

Reading and Writing Data Files

Unstructured vs Structured Plain-text Data

State of the Union Speeches

State of the Union Address

George Washington

December 8, 1790

Fellow-Citizens of the Senate and House of Representatives:

In meeting you again I feel much satisfaction in being able to repeat my congratulations on the favorable prospects which continue to distinguish our public affairs. The abundant fruits of another year have blessed our country with plenty and with the means of a flourishing commerce.

Web Log Entries

169.237.46.168 -- [26/Jan/2004:10:47:58 -0800]

"GET /stat141/Winter04 HTTP/1.1" 301 328

"http://anson.ucdavis.edu/courses/"

"Mozilla/4.0 (compatible; MSIE 6.0; Windows NT 5.0; .NET CLR 1.1.4322) "

169.237.46.168 -- [26/Jan/2004:10:47:58 -0800]

"GET /stat141/Winter04/ HTTP/1.1" 200 2585

"http://anson.ucdavis.edu/courses/"

"Mozilla/4.0 (compatible; MSIE 6.0; Windows NT 5.0; .NET CLR 1.1.4322)"

Web Log Entries – extract & omit

169.237.46.168 -- [26/Jan/2004:10:47:58 -0800]

"GET /stat141/Winter04 HTTP/1.1" 301 328

"http://anson.ucdavis.edu/courses/"

"Mozilla/4.0 (compatible; MSIE 6.0; Windows NT 5.0; .NET CLR 1.1.4322) "

169.237.46.168 -- [26/Jan/2004:10:47:58 -0800]

"GET /stat141/Winter04/ HTTP/1.1" 200 2585

"http://anson.ucdavis.edu/courses/"

"Mozilla/4.0 (compatible; MSIE 6.0; Windows NT 5.0; .NET CLR 1.1.4322)"

`readLines()`

- The `readLines()` function reads each line of text in a file and creates a character vector with one element per line
- We can then use regular expressions to extract the data we want.

```
wlist = strsplit(wl, " \| -- \\[|\" ")
```

SPLIT on either
blank" or
blank--blank[or
"blank

```
wlist[[1]]  
[1] "169.237.46.168"  
[2] "26/Jan/2004:10:47:58 -0800]"  
[3] "GET /stat141/Winter04 HTTP/1.1"  
[4] "301 328"  
[5] "http://anson.ucdavis.edu/courses/"  
[6] "\"Mozilla/4.0 (compatible; MSIE 6.0; Windows  
NT 5.0; .NET CLR 1.1.4322)\""
```

```
> wlist[[1]][3]
```

```
[1] "GET /stat141/Winter04 HTTP/1.1"
```

Eliminate the unwanted characters in the third element

```
> apply(wlist,
```

```
      function(x) gsub(" .*$", "", x[3]))
```

```
[1] "GET" "GET"
```


Fixed-width formats

`read.fwf()`

- The `read.fwf()` function is handy if the pieces of information are always the same width
- “fwf” stands for fixed-width-format
- The web log data is close to a fwf

123456789012345678901234567890123456789...

ip is 1-14 | skip| |

169.237.46.168 -- [26/Jan/2004:10:47:58...

read.fwf(fileLoc,

widths = c(14,5,2,1,3,1,4,18,3))

	V1	V2	V3	V4	V5	V6	V7	...
1	169.237.46.168	--	[26	/	Jan	/	2004 ...
2	169.237.46.168	--	[26	/	Jan	/	2004 ...

Delimited data

Reading data into R

- Many data sets are stored in text files.
- The easiest way to read these into R is using either the **read.table** or **read.csv** function, both of which return a data frame.
- Consider the data at the following site

```
fileLoc = "http://www-  
958.ibm.com/software/data/cognos/manyeyes/datasets/o  
lympic2012withgdp/versions/1.txt"
```

The data

ISO	Gold/medals				Silver/medals				Bronze/medals		...
ABW	0	0	0	0	0	2,456,000,000.00	108,000...				
AFG	0	0	1	1	1	20,343,461,030.00	34,385,000	...			
AGO	0	0	0	0	0	100,990,000,000.00	...				
ALB	0	0	0	0	0	12,959,563,902.00	3,205,000	...			

