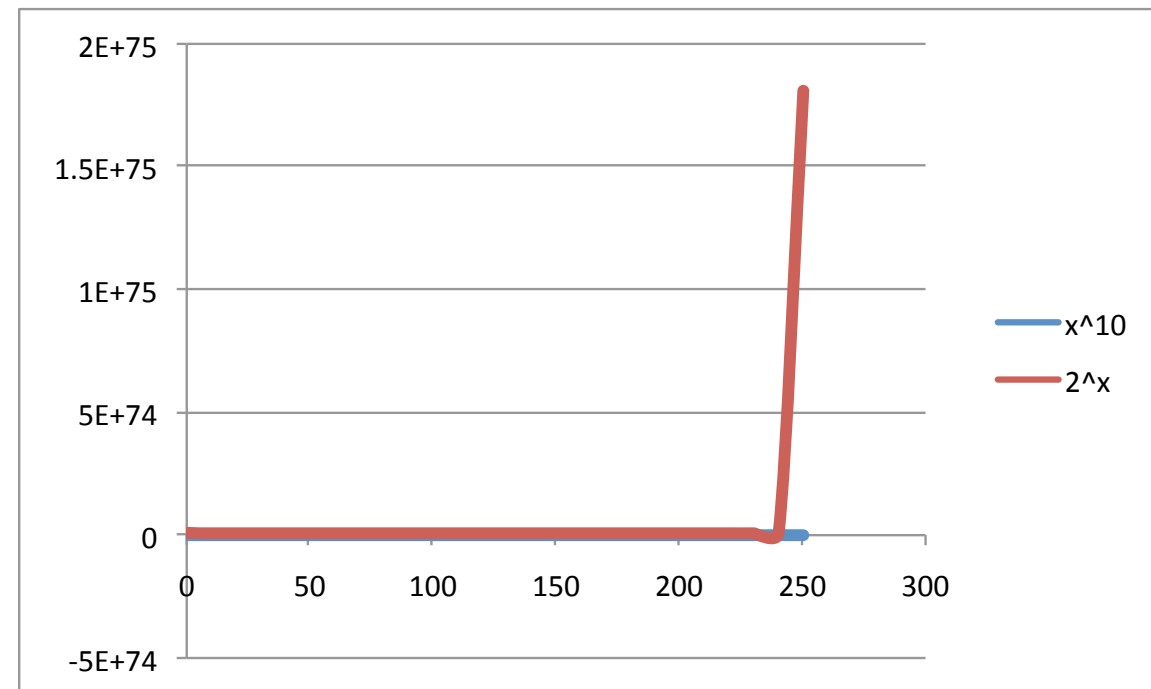
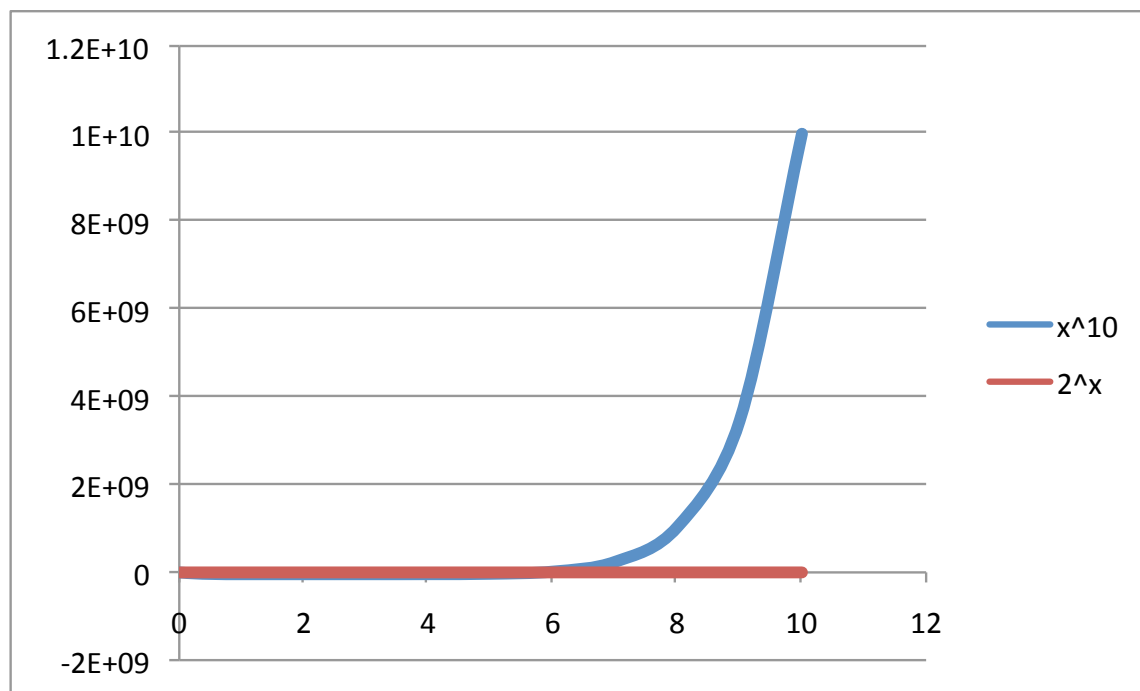


