

SpaceX Falcon 9 first stage Landing Prediction

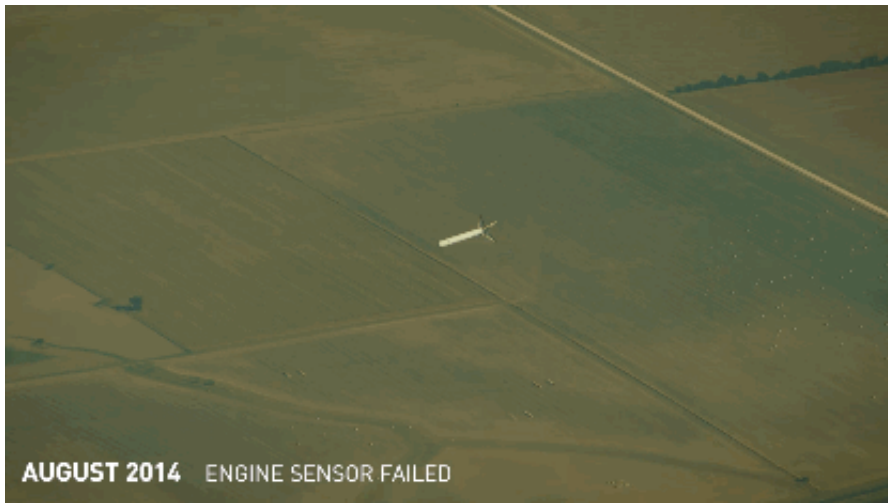
Lab 1: Collecting the data

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 formatting.

- 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 [23]: # Requests allows us to make HTTP requests which we will use to get data
import requests
# Pandas is a software library written for the Python programming language
import pandas as pd
# NumPy is a library for the Python programming language, adding support
import numpy as np
# Datetime is a library that allows us to represent dates
import datetime

# Setting this option will print all columns 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 [24]: # Takes the dataset and uses the rocket column to call the API and append
def getBoosterVersion(data):
    for x in data['rocket']:
        if x:
            response = requests.get("https://api.spacexdata.com/v4/rockets/"+
            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 [25]: # Takes the dataset and uses the launchpad column to call the API and app
def getLaunchSite(data):
    for x in data['launchpad']:
        if x:
            response = requests.get("https://api.spacexdata.com/v4/launchpad
            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 [26]: # Takes the dataset and uses the payloads column to call the API and appe
def getPayloadData(data):
    for load in data['payloads']:
        if load:
            response = requests.get("https://api.spacexdata.com/v4/payloads/"
            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 [27]: # Takes the dataset and uses the cores column to call the API and append
def getCoreData(data):
    for core in data['cores']:
        if core['core'] != None:
            response = requests.get("https://api.spacexdata.com/v4/co
            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['lan
    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 [28]: spacex_url="https://api.spacexdata.com/v4/launches/past"
```

```
In [29]: response = requests.get(spacex_url)
```

Check the content of the response