These data are tab delimited

The variable names have slashes in them

The numbers have commas in them

read.table() or **read.csv()**

- These functions are useful for reading delimited plain text files
- They have quite a few options. Some of the important ones are:
 - file - name or URL
 - header - are column names at the top of the file?
 - sep - what divides elements of the table
 - na.strings - symbol for missing values, like 9999
 - skip - number of lines at the top of the file to ignore

```
> ctry = read.csv(
  fileLoc, skip = 1, sep = "\t", header = FALSE,
  colClasses = c("character", rep("numeric", 5),
                 rep("character", 3)))
```

```
> head(ctry)
```

	V1	V2	V3	V4	V5	V6	V7	V8	V9
1	ABW	0	0	0	0	0	2,456,000,000.00	108,000	22740.7407
2	AFG	0	0	1	1	1	20,343,461,030.00	34,385,000	591.6377
3	AGO	0	0	0	0	0	100,990,000,000.00	19,082,000	5292.4222
4	ALB	0	0	0	0	0	12,959,563,902.00	3,205,000	4043.5457
5	AND	0	0	0	0	0	3,491,000,000.00	84,864	41136.4065
6	ARE	0	0	0	0	0	360,245,000,000.00	7,512,000	47955.9372

Note we skipped the first row because the names would be problematic

Next we need to:

Clean up the GDP and POP by removing ,s and converting character strings to numeric


```
> head(data$V7)
```

```
[1] "2,456,000,000.00"    "20,343,461,030.00"    "100,990,000,000.00"  
[4] "12,959,563,902.00"   "3,491,000,000.00"     "360,245,000,000.00"
```

```
> fix7 = as.numeric(  
           gsub(",", "", data$V7))
```

```
> head(fix7)
```

```
[1]    2456000000    20343461030  1009900000000  
[4]   12959563902    3491000000   360245000000
```

Data Available on the Web

- HTML
 - Table (e.g., your simulation results)
 - plain text format (e.g., the ManyEyes data)
- Other Format:
 - JSON
 - XML

HTML

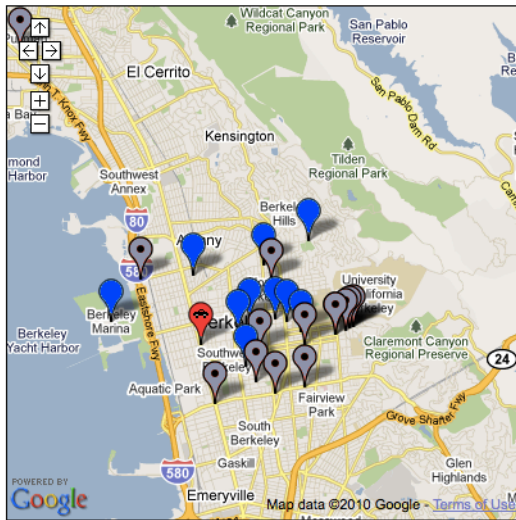
Scraping data from a Web page

- Means to write code to automatically extract data from one or more web pages.
- HTML is like XML – We can use parsing capabilities in the XML package.
`htmlParse()` can create a tree structure from ill-formed HTML.
- The information is all in text and we may need to use regular expressions to extract the relevant pieces

- Much of the data available on the web is not provided as a separate downloadable file; it's embedded in the website itself.

All incidents within 7 days

Displaying 1 - 25 of 28 incidents. < Previous | Next >



Top categories		
Theft	10	36%
Disturbances	5	18%
VANDALISM	5	18%
Aggravated Assault	3	11%
Burglary	3	11%
Stolen Auto	1	4%
Robbery	1	4%

Case num	Date	Category	Offense	Location
10066504	2010-11-01 03:40PM	Disturbances	Disturbance	1600 Block Milvia St
10066476	2010-11-01 11:45AM	Burglary	BURGLARY RESIDENTIAL	2400 Block Warring :
10066502	2010-11-01 10:30AM	Aggravated Assault	ASSAULT/BATTERY FELONY	600 Block Gilman St
10066447	2010-11-01 09:59AM	Theft	THEFT FELONY	2100 Block Mcgee Av
10066443	2010-11-01 09:35AM	Theft	THEFT FROM AUTO	1600 Block Carleton
10066431	2010-11-01 07:58AM	Disturbances	DOMESTIC VIOLENCE	3000 Block Martin Lu
10066419	2010-11-01 03:05AM	Robbery	Robbery	2700 Block Haste St

Popular Baby Names



Popular Names by Birth Year

November 7, 2010

Popularity in 2009

Rank	Male name	Female name
1	Jacob	Isabella
2	Ethan	Emma
3	Michael	Olivia
4	Alexander	Sophia
5	William	Ava
6	Joshua	Emily
7	Daniel	Madison
8	Jayden	Abigail
9	Noah	Chloe
10	Anthony	Mia
11	Christopher	Elizabeth
12	Aiden	Addison
13	Matthew	Alexis
14	David	Ella
15	Andrew	Samantha
16	Joseph	Natalie
17	Logan	Grace
18	James	Lily
19	Ryan	Alyssa
20	Benjamin	Ashley
21	Elijah	Sarah
22	Gabriel	Taylor