3D Numerical Matching and Complexity

Linda Cook
Advisor: Jacob Baron

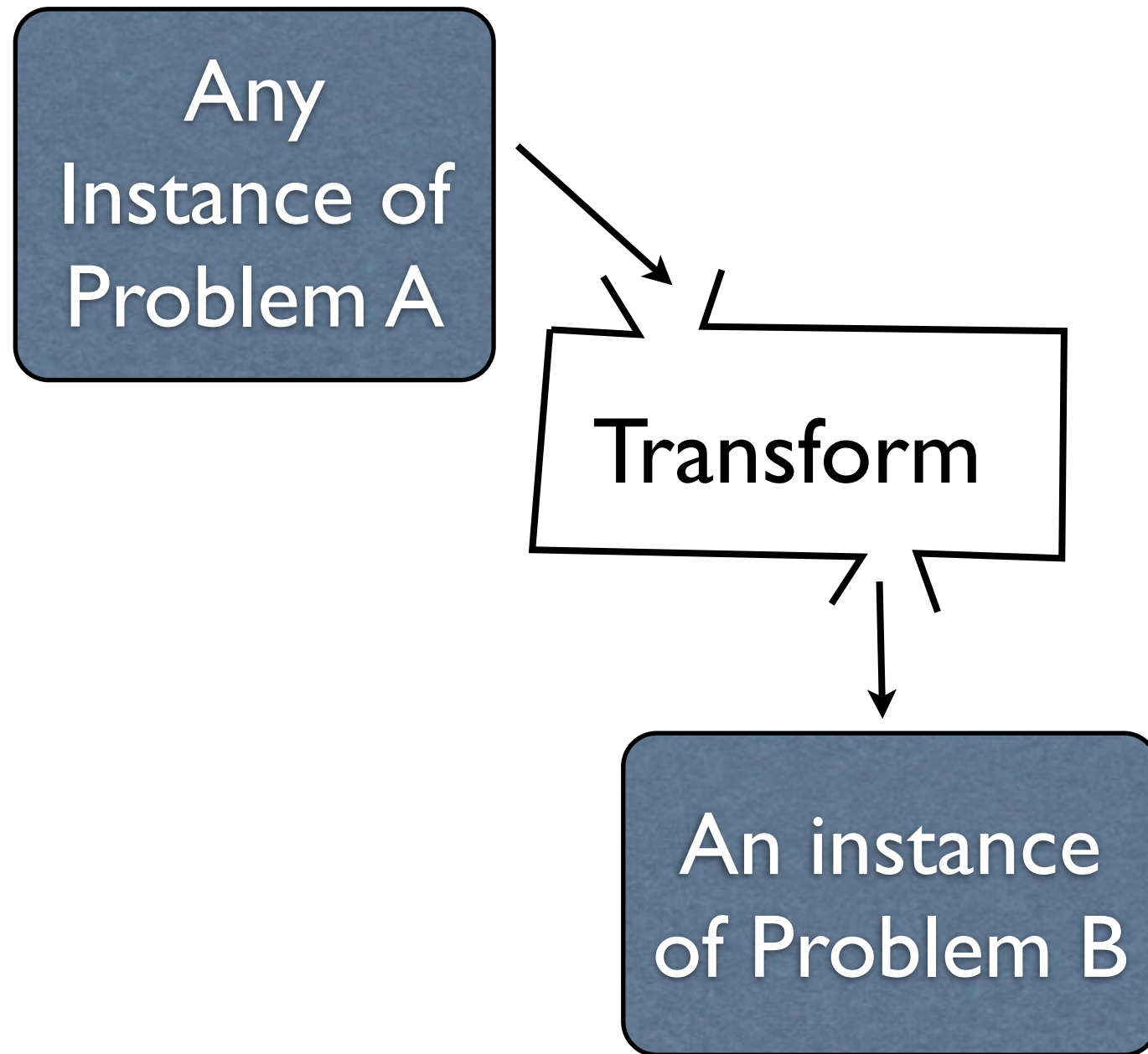
Intractability



NP

- nondeterministic polynomial time
- decision problems
- verification in polynomial time

