

CS 220 / CS319

Tabular Data

(CSV and Spreadsheets)

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Learning Objectives Today

CSV format

- purpose
- syntax
- comparison to spreadsheets

Reading CSV files

- without header
- with header
- type casting

Chapter 16 of Sweigart, to (and including)
“Reading Data from Reader Objects in a for Loop”

Today's Outline

Spreadsheets

CSVs

Reading a CSV to a list of lists

Coding examples

Spreadsheets (e.g., Excel)

Spreadsheets are tables of cells, organized by rows and columns

cells

The screenshot shows a Microsoft Excel spreadsheet titled "Search Sheet". The ribbon menu is visible at the top, with "Home" selected. The table has 13 rows and 6 columns, labeled A through F. Row 1 contains the column headers: "name", "year", "mph", "damage", and "deaths". Rows 2 through 13 contain data for various hurricanes. The cell for "name" in row 4 (Eloise) is highlighted with a red border. The cell for "damage" in row 3 (Camille) is also highlighted with a red border. The cell for "year" in row 7 (Danny) is highlighted with a red border. The cell for "damage" in row 10 (Katrina) is highlighted with a red border. The cell for "name" in row 1 (name) is highlighted with a green border. The cell for "name" in row 1 (name) is also highlighted with a green border.

	A	B	C	D	E	F
1	name	year	mph	damage	deaths	
2	Baker	1950	120	2550000	38	
3	Camille	1969	175	1.43B	259	
4	Eloise	1975	125	560M	80	
5	Frederic	1979	130	1770000000	12	
6	Elena	1985	125	1300000000	9	
7	Danny	1997	80	100000000	4	
8	Ivan	2004	165	26100000000	92	
9	Dennis	2005	150	3980000000	76	
10	Katrina	2005	175	125B	1836	
11	Michael	2018	155	25100000000	72	
12	Carol	1954	115	462000000	72	
13	Donna	1960	145	980000000	439	

Spreadsheets (e.g., Excel)

Spreadsheets are tables of cells, organized by rows and columns

	name	year	mph	damage	deaths
1	Baker	1950	120	2550000	38
2	Camille	1969	175	1.43B	259
3	Eloise	1975	125	560M	80
4	Frederic	1979	130	1770000000	12
5	Elena	1985	125	1300000000	9
6	Danny	1997	80	100000000	4
7	Ivan	2004	165	26100000000	92
8	Dennis	2005	150	3980000000	76
9	Katrina	2005	175	125B	1836
10	Michael	2018	155	25100000000	72
11	Carol	1954	115	462000000	72
12	Donna	1960	145	980000000	439

Spreadsheets (e.g., Excel)