```
In [30]: print(response.content)
```

```
b' [{"fairings":{"reused":false,"recovery_attempt":false,"recovered":false
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```

```

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yloads":["5eb0e4beb6c3bb0006eeb1fc"],"launchpad":"5e9e4501f509094ba4566f84","flight_number":24,"name":"CRS-7","date_utc":"2015-06-28T14:21:00.000Z","date_unix":1435501260,"date_local":"2015-06-28T10:21:00-04:00","date_precision":"hour","upcoming":false,"cores":[{"core":"5e9e28a1f35918683c3b263a","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":"5eb87cefffd86e000604b341"},{"fairings":{"reused":false,"recovery_attempt":false,"recovered":false,"ships":[]},"links":{"patch":{"small":"https://images2.imgbox.com/6a/7e/J7IQfBqg_o.png","large":"https://images2.imgbox.com/99/d4/0aIlpFpw_o.png"},"reddit":{"campaign":null,"launch":"https://www.reddit.com/r/spacex/comments/3xgxh5","media":"https://www.reddit.com/r/spacex/comments/3xm83h/","recovery":null},"flickr":{"small":[],"original":["https://farm2.staticflickr.com/1648/23827554109_837b21739e_o.jpg","https://farm1.staticflickr.com/597/23802553412_d41e4dcc64_o.jpg","https://farm6.staticflickr.com/5806/23802550622_9ff8c90098_o.jpg","https://farm1.staticflickr.com/571/23604164970_2a1a2366e4_o.jpg","https://farm6.staticflickr.com/5773/23271687254_5e64d726ba_o.jpg","https://farm6.staticflickr.com/5766/23526044959_5bfe74bc88_o.jpg","https://farm6.staticflickr.com/5723/23785609832_83038751d1_o.jpg","https://farm1.staticflickr.com/715/23833499336_d3fde6a25a_o.jpg"]},"presskit":"http://www.spacex.com/sites/spacex/files/spacex_orbcomm_press_kit_final2.pdf","webcast":"https://www.youtube.com/watch?v=05bTbVbe4e4","youtube_id":"05bTbVbe4e4","article":"https://spaceflightnow.com/2015/12/22/round-trip-rocket-flight-gives-space-x-a-trifecta-of-successes/","wikipedia":"https://en.wikipedia.org/wiki/Falcon_9_flight_20"},"static_fire_date_utc":"2015-12-19T00:09:00.000Z","static_fire_date_unix":1450483740,"net":false,"window":0,"rocket":"5e9d0d95eda69973a809d1ec","success":true,"failures":[],"details":"Total payload mass was 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 (later called Falcon 9 Full Thrust), with a 30 percent power increase. Orbcomm had originally agreed to be the third flight of the enhanced-thrust rocket, 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 ground at Cape Canaveral, and succeeded.","crew":[],"ships":[],"capsules":[],"payloads":["5eb0e4beb6c3bb0006eeb1fd"],"launchpad":"5e9e4501f509094ba4566f84","flight_number":25,"name":"OG-2 Mission 2","date_utc":"2015-12-22T01:29:00.000Z","date_unix":1450747740,"date_local":"2015-12-22T21:29:00-04:00","date_precision":"hour","upcoming":false,"cores":[{"core":"5e9e28a1f3591867753b263b","flight":1,"gridfins":true,"legs":true,"reused":false,"landing_attempt":true,"landing_success":true,"landing_type":"RTLS","landpad":"5e9e3032383ecb267a34e7c7"}],"auto_update":true,"tbd":false,"launch_library_id":null,"id":"5eb87cefffd86e000604b342"},{"fairings":{"reused":false,"recovery_attempt":false,"recovered":false,"ships":[]},"links":{"patch":{"small":"https://images2.imgbox.com/8a/44/PSksEBjD_o.png","large":"https://images2.imgbox.com/d9/c9/57ioWDgW_o.png"},"reddit":{"campaign":null,"launch":"https://www.reddit.com/r/spacex/comments/417weg","media":"https://www.reddit.com/r/spacex/comments/41cvdm","recovery":null},"flickr":{"small":[],"original":["https://farm2.staticflickr.com/1460/24382360351_9b1f2fcabc_o.jpg","https://farm2.staticflickr.com/1669/24423604506_27d3c4548b_o.jpg","https://farm2.staticflickr.com/1618/24151425850_1cb6040569_o.jpg","https://farm2.staticflickr.com/1622/24127012370_07edc62046_o.jpg","https://farm2.staticflickr.com/1508/24127011190_92ef932c96_o.jpg","https://farm2.staticflickr.com/1591/23778325594_08231286fc_o.jpg","https://farm2.staticflickr.com/1542/24038722499_34c10216a3_o.jpg"]},"presskit":"http://www.spacex.com/sites/spacex/files/spacex_jason3_press_kit.pdf","webcast":"https://www.youtube.com/watch?v=ivdKRJzl6y0","youtube_id":"

ivdKRJzl6y0","article":"https://spaceflightnow.com/2016/01/18/satellite-launched-to-measure-motions-of-the-oceans/","wikipedia":"https://en.wikipedia.org/wiki/Jason-3"},"static_fire_date_utc":"2016-01-11T18:42:00.000Z","static_fire_date_unix":1452537720,"net":false,"window":0,"rocket":"5e9d0d95eda69973a809d1ec","success":true,"failures":[],"details":"First launch of NASA and NOAA joint 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 launch vehicle. The Jason-3 satellite was successfully deployed to target orbit. SpaceX again attempted a recovery of the first stage booster by landing 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 of the landing legs failed to latch, so that the booster fell over and exploded.", "crew":[],"ships":["5ea6ed2f080df4000697c910","5ea6ed30080df4000697c912","5ea6ed30080df4000697c914"],"capsules":[],"payloads":["5eb0e4beb6c3bb0006eeb1fe"],"launchpad":"5e9e4502f509092b78566f87","flight_number":26,"name":"Jason 3","date_utc":"2016-01-17T15:42:00.000Z","date_unix":1453045320,"date_local":"2016-01-17T08:42:00-07:00","date_precision":"hour","upcoming":false,"cores":[{"core":"5e9e28a1f3591842fa3b263c","flight":1,"gridfins":true,"legs":true,"reused":false,"landing_attempt":true,"landing_success":false,"landing_type":"ASDS","landpad":"5e9e3033383ecbb9e534e7cc"}],"auto_update":true,"tbd":false,"launch_library_id":null,"id":"5eb87cf0ffd86e000604b343"},"fairings":{"reused":false,"recovery_attempt":false,"recovered":false,"ships":[]},"links":{"patch":{"small":"https://images2.imgbox.com/7f/15/rjv54Es5_o.png","large":"https://images2.imgbox.com/c9/7f/EQ1g4Iv2_o.png"},"reddit":{"campaign":null,"launch":"https://www.reddit.com/r/spacex/comments/48u4yq","media":"https://www.reddit.com/r/spacex/comments/472k8c","recovery":null},"flickr":{"small":[],"original":["https://farm2.staticflickr.com/1623/25395662282_942fd68ba3_o.jpg","https://farm2.staticflickr.com/1458/25395661442_bfd783f18a_o.jpg","https://farm2.staticflickr.com/1641/25421381351_38390bcb8e_o.jpg","https://farm2.staticflickr.com/1616/25514167315_b19b0a4365_o.jpg","https://farm2.staticflickr.com/1482/24883160354_b03cefd416_o.jpg","https://farm2.staticflickr.com/1653/25420915781_8fc648b4a4_o.jpg","https://farm2.staticflickr.com/1610/25486858116_9c06dfea59_o.jpg","https://farm2.staticflickr.com/1617/25168697841_00dfff89bb_o.jpg","https://farm2.staticflickr.com/1533/24631230904_83b1624807_o.jpg","https://farm2.staticflickr.com/1627/25145624551_1b8743116f_o.jpg","https://farm2.staticflickr.com/1622/25120540712_7fc1a5ed72_o.jpg","https://farm2.staticflickr.com/1550/24585667074_aa712b13a8_o.jpg"]},"presskit":"http://www.spacex.com/sites/spacex/files/spacex_ses9_press_kit_final.pdf","webcast":"https://www.youtube.com/watch?v=muDPSy07-A0","youtube_id":"muDPSy07-A0","article":"https://spaceflightnow.com/2016/03/05/tv-broadcasting-satellite-finally-launched-on-falcon-9/","wikipedia":"https://en.wikipedia.org/wiki/SES-9"},"static_fire_date_utc":"2016-10-02T14:11:00.000Z","static_fire_date_unix":1475417460,"net":false,"window":5400,"rocket":"5e9d0d95eda69973a809d1ec","success":true,"failures":[],"details":"Second launch of the enhanced Falcon 9 Full Thrust launch vehicle. Following the launch, SpaceX attempted an experimental landing test to a drone ship, although a successful landing was not expected because launch mass exceeded previously indicated limit for a GTO there was little fuel left. As predicted, booster recovery failed: the spent first stage \"landed hard\", but the controlled-descent, atmospheric re-entry and navigation to the drone ship were successful and returned significant test data on bringing back high-energy Falcon 9s.", "crew":[],"ships":["5ea6ed2e080df4000697c906","5ea6ed2f080df4000697c90b","5ea6ed2f080df4000697c90c","5ea6ed30080df4000697c913"],"capsules":[],"payloads":["5eb0e4beb6c3bb0006eeb1ff"],"launchpad":"5e9e4501f509094ba4566f84","flight_number":27,"name":"SES-9","date_utc":"2016-03-04T23:35:00.000Z","date_unix":145

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_success":false,"landing_type":"ASDS","landpad":"5e9e3032383ecb6bb234e7ca
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.reddit.com/r/spacex/comments/4dtoly","media":"https://www.reddit.com/r/s
pacex/comments/4dtpxn/","recovery":"https://www.reddit.com/r/spacex/comme
nts/4ee2zy"},"flickr":{"small":[],"original":["https://farm2.staticflickr
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ttps://farm2.staticflickr.com/1449/25709481274_60f8c77358_o.jpg","https:/
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r.com/1495/25916886442_821a152917_o.jpg"]},"presskit":"http://www.spacex.
com/sites/spacex/files/spacex_crs8_press_kit.pdf","webcast":"https://www.
youtube.com/watch?v=7pUAYdjne5M","youtube_id":"7pUAYdjne5M","article":"ht
tps://spaceflightnow.com/2016/04/08/spacex-lands-rocket-on-floating-platf
orm-after-station-resupply-launch/","wikipedia":"https://en.wikipedia.org
/wiki/SpaceX_CRS-8"},"static_fire_date_utc":"2016-04-05T00:00:00.000Z","s
tatic_fire_date_unix":1459814400,"net":false,"window":0,"rocket":"5e9d0d9
5eda69973a809d1ec","success":true,"failures":[],"details":"Dragon carried
over 1500 kg of supplies and delivered (stowed in its trunk) the inflatab
le Bigelow Expandable Activity Module (BEAM) to the ISS for two years of
in-orbit tests. The rocket's first stage landed smoothly on SpaceX's au
tonomous 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
of an orbital launch. The first stage B1021 was later also the first orbi
tal booster to be used again, when launching SES-10 on March 30, 2017.",
