Taller 6

Métodos Computacionales para Políticas Públicas - URosario

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Instrucciones:

- Guarde una copia de este *Jupyter Notebook* en su computador, idealmente en una carpeta destinada al material del curso.
- Modifique el nombre del archivo del *notebook*, agregando al final un guión inferior y su nombre y apellido, separados estos últimos por otro guión inferior. Por ejemplo, mi *notebook* se llamaría: mcpp_taller6_santiago_matallana
- Marque el *notebook* con su nombre y e-mail en el bloque verde arriba. Reemplace el texto "[Su nombre acá]" con su nombre y apellido. Similar para su e-mail.
- Desarrolle la totalidad del taller sobre este *notebook*, insertando las celdas que sea necesario debajo de cada pregunta. Haga buen uso de las celdas para código y de las celdas tipo *markdown* según el caso.
- Recuerde salvar periódicamente sus avances.
- Cuando termine el taller:
    1. Descárguelo en PDF. Si tiene algún problema con la conversión, descárguelo en HTML.
    2. Suba todos los archivos a su repositorio en GitHub, en una carpeta destinada exclusivamente para este taller, antes de la fecha y hora límites.

(Todos los ejercicios tienen el mismo valor.)

Resuelva la parte 1 de este documento.

In [2]:
```
import numpy as np
import scipy.linalg as la
import matplotlib.pyplot as plt
```

In [4]:
```
plt.rcParams["figure.figsize"] = [15.0, 5.0]
```

1. Choose a value and set the variable x to that value.

In [5]:
```
x = 5
```

2. What is command to compute the square of x? Its cube?

In [6]:
```
x1 = x**2
print(x1, "el comando es **2 para hallar el cuadrado")
x2 = x**3
print(x2, "el comando es **3 para hallar el cubo")
```

```
25 el comando es **2 para hallar el cuadrado
125 el comando es **3 para hallar el cubo
```

3. Choose an angle θ and set the variable theta to its value (a number).

In [7]:
```
theta = 45
```

4. What is sin θ? cos θ? Angles can be measured in degrees or radians. Which of these are being used used?

In [8]:
```
print("El seno del ángulo theta",theta,"es", np.sin(theta))
print("El seno del ángulo theta",theta,"es", np.cos(theta))
print("La libreria Numpy, tiene por default medida en radianes")
```

```
El seno del ángulo theta 45 es 0.8509035245341184
El seno del ángulo theta 45 es 0.5253219888177297
La libreria Numpy, tiene por default medida en radianes
```

5. Use the np.linspace function to create a row vector called meshPoints

containing exactly 500 values with values evenly spaced between -1 and 1.

