Introduction to Data Science

Daniel Gutierrez, Data Scientist

Los Angeles, Calif.

Course Outcomes

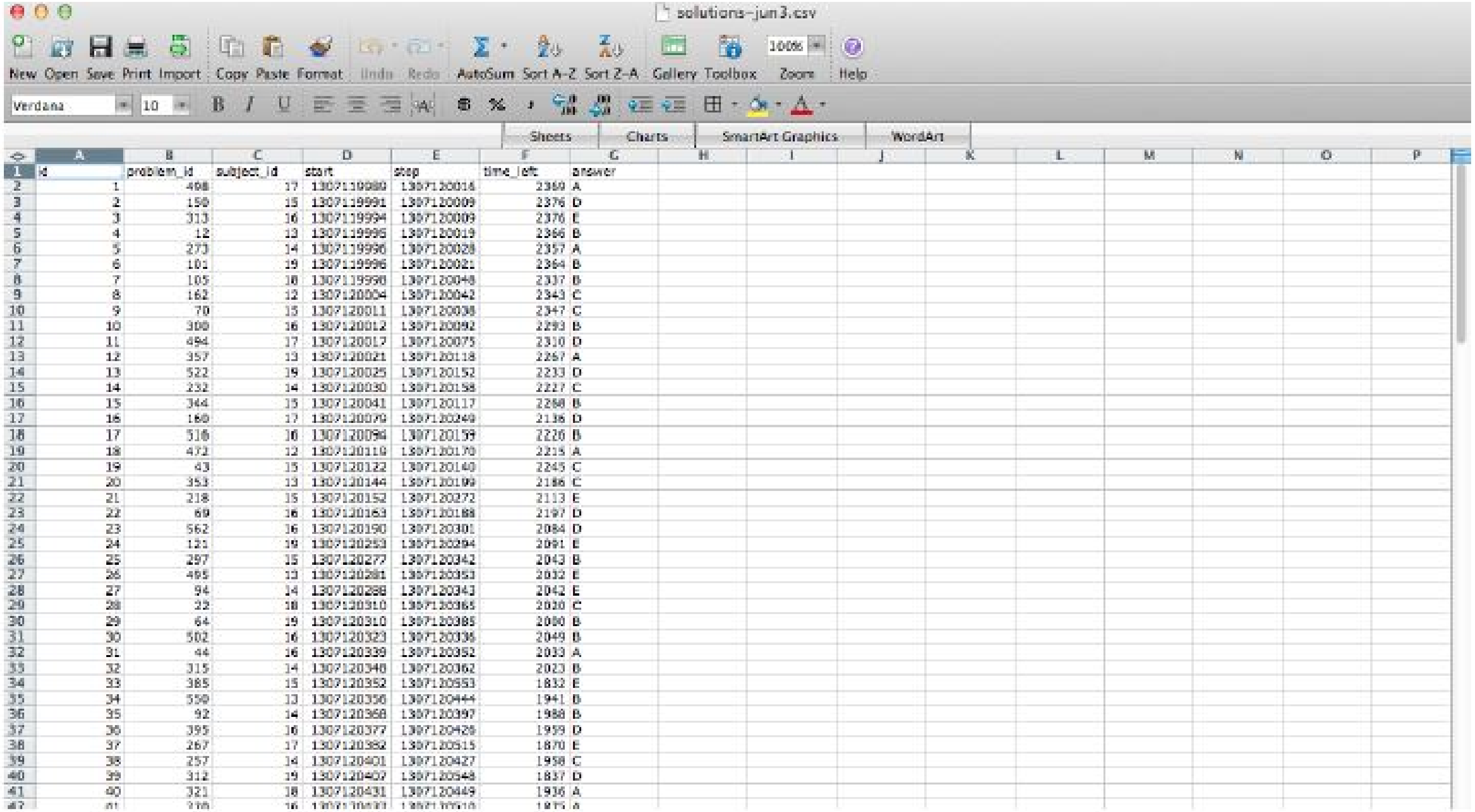
- Accessing data sets from R
- Review of commonly accessed data sources
- Provide reusable code snippets for accessing data
- Learn how to write data files

Lesson Objectives

- Accessing data sources
- Downloading files from the web
- Comma separated value (CSV)
- Excel
- JSON
- Web page scraping
- SQL databases
- SQL equivalents in R
- Writing data

