In [3]:
```
hideMe="Yes" # hide this cell from show in Jupyter notebook
# This is a cell to hide code snippets from displaying
# This must be at first cell!

from IPython.display import HTML

HTML('''<script>
code_show=true;
function code_toggle() {
  if (code_show) {
    $('div.input').each(function(id) {
      el = $(this).find('.cm-variable:last');
      el2 = $(this).find('.cm-variable:first');
      eltikz = $(this).find('.cm-variable:first');
      if(id == 0 || el.text() == 'hideMe' || el2.text() == 'hideMe' || eltikz.text() == 'tikz')
        {$(this).hide();}
    });
    $('div.output_prompt').css('opacity', 0);
  } else {
    $('div.input').each(function(id) {$(this).show(); });
    $('div.output_prompt').css('opacity', 1);
    $('.input_area').show();
  }
  code_show = !code_show
}
$( document ).ready(code_toggle);
</script>
<form action="javascript:code_toggle()"><input type="submit" value="Click here to toggle on/off the raw code."><
```

Out[3]:

Click here to toggle on/off the raw code.

In [23]:
```
hideMe="Yes" # hide this cell from show in Jupyter notebook
%load_ext tikzmagic
#from __future__ import print_function
import tikzmagic
from IPython.display import display, Math, Markdown, Latex
import numpy as np

def printMatrixs(matrixS):
    raw_counts = max([len(a) for a in matrixS])
    for i in range(0,raw_counts):
        for A in matrixS:
            if len(A)>=i: printMatrix(A,i)
        print()

def printMatrix(matrixA,raw_current):
    print("[", end = "") #spec = "{:<"+str(col_width)+"G}"
    for j in range (len(matrixA[raw_current])):
        col_width = max([len("{:G}".format(a)) for a in  matrixA[:,j]])
        if j>0: print(" ",end = "")
        print( ("{:<"+str(col_width)+"G}").format(matrixA[raw_current][j]), end = "")
    print("]", end = "")
#import notebook
#from jupyter_core.paths import jupyter_config_dir, jupyter_config_path
#print(jupyter_config_dir())
#print(jupyter_config_path())
```

```
The tikzmagic extension is already loaded. To reload it, use:
  %reload_ext tikzmagic
```