In [9]:
```
meshPoints = np.linspace(-1,1,500)
print(meshPoints)
```

```
[-1.         -0.99599198 -0.99198397 -0.98797595 -0.98396794 -0.9799599
2
 -0.9759519  -0.97194389 -0.96793587 -0.96392786 -0.95991984 -0.9559118
2
 -0.95190381 -0.94789579 -0.94388778 -0.93987976 -0.93587174 -0.9318637
3
 -0.92785571 -0.9238477  -0.91983968 -0.91583166 -0.91182365 -0.9078156
3
 -0.90380762 -0.8997996  -0.89579158 -0.89178357 -0.88777555 -0.8837675
4
 -0.87975952 -0.8757515  -0.87174349 -0.86773547 -0.86372745 -0.8597194
4
```

```
 -0.85571142 -0.85170341 -0.84769539 -0.84368737 -0.83967936 -0.8356713
4
 -0.83166333 -0.82765531 -0.82364729 -0.81963928 -0.81563126 -0.8116232
5
 -0.80761523 -0.80360721 -0.7995992  -0.79559118 -0.79158317 -0.7875751
5
 -0.78356713 -0.77955912 -0.7755511  -0.77154309 -0.76753507 -0.7635270
5
 -0.75951904 -0.75551102 -0.75150301 -0.74749499 -0.74348697 -0.7394789
6
 -0.73547094 -0.73146293 -0.72745491 -0.72344689 -0.71943888 -0.7154308
6
 -0.71142285 -0.70741483 -0.70340681 -0.6993988  -0.69539078 -0.6913827
7
 -0.68737475 -0.68336673 -0.67935872 -0.6753507  -0.67134269 -0.6673346
7
 -0.66332665 -0.65931864 -0.65531062 -0.65130261 -0.64729459 -0.6432865
7
 -0.63927856 -0.63527054 -0.63126253 -0.62725451 -0.62324649 -0.6192384
8
 -0.61523046 -0.61122244 -0.60721443 -0.60320641 -0.5991984  -0.5951903
8
 -0.59118236 -0.58717435 -0.58316633 -0.57915832 -0.5751503  -0.5711422
8
 -0.56713427 -0.56312625 -0.55911824 -0.55511022 -0.5511022  -0.5470941
9
 -0.54308617 -0.53907816 -0.53507014 -0.53106212 -0.52705411 -0.5230460
9
 -0.51903808 -0.51503006 -0.51102204 -0.50701403 -0.50300601 -0.498998
 -0.49498998 -0.49098196 -0.48697395 -0.48296593 -0.47895792 -0.4749499
 -0.47094188 -0.46693387 -0.46292585 -0.45891784 -0.45490982 -0.4509018
 -0.44689379 -0.44288577 -0.43887776 -0.43486974 -0.43086172 -0.4268537
1
 -0.42284569 -0.41883768 -0.41482966 -0.41082164 -0.40681363 -0.4028056
1
 -0.3987976  -0.39478958 -0.39078156 -0.38677355 -0.38276553 -0.3787575
2
 -0.3747495  -0.37074148 -0.36673347 -0.36272545 -0.35871743 -0.3547094
2
```

```
 -0.3507014  -0.34669339 -0.34268537 -0.33867735 -0.33466934 -0.3306613
2
 -0.32665331 -0.32264529 -0.31863727 -0.31462926 -0.31062124 -0.3066132
3
 -0.30260521 -0.29859719 -0.29458918 -0.29058116 -0.28657315 -0.2825651
3
 -0.27855711 -0.2745491  -0.27054108 -0.26653307 -0.26252505 -0.2585170
3
 -0.25450902 -0.250501   -0.24649299 -0.24248497 -0.23847695 -0.2344689
4
 -0.23046092 -0.22645291 -0.22244489 -0.21843687 -0.21442886 -0.2104208
4
 -0.20641283 -0.20240481 -0.19839679 -0.19438878 -0.19038076 -0.1863727
5
 -0.18236473 -0.17835671 -0.1743487  -0.17034068 -0.16633267 -0.1623246
5
 -0.15831663 -0.15430862 -0.1503006  -0.14629259 -0.14228457 -0.1382765
5
 -0.13426854 -0.13026052 -0.12625251 -0.12224449 -0.11823647 -0.1142284
6
 -0.11022044 -0.10621242 -0.10220441 -0.09819639 -0.09418838 -0.0901803
6
 -0.08617234 -0.08216433 -0.07815631 -0.0741483  -0.07014028 -0.0661322
6
 -0.06212425 -0.05811623 -0.05410822 -0.0501002  -0.04609218 -0.0420841
7
 -0.03807615 -0.03406814 -0.03006012 -0.0260521  -0.02204409 -0.0180360
7
 -0.01402806 -0.01002004 -0.00601202 -0.00200401  0.00200401  0.0060120
2
  0.01002004  0.01402806  0.01803607  0.02204409  0.0260521   0.0300601
2
  0.03406814  0.03807615  0.04208417  0.04609218  0.0501002   0.0541082
2
  0.05811623  0.06212425  0.06613226  0.07014028  0.0741483   0.0781563
1
  0.08216433  0.08617234  0.09018036  0.09418838  0.09819639  0.1022044
1
  0.10621242  0.11022044  0.11422846  0.11823647  0.12224449  0.1262525
```

```
1
 0.13026052  0.13426854  0.13827655  0.14228457  0.14629259  0.1503006
 0.15430862  0.15831663  0.16232465  0.16633267  0.17034068  0.1743487
 0.17835671  0.18236473  0.18637275  0.19038076  0.19438878  0.1983967
9
 0.20240481  0.20641283  0.21042084  0.21442886  0.21843687  0.2224448
9
 0.22645291  0.23046092  0.23446894  0.23847695  0.24248497  0.2464929
9
 0.250501    0.25450902  0.25851703  0.26252505  0.26653307  0.2705410
8
 0.2745491   0.27855711  0.28256513  0.28657315  0.29058116  0.2945891
8
 0.29859719  0.30260521  0.30661323  0.31062124  0.31462926  0.3186372
7
 0.32264529  0.32665331  0.33066132  0.33466934  0.33867735  0.3426853
7
 0.34669339  0.3507014   0.35470942  0.35871743  0.36272545  0.3667334
7
 0.37074148  0.3747495   0.37875752  0.38276553  0.38677355  0.3907815
6
 0.39478958  0.3987976   0.40280561  0.40681363  0.41082164  0.4148296
6
 0.41883768  0.42284569  0.42685371  0.43086172  0.43486974  0.4388777
6
 0.44288577  0.44689379  0.4509018   0.45490982  0.45891784  0.4629258
5
 0.46693387  0.47094188  0.4749499   0.47895792  0.48296593  0.4869739
5
 0.49098196  0.49498998  0.498998    0.50300601  0.50701403  0.5110220
4
 0.51503006  0.51903808  0.52304609  0.52705411  0.53106212  0.5350701
4
 0.53907816  0.54308617  0.54709419  0.5511022   0.55511022  0.5591182
4
 0.56312625  0.56713427  0.57114228  0.5751503   0.57915832  0.5831663
3
 0.58717435  0.59118236  0.59519038  0.5991984   0.60320641  0.6072144
3
```

```
  0.61122244  0.61523046  0.61923848  0.62324649  0.62725451  0.6312625
3
  0.63527054  0.63927856  0.64328657  0.64729459  0.65130261  0.6553106
2
  0.65931864  0.66332665  0.66733467  0.67134269  0.6753507   0.6793587
2
  0.68336673  0.68737475  0.69138277  0.69539078  0.6993988   0.7034068
1
  0.70741483  0.71142285  0.71543086  0.71943888  0.72344689  0.7274549
1
  0.73146293  0.73547094  0.73947896  0.74348697  0.74749499  0.7515030
1
  0.75551102  0.75951904  0.76352705  0.76753507  0.77154309  0.7755511
  0.77955912  0.78356713  0.78757515  0.79158317  0.79559118  0.7995992
  0.80360721  0.80761523  0.81162325  0.81563126  0.81963928  0.8236472
9
  0.82765531  0.83166333  0.83567134  0.83967936  0.84368737  0.8476953
9
  0.85170341  0.85571142  0.85971944  0.86372745  0.86773547  0.8717434
9
  0.8757515   0.87975952  0.88376754  0.88777555  0.89178357  0.8957915
8
  0.8997996   0.90380762  0.90781563  0.91182365  0.91583166  0.9198396
8
  0.9238477   0.92785571  0.93186373  0.93587174  0.93987976  0.9438877
8
  0.94789579  0.95190381  0.95591182  0.95991984  0.96392786  0.9679358
7
  0.97194389  0.9759519   0.97995992  0.98396794  0.98797595  0.9919839
7
  0.99599198  1.        ]
```

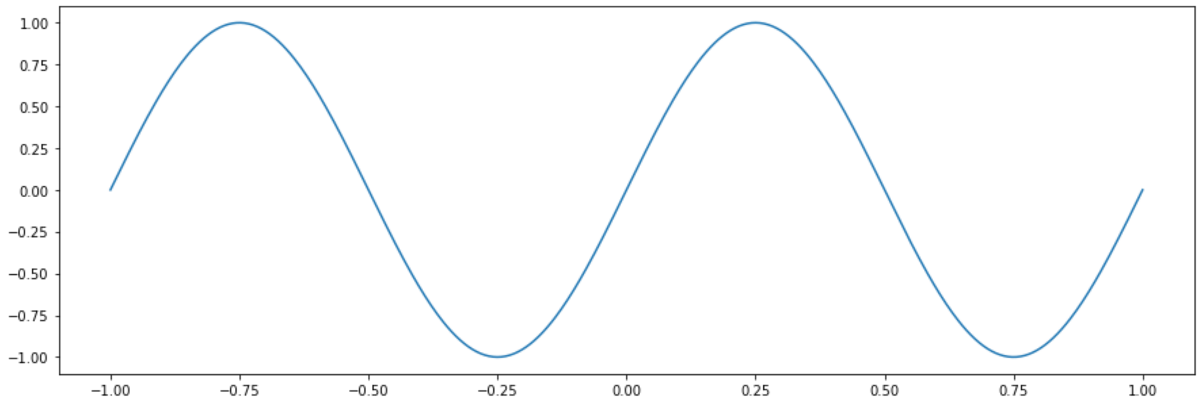
6. What expression will yield the value of the 53th element of meshPoints?

