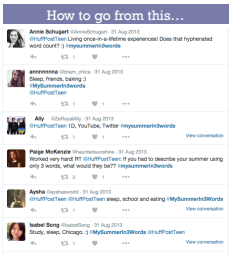
Word Clouds

What is a word cloud?

Source:
http://www.huffingtonpost.com/2013/09/01/1100-words-to-describe-your-summer00-words-to-describe-you_n_3853071.html

Text Processing

How to go from this…



…to this?

Text Processing

Data Visualization Process	Text Visualization
▪ Acquire - Obtain the data from some source	▪ Source = Document
▪ Parse - Give the data some structure, clean up	▪ Parse = Words
▪ Filter - Remove all but the data of interest	▪ Filter = Word Set with counts
▪ Mine - Use the data to derive interesting properties	▪ Mine = Get relevant words
▪ Represent - Chose a visual representation	▪ Represent = Fonts/Placement
▪ Refine – Improve to make it more visually engaging	▪ Refine/Interact
▪ Interact - Make it interactive	

Strings are Objects

Defined using a class
Have fields, methods, one or more constructors

String objects hold an array of 'chars'
What's a char?
- A character enclosed by single quotes ('A')

```
String msg = "I Love CS 110!";
```

msg

0	1	2	3	4	5	6	7	8	9	10	11	12	13
'I'	' '	'L'	'o'	'v'	'e'	' '	'C'	'S'	' '	'1'	'1'	'0'	'!'

Char	Dec	Char	Dec	Char	Dec	Char	Dec	Char	Dec	Char	Dec	Char	Dec
(nul)	0	(dc4)	20	(	40	<	60	P	80	d	100	x	120
(soh)	1	(nak)	21	)	41	=	61	Q	81	e	101	y	121
(stx)	2	(syn)	22	*	42	>	62	R	82	f	102	z	122
(etx)	3	(etb)	23	+	43	?	63	S	83	g	103	{	123
(eot)	4	(can)	24	,	44	@	64	T	84	h	104	|	124
(enq)	5	(em)	25	-	45	A	65	U	85	i	105	}	125
(ack)	6	(sub)	26	.	46	B	66	V	86	j	106	~	126
(bel)	7	(esc)	27	/	47	C	67	W	87	k	107	(del)	127
(bs)	8	(fs)	28	**0**	**48**	D	68	X	88	l	108		
(ht)	9	(gs)	29	**1**	**49**	E	69	Y	89	m	109		
(nl)	10	(rs)	30	**2**	**50**	F	70	Z	90	n	110		
(vt)	11	(us)	31	**3**	**51**	G	71	[	91	o	111		
(np)	12	(sp)	32	**4**	**52**	H	72	\	92	p	112		
(cr)	13	!	33	**5**	**53**	I	73	]	93	q	113		
(so)	14	"	34	**6**	**54**	J	74	^	94	r	114		
(si)	15	#	35	**7**	**55**	K	75	_	95	s	115		
(dle)	16	$	36	**8**	**56**	L	76	`	96	t	116		
(dc1)	17	%	37	9	57	M	77	a	97	u	117		
(dc2)	18	&	38	:	58	N	78	b	98	v	118		
(dc3)	19	'	39	;	59	O	79	c	99	w	119		

Split a String based on a single or multiple separator chars

```
String s1 = "12, 34, 56";
String[] as;

void setup() {
  as = split(s1, ",");
  //as = trim(as);
  println( as );
}
```

```
[0] "12"
[1] " 34"
[2] " 56"
```

```
String s1 = "Data: 12, 34, 56";
String[] as;

void setup() {
  as = splitTokens(s1, ":,");
  //as = trim(as);
  println( as );
}
```

```
[0] "Data"
[1] " 12"
[2] " 34"
[3] " 56"
```

Join a String Array with a join char

```
String[] as = new String[] {"one", "two", "buckle my shoe"};

void setup() {
  String s1 = join( as, " | " );
  println( s1 );
}
```

```
one | two | buckle my shoe
```

Numbers can be formatted as Strings

```
String s1 = "She is the";
String s2 = "programmer.";

phrase = s1 +  nf(7, 3) + " " + s2;
// nf( integer, number of digits )
// "She is the 007 programmer."

phrase = s1 + nf(3.14159,3, 2) + " " + s2;
// nf( float, digits before decimal, digits after decimal )
// "She is the 003.14 programmer."
```

Acquire data: Source = Document

- `// Sketch 7-1: Parsing an input text file`
  `String inputTextFile = "NewYorkPrimaries.txt";`
  `String [] fileContents;`
  `fileContents = loadStrings(inputTextFile);`
- `fileContents` has the source!
- What next?

Parsing

- CSV files
  - always split on ", " first
- Special characters
  - `\", \', \\`
- Removing " (or anything else)
  - `int i = str.indexOf("\"");`
  - `String front = str.substring(0, i);`
  - `String back = str.substring(i+1);`
  - `str = front+back;`

Parse

- How do we turn `fileContents` into words?
- join array into one long string
  `String rawText;`
  `rawText = join(fileContents, " ");`
- make all same case
  `rawText = rawText.toLowerCase();`
- remove symbols and split string into words
  `String delimiters = " ,./?<>;:'\"[{]}\\|=+-_()*&^%$#@!~";`
  `tokens = splitTokens(rawText, delimiters);`

Display the words

- Let's start by displaying all of the words:

```
for (String t : tokens) {
    //textSize(15);
    if(random(100) < 40) { // more blue than red
      fill(random(150,250),0, 0,190); // make red
    } else {
      fill(0, 0, random(150,250),190); // make blue
    }
    text(t, random(0,width-50), random(20,height));
} // for
```

