 cognitiveclass.ai logo

SpaceX Falcon 9 first stage Landing Prediction

Lab 1: Collecting the data

Estimated time needed: **45** minutes

In this capstone, we will predict if the Falcon 9 first stage will land successfully. SpaceX advertises Falcon 9 rocket launches on its website with a cost of 62 million dollars; other providers cost upward of 165 million dollars each, much of the savings is because SpaceX can reuse the first stage. Therefore if we can determine if the first stage will land, we can determine the cost of a launch. This information can be used if an alternate company wants to bid against SpaceX for a rocket launch. In this lab, you will collect and make sure the data is in the correct format from an API. The following is an example of a successful and launch.

Several examples of an unsuccessful landing are shown here:

Most unsuccessful landings are planned. Space X performs a controlled landing in the oceans.

Objectives

In this lab, you will make a get request to the SpaceX API. You will also do some basic data wrangling and formating.

- Request to the SpaceX API
- Clean the requested data

Import Libraries and Define Auxiliary Functions

We will import the following libraries into the lab

In [1]:

```
# Requests allows us to make HTTP requests which we will use to get data from an API
import requests
# Pandas is a software library written for the Python programming language for data man
ipulation and analysis.
import pandas as pd
# NumPy is a library for the Python programming language, adding support for large, mul
ti-dimensional arrays and matrices, along with a large collection of high-level mathema
tical functions to operate on these arrays
import numpy as np
# Datetime is a library that allows us to represent dates
import datetime

# Setting this option will print all collumns of a dataframe
pd.set_option('display.max_columns', None)
# Setting this option will print all of the data in a feature
pd.set_option('display.max_colwidth', None)
```

Below we will define a series of helper functions that will help us use the API to extract information using identification numbers in the launch data.

From the `rocket` column we would like to learn the booster name.

In [2]:

```
# Takes the dataset and uses the rocket column to call the API and append the data to t
he list
def getBoosterVersion(data):
    for x in data['rocket']:
        response = requests.get("https://api.spacexdata.com/v4/rockets/"+str(x)).json()
        BoosterVersion.append(response['name'])
```

From the `launchpad` we would like to know the name of the launch site being used, the logitude, and the latitude.

In [3]:

```
# Takes the dataset and uses the launchpad column to call the API and append the data t
o the list
def getLaunchSite(data):
    for x in data['launchpad']:
        response = requests.get("https://api.spacexdata.com/v4/launchpads/"+str(x)).jso
n()
        Longitude.append(response['longitude'])
        Latitude.append(response['latitude'])
        LaunchSite.append(response['name'])
```

From the `payload` we would like to learn the mass of the payload and the orbit that it is going to.

In [4]:

```
# Takes the dataset and uses the payloads column to call the API and append the data to
the lists
def getPayloadData(data):
    for load in data['payloads']:
        response = requests.get("https://api.spacexdata.com/v4/payloads/"+load).json()
        PayloadMass.append(response['mass_kg'])
        Orbit.append(response['orbit'])
```

From `cores` we would like to learn the outcome of the landing, the type of the landing, number of flights with that core, whether gridfins were used, wheter the core is reused, wheter legs were used, the landing pad used, the block of the core which is a number used to seperate version of cores, the number of times this specific core has been reused, and the serial of the core.

In [5]:

```
# Takes the dataset and uses the cores column to call the API and append the data to th
e lists
def getCoreData(data):
    for core in data['cores']:
            if core['core'] != None:
                response = requests.get("https://api.spacexdata.com/v4/cores/"+core['co
re']).json()
                Block.append(response['block'])
                ReusedCount.append(response['reuse_count'])
                Serial.append(response['serial'])
            else:
                Block.append(None)
                ReusedCount.append(None)
                Serial.append(None)
            Outcome.append(str(core['landing_success'])+' '+str(core['landing_type']))
            Flights.append(core['flight'])
            GridFins.append(core['gridfins'])
            Reused.append(core['reused'])
            Legs.append(core['legs'])
            LandingPad.append(core['landpad'])
```

Now let's start requesting rocket launch data from SpaceX API with the following URL:

In [6]:

```
spacex_url="https://api.spacexdata.com/v4/launches/past"
```

In [7]:

```
response = requests.get(spacex_url)
```

Check the content of the response

In [8]:

```
print(response.content)
```

b'[{"fairings":{"reused":false,"recovery_attempt":false,"recovered":fals
e,"ships":[]},"links":{"patch":{"small":"https://images2.imgbox.com/3c/0e/
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h.html","wikipedia":"https://en.wikipedia.org/wiki/DemoSat"},"static_fire_
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g to premature engine shutdown"}],"details":"Successful first stage burn a
nd transition to second stage, maximum altitude 289 km, Premature engine s
hutdown at T+7 min 30 s, Failed to reach orbit, Failed to recover first st
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ting vehicle safety rules, and the primary payload owner\'s contractual ri
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to perform an ocean touchdown test of the discarded booster vehicle. The t
est provided good test data on the experiment-its primary objective-but as
the booster neared the ocean, aerodynamic forces caused an uncontrollable
roll. The center engine, depleted of fuel by centrifugal force, shut down
resulting in the impact and destruction of the vehicle.","crew":[],"ship
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-falcon-9-v1-1-milestone-ses-8-launch/","wikipedia":"https://en.wikipedia.
org/wiki/SES-8"},"static_fire_date_utc":"2013-11-22T06:26:00.000Z","static
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s":[],"details":"Second GTO launch for Falcon 9. The USAF evaluated launch
data from this flight as part of a separate certification program for Spac
eX to qualify to fly U.S. military payloads and found that the Thaicom 6 l
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cond burnoff\\"","crew":[],"ships":[],"capsules":[],"payloads":["5eb0e4bbb
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m/7617/16855338881_69542a2fa9_o.jpg"]},"presskit":"http://www.spacex.com/s
ites/spacex/files/spacexcrs-3_presskit_042014.pdf","webcast":"https://www.
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ps://newatlas.com/crs-3-launch-spacex/31671/","wikipedia":"https://en.wiki
pedia.org/wiki/SpaceX_CRS-3"},"static_fire_date_utc":"2014-03-08T00:00:00.
000Z","static_fire_date_unix":1394236800,"net":false,"window":0,"rocke
t":"5e9d0d95eda69973a809d1ec","success":true,"failures":[],"details":"Foll
owing second-stage separation, SpaceX conducted a second controlled-descen
t test of the discarded booster vehicle and achieved the first successful
controlled ocean touchdown of a liquid-rocket-engine orbital booster. Foll
owing touchdown the first stage tipped over as expected and was destroyed.
This was the first Falcon 9 booster to fly with extensible landing legs an
d the first Dragon mission with the Falcon 9 v1.1 launch vehicle.","crew":
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ticle":"https://www.nasa.gov/press/2014/september/nasa-cargo-launches-to-s
pace-station-aboard-spacex-resupply-mission-0","wikipedia":"https://en.wik
ipedia.org/wiki/SpaceX_CRS-4"},"static_fire_date_utc":"2014-09-17T00:00:0
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7x-SumbynI","article":"https://spaceflightnow.com/2015/01/10/dragon-succes
sfully-launched-rocket-recovery-demo-crash-lands/","wikipedia":"https://e
n.wikipedia.org/wiki/SpaceX_CRS-5"},"static_fire_date_utc":"2014-12-19T00:
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llowing second stage separation, SpaceX performed a test flight which atte
mpted to return the first stage of the Falcon 9 through the atmosphere and
land it on an approximately 90-by-50-meter (300 ft x 160 ft) floating plat
form-called the autonomous spaceport drone ship. Many of the test objectiv
es were achieved, including precision control of the rocket\'s descent to
land on the platform at a specific point in the Atlantic ocean, and a larg
e amount of test data was obtained from the first use of grid fin control
surfaces used for more precise reentry positioning. The grid fin control s
ystem ran out of hydraulic fluid a minute before landing and the landing i
tself resulted in a crash.","crew":[],"ships":["5ea6ed2e080df4000697c90
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outube.com/watch?v=OvHJSIKP0Hg","youtube_id":"OvHJSIKP0Hg","article":"http
s://spaceflightnow.com/2015/02/12/space-weather-observatory-blasts-off-aft
er-17-year-wait/","wikipedia":"https://en.wikipedia.org/wiki/Deep_Space_Cl
imate_Observatory"},"static_fire_date_utc":"2015-01-31T00:00:00.000Z","sta
tic_fire_date_unix":1422662400,"net":false,"window":0,"rocket":"5e9d0d95ed
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USAF\'s OSP 3 launch contract. First SpaceX launch to put a satellite to a
n orbit with an orbital altitude many times the distance to the Moon: Sun-
Earth libration point L1. The first stage made a test flight descent to an
over-ocean landing within 10 m (33 ft) of its intended target.","crew":
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edia":"https://www.reddit.com/r/spacex/comments/2xmumx","recovery":nul
l},"flickr":{"small":[],"original":["https://farm9.staticflickr.com/8749/1