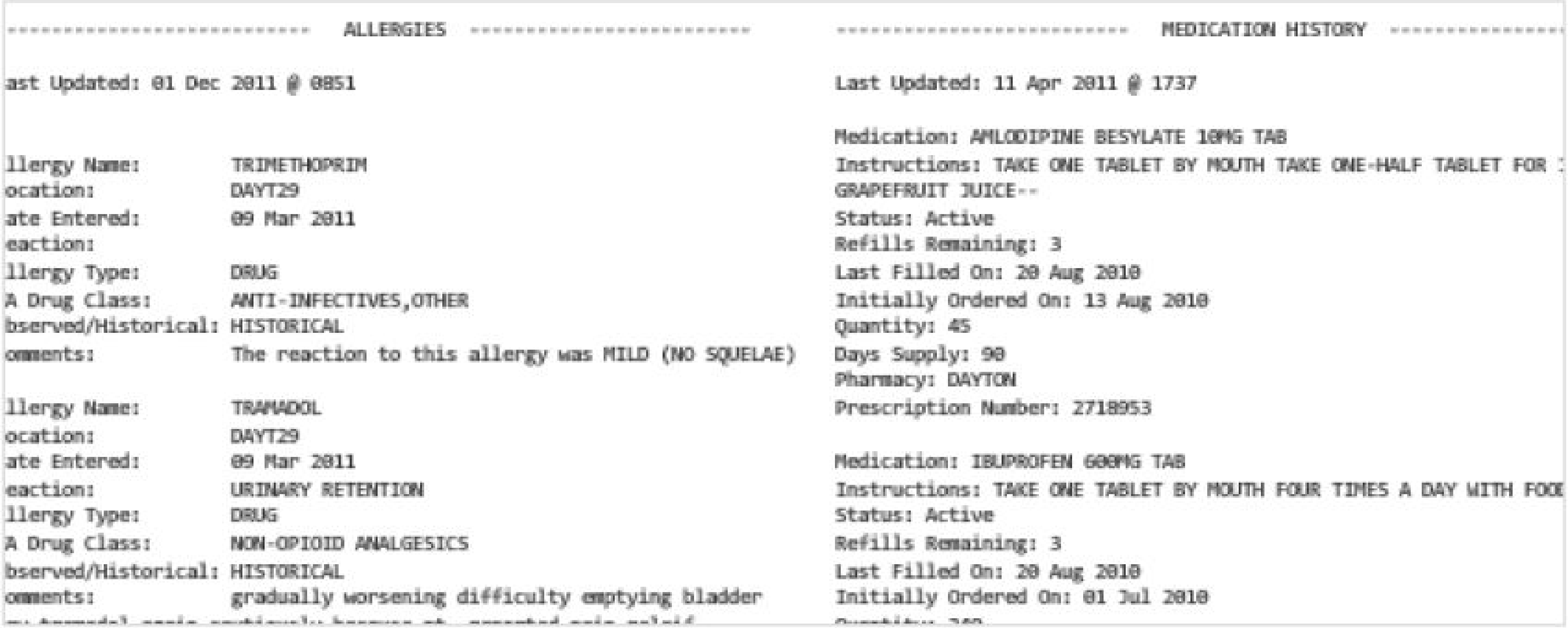
Data Access

What you wish data looked like



	A	B	C	D	E	F	G
1	id	problem_id	subject_id	start	stop	time_left	answer
2	1	498	17	1307119980	1307120016	2369	A
3	2	150	15	1307119991	1307120009	2376	D
4	3	313	16	1307119994	1307120009	2376	E
5	4	12	13	1307119995	1307120019	2366	B
6	5	273	14	1307119996	1307120028	2357	A
7	6	101	19	1307119996	1307120021	2364	B
8	7	105	18	1307119998	1307120048	2337	B
9	8	162	12	1307120004	1307120042	2343	C
10	9	70	15	1307120011	1307120038	2347	C
11	10	300	16	1307120012	1307120092	2293	B
12	11	494	17	1307120017	1307120075	2310	D
13	12	357	13	1307120021	1307120118	2267	A
14	13	522	19	1307120025	1307120152	2233	D
15	14	232	14	1307120030	1307120158	2227	C
16	15	344	15	1307120041	1307120117	2268	B
17	16	160	17	1307120079	1307120249	2136	D
18	17	518	18	1307120098	1307120159	2226	B
19	18	472	12	1307120119	1307120170	2215	A
20	19	43	15	1307120122	1307120140	2245	C
21	20	353	13	1307120144	1307120199	2186	C
22	21	218	15	1307120152	1307120272	2113	E
23	22	69	16	1307120163	1307120188	2197	D
