Programming on Python

Lecture 7

Regular expression

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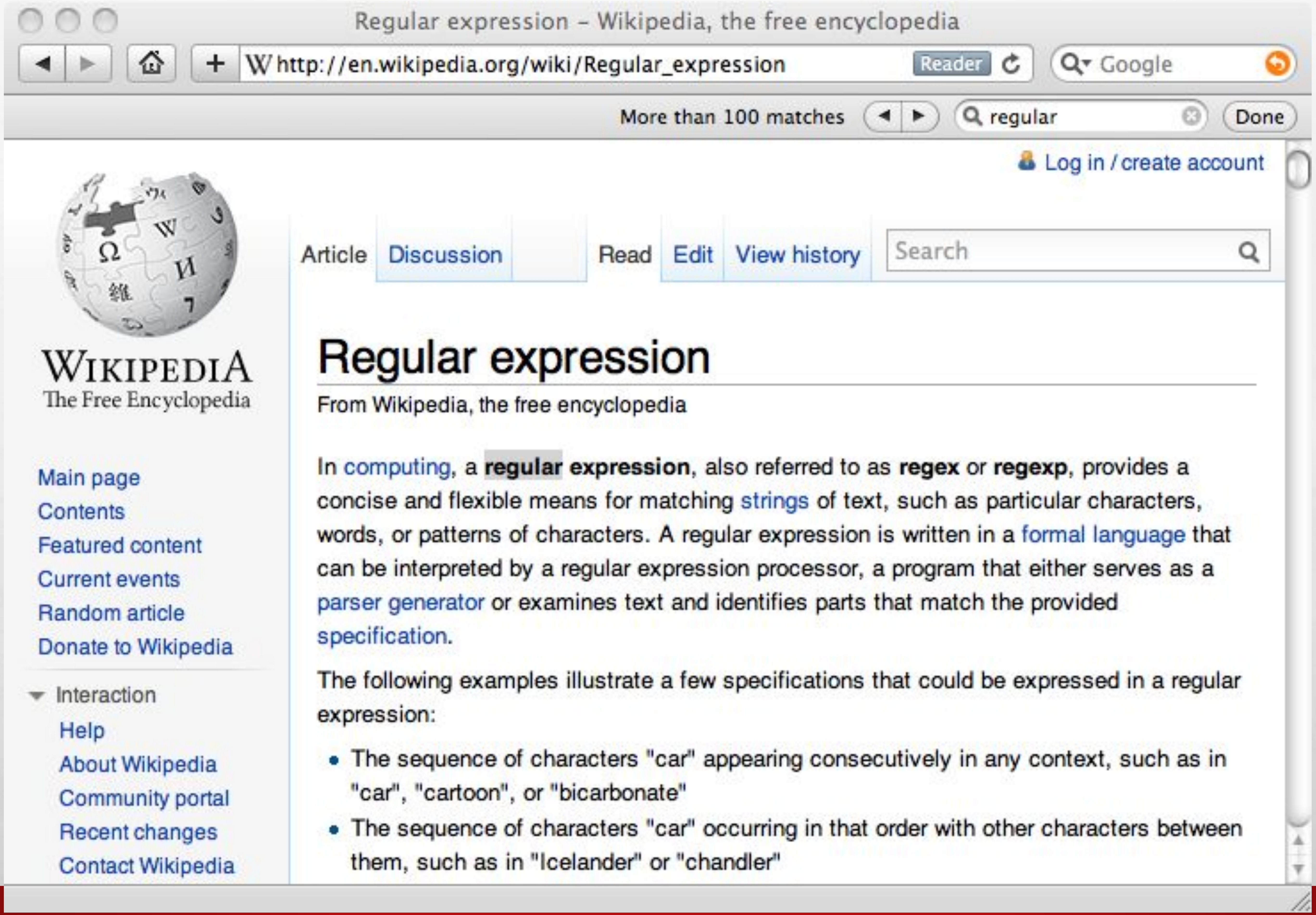
Regular Expression



Regular expression

From Wikipedia, the free encyclopedia

In computing, a **regular expression**, also referred to as **regex** or **regexp**, provides a concise and flexible means for matching strings of text, such as particular characters, words, or patterns of characters. A regular expression is written in a formal language that can be interpreted by a regular expression processor, a program that either serves as a parser generator or examines text and identifies parts that match the provided specification.

The following examples illustrate a few specifications that could be expressed in a regular expression:

- The sequence of characters "car" appearing consecutively in any context, such as in "car", "cartoon", or "bicarbonate"
- The sequence of characters "car" occurring in that order with other characters between them, such as in "Icelander" or "chandler"

WHAT IS A REGULAR EXPRESSION?

