Web Services and Application Programming Interfaces

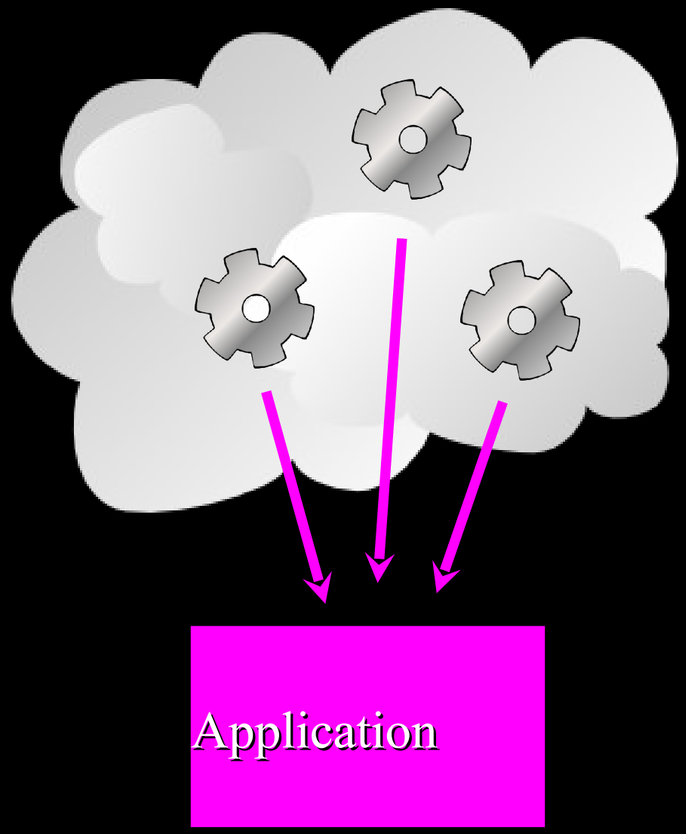
SI539 - Charles Severance

Service Oriented Approach

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

Service Oriented Approach

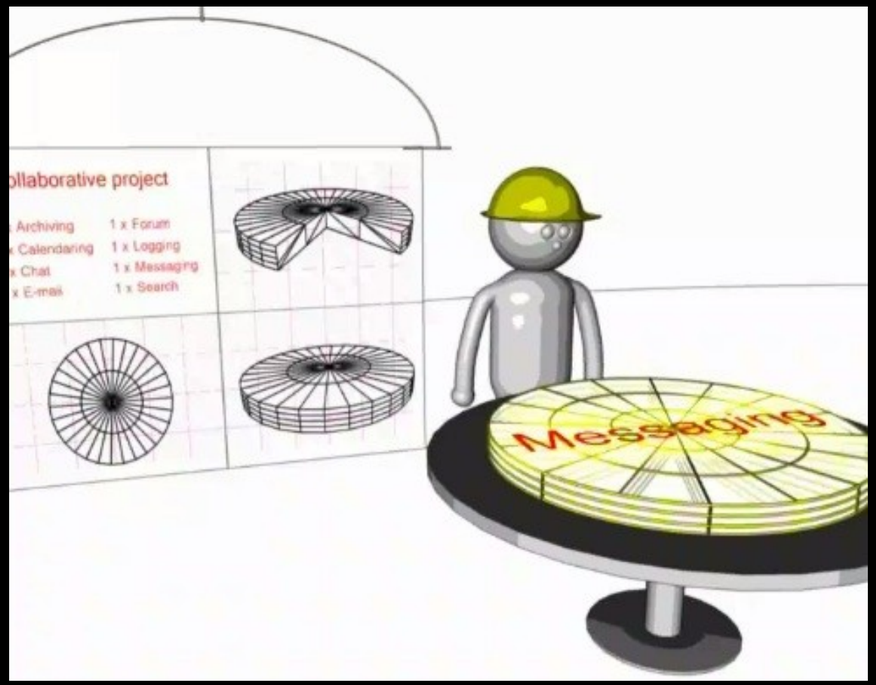
- Most non-trivial web applications are service oriented
- They use services from other applications
  - Credit Card Charge
  - Hotel Reservation systems
  - Twitter



(Gears) Source: http://www.clker.com/clipart-2952.html
(Cloud) Source: http://www.clker.com/search/networksym/1

Multiple Systems

- Initially - two systems cooperate and split the problem
- As the data/service becomes useful - multiple applications want to use the information / application
- Standards for SOA need to be developed



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

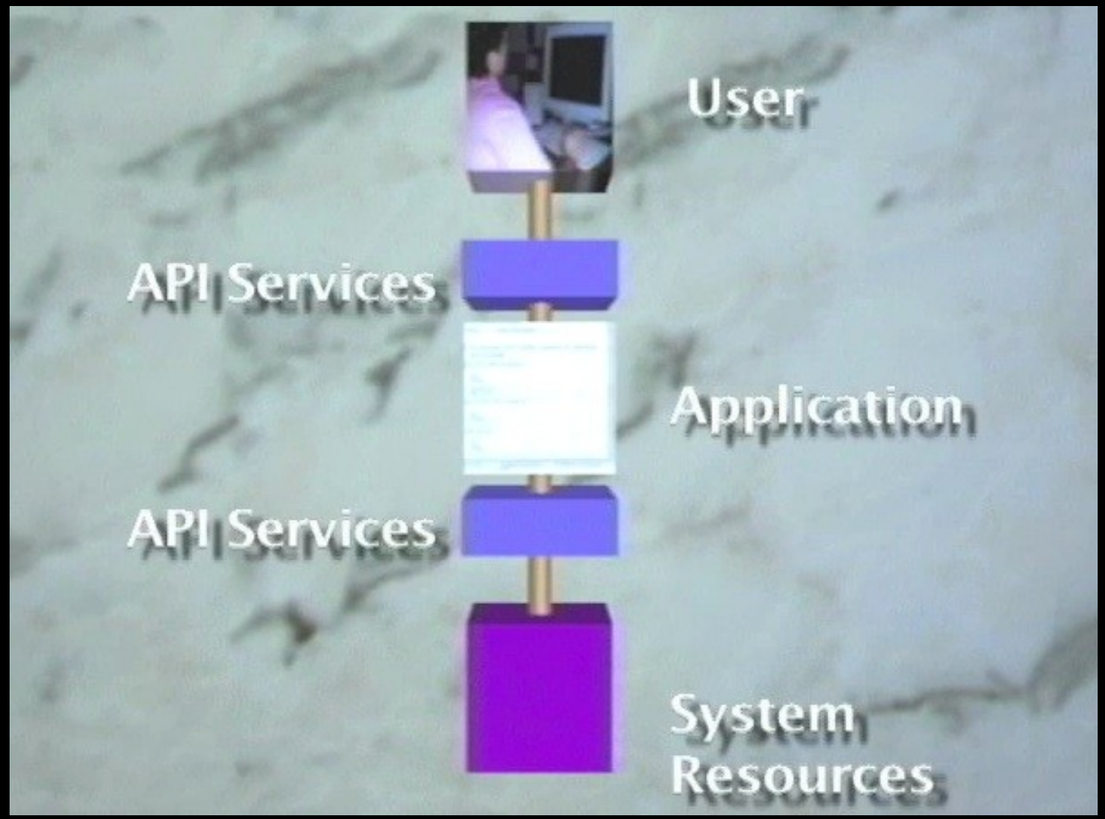
Application Progam Interface

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

Application Program Interface

- An API is a layer that is "between" an application and some aspect of the environment such as a system resource.
- The API is a contract that simplifies interacting with a resource - hides detail



