CS-270: Algorithms **Lab classes - Week 6+7** Dr Oliver Kullmann

1 General remarks

This week is about

- graphs (no digraphs this time – first the easier stuff)
- connected graphs and trees

2 Constructing graphs

Recall a graph has *vertices* and *edges*, connecting (exactly) two vertices. In a *connected graph* from every vertex one can reach every other vertex by some path (which uses the edges). The *connected components* of a graph are the maximal vertex-subsets, so that any two vertices in the subset are connected by a path. So a graph G is connected iff G has at most one connected component.

Q1 Find a connected graph with 10 vertices and 9 edges.

Q2 Find a graph with (exactly) two connected components, 6 vertices and the maximal number of edges.

Q3 Find a graph with (exactly) two connected components, 8 edges and the maximal number of vertices.

Q4 Is there a graph with 5 vertices and five connected components?

Q5 How many connected components has the empty graph (no vertices)?

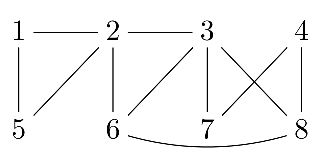
Q6 Is the empty graph connected?

Q7 Find a graph with 6 vertices, which does not contain a triangle (three vertices with all three edges between them), and which has the maximal number of edges.

3 Spanning trees

Q8 How does a BFS-spanning tree of a K_n look like?

Q9 Compute *the* BFS-spanning-tree for the graph G and start vertex $s = 2$, given as follows:



Uniqueness of the spanning tree is achieved by following *numerical order* (smallest first), if there is a choice between vertices.

Q10 Obtain graph G' from G by adding the edge $\{3, 4\}$. Is the above spanning tree still a BFS-spanning-tree for G'? If not, why not? And show the new BFS-spanning-tree for G' (again, following numerical order).

Q11 Can you find an edge which can be added to G, such that the tree from Q9 remains a BFS-spanning-tree?

4 Looking at graphs

Consider Graph gallery (can be found by search for “gallery of graphs”):

Q12 Identify the two graph classes we already considered.

Q13 Find your favourite graph.