

## ON THE UNAVOIDABILITY OF PRIMITIVE WORDS AND OTHER LANGUAGES

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### ABSTRACT

Most of the well-known language classes contain very different languages that often have no words at all in common. Therefore it might seem improbable at first sight, that there could be a language non-trivially sharing infinitely many words with each of the individual languages. Non-trivially here means, that the language itself has infinite complement so that there do exist infinite languages that have empty intersection with it.

We formalize this idea of being unavoidable. Then we fill the concept with life by providing examples of languages that are unavoidable for classes of regular, context-free and context-sensitive languages. Primitive words play a central role in many of these examples.

*Keywords:* primitive words, context-free languages, unavoidability

### 1. The Language of Primitive Words

When one considers the scientific lifetime achievements of Masami Ito and Pál Dömösi in Theoretical Informatics, there is one topic that is absolutely unavoidable: primitive words. In 1991, together with Sándor Horváth, they first raised the question whether the language  $Q$  of all primitive words is context-free or not [5]. To this day, 28 years later, this question remains unanswered. The reason for this is not at all a lack of interest of the community. Many researchers have spent a great deal of time on intents to solve this problem. Some of these efforts have led to partial or related results. While many of the results are compiled in the book authored by Masami Ito and Pál Dömösi [6], we still give an overview of relevant work to situate the research presented here.

So far, it is only known for smaller language classes like the regular and linear ones, as well as the deterministic and the unambiguous context-free ones that they cannot contain the language of all primitive words [14, 4, 25]. On the other hand, it is straight-forward to see that the language of primitive words is context-sensitive. Mainly the relation to the class of context-free languages remains unclear.