http://www.youtube.com/watch?v=31bS6cUHj-U

The Twitter API

Biz Stone (Founder of Twitter): Yeah. The API has been arguably the most important, or maybe even inarguably, the most important thing we've done with Twitter. It has allowed us, first of all, to keep the service very simple and create a simple API so that developers can build on top of our infrastructure and come up with ideas that are way better than our ideas, and build things like Twitterrific, which is just a beautiful elegant way to use Twitter that we wouldn't have been able to get to, being a very small team.So, the API which has easily 10 times more traffic than the website, has been really very important to us.

http://readwritetalk.com/2007/09/05/biz-stone-co-founder-twitter/

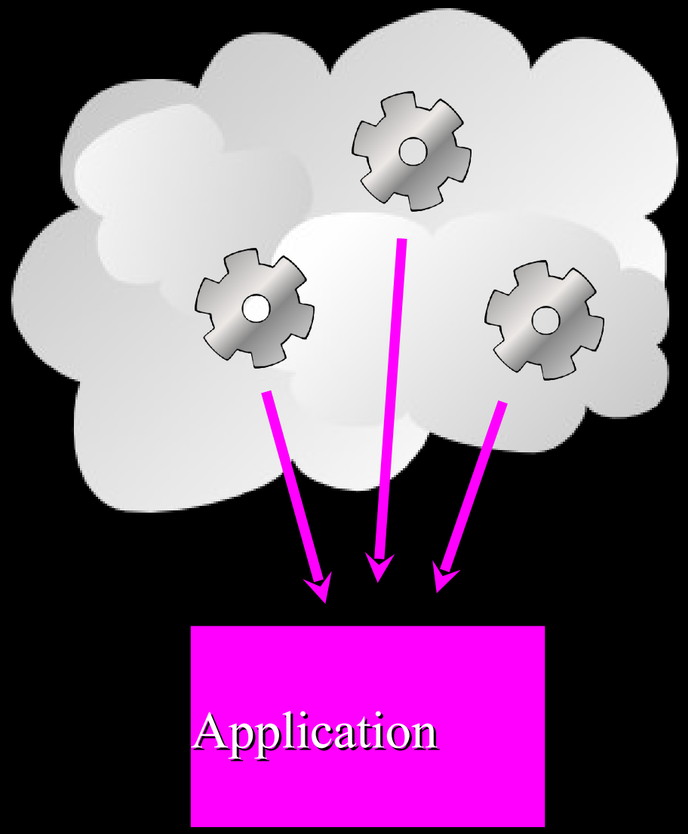
Web Services

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

(Gears) Source: http://www.clker.com/clipart-2952.html
(Cloud) Source: http://www.clker.com/search/networksym/1

Web Service Protocols

- Since the Service Oriented Architecture (SOA) and Applicaiton Program Interface (API) approaches are so common we have developed general-purpose infrastructure to use applications remotely and work with remote resources across the web



http://en.wikipedia.org/wiki/Image:Webservice_xrpc.png

Web Service Technologies

- SOAP - Simple Object Access Protocol (software)
  - Remote programs/code which we use over the network
  - Note: Chuck does not like SOAP because it is overly complex*
- REST - Representational State Transfer (resource focused)
  - Remote resources which we create, read, update and delete remotely

http://en.wikipedia.org/wiki/SOAP_(protocol)

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

REST
Representational State Transfer

http://www.ics.uci.edu/~fielding/pubs/dissertation/rest_arch_style.htm

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

http://www.infoq.com/articles/rest-introduction

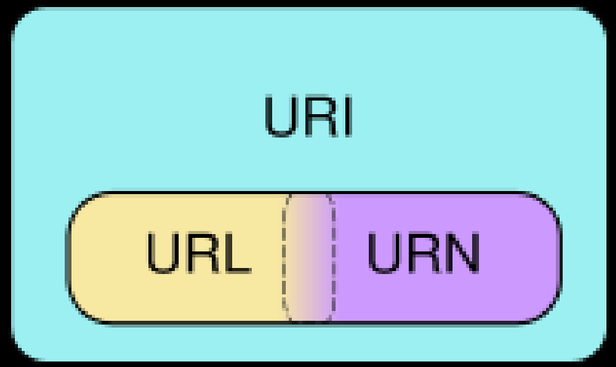
http://wiki.developer.mindtouch.com/REST/REST_for_the_Rest_of_Us

REpresentational State Transfer

- Rest goes back to the basic concepts of the Internet
  - URLs = Documents
  - We have HTTP Operations on URLs: GET, PUT, POST, and DELETE
- Actually there are called URIs - Uniform Resource Identifiers

URI versus URN versus URL

- Uniform Resource Locator - Where to get a resources
  - http://en.wikipedia.org/wiki/Uniform_Resource_Locator
- Uniform Resource Name - More of a “look up key”
  - urn:isbn:0-486-27557-4
- Advice - For now pretend URI = URL



