Regular Expressions

Chapter 11

Python for Everybody
www.py4e.com

Regular Expressions

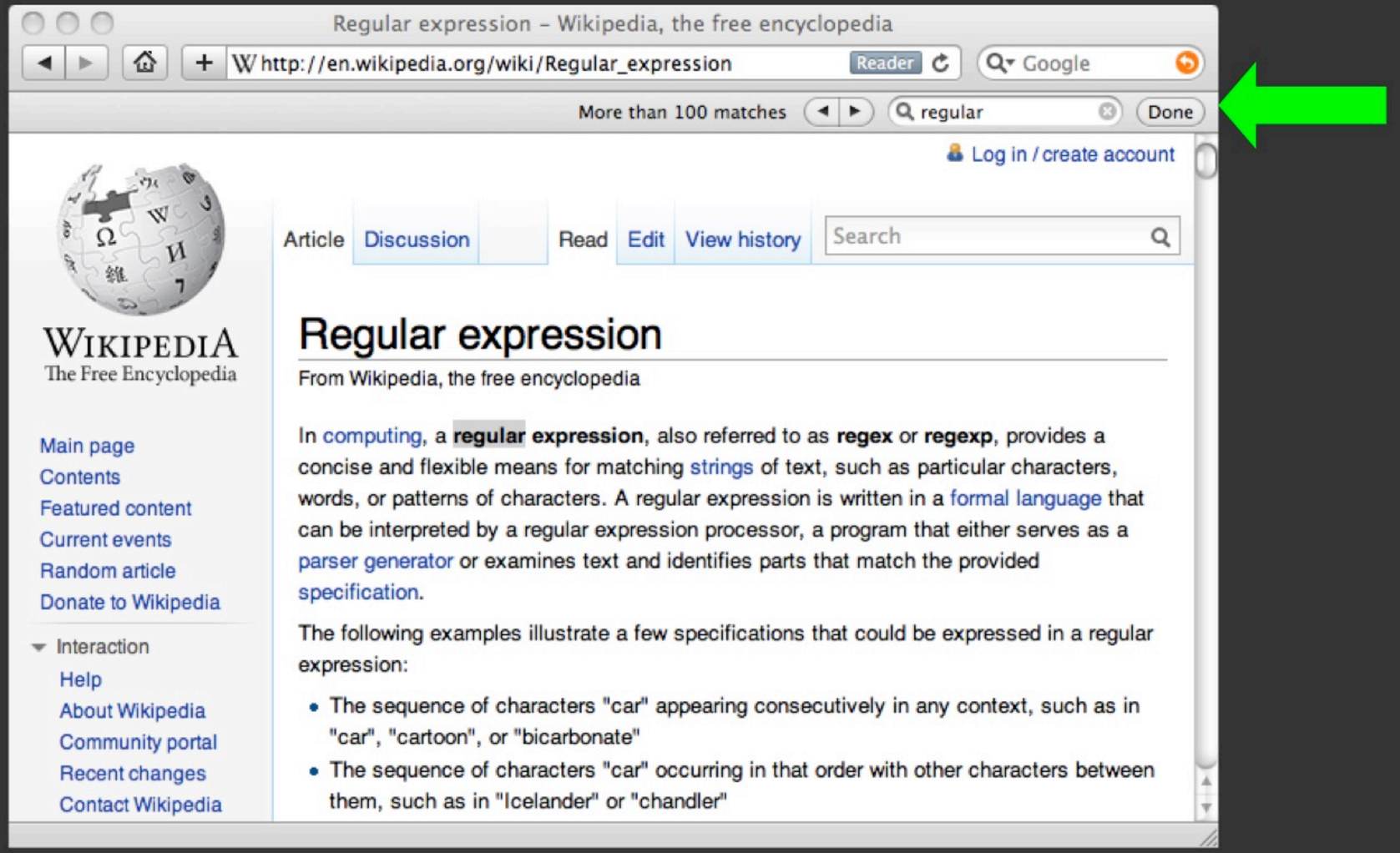
In computing, a regular expression, also referred to as “regex” or “regexp”, provides a concise and flexible means for matching strings of text, such as particular characters, words, or patterns of characters. A regular expression is written in a formal language that can be interpreted by a regular expression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



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

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.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)
```

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
```

```
^X.*:
```

Wild-Card Characters

- The dot character matches any character
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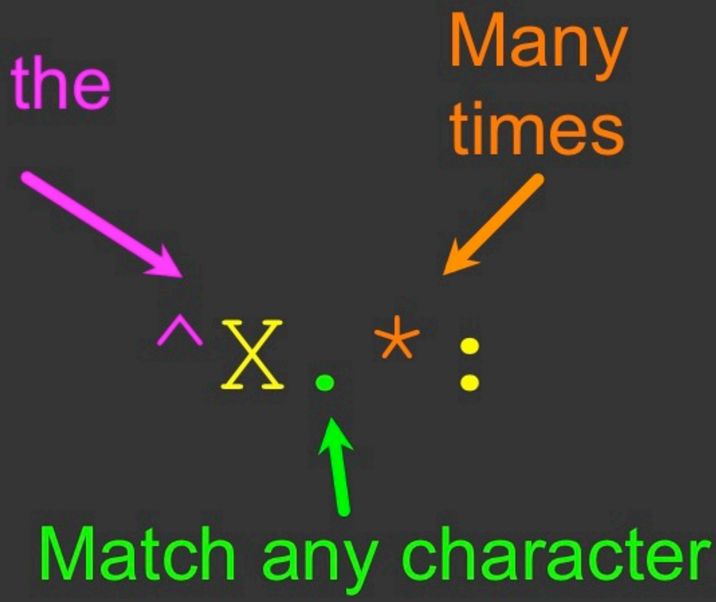
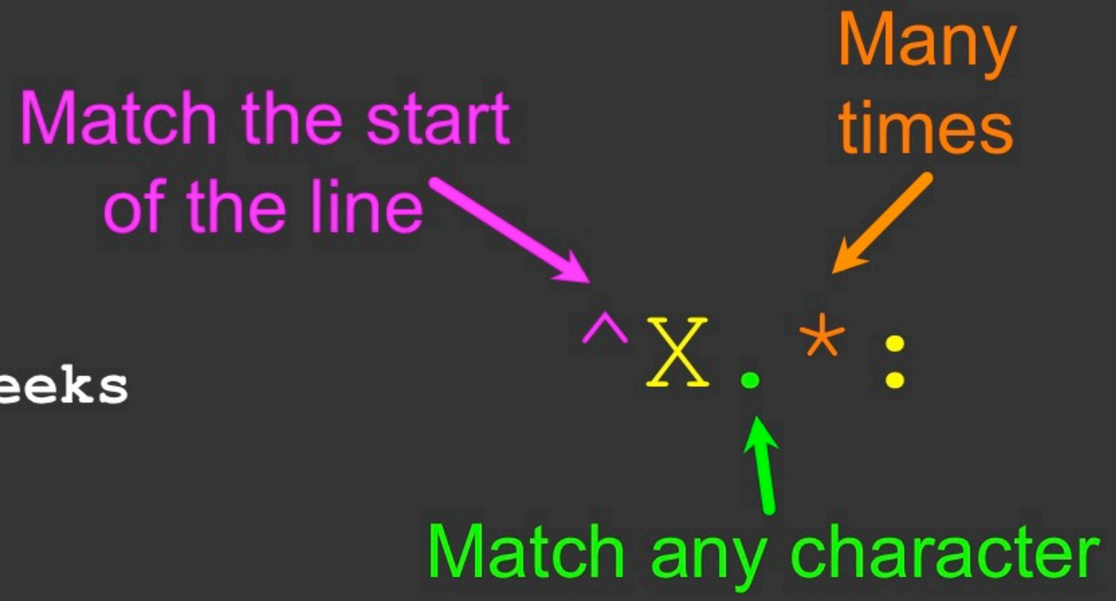
```
X-Sieve: CMU Sieve 2.3
X-DSPAM-Result: Innocent
X-DSPAM-Confidence: 0.8475
X-Content-Type-Message-Body: text/plain
```



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

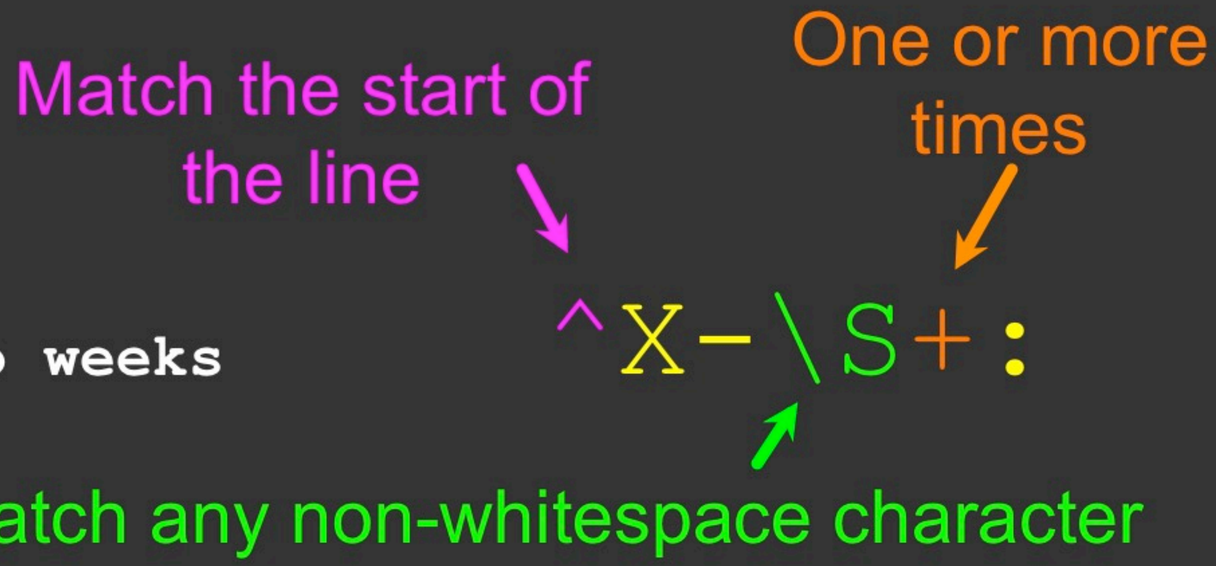
```
X-Sieve: CMU Sieve 2.3
X-DSPAM-Result: Innocent
X-Plane is behind schedule: two weeks
```



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
```



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

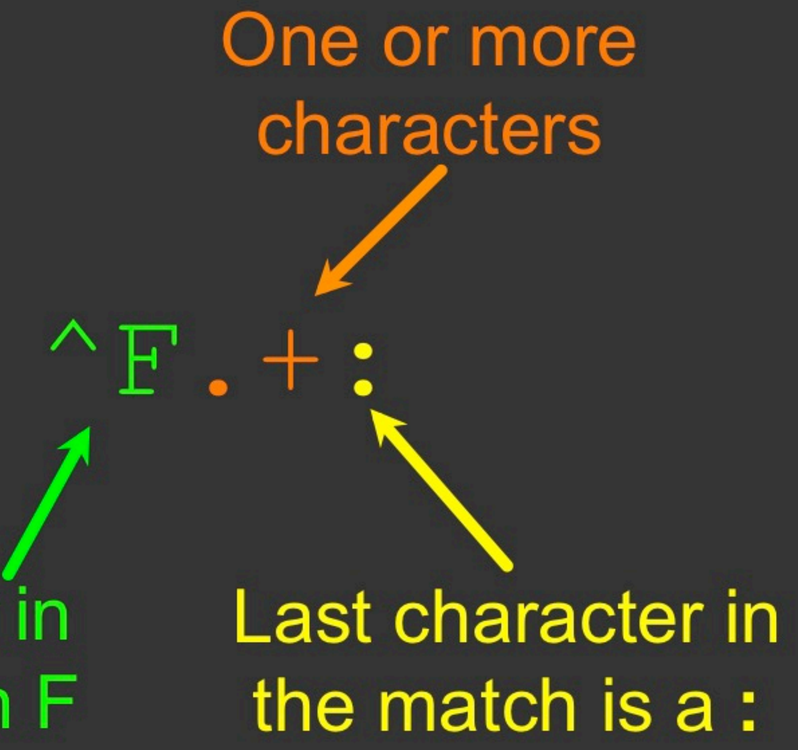
```
>>> import re
>>> x = 'My 2 favorite numbers are 19 and 42'
>>> y = re.findall('[0-9]+',x)
>>> print(y)
['2', '19', '42']
>>> y = re.findall('[AEIOU]+',x)
>>> print(y)
[]
```

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 :']
```

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 :

Advanced RegEx...

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+)
```


```
>>> 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']
```

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

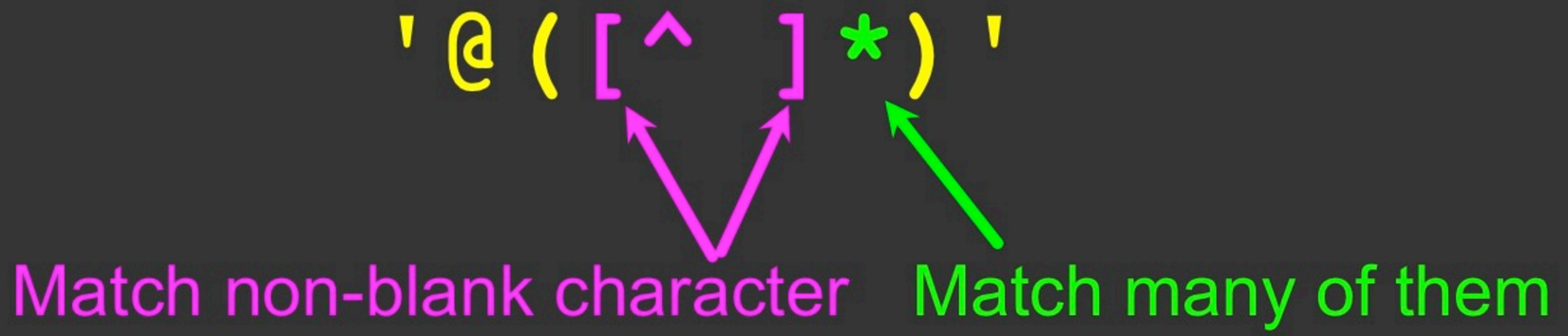
Look through the string until you find an at sign

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']
```



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']
```

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

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))
```

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

python ds.py
Maximum: 0.9907

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

...

Networked Programs

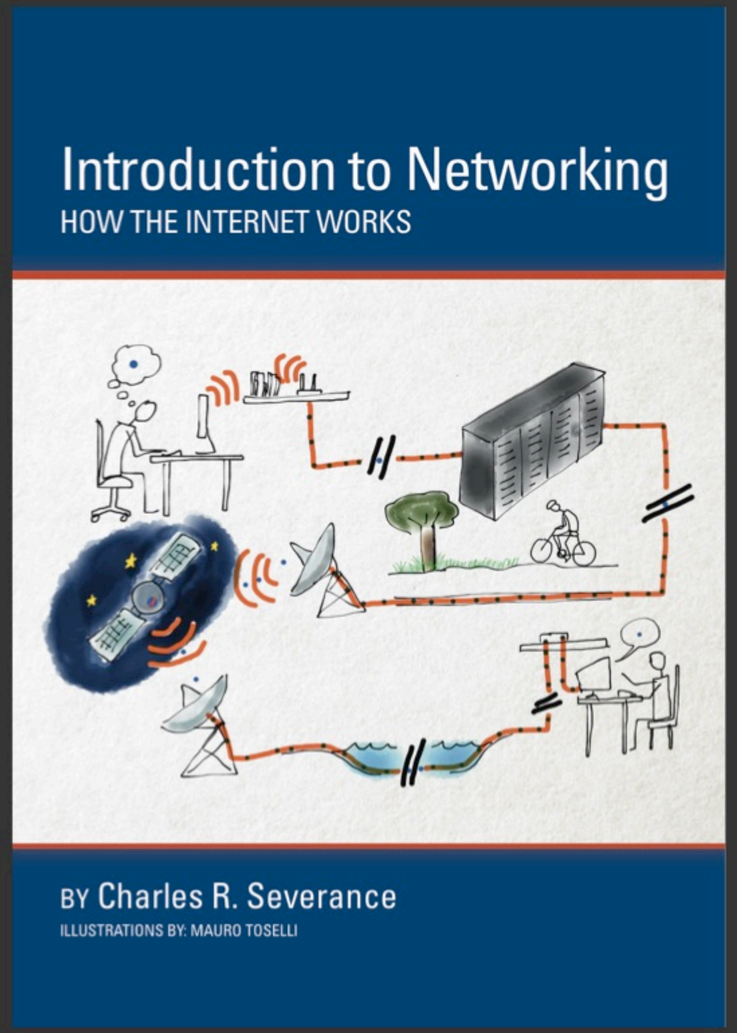
Chapter 12

Python for Everybody
www.py4e.com

A Free Book on Network Architecture

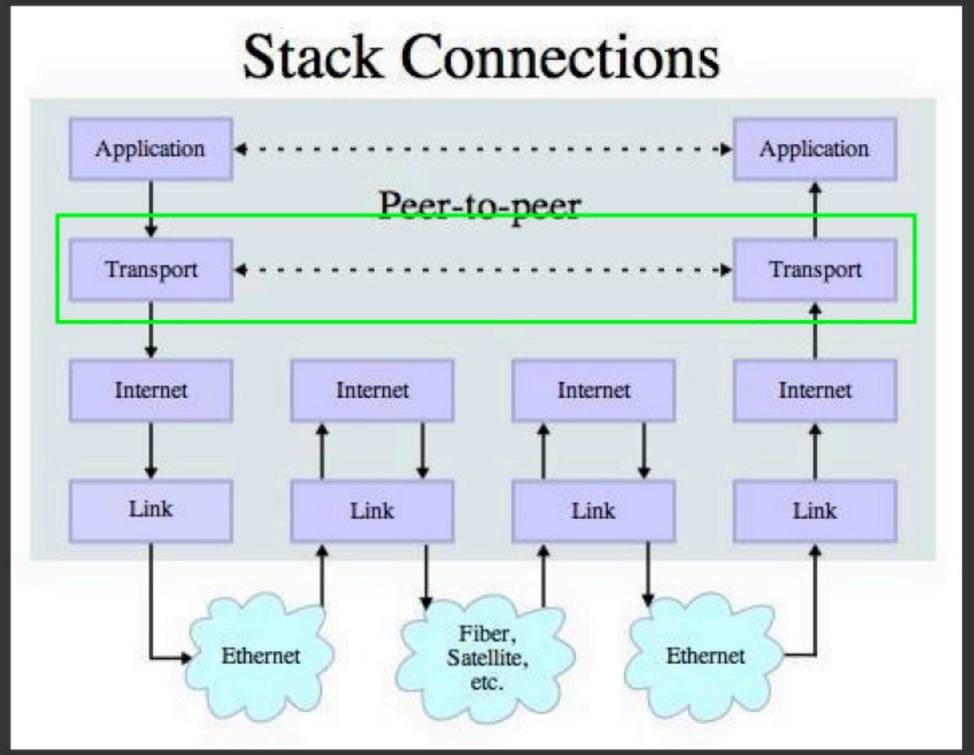
If you find this topic area interesting and/or need more detail

www.net-intro.com



Transport Control Protocol (TCP)

