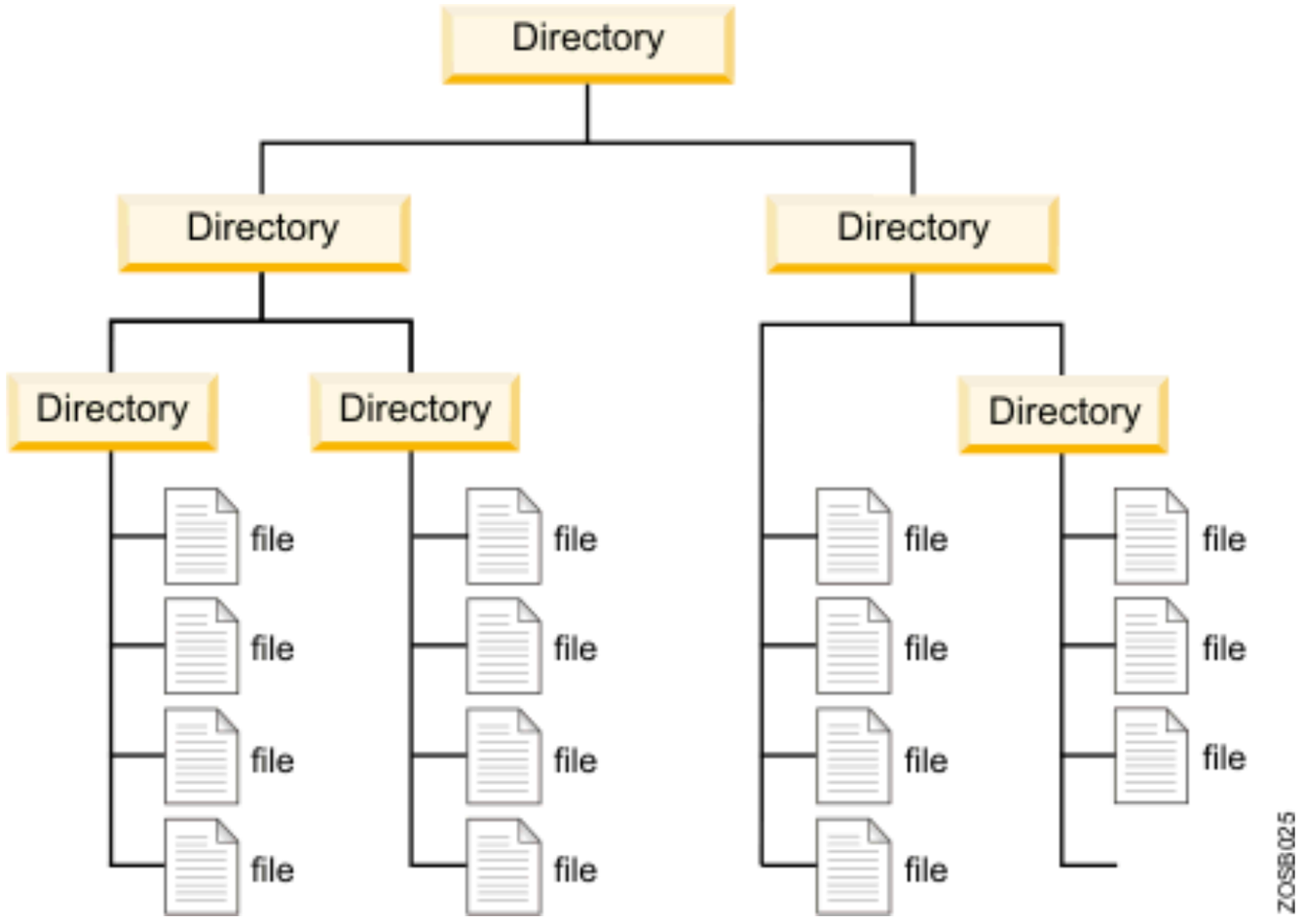
Module 12

Tree-Structured data

Trees

Some data is **hierarchical**: we think of each part (“node”) as “owning” or “enclosing” some sub-parts, down to some base level.