24	23	562	16	1307120190	1307120301	2084	D
25	24	121	19	1307120253	1307120294	2091	E
26	25	297	15	1307120277	1307120342	2043	B
27	26	495	13	1307120281	1307120353	2032	E
28	27	94	14	1307120288	1307120343	2042	E
29	28	22	18	1307120310	1307120365	2020	C
30	29	64	19	1307120310	1307120385	2000	B
31	30	502	16	1307120323	1307120336	2049	B
32	31	44	16	1307120339	1307120352	2033	A
33	32	315	14	1307120348	1307120362	2023	B
34	33	385	15	1307120352	1307120553	1832	E
35	34	550	13	1307120356	1307120444	1941	B
36	35	92	14	1307120368	1307120397	1988	B
37	36	395	16	1307120377	1307120426	1959	D
38	37	267	17	1307120382	1307120515	1870	E
39	38	257	14	1307120401	1307120427	1958	C
40	39	312	19	1307120407	1307120548	1837	D
41	40	321	18	1307120431	1307120449	1936	A
42	41	330	16	1307120433	1307120510	1875	A

What does data really look like?

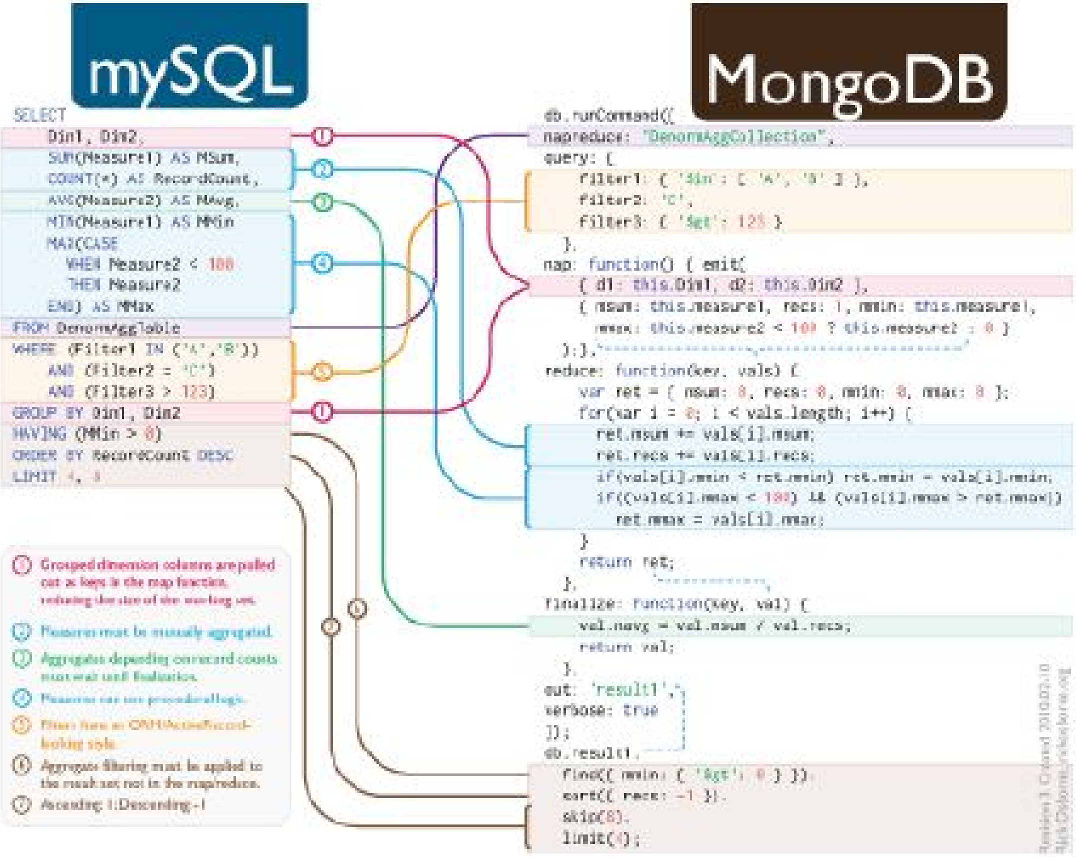


```
---------------------------   ALLERGIES   -------------------------

ast Updated: 01 Dec 2011 @ 0851


llergy Name:         TRIMETHOPRIM
ocation:             DAYT29
ate Entered:         09 Mar 2011
eaction:
llergy Type:         DRUG
A Drug Class:        ANTI-INFECTIVES,OTHER
bserved/Historical:  HISTORICAL
omments:             The reaction to this allergy was MILD (NO SQUELAE)

llergy Name:         TRAMADOL
ocation:             DAYT29
ate Entered:         09 Mar 2011
eaction:             URINARY RETENTION
llergy Type:         DRUG
A Drug Class:        NON-OPIOID ANALGESICS
bserved/Historical:  HISTORICAL
omments:             gradually worsening difficulty emptying bladder
```

```
--------------------------   MEDICATION HISTORY   ---------------

Last Updated: 11 Apr 2011 @ 1737

Medication: AMLODIPINE BESYLATE 10MG TAB
Instructions: TAKE ONE TABLET BY MOUTH TAKE ONE-HALF TABLET FOR 
GRAPEFRUIT JUICE--
Status: Active
Refills Remaining: 3
Last Filled On: 20 Aug 2010
Initially Ordered On: 13 Aug 2010
Quantity: 45
Days Supply: 90
Pharmacy: DAYTON
Prescription Number: 2718953

Medication: IBUPROFEN 600MG TAB
Instructions: TAKE ONE TABLET BY MOUTH FOUR TIMES A DAY WITH FOOD
Status: Active
Refills Remaining: 3
Last Filled On: 20 Aug 2010
Initially Ordered On: 01 Jul 2010
```