- Built on top of IP (Internet Protocol)
- Assumes IP might lose some data - stores and retransmits data if it seems to be lost
- Handles “flow control” using a transmit window
- Provides a nice reliable pipe



Source: http://en.wikipedia.org/wiki/Internet_Protocol_Suite

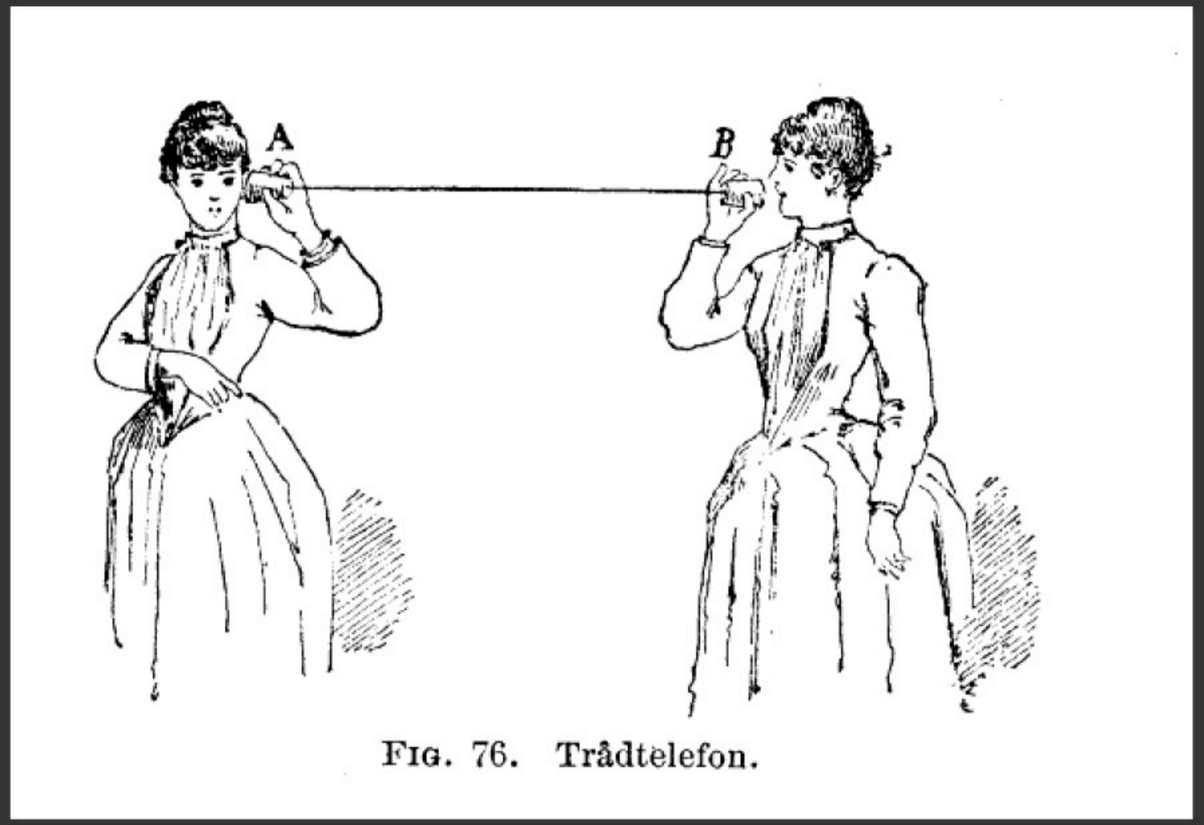


Fig. 76. Trådtelefon.

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

http://www.flickr.com/photos/kitcowan/2103850699/

TCP Connections / Sockets

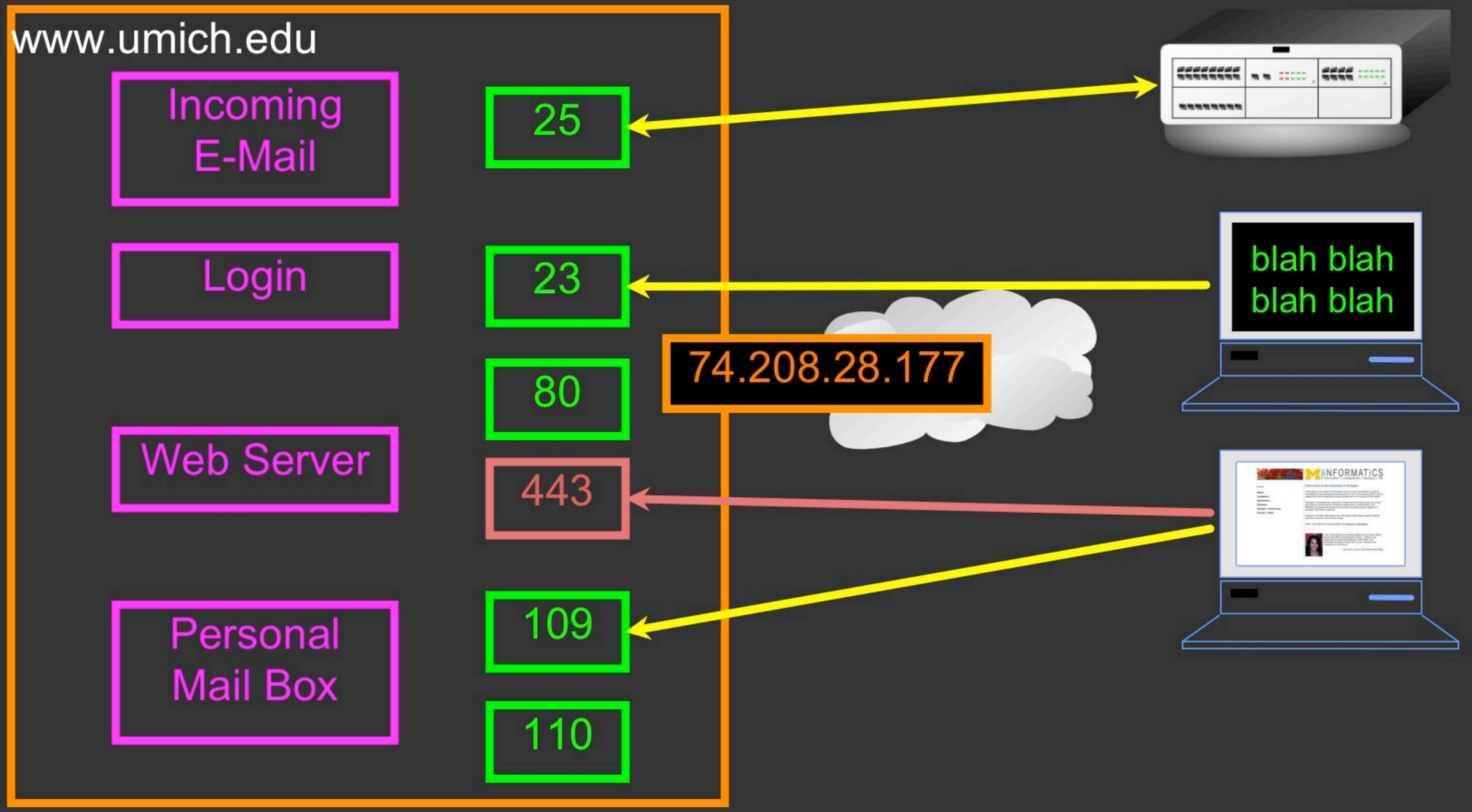
"In computer networking, an Internet socket or network socket is an endpoint of a bidirectional inter-process communication flow across an Internet Protocol-based computer network, such as the Internet."

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

TCP Port Numbers

- A port is an application-specific or process-specific software communications endpoint
- It allows multiple networked applications to coexist on the same server.
- There is a list of well-known TCP port numbers

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

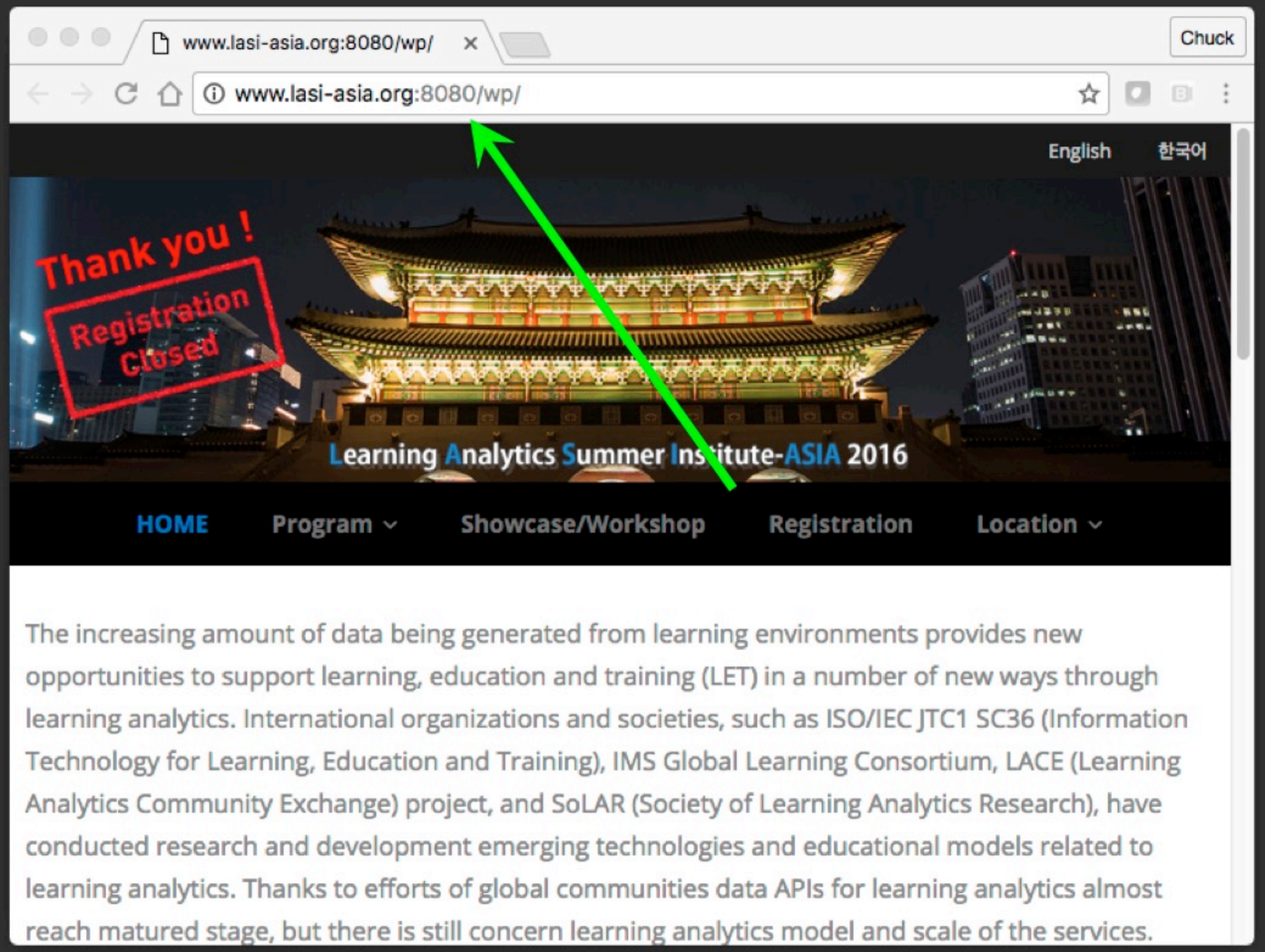


Clipart: http://www.clker.com/search/networksym/1

Common TCP Ports

- Telnet (23) - Login
- SSH (22) - Secure Login
- HTTP (80)
- HTTPS (443) - Secure
- SMTP (25) (Mail)
- IMAP (143/220/993) - Mail Retrieval
- POP (109/110) - Mail Retrieval
- DNS (53) - Domain Name
- FTP (21) - File Transfer

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



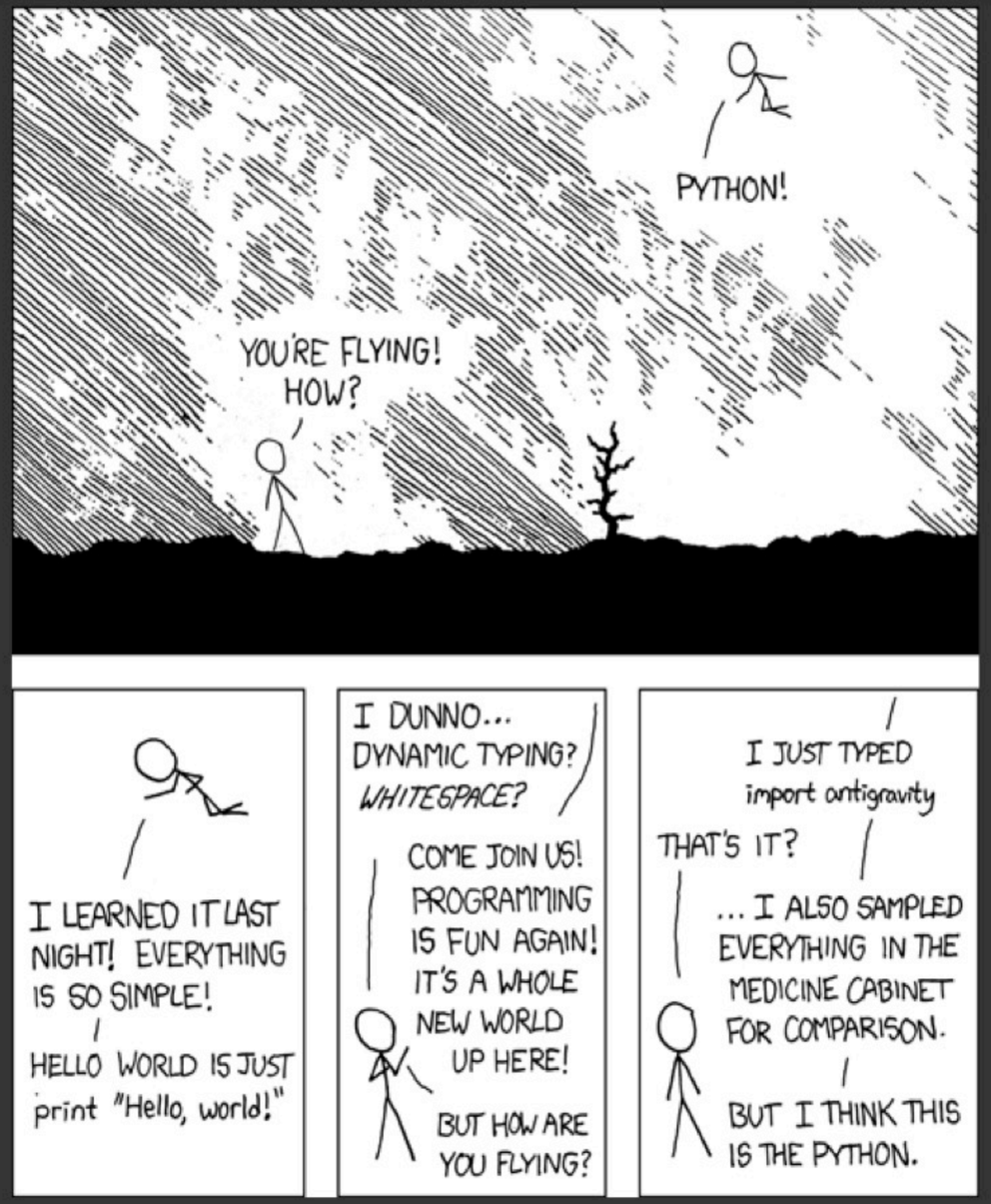
Sometimes we see the port number in the URL if the web server is running on a “non-standard” port.

Sockets in Python

Python has built-in support for TCP Sockets

```
import socket
mysock = socket.socket(socket.AF_INET, socket.SOCK_STREAM)
mysock.connect( ('data.pr4e.org', 80) )
```

http://docs.python.org/library/socket.html



http://xkcd.com/353/

Communicating on Sockets in Python

Acknowledgements / Contributions

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

… Insert new Contributors here

...

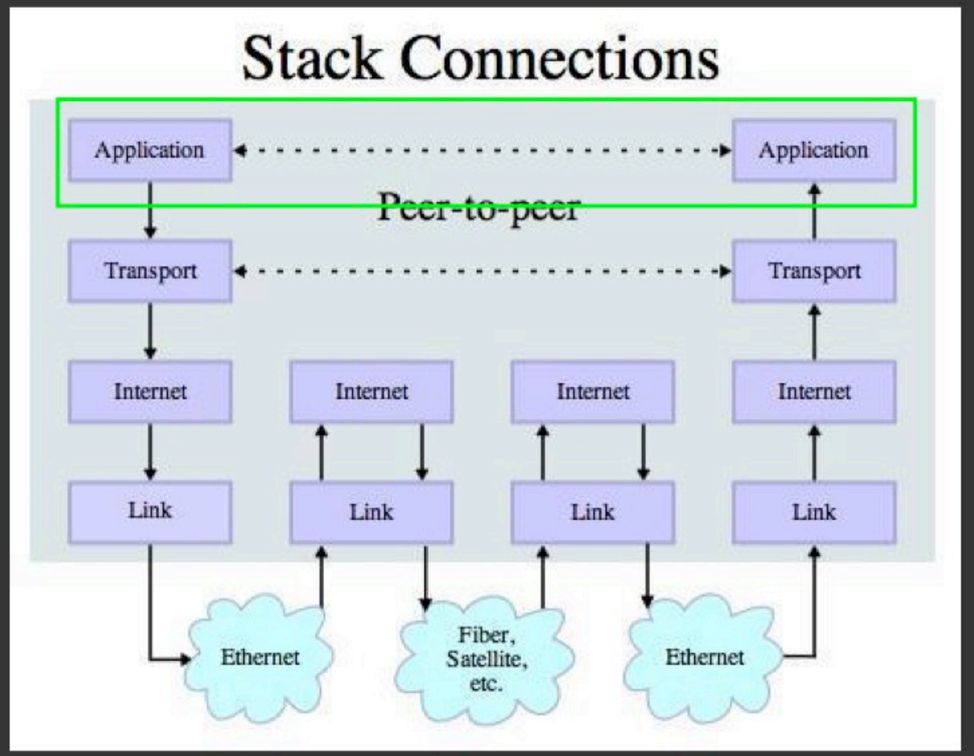
Application Protocol

- Since TCP (and Python) gives us a reliable socket, what do we want to do with the socket? What problem do we want to solve?

