Computational Linguistics Introduction

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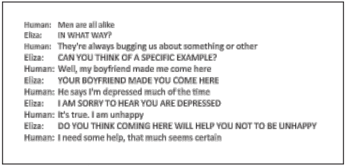
WARMUP

Roadmap

My the end of this class you should . . .

- Write regular expressions to find (linguistic) patterns
- Do simple counting using nltk
- Play around with Python interpreter
- Access corpora from nltk
- Manipulate conditional probabilities

eliza: a cautionary tale



```
Human:  Men are all alike
Eliza:  IN WHAT WAY?
Human:  They're always bugging us about something or other
Eliza:  CAN YOU THINK OF A SPECIFIC EXAMPLE?
Human:  Well, my boyfriend made me come here
Eliza:  YOUR BOYFRIEND MADE YOU COME HERE
Human:  He says I'm depressed much of the time
Eliza:  I AM SORRY TO HEAR YOU ARE DEPRESSED
Human:  It's true. I am unhappy
Eliza:  DO YOU THINK COMING HERE WILL HELP YOU NOT TO BE UNHAPPY
Human:  I need some help, that much seems certain
```

- Claim: an electronic psychiatrist
- Is there anything interesting going on?

`http://www.masswerk.at/elizabot/`

What are eliza's tricks?

I feel *Y*

How often do you feel *Y*?

I want *Y*

Suppose you got *Y* soon . . .

If *Y*

Do you think that it's likely that *Y*?

Other tricks

- Convert "my" to "your" in reply (and other pronouns)
- Randomly produce a change of subject if no rule matches: "tell me about your mother"

How do they do it?

- eliza is about finding patterns
- But users can type many different things
- We thus need a system for expressing many general patterns

How do they do it?

- eliza is about finding patterns
- But users can type many different things
- We thus need a system for expressing many general patterns
- Regular expressions

Wait a minute!

- Very stupid
- Brute-force

Wait a minute!

- Very elegant
- Low resource

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- But still require clever humans to write

Wait a minute!

- Very elegant
- Low resource
- But still require clever humans to write
- Even if you know regexps inside and out, it's important know how to apply them to language

Why in an NLP course?

- Searching for linguistic phenomena (does eat ever take the object "loss")?
- Creating features for supervised algorithms
- Useful for morphology
- Thinking about regular expressions (nice tool) will help you think about finite state machines (theoretical framework)

Symbols and Operators

Symbol	Meaning
[]	Set of characters
^	Start of line / Negation
$	End of the line
|	Or
-	Range of Characters
+	At least one appearance
*	Any number of appearances
$\{N\}$	Exactly *N* appearances

Sets

\d	digits
\D	non-digits
\s	whitespace
\S	non-whitespace
\w	“words”
\W	non-“words”
\b	empty string at word start
.	any character except for newline

Sets

\d	digits	[0-9]
\D	non-digits	[^0-9]
\s	whitespace	[\t\n\r\f\v]
\S	non-whitespace	[^\t\n\r\f\v]
\w	“words”	[a-zA-Z0-9_]
\W	non-“words”	[^a-zA-Z0-9_]
\b	empty string at word start	\W\b\w
.	any character except for newline	b.d

Backreference

- If you enclose a subexpression in parens `(a.)`
- You can reference that expression again `\1` (for most recent)
- For less recent, the numbers increment `\2`, etc.

Ranges

What does this RegEx do?

```
\b[a-z]+l
```

Ranges

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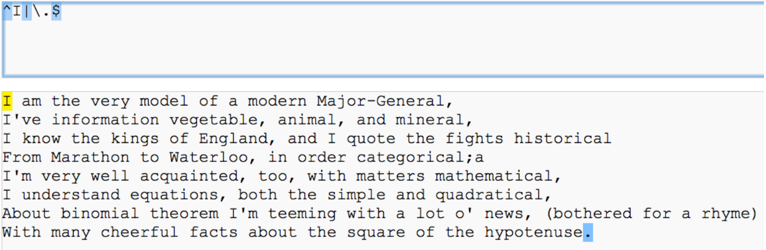

```
^I|\.$
```

```
I am the very model of a modern Major-General,
I've information vegetable, animal, and mineral,
I know the kings of England, and I quote the fights historical
From Marathon to Waterloo, in order categorical;a
I'm very well acquainted, too, with matters mathematical,
I understand equations, both the simple and quadratical,
About binomial theorem I'm teeming with a lot o' news, (bothered for a rhyme)
With many cheerful facts about the square of the hypotenuse.
```

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What does this RegEx do?