What is this value?

In [10]:
```
meshPoints[54]
```
Out[10]:
```
-0.7835671342685371
```

7. Produce a plot of a sinusoid on the interval [−1, 1] using the command

plt.plot(meshPoints,np.sin(2*pi*meshPoints)) Please save this plot as a jpeg (.jpg) file and send it along with your work.

In [11]:
```
from math import pi
plt.plot(meshPoints,np.sin(2*pi*meshPoints));
```


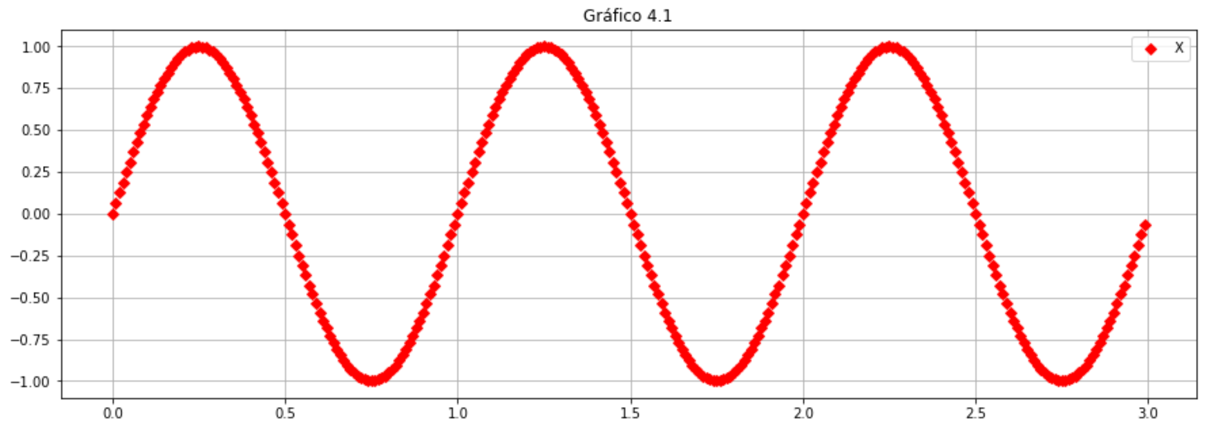
In [12]:
```
plt.savefig('punto7.jpg')
```
```
<Figure size 1080x360 with 0 Axes>
```

Resuelva los ejercicios de las secciones 4.1, 5.1, 6.1, 7.4 y 8.5 de este documento.

4.1 Exercises

1. Plot a simple graph of a sinus function in the range 0 to 3 with a step size of 0.01.
2. Make the line red. Add diamond-shaped markers with size of 5.
3. Add a legend and a grid to the plot.

In [13]:
```
x = np.arange(0,3,0.01)
plt.plot(x, np.sin(2*x*pi),"rD", markersize=5);
plt.title("Gráfico 4.1")
plt.legend("X")
plt.grid()
```



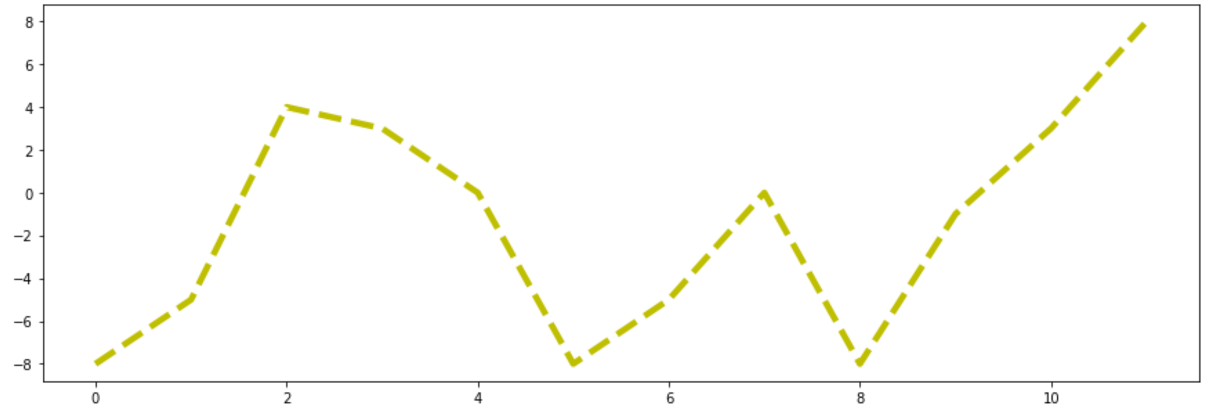
5.1 Exercise

1. Apply different line styles to a plot. Change line color and thickness as well as the size and the kind of the marker. Experiment with different styles.

