

A Linear Program

A linear program is defined by:

Real-valued **variables**

Subject to a list of **linear constraints**

A linear constraint is a statement of the form: $\sum a_i x_i \leq c_i$
where a_i are constants, the x_i are variables and c_i is a constant.

Maximizing or minimizing a linear objective function

A linear objective function is a function of the form: $\sum b_i x_i$
where b_i are constants and the x_i are variables.

LP for Independent set

Max: $\sum x_u$

Subject to:

$x_u + x_v \leq 1$ for all $(u, v) \in E$

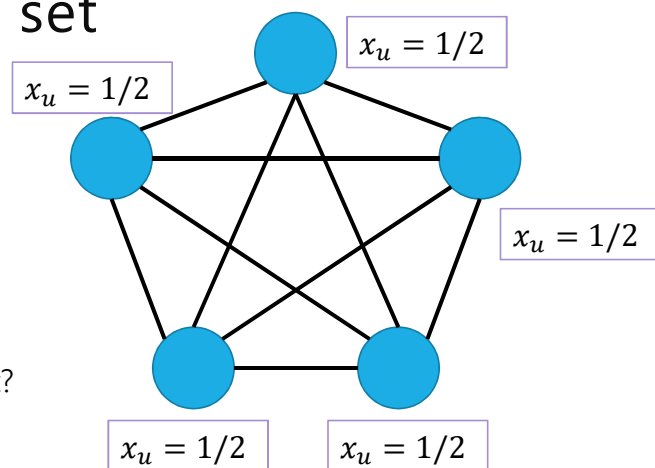
$0 \leq x_u \leq 1$ for all u

How big is the biggest independent set?

1

What does the LP find

2.5 – there's no "real" independent set this corresponds to.



Vertex Cover LP

Pollev.com/robbie

Write an LP for finding the minimum weight vertex cover

A set S of vertices is a vertex cover if for every edge (u, v) , u is in S , v is in S or both are in S .

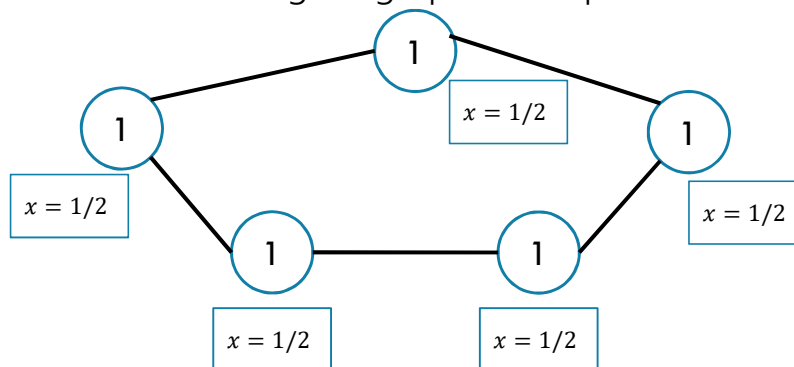
What are your variables, then how do you constrain them?

Let $w(u)$ be the weight for a vertex u . You can treat $w(u)$ as a constant.

Non-Bipartite

We needed the graph to be bipartite to be able to 2-color it.

What if our original graph isn't bipartite?



The LP finds a fractional vertex cover of weight 2.5

There's no "real"/integral VC of weight 2.5. – lightest is weight 3.

There's a "gap" between integral and fractional solutions.