In [1]:

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

Problem 1 (Looped Single Panel Plot)

Problem 1.1

In [2]:

```
x = np.linspace(0,1,101) #creating an array from 0 to 1 with 101 steps
x
```

Out[2]:

```
array([0.  , 0.01, 0.02, 0.03, 0.04, 0.05, 0.06, 0.07, 0.08, 0.09, 0.1 ,
       0.11, 0.12, 0.13, 0.14, 0.15, 0.16, 0.17, 0.18, 0.19, 0.2 , 0.21,
       0.22, 0.23, 0.24, 0.25, 0.26, 0.27, 0.28, 0.29, 0.3 , 0.31, 0.32,
       0.33, 0.34, 0.35, 0.36, 0.37, 0.38, 0.39, 0.4 , 0.41, 0.42, 0.43,
       0.44, 0.45, 0.46, 0.47, 0.48, 0.49, 0.5 , 0.51, 0.52, 0.53, 0.54,
       0.55, 0.56, 0.57, 0.58, 0.59, 0.6 , 0.61, 0.62, 0.63, 0.64, 0.65,
       0.66, 0.67, 0.68, 0.69, 0.7 , 0.71, 0.72, 0.73, 0.74, 0.75, 0.76,
       0.77, 0.78, 0.79, 0.8 , 0.81, 0.82, 0.83, 0.84, 0.85, 0.86, 0.87,
       0.88, 0.89, 0.9 , 0.91, 0.92, 0.93, 0.94, 0.95, 0.96, 0.97, 0.98,
       0.99, 1.  ])
```

Problem 1.2

In [3]:

```
colors = np.array(["cyan", "magenta", "yellow", "black"]) #four colors array
colors
```

Out[3]:

```
array(['cyan', 'magenta', 'yellow', 'black'], dtype='<U7')
```

Problem 1.3

In [4]:

```
labels = np.array(["$y = x^1$; linear", "$y = x^2$; quadratic", "$y = x^3$; cubic", "$y =
 x^4$; quartic"]) #creating an array of labels
labels
```

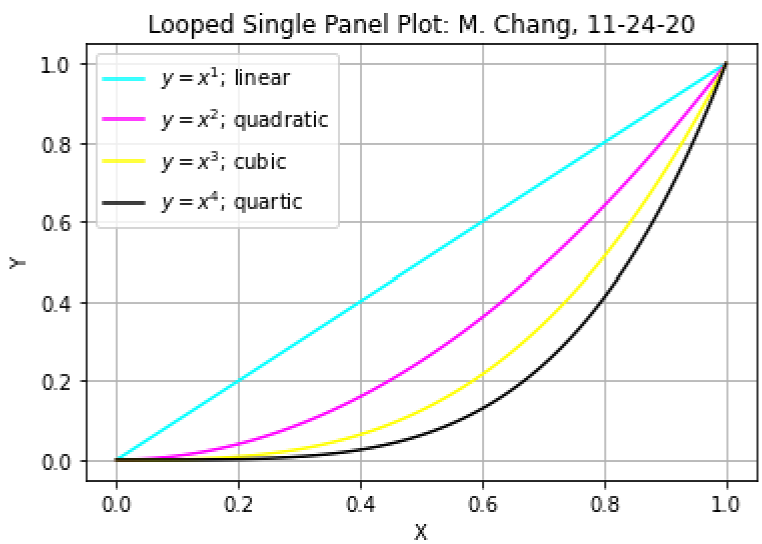
Out[4]:

```
array(['$y = x^1$; linear', '$y = x^2$; quadratic', '$y = x^3$; cubic',
       '$y = x^4$; quartic'], dtype='<U20')
```

Problem 1.4

In [5]:

```
for i in [1,2,3,4]:
    y = x**i #the associated equation, should be linear first, then quadratic, cubic, and quartic
    plt.plot(x, y, label = labels[i-1], color = colors[i-1]) #plotting the equation, labels and colors are an index off, so 1 needs to be subtracted

#labels
plt.xlabel("X")
plt.ylabel("Y")

#grid
plt.grid()

#legend
plt.legend()

#title
plt.title("Looped Single Panel Plot: M. Chang, 11-24-20")

#saving figure
plt.savefig("Chang_LoopedSinglePanel.png", dpi=200)
```