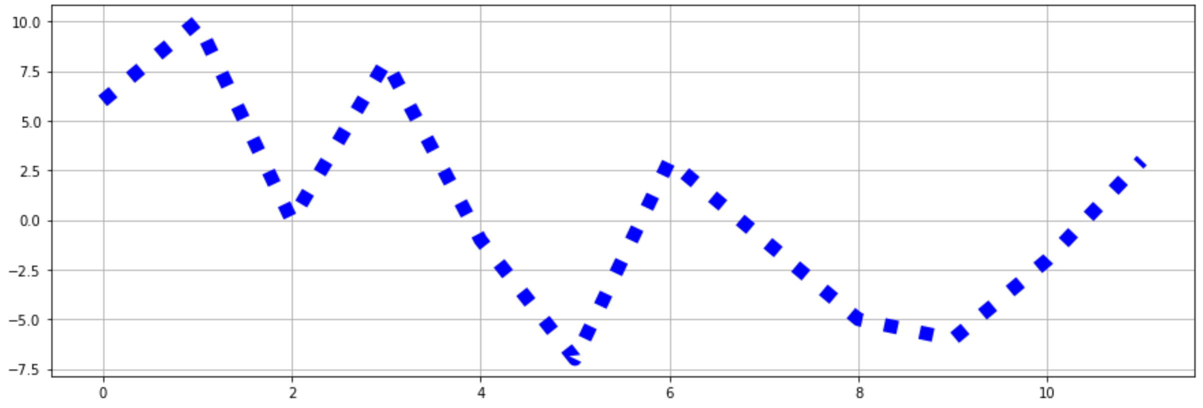
In [14]:
```
import random
x = [random.randint(-10,10) for x in range(12)]
y = [random.randint(-10,10) for x in range(12)]
print(x,y)
```

```
[-8, -5, 4, 3, 0, -8, -5, 0, -8, -1, 3, 8] [6, 10, 0, 8, -1, -7, 3, -1,
-5, -6, -2, 3]
```

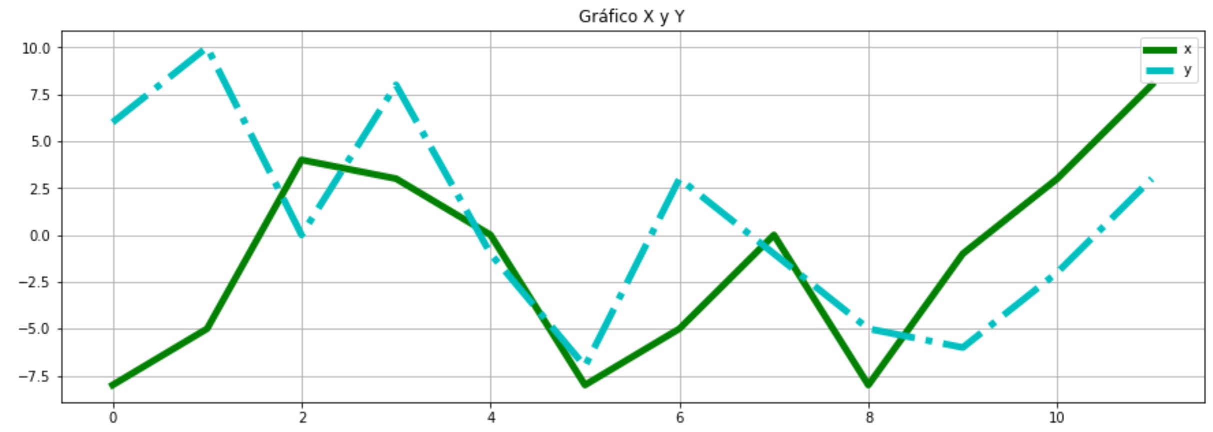
In [15]:
```
plt.plot(x,"y--", label="Gráfica x",linewidth=4.5);
```



In [16]:
```
plt.plot(y,"b:", label="Gráfica de y",linewidth=10,markersize=9);
plt.grid(True)
```



In [17]:
```
plt.plot(x,"g" , y, "c-.", linewidth=5);
plt.title("Gráfico X y Y")
plt.legend("xy")
plt.grid()
```



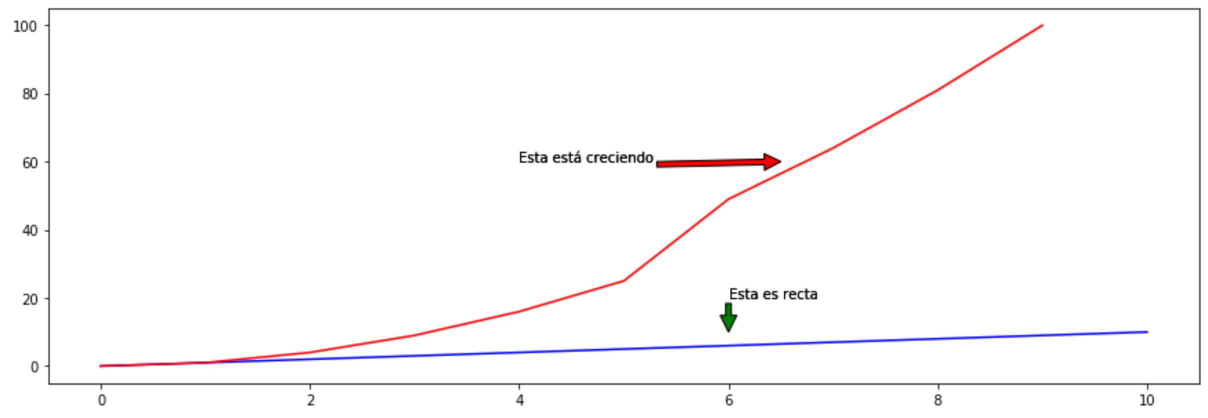
6.1 Exercise

1. Annotate a line at two places with text. Use green and red arrows and align it according to figure points and data.

In [18]:
```
x = [0,1,2,3,4,5,6,7,8,9,10]
y = [0,1,4,9,16,25,49,64,81,100]
```

In [35]:
```
plt.plot(x,"b" , y, "r");
ax = plt.gca()
ax.annotate('Esta está creciendo', xy = (3.7, 20), xytext=(4,60))
ax.annotate('Esta está creciendo', xy = (6.5, 60), xytext=(4,60),arrowp
rops={
'facecolor': 'r'})
ax.annotate('Esta es recta', xy = (4, 20), xytext=(6,20))
ax.annotate('Esta es recta', xy = (6, 10), xytext=(6,20),arrowprops={
'facecolor': 'g'})
```

