Regular Expressions

Chapter 11

Python for Everybody
www.py4e.com

Regular Expressions

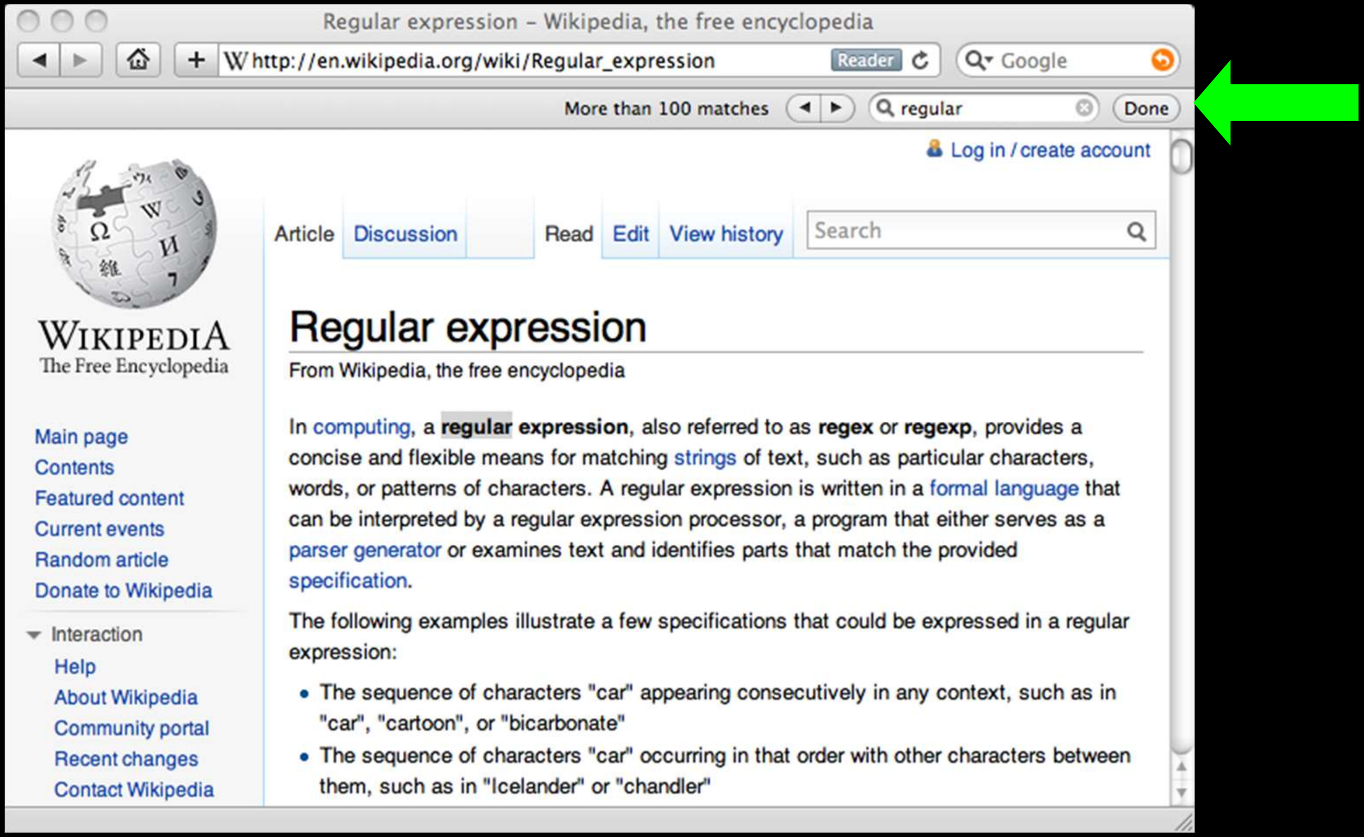
In computing, a regular expression, also referred to as “regex” or “regexp”, provides a concise and flexible means for matching strings of text, such as particular characters, words, or patterns of characters. A regular expression is written in a formal language that can be interpreted by a regular expression processor.

http://en.wikipedia.org/wiki/Regular_expression

Regular Expressions

Really clever “wild card” expressions for matching and parsing strings

http://en.wikipedia.org/wiki/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"

Really smart “Find” or “Search”

Understanding Regular Expressions

- Very powerful and quite cryptic
- Fun once you understand them
- Regular expressions are a language unto themselves
- A language of “marker characters” - programming with characters
- It is kind of an “old school” language - compact

