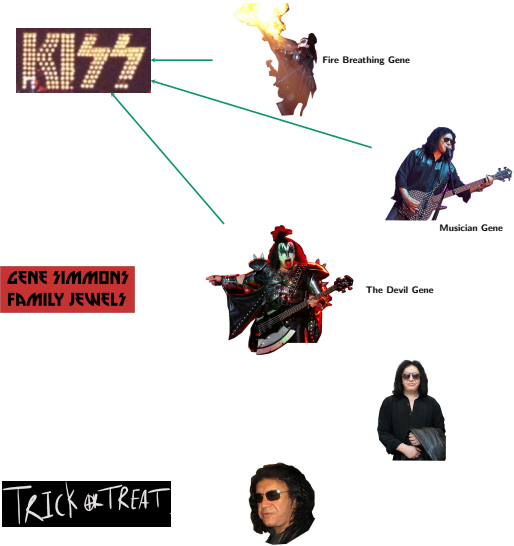
TRICK & TREAT



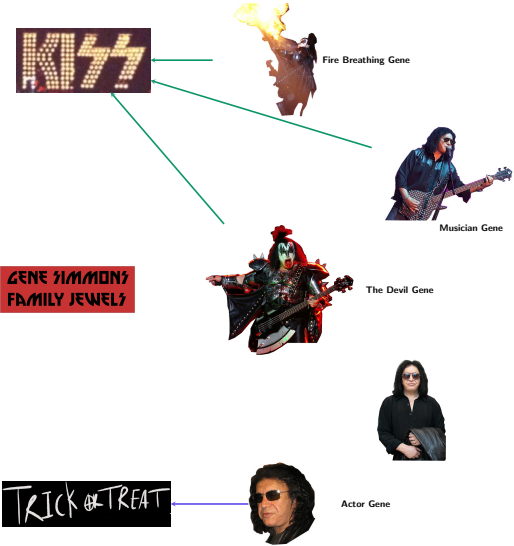
Modules



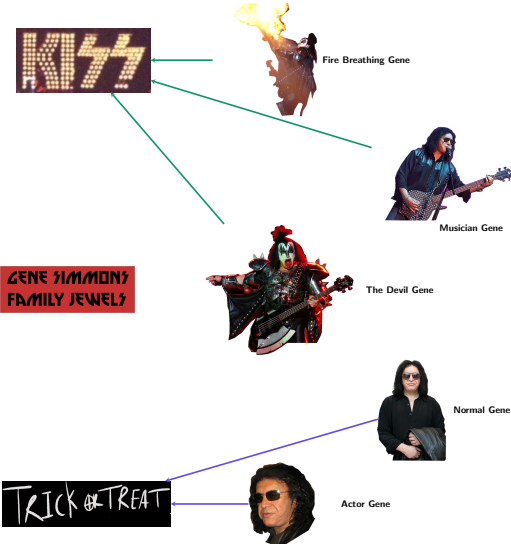
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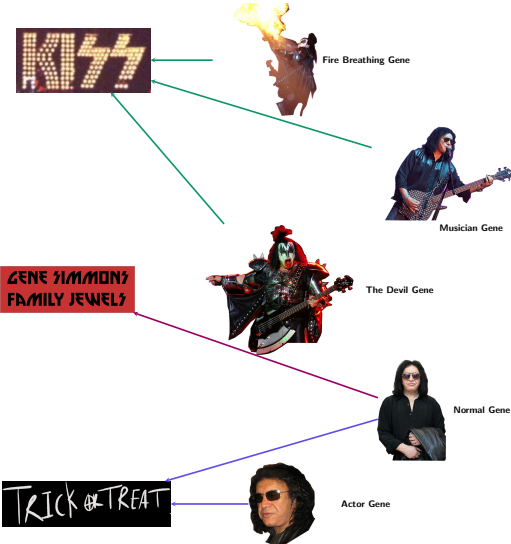
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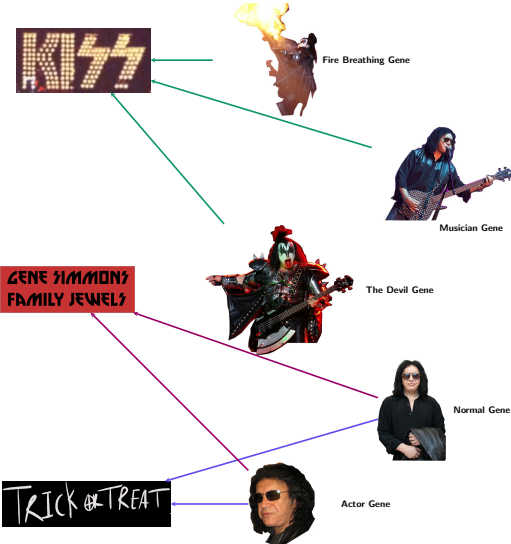
Modules