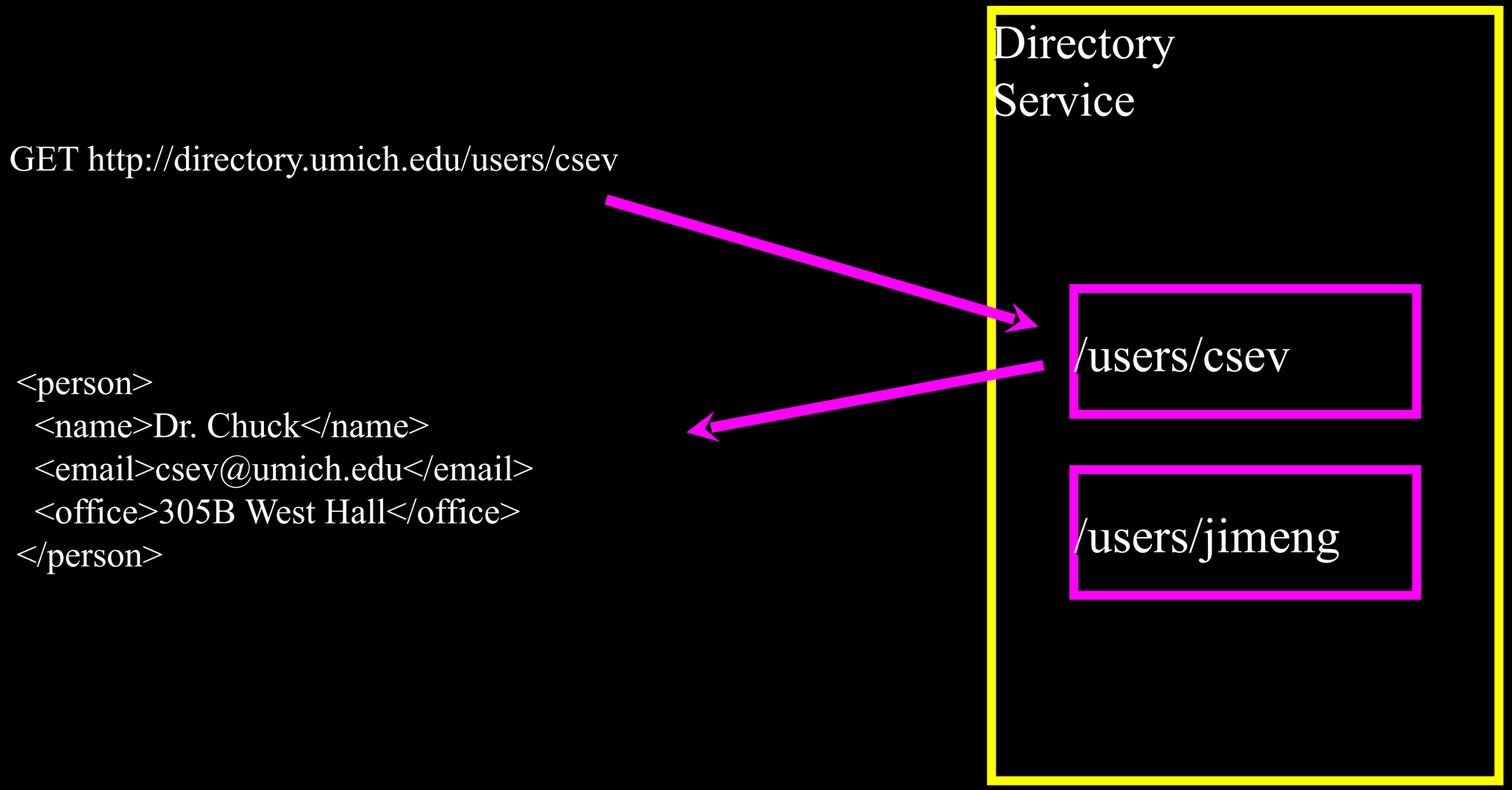
http://en.wikipedia.org/wiki/Uniform_Resource_Identifier

HTTP Methods

- HTTP Methods Operate on a URI
  - GET - Retrieve a resource at a URI
  - POST - Create/Modify a resource at a URL (remember <form>)
  - PUT - Create/Replace/Overwrite a resource at a URI
  - DELETE - Delete a resource at a URI

What does a REST Resource look like?

- It depends - the idea is that when you GET the “resource” is returned to you in the most convenient format
  - If it is an image - it is the bytes which make up the image
  - If it is an “Object” such as a person - it may be an XML representation of that person


Directory
Service
GET http://directory.umich.edu/users/csev
/users/csev
/users/jimeng
<person>
<name>Dr. Chuck</name>
<email>csev@umich.edu</email>
<office>305B West Hall</office>
</person>
An XML Serialization of the resource.

Twitter - a REST Example

Twitter REST API

- A series of URLs which you retrieve which return data
- Much like the information on twitter.com
- Returns XML data in the HTTP Document

http://apiwiki.twitter.com/REST+API+Documentation

User Methods

statuses/friends

Returns the authenticating user's friends, each with current status inline. They are ordered by the order in which they were added as friends. It's also possible to request another user's recent friends list via the `id` parameter below.

URL: `http://twitter.com/statuses/friends.format`

Formats: xml, json

Method(s): GET

Parameters:

- `id`. Optional. The ID or screen name of the user for whom to request a list of friends. Ex: `http://twitter.com/statuses/friends/12345.json` or `http://twitter.com/statuses/friends/bob.xml`
- `user_id`. Optional. Specfies the ID of the user for whom to return the list of friends. Helpful for disambiguating when a valid user ID is also a valid screen name. Ex: `http://twitter.com/statuses/friends.xml?user_id=1401881`
- `screen_name`. Optional. Specfies the screen name of the user for whom to return the list of friends. Helpful for disambiguating when a valid screen name is also a user ID. Ex: `http://twitter.com/statuses/friends.xml?screen_name=101010`
- `page`. Optional. Retrieves the next 100 friends. Ex: `http://twitter.com/statuses/friends.xml?page=2`

Returns: list of basic user information elements

http://apiwiki.twitter.com/REST+API+Documentation

Basic user information element

Basic user information elements contain primary user information with nested a *<status>* element to describe the user's most current update.

<user>
- id
- name
- screen_name
- location
- description
- profile_image_url
- url
- protected
- followers_count
- *<status>*
  - created_at
  - id
  - text
  - source
  - truncated
  - in_reply_to_status_id
  - in_reply_to_user_id
  - favorited
  - in_reply_to_screen_name

```
<?xml version="1.0" encoding="UTF-8"?>
<users type="array">
<user>
  <id>14870169</id>
  <name>gbhatnag</name>
  <screen_name>gbhatnag</screen_name>
  <location>iPhone: 42.284775,-83.732422</location>
<profile_image_url>http://s3.amazonaws.com/twitter_production/profile_images/54535105/profi
le_normal.jpg</profile_image_url>  <followers_count>29</followers_count>
  <status>
    <created_at>Sun Mar 15 17:52:44 +0000 2009</created_at>      <id>1332217519</id>
    <text>to add to @aatorres: projects that may fall into pervasive computing, situated
technologies, distributed media, would be interesting #sxsw</text>  </status>
</user>
<user>
  <id>928961</id>
  <name>Rasmus Lerdorf</name>
    ……..
</user>
</users>
```

http://twitter.com/statuses/friends/drchuck.xml

Retrieving Twitter Data in Python

cat twpals1.py

```
import urllib

TWITTER_URL = 'http://twitter.com/statuses/friends/ACCT.xml‘

while True:
    print '‘
    acct = raw_input('Enter Twitter Account:')
    if ( len(acct) < 1 ) : break
    url = TWITTER_URL.replace('ACCT', acct)
    document = urllib.urlopen (url).read()
    print document[:250]
```

