

# Rough PDA, Rough CFG and Its Application to Healthcare Systems

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**Abstract.** The present work proposes a new computational model, Rough Pushdown Automata (R-PDA), which is an extension of Pushdown Automata, amalgamating Rough Set Theory. The proposed R-PDA model can deal with imprecise and uncertain data. Our work demonstrates the effectiveness of R-PDA in decision-making under uncertain conditions. Alongside the R-PDA, we further developed the concept of rough context-free grammar (R-CFG) and proved its equivalence to R-PDA. That is, for every R-PDA, there is an R-CFG that generates the same language accepted by the R-PDA, and vice versa. Some closure properties of R-CFG are also established to demonstrate the efficacy of the proposed model mathematically. The proposed R-PDA model has potential applications in various domains where uncertainty and incompleteness are common, thereby contributing to the development of more accurate and efficient decision support systems. The research provides insights into the use of rough set theory in automata theory and its potential strength in solving real-world problems. In this era of technological advancement, coping with uncertainty is more crucial than ever. The medical domain is no exception. The proposed R-PDA model integrates the intuition and logic of a medical practitioner to aid decision-making under uncertain conditions for patients and the surrounding environment. The efficacy of the proposed R-PDA model is demonstrated through a case study on the treatment of asthma, one of the most common chronic diseases worldwide. Although Rough FSA has already been proposed in the literature, the concept of R-PDA appears to be novel. Moreover, the application of Automata theory is rarely discussed in the healthcare system. The proposed model helps bridge this gap effectively.

**Keywords:** Rough Sets, Pushdown Automata, Context Free Grammar, Healthcare Systems.