Data Access

Where is data?



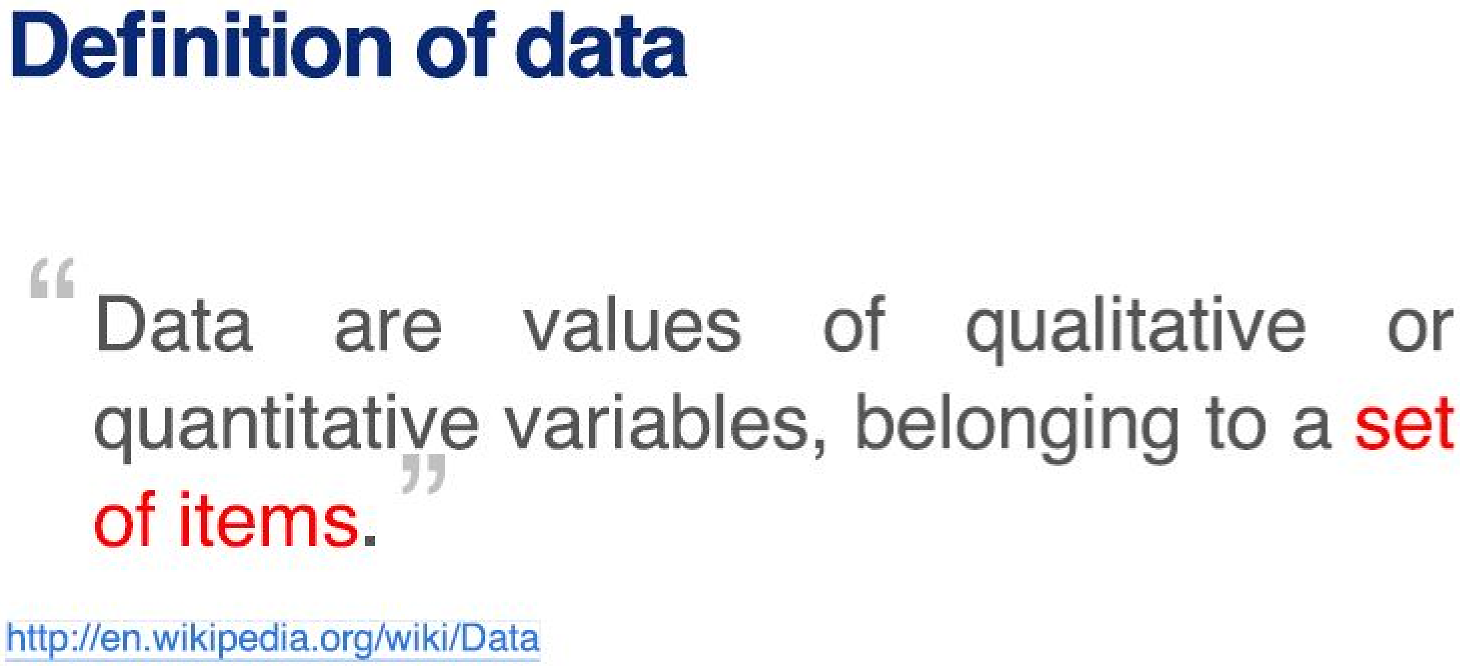
```
SELECT
    Dim1, Dim2,
    SUM(Measure1) AS MSum,
    COUNT(*) AS RecordCount,
    AVG(Measure2) AS MAvg,
    MIN(Measure1) AS MMin
    MAX(CASE
      WHEN Measure2 < 100
      THEN Measure2
    END) AS MMax
FROM DenormAggTable
WHERE (Filter1 IN ('A','B'))
    AND (Filter2 = 'C')
    AND (Filter3 > 123)
GROUP BY Dim1, Dim2
HAVING (MMin > 0)
ORDER BY RecordCount DESC
LIMIT 4, 8
```

```
db.runCommand({
mapreduce: "DenormAggCollection",
query: {
    filter1: { '$in': [ 'A', 'B' ] },
    filter2: 'C',
    filter3: { '$gt': 123 }
  },
map: function() { emit(
    { d1: this.Dim1, d2: this.Dim2 },
    { msum: this.measure1, recs: 1, mmin: this.measure1,
      mmax: this.measure2 < 100 ? this.measure2 : 0 }
  );},
reduce: function(key, vals) {
    var ret = { msum: 0, recs: 0, mmin: 0, mmax: 0 };
    for(var i = 0; i < vals.length; i++) {
      ret.msum += vals[i].msum;
      ret.recs += vals[i].recs;
      if(vals[i].mmin < ret.mmin) ret.mmin = vals[i].mmin;
      if((vals[i].mmax < 100) && (vals[i].mmax > ret.mmax))
        ret.mmax = vals[i].mmax;
    }
    return ret;
  },
finalize: function(key, val) {
    val.mavg = val.msum / val.recs;
    return val;
  },
out: 'result1',
verbose: true
});
db.result1.
  find({ mmin: { '$gt': 0 } }).
  sort({ recs: -1 }).
  skip(4).
  limit(8);
```

1. Grouped dimension columns are pulled out as keys in the map function, reducing the size of the working set.
2. Measures must be manually aggregated.
3. Aggregates depending on record counts must wait until finalization.
4. Measures can use procedural logic.
5. Filters have an ORM/ActiveRecord-looking style.
6. Aggregate filtering must be applied to the result set, not in the mapreduce.
7. Ascending: 1; Descending: -1

