Saros Fit Strava App Implemented in AWS

By Sheraz Choudhary

Full Saros Fit (Strava App) Implemented in AWS YouTube Video (Long [17:22]):

- https://www.youtube.com/watch?v=hJLA_NPalJw

This project will live in GitHub at:

- https://github.com/sherazch00/strava-app

Getting all the data into AWS and providing the ability to get new Strava activity data is the main goal of this project.

I extensively use Strava to record all my workouts. Unfortunately, Strava website does not allow me to run all the analysis I would like to on my activities or download all my activities easily. Fortunately, Strava does provide an API to access all Strava data.

The initial step of this project was to create a Strava App that can access all of a user's data using the Strava API. The application first downloads an overview of all the Strava activities. This activity overview data provides a lot of the basic information needed for each activity. To get rich data for every second of a workout the application then downloads the detailed activity streams for each new activity in the activity overview data. This part of the project required learning to use and authenticate with the Strava using the REST API.

The python script was configured to run on AWS EC2 instance(s) and to use S3 to store the two csv files (activities_overview and activities_details). Strava limits the number of requests a Strava App can make via the API so each call will have to be made efficiently with wait timers.

Initially, I followed the usual steps and created an EC2 instance, setup security groups, SSH'd, created a python environment and used a text-based editor such as nano. This approach worked but was cumbersome and not very useful when debugging. The Cloud9 IDE really simplified the process while provided a lot more tools that were extremely helpful when coding and debugging the python scripts!

Future steps:

- AWS RDS to query the activities overview dataframe using SQL.
- AWS EMR to analyze the activities details dataframe *(1.8 million rows only for my personal Strava data).*
- AWS SageMaker/ML to find patterns in the activities details dataframe
- AWS Lambda for creating calculated fields from the data
- AWS SNS for notifications based on rules
- Amazon Alexa for daily summaries and refreshing data
- Host application on AWS Cloud
- Integrate with Golden Cheetah (open-source fitness analysis app

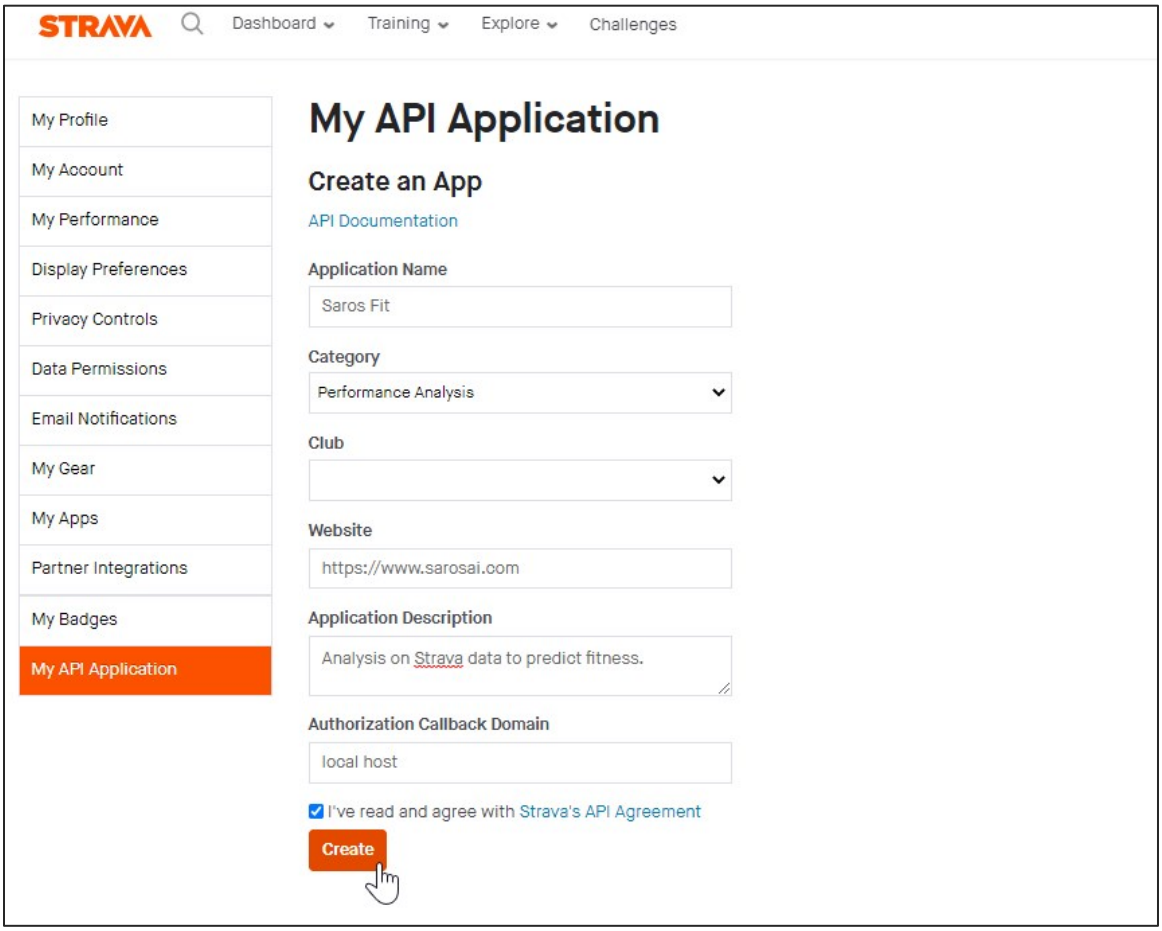
STEP 1: CREATING STRAVA APP AND LEARNING STRAVA API

https://developers.strava.com/
https://towardsdatascience.com/using-the-strava-api-and-pandas-to-explore-your-activity-data-d94901d9bfde

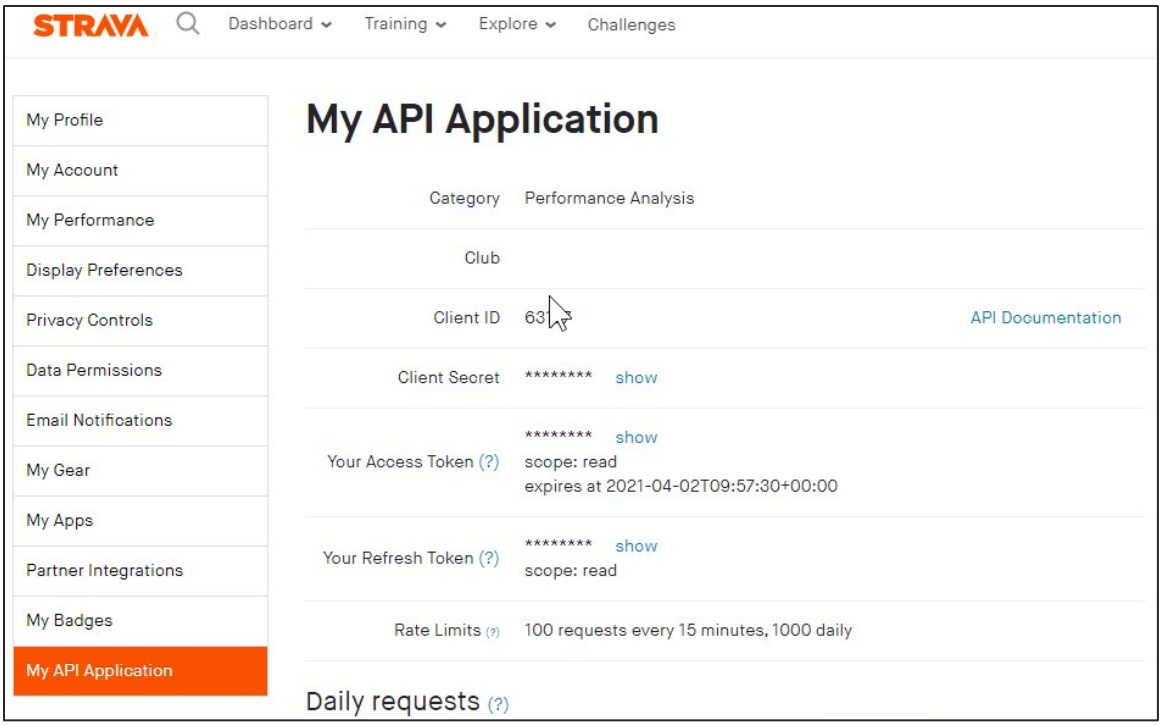
Follow the steps in the 'Getting Started Guide' to create a Strava App. The first tricky part was to get the temporary refresh token that had read all access to Strava data.

Once that step is accomplished the next challenge is to craft calls to the API that provide the data desired from Strava.

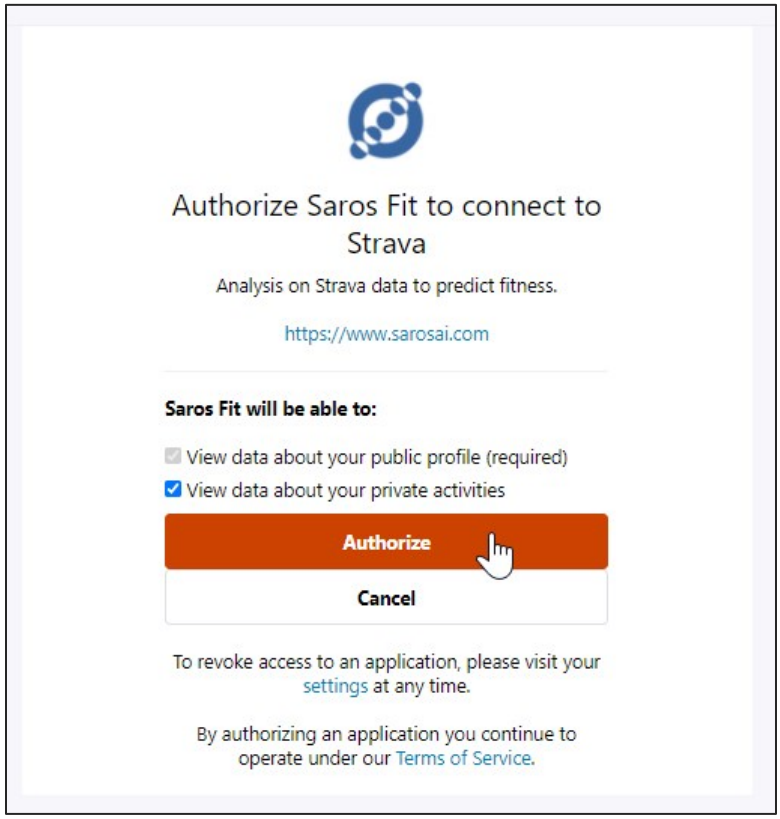
Create Strava API Application:



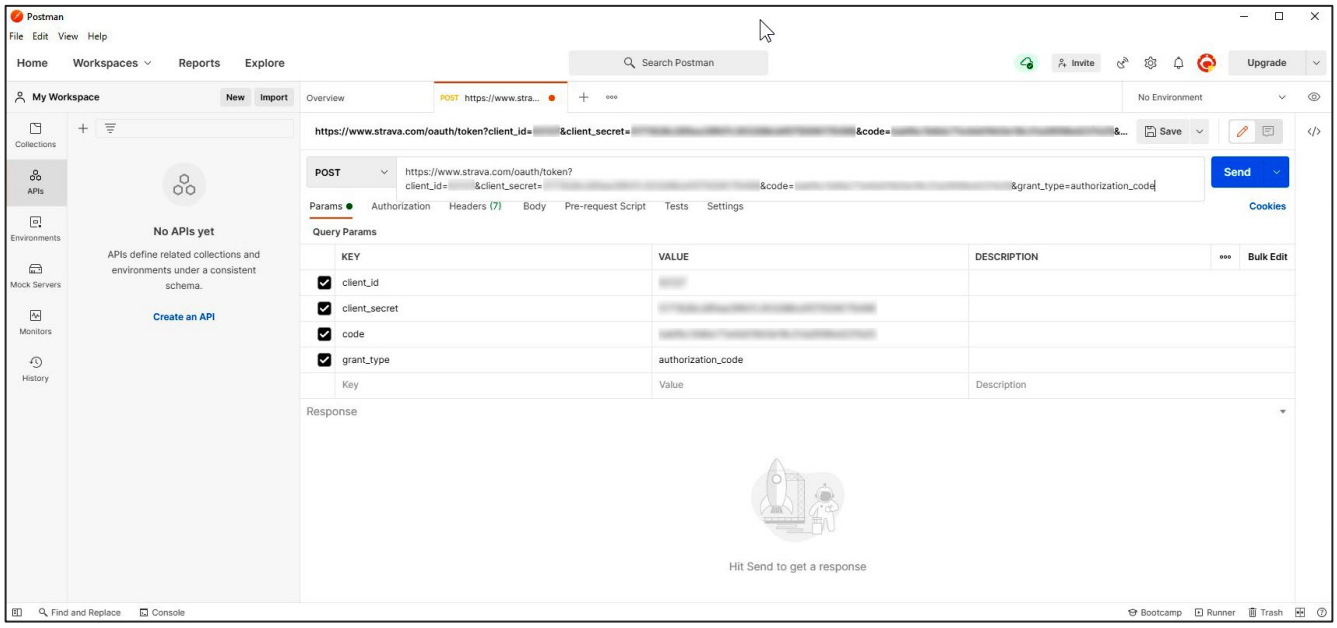
Details about Strava API Application:



Access Application from Strava User and Authorize It *(detailed instructions in guide)*:



Use Strava API documentation to get the syntax for the calls to get the temporary 'Refresh Token' which is needed to access Strava data:



The Strava API documentation was especially hard to figure out when trying to get activity streams from Strava. It took a long time to figure out the exact call to make to successfully get an activity stream.

Initially, I was getting streams one at a time for each of the 11 streams individually for each activity. So, I could only download around 10 activities before I hit the 100 requests per 15 minutes limit! There was no example I found that tried to get multiple streams in one request but I tried it and it worked!!!

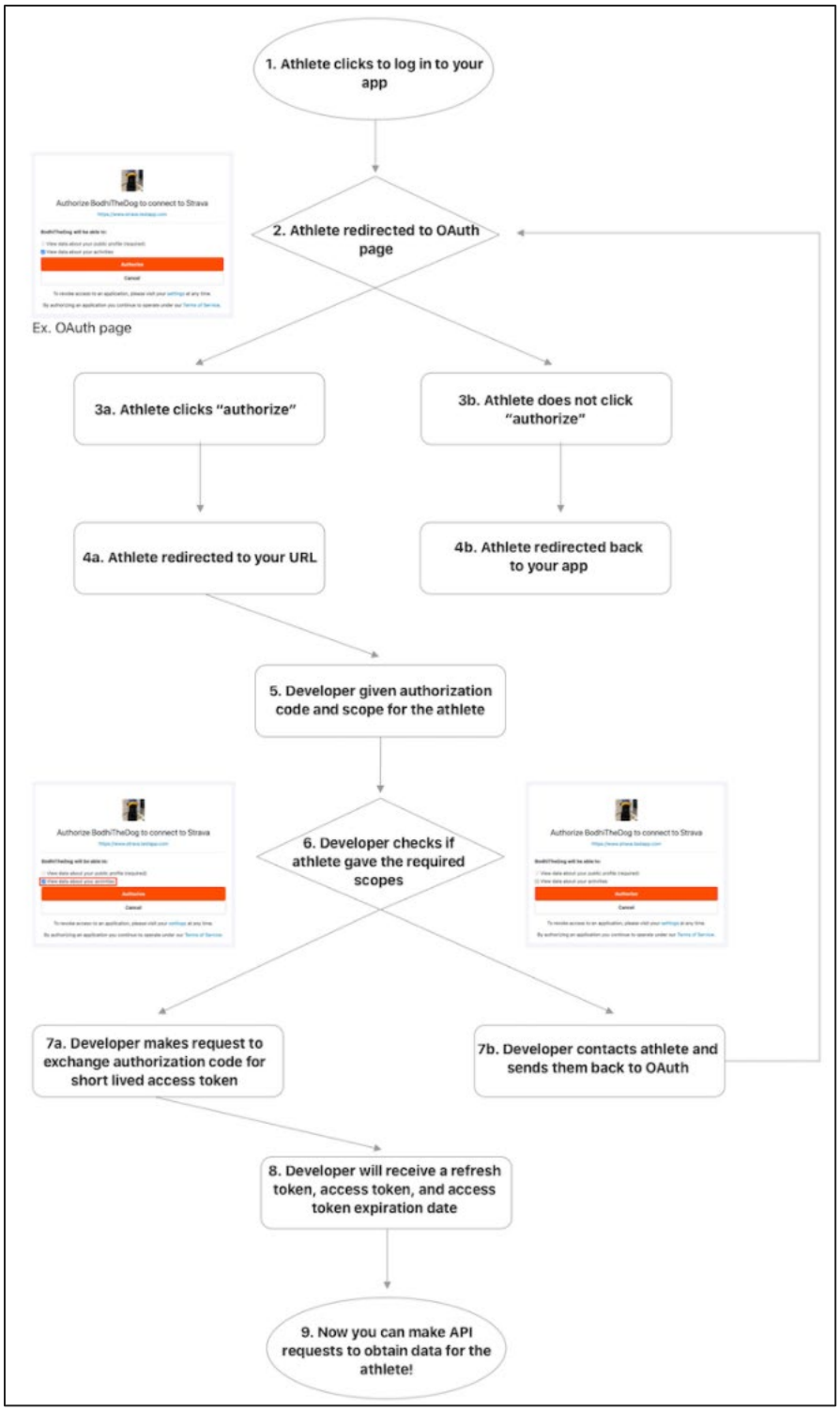
JSON Request:

`requests.get(https://www.strava.com/api/v3/activities/<activity_id>/streams?access_token=<access_token>&keys=time,distance,latlng,altitude,velocity_smooth,heartrate,cadence,watts,temp,moving,grade_smooth&key_by_type=true)`

