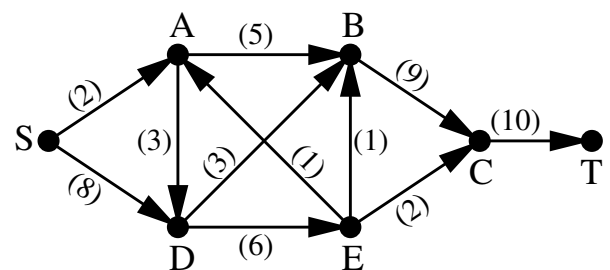


- The simple graph G on 14 vertices is constructed from two (vertex-disjoint) paths, one on 6 the other on 8 vertices in such a way that we connect each vertex of one path with every vertex of the other path. What is the length of a shortest walk in G that contains each edge of G (at least once)? (The length of a walk is the number of its edges.)
- The vertex set of the simple, undirected graph G is $V(G) = \{a, b, c, d, e, f, g\}$. We ran the BFS algorithm on G starting from vertex a , and we obtained the following list for the predecessors (or parents) for the vertices:

v	:	a	b	c	d	e	f	g
$p(v)$:	*	a	a	b	c	c	f

- What is $dist(g)$, i.e. the distance of g from a ?
 - What is the degree of a in G ?
 - What is the degree of g in G , if the BFS algorithm visited the vertices in alphabetic order?
- The simple graph G on 12 vertices is constructed from two (vertex-disjoint) cycles, one on 5 the other on 7 vertices in such a way that we connect each vertex of one cycle with every vertex of the other cycle. Determine $\chi(G)$, the chromatic number of G , and $\omega(G)$, the clique number of G .
 - The simple graph G on 14 vertices is constructed from two cycles on the vertices $\{a_1, a_2, \dots, a_7\}$ and $\{b_1, b_2, \dots, b_7\}$, respectively, and 7 more edges $\{a_i, b_i\}$, $i = 1, 2, \dots, 7$. Determine $\chi_e(G)$, the edge-chromatic number of G .

- Determine a minimum S, T -cut in the network on the right.
 - We change the capacity of the edge (C, T) to p , where p is a parameter. Determine a minimum S, T -cut in the network obtained for all $p \geq 0$.



- * Show that $\chi(\overline{G}) \leq \rho(G)$ holds for all simple graphs G without isolated vertices. (Here $\chi(\overline{G})$ is the chromatic number of the complement of G , and $\rho(G)$ is the size of a minimum edge cover in G .)

Please work on stapled sheets only, including drafts, and submit all of them at the end of the midterm.

Write your name on every sheet you work on, and write your Neptun code and the name of your practice instructor (according to neptun) on the first page.

The details of the solutions must be explained; giving the result only is not worth any points. Notes, calculators or any additional devices cannot be used.

You have 90 minutes to work on the problems. Each of them is worth 10 points. The problem marked with an * is supposed to be more difficult. To obtain a signature you have to achieve at least 24 points.