Brian — PS 20 — 2025-04-22 — Solution

HELP: I don't know how to do 45.5.

EIWL3 Sections 45 and 46

Section 45 is quite important from a practical standpoint. It is an introduction to the set of tools that Mathematica provides to do "data science." In Python the corresponding toolset is called pandas. As Wolfram says, "especially in larger organizations, computing often centers around dealing with large amounts of structured data." This is what makes these tools practically important, even if they don't seem like they are at the core of the language and the available functions.

Historically (and mostly still), these kinds of operations were done in SQL (pronounced "sequel" and short for "Structured Query Language"). SQL is a language that operates on data in "relational databases." As you learn the techniques in Section 45, you are really learning how to access structured data, and much of what you learn is applicable to whatever tools you might use to access the structured data. BTW, relational databases have a major competitor nowadays, known as No-SQL databases. An example is Mongo, in which each record is a JSON document. There is still structure (at least to the extent that each JSON document in a table has a common format with all the other JSON documents in the table).

Even though I am pretty good with SQL, it took me two readings of Section 45 to start getting the hang of how operations on relational data are accomplished in Mathematica.

Section 46 is less important, unless you happen to need to deal with audio and video, in which case it might turn out to be essential.

Exercises from *EIWL3* Section 45

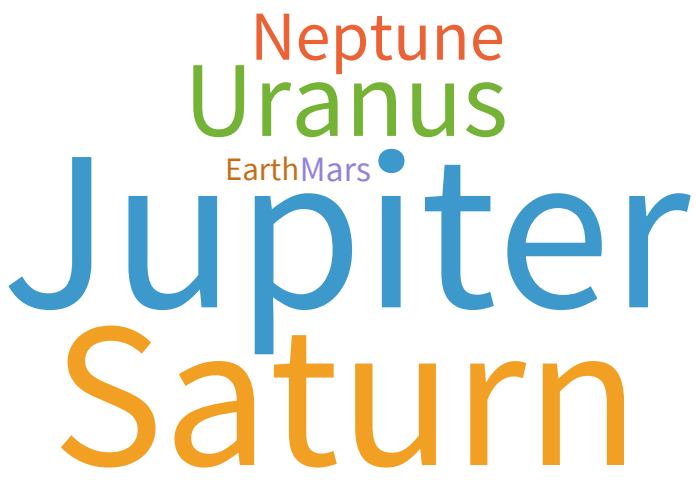
In[35]:=
```
(* For a bunch of the exercises, we need to have defined: *)

planets = CloudGet["http://wolfr.am/7FxLgPm5"]
```

Out[35]=

	Mass	Radius	Moons		
				Mass	Radius
Mercury	3.30104×10^{23} kg	1516.0 mi			
Venus	4.86732×10^{24} kg	3760.4 mi			
Earth	5.9721986×10^{24} kg	3958.761 mi	Moon	7.3459×10^{22} kg	1079.6 mi
Mars	6.41693×10^{23} kg	2106.1 mi	Deimos	1.5×10^{15} kg	3.9 mi
			Phobos	1.072×10^{16} kg	6.90 mi
Jupiter	1.89813×10^{27} kg	43 441. mi	Adrastea	$7. \times 10^{15}$ kg	5.1 mi
			Aitne	$4. \times 10^{13}$ kg	0.93 mi
			69 total ›		
Saturn	5.68319×10^{26} kg	36 184. mi	Aegaeon	—	0.16 mi
			Aegir	—	1.9 mi
			62 total ›		
Uranus	8.68103×10^{25} kg	15 759. mi	Ariel	1.35×10^{21} kg	359.7 mi
			Belinda	3.57×10^{17} kg	25.0 mi
			27 total ›		
Neptune	1.02410×10^{26} kg	15 299. mi	Despina	2.1×10^{18} kg	47. mi
			Galatea	3.7×10^{18} kg	55. mi
			14 total ›		