WHENEVER I LEARN A NEW SKILL I CONCOCT ELABORATE FANTASY SCENARIOS WHERE IT LETS ME SAVE THE DAY.
OH NO! THE KILLER MUST HAVE FOLLOWED HER ON VACATION!
BUT TO FIND THEM WE'D HAVE TO SEARCH THROUGH 200 MB OF EMAILS LOOKING FOR SOMETHING FORMATTED LIKE AN ADDRESS!
IT'S HOPELESS!
EVERYBODY STAND BACK.
I KNOW REGULAR EXPRESSIONS.
PERL!
TAP TAP

http://xkcd.com/208/

Regular Expression Quick Guide

^	Matches the beginning of a line
$	Matches the end of the line
.	Matches any character
\s	Matches whitespace
\S	Matches any non-whitespace character
*	Repeats a character zero or more times
*?	Repeats a character zero or more times (non-greedy)
+	Repeats a character one or more times
+?	Repeats a character one or more times (non-greedy)
[aeiou]	Matches a single character in the listed set
[^XYZ]	Matches a single character not in the listed set
[a-z0-9]	The set of characters can include a range
(	Indicates where string extraction is to start
)	Indicates where string extraction is to end

https://www.py4e.com/lectures3/Pythonlearn-11-Regex-Handout.txt

The Regular Expression Module

- Before you can use regular expressions in your program, you must import the library using “import re”
- You can use re.search() to see if a string matches a regular expression, similar to using the find() method for strings
- You can use re.findall() to extract portions of a string that match your regular expression, similar to a combination of find() and slicing: var[5:10]

Using re.search() Like find()

```
hand = open('mbox-short.txt')
for line in hand:
    line = line.rstrip()
    if line.find('From:') >= 0:
        print(line)
```

```
import re

hand = open('mbox-short.txt')
for line in hand:
    line = line.rstrip()
    if re.search('From:', line) :
        print(line)
```

Using re.search() Like startswith()

```
hand = open('mbox-short.txt')
for line in hand:
    line = line.rstrip()
    if line.startswith('From:') :
        print(line)
```

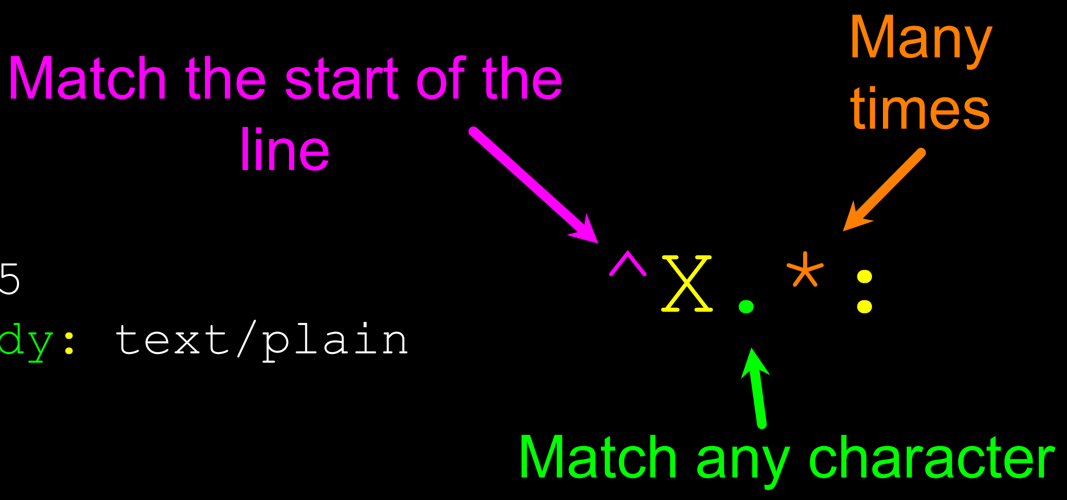
```
import re

hand = open('mbox-short.txt')
for line in hand:
    line = line.rstrip()
    if re.search('^From:', line) :
        print(line)
```

We fine-tune what is matched by adding special characters to the string

Wild-Card Characters

- The dot character matches any character
- If you add the asterisk character, the character is “any number of times”

```
X-Sieve: CMU Sieve 2.3
X-DSPAM-Result: Innocent
X-DSPAM-Confidence: 0.8475
X-Content-Type-Message-Body: text/plain
```