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uto_update":true,"tbd":false,"launch_library_id":null,"id":"5eb87cf3ffd86
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XT will replace the original Iridium constellation, launched in the late
1990s. Each Falcon mission will carry 10 satellites, with a goal to compl
ete deployment of the 66 plus 9 spare satellite constellation by mid 2018
. The first two Iridium qualification units were supposed to ride a Dnepr
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first batch of 10 satellites instead.", "crew":[],"ships":["5ea6ed2f080df4
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lightnow.com/2017/02/19/historic-launch-pad-back-in-service-with-thunderi
ng-blastoff-by-spacex/","wikipedia":"https://en.wikipedia.org/wiki/SpaceX
_CRS-10"},"static_fire_date_utc":"2017-02-12T21:30:00.000Z","static_fire_
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Reused booster from third Iridium flight, and although controlled descent was performed, the booster was expended into the ocean. SpaceX planned a second recovery attempt of one half of the fairing using the specially modified boat Mr. Steven. However, the fairing's parafoil twisted during the recovery, which led to water impact at high speed"](https://www.spacex.com/sites/spacex/files/iridium-5_press_kit_2018.pdf),["crew":\[\]](https://www.spacex.com/sites/spacex/files/iridium-5_press_kit_2018.pdf),["ships":\["5ea6ed2e080df4000697c908"\]](https://www.spacex.com/sites/spacex/files/iridium-5_press_kit_2018.pdf),["capsules":\[\]](https://www.spacex.com/sites/spacex/files/iridium-5_press_kit_2018.pdf),["payloads":\["5eb0e4c7b6c3bb0006eeb220"\]](https://www.spacex.com/sites/spacex/files/iridium-5_press_kit_2018.pdf),["launchpad":"5e9e4502f509092b78566f87"](https://www.spacex.com/sites/spacex/files/iridium-5_press_kit_2018.pdf),["flight_number":58](https://www.spacex.com/sites/spacex/files/iridium-5_press_kit_2018.pdf),["name":"Iridium NEXT Mission 5"](https://www.spacex.com/sites/spacex/files/iridium-5_press_kit_2018.pdf),["date_utc":"2018-03-30T14:13:51.000Z"](https://www.spacex.com/sites/spacex/files/iridium-5_press_kit_2018.pdf),["date_unix":1522419231](https://www.spacex.com/sites/spacex/files/iridium-5_press_kit_2018.pdf),["date_local":"2018-03-30T07:13:51-08:00"](https://www.spacex.com/sites/spacex/files/iridium-5_press_kit_2018.pdf),["date_precision":"hour"](https://www.spacex.com/sites/spacex/files/iridium-5_press_kit_2018.pdf),["upcoming":false](https://www.spacex.com/sites/spacex/files/iridium-5_press_kit_2018.pdf),["cores":\[{"core":"5e9e28a4f3591843103b2650","flight":2,"gridfins":true,"legs":true,"reused":true,"landing_attempt":false,"landing_success":null,"landing_type":null,"landpad":null}\],](https://www.spacex.com/sites/spacex/files/iridium-5_press_kit_2018.pdf)["auto_update":true](https://www.spacex.com/sites/spacex/files/iridium-5_press_kit_2018.pdf),["tbd":false](https://www.spacex.com/sites/spacex/files/iridium-5_press_kit_2018.pdf),["launch_library_id":null](https://www.spacex.com/sites/spacex/files/iridium-5_press_kit_2018.pdf),["id":"5eb87d16ffd86e000604b363"}},{"fairings":null,"links":{"patch":{"small":"https://images2.imgbox.com/49/e8/6TmdhwLq_o.png","large":"https://images2.imgbox.com/28/c4/dc3rQbGy_o.png"},"reddit":{"campaign":"https://www.reddit.com/r/spacex/comments/82op7a/crs14_launch_campaign_thread/","launch":"https://www.reddit.com/r/spacex/comments/88s8a7/rspacex_crs14_official_launch_discussion_updates/","media":"https://www.reddit.com/r/spacex/comments/88l52i/rspacex_crs14_media_thread_videos_images_gifs/","recovery":null},"flickr":{"small":\[\],"original":\["https://farm1.staticflickr.com/819/26326005987_c3aec29db5_o.jpg","https://farm1.staticflickr.com/791/40303273215_4926c917c4_o.jpg","https://farm1.staticflickr.com/867/26326007227_39e71e6775_o.jpg"\]}},\["presskit":"http://www.spacex.com/sites/spacex/files/crs-14presskit2018.pdf"\]\(http://www.spacex.com/sites/spacex/files/crs-14presskit2018.pdf\),\["webcast":"https://www.youtube.com/watch?v=BPQHG-LevZM"\]\(https://www.youtube.com/watch?v=BPQHG-LevZM\),\["youtube_id":"BPQHG-LevZM"\]\(https://www.youtube.com/watch?v=BPQHG-LevZM\),\["article":"https://spaceflightnow.com/2018/04/02/spacex-supply-ship-departs-cape-canaveral-for-space-station/"\]\(https://spaceflightnow.com/2018/04/02/spacex-supply-ship-departs-cape-canaveral-for-space-station/\),\["wikipedia":"https://en.wikipedia.org/wiki/SpaceX_CRS-14"\]\(https://en.wikipedia.org/wiki/SpaceX_CRS-14\)},\["static_fire_date_utc":"2018-03-28T15:52:00.000Z"\]\(https://www.spacex.com/sites/spacex/files/iridium-5_press_kit_2018.pdf\),\["static_fire_date_unix":1522252320\]\(https://www.spacex.com/sites/spacex/files/iridium-5_press_kit_2018.pdf\),\["net":false\]\(https://www.spacex.com/sites/spacex/files/iridium-5_press_kit_2018.pdf\),\["window":0\]\(https://www.spacex.com/sites/spacex/files/iridium-5_press_kit_2018.pdf\),\["rocket":"5e9d0d95eda69973a809d1ec"\]\(https://www.spacex.com/sites/spacex/files/iridium-5_press_kit_2018.pdf\),\["success":true\]\(https://www.spacex.com/sites/spacex/files/iridium-5_press_kit_2018.pdf\),\["failures":\\[\\]\]\(https://www.spacex.com/sites/spacex/files/iridium-5_press_kit_2018.pdf\),\["details":"The launch used a refurbished booster \\(from CRS-12\\) for the 11th time, and a refurbished capsule \\(C110 from CRS-8\\) for the third time. External payloads include a materials research platform MISSE-FF phase 3 of the Robotic Refueling Mission TSIS, heliophysics sensor several crystallization experiments, and the RemoveDebris spacecraft aimed at space junk removal. The booster was expended in order to test a new landing profile."\]\(https://www.spacex.com/sites/spacex/files/iridium-5_press_kit_2018.pdf\),\["crew":\\[\\]\]\(https://www.spacex.com/sites/spacex/files/iridium-5_press_kit_2018.pdf\),\["ships":\\["5ea6ed30080df4000697c912"\\]\]\(https://www.spacex.com/sites/spacex/files/iridium-5_press_kit_2018.pdf\),\["capsules":\\["5e9e2c5cf3591885d43b266d"\\]\]\(https://www.spacex.com/sites/spacex/files/iridium-5_press_kit_2018.pdf\),\["payloads":\\["5eb0e4c7b6c3bb0006eeb221"\\]\]\(https://www.spacex.com/sites/spacex/files/iridium-5_press_kit_2018.pdf\),\["launchpad":"5e9e4501f509094ba4566f84"\]\(https://www.spacex.com/sites/spacex/files/iridium-5_press_kit_2018.pdf\),\["flight_number":59\]\(https://www.spacex.com/sites/spacex/files/iridium-5_press_kit_2018.pdf\),\["name":"CRS-14"\]\(https://www.spacex.com/sites/spacex/files/iridium-5_press_kit_2018.pdf\),\["date_utc":"2018-04-02T20:30:41.000Z"\]\(https://www.spacex.com/sites/spacex/files/iridium-5_press_kit_2018.pdf\),\["date_unix":1522701041\]\(https://www.spacex.com/sites/spacex/files/iridium-5_press_kit_2018.pdf\),\["date_local":"2018-04-02T16:30:41-04:00"\]\(https://www.spacex.com/sites/spacex/files/iridium-5_press_kit_2018.pdf\),\["date_precision":"hour"\]\(https://www.spacex.com/sites/spacex/files/iridium-5_press_kit_2018.pdf\),\["upcoming":false\]\(https://www.spacex.com/sites/spacex/files/iridium-5_press_kit_2018.pdf\),\["cores":\\[{"core":"5e9e28a4f3591884ee3b264d","flight":2,"gridfins":true,"legs":true,"reused":true,"landing_attempt":false,"landing_success":null,"landing_type":null,"landpad":null}\\],\]\(https://www.spacex.com/sites/spacex/files/iridium-5_press_kit_2018.pdf\)\["auto_update":true\]\(https://www.spacex.com/sites/spacex/files/iridium-5_press_kit_2018.pdf\),\["tbd":false\]\(https://www.spacex.com/sites/spacex/files/iridium-5_press_kit_2018.pdf\),\["launch_library_id":null\]\(https://www.spacex.com/sites/spacex/files/iridium-5_press_kit_2018.pdf\),\["id":"5eb87d16ffd86e000604b364"}},{"fairings":{"reused":false,"recovery_attempt":false,"recovered":false,"ships":\\[\\]},"links":{"patch":{"sm\]\(https://www.spacex.com/sites/spacex/files/iridium-5_press_kit_2018.pdf\)](https://www.spacex.com/sites/spacex/files/iridium-5_press_kit_2018.pdf)

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com/2018/11/15/spacex-launches-qatars-eshail-2-communications-satellite/"
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rst for Es'hailSat. Es'hail-2 is a communications satellite delivering
television and internet to Qatar and the surrounding region. It was launc
hed into a geostationary transfer orbit from LC-39A at Kennedy Space Cent
er. The booster landed on OCISLY.", "crew":[],"ships":["5ea6ed2f080df40006