Out[35]:
```
Text(6, 20, 'Esta es recta')
```

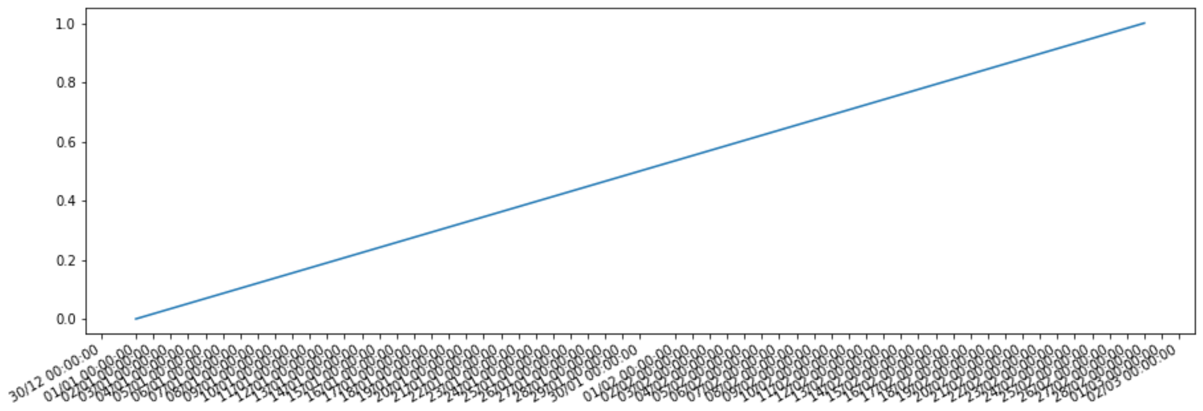


7.4 Exercises

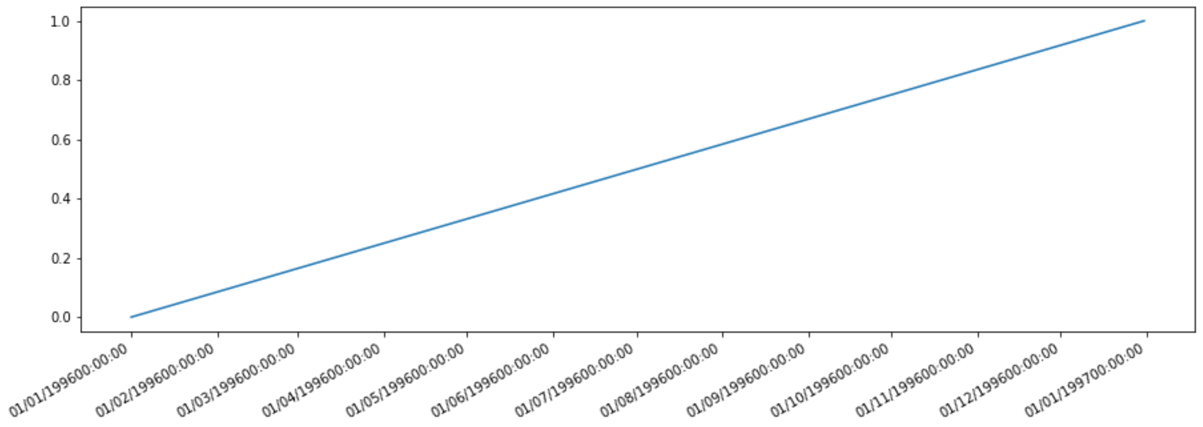
1. Plot a graph with dates for one year with daily values at the x axis using the built-in module datetime.
2. Format the dates in such a way that only the first day of the month is shown.
3. Display the dates with and without the year. Show the month as number and as first three letters of the month name.

In [36]:
```
import matplotlib.dates as mdates
import datetime as dt
```

In [37]:
```
import matplotlib.dates as mdates
import datetime as dt
dates = ['01/01 00:00:00','28/02 00:00:00']#no pongo todo el año porque
 la gráfica quedaría muy saturada y no se entiende
x = [dt.datetime.strptime(d,'%d/%m %H:%M:%S').date() for d in dates]
y = range(len(x))
plt.gca().xaxis.set_major_formatter(mdates.DateFormatter('%d/%m %H:%M:%
S'))
plt.gca().xaxis.set_major_locator(mdates.DayLocator(range(1, 31)))
plt.plot(x,y)
plt.gcf().autofmt_xdate()
```

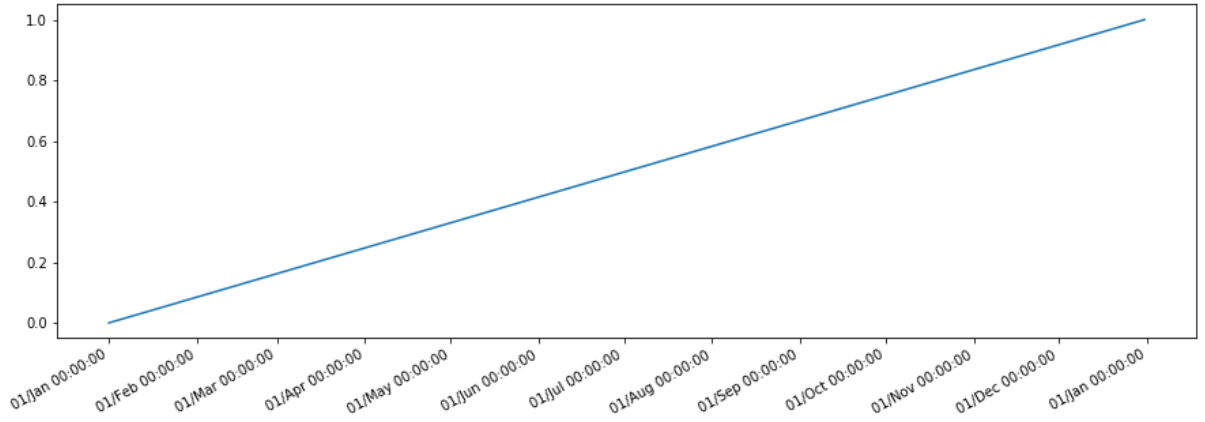


```
In [38]: dates = ['01/01/1996 00:00:00','31/12/1996 00:00:00']
x = [dt.datetime.strptime(d,'%d/%m/%Y %H:%M:%S').date() for d in dates]
y = range(len(x))
plt.gca().xaxis.set_major_formatter(mdates.DateFormatter('%d/%m/%Y%H:%
M:%S'))
plt.gca().xaxis.set_major_locator(mdates.MonthLocator(range(1, 13)))
plt.plot(x,y)
plt.gcf().autofmt_xdate()
```



```
In [39]: import matplotlib.dates as mdates
import datetime as dt
dates = ['01/Jan 00:00:00','31/Dec 00:00:00']
```

```
x = [dt.datetime.strptime(d,'%d/%b %H:%M:%S').date() for d in dates]
y = range(len(x))
plt.gca().xaxis.set_major_formatter(mdates.DateFormatter('%d/%b %H:%M:%
S'))
plt.gca().xaxis.set_major_locator(mdates.MonthLocator(range(1, 13)))
plt.plot(x,y)
plt.gcf().autofmt_xdate()
```