Match the start of the line

Many times

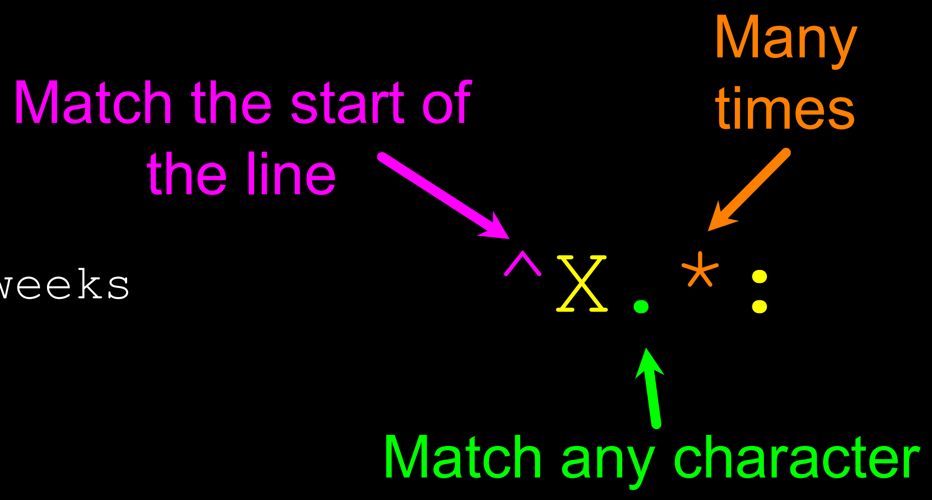
`^X.*:`

Match any character

Fine-Tuning Your Match

Depending on how “clean” your data is and the purpose of your application, you may want to narrow your match down a bit

```
X-Sieve: CMU Sieve 2.3
X-DSPAM-Result: Innocent
X-Plane is behind schedule: two weeks
X-: Very short
```



Match the start of the line

Many times

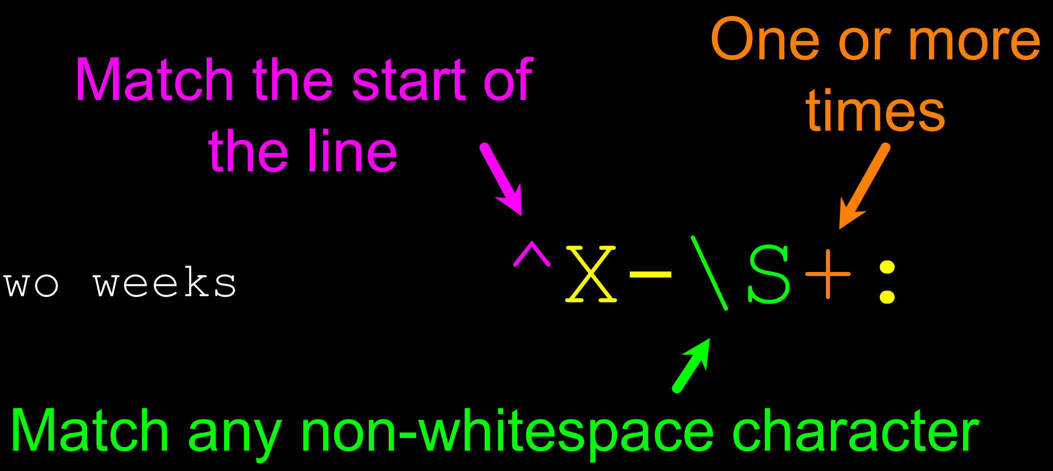
^X.*:

Match any character

Fine-Tuning Your Match

Depending on how “clean” your data is and the purpose of your application, you may want to narrow your match down a bit

```
X-Sieve: CMU Sieve 2.3
X-DSPAM-Result: Innocent
X-: Very Short
X-Plane is behind schedule: two weeks
```



Match the start of the line

One or more times

^X-\S+:

Match any non-whitespace character

Matching and Extracting Data

- re.search() returns a True/False depending on whether the string matches the regular expression
- If we actually want the matching strings to be extracted, we use re.findall()

```
[0-9]+
```

One or more digits

```
>>> import re
>>> x = 'My 2 favorite numbers are 19 and 42'
>>> y = re.findall('[0-9]+',x)
>>> print(y)
['2', '19', '42']
```