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_o.jpg","https://farm8.staticflickr.com/7618/16601658850_13b826e705_o.jp
g","https://farm9.staticflickr.com/8617/16510041628_883af57512_o.jpg"]},"p
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d":"mN7lyaCBzT8","article":"https://www.space.com/28702-spacex-rocket-laun
ches-satellites-video.html","wikipedia":"https://en.wikipedia.org/wiki/ABS
-3A"},"static_fire_date_utc":"2015-02-25T19:10:00.000Z","static_fire_date_
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c","success":true,"failures":[],"details":"The launch was Boeing\'s first-
ever conjoined launch of a lighter-weight dual-commsat stack that was spec
ifically designed to take advantage of the lower-cost SpaceX Falcon 9 laun
ch vehicle. Per satellite, launch costs were less than $30 million. The AB
S satellite reached its final destination ahead of schedule and started op
erations on September 10.","crew":[],"ships":[],"capsules":[],"payloads":
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resskit":"https://www.nasa.gov/sites/default/files/files/SpaceX_NASA_CRS-6
_PressKit.pdf","webcast":"https://www.youtube.com/watch?v=csVpa25iqH0","yo
utube_id":"csVpa25iqH0","article":"https://spaceflightnow.com/2015/04/14/f
alcon-9-successfully-launches-descends-to-off-balance-landing/","wikipedi
a":"https://en.wikipedia.org/wiki/SpaceX_CRS-6"},"static_fire_date_utc":"2
015-04-11T00:00:00.000Z","static_fire_date_unix":1428710400,"net":false,"w
indow":0,"rocket":"5e9d0d95eda69973a809d1ec","success":true,"failures":
[],"details":"Following the first-stage boost, SpaceX attempted a controll
ed-descent test of the first stage. The first stage contacted the ship, bu
t soon tipped over due to excess lateral velocity caused by a stuck thrott
le valve resulting in a later-than-intended downthrottle.","crew":[],"ship
s":["5ea6ed2e080df4000697c906","5ea6ed2f080df4000697c90b","5ea6ed2f080df40
00697c90c","5ea6ed2f080df4000697c90f","5ea6ed30080df4000697c912"],"capsule
s":["5e9e2c5cf359188bfb3b266b"],"payloads":["5eb0e4bdb6c3bb0006eeb1fa"],"l
aunchpad":"5e9e4501f509094ba4566f84","flight_number":22,"name":"CRS-6","da
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f56_o.jpg","https://farm9.staticflickr.com/8739/17140415959_38b5ee8bc6_o.j
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g"]},"presskit":"http://www.spacex.com/sites/spacex/files/spacexthalesfact
sheet_final.pdf","webcast":"https://www.youtube.com/watch?v=nBwAYT_ogj
4","youtube_id":"nBwAYT_ogj4","article":"https://spaceflightnow.com/2015/0
4/28/falcon-9-rocket-powers-into-space-with-satellite-for-turkmenista
n/","wikipedia":"https://en.wikipedia.org/wiki/T%C3%BCrkmen%C3%84lem_52%C
2%B0E_/_MonacoSAT"},"static_fire_date_utc":"2015-04-22T11:11:00.000Z","sta
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3\x84lem 52\xc2\xb0E / MonacoSAT","date_utc":"2015-04-27T23:03:00.000Z","d
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ion":"hour","upcoming":false,"cores":[{"core":"5e9e28a1f35918233f3b263
9","flight":1,"gridfins":false,"legs":false,"reused":false,"landing_attemp
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flickr.com/287/18999110808_6e153fed64_o.jpg"]},"presskit":"https://www.nas
a.gov/sites/default/files/atoms/files/spacex_nasa_crs-7_presskit.pdf","web
cast":"https://www.youtube.com/watch?v=PuNymhcTtSQ","youtube_id":"PuNymhcT
tSQ","article":"https://spaceflightnow.com/2015/06/28/falcon-9-rocket-dest
royed-in-launch-mishap/","wikipedia":"https://en.wikipedia.org/wiki/SpaceX
_CRS-7"},"static_fire_date_utc":"2015-06-26T05:00:00.000Z","static_fire_da
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1ec","success":false,"failures":[{"time":139,"altitude":40,"reason":"heliu
m tank overpressure lead to the second stage LOX tank explosion"}],"detail
s":"Launch performance was nominal until an overpressure incident in the s
econd-stage LOX tank, leading to vehicle breakup at T+150 seconds. The Dra
gon capsule survived the explosion but was lost upon splashdown because it
s software did not contain provisions for parachute deployment on launch v
ehicle failure.","crew":[],"ships":["5ea6ed2e080df4000697c906","5ea6ed2f08
0df4000697c90b","5ea6ed2f080df4000697c90c"],"capsules":["5e9e2c5cf35918407
d3b266c"],"payloads":["5eb0e4beb6c3bb0006eeb1fc"],"launchpad":"5e9e4501f50
9094ba4566f84","flight_number":24,"name":"CRS-7","date_utc":"2015-06-28T1
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ing_attempt":true,"landing_success":null,"landing_type":"ASDS","landpa
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www.reddit.com/r/spacex/comments/3xm83h/","recovery":null},"flickr":{"smal
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r.com/5723/23785609832_83038751d1_o.jpg","https://farm1.staticflickr.com/7
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s/spacex/files/spacex_orbcomm_press_kit_final2.pdf","webcast":"https://ww
w.youtube.com/watch?v=O5bTbVbe4e4","youtube_id":"O5bTbVbe4e4","article":"h
ttps://spaceflightnow.com/2015/12/22/round-trip-rocket-flight-gives-spacex
-a-trifecta-of-successes/","wikipedia":"https://en.wikipedia.org/wiki/Falc
on_9_flight_20"},"static_fire_date_utc":"2015-12-19T00:09:00.000Z","static
_fire_date_unix":1450483740,"net":false,"window":0,"rocket":"5e9d0d95eda69
973a809d1ec","success":true,"failures":[],"details":"Total payload mass wa
s 2,034 kg (4,484 lb) : 11 satellites weighing 172 kg each, plus a 142-kg
mass simulator. This was the first launch of the upgraded v1.1 variant (la
ter called Falcon 9 Full Thrust), with a 30 percent power increase. Orbcom
m had originally agreed to be the third flight of the enhanced-thrust rock
et, but the change to the maiden flight position was announced in October
2015. SpaceX received a permit from the FAA to land the booster on solid g
round at Cape Canaveral, and succeeded.","crew":[],"ships":[],"capsules":
[],"payloads":["5eb0e4beb6c3bb0006eeb1fd"],"launchpad":"5e9e4501f509094ba4
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rary_id":null,"id":"5eb87cefffd86e000604b342"},{"fairings":{"reused":fals
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s://images2.imgbox.com/71/59/j489OwAI_o.png"},"reddit":{"campaign":null,"l
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www.reddit.com/r/spacex/comments/41cvdm","recovery":null},"flickr":{"smal
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arm2.staticflickr.com/1508/24127011190_92ef932c96_o.jpg","https://farm2.st
aticflickr.com/1591/23778325594_08231286fc_o.jpg","https://farm2.staticfli
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x.com/sites/spacex/files/spacex_jason3_press_kit.pdf","webcast":"https://w
ww.youtube.com/watch?v=ivdKRJzl6y0","youtube_id":"ivdKRJzl6y0","articl
e":"https://spaceflightnow.com/2016/01/18/satellite-launched-to-measure-mo
tions-of-the-oceans/","wikipedia":"https://en.wikipedia.org/wiki/Jason-
3"},"static_fire_date_utc":"2016-01-11T18:42:00.000Z","static_fire_date_un
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c","success":true,"failures":[],"details":"First launch of NASA and NOAA j
oint science mission under the NLS II launch contract (not related to NASA
CRS or USAF OSP3 contracts). Last launch of the original Falcon 9 v1.1 lau
nch vehicle. The Jason-3 satellite was successfully deployed to target orb
it. SpaceX again attempted a recovery of the first stage booster by landin
g on an autonomous drone ship; this time located in the Pacific Ocean. The
first stage did achieve a soft-landing on the ship, but a lockout on one o
f the landing legs failed to latch, so that the booster fell over and expl
oded.","crew":[],"ships":["5ea6ed2f080df4000697c910","5ea6ed30080df4000697
c912","5ea6ed30080df4000697c914"],"capsules":[],"payloads":["5eb0e4beb6c3b
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ame":"Jason 3","date_utc":"2016-01-17T15:42:00.000Z","date_unix":145304532
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ng":false,"cores":[{"core":"5e9e28a1f3591842fa3b263c","flight":1,"gridfin
s":true,"legs":true,"reused":false,"landing_attempt":true,"landing_succes
s":false,"landing_type":"ASDS","landpad":"5e9e3033383ecbb9e534e7cc"}],"aut
o_update":true,"tbd":false,"launch_library_id":null,"id":"5eb87cf0ffd86e00
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_o.png"},"reddit":{"campaign":null,"launch":"https://www.reddit.com/r/spac
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ticflickr.com/1550/24585667074_aa712b13a8_o.jpg"]},"presskit":"http://www.
spacex.com/sites/spacex/files/spacex_ses9_press_kit_final.pdf","webcas
t":"https://www.youtube.com/watch?v=muDPSyO7-A0","youtube_id":"muDPSyO7-A
0","article":"https://spaceflightnow.com/2016/03/05/tv-broadcasting-satell
ite-finally-launched-on-falcon-9/","wikipedia":"https://en.wikipedia.org/w
iki/SES-9"},"static_fire_date_utc":"2016-10-02T14:11:00.000Z","static_fire
_date_unix":1475417460,"net":false,"window":5400,"rocket":"5e9d0d95eda6997
3a809d1ec","success":true,"failures":[],"details":"Second launch of the en
hanced Falcon 9 Full Thrust launch vehicle. Following the launch, SpaceX a
ttempted an experimental landing test to a drone ship, although a successf
ul landing was not expected because launch mass exceeded previously indica
ted limit for a GTO there was little fuel left. As predicted, booster reco
very failed: the spent first stage \\"landed hard\\", but the controlled-d
escent, atmospheric re-entry and navigation to the drone ship were success
ful and returned significant test data on bringing back high-energy Falcon
9s.","crew":[],"ships":["5ea6ed2e080df4000697c906","5ea6ed2f080df4000697c9
0b","5ea6ed2f080df4000697c90c","5ea6ed30080df4000697c913"],"capsules":
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566f84","flight_number":27,"name":"SES-9","date_utc":"2016-03-04T23:35:00.
000Z","date_unix":1457134500,"date_local":"2016-03-04T19:35:00-04:00","dat
e_precision":"hour","upcoming":false,"cores":[{"core":"5e9e28a1f359188def3
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reddit.com/r/spacex/comments/4dtpxn/","recovery":"https://www.reddit.com/
r/spacex/comments/4ee2zy"},"flickr":{"small":[],"original":["https://farm
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ticflickr.com/1495/25916886442_821a152917_o.jpg"]},"presskit":"http://www.
spacex.com/sites/spacex/files/spacex_crs8_press_kit.pdf","webcast":"http
s://www.youtube.com/watch?v=7pUAydjne5M","youtube_id":"7pUAydjne5M","artic
le":"https://spaceflightnow.com/2016/04/08/spacex-lands-rocket-on-floating
-platform-after-station-resupply-launch/","wikipedia":"https://en.wikipedi
a.org/wiki/SpaceX_CRS-8"},"static_fire_date_utc":"2016-04-05T00:00:00.000

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ied over 1500 kg of supplies and delivered (stowed in its trunk) the infla
table Bigelow Expandable Activity Module (BEAM) to the ISS for two years o
f in-orbit tests. The rocket\'s first stage landed smoothly on SpaceX\'s a
utonomous spaceport drone ship 9 minutes after liftoff, making this the fi
rst ever successful landing of a rocket booster on a ship at sea as part o
f an orbital launch. The first stage B1021 was later also the first orbita
l booster to be used again, when launching SES-10 on March 30, 2017.","cre
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05/06/falcon-9-succeeds-in-middle-of-the-night-launch/","wikipedia":"http
s://en.wikipedia.org/wiki/JCSAT-2B"},"static_fire_date_utc":"2016-05-01T2
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fect JSAT Corp. JCSAT 14 will support data networks, television broadcaste
rs and mobile communications users in Japan, East Asia, Russia, Oceania, H
awaii and other Pacific islands. This was the first time a booster success
fully landed after a GTO mission.","crew":[],"ships":["5ea6ed2e080df400069
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station-lands-another-falcon-rocket/","wikipedia":"https://en.wikipedia.or
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o, an International Docking Adapter (IDA-2) was carried to the ISS. This m
ission had a successful first-stage landing at Cape Canaveral.*Including t
he reusable Dragon Capsule, total payload to orbit was 6457 kg.","crew":
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t":"https://www.youtube.com/watch?v=QZTCEO0gvLo","youtube_id":"QZTCEO0gvL

o","article":"https://spaceflightnow.com/2016/08/14/falcon-9-rocket-launches-japanese-satellite-then-nails-bullseye-landing/","wikipedia":"https://en.wikipedia.org/wiki/JCSAT-16"},"static_fire_date_utc":"2016-08-11T04:01:00.000Z","static_fire_date_unix":1470888060,"net":false,"window":7200,"rocket":"5e9d0d95eda69973a809d1ec","success":true,"failures":[],"details":"First attempt to touch down from a ballistic trajectory using a single-engine landing burn. All previous landings from a ballistic trajectory had fired three engines on the landing-burn, which provided more braking force, but subjected the vehicle to greater structural stresses. The single-engine landing burn takes more time and fuel, but puts less stress on the vehicle.","crew":[],"ships":["5ea6ed2e080df4000697c906","5ea6ed2f080df4000697c90b","5ea6ed2f080df4000697c90c","5ea6ed30080df4000697c913"],"capsules":[],"payloads":["5eb0e4c1b6c3bb0006eeb206"],"launchpad":"5e9e4501f509094ba4566f84","flight_number":33,"name":"JCSAT-16","date_utc":"2016-08-14T05:26:00.000Z","date_unix":1471152360,"date_local":"2016-08-14T01:26:00-04:00","date_precision":"hour","upcoming":false,"cores":[{"core":"5e9e28a2f35918b8243b2643","flight":1,"gridfins":true,"legs":true,"reused":false,"landing_attempt":true,"landing_success":true,"landing_type":"ASDS","landpad":"5e9e3032383ecb6bb234e7ca"}],"auto_update":true,"tbd":false,"launch_library_id":null,"id":"5eb87cfaffd86e000604b34a"},{"fairings":{"reused":false,"recovery_attempt":false,"recovered":false,"ships":[]},"links":{"patch":{"small":"https://imgur.com/OADkTym.png","large":"https://imgur.com/2F5PYz5.png"},"reddit":{"campaign":"https://www.reddit.com/r/spacex/comments/4pv7jl","launch":null,"media":null,"recovery":null},"flickr":{"small":[],"original":[]},"presskit":null,"webcast":"https://www.youtube.com/watch?v=_BgJEXQkjNQ","youtube_id":"_BgJEXQkjNQ","article":"https://spaceflightnow.com/2016/09/01/spacex-rocket-and-israeli-satellite-destroyed-in-launch-pad-explosion/","wikipedia":"https://en.wikipedia.org/wiki/Amos-6"},"static_fire_date_utc":"2016-09-01T13:07:00.000Z","static_fire_date_unix":1472735220,"net":false,"window":null,"rocket":"5e9d0d95eda69973a809d1ec","success":false,"failures":[{"time":-165180,"altitude":0,"reason":"buckled liner in several of the COPV tanks, causing perforations that allowed liquid and/or solid oxygen to accumulate underneath the lining, which was ignited by friction."}],"details":"The rocket and Amos-6 payload were lost in a launch pad explosion on September 1, 2016 during propellant fill prior to a static fire test. The pad was clear of personnel and there were no injuries.","crew":[],"ships":[],"capsules":[],"payloads":["5eb0e4c1b6c3bb0006eeb207"],"launchpad":"5e9e4501f509094ba4566f84","flight_number":34,"name":"Amos-6","date_utc":"2016-09-01T13:07:00.000Z","date_unix":1472735220,"date_local":"2016-09-01T09:07:00-04:00","date_precision":"hour","upcoming":false,"cores":[{"core":"5e9e28a2f359187ee83b2644","flight":1,"gridfins":true,"legs":true,"reused":false,"landing_attempt":true,"landing_success":null,"landing_type":"ASDS","landpad":"5e9e3032383ecb6bb234e7ca"}],"auto_update":true,"tbd":false,"launch_library_id":null,"id":"5eb87cfbffd86e000604b34b"},{"fairings":{"reused":false,"recovery_attempt":false,"recovered":false,"ships":[]},"links":{"patch":{"small":"https://images2.imgbox.com/a6/e8/5PyY296y_o.png","large":"https://images2.imgbox.com/ab/b8/USCniUHy_o.png"},"reddit":{"campaign":"https://www.reddit.com/r/spacex/comments/5dii6z","launch":"https://www.reddit.com/r/spacex/comments/5nsaqm","media":"https://www.reddit.com/r/spacex/comments/5nsico","recovery":"https://www.reddit.com/r/spacex/comments/5oe9kk"},"flickr":{"small":[],"original":["https://farm1.staticflickr.com/658/32394688795_55a9873ea7_o.jpg","https://farm1.staticflickr.com/506/32394688095_a3339f3c6d_o.jpg","https://farm1.staticflickr.com/745/32394687645_63ae2b4740_o.jpg","https://farm1.staticflickr.com/318/31548291014_e3a30abca8_o.jpg","https://farm1.staticflickr.com/670/32351549066_e9cffe8d2b_o.jpg","https://farm6.staticflickr.com/5518/31579784413_83aeac560a_o.jpg","https://farm6.staticflickr.com/5556/32312421135_22c197c156_o.jpg","https://farm1.staticflickr.com/529/32312420015_5d2403a847_o.jpg","https://farm1.staticflickr.com/435/32312417695_19c0e50c4b_o.jpg","https://farm1.staticflickr.com/735/32312416415_b90892af0a_o.jpg","https://farm1.staticflickr.com/293/32312415025_cae16d1994_o.jpg","https://farm1.staticflickr.