Reductions

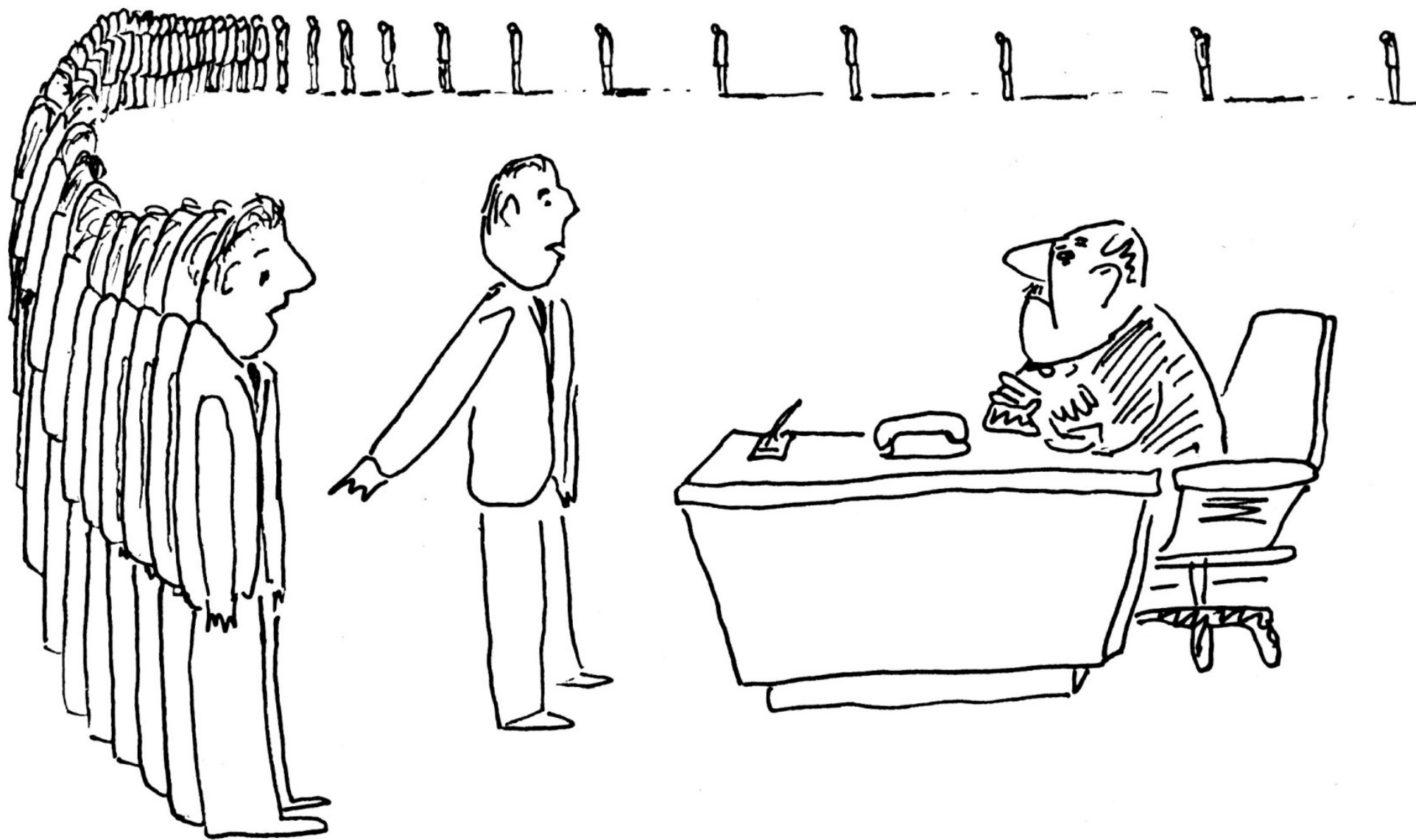


- If we can solve Problem B, we can solve Problem A
- Polynomial Time

NP-Hard

- The “Hardest” in NP
- Every problem in NP can be reduced to it in polynomial time