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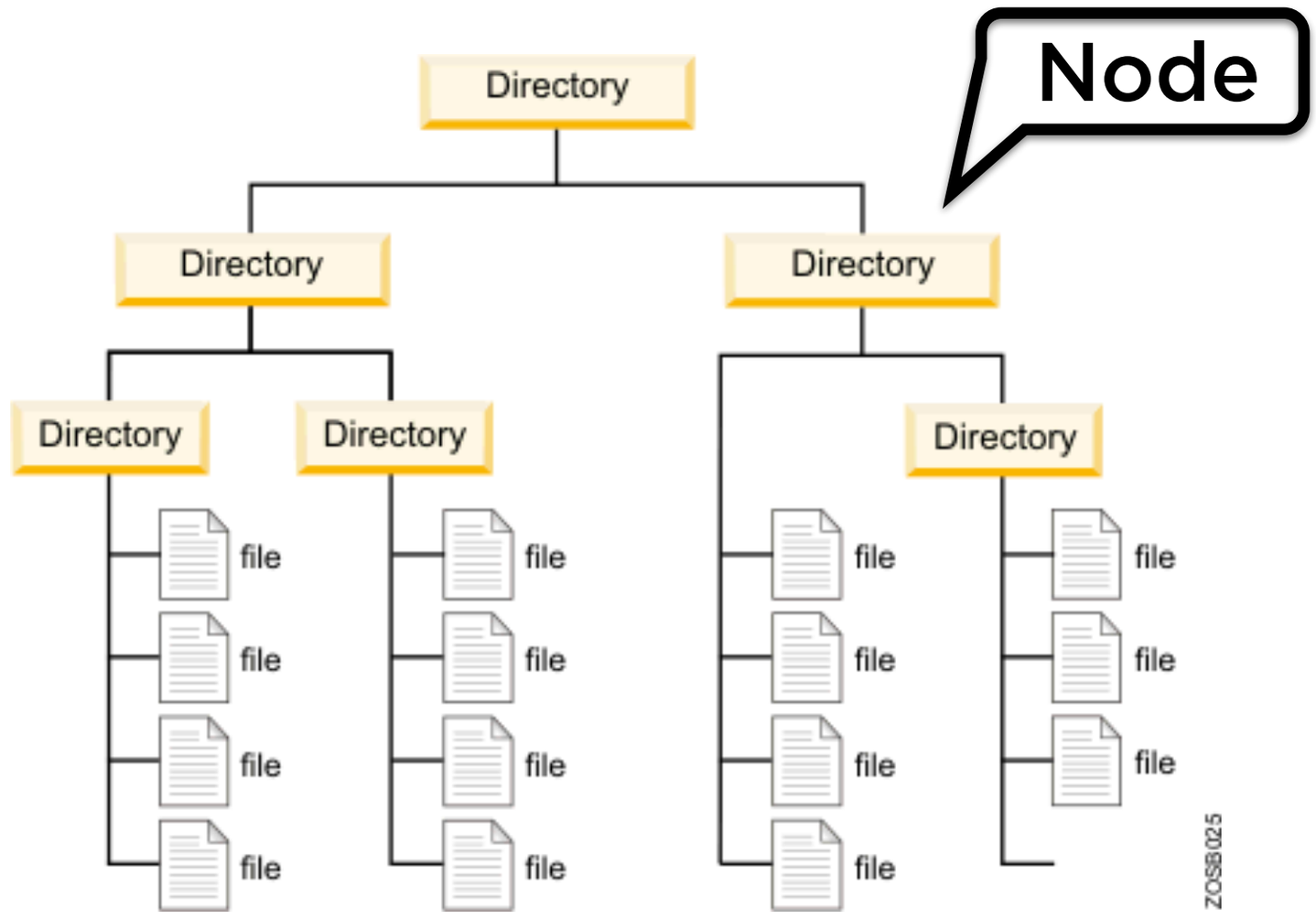
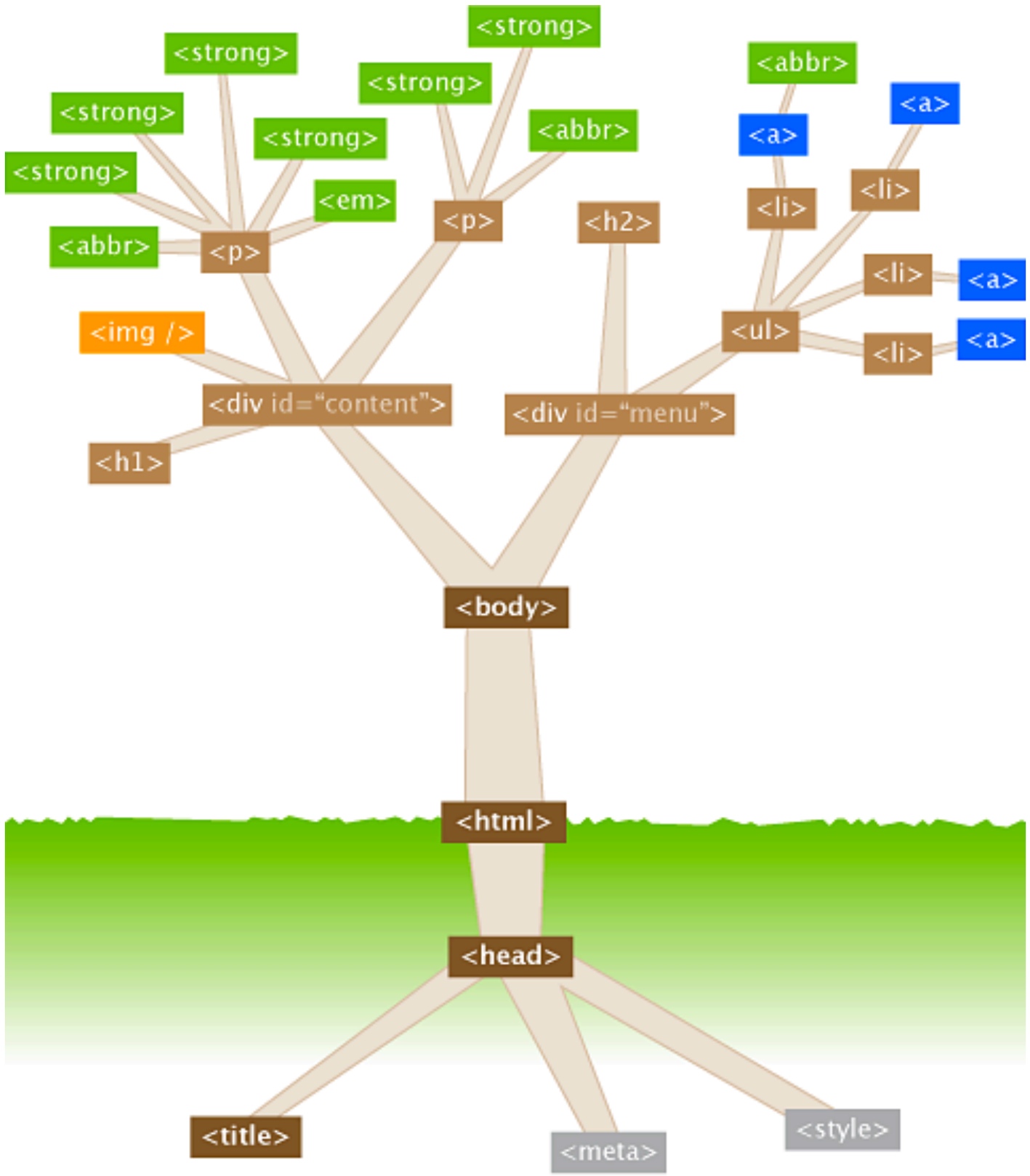



