Is Formalizing Semifield Duality Worth it?

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Abstract. Motivated by years of frustration in teaching EE students
an improper duality, we explore whether it is worth to require of them
the extra effort of learning the formalization of series-parallel duality
operators for electrical circuit analysis. For that purpose we revisit the
Series-Parallel algebra proposed by Ellerman which is an instance of the
semifield duality found in the positive reals and already formalized by
Moreau for convex analysis. We complete and present this duality in
the larger context of positive semifields and explore it for the related
application of formalizing flows in networks, that is, weighted, directed
graphs. Ultimately, our interest lies in idempotent semifields, e.g. the
tropical and polar algebras, and how they could help us formalize and
model information flows in neural networks, both natural and artificial—
in work that heeds back that of Tishby and colleagues.