Regex

“Women and children can be careless, not men”
- Mario Puzo, The Godfather

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Outline

1. Regex Language
    - Group
    - Anchor
    - Shorthand Class
    - …
2. Practices
3. Regex Engine
    - How Regex Engine Works
    - Best Practices

1. Regex Language

1.1. Introduction

- Regular expression (regex) is **powerful tool for pattern matching within strings**.
- Use cases:
  - Data validation
  - Search operations
  - Parsing
  - Text manipulation
- **Each language has its own regex engine** and they are not the same at all
  - Regex is like a interface
  - Regex engine is like a implementation

1.2. Matches

- Input:
  - String
  - Regular Expression (Regex)
- Output:
  - Match(es)

Example: https://regex101.com/r/nAIn2B/1

1.3. Group

- Grouping part of regex
- Use **(...)** to group
- To name the group: (?<group_name>expression)

Example: https://regex101.com/r/FiNWUT/1

1.4. Alternation

- Match a single regular expression out of several possible regular expressions
- Use | to separate alternatives

Example: https://regex101.com/r/PXkj2Q/1

1.5. Optional Item

- Regex: a|b|c = **[abc]**
- Range: [a-z], [0-9], [a-zA-Z0-9]

Example: https://regex101.com/r/3wx3UI/1

1.6. Negation

- A character not in the range
- Syntax: **[^...]**

Example: https://regex101.com/r/LjCGqB/1

1.7. Anchors

- **^**: Start of line
  - Ex: https://regex101.com/r/nPuQHa/2
- **$**: End of line
  - Ex: https://regex101.com/r/U0MT13/1
- **\b**: Word boundary
  - Ex: https://regex101.com/r/HCgJVG/1

1.8. Shorthand Class

- **\d**: any digit. = [0-9]
- **\w**: any word character. = [A-Za-z0-9_]
- **\s**: any whitespace character. = [\t\r\n\f]
- **.**: any single character
- \: escape special characters. Ex: [a-z\.]

1.9. Quantifier

- *: zero or more. https://regex101.com/r/74iagP/1
- **+**: one or more. https://regex101.com/r/eP7ASu/1
- **?**: zero or one. https://regex101.com/r/1IvdIG/1
- **{n}**: Exactly n times. https://regex101.com/r/6bwjm3/1
- **{n,}**: At least n times. https://regex101.com/r/nxTa4l/1
- **{n, m}**: From n to m times. https://regex101.com/r/pdXCE2/1

1.10. Flags

- **g** (global): returns all matches, do not return after first match
- **i** (insensitive): regex is case sensitive by default
- **m** (multi line): scan on multiple lines

Example: https://regex101.com/r/Rjl8tu/2

2. Practices

2.0. Practices

- https://regex101.com/
- Cheat Sheets: https://cheatography.com/davechild/cheat-sheets/regular-expressions/
- Google for solutions
- Note:
  - Choose the regex engine of javascript
  - The regex engine of Java works not well
  - **If regex on regex101 does not work, then try it on real code**

2.1. Exercise 1: Image File Names

- Find names of image files
- Ex: https://regex101.com/r/mzxKHU/2

2.2. Exercise 2: Number

- Find numbers
- Ex: https://regex101.com/r/cO5Bsk/3

2.3. Exercise 3: Emails

- Validate email
- Ex: https://regex101.com/r/KSnBDi/1

2.4. Exercise 4: Network Configuration

- Extract network configurations
- Ex: https://regex101.com/r/ubTXiV/1

2.5. Case Study 1: Transform logs into CSV

- Ex: https://regex101.com/r/OxMoHy/1
- Requirement:
  - Extract voucher info only
  - Format: CSV
  - Output example: 2023-09-12T13:23:48.796+07:00, U56, V12
- Use VScode

2.6. Challenge

- Ex: https://regex101.com/r/Tcgfo2/1
- Match Passport Number Only
- **Passport number and citizen id is the same pattern**
- Allow to google
- Not allow to ask ChatGPT
- Hint: Apply an operation that is not taught yet

2.6. Look around

- Look ahead: what is coming up next without consuming the characters
  - Example: https://regex101.com/r/fBhwIN/1
- Look behind: what came before current character
- IF condition THEN expression

