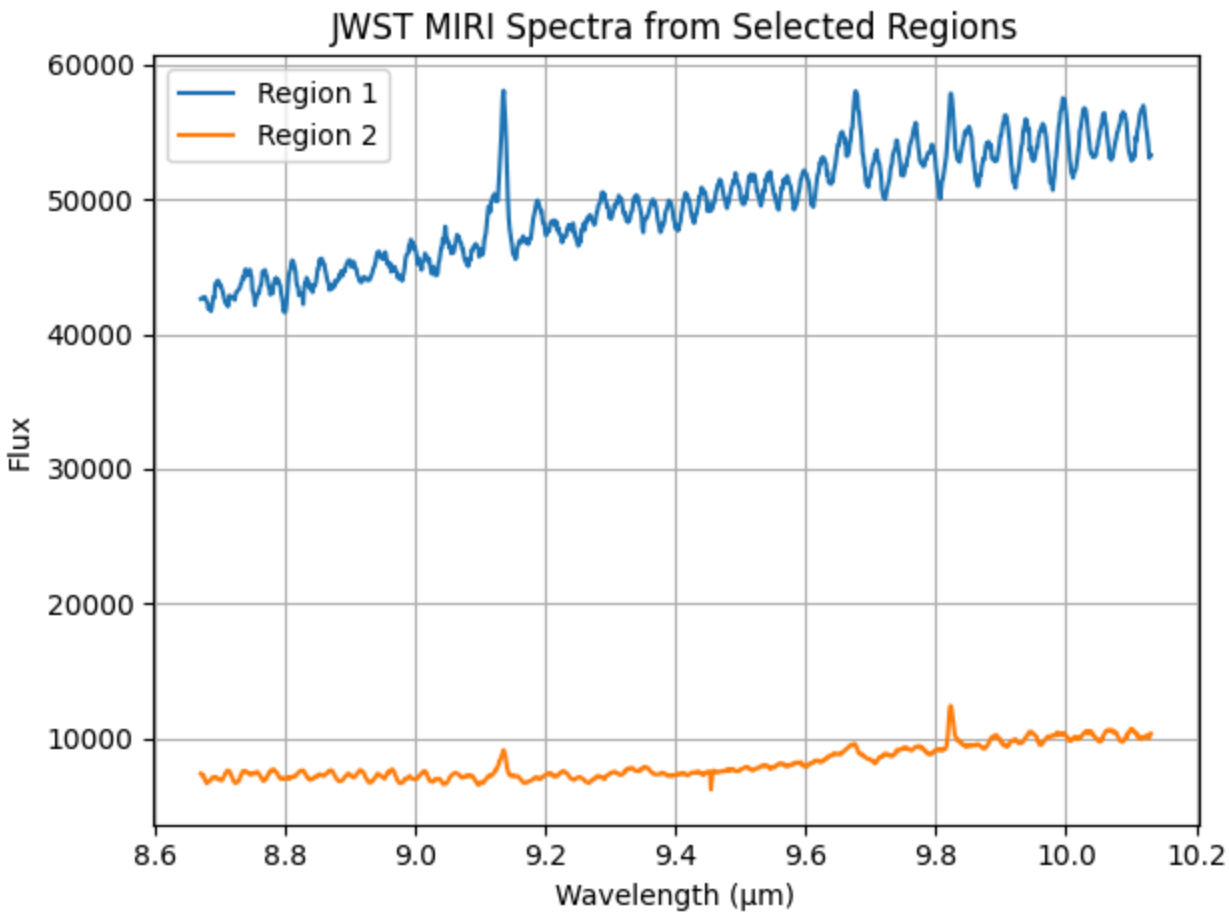
```
import numpy as np
import pandas as pd
import matplotlib.pyplot as plt

from astropy.io import fits
from astropy.wcs import WCS
from astropy.coordinates import SkyCoord
import astropy.units as u
from regions import Regions, CircleSkyRegion



# Update to your actual file paths
fits_file = r"C:\Users\suman\Downloads\MAST_2025-06-19T1821\MAST_2025-06-19T1821\JWS
reg_file = r"C:\Users\suman\Downloads\MAST_2025-06-19T1821\MAST_2025-06-19T1821\JWST



# Load the FITS file
hdul = fits.open(fits_file)
data_cube = hdul['SCI'].data
wcs_3d = WCS(hdul['SCI'].header, hdul)

# Load the regions from DS9
regions = Regions.read(reg_file, format='ds9')
```

```
WARNING: FITSFixedWarning: 'datfix' made the change 'Set DATE-BEG to '2022-07-04
    Set DATE-AVG to '2022-07-04T04:11:31.595' from MJD-AVG.