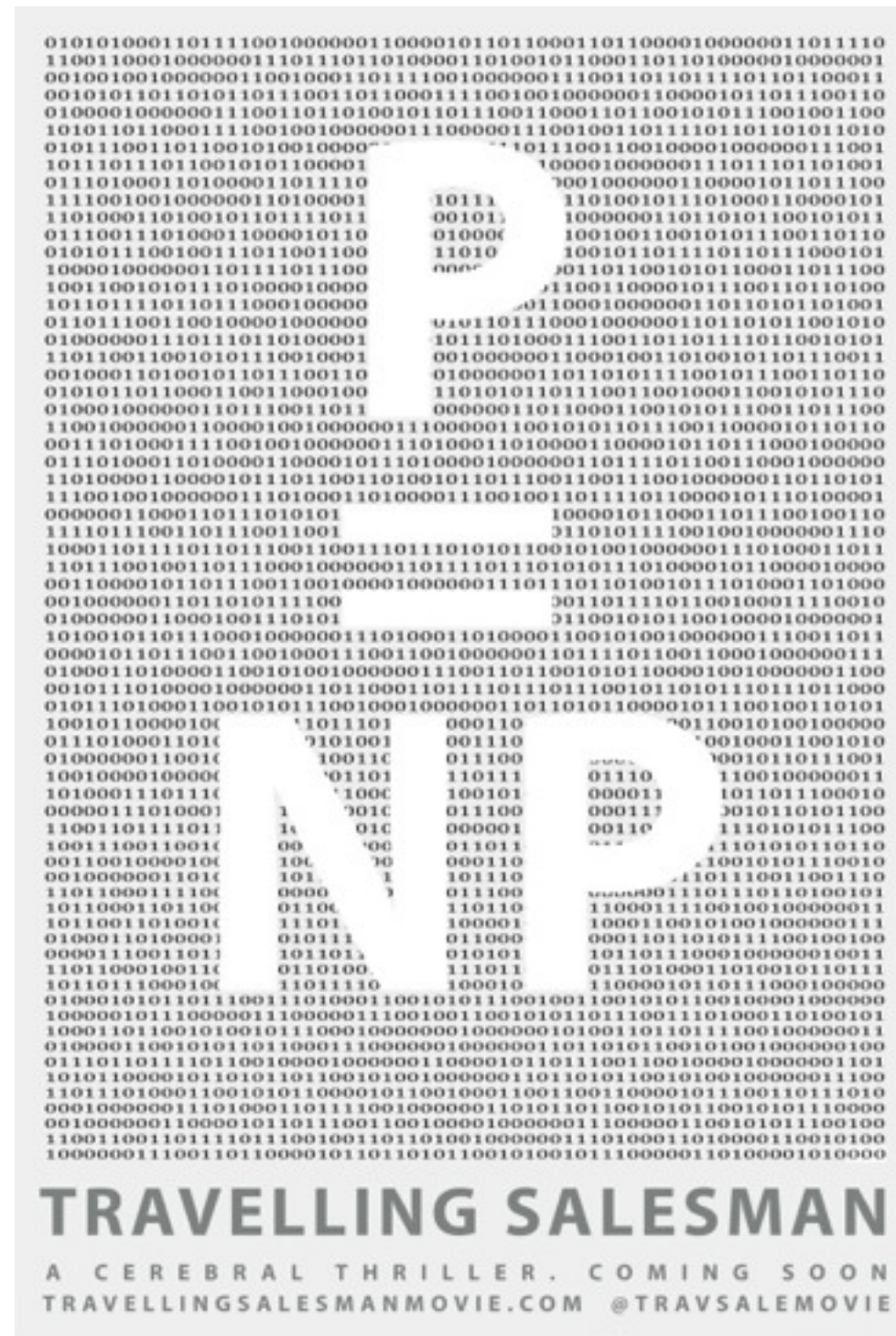
NP-Hard



"I CAN'T SOLVE IT - BUT NEITHER CAN ALL THESE FAMOUS PEOPLE ! "

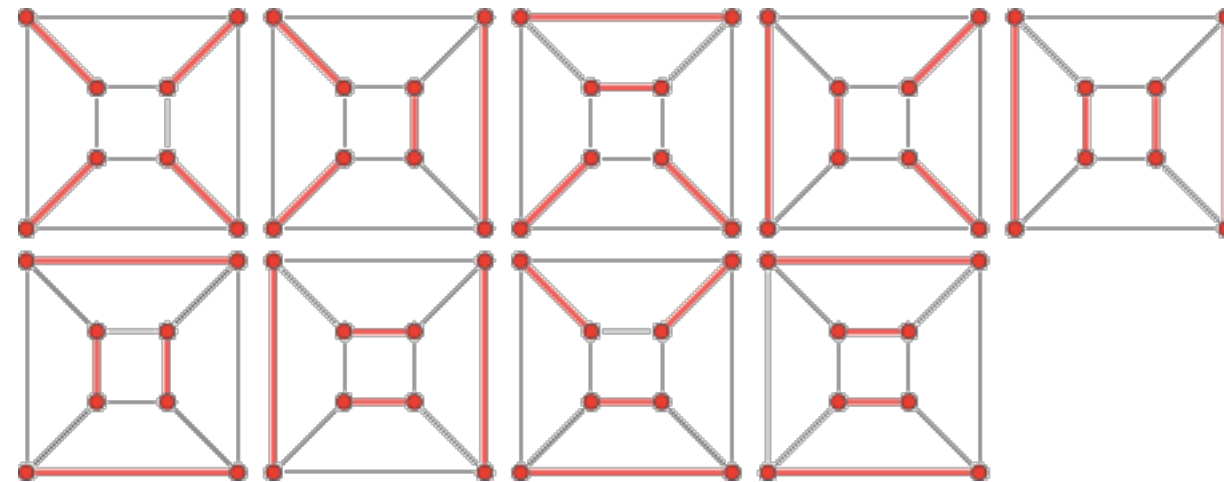
Computers and Intractability: A Guide to the Theory of NP-Completeness
W. H. Freeman & Co. New York, NY, USA ©1979

Is NP-hard intractable?



Imdb. "Travelling Salesman." *Internet Movie Database*. N.p., n.d. Web.

Matchings



[Weisstein, Eric W.](http://mathworld.wolfram.com/PerfectMatching.html) "Perfect Matching." From [MathWorld](http://mathworld.wolfram.com/PerfectMatching.html)--A Wolfram Web Resource. <http://mathworld.wolfram.com/PerfectMatching.html>