- Web pages are created when your browser software represents or “renders” a specially formatted (HTML) text file. Most browsers allow you to see this file under something like View > Page Source.

```
<!DOCTYPE HTML PUBLIC "-//W3C//DTD HTML 4.01 Transitional//EN" "http://www.w3.org/TR/html4/loose.dtd">
```

```
<html>
<head>
<meta http-equiv="X-UA-Compatible" content="IE=EmulateIE7" />
<meta http-equiv="content-type" content="text/html; charset=iso-8859-1">
<title>IMDb Charts</title>
<link rel="canonical" href="http://www.imdb.com/chart/" />
<meta name="title" content="IMDb Charts">
<meta name="description" content="IMDb: The biggest, best, most award-winning movie site on the planet.">

<meta name="keywords" content="movies,films,movie database,actors,actresses,directors,hollywood,stars,quotes">
<link rel="stylesheet" type="text/css" media="screen" href="http://i.media-imdb.com/images/SF05d2bd4730c135f1c4bceb
<script type="text/javascript" src="http://i.media-imdb.com/images/SF3ee6861263732f8e66aaecfd1850b466/a/js/ads.js">

<script type="text/javascript">
    generic.monitoring.set_twilight_info("chart", "US", "83e50b7a3b50b8f7118fc7864f59906f20c5aeb4", "2009-10-07T18%
</script>

<script type="text/javascript">
    generic.monitoring.start_timing("page_load");
</script>
<script type="text/javascript">
    var aan = {
        url:"http://aan.amazon.com/2009-05-01/imdb/default?slot=sitewide-iframe&ord=[CLIENT_SIDE_ORD]",
        oncall:custom.amazon.aan_iframe_oncall
    }
</script>
<iframe src="/images/SF0ed0def01846066a8fbf875202fe91fcd/a/js/scriptloader.html#aan" style="width:0px;height:0px;dis
<link rel="icon" href="http://i.imdb.com/favicon.ico" />
<link rel="apple-touch-icon" href="http://i.media-imdb.com/apple-touch-icon.png" />
```

IMDb Charts: IMDb Top 250

IMDb Charts

[Main index](#)

IMDb Top 250

[IMDb Bottom 100](#)

US Box Office

[USA Top 10](#)

[USA Archive](#)

UK Box Office

[UK Top 10](#)

[UK Archive](#)

All-Time Box Office

[USA](#)

[Non-USA](#)

[World-wide](#)

DVD Rentals

[USA Weekly Top 20](#)

Top 250 movies as voted by our users

For this top 250, only votes from regular voters are considered.

Track which films you've seen from the Top 250 [right here!](#)

Rank	Rating	Title	Votes
1.	9.2	The Shawshank Redemption (1994)	734,730
2.	9.2	The Godfather (1972)	549,126
3.	9.0	The Godfather: Part II (1974)	346,262
4.	8.9	Pulp Fiction (1994)	577,751
5.	8.9	The Good, the Bad and the Ugly (1966)	229,684
6.	8.9	12 Angry Men (1957)	180,224
7.	8.9	Schindler's List (1993)	386,132
8.	8.8	The Dark Knight (2008)	669,650
9.	8.8	The Lord of the Rings: The Return of the King (2003)	516,592
10.	8.8	One Flew Over the Cuckoo's Nest (1975)	309,957
11.	8.8	Star Wars: Episode V - The Empire Strikes Back (1980)	374,476
12.	8.8	Fight Club (1999)	556,117
13.	8.8	Inception (2010)	524,009



1st pair free

Get your first pair of glasses FREE!

*See site for details

Coastal.com

SHOP GLASSES »

[ad feedback](#)

Our goal:
Extract this
information and
put it in a
dataframe

JSON

JavaScript Object Notation

- Text format
- Lightweight data-interchange
- Easy for humans to read and write.
- Easy for machines to parse and generate

JSON Structure

- JSON is built on two structures:
- An unordered collection of comma-separated name:value pairs