[aeiou]{2,}

Ranges

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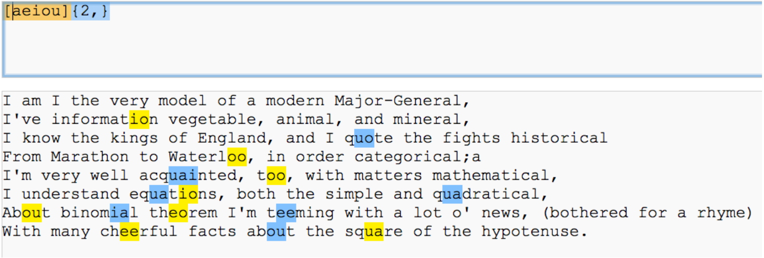

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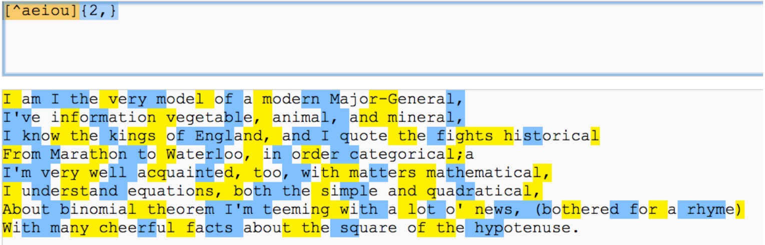

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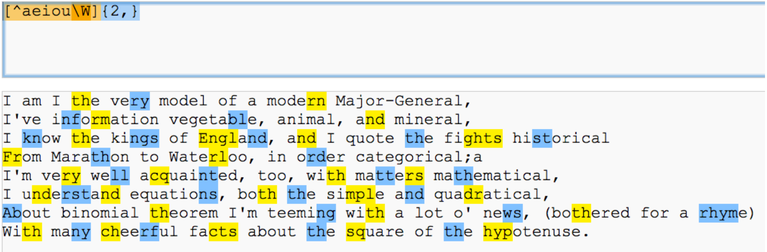

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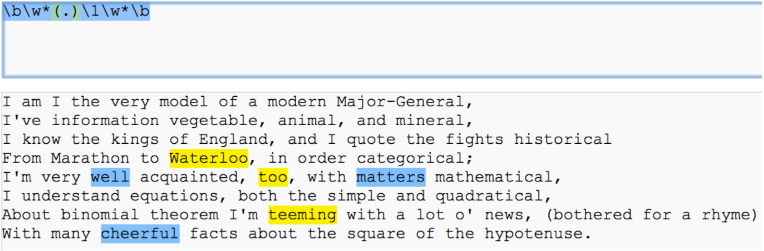

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Thou Must

Challenge

Find all examples of “thou ___t” in the bible; what are the most frequent?

- `nltk.corpus.gutenberg`
- `import re`
- `FreqDist` or `Counter`

Thou Must

Thou Must

```
thou_regexp = re.compile(r"[Tt]hou\s[\w]*t\s")
thou_count = FreqDist()
for ii in thou_regexp.findall(gutenberg.raw(’bible-kjv.txt’
    thou_count[ii] += 1
thou_count.tabulate(5)
```

Find a Street

Challenge

Find all examples of "Capital Word" Street in all of the Gutenberg text.

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

Find a Street

Find a Street

```
street_regexp = re.compile(r"[A-Z]\w*\s[S]treet")
    for fileid in gutenberg.fileids():
        print(fileid, street_regexp.findall(gutenberg.raw(f
```

Repeated Words

Challenge

1. Find all examples of repeated words in all of Gutenberg.
2. Find all examples of repeated words separated by some other word in Gutenberg.

- `finditer`
- `group`
- Back references

Repeated Words

Repeated Words

```
repeat_regexp = re.compile(r’\b(\w+)\s(\1\b)+’)
for fileid in gutenberg.fileids():
    matches = list(repeat_regexp.finditer(gutenberg.raw(fil
    print(fileid, [x.group(0) for x in matches])
```

Repeated Words (with something in between)

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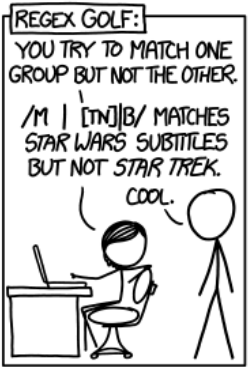
Regexp Golf


REGEX GOLF:
YOU TRY TO MATCH ONE GROUP BUT NOT THE OTHER.
/M | [TN]|B/ MATCHES STAR WARS SUBTITLES BUT NOT STAR TREK.
COOL.

Regexp Golf

Regexp	Matches	Doesn’t Match
	afoot	Atlas
	tick	trickingly
	abac	beam
	undergrounder	hypergoddess
	civic	cinnabar
	unintelligibility	unregainable

Regexp Golf

Regexp	Matches	Doesn't Match
`foo`	afoot	Atlas
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Regexp Golf

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`foo`	afoot	Atlas
`k$`	tick	trickingly
`^[a-f]+$`	abac	beam
`(\w3).*\1`	undergrounder	hypergoddess
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Regexp Golf

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`foo`	afoot	Atlas
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`foo`	afoot	Atlas
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`(.)(.).?\2\1`	civic	cinnabar
`(.)(.\1){3}`	unintelligibility	unregainable

Changin Gears: Bayes Rule

There’s a test for Boogie Woogie Fever (BWF). The probability of geting a positive test result given that you have BWF is 0.8, and the probability of getting a positive result given that you do not have BWF is 0.01. The overall incidence of BWF is 0.01.

1. What is the marginal probability of getting a positive test result?
2. What is the probability of having BWF given that you got a positive test result?

Conditional Probabilities

One coin in a collection of 65 has two heads. The rest are fair. If a coin, chosen at random from the lot and then tossed, turns up heads 6 times in a row, what is the probability that it is the two-headed coin?