com/738/31467130724_92e02c9524_o.jpg","https://farm1.staticflickr.com/464/31467130374_9f7a7d380e_o.jpg","https://farm1.staticflickr.com/581/31467129424_bac77d594a_o.jpg","https://farm1.staticflickr.com/380/32308163845_c1731a4b1f_o.jpg","https://farm1.staticflickr.com/447/31450835954_72ed10a19e_o.jpg","https://farm1.staticflickr.com/507/31450834974_b8a3f4aca5_o.jpg"]},"presskit":"https://drive.google.com/open?id=0BwA3a65ef1OvZC1aU3FuMlQzalE","webcast":"https://www.youtube.com/watch?v=7WimRhydggo","youtube_id":"7WimRhydggo","article":"https://spaceflightnow.com/2017/01/14/spacex-resumes-flights-with-on-target-launch-for-iridium/","wikipedia":"https://en.wikipedia.org/wiki/Iridium_satellite_constellation#Next-generation_constellation"},"static_fire_date_utc":"2017-01-05T19:40:00.000Z","static_fire_date_unix":1483645200,"net":false,"window":0,"rocket":"5e9d0d95eda69973a809d1ec","success":true,"failures":[],"details":"Return-to-flight mission after the loss of Amos-6 in September 2016. Iridium NEXT will replace the original Iridium constellation, launched in the late 1990s. Each Falcon mission will carry 10 satellites, with a goal to complete deployment of the 66 plus 9 spare satellite constellation by mid 2018. The first two Iridium qualification units were supposed to ride a Dnepr rocket in April 2016 but were delayed, so Iridium decided to qualify the first batch of 10 satellites instead.","crew":[],"ships":["5ea6ed2f080df4000697c910","5ea6ed30080df4000697c912","5ea6ed30080df4000697c915"],"capsules":[],"payloads":["5eb0e4c2b6c3bb0006eeb208"],"launchpad":"5e9e4502f509092b78566f87","flight_number":35,"name":"Iridium NEXT Mission 1","date_utc":"2017-01-14T17:54:00.000Z","date_unix":1484416440,"date_local":"2017-01-14T10:54:00-07:00","date_precision":"hour","upcoming":false,"cores":[{"core":"5e9e28a3f359189e3a3b2645","flight":1,"gridfins":true,"legs":true,"reused":false,"landing_attempt":true,"landing_success":true,"landing_type":"ASDS","landpad":"5e9e3033383ecbb9e534e7cc"}],"auto_update":true,"tbd":false,"launch_library_id":null,"id":"5eb87cfdffd86e000604b34c"},{"fairings":null,"links":{"patch":{"small":"https://images2.imgbox.com/d3/08/7YmXiSOQ_o.png","large":"https://images2.imgbox.com/02/52/hp8DpyGM_o.png"},"reddit":{"campaign":"https://www.reddit.com/r/spacex/comments/5n2eqx","launch":"https://www.reddit.com/r/spacex/comments/5uw4bh","media":"https://www.reddit.com/r/spacex/comments/5uoy8o","recovery":"https://www.reddit.com/r/spacex/comments/609aq4"},"flickr":{"small":[],"original":["https://farm3.staticflickr.com/2815/32761844973_d2e8d76e9c_o.jpg","https://farm4.staticflickr.com/3878/32761843663_8e366494f4_o.jpg","https://farm3.staticflickr.com/2790/32852846842_6f1f7b26b9_o.jpg","https://farm3.staticflickr.com/2295/32852845662_e7ae0daf4a_o.jpg","https://farm4.staticflickr.com/3888/33000639155_2a6e2bb23d_o.jpg","https://farm1.staticflickr.com/405/33000638185_b4ec7c7b93_o.jpg","https://farm1.staticflickr.com/574/32874779241_9f463de901_o.jpg","https://farm4.staticflickr.com/3710/32153433074_96337a54db_o.jpg","https://farm1.staticflickr.com/327/32153432924_09dd1482d8_o.jpg","https://farm3.staticflickr.com/2881/32183025803_36bf976b9e_o.jpg","https://farm3.staticflickr.com/2362/32183025493_2a37b4e22c_o.jpg","https://farm1.staticflickr.com/504/32178458813_ff47f61bb9_o.jpg","https://farm1.staticflickr.com/265/32176806823_879ccc5da0_o.jpg","https://farm1.staticflickr.com/401/32866357531_69c6d289ed_o.jpg","https://farm3.staticflickr.com/2105/32945170805_553d45ca56_o.jpg","https://farm4.staticflickr.com/3865/32945170225_58129f00dc_o.jpg"]},"presskit":"http://www.spacex.com/sites/spacex/files/crs10presskitfinal.pdf","webcast":"https://www.youtube.com/watch?v=giNhaEzv_PI","youtube_id":"giNhaEzv_PI","article":"https://spaceflightnow.com/2017/02/19/historic-launch-pad-back-in-service-with-thundering-blastoff-by-spacex/","wikipedia":"https://en.wikipedia.org/wiki/SpaceX_CRS-10"},"static_fire_date_utc":"2017-02-12T21:30:00.000Z","static_fire_date_unix":1486935000,"net":false,"window":0,"rocket":"5e9d0d95eda69973a809d1ec","success":true,"failures":[],"details":"First Falcon 9 flight from the historic LC-39A launchpad at Kennedy Space Center, carrying supplies and materials to support dozens of science and research investigations scheduled during ISS Expeditions 50 and 51. The first stage returned to launch site and landed at LZ-1.","crew":[],"ships":["5ea6ed30080df4000697c912"],"capsules":["5e9e2c5cf359185d753b266f"],"p

ayloads":["5eb0e4c3b6c3bb0006eeb209"],"launchpad":"5e9e4502f509094188566f8
8","flight_number":36,"name":"CRS-10","date_utc":"2017-02-19T14:39:00.000
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46","flight":1,"gridfins":true,"legs":true,"reused":false,"landing_attemp
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m/r/spacex/comments/5n2e10/echostar_23_launch_campaign_thread/","launc
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_echostar23_official_launch/","media":"https://www.reddit.com/r/spacex/com
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9/33094074350_ae56bd5c73_o.jpg","https://farm3.staticflickr.com/2935/33094
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1a85e82ba_o.jpg","https://farm3.staticflickr.com/2876/33094072100_546090a4
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p://www.spacex.com/sites/spacex/files/echostarxxiiifinal.pdf","webcast":"h
ttps://www.youtube.com/watch?v=lZmqbL-hz7U","youtube_id":"lZmqbL-hz7U","ar
ticle":"http://spacenews.com/spacex-launches-echostar-23/","wikipedia":"ht
tps://en.wikipedia.org/wiki/EchoStar#Satellite_fleet"},"static_fire_date_u
tc":"2017-03-09T23:00:00.000Z","static_fire_date_unix":1489100400,"net":fa
lse,"window":9000,"rocket":"5e9d0d95eda69973a809d1ec","success":true,"fail
ures":[],"details":"Communications satellite for EchoStar Corp. EchoStar X
XIII, based on a spare platform from the cancelled CMBStar 1 satellite pro
gram, will provide direct-to-home television broadcast services over Brazi
l. There was no attempt at a first-stage recovery so this rocket did not h
ave landing legs or grid fins.","crew":[],"ships":[],"capsules":[],"payloa
ds":["5eb0e4c3b6c3bb0006eeb20a"],"launchpad":"5e9e4502f509094188566f88","f
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cex/comments/62aqi7/rspacex_ses10_official_launch_discussion_updates/","me
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kr.com/3775/32915200224_b6ecfabd7e_o.jpg","https://farm4.staticflickr.com/
3886/32915199874_b826eac153_o.jpg","https://farm3.staticflickr.com/2842/32
915199514_6c44178e87_o.jpg","https://farm4.staticflickr.com/3771/329151989
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o.jpg","https://farm4.staticflickr.com/3830/33616913981_f04b6e2351_o.jp
g","https://farm4.staticflickr.com/3819/33616913111_e699b48d66_o.jpg","htt

ps://farm4.staticflickr.com/3835/33361035860_c57ed61239_o.jpg","https://farm4.staticflickr.com/3783/33361035200_bfb797d38f_o.jpg","https://farm4.staticflickr.com/3698/33611796351_54d5a6d65a_o.jpg","https://farm3.staticflickr.com/2857/33611795531_82cc2d8789_o.jpg"]},"presskit":"http://www.spacex.com/sites/spacex/files/finalses10presskit.pdf","webcast":"https://www.youtube.com/watch?v=xsZSXav4wI8","youtube_id":"xsZSXav4wI8","article":"https://spaceflightnow.com/2017/03/31/spacex-flies-rocket-for-second-time-in-historic-test-of-cost-cutting-technology/","wikipedia":"https://en.wikipedia.org/wiki/SES-10"},"static_fire_date_utc":"2017-03-27T18:00:00.000Z","static_fire_date_unix":1490637600,"net":false,"window":9000,"rocket":"5e9d0d95eda69973a809d1ec","success":true,"failures":[],"details":"First payload to fly on a reused first stage, B1021, previously launched with CRS-8, which also landed a second time. In what is also a first, the payload fairing remained intact after a successful splashdown achieved with thrusters and a steerable parachute.","crew":[],"ships":["5ea6ed2e080df4000697c906","5ea6ed2f080df4000697c90b","5ea6ed2f080df4000697c90c","5ea6ed30080df4000697c913"],"capsules":[],"payloads":["5eb0e4c3b6c3bb0006eeb20b"],"launchpad":"5e9e4502f509094188566f88","flight_number":38,"name":"SES-10","date_utc":"2017-03-30T22:27:00.000Z","date_unix":1490912820,"date_local":"2017-03-30T18:27:00-04:00","date_precision":"hour","upcoming":false,"cores":[{"core":"5e9e28a2f359182d0b3b263e","flight":2,"gridfins":true,"legs":true,"reused":true,"landing_attempt":true,"landing_success":true,"landing_type":"ASDS","landpad":"5e9e3032383ecb6bb234e7ca"}],"auto_update":true,"tbd":false,"launch_library_id":null,"id":"5eb87d00ffd86e000604b34f"},{"fairings":{"reused":false,"recovery_attempt":false,"recovered":false,"ships":[]},"links":{"patch":{"small":"https://images2.imgbox.com/0d/06/aNPEVF72_o.png","large":"https://images2.imgbox.com/8e/6e/dM1L8DMs_o.png"},"reddit":{"campaign":"https://www.reddit.com/r/spacex/comments/601ykx","launch":"https://www.reddit.com/r/spacex/comments/68bn8y/","media":"https://www.reddit.com/r/spacex/comments/68bpii","recovery":null},"flickr":{"small":[],"original":["https://farm3.staticflickr.com/2922/33578359423_4169ac8f98_o.jpg","https://farm3.staticflickr.com/2900/33578357343_85c247ebce_o.jpg","https://farm5.staticflickr.com/4166/34006001860_8c45f28e69_o.jpg","https://farm5.staticflickr.com/4166/34005999880_77684dba4b_o.jpg","https://farm3.staticflickr.com/2934/34005998140_c77076b6fb_o.jpg","https://farm5.staticflickr.com/4191/34005996220_fe9e4342d3_o.jpg","https://farm3.staticflickr.com/2883/33575654563_699c544776_o.jpg","https://farm3.staticflickr.com/2902/33575652913_0dece34db4_o.jpg","https://farm5.staticflickr.com/4163/33575651063_24e05826c5_o.jpg","https://farm3.staticflickr.com/2876/33994851620_fabd14770f_o.jpg","https://farm3.staticflickr.com/2832/33973172140_b370b79c51_o.jpg","https://farm3.staticflickr.com/2874/34357262105_11b417bea2_o.jpg","https://farm5.staticflickr.com/4158/34357260545_16870a94ba_o.jpg"]},"presskit":"http://www.spacex.com/sites/spacex/files/nrol76presskit.pdf","webcast":"https://www.youtube.com/watch?v=EzQpkQ1etdA","youtube_id":"EzQpkQ1etdA","article":"https://techcrunch.com/2017/05/01/spacex-successfully-launches-nrol-76-u-s-military-satellite/","wikipedia":"https://en.wikipedia.org/wiki/List_of_NRO_launches"},"static_fire_date_utc":"2017-04-25T19:02:00.000Z","static_fire_date_unix":1493146920,"net":false,"window":7200,"rocket":"5e9d0d95eda69973a809d1ec","success":true,"failures":[],"details":"First launch under SpaceX\'s certification for national security space missions, which allows SpaceX to contract launch services for classified payloads. Second-stage speed and altitude telemetry were omitted from the launch webcast, which displayed first-stage telemetry instead, with continuous tracking of the booster from liftoff to landing for the first time.","crew":[],"ships":["5ea6ed2f080df4000697c90c"],"capsules":[],"payloads":["5eb0e4c3b6c3bb0006eeb20c"],"launchpad":"5e9e4502f509094188566f88","flight_number":39,"name":"NROL-76","date_utc":"2017-05-01T11:15:00.000Z","date_unix":1493637300,"date_local":"2017-05-01T07:15:00-04:00","date_precision":"hour","upcoming":false,"cores":[{"core":"5e9e28a3f3591811f83b2648","flight":1,"gridfins":true,"legs":true,"reused":false,"landing_attempt":true,"landing_success":true,"landing_type":"RTLS","landpad":"5e9e3032383ecb267a34e7c7"}],"auto_update":tru