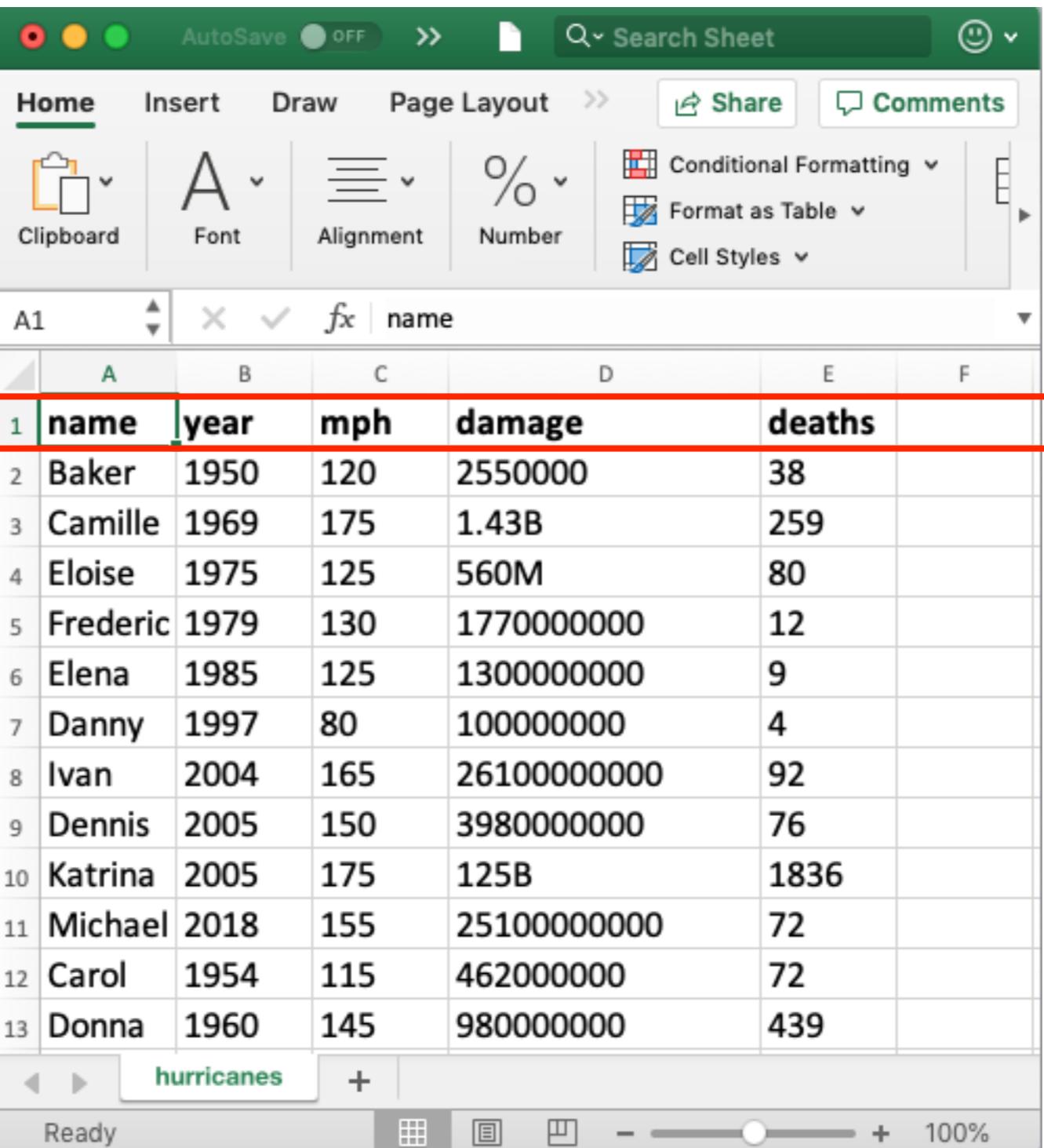
Spreadsheets are tables of cells, organized by rows and columns

rows

	A	B	C	D	E	F
1	name	year	mph	damage	deaths	
2	Baker	1950	120	2550000	38	
3	Camille	1969	175	1.43B	259	
4	Eloise	1975	125	560M	80	
5	Frederic	1979	130	1770000000	12	
6	Elena	1985	125	1300000000	9	
7	Danny	1997	80	100000000	4	
8	Ivan	2004	165	26100000000	92	
9	Dennis	2005	150	3980000000	76	
10	Katrina	2005	175	125B	1836	
11	Michael	2018	155	25100000000	72	
12	Carol	1954	115	462000000	72	
13	Donna	1960	145	980000000	439	

Spreadsheets (e.g., Excel)

Spreadsheets are tables of cells, organized by rows and columns



The screenshot shows a Microsoft Excel spreadsheet titled "Search Sheet". The ribbon menu is visible at the top, with "Home" selected. The formula bar shows "A1" and "name". The main area contains a table of data with the following columns: "name", "year", "mph", "damage", and "deaths". The first row is labeled "header" in red text. A red box highlights the header row. The data rows are numbered 2 through 13. The "damage" column contains large values like "2550000" and "1770000000", while the "deaths" column contains smaller values like "38" and "12". The "damage" column uses scientific notation for large numbers.

1	name	year	mph	damage	deaths
2	Baker	1950	120	2550000	38
3	Camille	1969	175	1.43B	259
4	Eloise	1975	125	560M	80
5	Frederic	1979	130	1770000000	12
6	Elena	1985	125	1300000000	9
7	Danny	1997	80	100000000	4
8	Ivan	2004	165	26100000000	92
9	Dennis	2005	150	3980000000	76
10	Katrina	2005	175	125B	1836
11	Michael	2018	155	25100000000	72
12	Carol	1954	115	462000000	72
13	Donna	1960	145	980000000	439

Spreadsheets (e.g., Excel)