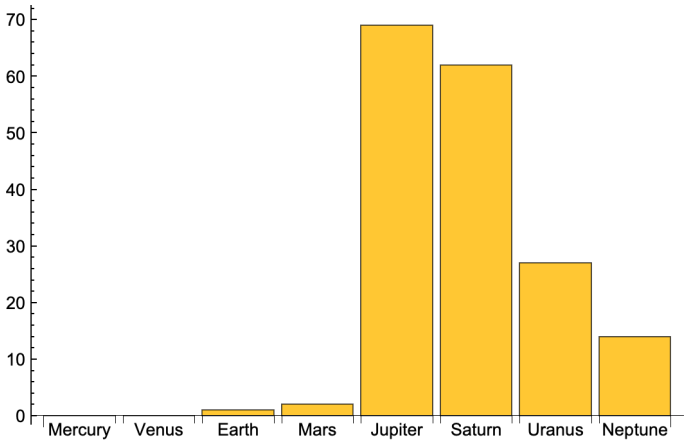
In[36]:=
```
(* 45.1 *) WordCloud[planets[All, "Moons", Length]]
```

Out[36]=



In[37]:=
```
(* 45.2 *)BarChart[planets[All, "Moons", Length], ChartLabels → Automatic]
```

Out[37]=



In[38]:=
```
(* 45.3 *)planetsSortedByNumberOfMoonsDescending =
  Reverse[planets[SortBy[Length[#Moons] &]]];
planetsSortedByNumberOfMoonsDescending[All, "Mass"]
```

Out[39]=

Jupiter	1.89813×10^{27} kg
Saturn	5.68319×10^{26} kg
Uranus	8.68103×10^{25} kg
Neptune	1.02410×10^{26} kg
Mars	6.41693×10^{23} kg
Earth	5.9721986×10^{24} kg
Venus	4.86732×10^{24} kg
Mercury	3.30104×10^{23} kg

In[78]:=
```
(* 45.4 *) planets[All, "Moons", Max, "Mass"]
```

Out[78]=

Mercury	$-\infty$
Venus	$-\infty$
Earth	7.3459×10^{22} kg
Mars	1.072×10^{16} kg
Jupiter	1.4815×10^{23} kg
Saturn	1.3452×10^{23} kg
Uranus	3.526×10^{21} kg
Neptune	2.1394×10^{22} kg

```
(* 45.5 *) Sort[planets[All, "Moons", Max, "Mass"]]
(* How am I supposed to get the planet masses back into the table? *)
```

Out[87]=

Mercury	$-\infty$
Venus	$-\infty$
Mars	1.072×10^{16} kg
Uranus	3.526×10^{21} kg
Neptune	2.1394×10^{22} kg
Earth	7.3459×10^{22} kg
Saturn	1.3452×10^{23} kg
Jupiter	1.4815×10^{23} kg

In[80]:=
```
(* 45.6 *) planets[All, "Moons", Median, "Mass"]
```

Out[80]=

Mercury	—
Venus	—
Earth	7.3459×10^{22} kg
Mars	6.10×10^{15} kg
Jupiter	1.9×10^{14} kg
Saturn	8.2×10^{15} kg
Uranus	3.57×10^{17} kg
Neptune	3.7×10^{18} kg