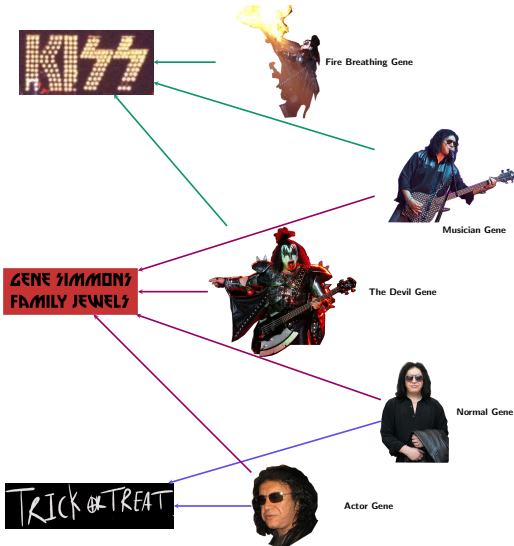
Modules



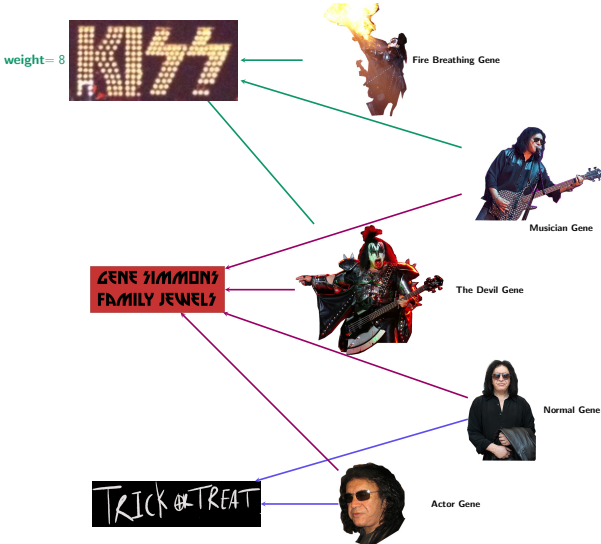
Modules



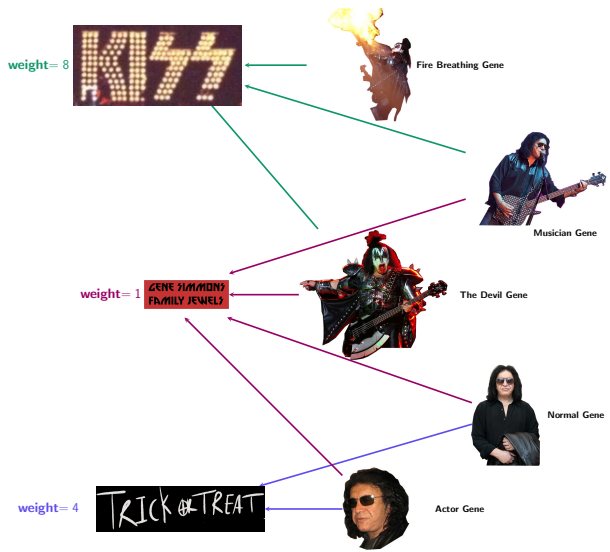
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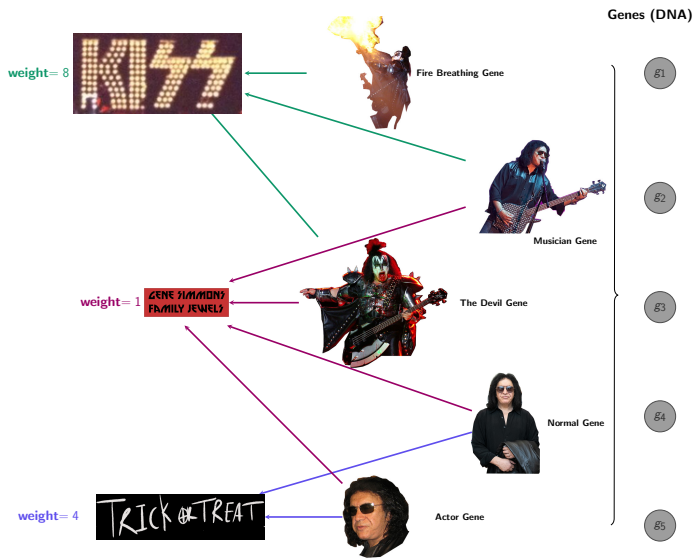
Modules