Home
Shop
Socks
Sports Socks
Business Socks
Shoes
Women's Shoes
Men's Shoes
About Us
Our History
Our People
Contact Us



watershedcreative.com/naked/html-tree.html

LIBRARY OF CONGRESS CLASSIFICATION

A GENERAL WORKS

AE	Encyclopedias
AY	Almanacs

B-BJ PHILOSOPHY

BF	Psychology
BL-BX	Religion

C HISTORY

CB	History of Civilization
CC	Archaeology
CT	General Biography

D HISTORY

DA-DQ	
DK	Russian History
DS-DT	

E U.S. HISTORY

E186	Colonial History
E456	Civil War
E740	Twentieth Century

F HISTORY OF THE AMERICAS

F1	State Histories
F381	Texas
F1001	Canada
F1201	Mexico. Latin America

G GEOGRAPHY

N FINE ARTS

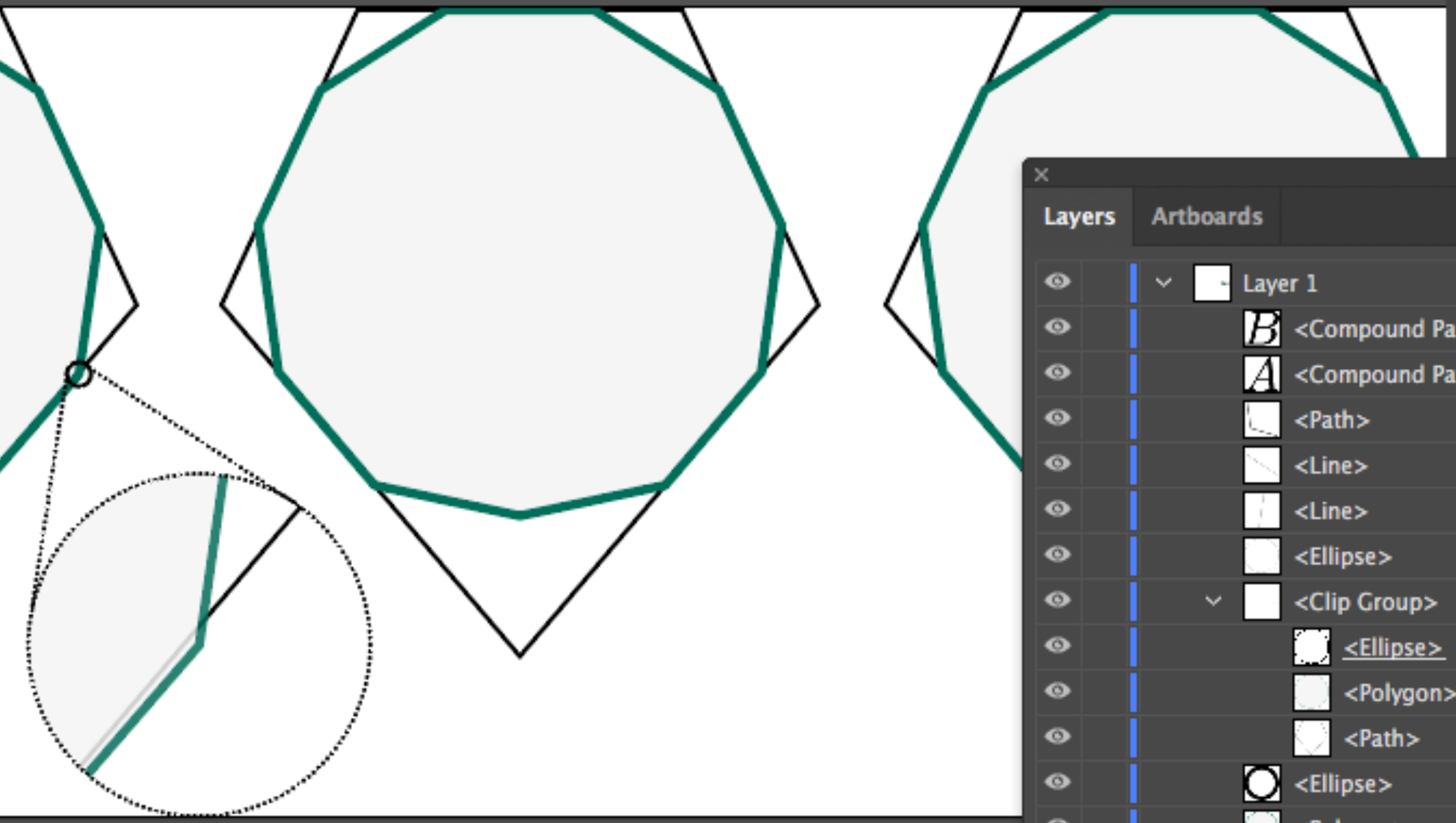
NA-NB	Architecture. Sculpture
NC-NE	Drawing, Painting, Prints
NK	Crafts

P LANGUAGE AND LITERATURE

PA	Classical Language, Literature
PC2001	French Language
PC4001	Spanish Language
PE	English Language
PE1128	English as a Second Language
PF	German Language
PL	Japanese. Korean. Chinese Languages
PN	Poetry. Theater. Speech. Journalism
PQ1	French Literature
PQ6001	Spanish Literature
PR	British Literature
PS	American Literature
PT	German Literature
PZ	Children's, Young Adult Literature