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er, due to the ongoing investigation and clean-up following the Crew Drag on testing incident, it is likely to land on OCISLY instead.\\n", "crew": [], "ships": ["5ea6ed30080df4000697c913", "5ea6ed2f080df4000697c90e", "5ea6ed2f080df4000697c90b"], "capsules": ["5e9e2c5cf3591869b63b2670"], "payloads": ["5eb0e4cbb6c3bb0006eeb237"], "launchpad": "5e9e4501f509094ba4566f84", "flight_number": 78, "name": "CRS-17", "date_utc": "2019-05-04T06:48:00.000Z", "date_unix": 1556952480, "date_local": "2019-05-04T02:48:00-04:00", "date_precision": "hour", "upcoming": false, "cores": [{"core": "5e9e28a7f3591809313b2660", "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": "5eb87d2effd86e000604b377", {"fairings": {"reused": false, "recovery_attempt": true, "recovered": true, "ships": ["5ea6ed2f080df4000697c90c"]}}, {"links": {"patch": {"small": "https://images2.imgbox.com/79/ec/T0E2PBjq_o.png", "large": "https://images2.imgbox.com/39/aa/5of7buxK_o.png"}, "reddit": {"campaign": "https://www.reddit.com/comments/bjybrl", "launch": "https://www.reddit.com/r/spacex/comments/brfbic/rspacex_starlink_official_launch_discussion", "media": "https://www.reddit.com/r/spacex/comments/bp0479/rspacex_starlink_media_thread_videos_images_gifs", "recovery": "https://www.reddit.com/r/spacex/comments/bsaljm/rspacex_starlink_b10493_recovery_discussion_and"}, "flickr": {"small": [], "original": ["https://live.staticflickr.com/65535/47926143711_4a0b2680bf_o.jpg", "https://live.staticflickr.com/65535/47926136902_d8ce35223d_o.jpg", "https://live.staticflickr.com/65535/47926144123_2a828b66d5_o.jpg", "https://live.staticflickr.com/65535/47926137127_ef58152b6b_o.jpg", "https://live.staticflickr.com/65535/47926137017_e6d86fa820_o.jpg"]}}, "presskit": "https://www.spacex.com/sites/spacex/files/starlink_press_kit.pdf", "webcast": "https://www.youtube.com/watch?v=riBaVeDTEWI", "youtube_id": "riBaVeDTEWI", "article": "https://spaceflightnow.com/2019/05/24/spacexs-first-60-starlink-broadband-satellites-deployed-in-orbit", "wikipedia": "https://en.wikipedia.org/wiki/Starlink_(satellite_constellation)"}, {"static_fire_date_utc": "2019-05-13T20:06:00.000Z", "static_fire_date_unix": 155777960, "net": false, "window": 9000, "rocket": "5e9d0d95eda69973a809d1ec", "success": true, "failures": [], "details": "SpaceX will launch dozens of Starlink demonstration satellites from SLC-40, Cape Canaveral AFS. Starlink is a low Earth orbit 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 prototype satellites, Microsats 2a and 2b, were launched from Vandenberg AFB in February 2018. The booster for this mission will land on OCISLY.", "crew": [], "ships": ["5ea6ed30080df4000697c913", "5ea6ed2f080df4000697c90c", "5ea6ed2f080df4000697c90e", "5ea6ed2f080df4000697c90b", "5ea6ed2e080df4000697c909"], "capsules": [], "payloads": ["5eb0e4cbb6c3bb0006eeb238"], "launchpad": "5e9e4501f509094ba4566f84", "flight_number": 79, "name": "Starlink v0.9", "date_utc": "2019-05-24T02:30:00.000Z", "date_unix": 1558665000, "date_local": "2019-05-23T22:30:00-04:00", "date_precision": "hour", "upcoming": false, "cores": [{"core": "5e9e28a5f3591833b13b2659", "flight": 3, "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": "5eb87d30ffd86e000604b378", {"fairings": {"reused": false, "recovery_attempt": false, "recovered": null, "ships": []}}, {"links": {"patch": {"small": "https://images2.imgbox.com/39/af/ygmjLYhv_o.png", "large": "https://images2.imgbox.com/03/18/xlkSHLy1_o.png"}, "reddit": {"campaign": "https://www.reddit.com/r/spacex/comments/buq487/radar_sat_constellation_launch_campaign_thread", "launch": "https://www.reddit.com/r/spacex/comments/byp69f/rspacex_radarsat_constellation_official_launch", "media": null, "recovery": null}, "flickr": {"small": [], "original": ["https://live.staticflickr.com/65535/48052269657_71764b0fb3_o.jpg", "https://live.

staticflickr.com/65535/48052269617_34447619f0_o.jpg", "https://live.staticflickr.com/65535/48052224858_20ea2a411e_o.jpg", "https://live.staticflickr.com/65535/48052269562_325c117b81_o.jpg", "https://live.staticflickr.com/65535/48052182461_a419db6b84_o.jpg", "https://live.staticflickr.com/65535/48052224733_f89f1dd046_o.jpg"]}, "presskit": "https://www.spacex.com/sites/spacex/files/radarsat_constellation_mission_press_kit.pdf", "webcast": "https://youtu.be/8A2nJd9UrK8", "youtube_id": "8A2nJd9UrK8", "article": "https://spaceflightnow.com/2019/06/12/three-canadian-radar-surveillance-satellites-ride-spacex-rocket-into-orbit/", "wikipedia": "https://en.wikipedia.org/wiki/RADARSAT_Constellation"}, {"static_fire_date_utc": "2019-06-08T08:39:00.000Z", "static_fire_date_unix": 1559983140, "net": false, "window": 780, "rocket": "5e9d0d95eda69973a809d1ec", "success": true, "failures": [], "details": "Space X is launching the three satellite RADARSAT Constellation Mission into Sun Synchronous orbit from SLC-4E, VAFB. The RCM spacecraft are synthetic aperture radar (SAR) Earth observation satellites built by the Canadian space company, MDA, for the Canadian Space Agency. This mission was delayed when the originally slated booster failed to land after CRS-16. The booster is expected to return to LZ-4.", "crew": [], "ships": [], "capsules": [], "payloads": ["5eb0e4ccb6c3bb0006eeb239"], "launchpad": "5e9e4502f509092b78566f87", "flight_number": 80, "name": "RADARSAT Constellation", "date_utc": "2019-06-12T14:17:00.000Z", "date_unix": 1560349020, "date_local": "2019-06-12T07:17:00-07:00", "date_precision": "hour", "upcoming": false, "cores": [{"core": "5e9e28a6f35918c0803b265c", "flight": 2, "gridfins": true, "legs": true, "reused": true, "landing_attempt": true, "landing_success": true, "landing_type": "RTLS", "landpad": "5e9e3032383ecb554034e7c9"}], "auto_update": true, "tbd": false, "launch_library_id": null, "id": "5eb87d31ffd86e000604b379"}, {"fairings": {"reused": false, "recovery_attempt": true, "recovered": true, "ships": ["5ea6ed2e080df4000697c908"]}, "links": {"patch": {"small": "https://images2.imgbox.com/b0/90/fA4QaCAi_o.png", "large": "https://images2.imgbox.com/81/9e/p6AaiJwj_o.png"}, "reddit": {"campaign": "https://www.reddit.com/r/spacex/comments/bw6aa8/stp2_launch_campaign_thread/", "launch": "https://www.reddit.com/r/spacex/comments/c40a29/rspacex_stp2_official_launch_discussion_updates", "media": "https://www.reddit.com/r/spacex/comments/c4ng3a/rspacex_stp2_media_thread_videos_images_gifs", "recovery": null}, "flickr": {"small": [], "original": ["https://live.staticflickr.com/65535/48129211778_83c1769305_o.jpg", "https://live.staticflickr.com/65535/48129211908_8390c775b0_o.jpg", "https://live.staticflickr.com/65535/48129182836_fd53e5646b_o.jpg", "https://live.staticflickr.com/65535/48129269897_22d854be5c_o.jpg", "https://live.staticflickr.com/65535/48129182631_572051790c_o.jpg", "https://live.staticflickr.com/65535/48129211693_d23b0287f1_o.jpg", "https://live.staticflickr.com/65535/48129269942_eb9b5c25bc_o.jpg"]}, "presskit": "https://www.spacex.com/sites/spacex/files/stp-2_press_kit.pdf", "webcast": "https://youtu.be/WxH4CAIhtiQ", "youtube_id": "WxH4CAIhtiQ", "article": "https://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, "rocket": "5e9d0d95eda69974db09d1ed", "success": true, "failures": [], "details": "Space Test Program 2 is a rideshare managed by the U.S. Air Force Space and Missile Systems Center (SMC), launching from LC-39A, KSC. Most of the spacecraft will be delivered into low Earth orbit (LEO) in two deployment sequences separated by a second stage burn. These LEO payloads include the six Taiwan and United States owned COSMIC-2 microsatellites, the Planetary Society's LightSail-B demonstrator cubesat, and others. The third and final deployment 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 side cores from Arabsat 6A, which will return to LZ-1, and LZ-2. The new center core will boost b

ack to land on OCISLY less than 40 km from the launch site.", "crew": [], "ships": ["5ea6ed30080df4000697c913", "5ea6ed2f080df4000697c90b", "5ea6ed2e080df4000697c909", "5ea6ed2e080df4000697c908", "5ea6ed2f080df4000697c90e"], "capsules": [], "payloads": ["5eb0e4ccb6c3bb0006eeb23a", "5eb0e4ccb6c3bb0006eeb23b", "5eb0e4ccb6c3bb0006eeb23c", "5eb0e4ccb6c3bb0006eeb23d", "5eb0e4ccb6c3bb0006eeb23e", "5eb0e4cdb6c3bb0006eeb23f", "5eb0e4cdb6c3bb0006eeb240", "5eb0e4cdb6c3bb0006eeb241", "5eb0e4cdb6c3bb0006eeb242", "5eb0e4cdb6c3bb0006eeb243", "5eb0e4cdb6c3bb0006eeb244", "5eb0e4cdb6c3bb0006eeb245", "5eb0e4ceb6c3bb0006eeb246", "5eb0e4ceb6c3bb0006eeb247", "5eb0e4ceb6c3bb0006eeb248", "5eb0e4ceb6c3bb0006eeb249"], "launchpad": "5e9e4502f509094188566f88", "flight_number": 81, "name": "STP-2", "date_utc": "2019-06-25T03:30:00.000Z", "date_unix": 1561433400, "date_local": "2019-06-24T23:30:00-04:00", "date_precision": "hour", "upcoming": false, "cores": [{"core": "5e9e28a7f3591878063b2661", "flight": 1, "gridfins": true, "legs": true, "reused": false, "landing_attempt": true, "landing_success": false, "landing_type": "ASDS", "landpad": "5e9e3032383ecb6bb234e7ca"}, {"core": "5e9e28a6f359183c413b265d", "flight": 2, "gridfins": true, "legs": true, "reused": true, "landing_attempt": true, "landing_success": true, "landing_type": "RTLS", "landpad": "5e9e3032383ecb267a34e7c7"}, {"core": "5e9e28a6f359188fd53b265e", "flight": 2, "gridfins": true, "legs": true, "reused": true, "landing_attempt": true, "landing_success": true, "landing_type": "RTLS", "landpad": "5e9e3032383ecb90a834e7c8"}], "auto_update": true, "tbd": false, "launch_library_id": null, "id": "5eb87d35ffd86e000604b37a", {"fairings": null, "links": {"patch": {"small": "https://images2.imgbox.com/f1/70/USGBp3Dy_o.png", "large": "https://images2.imgbox.com/79/a5/ZdV48Vw0_o.png"}, "reddit": {"campaign": "https://www.reddit.com/r/spacex/comments/c8k6g5/crs18_launch_campaign_thread", "launch": "https://www.reddit.com/r/spacex/comments/ch2ml7/rspacex_crs18_official_launch_discussion_updates/", "media": "https://www.reddit.com/r/spacex/comments/chbr8i/rspacex_crs18_media_thread_videos_images_gifs/", "recovery": null}, "flickr": {"small": [], "original": ["https://live.staticflickr.com/65535/48380511527_190682b573_o.jpg", "https://live.staticflickr.com/65535/48380370691_7b0757a4d3_o.jpg", "https://live.staticflickr.com/65535/48380511492_51db1bf984_o.jpg", "https://live.staticflickr.com/65535/48380370626_a5d264c637_o.jpg", "https://live.staticflickr.com/65535/48380511427_97db52a9e3_o.jpg"]}, "presskit": "https://www.spacex.com/sites/spacex/files/crs-18_press_kit.pdf", "webcast": "https://youtu.be/SlgrxVuP5jk", "youtube_id": "SlgrxVuP5jk", "article": "https://spaceflightnow.com/2019/07/25/new-docking-port-spacesuit-and-supplies-en-route-to-space-station/", "wikipedia": "https://en.wikipedia.org/wiki/SpaceX_CRS-18"}, "static_fire_date_utc": "2019-07-19T15:31:00.000Z", "static_fire_date_unix": 1563550260, "net": false, "window": 0, "rocket": "5e9d0d95eda69973a809d1ec", "success": true, "failures": [], "details": "SpaceX's 18th Commercial Resupply Services mission out of a total of 20 such contracted flights for NASA, this launch will deliver essential supplies to the International Space Station using the reusable Dragon 1 cargo spacecraft. The external payload for this mission is International Docking Adapter 3, replacing IDA-1 lost in SpaceX's CRS-7 launch failure. This mission will launch from SLC-40 at Cape Canaveral AFS on a Falcon 9, and the first-stage booster is expected to land back at CCAFS LZ-1.", "crew": [], "ships": [], "capsules": ["5e9e2c5cf359188bfb3b266b"], "payloads": ["5eb0e4ceb6c3bb0006eeb24a"], "launchpad": "5e9e4501f509094ba4566f84", "flight_number": 82, "name": "CRS-18", "date_utc": "2019-07-25T22:01:00.000Z", "date_unix": 1564092060, "date_local": "2019-07-25T18:01:00-04:00", "date_precision": "hour", "upcoming": false, "cores": [{"core": "5e9e28a7f3591809313b2660", "flight": 2, "gridfins": true, "legs": true, "reused": true, "landing_attempt": true, "landing_success": true, "landing_type": "RTLS", "landpad": "5e9e3032383ecb267a34e7c7"}], "auto_update": true, "tbd": false, "launch_library_id": null, "id": "5eb87d36ffd86e000604b37b", {"fairings": {"reused": false, "recovery_attempt": true, "recovered": true, "ships": ["5ea6ed2e080df4000697c908"]}, "links"

