

CS 220

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

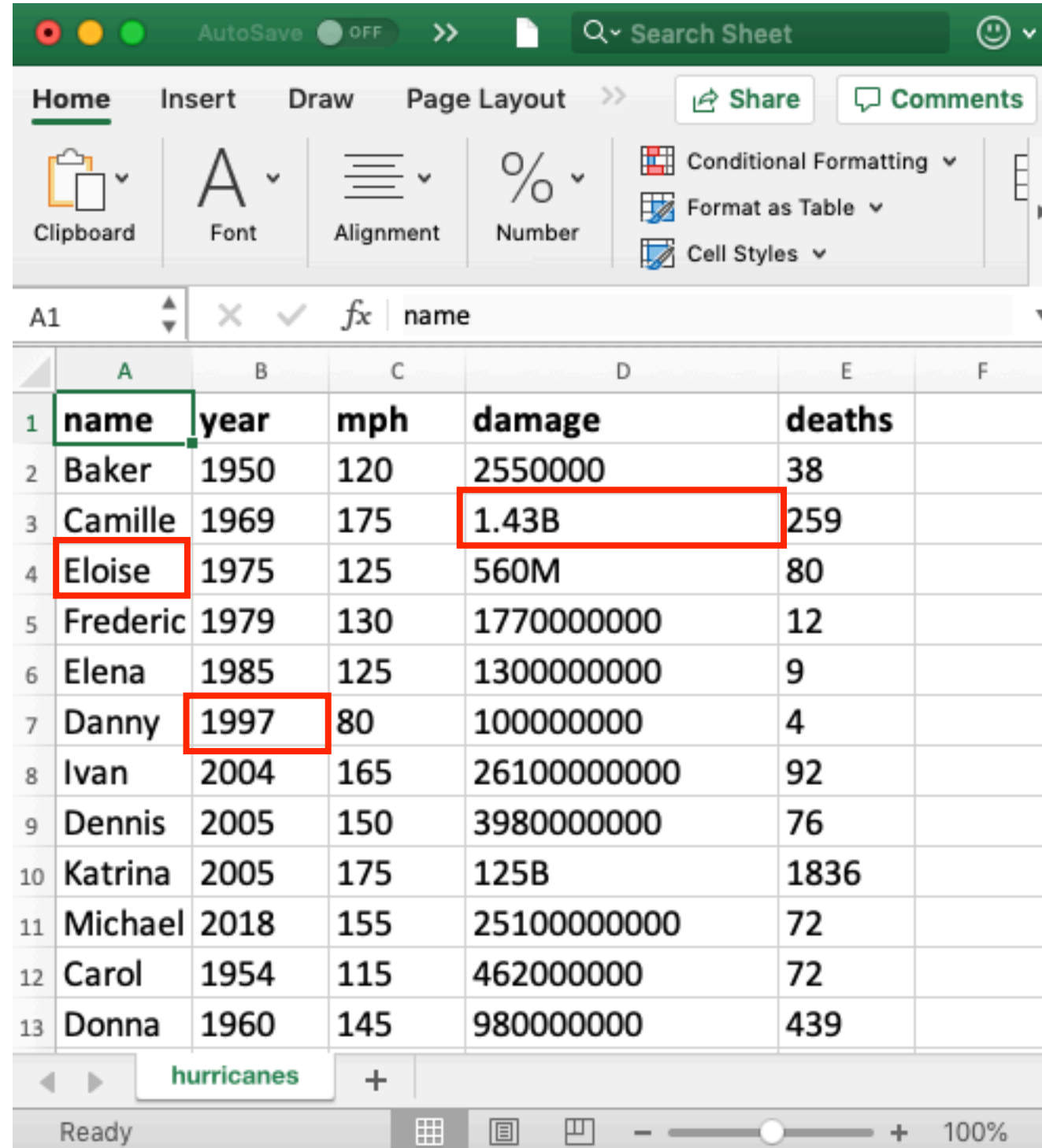
Reading a CSV to a list of lists

Coding examples

Spreadsheets (e.g., Excel)

Spreadsheets are tables of cells, organized by rows and columns

cells

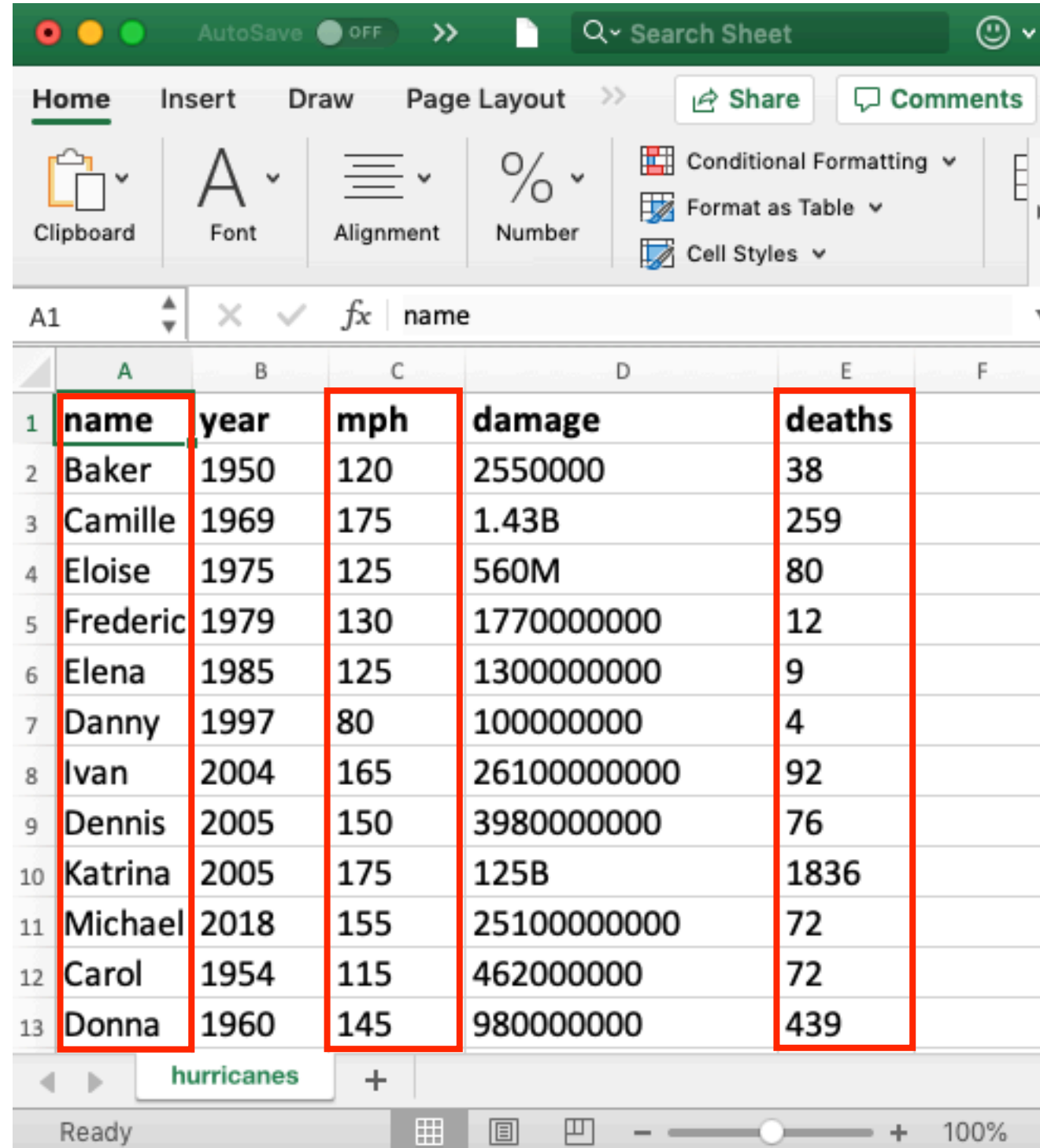


	A	B	C	D	E	F
1	name	year	mph	damage	deaths	
2	Baker	1950	120	2550000	38	
3	Camille	1969	175	1.43B	259	
4	Eloise	1975	125	560M	80	
5	Frederic	1979	130	1770000000	12	
6	Elena	1985	125	1300000000	9	
7	Danny	1997	80	100000000	4	
8	Ivan	2004	165	2610000000	92	
9	Dennis	2005	150	3980000000	76	
10	Katrina	2005	175	125B	1836	
11	Michael	2018	155	2510000000	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