Modules



Modules



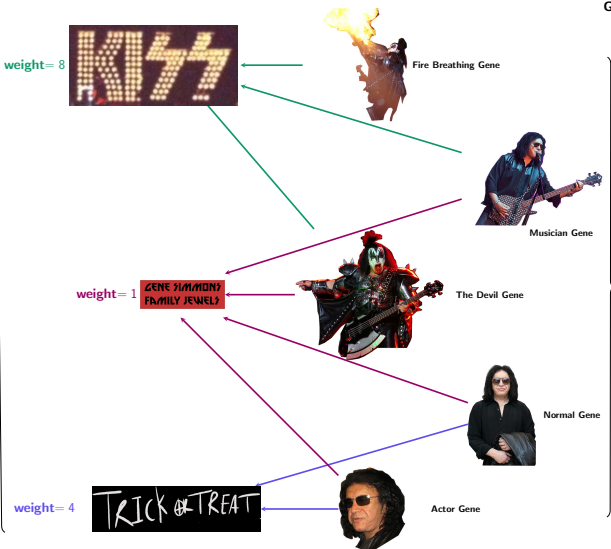
Modules

Biological Processes

Signal Transduction

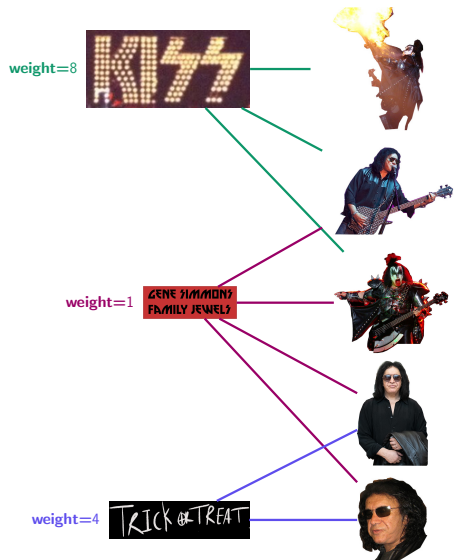
Metabolism

Process drugs

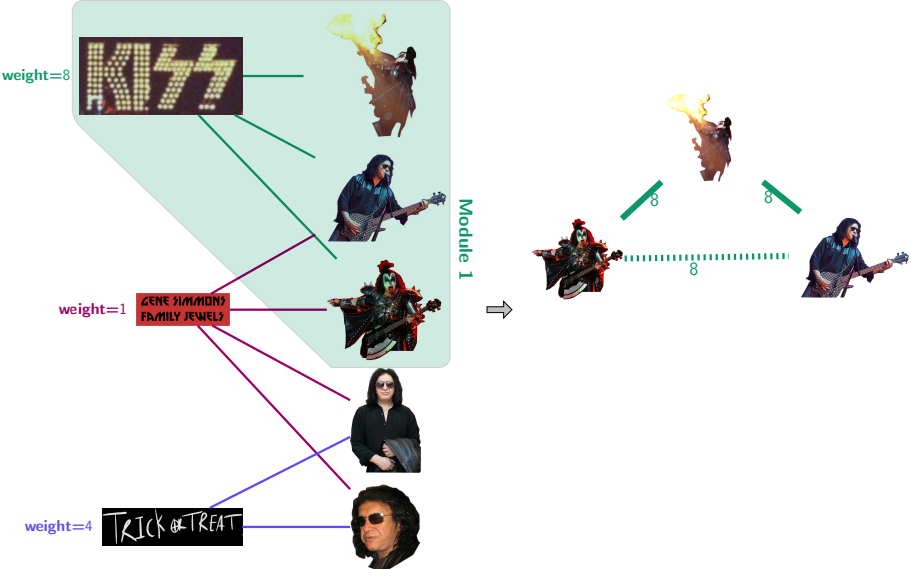


Genes (DNA)

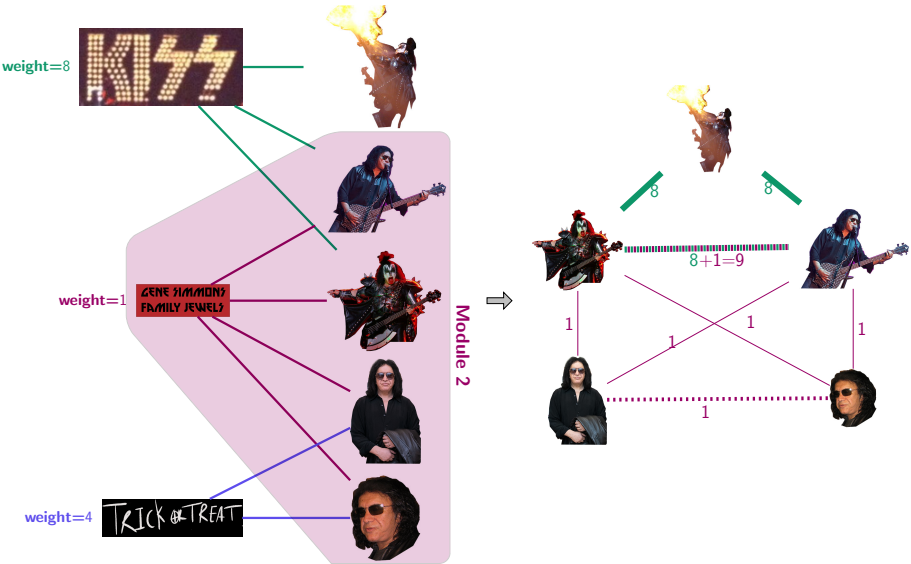
Gene-to-Gene Projection



