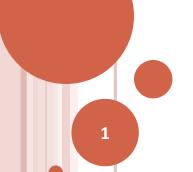
# CS F364 Design & Analysis of Algorithms

# **ALGORITHM DESIGN: GREEDY TECHNIQUE**

**Spanning Trees vs. Steiner Trees** 



#### STEINER TREES

- Recall: Given a computer network modeled as an graph:
  - Shortest paths minimize the cost of communication per source-destination pair.
  - Spanning trees form the (optimal) broadcast path
- Multicast Communication:
  - Within a network a subset of nodes are destinations.
  - How do you minimize the cumulative weight of the multicast path?
    - Observation: The subset may not form a connected component.

### STEINER TREES

- Given G=(V,E,w), w: E --> Z<sup>+</sup> and a subset S of V, a minimal Steiner tree T is the tree of minimum total weight that connects all vertices in S.
  - Special cases:

- When 2 < |S| < |V|
  - A spanning tree including only nodes of S may not exist
  - o Even if a spanning tree exists for S, the MST for S may not be a minimal Steiner tree.
    - oWhy?

## STEINER TREES

- Vertices in V \ S that are used in constructing a Steiner tree for S are referred to as Steiner vertices.
- No known polynomial time algorithm exists for solving the Minimal Steiner Tree problem:
  - Special case: a constant number of Steiner vertices are given.
    - i.e. Given G= (V,E,w), a subset S of V, a subset T of V-S, such that |T|=k, k is a constant,
    - find a tree of minimum total weight that connects all nodes in S but may include any vertex in S U T.

# MINIMUM STEINER TREES

#### • Exercise:

- Provide an intuitive explanation of why the
  - o <u>Minimum Steiner Tree</u> problem is harder to solve than the <u>Minimum Spanning Tree</u> problem.
- Write an algorithm for the special case in the previous slide.
  - Analyze the algorithm for time complexity.