Problem 2 (2-Month Weather Station Data Import)

Problem 2.1

In [6]:

```
time, kpa, temp, inten = [], [], [], [] #setting up our lists for time, pressure, temperat
ure, and intensity

#path names
folder = "WSD-MayJune2014/"
fname_beginning = "Weather_Data_14-"

for i in np.arange(1,62,1):
    if (i < 32): #for the month of May
        if (i < 10): #if the date is single digit
            fname = folder + fname_beginning + "05-0" + str(i) + ".dat" #need to put a zer
o before the single digit date

            #loading in text
            a,b,c,d = np.loadtxt(fname, skiprows=22,unpack=True)

            #adding data to list
            time += list(a)
            kpa += list(b)
            temp += list(c)
            inten += list(d)
        else: #for double digit dates in May
            fname = folder + fname_beginning + "05-" + str(i) + ".dat" #no zero before dou
ble digit date

            #loading in text
            a,b,c,d = np.loadtxt(fname, skiprows=22,unpack=True)

            #adding data to list
            time += list(a)
            kpa += list(b)
            temp += list(c)
            inten += list(d)
    else: #for the month of June
        if (i < 41): #if the date is single digit in June
            fname = folder + fname_beginning + "06-0" + str(i - 31) + ".dat" #need zero be
fore single digit date as specified in format, subtract 31 to get single digit

            #loading in data
            a,b,c,d = np.loadtxt(fname, skiprows=22,unpack=True)

            #adding to list
            time += list(a)
            kpa += list(b)
            temp += list(c)
            inten += list(d)
        else: #for double digit dates in June
            fname = folder + fname_beginning + "06-" + str(i - 31) + ".dat" #no zero befor
e date needed, subtract 31 to get single digit

            #loading in data
            a,b,c,d = np.loadtxt(fname, skiprows=22,unpack=True)
            #adding to list

            time += list(a)
```

```
            kpa += list(b)
            temp += list(c)
            inten += list(d)
```

Problem 2.2

In [7]:

```
bar = np.array(kpa) * (1 / (100)) #converting kPa to bars, which is 1 bar = 100 kPa

t = (time - time[0]) / 86400 #converting to days in array, 1 day = 86400s, our array start
s at 0 now

#data starts at 11:49:40, we want t=0 at 0:00 to be our reference point, so we need to shi
ft t so that the data lines up with 11:49:40
#as our starting point

#converting 11:49:40 to days, so we split each element of the time into hours, minutes, an
d seconds
hour = 11 / 24 #1 day = 24 hours
minute = 49 / 1440 #1 day = 1440 minutes
second = 40 / 86400 #1 day = 86400s

#add up all elements to get days
new_time = hour + minute + second

t = t + new_time
```