Python Code:

```
def activity_streams(id):
    a_dict = {}
    a_df = pd.DataFrame()
    a_url = "https://www.strava.com/api/v3/activities/"

    streams_list = ['time','distance','latlng','altitude','velocity_smooth','heartrate','cadence','watts','temp',
                    'moving','grade_smooth']
    streams_text = 'time,distance,latlng,altitude,velocity_smooth,heartrate,cadence,watts,temp,moving,grade_smooth'

    a_json = pd.json_normalize(requests.get(a_url + str(id) + '/streams?access_token=' + access_token +
                                            '&keys=time,distance,latlng,altitude,velocity_smooth,heartrate,cadence,watts,temp,mo
ving,grade_smooth' +
                                            '&key_by_type=true').json())

    for a in range(0,len(streams_list)):
        try:
            a_df[streams_list[a]] = a_json[str(streams_list[a]) +'.data'][0]
        except:
            a_df[streams_list[a]] = np.nan

    a_df['id'] = id
    idx = activities_overview.index[activities_overview['id'] == id].tolist()[0]

    a_df['date'] = activities_overview['start_date_local'][idx]
    a_df['name'] = activities_overview['name'][idx]
    a_df['type'] = activities_overview['type'][idx]

    return a_df
```

Strava Flow Chart of How to Authorize a Strava App to Get User Data:



STEP 2: WRITING PYTHON SCRIPTS TO DOWNLOAD STRAVA DATA

The python script was initially written locally in Jupyter Notebooks. The script was then migrated to AWS with the following changes:

- boto3 was imported to read and write from S3 bucket
- AWS Secret Manager function was added
- AWS Secret Manager was used to get the tokens rather than a local environmental file
- All files are written to S3 in addition to the local folder
- Code was added to resolve <NA> error when calling `to_pickle`

Full Saros Fit Strava App in AWS Python Script (saros-fit.py)

Yellow-highlighted sections are specific to AWS and will fail on a local machine

```
# # Download Activity Summary and Details from Strava
#
# Strava provides basic information on how to get access to the API at https://developers.strava.com/docs/getting-started/.
# The information from the Strava API page combined with
# https://towardsdatascience.com/using-the-strava-api-and-pandas-to-explore-your-activity-data-d94901d9bfde and other websites
# allowed me to write the code necessary to connect to Strava.
#
# With some additional research I was able to download all my activities and their summary data.  Though, in all my online
# searching I could not find any good examples of how to download all the detailed activity streams associated with each
# Strava activity.  The code to download activity details was mostly written from scratch.
#
# **The value of this notebook is:**
#    - example of code to authenticate and connect to the Strava API (follow Strava instructions to create an app)
#    - download all activities and their associated summaries to a dataframe
#    - download all 11 detailed activity streams for each activity to a dataframe
#    - single notebook that authenticates to Strava, downloads activity summaries and downloads activity details
#
# **Additional useful features:**
#    - controls the number of requests so they don't exceed Strava's default limits (100 requests/15 min)
#    - stores all download activity details in pkl and csv format
#    - loads previously downloaded activity details and then only downloads details for new activities
#
# ###### NEXT STEPS:
#   - Create a separate notebook that loads the pkl file with activity details
#       - run basic analysis and create visualizations on the activity details
#       - run machine learning models on the activity details to find patterns in heartrate and wattage numbers
# ---
#
# **Written by:  Sheraz Choudhary**
# **Date:        November 2021**
# ---

# import libraries
import numpy as np
import pandas as pd

import os
import sys
import subprocess
import pathlib
import requests
import urllib3
urllib3.disable_warnings(urllib3.exceptions.InsecureRequestWarning)

import codecs
from codecs import open
from datetime import date
import time

import boto3
import base64
from botocore.exceptions import ClientError

cli = boto3.client('s3')

# AWS Secret Keeper Function
def get_secret(secret_name, region_name = "us-east-1"):
    # Create a Secrets Manager client
    session = boto3.session.Session()
    client = session.client(
        service_name='secretsmanager',
        region_name=region_name
    )
```

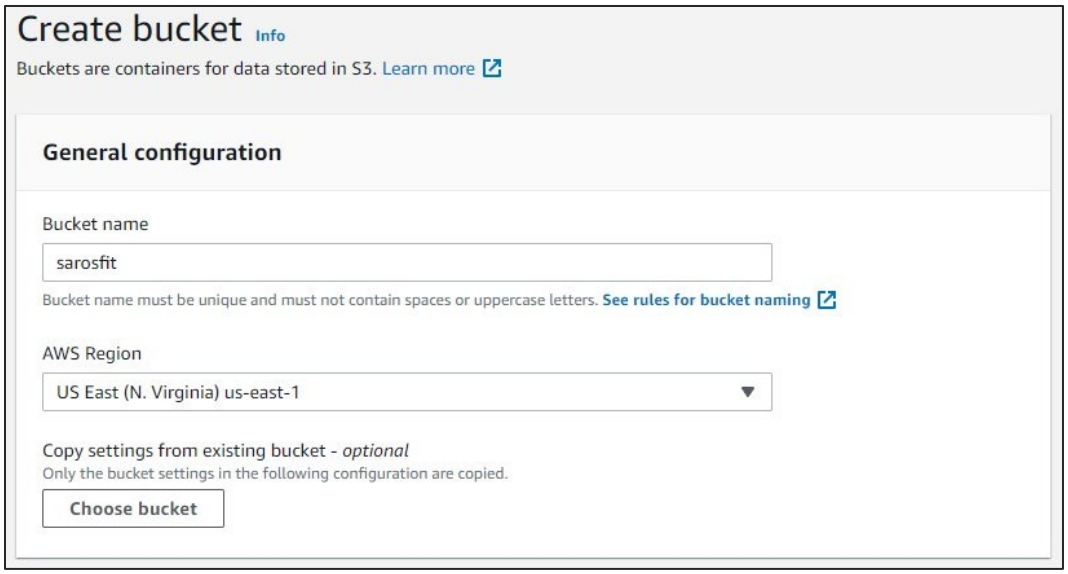
```
    # In this sample we only handle the specific exceptions for the 'GetSecretValue' API.
    # See https://docs.aws.amazon.com/secretsmanager/latest/apireference/API_GetSecretValue.html
    # We rethrow the exception by default.

    try:
        get_secret_value_response = client.get_secret_value(SecretId=secret_name)
    except ClientError as e:
        if e.response['Error']['Code'] == 'DecryptionFailureException':
            # Secrets Manager can't decrypt the protected secret text using the provided KMS key.
            # Deal with the exception here, and/or rethrow at your discretion.
            raise e
        elif e.response['Error']['Code'] == 'InternalServiceErrorException':
            # An error occurred on the server side.
            # Deal with the exception here, and/or rethrow at your discretion.
            raise e
        elif e.response['Error']['Code'] == 'InvalidParameterException':
            # You provided an invalid value for a parameter.
            # Deal with the exception here, and/or rethrow at your discretion.
            raise e
        elif e.response['Error']['Code'] == 'InvalidRequestException':
            # You provided a parameter value that is not valid for the current state of the resource.
            # Deal with the exception here, and/or rethrow at your discretion.
            raise e
        elif e.response['Error']['Code'] == 'ResourceNotFoundException':
            # We can't find the resource that you asked for.
            # Deal with the exception here, and/or rethrow at your discretion.
            raise e
    else:
        # Decrypts secret using the associated KMS CMK.
        # Depending on whether the secret is a string or binary, one of these fields will be populated.
        if 'SecretString' in get_secret_value_response:
            secret = get_secret_value_response['SecretString']
        else:
            secret = base64.b64decode(get_secret_value_response['SecretBinary'])

    return secret


# ## Connect to Strava -- Get Current Access Token
# (https://towardsdatascience.com/how-i-manage-credentials-in-python-using-aws-secrets-manager-1bd1bf5da598)
client_id = get_secret("<arn for client_id>")
client_secret = get_secret("<arn for client_secret>")
refresh_token = get_secret("<arn for refresh_token>")

# (https://github.com/franchyze923/Code_From_Tutorials/blob/master/Strava_Api/strava_api.py)
auth_url = "https://www.strava.com/oauth/token"

payload = {
    'client_id': client_id,
    'client_secret': client_secret,
    'refresh_token': refresh_token,
    'grant_type': "refresh_token",
    'f': 'json'
}

print("\nRequesting Token...")
res = requests.post(auth_url, data=payload, verify=False)
access_token = res.json()['access_token']
print("Access Token Received!")
print("")

# ## Create Dataframe with Summary Info for All Activities *(Strava API)*
# (http://www.hainke.ca/index.php/2018/08/23/using-the-strava-api-to-retrieve-activity-data/)
# Initialize the dataframe
activities_overview = pd.DataFrame()

url = "https://www.strava.com/api/v3/athlete/activities"
page = 1

while True:
    # get page of activities from Strava
    page_json = requests.get(url + '?access_token=' + access_token + '&per_page=200' + '&page=' + str(page)).json()

    for a in range(len(page_json)):
        # (https://stackoverflow.com/questions/21104592/)
        activity_json = pd.json_normalize(page_json[a])
        activities_overview = activities_overview.append(activity_json, ignore_index=True)

    # if no results then exit loop
    if (not page_json):
        break

    # increment page
    page += 1

# makes sense since new added on bottom
activities_overview = activities_overview.sort_values(by='id', ascending=True)

# activities_overview.tail(5)
```

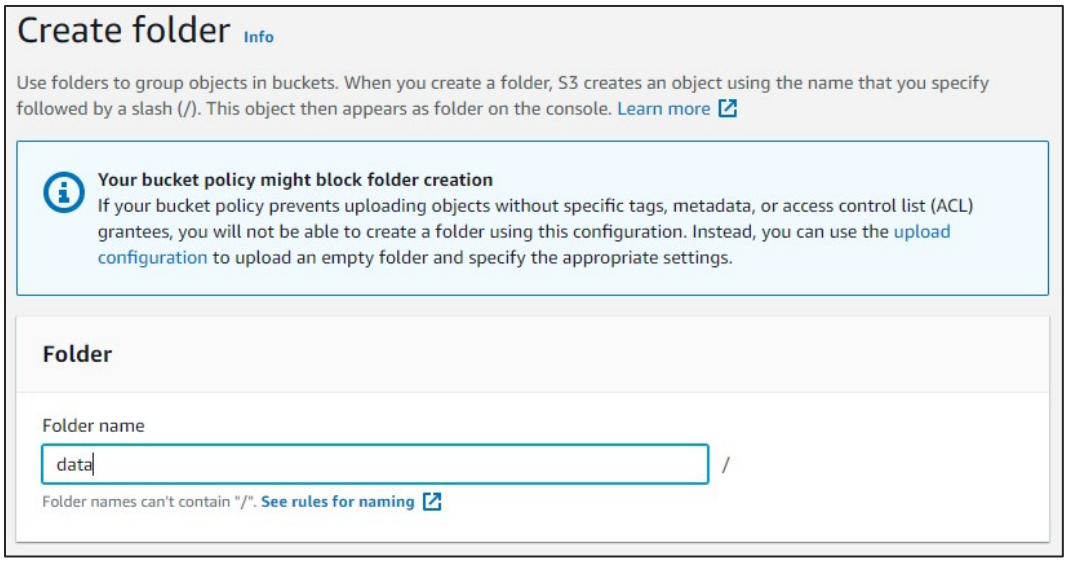
```
print("Number of Strava Activities Found: ", activities_overview.shape)
print("")

activities_overview.to_csv('activities_overview.csv', header=True)
print("OVERVIEW CSV FILE UPDATED\n")

# (https://faun.pub/write-files-from-ec2-to-s3-in-aws-programmatically-716d1a4ef639)
cli.put_object(
  Body='activities_overview.csv',
  Bucket='sarosfit',
  Key='data/activities_overview.csv')

print("OVERVIEW FILE UPDATED IN S3 BUCKET\n")

# ## Create Dataframe with DETAILED ACTIVITY DATA Streams for New Activities *(Strava API)*
# Streams Available via Strava API (https://developers.strava.com/docs/reference/#api-models-StreamSet)
# time.....................TimeStream    An instance of TimeStream.
# distance.................DistanceStream    An instance of DistanceStream.
# latlng...................LatLngStream  An instance of LatLngStream.
# altitude.................AltitudeStream    An instance of AltitudeStream.
# velocity_smooth.........SmoothVelocityStream  An instance of SmoothVelocityStream.
# heartrate...............HeartrateStream   An instance of HeartrateStream.
# cadence.................CadenceStream An instance of CadenceStream.
# watts...................PowerStream   An instance of PowerStream.
# temp....................TemperatureStream An instance of TemperatureStream.
# moving..................MovingStream  An instance of MovingStream.
# grade_smooth............SmoothGradeStream An instance of SmoothGradeStream.

# https://www.strava.com/api/v3/activities/4998708851/streams?access_token=######&keys=moving&key_by_type=true

def activity_streams(id):
    a_dict = {}
    a_df = pd.DataFrame()
    a_url = "https://www.strava.com/api/v3/activities/"

    streams_list = ['time','distance','latlng','altitude','velocity_smooth','heartrate','cadence','watts','temp',
                    'moving','grade_smooth']
    streams_text = 'time,distance,latlng,altitude,velocity_smooth,heartrate,cadence,watts,temp,moving,grade_smooth'

    a_json = pd.json_normalize(requests.get(a_url + str(id) + '/streams?access_token=' + access_token +
                                            '&keys=time,distance,latlng,altitude,velocity_smooth,heartrate,cadence,watts,temp,mo
ving,grade_smooth' +
                                            '&key_by_type=true').json())

    for a in range(0,len(streams_list)):
        try:
            a_df[streams_list[a]] = a_json[str(streams_list[a]) +'.data'][0]
        except:
            a_df[streams_list[a]] = np.nan

    a_df['id'] = id
    idx = activities_overview.index[activities_overview['id'] == id].tolist()[0]

    a_df['date'] = activities_overview['start_date_local'][idx]
    a_df['name'] = activities_overview['name'][idx]
    a_df['type'] = activities_overview['type'][idx]

    return a_df

# ### Load Already Downloaded Activity Details if Present
try:
    # Check to see if there is a local file
    activities_details = pd.read_pickle('activities_details.pkl')
except:
    try:
        # Check the s3 bucket to see if there is a file
        cli.download_file(
            Bucket='sarosfit',
            Key='data/activities_details.pkl',
            Filename='activities_details.pkl')

        activities_details = pd.read_pickle('activities_details.pkl')
    except:
        # Create a new empty dataframe (usually because first run)
        activities_details = pd.DataFrame()

# activities_details.info()
# activities_details.tail()

# ### Download only Details for New Activities
# (https://thispointer.com/pandas-check-if-a-value-exists-in-a-dataframe-using-in-not-in-operator-isin/)

a_details_to_import = []
try:
    a_already_downloaded = activities_details['id'].unique()
except:
    a_already_downloaded = []
```

```
for a in activities_overview['id']:
    # faster searching in only one column
    try:
        if a in a_already_downloaded:
            pass
        else:
            a_details_to_import.append(a)

    # if empty dataframe searching in 'id' column will fail
    except:
        if a in activities_details.values:
            pass
        else:
            a_details_to_import.append(a)

print("Number of Activities to Import:  " + str(len(a_details_to_import)))

# Activities that have no details will always show up because they will never have any details added
# a_details_to_import

a_range_l = 0
a_range_h = 89
a_number = len(a_details_to_import)

while a_range_l < a_number:
    if a_range_l > 0:
        print('Waiting...')
        # wait a little over 16m40s to be safe (100 requests per 15min limit)
        time.sleep(1000)

    print('Downloading activities ' + str(a_range_l) + ' to ' + str(a_range_h) +' ...')

    for a in a_details_to_import[a_range_l:a_range_h]:
        print('Downloading activity ', a)
        a_df_curr = activity_streams(a)
        activities_details = activities_details.append(a_df_curr, ignore_index=True)

    # 90 rather than 100 to be safe
    a_range_l = a_range_l + 90
    a_range_h = a_range_h + 90

print('Done getting details for all new activities.\n')

# print(activities_details.head(2))
# print(activities_details.tail(2))

print("Number of Rows for all Activities Found: ", activities_details.shape)
print("Sum of Moving Time:   ", activities_overview['moving_time'].sum())
print("Sum of Elapsed Time:  ", activities_overview['elapsed_time'].sum())

# resolve Error: _pickle.PicklingError: Can't pickle <NA>: it's not the same object as pandas._libs.missing.NA
activities_details['latlng'] = activities_details['latlng'].astype("string")
activities_details = activities_details.replace('<NA>', '')

activities_details.to_pickle('activities_details.pkl')
activities_details.to_csv('activities_details.csv', header=True)

print("\nDETAILED CSV and PKL FILES UPDATED\n")

cli.put_object(
  Body='activities_details.csv',
  Bucket='sarosfit',
  Key='data/activities_details.csv')

cli.put_object(
  Body='activities_details.pkl',
  Bucket='sarosfit',
  Key='data/activities_details.pkl')

print("DETAILED FILES UPDATED IN S3 BUCKET\n")

print("EXITING SAROS FIT\n")
```

STEP 3: CREATE S3 BUCKET

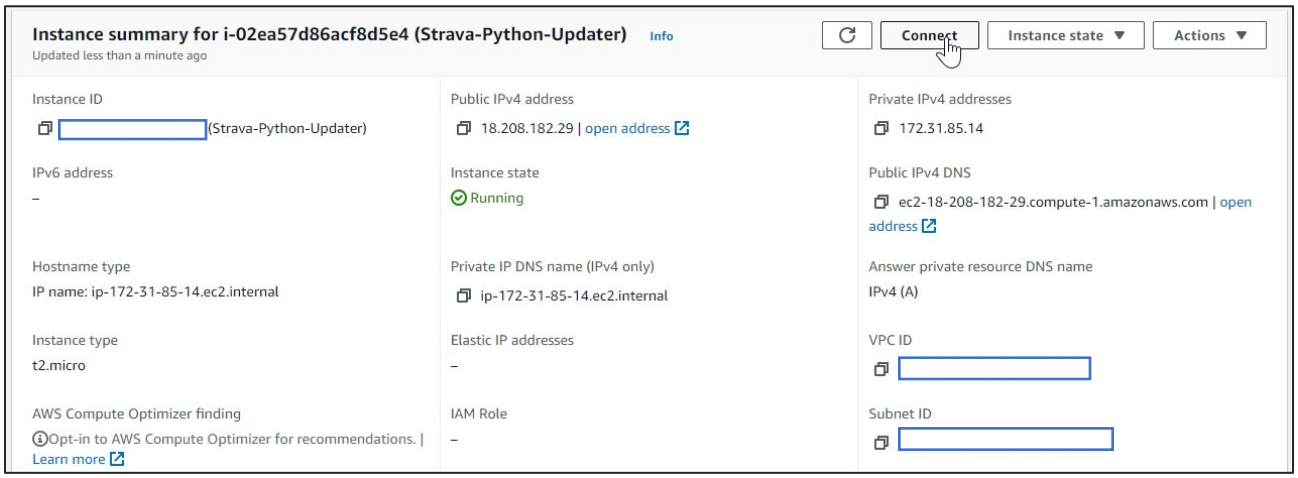
Create S3 bucket and create a ‘data’ folder to store the files created by the python script





STEP 4: AMAZON EC2, SSH, CLI

Launch EC2 instance with SSH access from Local IP address



Connect via SSH to the instance and run the following commands

- `aws configure` (enter Key ID, Secret Access Key, Region *(same as instance and bucket)*)

- `python3 -m venv my_app/env`
- `source ~/my_app/env/bin/activate`

- `sudo yum -y update`
- `pip install pip –upgrade`

- `pip install boto3`
- `pip install numpy`
- `pip install pandas`
- `pip install requests`

- `aws secretsmanager create-secret --name sarosfit_client_id --secret-string xxx`
- `aws secretsmanager create-secret --name sarosfit_client_secret --secret-string xxx`
  (Update python scripts with ARNs for each secret)

- Upload following local python files using SCP and move to correct directory:
  `scp -i " US-East-2_Sheraz_E90.pem" saros-fit.py ec2-user@172-31-85-14:~/.`
  -or-
  Use nano editor to create the following python scripts
  - saros-fit.py
  - *(optional)* test-credentials.py, test-s3.py, test-summary.py, test-pickle.py

- `python saros-fit.py`

Test all scripts to ensure that they work as expected.