`{"lender_id":"matt", "loan_count":23}`

- An ordered array of values

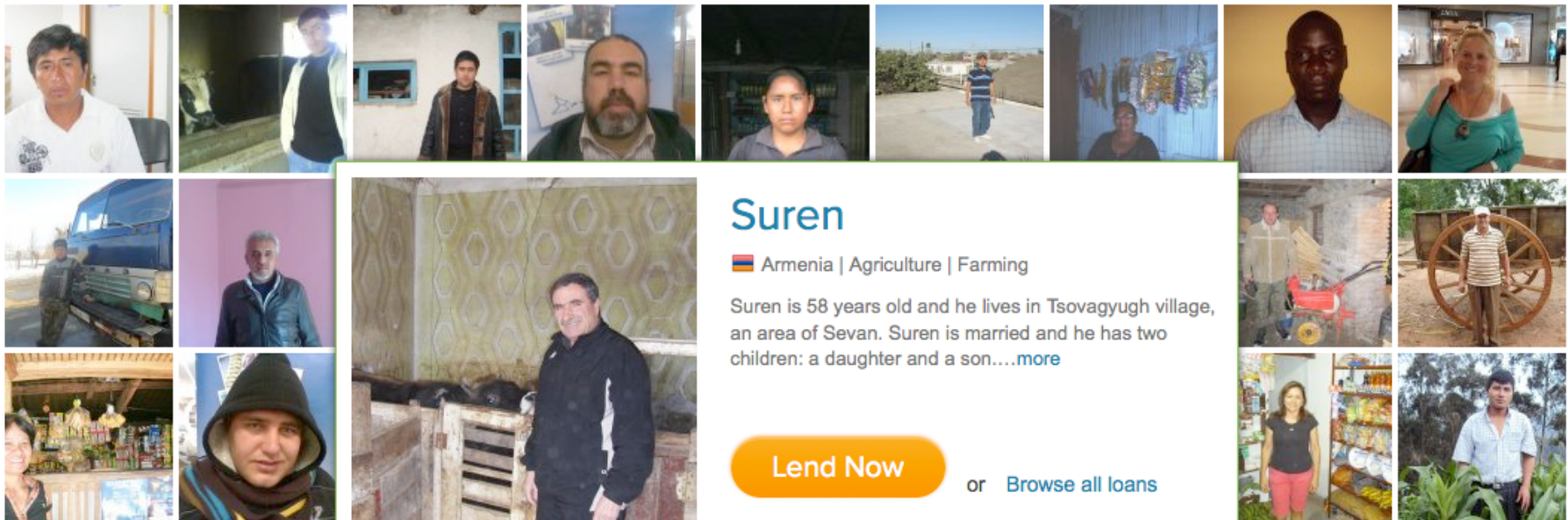
`[1, [true, false, true], [1, 2, 10, 20], {"lender_id":"skylar", "loan_count":1}]`

Comparison to XML


- JSON is simpler
- Not as rich – no attributes, unordered, no schema for describing acceptable format
- Compressed JSON and XML not much different in size

[Lend](#)[About](#)[Community](#)[Updates](#)[My Portfolio](#)

Empower people around the world with a \$25 loan



Suren

 Armenia | Agriculture | Farming

Suren is 58 years old and he lives in Tsovagyugh village, an area of Sevan. Suren is married and he has two children: a daughter and a son....[more](#)

[Lend Now](#) or [Browse all loans](#)

```
{"header":{"total":"576803","page":1,"date":"2010-01-29T20:00:23Z","page_size":1000},
"lenders":[
{"lender_id":"matt",
  "name":"Matt",
  "image":{"id":12829,"template_id":1}, "whereabouts":"San Francisco CA",
  "country_code":"US",
  "uid":"matt",
  "member_since":"2006-01-01T09:01:01Z",
  "personal_url":"www.socialedge.org/blogs/kiva-chronicles",
  "occupation":"Entrepreneur",
  "loan_because":"I love the stories. ",
  "occupational_info":"I co-founded a startup nonprofit (this one!) and I work with an amazing group of people dreaming up ways to alleviate poverty through personal lending. ",
  "loan_count":89,
  "invitee_count":23},
{"lender_id":"jessica",
  "name":"Jessica",
  "image":{"id":197292,
  "template_id":1}, ...
```

XML

eXtensible Markup Language

Most of the data sets we have seen have been in the form of ASCII tables.

Date	Time	Lat	Lon	Depth	Mag
1968/01/12	22:19:10.35	36.6453	-121.2497	6.84	3.00
1968/02/09	13:42:37.05	37.1527	-121.5448	8.49	3.00
1968/02/21	14:39:48.10	37.1783	-121.5780	6.95	3.80
1968/03/02	04:25:53.94	36.8343	-121.5447	5.35	3.00
1968/03/17	15:07:02.12	37.3088	-121.6615	4.39	3.00
1968/03/21	21:54:59.94	37.0378	-121.7407	11.86	4.30

- **Advantages:**

- easy to read, write, and process
- in standard cases, don't need a lot of extra information

- But these advantages can quickly disappear....

XML is a standard for *semantic*, *hierarchical* representation of data

```
<state>
<gml:name abbreviation="AL"> ALABAMA </gml:name>
<county>
<gml:name> Autauga County </gml:name>
<gml:location>
<gml:coord>
<gml:X> -86641472</gml:X>
<gml:Y> 32542207</gml:Y>
</gml:coord>
</gml:location>
</county>
```

Relationships between
pieces of data reflect
relationships in the real
world.