- Application Protocols

    - Mail

    - World Wide Web



Source: http://en.wikipedia.org/wiki/Internet_Protocol_Suite

HTTP - Hypertext Transfer Protocol

- The dominant Application Layer Protocol on the Internet
- Invented for the Web - to Retrieve HTML, Images, Documents, etc
- Extended to be data in addition to documents - RSS, Web Services, etc..Basic Concept - Make a Connection - Request a document - Retrieve the Document - Close the Connection

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

HTTP

The HyperText Transfer Protocol is the set of rules to allow browsers to retrieve web documents from servers over the Internet

What is a Protocol?

- A set of rules that all parties follow so we can predict each other's behavior
- And not bump into each other
    - On two-way roads in USA, drive on the right-hand side of the road
    - On two-way roads in the UK, drive on the left-hand side of the road

http://www.dr-chuck.com/page1.htm

protocol host document

http://www.youtube.com/watch?v=x2GylLq59rI

1:17 - 2:19

Getting Data From The Server

Each the user clicks on an anchor tag with an href= value to switch to a new page, the browser makes a connection to the web server and issues a "GET" request - to GET the content of the page at the specified URL

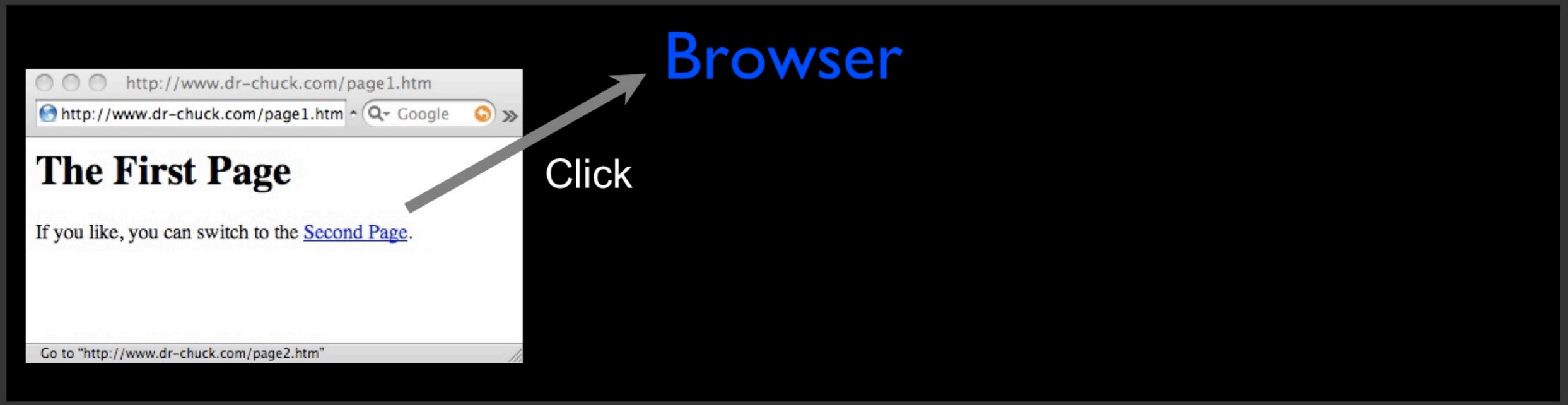
The server returns the HTML document to the Browser which formats and displays the document to the user.

Web Server

80

Browser


Web Server
80


Browser
http://www.dr-chuck.com/page1.htm
http://www.dr-chuck.com/page1.htm
Google
The First Page
If you like, you can switch to the Second Page.
Go to "http://www.dr-chuck.com/page2.htm"
Click

Request

Web Server

80

GET http://www.dr-chuck.com/page2.htm

Browser

Click

Request

Web Server

80

GET http://www.dr-chuck.com/page2.htm

Browser

Click

Request

Web Server

80

Response

GET http://www.dr-chuck.com/page2.htm

<h1>The Second Page</h1> If you like, you can switch back to the First Page.

Browser

Click

Request

Web Server

80

Response

GET http://www.dr-chuck.com/page2.htm

<h1>The Second Page</h1> If you like, you can switch back to the First Page.

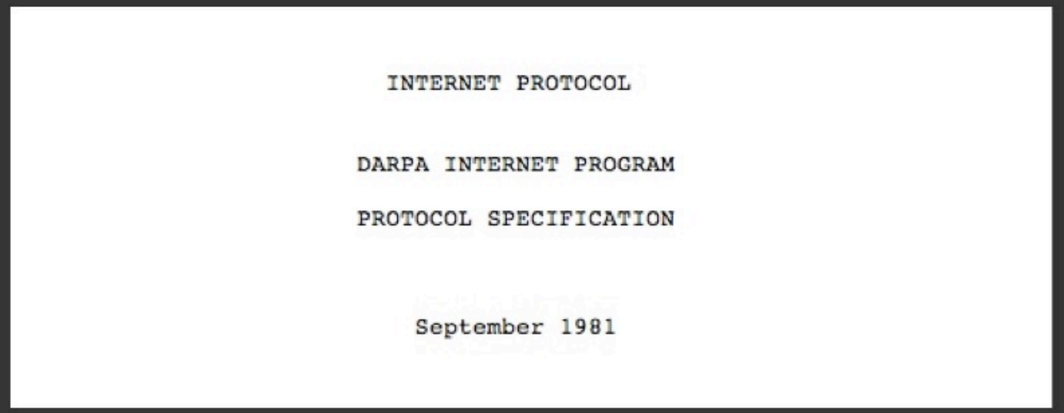
Browser

Click

Parse/
Render

Internet Standards

- The standards for all of the Internet protocols (inner workings) are developed by an organization
- Internet Engineering Task Force (IETF)
- www.ietf.org
- Standards are called "RFCs" - "Request for Comments"



INTERNET PROTOCOL

DARPA INTERNET PROGRAM

PROTOCOL SPECIFICATION

September 1981

The internet protocol treats each internet datagram as an independent entity unrelated to any other internet datagram. There are no connections or logical circuits (virtual or otherwise).

The internet protocol uses four key mechanisms in providing its service: Type of Service, Time to Live, Options, and Header Checksum.

Source: http://tools.ietf.org/html/rfc791

http://www.w3.org/Protocols/rfc2616/rfc2616.txt

Network Working Group
Request for Comments: 2616
Obsoletes: 2068
Category: Standards Track

R. Fielding
UC Irvine
J. Gettys
Compaq/W3C
J. Mogul
Compaq
H. Frystyk
W3C/MIT
L. Masinter
Xerox
P. Leach
Microsoft
T. Berners-Lee
W3C/MIT
June 1999

Hypertext Transfer Protocol -- HTTP/1.1

Status of this Memo

This document specifies an Internet standards track protocol for the Internet community, and requests discussion and suggestions for improvements. Please refer to the current edition of the "Internet Official Protocol Standards" (STD 1) for the standardization state and status of this protocol. Distribution of this memo is unlimited.

Abstract

The Hypertext Transfer Protocol (HTTP) is an application-level protocol for distributed, collaborative, hypermedia information

```
5 Request

   A request message from a client to a server includes, within the
   first line of that message, the method to be applied to the resource,
   the identifier of the resource, and the protocol version in use.

        Request       = Request-Line              ; Section 5.1
                        *(( general-header        ; Section 4.5
                         | request-header         ; Section 5.3
                         | entity-header ) CRLF)  ; Section 7.1
                        CRLF
                        [ message-body ]          ; Section 4.3

5.1 Request-Line

   The Request-Line begins with a method token, followed by the
   Request-URI and the protocol version, and ending with CRLF. The
   elements are separated by SP characters. No CR or LF is allowed
   except in the final CRLF sequence.

        Request-Line   = Method SP Request-URI SP HTTP-Version CRLF
```

Making an HTTP request

Connect to the server like www.dr-chuck.com"

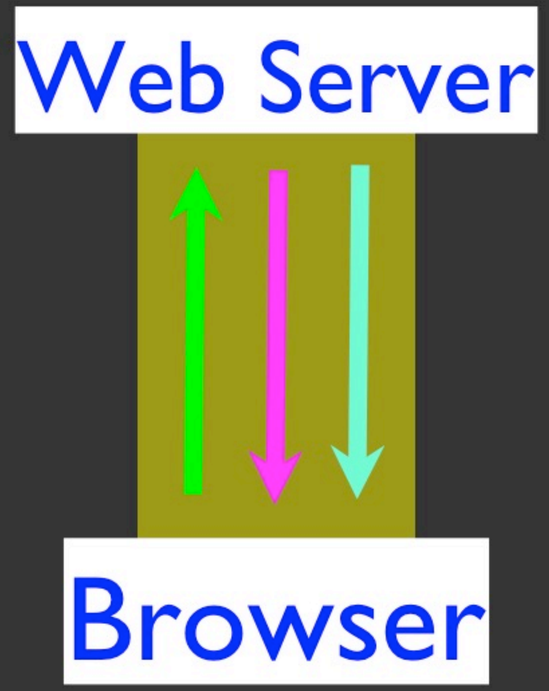
Request a document (or the default document)

- *GET http://www.dr-chuck.com/page1.htm HTTP/1.0*
- *GET http://www.mlive.com/ann-arbor/ HTTP/1.0*
- *GET http://www.facebook.com HTTP/1.0*

```
$ telnet www.dr-chuck.com 80
Trying 74.208.28.177...
Connected to www.dr-chuck.com.Escape character is '^]'.
GET http://www.dr-chuck.com/page1.htm HTTP/1.0

HTTP/1.1 200 OK
Date: Thu, 08 Jan 2015 01:57:52 GMT
Last-Modified: Sun, 19 Jan 2014 14:25:43 GMT
Connection: close
Content-Type: text/html

<h1>The First Page</h1>
<p>If you like, you can switch to
the <a href="http://www.dr-chuck.com/page2.htm">Second
Page</a>.</p>
Connection closed by foreign host.
```



Accurate Hacking in the Movies

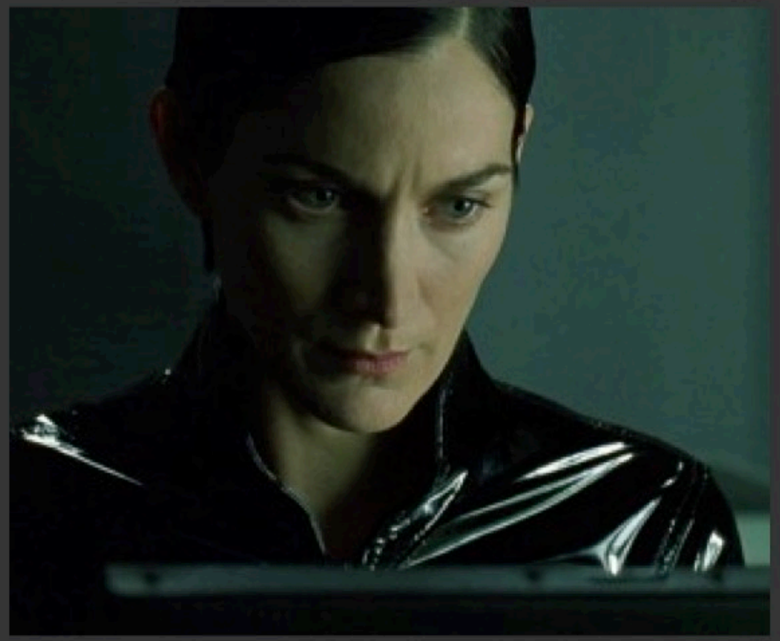
Matrix Reloaded

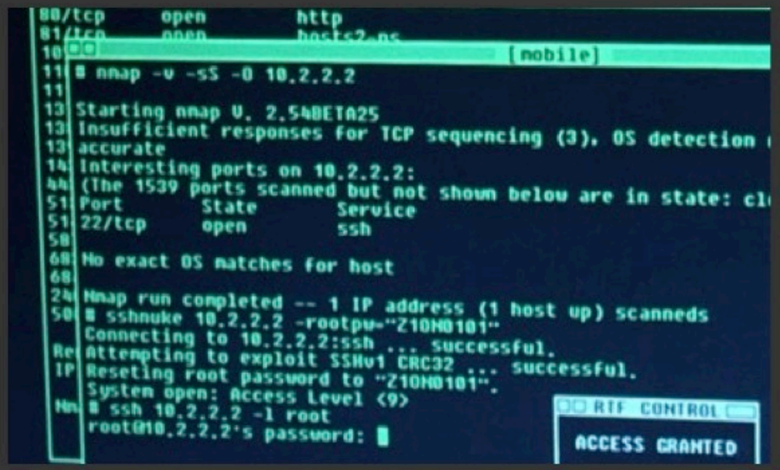
Bourne Ultimatum

Die Hard 4

...

http://nmap.org/movies.html



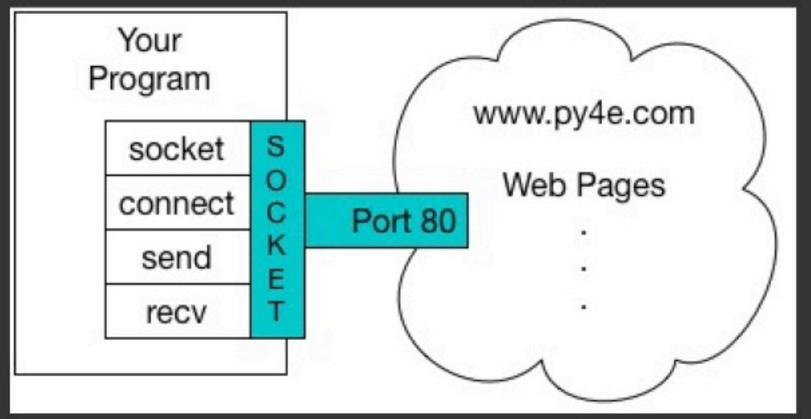


An HTTP Request in Python

```
import socket

mysock = socket.socket(socket.AF_INET, socket.SOCK_STREAM)
mysock.connect(('data.pr4e.org', 80))
cmd = 'GET http://data.pr4e.org/romeo.txt HTTP/1.0\n\n'.encode()
mysock.send(cmd)

while True:
    data = mysock.recv(512)
    if (len(data) < 1):
        break
    print(data.decode())
mysock.close()
```



```
HTTP/1.1 200 OK
Date: Sun, 14 Mar 2010 23:52:41 GMT
Server: Apache
Last-Modified: Tue, 29 Dec 2009 01:31:22 GMT
ETag: "143c1b33-a7-4b395bea"
Accept-Ranges: bytes
Content-Length: 167
Connection: close
Content-Type: text/plain

But soft what light through yonder window breaks
It is the east and Juliet is the sun
Arise fair sun and kill the envious moon
Who is already sick and pale with grief
```

HTTP Header

```
while True:
    data = mysock.recv(512)
    if ( len(data) < 1 ) :
        break
    print(data.decode())
```

HTTP Body

About Characters and Strings…

Acknowledgements / Contributions

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

… Insert new Contributors here

...

ASCII

American Standard Code for Information Interchange

Dec	Hex	Oct	Bin	Char	Dec	Hex	Oct	Bin	Char	Dec	Hex	Oct	Bin	Char	Dec	Hex	Oct	Bin	Char
0	0x00	000	0000000	NUL	32	0x20	040	0100000	space	64	0x40	100	1000000	@	96	0x60	140	1100000	`
1	0x01	001	0000001	SOH	33	0x21	041	0100001	!	65	0x41	101	1000001	A	97	0x61	141	1100001	a
2	0x02	002	0000010	STX	34	0x22	042	0100010	"	66	0x42	102	1000010	B	98	0x62	142	1100010	b
3	0x03	003	0000011	ETX	35	0x23	043	0100011	#	67	0x43	103	1000011	C	99	0x63	143	1100011	c
4	0x04	004	0000100	EOT	36	0x24	044	0100100	$	68	0x44	104	1000100	D	100	0x64	144	1100100	d
5	0x05	005	0000101	ENQ	37	0x25	045	0100101	%	69	0x45	105	1000101	E	101	0x65	145	1100101	e
6	0x06	006	0000110	ACK	38	0x26	046	0100110	&	70	0x46	106	1000110	F	102	0x66	146	1100110	f
7	0x07	007	0000111	BEL	39	0x27	047	0100111	'	71	0x47	107	1000111	G	103	0x67	147	1100111	g
8	0x08	010	0001000	BS	40	0x28	050	0101000	(	72	0x48	110	1001000	H	104	0x68	150	1101000	h
9	0x09	011	0001001	TAB	41	0x29	051	0101001	)	73	0x49	111	1001001	I	105	0x69	151	1101001	i
10	0x0A	012	0001010	LF	42	0x2A	052	0101010	*	74	0x4A	112	1001010	J	106	0x6A	152	1101010	j
11	0x0B	013	0001011	VT	43	0x2B	053	0101011	+	75	0x4B	113	1001011	K	107	0x6B	153	1101011	k
12	0x0C	014	0001100	FF	44	0x2C	054	0101100	,	76	0x4C	114	1001100	L	108	0x6C	154	1101100	l
13	0x0D	015	0001101	CR	45	0x2D	055	0101101	-	77	0x4D	115	1001101	M	109	0x6D	155	1101101	m
14	0x0E	016	0001110	SO	46	0x2E	056	0101110	.	78	0x4E	116	1001110	N	110	0x6E	156	1101110	n
15	0x0F	017	0001111	SI	47	0x2F	057	0101111	/	79	0x4F	117	1001111	O	111	0x6F	157	1101111	o
16	0x10	020	0010000	DLE	48	0x30	060	0110000	0	80	0x50	120	1010000	P	112	0x70	160	1110000	p
17	0x11	021	0010001	DC1	49	0x31	061	0110001	1	81	0x51	121	1010001	Q	113	0x71	161	1110001	q
18	0x12	022	0010010	DC2	50	0x32	062	0110010	2	82	0x52	122	1010010	R	114	0x72	162	1110010	r
19	0x13	023	0010011	DC3	51	0x33	063	0110011	3	83	0x53	123	1010011	S	115	0x73	163	1110011	s
20	0x14	024	0010100	DC4	52	0x34	064	0110100	4	84	0x54	124	1010100	T	116	0x74	164	1110100	t
21	0x15	025	0010101	NAK	53	0x35	065	0110101	5	85	0x55	125	1010101	U	117	0x75	165	1110101	u
22	0x16	026	0010110	SYN	54	0x36	066	0110110	6	86	0x56	126	1010110	V	118	0x76	166	1110110	v
23	0x17	027	0010111	ETB	55	0x37	067	0110111	7	87	0x57	127	1010111	W	119	0x77	167	1110111	w
24	0x18	030	0011000	CAN	56	0x38	070	0111000	8	88	0x58	130	1011000	X	120	0x78	170	1111000	x
25	0x19	031	0011001	EM	57	0x39	071	0111001	9	89	0x59	131	1011001	Y	121	0x79	171	1111001	y
26	0x1A	032	0011010	SUB	58	0x3A	072	0111010	:	90	0x5A	132	1011010	Z	122	0x7A	172	1111010	z
27	0x1B	033	0011011	ESC	59	0x3B	073	0111011	;	91	0x5B	133	1011011	[	123	0x7B	173	1111011	{
28	0x1C	034	0011100	FS	60	0x3C	074	0111100	<	92	0x5C	134	1011100	\	124	0x7C	174	1111100	|
29	0x1D	035	0011101	GS	61	0x3D	075	0111101	=	93	0x5D	135	1011101	]	125	0x7D	175	1111101	}
30	0x1E	036	0011110	RS	62	0x3E	076	0111110	>	94	0x5E	136	1011110	^	126	0x7E	176	1111110	~
31	0x1F	037	0011111	US	63	0x3F	077	0111111	?	95	0x5F	137	1011111	_	127	0x7F	177	1111111	DEL

https://en.wikipedia.org/wiki/ASCII

http://www.catonmat.net/download/ascii-cheat-sheet.png

Representing Simple Strings

- Each character is represented by a number between 0 and 256 stored in 8 bits of memory