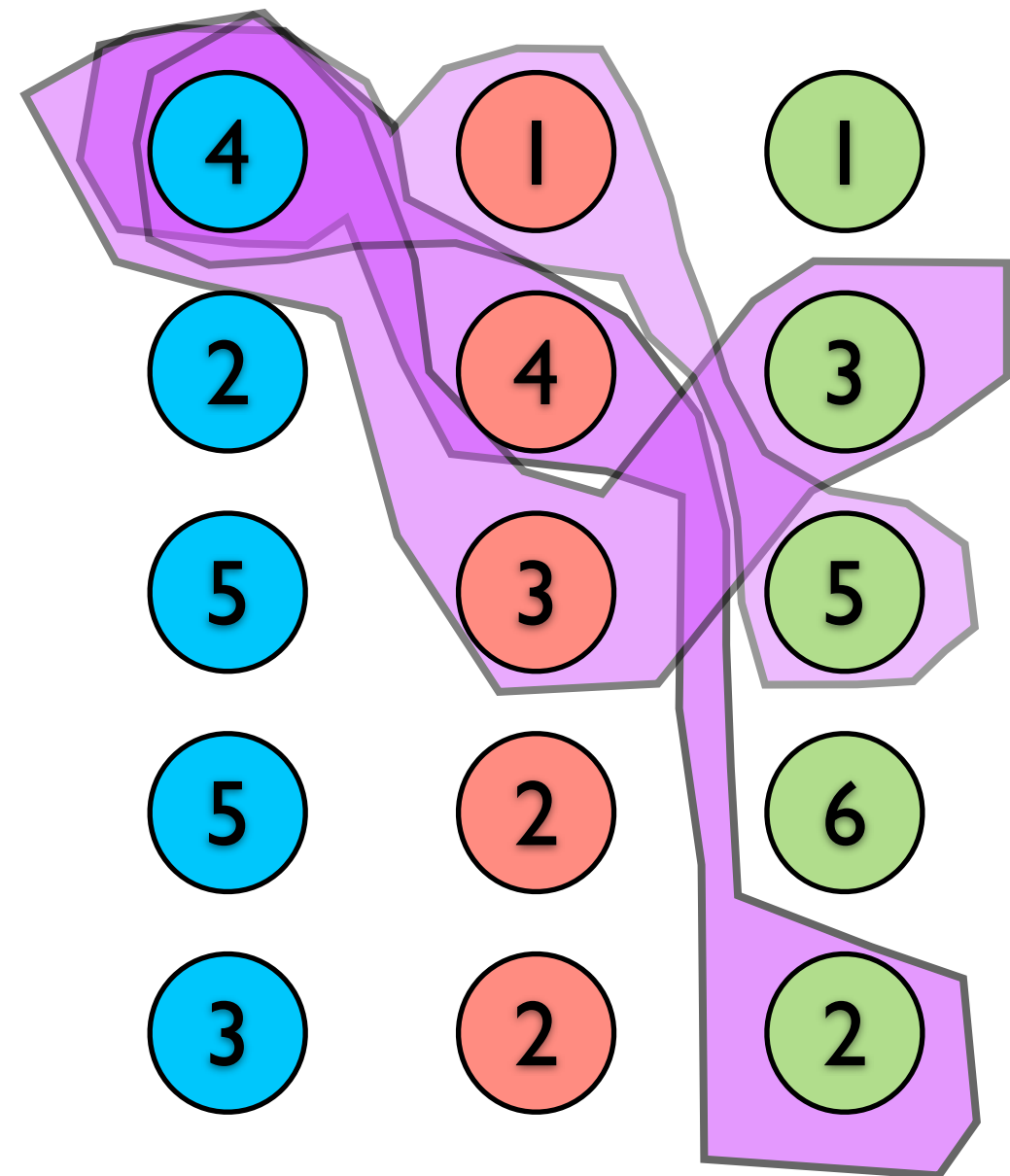
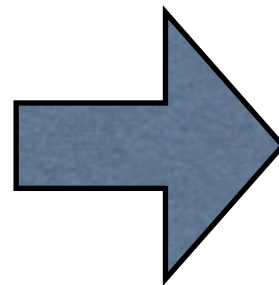
- independent set of edges
- no two edges are adjacent
- perfect matching - an independent set for that covers every vertex