Spreadsheets often allow different **data types**

text numbers

	A	B	C	D	E	F
1	name	year	mph	damage	deaths	
2	Baker	1950	120	2550000	38	
3	Camille	1969	175	1.43B	259	
4	Eloise	1975	125	560M	80	
5	Frederic	1979	130	1770000000	12	
6	Elena	1985	125	1300000000	9	
7	Danny	1997	80	100000000	4	
8	Ivan	2004	165	26100000000	92	
9	Dennis	2005	150	3980000000	76	
10	Katrina	2005	175	125B	1836	
11	Michael	2018	155	25100000000	72	
12	Carol	1954	115	462000000	72	
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Spreadsheets (e.g., Excel)

Spreadsheets often allow different fonts, text sizes, colors, highlighting

The screenshot shows a Microsoft Excel spreadsheet titled "Search Sheet". The ribbon menu is visible at the top, with the "Home" tab selected. The table below contains data about hurricanes, with the first row serving as the header. The column headers are "name", "year", "mph", "damage", and "deaths". The cell for "name" in the first row is bolded, while the cell for "Eloise" in the fourth row is regular. Red arrows point from the labels "bold" and "regular" to their respective cells.

name	year	mph	damage	deaths
Baker	1950	120	2550000	38
Camille	1969	175	1.43B	259
Eloise	1975	125	560M	80
Frederic	1979	130	1770000000	12
Elena	1985	125	1300000000	9
Danny	1997	80	100000000	4
Ivan	2004	165	26100000000	92
Dennis	2005	150	3980000000	76
Katrina	2005	175	125B	1836
Michael	2018	155	25100000000	72
Carol	1954	115	462000000	72
Donna	1960	145	980000000	439

Spreadsheets (e.g., Excel)

Spreadsheets often support **multiple sheets**

The screenshot shows a Microsoft Excel spreadsheet titled "hurricanes". The table has columns labeled "name", "year", "mph", "damage", and "deaths". The first row contains the column headers. The data starts from row 2 and ends at row 13. A red box highlights the "+" button in the bottom-left corner of the sheet tab bar, which is used to add new sheets. The status bar at the bottom shows "Ready".

	A	B	C	D	E	F
1	name	year	mph	damage	deaths	
2	Baker	1950	120	2550000	38	
3	Camille	1969	175	1.43B	259	
4	Eloise	1975	125	560M	80	
5	Frederic	1979	130	1770000000	12	
6	Elena	1985	125	1300000000	9	
7	Danny	1997	80	100000000	4	
8	Ivan	2004	165	26100000000	92	
9	Dennis	2005	150	3980000000	76	
10	Katrina	2005	175	125B	1836	
11	Michael	2018	155	25100000000	72	
12	Carol	1954	115	462000000	72	
13	Donna	1960	145	980000000	439	

more tables of data

Excel Files

Extension: .xlsx

Format: **binary** → just 0's and 1's, not human-readable characters.
Need special software...

```
ty-mac:lec-15$ cat hurricanes.xlsx
P!b?h^[Content_Types].xml ?(????N?0E?H?C?-J5??*Q>?é]c[?ii????B?j7??
?{2??h?nm???R
????U^/???%??rZY?1__?f??q??R4D?AJ?h>????V? 
?Z?9????NV
?8f]????ji){^??-I?"{?v^?P!XS)bR?r??K?s(?3?'c?0?????????M4?????ZEk+?|_
\|z?(??P??6h_-[@?!!?Pk??2n?}??L??? ??%??????dN"m,?ÅD097*?~?? 
8?0?c|n???E??????B??!$}?????;{???[????2???P!?U0#?L
_rels/.rels ?(???M0?0
??9L?3?sbg_!_l!??USh9i?b?r:"y_dl??D???|-N??R"4?2?G?%??Z?4?"y?7  ?
??????P!?>???xl/_rels/workbook.xml.rels ?(??RMK?0?T~?I????$ T?G?~??
??<???!??4??;#?w????qu*&r?Fq???v?????GJy(v??*????K??#F??D???.W      ?
?=??Z?MY?b???BS??????ç? ??
??0w?v?t/"?UN)?&
3~??]X?K/o?y???v?5???+??zl?;o??b???G?????
?s?>??,?8??(%???"D??4j?0u2j
s??MY?`??S? ??)f???C????y?? Iy??!+??E??fMy?k??
??K?5=|?t ??G)?s墙 ?U??tB??)???,??f??????P!u???
```