- We refer to "8 bits of memory as a "byte" of memory – (i.e. my disk drive contains 3 Terabytes of memory)

- The ord() function tells us the numeric value of a simple ASCII character

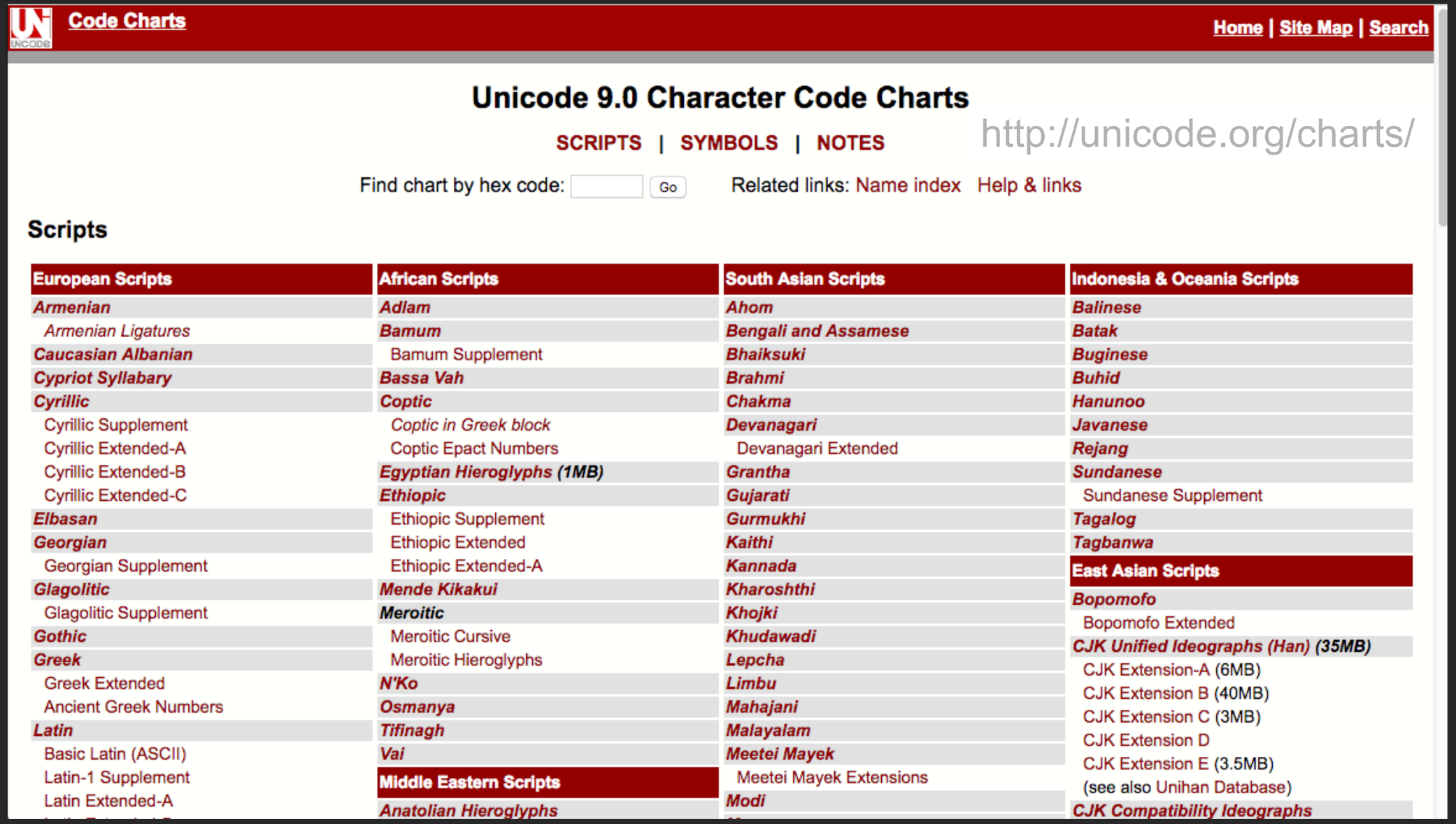
```
>>> print(ord('H'))
72
>>> print(ord('e'))
101
>>> print(ord('\n'))
10
>>>
```

ASCII

```
>>> print(ord('H'))
72
>>> print(ord('e'))
101
>>> print(ord('\n'))
10
>>>
```

In the 1960s and 1970s, we just assumed that one byte was one character

Dec	Hex	Oct	Bin	Char	Dec	Hex	Oct	Bin	Char	Dec	Hex	Oct	Bin	Char	Dec	Hex	Oct	Bin	Char
0	0x00	000	0000000	NUL	32	0x20	040	0100000	space	64	0x40	100	1000000	@	96	0x60	140	1100000	`
1	0x01	001	0000001	SOH	33	0x21	041	0100001	!	65	0x41	101	1000001	A	97	0x61	141	1100001	a
2	0x02	002	0000010	STX	34	0x22	042	0100010	"	66	0x42	102	1000010	B	98	0x62	142	1100010	b
3	0x03	003	0000011	ETX	35	0x23	043	0100011	#	67	0x43	103	1000011	C	99	0x63	143	1100011	c
4	0x04	004	0000100	EOT	36	0x24	044	0100100	$	68	0x44	104	1000100	D	100	0x64	144	1100100	d
5	0x05	005	0000101	ENQ	37	0x25	045	0100101	%	69	0x45	105	1000101	E	101	0x65	145	1100101	e
6	0x06	006	0000110	ACK	38	0x26	046	0100110	&	70	0x46	106	1000110	F	102	0x66	146	1100110	f
7	0x07	007	0000111	BEL	39	0x27	047	0100111	'	71	0x47	107	1000111	G	103	0x67	147	1100111	g
8	0x08	010	0001000	BS	40	0x28	050	0101000	(	72	0x48	110	1001000	H	104	0x68	150	1101000	h
9	0x09	011	0001001	TAB	41	0x29	051	0101001	)	73	0x49	111	1001001	I	105	0x69	151	1101001	i
10	0x0A	012	0001010	LF	42	0x2A	052	0101010	*	74	0x4A	112	1001010	J	106	0x6A	152	1101010	j
11	0x0B	013	0001011	VT	43	0x2B	053	0101011	+	75	0x4B	113	1001011	K	107	0x6B	153	1101011	k
12	0x0C	014	0001100	FF	44	0x2C	054	0101100	,	76	0x4C	114	1001100	L	108	0x6C	154	1101100	l
13	0x0D	015	0001101	CR	45	0x2D	055	0101101	-	77	0x4D	115	1001101	M	109	0x6D	155	1101101	m
14	0x0E	016	0001110	SO	46	0x2E	056	0101110	.	78	0x4E	116	1001110	N	110	0x6E	156	1101110	n
15	0x0F	017	0001111	SI	47	0x2F	057	0101111	/	79	0x4F	117	1001111	O	111	0x6F	157	1101111	o
16	0x10	020	0010000	DLE	48	0x30	060	0110000	0	80	0x50	120	1010000	P	112	0x70	160	1110000	p
17	0x11	021	0010001	DC1	49	0x31	061	0110001	1	81	0x51	121	1010001	Q	113	0x71	161	1110001	q
18	0x12	022	0010010	DC2	50	0x32	062	0110010	2	82	0x52	122	1010010	R	114	0x72	162	1110010	r
19	0x13	023	0010011	DC3	51	0x33	063	0110011	3	83	0x53	123	1010011	S	115	0x73	163	1110011	s
20	0x14	024	0010100	DC4	52	0x34	064	0110100	4	84	0x54	124	1010100	T	116	0x74	164	1110100	t
21	0x15	025	0010101	NAK	53	0x35	065	0110101	5	85	0x55	125	1010101	U	117	0x75	165	1110101	u
22	0x16	026	0010110	SYN	54	0x36	066	0110110	6	86	0x56	126	1010110	V	118	0x76	166	1110110	v
23	0x17	027	0010111	ETB	55	0x37	067	0110111	7	87	0x57	127	1010111	W	119	0x77	167	1110111	w
24	0x18	030	0011000	CAN	56	0x38	070	0111000	8	88	0x58	130	1011000	X	120	0x78	170	1111000	x
25	0x19	031	0011001	EM	57	0x39	071	0111001	9	89	0x59	131	1011001	Y	121	0x79	171	1111001	y
26	0x1A	032	0011010	SUB	58	0x3A	072	0111010	:	90	0x5A	132	1011010	Z	122	0x7A	172	1111010	z
27	0x1B	033	0011011	ESC	59	0x3B	073	0111011	;	91	0x5B	133	1011011	[	123	0x7B	173	1111011	{
28	0x1C	034	0011100	FS	60	0x3C	074	0111100	<	92	0x5C	134	1011100	\	124	0x7C	174	1111100	|
29	0x1D	035	0011101	GS	61	0x3D	075	0111101	=	93	0x5D	135	1011101	]	125	0x7D	175	1111101	}
30	0x1E	036	0011110	RS	62	0x3E	076	0111110	>	94	0x5E	136	1011110	^	126	0x7E	176	1111110	~
31	0x1F	037	0011111	US	63	0x3F	077	0111111	?	95	0x5F	137	1011111	_	127	0x7F	177	1111111	DEL



Code Charts

Home | Site Map | Search

Unicode 9.0 Character Code Charts

http://unicode.org/charts/

SCRIPTS | SYMBOLS | NOTES

Find chart by hex code: Go Related links: Name index Help & links

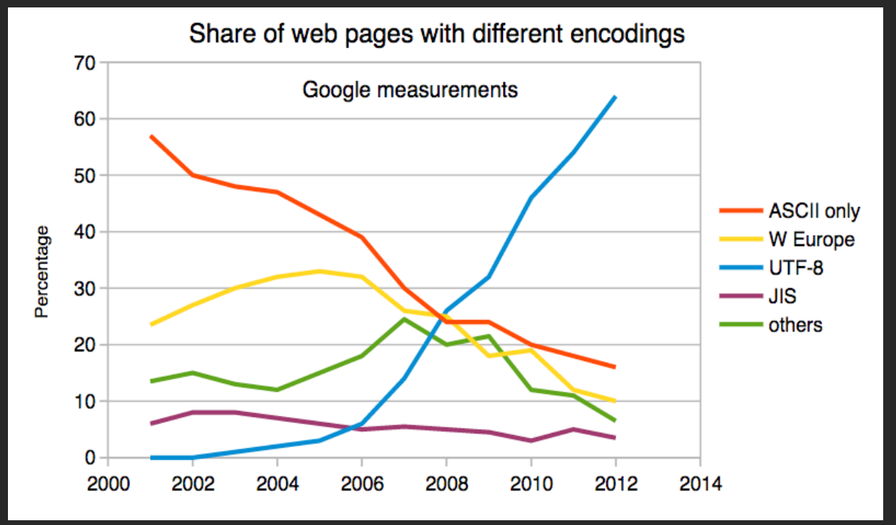
Scripts

European Scripts	African Scripts	South Asian Scripts	Indonesia & Oceania Scripts
Armenian	*Adlam*	*Ahom*	*Balinese*
Armenian Ligatures	*Bamum*	*Bengali and Assamese*	*Batak*
Caucasian Albanian	Bamum Supplement	*Bhaiksuki*	*Buginese*
Cypriot Syllabary	*Bassa Vah*	*Brahmi*	*Buhid*
Cyrillic	*Coptic*	*Chakma*	*Hanunoo*
Cyrillic Supplement	*Coptic in Greek block*	*Devanagari*	*Javanese*
Cyrillic Extended-A	Coptic Epact Numbers	Devanagari Extended	*Rejang*
Cyrillic Extended-B	*Egyptian Hieroglyphs (1MB)*	*Grantha*	*Sundanese*
Cyrillic Extended-C	*Ethiopic*	*Gujarati*	Sundanese Supplement
Elbasan	Ethiopic Supplement	*Gurmukhi*	*Tagalog*
Georgian	Ethiopic Extended	*Kaithi*	*Tagbanwa*
Georgian Supplement	Ethiopic Extended-A	*Kannada*	**East Asian Scripts**
Glagolitic	*Mende Kikakui*	*Kharoshthi*	*Bopomofo*
Glagolitic Supplement	*Meroitic*	*Khojki*	Bopomofo Extended
Gothic	Meroitic Cursive	*Khudawadi*	*CJK Unified Ideographs (Han) (35MB)*
Greek	Meroitic Hieroglyphs	*Lepcha*	CJK Extension-A (6MB)
Greek Extended	*N'Ko*	*Limbu*	CJK Extension B (40MB)
Ancient Greek Numbers	*Osmanya*	*Mahajani*	CJK Extension C (3MB)
Latin	*Tifinagh*	*Malayalam*	CJK Extension D
Basic Latin (ASCII)	*Vai*	*Meetei Mayek*	CJK Extension E (3.5MB)
Latin-1 Supplement	**Middle Eastern Scripts**	Meetei Mayek Extensions	(see also Unihan Database)
Latin Extended-A	*Anatolian Hieroglyphs*	*Modi*	*CJK Compatibility Ideographs*

Multi-Byte Characters

- To represent the wide range of characters computers must handle we represent characters with more than one byte
  - UTF-16 – Variable length – Two or Four Bytes
  - UTF-32 – Fixed Length – Four Bytes
  - UTF-8 – 1-4 bytes
    - *Upwards compatible with ASCII*
    - *Automatic detection between ASCII and UTF-8*
    - *UTF-8 is recommended practice for encoding data to be exchanged between systems*

https://en.wikipedia.org/wiki/UTF-8



Two Kinds of Strings in Python

```
Python 2.7.10
>>> x = '이광춘'
>>> type(x)
<type 'str'>
>>> x = u'이광춘'
>>> type(x)
<type 'unicode'>
>>>
```

```
Python 3.5.1
>>> x = '이광춘'
>>> type(x)
<class 'str'>
>>> x = u'이광춘'
>>> type(x)
<class 'str'>
>>>
```

In Python 3, all strings are Unicode

Python 2 Versus Python 3

```
Python 2.7.10
>>> x = b'abc'
>>> type(x)
<type 'str'>
>>> x = '이광춘'
>>> type(x)
<type 'str'>
>>> x = u'이광춘'
>>> type(x)
<type 'unicode'>
```

```
Python 3.5.1
>>> x = b'abc'
>>> type(x)
<class 'bytes'>
>>> x = '이광춘'
>>> type(x)
<class 'str'>
>>> x = u'이광춘'
>>> type(x)
<class 'str'>
```

Python 3 and Unicode

In Python 3, all strings internally are UNICODE

Working with string variables in Python programs and reading data from files usually "just works"

When we talk to a network resource using sockets or talk to a database we have to encode and decode data (usually to UTF-8)

```
Python 3.5.1
>>> x = b'abc'
>>> type(x)
<class 'bytes'>
>>> x = '이광춘'
>>> type(x)
<class 'str'>
>>> x = u'이광춘'
>>> type(x)
<class 'str'>
```

Python Strings to Bytes

- When we talk to an external resource like a network socket we sends bytes, so we need to encode Python 3 strings into a given character encoding
- When we read data from an external resource, we must decode it based on the character set so it is properly represented in Python 3 as a string

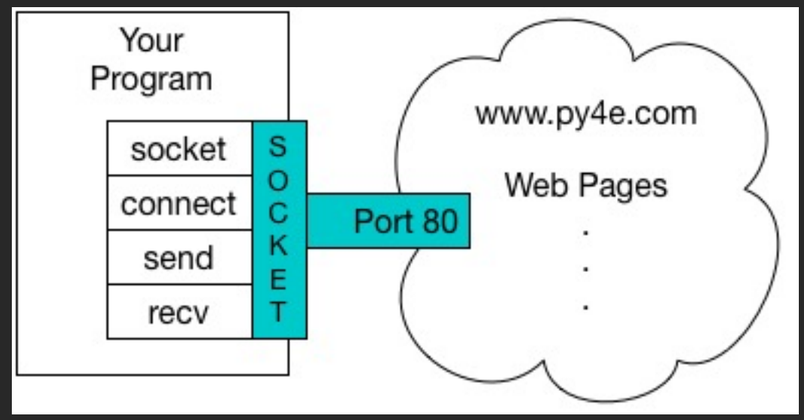
```
while True:
    data = mysock.recv(512)
    if ( len(data) < 1 ) :
        break
    mystring = data.decode()
    print(mystring)
```

An HTTP Request in Python

```
import socket

mysock = socket.socket(socket.AF_INET, socket.SOCK_STREAM)
mysock.connect(('data.pr4e.org', 80))
cmd = 'GET http://data.pr4e.org/romeo.txt HTTP/1.0\n\n'.encode()
mysock.send(cmd)

while True:
    data = mysock.recv(512)
    if (len(data) < 1):
        break
    print(data.decode())
mysock.close()
```



`bytes.`**`decode`**`(`*`encoding="utf-8", errors="strict"`*`)`

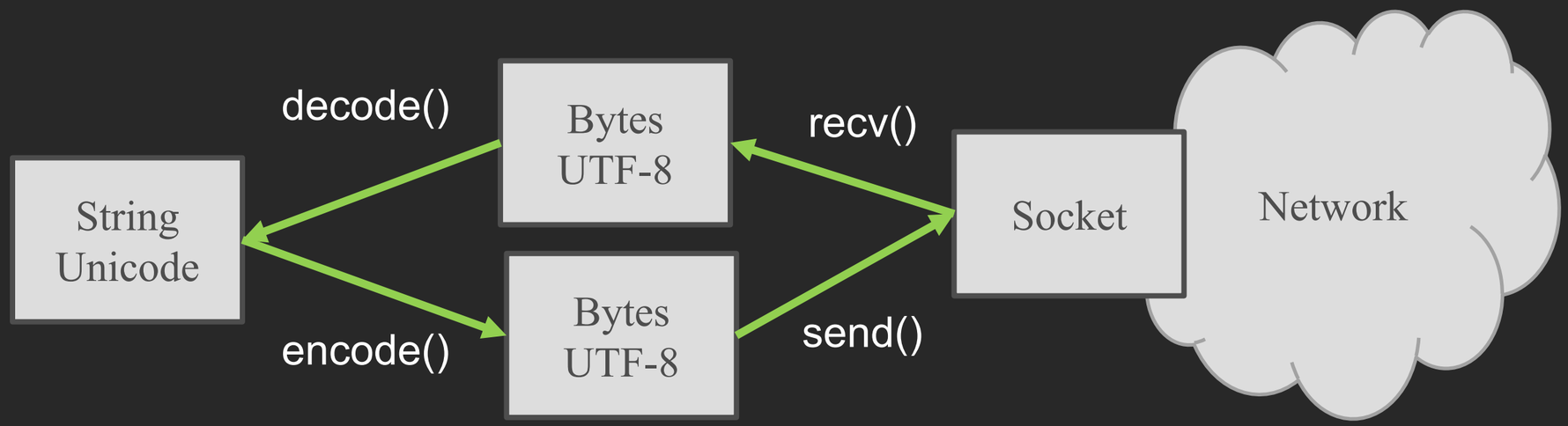
`bytearray.`**`decode`**`(`*`encoding="utf-8", errors="strict"`*`)`

Return a string decoded from the given bytes. Default encoding is `'utf-8'`. *errors* may be given to set a different error handling scheme. The default for *errors* is `'strict'`, meaning that encoding errors raise a `UnicodeError`. Other possible values are `'ignore'`, `'replace'` and any other name registered via `codecs.register_error()`, see section Error Handlers. For a list of possible encodings, see section Standard Encodings.