Parsing XML in Python

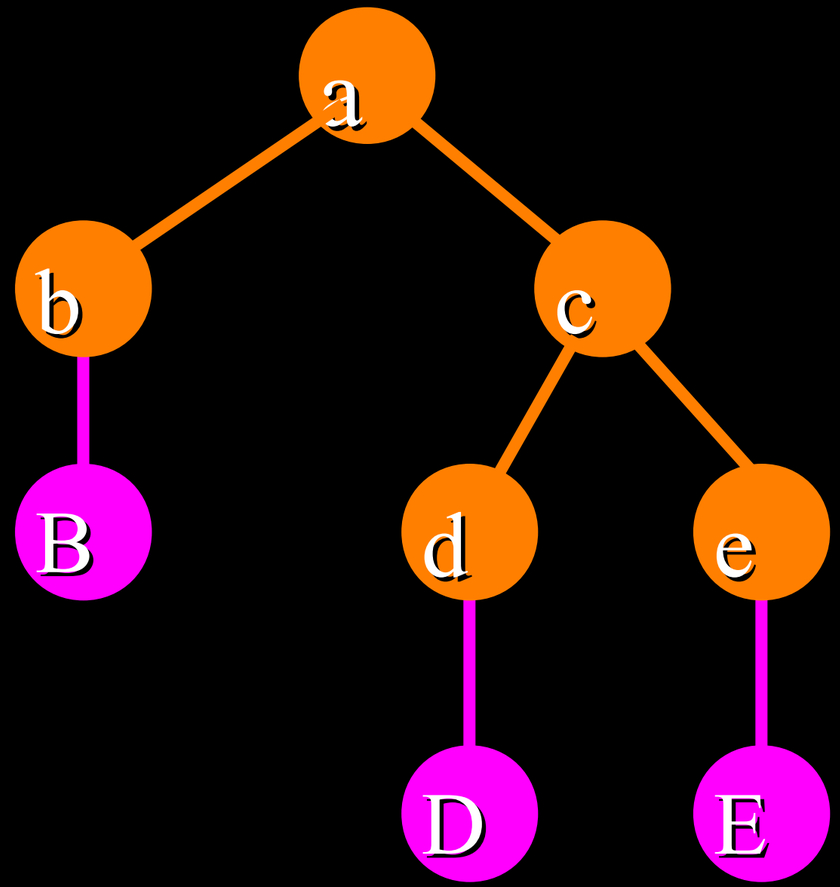
- XML Becomes a Document Object Model - DOM

The Document Object Model (DOM) is a platform- and language-independent standard object model for representing HTML or XML documents as well as an Application Programming Interface (API) for querying, traversing and manipulating such documents.

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

XML as a Tree

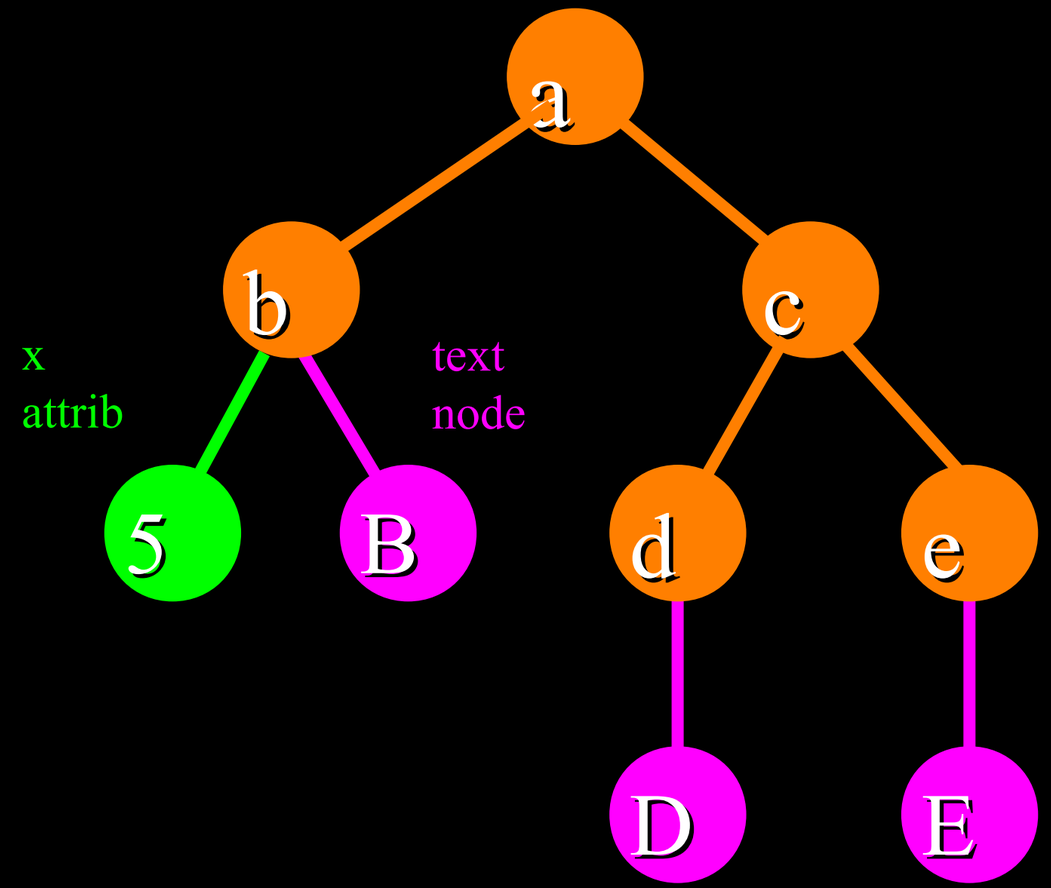
```
<a>
        <b>B</b>
        <c>
           <d>D</d>
        <e>E</e>
        </c>
</a>
```