Problem 2.3

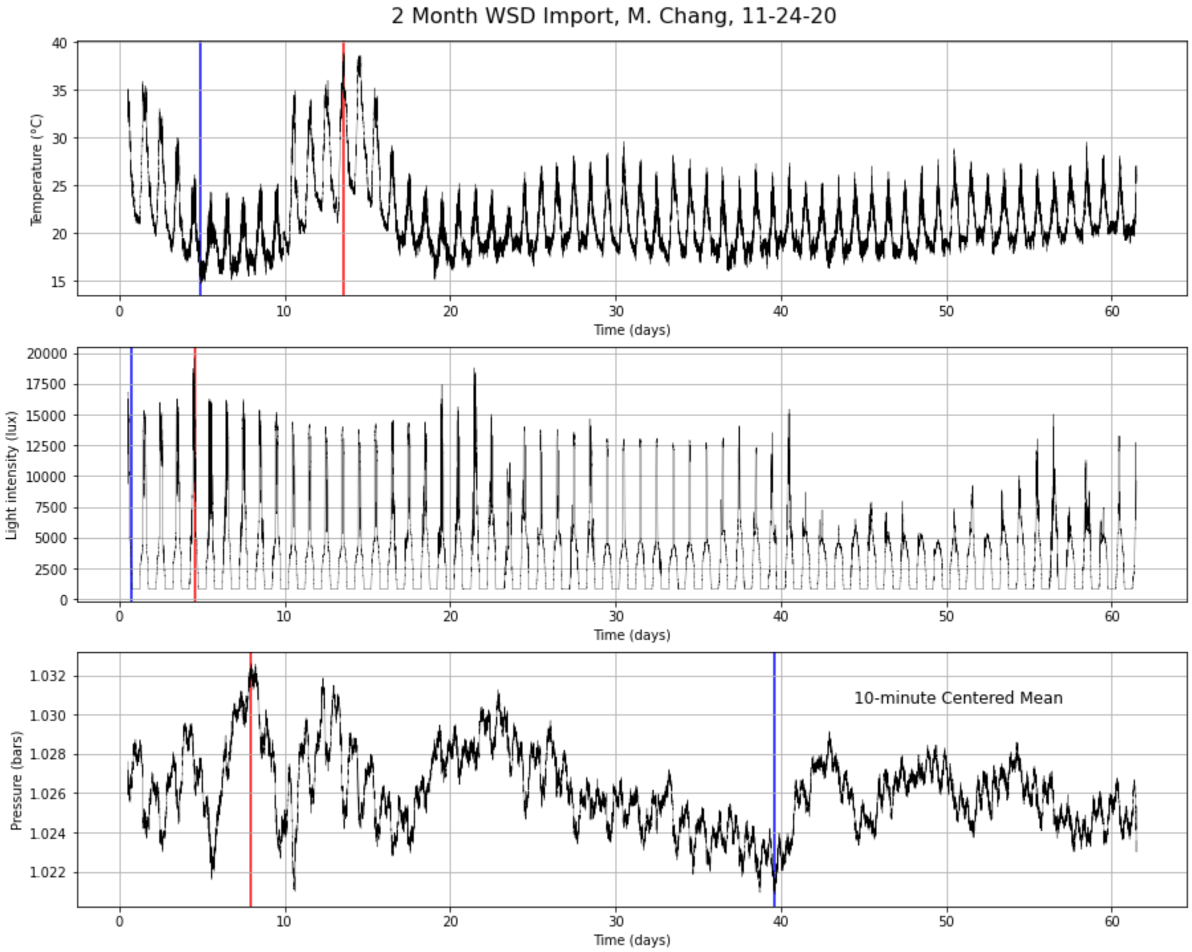
In [8]:

```
sampling_rate = 1 / 30 # 1 sample every 30 seconds
seconds = 60 # 1 minute = 60 seconds
window = 5 # 5 minute window
n_5 = (sampling_rate) * (seconds) * (window) #number of data points in a 5 minute window
n_5 = int(n_5) #making n_5 an integer
centermean_n = [] #list containing 10 minute means for each point

for n in np.arange(0, len(bar), 1): #going through all the points
    if (n < n_5): #data points within first five minutes are NOT averaged
        centermean_n.append(bar[n])
    elif ((n >= n_5)&(n <= len(bar) - n_5)): #data points after first five minutes and bef
ore last five minutes are averaged
        centermean_n.append(np.mean(bar[n - n_5:n + n_5]))
    elif ((n > len(bar) - n_5)): #data points within last five minutes are NOT averaged
        centermean_n.append(bar[n])

# what if we change the averaging window to 30 minutes or 1 hour? Well, we will have many
 more points in that window, and as a result, the averaged points will have less variatio
n, and thus the line of the data will be smoother (thinner).
```

Problem 2.4

In [9]:

```
factors = [temp, inten, centermean_n] #data array
lbls = ["Temperature (°C)", "Light intensity (lux)", "Pressure (bars)"] #labels array

f1, ax = plt.subplots(3, 1, figsize = (15,12)) #setting up the figure

for i in [0,1,2]:
    ax[i].plot(t, factors[i], color="black", linewidth=0.3) #plotting the actual data, mak
ing it black and thin

    #labels
    ax[i].set_xlabel("Time (days)")
    ax[i].set_ylabel(lbls[i])

    #finding the day where the minimum value occurs for each dataset
    min_value_BA = (factors[i] == np.min(factors[i]))
    min_value = t[min_value_BA]

    ax[i].axvline(x = min_value[0], color = "blue", zorder = -1) #vertical line for minimu
m is blue

    #finding the day where the maximum value occurs of for each dataset
    max_value_BA = (factors[i] == np.max(factors[i]))
    max_value = t[max_value_BA]

    ax[i].axvline(x = max_value[0], color = "red", zorder = -1) #vertical line for maximum
is red

    ax[i].grid() #adding grid lines to plots

ax[2].text(0.7, 0.8, str(n_5)+ "-minute Centered Mean", transform = ax[2].transAxes, fonts
ize = 12) #putting 10-minute mean label at top right

#adding title
plt.suptitle("2 Month WSD Import, M. Chang, 11-24-20", y = 0.91, fontsize = 16)

#saving figure
plt.savefig("Chang_2MonthWSD.png", dpi=200)
```


