More List Comprehensions
An Example

MARCH 28, 2014

Programming Problem

Write a program that reads a literary text (e.g., “War and Peace” or “The Illiad”) and does simple text analysis to figure out the *principal characters* of the novel.

For example, when I ran my program on “The Illiad” the most frequent characters were:

```
(563, 'Trojans'), (548, 'Achaeans'), (447, 'Jove'), (421,
'Hector'), (383, 'Achilles'), (183, 'Agamemnon'), (178, 'Priam'),
(160, 'Patroclus'), (146, 'Minerva'), (137, 'Ajax')
```

Main Idea

- Since character names are proper nouns, starting with upper case letters, the idea is to look for words starting with upper case letters that do not appear at the beginning of sentences.

- So the program also attempts to partition the text into sentences, assuming that ".", "!", and "?” are all the possible sentence delimiters.

- Then we count the frequency of the proper nouns and report the most frequent of these. We only keep names that are at least 4 letters long.

Function parseSentences

```
# Takes a string as parameter and "splits" it into "sentences."
# We assume that ".", "!", and "?" are sentence delimiters

def parseSentences(bigString):
    return bigString.replace("!", ".").replace("?", ".").split(".")
```

- This returns a list – each element in the list is a string representing a sentence.

Next task: split sentences in word sequences

- We have solved this problem earlier and written a function called “parse” for it.

- That algorithm examined the string character-by-character and pulled out contiguous sequences of letters.

- Now we will use a different algorithm to solve this problem.

Algorithmic Idea

1. Replace every non-letter in each sentence by space.

2. Then split on spaces.

- **Question:** How do we specify all non-letter characters?

Two useful built-in functions

- ord(ch)

  if ch is a single character string, this function returns the ASCII code for ch

- chr(i)

  returns a string of one character whose ASCII code is the integer *i*

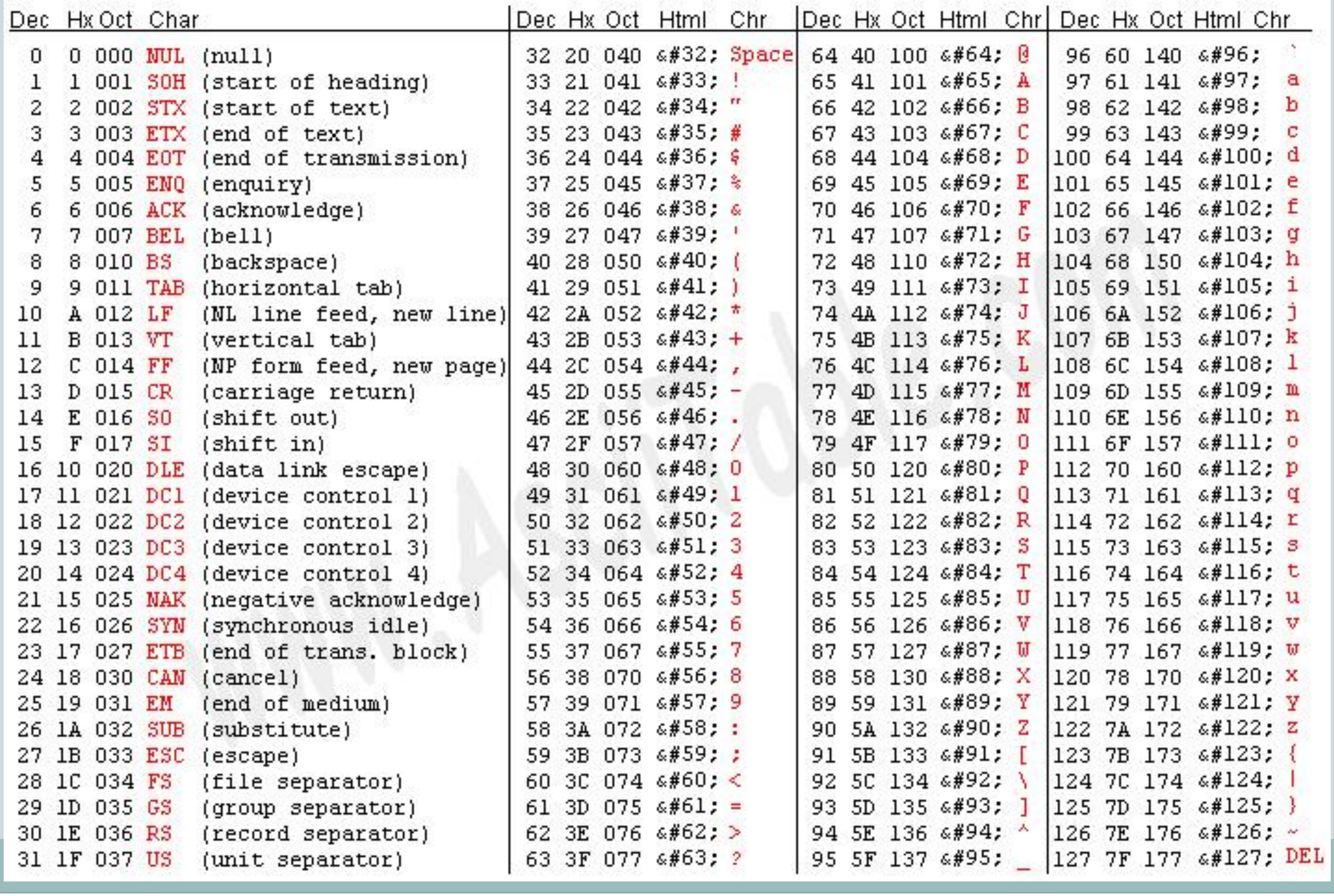
What is ASCII?