columns



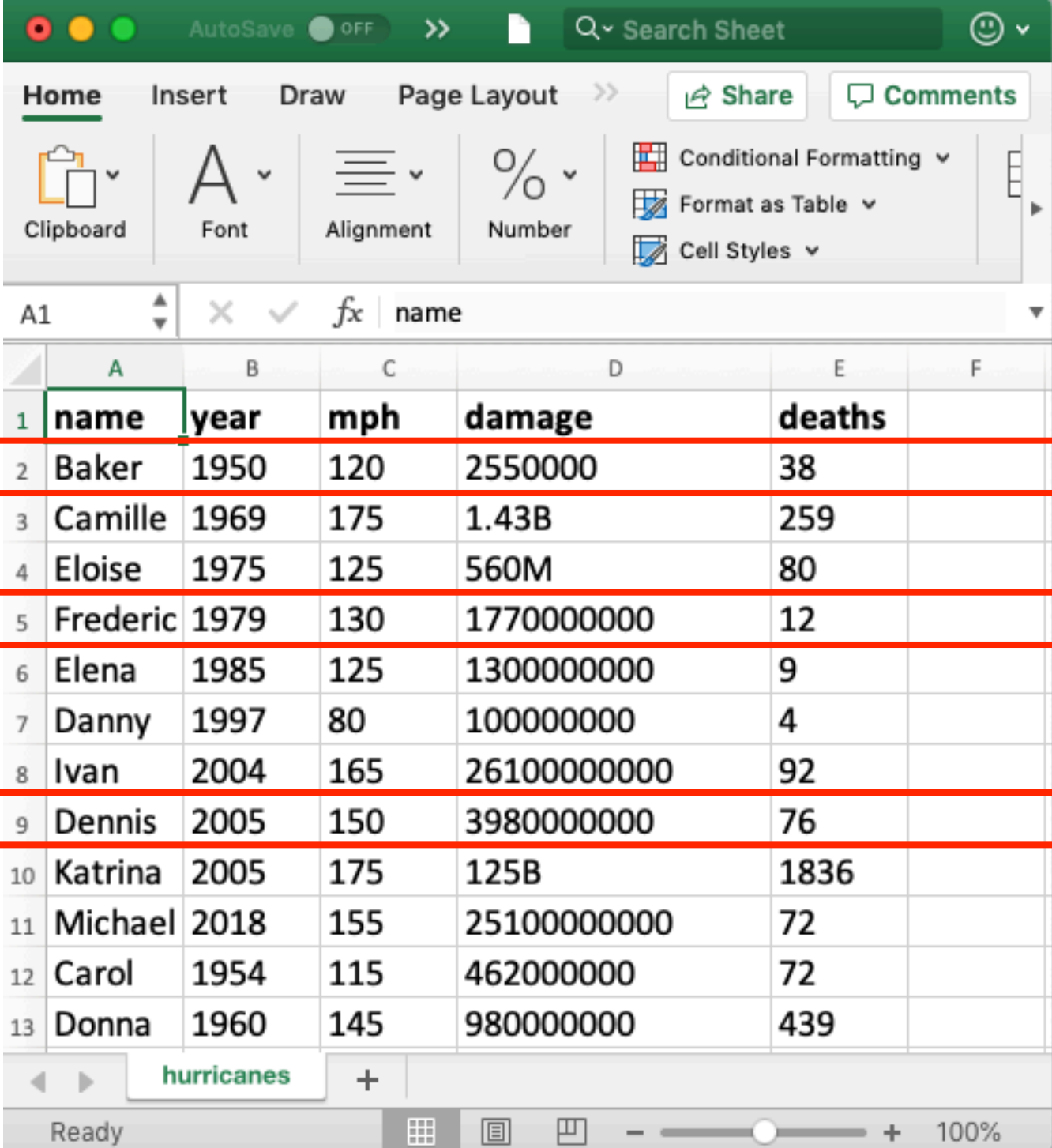
The screenshot shows a spreadsheet application with a table of hurricane data. The columns are labeled name, year, mph, damage, and deaths. The rows list hurricanes from Baker to Donna. Red boxes highlight the column headers and the data rows.

	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	
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Spreadsheets (e.g., Excel)

Spreadsheets are tables of cells, organized by rows and columns

rows



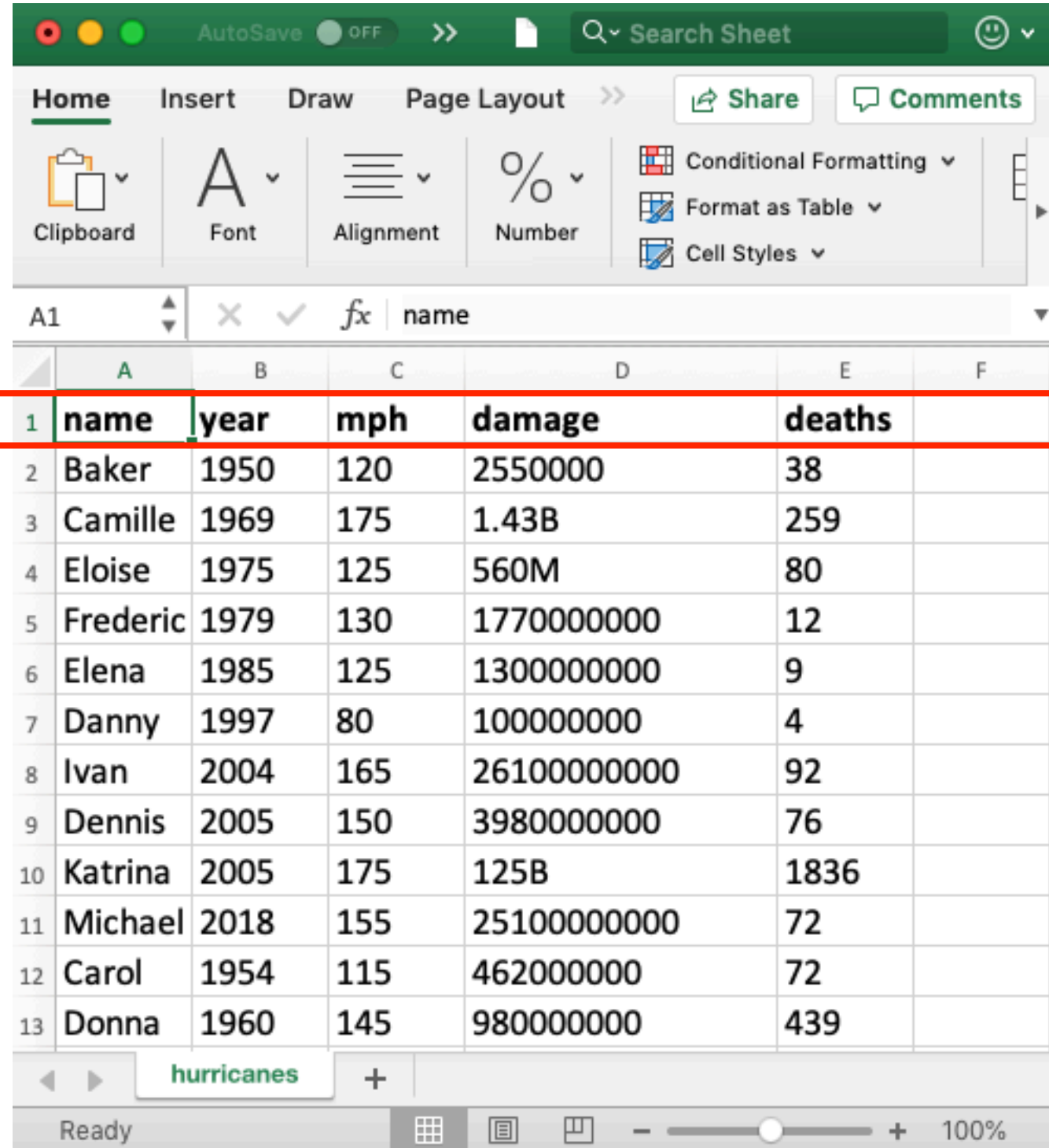
The screenshot shows a Google Sheet interface with a table of hurricane data. The table has columns for name, year, mph, damage, and deaths. The rows are numbered 1 through 13. The first row is the header row. The following rows are highlighted with red boxes: row 2 (Baker), row 5 (Frederic), and row 9 (Dennis). The status bar at the bottom indicates 'Ready' and '100%' zoom.