Matching and Extracting Data

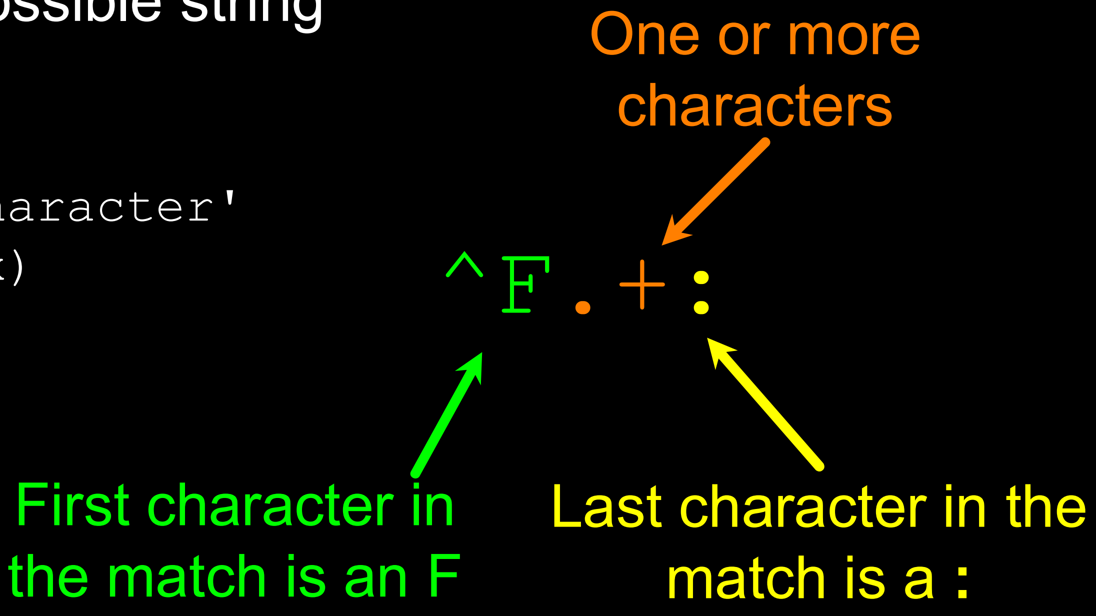
When we use re.findall(), it returns a list of zero or more sub-strings that match the regular expression

```
>>> import re
>>> x = 'My 2 favorite numbers are 19 and 42'
>>> y = re.findall('[0-9]+',x)
>>> print(y)
['2', '19', '42']
>>> y = re.findall('[AEIOU]+',x)
>>> print(y)
[]
```

Warning: Greedy Matching

The repeat characters (* and +) push outward in both directions (greedy) to match the largest possible string

```
>>> import re
>>> x = 'From: Using the : character'
>>> y = re.findall('^F.+:', x)
>>> print(y)
['From: Using the :']
```



One or more characters

^F.+:

First character in the match is an F

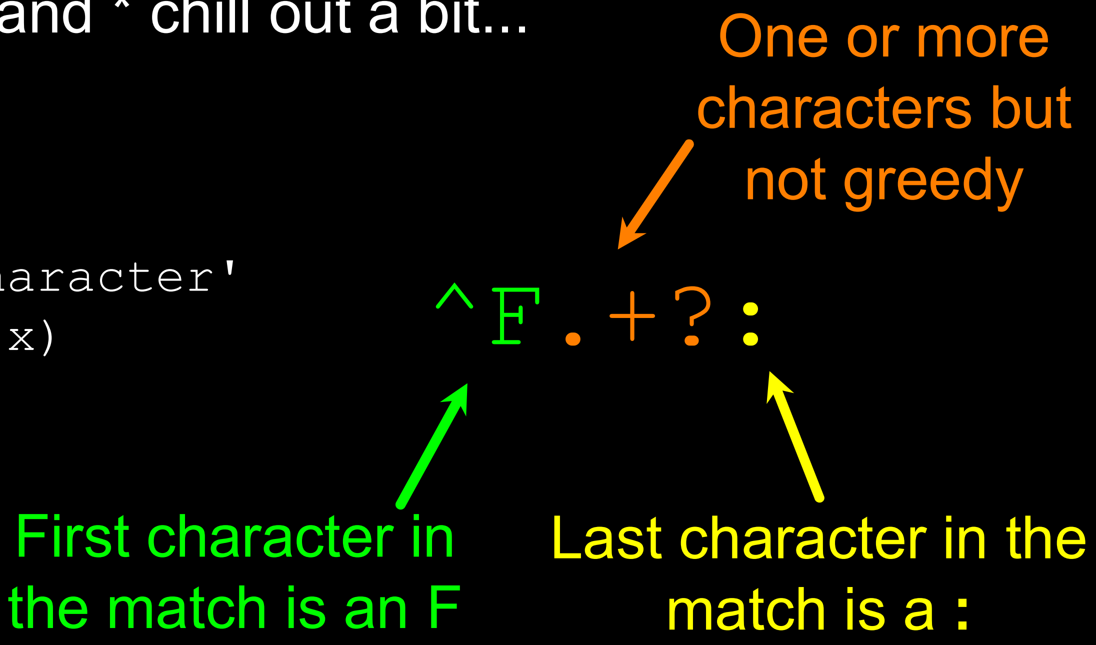
Last character in the match is a :

Why not 'From:' ?