- test-credentials.py should print ‘Access Token Received!’
- test-s3.py should put a activities_overview_test.csv file in s3 and then get the same file from s3
- test-summary.py should get all summary activity data from Strava and write a activities_overview.csv
- test-pickle.py should not result in an error and exit cleanly

One of the issues I ran into when running the full script was the process getting killed. AWS CLI provided absolutely no input on what was happening.

```
(env) [ec2-user@ip-172-31-85-14 ~]$ python saros-fit.py

Requesting Token...
Access Token Received!

Number of Strava Activities Found:  (534, 60)

OVERVIEW CSV FILE UPDATED

OVERVIEW FILE UPDATED IN S3 BUCKET

Killed
(env) [ec2-user@ip-172-31-85-14 ~]$
```

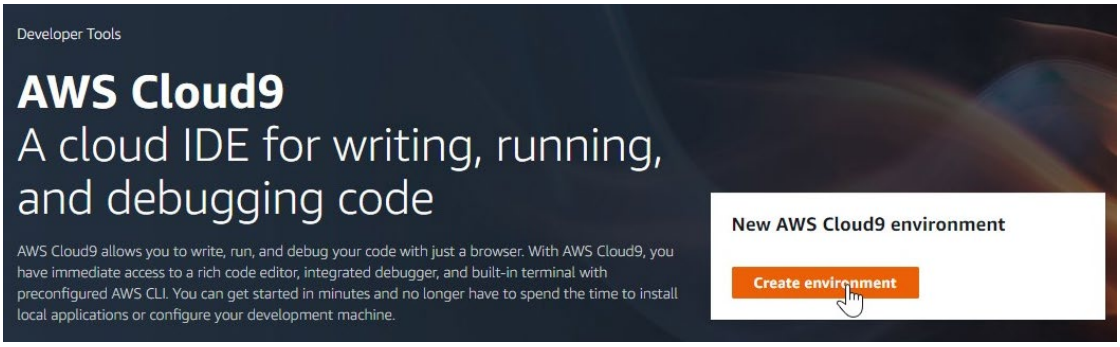
A lot of internet research led me to checking the last few entries in the log files (/var/log/messages) of the EC2 instance. The mention of out of memory made me realize that I needed a bigger size EC2 instance (moved from t2.micro to t2.medium)

```
Nov 30 06:54:04 ip-172-31-85-14 kernel: dump_header+0x4a/0x1f0
Nov 30 06:54:04 ip-172-31-85-14 kernel: oom_kill_process.cold+0xb/0x10
Nov 30 06:54:04 ip-172-31-85-14 kernel: out_of_memory.part.0+0xbd/0x260
Nov 30 06:54:04 ip-172-31-85-14 kernel: out_of_memory+0x3d/0x80
Nov 30 06:54:04 ip-172-31-85-14 kernel: __alloc_pages_slowpath.constprop.0+0x8a8/0x960
Nov 30 06:54:04 ip-172-31-85-14 kernel: __alloc_pages_nodemask+0x2d6/0x300
Nov 30 06:54:04 ip-172-31-85-14 kernel: alloc_pages_vma+0x80/0x260
Nov 30 06:54:04 ip-172-31-85-14 kernel: do_anonymous_page+0xd3/0x510
Nov 30 06:54:04 ip-172-31-85-14 kernel: __handle_mm_fault+0x333/0x640
Nov 30 06:54:04 ip-172-31-85-14 kernel: handle_mm_fault+0xbe/0x290
Nov 30 06:54:04 ip-172-31-85-14 kernel: do_user_addr_fault+0x1b3/0x3e0
Nov 30 06:54:04 ip-172-31-85-14 kernel: exc_page_fault+0x68/0x120
Nov 30 06:54:04 ip-172-31-85-14 kernel: ? asm_exc_page_fault+0x8/0x30
Nov 30 06:54:04 ip-172-31-85-14 kernel: asm_exc_page_fault+0x1e/0x30
Nov 30 06:54:04 ip-172-31-85-14 kernel: RIP: 0033:0x7fc737c2ae3d
Nov 30 06:54:04 ip-172-31-85-14 kernel: Code: 01 00 00 48 83 fa 40 77 77 c5 fe 7f 44 17 e0 c5 fe 7f 07 c5 f8 77 c3 66 0f 1f 44 00 00 c5 f8 77 48 89 d1 40 0f b6 c6 48 89 fa <f3> aa 48 89 d0 c3 0f
 1f 00 66 2e 0f 1f 84 00 00 00 00 00 48 39 d1
Nov 30 06:54:04 ip-172-31-85-14 kernel: RSP: 002b:00007ffecb0edba8 EFLAGS: 00010202
Nov 30 06:54:04 ip-172-31-85-14 kernel: RAX: 0000000000000000 RBX: 0000000000000008 RCX: 00000000015cefc0
Nov 30 06:54:04 ip-172-31-85-14 kernel: RDX: 00007fc6f71b1010 RSI: 0000000000000000 RDI: 00007fc6f8410000
Nov 30 06:54:04 ip-172-31-85-14 kernel: RBP: 00007ffecb0edbf0 R08: 0000000000000001 R09: 0000000000000000
Nov 30 06:54:04 ip-172-31-85-14 kernel: R10: 0000000000000022 R11: 0000000000000246 R12: 00000000282dfb0
Nov 30 06:54:04 ip-172-31-85-14 kernel: R13: 00007fc7217e6390 R14: 00007ffecb0edbc4 R15: 00007ffecb0edbd8
Nov 30 06:54:04 ip-172-31-85-14 kernel: Mem-Info:
Nov 30 06:54:04 ip-172-31-85-14 kernel: active_anon:68 inactive_anon:222071 isolated_anon:0#012 active_file:2 inactive_file:2 isolated_file:0#012 unevictable:0 dirty:0 writeback:0#012 slab_recla
imable:4198 slab_unreclaimable:4548#012 mapped:5 shmem:100 pagetables:1579 bounce:0#012 free:12164 free_pcp:122 free_cma:0
Nov 30 06:54:04 ip-172-31-85-14 kernel: Node 0 active_anon:272kB inactive_anon:888284kB active_file:8kB inactive_file:8kB unevictable:0kB isolated(anon):0kB isolated(file):0kB mapped:20kB dirty:
0kB writeback:0kB shmem:400kB shmem_thp: 0kB shmem_pmdmapped: 0kB anon_thp: 0kB writeback_tmp:0kB kernel_stack:2064kB all_unreclaimable? yes
Nov 30 06:54:04 ip-172-31-85-14 kernel: Node 0 DMA free:4460kB min:736kB low:920kB high:1104kB reserved_highatomic:0KB active_anon:0kB inactive_anon:11276kB active_file:0kB inactive_file:0kB une
victable:0kB writepending:0kB present:15988kB managed:15904kB mlocked:0kB pagetables:24kB bounce:0kB free_pcp:0kB local_pcp:0kB free_cma:0kB
Nov 30 06:54:04 ip-172-31-85-14 kernel: lowmem_reserve[]: 0 932 932 932
Nov 30 06:54:04 ip-172-31-85-14 kernel: Node 0 DMA32 free:44196kB min:44316kB low:55392kB high:66468kB reserved_highatomic:0KB active_anon:272kB inactive_anon:876996kB active_file:8kB inactive_f
ile:8kB unevictable:0kB writepending:0kB present:1032192kB managed:973236kB mlocked:0kB pagetables:6292kB bounce:0kB free_pcp:488kB local_pcp:488kB free_cma:0kB
Nov 30 06:54:04 ip-172-31-85-14 kernel: lowmem_reserve[]: 0 0 0 0
Nov 30 06:54:04 ip-172-31-85-14 kernel: Node 0 DMA: 1*4kB (M) 1*8kB (U) 2*16kB (UM) 4*32kB (UM) 3*64kB (UM) 2*128kB (UM) 3*256kB (UM) 2*512kB (UM) 2*1024kB (U) 0*2048kB 0*4096kB = 4460kB
Nov 30 06:54:04 ip-172-31-85-14 kernel: Node 0 DMA32: 729*4kB (UME) 566*8kB (UME) 423*16kB (UME) 273*32kB (UME) 148*64kB (UME) 50*128kB (UME) 15*256kB (UME) 3*512kB (UM) 0*1024kB 0*2048kB 0*4096
kB = 44196kB
Nov 30 06:54:04 ip-172-31-85-14 kernel: Node 0 hugepages_total=0 hugepages_free=0 hugepages_surp=0 hugepages_size=2048kB
Nov 30 06:54:04 ip-172-31-85-14 kernel: 102 total pagecache pages
Nov 30 06:54:04 ip-172-31-85-14 kernel: 0 pages in swap cache
Nov 30 06:54:04 ip-172-31-85-14 kernel: Swap cache stats: add 0, delete 0, find 0/0
Nov 30 06:54:04 ip-172-31-85-14 kernel: Free swap  = 0kB
Nov 30 06:54:04 ip-172-31-85-14 kernel: Total swap = 0kB
Nov 30 06:54:04 ip-172-31-85-14 kernel: 262045 pages RAM
Nov 30 06:54:04 ip-172-31-85-14 kernel: 0 pages HighMem/MovableOnly
Nov 30 06:54:04 ip-172-31-85-14 kernel: 14760 pages reserved
Nov 30 06:54:04 ip-172-31-85-14 kernel: 0 pages hwpoisoned
Nov 30 06:54:04 ip-172-31-85-14 kernel: Tasks state (memory values in pages):
Nov 30 06:54:04 ip-172-31-85-14 kernel: [  pid  ]   uid  tgid total_vm      rss pgtables_bytes swapents oom_score_adj name
Nov 30 06:54:04 ip-172-31-85-14 kernel: [   1705]     0  1705     9741       86   122880        0             0 systemd-journal
Nov 30 06:54:04 ip-172-31-85-14 kernel: [   1737]     0  1737    29701       66   126976        0             0 lvmetad
Nov 30 06:54:04 ip-172-31-85-14 kernel: [   1738]     0  1738     9344      190   122880        0         -1000 systemd-udevd
Nov 30 06:54:04 ip-172-31-85-14 kernel: [   2521]     0  2521    14935      104   131072        0         -1000 auditd
Nov 30 06:54:04 ip-172-31-85-14 kernel: [   2552]   999  2552     3156       42    69632        0             0 lsmd
Nov 30 06:54:04 ip-172-31-85-14 kernel: [   2554]     0  2554     7116       90    98304        0             0 systemd-logind
Nov 30 06:54:04 ip-172-31-85-14 kernel: [   2558]    81  2558    15089      119   155648        0          -900 dbus-daemon
Nov 30 06:54:04 ip-172-31-85-14 kernel: [   2562]    32  2562    17338      137   176128        0             0 rpcbind
Nov 30 06:54:04 ip-172-31-85-14 kernel: [   2564]     0  2564    25399      118   155648        0             0 gssproxy
Nov 30 06:54:04 ip-172-31-85-14 kernel: [   2593]   998  2593    23512      212   221184        0             0 rngd
Nov 30 06:54:04 ip-172-31-85-14 kernel: [   2595]   996  2595    30597      127   147456        0             0 chronyd
Nov 30 06:54:04 ip-172-31-85-14 kernel: [   2796]     0  2796    25171      517   225280        0             0 dhclient
Nov 30 06:54:04 ip-172-31-85-14 kernel: [   2843]     0  2843    25171      511   208896        0             0 dhclient
Nov 30 06:54:04 ip-172-31-85-14 kernel: [   2989]     0  2989    22577      263   192512        0             0 master
Nov 30 06:54:04 ip-172-31-85-14 kernel: [   2991]    89  2991    22618      256   200704        0             0 qmgr
Nov 30 06:54:04 ip-172-31-85-14 kernel: [   3047]     0  3047    54650      220   188416        0             0 rsyslogd
Nov 30 06:54:04 ip-172-31-85-14 kernel: [   3050]     0  3050   179174     1748   122880        0             0 amazon-ssm-agen
Nov 30 06:54:04 ip-172-31-85-14 kernel: [   3058]     0  3058     6171      158    94208        0             0 crond
Nov 30 06:54:04 ip-172-31-85-14 kernel: [   3070]     0  3070     6972       51    98304        0             0 atd
Nov 30 06:54:04 ip-172-31-85-14 kernel: [   3100]     0  3100     2638       31    69632        0             0 agetty
Nov 30 06:54:04 ip-172-31-85-14 kernel: [   3101]     0  3101    30326       31    73728        0             0 agetty
Nov 30 06:54:04 ip-172-31-85-14 kernel: [   3209]     0  3209   182280     3276   159744        0             0 ssm-agent-worke
Nov 30 06:54:04 ip-172-31-85-14 kernel: [   3225]     0  3225    28218      256   258048        0         -1000 sshd
Nov 30 06:54:04 ip-172-31-85-14 kernel: [   3252]     0  3252     1066       26    53248        0             0 acpid
Nov 30 06:54:04 ip-172-31-85-14 kernel: [   3281]     0  3281    37636      330   335872        0             0 sshd
Nov 30 06:54:04 ip-172-31-85-14 kernel: [   3299]  1000  3299    37676      380   331776        0             0 sshd
Nov 30 06:54:04 ip-172-31-85-14 kernel: [   3300]  1000  3300    31678      254    77824        0             0 bash
Nov 30 06:54:04 ip-172-31-85-14 kernel: [   1053]    89  1053    22599      255   208896        0             0 pickup
Nov 30 06:54:04 ip-172-31-85-14 kernel: [   1054]  1000  1054   305733   211756  2187264        0             0 python
Nov 30 06:54:04 ip-172-31-85-14 kernel: oom-kill:constraint=CONSTRAINT_NONE,nodemask=(null),cpuset=/,mems_allowed=0,global_oom,task_memcg=/,task=python,pid=1054,uid=1000
Nov 30 06:54:04 ip-172-31-85-14 kernel: Out of memory: Killed process 1054 (python) total-vm:1222932kB, anon-rss:847016kB, file-rss:8kB, shmem-rss:0kB, UID:1000 pgtables:2136kB oom_score_adj:0
Nov 30 06:54:04 ip-172-31-85-14 kernel: oom_reaper: reaped process 1054 (python), now anon-rss:0kB, file-rss:0kB, shmem-rss:0kB
Nov 30 06:54:57 ip-172-31-85-14 dhclient[2843]: XMT: Solicit on eth0, interval 111460ms.
Nov 30 06:56:49 ip-172-31-85-14 dhclient[2843]: XMT: Solicit on eth0, interval 125740ms.
Nov 30 06:58:54 ip-172-31-85-14 dhclient[2843]: XMT: Solicit on eth0, interval 114010ms.
(env) [ec2-user@ip-172-31-85-14 log]$
```

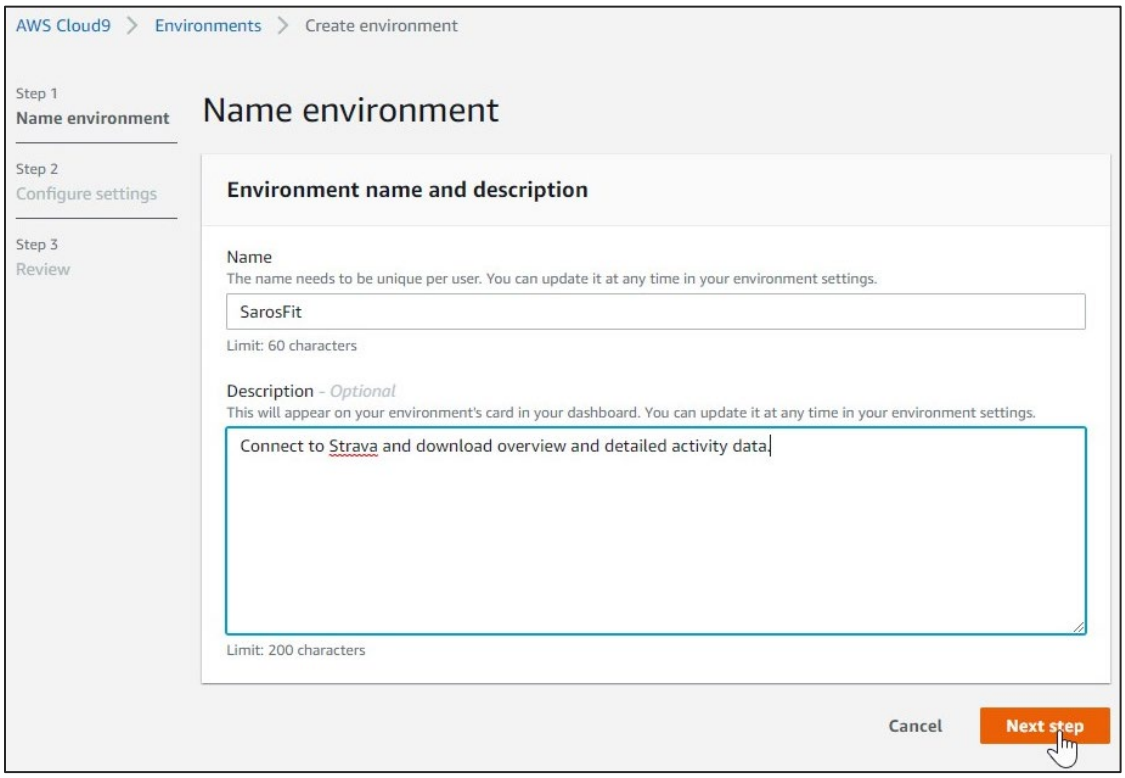
STEP 5: CLOUD9 IDE ENVIRONMENT

After using the standard process outlined in Step 4, I decided to try the AWS Cloud9 IDE. Cloud9 greatly streamlines the process in Step 4 while being a lot more user-friendly and powerful!

