In [185…
```
import polars as pl
```

In [186…
```
df = (pl.read_csv("UCS-Satellite-Database-5-1-2022.csv"))
```

In [187…
```
df
```

Out[187… shape: (5467, 67)

Name of Satellite, Alternate Names	Current Official Name of Satellite	Country/Org of UN Registry	Country of Operator/Owner	Operator/Owner	Users	Purpos
str	str	str	str	str	str	st
"1HOPSAT-TD (1s...	"1HOPSAT-TD"	"NR"	"USA"	"Hera Systems"	"Commercial"	"Earth Observat
"Aalto-1 "	"Aalto-1"	"Finland"	"Finland"	"Aalto Universi...	"Civil"	"Technology Dev
"AAUSat-4"	"AAUSat-4"	"Denmark"	"Denmark"	"University of ...	"Civil"	"Earth Observat
"ABS-2 (Koreasa...	"ABS-2"	"NR"	"Multinational"	"Asia Broadcast...	"Commercial"	"Communications
"ABS-2A"	"ABS-2A"	"NR"	"Multinational"	"Asia Broadcast...	"Commercial"	"Communications
"ABS-3A "	"ABS-3A"	"NR"	"Multinational"	"Asia Broadcast...	"Commercial"	"Communications
"ABS-4 (ABS-2i,...	"ABS-4"	"NR"	"Multinational"	"Asia Broadcast...	"Commercial"	"Communications
"ABS-6 (ABS-1, ...	"ABS-6"	"NR"	"Multinational"	"Asia Broadcast...	"Commercial"	"Communications
"Adelis-Sampson...	"Adelis-Sampson...	"NR"	"Israel"	"Asher Space Re...	"Government"	"Technology Dev
"Adelis-Sampson...	"Adelis-Sampson...	"NR"	"Israel"	"Asher Space Re...	"Government"	"Technology Dev
"Adelis-Sampson...	"Adelis-Sampson...	"NR"	"Israel"	"Asher Space Re...	"Government"	"Technology Dev
"Advanced Orion...	"USA 311"	"USA"	"USA"	"National Recon...	"Military"	"Earth Observat
…	…	…	…	…	…	…
"Zhuhai 1-04 (O...	"OHS-1"	"China"	"China"	"Zhuhai Orbita ...	"Commercial"	"Earth Observat
"Zhuhai 1-05 (O...	"OHS-2"	"China"	"China"	"Zhuhai Orbita ...	"Commercial"	"Earth Observat
"Zhuhai 1-06 (O...	"OHS-3"	"China"	"China"	"Zhuhai Orbita ...	"Commercial"	"Earth Observat
"Zhuhai 1-07 (O...	"OHS-4"	"China"	"China"	"Zhuhai Orbita ...	"Commercial"	"Earth Observat
"Ziyuan 1-02C"	"Ziyuan 1-02C"	"China"	"China"	"China Centre f...	"Government"	"Earth Observat
"Ziyuan 1-2D"	"Ziyuan 1-2D"	"NR"	"China"	"China Centre f...	"Government"	"Earth Observat
"Ziyuan 3 (ZY-3...	"Ziyuan 3"	"China"	"China"	"China Centre f...	"Government"	"Earth Observat
"Ziyuan 3-2"	"Ziyuan 3-2"	"China"	"China"	"China Centre f...	"Government"	"Earth Observat
"Ziyuan 3-3"	"Ziyuan 3-3"	"China"	"China"	"China Centre f...	"Government"	"Earth Observat
"Z-Sat"	"Z-Sat"	"NR (1/22)"	"Japan"	"Mitsubishi Hea...	"Commercial"	"Technology Dev
null	null	null	null	null	null	nu

Name of Satellite, Alternate Names	Current Official Name of Satellite	Country/Org of UN Registry	Country of Operator/Owner	Operator/Owner	Users	Purpos
str	str	str	str	str	str	st
null	null	null	null	null	null	nu