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h":"https://www.reddit.com/r/spacex/comments/6b88hz/","media":"https://ww
w.reddit.com/r/spacex/comments/6bcf8j/","recovery":null},"flickr":{"smal
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7d5_o.jpg","https://farm5.staticflickr.com/4158/33859520764_5bb7a7daf6_o.j
pg","https://farm5.staticflickr.com/4182/33859520404_a9c78c971d_o.jpg","ht
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arm5.staticflickr.com/4179/34556139821_b2d6255e07_o.jpg","https://farm5.st
aticflickr.com/4187/34684981395_2f93965492_o.jpg","https://farm5.staticfli
ckr.com/4155/34684980875_77b745158a_o.jpg","https://farm5.staticflickr.co
m/4183/34296430820_8d3a42c0d7_o.jpg"]},"presskit":"https://www.spacex.com/
sites/spacex/files/inmarsat5f4presskit_final.pdf","webcast":"https://www.y
outube.com/watch?v=ynMYE64IEKs","youtube_id":"ynMYE64IEKs","article":"http
s://www.space.com/36852-spacex-launches-inmarsat-5-f4-satellite.html","wik
ipedia":"https://en.wikipedia.org/wiki/Inmarsat#Satellites"},"static_fire_
date_utc":"2017-05-11T16:45:00.000Z","static_fire_date_unix":1494521100,"n
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e,"failures":[],"details":"At 6,070 kg this was the heaviest payload launc
hed to GTO by a Falcon 9 rocket. The launch was originally scheduled for t
he Falcon Heavy, but performance improvements allowed the mission to be ca
rried out by an expendable Falcon 9 instead.","crew":[],"ships":[],"capsul
es":[],"payloads":["5eb0e4c3b6c3bb0006eeb20d"],"launchpad":"5e9e4502f50909
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utube.com/watch?v=JuZBOUMsYws","youtube_id":"JuZBOUMsYws","article":"http
s://spaceflightnow.com/2017/06/03/reused-dragon-cargo-capsule-launched-on-
journey-to-space-station/","wikipedia":"https://en.wikipedia.org/wiki/Spac
eX_CRS-11"},"static_fire_date_utc":"2017-05-28T16:00:00.000Z","static_fire
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Neutron Star Interior Composition Explorer (NICER) to the ISS, along with
 the MUSES Earth imaging platform and ROSA solar array. For the first tim
e, this mission launched a refurbished Dragon capsule, serial number C106
 which first flew in September 2014 on the CRS-4 mission. Originally sched
uled to launch on June 1, but was scrubbed due to inclement weather.","cre

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Sat-1","wikipedia":"https://en.wikipedia.org/wiki/BulgariaSat-1"},"static_
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ond flight of B1029 after the Iridium mission of January 2017. The satelli
te will be the first commercial Bulgarian-owned communications satellite a
nd it will provide television broadcasts and other communications services
over southeast Europe.","crew":[],"ships":["5ea6ed2e080df4000697c906","5ea
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ond-launch-three-days.html","wikipedia":"https://en.wikipedia.org/wiki/Iri
dium_satellite_constellation"},"static_fire_date_utc":"2017-06-20T22:10:0
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s/intelsat35epresskit.pdf","webcast":"https://www.youtube.com/watch?v=MIHV
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2017/07/06/spacex-delivers-for-intelsat-on-heavyweight-falcon-9-missio
n/","wikipedia":"https://en.wikipedia.org/wiki/Intelsat_35e"},"static_fire
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le":"https://spaceflightnow.com/2017/08/17/photos-falcon-9-rocket-soars-in
to-space-lands-back-at-cape-canaveral/","wikipedia":"https://en.wikipedia.
org/wiki/SpaceX_CRS-12"},"static_fire_date_utc":"2017-08-10T13:10:00.000
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xpected to carry 2,349 kg (5,179 lb) of pressurized mass and 961 kg (2,119
lb) unpressurized. The external payload manifested for this flight is the
 CREAM cosmic-ray detector. First flight of the Falcon 9 Block 4 upgrade.
 Last flight of a newly-built Dragon capsule; further missions will use re
furbished spacecraft.","crew":[],"ships":["5ea6ed30080df4000697c912"],"cap
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e-satellite-rides-spacex-rocket-into-orbit/","wikipedia":"https://en.wikip
edia.org/wiki/Formosat-5"},"static_fire_date_utc":"2017-08-24T18:50:00.000
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osat-5 is an Earth observation satellite of the Taiwanese space agency. Th
e SHERPA space tug by Spaceflight Industries was removed from the cargo ma
nifest of this mission. The satellite has a mass of only 475 kg.","crew":
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icial_launch/","media":"https://www.reddit.com/r/spacex/comments/7vimtm/rs
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htnow.com/2018/02/07/spacex-debuts-worlds-most-powerful-rocket-sends-tesla
-toward-the-asteroid-belt/","wikipedia":"https://en.wikipedia.org/wiki/Elo
n_Musk%27s_Tesla_Roadster"},"static_fire_date_utc":"2018-01-24T17:30:00.00
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cent ground pads. Drone ship landing of the central core failed. Final bur
n to heliocentric mars-earth orbit was successful after the second stage a
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018/02/22/recycled-spacex-rocket-boosts-paz-radar-satellite-first-starlink
-testbeds-into-orbit/","wikipedia":"https://en.wikipedia.org/wiki/Paz_(sat
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frp-GMKKM","youtube_id":"Kpfrp-GMKKM","article":"https://spaceflightnow.co
m/2018/03/06/hefty-hispasat-satellite-rides-spacex-rocket-into-orbit/","wi
kipedia":"https://en.wikipedia.org/wiki/Hispasat_30W-6"},"static_fire_date
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8.pdf","webcast":"https://www.youtube.com/watch?v=mp0TW8vkCLg","youtube_i
d":"mp0TW8vkCLg","article":"https://spaceflightnow.com/2018/03/30/iridium-
messaging-network-gets-another-boost-from-spacex/","wikipedia":"https://e
n.wikipedia.org/wiki/Iridium_satellite_constellation#Next-generation_const
ellation"},"static_fire_date_utc":"2018-03-25T12:23:00.000Z","static_fire_
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 to deploy ten Iridium NEXT satellites. Reused booster from third Iridium
 flight, and although controlled descent was performed, the booster was ex
pended into the ocean. SpaceX planned a second recovery attempt of one hal
f of the fairing using the specially modified boat Mr. Steven. However, th
e fairing\'s parafoil twisted during the recovery, which led to water impa
ct at high speed","crew":[],"ships":["5ea6ed2e080df4000697c908"],"capsule
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M","youtube_id":"BPQHG-LevZM","article":"https://spaceflightnow.com/2018/0
4/02/spacex-supply-ship-departs-cape-canaveral-for-space-station/","wikipe
dia":"https://en.wikipedia.org/wiki/SpaceX_CRS-14"},"static_fire_date_ut
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he 11th time, and a refurbished capsule (C110 from CRS-8) for the third ti
me. External payloads include a materials research platform MISSE-FF phase
3 of the Robotic Refueling Mission TSIS, heliophysics sensor several cryst
allization experiments, and the RemoveDebris spacecraft aimed at space jun
k removal. The booster was expended in order to test a new landing profil
e.","crew":[],"ships":["5ea6ed30080df4000697c912"],"capsules":["5e9e2c5cf3
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unched-from-cape-canaveral-on-the-hunt-for-exoplanets/","wikipedia":"http
s://en.wikipedia.org/wiki/Transiting_Exoplanet_Survey_Satellite"},"static_
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rue,"failures":[],"details":"Part of the Explorers program, this space tel
escope is intended for wide-field search of exoplanets transiting nearby s
tars. It is the first NASA high priority science mission launched by Space
X. It was the first time SpaceX launched a scientific satellite not primar
ily intended for Earth observations. The second stage placed it into a hig
h-Earth elliptical orbit, after which the satellite\'s own booster will pe
rform complex maneuvers including a lunar flyby, and over the course of tw
o months, reach a stable, 2:1 resonant orbit with the Moon. In January 201
8, SpaceX received NASA\'s Launch Services Program Category 2 certificatio
n of its Falcon 9 \'Full Thrust\', certification which is required for lau
nching medium risk missions like TESS. It was the last launch of a new Blo
ck 4 booster, and marked the 24th successful recovery of the booster. An e
xperimental water landing was performed in order to attempt fairing recove
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k","article":"https://spaceflightnow.com/2018/05/11/spacex-debuts-an-impro
ved-human-rated-model-of-the-falcon-9-rocket/","wikipedia":"https://en.wik
ipedia.org/wiki/Bangabandhu-1"},"static_fire_date_utc":"2018-05-04T23:25:0
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_0GgKfwCSk","article":"https://spaceflightnow.com/2018/05/22/rideshare-lau
nch-by-spacex-serves-commercial-and-scientific-customers/","wikipedia":"ht
tps://en.wikipedia.org/wiki/Gravity_Recovery_and_Climate_Experiment"},"sta
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s":true,"failures":[],"details":"GFZ arranged a rideshare of GRACE-FO on a
Falcon 9 with Iridium following the cancellation of their Dnepr launch con
tract in 2015. Iridium CEO Matt Desch disclosed in September 2017 that GRA
CE-FO would be launched on the sixth Iridium NEXT mission. The booster reu
se turnaround was a record 4.5 months between flights.","crew":[],"ships":
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m/2018/07/22/spacex-delivers-for-telesat-with-successful-early-morning-lau
nch/","wikipedia":"https://en.wikipedia.org/wiki/Telstar_19V"},"static_fir
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e":"https://spaceflightnow.com/2018/07/25/spacexs-second-launch-in-three-d
ays-lofts-10-more-iridium-satellites/","wikipedia":"https://en.wikipedia.o
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 seventh of eight launches in a half-a-billion-dollar contract with Iridiu
m. Will use a Block 5 first stage, to be recovered in the Pacific Ocean. O
nly one mission will be left for Iridium, with 10 more satellites. First a
ttempt to recover a Fairing with the upgraded net. Fairing recovery was no
t successful.","crew":[],"ships":["5ea6ed2f080df4000697c910","5ea6ed2e080d
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om/2018/08/07/indonesian-communications-satellite-deployed-in-orbit-by-spa
cex/","wikipedia":"https://en.wikipedia.org/wiki/Telkom_Indonesia"},"stati
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ed the Merah Putih (also known as Telkom-4) geostationary communications s
atellite for Telkom Indonesia. It marked the first reuse of any Block 5 fi
rst stage; the booster B1046 had previously launched Bangabandhu-1. The st
age was recovered and is expected to become the first Falcon 9 booster to
 fly three missions.","crew":[],"ships":["5ea6ed2f080df4000697c90d","5ea6e
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t-achieve-repeat-success-with-midnight-hour-launch/","wikipedia":"https://
en.wikipedia.org/wiki/Telstar_18V"},"static_fire_date_utc":"2018-09-05T07:
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s":"SpaceX\'s sixteenth flight of 2018 launched the Telstar 18v GEO commun

