Foundation of Computer Science 1

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Revision 3
December 9, 2009

Problem 1.

(1.1) Let $a, b, c, d, e, f, x, y, z, w \in \mathbb{N}$. For each of the expressions

(i) $(x + y) * (x - 3)$

(ii) $((x - y) * z + (y - w)) * x$

(ii) $\Big(\big(((a * x + b) * x + c) * x + d \big) * x + e \Big) * x + f$

do the following:

(a) Construct the syntax tree;

(b) Find the equivalent prefix notation;

(c) Find the equivalent postfix notation.

(1.2) Let $a, b, c, d, e, f \in \mathbb{N}$. Convert the expression $abc * +def + -*$ from postfix to

(a) infix;

(b) prefix.

Problem 2.

(2.1) Consider the graph given by the adjacency matrix:

	1	2	3	4	5	6	7
1	0	1	0	1	1	0	0
2	1	0	1	0	1	1	1
3	0	1	0	0	1	1	1
4	1	0	0	0	1	1	0
5	1	1	1	1	0	1	1
6	0	1	1	1	1	0	1
7	0	1	1	0	1	1	0

(a) What is the degree of node 7?

(b) Find a 5-clique in the graph, and list the set of nodes defining this 5-clique!

(2.2) Hamilton and Euler went to holiday. They visited a country with 7 cities (nodes) connected by a system of roads (edges) described by the graph given in the following adjacency matrix:

	1	2	3	4	5	6	7
1	0	1	0	1	0	0	0
2	1	0	1	1	1	0	0
3	0	1	0	0	1	1	0
4	1	1	0	0	1	0	0
5	0	1	1	1	0	1	1
6	0	0	1	0	1	0	1
7	0	0	0	0	1	1	0

(a) Could Hamilton visit each city once and return to his starting city? If yes, list the path defining the corresponding hamiltonian cycle!

(b) Could Euler visit each road once? If yes, give the path defining the corresponding eulerian path!

Problem 3. Estimate the upper bounds of the following functions in $n \in \mathbb{N}$. Your estimations should be as tight as possible!

(3.1) $n + \log n$;

(3.2) $(2 * n^2) * 2^n$;

(3.3) $\log(3 * n^2)$ with $n > 0$;

(3.4) $\mathrm{ld}(3 * n^2 - 1)$ with $n > 0$;

(3.5) $\frac{n*(n+1)}{2} + 3 * n$;

(3.6) $O(f)^3 + O(g) * O(h)$, where f, g, h are functions in $n \in \mathbb{N}$;

(3.7) $2 * O(f) + O(g)$, where f, g are functions in $n \in \mathbb{N}$.

Justify your answer!