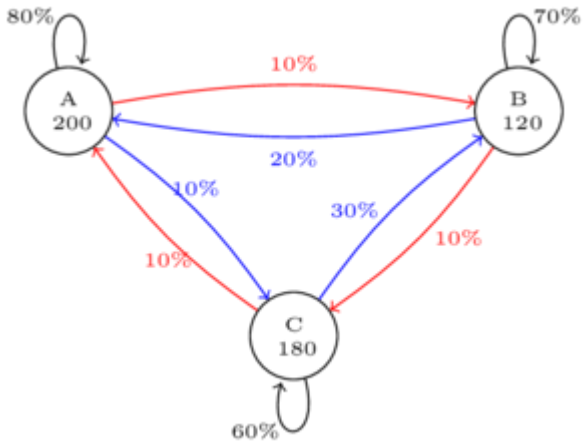
In [24]:

```
%%tikz -s 300,300

\node [circle, draw, align=center, text width=0.3cm, font=\tiny] at (0,0) (A) {A 200};
\node [circle, draw, align=center, text width=0.3cm, font=\tiny] at (4,0) (B) {B 120};
\node [circle, draw, align=center, text width=0.3cm, font=\tiny] at (2,-2)(C) {C 180};

\path (A) edge [loop above, left]  node {\tiny 80\%}(A);
\path (B) edge [loop above, right] node {\tiny 70\%}(B);
\path (C) edge [loop below, left]  node {\tiny 60\%}(C);

\draw[->][red] (A) edge [bend left=10,above] node {\tiny 10\%}(B);
\draw[->][blue](B) edge [bend left=10,below] node {\tiny 20\%}(A);
\draw[->][red] (B) edge [bend left=10,right] node {\tiny 10\%}(C);
\draw[->][blue](C) edge [bend left=10,left]  node {\tiny 30\%}(B);
\draw[->][red] (C) edge [bend left=10,below] node {\tiny 10\%}(A);
\draw[->][blue](A) edge [bend left=10,above] node {\tiny 10\%}(C);
```




```
<table>
<tr style="text-align:left;">
<td>
$$
\boxed{\left[\substack{\text{Next State}\\ \text{Future State}}\right] =
\left[
\substack{\text{Matrix of}\\ \text{Transition}\\ \text{Probabilities}}
\right]
*[\text{Current State}]}
% ----------------------
% P0 =
```

```
\begin{matrix} %This is the super matrix
%(1 first-line, 1 first-column)
\\
\hphantom{\begin{matrix}\end{matrix}}
\\
%(2 second-line,2 second-col)
\left[P_0\right] =
\\
%(3 third-line, 1 first-column )
\vphantom{\begin{matrix}\end{matrix}}
%This is the super matrix
\end{matrix} %This is the super matrix
% ----------------------
\begin{matrix} %This is the super matrix
%(1 first-line, 1 first-column) cell: Brace spanning columns
\begin{matrix}   %One-row matrix to hold the brace
\overbrace{\begin{matrix}A & \hphantom{\text{0.}}B & \hphantom{\text{0.}}C\end{matrix}}^{P_0\text{:from}}
\end{matrix}
\\
%(2 second-line, 1 first-column) cell: Actual matrix
\begin{bmatrix}
0.8 & 0.2 & 0.1 \\
0.1 & 0.7 & 0.3 \\
\underline{0.1} & \underline{0.1} & \underline{0.6}
\end{bmatrix}
&
%(2 second-line,2 second-col)
\begin{matrix}to A\\ to B\\ to C\end{matrix}
%The inter-column spacing of the super matrix looks too big by default
%\mspace{-33mu}
\\
%(3 third-line, 1 first-column )
\begin{array}{lcr}1.0 & 1.0 & 1.0 \end{array}
&
%(3 third-line,2 second-col)
\vphantom{\begin{matrix}\end{matrix}}
%This is the super matrix
\end{matrix}
\quad
% ----------------------
% X0 =
\begin{matrix} %This is the super matrix
%(1 first-line, 1 first-column)
```

```
\\
\hphantom{\begin{matrix}\end{matrix}}
\\
%(2 second-line,2 second-col)
\left[X_0\right] =
\\
%(3 third-line, 1 first-column )
\vphantom{\begin{matrix}\end{matrix}}
%This is the super matrix
\end{matrix} %This is the super matrix
% ----------------------
\begin{matrix} %This is the super matrix
%(1 first-line, 1 first-column)
\vphantom{\begin{matrix}text{X_0}\end{matrix}}
\\
%(2 second-line,2 second-col)
\overbrace{
\left[
\begin{matrix}0.40 & A=200\\ 0.24 & B=120\\ \underline{0.36} & \underline{C=180}\end{matrix}
\right]}^{X_0}
\\
%(3 third-line, 1 first-column )
\begin{matrix} 1.0 & \hphantom{\text{A==}} 500\end{matrix}
%This is the super matrix
\end{matrix}
$$
</td>
</tr>
<tr>
<td>
$$[X_1] = [P]*[X_0]$$
</td>
</tr>
<tr style="text-align:left;">
<td>
$$
% ----------------------
% X1 =
\begin{matrix} %This is the super matrix
%(1 first-line, 1 first-column)
\\
\hphantom{\begin{matrix}\end{matrix}}
\\
```

```
%(2 second-line,2 second-col)
\left[X_1\right] =
\\
%(3 third-line, 1 first-column )
\vphantom{\begin{matrix}\end{matrix}}
%This is the super matrix
\end{matrix} %This is the super matrix
% ----------------------
\begin{matrix} %This is the super matrix