Simply select 'Create environment'

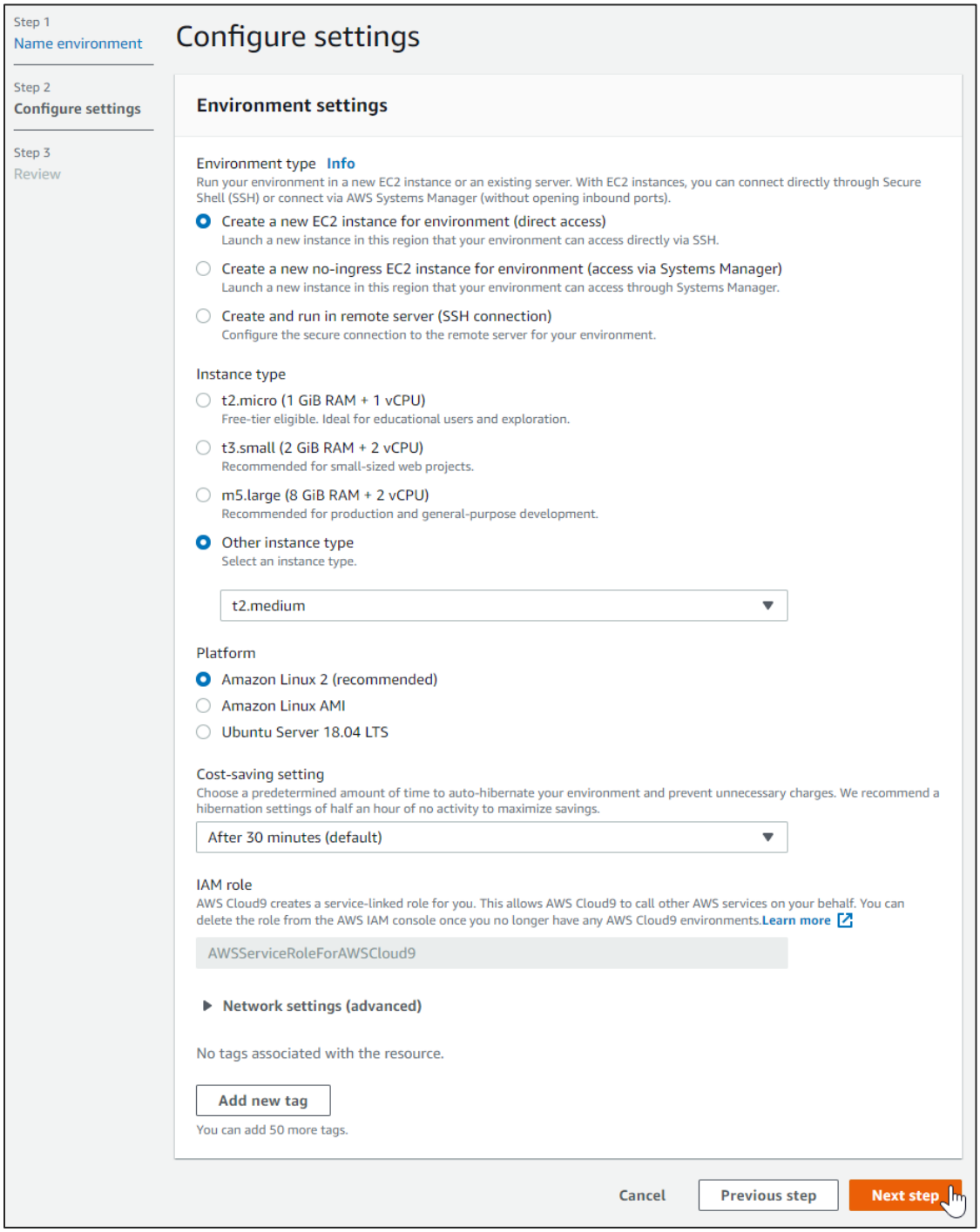


Give the environment a Name and optionally a Description

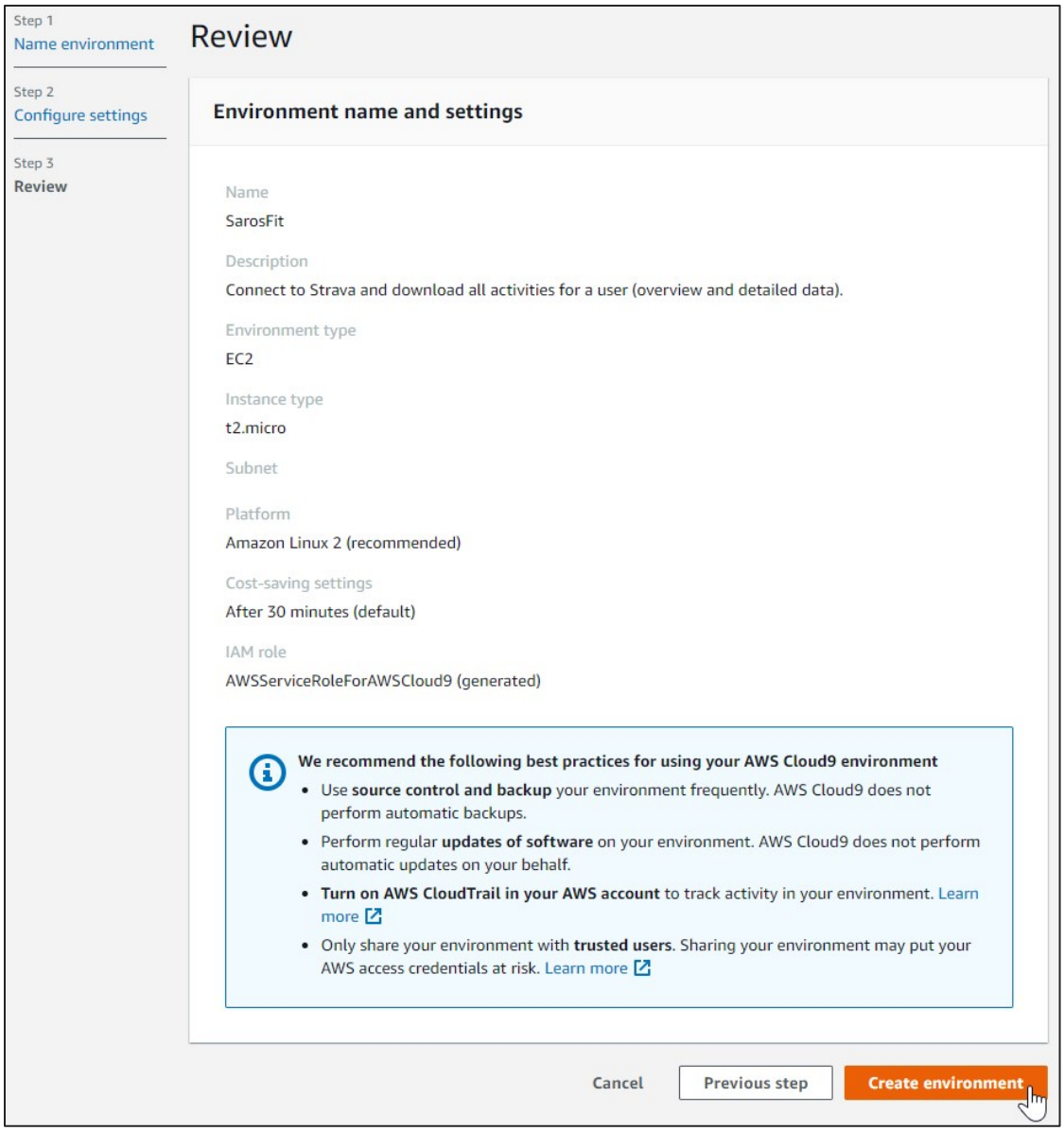


All the default options are appropriate except that for the saros-fit.py script we require a t2.medium instance type.

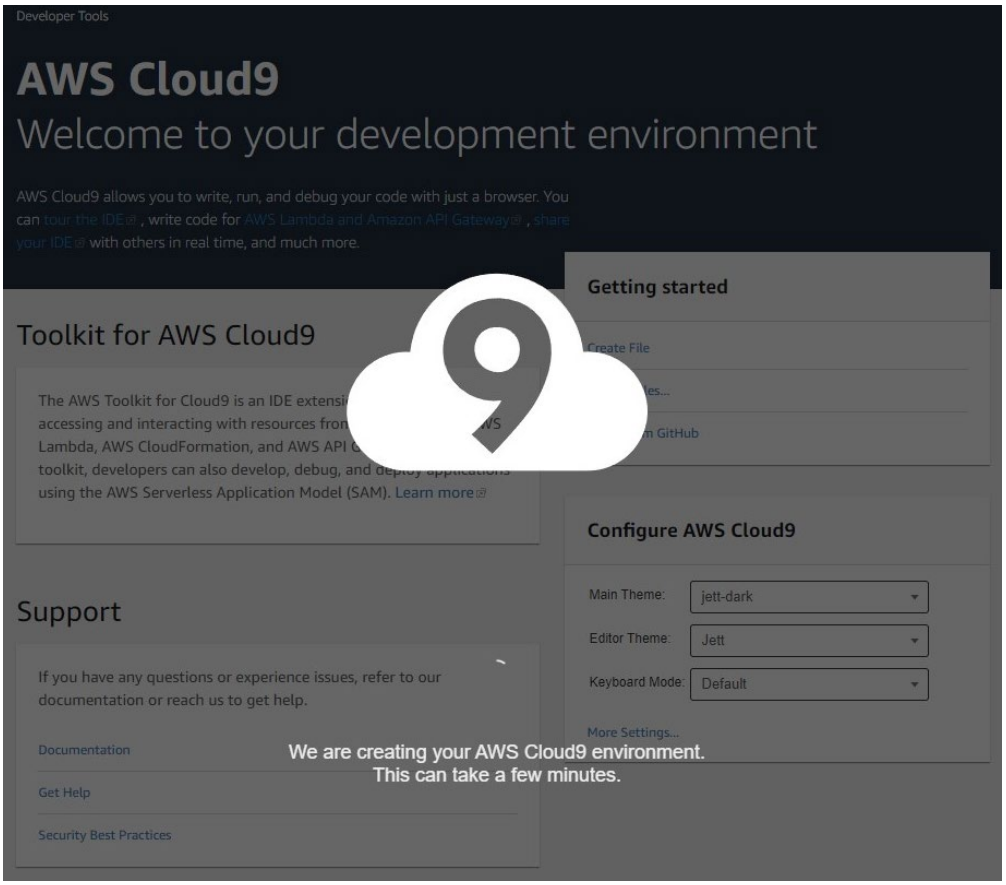
Note: Cloud9 EC2 instances even stop themselves automatically when not in use to save money.

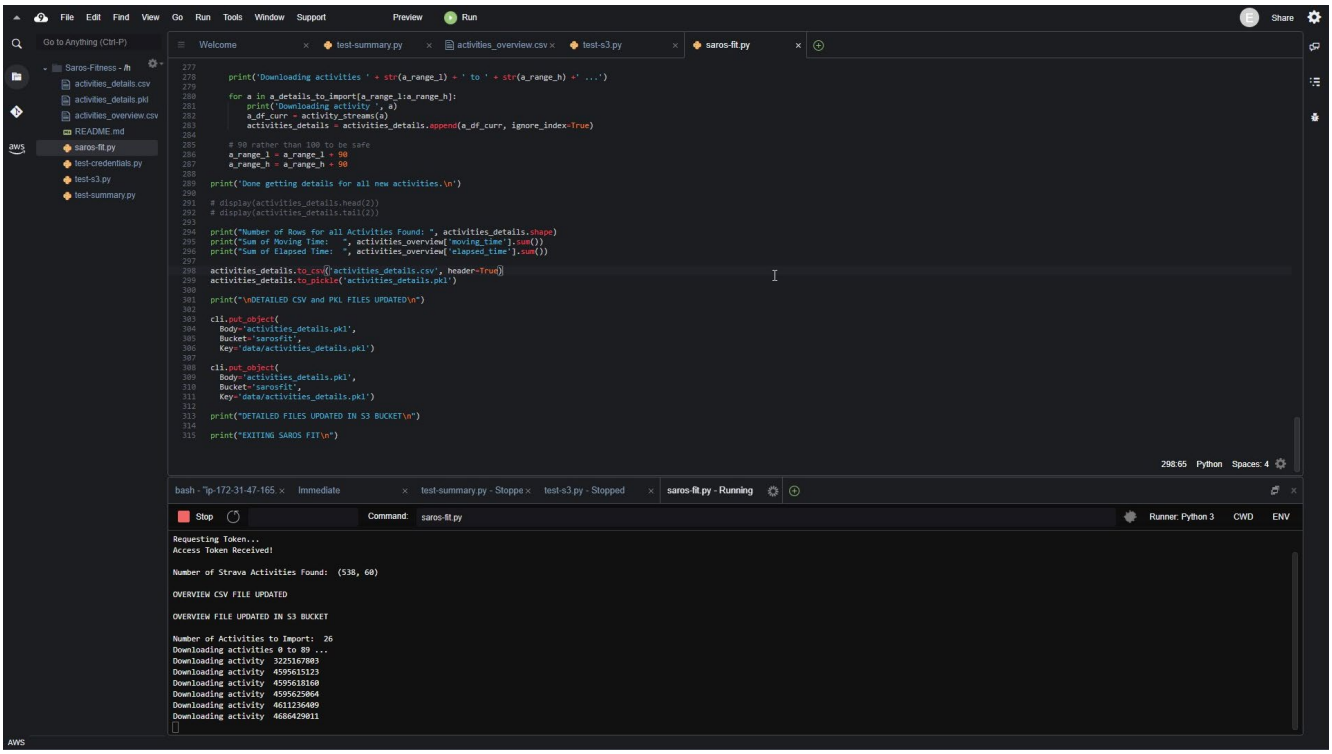


That is everything required and in this step we just review the setting and click ‘Create environment’.

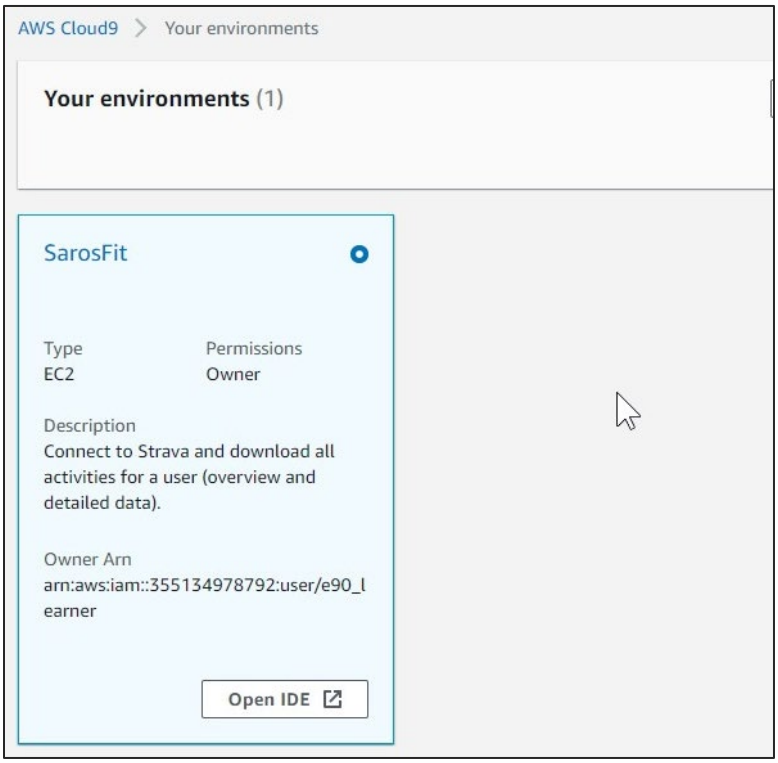


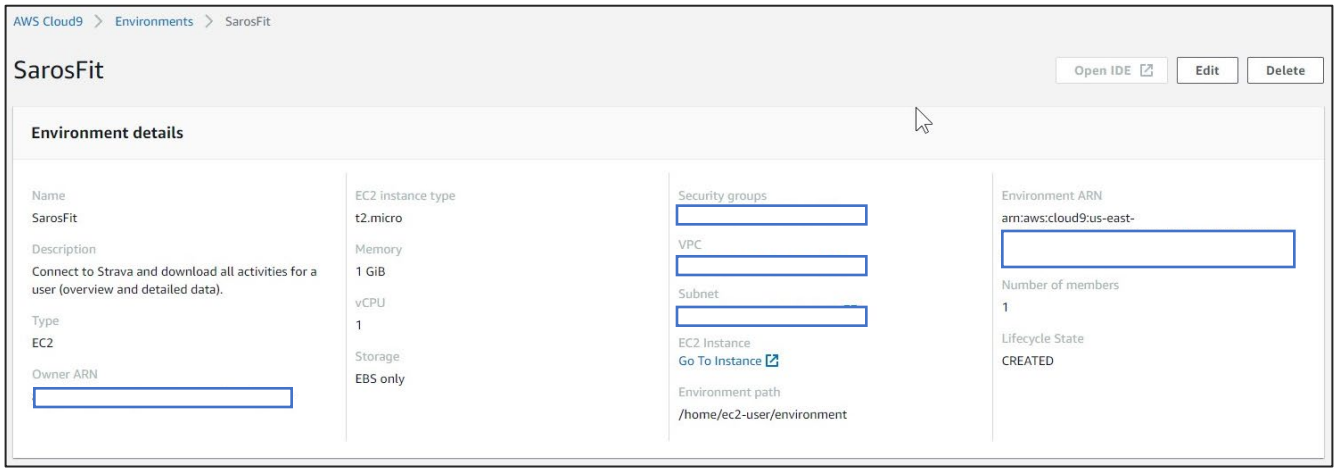
In 2-3 minutes we have an EC2 instance with python already installed an a user-friendly IDE environment