2 Month WSD Import, M. Chang, 11-24-20
Temperature (°C)
Time (days)
Light intensity (lux)
Time (days)
Pressure (bars)
10-minute Centered Mean
Time (days)

Problem 2.5

In your opinion, which sensor is working the best?</br> The light sensor because it's constant and steady.

Why is there a minimum in the light intensity data? What does it mean that the light intensity data has this minimum? </br> Because it's night, and there's no sun?

Similarly, why are there spikes in the light intensity data? Roughly, what time does that correspond to per day? </br> Because the sun is out, and it's about noon when the sun is at peak intensity in the sky.

Why is there so much more structure in the 10-minute centered mean pressure data, versus the raw data? </br> Because we have removed the flipping noise by averaging the points, and so the data is more "compact" (less outliers here and there).

Why are there no spikes in light intensity data from about days 42 to 51? </br> There are might be clouds covering up the sun?

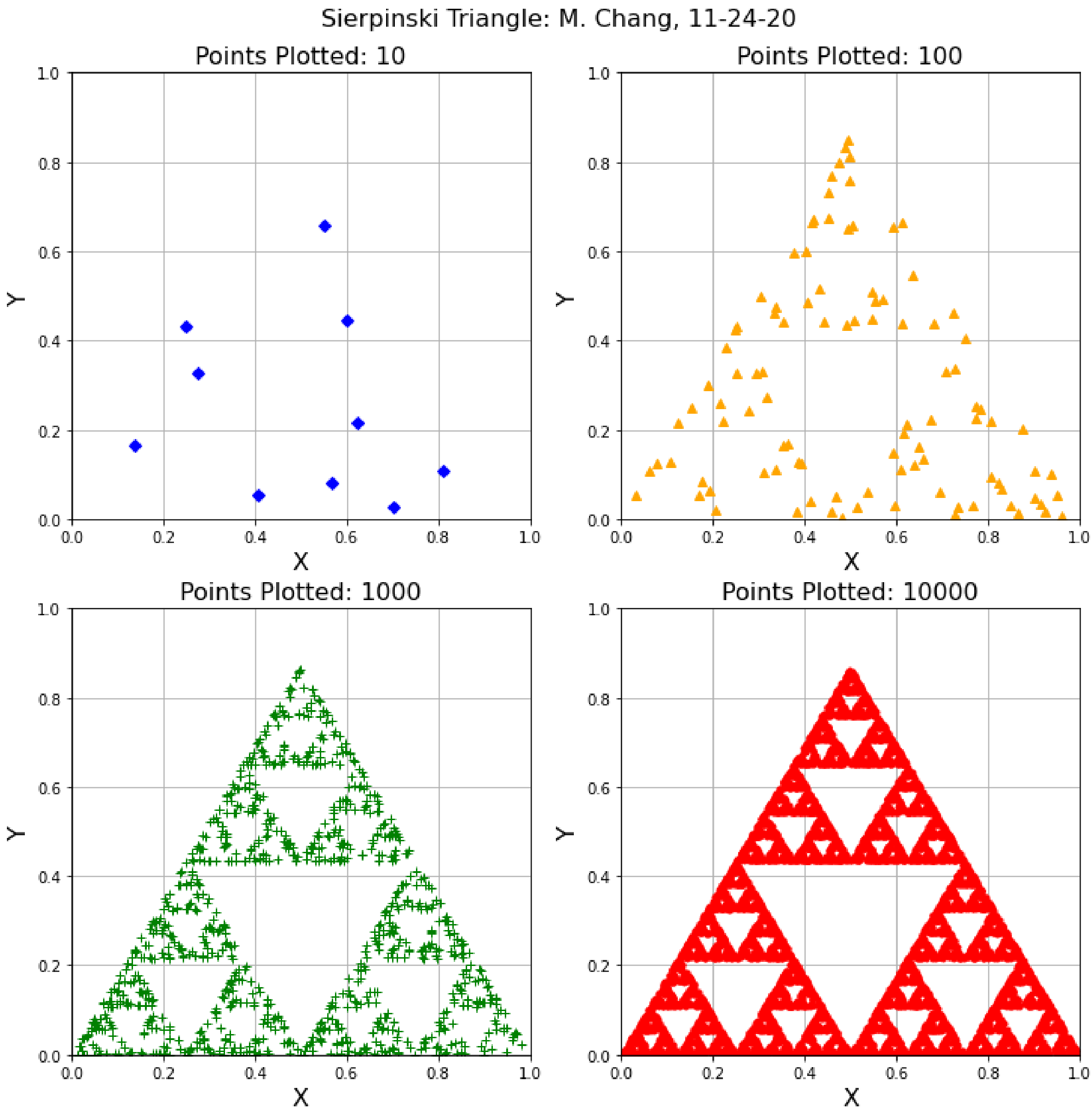
Problem 3 (The Sierpinski Triangle)

