

Fundamental Algorithm Techniques

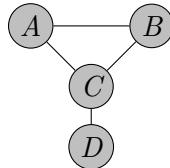
Problem Set #7

Review on November 22

Problem 1 (Graph Play, 3/10 pts). *Draw a few undirected graphs and a few directed graphs.*

1. *create few examples of (directed) graphs and their transposed graphs*
2. *create few examples of (undirected) graphs and their inverse graphs.*
3. *What happens if the original is dense for the inverse?*
4. *create few very simple examples of (undirected) graphs and their dual graphs*
5. *Why is the dual only well-defined for planar graphs? Provide one example of a non-planar graph and explain why it has no dual.*

Problem 2 (Bron–Kerbosch Execution, 7/10 pts). *Consider the following undirected graph G with vertices $V = \{A, B, C, D\}$ and edges: $E = \{AB, AC, BC, CD\}$.*



The graph can be represented as an adjacency list:

```
graph = {
    "A": ["B", "C"], "B": ["A", "C"], "C": ["A", "B", "D"], "D": ["C"]}
```

Apply the BronKerbosch algorithm (without pivoting) to find all maximal cliques:

1. *Write the initial call to the algorithm (i.e., the starting values of R , P , and X).*
2. *Trace the first two recursive calls that lead to reporting a maximal clique. Show the values of (R, P, X) at each step.*
3. *List all maximal cliques of G . Which one(s) are maximum?*