Pros

- data is self-describing
- format separates content from structure
- data can be easily merged and exchanged
- file is human-readable
- file is also easily machine-generated
- standards are widely adopted

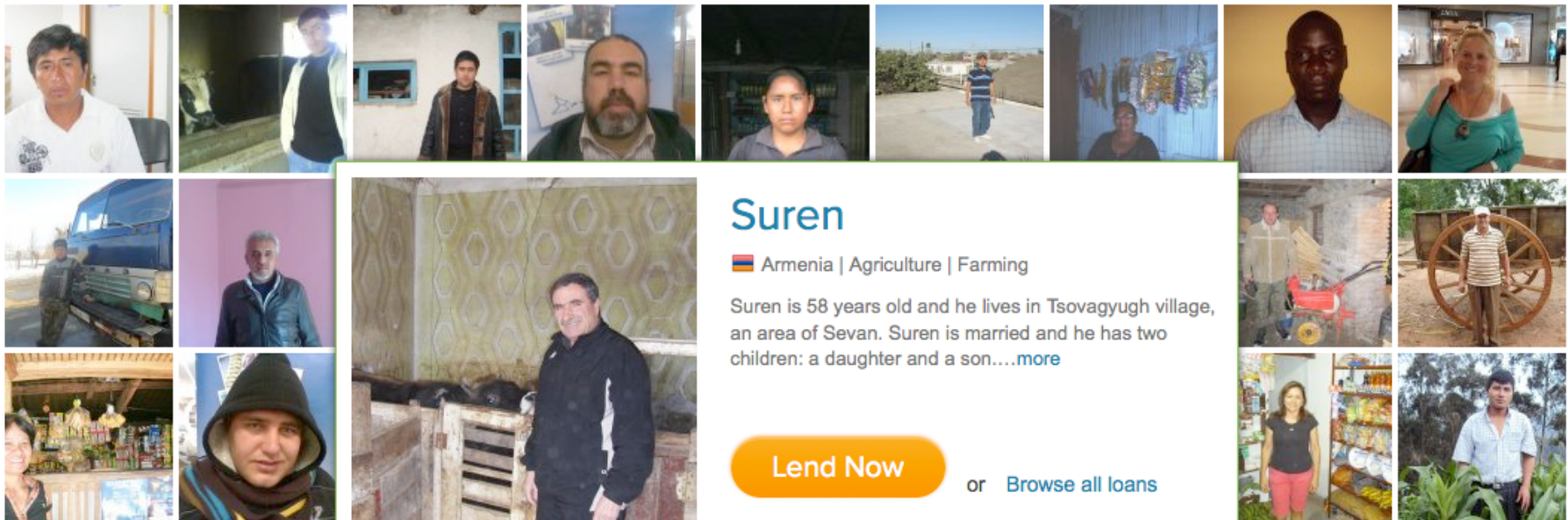
Cons

- XML documents can be very verbose and hard to read
- It's so general that it's hard to develop tools for all cases
- Files can be quite large due to high amount of redundancy


- XML is has become quite popular in many scientific fields, and it is standard in many web applications for the exchange and visualization of data.
- Well learn how to
 - create it and
 - read/process it.
- Well do both of these things from within R, but first let's start with an overview of what XML documents look like.

[Lend](#)[About](#)[Community](#)[Updates](#)[My Portfolio](#)

Empower people around the world with a \$25 loan



Suren

 Armenia | Agriculture | Farming

Suren is 58 years old and he lives in Tsovagyugh village, an area of Sevan. Suren is married and he has two children: a daughter and a son....[more](#)

[Lend Now](#) or [Browse all loans](#)

<lender>

<lender_id>matt</lender_id>

<name>Matt</name>

<image>

<id>12829</id>

<template_id>1</template_id>

</image>

<whereabouts>San Francisco CA</whereabouts>

<country_code>US</country_code>

<uid>matt</uid>

<member_since>2006-01-01T09:01:01Z</member_since>

<personal_url>www.socialedge.org/blogs/kiva-chronicles
</personal_url>

<occupation>Entrepreneur</occupation>

<loan_because>I love the stories. </loan_because>

<occupational_info>I co-founded a startup nonprofit (this one!)
and I work with an amazing group of people dreaming up ways to
alleviate poverty through personal lending.

</occupational_info>

<loan_count>89</loan_count>

<invitee_count>23</invitee_count>

</lender>

Snippet of Kiva
Data for one
lender

Euro foreign exchange reference rates

The reference rates are usually updated by 3 p.m. C.E.T. They are based on a regular daily concertation procedure between central banks across Europe and worldwide, which normally takes place at 2.15 p.m. CET.