In [188…

```
df.columns
```

Out[188…

```
['Name of Satellite, Alternate Names',
 'Current Official Name of Satellite',
 'Country/Org of UN Registry',
 'Country of Operator/Owner',
 'Operator/Owner',
 'Users',
 'Purpose',
 'Detailed Purpose',
 'Class of Orbit',
 'Type of Orbit',
 'Longitude of GEO (degrees)',
 'Perigee (km)',
 'Apogee (km)',
 'Eccentricity',
 'Inclination (degrees)',
 'Period (minutes)',
 'Launch Mass (kg.)',
 ' Dry Mass (kg.) ',
 'Power (watts)',
 'Date of Launch',
 'Expected Lifetime (yrs.)',
 'Contractor',
 'Country of Contractor',
 'Launch Site',
 'Launch Vehicle',
 'COSPAR Number',
 'NORAD Number',
 'Comments',
 '',
 'Source Used for Orbital Data',
 'Source',
 'Source_duplicated_0',
 'Source_duplicated_1',
 'Source_duplicated_2',
 'Source_duplicated_3',
 'Source_duplicated_4',
 'Source_duplicated_5',
 '_duplicated_0',
 '_duplicated_1',
 '_duplicated_2',
 '_duplicated_3',
 '_duplicated_4',
 '_duplicated_5',
 '_duplicated_6',
 '_duplicated_7',
 '_duplicated_8',
 '_duplicated_9',
 '_duplicated_10',
 '_duplicated_11',
 '_duplicated_12',
 '_duplicated_13',
 '_duplicated_14',
 '_duplicated_15',
```

```
'_duplicated_16',
'_duplicated_17',
'_duplicated_18',
'_duplicated_19',
'_duplicated_20',
'_duplicated_21',
'_duplicated_22',
'_duplicated_23',
'_duplicated_24',
'_duplicated_25',
'_duplicated_26',
'_duplicated_27',
'_duplicated_28',
'_duplicated_29']
```

In [189…

```
df.shape
```

Out[189…

```
(5467, 67)
```

In [190…

```
#Who owns the most satellites?
df['Country of Operator/Owner'].value_counts(sort=True)
```

Out[190… shape: (109, 2)

Country of Operator/Owner	counts
str	u32
"USA"	3415
"China"	535
"United Kingdom…	486
"Russia"	170
"Japan"	88
"ESA"	62
"Multinational"	60
"India"	59
"Canada"	56
"Germany"	45
"Luxembourg"	42
"Argentina"	35
…	…
"USA/Sweden"	1
"Sudan"	1
"Singapore/Taiw…	1
"Poland/UK"	1
"USA/United Kin…	1

Country of Operator/Owner	counts
str	u32
"Iraq"	1
"Bolivia"	1
"Estonia"	1
"Austria"	1
"Turkmenistan/M..."	1
"France/Israel"	1
"China/Italy"	1

In [191…

```
# What is the most common type of satellite?
df['Type of Orbit'].value_counts(sort=True)
```

Out[191… shape: (9, 2)

Type of Orbit	counts
str	u32
"Non-Polar Incl..."	2677
"Sun-Synchronou..."	1414
"Polar"	673
null	624
"Equatorial"	38
"Molniya"	23
"Deep Highly Ec..."	9
"Elliptical"	8
"Cislunar"	1

In [192…

```
# What is the most common purpose of satellite?
df['Purpose'].value_counts(sort=True)
```

Out[192… shape: (33, 2)

Purpose	counts
str	u32
"Communications..."	3602
"Earth Observat..."	1113
"Technology Dev..."	361
"Navigation/Glo..."	139

Purpose	counts
str	u32
"Space Science"	98
"Technology Dem...	40
"Earth Science"	23
"Navigation/Reg...	13
"Surveillance"	12
"Space Observat...	9
"Amateur Radio"	8
"Earth Observat...	7
...	...
"Space Science/...	1
"Signals Intell...	1
"Educational"	1
"Earth Observat...	1
"Platform"	1
"Earth Observat...	1
"Communications...	1
"Earth Observar...	1
"Space Science/...	1
"Earth Science/...	1
"Earth Observat...	1
"Satellite Posi...	1

In [193…

```
# What is the most common class of satellite?

df['Class of Orbit'].value_counts(sort=True)
```

Out[193… shape: (5, 2)

Class of Orbit	counts
str	u32
"LEO"	4700
"GEO"	565
"MEO"	140
"Elliptical"	60

Class of Orbit	counts
str	u32
null	2

In [194…

```
df['Launch Site'].value_counts(sort=True)
```

Out[194… shape: (40, 2)