Non-Greedy Matching

Not all regular expression repeat codes are greedy!
If you add a ? character, the + and * chill out a bit...

```
>>> import re
>>> x = 'From: Using the : character'
>>> y = re.findall('^F.+?:', x)
>>> print(y)
['From:']
```



One or more characters but not greedy

`^F.+?:`

First character in the match is an F

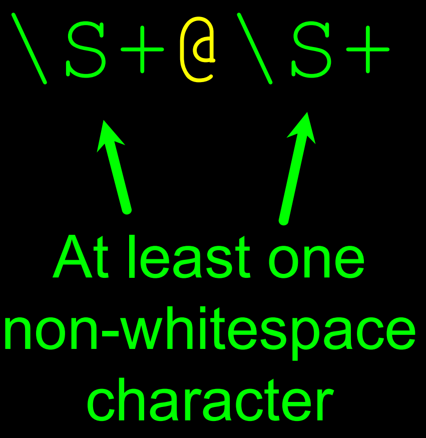
Last character in the match is a :

Fine-Tuning String Extraction

You can refine the match for re.findall() and separately determine which portion of the match is to be extracted by using parentheses

```
From stephen.marquard@uct.ac.za Sat Jan  5 09:14:16 2008
```

```
>>> y = re.findall('\S+@\S+',x)
>>> print(y)
['stephen.marquard@uct.ac.za’]
```



\S+@\S+

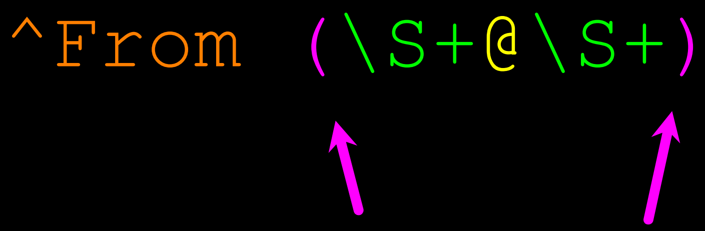
At least one non-whitespace character

Fine-Tuning String Extraction

Parentheses are not part of the match - but they tell where to start and stop what string to extract

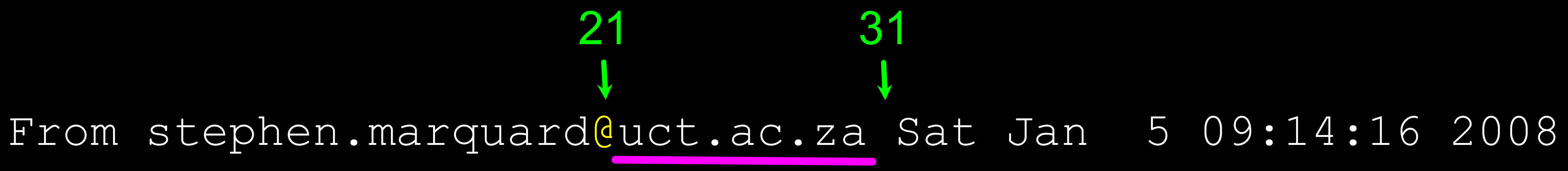
```
From stephen.marquard@uct.ac.za Sat Jan  5 09:14:16 2008
```

```
>>> y = re.findall('\S+@\S+',x)
>>> print(y)
['stephen.marquard@uct.ac.za']
>>> y = re.findall('^From (\S+@\S+)',x)
>>> print(y)
['stephen.marquard@uct.ac.za']
```



```
^From (\S+@\S+)
```

String Parsing Examples…



```
From stephen.marquard@uct.ac.za Sat Jan  5 09:14:16 2008
```

```
>>> data = 'From stephen.marquard@uct.ac.za Sat Jan  5 09:14:16 2008'
>>> atpos = data.find('@')
>>> print(atpos)
21
>>> sppos = data.find(' ',atpos)
>>> print(sppos)
31
>>> host = data[atpos+1 : sppos]
>>> print(host)
uct.ac.za
```