	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	
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9	Dennis	2005	150	3980000000	76	
10	Katrina	2005	175	125B	1836	
11	Michael	2018	155	2510000000	72	
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Spreadsheets (e.g., Excel)

Spreadsheets are tables of cells, organized by rows and columns

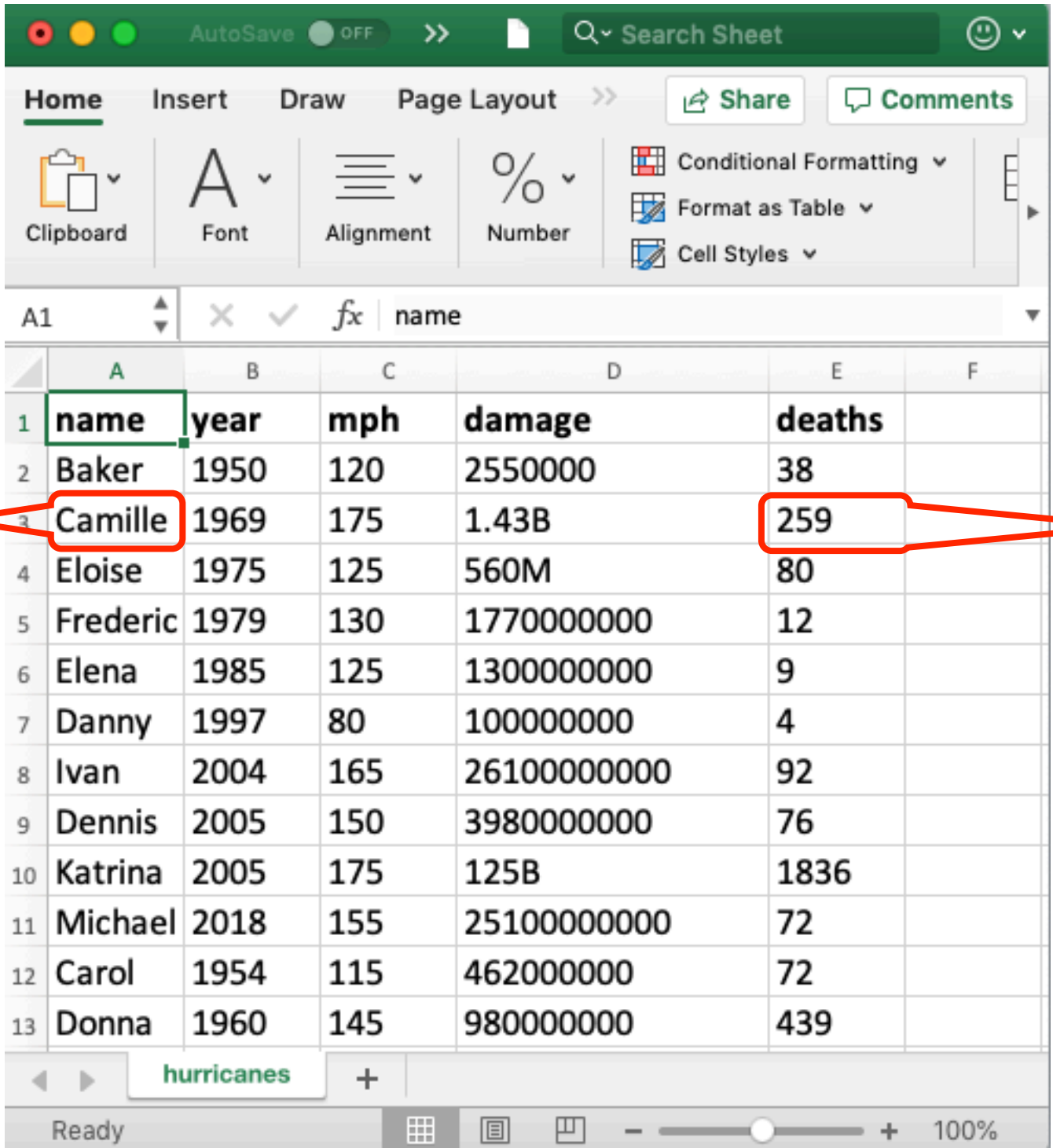
header



	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	
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8	Ivan	2004	165	2610000000	92	
9	Dennis	2005	150	3980000000	76	
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Spreadsheets (e.g., Excel)

Spreadsheets often allow different **data types**



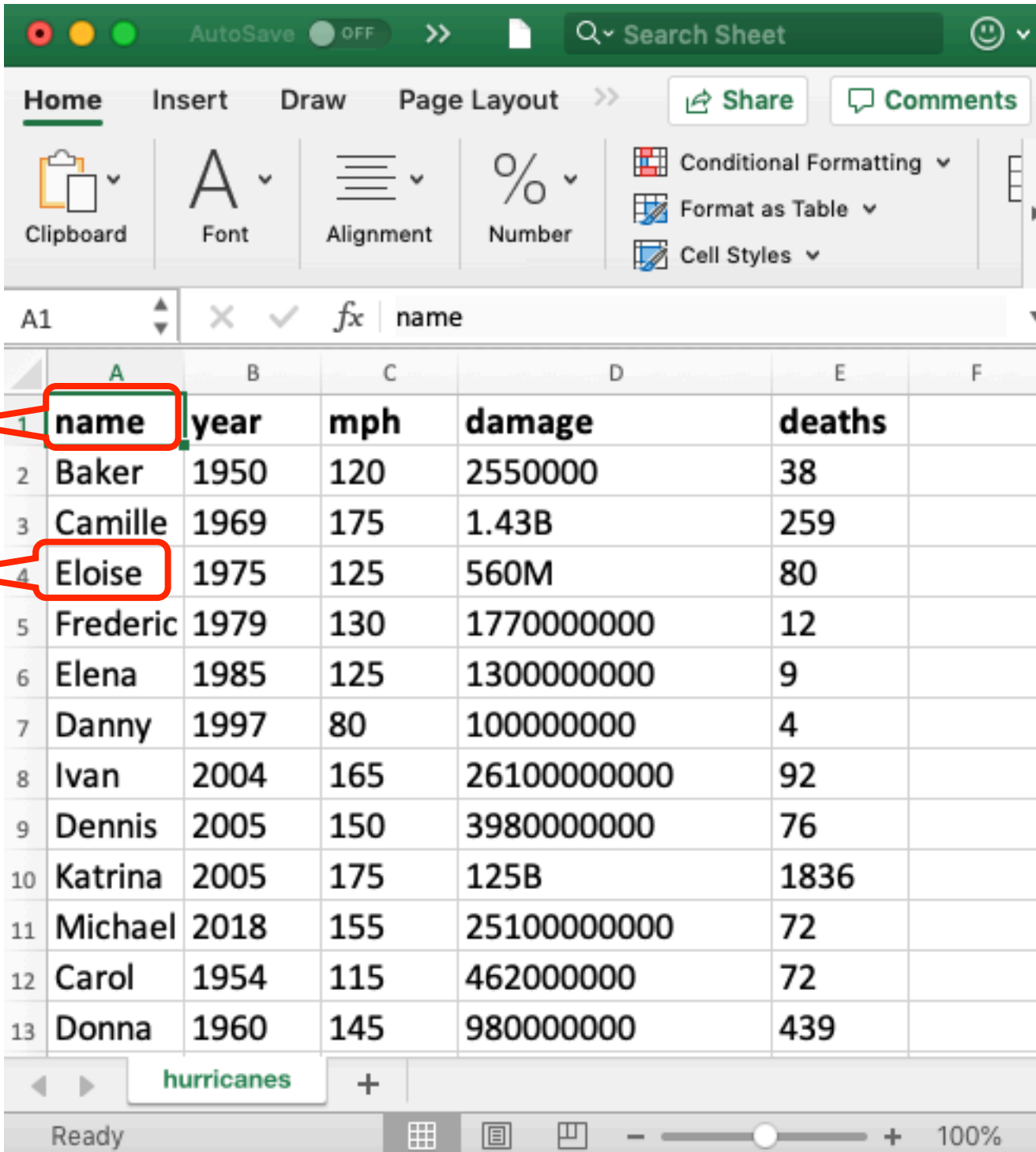
The screenshot shows a spreadsheet application interface. The top bar includes window controls, 'AutoSave' (OFF), a search bar, and a smiley face icon. The ribbon has tabs for 'Home', 'Insert', 'Draw', and 'Page Layout'. The 'Home' tab is active, showing groups for 'Clipboard', 'Font', 'Alignment', 'Number', 'Conditional Formatting', 'Format as Table', and 'Cell Styles'. The formula bar shows 'A1' and 'name'. The spreadsheet data is as follows:

	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	
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Red arrows point to the 'name' column header and the '259' value in the 'deaths' column, with labels 'text' and 'numbers' respectively.

Spreadsheets (e.g., Excel)

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



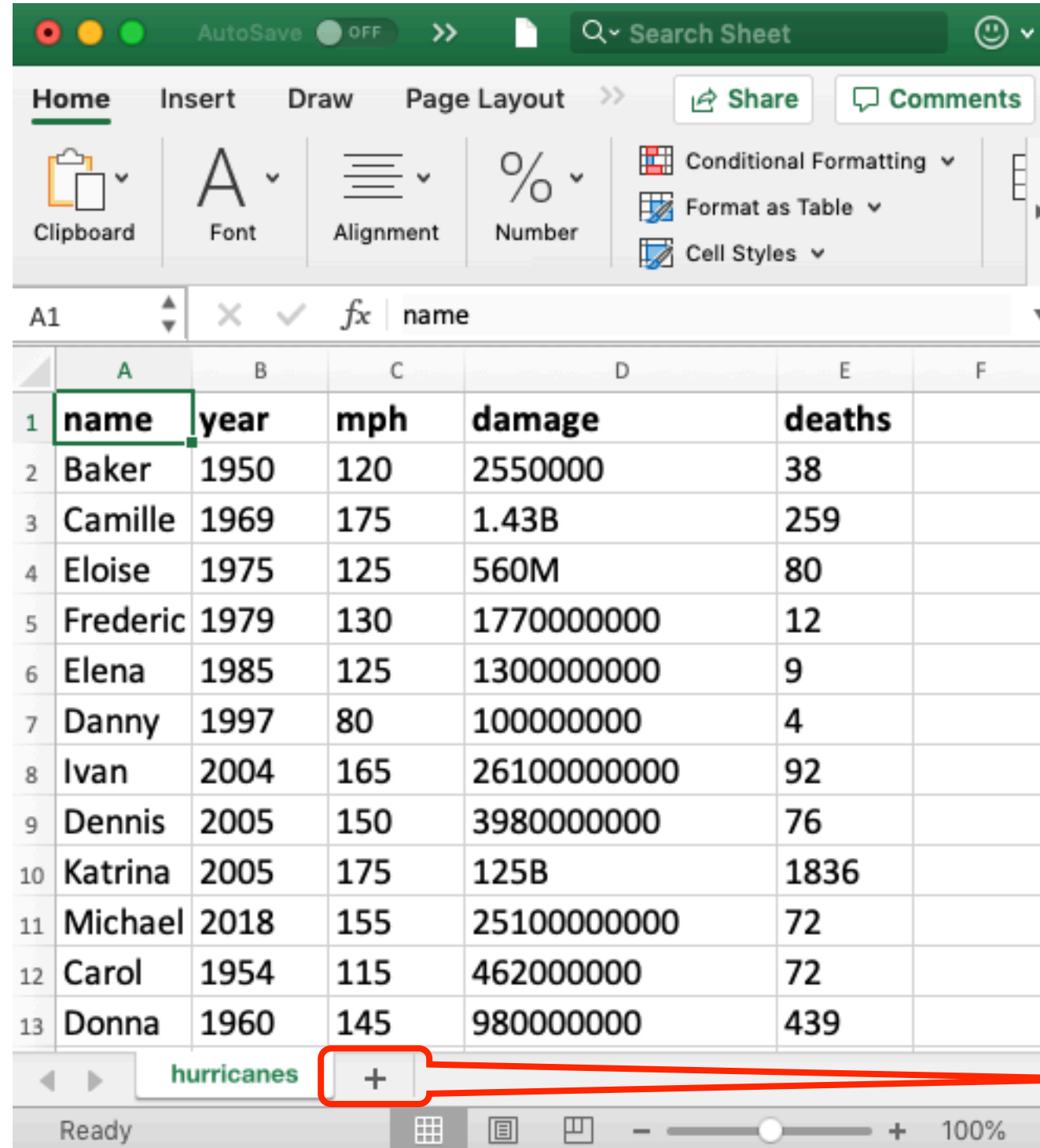
bold

regular

	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	
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Spreadsheets (e.g., Excel)

Spreadsheets often support **multiple sheets**



The screenshot shows a spreadsheet application interface. At the top, there's a green header bar with 'AutoSave' (OFF), a search bar 'Search Sheet', and a smiley face icon. Below this is a ribbon with tabs: 'Home', 'Insert', 'Draw', and 'Page Layout'. The 'Home' tab is active, showing options for Clipboard, Font, Alignment, Number, Conditional Formatting, Format as Table, and Cell Styles. Below the ribbon is a formula bar showing 'A1' and 'name'. The main area contains a table with 13 rows and 6 columns. The columns are labeled 'name', 'year', 'mph', 'damage', and 'deaths'. The rows contain data for various hurricanes. At the bottom, there's a sheet tab labeled 'hurricanes' with a '+' button next to it, indicating the ability to add more sheets. A red line points from the text 'more tables of data' to this '+' button.

	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	
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8	Ivan	2004	165	2610000000	92	
9	Dennis	2005	150	3980000000	76	
10	Katrina	2005	175	125B	1836	
11	Michael	2018	155	2510000000	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...

```
lec-15 — -bash — 67x24
ty-mac:lec-15$ cat hurricanes.xlsx
P!b?h^[Content_Types].xml ?(????N?0E?H?C?-J5??*Q>?ē[c[?i?i????B?j7??
?{2??h?nm????2R

????U^/???%??rZY?1__?f??q??R4D?AJ?h>????V?Σ

????Z?9????NV
?8h?????ji){^??-I?"{?v^?P!XS)bR?r??K?s(3?`c?0????????7M4?????ZEk+?|
\|z?(???P???6h_-[?@?!???Pk???2n?}???L??? ??%???????dN"m,?ÅD097*?~???ϕ
8?0?c|n???E?????B??!$}?????;{???[????2???P!U0#?L

_rels/.rels ?(???M0?0
??9L?3?sbgb|?l!??US9i?b?r:"y_dl??D???|-N??R"4?2?G?%??Z?4?"y?? ẽ??
? ?????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???????çr ??

????w?v?t/"?UN)?&!

3~??]X?K/o?y???v?5????+??zl?;o??b???G????

?s?>??,?8??(%???D??4j?0u2j
s??MY?^???S葵 ??? ?)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