Q SCIENCE

QA	Mathematics
QA76	Computer Science
QB	Astronomy
QC	Physics
QD	Chemistry
QE	Geology
QH	Natural History



Layers | Artboards

- Layer 1
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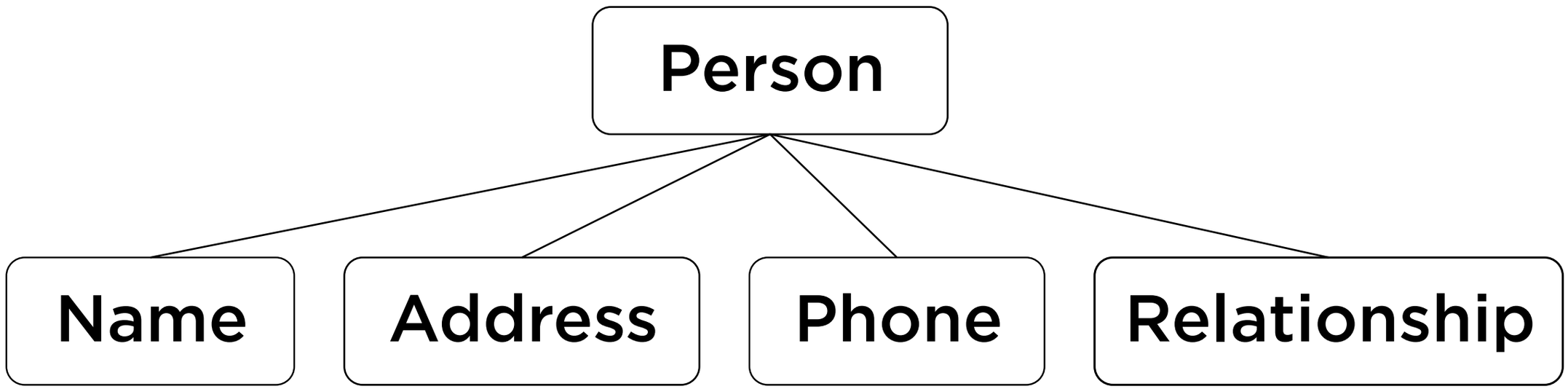
  - <Compound Path>
  - <Path>
  - <Line>
  - <Line>
  - <Ellipse>
  - <Clip Group>
    - <Ellipse>
    - <Polygon>
    - <Path>
  - <Ellipse>
  - <Polygon>
  - <Group>
    - <Path>
    - <Path>
  - <Group>
    - <Path>
    - <Path>
  - <Path>

1 Layer

Sometimes, a node behaves like a Processing **class**: it has a specific slot set aside for each kind of child.



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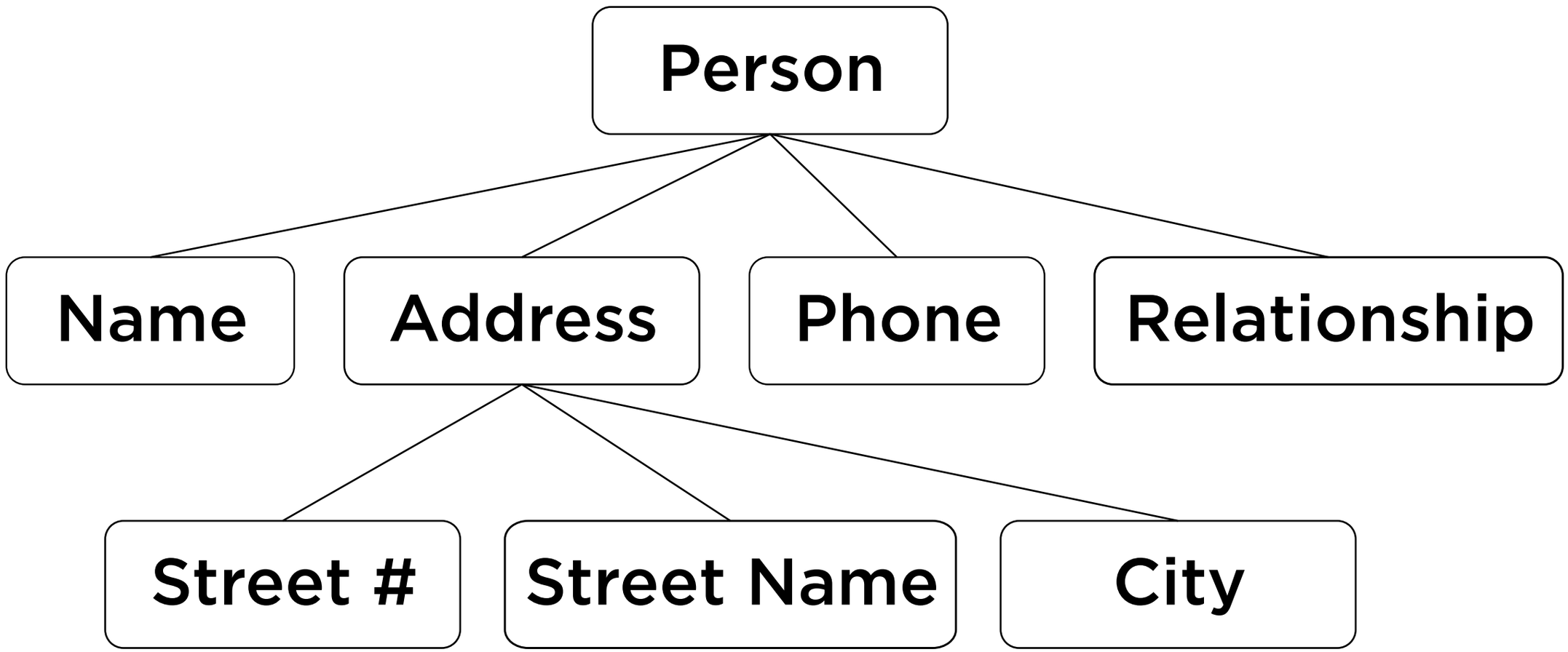
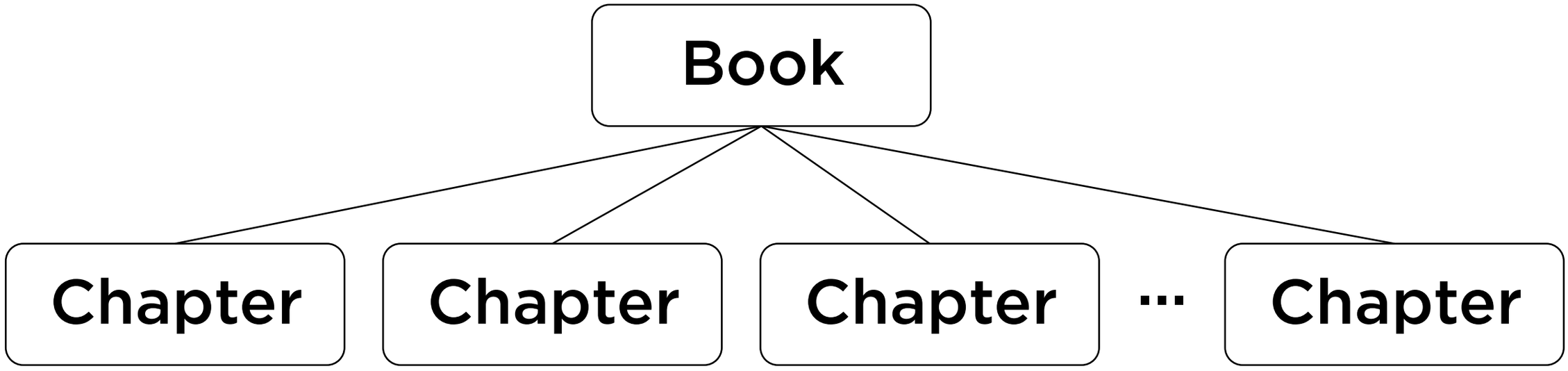