Extracting a host name - using find and string slicing

The Double Split Pattern

Sometimes we split a line one way, and then grab one of the pieces of the line and split that piece again

```
From stephen.marquard@uct.ac.za Sat Jan  5 09:14:16 2008
```

```
words = line.split()
email = words[1]
pieces = email.split('@')
print(pieces[1])
```

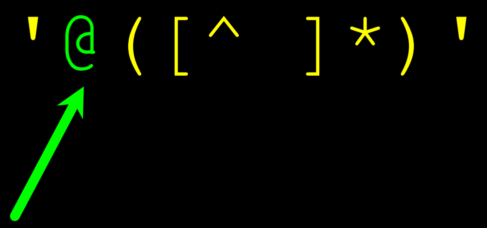
```
stephen.marquard@uct.ac.za
['stephen.marquard', 'uct.ac.za']
'uct.ac.za'
```

The Regex Version

```
From stephen.marquard@uct.ac.za Sat Jan  5 09:14:16 2008
```

```
import re
lin = 'From stephen.marquard@uct.ac.za Sat Jan  5 09:14:16 2008'
y = re.findall('@([^ ]*)',lin)
print(y)
```

```
['uct.ac.za']
```



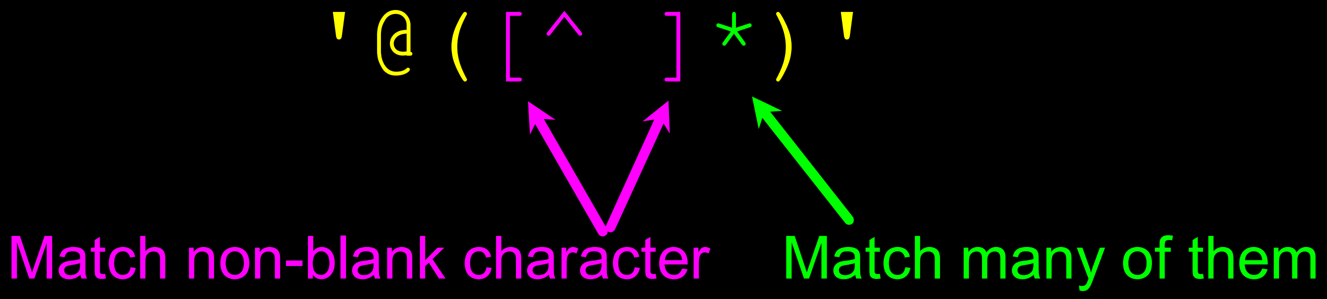
```
'@([^ ]*)'
```

Look through the string until you find an at sign

The Regex Version

```
From stephen.marquard@uct.ac.za Sat Jan  5 09:14:16 2008
```

```
import re
lin = 'From stephen.marquard@uct.ac.za Sat Jan  5 09:14:16 2008'
y = re.findall('@([^ ]*)',lin)
print(y)

['uct.ac.za']
```



```
'@([^ ]*)'
```

Match non-blank character

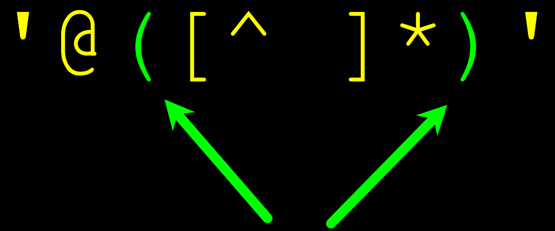
Match many of them

The Regex Version

```
From stephen.marquard@uct.ac.za Sat Jan  5 09:14:16 2008
```

```
import re
lin = 'From stephen.marquard@uct.ac.za Sat Jan  5 09:14:16 2008'
y = re.findall('@([^ ]*)',lin)
print(y)
```

```
['uct.ac.za']
```



`'@([^ ]*)'`

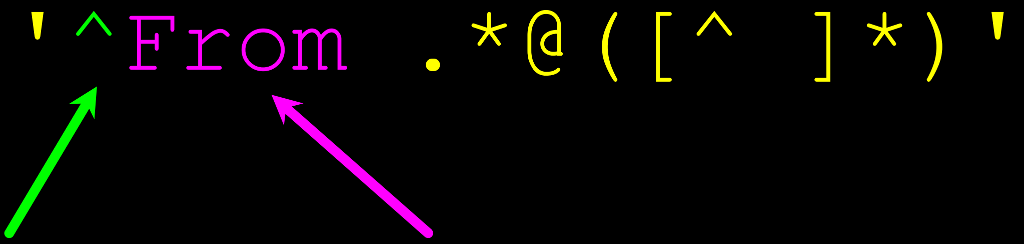
Extract the non-blank characters

Even Cooler Regex Version

```
From stephen.marquard@uct.ac.za Sat Jan  5 09:14:16 2008
```

```
import re
lin = 'From stephen.marquard@uct.ac.za Sat Jan  5 09:14:16 2008'
y = re.findall('^From .*@([^ ]*)',lin)
print(y)
```

```
['uct.ac.za']
```