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rom SLC-40, Cape Canaveral AFS. They are expected to contribute to the 55 0 km x 53 shell. It is the second 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 satellites 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/5d/26/ZP75Il1j_o.png", "large": "https://images2.imgbox.com/6e/76/jVcSQg0K_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/2c/03/fMLdgNQ4_o.png", "large": "https://images2.imgbox.com/73/e2/4I30s6n7_o.png"}, "reddit": {"campaign": "https://www.reddit.com/r/spacex/comments/e5w6i8/jcsat18kacific1_launch_campaign_thread", "launch": "https://www.reddit

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und terminals around the world. The booster for this mission is expected to land on OCISLY.", "crew": [], "ships": ["5ea6ed2e080df4000697c908", "5ea6ed30080df4000697c913", "5ea6ed2e080df4000697c909", "5ea6ed2f080df4000697c90b", "5ea6ed2f080df4000697c90d"], "capsules": [], "payloads": ["5eb0e4cfb6c3bb0006eeb24f"], "launchpad": "5e9e4501f509094ba4566f84", "flight_number": 87, "name": "Starlink-2", "date_utc": "2020-01-07T02:19:00.000Z", "date_unix": 1578363540, "date_local": "2020-01-06T21:19:00-05:00", "date_precision": "hour", "upcoming": false, "cores": [{"core": "5e9e28a5f3591833b13b2659", "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": "5eb87d3cffd86e000604b380", {"fairings": {"reused": null, "recovery_attempt": null, "recovered": null, "ships": []}, "links": {"patch": {"small": "https://images2.imgbox.com/c0/9d/SJYvC4hT_o.png", "large": "https://images2.imgbox.com/19/df/IH0nVnSr_o.png"}, "reddit": {"campaign": "https://www.reddit.com/r/spacex/comments/ek7eny/in_flight_abort_test_launch_campaign_thread", "launch": "https://www.reddit.com/r/spacex/comments/eq24ap/rspacex_inflight_abort_test_official_launch", "media": "https://www.reddit.com/r/spacex/comments/eq7pg4/rspacex_inflight_abort_test_media_thread_videos/", "recovery": null}, "flickr": {"small": [], "original": ["https://live.staticflickr.com/65535/49421605028_b7ba890f0e_o.jpg", "https://live.staticflickr.com/65535/49422067976_cda2b8f021_o.jpg", "https://live.staticflickr.com/65535/49422067876_13ed519fe6_o.jpg", "https://live.staticflickr.com/65535/49421604803_0093a5d2cb_o.jpg", "https://live.staticflickr.com/65535/4942294602_0d5e7d8e82_o.jpg", "https://live.staticflickr.com/65535/49422068111_2ed613b19b_o.jpg"]}, "presskit": "https://www.spacex.com/sites/spacex/files/in-flight_abort_test_press_kit.pdf", "webcast": "https://youtu.be/mhrkdHshb3E", "youtube_id": "mhrkdHshb3E", "article": "https://spaceflightnow.com/2020/01/19/spacex-aces-final-major-test-before-first-crew-mission", "wikipedia": "https://en.wikipedia.org/wiki/Commercial_Crew_Development"}, "static_fire_date_utc": "2020-01-11T09:42:00.000Z", "static_fire_date_unix": 1578735720, "net": false, "window": 14400, "rocket": "5e9d0d95eda69973a809d1ec", "success": true, "failures": [], "details": "SpaceX will launch a Crew Dragon capsule 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 part of NASA's Commercial Crew Integrated Capability program (CCiCap) this test will contribute valuable data to help validate Crew Dragon and its launch abort system. The Crew Dragon will be recovered by GO Searcher after splashdown in the Atlantic Ocean. This flight does not go to orbit. The booster and upper stage are expected to break up following capsule separation and there will be no landing attempt.", "crew": [], "ships": ["5ea6ed2f080df4000697c90c"], "capsules": ["5e9e2c5df359184c9a3b2672"], "payloads": ["5eb0e4d0b6c3bb0006eeb250"], "launchpad": "5e9e4502f509094188566f88", "flight_number": 88, "name": "Crew Dragon In Flight Abort Test", "date_utc": "2020-01-19T14:00:00.000Z", "date_unix": 1579442400, "date_local": "2020-01-19T09:00:00-05:00", "date_precision": "hour", "upcoming": false, "cores": [{"core": "5e9e28a5f359182b023b2656", "flight": 4, "gridfins": false, "legs": false, "reused": true, "landing_attempt": false, "landing_success": null, "landing_type": null, "landpad": null}], "auto_update": true, "tbd": false, "launch_library_id": null, "id": "5eb87d3dffd86e000604b381", {"fairings": {"reused": false, "recovery_attempt": true, "recovered": true, "ships": ["5ea6ed2e080df4000697c908"]}, "links": {"patch": {"small": "https://images2.imgbox.com/3a/c6/ueu9Acdh_o.png", "large": "https://images2.imgbox.com/1c/55/xNcI0R8Z_o.png"}, "reddit": {"campaign": "https://www.reddit.com/r/spacex/comments/eof5pr/starlink3_launch_campaign_thread/", "launch": "https://www.reddit.com/r/spacex/comments/eudve3/rspacex_starlink_3_official_launch_discussion/", "media": "https://www.reddit.com/r/spacex/comments/evjdw5/rspacex_starlink3_media_thread_videos_images_gifs/", "recovery": "https://www.redd

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It is the ninth Starlink launch overall. The satellites will be delivered to low Earth orbit and will spend a few weeks maneuvering to their operational altitude of 550 km. This mission includes rideshare payloads, SkySats 16-18, on top of the Starlink stack. 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e of 550 km. The booster for this mission is expected to land on JRTI.", "crew": [], "ships": ["5ea6ed2f080df4000697c910", "5ea6ed2f080df4000697c90b", "5ea6ed2e080df4000697c907", "5ea6ed2e080df4000697c908"], "capsules": [], "payloads": ["5ef6a4ea0059c33cee4a82a2"], "launchpad": "5e9e4501f509094ba4566f84", "flight_number": 105, "name": "Starlink-14 (v1.0)", "date_utc": "2020-10-24T15:31:00.000Z", "date_unix": 1603553460, "date_local": "2020-10-24T11:31:00-04:00", "date_precision": "hour", "upcoming": false, "cores": [{"core": "5ef670f10059c33cee4a826c", "flight": 3, "gridfins": true, "legs": true, "reused": true, "landing_attempt": true, "landing_success": true, "landing_type": "ASDS", "landpad": "5e9e3033383ecbb9e534e7cc"}], "auto_update": true, "tbd": false, "launch_library_id": null, "id": "5ef6a2e70059c33cee4a8293", {"fairings": {"reused": null, "recovery_attempt": true, "recovered": null, "ships": ["5ea6ed2e080df4000697c907"]}, "links": {"patch": {"small": "https://images2.imgbox.com/5e/b7/Kn4Vn6nM_o.png", "large": "https://images2.imgbox.com/c8/f5/tRqtdHD6_o.png"}, "reddit": {"campaign": "https://www.reddit.com/r/spacex/comments/io0swm/gps_iii_sv04_launch_campaign_thread/", "launch": "https://www.reddit.com/r/spacex/comments/jobxn2/rspacex_gps_iii_sv04_sacagawea_official_launch/", "media": null, "recovery": null}, "flickr": {"small": [], "original": ["https://live.staticflickr.com/65535/50611865511_2299e11860_o.jpg", "https://live.staticflickr.com/65535/50611118958_448d239fe1_o.jpg", "https://live.staticflickr.com/65535/50611979827_48811d2ea6_o.jpg"]}, "presskit": null, "webcast": "https://youtu.be/wufXF5YKR1M", "youtube_id": "wufXF5YKR1M", "article": "https://spaceflightnow.com/2020/11/06/spacex-launches-gps-navigation-satellite-from-cape-canaveral/", "wikipedia": "https://en.wikipedia.org/wiki/GPS_Block_III"}], "static_fire_date_utc": "2020-09-25T05:42:00.000Z", "static_fire_date_unix": 1601012520, "net": false, "window": null, "rocket": "5e9d0d95eda69973a809d1ec", "success": true, "failures": [], "details": "SpaceX will launch GPS Block II Space Vehicle 04 from SLC-40, Cape Canaveral AFS aboard a Falcon 9. GPS III is owned and operated by the US Air Force and produced by Lockheed Martin. This will be the fourth GPS III satellite launched and the third launched by SpaceX. The satellite will be delivered into a ME0 transfer orbit. The booster for this mission will land on an ASDS.", "crew": [], "ships": ["5ea6ed30080df4000697c913", "5ee68c683c228f36bd5809b5", "5ea6ed2e080df4000697c907"], "capsules": [], "payloads": ["5eb0e4d2b6c3bb0006eeb25e"], "launchpad": "5e9e4501f509094ba4566f84", "flight_number": 106, "name": "GPS III SV04 (Sacagawea)", "date_utc": "2020-11-05T23:24:00.000Z", "date_unix": 1604618640, "date_local": "2020-11-05T18:24:00-05:00", "date_precision": "hour", "upcoming": false, "cores": [{"core": "5f57c5440622a633027900a0", "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": "5eb87d4cffd86e000604b38d", {"fairings": null, "links": {"patch": {"small": "https://images2.imgbox.com/98/cc/UJd0SS73_o.png", "large": "https://images2.imgbox.com/03/3d/LzQWXPfy_o.png"}, "reddit": {"campaign": "https://www.reddit.com/r/spacex/comments/iwb8bl/crew1_launch_campaign_thread/", "launch": "https://www.reddit.com/r/spacex/comments/ju7fxv/rspacex_crew1_official_launch_coast_docking/", "media": "https://www.reddit.com/r/spacex/comments/judv0r/rspacex_crew1_media_thread_photographer_contest/", "recovery": null}, "flickr": {"small": [], "original": ["https://live.staticflickr.com/65535/50618376646_8f52c31fc4_o.jpg", "https://live.staticflickr.com/65535/50618376731_43ddaab1b8_o.jpg", "https://live.staticflickr.com/65535/50618376671_ba4e60af7c_o.jpg", "https://live.staticflickr.com/65535/50618376351_ecfdee4ab2_o.jpg", "https://live.staticflickr.com/65535/50618727917_01e579c4d9_o.jpg", "https://live.staticflickr.com/65535/50618355216_2872d1fe98_o.jpg", "https://live.staticflickr.com/65535/50618354801_ff3e722884_o.jpg", "https://live.staticflickr.com/65535/50618463487_41642939a4_o.jpg", "https://live.staticflickr.com/65535/50617619613_5630422345_o.jpg", "https://live.staticflickr.com/65535/50"}]