It stands for the *American Standard Code for Information Interchange*. It assigns a number in the range 0..255 to every character that can be entered at the keyboard.

More on ASCII

- The numbers 0..31 are reserved for unprintable characters, e.g., the tab character ("\t"), the end of line character ("\n"), etc.
- 32 is the ASCII value of the space character (" ")
- 33..47 is used for some punctuation characters
- 48..57 is used for digits "0" through "9"
- 65..90 is used for upper case letters
- 97..122 is used for lower case letters

ASCII Table



Dec	Hx	Oct	Char		Dec	Hx	Oct	Html	Chr	Dec	Hx	Oct	Html	Chr	Dec	Hx	Oct	Html	Chr
0	0	000	NUL	(null)	32	20	040	&#32;	Space	64	40	100	&#64;	@	96	60	140	&#96;	`
1	1	001	SOH	(start of heading)	33	21	041	&#33;	!	65	41	101	&#65;	A	97	61	141	&#97;	a
2	2	002	STX	(start of text)	34	22	042	&#34;	"	66	42	102	&#66;	B	98	62	142	&#98;	b
3	3	003	ETX	(end of text)	35	23	043	&#35;	#	67	43	103	&#67;	C	99	63	143	&#99;	c
4	4	004	EOT	(end of transmission)	36	24	044	&#36;	$	68	44	104	&#68;	D	100	64	144	&#100;	d
5	5	005	ENQ	(enquiry)	37	25	045	&#37;	%	69	45	105	&#69;	E	101	65	145	&#101;	e
6	6	006	ACK	(acknowledge)	38	26	046	&#38;	&	70	46	106	&#70;	F	102	66	146	&#102;	f
7	7	007	BEL	(bell)	39	27	047	&#39;	'	71	47	107	&#71;	G	103	67	147	&#103;	g
8	8	010	BS	(backspace)	40	28	050	&#40;	(	72	48	110	&#72;	H	104	68	150	&#104;	h
9	9	011	TAB	(horizontal tab)	41	29	051	&#41;	)	73	49	111	&#73;	I	105	69	151	&#105;	i
10	A	012	LF	(NL line feed, new line)	42	2A	052	&#42;	*	74	4A	112	&#74;	J	106	6A	152	&#106;	j
11	B	013	VT	(vertical tab)	43	2B	053	&#43;	+	75	4B	113	&#75;	K	107	6B	153	&#107;	k
12	C	014	FF	(NP form feed, new page)	44	2C	054	&#44;	,	76	4C	114	&#76;	L	108	6C	154	&#108;	l
13	D	015	CR	(carriage return)	45	2D	055	&#45;	-	77	4D	115	&#77;	M	109	6D	155	&#109;	m
14	E	016	SO	(shift out)	46	2E	056	&#46;	.	78	4E	116	&#78;	N	110	6E	156	&#110;	n
15	F	017	SI	(shift in)	47	2F	057	&#47;	/	79	4F	117	&#79;	O	111	6F	157	&#111;	o
16	10	020	DLE	(data link escape)	48	30	060	&#48;	0	80	50	120	&#80;	P	112	70	160	&#112;	p
17	11	021	DC1	(device control 1)	49	31	061	&#49;	1	81	51	121	&#81;	Q	113	71	161	&#113;	q
18	12	022	DC2	(device control 2)	50	32	062	&#50;	2	82	52	122	&#82;	R	114	72	162	&#114;	r
19	13	023	DC3	(device control 3)	51	33	063	&#51;	3	83	53	123	&#83;	S	115	73	163	&#115;	s
20	14	024	DC4	(device control 4)	52	34	064	&#52;	4	84	54	124	&#84;	T	116	74	164	&#116;	t
21	15	025	NAK	(negative acknowledge)	53	35	065	&#53;	5	85	55	125	&#85;	U	117	75	165	&#117;	u
22	16	026	SYN	(synchronous idle)	54	36	066	&#54;	6	86	56	126	&#86;	V	118	76	166	&#118;	v