Writing code to read data from Excel files is tricky, unless you use special modules

Today's Outline

Spreadsheets

CSVs

Reading a CSV to a list of lists

Coding examples

CSVs

CSV is a simple data format that stands for
Comma-Separated Values

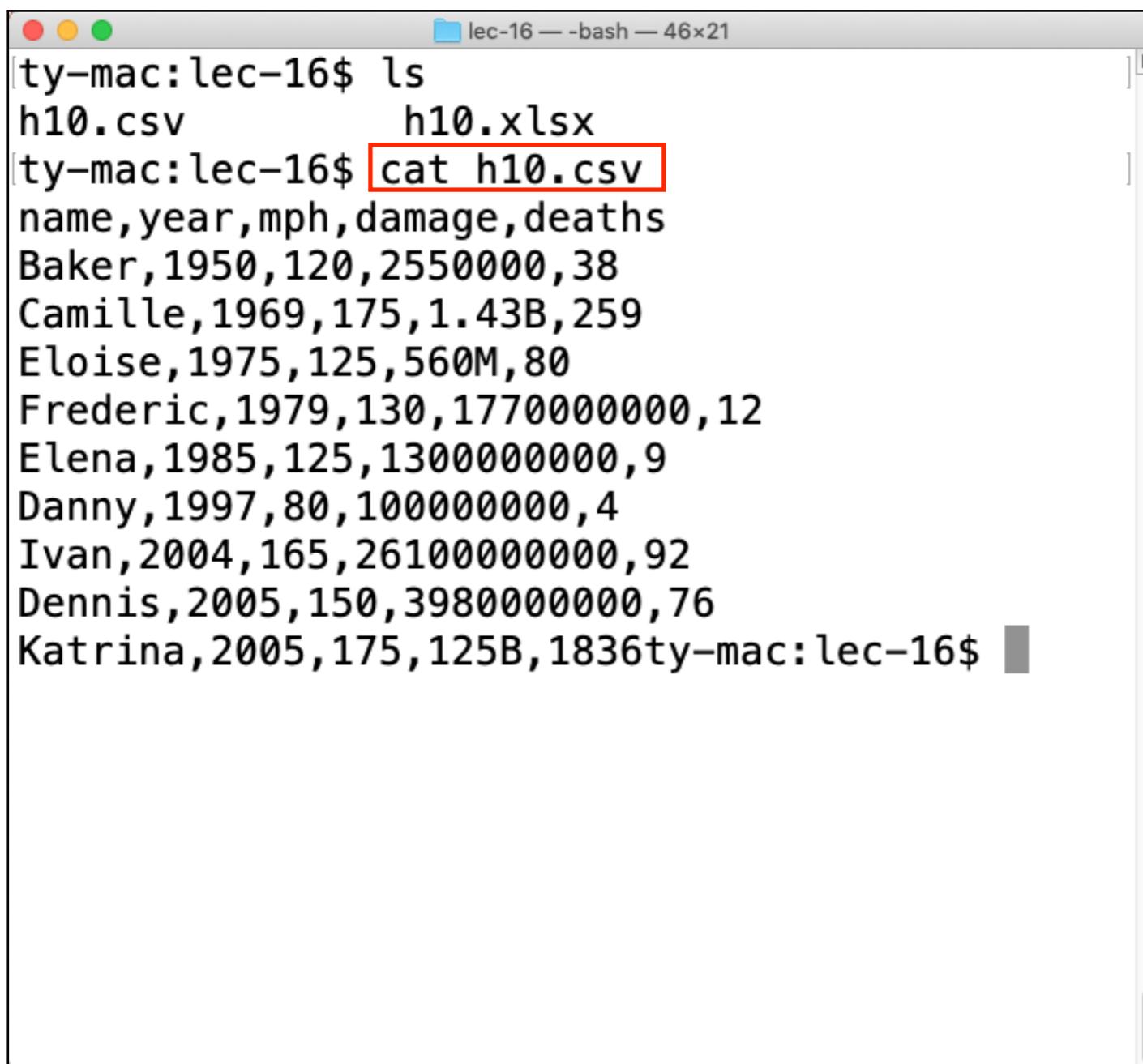
CSVs are like simple spreadsheets

- organize cells of data into rows and columns
 - only one sheet per file
 - only holds strings
 - no way to specify font, borders, cell size, etc
- we'll do lots of type casting/conversion!
- 