A **Reg**ular **Ex**pression (RegEx) is a sequence of characters that defines
a search pattern.
For example,

```
^a...s$
```

The above code defines a RegEx pattern.
The pattern is: **any five letter string starting with a and ending with s**.

A pattern defined using RegEx can be used to match against a string.

Expression	String	Matched?
	abs	No match
	alias	Match
^a...s$	abyss	Match
	Alias	No match
	An abacus	No match

Python has a module named **re** to work with RegEx. Here's an example:

```
import re
pattern = '^a...s$'
test_string = 'abyss'
result =
re.match(pattern,
test_string)

if result:
print("Search
successful.")
```

Here, we used **re.match()** function to search **pattern** within the **test_string**.
The method returns a match object if the search is successful. If not, it returns **None**.

THERE ARE OTHER SEVERAL FUNCTIONS DEFINED IN THE ***RE*** MODULE TO WORK WITH REGEX. BEFORE WE EXPLORE THAT, LET'S LEARN ABOUT REGULAR EXPRESSIONS.

SPECIFY PATTERN USING REGEX

To specify regular expressions, metacharacters are used.

In the previous example, ^ and $ are metacharacters.

METACHARACTERS

METACHARACTERS ARE CHARACTERS THAT ARE INTERPRETED IN A SPECIAL WAY BY A REGEX ENGINE. HERE'S A LIST OF METACHARACTERS:

[] . ^ $ * + ? {} () \ |

METACHARACTERS

[] - Square brackets

Square brackets specifies a set of characters you wish to match.

Expression	String	Matched?
[abc]	a	1 match
	ac	2 matches
	Hey Jude	No match
	abc de ca	5 matches

Here, **[abc]** will match if the string you are trying to match contains any of the **a**, **b** or **c**.

METACHARACTERS

You can also specify a range of characters using **-** inside square brackets.

- **[a-e]** is the same as **[abcde]**.
- **[1-4]** is the same as **[1234]**.
- **[0-39]** is the same as **[01239]**.

You can complement (invert) the character set by using caret **^** symbol at the start of a square-bracket.

- **[^abc]** means any character except **a** or **b** or **c**.
- **[^0-9]** means any non-digit character.

METACHARACTERS

. - Period

A period matches any single character (except newline **'\n'**).

Expression	String	Matched?
..	a	No match
	ac	1 match
	acd	1 match
	acde	2 matches (contains 4 characters)

METACHARACTERS

^ - Caret

The caret symbol ^ is used to check if a string **starts with** a certain character.

Expression	String	Matched?
^a	a	1 match
	abc	1 match
	bac	No match
^ab	abc	1 match
	acb	No match (starts with a but not followed by b)

METACHARACTERS

$ - Dollar

The dollar symbol **$** is used to check if a string **ends with** a certain character.

Expression	String	Matched?
	a	1 match
a$	formula	1 match
	cab	No match

METACHARACTERS

✱ - Star

The star symbol ✱ matches **zero or more occurrences** of the pattern left to it.

Expression	String	Matched?
ma*n	mn	1 match
	man	1 match
	maaan	1 match
	main	No match (a is not followed by n)
	woman	1 match

METACHARACTERS

+ - Plus

The plus symbol **+** matches **one or more occurrences** of the pattern left to it.

Expression	**String**	**Matched?**
	mn	No match (no a character)
	man	1 match
ma+n	maaan	1 match
	main	No match (a is not followed by n)
	woman	1 match

METACHARACTERS

? - Question Mark

The question mark symbol **?** matches **zero or one occurrence** of the pattern left to it.

Expression	String	Matched?
ma?n	mn	1 match
	man	1 match
	maaan	No match (more than one a character)
	main	No match (a is not followed by n)
	woman	1 match

METACHARACTERS

{} - **Braces**

Consider this code: **{n,m}**.

This means at least **n**, and at most **m** repetitions of the pattern left to it.

Expression	String	Matched?
	abc dat	No match
	abc daat	1 match (at daat)
a{2,3}	aabc daaat	2 matches (at aabc and daaat)
	aabc daaaat	2 matches (at aabc and daaaat)

METACHARACTERS

Let's try one more example. This RegEx **[0-9]{2, 4}** matches at least 2 digits but not more than 4 digits

Expression	String	Matched?
[0-9]{2,4}	ab123csde	1 match (match at ab<u>123</u>csde)
	12 and 345673	3 matches (<u>12</u>, <u>3456</u>, <u>73</u>)
	1 and 2	No match

METACHARACTERS

| - Alternation

Vertical bar **|** is used for alternation (**or** operator).

