In [1]:

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

import seaborn as sns
```

In [2]:

```
data_dir = '../data/'

returns_df = pd.read_csv(data_dir+'returns_all.csv')
```

In [3]:

```
returns_df['time'] = pd.to_datetime(returns_df['time'])
returns_df = returns_df.set_index('time')
```

In [4]:

```
len(returns_df.columns)
```

Out[4]:

```
124
```

In [5]:

```
returns_df.head()
```

Out[5]:

	AU200AUD	AUDCAD	AUDCHF	AUDHKD	AUDJPY	AUDNZD	AUDSGD	AU
time								
2011-08-29	-0.013380	0.003423	0.007609	0.002413	0.001245	-0.005630	0.003296	0.0
2011-09-01	-0.019738	0.000802	-0.016241	-0.006563	-0.008939	-0.004032	-0.007884	-0.(
2011-09-05	0.008129	-0.006565	0.084556	-0.005776	0.003531	0.005082	-0.003758	-0.(
2011-09-06	0.026472	0.009459	0.011441	0.016753	0.011576	0.005447	0.014015	0.0
2011-09-07	-0.016923	-0.001814	0.012760	-0.008196	-0.004868	-0.006688	-0.001586	-0.(

5 rows × 124 columns

In [6]:

```
avg_returns = returns_df.sum(axis=0)
```

In [7]:

```
avg_returns = avg_returns.sort_values(ascending=False)
```

In [8]:

```
avg_returns.head()
```

Out[8]:

```
NAS100USD    0.813275
XAUXAG       0.795655
USDTRY       0.764107
JP225USD     0.590379
SPX500USD    0.572181
dtype: float64
```

In [9]:

```python
avg_returns.index
```

Out[9]:

```
Index(['NAS100USD', 'XAUXAG', 'USDTRY', 'JP225USD', 'SPX500USD', 'US3
0USD',
       'US2000USD', 'EURTRY', 'DE30EUR', 'USDZAR',
       ...
       'XAGCAD', 'XAGNZD', 'XAGJPY', 'XAGEUR', 'XAGGBP', 'XAGSGD', 'S
UGARUSD',
       'XAGCHF', 'XAGHKD', 'XAGUSD'],
      dtype='object', length=124)
```

Conditional Labeller - To find maximum value and return that as a label value

In [10]:

```python
def cond_labeller(series, value):
#     return series[series>value].index
    return series[series==series.max()].index
```

In [11]:

```python
cond_labeller(avg_returns,0.4)
```

Out[11]:

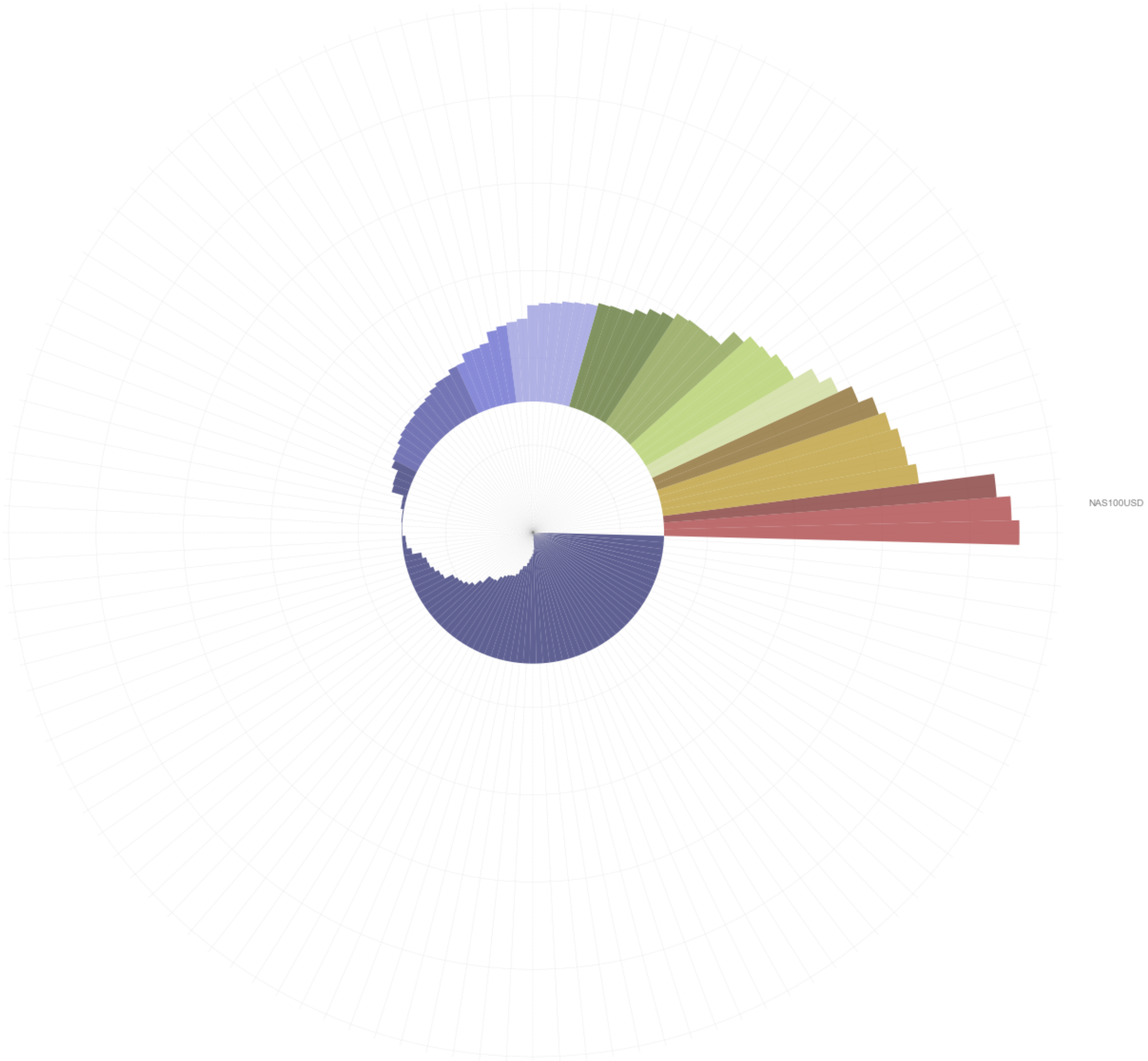
```
Index(['NAS100USD'], dtype='object')
```

Radial Histogram | Radial Barchart

In [12]:

```
plt.figure(figsize=(12,12))

params = {'legend.fontsize': 10,
          'figure.figsize': (20, 60),
          'axes.facecolor' : 'white',
          'axes.labelsize': 10,
          'axes.titlesize': 12,
          'xtick.color': 'gray',
          'xtick.labelsize': 10,
          'ytick.color': 'gray',
          'ytick.labelsize': 0,
         'text.color':'gray',
         'figure.subplot.wspace':0.4,
         'figure.subplot.hspace':0.9,
         'axes.linewidth': 0.1,
         'axes.grid': False,
         'grid.color': 'gray',
         'grid.linestyle': ':',
         'grid.linewidth': 0.3,
         'grid.alpha': 0.5}
# See https://matplotlib.org/users/customizing.html
plt.rcParams.update(params)
fig = plt.figure()


N = len(returns_df.columns)
bottom = 3
max_height = avg_returns.max()
# sns.set_style('white')
theta = np.linspace(0.0, 2*np.pi, N, endpoint=False)
width = (2*np.pi)/N

ax = plt.subplot(111, polar=True)
bars = ax.bar(theta, avg_returns*10, width=width, bottom=bottom)
ax.set_xticks(theta + width)
ax.set_xticklabels(cond_labeller(avg_returns, 0.5))
for r, bar in zip(avg_returns, bars):
    bar.set_facecolor(plt.cm.tab20b(r/1.2))
    bar.set_alpha(0.8)

plt.show()
```

```
<matplotlib.figure.Figure at 0x1117e7c50>
```



In [13]:
```
returns_df['Year'] = returns_df.index.year
```

In [14]:
```
annual_returns = returns_df.groupby('Year').sum(axis=0)
```