CSV Files

Extension: .csv

Format: plain text → just open in any editor (notepad, textedit, idle, etc)
and you'll be able to read it



A screenshot of a terminal window titled "lec-16 — bash — 46x21". The window shows the following command-line session:

```
[ty-mac:lec-16$ ls
h10.csv      h10.xlsx
[ty-mac:lec-16$ cat h10.csv
name,year,mph,damage,deaths
Baker,1950,120,2550000,38
Camille,1969,175,1.43B,259
Eloise,1975,125,560M,80
Frederic,1979,130,1770000000,12
Elena,1985,125,1300000000,9
Danny,1997,80,100000000,4
Ivan,2004,165,2610000000,92
Dennis,2005,150,3980000000,76
Katrina,2005,175,125B,1836
ty-mac:lec-16$ ]
```

The command `cat h10.csv` is highlighted with a red box. The output shows a CSV file with columns: name, year, mph, damage, and deaths. The last row contains a trailing newline character.

Writing code that understands
CSV files is easy

Basic Syntax

Table

Name	Date	Time	Status	Latitude	Longitude	WindSpeed	Ocean
HEIDI	19671019	1200	TD	20.5N	54.0W	25	Atlantic
OLAF	19850822	0	TD	12.9N	102.2W	25	Pacific
TINA	19920917	1200	TD	10.4N	98.5W	25	Pacific
EMMY	19760820	1200	TD	14.0N	48.0W	20	Atlantic

Corresponding CSV

Name,Date,Time,Status,Latitude,Longitude,WindSpeed,Ocean
HEIDI,19671019,1200,TD,20.5N,54.0W,25,Atlantic
OLAF,19850822,0,TD,12.9N,102.2W,25,Pacific
TINA,19920917,1200,TD,10.4N,98.5W,25,Pacific
EMMY,19760820,1200,TD,14.0N,48.0W,20,Atlantic

Each row is a line of the file

Basic Syntax

Table

Name	Date	Time	Status	Latitude	Longitude	WindSpeed	Ocean
HEIDI	19671019	1200	TD	20.5N	54.0W	25	Atlantic
OLAF	19850822	0	TD	12.9N	102.2W	25	Pacific
TINA	19920917	1200	TD	10.4N	98.5W	25	Pacific
EMMY	19760820	1200	TD	14.0N	48.0W	20	Atlantic

Corresponding CSV

Name,Date,Time,Status,Latitude,Longitude,WindSpeed,Ocean
HEIDI,19671019,1200,TD,20.5N,54.0W,25,Atlantic
OLAF,19850822,0,TD,12.9N,102.2W,25,Pacific
TINA,19920917,1200,TD,10.4N,98.5W,25,Pacific
EMMY,19760820,1200,TD,14.0N,48.0W,20,Atlantic

Cells...

Basic Syntax

Table

Name	Date	Time	Status	Latitude	Longitude	WindSpeed	Ocean
HEIDI	19671019	1200	TD	20.5N	54.0W	25	Atlantic
OLAF	19850822	0	TD	12.9N	102.2W	25	Pacific
TINA	19920917	1200	TD	10.4N	98.5W	25	Pacific
EMMY	19760820	1200	TD	14.0N	48.0W	20	Atlantic

Corresponding CSV

Name,Date,Time,Status,Latitude,Longitude,WindSpeed,Ocean
HEIDI,19671019,1200,TD,20.5N,54.0W,25,Atlantic
OLAF,19850822,0,TD,12.9N,102.2W,25,Pacific
TINA,19920917,1200,TD,10.4N,98.5W,25,Pacific
EMMY,19760820,1200,TD,14.0N,48.0W,20,Atlantic

... are separated by commas

Basic Syntax

Table

Name	Date	Time	Status	Latitude	Longitude	WindSpeed	Ocean
HEIDI	19671019	1200	TD	20.5N	54.0W	25	Atlantic
OLAF	19850822	0	TD	12.9N	102.2W	25	Pacific
TINA	19920917	1200	TD	10.4N	98.5W	25	Pacific
EMMY	19760820	1200	TD	14.0N	48.0W	20	Atlantic

Cori We call characters that act as separators “**delimiters**”