'^From .*@([^]*)'

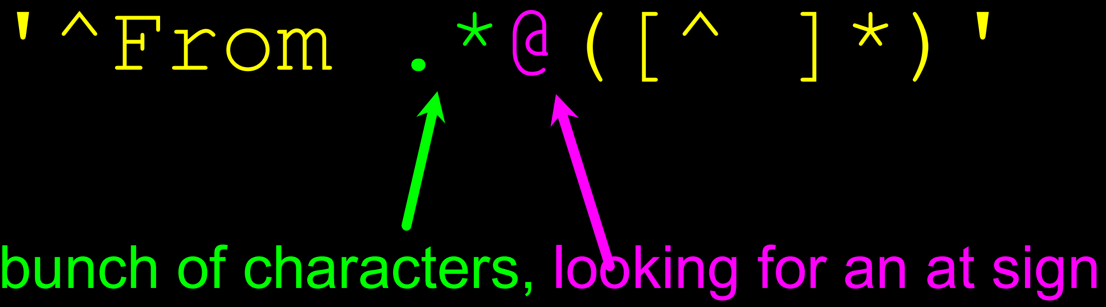
Starting at the beginning of the line, look for the string 'From '

Even Cooler Regex Version

```
From stephen.marquard@uct.ac.za Sat Jan  5 09:14:16 2008
```

```
import re
lin = 'From stephen.marquard@uct.ac.za Sat Jan  5 09:14:16 2008'
y = re.findall('^From .*@([^ ]*)',lin)
print(y)
```

```
['uct.ac.za']
```



`'^From .*@([^ ]*)'`

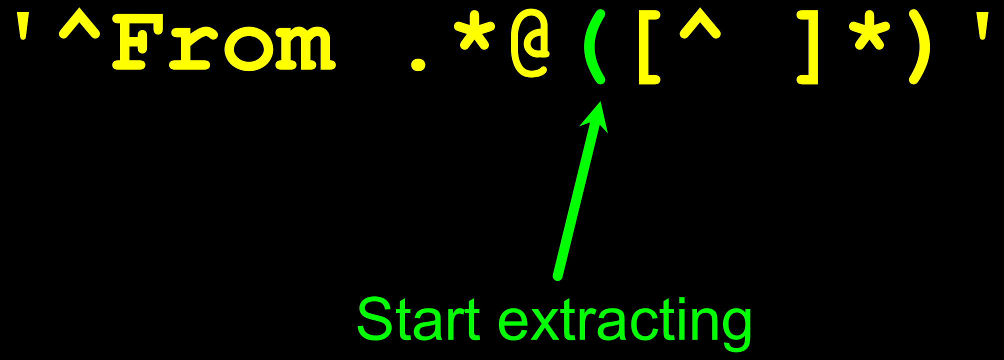
Skip a bunch of characters, looking for an at sign

Even Cooler Regex Version

```
From stephen.marquard@uct.ac.za Sat Jan  5 09:14:16 2008
```

```
import re
lin = 'From stephen.marquard@uct.ac.za Sat Jan  5 09:14:16 2008'
y = re.findall('^From .*@([^ ]*)',lin)
print(y)
```

```
['uct.ac.za']
```



```
'^From .*@([^ ]*)'
```