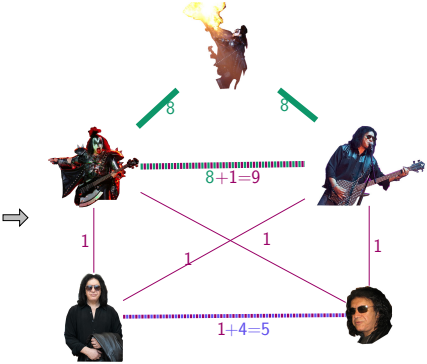
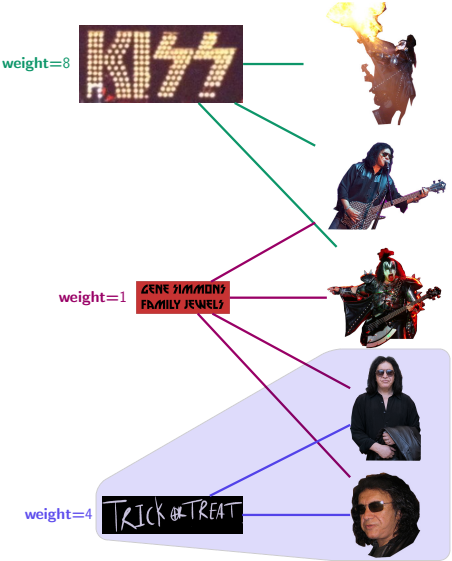
Gene-to-Gene Projection



Gene-to-Gene Projection



Gene-to-Gene Projection



Contributions

EXACT WEIGHTED CLIQUE DECOMPOSITION (EWCD)

Input: a graph G , non-negative edge weights w , integer k .