In[44]:=
```
(* 45.7 *) earthMass = Earth PLANET [ mass ];
```

In[89]:=
```
planets[All, "Moons", Select[#Mass > 0.0001 earthMass &]]
```

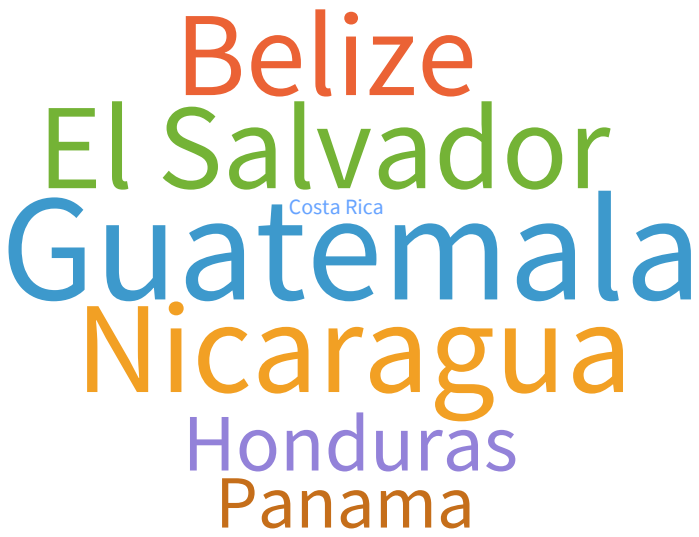
Out[89]=

		Mass	Radius
Mercury			
Venus			
Earth	Moon	7.3459×10^{22} kg	1079.6 mi
Mars			
Jupiter	Callisto	1.0757×10^{23} kg	1497.7 mi
	Europa	4.7987×10^{22} kg	969.84 mi
	4 total ›		
Saturn	Dione	1.0955×10^{21} kg	349.5 mi
	Iapetus	1.8055×10^{21} kg	456.4 mi
	5 total ›		
Uranus	Ariel	1.35×10^{21} kg	359.7 mi
	Oberon	3.013×10^{21} kg	473.1 mi
	4 total ›		
Neptune	Triton	2.1394×10^{22} kg	840.96 mi

```
Association
```

In[101]:=
```
(* 45.8 *) countryNames = Central America COUNTRIES ["Name"];
WordCloud[Association[# → StringLength[WikipediaData[#]] & /@ countryNames]]
```

Out[102]=



In[119]:=
```
(* 45.9 *) fireballs = ResourceData["Fireballs and Bolides"]
```

Out[119]=

PeakBrightness	Coordinates	NearestCity	Altitude
Thu 8 Oct 2009 02:57:00	4.2°S 120.6°E	Bone	19.1 km
Sat 21 Nov 2009 20:53:00	22.0°S 29.2°E	Kobojango	38 km
Sat 25 Dec 2010 23:24:00	38.0°N 158.0°E	Kurilsk	26 km
Sat 21 Apr 2012 16:08:23	15.8°S 174.8°W	Hihifo	—
Mon 23 Apr 2012 22:01:10	36.2°N 107.4°E	Pingliang	25.2 km
Fri 4 May 2012 21:54:49	76.7°N 10.6°W	Illoqqortoormiut	—
Tue 15 May 2012 11:04:17	61.8°S 135.5°W	Owenga	33.3 km
Fri 25 May 2012 11:31:24	41.8°S 36.2°W	Grytviken	—
Wed 25 Jul 2012 07:48:20	36.4°N 41.5°E	Sinjar	26.8 km
Fri 27 Jul 2012 04:19:50	63.1°N 172.3°E	Anadyr	27.2 km
Sun 26 Aug 2012 14:55:47	11.8°N 117.0°E	El Nido	36 km
Mon 27 Aug 2012 06:57:43	18.3°S 64.2°E	Quatre Cocos	38.7 km
Mon 10 Sep 2012 01:03:32	69.8°S 111.7°W	Rothera - permanent station of the UK	23.8 km
Tue 11 Sep 2012 22:07:30	18.9°S 105.2°E	The Settlement	—
Tue 18 Sep 2012 19:34:39	1.2°N 52.2°W	Mazagão	28.1 km
Fri 28 Sep 2012 05:44:12	6.9°S 73.7°E	Feydhoo	—
Tue 2 Oct 2012 16:38:38	8.1°S 111.9°W	Hanga Roa	35 km
Wed 3 Oct 2012 22:50:12	41.5°S 21.9°W	Edinburgh	—
Tue 9 Oct 2012 00:54:55	51.2°N 84.6°W	Hearst	27.8 km
Fri 19 Oct 2012 16:26:22	75.4°S 49.6°E	Syowa - permanent station of Japan	29.3 km