In [ ]:

```

```

8.5 Exercises

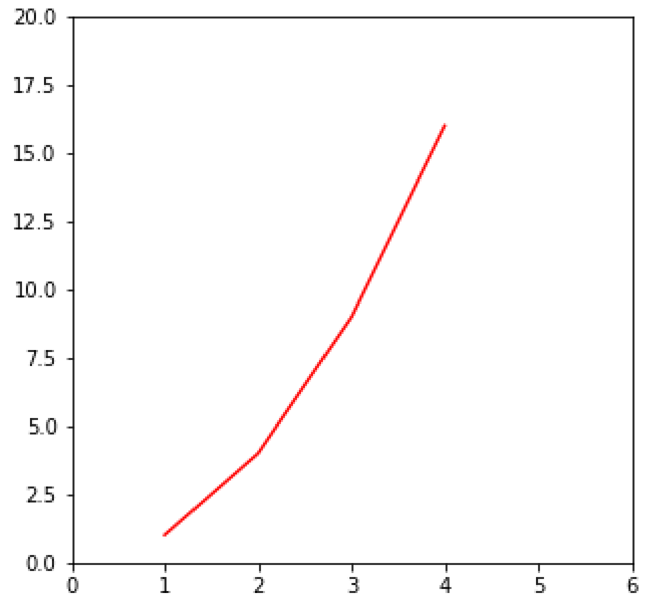
1. Draw two figures, one 5 by 5, one 10 by 10 inches.
2. Add four subplots to one figure. Add labels and ticks only to the outermost axes.
3. Place a small plot in one bigger plot.

In [40]:

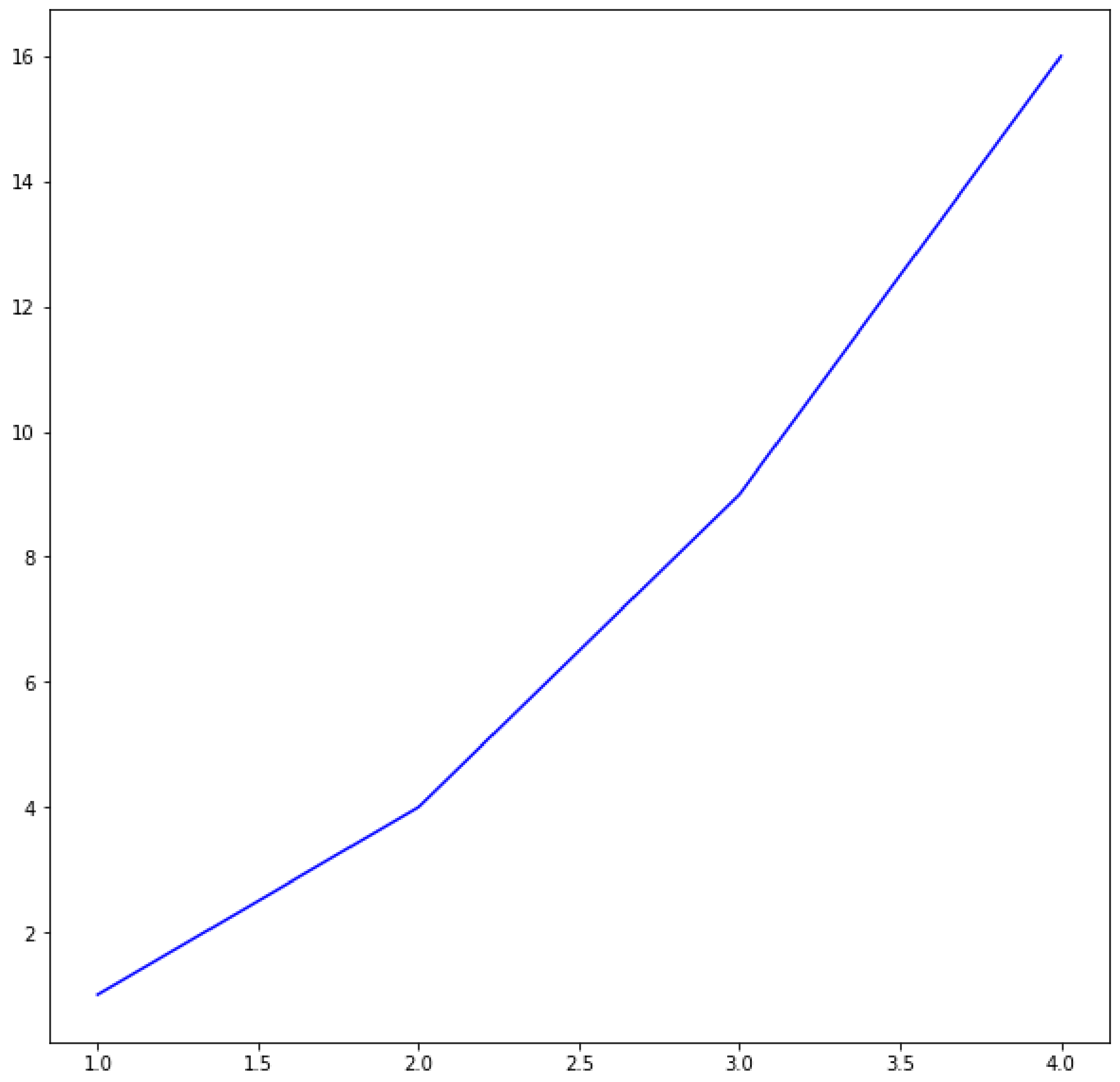
```
from pylab import rcParams
rcParams['figure.figsize'] = 5, 5
```

In [41]:

```
plt.plot([1,2,3,4], [1,4,9,16], 'r')
plt.axis([0, 6, 0, 20])
plt.show()
```