ication satellite for Telesat, the second launch for the canadian company
 in a few months. The first stage was a new Falcon 9 V1.2 Block 5 which wa
s successfully recovered on OCISLY.","crew":[],"ships":["5ea6ed30080df4000
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ces-first-rocket-landing-in-california-after-launching-argentine-satellit
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alse,"window":0,"rocket":"5e9d0d95eda69973a809d1ec","success":true,"failur
es":[],"details":"SpaceX\'s seventeenth flight of 2018 was the first launc
h of the Saocom Earth observation satellite constellation of the Argentine
Space Agency CONAE. The second launch of Saocom 1B will happen in 2019. Th
is flight marked the first RTLS launch out of Vandenberg, with a landing o
n the concrete pad at SLC-4W, very close to the launch pad.","crew":[],"sh
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paceflightnow.com/2018/11/15/spacex-launches-qatars-eshail-2-communication
s-satellite/","wikipedia":"https://en.wikipedia.org/wiki/Es%27hailSat"},"s
tatic_fire_date_utc":"2018-11-12T18:13:00.000Z","static_fire_date_unix":15
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as its first for Es\'hailSat. Es\'hail-2 is a communications satellite del
ivering television and internet to Qatar and the surrounding region. It wa
s launched into a geostationary transfer orbit from LC-39A at Kennedy Spac
e Center. The booster landed on OCISLY.","crew":[],"ships":["5ea6ed2f080df
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s://www.youtube.com/watch?v=Wq8kS6UoOrQ","youtube_id":"Wq8kS6UoOrQ","artic
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ites-re-flies-rocket-for-third-time/","wikipedia":"https://en.wikipedia.or
g/wiki/Spaceflight_Industries"},"static_fire_date_utc":"2018-11-15T21:55:0
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et":"5e9d0d95eda69973a809d1ec","success":true,"failures":[],"details":"Spa
ceX\'s nineteenth flight of 2018 will fly SSO-A: SmallSat Express out of V
andenberg SLC-4E for Spaceflight. SSO-A is a rideshare to sun synchronus l
ow earth orbit consisting of 64 individual microsatellites and cubesats. I
t is also likely to be the third flight of core B1046 which previously fle
w Bangabandhu-1 and Merah Putih. If this happens it will be the first time
a Falcon 9 has flown more than two missions. ","crew":[],"ships":["5ea6ed2
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ate_local":"2018-12-03T10:34:00-08:00","date_precision":"hour","upcoming":
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s://www.youtube.com/watch?v=Esh1jHT9oTA","youtube_id":"Esh1jHT9oTA","artic
le":"https://spaceflightnow.com/2018/12/05/spacex-falcon-9-boosts-dragon-c
argo-ship-to-orbit-first-stage-misses-landing-target/","wikipedia":"http
s://en.wikipedia.org/wiki/SpaceX_CRS-16"},"static_fire_date_utc":"2018-11-
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s":"SpaceX\'s 16th Crew Resupply Mission on behalf of NASA, with a total o
f 20 contracted flights. This will bring essential supplies to the Interna
tional Space Station using SpaceX\'s reusable Dragon spacecraft. The Falco
n 9 will launch from SLC-40 at Cape Canaveral Air Force Station. During th
e landing of the first stage, a grid fin hydraulic pump stalled, causing t
he core to enter an uncontrolled roll, and resulting in a (succesful) wate
r landing.","crew":[],"ships":["5ea6ed2f080df4000697c90b"],"capsules":["5e
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pacex/files/gps_iii_press_kit.pdf","webcast":"https://youtu.be/yRiLPoy_Mz
c","youtube_id":"yRiLPoy_Mzc","article":"https://spaceflightnow.com/2018/1
2/23/spacex-closes-out-year-with-successful-gps-satellite-launch/","wikipe
dia":"https://en.wikipedia.org/wiki/GPS_Block_IIIA"},"static_fire_date_ut
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res":[],"details":"SpaceX\'s twenty-first flight of 2018 launched the firs
t of the new GPS III satellites (Block IIIA) for the United States Air For
ce and was SpaceX\'s first EELV mission. The spacecraft was delivered to a
MEO transfer orbit from SLC-40 at Cape Canaveral Air Force Station. This m
ission was the first to fly with the redesigned COPV on the first stage (B
1054) as well as the second. The booster was expended.","crew":[],"ships":

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afZvwrg","article":"https://spaceflightnow.com/2019/01/11/spacex-begins-20
19-with-eighth-and-final-for-upgraded-iridium-network/","wikipedia":"http
s://en.wikipedia.org/wiki/Iridium_satellite_constellation#Next-generation_
constellation"},"static_fire_date_utc":"2019-01-06T13:51:00.000Z","static_
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of 2019 will be the eighth and final launch of its planned Iridium flight
s. Delivering 10 satellites to low earth orbit, this brings the total up t
o 75 and completes the Iridium NEXT constellation. This mission launches f
rom SLC-4E at Vandenberg AFB. The booster is expected to land on JRTI.","c
rew":[],"ships":["5ea6ed2f080df4000697c910","5ea6ed30080df4000697c912","5e
a6ed30080df4000697c914"],"capsules":[],"payloads":["5eb0e4cab6c3bb0006eeb2
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sraeli-moon-lander-hitches-ride-on-spacex-launch-with-indonesian-comsa
t/","wikipedia":"https://en.wikipedia.org/wiki/PT_Pasifik_Satelit_Nusantar
a"},"static_fire_date_utc":"2019-02-18T17:03:00.000Z","static_fire_date_un
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c","success":true,"failures":[],"details":"SpaceX will launch this ridesha
re to GTO for Space Systems Loral (SSL). The primary payload for this miss
ion is Nusantara Satu, a communications satellite built by SSL for the pri
vate Indonesian company PT Pasifik Satelit Nusantara (PSN). Spaceflight In
dustries\' GTO-1 mission consists of two secondary payloads. One of those
 is Beresheet, the lunar lander built by the Israeli non-profit organizati
on, SpaceIL. Beresheet will make its own way to the moon from GTO. The oth
er secondary is Air Force Research Lab\'s (Space Situational Awareness) S5
mission, which hitches a ride to GEO aboard Nusantara Satu. This mission l
aunches from SLC-40 at Cape Canaveral AFS. The booster is expected to land
on OCISLY.","crew":[],"ships":["5ea6ed30080df4000697c913"],"capsules":
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er":75,"name":"Nusantara Satu (PSN-6) / S5 / Beresheet","date_utc":"2019-0
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E","article":"https://spaceflightnow.com/2019/03/02/spacex-launches-first-
crew-dragon-ferry-ship/","wikipedia":"https://en.wikipedia.org/wiki/SpX-DM
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 will launch Dragon 2 as part of NASA\'s Commercial Crew Transportation Ca
pability program. This mission will demonstrate Dragon 2, and Falcon 9 in
 its configuration for crewed missions. DM-1 will launch from LC-39A at Ke
nnedy Space Center, likely carrying some cargo to the International Space
 Station. The booster is expected to land on OCISLY.","crew":[],"ships":
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falcon-heavy-successful-in-commercial-debut/","wikipedia":"https://en.wiki
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eX will launch Arabsat 6A to a geostationary transfer orbit from SLC-39A,
 KSC. The satellite is a geostationary telecommunications satellite built
 by Lockheed Martin for the Saudi Arabian company Arabsat. This will be th
e first operational flight of Falcon Heavy, and also the first Block 5 Fal
con Heavy. All three cores will be new Block 5 cores. The side cores are e
xpected to land at LZ-1 and LZ-2, and the center core is expected to land
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ddit.com/r/spacex/comments/bd2l28/crs17_launch_campaign_thread/","launc
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hX5TvP0M","article":"https://spaceflightnow.com/2019/05/04/spacex-launches
-space-station-resupply-mission-lands-rocket-on-drone-ship/","wikipedi
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ASA out of a total of 20 contracted flights, this mission brings essential
supplies to the International Space Station using SpaceX\'s reusable Drago
n 1 spacecraft. The external payloads for this mission include Orbital Car
bon Observatory 3 and Space Test Program-Houston 6. The Falcon 9 launches
 from SLC-40 at Cape Canaveral AFS. The booster was expected to land at LZ
-1, however, due to the ongoing investigation and clean-up following the C
rew Dragon testing incident, it is likely to land on OCISLY instead.\\n
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d5_o.jpg","https://live.staticflickr.com/65535/47926137127_ef58152b6b_o.jp
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-60-starlink-broadband-satellites-deployed-in-orbit","wikipedia":"https://
en.wikipedia.org/wiki/Starlink_(satellite_constellation)"},"static_fire_da
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e,"failures":[],"details":"SpaceX will launch dozens of Starlink demonstra
tion satellites from SLC-40, Cape Canaveral AFS. Starlink is a low Earth o
rbit broadband internet constellation developed and owned by SpaceX which
 will eventually consist of nearly 12 000 satellites and will provide low
 latency internet service to ground terminals around the world. Two protot
ype satellites, Microsats 2a and 2b, were launched from Vandenberg AFB in
 February 2018. The booster for this mission will land on OCISLY.","crew":
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6/12/three-canadian-radar-surveillance-satellites-ride-spacex-rocket-into-
orbit/","wikipedia":"https://en.wikipedia.org/wiki/RADARSAT_Constellatio
n"},"static_fire_date_utc":"2019-06-08T08:39:00.000Z","static_fire_date_un
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atellite RADARSAT Constellation Mission into Sun Synchronous orbit from SL
C-4E, VAFB. The RCM spacecraft are synthetic aperture radar (SAR) Earth ob
servation satellites built by the Canadian space company, MDA, for the Can
adian Space Agency. This mission was delayed when the originally slated bo
oster failed to land after CRS-16. The booster is expected to return to LZ
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tps://spaceflightnow.com/2019/06/25/falcon-heavy-launches-on-military-led-
rideshare-mission-boat-catches-fairing","wikipedia":"https://en.wikipedia.
org/wiki/Space_Test_Program"},"static_fire_date_utc":"2019-06-19T21:52:00.
000Z","static_fire_date_unix":1560981120,"net":false,"window":14400,"rocke
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e Test Program 2 is a rideshare managed by the U.S. Air Force Space and Mi
ssile Systems Center (SMC), launching from LC-39A, KSC. Most of the spacec
raft will be delivered into low Earth orbit (LEO) in two deployment sequen
ces separated by a second stage burn. These LEO payloads include the six T

aiwan and United States owned COSMIC-2 microsatellites, the Planetary Soci
ety\'s LightSail-B demonstrator cubesat, and others. The third and final d
eployment will be the Air Force Research Lab\'s DSX spacecraft, which will
be delivered to a medium Earth orbit (MEO). This mission will reuse the si
de cores from Arabsat 6A, which will return to LZ-1, and LZ-2. The new cen
ter core will boost back to land on OCISLY less than 40 km from the launch
site.","crew":[],"ships":["5ea6ed30080df4000697c913","5ea6ed2f080df4000697
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thread","launch":"https://www.reddit.com/r/spacex/comments/ch2ml7/rspacex_
crs18_official_launch_discussion_updates/","media":"https://www.reddit.co
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king-port-spacesuit-and-supplies-en-route-to-space-station/","wikipedi
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s":[],"details":"SpaceX\'s 18th Commercial Resupply Services mission out o
f a total of 20 such contracted flights for NASA, this launch will deliver
essential supplies to the International Space Station using the reusable D
ragon 1 cargo spacecraft. The external payload for this mission is Interna
tional Docking Adapter 3, replacing IDA-1 lost in SpaceX\'s CRS-7 launch f
ailure. This mission will launch from SLC-40 at Cape Canaveral AFS on a Fa
lcon 9, and the first-stage booster is expected to land back at CCAFS LZ-
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8/07/spacex-launches-israeli-owned-telecom-satellite/","wikipedia":"http
s://en.wikipedia.org/wiki/Spacecom"},"static_fire_date_utc":"2019-08-01T0
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s":"SpaceX will launch Boeing built Amos-17, a geostationary communication
s satellite for Israeli company Spacecom. The satellite will be delivered
 to GTO from KSC LC-39A or possibly CCAFS SLC-40, and will replace the def
unct Amos-5 at 17\xc2\xb0 E. Amos-17 carries multi-band high throughput an
d regional beams servicing Africa, Europe and the Middle East. The cost of
this launch is covered for Spacecom by SpaceX credit following the Amos-6
 incident. A recovery of the booster for this mission is not expected.","c
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s":"This mission will launch the first batch of Starlink version 1.0 satel
lites, from SLC-40, Cape Canaveral AFS. They are expected to contribute to
the 550 km x 53\xc2\xb0 shell. It is the second Starlink launch overall. S
tarlink is a low Earth orbit broadband internet constellation developed an
d owned by SpaceX which will eventually consist of nearly 12 000 satellite

