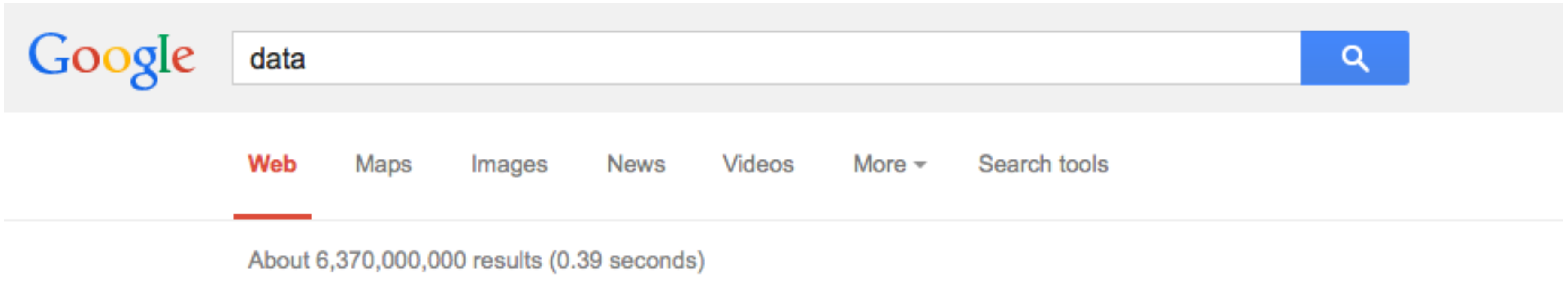
Managing Data & Databases

Session 2

Saving, retrieving and exchanging data

The data



About 6,370,000,000 results (0.39 seconds)

If it is so abundant, why is it so valuable?

What does that mean?

- Pre-analytical, pre-factual…
- Different from facts, evidence…
- Different from information, knowledge…
- Not ontological, not epistemological, but rhetorical…

- What the… :D

And what defines a data type?

2 + 2 = ?

“2” + “2” = ?

What’s the deal with data structures?

Structured = Fixed structure
Semi-structured = Floating structure
Unstructured = No readily identifiable/described structure

But why should we structure the data?

What is qualitative anyway?

Storage?
Structure?
Interpretation?

The statisticians' conception of data types

- Nominal
  - Notion of categories
  - Married > Unmarried? Unmarried > Married? Married < Divorced?
  - If the comparison is subjective, you are not dealing with data anymore
- Ordinal
  - Notion of order
  - Medium > Small, Large > Medium => Large > Small
  - But is L - M = M – S? Or at least L – M = f(M – S)
  - If the answer is subjective, you are not dealing with data anymore
- Interval
  - Notion of difference / subtraction
  - Discrete = Count, Continuous = Almost all measures
  - Intervals can have a fixed point = Ratio
  - Intervals can have be non-linear = Decibels, Richter

What is the largest category of nominal data you know about?

The computer scientists' perception of data types

- Primitive
  - Numerical: Digits, Integers, Real numbers, Hexadecimal numbers, Large integers, Rational numbers, Double precision floating point real numbers!
  - Logical: Booleans, Factors
  - Characters, Strings (of characters), Text
    - Code is machine-interpretable / executable text
  - Pointers, References, Links
- Composite
  - Any larger data structure encompassing a combination of the above
- Binary
  - Machine-readable anything
  - Where we can't deal with the raw data
  - Compiled code, encrypted text, images, audio, video, multimedia

Some simple composite data types

- 1D
  - Tuples (Pairs)
  - Ranges
  - Linked Lists (or Lists)
  - Vectors
  - Rows
  - Columns
  - Collections
- 2D or more
  - Arrays (Vectors of vectors)
  - Tables (Collection of columns and rows)

Some more complex data structures

- Linked tables
- Trees (and Hierarchies)
- Graphs (and Networks)
  - Multi-graphs
  - Multi-mode Graphs
  - Hyper-graphs
- Documents
- And most importantly: **Objects**
  - Collections of diverse variables / attributes / properties and coded behaviors

How do we save it?

