Syntax highlighter

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TC2037 - Computers methods implementation

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Summary

In this project, I'm to create a code processor capable of reading Elixir code files and converting them into HTML files. The purpose of this transformation is to provide a syntax-highlighted representation of the Elixir code for better readability and presentation in a web browser based on different types of reserved words and tokens.

Lexical categories

Based on the elixir language the used categories are:

- Reserved words
  - defmodule, defp, def, do, end, false, true, cond, case, if, else, nil.
  - `~r/^(defmodule|defp|def|do|end|false|true|cond|case|when|if|else|nil)(?=\s)/`
- Functions
  - every word started in lowercase followed by a opening parenthesis.
  - `~r/^[a-z]\w*(\!+)?(?=\()/`
- Unused variables
  - this variables are the ones that exists in a function but is not called
  - `~r/^\_[a-z]\w*(\d)*?(\:+)?/`
- Variables
  - every word started in lowercase
  - `~r/^[a-z]\w*(\d)*?(\:+)?/`
- Comments

    - everything after a "#" symbol
    - `~r/^\#.*/`
- Modules
    - every word started with uppercase
    - `~r/^[A-Z]\w*(\d)*?/`
- Attributes
    - This are based on the attributes of a module
    - `~r/^\@\w*/`
- String
    - everything inside quote symbols
    - `~r/^\".*\"/`
- Numbers
    - every number
    - `~r/^\d+(\.\d+)?/`
- Operators
    - +, -, *, /, =, ==, ===, !=, ., ,, |>, ->, &, <>, <, and >.
    - `~r/^(\+|\-|\*|\/|\=|\==|\===|\!=|\.|\,|\|>|\->|\&|\<>|\<|\>)/`
- Atoms
    - every *single* word after a ":"
    - `~r/^\:\w+(\d)*?/`
- Containers
    - (,), {, }, [,]
    - `~r/^[\(\)\{\}\[\]]/`
- Regular expression
    - based on the regular expression syntax wrote between "r~/" and "/"
    - `~r/^\~r.+\//`
- Spaces
    - captures single spaces and tabs
    - `~r/^\s/`

Code reasoning

To use this code correctly you'll need to move the your elixir file to the same direction. For organization purposes you'll need to move you to read file to the folder called "ToReadElixirFiles", but when calling the function DO NOT write the folder direction, the program all ready knows here to find your file, call the function "convert_file" this way `Project.convert_file("file_name.ex")` or `Project.convert_file("file_name.exs")`. If you followed the previews steps you'll find in your terminal an ":ok" message, and you can find your new html file in the "HTML_Results" folder.

What this does it that it will create a new html file based on the name of the file your are sending, then it will write the opening structure of HTML architecture, then it'll read line by line the code elixir code you sent.

On the other hand, we have `Project.convert_folder_parallel("ToReadElixirFiles")`. This function reads all the files inside this directory using threads to speed up the process. There is also `Project.convert_folder("ToReadElixirFiles")`, which serves the same purpose but does not use threads, processing the files in the normal way

To achieve our program to read line by line the file provided by the user, I used the `File.stream!()` function. Followed by a `Enum.map()` function that helps the program to implement the token rules to each line. This map will call the menu function `find_coincidences()` which leads as its name says, to find the coincidences with the regular expression rules.

`find_coincidences()` first call is to find if the first word of the sentence is a reserved word, if not it will skip to the next function which searches if the first word is a function, if not it will skip to the next function, and so on with the other categories mentioned before.

In case of having a match depending on the rule, it'll save the hole coincidence in a list of lists called *result* in this way `[["token","match"],["token","match]]`. Each function has each's own token depending on what we match with. After saving the match will divide the sentence by the length of the coincidence, so the start of the sentence updates an we can do the process again to find the coincidences with the rest.

After gathering all coincidences, the program will write the results in the html template with the function `write_results()` . The template this function use is `match. In case that the token is a space it will just write a space and not the hole template.

Reflexion

This situation is crucial to understand and implement the use of regular expression comparisons, using this algorithm in which each rule is divided by names of what it do makes it easy to read and understand to third parties. However this can make the BigO complexity a little high, but this will depends on the size of the line and file, and how many functions it need to hop in to find the coincidence, this can make waiting time longer, but will detail more of the BigO complexity later on.

But in short words, execution time is not slow, thanks to the elixir functions such as `Enum.map()`

BigO complexity

Understanding how the code works we can say that depending on how many lines the file has and how long the lines in the script is, therefore the BigO complexity is approximately $O_{(C \times L)}$ where C is the number of coincidences and L is the number of lines in the file.

Ethical implications

The development of advanced code processing tools offers significant benefits in terms of efficiency and accuracy, but it also comes with a set of ethical responsibilities. It is crucial for developers to carefully consider these implications and work to mitigate potential risks, ensuring that their technology is used safely, fairly, and responsibly for the benefit of society as a whole.

Some unethical usage could be using this technology to find sensitive information like names, directions, date births, phone numbers, mails or passwords of people who hasn't given you their concent.

Alternative Tools

As mentioned before, we used threading to optimize the program's performance. This technique divides the program into smaller tasks that run concurrently on different CPU cores. Each thread processes a specific file, distributing the workload efficiently and maximizing system resource usage.

Threading is particularly useful for intensive I/O operations, such as reading and converting multiple code files to HTML. By allowing multiple threads to work simultaneously, we can significantly reduce the total processing time. Instead of sequentially processing files, threading enables multiple files to be processed at once, speeding up the overall process.

Additionally, using threads improves efficiency in multi-core environments. Each available core is assigned to a thread handling a file, ensuring effective utilization of all system resources. This not only boosts the program's performance but also enhances scalability, as adding more cores can further increase processing speed.

Comparison

Using our function `Project.calc_time("function")`, we measured the time in seconds that our program takes to process files in a folder using the lexer. With a folder containing 8 files, the function using threads has an average completion time of 1.5 seconds. This is a noticeable improvement compared to the function that doesn't use threads, which takes an average of 5.5 seconds. The significant difference in performance highlights the efficiency of threading in speeding up the processing time.

New technologies

The appearance of new technologies varies greatly across different areas, driven by the unique demands and innovations within each field.

New tools and frameworks appear frequently, often driven by the need for more efficient coding practices, better performance, and enhanced user experiences, just as we did by using more cores that our computer has to make the program faster. Tech industry is constantly evolving, with new front-end and back-end technologies, frameworks, and tools appearing frequently. This rapid pace is driven by the need for responsive, user-friendly web applications and the constant push for better performance and security.

Final reflexion

This new technology is helpful for everyone since, as mentioned before, it is more user-friendly and developer-friendly. It allows programs to run faster and makes development easier in many ways.

For users, new technologies often translate into more intuitive and responsive interfaces. For example, modern web development frameworks like React and Angular enable the creation of dynamic and interactive web applications that enhance user engagement and satisfaction.

For developers, these technologies provide powerful tools and libraries that simplify complex tasks. For instance, multithreading libraries and frameworks enable developers to write concurrent and parallel code more easily, improving the performance of applications and reducing development time.

In conclution, new technologies provide significant benefits by improving user experience, streamlining development processes, enhancing performance, and facilitating the maintenance and scalability of applications. These advancements contribute to creating more robust, efficient, and user-friendly software solutions.