Nar

HEI

OLA

TIN

EMMY,19760820,1200, TD,14.0N,48.0W,20,Atlantic

Newlines delimit rows

The comma is a delimiter between cells in a row

... are separated by commas

Advanced Syntax

We won't go into details here, but there are some complexities

Motivation for more complicated syntax

- *what if a cell contains a newline?*
- *what if we want a comma inside a cell?*
- *what if a cell contains a quote?*
- *what if we want to use different delimiters between rows/cells?*

usually better to use a general CSV module than write our own

Today's Outline

Spreadsheets

CSVs

Reading a CSV to a list of lists

Coding examples

Data Management

1. spreadsheet in Excel

	A	B	C	D	E	F
1	name	year	mph	damage	deaths	
2	Baker	1950	120	2550000	38	
3	Camille	1969	175	1.43B	259	
4	Eloise	1975	125	560M	80	
5	Frederic	1979	130	1770000000	12	
6	Elena	1985	125	1300000000	9	

Save As
.CSV

2. CSV file saved somewhere

```
name,year,mph,damage,deaths
Baker,1950,120,2550000,38
Camille,1969,175,1.43B,259
Eloise,1975,125,560M,80
Frederic,1979,130,1770000000,12
```

3. Python Program

Analysis Code

`rows[1][0]` → "Baker"

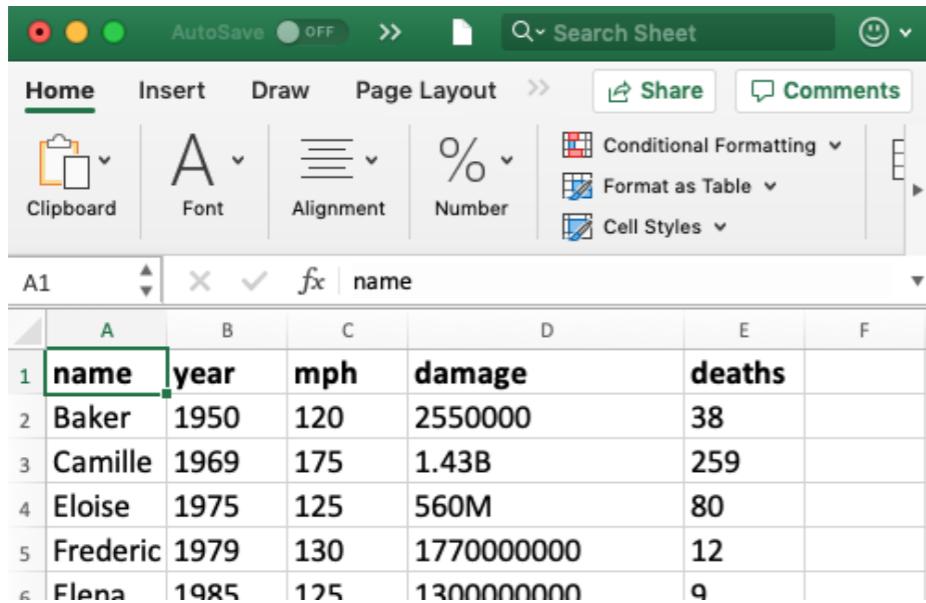
list of lists

```
[  
  ["name", "year", ...],  
  ["Baker", "1950", ...],  
  ...  
]
```

Parsing Code

Data Management

1. spreadsheet in Excel



	A	B	C	D	E	F
1	name	year	mph	damage	deaths	
2	Baker	1950	120	2550000	38	
3	Camille	1969	175	1.43B	259	
4	Eloise	1975	125	560M	80	
5	Frederic	1979	130	1770000000	12	
6	Elena	1985	125	1300000000	9	

Save As
.CSV

2. CSV file saved somewhere

```
name,year,mph,damage,deaths
Baker,1950,120,2550000,38
Camille,1969,175,1.43B,259
Eloise,1975,125,560M,80
Frederic,1979,130,1770000000,12
```

3. Python Program

Analysis Code

rows[3][1] → "1975"

[
["name", "year", ...],
["Baker", "1950", ...],
...
]

Parsing Code

list of lists

Data Management

1. spreadsheet in Excel

	A	B	C	D	E	F
1	name	year	mph	damage	deaths	
2	Baker	1950	120	2550000	38	
3	Camille	1969	175	1.43B	259	
4	Eloise	1975	125	560M	80	
5	Frederic	1979	130	1770000000	12	
6	Elena	1985	125	1300000000	9	