s and will provide low latency internet service to ground terminals around the world. The booster for this mission is expected to land on OCISLY.","crew":[],"ships":["5ea6ed2e080df4000697c908","5ea6ed30080df4000697c913","5ea6ed2e080df4000697c909","5ea6ed2f080df4000697c90d"],"capsules":[],"payloads":["5eb0e4cfb6c3bb0006eeb24c"],"launchpad":"5e9e4501f509094ba4566f84","flight_number":84,"name":"Starlink-1","date_utc":"2019-11-11T14:56:00.000Z","date_unix":1573484160,"date_local":"2019-11-11T09:56:00-05:00","date_precision":"hour","upcoming":false,"cores":[{"core":"5e9e28a5f3591809c03b2658","flight":4,"gridfins":true,"legs":true,"reused":true,"landing_attempt":true,"landing_success":true,"landing_type":"ASDS","landpad":"5e9e3032383ecb6bb234e7ca"}],"auto_update":true,"tbd":false,"launch_library_id":null,"id":"5eb87d39ffd86e000604b37d"},{"fairings":null,"links":{"patch":{"small":"https://images2.imgbox.com/05/f9/FQWx8g9k_o.png","large":"https://images2.imgbox.com/1f/40/3mc9OSdH_o.png"},"reddit":{"campaign":"https://www.reddit.com/r/spacex/comments/e0upb3/crs19_launch_campaign_thread/","launch":"https://www.reddit.com/r/spacex/comments/e5r8hj/rspacex_crs19_official_launch_discussion_updates","media":"https://www.reddit.com/r/spacex/comments/e6ln0m/rspacex_crs19_media_thread_videos_images_gifs","recovery":"https://www.reddit.com/r/spacex/comments/e6lbzy/rspacex_crs19_booster_recovery_discussion_updates"},"flickr":{"small":[],"original":["https://live.staticflickr.com/65535/49178460143_e3ae2bd506_o.jpg","https://live.staticflickr.com/65535/49178954221_8544835325_o.jpg","https://live.staticflickr.com/65535/49179161792_9f1801a963_o.jpg","https://live.staticflickr.com/65535/49178460368_62eb945db8_o.jpg","https://live.staticflickr.com/65535/49184948561_ce20b38bc6_o.jpg","https://live.staticflickr.com/65535/49185149122_00a7fa573d_o.jpg"]},"presskit":"https://www.spacex.com/sites/spacex/files/crs-19_mission_press_kit.pdf","webcast":"https://youtu.be/-aoAGdYXp_4","youtube_id":"-aoAGdYXp_4","article":"https://spaceflightnow.com/2019/12/05/dragon-soars-on-research-and-resupply-flight-to-international-space-station","wikipedia":"https://en.wikipedia.org/wiki/SpaceX_CRS-19"},"static_fire_date_utc":"2019-11-26T17:04:00.000Z","static_fire_date_unix":1574787840,"net":false,"window":0,"rocket":"5e9d0d95eda69973a809d1ec","success":true,"failures":[],"details":"SpaceX\'s 19th Crew Resupply Mission on behalf of NASA with a total of 20 contracted flights, this mission brings essential supplies to the International Space Station using SpaceX\'s reusable Dragon spacecraft. The external payloads for this mission include the Hyperspectral Imager Suite and a lithium-ion battery. Falcon 9 and Dragon will launch from SLC-40, Cape Canaveral AFS. The mission will be complete with return and recovery of the Dragon capsule and down cargo.","crew":[],"ships":["5ea6ed2f080df4000697c90d"],"capsules":["5e9e2c5bf3591880643b2669"],"payloads":["5eb0e4cfb6c3bb0006eeb24d"],"launchpad":"5e9e4501f509094ba4566f84","flight_number":85,"name":"CRS-19","date_utc":"2019-12-05T17:29:23.000Z","date_unix":1575566963,"date_local":"2019-12-05T12:29:23-05:00","date_precision":"hour","upcoming":false,"cores":[{"core":"5e9e28a7f359187afd3b2662","flight":1,"gridfins":true,"legs":true,"reused":false,"landing_attempt":true,"landing_success":true,"landing_type":"ASDS","landpad":"5e9e3032383ecb6bb234e7ca"}],"auto_update":true,"tbd":false,"launch_library_id":null,"id":"5eb87d39ffd86e000604b37e"},{"fairings":{"reused":false,"recovery_attempt":true,"recovered":false,"ships":["5ea6ed2e080df4000697c908"]},"links":{"patch":{"small":"https://images2.imgbox.com/3c/e7/PotxLenG_o.png","large":"https://images2.imgbox.com/49/eb/evB1Wi95_o.png"},"reddit":{"campaign":"https://www.reddit.com/r/spacex/comments/e5w6i8/jcsat18kacific1_launch_campaign_thread","launch":"https://www.reddit.com/r/spacex/comments/ebfr9t/rspacex_jcsat18kacific1_official_launch","media":"https://www.reddit.com/r/spacex/comments/ebn4g5/rspacex_jcsat18kacific1_media_thread_videos","recovery":"https://www.reddit.com/r/spacex/comments/ec48p3/jscat_18kacific1_recovery_discussion_and_updates"},"flickr":{"small":[],"original":["https://live.staticflickr.com/65535/49235364922_e55ceb61be_o.jpg","https://live.staticflickr.com/65535/49235136806_e5a3774904_o.jpg","https://live.staticflickr.com/65535/49235137056_585dc050e7_o.jpg"]},"presskit":"https://www.spacex.com/sites/spacex/files/jcsat18kacific1_mission_press_kit.pdf","webc

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e":"https://spaceflightnow.com/2019/12/17/startup-launches-broadband-satel
lite-on-spacex-rocket-to-connect-pacific-islands","wikipedia":"https://en.
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ite to geostationary transfer orbit from XXXX. JCSat 18 is a mobile broadb
and communications payload built for Sky Perfect JSAT Corporation of Japan
and will service Asia Pacific. Kacific 1 is a high throughput broadband in
ternet payload built for Kacific Broadband Satellites and will service cer
tain high demand areas of Southeast Asia and the Pacific. Both payloads sh
are a single chassis. The booster for this mission is expected to land on
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s":"This mission will launch the second batch of Starlink version 1.0 sate
llites, from SLC-40, Cape Canaveral AFS. They are expected to contribute t
o the 550 km x 53\xc2\xb0 shell. It is the third Starlink launch overall.
 Starlink is a low Earth orbit broadband internet constellation developed
 and owned by SpaceX which will eventually consist of nearly 12 000 satell
ites and will provide low latency internet service to ground terminals aro
und the world. The booster for this mission is expected to land on OCISL
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com/2020/01/19/spacex-aces-final-major-test-before-first-crew-mission","wi
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le from LC-39A, KSC on a fully fueled Falcon 9 rocket and then trigger the
launch escape system during the period of maximum dynamic pressure. As par
t of NASA\'a Commercial Crew Integrated Capability program (CCiCap) this t
est will contribute valuable data to help validate Crew Dragon and its lau
nch abort system. The Crew Dragon will be recovered by GO Searcher after s
plashdown in the Atlantic Ocean. This flight does not go to orbit. The boo
ster and upper stage are expected to break up following capsule separation
and there will be no landing attempt.","crew":[],"ships":["5ea6ed2f080df40
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272020.pdf","webcast":"https://youtu.be/1KmBDCiL7MU","youtube_id":"1KmBDCi
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re-starlink-satellites-into-orbit-after-weather-delays/","wikipedia":"http
s://en.wikipedia.org/wiki/SpaceX_Starlink"},"static_fire_date_utc":"2020-0
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ails":"This mission will launch the third batch of Starlink version 1.0 sa
tellites, from SLC-40, Cape Canaveral AFS. It is the fourth Starlink launc
h overall. The satellites will be delivered to low Earth orbit and will sp
end a few weeks maneuvering to their operational altitude of 550 km. The b
ooster for this mission is expected to land on OCISLY.","crew":[],"ships":
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2/17/spacex-delivers-more-starlink-satellites-to-orbit-booster-misses-dron
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AFS. It is the fifth Starlink launch overall. The satellites will be deliv
ered to low Earth orbit and will spend a few weeks maneuvering to their op
erational altitude of 550 km. The booster for this mission is expected to
 land on OCISLY.","crew":[],"ships":["5ea6ed2e080df4000697c908","5ea6ed2e0
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lightnow.com/2020/03/07/late-night-launch-of-spacex-cargo-ship-marks-end-o
f-an-era/","wikipedia":"https://en.wikipedia.org/wiki/SpaceX_CRS-20"},"sta
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s":true,"failures":[],"details":"SpaceX\'s 20th and final Crew Resupply Mi
ssion under the original NASA CRS contract, this mission brings essential
 supplies to the International Space Station using SpaceX\'s reusable Drag
on spacecraft. It is the last scheduled flight of a Dragon 1 capsule. (CRS
-21 and up under the new Commercial Resupply Services 2 contract will use
 Dragon 2.) The external payload for this mission is the Bartolomeo ISS ex
ternal payload hosting platform. Falcon 9 and Dragon will launch from SLC-
40, Cape Canaveral Air Force Station and the booster will land at LZ-1. Th
e mission will be complete with return and recovery of the Dragon capsule
 and down cargo.","crew":[],"ships":[],"capsules":["5e9e2c5cf359185d753b26
6f"],"payloads":["5eb0e4d0b6c3bb0006eeb253"],"launchpad":"5e9e4501f509094b
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-rocket-overcomes-engine-failure-to-deploy-starlink-satellites/","wikipedi
a":"https://en.wikipedia.org/wiki/Starlink"},"static_fire_date_utc":"2020-
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w":0,"rocket":"5e9d0d95eda69973a809d1ec","success":true,"failures":[],"det
ails":"The sixth Starlink launch overall and the fifth operational batch o
f Starlink satellites will launch into orbit aboard a Falcon 9 rocket. Thi
s mission is expected to deploy all sixty satellites into an elliptical or
bit about fifteen minutes into flight. In the weeks following launch the s
atellites are expected to utilize their onboard ion thrusters to raise the
ir orbits to 550 km in three groups of 20, making use of precession rates
 to separate themselves into three planes. The booster will land on a dron
e ship approximately 628 km downrange.","crew":[],"ships":["5ea6ed30080df4
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y_discussion/"},"flickr":{"small":[],"original":["https://live.staticflick

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han two weeks, however NASA has been considering an extension to as much a
s six weeks or three months. The astronauts have been undergoing additiona
l training for the possible longer mission.","crew":["5ebf1a6e23a9a60006e0
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ets-new-mark-in-rocket-reuse-10-years-after-first-falcon-9-launch/","wikip
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arlink satellites, which are expected to be version 1.0, from SLC-40, Cape
Canaveral AFS. It is the eighth Starlink launch overall. The satellites wi
ll be delivered to low Earth orbit and will spend a few weeks maneuvering
 to their operational altitude of 550 km. The booster for this mission is
 expected to land on JRTI on its first mission since arriving at Port Cana
veral.","crew":[],"ships":["5ea6ed2e080df4000697c908","5ea6ed2e080df400069
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6/13/starlink-satellite-deployments-continue-with-successful-falcon-9-laun
ch/","wikipedia":"https://en.wikipedia.org/wiki/Starlink"},"static_fire_da
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mission will launch the eighth batch of operational Starlink satellites, w

hich are expected to be version 1.0, from SLC-40, Cape Canaveral AFS. It i
s the ninth Starlink launch overall. The satellites will be delivered to l
ow Earth orbit and will spend a few weeks maneuvering to their operational
altitude of 550 km. This mission is includes rideshare payloads, SkySats 1
6-18, on top of the Starlink stack. The booster for this mission is expect
ed to land an ASDS.","crew":[],"ships":["5ea6ed2e080df4000697c908","5ea6ed
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21:00.000Z","date_unix":1592040060,"date_local":"2020-06-13T05:21:00-04:0
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g_attempt":true,"landing_success":true,"landing_type":"ASDS","landpad":"5e
9e3032383ecb6bb234e7ca"}],"auto_update":true,"tbd":false,"launch_library_i
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ery_attempt":true,"recovered":true,"ships":[]},"links":{"patch":{"smal
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tnow.com/2020/06/30/spacex-launches-its-first-mission-for-u-s-space-forc
e/","wikipedia":"https://en.wikipedia.org/wiki/GPS_Block_III"},"static_fir
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e,"failures":[],"details":"SpaceX will launch GPS Block III Space Vehicle
 03 from SLC-40, Cape Canaveral AFS aboard a Falcon 9. GPS III is owned an
d operated by the US Air Force and produced by Lockheed Martin. This is th
e third GPS III satellite and the second launched by SpaceX. The satellite
will be delivered into a MEO transfer orbit. The booster for this mission
 is expected to land on an ASDS.","crew":[],"ships":[],"capsules":[],"payl
oads":["5eb0e4d2b6c3bb0006eeb25c"],"launchpad":"5e9e4501f509094ba4566f8
4","flight_number":97,"name":"GPS III SV03 (Columbus)","date_utc":"2020-06
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koreas-first-military-satellite-into-on-target-orbit/","wikipedia":nul
l},"static_fire_date_utc":"2020-07-11T17:58:00.000Z","static_fire_date_uni
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c","success":true,"failures":[],"details":"SpaceX will launch ANASIS-II, a
South Korean geostationary military communication satellite from LC-39A, K
ennedy Space Center. It will be South Korea\'s first dedicated military co
mmunications satellite. Falcon 9 will deliver the satellite to a geostatio
nary transfer orbit. The booster is expected to land downrange on an ASD
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loses-out-busy-week-with-launch-of-more-starlink-satellites/","wikipedi
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Center. It is the tenth Starlink launch overall. The satellites will be de
livered to low Earth orbit and will spend a few weeks maneuvering to their
operational altitude of 550 km. This mission is includes a rideshare of tw
o BlackSky satellites on top of the Starlink stack. The booster for this m
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is the thirteenth Starlink launch overall. The satellites will be delivere
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euvering to their operational altitude of 550 km. The booster for this mis
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th orbit and will spend a few weeks maneuvering to their operational altit
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tps://spaceflightnow.com/2020/11/16/astronauts-ride-spacex-crew-capsule-in
-landmark-launch-for-commercial-spaceflight/","wikipedia":"https://en.wiki
pedia.org/wiki/SpaceX_Crew-1"},"static_fire_date_utc":"2020-11-11T16:17:0