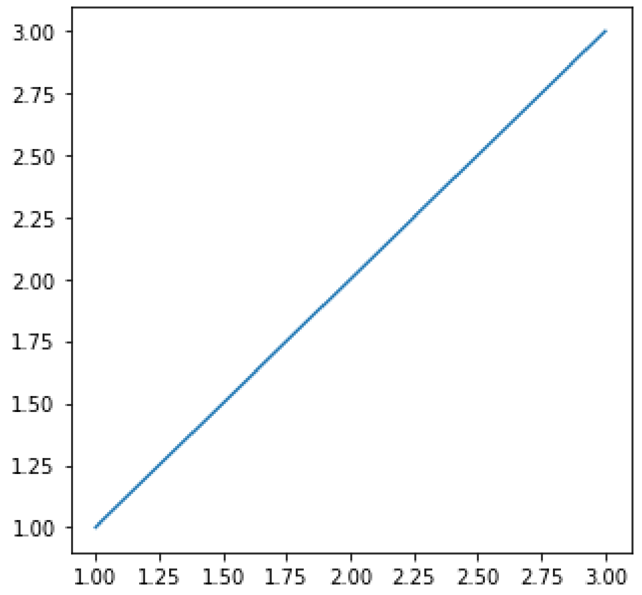
In [43]:
```
plt.plot([1,2,3,4], [1,4,9,16], 'b')
rcParams['figure.figsize'] = 10, 10
```



In [44]:
```
from matplotlib.pyplot import figure
figure(num=None, figsize=(8, 6), dpi=80, facecolor='w', edgecolor='k')
plt.show()
```

```
<Figure size 640x480 with 0 Axes>
```

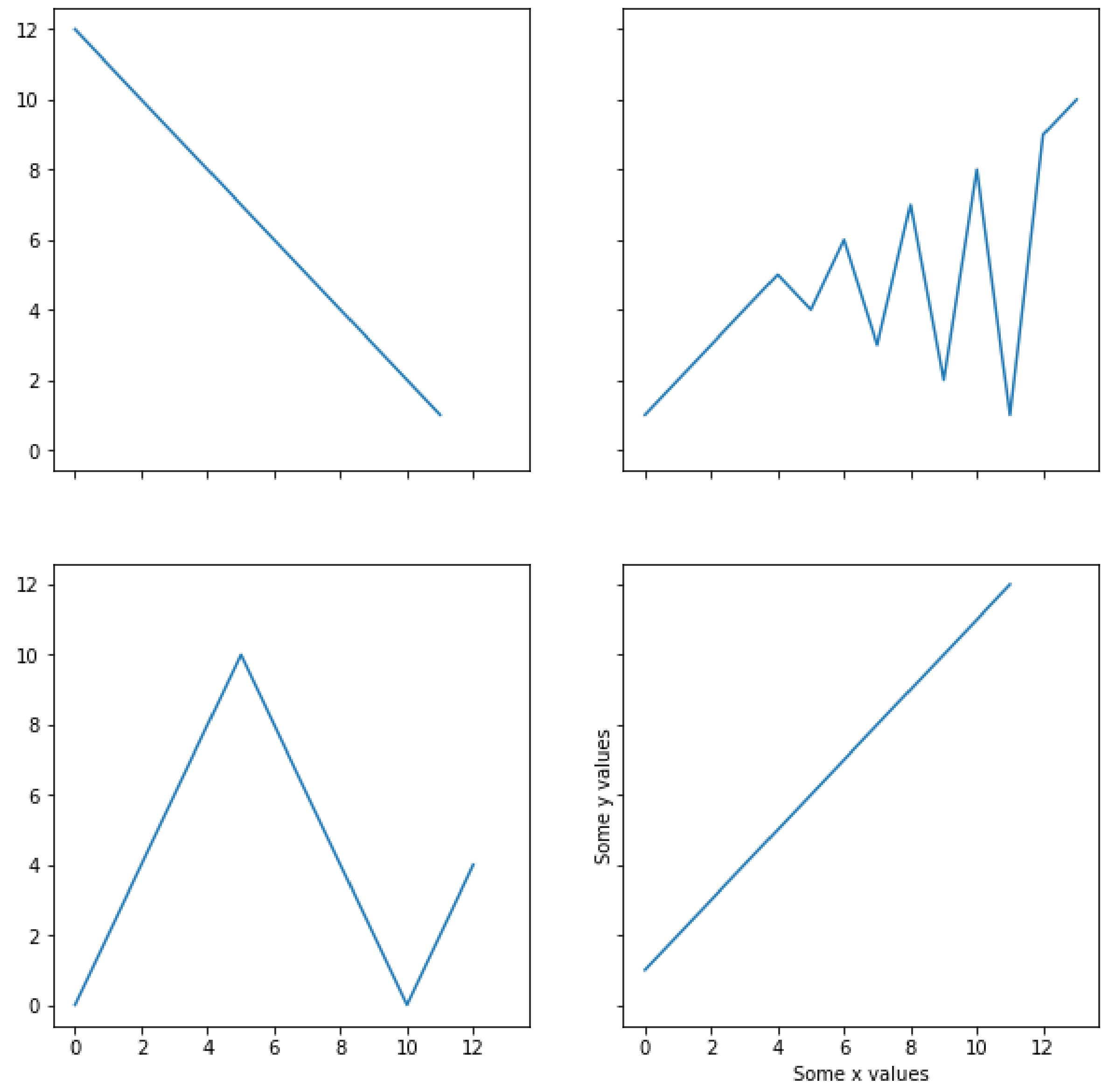
In [45]:
```
from matplotlib import pyplot as plt
plt.figure(figsize=(5,5))
x = [1,2,3]
plt.plot(x, x)
plt.show()
```



In [46]:
```
a=[1,2,3,4,5,6,7,8,9,10,11,12]
b=[12,11,10,9,8,7,6,5,4,3,2,1]
c=[0,2,4,6,8,10,8,6,4,2,0,2,4]
d=[1,2,3,4,5,4,6,3,7,2,8,1,9,10]
```