Latest overview


























[Download latest & previous rates](#)

Background

For developers

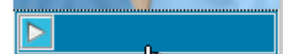
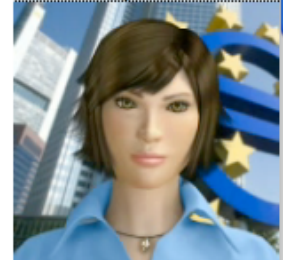
Euro foreign exchange reference rates as at 19 March 2012

All currencies quoted against the euro (base currency)

Currency		Spot	Charts	RSS
 USD	US dollar	1.3150 		
 JPY	Japanese yen	109.73 		
 BGN	Bulgarian lev	1.9558 =		
 CZK	Czech koruna	24.533 		
 DKK	Danish krone	7.4356 =		
 GBP	Pound sterling	0.82845 		
 HUF	Hungarian forint	289.44 		



Need help?



Press releases

→ Release calendar

QR Code for link
to daily rates



Snippet of exchange data

```
<Cube>
  <Cube time="2008-04-21">
    <Cube currency="USD" rate="1.5898"/>
    <Cube currency="JPY" rate="164.43"/>
    <Cube currency="BGN" rate="1.9558"/>
    <Cube currency="CZK" rate="25.091"/>
  </Cube>
  <Cube time="2008-04-17">
    <Cube currency="USD" rate="1.5872"/>
    <Cube currency="JPY" rate="162.74"/>
    <Cube currency="BGN" rate="1.9558"/>
    <Cube currency="CZK" rate="24.975"/>
  </Cube>
</Cube>
```



USGS Home
Contact Us
Search USGS

Earthquake Hazards Program

[Home](#)[About Us](#)[Contact Us](#)[EARTHQUAKES](#)[HAZARDS](#)[LEARN](#)[PREPARE](#)[MONITORING](#)[RESEARCH](#)

Past

[Past 8-30 days](#)[Significant Earthquakes](#)[Earthquake Lists & Maps](#)[Search for an Earthquake](#)

Present

[Real-time - CA/NV](#)[Real-time - USA](#)[Real-time - Worldwide](#)[About Earthquake Maps](#)[KML / RSS Feeds & Data](#)[Earthquake Notifications](#)[Did You Feel It?](#)[ShakeMaps](#)[PAGER](#)

Latest Earthquakes: Feeds & Data

In addition to web-based [maps and html pages](#), USGS provides several alternative ways to obtain real-time earthquake lists. Earthquake information is extracted from a merged catalog of earthquakes located by the USGS and [contributing networks](#). Earthquakes will be broadcast within a few minutes for California events, and within 30-minutes for worldwide events.

Google Earth KML

Display real-time earthquakes and [plate boundaries](#) in [Google Earth](#) (requires version 4+). To display earthquakes, download our earthquake KML feeds (below) and open it in Google Earth. Earthquakes refresh every 5-minutes. [More Google Earth](#)

 [M 1+ earthquakes, past 7 days \(colored by age\)](#)

Updated: Tue Mar 20 04:52:34 UTC (162 kB)

 [M 1+ earthquakes, past 7 days \(colored by depth\)](#)

Updated: Tue Mar 20 04:52:50 UTC (162 kB)


```
<event id="00068404" network-code="ak"
  time-stamp="2008/09/16_22:17:31 " version="2">
  <param name="year" value="2008"/>
  <param name="month" value="09"/>
  <param name="day" value="14"/>
  <param name="hour" value="00"/>
  <param name="minute" value="59"/>
  <param name="second" value="04.0"/>
  <param name="latitude" value="51.8106"/>
  <param name="longitude" value="-175.9250"/>
  <param name="depth" value="146.0"/>
  <param name="magnitude" value="3.8"/>
  <param name="num-stations" value="10"/>
  <param name="num-phases" value="15"/>
  <param name="dist-first-station" value="126.1"/>
  <param name="azimuthal-gap" value="53"/>
  <param name="magnitude-type" value="L"/>
  <param name="magnitude-type-ext"
    value="MI = local magnitude (synthetic Wood-Anderson)"/>
  <param name="location-method" value="a"/>
  <param name="location-method-ext"
    value="Auryn (Confirmed by human review)"/>
</event>
<event>
```

Snippet of USGS earthquake catalog data

Why all the changes? [Read More.](#)

X

Log In

govtrack.us

[HOME](#)[BROWSE](#)[ABOUT](#)[USE OUR DATA](#)

Developing with GovTrack Data

Everything on this page is for software developers. If you're looking for downloadable data for use in Excel, you'll have to look elsewhere on the site such as on the bill search page, the vote database page, etc.

[Data Documentation](#)[Data Access Terms & License](#)[Other Sites Using GovTrack Data](#)

If you are a developer looking to get involved in the open data movement, a great place to start is to contribute to the [Open States Project](#) run by the Sunlight Foundation. The goal is to build a database of legislation, like GovTrack, but for all 50 states.