`str.`**`encode`**`(`*`encoding="utf-8", errors="strict"`*`)`

Return an encoded version of the string as a bytes object. Default encoding is `'utf-8'`. *errors* may be given to set a different error handling scheme. The default for *errors* is `'strict'`, meaning that encoding errors raise a `UnicodeError`. Other possible values are `'ignore'`, `'replace'`, `'xmlcharrefreplace'`, `'backslashreplace'` and any other name registered via `codecs.register_error()`, see section Error Handlers. For a list of possible encodings, see section Standard Encodings.

https://docs.python.org/3/library/stdtypes.html#bytes.decode
https://docs.python.org/3/library/stdtypes.html#str.encode




```
import socket

mysock = socket.socket(socket.AF_INET, socket.SOCK_STREAM)
mysock.connect(('data.pr4e.org', 80))
cmd = 'GET http://data.pr4e.org/romeo.txt HTTP/1.0\n\n'.encode()
mysock.send(cmd)

while True:
    data = mysock.recv(512)
    if (len(data) < 1):
        break
    print(data.decode())
mysock.close()
```

Making HTTP (even) Easier With urllib

Acknowledgements / Contributions

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

… Insert new Contributors here

...

Using urllib in Python

Since HTTP is so common, we have a library that does all the socket work for us and makes web pages look like a file

```
import urllib.request, urllib.parse, urllib.error

fhand = urllib.request.urlopen('http://data.pr4e.org/romeo.txt')
for line in fhand:
    print(line.decode().strip())
```

urllib1.py

```
import urllib.request, urllib.parse, urllib.error

fhand = urllib.request.urlopen('http://data.pr4e.org/romeo.txt')
for line in fhand:
    print(line.decode().strip())
```

But soft what light through yonder window breaks
It is the east and Juliet is the sun
Arise fair sun and kill the envious moon
Who is already sick and pale with grief

urllib1.py

Like a File...

```
import urllib.request, urllib.parse, urllib.error

fhand = urllib.request.urlopen('http://data.pr4e.org/romeo.txt')

counts = dict()
for line in fhand:
    words = line.decode().split()
    for word in words:
        counts[word] = counts.get(word, 0) + 1
print(counts)
```

urlwords.py

Reading Web Pages

```
import urllib.request, urllib.parse, urllib.error

fhand = urllib.request.urlopen('http://www.dr-chuck.com/page1.htm')
for line in fhand:
    print(line.decode().strip())
```

```
<h1>The First Page</h1>
<p>If you like, you can switch to the <a
href="http://www.dr-chuck.com/page2.htm">Second
Page</a>.
</p>
```

urllib2.py

Following Links

```
import urllib.request, urllib.parse, urllib.error

fhand = urllib.request.urlopen('http://www.dr-chuck.com/page1.htm')
for line in fhand:
    print(line.decode().strip())
```

```
<h1>The First Page</h1>
<p>If you like, you can switch to the <a
href="http://www.dr-chuck.com/page2.htm">Second
Page</a>.
</p>
```

urllib2.py

The first lines of code @ Google?

```
import urllib.request, urllib.parse, urllib.error

fhand = urllib.request.urlopen('http://www.dr-chuck.com/page1.htm')
for line in fhand:
    print(line.decode().strip())
```

Parsing HTML (a.k.a. Web Scraping)

Acknowledgements / Contributions

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

… Insert new Contributors here

...

What is Web Scraping?

- When a program or script pretends to be a browser and retrieves web pages, looks at those web pages, extracts information, and then looks at more web pages
- Search engines scrape web pages - we call this “spidering the web” or “web crawling”

http://en.wikipedia.org/wiki/Web_scraping
http://en.wikipedia.org/wiki/Web_crawler

Why Scrape?

- Pull data - particularly social data - who links to who?
- Get your own data back out of some system that has no “export capability”
- Monitor a site for new information
- Spider the web to make a database for a search engine

Scraping Web Pages

- There is some controversy about web page scraping and some sites are a bit snippy about it.
- Republishing copyrighted information is not allowed
- Violating terms of service is not allowed

The Easy Way - Beautiful Soup

- You could do string searches the hard way
- Or use the free software library called BeautifulSoup from www.crummy.com

https://www.crummy.com/software/BeautifulSoup/

You didn't write that awful page. You're just trying to get some data out of it. Beautiful Soup is here to help. Since 2004, it's been saving programmers hours or days of work on quick-turnaround screen scraping projects.

Beautiful Soup

"A tremendous boon." -- Python411 Podcast

[Download | Documentation | Hall of Fame | Source | Discussion group]

If Beautiful Soup has saved you a lot of time and money, the best way to pay me back is to check out *Constellation Games*, my sci-fi novel about alien video games.
You can read the first two chapters for free, and the full novel starts at 5 USD. Thanks!

If you have questions, send them to the discussion group. If you find a bug, file it.

BeautifulSoup Installation

```
# To run this, you can install BeautifulSoup
# https://pypi.python.org/pypi/beautifulsoup4

# Or download the file
# http://www.py4e.com/code3/bs4.zip
# and unzip it in the same directory as this file

import urllib.request, urllib.parse, urllib.error
from bs4 import BeautifulSoup

...
```

urllinks.py

```
import urllib.request, urllib.parse, urllib.error
from bs4 import BeautifulSoup

url = input('Enter - ')
html = urllib.request.urlopen(url).read()
soup = BeautifulSoup(html, 'html.parser')

# Retrieve all of the anchor tags
tags = soup('a')
for tag in tags:
    print(tag.get('href', None))
```

python urllinks.py
Enter - http://www.dr-chuck.com/page1.htm
http://www.dr-chuck.com/page2.htm

Summary

- The TCP/IP gives us pipes / sockets between applications
- We designed application protocols to make use of these pipes
- HyperText Transfer Protocol (HTTP) is a simple yet powerful protocol
- Python has good support for sockets, HTTP, and HTML parsing

Acknowledgements / Contributions

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

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...

Using Web Services

Chapter 13

Python for Everybody
www.py4e.com

Data on the Web

- With the HTTP Request/Response well understood and well supported, there was a natural move toward exchanging data between programs using these protocols
- We needed to come up with an agreed way to represent data going between applications and across networks
- There are two commonly used formats: XML and JSON

Sending Data across the "Net"

a.k.a. "Wire Protocol" - What we send on the "wire"

Agreeing on a "Wire Format"

Agreeing on a "Wire Format"

JSON

XML

Marking up data to send across the network...

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

Acknowledgements / Contributions

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

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...

XML "Elements" (or Nodes)

- Simple Element
- Complex Element

```
<people>
  <person>
    <name>Chuck</name>
    <phone>303 4456</phone>
  </person>
  <person>
    <name>Noah</name>
    <phone>622 7421</phone>
  </person>
</people>
```

eXtensible Markup Language

- Primary purpose is to help information systems share structured data
- It started as a simplified subset of the Standard Generalized Markup Language (SGML), and is designed to be relatively human-legible

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

XML Basics

- Start Tag
- End Tag
- Text Content
- Attribute
- Self Closing Tag

```
<person>
  <name>Chuck</name>
  <phone type="intl">
     +1 734 303 4456
   </phone>
   <email hide="yes" />
</person>
```

White Space

```
<person>
  <name>Chuck</name>
  <phone type="intl">
     +1 734 303 4456
   </phone>
   <email hide="yes" />
</person>
```

Line ends do not matter.
White space is generally discarded on text elements.
We indent only to be readable.

```
<person>
  <name>Chuck</name>
  <phone type="intl">+1 734 303 4456</phone>
  <email hide="yes" />
</person>
```

Some XML...

```
<recipe name="bread" prep_time="5 mins" cook_time="3 hours">
  <title>Basic bread</title>
  <ingredient amount="8" unit="dL">Flour</ingredient>
  <ingredient amount="10" unit="grams">Yeast</ingredient>
  <ingredient amount="4" unit="dL" state="warm">Water</ingredient>
  <ingredient amount="1" unit="teaspoon">Salt</ingredient>
  <instructions>
    <step>Mix all ingredients together.</step>
    <step>Knead thoroughly.</step>
    <step>Cover with a cloth, and leave for one hour in warm room.</step>
    <step>Knead again.</step>
    <step>Place in a bread baking tin.</step>
    <step>Cover with a cloth, and leave for one hour in warm room.</step>
    <step>Bake in the oven at 180(degrees)C for 30 minutes.</step>
  </instructions>
</recipe>
```

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

XML Terminology

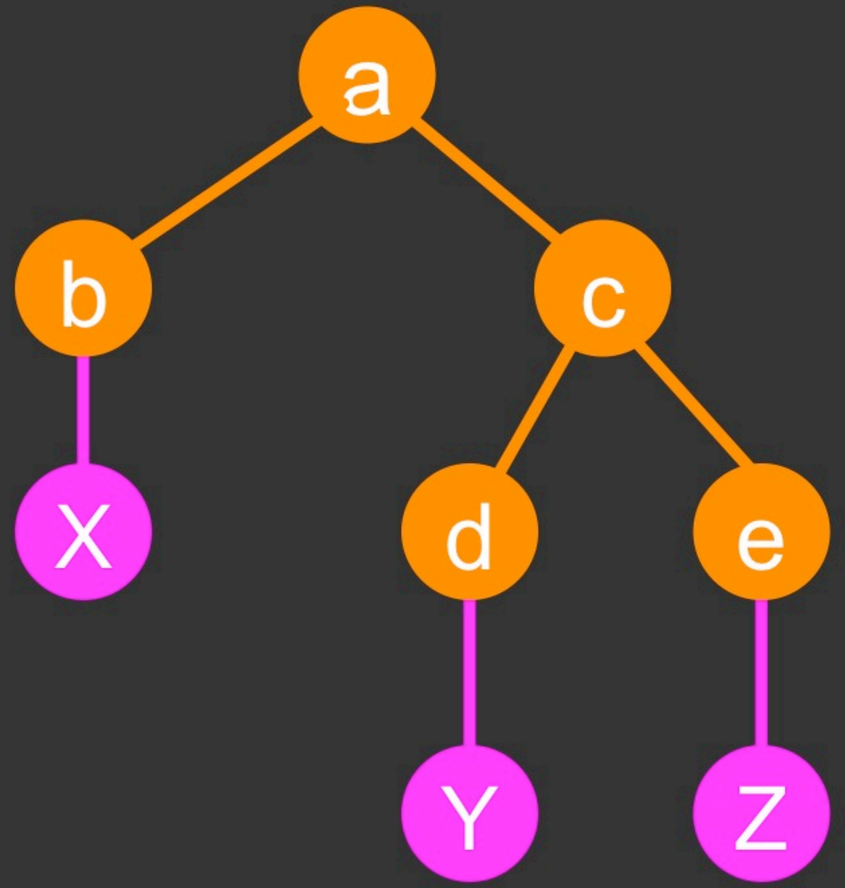
- Tags indicate the beginning and ending of elements
- Attributes - Keyword/value pairs on the opening tag of XML
- Serialize / De-Serialize - Convert data in one program into a common format that can be stored and/or transmitted between systems in a programming language-independent manner

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

XML as a Tree

```
<a>
  <b>X</b>
  <c>
    <d>Y</d>
    <e>Z</e>
  </c>
</a>
```

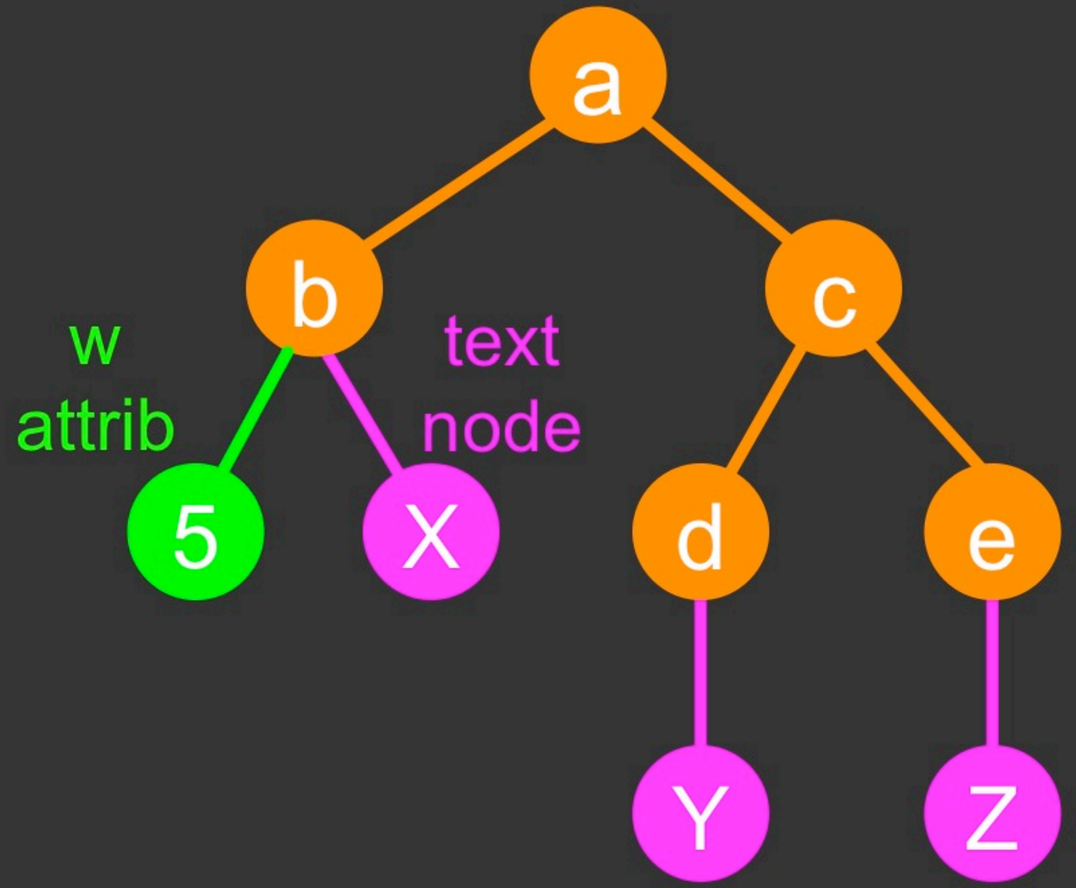
Elements Text



XML Text and Attributes

```
<a>
  <b w="5">X</b>
  <c>
    <d>Y</d>
    <e>Z</e>
  </c>
</a>
```

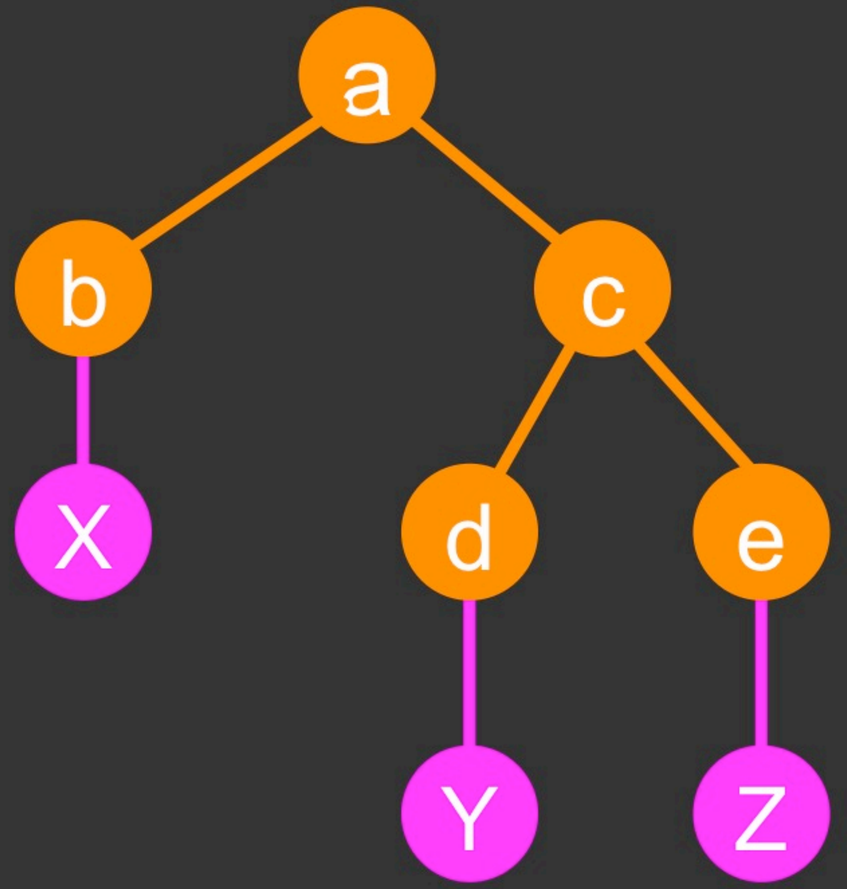
Elements Text



XML as Paths

```
<a>
  <b>X</b>
  <c>
    <d>Y</d>
    <e>Z</e>
  </c>
</a>
```

/a/b	X
/a/c/d	Y
/a/c/e	Z



Elements Text

XML Schema

Describing a "contract" as to what is acceptable XML.

