Floating-Point Evaluation of Polynomials

The goal of this post-doc is to develop formal proofs about the evaluation of a polynomial. In passing from a polynomial approximation to numerical values, we have to evaluate polynomials numerically. This is a known problem with a lot of literature. Nevertheless, this is a critical issue and formal proofs will help us in designing and implementing prototype libraries and applying our results to concrete problems originating in optimal control theory.

The bounds will be loose in certain cases, the study will continue with the study of compensated algorithms, that are both more costly and more accurate. It is not yet known how to obtain faithful rounding (i.e., the computed result is one of the two adjacent floating-point numbers surrounding the exact result) for polynomial evaluation. Formal proofs of the previous results will help us in studying this problem and design such an algorithm with hopefully a moderate overhead compared to the classic Horner scheme. This may be inspired by recent work for the computation of the Euclidean norm of a vector. Another direction of extension is the computation of rounding to the nearest floating-point number, which is important in order to get a reproducible result even if the computations are performed in parallel.

The formal proofs will be in Coq, and will rely on the Flocq library developed inside the team.

References:
Principales activités
Main activities:
- Study the state of the art of floating-point polynomial evaluation
- Develop formal proofs of these results
- Generalize these results to get tighter bounds and/or handle exceptional behavior
- Write reports and submit research articles

Compétences
The topic of the post-doc is at the intersection of two different research fields. The candidate should therefore have a PhD thesis in the domain of either formal methods (with a basic knowledge of an interactive prover such as Coq, Isabelle, or PVS) or floating-point arithmetic. An interest in the other topic is expected.

Avantages sociaux
- Subsidised catering service
- Partially-reimbursed public transport
- Social security
- Paid leave
- Flexible working hours
- Sports facilities

Rémunération
Monthly gross salary: 2.653 euros