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ΣΕΜΙΝΑΡΙΟ ΛΟΓΙΚΗΣ ΚΑΙ ΑΛΓΟΡΙΘΜΩΝ

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Θέμα: Horner's rule is optimal for Polynomial 0- testing

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Περίληψη

The value

$$V_{F,n}(a_0, \dots, a_n, x) = a_0 + a_1 x + a_2 x^2 + \cdots + a_n x^n$$

of a polynomial of degree $n > 0$ over a field F can be computed by Horner's rule using no more than n multiplications and n additions in F, and it is optimal (for many fields, including the reals and the complexes) by a classical result of Pan. I will describe Horner's rule and prove in outline that it is similarly optimal for *polynomial 0-testing*, the decision problem for the relation

$$N_{F,n}(a_0, \dots, a_n, x) \iff a_0 + a_1 x + a_2 x^2 + \cdots + a_n x^n = 0.$$

The result holds for all usual computation models and (arguably) for all algorithms which decide $N_{F,n}(a_0, \dots, a_n, x)$ from the field primitives $0, 1, +, -, \cdot, \div$ and $=$.

The classical methods of Pan (and Winograd) cannot be used to derive lower bounds for decision problems. I will use the *embedding method* which grounds the derivation of lower bounds (especially) for decision problems on three simple axioms that hold of all computation models and (arguably) for all algorithms from specified primitives. This is a method of proof on which I have spoken in the MPLA Seminar before, more recently last year; I will outline it very briefly and concentrate on the algebraic facts which justify its application to the problems of polynomial evaluation and 0-testing.