```
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,2004,165,26100000000,92
Dennis,2005,150,3980000000,76
Katrina,2005,175,125B,1836ty-mac:lec-16$
```

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
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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
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TINA	19920917	1200	TD	10.4N	98.5W	25	Pacific
EMMY	19760820	1200	TD	14.0N	48.0W	20	Atlantic

Cor We call characters that act a separators “**delimiters**”

Nan

Newlines delimit rows

HEIDI

OLAF

TINA

The comma is a delimiter between cells in a row

EMMY

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

... 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

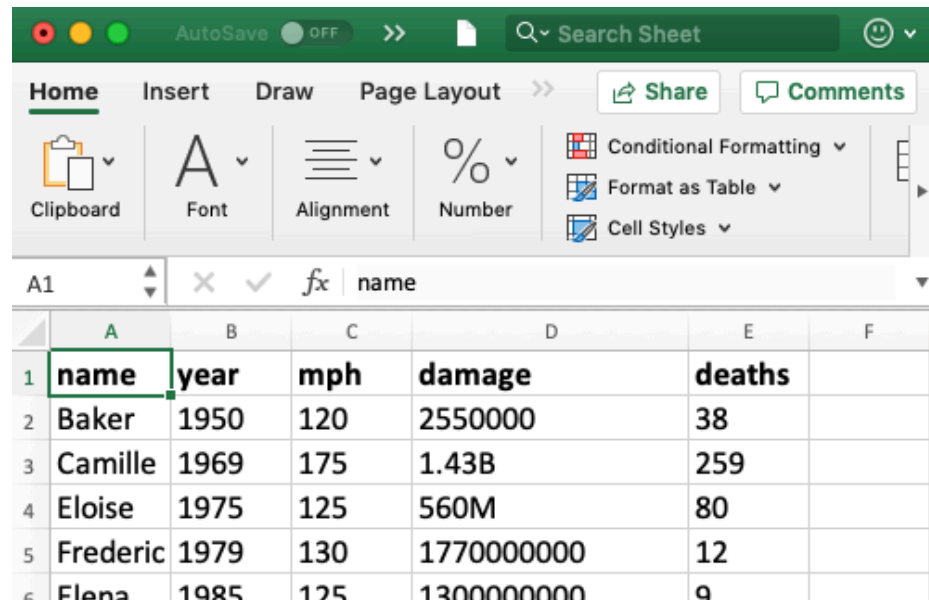
CSVs

Reading a CSV to a list of lists

Coding examples

Data Management

1. spreadsheet in Excel



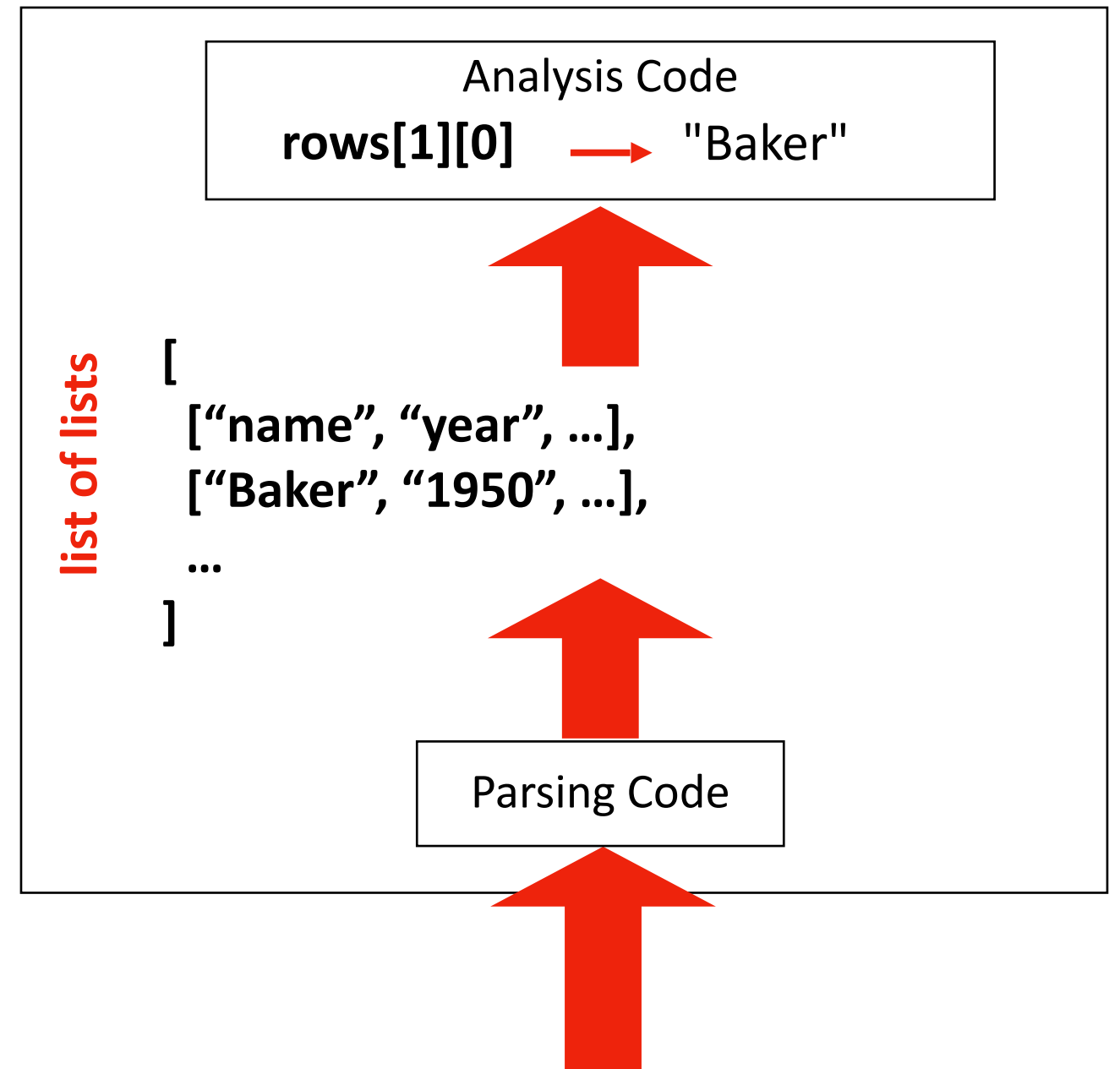