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eX will launch the first operational mission of its Crew Dragon vehicle as
part of NASA\'s Commercial Crew Transportation Capability Program (CCtCa
p), carrying 3 NASA astronauts and 1 JAXA astronaut to the International S
pace Station. This mission will be the second crewed flight to launch from
the United States since the end of the Space Shuttle program in 2011.","cr
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nternational-satellite-launches-to-extend-measurements-of-sea-level-ris
e/","wikipedia":"https://en.wikipedia.org/wiki/Copernicus_Sentinel-6"},"st
atic_fire_date_utc":"2020-11-17T13:17:00.000Z","static_fire_date_unix":160
5619020,"net":false,"window":null,"rocket":"5e9d0d95eda69973a809d1ec","suc
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 Freilich into low Earth orbit for NASA, NOAA, ESA, and the European Organ
ization for the Exploitation of Meteorological Satellites aboard a Falcon
 9 from SLC-4E, Vandenberg Air Force Station. Sentinel-6(A) is an ocean ob
servation satellite providing radar ocean surface altimetry data and also
 atmospheric temperature profiles as a secondary mission. The booster for
 this mission is will land at LZ-4.","crew":[],"ships":[],"capsules":[],"p
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lites-on-100th-falcon-9-flight/","wikipedia":"https://en.wikipedia.org/wik
i/Starlink"},"static_fire_date_utc":"2020-11-21T16:31:00.000Z","static_fir
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ch the fifteenth batch of operational Starlink satellites, which are versi
on 1.0, from SLC-40, Cape Canaveral Air Force Station. It will be the sixt
eenth Starlink launch overall. The satellites will be delivered to low Ear
th orbit and will spend a few weeks maneuvering to their operational altit
ude of 550 km. The booster for this mission is expected to land on an ASD
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2020/12/06/spacex-launches-first-in-new-line-of-upgraded-space-station-car
go-ships/","wikipedia":"https://en.wikipedia.org/wiki/SpaceX_CRS-21"},"sta
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ess":true,"failures":[],"details":"SpaceX\'s 21st ISS resupply mission on
 behalf of NASA and the first under the CRS-2 contract, this mission bring
s essential supplies to the International Space Station using the cargo va
riant of SpaceX\'s Dragon 2 spacecraft. The external payload for this miss
ion is the Nanoracks Bishop Airlock. Falcon 9 and Dragon launch from LC-39
A, Kennedy Space Center and the booster is expected to land on an ASDS. Th
e mission will be complete with return and recovery of the Dragon capsule
 and down cargo.","crew":[],"ships":["5ea6ed30080df4000697c913","5ea6ed2f0
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acex-deploys-turkish-satellite-in-first-launch-of-2021/","wikipedia":"http
s://en.wikipedia.org/wiki/T%C3%BCrksat_5A"},"static_fire_date_utc":null,"s
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a69973a809d1ec","success":true,"failures":[],"details":"SpaceX will launch
the first of two next generation satellites on contract for T\xc3\xbcrksa
t. T\xc3\xbcrksat 5A is a Ku-band broadcast satellite built by Airbus Defe
nse and Space and based on the Electric Orbit Raising version of the Euros
tar E3000 platform. This spacecraft will be delivered into a transfer orbi
t and will then raise itself to its operational 31\xc2\xb0 East geostation
ary orbit to serve Turkey, the Middle East, Europe, North Africa and South
Africa. The booster for this mission will be recovered downrange via ASD
S.","crew":[],"ships":["5ea6ed2f080df4000697c90d","5ea6ed2f080df4000697c91
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ith-successful-starlink-launch/","wikipedia":"https://en.wikipedia.org/wik
i/Starlink"},"static_fire_date_utc":null,"static_fire_date_unix":null,"ne
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e,"failures":[],"details":"This mission launches the sixteenth batch of op
erational Starlink satellites, which are version 1.0, from SLC-40 or LC-39
A. It is the seventeenth Starlink launch overall. The satellites will be d
elivered to low Earth orbit and will spend a few weeks maneuvering to thei
r operational altitude. The booster is expected to land on an ASDS.","cre
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The booster is expected to land on an ASDS.","crew":[],"ships":["5ea6ed300
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tnow.com/2021/02/16/spacex-successfully-deploys-60-more-starlink-satellite
s-but-loses-booster-on-descent/","wikipedia":"https://en.wikipedia.org/wik
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 the eighteenth batch of operational Starlink satellites, which are versio
n 1.0, from SLC-40. It is the nineteenth Starlink launch overall. The sate
llites will be delivered to low Earth orbit and will spend a few weeks man
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3/24/spacex-launches-25th-mission-to-build-out-starlink-internet-networ
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 The satellites will be delivered to low Earth orbit and will spend a few
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sion-from-floridas-space-coast/","wikipedia":"https://en.wikipedia.org/wik
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4/23/spacex-launches-astronauts-on-refurbished-capsule-and-flight-proven-r
ocket/","wikipedia":"https://en.wikipedia.org/wiki/SpaceX_Crew-2"},"static
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rue,"failures":[],"details":"SpaceX launches the second operational missio
n of its Crew Dragon vehicle as part of NASA\'s Commercial Crew Program, c
arrying NASA astronauts Shane Kimbrough, Megan McArthur, Thomas Pesquet, a
nd Akihiko Hoshide to the International Space Station. The Falcon 9 and Cr
ew Dragon lift off from LC-39A, Kennedy Space Center. Both the booster and
the capsule have flown previously, each a first for a commercial crew flig
ht. The booster for this mission is expected to land on an ASDS. The missi
on will be complete with the safe return of the astronauts to Earth.","cre
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n 1.0, from SLC-40. It is the 27th Starlink launch overall. The satellites will be delivered to low Earth orbit and will spend a few weeks maneuverin g to their operational altitude. The booster is expected to land on an ASD S.","crew":[],"ships":["5ea6ed30080df4000697c913","5ee68c683c228f36bd5809b 5","6059166413f40e27e8af34b6"],"capsules":[],"payloads":["6079bd5e9a06446e 8c61bf7c"],"launchpad":"5e9e4501f509094ba4566f84","flight_number":126,"nam e":"Starlink-27 (v1.0)","date_utc":"2021-05-09T06:42:00.000Z","date_unix": 1620542520,"date_local":"2021-05-09T02:42:00-04:00","date_precision":"hou r","upcoming":false,"cores":[{"core":"5e9e28a6f35918c0803b265c","flight":1 0,"gridfins":true,"legs":true,"reused":true,"landing_attempt":true,"landin g_success":true,"landing_type":"ASDS","landpad":"5e9e3032383ecb6bb234e7c a"}],"auto_update":true,"tbd":false,"launch_library_id":"e5085f22-208b-4b2 8-b66c-fd4bd9df90e7","id":"6079bd1c9a06446e8c61bf76"},{"fairings":{"reuse d":true,"recovery_attempt":true,"recovered":null,"ships":["6059166413f40e2 7e8af34b6"]},"links":{"patch":{"small":"https://imgur.com/BrW201S.png","la rge":"https://imgur.com/573IfGk.png"},"reddit":{"campaign":"https://www.re ddit.com/r/spacex/comments/jhu37i/starlink_general_discussion_and_deployme nt_thread/","launch":"https://www.reddit.com/r/spacex/comments/ncfexu/rspa cex_starlink26_launch_discussion_updates/","media":null,"recovery":"http s://www.reddit.com/r/spacex/comments/k2ts1q/rspacex_fleet_updates_discussi on_thread/"},"flickr":{"small":[],"original":["https://live.staticflickr.c om/65535/51171344450_6a3f0e08b9_o.jpg","https://live.staticflickr.com/6553 5/51170251791_9b36fba5b7_o.jpg","https://live.staticflickr.com/65535/51185 653708_86840b1672_o.jpg","https://live.staticflickr.com/65535/51185653723_ 7bd9ecab87_o.jpg","https://live.staticflickr.com/65535/51186506630_1a47a43 787_o.jpg"]},"presskit":null,"webcast":"https://youtu.be/tdgg_qwj-hI","you tube_id":"tdgg_qwj-hI","article":null,"wikipedia":"https://en.wikipedia.or g/wiki/Starlink"},"static_fire_date_utc":null,"static_fire_date_unix":nul l,"net":false,"window":0,"rocket":"5e9d0d95eda69973a809d1ec","success":tru e,"failures":[],"details":"This mission launches the 27th batch of operati onal Starlink satellites, which are version 1.0, from LC-39A or SLC-40. It is the 28th Starlink launch overall. The satellites will be delivered to l ow Earth orbit and will spend a few weeks maneuvering to their operational altitude. The booster is expected to land on an ASDS.","crew":[],"ships": ["5ea6ed30080df4000697c913","6059166413f40e27e8af34b6","608c1a06cf7f3d6152 666ad4","5ea6ed2f080df4000697c90b"],"capsules":[],"payloads":["605b4bfcaa5 433645e37d048","609f48374a12e4692eae4667","609f49c64a12e4692eae4668"],"lau nchpad":"5e9e4502f509094188566f88","flight_number":127,"name":"Starlink-26 (v1.0) + Capella-6 + Tyvak-0130","date_utc":"2021-05-15T22:54:00.000Z","da te_unix":1621119240,"date_local":"2021-05-15T18:54:00-04:00","date_precisi on":"hour","upcoming":false,"cores":[{"core":"5e9e28a7f3591817f23b2663","f light":8,"gridfins":true,"legs":true,"reused":true,"landing_attempt":tru e,"landing_success":true,"landing_type":"ASDS","landpad":"5e9e3032383ecb6b b234e7ca"}],"auto_update":true,"tbd":false,"launch_library_id":"c32d1f5e-2 dd9-4b55-ac8b-3eb8c4a4e955","id":"605b4b95aa5433645e37d041"},{"fairings": {"reused":true,"recovery_attempt":true,"recovered":true,"ships":["5ea6ed2e 080df4000697c909","5ea6ed2f080df4000697c90c"]},"links":{"patch":{"smal l":"https://imgur.com/BrW201S.png","large":"https://imgur.com/573IfGk.pn g"},"reddit":{"campaign":"https://www.reddit.com/r/spacex/comments/jhu37i/ starlink_general_discussion_and_deployment_thread/","launch":"https://www. reddit.com/r/spacex/comments/nkxg4s/rspacex_starlink28_launch_discussion_a nd_updates/","media":null,"recovery":"https://www.reddit.com/r/spacex/comm ents/k2ts1q/rspacex_fleet_updates_discussion_thread/"},"flickr":{"small": [],"original":["https://live.staticflickr.com/65535/51225270061_42bc3abb43 _o.jpg","https://live.staticflickr.com/65535/51226036719_584d141279_o.jp g","https://live.staticflickr.com/65535/51225480623_5ef7d3957a_o.jpg"]},"p resskit":null,"webcast":"https://youtu.be/xRu-ekesDyY","youtube_id":"xRu-e kesDyY","article":"https://spaceflightnow.com/2021/05/26/first-phase-of-sp acexs-starlink-network-nears-completion-with-falcon-9-launch/","wikipedi a":"https://en.wikipedia.org/wiki/Starlink"},"static_fire_date_utc":nul l,"static_fire_date_unix":null,"net":false,"window":0,"rocket":"5e9d0d95ed