Source Data

All of the source data that powers the site is made available in static XML files which you can download in bulk and reuse for other purposes. They are made available under open terms. — [Source Data Documentation](#) | [License Terms](#)

<actions>

<action datetime="2009-01-26">

<text>Referred to the Committee on Appropriations, and in addition to the Committee on the Budget, for a period to be subsequently determined by the Speaker, in each case for consideration of such provisions as fall within the jurisdiction of the committee concerned.

</text>

</action>

<action datetime="2009-01-26">

<text>Referred to House Appropriations</text>

</action>

</actions>

..

<relatedbills>

<bill relation="rule" session="111" type="hr" number="88" />

</relatedbills>

Snippet of
US
Congress
data



Search Google Developers



Sign in

Keyhole Markup Language



KML Tutorial

► KML in Google Maps

Interactive Sampler

▼ Documentation

Introduction

KML Tutorial

► Developer's Guide

Articles

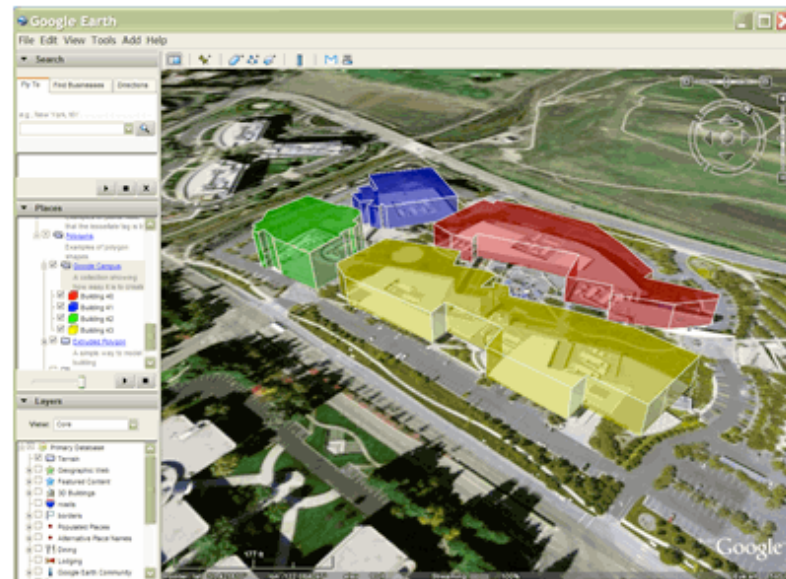
► KML Reference

► Forums

► More Resources

KML is a file format used to display geographic data in an Earth browser such as Google Earth, Google Maps, and Google Maps for mobile. KML uses a tag-based structure with nested elements and attributes and is based on the XML standard. All tags are case-sensitive and must appear exactly as they are listed in the [KML Reference](#). The Reference indicates which tags are optional. Within a given element, tags must appear in the order shown in the Reference.

If you're new to KML, explore this document and the accompanying sample files ([SamplesInEarth](#) and [SamplesInMaps](#)) to begin learning about the basic structure of a KML file and the most commonly used tags. The first section describes



```
<Placemark id="217">
```

```
<name>8.2</name>
```

```
<description>
```

```
Date: 2008-9-15
```

```
Magnitude: 1.5
```

```
Depth: 8.2 km
```

```
</description>
```

```
<styleUrl>#ball1-2</styleUrl>
```

```
<Point>
```

```
<coordinates>-147.426, 60.929, 0</coordinates>
```

```
</Point>
```

```
</Placemark>
```

Snippet of
KML for one
earthquake

XML Syntax

Syntax

The basic unit of XML code is called an “element” or “node.” It is made up of both *markup* and content. Markup consists of *tags*, *attributes*, and *comments*.

```
<CYL> 6 </CYL> <!-- elem with content 6 -->
```

Start tag Content End tag Comment - can go anywhere

```
<CYL> </CYL>
<CYL type="numeric" />
<CYL size="2"> 6 </CYL>
```

Elements with
no content

An attribute

Well-formed

- Tag names are case-sensitive; start and end tags must match exactly.
- No spaces are allowed between the `<` and the tag name.
- Tag names must begin with a letter and contain only alphanumeric characters.
- An element must have both an open and closing tag unless it is empty.
- An empty element that does not have a closing tag must be of the form `<tagname/>`.
- Tags must nest properly. (Inner tags must close before outer ones.)


```
<?xml version="1.0" encoding="ISO-8859-1"?>
<!-- Edited with XML Spy v2006 (http://www.altova.com) -->
<CATALOG>
```

```
  <PLANT>
```

```
    <COMMON>Bloodroot</COMMON>
```

```
    <BOTANICAL>Sanguinaria canadensis</BOTANICAL>
```

```
    <ZONE>4</ZONE>
```

```
    <LIGHT>Mostly Shady</LIGHT>
```

```
    <PRICE>$2.44</PRICE>
```

```
    <AVAILABILITY>031599</AVAILABILITY>
```

```
  </PLANT>
```

```
  <PLANT>
```

```
    <COMMON>Columbine</COMMON>
```

```
    <BOTANICAL>Aquilegia canadensis</BOTANICAL>
```

```
    <ZONE>3</ZONE>
```

```
    <LIGHT>Mostly Shady</LIGHT>
```

```
    <PRICE>$9.37</PRICE>
```

```
    <AVAILABILITY>030699</AVAILABILITY>
```

```
  </PLANT>
```

```
</CATALOG>
```

XML declaration
and processing
instructions

Note how indentation
makes it easier to
check that the tags
are correctly nested.