	A	B	C	D	E	F
1	name	year	mph	damage	deaths	
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4	Eloise	1975	125	560M	80	
5	Frederic	1979	130	1770000000	12	
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Save As
.CSV

2. CSV file saved somewhere

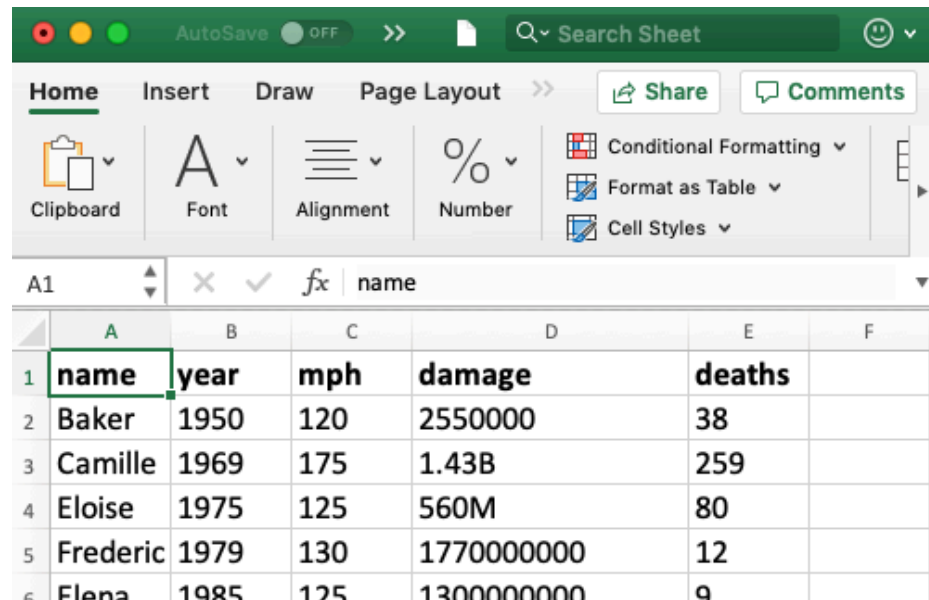
```
name,year,mph,damage,deaths
Baker,1950,120,2550000,38
Camille,1969,175,1.43B,259
Eloise,1975,125,560M,80
Frederic,1979,130,1770000000,12
```

3. Python Program



Data Management

1. spreadsheet in Excel



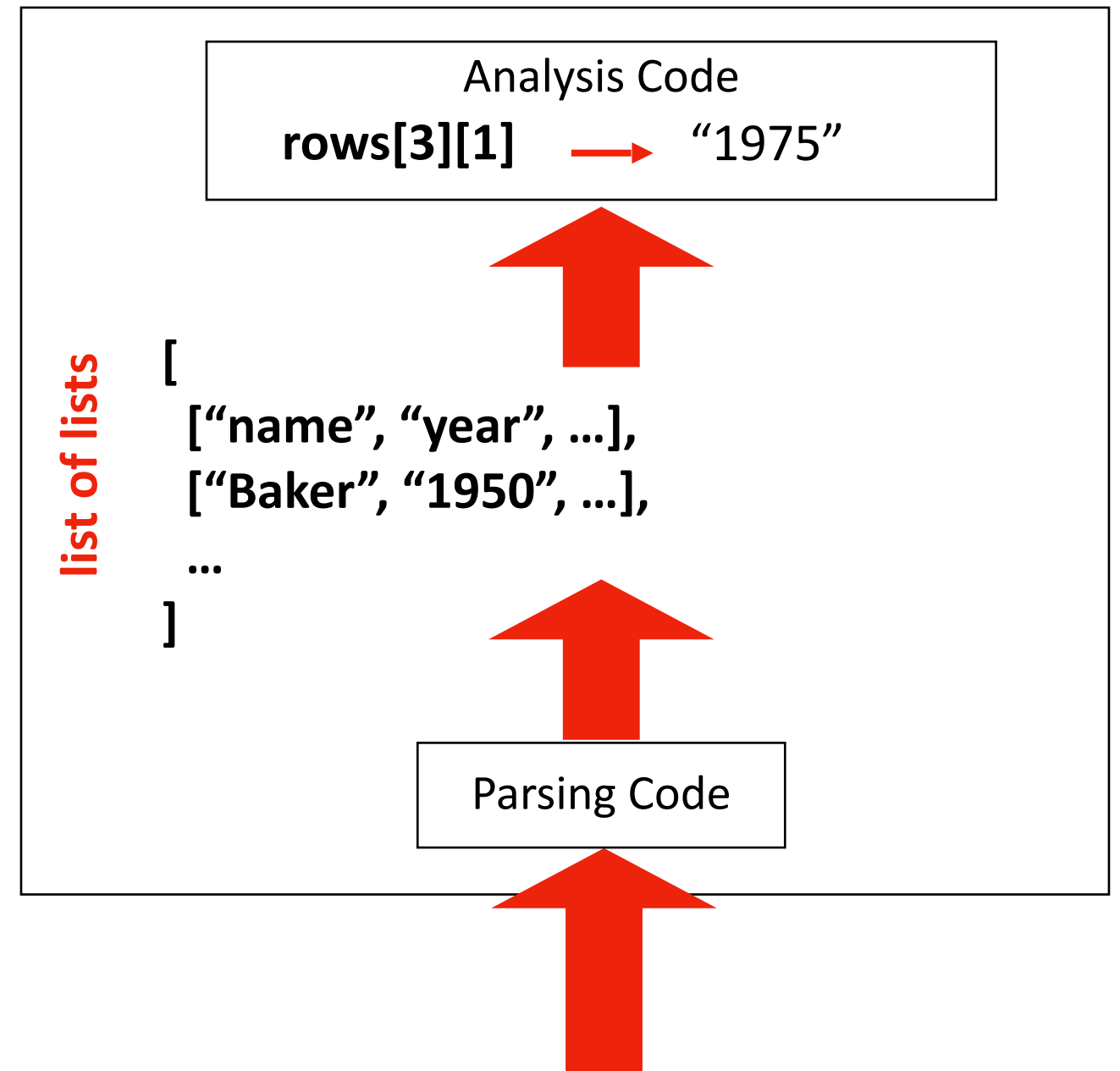
	A	B	C	D	E	F
1	name	year	mph	damage	deaths	
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5	Frederic	1979	130	17700000000	12	
6	Elena	1985	125	13000000000	9	

Save As
.CSV

2. CSV file saved somewhere

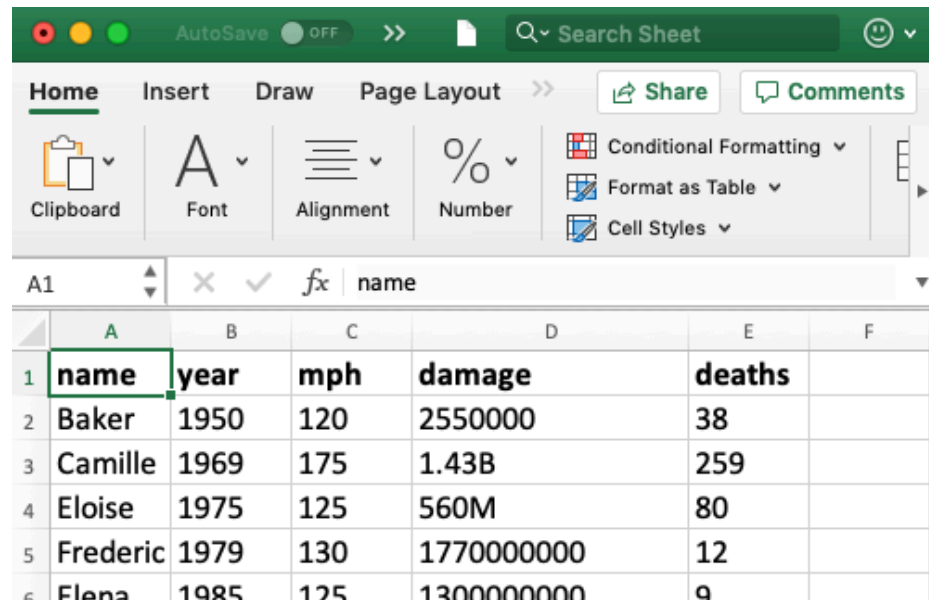
```
name,year,mph,damage,deaths
Baker,1950,120,2550000,38
