[320] Regular Expressions

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Reading

New text: ***Principles and Techniques of Data Science***
by Sam Lau, Joey Gonzalez, and Deb Nolan

Used for Berkeley's DS100 Course.

Read Chapter 13: https://www.textbook.ds100.org/ch/13/text_regex.html

```
# HIDDEN
def show_regex_match(text, regex):
    """
    Prints the string with the regex match highlighted.
    """
    print(re.sub(f'({regex})', r'\033[1;30;43m\1\033[m', text))
```

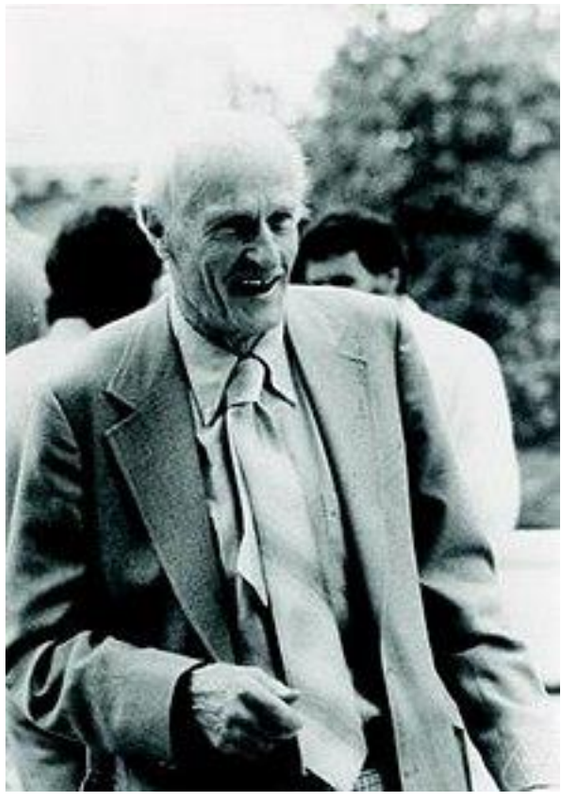
be sure to expand the hidden cells!

```
# The show_regex_match method highlights all regex matches in the
regex = r"green"
show_regex_match("Say! I like green eggs and ham!", regex)
```

```
Say! I like green eggs and ham!
```

Regular Expressions

Regex:
- a small language for describing patterns to search for
- regex patterns are used in many different programming languages (like how many different languages might use SQL queries)
- https://blog.teamtreehouse.com/regular-expressions-10-languages



Stephen Cole Kleene
(UW-Madison mathematician)

```
msg = "In CS 320, there are 13 labs, 7 projects, 26 lectures,
and 1000 things to learn.  CS 320 is awesome!"

# does the string contain "320"?
has_320 = msg.find("320") >= 0
```

`str.find` is VERY limited -- what if we want to:
- find all occurrences of "320"
- find any 3-digit numbers?
- find any numbers at all?
- find a number before the word "projects"?
- substitute a number for something else?

Regexes can do all these things!

In Python, regular expressions usually use "raw" strings

what character(s) does `print("A\tB")` print between "A" and "B"?

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TAB, because backslash is the escape character

what if we actually want a backslash and a "t"?

In Python, regular expressions usually use "raw" strings

what character(s) does `print("A\tB")` print between "A" and "B"?

TAB, because backslash is the escape character

what if we actually want a backslash and a "t"?