Well formed XML ctd.:

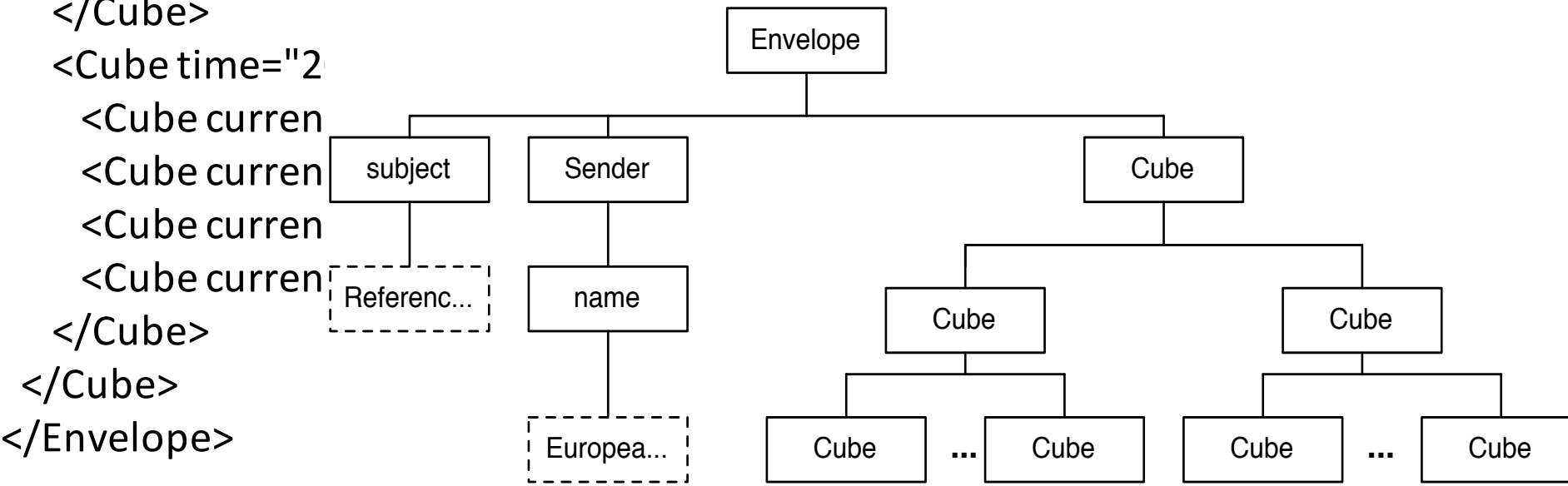
- All attributes must appear in quotes in the format:

name = "value"

- Isolated markup characters must be specified via entity references. `<` is specified by `<` and `>` is specified by `>`.
- All XML documents must contain a *root node* containing all the other nodes.

Tree Representation

```
<Envelope>
  <subject>Reference rates</subject>
  <Sender>
    <name>European Central Bank</name>
  </Sender>
  <Cube>
    <Cube time="2008-04-21">
      <Cube currency="USD" rate="1.5898"/>
      <Cube currency="JPY" rate="164.43"/>
      <Cube currency="BGN" rate="1.9558"/>
      <Cube currency="CZK" rate="25.091"/>
    </Cube>
```



```
<Cube time="2008-04-21">
  <Cube currency="USD" rate="1.5898"/>
  <Cube currency="JPY" rate="164.43"/>
  <Cube currency="BGN" rate="1.9558"/>
  <Cube currency="CZK" rate="25.091"/>
</Cube>
</Envelope>
```

Tree terminology

- There is only one *root or document node* in the tree, and all the other nodes are contained within it.
- We think of these other nodes as being *descendants* of the root node.
- We use the language of a family tree to refer to relationships between nodes. *Parents, children, siblings, ancestors, descendants*
- The *terminal nodes* in a tree are also known as *leaf nodes*. Content always falls in a leaf node.

Note:

- We'll learn to *create* and *process* XML documents from within R, but always keep in mind that R and XML are two separate things.
- In particular, it will be helpful to have in your mind the structure of the XML document *before* you do anything in R, especially when you're creating a new XML document.