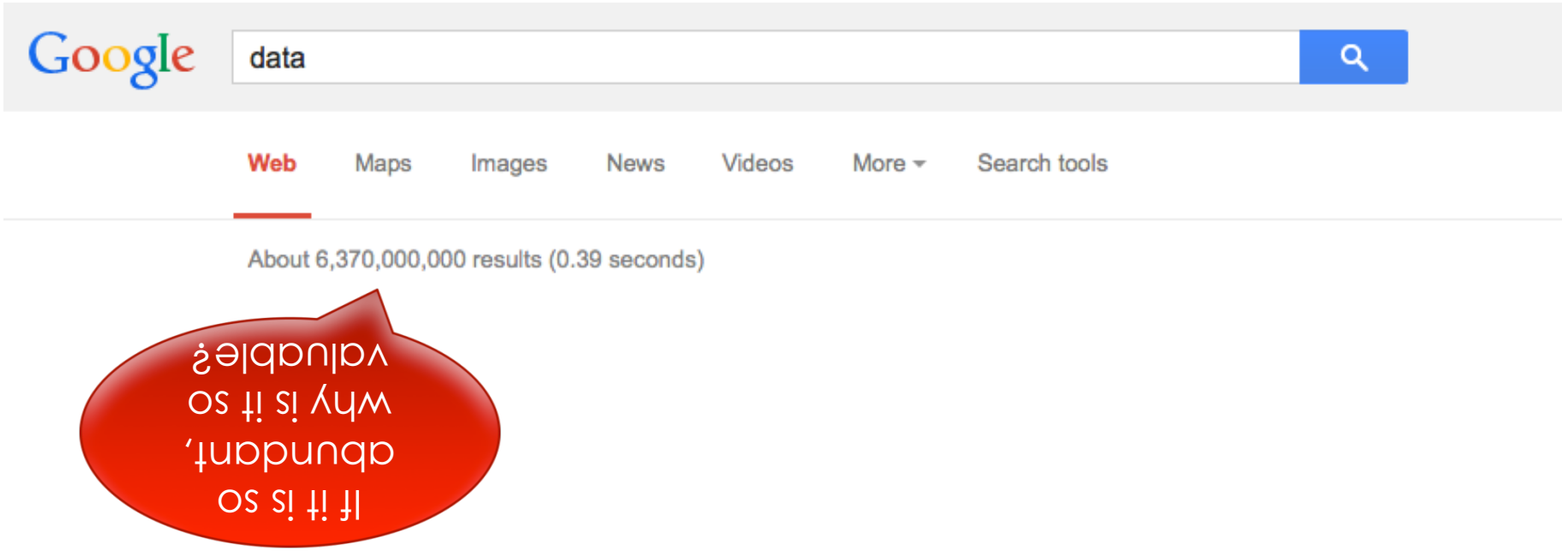
Managing Data & Databases

Session 2
Saving, retrieving and exchanging data

The data


Google
data
Web
Maps
Images
News
Videos
More
Search tools
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

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 Section 14.2.15.7, “Physical Row Structure” for information about CHAR data type storage requirements for InnoDB tables.
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?