Elements Text

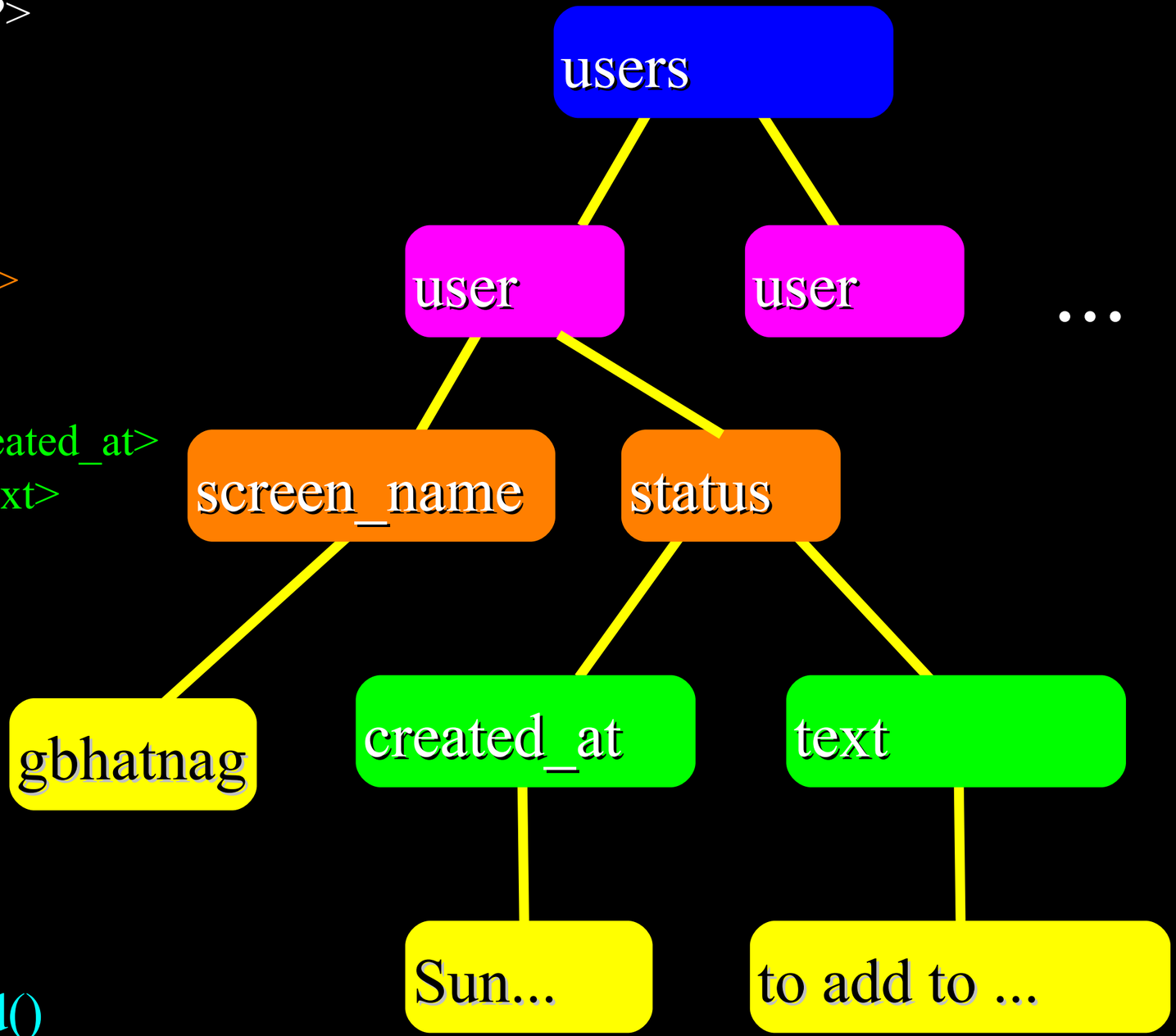
XML Text and Attributes

```
<a>
        <b x="5">B</b>
        <c>
           <d>D</d>
        <e>E</e>
        </c>
</a>
```



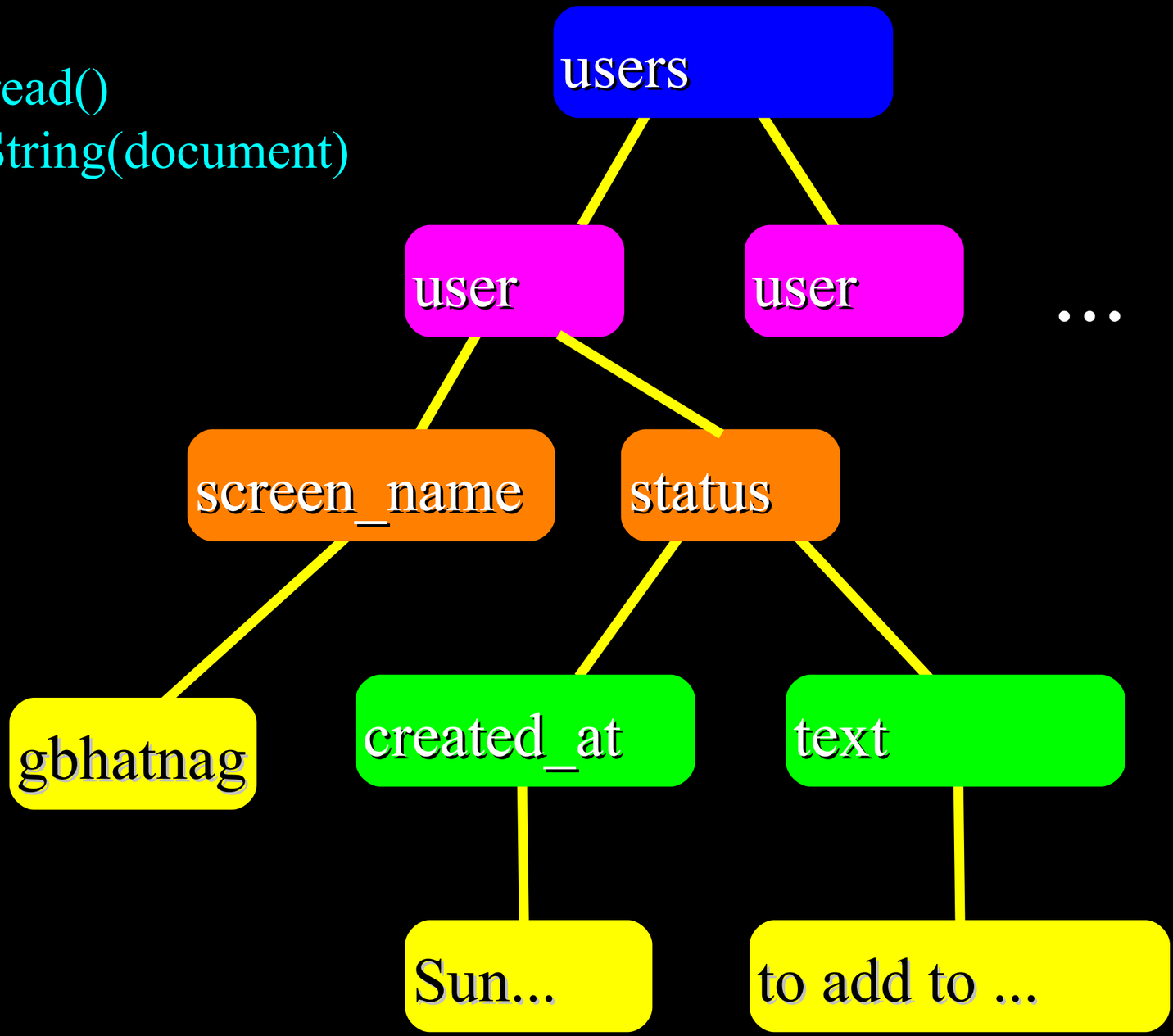
Elements Text

```
<?xml version="1.0" encoding="UTF-8"?>
<users type="array">
<user>
  <id>14870169</id>
  <name>Gaurav Bhatnagar</name>
  <screen_name>gbhatnag</screen_name>
  <location>42.28,-83.74</location>
  <status>
    <created_at>Sun Mar 15 17:52:44</created_at>
    <text>to add to @aatorres: projects</text>
  </status>
</user>
<user>
  <id>928961</id>
  <name>Rasmus Lerdorf</name>
    ……..
</user>
</users>
```

