# LP duality in the design of approximation algorithms

# Review: Approximation algorithm by LP-rounding

1. Find a LP relaxation for the problem
2. Find the optimal (fractional) solution x
3. "Round" x to output an integer solution x'

# Review: Analysis (maximization problem)

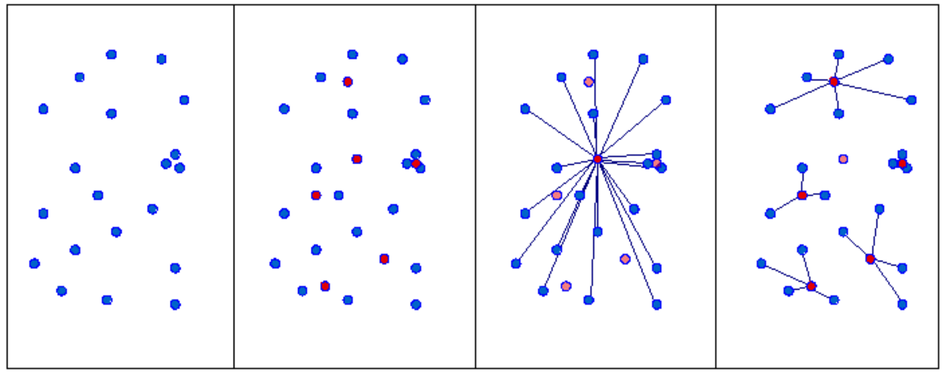
1. LP Relaxation: value(x) > OPT
2. Rounding is s.t. value(x') > value(x)/c
3. Together: value(output) > OPT/c

# Approximation algorithm primal-dual

1. Find a LP relaxation (P) for the problem
2. Let (D) be the dual LP.
3. "Construct" integer solutions x for (P), y for (D)

# Analysis (maximization problem)

1. Solutions are constructed s.t. value(x) >value(y)/c
2. Weak duality: value(y)>OPT
3. Together: value(output x) >OPT/c.



# Primal-dual approach for
- Steiner forest
- Facility location