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The satellites will be delivered to low Earth orbit and will spend a few weeks maneuvering to their operational altitude. 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It is the 26th Starlink launch overall. The satellites will be delivered to low Earth orbit and will spend a few weeks maneuvering to their operational altitude. The booster is expected to land on OCISLY.", "crew": [], "ships": ["608c1a06cf7f3d6152666ad4", "5ea6ed30080df4000697c913", "6059166413f40e27e8af34b6"], "capsules": [], "payloads": ["605b4befaa5433645e37d047"], "launchpad": "5e9e4502f509094188566f88", "flight_number": 125, "name": "Starlink-25 (v1.0)", "date_utc": "2021-05-04T19:01:00.000Z", "date_unix": 1620154860, "date_local": "2021-05-04T15:01:00-04:00", "date_precision": "hour", "upcoming": false, "cores": [{"core": "5e9e28a5f3591833b13b2659", "flight": 9, "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": "1ecc82c0-c5c8-41f0-aa58-b50a3b839ae0", "id": "605b4b7daa5433645e37d040"}, {"fairings": {"reused": true, "recovery_attempt": true, "recovered": true, "ships": ["6059166413f40e27e8af34b6"]}, "links": {"patch": {"small": "https://images2.imgbox.com/ad/eb/pq1vQuoW_o.png", "large": "https://images2.imgbox.com/97/83/Y1Qj9iUC_o.png"}, "reddit": {"campaign": "https://www.reddit.com/r/spacex/comments/jhu37i/starlink_general_discussion_and_deployment_thread/"}, "flickr": {"small": [], "original": []}, "presskit": null, "webcast": "https://youtu.be/xpl_JnG7rcg", "youtube_id": "xpl_JnG7rcg", "article": null, "wikipedia": "https://en.wikipedia.org/wiki/Starlink", "static_fire_date_utc": "2021-05-03T05:00:00.000Z", "static_fire_date_unix": 1620018000, "net": false, "window": 0, "rocket": "5e9d0d95eda69973a809d1ec", "success": true, "failures": [], "details": "This mission launches the 25th batch of operational Starlink satellites, which are version 1.0, from LC-39A. 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The mission will be complete with splashdown and recovery of the capsule and down cargo.", "crew": [], "ships": ["5ea6ed2f080df4000697c90b", "608c1a06cf7f3d6152666ad4", "5ea6ed30080df4000697c913"], "capsules": ["60b803421f83cc1e59f1644d"], "payloads": ["5fe3b642b3467846b324217b"], "launchpad": "5e9e4502f509094188566f88", "flight_number": 129, "name": "CRS-22 & IROSA", "date_utc": "2021-06-03T17:29:00.000Z", "date_unix": 1622741340, "date_local": "2021-06-03T13:29:00-04:00", "date_precision": "hour", "upcoming": false, "cores": [{"core": "60b800111f83cc1e59f16438", "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": "89a150ea-6e4b-489f-853c-3603ae684611", "id": "5fe3af84b3467846b3242161"}, {"fairings": {"reused": false, "recovery_attempt": true, "recovered": true, "ships": ["5ea6ed2f080df4000697c90b", "5ea6ed2e080df4000697c909"]}, "links": {"patch": {"small": "https://images2.imgbox.com/9a/f0/UVl6cZ6e_o.png", "large": "https://images2.imgbox.com/98/c3/8McdwgVu_o.png"}, "reddit": {"campaign": "https://www.reddit.com/r/spacex/comments/n9llxw/sxm8_launch_campaign_thread/", "launch": "https://www.reddit.com/r/spacex/comments/nss9br/rspacex_sxm8_launch_discussion_and_updates_thread/", "media": null, "recovery": null}, "flickr": {"small": [], "original": []}, "presskit": null, "webcast": "https://youtu.be/bgtDRR2F2wA", "youtube_id": "bgtDRR2F2wA", "article": null, "wikipedia": "https://en.wikipedia.org/wiki/Sirius_XM#Satellites"}, "static_fire_date_utc": "2021-06-03T06:32:00.000Z", "static_fire_date_unix": 1622701920, "net": false, "window": 5940, "rocket": "5e9d0d95eda69973a809d1ec", "success": true, "failures": [], "details": "SpaceX launches the second of two next generation satellites for SiriusXM from SLC-40, Cape Canaveral Space Force Station. 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The booster for this mission will land on an ASDS.", "crew": [], "ships": ["5ee68c683c228f36bd5809b5", "5ea6ed2f080df4000697c910", "5ea6ed2f080df4000697c90b", "5ea6ed2e080df4000697c909"], "capsules": [], "payloads": ["5fe3b57db3467846b324217a"], "launchpad": "5e9e4501f509094ba4566f84", "flight_number": 130, "name": "SXM-8", "date_utc": "2021-06-06T04:26:00.000Z", "date_unix": 1622953560, "date_local": "2021-06-06T00:26:00-04:00", "date_precision": "hour", "upcoming": false, "cores": [{"core": "5f57c53d0622a6330279009f", "flight": 3, "gridfins": true, "legs": true, "reused": true, "landing_attempt": true, "landing_success": true, "landing_type": "ASDS", "landpad": "5e9e3033383ecbb9e534e7cc"}], "auto_update": true, "tbd": false, "launch_library_id": "edaf9a8d-d67c-4e0e-8452-a37b111581d5", "id": "5fe3af6db3467846b3242160"}, {"fairings": {"reused": false, "recovery_attempt": true, "recovered": true, "ships": ["60c8c7a45d4819007ea69871"]}, "links": {"patch": {"small": 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spiration4 is the world's first all-civilian mission to space. The mission will be commanded by Jared Isaacman, the 37-year-old founder and Chief Executive Officer of Shift4 Payments and an accomplished pilot and adventurer. Inspiration4 will leave Earth from Kennedy Space Center's historic 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's population. Named in recognition of the four-person crew that will raise awareness and funds for St. Jude Children's Research Hospital, this milestone represents a new era for human spaceflight and exploration."},"crew":["607a3a5f5a906a44023e0870","607a3ab45a906a44023e0872","607b48375a906a44023e08b8","607b48da5a906a44023e08b9"],"ships":["5ea6ed2f080df4000697c910","5ee68c683c228f36bd5809b5","614251b711a64135defb3654"],"capsules":["5f6f99fddcfd403df379709"],"payloads":["607a382f5a906a44023e0867"],"launchpad":"5e9e4502f509094188566f88","flight_number":135,"name":"Inspiration4","date_utc":"2021-09-16T00:02:00.000Z","date_unix":1631750520,"date_local":"2021-09-15T20:02:00-04:00","date_precision":"hour","upcoming":false,"cores":[{"core":"5f57c5440622a633027900a0","flight":3,"gridfins":true,"legs":true,"reused":true,"landing_attempt":true,"landing_success":true,"landing_type":"ASDS","landpad":"5e9e3033383ecbb9e534e7cc"}],"auto_update":true,"tbd":false,"launch_library_id":"621d64e6-0513-45dc-8ffa-c9fd56518398","id":"607a37565a906a44023e0866"},"fairings":null,"links":{"patch":{"small":"https://images2.imgbox.com/5a/2f/w3woVyro_o.png","large":"https://images2.imgbox.com/80/34/J7R0sgsi_o.png"},"reddit":{"campaign":"https://www.reddit.com/r/spacex/comments/q8r52a/crew3_launch_campaign_thread/","launch":"https://www.reddit.com/r/spacex/comments/qij6f4/rspacex_crew3_launch_discussion_updates_thread/","media":null,"recovery":null},"flickr":{"small":[],"original":["https://live.staticflickr.com/65535/51673353699_e3da266245_o.jpg","https://live.staticflickr.com/65535/51673548360_64354b760f_o.jpg","https://live.staticflickr.com/65535/51672676881_3b88410a96_o.jpg","https://live.staticflickr.com/65535/51673548330_7acc53d2fb_o.jpg","https://live.staticflickr.com/65535/51671874407_4f56a87855_o.jpg","https://live.staticflickr.com/65535/51672676961_36371a6a76_o.jpg","https://live.staticflickr.com/65535/51672915563_7f5b373701_o.jpg","https://live.staticflickr.com/65535/51672915633_947e35cabo_o.jpg"]},"presskit":null,"webcast":"https://youtu.be/WZvtrnFIItNs","youtube_id":"WZvtrnFIItNs","article":"https://spaceflightnow.com/2021/11/11/spacex-debuts-new-dragon-capsule-in-launch-to-the-international-space-station/","wikipedia":"https://en.wikipedia.org/wiki/SpaceX_Crew-3"},"static_fire_date_utc":"2021-10-28T05:46:00.000Z","static_fire_date_unix":1635399960,"net":false,"window":0,"rocket":"5e9d0d95eda69973a809d1ec","success":true,"failures":[],"details":"SpaceX will launch the third operational mission of its Crew Dragon vehicle as part of NASA's Commercial Crew Program, carrying four astronauts to the International Space Station, including 1 international partner. This 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 space station in November."},"crew":["5fe3c587b3467846b3242198","5fe3c5beb3467846b3242199","5fe3c5f6b3467846b324219a","60c4b5ad4e041c0b356db393"],"ships":["5ea6ed2d080df4000697c904","5ee68c683c228f36bd5809b5","6142

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ld 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. The DART spacecraft will intercept the double asteroid, using autonomous guidance to crash into the smaller one. Moving at about 6 km/s, the transferred momentum should alter Dimorphos's 12 hour orbital period around its companion by several minutes. The mission tests several technologies, including 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's Evolutionary Xenon Thruster Commercial (NEXT-C) ion engine will also be demonstrated, although the spacecraft's primary propulsion is hydrazine thrusters. DART should arrive at Didymos in late September 2022, when it is about 11 million kilometers from Earth. Ten days before impact, the Italian Space Agency's cubesat LICIACube will be deployed to observe the collision and ejecta with its two cameras. Earth-based telescopes will be used to measure the altered orbit.