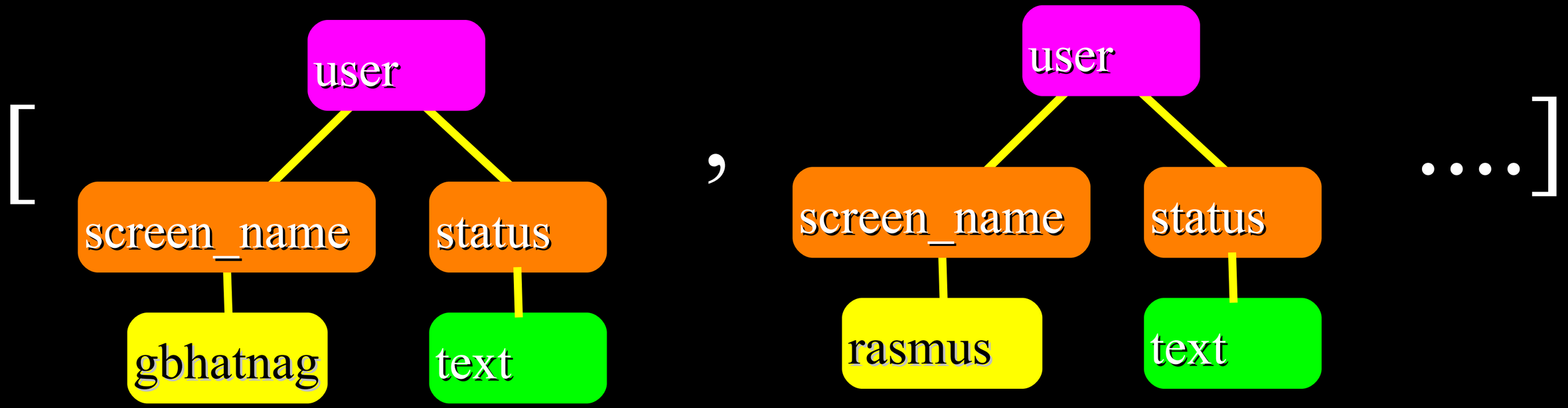



```
document = urllib.urlopen (url).read()
dom = xml.dom.minidom.parseString(document)
```

```
document = urllib.urlopen (url).read()
dom = xml.dom.minidom.parseString(document)
```



```
document = urllib.urlopen (url).read()
dom = xml.dom.minidom.parseString(document)
x = dom.getElementsByTagName('user')
```



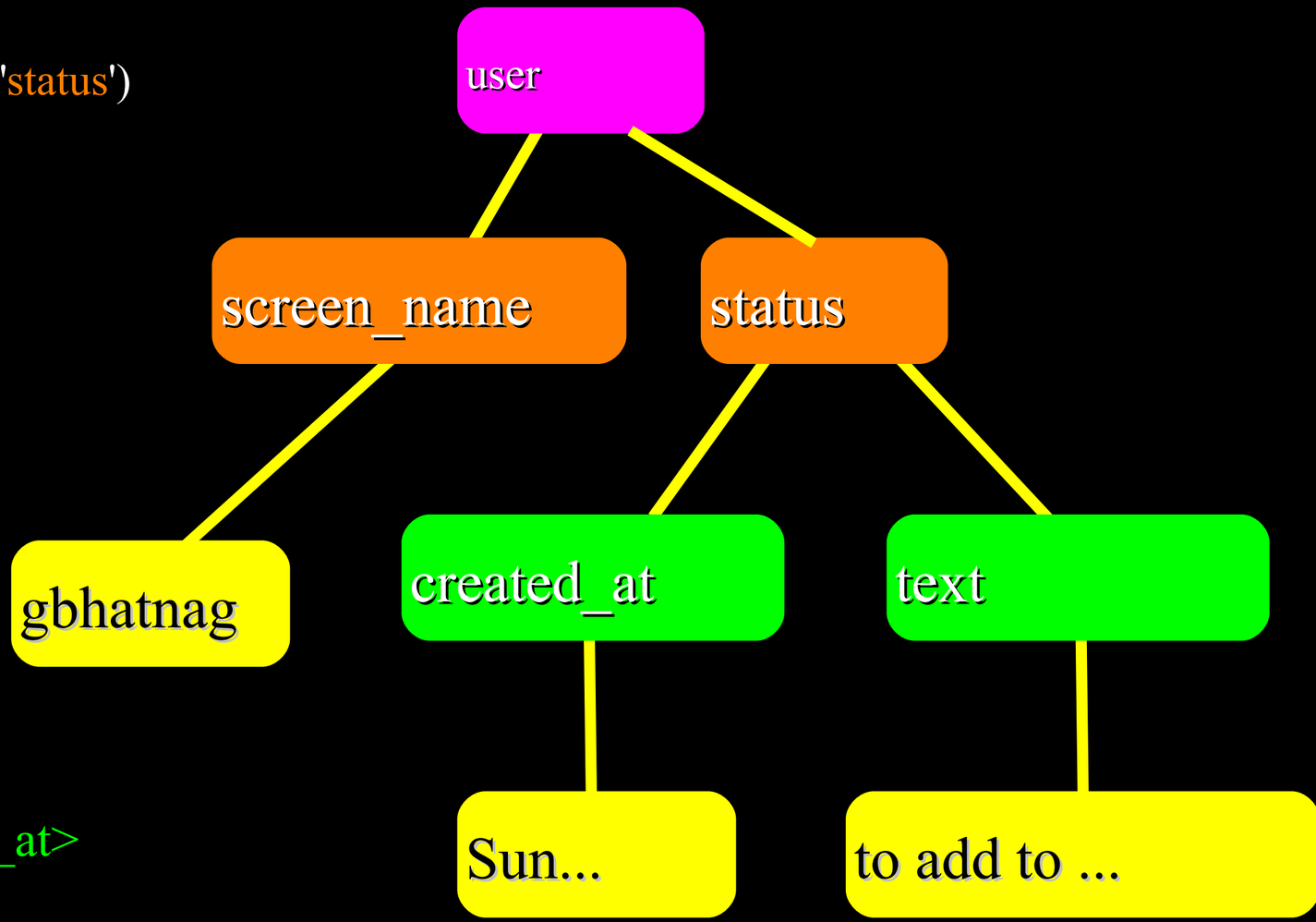
getElementsByTagName pulls out a Python List of sub-trees.

```
url = TWITTER_URL.replace('ACCT', acct)
document = urllib.urlopen (url).read()
dom = xml.dom.minidom.parseString(document)
count = 0
for user in dom.getElementsByTagName('user') :
    count = count + 1
print count
```