23	17	027	ETB	(end of trans. block)	55	37	067	&#55;	7	87	57	127	&#87;	W	119	77	167	&#119;	w
24	18	030	CAN	(cancel)	56	38	070	&#56;	8	88	58	130	&#88;	X	120	78	170	&#120;	x
25	19	031	EM	(end of medium)	57	39	071	&#57;	9	89	59	131	&#89;	Y	121	79	171	&#121;	y
26	1A	032	SUB	(substitute)	58	3A	072	&#58;	:	90	5A	132	&#90;	Z	122	7A	172	&#122;	z
27	1B	033	ESC	(escape)	59	3B	073	&#59;	;	91	5B	133	&#91;	[	123	7B	173	&#123;	{
28	1C	034	FS	(file separator)	60	3C	074	&#60;	<	92	5C	134	&#92;	\	124	7C	174	&#124;	|
29	1D	035	GS	(group separator)	61	3D	075	&#61;	=	93	5D	135	&#93;	]	125	7D	175	&#125;	}
30	1E	036	RS	(record separator)	62	3E	076	&#62;	>	94	5E	136	&#94;	^	126	7E	176	&#126;	~
31	1F	037	US	(unit separator)	63	3F	077	&#63;	?	95	5F	137	&#95;	_	127	7F	177	&#127;	DEL

Some examples of chr and ord in action

```
>>> ord("a")
97
>>> chr(97)
'a'
>>> ord(" ")
32
>>> ord("0")
48
>>> chr(48)
'0'
>>> chr(49)
'1'
>>> ord("A")
65
>>> ord("B")
66
```

Function replaceNonLetters

```
# Replaces all non-letters in a given string s by space
def replaceNonLetters(s):
    # Make a list of all non-letters.
    nonLetters = [chr(x) for x in range(0, 128) if not chr(x).isalpha()]

    # Replaces each nonletter character in s by space
    for char in nonLetters:
        s = s.replace(char, " ")

    return s
```

Function parseWords

```
# Takes a list of sentences and parses each sentence in this list into a list of words.
# So the result is a list of lists, e.g., [["This", "is", "ok"], ["This", "is", "not"]].
# We use the same definition of a word as before. It is a contiguous sequence of letters.

def parseWords(sentenceList):

    # Once non-letters have been replaced by spaces then a simple split() using
    # blank as the delimiter will help us get all the words. Note that this
    # constructs a nested list of words for each sentence.

    return [replaceNonLetters(x).split() for x in sentenceList]
```

Part of the main program

```
# main program
f = open("illiad.txt", "r")
bigString = f.read()
sentenceList = parseSentences(bigString)
nestedWordList = parseWords(sentenceList)

# This block of code walks through the list of words, ignores
# the first word in each sentence and of the remaining words, picks
# ones that start with an upper case and have length at least 4.

nestedWordList = [x[1:] for x in nestedWordList]
wordList = [y for x in nestedWordList for y in x]
characterNames = [x for x in wordList if x[0].isupper() and len(x) > 3]

[masterList, frequencies] = computeFrequencies(characterNames)
```