Launch Site	counts
str	u32
"Cape Canaveral...	2719
"Baikonur Cosmo...	442
"Guiana Space C...	380
"Vandenberg AFB...	338
"Vostochny Cosm...	270
"Satish Dhawan ...	236
"Jiuquan Satell...	193
"Taiyuan Launch...	169
"Xichang Satell...	160
"Plesetsk Cosmo...	134
"Rocket Lab Lau...	86
"Tanegashima Sp...	40
…	…
"Kodiak Launch ...	3
null	3
"FANTM-RAiL (Xt...	3
"Svobodny Cosmo...	2
"Kwajalein Isla...	2
"International ...	2
"Antares"	1
"Stargazer L-10...	1
"Shahroud Missi...	1
"Dragon CRS-17"	1
"Rocket Lab Lau...	1
"Naro Space Cen...	1

In [195…

```
# which countries have launched from Cape Canaveral?

df_launch_site = df.select(['Country of Operator/Owner', 'Launch Site'])

df_launch_site = df_launch_site.filter(pl.col('Launch Site') == 'Cape Canaveral')

df_launch_site['Country of Operator/Owner'].value_counts(sort=True) # expect most to the l
```

Out[195… shape: (44, 2)

Country of Operator/Owner	counts
str	u32
"USA"	2560
"Luxembourg"	15
"Canada"	15
"Switzerland"	12
"Multinational"	11
"Israel"	10
"Argentina"	10
"Finland"	9
"United Kingdom…	8
"Spain"	7
"Taiwan/USA"	6
"Germany"	4
…	…
"Greece"	1
"Netherlands"	1
"ESA/USA"	1
"Japan/Singapor…	1
"USA/Canada"	1
"Egypt"	1
"Kuwait"	1
"Nepal"	1
"Ukraine"	1
"USA/United Kin…	1
"Turkmenistan/M…	1
"ESA"	1

In [196…

```
# where does turkey launch from the most?

df_turkey = df.select(['Country of Operator/Owner', 'Launch Site'])


df_turkey = df_turkey.filter(pl.col('Country of Operator/Owner') == 'Turkey')

df_turkey['Launch Site'].value_counts(sort=True)

# Oh interesting, TR launches from Jiuquan, China? and Satish Dhawan Space Centre, India?
# Let's see what those missions are about.
```

Out[196… shape: (6, 2)

Launch Site	counts
str	u32
"Cape Canaveral…	3
"Guiana Space C…	2
"Baikonur Cosmo…	2
"Jiuquan Satell…	1
"Satish Dhawan …	1
"Dombarovsky Ai…	1

In [197…

```
df.columns
```

Out[197…

```
['Name of Satellite, Alternate Names',
 'Current Official Name of Satellite',
 'Country/Org of UN Registry',
 'Country of Operator/Owner',
 'Operator/Owner',
 'Users',
 'Purpose',
 'Detailed Purpose',
 'Class of Orbit',
 'Type of Orbit',
 'Longitude of GEO (degrees)',
 'Perigee (km)',
 'Apogee (km)',
 'Eccentricity',
 'Inclination (degrees)',
 'Period (minutes)',
 'Launch Mass (kg.)',
 ' Dry Mass (kg.) ',
 'Power (watts)',
 'Date of Launch',
 'Expected Lifetime (yrs.)',
 'Contractor',
 'Country of Contractor',
 'Launch Site',
 'Launch Vehicle',
 'COSPAR Number',
 'NORAD Number',
 'Comments',
 '',
 'Source Used for Orbital Data',
```

```
'Source',
'Source_duplicated_0',
'Source_duplicated_1',
'Source_duplicated_2',
'Source_duplicated_3',
'Source_duplicated_4',
'Source_duplicated_5',
'_duplicated_0',
'_duplicated_1',
'_duplicated_2',
'_duplicated_3',
'_duplicated_4',
'_duplicated_5',
'_duplicated_6',
'_duplicated_7',
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'_duplicated_15',
'_duplicated_16',
'_duplicated_17',
'_duplicated_18',
'_duplicated_19',
'_duplicated_20',
'_duplicated_21',
'_duplicated_22',
'_duplicated_23',
'_duplicated_24',
'_duplicated_25',
'_duplicated_26',
'_duplicated_27',
'_duplicated_28',
'_duplicated_29']
```