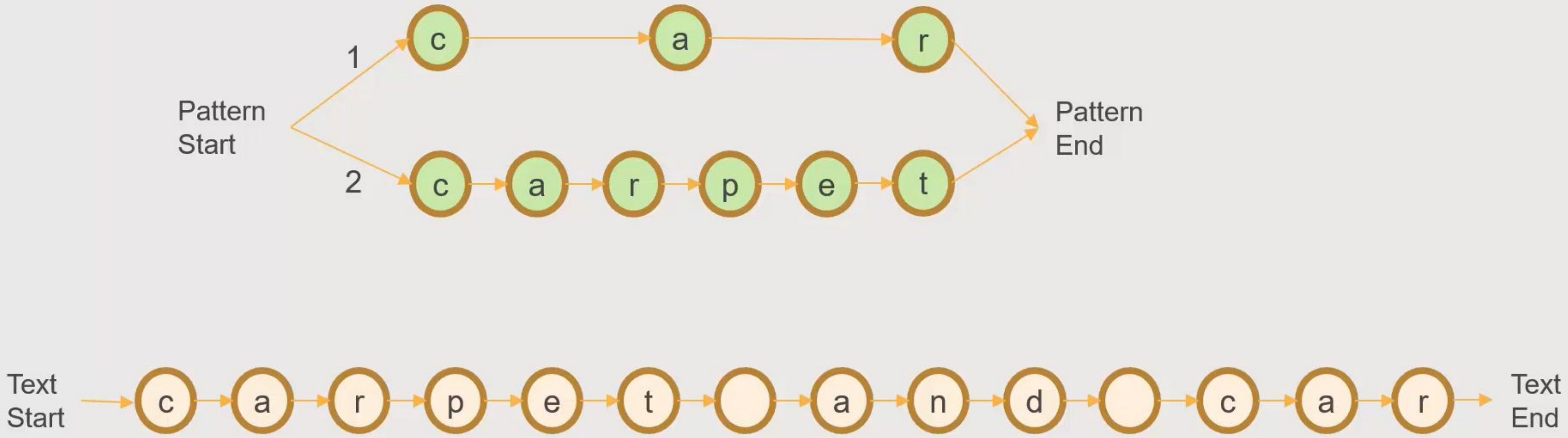
3. Regex Engine

3.1. Regex Engine

- **One character at a time**
- **Left to right**
  - Regex Engine use backtracking to evaluate other paths
- Greedy
  - Quantifier *, + are greedy. They try to match as much of input text as possible
- Lazy
  - Lazy matches as few times as possible and attempts to match rest of patterns
  - Turn to lazy by adding ? after the quantifier (*?, +?)

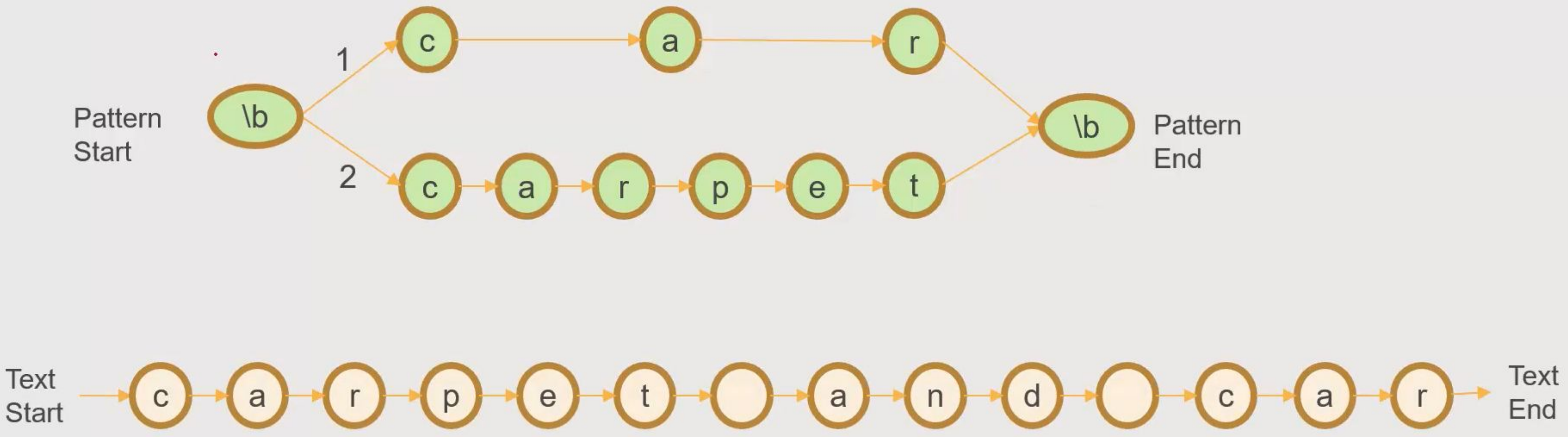
3.2.1. Regex Engine / Left to Right

```
Problem: Find all matches for the words - car, carpet
Pattern: car|carpet
Text: carpet and car
```