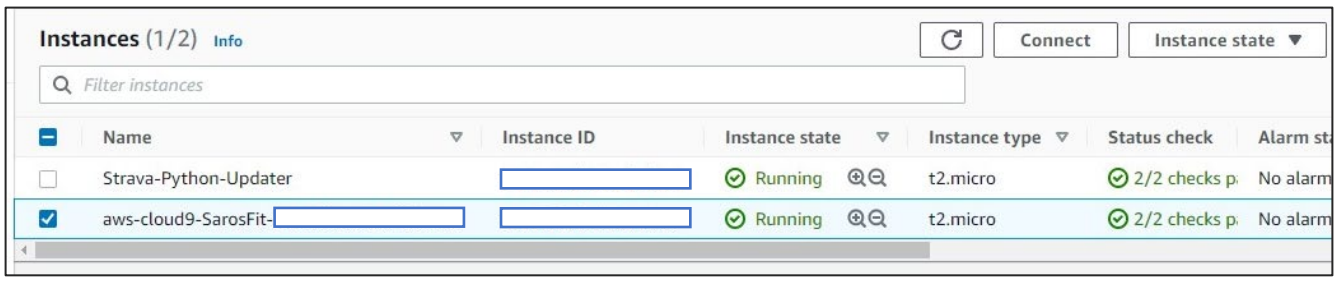


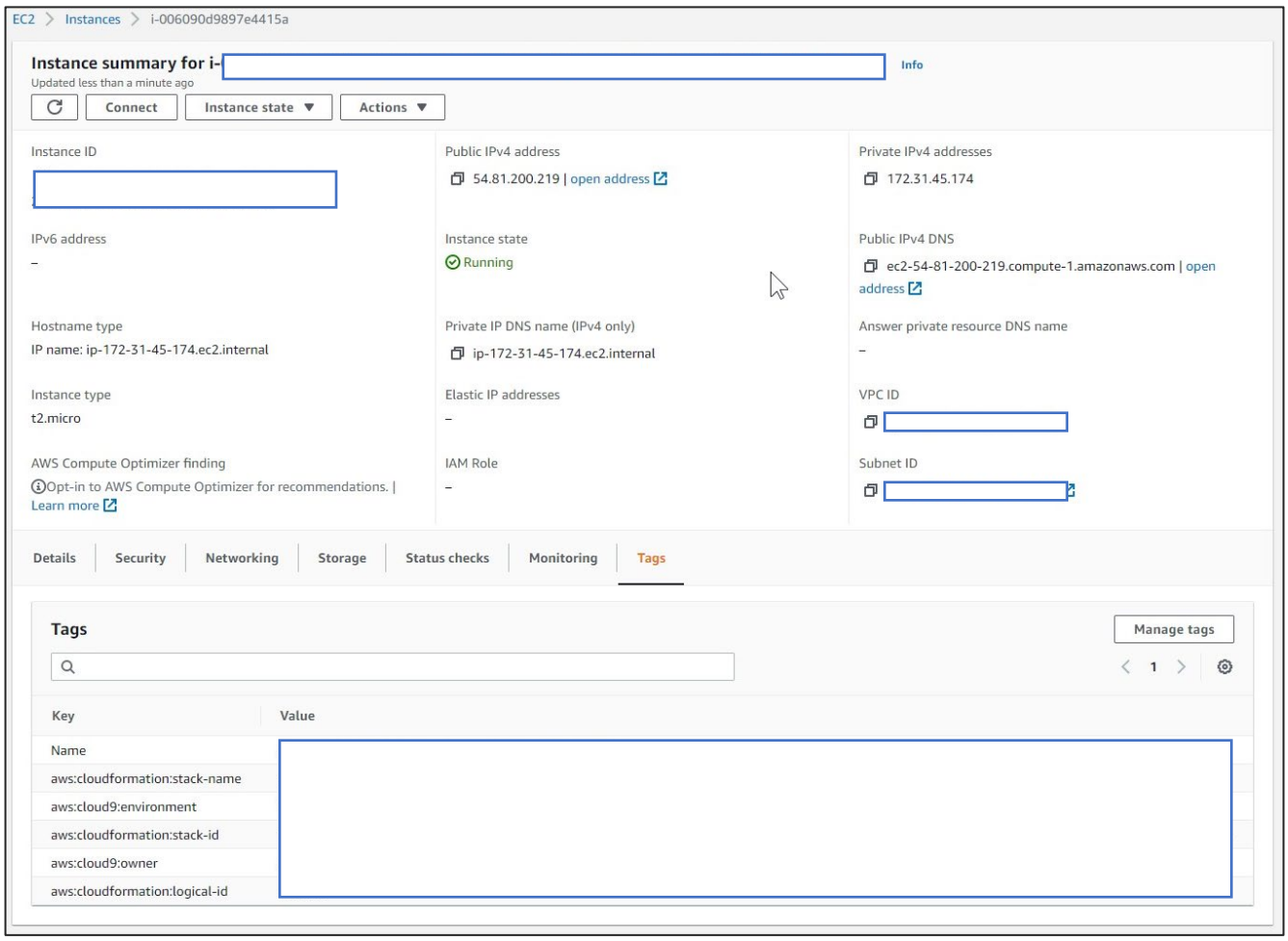
We can view all our environments and their associated details



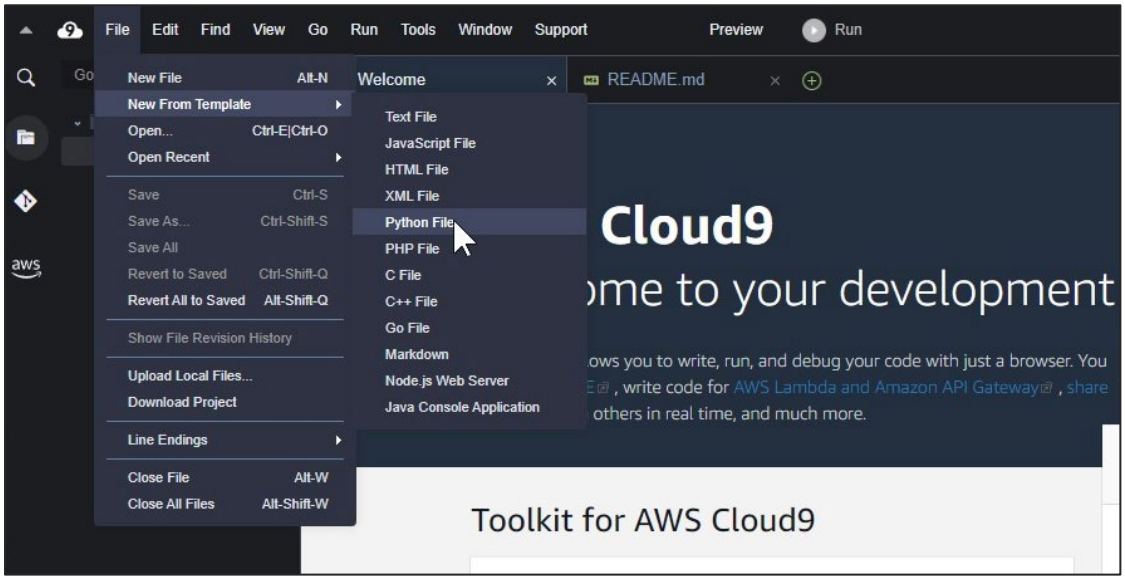


Clicking on the EC2 Instance link we can view that EC2 instance that Cloud9 automatically created

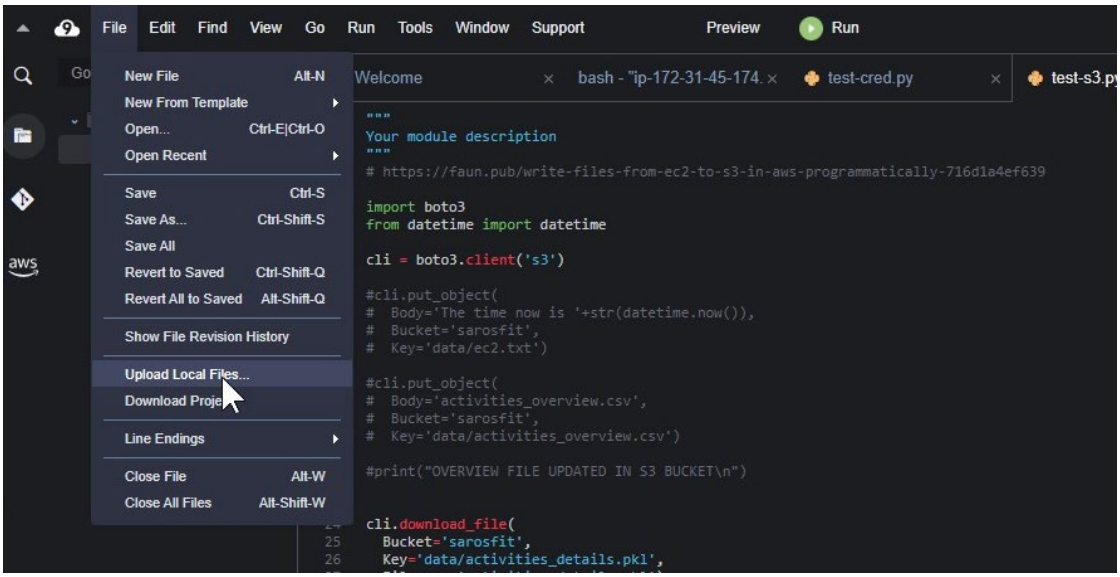


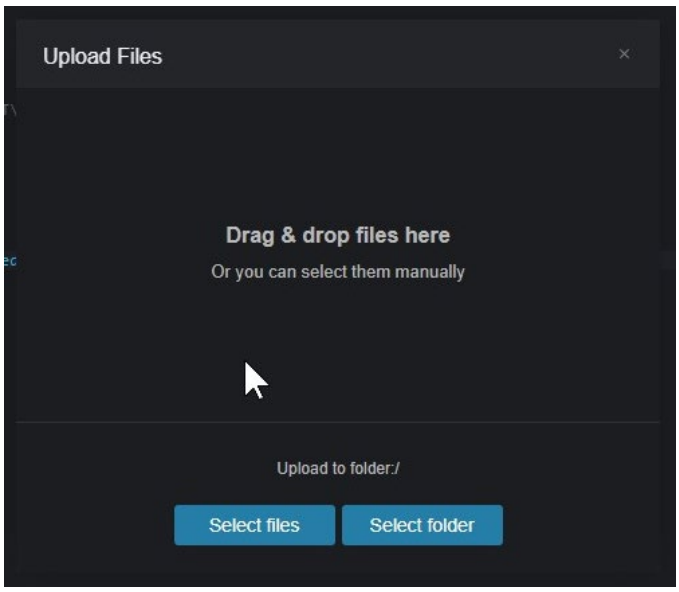


Creating a new file can easily be accomplished from the ‘File’ menu

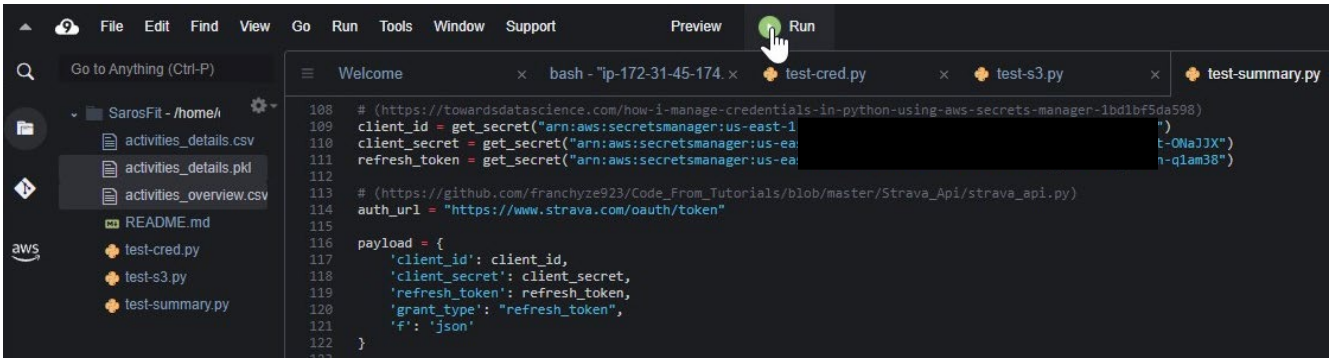


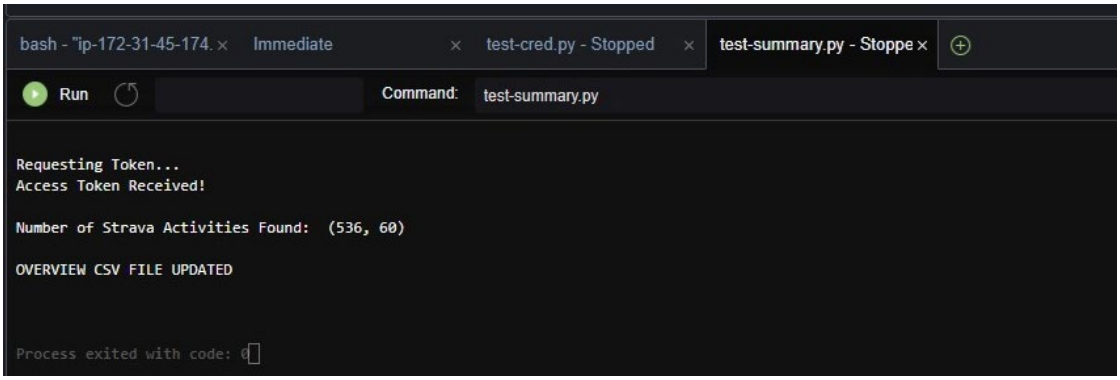
Uploading local files is as simple as clicking and dragging versus using scp from the command line



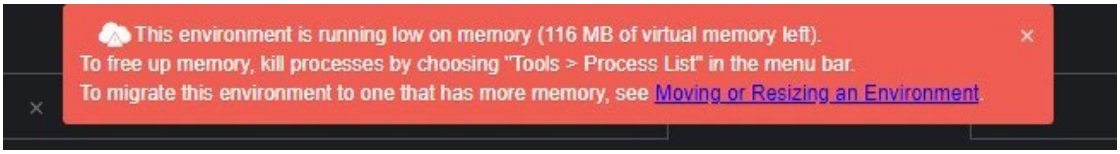


To execute a script click the 'Run' button and the output of the code is displayed in the bottom pane





Unlike AWS CLI, when the instance is running low on memory it displays a clear message to help quickly figure out why the script is failing



But it is still important to test all scripts in AWS even if they were tested locally. In AWS, <NA> values stored in the latlng column caused an error when trying to pickle the dataframe. Locally, the script ran fine without any errors.

```
Traceback (most recent call last):
  File "/home/ec2-user/environment/saros-fit.py", line 288, in <module>
    activities_details.to_pickle('activities_details.pkl')
  File "/home/ec2-user/.local/lib/python3.7/site-packages/pandas/core/generic.py", line 2962, in to_pickle
    storage_options=storage_options,
  File "/home/ec2-user/.local/lib/python3.7/site-packages/pandas/io/pickle.py", line 119, in to_pickle
    protocol=protocol,
_pickle.PicklingError: Can't pickle <NA>: it's not the same object as pandas._libs.missing.NA
```

```
time                                                395.0
distance                                           1599.0
latlng                                               <NA>
altitude                                              0.0
velocity_smooth                                       3.7
heartrate                                           157.0
cadence                                              23.0
watts                                               207.0
temp                                                  0.0
moving                                                1.0
grade_smooth                                          0.0
id                                           5287226391.0
date                            2021-05-12 16:57:49+00:00
name                  500m Intervals x 4 (2,2,4 min rest)
type                                                Rowing
Name: 970253, dtype: object
```

STEP 6: AWS SECRET MANAGER

For storing the Strava Access Tokens securely I used AWS Secret Manager. Passwords can be stored either via the command line or via the website.