Sometimes, a node holds something more like a **sequence** of children.



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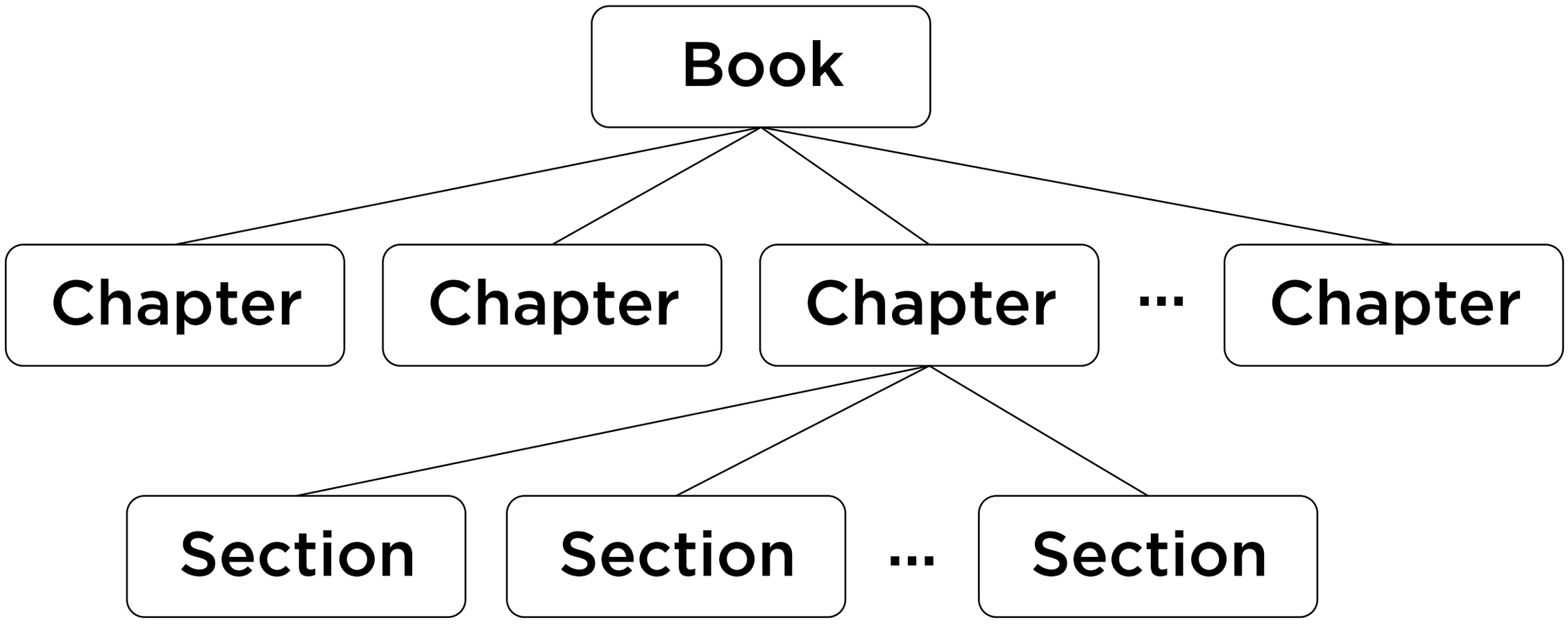

There are two standard ways that tree-structured data is passed around online:

- **XML**: eXtended Markup Language
- **JSON**: JavaScript Object Notation

Both are “simple” text-based formats for more or less arbitrary data.

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- **XML**: eXtended Markup Language
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Both are “simple” text-based formats for more or less arbitrary data.