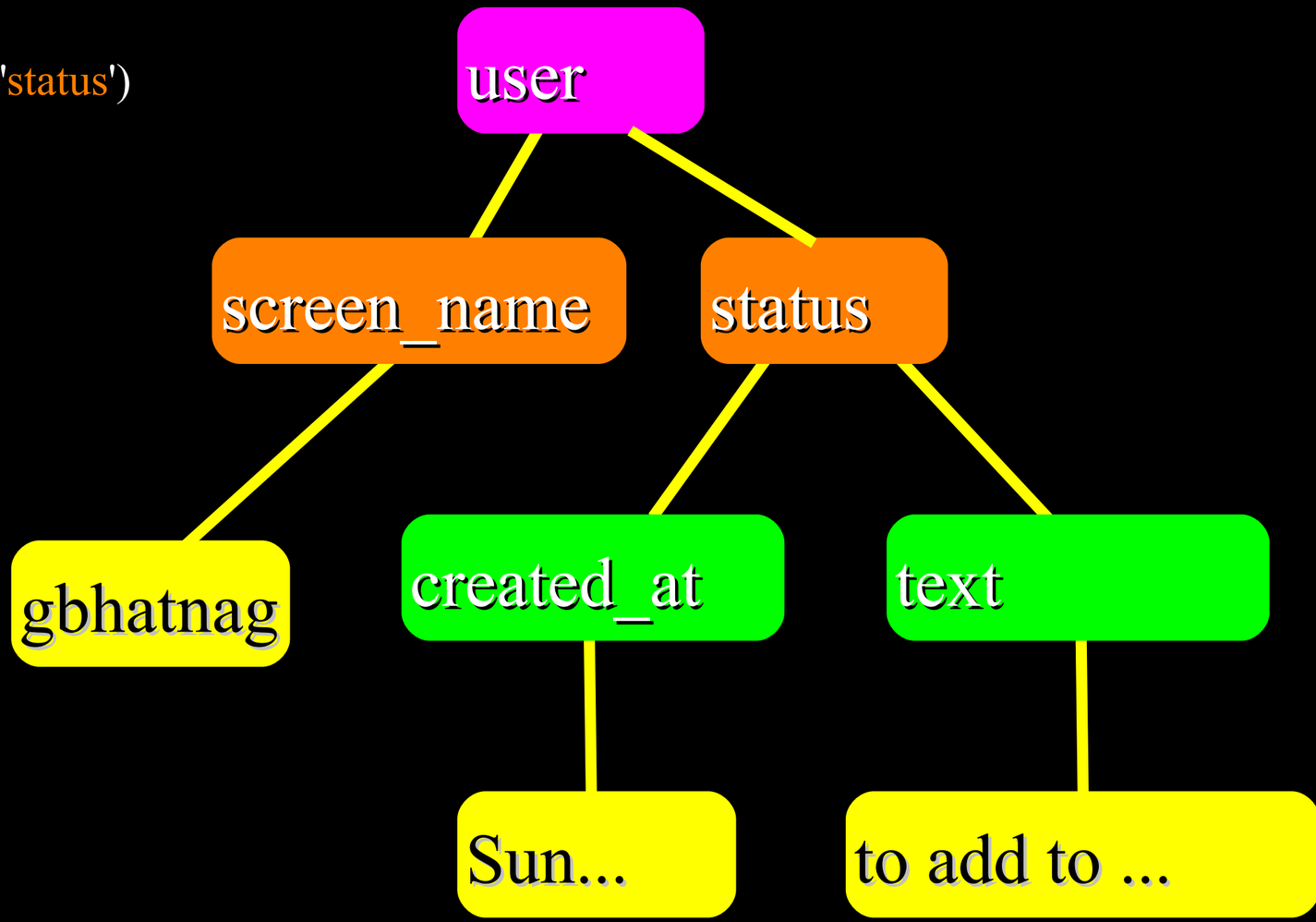
Counting the number of user tags...

```
for user in dom.getElementsByTagName('user') :
    name = getTag(user, 'screen_name')
    print name
    status = user.getElementsByTagName('status')
    text =  getTag(status,'text')
    if len(text) > 0 :
        print " ", text[:50]
```

```
<user>
  <id>14870169</id>
  <name>Gaurav Bhatnagar</name>
  <screen_name>gbhatnag</screen_name>
  <location>42.28,-83.74</location>
  <status>
    <created_at>Sun Mar 15 17:52:44</created_at>
    <text>to add to @aatorres: projects</text>
  </status>
</user>
```

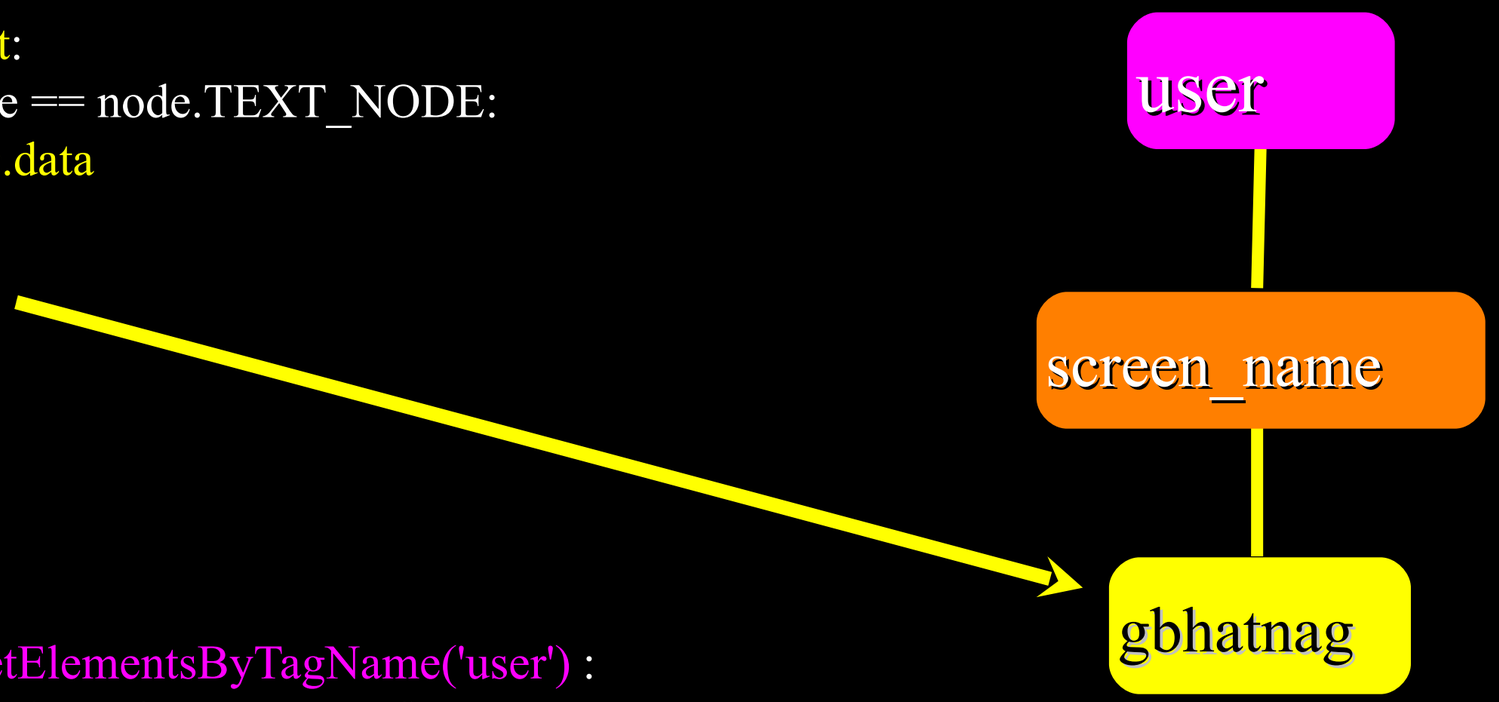


```
for user in dom.getElementsByTagName('user') :
    name = getTag(user, 'screen_name')
    print name
    status = user.getElementsByTagName('status')
    text =  getTag(status,'text')
    if len(text) > 0 :
        print " ", text[:50]
```




```
$ python twpals2.py

 Enter Twitter Account: drchuck
Gbhatnag
  to add to @aatorres: projects that
Rasmus
  @nine_L Which shop is that?
```