From Command Line:

- `aws secretsmanager create-secret --name sarosfit_client_id --secret-string xxx`
- `aws secretsmanager create-secret --name sarosfit_client_secret --secret-string xxx`

Note: The python script should be updated with the ARN's returned

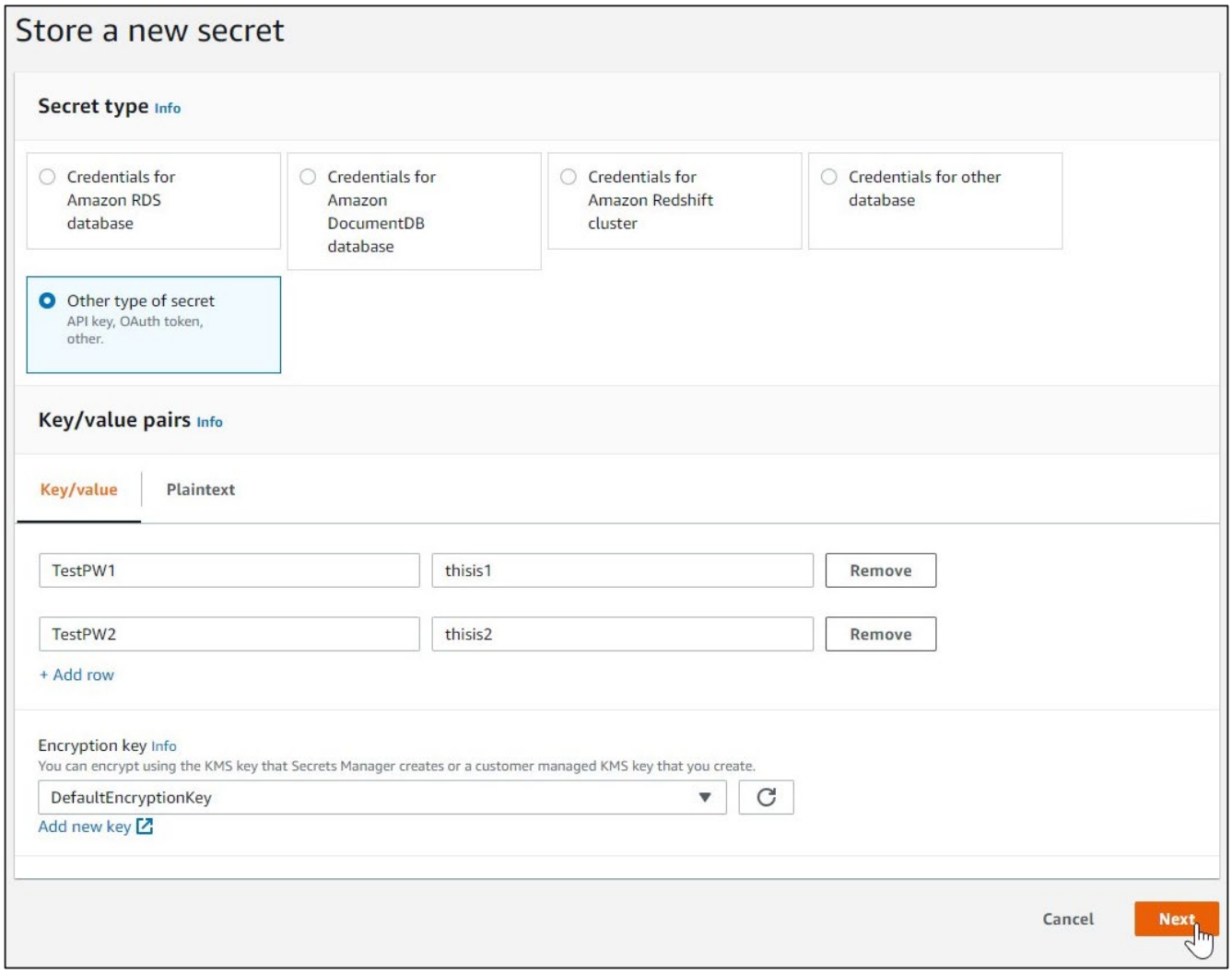
From the Website:

Click on 'Store a new secret' and click on secret type desired.

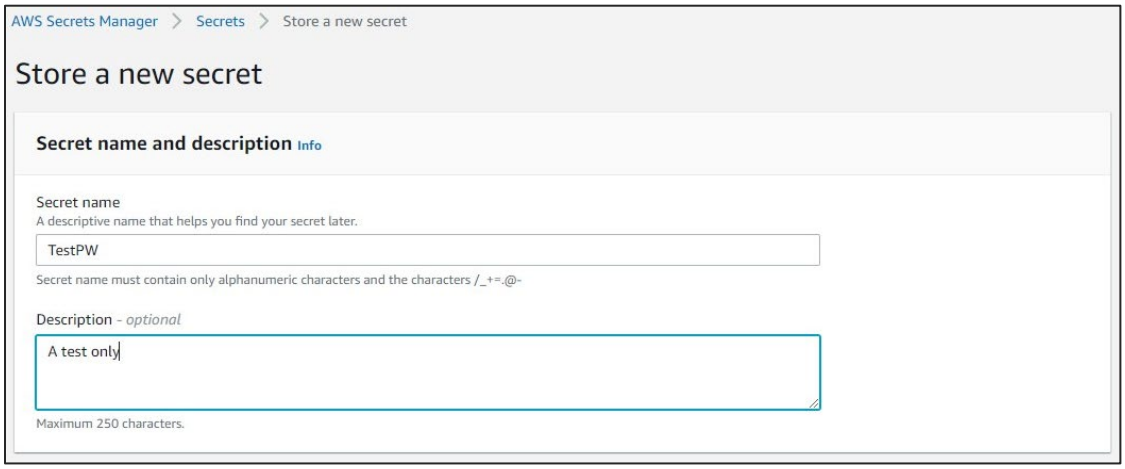
In our case we want to store a token so we pick 'Other type of secret'

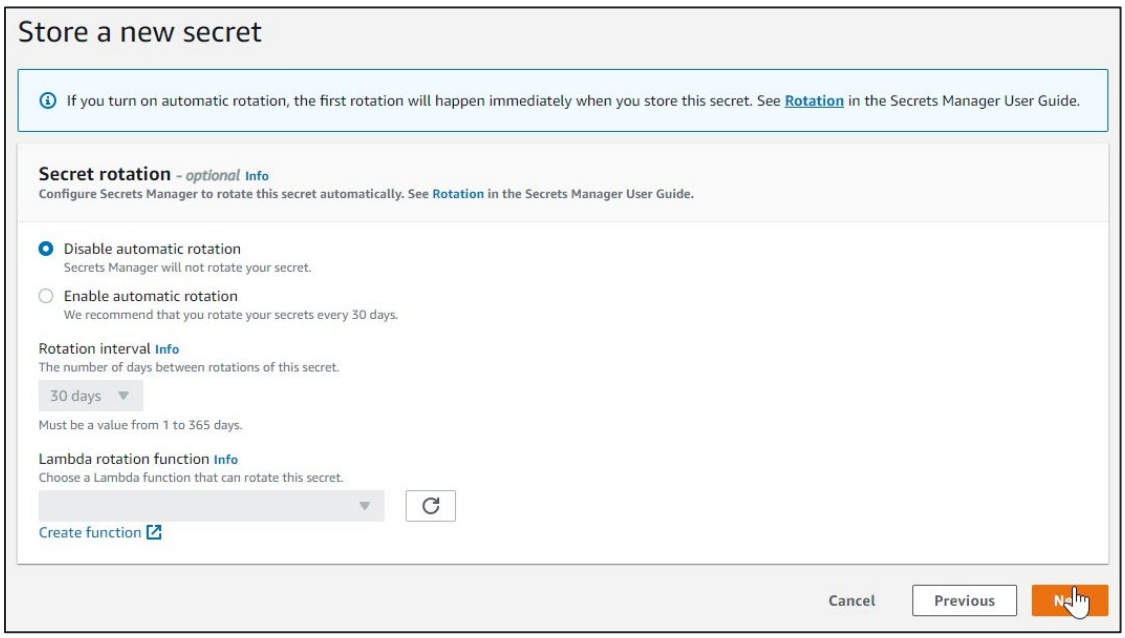
Key/value pairs can be entered simply

To store plain text, click on Plaintext and then clear the pre-entered text from the textbox and then enter the value



Give the secret a name, a description *(optional)* and type of secret rotation *(optional)*

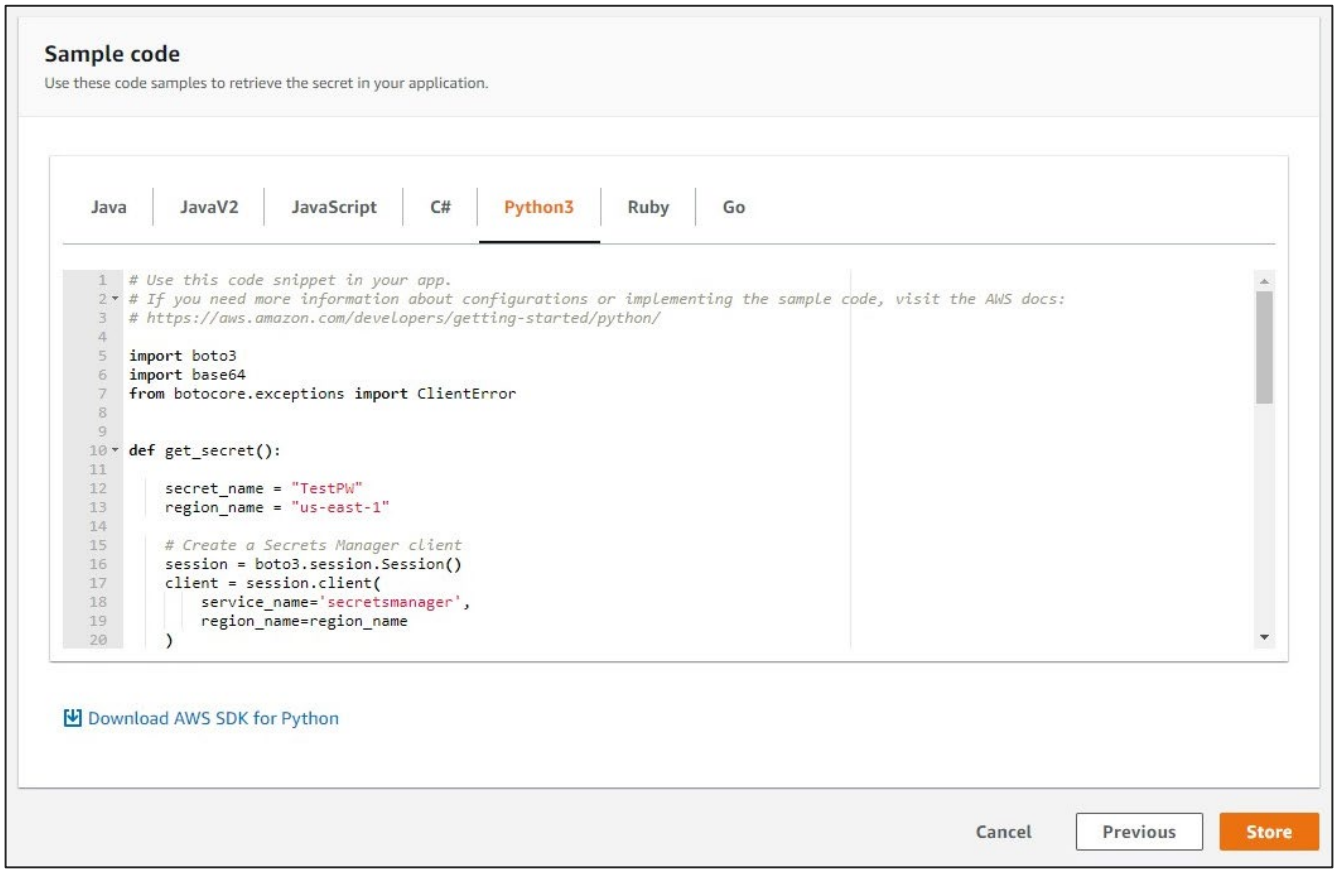


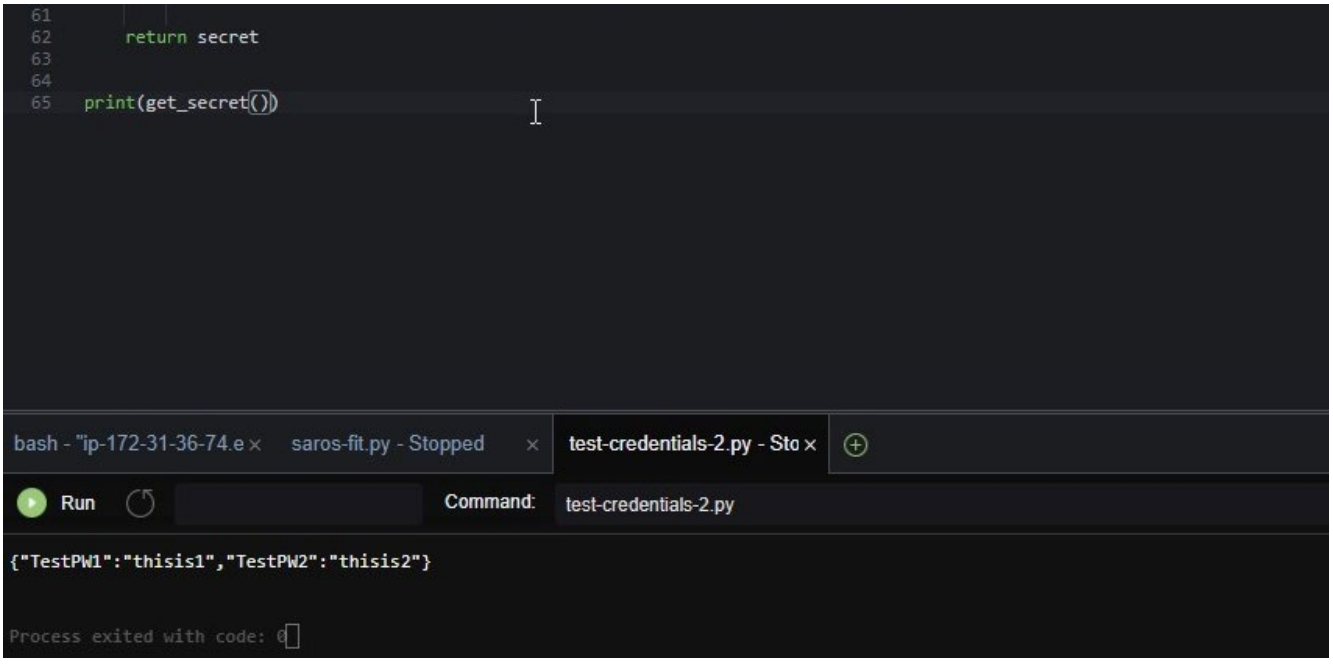


Copy python script to access secret.

Modify the script to return the secret value

Test to ensure the python code works using Cloud9 IDE

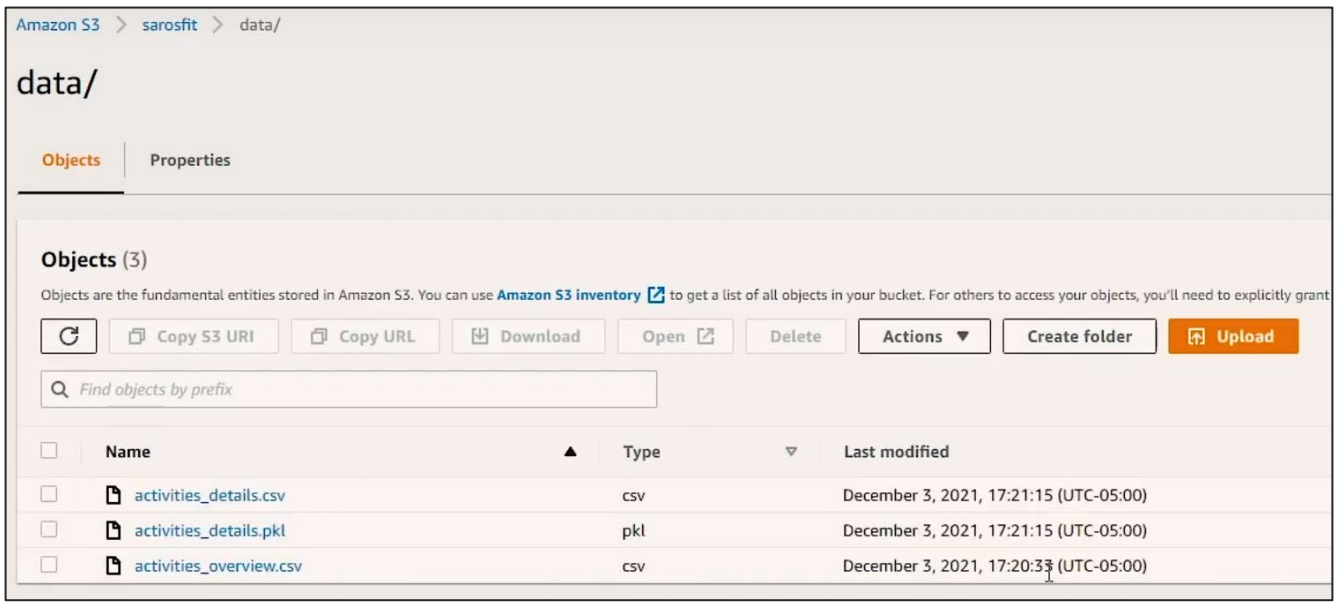




OUTPUT OF SCRIPT

Files in S3 Bucket

- activities_overview.csv contains all a user's activities along with 59 columns of summary data
- activities_details.csv contains 11 datapoints for every second of each activity
- activities_details.pkl file contains same info as activities_details.csv *(only used by script)*



The activities overview file is perfect for getting a summary overview of all Strava activities.

The activities details file is perfect for running detailed analysis on every second of every activity.

Examples of data from these two files are provided below.