In [198…

```
df_why_turkey = df.select(['Name of Satellite, Alternate Names',
 'Current Official Name of Satellite',
 'Country/Org of UN Registry',
 'Country of Operator/Owner',
 'Operator/Owner',
 'Users',
 'Purpose',
 'Detailed Purpose',
 'Class of Orbit',
 'Type of Orbit',
'Date of Launch',
 'Expected Lifetime (yrs.)',
 'Contractor',
 'Country of Contractor',
 'Launch Site',
 'Launch Vehicle',
])


df_why_turkey = df_why_turkey.filter(pl.col('Country of Operator/Owner') == 'Turkey')
```

In [199…

```
# get the line where the launch site is Jiuquan, China
df_why_turkey.filter(pl.col('Launch Site') == 'Jiuquan Satellite Launch Center')
```

Out[199… shape: (1, 16)

Name of Satellite, Alternate Names	Current Official Name of Satellite	Country/Org of UN Registry	Country of Operator/Owner	Operator/Owner	Users	Purpose	Detailed Purpose
str	str	str	str	str	str	str	str
"Göktürk 2"	"Göktürk 2"	"NR"	"Turkey"	"Turkish Minist...	"Military"	"Earth Observat...	"Optical Imagin...

In [200…
```
df_why_turkey.filter(pl.col('Launch Site') == 'Satish Dhawan Space Centre')
```

Out[200… shape: (1, 16)

Name of Satellite, Alternate Names	Current Official Name of Satellite	Country/Org of UN Registry	Country of Operator/Owner	Operator/Owner	Users	Purpose	Detailed Purpose	Cla Orl
str	str	str	str	str	str	str	str	
"ITU-pSAT1 (Ist...	"ITU-pSAT1"	"NR"	"Turkey"	"ITU Space Syst...	"Civil"	"Technology Dev...	null	"LE

In [201…
```
df_why_turkey.filter(pl.col('Launch Site') == 'Dombarovsky Air Base')
```

Out[201… shape: (1, 16)

Name of Satellite, Alternate Names	Current Official Name of Satellite	Country/Org of UN Registry	Country of Operator/Owner	Operator/Owner	Users	Purpose	Detailed Purpose
str	str	str	str	str	str	str	str
"RASAT"	"RASAT"	"Turkey"	"Turkey"	"Space Technolo...	"Government"	"Earth Observat...	"Optical Imagin...

In [202…
```
#Apparently the RASAT had 11 years of service, how many years was it planned for?

rasat = df_why_turkey.filter(pl.col('Name of Satellite, Alternate Names') == 'RASAT')
rasat.select(['Expected Lifetime (yrs.)'])
```

Out[202… shape: (1, 1)

Expected Lifetime (yrs.)
f64
3.0

In [203…
```
# Wow, it was planned for 3 years, but lasted 11 years. That's pretty good.
```

In [204…
```
# search for Georgia Tech satellites

big_df = df.select(['Name of Satellite, Alternate Names', 'Country of Operator/Owner', 'Op

gt_df = big_df.filter(pl.col('Operator/Owner') == 'Georgia Institute of Technology')
```

```
gt_df

# We can see that Georgia Tech has launched 3 satellites. Go Jackets!
```

Out[204… shape: (3, 14)

Name of Satellite, Alternate Names	Country of Operator/Owner	Operator/Owner	Users	Purpose	Detailed Purpose	Class of Orbit	Type of Orbit	
str	str	str	str	str	str	str	str	
"Prox-1 (Nanosa…	"USA"	"Georgia Instit…	"Civil"	"Technology Dev…	null	"LEO"	"Sun-Synchronou…	"6
"RANGE-A (Rangi…	"USA"	"Georgia Instit…	"Civil"	"Technology Dev…	null	"LEO"	"Sun-Synchronou…	"1
"RANGE-B (Rangi…	"USA"	"Georgia Instit…	"Civil"	"Technology Dev…	null	"LEO"	"Sun-Synchronou…	"1

In [205…

```
# what about the University of Georgia?
uga_df = big_df.filter(pl.col('Operator/Owner').str.contains("Georgia"))  # I'm not quite s

uga_df
```