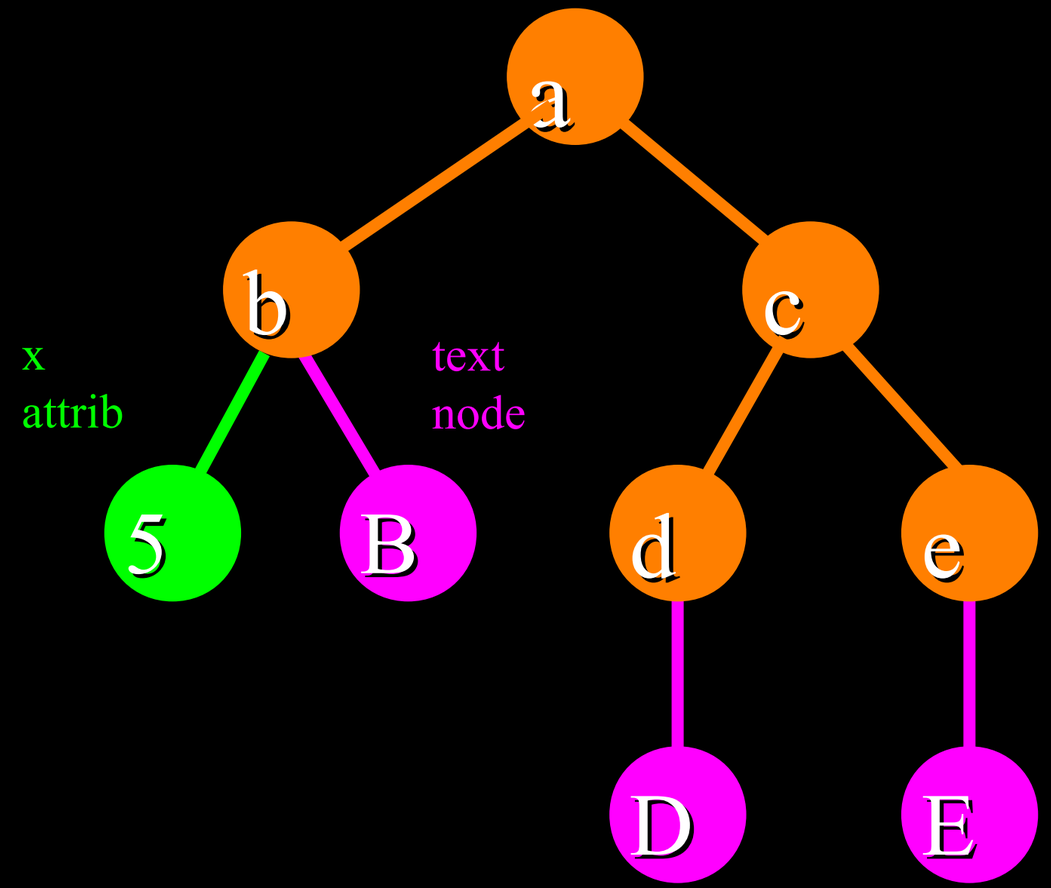
```
def getTag(node, tagname):
    if isinstance(node,list) and len(node) < 1 : return ''
    if isinstance(node, list): node = node[0]

    nodelist = node.getElementsByTagName(tagname)[0].childNodes
    rc = ''
    for node in nodelist:
        if node.nodeType == node.TEXT_NODE:
            rc = rc + node.data
    return rc
```




```
 for user in dom.getElementsByTagName('user') :
        name = getTag(user, 'screen_name')
```

XML Text and Attributes

```
<a>
        <b x=”5”>B</b>
        <c>
            <d>D</d>
          <e>E</e>
        </c>
</a>
```




```
rc = ''
for node in nodelist:
    if node.nodeType == node.TEXT_NODE:
        rc = rc + node.data
```

```
$ python twpals2.py

 Enter Twitter Account: drchuck
Gbhatnag
  to add to @aatorres: projects that may fall into p
Rasmus
  @nine_L Which shop is that?
Ptarjan
  Home sweet home
Olegliber
  introducing ourselves and our interests...
Wilm
  Randomness: my firewall just informed me that Skyp
Dugsong
  RT @themediaisdying Chicago Tribune changes masthe
```

```
<user>
  <id>14870169</id>
  <name>Gaurav Bhatnagar</name>
  <screen_name>gbhatnag</screen_name>
  <location>42.28,-83.74</location>
  <status>
    <created_at>Sun Mar 15 17:52:44</created_at>
    <text>to add to @aatorres: projects</text>
  </status>
</user>
```

```
python twpals3.py
 Enter Twitter Account:drchuck
Gbhatnag
  42.28,-83.74
  to add to @aatorres: projects that may fall into p
Rasmus
  Sunnyvale, California
  Grr..  #lazyweb, how do I tell Thunderbird to use
```

Summary

- Service Oriented Architecture - allows an application to be broken into parts and distributed across a network - and for standards to be developed for service reuse
- 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