Example of data from one activity in activities_overview.csv

resource_state	2
name	Bike Path to Bedford (so humid)
distance	48394.8
moving_time	7048
elapsed_time	8332
total_elevation_gain	213
type	Ride
id	5010668618
external_id	garmin_push_6492235391
upload_id	5343220029
start_date	2021-03-25T19:50:09Z
start_date_local	2021-03-25T15:50:09Z
timezone	(GMT-05:00) America/New_York
utc_offset	-14400
start_latlng	[42.377357, -71.107113]
end_latlng	[42.376815, -71.106558]
location_city	
location_state	
location_country	United States
start_latitude	42.377357
start_longitude	-71.106558
achievement_count	96
kudos_count	3
comment_count	2
athlete_count	1
photo_count	0
trainer	FALSE
commute	FALSE
manual	FALSE
private	FALSE
visibility	everyone
flagged	FALSE
gear_id	b6854735
from_accepted_tag	FALSE
upload_id_str	5343220029
average_speed	6.866
max_speed	13.2
average_cadence	78.7
average_watts	142.3
max_watts	599
weighted_average_watts	147
kilojoules	1003.2
device_watts	TRUE
has_heartrate	TRUE
average_heartrate	155.5
max_heartrate	176
heartrate_opt_out	FALSE
display_hide_heartrate_option	TRUE
elev_high	83
elev_low	11.8
pr_count	80
total_photo_count	0
has_kudoed	FALSE
athlete.id	51460571
athlete.resource_state	1
map.id	a5010668618
map.summary_polyline	[illegible]
map.resource_state	2
workout_type	10
average_temp	18

Example of data from a sample activity in activities_details.csv

(my personal 548 strava activities have 1.8 million rows in the activities_details file)

time	distance	latlng	altitude	velocity_smooth	heartrate	cadence	watts	temp	moving	grade_smooth	id	date	name	type
1000	6324.500	[42.399068, -71.144309]	12.800	7.800	161	87	195	19	1	0.000	5010668618	2021-03-25 15:50:09+00:00	Bike Path to Bedford (so humid) 😬	Ride
1001	6332.400	[42.399135, -71.144341]	12.800	7.800	161	87	236	19	1	0.000	5010668618	2021-03-25 15:50:09+00:00	Bike Path to Bedford (so humid) 😬	Ride
1002	6340.300	[42.399197, -71.144382]	12.800	7.900	162	87	236	19	1	0.600	5010668618	2021-03-25 15:50:09+00:00	Bike Path to Bedford (so humid) 😬	Ride
1003	6348.000	[42.39925, -71.144436]	12.800	7.900	162	88	225	19	1	0.600	5010668618	2021-03-25 15:50:09+00:00	Bike Path to Bedford (so humid) 😬	Ride
1004	6355.800	[42.399291, -71.144505]	13.000	7.800	162	85	167	19	1	0.600	5010668618	2021-03-25 15:50:09+00:00	Bike Path to Bedford (so humid) 😬	Ride
1005	6363.700	[42.399334, -71.144583]	13.000	7.800	163	88	148	19	1	0.600	5010668618	2021-03-25 15:50:09+00:00	Bike Path to Bedford (so humid) 😬	Ride
1006	6371.600	[42.399383, -71.144649]	13.000	7.800	163	88	172	19	1	0.600	5010668618	2021-03-25 15:50:09+00:00	Bike Path to Bedford (so humid) 😬	Ride
1007	6379.500	[42.399442, -71.144698]	13.000	7.800	164	87	157	19	1	0.600	5010668618	2021-03-25 15:50:09+00:00	Bike Path to Bedford (so humid) 😬	Ride
1008	6387.500	[42.399506, -71.14474]	13.200	7.900	164	88	165	19	1	0.600	5010668618	2021-03-25 15:50:09+00:00	Bike Path to Bedford (so humid) 😬	Ride
1009	6395.500	[42.39957, -71.144784]	13.200	7.900	164	89	167	19	1	1.300	5010668618	2021-03-25 15:50:09+00:00	Bike Path to Bedford (so humid) 😬	Ride
1010	6403.500	[42.399637, -71.144821]	13.200	8.000	165	88	172	19	1	0.600	5010668618	2021-03-25 15:50:09+00:00	Bike Path to Bedford (so humid) 😬	Ride
1011	6411.400	[42.399706, -71.144849]	13.400	8.000	165	88	127	19	1	0.600	5010668618	2021-03-25 15:50:09+00:00	Bike Path to Bedford (so humid) 😬	Ride
1012	6419.300	[42.399777, -71.144869]	13.400	8.000	165	88	110	19	1	0.600	5010668618	2021-03-25 15:50:09+00:00	Bike Path to Bedford (so humid) 😬	Ride
1013	6426.900	[42.399852, -71.144871]	13.400	7.900	165	83	137	19	1	0.000	5010668618	2021-03-25 15:50:09+00:00	Bike Path to Bedford (so humid) 😬	Ride
1014	6434.500	[42.399926, -71.144853]	13.400	7.800	165	87	105	19	1	0.000	5010668618	2021-03-25 15:50:09+00:00	Bike Path to Bedford (so humid) 😬	Ride
1015	6440.800	[42.399994, -71.144819]	13.400	7.500	165	85	69	19	1	0.000	5010668618	2021-03-25 15:50:09+00:00	Bike Path to Bedford (so humid) 😬	Ride
1016	6446.100	[42.400051, -71.144774]	13.400	6.900	165	85	0	19	1	0.000	5010668618	2021-03-25 15:50:09+00:00	Bike Path to Bedford (so humid) 😬	Ride
1017	6450.300	[42.400095, -71.144732]	13.400	6.200	165	0	0	19	1	0.000	5010668618	2021-03-25 15:50:09+00:00	Bike Path to Bedford (so humid) 😬	Ride
1018	6455.500	[42.400131, -71.144702]	13.400	5.700	165	0	0	19	1	0.000	5010668618	2021-03-25 15:50:09+00:00	Bike Path to Bedford (so humid) 😬	Ride
1019	6461.400	[42.400166, -71.144682]	13.400	5.400	164	26	72	19	1	0.000	5010668618	2021-03-25 15:50:09+00:00	Bike Path to Bedford (so humid) 😬	Ride
1020	6468.100	[42.400208, -71.144671]	13.400	5.500	164	70	439	19	1	0.000	5010668618	2021-03-25 15:50:09+00:00	Bike Path to Bedford (so humid) 😬	Ride
1021	6475.300	[42.40026, -71.144673]	13.400	5.800	164	70	312	19	1	0.000	5010668618	2021-03-25 15:50:09+00:00	Bike Path to Bedford (so humid) 😬	Ride
1022	6482.600	[42.40032, -71.14469]	13.400	6.500	164	79	312	19	1	0.000	5010668618	2021-03-25 15:50:09+00:00	Bike Path to Bedford (so humid) 😬	Ride
1023	6490.000	[42.400381, -71.144714]	13.400	6.900	165	81	148	19	1	0.700	5010668618	2021-03-25 15:50:09+00:00	Bike Path to Bedford (so humid) 😬	Ride
1024	6497.500	[42.400443, -71.144742]	13.400	7.200	165	81	128	19	1	0.700	5010668618	2021-03-25 15:50:09+00:00	Bike Path to Bedford (so humid) 😬	Ride
1025	6504.900	[42.400505, -71.144772]	13.600	7.400	164	82	107	19	1	0.700	5010668618	2021-03-25 15:50:09+00:00	Bike Path to Bedford (so humid) 😬	Ride
1026	6512.300	[42.400567, -71.144801]	13.600	7.400	164	86	114	19	1	0.700	5010668618	2021-03-25 15:50:09+00:00	Bike Path to Bedford (so humid) 😬	Ride
1027	6519.600	[42.40063, -71.144831]	13.600	7.400	164	86	0	19	1	0.000	5010668618	2021-03-25 15:50:09+00:00	Bike Path to Bedford (so humid) 😬	Ride
1028	6526.800	[42.40069, -71.144865]	13.600	7.400	164	0	0	19	1	0.000	5010668618	2021-03-25 15:50:09+00:00	Bike Path to Bedford (so humid) 😬	Ride
1029	6533.500	[42.400745, -71.144908]	13.600	7.200	164	20	0	19	1	0.000	5010668618	2021-03-25 15:50:09+00:00	Bike Path to Bedford (so humid) 😬	Ride
1030	6540.700	[42.400788, -71.14496]	13.600	7.200	164	77	302	19	1	0.000	5010668618	2021-03-25 15:50:09+00:00	Bike Path to Bedford (so humid) 😬	Ride
1031	6548.000	[42.40083, -71.14502]	13.600	7.100	164	81	296	20	1	0.000	5010668618	2021-03-25 15:50:09+00:00	Bike Path to Bedford (so humid) 😬	Ride
1032	6555.600	[42.400879, -71.145071]	13.600	7.200	164	83	198	20	1	0.000	5010668618	2021-03-25 15:50:09+00:00	Bike Path to Bedford (so humid) 😬	Ride
1033	6563.400	[42.400936, -71.14511]	13.600	7.300	164	84	134	20	1	0.600	5010668618	2021-03-25 15:50:09+00:00	Bike Path to Bedford (so humid) 😬	Ride
1034	6571.200	[42.400996, -71.145146]	13.600	7.500	164	86	150	20	1	0.600	5010668618	2021-03-25 15:50:09+00:00	Bike Path to Bedford (so humid) 😬	Ride
1035	6579.000	[42.401057, -71.145186]	13.800	7.700	164	86	162	20	1	0.600	5010668618	2021-03-25 15:50:09+00:00	Bike Path to Bedford (so humid) 😬	Ride
1036	6586.800	[42.40112, -71.145225]	13.800	7.800	164	87	142	20	1	0.600	5010668618	2021-03-25 15:50:09+00:00	Bike Path to Bedford (so humid) 😬	Ride
1037	6594.800	[42.401184, -71.145265]	13.800	7.800	164	87	157	20	1	0.000	5010668618	2021-03-25 15:50:09+00:00	Bike Path to Bedford (so humid) 😬	Ride
1038	6602.600	[42.40125, -71.145305]	13.800	7.800	164	88	140	20	1	0.000	5010668618	2021-03-25 15:50:09+00:00	Bike Path to Bedford (so humid) 😬	Ride
1039	6610.500	[42.401316, -71.145344]	13.800	7.900	164	84	174	20	1	0.000	5010668618	2021-03-25 15:50:09+00:00	Bike Path to Bedford (so humid) 😬	Ride
1040	6618.300	[42.401383, -71.145381]	13.800	7.900	164	87	164	20	1	0.000	5010668618	2021-03-25 15:50:09+00:00	Bike Path to Bedford (so humid) 😬	Ride
1041	6626.300	[42.40145, -71.145416]	13.800	7.900	164	87	187	20	1	0.000	5010668618	2021-03-25 15:50:09+00:00	Bike Path to Bedford (so humid) 😬	Ride
1042	6634.200	[42.401516, -71.14545]	13.800	7.900	164	88	191	20	1	0.000	5010668618	2021-03-25 15:50:09+00:00	Bike Path to Bedford (so humid) 😬	Ride
1043	6642.100	[42.401582, -71.145486]	13.800	7.900	164	89	161	20	1	0.000	5010668618	2021-03-25 15:50:09+00:00	Bike Path to Bedford (so humid) 😬	Ride
1044	6650.000	[42.401647, -71.145522]	13.800	7.900	163	87	142	20	1	0.000	5010668618	2021-03-25 15:50:09+00:00	Bike Path to Bedford (so humid) 😬	Ride
1045	6658.000	[42.401712, -71.145557]	13.800	7.900	163	88	198	20	1	0.000	5010668618	2021-03-25 15:50:09+00:00	Bike Path to Bedford (so humid) 😬	Ride
1046	6666.100	[42.401779, -71.145592]	13.800	8.000	163	90	182	20	1	0.000	5010668618	2021-03-25 15:50:09+00:00	Bike Path to Bedford (so humid) 😬	Ride
1047	6674.000	[42.401849, -71.145626]	13.800	8.000	163	90	138	20	1	0.000	5010668618	2021-03-25 15:50:09+00:00	Bike Path to Bedford (so humid) 😬	Ride
1048	6682.000	[42.401913, -71.145661]	13.800	8.000	163	88	138	20	1	0.000	5010668618	2021-03-25 15:50:09+00:00	Bike Path to Bedford (so humid) 😬	Ride
1049	6689.800	[42.401976, -71.145695]	13.800	8.000	163	87	158	20	1	0.000	5010668618	2021-03-25 15:50:09+00:00	Bike Path to Bedford (so humid) 😬	Ride
1050	6697.600	[42.402041, -71.145727]	13.800	7.900	163	87	168	20	1	0.600	5010668618	2021-03-25 15:50:09+00:00	Bike Path to Bedford (so humid) 😬	Ride
1051	6705.500	[42.402103, -71.145757]	13.800	7.900	163	87	198	20	1	0.600	5010668618	2021-03-25 15:50:09+00:00	Bike Path to Bedford (so humid) 😬	Ride
1052	6713.300	[42.402165, -71.145784]	14.000	7.900	163	85	185	20	1	0.600	5010668618	2021-03-25 15:50:09+00:00	Bike Path to Bedford (so humid) 😬	Ride
1053	6721.100	[42.402227, -71.145814]	14.000	7.800	163	88	173	20	1	0.600	5010668618	2021-03-25 15:50:09+00:00	Bike Path to Bedford (so humid) 😬	Ride
1054	6728.900	[42.402288, -71.145842]	14.000	7.800	163	86	174	20	1	0.000	5010668618	2021-03-25 15:50:09+00:00	Bike Path to Bedford (so humid) 😬	Ride
1055	6736.600	[42.402352, -71.145873]	14.000	7.800	163	86	178	20	1	0.000	5010668618	2021-03-25 15:50:09+00:00	Bike Path to Bedford (so humid) 😬	Ride
1056	6744.400	[42.402413, -71.145903]	14.000	7.800	163	85	191	20	1	0.000	5010668618	2021-03-25 15:50:09+00:00	Bike Path to Bedford (so humid) 😬	Ride
1057	6752.100	[42.402478, -71.145934]	14.000	7.800	163	86	191	20	1	0.000	5010668618	2021-03-25 15:50:09+00:00	Bike Path to Bedford (so humid) 😬	Ride
1058	6759.800	[42.402544, -71.145966]	14.000	7.700	163	86	193	20	1	0.000	5010668618	2021-03-25 15:50:09+00:00	Bike Path to Bedford (so humid) 😬	Ride
1059	6767.500	[42.40261, -71.145999]	14.000	7.700	163	85	195	20	1	0.000	5010668618	2021-03-25 15:50:09+00:00	Bike Path to Bedford (so humid) 😬	Ride
1060	6775.200	[42.402676, -71.146036]	14.000	7.700	163	85	190	20	1	0.600	5010668618	2021-03-25 15:50:09+00:00	Bike Path to Bedford (so humid) 😬	Ride
1061	6782.800	[42.402739, -71.146072]	14.000	7.700	163	85	187	20	1	0.600	5010668618	2021-03-25 15:50:09+00:00	Bike Path to Bedford (so humid) 😬	Ride
1062	6790.600	[42.402803, -71.146107]	14.200	7.700	163	85	187	20	1	0.600	5010668618	2021-03-25 15:50:09+00:00	Bike Path to Bedford (so humid) 😬	Ride
1063	6798.300	[42.402869, -71.146143]	14.200	7.700	163	85	162	20	1	0.600	5010668618	2021-03-25 15:50:09+00:00	Bike Path to Bedford (so humid) 😬	Ride
1064	6806.000	[42.402938, -71.146179]	14.200	7.700	163	85	179	20	1	0.000	5010668618	2021-03-25 15:50:09+00:00	Bike Path to Bedford (so humid) 😬	Ride
1065	6813.800	[42.403002, -71.146211]	14.200	7.700	163	87	157	20	1	0.700	5010668618	2021-03-25 15:50:09+00:00	Bike Path to Bedford (so humid) 😬	Ride
1066	6821.400	[42.403074, -71.146248]	14.200	7.700	163	84	159	20	1	0.700	5010668618	2021-03-25 15:50:09+00:00	Bike Path to Bedford (so humid) 😬	Ride
1067	6829.000	[42.403142, -71.146282]	14.400	7.700	162	86	142	20	1	0.700	5010668618	2021-03-25 15:50:09+00:00	Bike Path to Bedford (so humid) 😬	Ride
1068	6836.700	[42.403208, -71.14631]	14.400	7.700	162	84	160	20	1	1.300	5010668618	2021-03-25 15:50:09+00:00	Bike Path to Bedford (so humid) 😬	Ride
1069	6844.300	[42.403271, -71.146337]	14.400	7.700	162	84	142	20	1	0.700	5010668618	2021-03-25 15:50:09+00:00	Bike Path to Bedford (so humid) 😬	Ride
1070	6851.900	[42.403332, -71.146364]	14.600	7.600	162	84	142	20	1	0.700	5010668618	2021-03-25 15:50:09+00:00	Bike Path to Bedford (so humid) 😬	Ride
1071	6859.400	[42.403392, -71.146392]	14.600	7.600	162	83	159	20	1	0.700	5010668618	2021-03-25 15:50:09+00:00	Bike Path to Bedford (so humid) 😬	Ride
1072	6866.900	[42.403451, -71.14642]	14.600	7.600	162	82	162	20	1	0.000	5010668618	2021-03-25 15:50:09+00:00	Bike Path to Bedford (so humid) 😬	Ride
1073	6874.300	[42.403507, -71.146448]	14.600	7.500	162	83	152	20	1	0.700	5010668618	2021-03-25 15:50:09+00:00	Bike Path to Bedford (so humid) 😬	Ride
1074	6881.700	[42.403576, -71.146481]	14.600	7.500	162	84	103	20	1	0.700	5010668618	2021-03-25 15:50:09+00:00	Bike Path to Bedford (so humid) 😬	Ride
1075	6889.000	[42.403642, -71.146512]	14.800	7.400	162	82	88	20	1	0.700	5010668618	2021-03-25 15:50:09+00:00	Bike Path to Bedford (so humid) 😬	Ride
1076	6896.100	[42.403709, -71.146549]	14.800	7.300	162	81	85	20	1	0.700	5010668618	2021-03-25 15:50:09+00:00	Bike Path to Bedford (so humid) 😬	Ride
1077	6902.900	[42.403762, -71.146577]	14.800	7.200	162	81	0	20	1	0.000	5010668618	2021-03-25 15:50:09+00:00	Bike Path to Bedford (so humid) 😬	Ride
1078	6909.600	[42.403834, -71.146618]	14.800	7.100	161	0	0	20	1	0.000	5010668618	2021-03-25 15:50:09+00:00	Bike Path to Bedford (so humid) 😬	Ride
1079	6915.900	[42.403896, -71.146649]	14.800	6.800	160	0	0	20	1	0.000	5010668618	2021-03-25 15:50:09+00:00	Bike Path to Bedford (so humid) 😬	Ride
1080	6922.100	[42.403956, -71.146679]	14.800	6.600	159	0	0	20	1	0.000	5010668618	2021-03-25 15:50:09+00:00	Bike Path to Bedford (so humid) 😬	Ride
1081	6928.000	[42.404013, -71.146705]	14.800	6.400	158	0	0	20	1	0.900	5010668618	2021-03-25 15:50:09+00:00	Bike Path to Bedford (so humid) 😬	Ride
1082	6933.500	[42.40406, -71.146726]	14.800	6.100	157	0	0	20	1	0.900	5010668618	2021-03-25 15:50:09+00:00	Bike Path to Bedford (so humid) 😬	Ride
1083	6938.900	[42.404107, -71.146744]	15.000	5.900	157	0	0	20	1	1.000	5010668618	2021-03-25 15:50:09+00:00	Bike Path to Bedford (so humid) 😬	Ride
1084	6943.600	[42.404158, -71.146766]	15.000	5.500	156	0	0	20	1	1.200	5010668618	2021-03-25 15:50:09+00:00	Bike Path to Bedford (so humid) 😬	Ride
1085	6947.700	[42.404205, -71.146785]	15.000	5.100	155	0	0	20	1	0.000	5010668618	2021-03-25 15:50:09+00:00	Bike Path to Bedford (so humid) 😬	Ride
1086	6950.200	[42.404248, -71.14681]	15.000	4.400	155	0	0	20	1	8.700	5010668618	2021-03-25 15:50:09+00:00	Bike Path to Bedford (so humid) 😬	Ride
1087	6952.800	[42.404281, -71.146832]	15.000	3.900	154	0	0	20	1	6.800	5010668618	2021-03-25 15:50:09+00:00	Bike Path to Bedford (so humid) 😬	Ride
1088	6952.800	[42.404299, -71.146847]	15.200	2.800	153	0	0	20	0	7.300	5010668618	2021-03-25 15:50:09+00:00	Bike Path to Bedford (so humid) 😬	Ride
1116	6952.800	[42.404304, -71.14685]	15.800	0.000	134	0		20	0	6.200	5010668618	2021-03-25 15:50:09+00:00	Bike Path to Bedford (so humid) 😬	Ride
1117	6955.400	[42.404304, -71.14685]	15.800	0.100	134	0	0	20	1	5.800	5010668618	2021-03-25 15:50:09+00:00	Bike Path to Bedford (so humid) 😬	Ride
1118	6958.600	[42.404304, -71.14685]	15.800	0.200	134	13	0	20	1	-1.300	5010668618	2021-03-25 15:50:09+00:00	Bike Path to Bedford (so humid) 😬	Ride
1119	6963.100	[42.404308, -71.146852]	15.800	0.300	135	43	290	20	1	-1.100	5010668618	2021-03-25 15:50:09+00:00	Bike Path to Bedford (so humid) 😬	Ride
1120	6968.100	[42.40435, -71.146873]	15.600	0.500	135	52	295	20	1	-1.000	5010668618	2021-03-25 15:50:09+00:00	Bike Path to Bedford (so humid) 😬	Ride