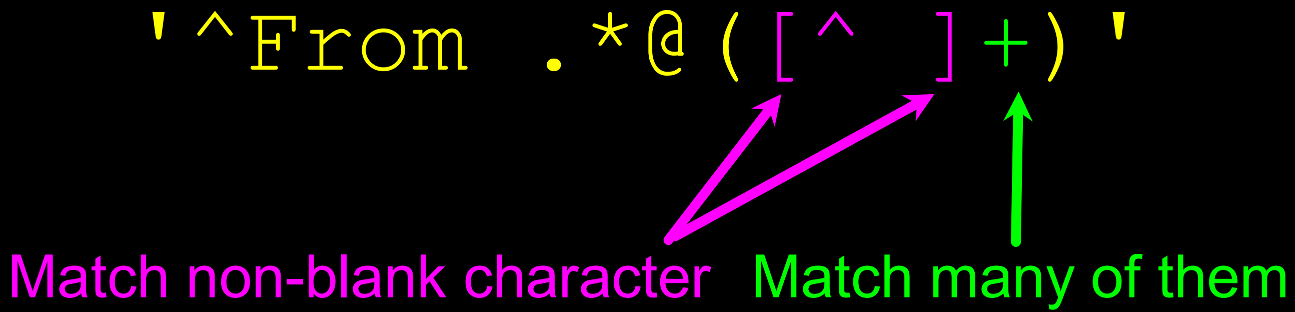
Start extracting

Even Cooler Regex Version

From stephen.marquard@uct.ac.za Sat Jan 5 09:14:16 2008

```
import re
lin = 'From stephen.marquard@uct.ac.za Sat Jan  5 09:14:16 2008'
y = re.findall('^From .*@([^ ]*)',lin)
print(y)
```

```
['uct.ac.za']
```



'^From .*@([^]+)'

Match non-blank character

Match many of them

Even Cooler Regex Version

```
From stephen.marquard@uct.ac.za Sat Jan  5 09:14:16 2008
```

```
import re
lin = 'From stephen.marquard@uct.ac.za Sat Jan  5 09:14:16 2008'
y = re.findall('^From .*@([^ ]*)',lin)
print(y)
```

```
['uct.ac.za']
```

```
'^From .*@([^ ]+)'
```

Stop extracting

Spam Confidence

```
import re
hand = open('mbox-short.txt')
numlist = list()
for line in hand:
    line = line.rstrip()
    stuff = re.findall('^X-DSPAM-Confidence: ([0-9.]+)', line)
    if len(stuff) != 1 :  continue
    num = float(stuff[0])
    numlist.append(num)
print('Maximum:', max(numlist))
```

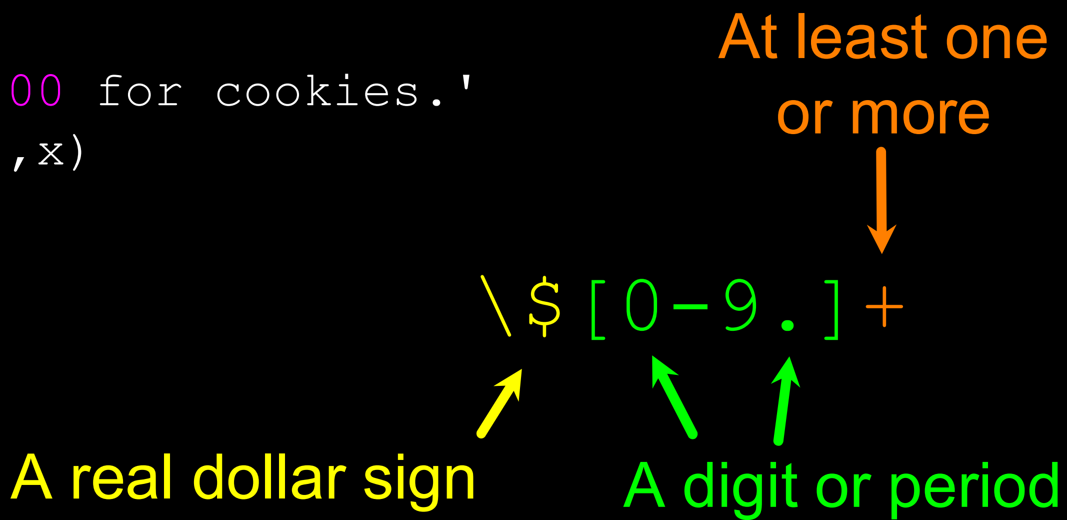
```
python ds.py
Maximum: 0.9907
```

```
X-DSPAM-Confidence: 0.8475
```

Escape Character

If you want a special regular expression character to just behave normally (most of the time) you prefix it with '\'

```
>>> import re
>>> x = 'We just received $10.00 for cookies.'
>>> y = re.findall('\$[0-9.]+',x)
>>> print(y)
['$10.00']
```



At least one or more

`\$[0-9.]+`

A real dollar sign

A digit or period

Summary

- Regular expressions are a cryptic but powerful language for matching strings and extracting elements from those strings
- Regular expressions have special characters that indicate intent

Acknowledgements / Contributions

Initial Development: Charles Severance, University of Michigan School of Information

… Insert new Contributors and Translations here

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