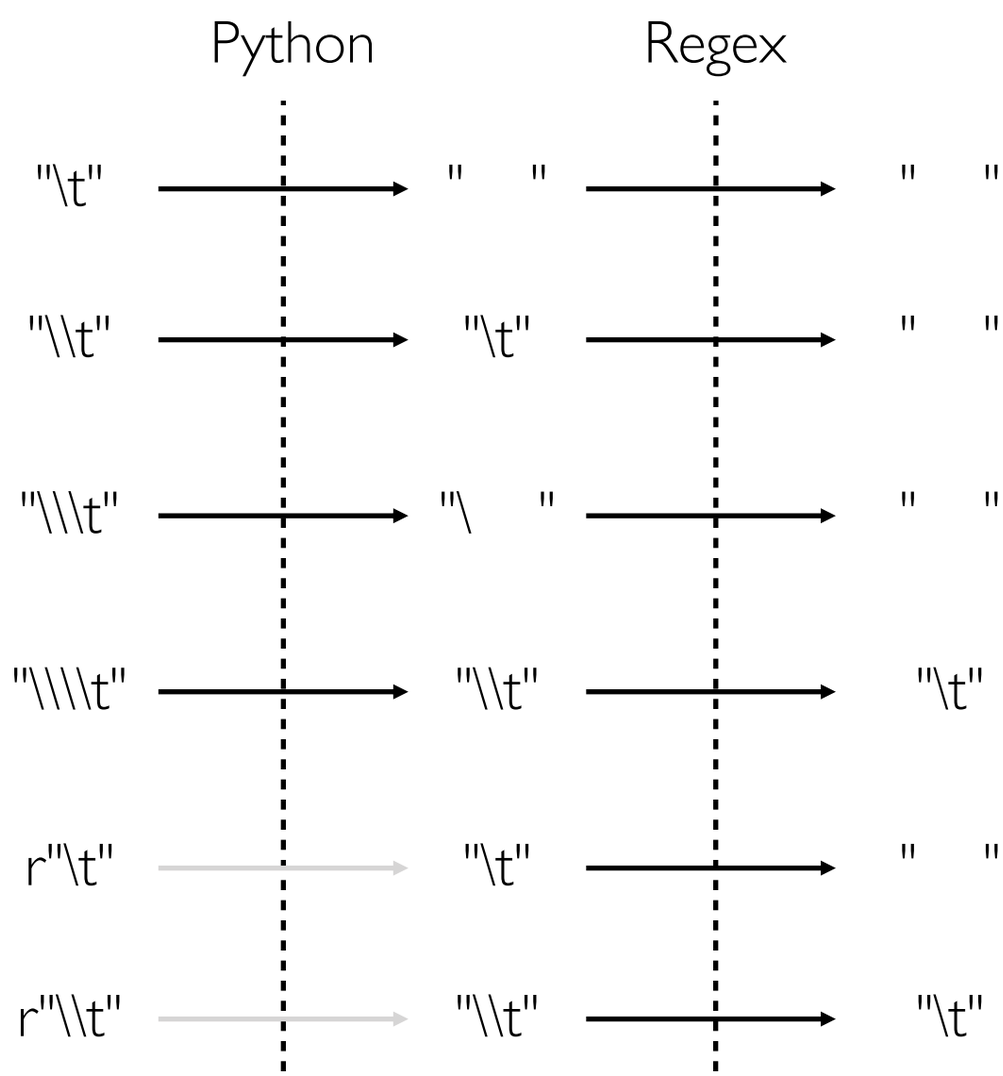
`print("A\\tB")`

`print(r"A\tB")`

this is a **raw** string,
so "\" isn't an escape character

Python regex functions do their own escaping, so this is very handy!

Double Escaping



Notebook Demos (copy/paste to start)...

```
import re

# from DS100 book...
def reg(regex, text):
    """
    Prints the string with the regex match highlighted.
    """
    print(re.sub(f'({regex})', r'\033[1;30;43m\1\033[m', text))
s1 = " ".join(["A DAG is a directed graph without cycles.",
               "A tree is a DAG where every node has one parent (except the root, which
has none).",
               "To learn more, visit www.example.com or call 1-608-123-4567. :) ¯\_(ツ
)_/¯"])
print(s1)

s2 = """1-608-123-4567
a-bcd-efg-hijg (not a phone number)
1-608-123-456 (not a phone number)
608-123-4567
123-4567
1-123-4567
"""
print(s2)

s3 = "In CS 320, there are 13 labs, 7 projects, 26 lectures, and 1000 things to
learn.  CS 320 is awesome!"
print(s3)

s4 = """In CS 320,  there are 13 labs,    7 projects,
26 lectures, and 1000 things to learn.  CS 320 is awesome!"""
print(s4)
```

Learn Regex Features!

Good overview here:
https://www.textbook.ds100.org/ch/08/text_regex.html#Reference-Tables

(screenshots here for convenience)

non-greedy equivalents: `*?` `+?`

Char	Description	Example	Matches	Doesn't Match
.	Any character except \n	`...`	abc	ab abcd
[]	Any character inside brackets	`[cb.]ar`	car .ar	jar
[^]	Any character *not* inside brackets	`[^b]ar`	car par	bar ar
*	≥ 0 or more of last symbol	`[pb]*ark`	bbark ark	dark
+	≥ 1 or more of last symbol	`[pb]+ark`	bbpark bark	dark ark
?	0 or 1 of last symbol	`s?he`	she he	the
{*n*}	Exactly *n* of last symbol	`hello{3}`	hellooo	hello
|	Pattern before or after bar	`we|[ui]s`	we us is	e s
\	Escapes next character	`\[hi\]`	[hi]	hi
^	Beginning of line	`^ark`	ark two	dark
$	End of line	`ark$`	noahs ark	noahs arks

