INTERACTIVE STORYTELLING WITH AUTOMATA, TRANSDUCERS, AND CONTEXT-INDEPENDENT GRAMMARS

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Introduction

The theory of formal languages and automata, along with the power of grammars, are fundamental pillars in computer science and informatics. These concepts play an essential role in the creation of programming languages, natural language processing and a wide range of technological applications. In this context, this poster focuses on an exciting educational and interactive challenge that explores three key areas: finite automata, transducers, and context-independent grammars (CIGs), all applied in the context of a captivating narrative.

Objectives

General Objective:

- To understand and apply the concepts and tools of **formal language and automata theory** in the context of **Python** with **Pyformlang**, in order to solve computational problems and develop **Domain-Specific Languages (DSLs)** effectively.

Specific Objectives:

- Understand the fundamental concepts of different **finite automata**, **transducers**, **grammars and regular expressions** in an **interactive environment**.
- Experiment with the equivalence between **regular expressions** and **finite automata** in a **text processing context**.
- Apply these concepts to **verify**, **modify and validate** names in a story, using **Python** with the **Pyformlang** library as the main tool.
- Explore the importance of **normal forms and linguistic ambiguity** in the definition of **grammars** and their impact on the creation of **domain-specific languages (DSLs)**.

Methodology

First, we will see a definition of the concepts covered in this project, then the methodology of use of the concepts in the project.

- **Automata:**

Automata are mathematical devices that model the behavior of abstract machines capable of processing information and making decisions.

- **Transducers:**

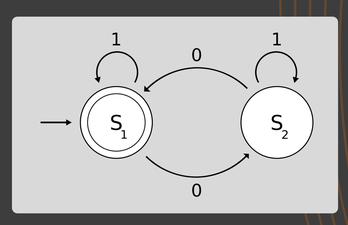
Transducers are devices that transform or translate an input sequence into an output sequence following predefined rules.

- **Grammars:**

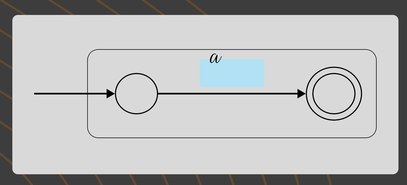
Grammars are formal systems that describe the syntactic structure of a language by means of production rules.

- **Regular language:**

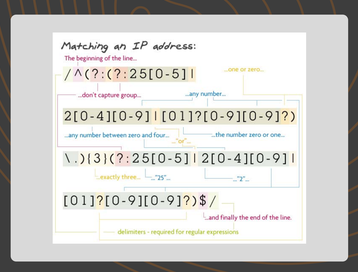
A regular language is a set of text strings that can be recognized by a regular expression or a finite automaton. Regular languages are used to describe simple patterns in text.



Automata



Transducers



Regular Expressions

The methodology we will follow to carry out this project is based on the requirement of using automata, transducers, context independent grammars (CIG) and regular languages in Python with Pyformlang.

As inputs to this project we will have the user who will interact with the story, the options chosen by the user in the story, and a new name for a character if desired. For the design of the automata, the story was written first, and then options were given to give different paths to the same story, these chosen from a number. The regular expressions validate in the input of the names, a pattern was determined (^[a-zA-Z]+ [a-zA-Z]+$) such that only upper and lower case letters and no numbers are allowed. In the transducers it was designed that with the user name typed at the beginning, the user would be the one to appear in the story, but also with the possibility of changing it in the middle of the story. The GIC was designed to receive the user's interaction with the special events in the story. In addition to this, we test each method used to check which cases it should and should not accept.

Results

As a result we saw how automata, context-independent grammars, regular languages and transducers are applied in a given context. We understood their operation for concrete cases and the approach and union of them to solve this exercise. Checking its operation we have the following images:

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¡Bienvenido a la Historia Interactiva!
Por favor, ingresa tu nombre: juan8
Por favor, ingresa un nombre válido.
¡Bienvenido a la Historia Interactiva!
Por favor, ingresa tu nombre: juan
Comencemos, juan.

juan llego cansado del trabajo y solo quiere descansar. Prende la television y ve que estan presentando algo sobre zombies, ¿que hace?
0: juan empieza a llamar a todos sus conocidos para verificar si lo que esta pasando es real.
1: juan se queda sentado pensando que es una pelicula.
3: Cambiar nombre de usuario
Elija un número para avanzar (o 'q' para salir): 1


0: A juan le parece raro que la pelicula siga siendo mas una noticia que entretenimiento.
1: juan decide pedir una pizza por domicilio como cena.
3: Cambiar nombre de usuario
Elija un número para avanzar (o 'q' para salir): 3
Por favor, ingresa un nuevo nombre: juan duque


0: A juan duque le parece raro que la pelicula siga siendo mas una noticia que entretenimiento.
1: juan duque decide pedir una pizza por domicilio como cena.
3: Cambiar nombre de usuario
Elija un número para avanzar (o 'q' para salir): 1


0: Llega la pizza, juan duque abre la puerta para recibirla, y resulta ser un zombie. ¡juan duque ESTA MUERTO!
3: Cambiar nombre de usuario
Elija un número para avanzar (o 'q' para salir): 0


Lo siento, HAZ MUERTO
```

Pruebas	**Cadena de Entrada**	**Resultado Esperado**
test_accepts	"Juan Perez"	True
test_accepts	"Juan Duque"	True
test_accepts	"Gabriel"	True
test_no_accepts	"Alice_Doe"	False
test_no_accepts	"user_name 123"	False
test_no_accepts	"MarieCurie 9"	False

Conclusion

The operation of automata, context-independent grammars and regular expressions applied to a specific context was understood. We verified, modified and validated the names entered by the user in each part of the story. The realization of this exercise serves to understand how to apply automata, GIC and regular languages in a specific context, in addition to linking their functionalities for greater scalability and completeness of a software.