%(1 first-line, 1 first-column) cell: Brace spanning columns
\begin{matrix}   %One-row matrix to hold the brace
\overbrace{\begin{matrix}A & \hphantom{\text{0.}}B & \hphantom{\text{0.}}C\end{matrix}}^{P_0\text{:from}}
\end{matrix}
\\
%(2 second-line, 1 first-column) cell: Actual matrix
\begin{bmatrix}
0.8 & 0.2 & 0.1 \\
0.1 & 0.7 & 0.3 \\
\underline{0.1} & \underline{0.1} & \underline{0.6}
\end{bmatrix}
&
%(2 second-line,2 second-col)
\begin{matrix}to A\\ to B\\ to C\end{matrix}
%The inter-column spacing of the super matrix looks too big by default
%\mspace{-33mu}
\\
%(3 third-line, 1 first-column )
\begin{array}{lcr}1.0 & 1.0 & 1.0 \end{array}
&
%(3 third-line,2 second-col)
\vphantom{\begin{matrix}\end{matrix}}
%This is the super matrix
\end{matrix}
% ----------------------
% Sign Multiplication
\begin{matrix} %This is the super matrix
%(1 first-line, 1 first-column)
\\
\hphantom{\begin{matrix}\end{matrix}}
\\
%(2 second-line,2 second-col)
\begin{matrix}*\end{matrix}
\\
```

```
%(3 third-line, 1 first-column )
\vphantom{\begin{matrix}\end{matrix}}
%This is the super matrix
\end{matrix}
% ----------------------
\begin{matrix} %This is the super matrix
%(1 first-line, 1 first-column)
\vphantom{\begin{matrix}text{X_0}\end{matrix}}
\\
%(2 second-line,2 second-col)
\overbrace{
\left[
\begin{matrix}0.40 & A=200\\ 0.24 & B=120\\ \underline{0.36} & \underline{C=180}\end{matrix}
\right]}^{X_0}
\\
%(3 third-line, 1 first-column )
\begin{matrix} 1.0 & \hphantom{\text{A==}} 500\end{matrix}
%This is the super matrix
\end{matrix}
% ----------------------
% Sign =
\begin{matrix} %This is the super matrix
%(1 first-line, 1 first-column)
\\
\hphantom{\begin{matrix}\end{matrix}}
\\
%(2 second-line,2 second-col)
\begin{matrix}=\end{matrix}
\\
%(3 third-line, 1 first-column )
\vphantom{\begin{matrix}\end{matrix}}
%This is the super matrix
\end{matrix}
% ----------------------
\begin{matrix} %This is the super matrix
%(1 first-line, 1 first-column) cell: Brace spanning columns
\begin{matrix}   %One-row matrix to hold the brace
\end{matrix}
\\
%(2 second-line, 1 first-column) cell: Actual matrix
\overbrace{
\left[
\begin{array}{ccccc}
```

```
0.8*0.4 &+& 0.2*0.24 &+&  0.1*0.36\\
0.1*0.4 &+& 0.7*0.24 &+&  0.3*0.36\\
0.1*0.4 &+& 0.1*0.24 &+&  0.6*0.36
\end{array}
\right]}^{X_1}
\\
%(3 third-line, 1 first-column )
\vphantom{\begin{matrix}\end{matrix}}
%This is the super matrix
\end{matrix}
% ----------------------
% Sign =
\begin{matrix} %This is the super matrix
%(1 first-line, 1 first-column)
\\
\hphantom{\begin{matrix}\end{matrix}}
\\
%(2 second-line,2 second-col)
\begin{matrix}=\end{matrix}
\\
%(3 third-line, 1 first-column )
\vphantom{\begin{matrix}\end{matrix}}
%This is the super matrix
\end{matrix}
$$

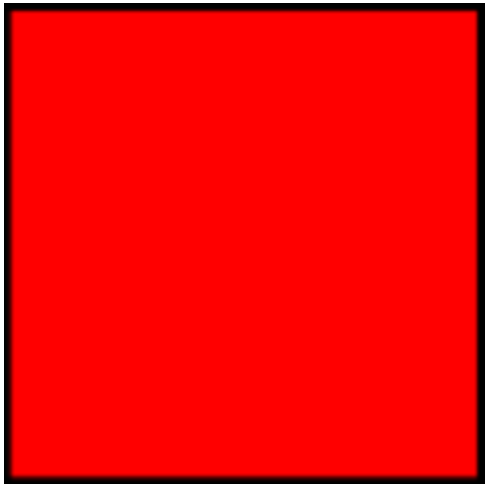
$
% ----------------------
%  X_1 =
\begin{matrix} %This is the super matrix
%(1 first-line, 1 first-column)
\\
\hphantom{\begin{matrix}\end{matrix}}
\\
%(2 second-line,2 second-col)
\left[X_1\right] =
\\
%(3 third-line, 1 first-column )
\vphantom{\begin{matrix}\end{matrix}}
%This is the super matrix
\end{matrix} %This is the super matrix
% ----------------------
\begin{matrix} %This is the super matrix
```

```
%(1 first-line, 1 first-column)
\vphantom{\begin{matrix}text{X_1}\end{matrix}}
\\
%(2 second-line,2 second-col)
\overbrace{
\left[
\begin{matrix}0.404 & A=202\\ 0.316 & B=158\\ \underline{0.280} & \underline{C=140}\end{matrix}
\right]}^{X_1}
\\
%(3 third-line, 1 first-column )
\begin{matrix} 1.0 & \hphantom{\text{A==}} 500\end{matrix}
%This is the super matrix
\end{matrix} %This is the super matrix
$
</td>
</tr>
</table>
```