Expression	String	Matched?
a|b	cde	No match
	ade	1 match (match at ade)
	acdbea	3 matches (at acdbea)

Here, **a|b** match any string that contains either **a** or **b**

METACHARACTERS

() - **Group**

Parentheses **()** is used to group sub-patterns. For example, **(a|b|c)xz** match any string that
matches either **a** or **b** or **c** followed by **xz**

Expression	**String**	**Matched?**
(a|b|c)xz	ab xz	No match
	abxz	1 match (match at abxz)
	axz cabxz	2 matches (at axz cabxz)

METACHARACTERS

\\ - Backslash

Backlash \ is used to escape various characters including all metacharacters.

For example,

\\$a match if a string contains **$** followed by **a**. Here, **$** is not interpreted by a RegEx engine in a special way.

If you are unsure if a character has special meaning or not, you can put \ in front of it. This makes sure the character is not treated in a special way.

SPECIAL SEQUENCES

Special sequences make commonly used patterns easier to write. Here's a list of special sequences:

\A - Matches if the specified characters are at the start of a string.

Expression	String	Matched?
\Athe	the sun	Match
	In the sun	No match

SPECIAL SEQUENCES

\b - Matches if the specified characters are at the beginning or end of a word.

Expression	String	Matched?
	football	Match
\bfoo	a football	Match
	afootball	No match
	the foo	Match
foo\b	the afoo test	Match
	the afootest	No match

SPECIAL SEQUENCES

\B - Opposite of **\b**. Matches if the specified characters are **not** at the beginning or end of a word.

Expression	**String**	**Matched?**
	football	No match
\Bfoo	a football	No match
	afootball	Match
	the foo	No match
foo\B	the afoo test	No match
	the afootest	Match

SPECIAL SEQUENCES

\d - Matches any decimal digit. Equivalent to **[0-9]**

Expression	String	Matched?
\d	12abc3	3 matches (at 12abc3)
	Python	No match

\D - Matches any non-decimal digit. Equivalent to **[^0-9]**

Expression	String	Matched?
\D	1ab34"50	3 matches (at 1ab34"50)
	1345	No match

SPECIAL SEQUENCES

\s - Matches where a string contains any whitespace character. Equivalent to **[\t\n\r\f\v]**.

Expression	String	Matched?
\s	Python RegEx	1 match
	PythonRegEx	No match

\S - Matches where a string contains any non-whitespace character. Equivalent to **[^ \t\n\r\f\v]**.

Expression	String	Matched?
\S	a b	2 matches (at a b)
		No match

SPECIAL SEQUENCES

\w - Matches any alphanumeric character (digits and alphabets). Equivalent to **[a-zA-Z0-9_]**.
By the way, underscore **_** is also considered an alphanumeric character.

Expression	String	Matched?
\w	12&": ;c	3 matches (at 12&": ;c)
	%"> !	No match

\W - Matches any non-alphanumeric character. Equivalent to **[^a-zA-Z0-9_]**

Expression	String	Matched?
\W	1a2%c	1 match (at 1a2%c)
	Python	No match

SPECIAL SEQUENCES

\Z - Matches if the specified characters are at the end of a string.

Expression	String	Matched?
	I like Python	1 match
Python\Z	I like Python Programming	No match
	Python is fun.	No match

SPECIAL SEQUENCES

Tip: To build and test regular expressions, you can use RegEx tester tools such as regex101.com. This tool not only helps you in creating regular expressions, but it also helps you learn it.

Now we understand the basics of RegEx, let’s learn how to use RegEx in Python code.

PYTHON REGEX

Python has a module named `re` to work with regular expressions.
To use it, we need to import the module.

```
import re
```

The module defines several functions and constants to work with RegEx.

PYTHON REGEX

re.findall()

The **re.findall()** method returns a list of strings containing all matches.

Example 1: re.findall()

```
# Program to extract numbers from a string
import re
string = 'hello 12 hi 89. Howdy 34'
pattern = '\d+'
result = re.findall(pattern, string)
print(result) # Output: ['12', '89', '34']
```

If the pattern is not found, **re.findall()** returns an empty list.

PYTHON REGEX

re.split()

The **re.split** method splits the string where there is a match and returns a list of strings
where the splits have occurred.