Save As
.CSV

2. CSV file saved somewhere

```
name,year,mph,damage,deaths
Baker,1950,120,2550000,38
Camille,1969,175,1.43B,259
Eloise,1975,125,560M,80
Frederic,1979,130,1770000000,12
```

3. Python Program

Analysis Code

rows[1][-1] → "38"

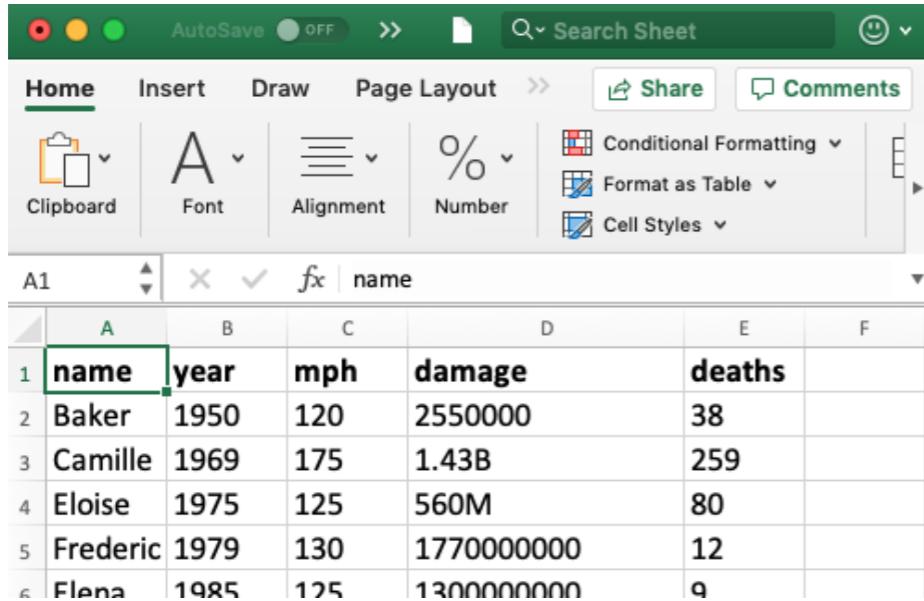
list of lists

```
[["name", "year", ...],  
 ["Baker", "1950", ...],  
 ...]
```

Parsing Code

Data Management

1. spreadsheet in Excel



	A	B	C	D	E	F
1	name	year	mph	damage	deaths	
2	Baker	1950	120	2550000	38	
3	Camille	1969	175	1.43B	259	
4	Eloise	1975	125	560M	80	
5	Frederic	1979	130	1770000000	12	
6	Elena	1985	125	1300000000	9	

Save As
.CSV

2. CSV file saved somewhere

```
name,year,mph,damage,deaths
Baker,1950,120,2550000,38
Camille,1969,175,1.43B,259
Eloise,1975,125,560M,80
Frederic,1979,130,1770000000,12
```

3. Python Program

Analysis Code

`rows[0][-2]` → "damage"

list of lists

```
[  
  ["name", "year", ...],  
  ["Baker", "1950", ...],  
  ...  
,
```

Parsing Code

Data Management

1. spreadsheet in Excel

	A	B	C	D	E	F
1	name	year	mph	damage	deaths	
2	Baker	1950	120	2550000	38	
3	Camille	1969	175	1.43B	259	
4	Eloise	1975	125	560M	80	
5	Frederic	1979	130	1770000000	12	
6	Elena	1985	125	1300000000	9	

Save As
.CSV

2. CSV file saved somewhere

```
name,year,mph,damage,deaths
Baker,1950,120,2550000,38
Camille,1969,175,1.43B,259
Eloise,1975,125,560M,80
Frederic,1979,130,1770000000,12
```

3. Python Program

Analysis Code

`rows[0][-2] → "damage"`

[

`["name", "year", ...],
["Baker", "1950", ...],
...`

]

Parsing Code

What does this look like?