rows 1–20 of **92**

In[108]:=
```
fireballs[Max, "Altitude"]
```

Out[108]=
```
66.6 km
```

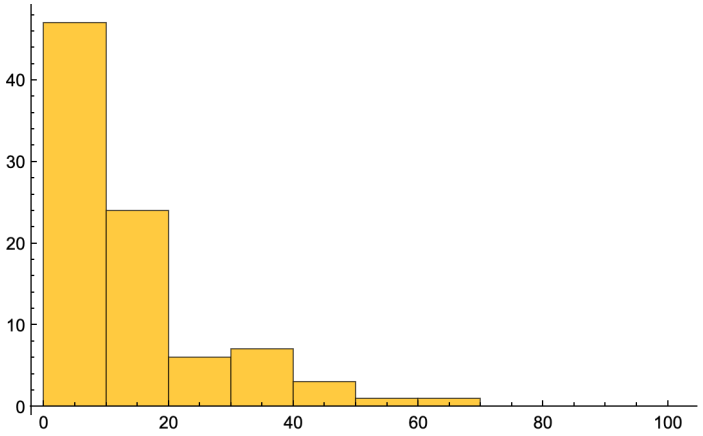
In[118]:=
```
(* 45.10 *) Take[Sort[fireballs[All, "Altitude"]], -5]
```

Out[118]=

44 km
45.5 km
50 km
59.3 km
66.6 km

In[123]:=
```
(* 45.11 *) Histogram[Differences[fireballs[All, "PeakBrightness"]]]
```

Out[123]=



In[139]:=
```
(* 45.12 *)
nearestCities = Interpreter["City"] /@ Take[fireballs[All, "NearestCity"], 10];
GeoListPlot[Labeled /@ nearestCities]
```

Out[140]=

In[142]:=

```
Reverse[fireballs[SortBy[#Altitude &]]]
```

Out[142]=

PeakBrightness	Coordinates	NearestCity	Altitude
Mon 12 Aug 2013 18:08:02	34.4°S 118.2°E	Albany	66.6 km
Thu 21 Nov 2013 01:50:35	44.7°N 35.3°E	Ordzhonikidze	59.3 km
Wed 18 Mar 2015 00:04:50	5.4°S 159.3°E	Buala	50 km
Wed 7 Jan 2015 01:05:59	45.7°N 26.9°E	Andreiasu de Jos	45.5 km
Fri 16 May 2014 12:42:48	44.2°S 176.2°W	Owenga	44 km
Wed 25 Feb 2015 10:53:24	12.4°N 122.4°W	Cabo San Lucas	42 km
Tue 24 Sep 2013 15:31:16	10.3°S 164.7°W	Roto	40.7 km
Sun 21 Apr 2013 06:23:12	28.1°S 64.6°W	Santiago del Estero	40.7 km
Wed 4 Mar 2015 04:30:05	15.9°S 88.1°E	West Island	39.8 km
Tue 17 Feb 2015 13:19:50	8.0°S 11.2°W	Georgetown	39 km
Fri 17 Oct 2014 14:07:36	4.6°S 66.3°W	Carauari	39 km
Mon 27 Aug 2012 06:57:43	18.3°S 64.2°E	Quatre Cocos	38.7 km
Fri 2 Jan 2015 13:39:19	31.1°S 140.0°E	Broken Hill	38.1 km
Thu 27 Nov 2014 12:12:52	18.8°S 73.4°W	Mollendo	38 km
Sat 21 Nov 2009 20:53:00	22.0°S 29.2°E	Kobojango	38 km
Tue 21 Apr 2015 01:42:51	37.7°N 39.6°W	Ribeira Grande	37.4 km
Wed 26 Nov 2014 17:40:16	68.2°S 24.0°W	Neumayer - permanent station of Germany	37 km
Sun 12 Jan 2014 16:00:48	2.9°N 64.4°E	Mandhoo	37 km
Fri 26 Jul 2013 11:32:26	21.0°N 178.5°W	Fagalii	37 km
Wed 8 Apr 2015 04:06:31	25.5°S 51.5°E	Taolanaro	36.3 km

rows 1–20 of **92**

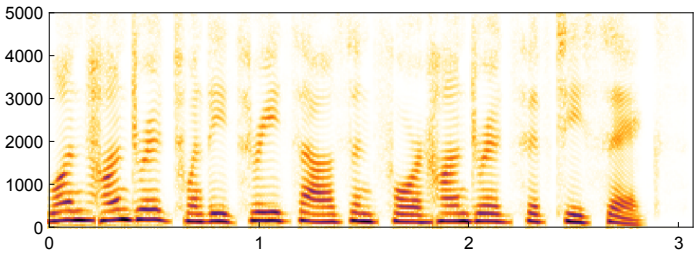
In[146]:=
```
(* 45.13 *)nearestCitiesLargestAltitudes = Interpreter["City"] /@
   Take[Reverse[fireballs[SortBy[#Altitude &]]], 10][All, "NearestCity"];
GeoListPlot[Labeled /@ nearestCitiesLargestAltitudes]
```