Both are available in Processing. We’ll use JSON because it’s nicer to read.

JSON is a small subset of the syntax of Javascript, which can be used to describe a few important data types.

Primitive types:

- Integers
- Floats
- Booleans
- Strings

Compound types:

- Arrays
- Trees

JSON primitive values

Integers: `0, 27, -4…`

Floats: `0.003, 3.1415926, -18.77…`

Booleans: `true, false`

Strings: “`hello`”, “`pancakes!!`”…

`null`

JSON arrays

A JSON array is a comma-separated list of values, enclosed in square brackets

```
[]
[1, 2, 3]
[1, true, “hello”]
[-3.14, “kumquat”, [true, false]]
```

The elements do not need to be of one type!

JSON objects

A JSON object is a comma-separated list of key/value pairs, enclosed in curly braces. It behaves like a dictionary!

```
{}

{ “name”: “Craig”, “extension”: 34589 }

{ “digits”: [1,2,3], “good”: true,
  “remark”: “best digits ever” }
```

```
{
  "firstName": "John",
  "lastName": "Smith",
  "age": 35,
  "address": {
    "streetAddress": "51 Strange Street",
    "city": "Kitchener",
    "province": "ON",
    "postalCode": "N3K 1E7"
  },
  "phoneNumbers": [
    {
      "type": "home",
      "number": "519 555-1234"
    },
    {
      "type": "mobile",
      "number": "226 555-4567"
    }
  ],
  "children": ["Eunice", "Murgatroyd"],
  "spouse": null
}
```

Getting JSON Objects

```
JSONObject stuff = loadJSONObject( "filename.json" );
```

Read the contents of the file into a `JSONObject`**.**

Also `loadJSONArray()`, `parseJSONObject()`, `parseJSONArray()`.

Working with JSONArray

```
JSONArray arr = …

int num_entries = arr.size();

… arr.getInt( 0 ) …
… arr.getFloat( 12 ) …
… arr.getBoolean( idx ) …
… arr.getString( jdx ) …

… arr.getJSONObject( 5 ) …
… arr.getJSONArray( num_entries - 1 ) …
```

Working with JSONObject

```
JSONObject obj = …

… obj.getInt( "key" ) …
… obj.getFloat( "fieldname" ) …
… obj.getBoolean( "phone" ) …
… obj.getString( "address" ) …
… obj.getJSONObject( "whatever" ) …
… obj.getJSONArray( “etc.” ) …
```

```
{
  "firstName": "John",
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  "age": 35,
  "address": {
    "streetAddress": "51 Strange Street",
    "city": "Kitchener",
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      "number": "519 555-1234"
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    {
      "type": "mobile",
      "number": "226 555-4567"
    }
  ],
  "children": ["Eunice", "Murgatroyd"],
  "spouse": null
}
```

obj

```
{
  "firstName": "John",
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  "age": 35,
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    "province": "ON",
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    {
      "type": "home",
      "number": "519 555-1234"
    },
    {
      "type": "mobile",
      "number": "226 555-4567"
    }
  ],
  "children": ["Eunice", "Murgatroyd"],
  "spouse": null
}
```


```
obj.getString( "firstName" );
```

```
{
  "firstName": "John",
  "lastName": "Smith",
  "age": 35,
  "address": {
    "streetAddress": "51 Strange Street",
    "city": "Kitchener",
    "province": "ON",
    "postalCode": "N3K 1E7"
  },
  "phoneNumbers": [
    {
      "type": "home",
      "number": "519 555-1234"
    },
    {
      "type": "mobile",
      "number": "226 555-4567"
    }
  ],
  "children": ["Eunice", "Murgatroyd"],
  "spouse": null
}
```


```
obj.getInt( "age" );
```

```
{
  "firstName": "John",
  "lastName": "Smith",
  "age": 35,
  "address": {
    "streetAddress": "51 Strange Street",
    "city": "Kitchener",
    "province": "ON",
    "postalCode": "N3K 1E7"
  },
  "phoneNumbers": [
    {
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      "number": "226 555-4567"
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obj

```
{
  "firstName": "John",
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    "city": "Kitchener",
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    {
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    {
      "type": "mobile",
      "number": "226 555-4567"
    }
  ],
  "children": ["Eunice", "Murgatroyd"],
  "spouse": null
}
```


```
obj.getJSONArray( "phoneNumbers" )
```

```
{
  "firstName": "John",
  "lastName": "Smith",
  "age": 35,
  "address": {
    "streetAddress": "51 Strange Street",
    "city": "Kitchener",
    "province": "ON",
    "postalCode": "N3K 1E7"
  },
  "phoneNumbers": [
    {
      "type": "home",
      "number": "519 555-1234"
    },
    {
      "type": "mobile",
      "number": "226 555-4567"
    }
  ],
  "children": ["Eunice", "Murgatroyd"],
  "spouse": null
}
```


```
obj.getJSONArray( "phoneNumbers" ).getJSONObject( 1 )
```

```
{
  "firstName": "John",
  "lastName": "Smith",
  "age": 35,
  "address": {
    "streetAddress": "51 Strange Street",
    "city": "Kitchener",
    "province": "ON",
    "postalCode": "N3K 1E7"
  },
  "phoneNumbers": [
    {
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      "number": "519 555-1234"
    },
    {
      "type": "mobile",
      "number": "226 555-4567"
    }
  ],
  "children": ["Eunice", "Murgatroyd"],
  "spouse": null
}
```