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

http://en.wikibooks.org/wiki/XML_Schema

Acknowledgements / Contributions

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

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XML Schema

Describing a "contract" as to what is acceptable XML.

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

http://en.wikibooks.org/wiki/XML_Schema

XML Schema

- Description of the legal format of an XML document
- Expressed in terms of constraints on the structure and content of documents
- Often used to specify a "contract" between systems - "My system will only accept XML that conforms to this particular Schema."
- If a particular piece of XML meets the specification of the Schema - it is said to "validate"

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

XML Validation

XML Document

XML Schema Contract

XML Validation

XML Document

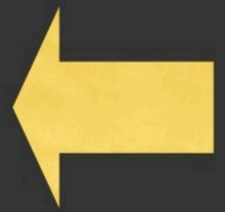
```
<person>
  <lastname>Severance</lastname>
  <age>17</age>
  <dateborn>2001-04-17</dateborn>
</person>
```

XML Schema Contract

```
<xs:complexType name=”person”>
 <xs:sequence>
  <xs:element name="lastname" type="xs:string"/>
  <xs:element name="age" type="xs:integer"/>
  <xs:element name="dateborn" type="xs:date"/>
 </xs:sequence>
</xs:complexType>
```

Many XML Schema Languages

- Document Type Definition (DTD)
  - http://en.wikipedia.org/wiki/Document_Type_Definition
- Standard Generalized Markup Language (ISO 8879:1986 SGML)
  - http://en.wikipedia.org/wiki/SGML
- XML Schema from W3C - (XSD)
  - http://en.wikipedia.org/wiki/XML_Schema_(W3C)



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

XSD XML Schema (W3C spec)

- We will focus on the World Wide Web Consortium (W3C) version
- It is often called “W3C Schema” because “Schema” is considered generic
- More commonly it is called XSD because the file names end in .xsd

http://www.w3.org/XML/Schema

http://en.wikipedia.org/wiki/XML_Schema_(W3C)

XSD Structure

xs:element

xs:sequence

xs:complexType

```
<person>
  <lastname>Severance</lastname>
  <age>17</age>
  <dateborn>2001-04-17</dateborn>
</person>
```

```
<xs:complexType name=”person”>
 <xs:sequence>
  <xs:element name="lastname" type="xs:string"/>
  <xs:element name="age" type="xs:integer"/>
  <xs:element name="dateborn" type="xs:date"/>
 </xs:sequence>
</xs:complexType>
```

XSD Constraints

```
<xs:element name="person">
  <xs:complexType>
    <xs:sequence>
      <xs:element name="full_name" type="xs:string"
          minOccurs="1" maxOccurs="1" />
      <xs:element name="child_name" type="xs:string"
          minOccurs="0" maxOccurs="10" />
    </xs:sequence>
  </xs:complexType>
</xs:element>
```

```
<person>
  <full_name>Tove Refsnes</full_name>
  <child_name>Hege</child_name>
  <child_name>Stale</child_name>
  <child_name>Jim</child_name>
  <child_name>Borge</child_name>
</person>
```

http://www.w3schools.com/Schema/schema_complex_indicators.asp

XSD Data Types

```
<xs:element name="customer" type="xs:string"/>
<xs:element name="start" type="xs:date"/>
<xs:element name="startdate" type="xs:dateTime"/>
<xs:element name="prize" type="xs:decimal"/>
<xs:element name="weeks" type="xs:integer"/>
```

It is common to represent time in UTC/GMT, given that servers are often scattered around the world.

```
<customer>John Smith</customer>
<start>2002-09-24</start>
<startdate>2002-05-30T09:30:10Z</startdate>
<prize>999.50</prize>
<weeks>30</weeks>
```

http://www.w3schools.com/Schema/schema_dtypes_numeric.asp

ISO 8601 Date/Time Format

2002-05-30T09:30:10Z

Year-month-day

Time of day

Timezone - typically specified in UTC / GMT rather than local time zone.

http://en.wikipedia.org/wiki/ISO_8601

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

```
<?xml version="1.0" encoding="utf-8" ?>
<xs:schema elementFormDefault="qualified" xmlns:xs="http://www.w3.org/2001/XMLSchema">
  <xs:element name="Address">
    <xs:complexType>
      <xs:sequence>
        <xs:element name="Recipient" type="xs:string" />
        <xs:element name="House" type="xs:string" />
        <xs:element name="Street" type="xs:string" />
        <xs:element name="Town" type="xs:string" />
        <xs:element minOccurs="0" name="County" type="xs:string" />
        <xs:element name="PostCode" type="xs:string" />
        <xs:element name="Country">
          <xs:simpleType>
            <xs:restriction base="xs:string">
              <xs:enumeration value="FR" />
              <xs:enumeration value="DE" />
              <xs:enumeration value="ES" />
              <xs:enumeration value="UK" />
              <xs:enumeration value="US" />
            </xs:restriction>
          </xs:simpleType>
        </xs:element>
      </xs:sequence>
    </xs:complexType>
  </xs:element>
</xs:schema>
```



```
<?xml version="1.0" encoding="utf-8"?>
<Address
    xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
    xsi:noNamespaceSchemaLocation="SimpleAddress.xsd">
  <Recipient>Mr. Walter C. Brown</Recipient>
  <House>49</House>
  <Street>Featherstone Street</Street>
  <Town>LONDON</Town>
  <PostCode>EC1Y 8SY</PostCode>
  <Country>UK</Country>
</Address>
```

```
<?xml version="1.0" encoding="ISO-8859-1" ?>
<xs:schema xmlns:xs="http://www.w3.org/2001/XMLSchema">
<xs:element name="shiporder">
 <xs:complexType>
  <xs:sequence>
   <xs:element name="orderperson" type="xs:string"/>
   <xs:element name="shipto">
    <xs:complexType>
     <xs:sequence>
      <xs:element name="name" type="xs:string"/>
      <xs:element name="address" type="xs:string"/>
      <xs:element name="city" type="xs:string"/>
      <xs:element name="country" type="xs:string"/>
     </xs:sequence>
    </xs:complexType>
   </xs:element>
   <xs:element name="item" maxOccurs="unbounded">
    <xs:complexType>
     <xs:sequence>
      <xs:element name="title" type="xs:string"/>
      <xs:element name="note" type="xs:string" minOccurs="0"/>
      <xs:element name="quantity" type="xs:positiveInteger"/>
      <xs:element name="price" type="xs:decimal"/>
     </xs:sequence>
    </xs:complexType>
   </xs:element>
  </xs:sequence>
  <xs:attribute name="orderid" type="xs:string" use="required"/>
 </xs:complexType>
</xs:element>
</xs:schema>
```

http://www.w3schools.com/Schema/schema_example.asp

Parsing XML in Python

Acknowledgements / Contributions

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

… Insert new Contributors here

...

Parsing XML in Python

xml1.py

```
import xml.etree.ElementTree as ET
data = '''<person>
  <name>Chuck</name>
  <phone type="intl">
     +1 734 303 4456
   </phone>
   <email hide="yes"/>
</person>'''

tree = ET.fromstring(data)
print('Name:',tree.find('name').text)
print('Attr:',tree.find('email').get('hide'))
```

xml2.py

```
import xml.etree.ElementTree as ET
input = '''<stuff>
    <users>
        <user x="2">
            <id>001</id>
            <name>Chuck</name>
        </user>
        <user x="7">
            <id>009</id>
            <name>Brent</name>
        </user>
    </users>
</stuff>'''

stuff = ET.fromstring(input)
lst = stuff.findall('users/user')
print('User count:', len(lst))
for item in lst:
    print('Name', item.find('name').text)
    print('Id', item.find('id').text)
    print('Attribute', item.get("x"))
```

JavaScript Object Notation

Acknowledgements / Contributions

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

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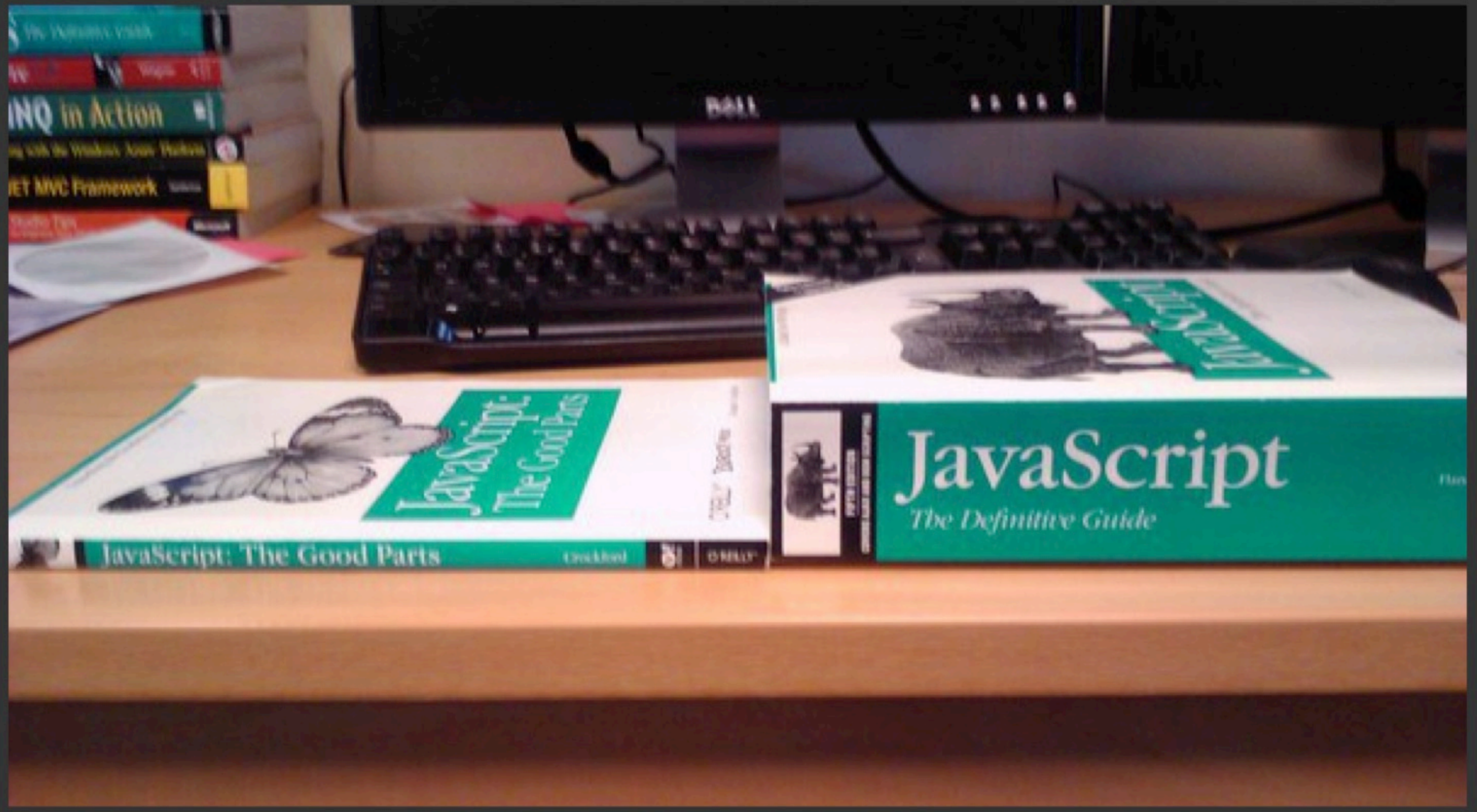
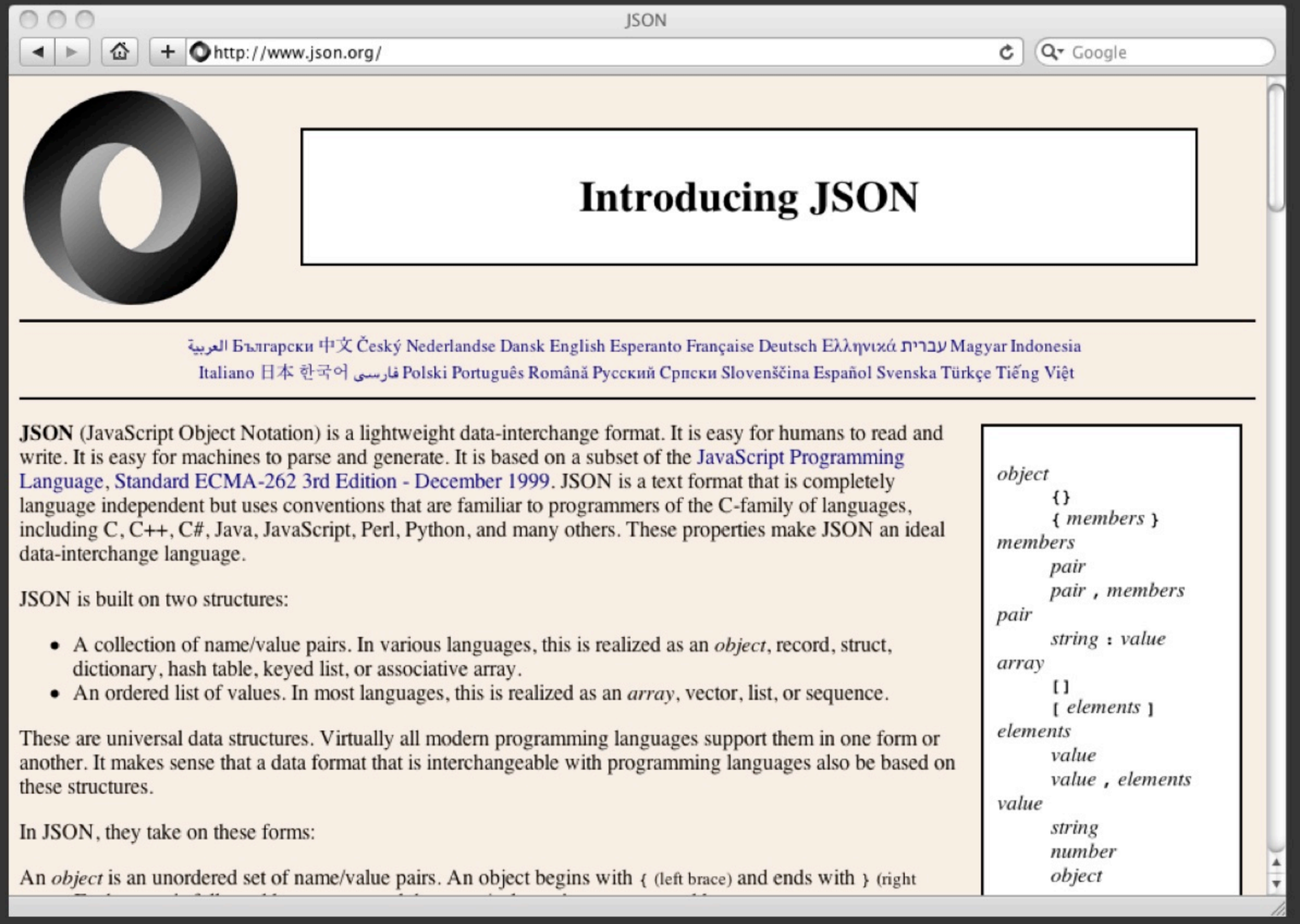
...

JavaScript Object Notation

- Douglas Crockford - "Discovered" JSON
- Object literal notation in JavaScript

http://www.youtube.com/watch?v=kc8BAR7SHJI


JavaScript
The Definitive Guide
JavaScript: The Good Parts


JSON
http://www.json.org/
Google
Introducing JSON
العربية Български 中文 Český Nederlandse Dansk English Esperanto Française Deutsch Ελληνικά עברית Magyar Indonesia
Italiano 日本 한국어 فارسی Polski Português Română Русский Српски Slovenščina Español Svenska Türkçe Tiếng Việt
JSON (JavaScript Object Notation) is a lightweight data-interchange format. It is easy for humans to read and write. It is easy for machines to parse and generate. It is based on a subset of the JavaScript Programming Language, Standard ECMA-262 3rd Edition - December 1999. JSON is a text format that is completely language independent but uses conventions that are familiar to programmers of the C-family of languages, including C, C++, C#, Java, JavaScript, Perl, Python, and many others. These properties make JSON an ideal data-interchange language.
JSON is built on two structures:
A collection of name/value pairs. In various languages, this is realized as an object, record, struct, dictionary, hash table, keyed list, or associative array.
An ordered list of values. In most languages, this is realized as an array, vector, list, or sequence.
These are universal data structures. Virtually all modern programming languages support them in one form or another. It makes sense that a data format that is interchangeable with programming languages also be based on these structures.
In JSON, they take on these forms:
An object is an unordered set of name/value pairs. An object begins with { (left brace) and ends with } (right
object
{}
{ members }
members
pair
pair , members
pair
string : value
array
[]
[elements]
elements
value
value , elements
value
string
number
object

json1.py

```
import json
data = '''{
  "name" : "Chuck",
  "phone" : {
    "type" : "intl",
    "number" : "+1 734 303 4456"
   },
   "email" : {
     "hide" : "yes"
   }
}'''

info = json.loads(data)
print('Name:',info["name"])
print('Hide:',info["email"]["hide"])
```

JSON represents data as nested “lists” and “dictionaries”

json2.py

```
import json
input = '''[
  { "id" : "001",
    "x" : "2",
    "name" : "Chuck"
  } ,
  { "id" : "009",
    "x" : "7",
    "name" : "Chuck"
  }
]'''

info = json.loads(input)
print('User count:', len(info))
for item in info:
    print('Name', item['name'])
    print('Id', item['id'])
    print('Attribute', item['x'])
```

JSON represents data as nested “lists” and “dictionaries”

Service Oriented Approach

http://en.wikipedia.org/wiki/Service-oriented_architecture

Acknowledgements / Contributions

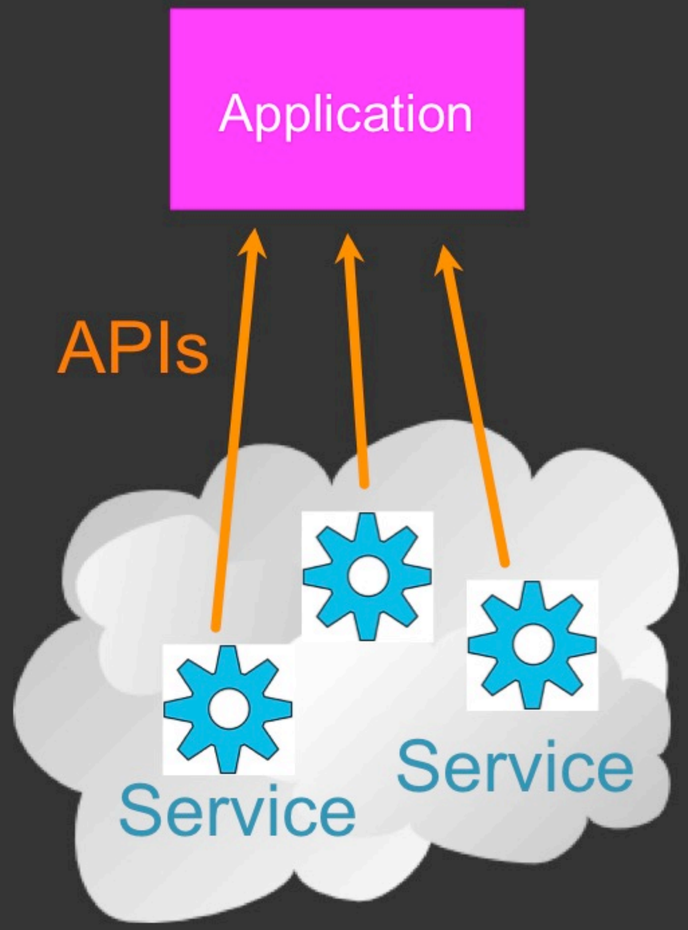
Initial Development: Charles Severance, University of Michigan School of Information

… Insert new Contributors here

...