Out[147]=

Exercises from *EIWL3* Section 46

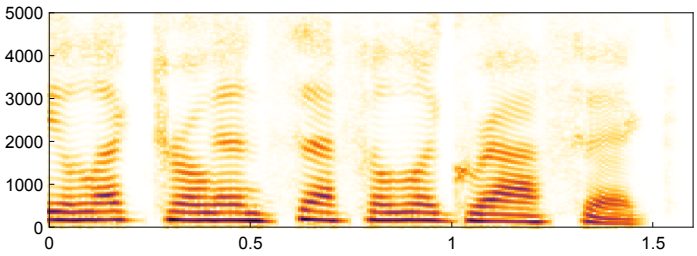
In[46]:=
```
(* 46.1 *) Spectrogram[SpeechSynthesize[IntegerName[123 456]]]
```

Out[46]=



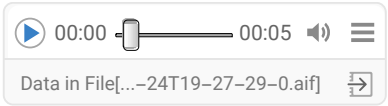
In[47]:=
```
(* 46.2 *) Spectrogram[SpeechSynthesize[SortBy[WordList[], StringLength[#] &][[-1]]]
```

Out[47]=



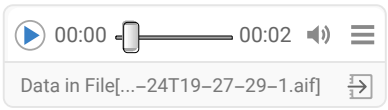
In[48]:=
```
(* 46.3 *) spokenAlphabet = SpeechSynthesize[StringRiffle[Alphabet[], " "]]
```

Out[48]=



In[49]:=
```
(* 46.4 *) SpeechSynthesize[spokenAlphabet]
```

Out[49]=

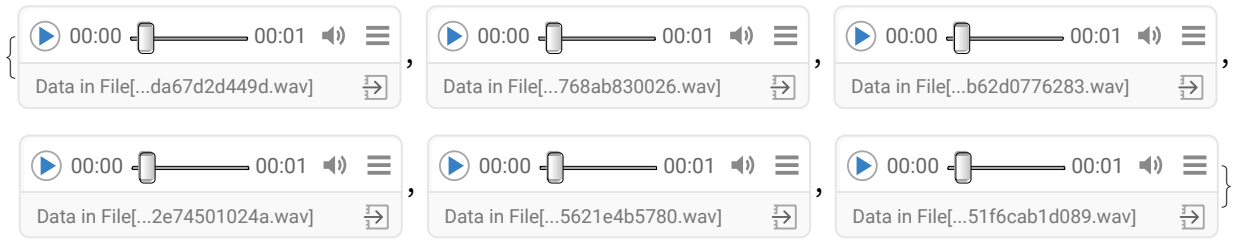


In[50]:=
```
(* 46.5 *) AudioPitchShift[SpeechSynthesize["hello"], 2]
```

Out[50]=

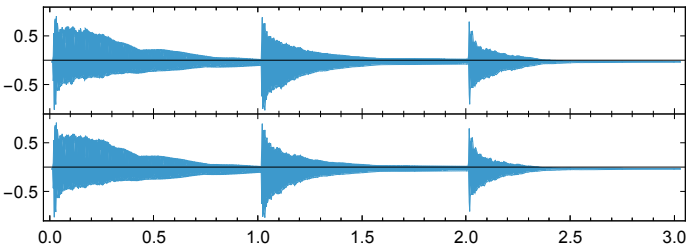
In[51]:=
```
(* 46.6 *)
Table[AudioPitchShift[SpeechSynthesize["computer"], r], {r, 1.0, 1.5, 0.1}]
```