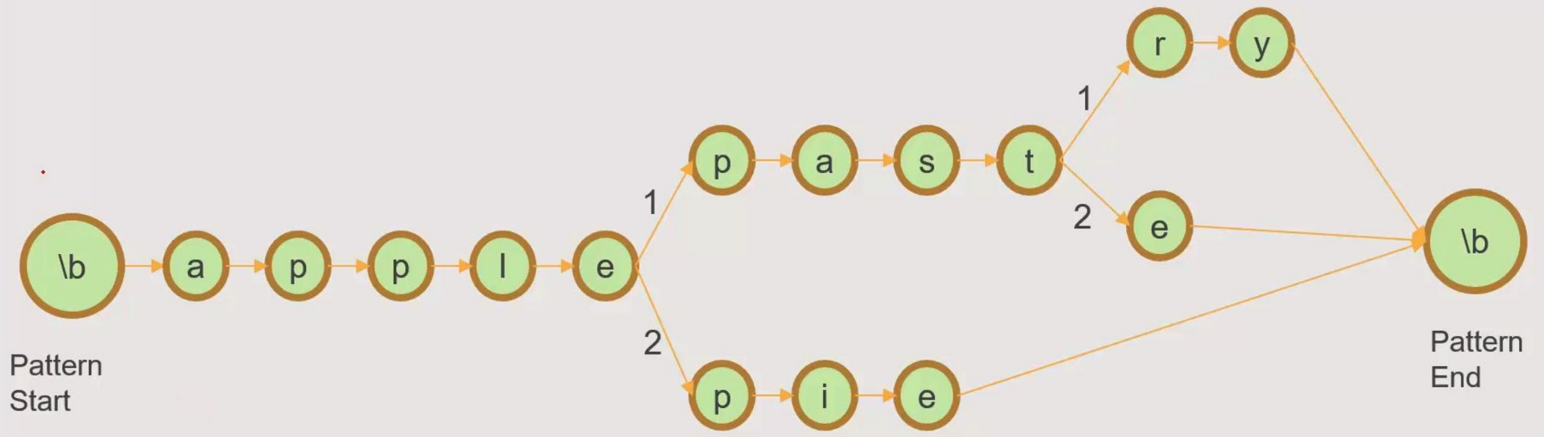
3.2.2. Regex Engine / Left to Right

```
Problem: Find all matches for the words - car, carpet
Pattern: \b(car|carpet)\b
Text: carpet and car
```



3.3. Regex Engine / Backtracking

```
Problem: Find all matches for applepastry, applepaste or applepie
Pattern: \bapple(past(ry|e)|pie)\b
```



```
Text: Twenty popular recipes to make applepaste
Popular applepie recipe
```

3.4. Best Practices

- **Compile regular expressions once**
- Avoid Making Everything Optional. It is more important to **consider what it should not match**, than what it should
- Use The ***, +** Sparingly (greedy). The regex also matches in cases where it should not match.
- Leverage lazy processing **+?**
- Use Negated Character Classes Instead of the Dot
- Group capture is expensive → non-capturing group **(?:)**
- Avoid exponential. Ex: ^(\w*)*$
- Add a timeout to against unexpected scenarios (if possible)

Read more

- Regex Engine:
  - Greedy
  - Lazy
- Lookaround (Lookahead & Lookbehind)

Recap

- Syntax
- How regex engine work
- Practices
    - Start with small regex

References

- Tutorial:
  - https://www.youtube.com/watch?v=sa-TUpSx1JA
  - https://github.com/ziishaned/learn-regex
- Practices:
  - https://regex101.com/
  - https://cheatography.com/davechild/cheat-sheets/regular-expressions/
- Document:
  - https://www.regular-expressions.info/
- Performance:
  - http://www.javapractices.com/topic/TopicAction.do?Id=104
  - https://www.baeldung.com/java-regex-performance

Homework

1. Game

https://regex101.com/quiz/1
https://regex101.com/quiz/3
https://regex101.com/quiz/6
https://regex101.com/quiz/12

2.

- Find duplicate lines
- Remove duplicate lines
- Remove duplicate lines and the original line

```
U123
U234
U452
U341
U123
U789
U1092
U109
U2342
U1092
U603
U745
```

Thank you 🙏

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