Example Copied From Sweigart Ch 16

Code

```
import csv
exampleFile = open('example.csv')
exampleReader = csv.reader(exampleFile)
exampleData = list(exampleReader)
```

example.csv

4/5/2015 13:34,Apples,73
4/5/2015 3:41,Cherries,85
4/6/2015 12:46,Pears,14
4/8/2015 8:59,Oranges,52
4/10/2015 2:07,Apples,152
4/10/2015 18:10,Bananas,23
4/10/2015 2:40,Strawberries,98

Example Copied From Sweigart Ch 16

Code

```
import csv  
exampleFile = open('example.csv')  
exampleReader = csv.reader(exampleFile)  
exampleData = list(exampleReader)
```

list of lists

exampleData



```
[['4/5/2015 13:34', 'Apples', '73'], ['4/5/2015 3:41', 'Cherries', '85'],  
 ['4/6/2015 12:46', 'Pears', '14'], ['4/8/2015 8:59', 'Oranges', '52'],  
 ['4/10/2015 2:07', 'Apples', '152'], ['4/10/2015 18:10', 'Bananas', '23'],  
 ['4/10/2015 2:40', 'Strawberries', '98']]
```

Example Copied From Sweigart Ch 16

```
import csv
exampleFile = open('example.csv')
exampleReader = csv.reader(exampleFile)
exampleData = list(exampleReader)
exampleData
```

let's generalize this to a function
(don't need to know exactly how the code
works, though we will eventually)

Example Copied From Sweigart Ch 16

```
import csv                                input
exampleFile = open ('example.csv')
exampleReader = csv.reader(exampleFile)
exampleData = list(exampleReader)
exampleData
output
```

let's generalize this to a function
(don't need to know exactly how the code
works, though we will eventually)

Example Copied From Sweigart Ch 16

```
def process_csv():
    import csv
    exampleFile = open('example.csv')
    exampleReader = csv.reader(exampleFile)
    exampleData = list(exampleReader)
    exampleData
```

1. move code to a function

Example Copied From Sweigart Ch 16

```
import csv

def process_csv():
    import csv
    exampleFile = open('example.csv')
    exampleReader = csv.reader(exampleFile)
    exampleData = list(exampleReader)
    exampleData
```

2. move out imports

Example Copied From Sweigart Ch 16

```
import csv

def process_csv():
    import csv
    exampleFile = open('example.csv')
    exampleReader = csv.reader(exampleFile)
    exampleData = list(exampleReader)
    exampleFile.close()
    return exampleData
```

3. return data to get it out of the function

Example Copied From Sweigart Ch 16

```
import csv

def process_csv():
    import csv
    exampleFile = open('example.csv')
    exampleReader = csv.reader(exampleFile)
    exampleData = list(exampleReader)
    return exampleData
```

4. generalize input

Example Copied From Sweigart Ch 16

```
import csv

def process_csv(filename):
    import csv
    exampleFile = open(filename)
    exampleReader = csv.reader(exampleFile)
    exampleData = list(exampleReader)
    return exampleData
```

4. generalize input

Example Copied From Sweigart Ch 16

```
import csv
```

```
# copied from https://automatetheboringstuff.com/2e/chapter16/
def process_csv(filename):
    import csv
    exampleFile = open(filename)
    exampleReader = csv.reader(exampleFile)
    exampleData = list(exampleReader)
    return exampleData
```

Reminder!
cite code
copied online

5. cite the code

Example Copied From Sweigart Ch 16

```
import csv

# inspired by https://automatetheboringstuff.com/2e/chapter16/
def process_csv(filename):
    example_file = open(filename, encoding="utf-8")
    example_reader = csv.reader(example_file)
    example_data = list(example_reader)
    example_file.close()
    return example_data
```

keep this handy for copy/paste

Encoding required for international computers
We use this file format for all csv files for the class

Remember to close your files

Today's Outline

Spreadsheets

CSVs

Reading a CSV to a list of lists

Coding examples

Example: Student Information Survey

Goal: find the average age of the students, for each lecture

Input:

- Student data (a CSV file)

Output:

- Average student age for a given lecture

Goal: column name, print that data for all hurricanes

Example:

LEC001: 18.5

LEC002: 18.2

LEC003: 18.6

...

Challenge: Hurricane Column Dump

Goal: column name, print that data for all hurricanes

Input:

- column name (and a CSV file)



Output:

- data in given column, associated with name

Example:

Baker: 1950

Camille: 1969

Eloise: 1975

...

Challenge: Hurricanes per Year

Goal: column name, print that data for all hurricanes

Input:

- none typed (only a CSV file)



Output:

- the number of hurricanes in each year

Example:

1967: 23

1968: 29

1969: 15

...