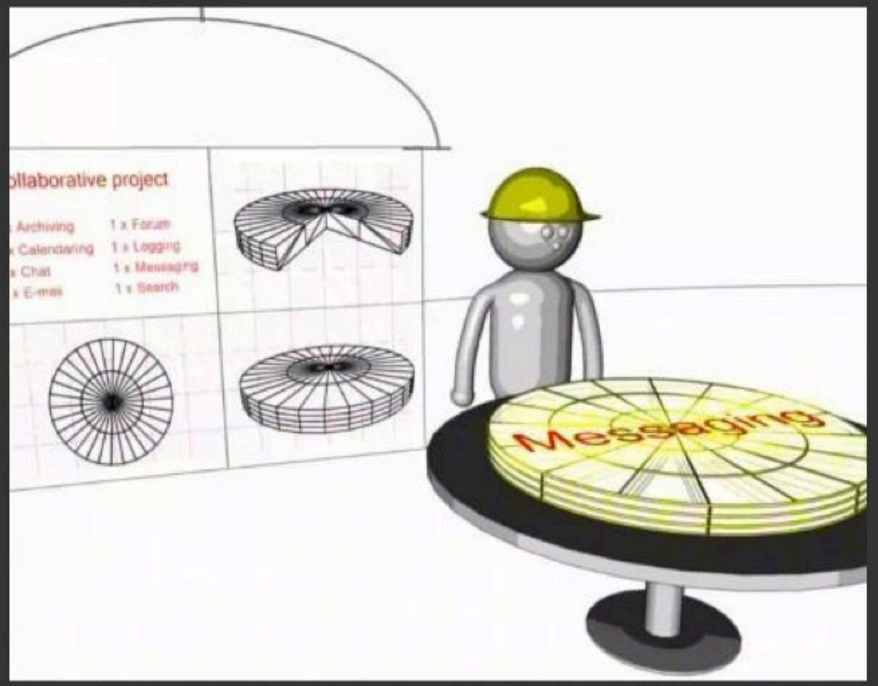
Service Oriented Approach

- Most non-trivial web applications use services
- They use services from other applications
    - Credit Card Charge
    - Hotel Reservation systems
- Services publish the “rules” applications must follow to make use of the service (API)



Multiple Systems

- Initially - two systems cooperate and split the problem
- As the data/service becomes useful - multiple applications want to use the information / application



http://www.youtube.com/watch?v=mj-kCFzF0ME

5:15

Acknowledgements / Contributions

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

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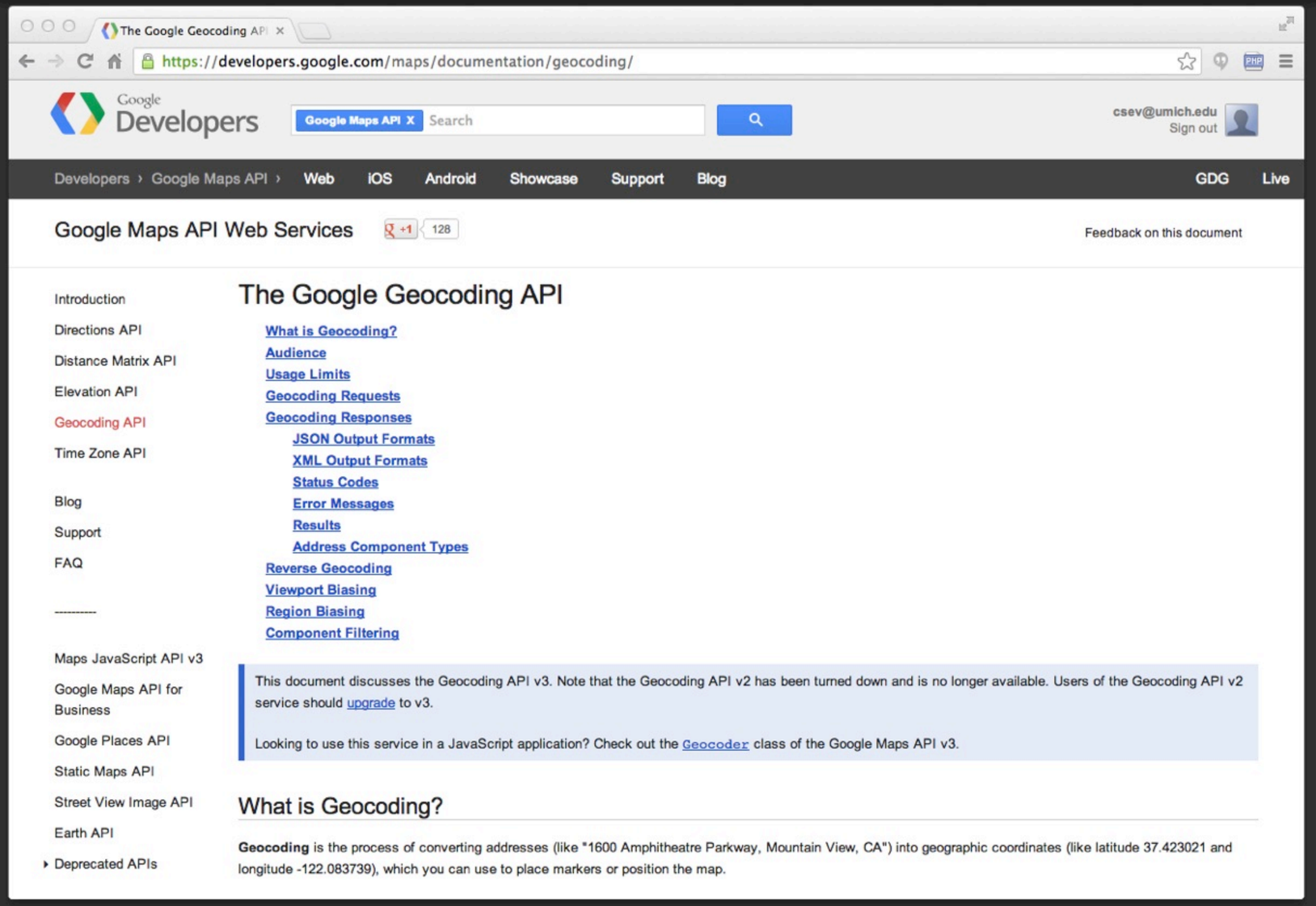
Application Program Interface

The API itself is largely abstract in that it specifies an interface and controls the behavior of the objects specified in that interface. The software that provides the functionality described by an API is said to be an "implementation" of the API. An API is typically defined in terms of the programming language used to build an application.

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



https://developers.google.com/maps/documentation/geocoding/

```
{
    "status": "OK",
     "results": [
        {
            "geometry": {
                "location_type": "APPROXIMATE",
                 "location": {
                    "lat": 42.2808256,
                     "lng": -83.7430378
                }
            },
            "address_components": [
                {
                    "long_name": "Ann Arbor",
                     "types": [
                        "locality",
                         "political"
                    ],
                    "short_name": "Ann Arbor"
                }
             ],
             "formatted_address": "Ann Arbor, MI, USA",
             "types": [
                "locality",
                "political"
            ]
        }
    ]
}
```


http://maps.googleapis.com/maps/api/geocode/json?address=Ann+Arbor%2C+MI

geojson.py

```
import urllib.request, urllib.parse, urllib.error
import json

serviceurl = 'http://maps.googleapis.com/maps/api/geocode/json?'

while True:
    address = input('Enter location: ')
    if len(address) < 1: break

    url = serviceurl + urllib.parse.urlencode({'address': address})

    print('Retrieving', url)
    uh = urllib.request.urlopen(url)
    data = uh.read().decode()
    print('Retrieved', len(data), 'characters')

    try:
        js = json.loads(data)
    except:
        js = None

    if not js or 'status' not in js or js['status'] != 'OK':
        print('==== Failure To Retrieve ====')
        print(data)
        continue

    lat = js["results"][0]["geometry"]["location"]["lat"]
    lng = js["results"][0]["geometry"]["location"]["lng"]
    print('lat', lat, 'lng', lng)
    location = js['results'][0]['formatted_address']
    print(location)
```

```
Enter location: Ann Arbor, MI
Retrieving http://maps.googleapis.com/...
Retrieved 1669 characters
lat 42.2808256 lng -83.7430378
Ann Arbor, MI, USA
Enter location:
```

geojson.py

API Security and Rate Limiting

Acknowledgements / Contributions

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

… Insert new Contributors here

...

API Security and Rate Limiting

- The compute resources to run these APIs are not “free”
- The data provided by these APIs is usually valuable
- The data providers might limit the number of requests per day, demand an API “key”, or even charge for usage
- They might change the rules as things progress...

Usage Limits

The Google Geocoding API has the following limits in place:

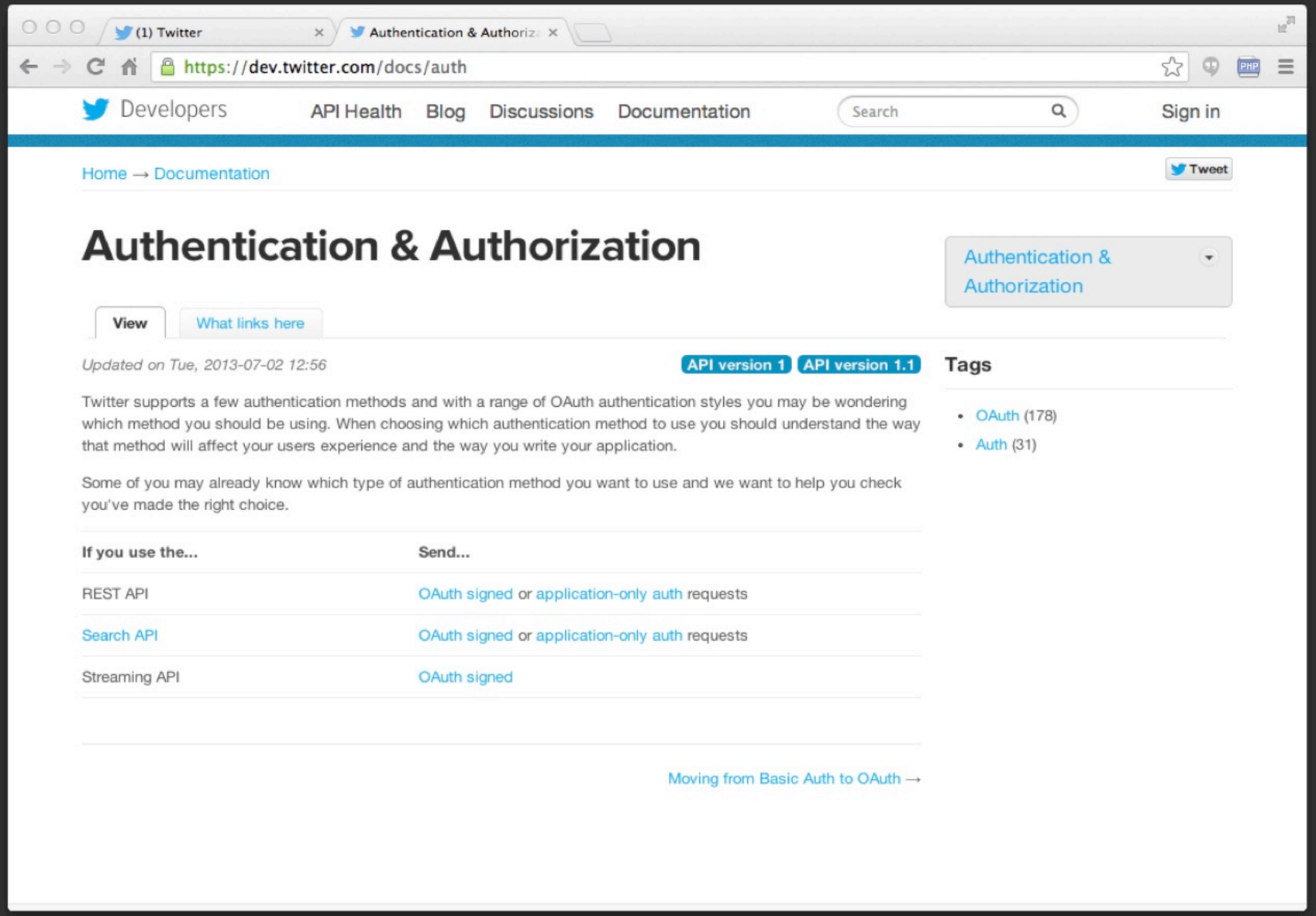
- 2,500 requests per day.

Google Maps API for Business customers have higher limits:

- 100,000 requests per day.

These limits are enforced to prevent abuse and/or repurposing of the Geocoding API, and may be changed in the future without notice. Additionally, we enforce a request rate limit to prevent abuse of the service. If you exceed the 24-hour limit or otherwise abuse the service, the Geocoding API may stop working for you temporarily. If you continue to exceed this limit, your access to the Geocoding API may be blocked.

The Geocoding API may only be used in conjunction with a Google map; geocoding results without displaying them on a map is prohibited. For complete details on allowed usage, consult the Maps API Terms of Service License Restrictions.


(1) Twitter
Authentication & Authoriz
https://dev.twitter.com/docs/auth
Developers
API Health
Blog
Discussions
Documentation
Search
Sign in
Home → Documentation
Tweet
Authentication & Authorization
Authentication & Authorization
View
What links here
Updated on Tue, 2013-07-02 12:56
API version 1
API version 1.1
Twitter supports a few authentication methods and with a range of OAuth authentication styles you may be wondering which method you should be using. When choosing which authentication method to use you should understand the way that method will affect your users experience and the way you write your application.
Some of you may already know which type of authentication method you want to use and we want to help you check you've made the right choice.
If you use the...
Send...
REST API
OAuth signed or application-only auth requests
Search API
OAuth signed or application-only auth requests
Streaming API
OAuth signed
Moving from Basic Auth to OAuth →
Tags
OAuth (178)
Auth (31)

Tweets | Twitter Developer

https://dev.twitter.com/docs/platform-objects/tweets

Developers API Health Blog Discussions Documentation Search Sign in

Home → Documentation → Platform Objects

Tweet

Tweets

View What links here

Updated on Tue, 2013-08-13 17:29

API version 1 API version 1.1

Tweets are the basic atomic building block of all things Twitter. Users tweet Tweets, also known more generically as "status updates." Tweets can be embedded, replied to, favorited, unfavorited and deleted.

Brian Sutorius
@bsuto

Follow

The "http://" at the beginning of URLs is a command to the browser. It stands for "head to this place:" followed by two laser-gun noises.

4:29 PM - 21 Feb 2012

4,218 RETWEETS **1,768** FAVORITES

Field Guide

Consumers of Tweets should tolerate the addition of new fields and variance in ordering of fields with ease. Not all fields appear in all contexts. It is generally safe to consider a nulled field, an empty set, and the absence of a field as the same thing. Please note that Tweets found in Search results vary somewhat in structure from this document.

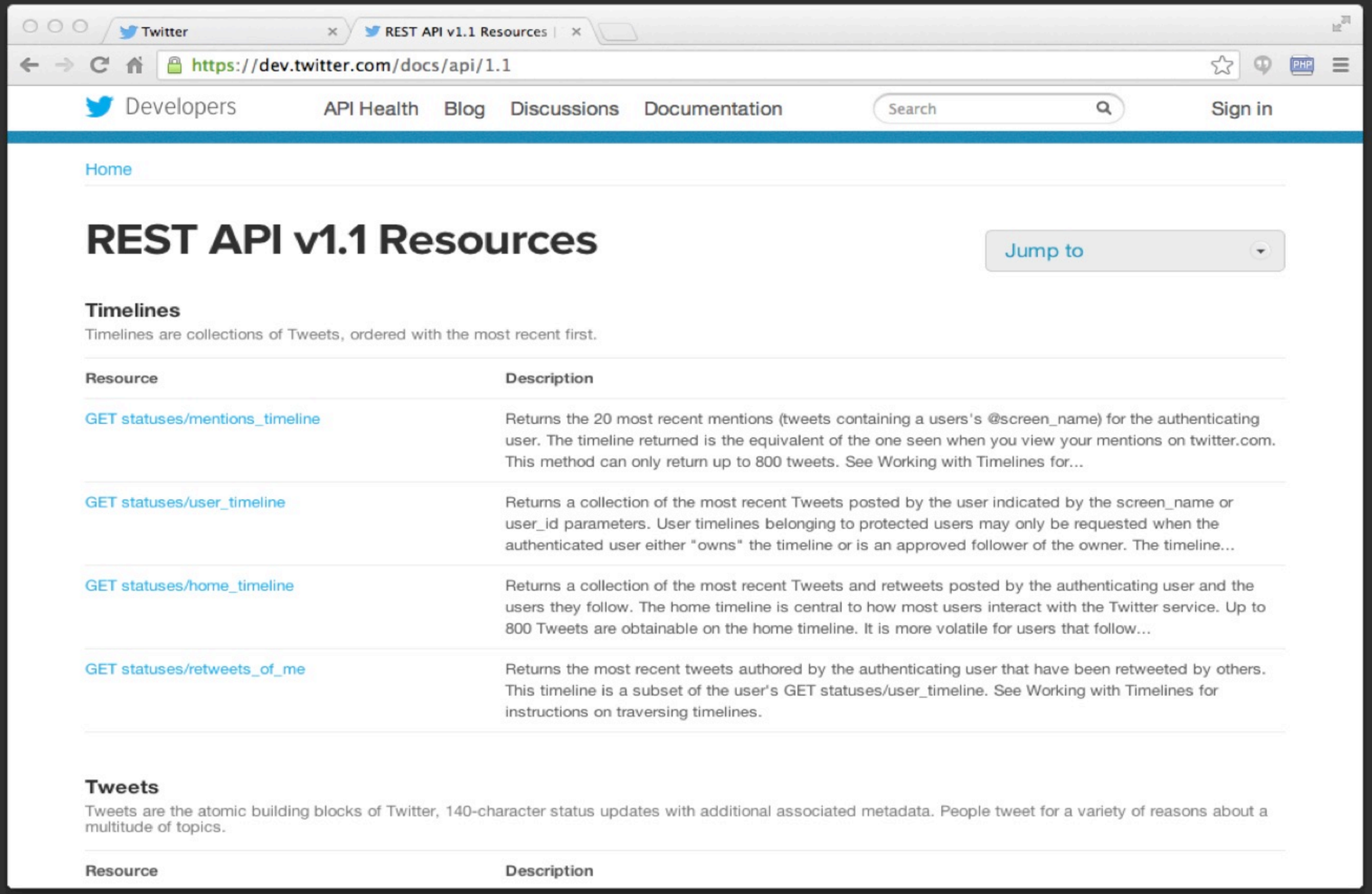
Field	Type	Description
annotations	Object	*Unused.* Future/beta home for status annotations.