APPENDIX A: PYTHON SCRIPT TO RUN ON LOCAL MACHINE

Full Saros Fit Strava App Python Script for use on Local Machine (saros-fit-local.py)

```
# ---
# # Download Activity Summary and Details from Strava
#
# Strava provides basic information on how to get access to the API at https://developers.strava.com/docs/getting-started/.
# The information from the Strava API page combined with
# https://towardsdatascience.com/using-the-strava-api-and-pandas-to-explore-your-activity-data-d94901d9bfde and other websites
# allowed me to write the code necessary to connect to Strava.
#
# With some additional research I was able to download all my activities and their summary data.  Though, in all my online
# searching I could not find any good examples of how to download all the detailed activity streams associated with each
# Strava activity.  The code to download activity details was mostly written from scratch.
#
# **The value of this notebook is:**
#    - example of code to authenticate and connect to the Strava API (follow Strava instructions to create an app)
#    - download all activities and their associated summaries to a dataframe
#    - download all 11 detailed activity streams for each activity to a dataframe
#    - single notebook that authenticates to Strava, downloads activity summaries and downloads activity details
#
# **Additional useful features:**
#    - controls the number of requests so they don't exceed Strava's default limits (100 requests/15 min)
#    - stores all download activity details in pkl and csv format
#    - loads previously downloaded activity details and then only downloads details for new activities
#
# ###### NEXT STEPS:
#   - Create a separate notebook that loads the pkl file with activity details
#       - run basic analysis and create visualizations on the activity details
#       - run machine learning models on the activity details to find patterns in heartrate and wattage numbers
# ---
#
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# import libraries
import requests
import urllib3
urllib3.disable_warnings(urllib3.exceptions.InsecureRequestWarning)
import warnings

import numpy as np
import pandas as pd

import os
from os.path import join, dirname
import sys
import subprocess
import pathlib
from dotenv import load_dotenv

import codecs
from codecs import open
from datetime import date
import time

# ## Connect to Strava -- Get Current Access Token
# (https://www.realpythonproject.com/3-ways-to-store-and-read-credentials-locally-in-python/)
credential_file = join(os.getcwd(), 'strava-credentials.env')

load_dotenv(credential_file)
client_id = os.environ.get('client_id')
client_secret = os.environ.get('client_secret')
refresh_token = os.environ.get('refresh_token')

# (https://github.com/franchyze923/Code_From_Tutorials/blob/master/Strava_Api/strava_api.py)
auth_url = "https://www.strava.com/oauth/token"

payload = {
    'client_id': client_id,
    'client_secret': client_secret,
    'refresh_token': refresh_token,
    'grant_type': "refresh_token",
    'f': 'json'
}

print("\nRequesting Token...")
res = requests.post(auth_url, data=payload, verify=False)
access_token = res.json()['access_token']
print("Access Token Received!")
print("")

# ## Create Dataframe with Summary Info for All Activities *(Strava API)*
# (http://www.hainke.ca/index.php/2018/08/23/using-the-strava-api-to-retrieve-activity-data/)
# Initialize the dataframe
```

```
activities_overview = pd.DataFrame()

url = "https://www.strava.com/api/v3/athlete/activities"
page = 1

while True:
    # get page of activities from Strava
    page_json = requests.get(url + '?access_token=' + access_token + '&per_page=200' + '&page=' + str(page)).json()

    for a in range(len(page_json)):
        # (https://stackoverflow.com/questions/21104592/)
        activity_json = pd.json_normalize(page_json[a])
        activities_overview = activities_overview.append(activity_json, ignore_index=True)

    # if no results then exit loop
    if (not page_json):
        break

    # increment page
    page += 1

# makes sense since new added on bottom
activities_overview = activities_overview.sort_values(by='id', ascending=True)

# activities_overview.tail(5)

print("Number of Strava Activities Found: ", activities_overview.shape)
print("")

activities_overview.to_csv('activities_overview.csv', header=True)
print("OVERVIEW CSV FILE UPDATED\n")

# ## Create Dataframe with DETAILED ACTIVITY DATA Streams for New Activities *(Strava API)*
# Streams Available via Strava API (https://developers.strava.com/docs/reference/#api-models-StreamSet)
# time...................TimeStream    An instance of TimeStream.
# distance...............DistanceStream    An instance of DistanceStream.
# latlng.................LatLngStream  An instance of LatLngStream.
# altitude...............AltitudeStream    An instance of AltitudeStream.
# velocity_smooth.........SmoothVelocityStream  An instance of SmoothVelocityStream.
# heartrate..............HeartrateStream   An instance of HeartrateStream.
# cadence................CadenceStream An instance of CadenceStream.
# watts..................PowerStream   An instance of PowerStream.
# temp...................TemperatureStream An instance of TemperatureStream.
# moving.................MovingStream  An instance of MovingStream.
# grade_smooth...........SmoothGradeStream An instance of SmoothGradeStream.

# https://www.strava.com/api/v3/activities/4998708851/streams?access_token=######&keys=moving&key_by_type=true

def activity_streams(id):
    a_dict = {}
    a_df = pd.DataFrame()
    a_url = "https://www.strava.com/api/v3/activities/"

    streams_list = ['time','distance','latlng','altitude','velocity_smooth','heartrate','cadence','watts','temp',
                    'moving','grade_smooth']
    streams_text = 'time,distance,latlng,altitude,velocity_smooth,heartrate,cadence,watts,temp,moving,grade_smooth'

    a_json = pd.json_normalize(requests.get(a_url + str(id) + '/streams?access_token=' + access_token +
                                            '&keys=time,distance,latlng,altitude,velocity_smooth,heartrate,cadence,watts,temp,mo
ving,grade_smooth' +
                                            '&key_by_type=true').json())

    for a in range(0,len(streams_list)):
        try:
            a_df[streams_list[a]] = a_json[str(streams_list[a]) +'.data'][0]
        except:
            a_df[streams_list[a]] = np.nan

    a_df['id'] = id
    idx = activities_overview.index[activities_overview['id'] == id].tolist()[0]

    a_df['date'] = activities_overview['start_date_local'][idx]
    a_df['name'] = activities_overview['name'][idx]
    a_df['type'] = activities_overview['type'][idx]

    return a_df

# ### Load Already Downloaded Activity Details if Present
try:
    activities_details = pd.read_pickle('activities_details.pkl')
except:
    activities_details = pd.DataFrame()

# activities_details.info()
# activities_details.tail()

# ### Download only Details for New Activities
# (https://thispointer.com/pandas-check-if-a-value-exists-in-a-dataframe-using-in-not-in-operator-isin/)
```

```
a_details_to_import = []
try:
    a_already_downloaded = activities_details['id'].unique()
except:
    a_already_downloaded = []

for a in activities_overview['id']:
    # faster searching in only one column
    try:
        if a in a_already_downloaded:
            pass
        else:
            a_details_to_import.append(a)

    # if empty dataframe searching in 'id' column will fail
    except:
        if a in activities_details.values:
            pass
        else:
            a_details_to_import.append(a)

print("Number of Activities to Import:  " + str(len(a_details_to_import)))

# Activities that have no details will always show up because they will never have any details added
# a_details_to_import

a_range_l = 0
a_range_h = 89
a_number = len(a_details_to_import)

while a_range_l < a_number:
    if a_range_l > 0:
        print('Waiting...')
        # wait a little over 16m40s to be safe (100 requests per 15min limit)
        time.sleep(1000)

    print('Downloading activities ' + str(a_range_l) + ' to ' + str(a_range_h) +' ...')

    for a in a_details_to_import[a_range_l:a_range_h]:
        print('Downloading activity ', a)
        a_df_curr = activity_streams(a)
        activities_details = activities_details.append(a_df_curr, ignore_index=True)

    # 90 rather than 100 to be safe
    a_range_l = a_range_l + 90
    a_range_h = a_range_h + 90

print('Done getting details for all new activities.\n')

# print(activities_details.head(2))
# print(activities_details.tail(2))

print("Number of Rows for all Activities Found: ", activities_details.shape)
print("Sum of Moving Time:   ", activities_overview['moving_time'].sum())
print("Sum of Elapsed Time:  ", activities_overview['elapsed_time'].sum())

activities_details.to_pickle('activities_details.pkl')

activities_details.to_csv('activities_details.csv', header=True)

print("\nDETAILED CSV and PKL FILES UPDATED")
print("")
print("EXITING SAROS FIT")
```

APPENDIX B: PYTHON TEST SCRIPTS

Acquire Refresh Token from Strava Python Script (test-credentials.py)

```
# import libraries
import numpy as np
import pandas as pd
import os
import sys
import subprocess
import pathlib
import requests
import urllib3
urllib3.disable_warnings(urllib3.exceptions.InsecureRequestWarning)

import codecs
from codecs import open
from datetime import date
import time

# AWS Secret Keeper Function
def get_secret(secret_name, region_name = "us-east-1"):
    # Create a Secrets Manager client
    session = boto3.session.Session()
    client = session.client(
        service_name='secretsmanager',
        region_name=region_name
    )

    # In this sample we only handle the specific exceptions for the 'GetSecretValue' API.
    # See https://docs.aws.amazon.com/secretsmanager/latest/apireference/API_GetSecretValue.html
    # We rethrow the exception by default.

    try:
        get_secret_value_response = client.get_secret_value(SecretId=secret_name)
    except ClientError as e:
        if e.response['Error']['Code'] == 'DecryptionFailureException':
            # Secrets Manager can't decrypt the protected secret text using the provided KMS key.
            # Deal with the exception here, and/or rethrow at your discretion.
            raise e
        elif e.response['Error']['Code'] == 'InternalServiceErrorException':
            # An error occurred on the server side.
            # Deal with the exception here, and/or rethrow at your discretion.
            raise e
        elif e.response['Error']['Code'] == 'InvalidParameterException':
            # You provided an invalid value for a parameter.
            # Deal with the exception here, and/or rethrow at your discretion.
            raise e
        elif e.response['Error']['Code'] == 'InvalidRequestException':
            # You provided a parameter value that is not valid for the current state of the resource.
            # Deal with the exception here, and/or rethrow at your discretion.
            raise e
        elif e.response['Error']['Code'] == 'ResourceNotFoundException':
            # We can't find the resource that you asked for.
            # Deal with the exception here, and/or rethrow at your discretion.
            raise e
    else:
        # Decrypts secret using the associated KMS CMK.
        # Depending on whether the secret is a string or binary, one of these fields will be populated.
        if 'SecretString' in get_secret_value_response:
            secret = get_secret_value_response['SecretString']
        else:
            secret = base64.b64decode(get_secret_value_response['SecretBinary'])
    return secret

# ## Connect to Strava -- Get Current Access Token
# (https://towardsdatascience.com/how-i-manage-credentials-in-python-using-aws-secrets-manager-1bd1bf5da598)
client_id = get_secret("<arn for client_id>")
client_secret = get_secret("<arn for client_secret>")
refresh_token = get_secret("<arn for refresh_token>")

# (https://github.com/franchyze923/Code_From_Tutorials/blob/master/Strava_Api/strava_api.py)
auth_url = "https://www.strava.com/oauth/token"

payload = {
    'client_id': client_id,
    'client_secret': client_secret,
    'refresh_token': refresh_token,
    'grant_type': "refresh_token",
    'f': 'json'
}

print("\nRequesting Token...\n")
res = requests.post(auth_url, data=payload, verify=False)
access_token = res.json()['access_token']
print("Access Token Received\n")

print("EXITING SAROS FIT\n")
```

Test S3 Upload and Download Python Script (test-s3.py)

```
# https://faun.pub/write-files-from-ec2-to-s3-in-aws-programmatically-716d1a4ef639

# import libraries
import boto3
from datetime import datetime

cli = boto3.client('s3')

cli.put_object(
 Bucket='sarosfit',
 Body='activities_overview.csv',
 Key='data/activities_overview_test.csv')

print("TEST OVERVIEW FILE UPDATED IN S3 BUCKET\n")

cli.download_file(
  Bucket='sarosfit',
  Key='data/activities_overview_test.csv',
  Filename='activities_overview_test.csv')

print("TEST OVERVIEW FILE DOWNLOADED FROM S3 BUCKET\n")

print("EXITING SAROS FIT\n")
```

Debug AWS Pickle Errors Python Script (test-pickle.py)

```
# import libraries
import numpy as np
import pandas as pd

import os
import sys
import subprocess
import pathlib
import requests
import urllib3
urllib3.disable_warnings(urllib3.exceptions.InsecureRequestWarning)

import codecs
from codecs import open
from datetime import date
import time

import boto3
import base64
from botocore.exceptions import ClientError

cli = boto3.client('s3')

# ### Load Already Downloaded Activity Details if Present
try:
    # Check to see if there is a local file
    activities_details = pd.read_pickle('activities_details.pkl')
except:
    try:
        # Check the s3 bucket to see if there is a file
        cli.download_file(
            Bucket='sarosfit',
            Key='data/activities_details.pkl',
            Filename='activities_details.pkl')

        activities_details = pd.read_pickle('activities_details.pkl')
    except:
        # Create a new empty dataframe (usually because first run)
        activities_details = pd.DataFrame()

# resolve Error: _pickle.PicklingError: Can't pickle <NA>: it's not the same object as pandas._libs.missing.NA
activities_details['latlng'] = activities_details['latlng'].astype("string")
activities_details = activities_details.replace('<NA>', '')

print(activities_details.iloc[970253])

activities_details.to_pickle('activities_details_test.pkl')

print("EXITING SAROS FIT\n")
```

APPENDIX C: PYTHON SCRIPT FOR GETTING MAX OVER TIME DURATION

Calculate Rolling Means and Maxes (rolling-maxes.py) … *(potentially use AWS Lambda)*

```
# Rolling Maxes

# import libraries
import numpy as np
import pandas as pd

# prepare test activity dataframe
df_activity = pd.read_csv('../Golden-Cheetah/2021_02_05_15_59_07.csv') #Time Trial

df_activity = df_activity.drop(['nm', 'headwind', 'slope', 'temp', 'interval', 'lrbalance', 'lte', 'rte',
              'lps', 'rps', 'smo2', 'thb', 'o2hb', 'hhb'], axis=1)

# add rolling means columns to dataframe
def rolling_means(df, col, durations):
    for d in durations:
        df[col+str(d)] = df[col].rolling(d, min_periods=d).mean()

durations = [1,5,15,30,60,120,300,600,1200,1800,3600,5400,7200]

rolling_means(df_activity, 'watts', durations)
rolling_means(df_activity, 'hr', durations)
rolling_means(df_activity, 'kph', durations)
rolling_means(df_activity, 'cad', durations)

# get max value in each rolling means columns
def rolling_max(df, col, durations):
    maxes = [['Field', 'Duration', 'Max', 'Start', 'End']]
    for d in durations:
        maxes.append([col, d, df[col+str(d)].max(), (df[col+str(d)].idxmax()-(d-1)), df[col+str(d)].idxmax()])
    return maxes

max_watts = rolling_max(df_activity, 'watts', durations)
max_hr = rolling_max(df_activity, 'hr', durations)
max_kph = rolling_max(df_activity, 'kph', durations)
max_cad = rolling_max(df_activity, 'cad', durations)

# print max watts, HR, speed, cadence over different time durations
print(max_watts[1:])
print(max_hr[1:])
print(max_kph[1:])
print(max_cad[1:])
```