Out[51]=



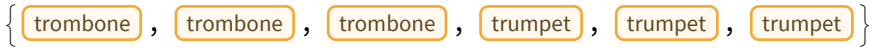
In[52]:=
```
(* 46.7 *) AudioPlot[Sound[Table[SoundNote[note, 1, "Guitar"], {note, {0, 12, 24}}]]]
```

Out[52]=



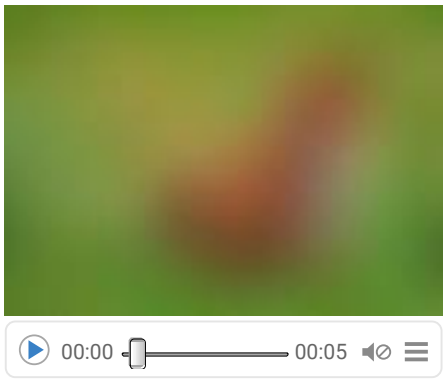
In[53]:=
```
(* 46.8 *) Table[
 AudioIdentify[AudioPitchShift[SoundNote[0, 1, "Trumpet"], r]], {r, 0.5, 1.0, 0.1}]
```

Out[53]=



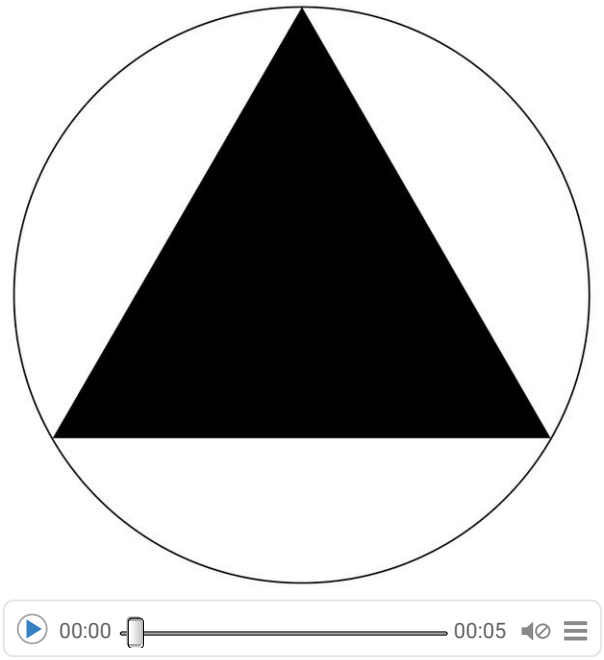
In[54]:=
```
(* 46.9 *) foxImage = red fox SPECIES SPECIFICATION [ image ];
AnimationVideo[Blur[foxImage, 20 - step], {step, 0, 20}]
```

Out[55]=



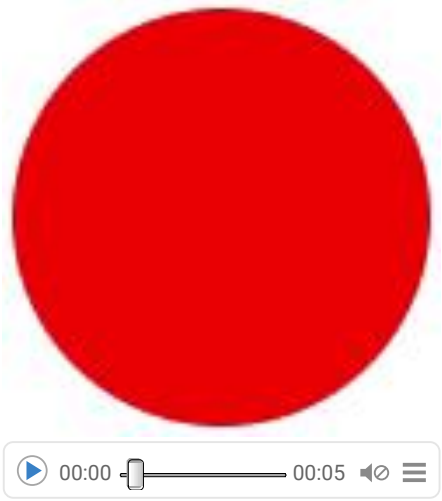
In[56]:=
```
(* 46.10 *)
AnimationVideo[Graphics[{Circle[], RegularPolygon[vertices]}], {vertices, 3, 20}]
```

Out[56]=



In[57]:=
```
(* 46.11 *) AnimationVideo[Graphics[{Hue[hue], Disk[]}, ImageSize → 50], {hue, 0, 1}]
```

Out[57]=



In[58]:=
```
(* 46.12 *) AnimationVideo[Graphics[Rasterize[letter, RasterSize → 200]],
 {letter, Capitalize[Alphabet[]]}, FrameRate → 2]
```

Out[58]=