Parse and Filter

```
String raw;
String delimiters = " ,.?!;:-\'\"()*![]{}|\\~`@#$%^&";
String[] fileText, words;
int[] freqs;

void setup() {
  fileText = loadStrings("EliotLoveSong.txt");
  println("Read " + fileText.length + " lines.");

  raw = join(fileText, " ");
  raw = raw.toLowerCase();

  words = splitTokens(raw, delimiters);
  println("Found " + words.length + " words.");
}
```

Filter

```
String raw;
String delimiters = " ,.?!;:-\'\"()*![]{}|\\~`@#$%^&";
String[] fileText, words, uniqueWords;
int[] freqs;

void setup() {
  fileText = loadStrings("EliotLoveSong.txt");
  println("Read " + fileText.length + " lines.");

  raw = join(fileText, " ");
  raw = raw.toLowerCase();

  words = splitTokens(raw, delimiters);
  println("Found " + words.length + " words.");

  freqs = makeUnique(words);
  println("Found "+uniqueWords.length+" unique words.");
}
```

Filtering: Word Frequency List

- Create a set of word frequency pairs.
- Algorithm:
  - create empty set pairs
  - for each token
    - if pairs has (token,count)
      - increment count
    - otherwise
      - add (token, 1)

The word class

```
class Word {
  // Each Word is a pair: the word, and its frequency
  String word;
  int freq;
  Word(String newWord) {  // Constructor
    word = newWord;
    freq = 1;
  } // Word()
  String getWord() {
    return word;
  } // getWord()
  int getFreq() {
    return freq;
  } // getFreq()
  void incr() {  // increments the word count
    freq++;
  } // incr()
  String toString() {  // print representation of Word objects
    return "<"+word+", "+freq+">";
  }
} // class Word
```

Data Structures

- Ways of storing and organizing data
- Arrays
  - Must know the size ahead of time
  - Can not grow and shrink at will
  - except:
    - `append(array, value)` - Expands an array by one element and adds value to the new position. Type of value must match type of array. Creates a new array.

Built-in Collection Classes

- ArrayList
  - A built-in object that stores and manages an *arbitrary* number of data items of any type (Objects).
  - Objects in an ArrayList are accessed by **index** [0..size-1]
- HashMap
  - A built-in object that stores and manages an *arbitrary* number of data items of any type (Objects).
  - Objects in a HashMap are accessed by a **key**, which can be another Object, frequently a String.

ArrayList

- Constructors

```
ArrayList lst1 = new ArrayList();
ArrayList lst2 = new ArrayList(int initialSize);
ArrayList<String> strList = new ArrayList();
```

- Fields
- Methods

```
size()                          // Returns the num of items held.
add(Object o)                   // Appends o to end.
add(int idx, Object o)          // Inserts o at pos idx.
remove(int idx)                 // Removes item at pos idx.
get(int idx)                    // Gets items at idx. No removal.
set(int idx, Object o)          // Replaces item at idx with o.
clear()                         // Removes all items.
isEmpty()                       // true if empty.
toArray()                       // returns an array that contains
                                // the contents of the list
```

ArrayList Example – Box Dropper

```
// Box Dropper
ArrayList boxes = new ArrayList();
//ArrayList<Box> boxes new ArrayList();

void setup() { size(500, 500); }

void draw() {
  background(0);

  for (int i = boxes.size()-1; i>=0; i--) {
    //boxes.get(i).draw();      // Fails. Why?
    Box b = (Box)boxes.get(i);  // Type cast Object->Box
    if(b.update()) {
      boxes.remove(i);
      println(boxes.size() + " boxes remaining");
    }
    else {
      b.draw();
    }
  }
}

void mousePressed() {
  Box b = new Box(mouseX, mouseY);
  boxes.add(b);
  println( boxes.size() + " boxes in ArrayList" );
}
```

```
// A simple Box class
class Box {
  float x, y, v;

  Box(float tx, float ty) {
    x = tx;  // x position
    y = ty;  // y position
    v = 0.0; // y velocity
  }

  void draw() {
    fill(200);
    rect(x, y, 20, 20);
  }

  boolean update(){
    y += v;
    v += 0.02;
    return (y>height);
  }
}
```

- Why can we not call draw() directly on item in ArrayList?
- Why do we loop over ArrayList backwards?

ArrayList Example - Fireworks

Make the set using an ArrayList

```
ArrayList<Word> wordFrequency = new ArrayList();

// Compute the wordFrequency table using tokens
for (String t : tokens) {
  // See if token t is already a known word
  int index = search(t, wordFrequency);
  if (index >= 0) {
    wordFrequency.get(index).incr();
  }
  else {
    wordFrequency.add(new Word(t));
  } // if
} // for
```

HashMap

- Constructors

```
HashMap map1 = new HashMap();
HashMap map2 = new HashMap(int initialCapacity);
```

- Fields
- Methods

```
size()                          // Returns num of items held.

put(Object key, Object o)       // Puts o in map at key

remove(Object key)              // Remove Object at key

get(Object key)                 // Get Object at key

containsKey(Object key) // True if map contains key

containsValue(Object val)       // True if map contains val

clear()                         // Removes all items.

isEmpty()                       // true if empty.
```

Count the words (second way)

- Use a HashMap (a dictionary from words → counts)
- `HashMap <String,Integer> wordCountSet = new HashMap<String,Integer>();`
- to add a new word:
  - `wordCountSet.put(word,1); // initial count is 1`
- to get the frequency of a word:
  - `Integer frequency = wordCountSet.get(word); // if null, then none`
- to update the frequency of a word:
  - `wordCountSet.put(word, frequeny + 1);`