3-Dimensional Numerical Matching

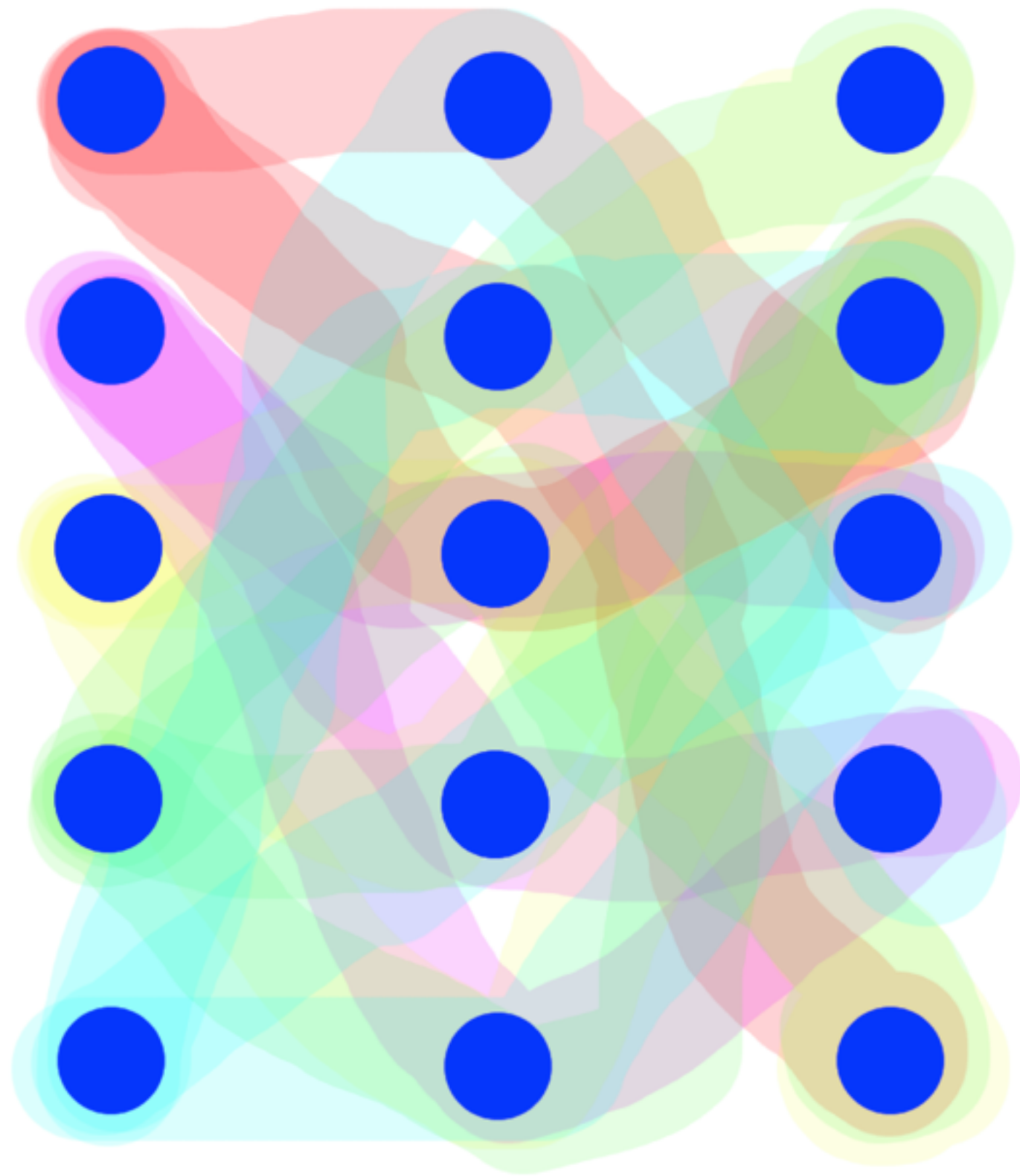
- Inputs
 - 3 k -element multisets of integers **F**, **S**, **W**
 - a bound b
- Goal
 - A subset of **F** $\times$ **S** $\times$ **W** s.t. every element in **F**, **S**, **W** is in exactly one triple and the sum of each triple = b

Limit $b=10$

	F	S	W
A	4	1	1
B	2	4	3
C	5	3	5
D	5	2	6
E	3	2	2



Hypergraph



A Special Case: $F=S=W$

	F	S	W
A	4	4	4
B	2	2	2
C	5	5	5
D	5	5	5
E	3	3	3

- 3DIM is proven to be NP-Hard
- Is the special case also NP-Hard?
- Search for: Reduction, Polynomial Time Algorithm

References

Computers and Intractability: A Guide to
the Theory of NP-Completeness

W. H. Freeman & Co. New York, NY, USA

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