Type *Markdown* and LaTeX: α^2

In [30]:
```
hideMe="Yes" # hide this cell from show in Jupyter notebook
tikz_str = """
\draw[fill=red] (0,0) rectangle (1,1);
"""
%tikz $tikz_str

X0 = np.array([0.4, 0.24, 0.36])
X1 = P0.dot(X0)
P0 = np.array([[0.8, 0.2, 0.1],
               [0.1, 0.7, 0.3],
               [0.1, 0.1, 0.6]])
P1 = P0.dot(P0)
P2 = P1.dot(P0)
P3 = P2.dot(P0)
P4 = P3.dot(P0)
#print(P0[0,:],P0[0][2],P1[0])
printMatrixs([P0,P1,P2,P3,P4]); print(X1)
hideMe="Yes" # hide this cell from show in Jupyter notebook
```



```
[0.8 0.2 0.1][0.67 0.31 0.2][0.587 0.371 0.28][0.5347 0.4051 0.338][0.50207 0.42431 0.3778]
[0.1 0.7 0.3][0.18 0.54 0.4][0.238 0.454 0.42][0.2778 0.4074 0.412][0.30418 0.38194 0.3972]
[0.1 0.1 0.6][0.15 0.15 0.4][0.175 0.175 0.3 ][0.1875 0.1875 0.25 ][0.19375 0.19375 0.225 ]
[0.404 0.316 0.28 ]
```

In [7]:
```
P0 = np.array([[0.8, 0.2, 0.1],
               [0.1, 0.7, 0.3],
               [0.1, 0.1, 0.6]])
P1 = P0.dot(P0)
P2 = P1.dot(P0)
P3 = P2.dot(P0)
P4 = P3.dot(P0)
#print(P0[0,:],P0[0][2],P1[0])
printMatrixs([P0,P1,P2,P3,P4])
hideMe="Yes" # hide this cell from show in Jupyter notebook
```

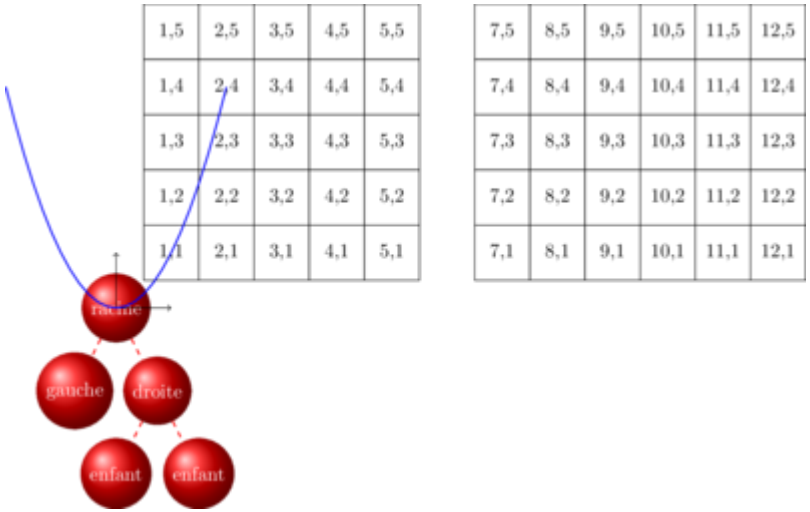
```
[0.8 0.2 0.1][0.67 0.31 0.2][0.587 0.371 0.28][0.5347 0.4051 0.338][0.50207 0.42431 0.3778]
[0.1 0.7 0.3][0.18 0.54 0.4][0.238 0.454 0.42][0.2778 0.4074 0.412][0.30418 0.38194 0.3972]
[0.1 0.1 0.6][0.15 0.15 0.4][0.175 0.175 0.3 ][0.1875 0.1875 0.25 ][0.19375 0.19375 0.225 ]
```