Example 2: re.split()

```
import re
string = 'Twelve:12 Eighty nine:89.'
pattern = '\d+'
result = re.split(pattern, string)
print(result)
# Output: ['Twelve:', ' Eighty nine:', '.']
```

If the pattern is not found, **re.split()** returns a list containing the original string.

PYTHON REGEX

You can pass **maxsplit** argument to the **re.split()** method. It's the maximum number of splits that will occur.

```
import re
string = 'Twelve:12 Eighty nine:89 Nine:9.'
pattern = '\d+' # maxsplit = 1 # split only at the first occurrence
result = re.split(pattern, string, 1)
print(result)
# Output: ['Twelve:', ' Eighty nine:89 Nine:9.']
```

By the way, the default value of **maxsplit** is 0; meaning all possible splits.

PYTHON REGEX

re.sub()

The syntax of **re.sub()** is:

re.sub(pattern, replace, string)

The method returns a string where matched occurrences are replaced with the content of **replace** variable.

PYTHON REGEX

Example 3: re.sub()

```
# Program to remove all whitespaces
import re
# multiline string
string = 'abc 12\ de 23 \n f45 6'
# matches all whitespace characters
pattern = '\s+'
# empty string
replace = ''
new_string = re.sub(pattern, replace, string)
print(new_string)
 # Output: abc12de23f456
```

If the pattern is not found, **re.sub()** returns the original string.

PYTHON REGEX

You can pass **count** as a fourth parameter to the **re.sub()** method.
If omitted, it results to 0. This will replace all occurrences.

```
import re
# multiline string
string = 'abc 12\ de 23 \n f45 6'
# matches all whitespace characters
pattern = '\s+'
replace = ''
new_string = re.sub(pattern, replace, string, 1)
print(new_string)

# Output:
# abc12\ de 23
# f45 6
```

PYTHON REGEX

re.subn()

The `re.subn()` is similar to `re.sub()` expect it returns a tuple of 2 items containing the

new string and the number of substitutions made.

Example 4: re.subn()

```
# Program to remove all
whitespaces
import re
# multiline string
string = 'abc 12\ de 23 \n
f45 6'
# matches all whitespace
characters
pattern = '\s+'
# empty string
replace = ''
new_string =
re.subn(pattern,
replace, string)
print(new_string)
# Output:
('abc12de23f456', 4)
```

PYTHON REGEX

re.search()

The **re.search()** method takes two arguments: a pattern and a string.
The method looks for the first location where the RegEx pattern produces a match
with the string.
If the search is successful, **re.search()** returns a match object; if not, it returns **None**.

```
match = re.search(pattern, str)
```

PYTHON REGEX

Example 5: re.search()

```
import re
string = "Python is fun"
# check if 'Python' is at the beginning
match = re.search('\APython', string)
if match:
print(“pattern found inside the string”)
else:
print(“pattern not found”)
# Output: pattern found inside the string
```

Here, **match** contains a match object

MATCH OBJECT

You can get methods and attributes of a match object using dir() function.
Some of the commonly used methods and attributes of match objects are:

match.group()

The **group()** method returns the part of the string where there is a match.

Example 6: Match object

```
import re string = '39801 356, 2102 1111'
# Three digit number followed by space followed by two digit number
pattern = '(\d{3}) (\d{2})'
# match variable contains a Match object.
match = re.search(pattern, string)
if match:
print(match.group())
else: print("pattern not found")
# Output: 801 35
```

Here, **match** variable contains a match object.

MATCH OBJECT

match.start(), match.end() and match.span()

The **start()** function returns the index of the start of the matched substring. Similarly, **end()** returns the end index of the matched substring.

```
>>> match.start()
2
>>> match.end()
8
```

The **span()** function returns a tuple containing start and end index of the matched part.

```
>>> match.span()
(2, 8)
```

MATCH OBJECT

match.re and match.string

The re attribute of a matched object returns a regular expression object.

Similarly, string attribute returns the passed string.

```
>>> match.re
re.compile('(\\d{3}) (\\d{2})')
>>> match.string
'39801 356, 2102 1111'
```

USING R PREFIX BEFORE REGEX

When **r** or **R** prefix is used before a regular expression, it means raw string. For example, **'\n'** is a new line whereas **r'\n'** means two characters: a backslash \ followed by **n**.
Backlash \ is used to escape various characters including all metacharacters. However, using **r** prefix makes \ treat as a normal character.

Example 7: Raw string using r prefix

```
import re
string = '\n and \r are
escape sequences.'
result =
re.findall(r'[\n\r]',
string)
print(result)
# Output: ['\n', '\r']
```

See you next time!

THANK YOU!