Out[205… shape: (3, 14)

Name of Satellite, Alternate Names	Country of Operator/Owner	Operator/Owner	Users	Purpose	Detailed Purpose	Class of Orbit	Type of Orbit	
str	str	str	str	str	str	str	str	
"Prox-1 (Nanosa…	"USA"	"Georgia Instit…	"Civil"	"Technology Dev…	null	"LEO"	"Sun-Synchronou…	"6
"RANGE-A (Rangi…	"USA"	"Georgia Instit…	"Civil"	"Technology Dev…	null	"LEO"	"Sun-Synchronou…	"1
"RANGE-B (Rangi…	"USA"	"Georgia Instit…	"Civil"	"Technology Dev…	null	"LEO"	"Sun-Synchronou…	"1

In [206…

```
# Nope, no satellites for UGA. I know they're working on a project called MEMESat, but it
# http://www.smallsat.uga.edu/missions
```

In [207…

```
# Does MIT have any satellites as a contractor?

list_of_possible_names_for_mit = ['Massachusetts Institute of Technology', 'MIT', 'Massach

list_of_satellites_for_mit = []
for name in list_of_possible_names_for_mit:
    list_of_satellites_for_mit.append(big_df.filter(pl.col('Contractor').str.contains(name
```

In [208…

```
list_of_satellites_for_mit
```

Out[208…

```
[shape: (1, 14)
┌──────────────┬──────────────┬──────────┬───────┬─────┬──────────┬──────────┬──────────┐
│ Name of      ┆ Country of   ┆ Operator/O ┆ Users ┆ ... ┆ Contract ┆ Country of ┆ Launch   │
│ Satellite,   ┆ Operator/O   ┆ wner       ┆ ---   ┆     ┆ or       ┆ Contractor ┆ Site     │
│ Alternate    ┆ wner         ┆ ---        ┆ str   ┆     ┆ ---      ┆ ---        ┆ ---      │
```

Nam...	---	str			str	str	str
	str						
---	str						
str							

DeMi (Defo	USA	Massachuse	Civil	...	Massachu	USA	Inter
nati	Nanorack						
rmable		tts			setts		onal
	Deployer						
Mirror)		Institute			Institut		Space
		of			e of		Stati
on							
		Techn...			Techn...		

shape: (4, 14)

Name of	Country of	Operator/O	Us	...	Contract	Country of	Launch
Launch							
Satellite,	Operator/O	wner	er		or	Contractor	Site
Vehicle							
Alternate	wner	---	s		---	---	---

Nam...	---	str	--		str	str	str
str							
---	str		-				
str			st				
			r				

MicroMAS-2	USA	MIT/Lincol	Ci	...	MIT/LL-U	USA	Satish
PSLV							
A (Micro-s		n Laborato	vi		M		Dhawan
ized		ry-Univers	l/		Amherst		Space
Microwa...		it...	Go				Centre
			ve				
			rn				
			me				
			nt				