In [8]:

```
%%tikz -s 400,400 -sc 1 -f png
\foreach \x in {1,2,...,5,7,8,...,12}
\foreach \y in {1,...,5}
{
\draw (\x,\y) +(-.5,-.5) rectangle ++(.5,.5);
\draw (\x,\y) node{\x,\y};
}

[parent anchor=east,child anchor=west,grow=east]
\tikzstyle{every node}=[ball color=red,circle,text=white]
\tikzstyle{edge from parent}=[draw,dashed,thick,red]
\node {racine}
child {node {gauche}}
child {node {droite}
child {node {enfant}}
child {node {enfant}}
};

\draw [<->] (0,1) -- (0,0) -- (1,0);
\draw[blue,thick, domain=-2:2] plot (\x, {\x*\x});
%https://share.cocalc.com/share/96fd2324ae3de4c1f97ef1a116a87fd0839c3c2b/tikzimpatient.ipynb?viewer=share
```



In [9]:

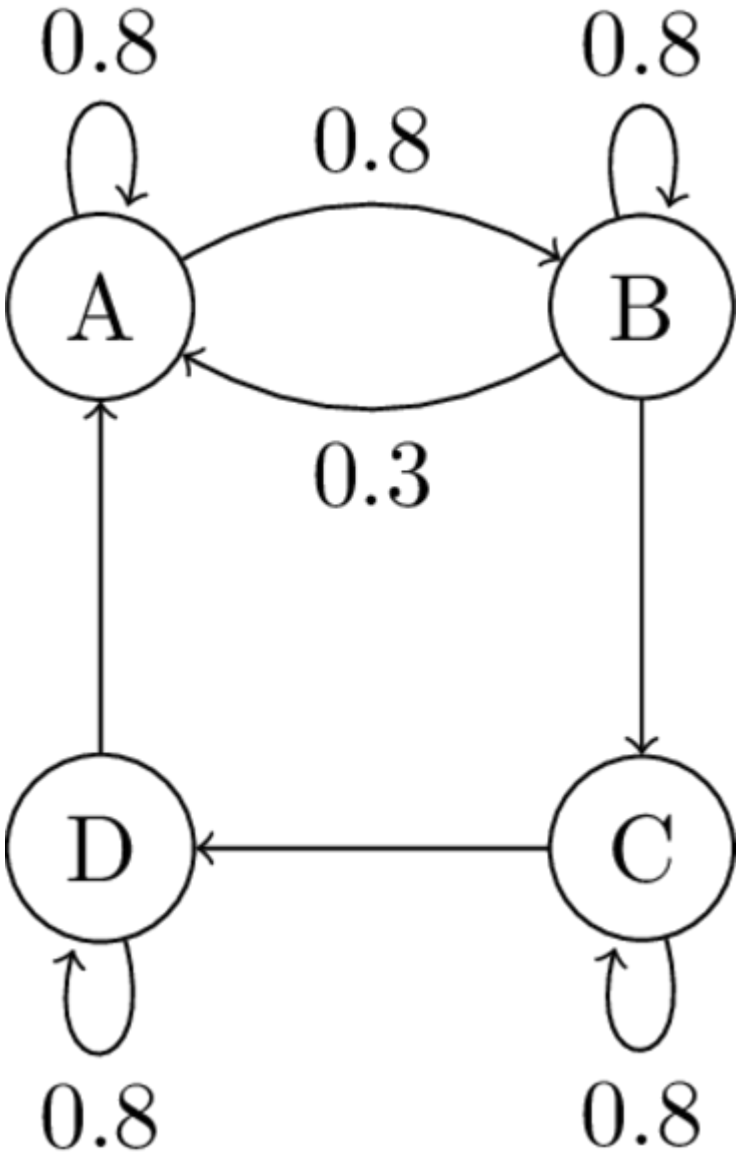
```
%%tikz -s 600,600

\node [circle, draw] at (0,0)  (A) {A};
\node [circle, draw] at (2,0)  (B) {B};
\node [circle, draw] at (2,-2) (C) {C};
\node [circle, draw] at (0,-2) (D) {D};

\path (A) edge [loop above] node {0.8}(A);
\path (B) edge [loop above] node {0.8}(B);
\path (C) edge [loop below] node {0.8}(C);
\path (D) edge [loop below] node {0.8}(D);

\draw[->](A) edge [bend left,above] node {0.8}(B);
\draw[->](B) edge [bend left,below] node {0.3}(A);

\draw[->] (B) -- (C);
\draw[->] (C) -- (D);
\draw[->] (D) -- (A);
```