Revision 1, Created 2010.02.10
Rick Osborne, rickosborne.org

Data Access



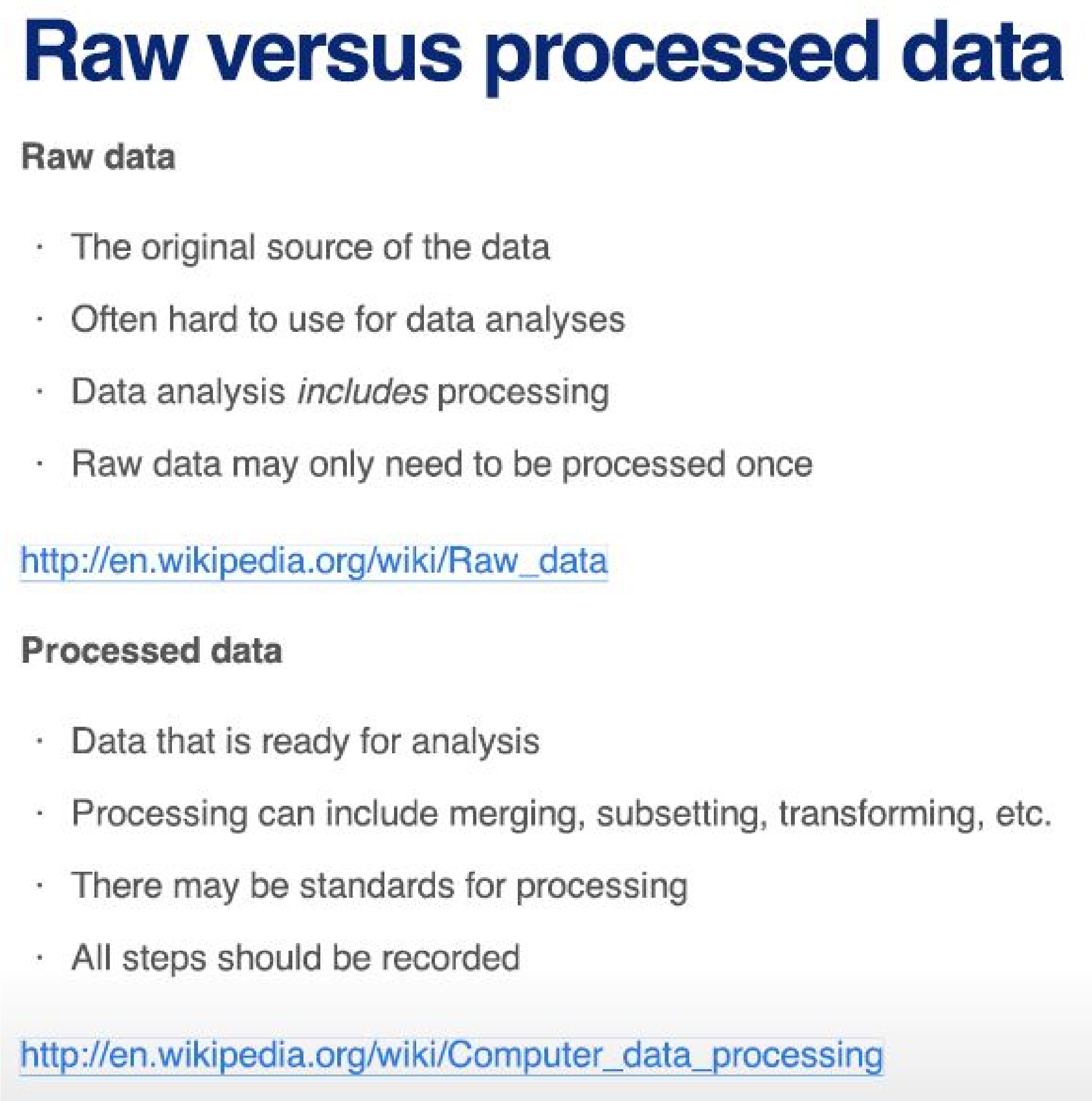
Definition of data

> “Data are values of qualitative or quantitative variables, belonging to a **set of items**.”

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

- Set of items – sometimes called the population; the set of objects you are interested in
- Variables – a measurement or characteristic of an item
- Qualitative item – country of origin, gender, department, etc.
- Quantitative item – Q1 sales, salary, square feet, etc.

Data Access



Raw versus processed data

Raw data

- The original source of the data
- Often hard to use for data analyses
- Data analysis *includes* processing
- Raw data may only need to be processed once