```
obj.getJSONArray( "phoneNumbers" ).getJSONObject( 1 ).getString( "number" );
```

Example: RSS Feeds

Radiolab

A podcast powered by FeedBurner

A podcast is rich media, such as audio or video, distributed via RSS. Feeds like this one provide updates whenever there is new content. FeedBurner makes it easy to receive content updates in popular podcatchers.

Learn more about syndication and FeedBurner...

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...with iTunes:

Add to iTunes

...with something else (copy this address):

http://feeds.wnyc.org/radiolab

Get more info on other podcatchers:

GETJUICE | GET FIREANT | nimiq | GET ZIE P O D

View Feed XML

feeds.wnyc.org/radiolab

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    <channel>
        <title>Radiolab</title>
        <link>http://www.radiolab.org/series/podcasts/</link>
        <description>Radiolab is a show about curiosity. Where sound illuminates ide
Radiolab is heard around the country on more than 500 member stations. Check your lo
Embed the Radiolab widget on your blog or website.

Radiolab is supported, in part, by the Alfred P. Sloan Foundation, enhancing public
All press inquiries may be directed to Jennifer Houlihan Roussel at (646) 829-4497.<
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```
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      "title": "Radiolab"
      "link": "http://www.radiolab.org/series/podcasts/"
      "author": "WNYC Studios"
      "description": "Radiolab is a show about curiosity. Where sound illuminates i
      than 500 member stations. Check your local station for airtimes. Embed the Ra
      understanding of science and technology in the modern world. More information
      "image": "https://media2.wnyc.org/i/1400/1400/l/80/1/Radiolab-wnycstudios.jpg
   }
   "items": [
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            "duration": 1766
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            "rating": {
               "scheme": "urn:itunes"
```

```
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   "feed": {
      "url": "http://feeds.wnyc.org/radiolab?format=xml"
      "title": "Radiolab"
      "link": "http://www.radiolab.org/series/podcasts/"