Problem 3.1

In [11]:

```
plt.figure(figsize = (12,12)) #setting up figure window
shape = ["D", "^", "+", "."]#shape marker list: diamonds, triangles, plus signs, and point
s
colors = ["blue", "orange", "green", "red"] #colors we will be using
fs=16 #fontsize for text

for s in np.arange(0, 4, 1): #this outer loop for choosing iteration size and setting up t
he subplots
    #initial values are zero
    x_n = 0
    y_n = 0

    #lists to contain the plotted values
    x = []
    y = []

    #iteration size we are looping through
    i = 10 ** (s + 1)

    for n in np.arange(0, i, 1): #choosing the rules and how many times based on the itera
tion size
        rule = np.random.randint(1,4) #randomly choosing a number between 1-3, correspondi
ng to a rule
        if (rule == 1): #rule 1

            #equations
            x_n = 0.5 * x_n
            y_n = 0.5 * y_n

            #adding to lists
            x.append(x_n)
            y.append(y_n)

        elif (rule == 2): #rule 2

            #equations for x and y
            x_n = (0.5 * x_n) + 0.25
            y_n = (0.5 * y_n) + (np.sqrt(3) / 4)

            #adding to lists
            x.append(x_n)
            y.append(y_n)

        elif (rule == 3): #rule 3

            #equations for x and y
            x_n = (0.5 * x_n) + 0.5
            y_n = 0.5 * y_n

            #adding to lists
            x.append(x_n)
            y.append(y_n)

    #creating the subplot
    plt.subplot(2, 2, s + 1)
```

```
    #the actual data
    plt.plot(x, y, marker=shape[s], color=colors[s], ls = "None")

    #labels and title
    plt.title("Points Plotted: " + str(i), fontsize=fs)
    plt.xlabel("X", fontsize = fs)
    plt.ylabel("Y", fontsize = fs)

    #setting window to go from 0 to 1
    plt.xlim(0,1)
    plt.ylim(0,1)

    #grid lines
    plt.grid()

plt.suptitle("Sierpinski Triangle: M. Chang, 11-24-20", y = 0.93, fontsize=fs)
plt.savefig("Chang_Sierpinski.png", dpi = 200)

#To make N = 10^2, 10^3, 10^4, 10^5, we change the script by one number by changing i = 10
** (s + 1) to be i = 10 ** (s + 2)
```


Sierpinski Triangle: M. Chang, 11-24-20
Points Plotted: 10
Points Plotted: 100
Points Plotted: 1000
Points Plotted: 10000
X
Y
0.0
0.2
0.4
0.6
0.8
1.0

Feedback

1. This assignment took me about 4 hours
2. I thought it was a bit on the harder side
3. I feel a bit more anxious because if I had these problems on an exam, there's no way I would have been able to finish on time (lots of just sitting, having to think what to do next, how to carry, and looking things up even if prior knowledge is enough) </br>

4 & 5. I attend lecture!