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4-34 (v1.5)","date_utc":"2022-09-17T01:05:00.000Z","date_unix":1663376700,"date_local":"2022-09-16T21:05:00-04:00","date_precision":"hour","upcoming":false,"cores":[{"core":"60b800111f83cc1e59f16438","flight":6,"gridfins":true,"legs":true,"reused":true,"landing_attempt":true,"landing_success":true,"landing_type":"ASDS","landpad":"5e9e3033383ecb9e534e7cc"}],"auto_update":true,"tbd":false,"launch_library_id":"9ba04064-c329-40bf-b477-ff468d7d8058","id":"63161329ffc78f3b8567070b"},{"fairings":{"reused":null,"recovery_attempt":null,"recovered":null,"ships":[]},"links":{"patch":{"small":"https://images2.imgbox.com/a9/9a/NXVktZCE_o.png","large":"https://images2.imgbox.com/e3/cc/hN96PmST_o.png"},"reddit":{"campaign":"https://www.reddit.com/r/spacex/comments/jhu37i/starlink_general_discussion_and_deployment_thread/"},"launch":"https://www.reddit.com/r/spacex/comments/xd8vhj/rspacex_starlink_434_launch_discussion_and/"},"media":null,"recovery":"https://www.reddit.com/r/spacex/comments/k2ts1q/rspacex_fleet_updates_discussion_thread/"},"flickr":{"small":[],"original":[]},"presskit":null,"webcast":null,"youtube_id":null,"article":null,"wikipedia":null},"static_fire_date_utc":null,"static_fire_date_unix":null,"net":false,"window":null,"rocket":"5e9d0d95eda69973a809d1ec","success":true,"failures":[],"details":null,"crew":[],"ships":[],"capsules":[],"payloads":["63161699ffc78f3b85670719"],"launchpad":"5e9e4501f509094ba4566f84","flight_number":185,"name":"Starlink 4-34 (v1.5)","date_utc":"2022-09-17T01:05:00.000Z","date_unix":1663376700,"date_local":"2022-09-16T21:05:00-04:00","date_precision":"hour","upcoming":false,"cores":[{"core":"60b800111f83cc1e59f16438","flight":6,"gridfins":true,"legs":true,"reused":true,"landing_attempt":true,"landing_success":true,"landing_type":"ASDS","landpad":"5e9e3033383ecb9e534e7cc"}],"auto_update":true,"tbd":false,"launch_library_id":"9ba04064-c329-40bf-b477-ff468d7d8058","id":"63161329ffc78f3b8567070b"},{"fairings":{"reused":null,"recovery_attempt":null,"recovered":null,"ships":[]},"links":{"patch":{"small":"https://images2.imgbox.com/a9/9a/NXVktZCE_o.png","large":"https://images2.imgbox.com/e3/cc/hN96PmST_o.png"},"reddit":{"campaign":"https://www.reddit.com/r/spacex/comments/jhu37i/starlink_general_discussion_and_deployment_thread/"},"launch":"https://www.reddit.com/r/spacex/comments/xd8vhj/rspacex_starlink_434_launch_discussion_and/"},"media":null,"recovery":"https://www.reddit.com/r/spacex/comments/k2ts1q/rspacex_fleet_updates_discussion_thread/"},"flickr":{"small":[],"original":[]},"presskit":null,"webcast":null,"youtube_id":null,"article":null,"wikipedia":null},"static_fire_date_utc":null,"static_fire_date_unix":null,"net":false,"window":null,"rocket":"5e9d0d95eda69973a809d1ec","success":true,"failures":[],"details":null,"crew":[],"ships":[],"capsules":[],"payloads":["63161699ffc78f3b85670719"],"launchpad":"5e9e4501f509094ba4566f84","flight_number":185,"name":"Starlink 4-34 (v1.5)","date_utc":"2022-09-17T01:05:00.000Z","date_unix":1663376700,"date_local":"2022-09-16T21:05:00-04:00","date_precision":"hour","upcoming":false,"cores":[{"core":"60b800111f83cc1e59f16438","flight":6,"gridfins":true,"legs":true,"reused":true,"landing_attempt":true,"landing_success":true,"landing_type":"ASDS","landpad":"5e9e3033383ecb9e534e7cc"}],"auto_update":true,"tbd":false,"launch_library_id":"9ba04064-c329-40bf-b477-ff468d7d8058","id":"63161329ffc78f3b8567070b"},{"fairings":{"reused":null,"recovery_attempt":null,"recovered":null,"ships":[]},"links":{"patch":{"small":"https://images2.imgbox.com/a9/9a/NXVktZCE_o.png","large":"https://images2.imgbox.com/e3/cc/hN96PmST_o.png"},"reddit":{"campaign":"https://www.reddit.com/r/spacex/comments/jhu37i/starlink_general_discussion_and_deployment_thread/"},"launch":"https://www.reddit.com/r/spacex/comments/xd8vhj/rspacex_starlink_434_launch_discussion_and/"},"media":null,"recovery":"https://www.reddit.com/r/spacex/comments/k2ts1q/rspacex_fleet_updates_discussion_thread/"},"flickr":{"small":[],"original":[]},"presskit":null,"webcast":null,"youtube_id":null,"article":null,"wikipedia":null},"static_fire_date_utc":null,"static_fire_date_unix":null,"net":false,"window":null,"rocket":"5e9d0d95eda69973a809d1ec","success":true,"failures":[],"details":null,"crew":[],"ships":[],"capsules":[],"payloads":["63161699ffc78f3b85670719"],"launchpad":"5e9e4501f509094ba4566f84","flight_number":185,"name":"Starlink 4-34 (v1.5)","date_utc":"2022-09-17T01:05:00.000Z","date_unix":1663376700,"date_local":"2022-09-16T21:05:00-04:00","date_precision":"hour","upcoming":false,"cores":[{"core":"60b800111f83cc1e59f16438","flight":6,"gridfins":true,"legs":true,"reused":true,"landing_attempt":true,"landing_success":true,"landing_type":"ASDS","landpad":"5e9e3033383ecb9e534e7cc"}],"auto_update":true,"tbd":false,"launch_library_id":"9ba04064-c329-40bf-b477-ff468d7d8058","id":"63161329ffc78f3b8567070b"},{"fairings":{"reused":null,"recovery_attempt":null,"recovered":null,"ships":[]},"links":{"patch":{"small":"https://images2.imgbox.com/a9/9a/NXVktZCE_o.png","large":"https://images2.imgbox.com/e3/cc/hN96PmST_o.png"},"reddit":{"campaign":"https://www.reddit.com/r/spacex/comments/jhu37i/starlink_general_discussion_and_deployment_thread/"},"launch":"https://www.reddit.com/r/spacex/comments/xd8vhj/rspacex_starlink_434_launch_discussion_and/"},"media":null,"recovery":"https://www.reddit.com/r/spacex/comments/k2ts1q/rspacex_fleet_updates_discussion_thread/"},"flickr":{"small":[],"original":[]},"presskit":null,"webcast":null,"youtube_id":null,"article":null,"wikipedia":null},"static_fire_date_utc":null,"static_fire_date_unix":null,"net":false,"window":null,"rocket":"5e9d0d95eda69973a809d1ec","success":true,"failures":[],"details":null,"crew":[],"ships":[],"capsules":[],"payloads":["63161699ffc78f3b85670719"],"launchpad":"5e9e4501f509094ba4566f84","flight_number":185,"name":"Starlink 4-34 (v1.5)","date_utc":"2022-09-17T01:05:00.000Z","date_unix":1663376700,"date_local":"2022-09-16T21:05:00-04:00","date_precision":"hour","upcoming":false,"cores":[{"core":"60b800111f83cc1e59f16438","flight":6,"gridfins":true,"legs":true,"reused":true,"landing_attempt":true,"landing_success":true,"landing_type":"ASDS","landpad":"5e9e3033383ecb9e534e7cc"}],"auto_update":true,"tbd":false,"launch_library_id":"9ba04064-c329-40bf-b477-ff468d7d8058","id":"63161329ffc78f3b8567070b"},{"fairings":{"reused":null,"recovery_attempt":null,"recovered":null,"ships":[]},"links":{"patch":{"small":"https://images2.imgbox.com/a9/9a/NXVktZCE_o.png","large":"https://images2.imgbox.com/e3/cc/hN96PmST_o.png"},"reddit":{"
```

```
2. imgbox.com/e3/cc/hN96PmST_o.png"}, "reddit": {"campaign": "https://www.reddit.com/r/spacex/comments/jhu37i/starlink_general_discussion_and_deployement_thread/", "launch": "https://www.reddit.com/r/spacex/comments/xn028t/rspacex_starlink_435_launch_discussion_and/", "media": null, "recovery": "https://www.reddit.com/r/spacex/comments/k2ts1q/rspacex_fleet_updates_discussion_thread/"}, "flickr": {"small": [], "original": []}, "presskit": null, "webcast": "https://youtu.be/VVu2bSJJhgI", "youtube_id": "VVu2bSJJhgI", "article": null, "wikipedia": null}, {"static_fire_date_utc": null, "static_fire_date_unix": null, "net": false, "window": null, "rocket": "5e9d0d95eda69973a809d1ec", "success": true, "failures": [], "details": null, "crew": [], "ships": [], "capsules": [], "payloads": ["631616a7ffc78f3b8567071a"], "launchpad": "5e9e4501f509094ba4566f84", "flight_number": 186, "name": "Starlink 4-35 (v1.5)", "date_utc": "2022-09-24T23:30:00.000Z", "date_unix": 1664062200, "date_local": "2022-09-24T19:30:00-04:00", "date_precision": "hour", "upcoming": false, "cores": [{"core": "627843d657b51b752c5c5a53", "flight": 4, "gridfins": true, "legs": true, "reused": true, "landing_attempt": true, "landing_success": true, "landing_type": "ASDS", "landpad": "5e9e3033383ecbb9e534e7cc"}], "auto_update": true, "tbd": false, "launch_library_id": "1c903b65-6667-4fd5-944d-296c5f13e01f", "id": "63161339ffc78f3b8567070c"}, {"fairings": null, "links": {"patch": {"small": "https://images2.imgbox.com/eb/d8/D1Yywp0w_o.png", "large": "https://images2.imgbox.com/33/2e/k6VE4iYl_o.png"}, "reddit": {"campaign": null, "launch": "https://www.reddit.com/r/spacex/comments/xvm76j/rspacex_crew5_launchcoast_docking_discussion_and/", "media": null, "recovery": null}, "flickr": {"small": [], "original": []}, "presskit": null, "webcast": "https://youtu.be/5EwW8ZkArL4", "youtube_id": "5EwW8ZkArL4", "article": null, "wikipedia": "https://en.wikipedia.org/wiki/SpaceX_Crew-5"}, {"static_fire_date_utc": null, "static_fire_date_unix": null, "net": false, "window": null, "rocket": "5e9d0d95eda69973a809d1ec", "success": true, "failures": [], "details": null, "crew": ["62dd7196202306255024d13c", "62dd71c9202306255024d13d", "62dd7210202306255024d13e", "62dd7253202306255024d13f"], "ships": [], "capsules": ["617c05591bad2c661a6e2909"], "payloads": ["62dd73ed202306255024d145"], "launchpad": "5e9e4502f509094188566f88", "flight_number": 187, "name": "Crew-5", "date_utc": "2022-10-05T16:00:00.000Z", "date_unix": 1664985600, "date_local": "2022-10-05T12:00:00-04:00", "date_precision": "hour", "upcoming": false, "cores": [{"core": "633d9da635a71d1d9c66797b", "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": "f33d5ece-e825-4cd8-809f-1d4c72a2e0d3", "id": "62dd70d5202306255024d139"}]}
```