    Set DATE-END to '2022-07-04T04:17:33.047' from MJD-END'. [astropy.wcs.wcs]
    WARNING: FITSFixedWarning: 'obsfix' made the change 'Set OBSGEO-L to   -72.55746
    Set OBSGEO-B to   -38.283459 from OBSGEO-[XYZ].
    Set OBSGEO-H to 1737461184.323 from OBSGEO-[XYZ]'. [astropy.wcs.wcs]
```

```
hdr = hdul['SCI'].header
n_wave = hdr['NAXIS3']
crval = hdr['CRVAL3']
cdelt = hdr['CDELT3']
crpix = hdr['CRPIX3']

wave = (np.arange(n_wave) - (crpix - 1)) * cdelt + crval
wave = wave / 1e6 if wave.max() > 1000 else wave  # Convert to microns if needed



all_spectra = []
region_labels = []

for i, region in enumerate(regions):
    if isinstance(region, CircleSkyRegion):
        pix_region = region.to_pixel(wcs_3d.celestial)
```

```
        x, y = int(pix_region.center.x), int(pix_region.center.y)
        r = int(pix_region.radius)

        yy, xx = np.ogrid[:data_cube.shape[1], :data_cube.shape[2]]
        mask = (xx - x)**2 + (yy - y)**2 <= r**2

        spectrum = []
        for z in range(data_cube.shape[0]):
            plane = data_cube[z]
            flux_vals = plane[mask]
            spectrum.append(np.nanmean(flux_vals))

        spectrum = np.array(spectrum)
        all_spectra.append(spectrum)
        region_labels.append(f"Region {i+1}")

        plt.plot(wave, spectrum, label=f"Region {i+1}")

# Plotting all spectra
plt.xlabel("Wavelength (μm)")
plt.ylabel("Flux")
plt.title("JWST MIRI Spectra from Selected Regions")
plt.legend()
plt.grid(True)
plt.tight_layout()
plt.show()
```




```
# Build DataFrame for display
df = pd.DataFrame({"Wavelength (μm)": wave})
for i, spectrum in enumerate(all_spectra):
    df[f"Region_{i+1}_Flux"] = spectrum

# Show DataFrame in notebook
df.head(50)  # You can display full DataFrame or use .to_string() for full display
```

	Wavelength (μm)	Region_1_Flux	Region_2_Flux
0	8.67065	42607.015625	7413.710449
1	8.67195	42661.273438	7326.557129
2	8.67325	42705.644531	7250.786621
3	8.67455	42703.125000	7301.446289
4	8.67585	42647.058594	7107.481445
5	8.67715	42731.402344	6938.884277
6	8.67845	42556.875000	6822.516602
7	8.67975	42406.941406	6693.388184
8	8.68105	42305.671875	6771.659668
9	8.68235	41866.058594	6790.631836
10	8.68365	42039.265625	6860.924316
11	8.68495	41870.273438	6907.087402
12	8.68625	41692.785156	6936.670410
13	8.68755	41948.078125	7082.065918
14	8.68885	42432.148438	7124.702637
15	8.69015	42738.531250	7167.846680
16	8.69145	42665.906250	7110.544922
17	8.69275	43658.046875	7166.691895
18	8.69405	43797.156250	7147.126465
19	8.69535	43857.078125	7081.240723
20	8.69665	43980.609375	7070.696289
21	8.69795	43930.246094	6960.997559
22	8.69925	43590.597656	6953.979004
23	8.70055	43676.210938	6974.940918
24	8.70185	43535.789062	6930.299805
25	8.70315	43326.835938	6912.763184
26	8.70445	43109.984375	7027.044922
27	8.70575	42832.371094	7159.491211
28	8.70705	42561.757812	7274.197266
29	8.70835	42308.472656	7419.895996

30	8.70965	42380.757812	7506.875977
31	8.71095	42365.535156	7617.958008
32	8.71225	42047.519531	7640.291992
33	8.71355	42435.093750	7588.113281
34	8.71485	42862.320312	7581.178223
35	8.71615	42697.714844	7426.178711
36	8.71745	42691.664062	7304.034668
37	8.71875	42776.320312	7113.602539
38	8.72005	42753.152344	6929.161621
39	8.72135	42703.324219	6833.740234
40	8.72265	42531.621094	6763.291016
41	8.72395	42888.843750	6701.927734
42	8.72525	43133.808594	6732.440918
43	8.72655	43158.765625	6791.266113
44	8.72785	43229.785156	6853.948242
45	8.72915	43316.617188	6882.756348
46	8.73045	43401.949219	7026.394531
47	8.73175	43677.558594	7266.624512
48	8.73305	43780.386719	7344.128418
49	8.73435	44058.554688	7507.965332