ORS-5 (Ope	USA	USAF /ORSO	Mi	...	MIT	USA	Cape
Minotaur 4							
rationally		(Operation	li		Lincoln		Canavera
l							
Responsive		ally	ta		Laborato		
...		Respon...	ry		ry		

```
┌──────────┬──────────────────────┬──────────────────┬──────┬─────┬──────────────────────┐
│ TESS (Tran ┆ USA          ┆ National    ┆ Go ┆ ... ┆ NASA/MIT ┆ USA          ┆ Cape
  ┆ Falcon 9   │
│ siting     ┆              ┆ Aeronautic ┆ ve ┆     ┆          ┆              ┆ Canavera
l ┆            │
│ Exoplanet  ┆              ┆ s and      ┆ rn ┆     ┆          ┆              ┆
  ┆            │
│ Surve...   ┆              ┆ Space A... ┆ me ┆     ┆          ┆              ┆
  ┆            │
│            ┆              ┆            ┆ nt ┆     ┆          ┆              ┆
  ┆            │
├──────────────────┼──────────────────┼──────┼─────┼──────────┼──────────────┼──────────
──────┼──────────────────────┼──────────────────┼──────┼─────┼──────────┼──────────────┼──────────
│ TROPICS    ┆ USA          ┆ National    ┆ Go ┆ ... ┆ MIT/Godd ┆ USA          ┆ Cape
  ┆ Falcon 9   │
│ Pathfinder ┆              ┆ Aeronautic ┆ ve ┆     ┆ ard      ┆              ┆ Canavera
l ┆            │
│ ( Time-Res ┆              ┆ s and      ┆ rn ┆     ┆ Space    ┆              ┆
  ┆            │
│ olv...     ┆              ┆ Space A... ┆ me ┆     ┆ Flight   ┆              ┆
  ┆            │
│            ┆              ┆            ┆ nt ┆     ┆ Center   ┆              ┆
  ┆            │
└──────────┴──────────────────────┴──────────────────┴──────┴─────┴──────────────────────┘
──────────┘,
 shape: (0, 14)
┌──────────┬──────────────┬──────────┬─────┬─────┬──────────┬──────────┬──────────
──────┐
│ Name of    ┆ Country of ┆ Operator/O ┆ Users ┆ ... ┆ Contract ┆ Country of ┆ Launc
h    ┆ Launch     │
│ Satellite, ┆ Operator/O ┆ wner       ┆ ---   ┆     ┆ or       ┆ Contractor ┆ Site
    ┆ Vehicle    │
│ Alternate  ┆ wner       ┆ ---        ┆ str   ┆     ┆ ---      ┆ ---        ┆ ---
    ┆ ---        │
│ Nam...     ┆ ---        ┆ str        ┆       ┆     ┆ str      ┆ str        ┆ str
    ┆ str        │
│ ---        ┆ str        ┆            ┆       ┆     ┆          ┆            ┆
    ┆            │
│ str        ┆            ┆            ┆       ┆     ┆          ┆            ┆
    ┆            │
╞══════════╪══════════════╪══════════╪═════╪═════╪══════════╪══════════╪══════════
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└──────────┴──────────────┴──────────┴─────┴─────┴──────────┴──────────┴──────────
──────┘,
 shape: (0, 14)
┌──────────┬──────────────┬──────────┬─────┬─────┬──────────┬──────────┬──────────
──────┐
│ Name of    ┆ Country of ┆ Operator/O ┆ Users ┆ ... ┆ Contract ┆ Country of ┆ Launc
h    ┆ Launch     │
│ Satellite, ┆ Operator/O ┆ wner       ┆ ---   ┆     ┆ or       ┆ Contractor ┆ Site
    ┆ Vehicle    │
│ Alternate  ┆ wner       ┆ ---        ┆ str   ┆     ┆ ---      ┆ ---        ┆ ---
    ┆ ---        │
│ Nam...     ┆ ---        ┆ str        ┆       ┆     ┆ str      ┆ str        ┆ str
    ┆ str        │
│ ---        ┆ str        ┆            ┆       ┆     ┆          ┆            ┆
    ┆            │
│ str        ┆            ┆            ┆       ┆     ┆          ┆            ┆
    ┆            │
╞══════════╪══════════════╪══════════╪═════╪═════╪══════════╪══════════╪══════════
══════╡
└──────────┴──────────────┴──────────┴─────┴─────┴──────────┴──────────┴──────────
──────┘]
```

In [209…

```
# convert the list of dataframes to a single dataframe
```

```
mit_df = pl.concat(list_of_satellites_for_mit)
```

In [210…

```
mit_df # MIT has launched 5 satellites as a contractor, but only operates two of them.
```

Out[210… shape: (5, 14)

Name of Satellite, Alternate Names	Country of Operator/Owner	Operator/Owner	Users	Purpose	Detailed Purpose	Class of Orbit
str	str	str	str	str	str	str
"DeMi (Deformab…	"USA"	"Massachusetts …	"Civil"	"Technology Dev…	null	"LEO"
"MicroMAS-2A (M…	"USA"	"MIT/Lincoln La…	"Civil/Governme…	"Earth Observat…	"Earth Science"	"LEO"
"ORS-5 (Operati…	"USA"	"USAF /ORSO (Op…	"Military"	"Technology Dem…	null	"LEO"
"TESS (Transiti…	"USA"	"National Aeron…	"Government"	"Space Science"	null	"Elliptical"
"TROPICS Pathfi…	"USA"	"National Aeron…	"Government"	"Earth Observat…	"Meteorology"	"LEO"