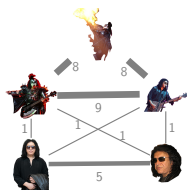
Output: a set of at most k weighted cliques such that w agrees with the sum of containing cliques on each edge.

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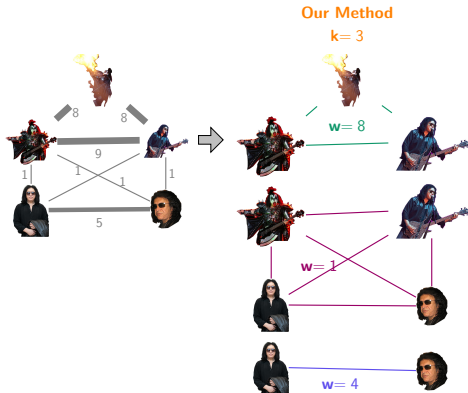


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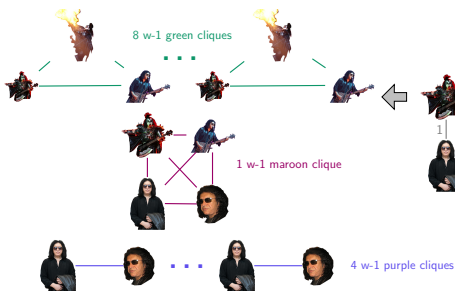
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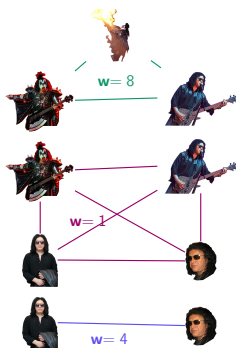
Feldmann et al. (2020)

$K=14$



Our Method

$k=3$



Contributions

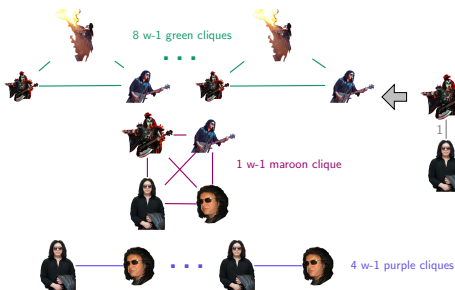
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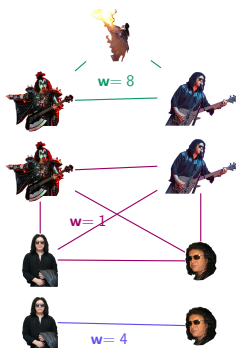
Feldmann et al. (2020)

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► $K \equiv \text{total \# of cliques}$

→

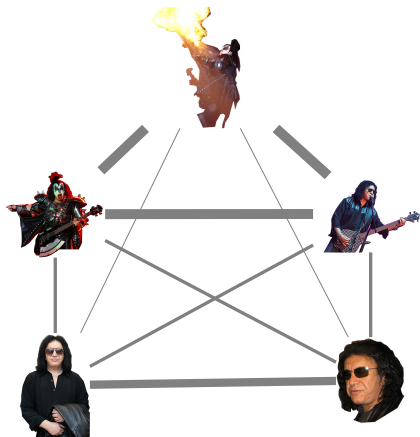
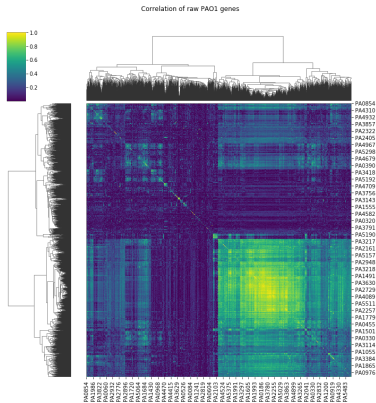
$k \equiv \text{\# distinct cliques}$

Challenges

- ▶ Simplified setting (integral weights, exact sums) vs. real data.