```
In [15]: annual_returns.iloc[1,:]
```

```
Out[15]: AU200AUD     0.126161
         AUDCAD       0.002809
         AUDCHF       0.007121
         AUDHKD      -0.016976
         AUDJPY       0.063507
         AUDNZD      -0.023822
         AUDSGD      -0.030133
         AUDUSD      -0.016613
         BCOUSD       0.078357
         CADCHF       0.001964
         CADHKD      -0.021743
         CADJPY       0.061948
         CADSGD      -0.034226
         CHFHKD      -0.024194
         CHFJPY       0.058531
         CHFZAR      -0.011416
         CN50USD      0.149487
         CORNUSD      0.100963
         DE10YBEUR    0.027636
         DE30EUR      0.200670
         EU50EUR      0.075438
         EURAUD       0.004825
         EURCAD       0.008449
         EURCHF       0.010748
         EURCZK       0.061942
         EURDKK       0.003692
         EURGBP      -0.034234
         EURHKD      -0.012755
         EURHUF      -0.010984
         EURJPY       0.070371
                        ...
         USDTHB      -0.025456
         USDTRY      -0.008574
         USDZAR       0.012288
         WHEATUSD     0.322609
         WTICOUSD     0.032019
         XAGAUD       0.031274
         XAGCAD       0.031291
         XAGCHF       0.034632
         XAGEUR       0.027164
         XAGGBP      -0.010594
         XAGHKD       0.013139
         XAGJPY       0.106778
         XAGNZD       0.004095
         XAGSGD      -0.000630
         XAGUSD       0.013383
         XAUAUD       0.090392
         XAUCAD       0.090447
         XAUCHF       0.094580
         XAUEUR       0.086249
         XAUGBP       0.049357
         XAUHKD       0.072705
         XAUJPY       0.164432
         XAUNZD       0.063898
         XAUSGD       0.059204
         XAUUSD       0.073014
         XAUXAG       0.059772
         XCUUSD       0.041449
         XPDUSD       0.008718
         XPTUSD       0.055565
```

```
ZARJPY       0.071619
Name: 2012, Length: 124, dtype: float64
```

In [16]:

```
len(annual_returns)
```

Out[16]:

```
7
```

In [17]:

```
annual_returns
```

Out[17]:

	AU200AUD	AUDCAD	AUDCHF	AUDHKD	AUDJPY	AUDNZD	AUDSGD	AUI
Year								
2011	-0.198757	0.008071	0.075860	-0.095872	-0.094106	0.021766	0.006669	-0.0
2012	0.126161	0.002809	0.007121	-0.016976	0.063507	-0.023822	-0.030133	-0.0
2013	0.097787	-0.129219	-0.229353	-0.184959	-0.088381	-0.122962	-0.160061	-0.1
2014	0.047522	-0.055126	-0.047498	-0.155150	-0.009112	-0.060283	-0.102691	-0.1
2015	-0.066384	0.092105	-0.162536	-0.083636	-0.094518	0.032831	-0.032228	-0.0
2016	0.057489	-0.083887	-0.071008	-0.068173	-0.086356	-0.063749	-0.051021	-0.0
2017	0.029550	0.044730	0.051910	0.118317	0.048177	0.057113	0.045785	0.11

7 rows × 124 columns

In [18]:

```
annual_returns.iloc[1,:].name
```

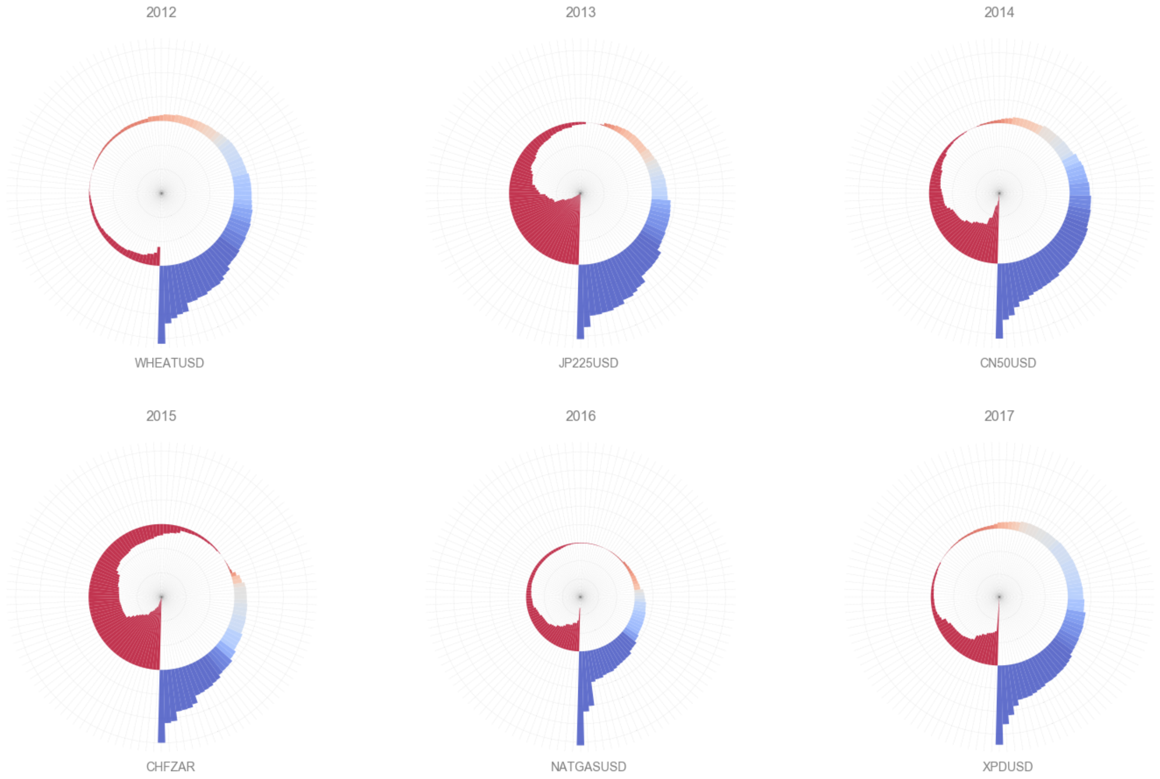
Out[18]:

```
2012
```

In [19]:

```
import matplotlib.gridspec as gridspec
plt.figure(figsize=(16,12))
params = {'legend.fontsize': 10,
          'figure.figsize': (24, 15),
          'axes.facecolor' : 'white',
          'axes.labelsize': 10,
          'axes.titlesize': 16,
          'axes.labelcolor': 'blue',
          'xtick.color': 'gray',
          'xtick.labelsize': 14,
#           'xtick.major.pad': 10,
#           'xtick.minor.pad': 20,
          'ytick.color': 'gray',
          'ytick.labelsize': 0,
         'text.color':'gray',
         'figure.subplot.wspace':0.1,
         'figure.subplot.hspace':0.2,
         'axes.linewidth': 0.1,
         'axes.grid': False,
         'grid.color': 'gray',
         'grid.linestyle': ':',
         'grid.linewidth': 0.3,
         'grid.alpha': 0.5}
# See https://matplotlib.org/users/customizing.html
plt.rcParams.update(params)
fig = plt.figure()
# plot_index = 320
gs = gridspec.GridSpec(2, 3)
gs.update(wspace=0.25, hspace=0.3)

for i in range(1, len(annual_returns)):
    N = len(annual_returns.columns)
    bottom = 3
    max_height = annual_returns.iloc[i,:].max()
    theta = np.linspace(0.0, 2*np.pi, N, endpoint=False)
    width = (2*np.pi)/N
    returns = annual_returns.iloc[i,:].sort_values(ascending=False)

    ax = plt.subplot(gs[i-1], polar=True)
    ax.set_theta_zero_location("S")
    bars = ax.bar(theta, returns*10, width=width, bottom=bottom)
    ax.set_title(returns.name)
    ax.set_xticks(theta + width)
    ax.set_xticklabels(cond_labeller(returns, 0.25))
    for r, bar in zip(returns, bars):
        bar.set_facecolor(plt.cm.coolwarm_r(r/0.1))
        bar.set_alpha(0.8)

#         plt.tight_layout()
plt.show()
```

```
<matplotlib.figure.Figure at 0x110820cf8>
```



Creating a Custom CMAP

In [20]:

```
color6 = matplotlib.colors.hex2color('#2b64a9')
color5 = matplotlib.colors.hex2color('#156fa4')
color4 = matplotlib.colors.hex2color('#82c3ed')
color3 = matplotlib.colors.hex2color('#f19cb9')
color2 = matplotlib.colors.hex2color('#d36a93')
color1 = matplotlib.colors.hex2color('#7d2b42')
```

In [21]:

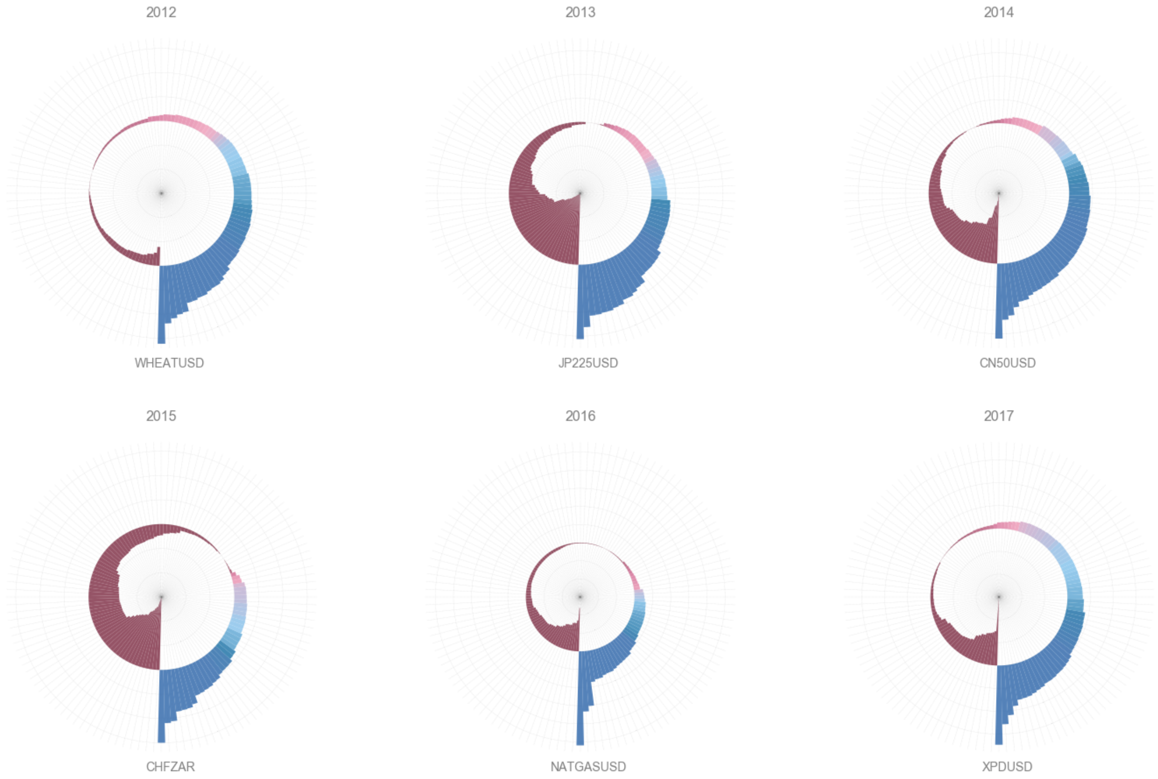
```
from matplotlib.colors import LinearSegmentedColormap
```

In [22]:

```
colors = [color1, color2, color3, color4, color5, color6]
n_bins = [3, 6, 10, 100]
cm = LinearSegmentedColormap.from_list('Bluish', colors, N=300)
```

```
In [23]: import matplotlib.gridspec as gridspec
plt.figure(figsize=(16,12))
params = {'legend.fontsize': 10,
          'figure.figsize': (24, 15),
          'axes.facecolor' : 'white',
          'axes.labelsize': 10,
          'axes.titlesize': 16,
          'axes.labelcolor': 'blue',
          'xtick.color': 'gray',
          'xtick.labelsize': 14,
#           'xtick.major.pad': 10,
#           'xtick.minor.pad': 20,
          'ytick.color': 'gray',
          'ytick.labelsize': 0,
         'text.color':'gray',
         'figure.subplot.wspace':0.1,
         'figure.subplot.hspace':0.2,
         'axes.linewidth': 0.1,
         'axes.grid': False,
         'grid.color': 'gray',
         'grid.linestyle': ':',
         'grid.linewidth': 0.3,
         'grid.alpha': 0.5}
# See https://matplotlib.org/users/customizing.html
plt.rcParams.update(params)
fig = plt.figure()
# plot_index = 320
gs = gridspec.GridSpec(2, 3)
gs.update(wspace=0.25, hspace=0.3)

for i in range(1, len(annual_returns)):
    N = len(annual_returns.columns)
    bottom = 3
    max_height = annual_returns.iloc[i,:].max()
    theta = np.linspace(0.0, 2*np.pi, N, endpoint=False)
    width = (2*np.pi)/N
    returns = annual_returns.iloc[i,:].sort_values(ascending=False)

    ax = plt.subplot(gs[i-1], polar=True)
    ax.set_theta_zero_location("S")
    bars = ax.bar(theta, returns*10, width=width, bottom=bottom)
    ax.set_title(returns.name)
    ax.set_xticks(theta + width)
    ax.set_xticklabels(cond_labeller(returns, 0.25))
    for r, bar in zip(returns, bars):
        bar.set_facecolor(cm(r/0.1))
        bar.set_alpha(0.8)

#         plt.tight_layout()
plt.show()
```

```
<matplotlib.figure.Figure at 0x1116c25c0>
```


2012
WHEATUSD
2013
JP225USD
2014
CN50USD
2015
CHFZAR
2016
NATGASUSD
2017
XPDUSD