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hes the 28th batch of operational Starlink satellites, which were version
 1.0, from SLC-40. It was the 29th Starlink launch overall. The satellites
plan to be delivered to low Earth orbit and will spend a few weeks maneuve
ring to their operational altitude. The booster is expected to land on ASD
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e,"landing_type":"ASDS","landpad":"5e9e3033383ecbb9e534e7cc"}],"auto_updat
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-supply-ship-launches-on-mission-to-begin-upgrading-space-station-electric
al-grid/","wikipedia":"https://en.wikipedia.org/wiki/SpaceX_CRS-22"},"stat
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s":"SpaceX\'s 22nd ISS resupply mission on behalf of NASA, this mission se
nds essential supplies to the International Space Station using the cargo
 variant of SpaceX\'s Dragon 2 spacecraft. The external payload for this m
ission is the first pair of ISS Roll Out Solar Arrays. Falcon 9 and Dragon
launch from LC-39A, Kennedy Space Center and the booster is expected to la
nd on an ASDS. The mission will be complete with splashdown and recovery o
f the capsule and down cargo.","crew":[],"ships":["5ea6ed2f080df4000697c90
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00Z","static_fire_date_unix":1624375440,"net":false,"window":0,"rocket":"5
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 launches to sun-synchronous polar orbit from Florida as part of SpaceX\'s
Rideshare program dedicated to smallsat customers. The mission lifts off f
rom SLC-40, Cape Canaveral on a southward azimuth and performs a dogleg ma
neuver. The booster for this mission is expected to return to LZ-1 based o
n FCC communications filings. This rideshare takes approximately 90 satell
ites and hosted payloads into orbit on a variety of deployers including th
ree free-flying spacecraft which dispense their customers\' satellites aft
er separation from the SpaceX stack.","crew":[],"ships":["60c8c7a45d481900
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ails":"SpaceX\'s 23rd ISS resupply mission on behalf of NASA, this mission
brings essential supplies to the International Space Station using the car
go variant of SpaceX\'s Dragon 2 spacecraft. Cargo includes several scienc
e experiments. The booster for this mission is expected to land on an ASD
S. The mission will be complete with return and recovery of the Dragon cap
sule and down cargo.","crew":[],"ships":["5ea6ed2d080df4000697c904"],"caps
ules":[],"payloads":["5fe3c4f2b3467846b3242193"],"launchpad":"5e9e4502f509
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tnow.com/2021/09/14/spacex-launches-first-full-batch-of-laser-equipped-sta
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he world\xe2\x80\x99s first all-civilian mission to space. The mission wil
l be commanded by Jared Isaacman, the 37-year-old founder and Chief Execut
ive Officer of Shift4 Payments and an accomplished pilot and adventurer. I
nspiration4 will leave Earth from Kennedy Space Center\xe2\x80\x99s histor
ic Launch Complex 39A, the embarkation point for Apollo and Space Shuttle
 missions, and travel across a low earth orbit on a multi-day journey that
will continually eclipse more than 90% of the earth\xe2\x80\x99s populatio
n. Named in recognition of the four-person crew that will raise awareness
 and funds for St. Jude Children\xe2\x80\x99s Research Hospital, this mile
stone represents a new era for human spaceflight and exploration.","crew":
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ails":"SpaceX will launch the third operational mission of its Crew Dragon
vehicle as part of NASA\'s Commercial Crew Program, carrying four astronau
ts to the International Space Station, including 1 international partner T
his mission will fly on a new capsule and a once used booster. The booster
will land downrange on a drone ship. The Crew-2 mission returns from the s
pace station in November.","crew":["5fe3c587b3467846b3242198","5fe3c5beb34
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aunch-starts-deployment-of-new-starlink-orbital-shell/","wikipedia":"http
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ire_date_unix":1637353200,"net":false,"window":null,"rocket":"5e9d0d95eda6
9973a809d1ec","success":true,"failures":[],"details":"NASA\'s Double Aster
oid Redirect Test (DART) will demonstrate the use of a kinetic impactor to
alter an asteroid\'s trajectory, an intervention that could be used in the
future to prevent devastating Earth impacts. The target system consists of
Didymos, 780 meters in diameter, and its moonlet Dimorphos, 160 meters. Th
e DART spacecraft will intercept the double asteroid, using autonomous gui
dance to crash into the smaller one. Moving at about 6 km/s, the transferr
ed momentum should alter Dimorphos\'s 12 hour orbital period around its co
mpanion by several minutes. The mission tests several technologies, includ
ing the Small-body Maneuvering Autonomous Real-Time Navigation (SMART Nav)
used to differentiate and steer toward the target body and Roll-Out Solar
 Arrays (ROSA) with Transformational Solar Array concentrators. NASA\xe2\x
80\x99s Evolutionary Xenon Thruster \xe2\x80\x94 Commercial (NEXT\xe2\x80
\x93C) ion engine will also be demonstrated, although the spacecraft\'s pr
imary propulsion is hydrazine thrusters. DART should arrive at Didymos in
 late September 2022, when it is about 11 million kilometers from Earth. T
en days before impact, the Italian Space Agency\'s cubesat LICIACube will
 be deployed to observe the collision and ejecta with its two cameras. Ear
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irbus Defense and Space\'s facilities in Toulouse, France, will soon be se
nt to the Cape Canaveral Space Launch Station located in Florida, United S
tates. The satellite will be launched into space onboard the Falcon 9 rock
et following pre-launch preparations. With an estimated in-orbit lifetime
 of 30 years and the aim of securing Turkey\xe2\x80\x99s orbital and frequ
ency rights, T\xc3\xbcrksat 5B will be launched into an orbital slot at 42
degrees East. With 12 kW power, T\xc3\xbcrksat 5B will provide TV broadcas
ting and data communication services over a wide coverage area that reache
s the entire Middle East, the Persian Gulf, the Red Sea, the Mediterranea
n, North Africa, East Africa, South Africa and Nigeria. Apart from that, t
he satellite will also provide customized services for airlines and commer
cial ship operators around the world thanks to the fact that it operates i
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h no earlier than 31 March 2022 and send four people to the ISS for an eig
ht-day stay","crew":["61eefc9c9eb1064137a1bd77","61eefcf89eb1064137a1bd7
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4"}]'

You should see the response contains massive information about SpaceX launches. Next, let's try to discover some more relevant information for this project.

Task 1: Request and parse the SpaceX launch data using the GET request

To make the requested JSON results more consistent, we will use the following static response object for this project:

In [9]:

```
static_json_url='https://cf-courses-data.s3.us.cloud-object-storage.appdomain.cloud/IBM
-DS0321EN-SkillsNetwork/datasets/API_call_spacex_api.json'
```

We should see that the request was successfull with the 200 status response code

In [10]:

```
response.status_code
```

Out[10]:

```
200
```

Now we decode the response content as a Json using `.json()` and turn it into a Pandas dataframe using `.json_normalize()`

In [11]:

```
# Use json_normalize meethod to convert the json result into a dataframe
data = pd.json_normalize(response.json())
```

Using the dataframe `data` print the first 5 rows

In [12]:

```
# Get the head of the dataframe
data.head()
```

Out[12]:

	static_fire_date_utc	static_fire_date_unix	net	window	rocket	succe
0	2006-03-17T00:00:00.000Z	1.142554e+09	False	0.0	5e9d0d95eda69955f709d1eb	Fa
1	None	NaN	False	0.0	5e9d0d95eda69955f709d1eb	Fa
2	None	NaN	False	0.0	5e9d0d95eda69955f709d1eb	Fa
3	2008-09-20T00:00:00.000Z	1.221869e+09	False	0.0	5e9d0d95eda69955f709d1eb	Tı
4	None	NaN	False	0.0	5e9d0d95eda69955f709d1eb	Tı

You will notice that a lot of the data are IDs. For example the rocket column has no information about the rocket just an identification number.

We will now use the API again to get information about the launches using the IDs given for each launch. Specifically we will be using columns `rocket`, `payloads`, `launchpad`, and `cores`.

In [13]:

```
# Lets take a subset of our dataframe keeping only the features we want and the flight
 number, and date_utc.
data = data[['rocket', 'payloads', 'launchpad', 'cores', 'flight_number', 'date_utc']]

# We will remove rows with multiple cores because those are falcon rockets with 2 extra
rocket boosters and rows that have multiple payloads in a single rocket.
data = data[data['cores'].map(len)==1]
data = data[data['payloads'].map(len)==1]

# Since payloads and cores are lists of size 1 we will also extract the single value in
the list and replace the feature.
data['cores'] = data['cores'].map(lambda x : x[0])
data['payloads'] = data['payloads'].map(lambda x : x[0])

# We also want to convert the date_utc to a datetime datatype and then extracting the d
ate leaving the time
data['date'] = pd.to_datetime(data['date_utc']).dt.date

# Using the date we will restrict the dates of the launches
data = data[data['date'] <= datetime.date(2020, 11, 13)]
```

- From the `rocket` we would like to learn the booster name
- From the `payload` we would like to learn the mass of the payload and the orbit that it is going to
- From the `launchpad` we would like to know the name of the launch site being used, the longitude, and the latitude.
- From `cores` we would like to learn the outcome of the landing, the type of the landing, number of flights with that core, whether gridfins were used, whether the core is reused, whether legs were used, the landing pad used, the block of the core which is a number used to seperate version of cores, the number of times this specific core has been reused, and the serial of the core.

The data from these requests will be stored in lists and will be used to create a new dataframe.

In [14]:

```
#Global variables
BoosterVersion = []
PayloadMass = []
Orbit = []
LaunchSite = []
Outcome = []
Flights = []
GridFins = []
Reused = []
Legs = []
LandingPad = []
Block = []
ReusedCount = []
Serial = []
Longitude = []
Latitude = []
```

These functions will apply the outputs globally to the above variables. Let's take a looks at `BoosterVersion` variable. Before we apply `getBoosterVersion` the list is empty:

In [15]:

```
BoosterVersion
```

Out[15]:

```
[]
```

Now, let's apply `getBoosterVersion` function method to get the booster version

In [16]:

```
# Call getBoosterVersion
getBoosterVersion(data)
```

the list has now been update

In [17]:

```
BoosterVersion[0:5]
```

Out[17]:

```
['Falcon 1', 'Falcon 1', 'Falcon 1', 'Falcon 1', 'Falcon 9']
```

we can apply the rest of the functions here:

In [18]:

```
# Call getLaunchSite
getLaunchSite(data)
```

In [19]:

```
# Call getPayloadData
getPayloadData(data)
```

In [20]:

```
# Call getCoreData
getCoreData(data)
```

Finally lets construct our dataset using the data we have obtained. We we combine the columns into a dictionary.

In [21]:

```
launch_dict = {'FlightNumber': list(data['flight_number']),
'Date': list(data['date']),
'BoosterVersion':BoosterVersion,
'PayloadMass':PayloadMass,
'Orbit':Orbit,
'LaunchSite':LaunchSite,
'Outcome':Outcome,
'Flights':Flights,
'GridFins':GridFins,
'Reused':Reused,
'Legs':Legs,
'LandingPad':LandingPad,
'Block':Block,
'ReusedCount':ReusedCount,
'Serial':Serial,
'Longitude': Longitude,
'Latitude': Latitude}
```

Then, we need to create a Pandas data frame from the dictionary launch_dict.

In [22]:

```
# Create a data from launch_dict
data = pd.DataFrame(launch_dict)
```

Show the summary of the dataframe

In [23]:

```
# Show the head of the dataframe
data.head()
```

Out[23]:

	FlightNumber	Date	BoosterVersion	PayloadMass	Orbit	LaunchSite	Outcome	Flights
0	1	2006-03-24	Falcon 1	20.0	LEO	Kwajalein Atoll	None None	1
1	2	2007-03-21	Falcon 1	NaN	LEO	Kwajalein Atoll	None None	1
2	4	2008-09-28	Falcon 1	165.0	LEO	Kwajalein Atoll	None None	1
3	5	2009-07-13	Falcon 1	200.0	LEO	Kwajalein Atoll	None None	1
4	6	2010-06-04	Falcon 9	NaN	LEO	CCSFS SLC 40	None None	1

Task 2: Filter the dataframe to only include `Falcon 9` launches

Finally we will remove the Falcon 1 launches keeping only the Falcon 9 launches. Filter the data dataframe using the `BoosterVersion` column to only keep the Falcon 9 launches. Save the filtered data to a new dataframe called `data_falcon9` .

In [24]:

```
# Hint data['BoosterVersion']!='Falcon 1'
data_falcon9 = data[data.BoosterVersion == 'Falcon 9']
```

Now that we have removed some values we should reset the FlgihtNumber column

In [25]:

```
pd.options.mode.chained_assignment = None
data_falcon9.loc[:,'FlightNumber'] = list(range(1, data_falcon9.shape[0]+1))
```

Data Wrangling

We can see below that some of the rows are missing values in our dataset.

In [26]:

```
data_falcon9.isnull().sum()
```

Out[26]:

```
FlightNumber       0
Date               0
BoosterVersion     0
PayloadMass        5
Orbit              0
LaunchSite         0
Outcome            0
Flights            0
GridFins           0
Reused             0
Legs               0
LandingPad        26
Block              0
ReusedCount        0
Serial             0
Longitude          0
Latitude           0
dtype: int64
```

Before we can continue we must deal with these missing values. The `LandingPad` column will retain None values to represent when landing pads were not used.

Task 3: Dealing with Missing Values

Calculate below the mean for the `PayloadMass` using the `.mean()`. Then use the mean and the `.replace()` function to replace `np.nan` values in the data with the mean you calculated.

In [27]:

```
# Calculate the mean value of PayloadMass column
Mean_PayloadMass = data_falcon9.PayloadMass.mean()

# Replace the np.nan values with its mean value
data_falcon9['PayloadMass'] = data_falcon9['PayloadMass'].replace(np.nan, Mean_PayloadMass)
```

You should see the number of missing values of the `PayLoadMass` change to zero.

Now we should have no missing values in our dataset except for in `LandingPad`.

We can now export it to a **CSV** for the next section,but to make the answers consistent, in the next lab we will provide data in a pre-selected date range.

```
data_falcon9.to_csv('dataset_part\_1.csv', index=False)
```

Authors

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Change Log

Date (YYYY-MM-DD)	Version	Changed By	Change Description
2020-09-20	1.1	Joseph	get result each time you run
2020-09-20	1.1	Azim	Created Part 1 Lab using SpaceX API
2020-09-20	1.0	Joseph	Modified Multiple Areas