- Serialization
  - That’s what you do when you write down your fluffy ideas

- Storage formats
  - Human-readable (Regularly used for data-interchange)
    - Linear
      - Plain text
    - Two-dimensional
      - Comma-delimited or tab-delimited text
      - Fixed-width text
    - Tree
      - Markup languages (HTML, XML, CSS)
      - Object notations (YAML, JSON)

  - Machine-readable (Regularly used for permanent data storage)
    - Most databases (apart from some new NoSQLs)
    - Most videos, most images, most audio formats, etc…

Comma-delimited text

```
"Date","Pupil","Grade"

"25 May","Bloggs, Fred","C"

"25 May","Doe, Jane","B"

"15 July","Bloggs, Fred","A"

"15 April","Muniz, Alvin ""Hank""","A"
```

XML

```
<!DOCTYPE glossary PUBLIC "-//OASIS//DTD DocBook V3.1//EN">
 <glossary><title>example glossary</title>
  <GlossDiv><title>S</title>
   <GlossList>
    <GlossEntry ID="SGML" SortAs="SGML">
     <GlossTerm>Standard Generalized Markup Language</GlossTerm>
     <Acronym>SGML</Acronym>
     <Abbrev>ISO 8879:1986</Abbrev>
     <GlossDef>
      <para>A meta-markup language, used to create markup
languages such as DocBook.</para>
      <GlossSeeAlso OtherTerm="GML">
      <GlossSeeAlso OtherTerm="XML">
     </GlossDef>
     <GlossSee OtherTerm="markup">
    </GlossEntry>
   </GlossList>
  </GlossDiv>
 </glossary>
```

JSON

```
{
    "glossary": {
        "title": "example glossary",
                "GlossDiv": {
            "title": "S",
                        "GlossList": {
                "GlossEntry": {
                    "ID": "SGML",
                                        "SortAs": "SGML",
                                        "GlossTerm": "Standard Generalized Markup Language",
                                        "Acronym": "SGML",
                                        "Abbrev": "ISO 8879:1986",
                                        "GlossDef": {
                        "para": "A meta-markup language, used to create markup languages such as DocBook.",
                                                "GlossSeeAlso": ["GML", "XML"]
                    },
                                        "GlossSee": "markup"
                }
            }
        }
    }
}
```

Now, does all this precision mean that honestly gathered, non-fabricated data is objective?

Why not?

MySQL Data Types

Data Type	Storage Required
TINYINT	1 byte
SMALLINT	2 bytes
MEDIUMINT	3 bytes
INT, INTEGER	4 bytes
BIGINT	8 bytes
FLOAT(p)	4 bytes if 0 <= p <= 24, 8 bytes if 25 <= p <= 53
FLOAT	4 bytes
DOUBLE [PRECISION], REAL	8 bytes
DECIMAL(M,D), NUMERIC(M,D)	Varies; see following discussion
BIT(M)	approximately (M+7)/8 bytes

MySQL Data Types

Data Type	Storage Required
YEAR	1 byte
DATE	3 bytes
TIME	3 bytes + fractional seconds storage
DATETIME	5 bytes + fractional seconds storage
TIMESTAMP	4 bytes + fractional seconds storage
ENUM('value1','value2',...)	1 or 2 bytes, depending on the number of enumeration values (65,535 values maximum)
SET('value1','value2',...)	1, 2, 3, 4, or 8 bytes, depending on the number of set members (64 members maximum)

MySQL Data Types

Data Type	Storage Required
CHAR(M)	M × w bytes, 0 <= M <= 255, where w is the number of bytes required for the maximum-length character in the character set. See
BINARY(M)	M bytes, 0 <= M <= 255
VARCHAR(M), VARBINARY(M)	L + 1 bytes if column values require 0 – 255 bytes, L + 2 bytes if values may require more than 255 bytes
TINYBLOB, TINYTEXT	L + 1 bytes, where L < 28
BLOB, TEXT	L + 2 bytes, where L < 216
MEDIUMBLOB, MEDIUMTEXT	L + 3 bytes, where L < 224
LONGBLOB, LONGTEXT	L + 4 bytes, where L < 232

What is all the fuss about metadata?

Is metadata data?
What kind of data?