      "author": "WNYC Studios"
      "description": "Radiolab is a show about curiosity. Where sound illuminates i
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      "image": "https://media2.wnyc.org/i/1400/1400/l/80/1/Radiolab-wnycstudios.jpg
   }
   "items": [
      {
"title": "Shots Fired: Part 2"
"pubDate": "2017-03-24 05:00:00"
"link": "http://www.radiolab.org/story/shots-fired-part-2/"
"guid": "http://www.radiolab.org/story/shots-fired-part-2/"
"author": "WNYC Studios"
"thumbnail": "https://media2.wnyc.org/i/130/130/c/80/1/3957814193_6fd835e7
"description": "We again join Ben Montgomery, reporter at the Tampa Bay Ti
"content": "We again join Ben Montgomery, reporter at the Tampa Bay Times,
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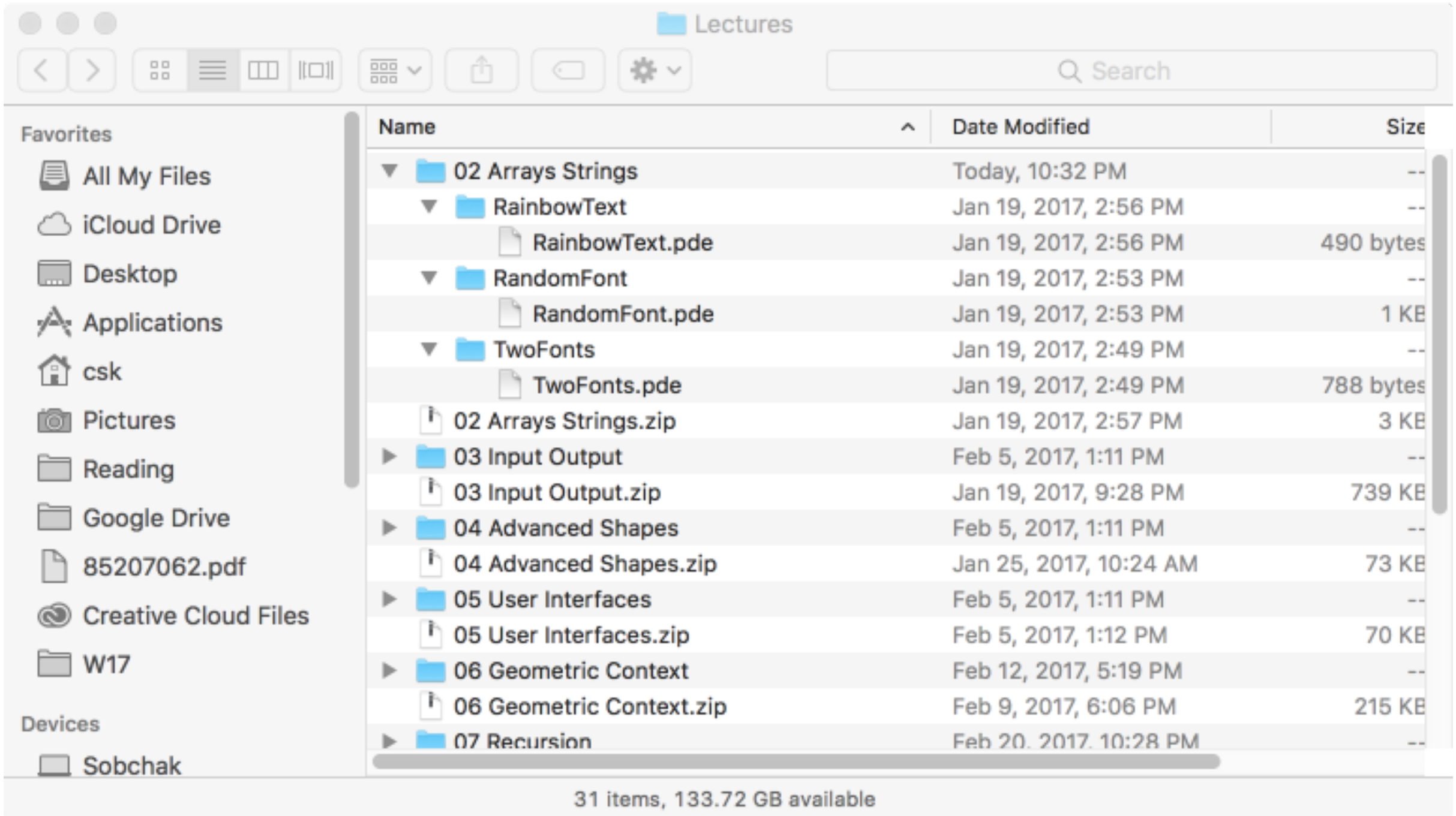
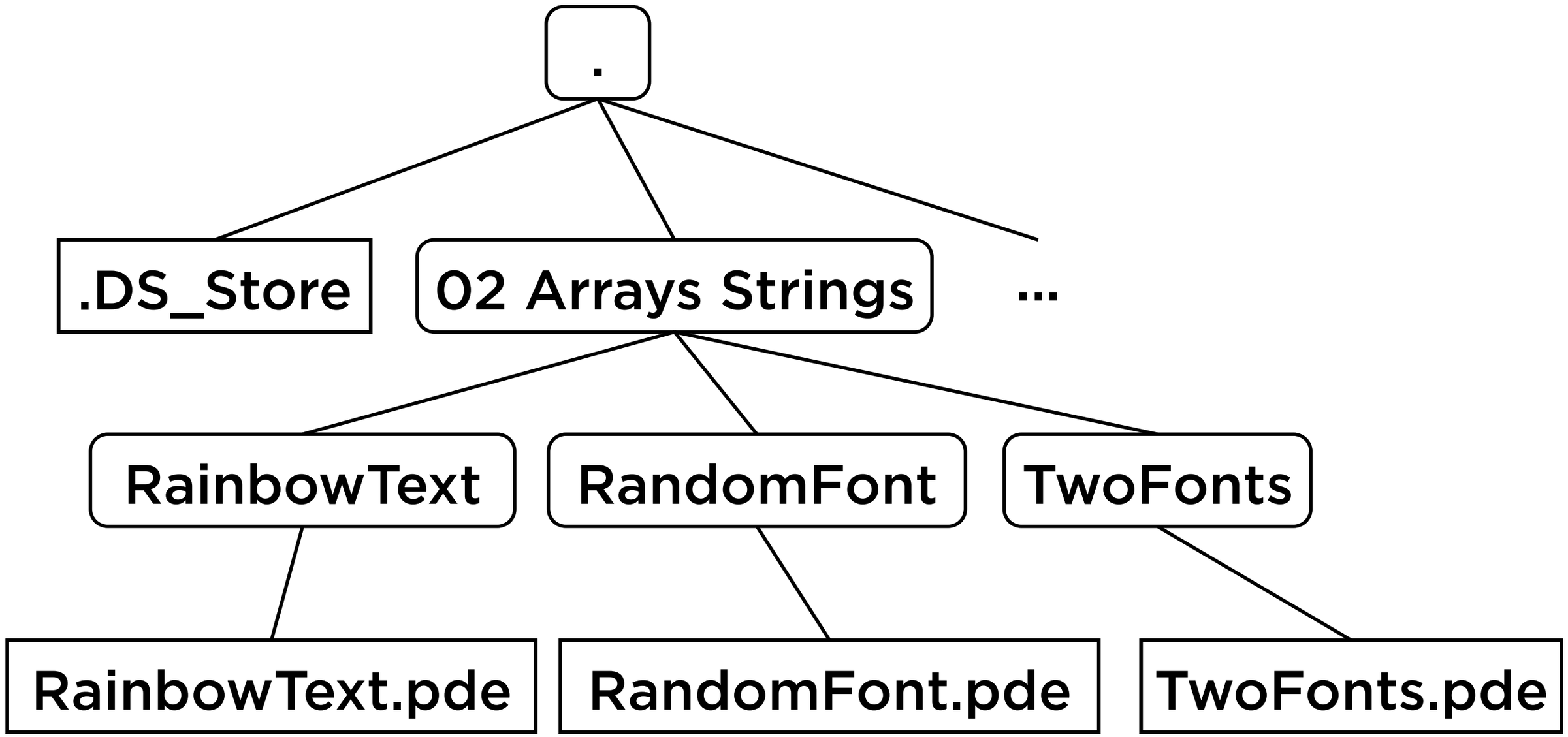
   "duration": 1766
   "thumbnail": "https://media2.wnyc.org/i/130/130/c/80/1/3957814193_6fd83
   "rating": {
      "scheme": "urn:itunes"
```


```
JSONObject obj = …;
String first_title =
   obj.getJSONArray( "items" )
      .getJSONObject( 0 )
      .getString( "title" );
```

Example: counting files




.
.DS_Store
02 Arrays Strings
...
RainbowText
RandomFont
TwoFonts
RainbowText.pde
RandomFont.pde
TwoFonts.pde

```
{
  "type": "directory",
  "name": ".",
  "children": [
    {
      "type": "file",
      "name": ".DS_Store"
    },
    {
      "type": "directory",
      "name": "02 Arrays Strings",
      "children": [
        {
          "type": "directory",
          "name": "RainbowText",
          "children": [
            {
              "type": "file",
              "name": "RainbowText.pde"
            }
          ]
        },
        {
          "type": "directory",
          "name": "RandomFont",
          "children": [
            {
              "type": "file",
```


+1!
LEVEL
UP

Going live

All `load` functions accept URLs as parameters in addition to file names!

```
loadStrings()
loadImage()
loadShape()
loadTable()
loadJSONObject()
loadJSONArray()
```

Functions like `loadStrings()` and `loadImage()` allow you to access fixed content over the internet. `loadJSONObject()` is more like *calling a function over the web*.