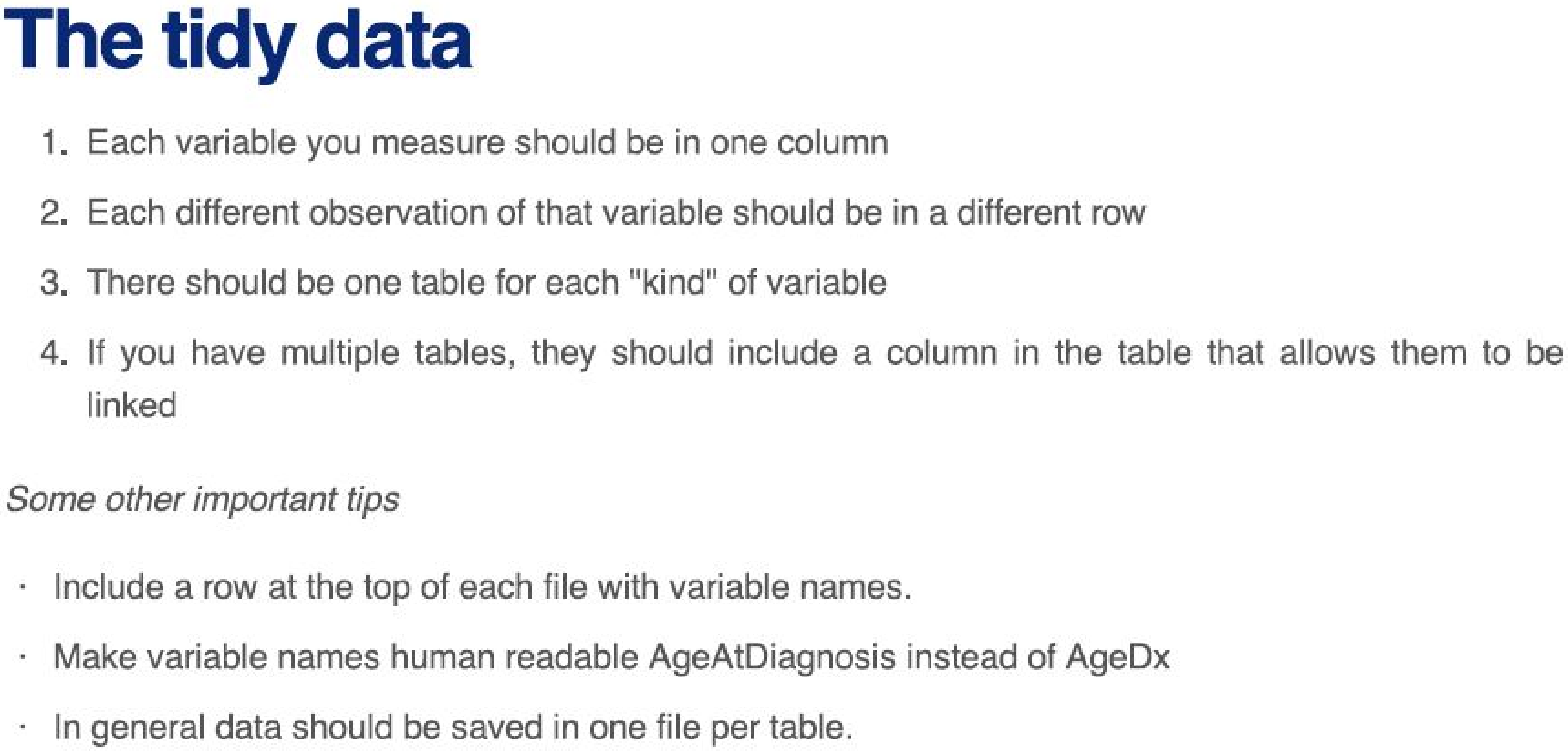
http://en.wikipedia.org/wiki/Raw_data

Processed data

- Data that is ready for analysis
- Processing can include merging, subsetting, transforming, etc.
- There may be standards for processing
- All steps should be recorded

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

Data Access



The tidy data

1. Each variable you measure should be in one column
2. Each different observation of that variable should be in a different row
3. There should be one table for each "kind" of variable
4. If you have multiple tables, they should include a column in the table that allows them to be linked

Some other important tips

- Include a row at the top of each file with variable names.
- Make variable names human readable AgeAtDiagnosis instead of AgeDx
- In general data should be saved in one file per table.

Code module

- WEEK 5-1 Code module – downloading files
- WEEK 5-2 Code module – reading CSV and Excel
- WEEK 5-3 Code module – reading JSON files
- WEEK 5-4 Code module – SQL databases
- WEEK 5-5 Code module – SQL equivalents in R
- WEEK 5-6 Code module – writing data files

Summary

- In WEEK 5 of Introduction to Data Science we continue to add useful items to our data science toolbox. This time, we added tools to access different data sources
- We saw how to download files from the web
- We read in files in CSV and Excel format
- We read in files in JSON format
- We saw how to scrape data off web pages
- We read in data from a SQL database
- We saw how to do SQL equivalents using R
- We wrote a new data file