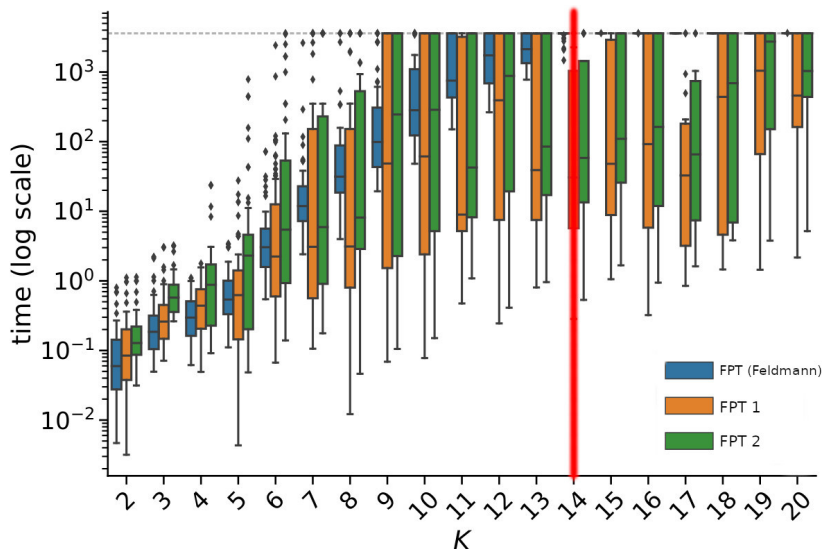
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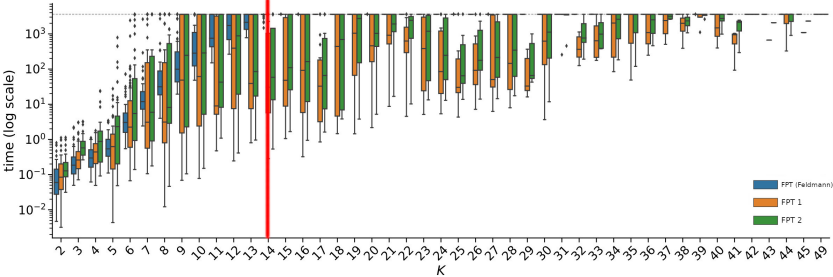


Results

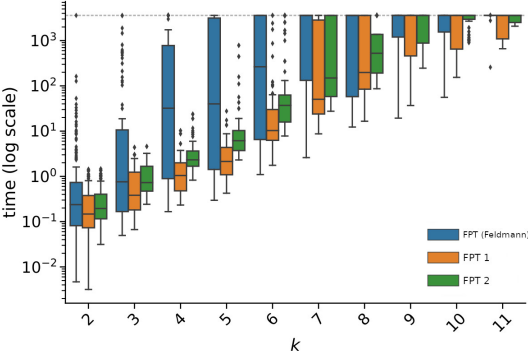
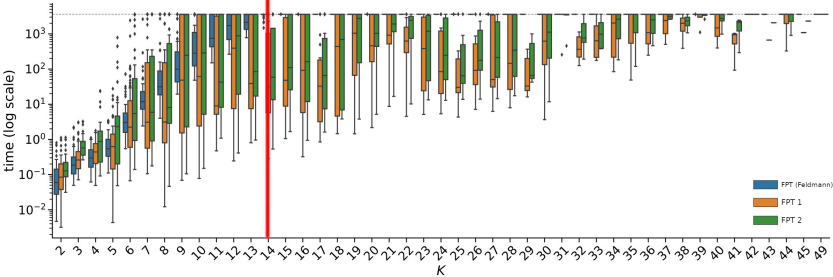
- ▶ Two new FPT algorithms for solving EWCD (FPT 1/FPT 2).



Results



Results



Thanks!

arXiv:2106.00657



Musician Gene Source: VSpectrum

Devil Gene Source: Alberto Cabello

Fire Breathing Gene Source: Alberto Cabello

Actor Gene Source: Patty Mooney

GORDON AND BETTY
MOORE
FOUNDATION