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Frederic,1979,130,17700000000,12
```

3. Python Program



Data Management

1. spreadsheet in Excel



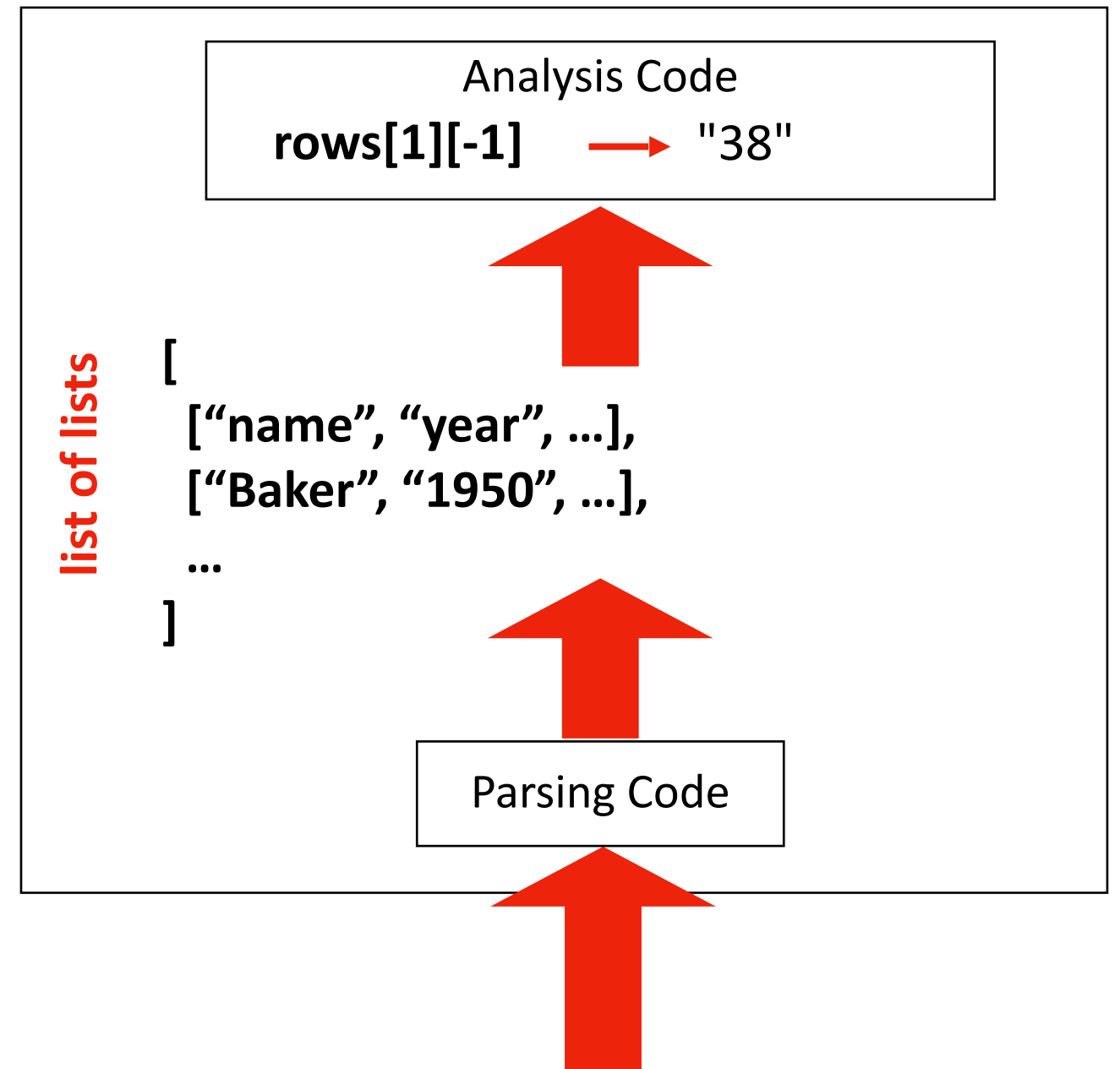
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Save As
.CSV

2. CSV file saved somewhere

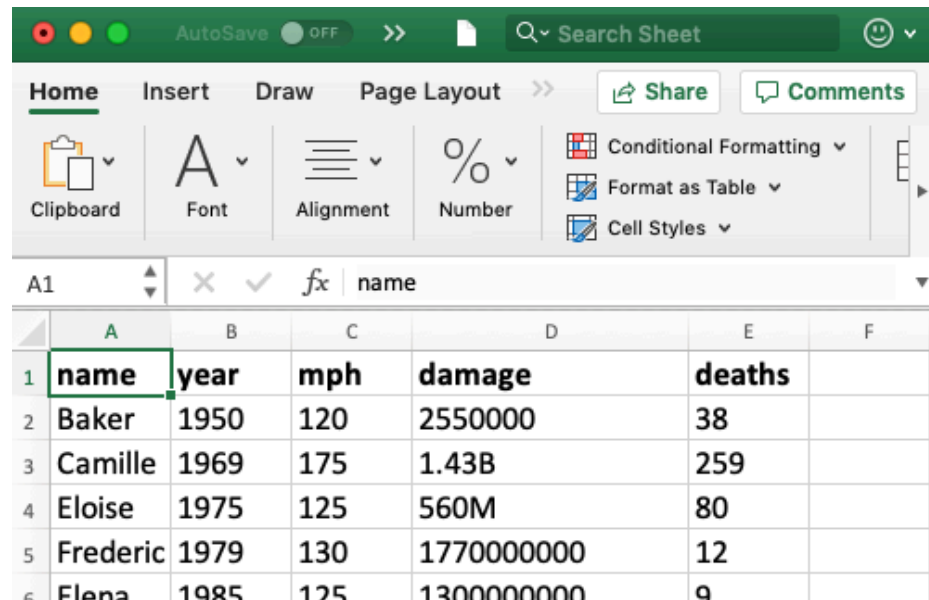
```
name,year,mph,damage,deaths
Baker,1950,120,2550000,38
Camille,1969,175,1.43B,259
Eloise,1975,125,560M,80
Frederic,1979,130,1770000000,12
```

3. Python Program



Data Management

1. spreadsheet in Excel



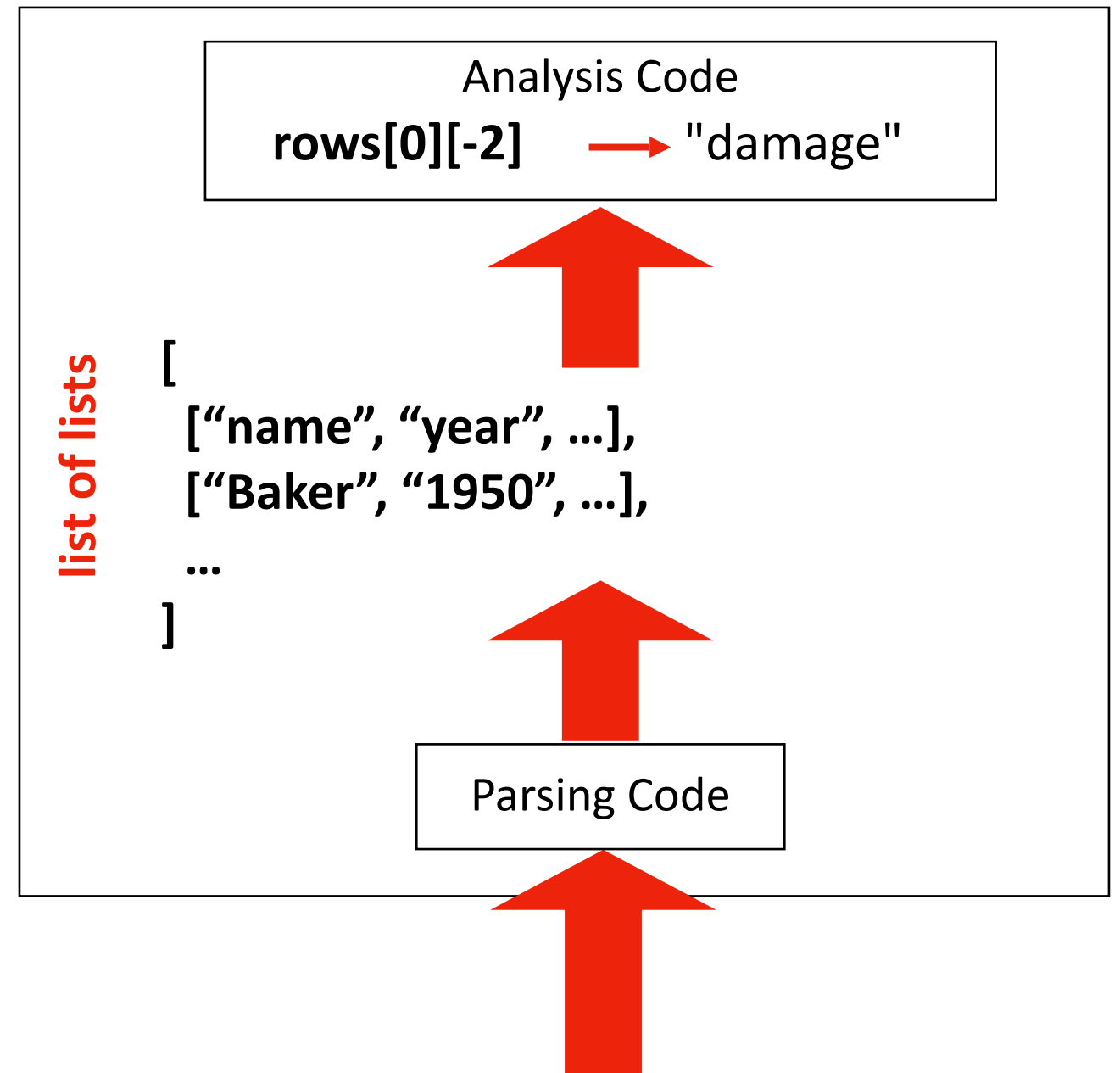
	A	B	C	D	E	F
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3	Camille	1969	175	1.43B	259	
4	Eloise	1975	125	560M	80	
5	Frederic	1979	130	17700000000	12	
6	Elena	1985	125	13000000000	9	

Save As
.CSV

2. CSV file saved somewhere

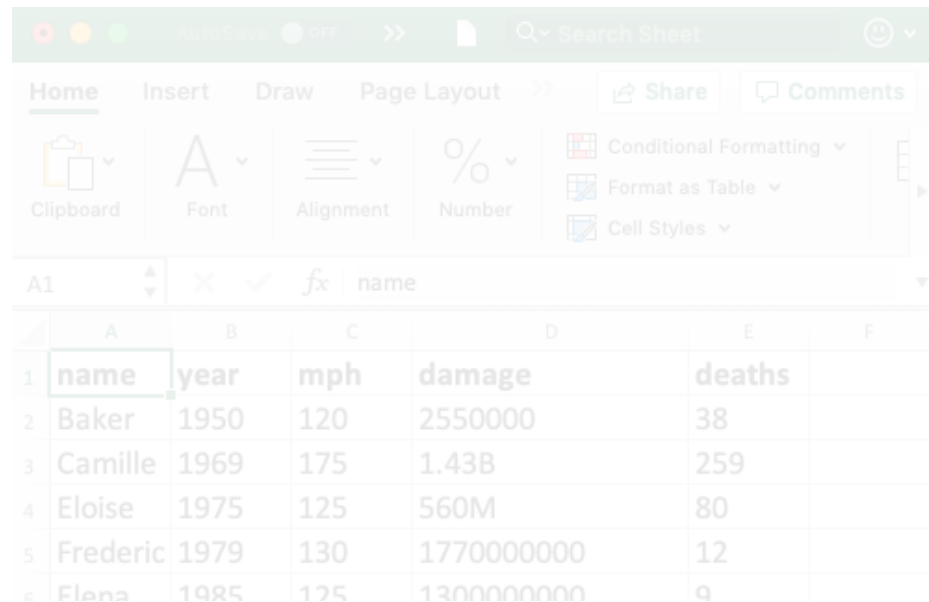
```
name,year,mph,damage,deaths
Baker,1950,120,2550000,38
Camille,1969,175,1.43B,259