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 [31]: static_json_url='https://cf-courses-data.s3.us.cloud-object-storage.appdo
```

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

```
In [32]: response.status_code
```


Out[32]: 200

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

```
In [33]: # 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 [34]: # Get the head of the dataframe
data.head(5)
```

```
Out[34]:
```

	static_fire_date_utc	static_fire_date_unix	net	window	rocket
0	2006-03-17T00:00:00.000Z	1.142554e+09	False	0.0	5e9d0d95eda69955f709d1eb
1	None	NaN	False	0.0	5e9d0d95eda69955f709d1eb
2	None	NaN	False	0.0	5e9d0d95eda69955f709d1eb

3	2008-09-20T00:00:00.000Z	1.221869e+09	False	0.0	5e9d0d95eda69955f709d1eb
4	None	NaN	False	0.0	5e9d0d95eda69955f709d1eb

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 [35]: # Lets take a subset of our dataframe keeping only the features we want a
data = data[['rocket', 'payloads', 'launchpad', 'cores', 'flight_number',

# We will remove rows with multiple cores because those are falcon 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 s
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 ex
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 separate 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 [36]: #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 look at `BoosterVersion` variable. Before we apply `getBoosterVersion` the list is empty:

```
In [37]: BoosterVersion
```

```
Out[37]: []
```

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

```
In [38]: # Call getBoosterVersion
getBoosterVersion(data)
```

the list has now been update

```
In [61]: BoosterVersion[0:6]
```

```
Out[61]: ['Falcon 1', 'Falcon 1', 'Falcon 1', 'Falcon 1', 'Falcon 9', 'Falcon 9']
```

we can apply the rest of the functions here:

```
In [40]: # Call getLaunchSite  
getLaunchSite(data)
```

```
In [41]: # Call getPayloadData  
getPayloadData(data)
```

```
In [42]: # Call getCoreData  
getCoreData(data)
```

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

```
In [43]: 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 [48]: # Create a data from launch_dict  
df = pd.DataFrame.from_dict(launch_dict)
```

Show the summary of the dataframe

```
In [49]: # Show the head of the dataframe  
df.head()
```

Out[49]:	FlightNumber	Date	BoosterVersion	PayloadMass	Orbit	LaunchSite	Outcome	FlightNumber
0	1	2006-03-24	Falcon 1	20.0	LEO	Kwajalein Atoll	None	None
1	2	2007-03-21	Falcon 1	NaN	LEO	Kwajalein Atoll	None	None
2	4	2008-09-28	Falcon 1	165.0	LEO	Kwajalein Atoll	None	None
3	5	2009-07-13	Falcon 1	200.0	LEO	Kwajalein Atoll	None	None
4	6	2010-06-04	Falcon 9	NaN	LEO	CCSFS SLC 40	None	None

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 [50]: # Hint data['BoosterVersion']!='Falcon 1'
data_falcon9 = df[df['BoosterVersion']!='Falcon 1']
```

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

```
In [51]: data_falcon9.loc[:, 'FlightNumber'] = list(range(1, data_falcon9.shape[0]+1))
data_falcon9
```

/home/jupyterlab/conda/envs/python/lib/python3.7/site-packages/pandas/core/indexing.py:1773: SettingWithCopyWarning:
A value is trying to be set on a copy of a slice from a DataFrame.
Try using .loc[row_indexer,col_indexer] = value instead

See the caveats in the documentation: https://pandas.pydata.org/pandas-docs/stable/user_guide/indexing.html#returning-a-view-versus-a-copy
self._setitem_single_column(ilocs[0], value, pi)

Out[51]:	FlightNumber	Date	BoosterVersion	PayloadMass	Orbit	LaunchSite	Outcome	Fli
4	1	2010-06-04	Falcon 9	NaN	LEO	CCSFS SLC 40	None	None
5	2	2012-05-22	Falcon 9	525.0	LEO	CCSFS SLC 40	None	None
6	3	2013-03-01	Falcon 9	677.0	ISS	CCSFS SLC 40	None	None
7	4	2013-09-29	Falcon 9	500.0	PO	VAFB SLC 4E	False	Ocean
8	5	2013-12-03	Falcon 9	3170.0	GTO	CCSFS SLC 40	None	None
...
89	86	2020-09-03	Falcon 9	15600.0	VLEO	KSC LC 39A	True	ASDS
90	87	2020-10-06	Falcon 9	15600.0	VLEO	KSC LC 39A	True	ASDS
91	88	2020-10-18	Falcon 9	15600.0	VLEO	KSC LC 39A	True	ASDS
92	89	2020-10-24	Falcon 9	15600.0	VLEO	CCSFS SLC 40	True	ASDS
93	90	2020-11-05	Falcon 9	3681.0	MEO	CCSFS SLC 40	True	ASDS

90 rows × 17 columns

Data Wrangling

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

```
In [52]: data_falcon9.isnull().sum()
```

```
Out[52]: 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 [53]: # Calculate the mean value of PayloadMass column
payloadmassavg = data_falcon9['PayloadMass'].mean()
# Replace the np.nan values with its mean value
data_falcon9['PayloadMass'].replace(np.nan, payloadmassavg, inplace=True)
```

```
/home/jupyterlab/conda/envs/python/lib/python3.7/site-packages/pandas/core/generic.py:6619: SettingWithCopyWarning:
A value is trying to be set on a copy of a slice from a DataFrame
```

```
See the caveats in the documentation: https://pandas.pydata.org/pandas-docs/stable/user_guide/indexing.html#returning-a-view-versus-a-copy
return self._update_inplace(result)
```

```
In [55]: data_falcon9.isnull().sum()
```

```
Out[55]: FlightNumber      0
         Date              0
         BoosterVersion    0
         PayloadMass       0
         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
```

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

[Joseph Santarcangelo](#) has a PhD in Electrical Engineering, his research focused on using machine learning, signal processing, and computer vision to determine how videos impact human cognition. Joseph has been working for IBM since he completed his PhD.

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

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