Description	Bracket Form	Shorthand
Alphanumeric character	`[a-zA-Z0-9]`	`\w`
Not an alphanumeric character	`[^a-zA-Z0-9]`	`\W`
Digit	`[0-9]`	`\d`
Not a digit	`[^0-9]`	`\D`
Whitespace	`[\t\n\f\r\p{Z}]`	`\s`
Not whitespace	`[^\t\n\f\r\p{z}]`	`\S`

Python re Module: findall and sub

```
import re

s = 'In CS 320, there are 13 labs, 7 projects, 26
lectures, and 1000 things to learn.  CS 320 is
awesome!'
```

```
re.findall(r"\d+", s)
```

pattern input str

```
re.sub(r"\d+", "###", s)
```

pattern replacement input str

Python re Module: findall and sub

```
import re

s = 'In CS 320, there are 13 labs, 7 projects, 26
lectures, and 1000 things to learn.  CS 320 is
awesome!'
```

```
re.findall(r"\d+", s)
```

pattern input str

```
['320', '13', '7',
'26', '1000', '320']
```

```
re.sub(r"\d+", "###", s)
```

pattern replacement input str

```
'In CS ###, there are ### quizzes, ###
projects, ### lectures, and ### things
to learn.  CS ### is awesome!'
```

Groups

```
import re

s = 'In CS 320, there are 13 labs, 7 projects, 26
lectures, and 1000 things to learn.  CS 320 is
awesome!'
```

```
re.findall(r"(\d+)  (\w+)", s)
```

group 1 group 2

Groups

```
import re

s = 'In CS 320, there are 13 labs, 7 projects, 26
lectures, and 1000 things to learn.  CS 320 is
awesome!'
```

```
re.findall(r"(\d+)  (\w+)", s)
```

group 1 group 2

```
[('13', 'labs'), ('7', 'projects'), ('26', 'lectures'),
 ('1000', 'things'), ('320', 'is')]
```

Groups

```
import re

s = 'In CS 320, there are 13 labs, 7 projects, 26
lectures, and 1000 things to learn.  CS 320 is
awesome!'
```

group 1

```
re.findall(r"((\d+)  (\w+))", s)
```

group 2 group 3

```
[('13 labs', '13', 'labs'),
 ('7 projects', '7', 'projects'),
 ('26 lectures', '26', 'lectures'),
 ('1000 things', '1000', 'things'),
 ('320 is', '320', 'is')]
```

Python re Module: findall and sub

```
import re
```

2 spaces tab newline

```
s = """In CS 320,  there are 13 labs,    7 projects,
26 lectures, and 1000 things to learn.  CS 320 is
awesome!"""
```

```
re.sub(r"\s+", " ", s)
```

pattern replacement input str

```
'In CS 320, there are 13 labs, 7 projects, 26
lectures, and 1000 things to learn. CS 320 is
awesome!'
```

single space is only separator!

Python re Module: findall and sub

```
import re

s = """In CS 320,  there are 13 labs,    7 projects,
26 lectures, and 1000 things to learn.  CS 320 is
awesome!"""
```

```
re.sub(r"(\d+)", "<b>\g<1></b>", s)
```

use \g<N> to refer to group N

Python re Module: findall and sub

```
import re

s = """In CS 320,  there are 13 labs,    7 projects,
26 lectures, and 1000 things to learn.  CS 320 is
awesome!"""
```

```
re.sub(r"(\d+)", "<b>\g<1></b>", s)
```

```
In CS <b>320</b>, there are <b>13</b> labs, <b>7</b>
projects, <b>26</b> lectures, and <b>1000</b> things
to learn.  CS <b>320</b> is awesome!
```

In CS **320**, there are **13** labs, **7** projects, **26** lectures, and **1000** things to learn. CS **320** is awesome!

Review Regular Expressions

Which regex will **NOT** match "123"

1. `r"\d\d\d"`
2. `r"\d{3}"`
3. `r"\D\D\D"`
4. `r"..."`

What will r"^A" match?

1. `"A"`
2. `"^A"`
3. `"BA"`
4. `"B"`
5. `"BB"`

Which one can match "HH"?

1. `r"HA+H"`
2. `r"HA+?H"`
3. `r"H(A+)?H"`

Which string(s) **will** match r"^(ha)*$"

1. `""`
2. `"hahah"`
3. `"that"`
4. `"HAHA"`

What is the type of the following?re.findall(r"(\d) (\w+)", some_str)[0]

1. `list`
2. `tuple`
3. `string`

What will it do?

```
re.sub(r"(\d{3})-(\d{3}-\d{4})",
       r"(\g<1>) \g<2>",
       "608-123-4567")
```

Practice

finding emails, extracting function names, other examples...