Eloise,1975,125,560M,80
Frederic,1979,130,17700000000,12
```

3. Python Program



Data Management

1. spreadsheet in Excel



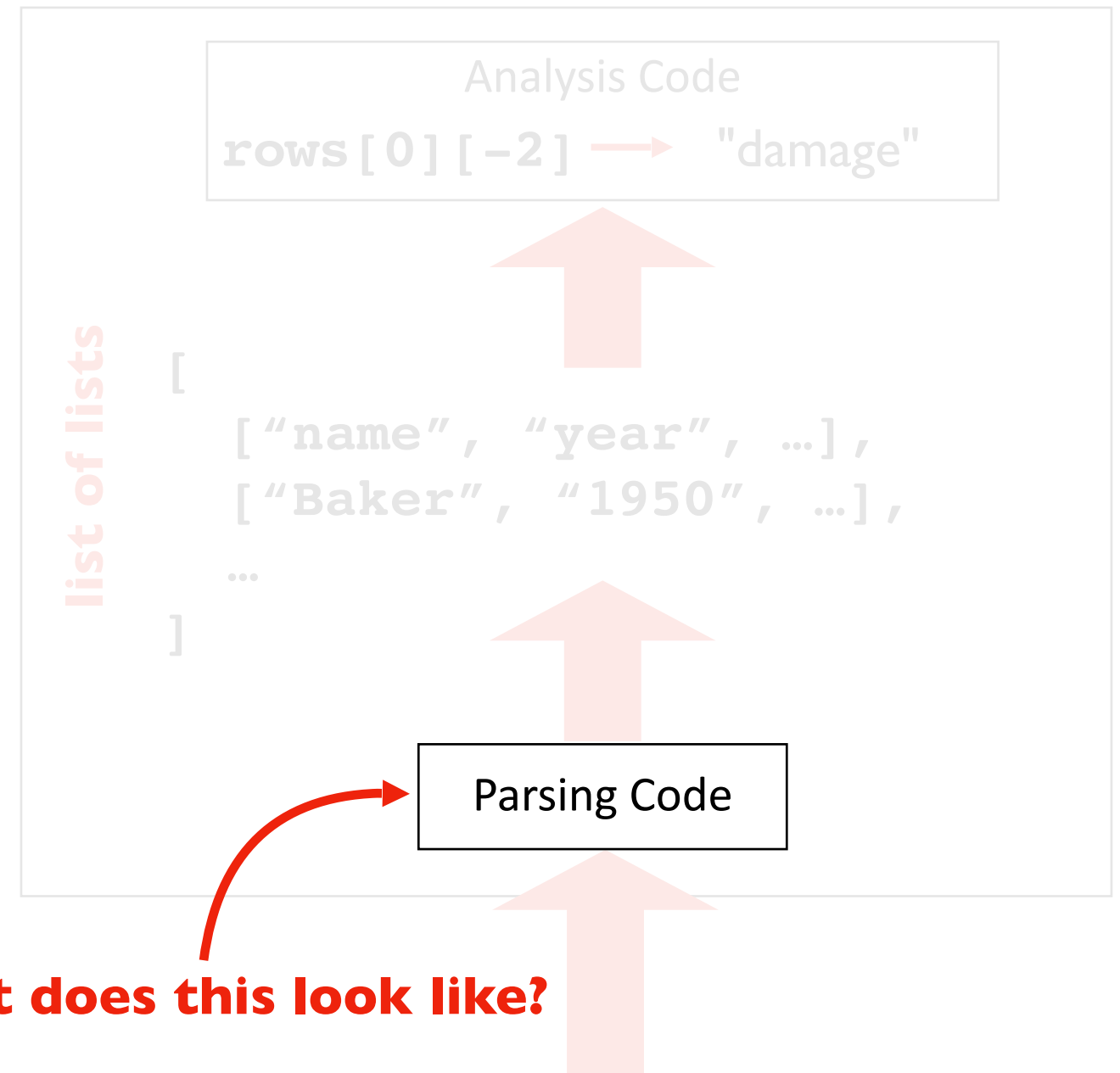
	A	B	C	D	E	F
1	name	year	mph	damage	deaths	
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3	Camille	1969	175	1.43B	259	
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5	Frederic	1979	130	1770000000	12	
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Save As
.CSV

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



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)
```

exampleData



**list of
lists**

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

input

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
```

I. 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

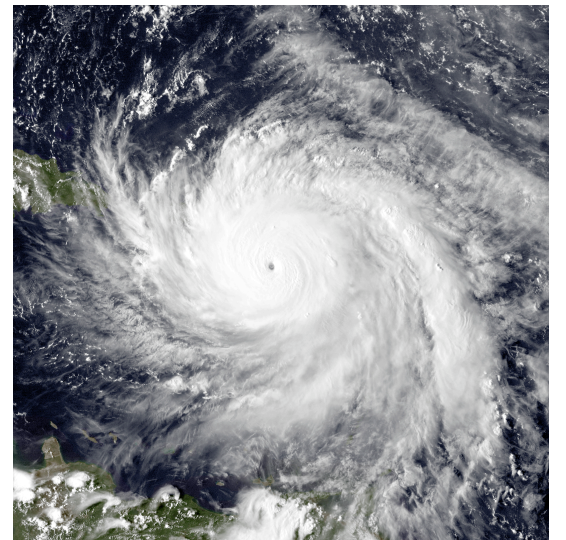
Example:

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

2969: 15

...