Natural habitat

Tweets can be found alone, within user objects, but most often within timelines.

Related API Resources

- GET favorites

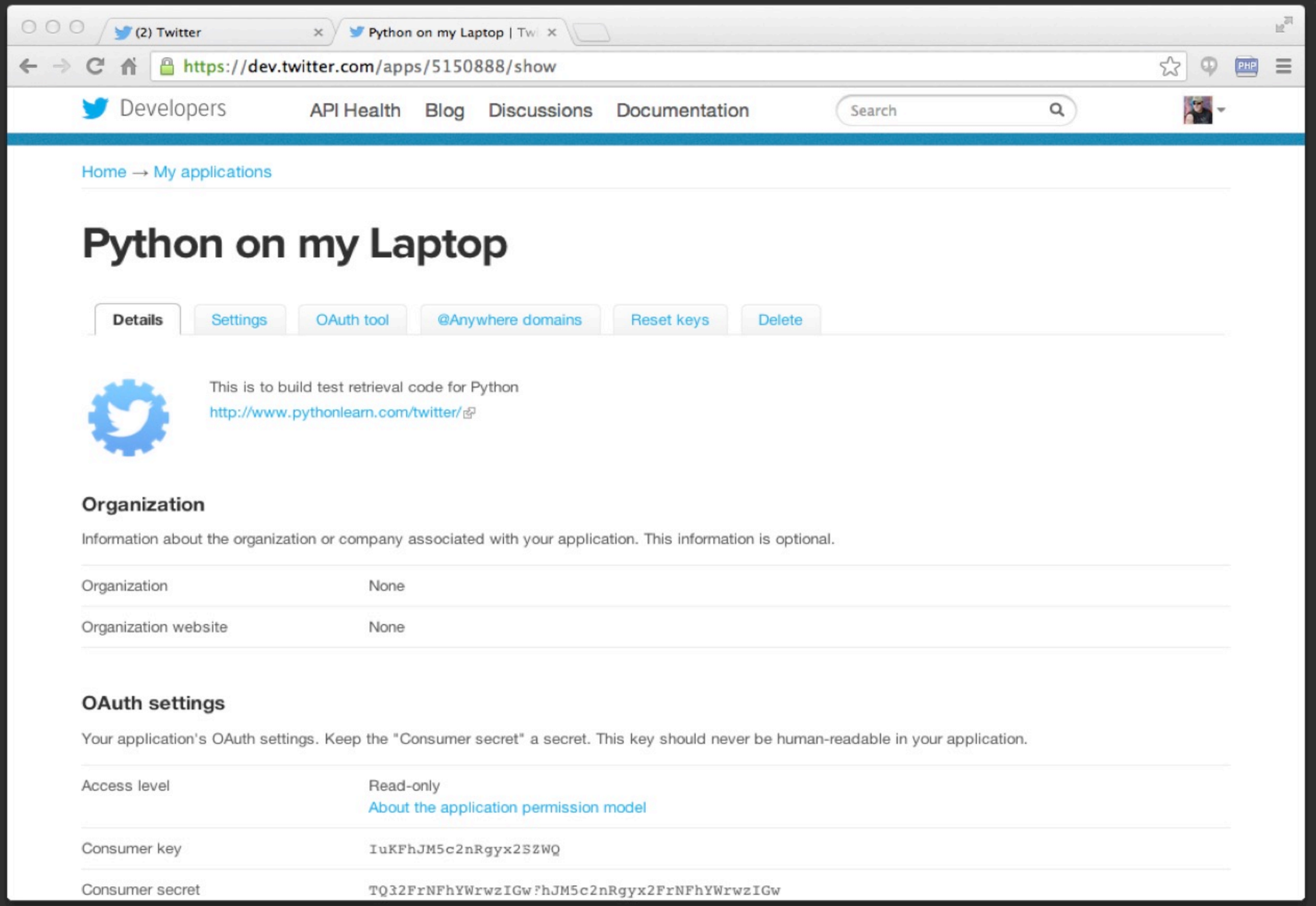

Twitter
REST API v1.1 Resources
https://dev.twitter.com/docs/api/1.1
Developers
API Health
Blog
Discussions
Documentation
Search
Sign in
Home
REST API v1.1 Resources
Jump to
Timelines
Timelines are collections of Tweets, ordered with the most recent first.
Resource
Description
GET statuses/mentions_timeline
Returns the 20 most recent mentions (tweets containing a users's @screen_name) for the authenticating user. The timeline returned is the equivalent of the one seen when you view your mentions on twitter.com. This method can only return up to 800 tweets. See Working with Timelines for...
GET statuses/user_timeline
Returns a collection of the most recent Tweets posted by the user indicated by the screen_name or user_id parameters. User timelines belonging to protected users may only be requested when the authenticated user either "owns" the timeline or is an approved follower of the owner. The timeline...
GET statuses/home_timeline
Returns a collection of the most recent Tweets and retweets posted by the authenticating user and the users they follow. The home timeline is central to how most users interact with the Twitter service. Up to 800 Tweets are obtainable on the home timeline. It is more volatile for users that follow...
GET statuses/retweets_of_me
Returns the most recent tweets authored by the authenticating user that have been retweeted by others. This timeline is a subset of the user's GET statuses/user_timeline. See Working with Timelines for instructions on traversing timelines.
Tweets
Tweets are the atomic building blocks of Twitter, 140-character status updates with additional associated metadata. People tweet for a variety of reasons about a multitude of topics.
Resource
Description

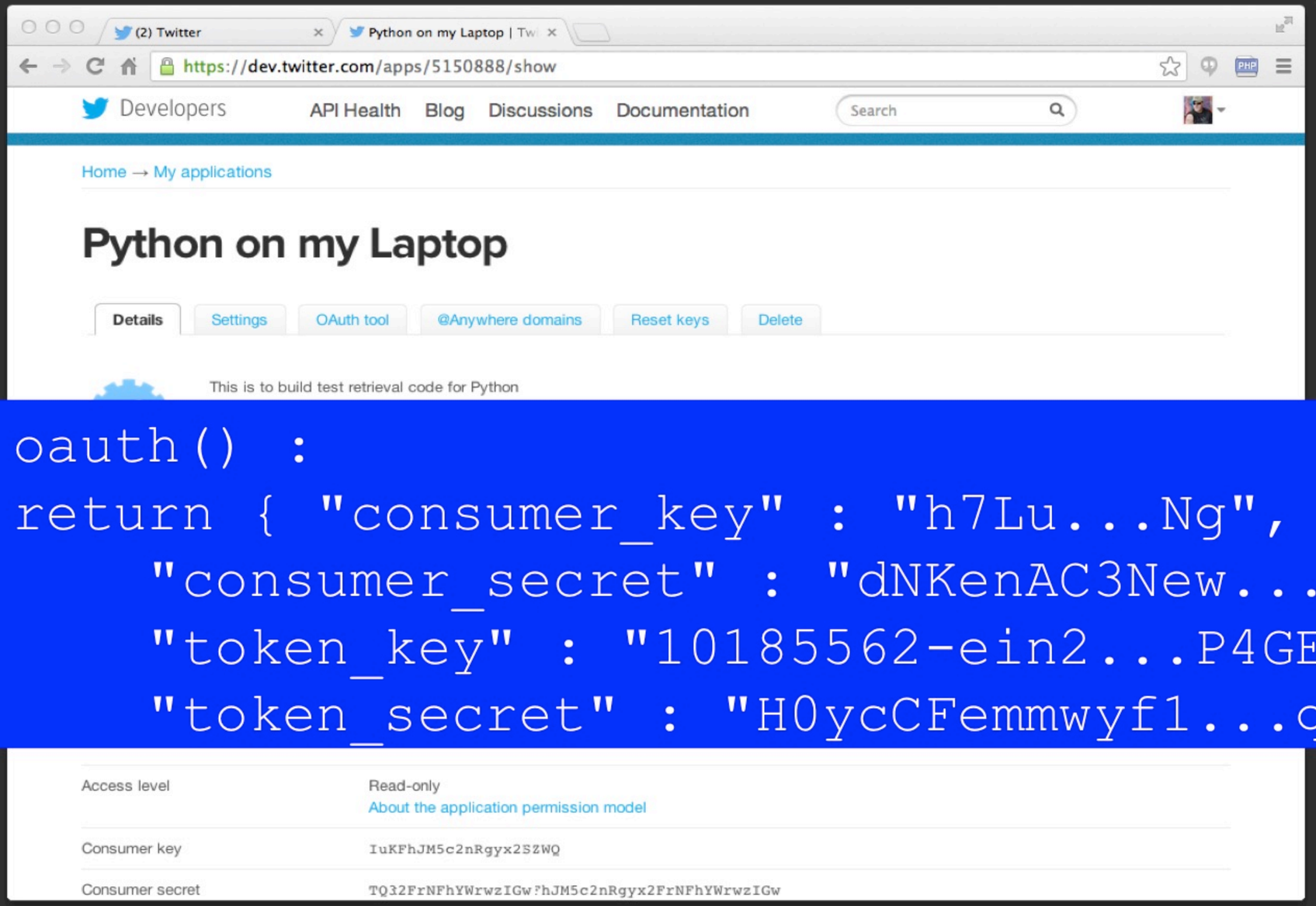
twitter2.py

```
import urllib.request, urllib.parse, urllib.error
import twurl
import json

TWITTER_URL = 'https://api.twitter.com/1.1/friends/list.json'

while True:
    print('')
    acct = input('Enter Twitter Account:')
    if (len(acct) < 1): break
    url = twurl.augment(TWITTER_URL,
                        {'screen_name': acct, 'count': '5'})
    print('Retrieving', url)
    connection = urllib.request.urlopen(url)
    data = connection.read().decode()
    headers = dict(connection.getheaders())
    print('Remaining', headers['x-rate-limit-remaining'])
    js = json.loads(data)
    print(json.dumps(js, indent=4))

    for u in js['users']:
        print(u['screen_name'])
        s = u['status']['text']
        print('  ', s[:50])
```

twitter2.py

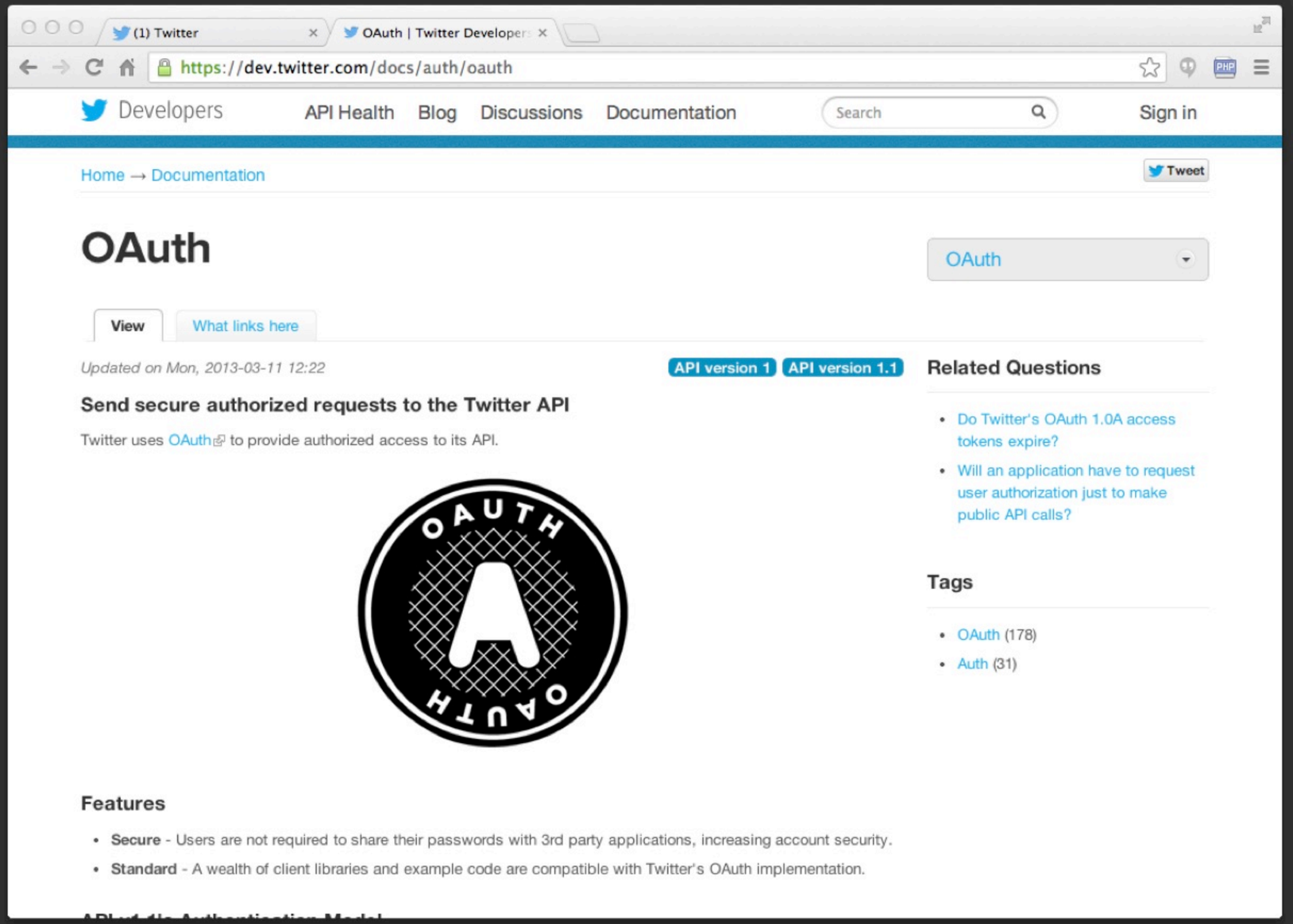
```
Enter Twitter Account:drchuck
Retrieving https://api.twitter.com/1.1/friends ...
Remaining 14
{
    "users": [
        {
            "status": {
                "text": "@jazzychad I just bought one .__.",
                 "created_at": "Fri Sep 20 08:36:34 +0000 2013",
             },
             "location": "San Francisco, California",
             "screen_name": "leahculver",
             "name": "Leah Culver",
         },
         {
            "status": {
                "text": "RT @WSJ: Big employers like Google ...",
                 "created_at": "Sat Sep 28 19:36:37 +0000 2013",
             },
             "location": "Victoria Canada",
             "screen_name": "_valeriei",
             "name": "Valerie Irvine",
     ],
}
Leahculver
   @jazzychad I just bought one .__._
Valeriei
   RT @WSJ: Big employers like Google, AT&amp;amp;T are h
Ericbollens
   RT @lukew: sneak peek: my LONG take on the good &a
halherzog
  Learning Objects is 10. We had a cake with the LO,
```


(2) Twitter
Python on my Laptop | Tw
https://dev.twitter.com/apps/5150888/show
Developers
API Health
Blog
Discussions
Documentation
Search
Home → My applications
Python on my Laptop
Details
Settings
OAuth tool
@Anywhere domains
Reset keys
Delete
This is to build test retrieval code for Python
http://www.pythonlearn.com/twitter/
Organization
Information about the organization or company associated with your application. This information is optional.
Organization
None
Organization website
None
OAuth settings
Your application's OAuth settings. Keep the "Consumer secret" a secret. This key should never be human-readable in your application.
Access level
Read-only
About the application permission model
Consumer key
IuKFhJM5c2nRgyx2SZWQ
Consumer secret
TQ32FrNFhYWrwzIGw?hJM5c2nRgyx2FrNFhYWrwzIGw



hidden.py

```
def oauth() :
    return { "consumer_key" : "h7Lu...Ng",
        "consumer_secret" : "dNKenAC3New...mmn7Q",
        "token_key" : "10185562-ein2...P4GEQQOSGI",
        "token_secret" : "H0ycCFemmwyf1...qoIpBo" }
```


(1) Twitter
OAuth | Twitter Developers
https://dev.twitter.com/docs/auth/oauth
Developers
API Health
Blog
Discussions
Documentation
Search
Sign in
Home → Documentation
Tweet
OAuth
OAuth
View
What links here
Updated on Mon, 2013-03-11 12:22
API version 1
API version 1.1
Send secure authorized requests to the Twitter API
Twitter uses OAuth to provide authorized access to its API.
OAUTH
OAUTH
Related Questions
Do Twitter's OAuth 1.0A access tokens expire?
Will an application have to request user authorization just to make public API calls?
Tags
OAuth (178)
Auth (31)
Features
Secure - Users are not required to share their passwords with 3rd party applications, increasing account security.
Standard - A wealth of client libraries and example code are compatible with Twitter's OAuth implementation.

twurl.py

```
import urllib
import oauth
import hidden

def augment(url, parameters) :
    secrets = hidden.oauth()
    consumer = oauth.OAuthConsumer(secrets['consumer_key'], secrets['consumer_secret'])
    token = oauth.OAuthToken(secrets['token_key'],secrets['token_secret'])
    oauth_request = oauth.OAuthRequest.from_consumer_and_token(consumer,
        token=token, http_method='GET', http_url=url, parameters=parameters)
    oauth_request.sign_request(oauth.OAuthSignatureMethod_HMAC_SHA1(), consumer, token)
    return oauth_request.to_url()
```

```
https://api.twitter.com/1.1/statuses/user_timeline.json?
count=2&oauth_version=1.0&oauth_token=101...SGI&screen_name=drc
huck&oauth_nonce=09239679&oauth_timestamp=1380395644&oauth_sign
ature=rLK...BoD&oauth_consumer_key=h7Lu...GNg&oauth_signature_m
ethod=HMAC-SHA1
```

Summary

- Service Oriented Architecture - allows an application to be broken into parts and distributed across a network
- An Application Program Interface (API) is a contract for interaction
- Web Services provide infrastructure for applications cooperating (an API) over a network - SOAP and REST are two styles of web services
- XML and JSON are serialization formats

Acknowledgements / Contributions

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

… Insert new Contributors here

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