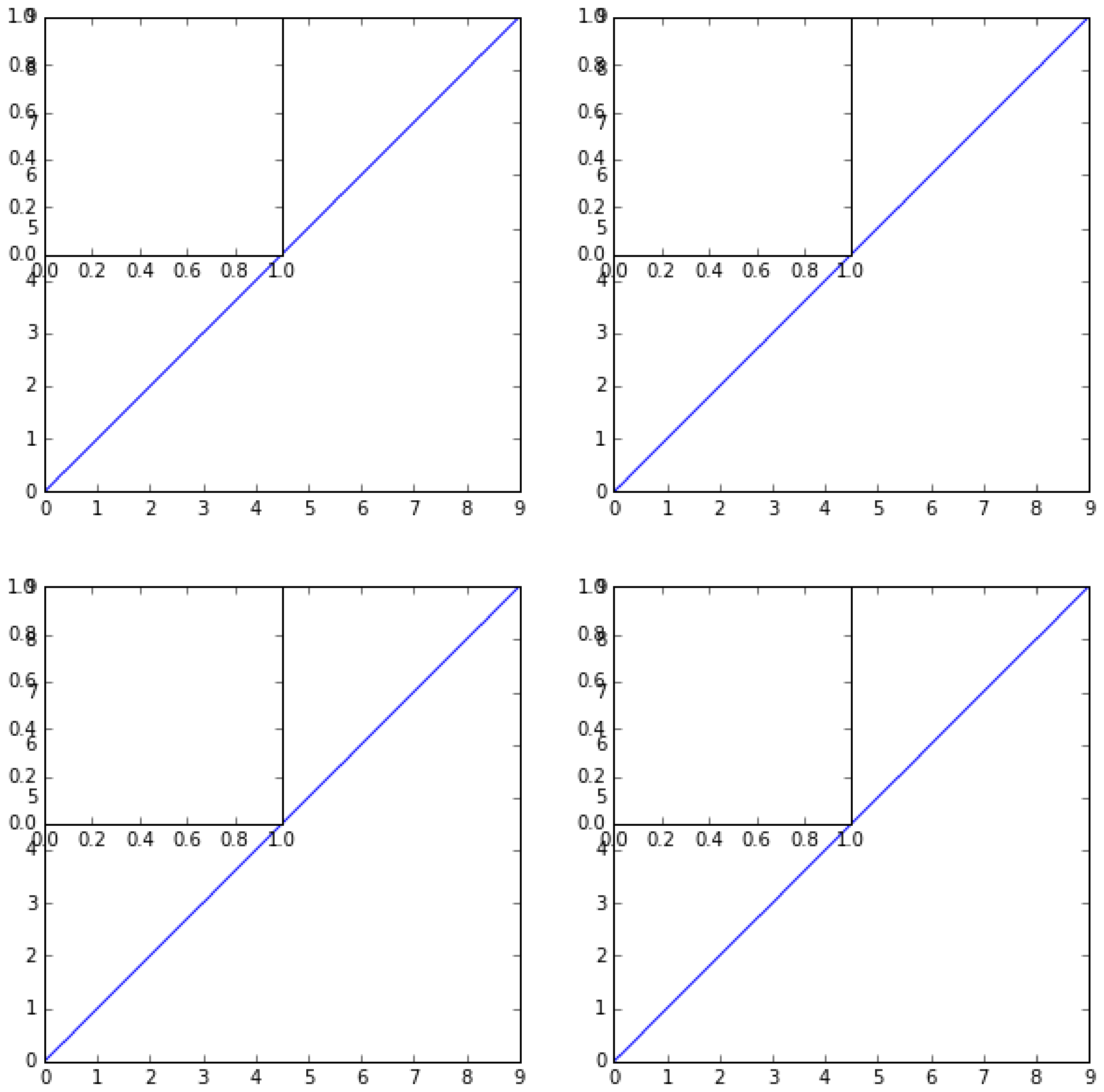
In [47]:
```
fig, axs = plt.subplots(2, 2, sharex=True, sharey=True)
axs[1,1].plot(a)
axs[0,0].plot(b)
axs[1,0].plot(c)
axs[0,1].plot(d)
plt.xlabel("Some x values")
plt.ylabel("Some y values")

plt.show()
```



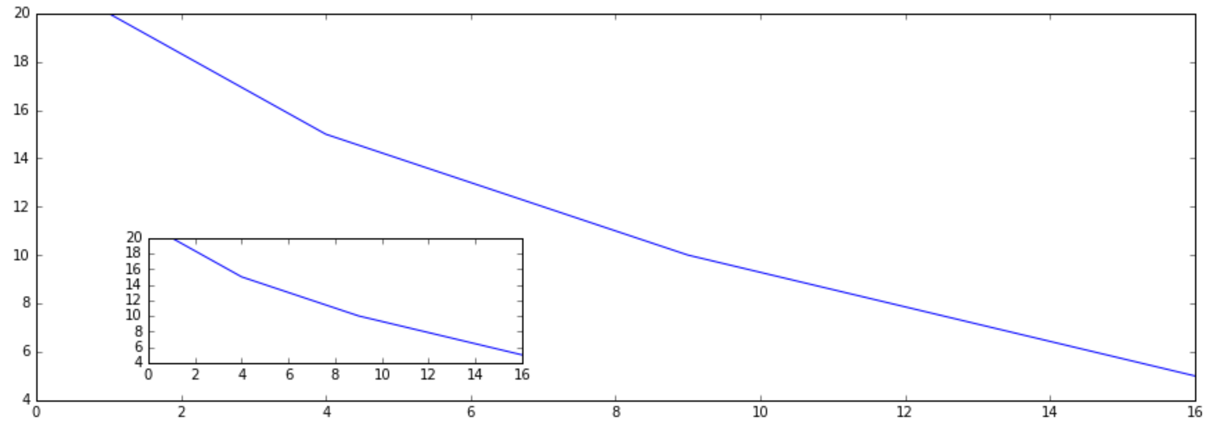
In [30]:

```
fig,axes = plt.subplots(2,2)
for ax in axes.flat:
    ax.plot(np.arange(10),np.arange(10))
    ins = ax.inset_axes([0,0.5,0.5,0.5])
plt.show()
```



In [51]:
```
l1 = [1,4,9,16]
l2 = [20,15,10,5]
plt.plot(l1,l2)
```

```
a = plt.axes([0.2, 0.2, 0.25, 0.25])
plt.plot(l1,l2);
```


20
18
16
14
12
10
8
6
4
0
2
4
6
8
10
12
14
16