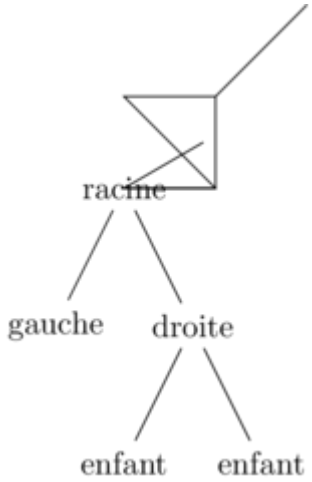

```
$$
\mathbf{J}
=
\frac{d \mathbf{f}}{d \mathbf{x}}
=
\left[ \frac{\partial \mathbf{f}}{\partial x_1}
\cdots \frac{\partial \mathbf{f}}{\partial x_n} \right]
```

```
=
\begin{bmatrix}
\frac{\partial f_1}{\partial x_1} & \cdots &
\frac{\partial f_1}{\partial x_n} \\
\vdots & \ddots & \vdots \\
\frac{\partial f_m}{\partial x_1} & \cdots &
\frac{\partial f_m}{\partial x_n}
\end{bmatrix}
$$

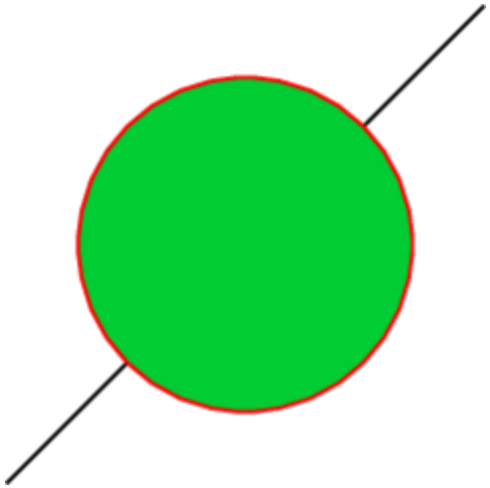
<table>
    <tr>
        <td>
\begin{eqnarray}
\nabla \times \vec{\mathbf{B}} -\, \frac1c\, \frac{\partial\vec{\mathbf{E}}}{\partial t} & = \frac{4\pi}
{c}\vec{\mathbf{j}} \\
\nabla \cdot \vec{\mathbf{E}} & = 4 \pi \rho \\
\end{eqnarray}
        </td>
        <td>
\begin{eqnarray}
\nabla \times \vec{\mathbf{E}}\, +\, \frac1c\, \frac{\partial\vec{\mathbf{B}}}{\partial t} & = \vec{\mathbf{0}}
\\
\nabla \cdot \vec{\mathbf{B}} & = 0
\end{eqnarray}
        </td>
    </tr>
</table>
```

In [10]:
```
%%tikz
\draw (0,0) --  +(1,0) --  +(0,1) --  +(1,1);<br>
\draw (0,0) -- ++(1,0) -- ++(0,1) -- ++(1,1);<br>
\draw (1,0) -- (0,0) -- (30:1);

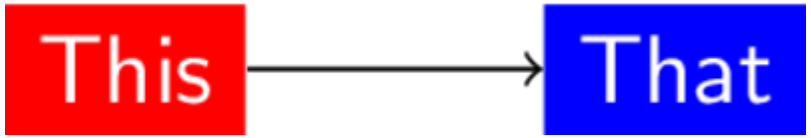
\node {racine}
child {node {gauche}}
child {node {droite}
child {node {enfant}}
child {node {enfant}}
};
```



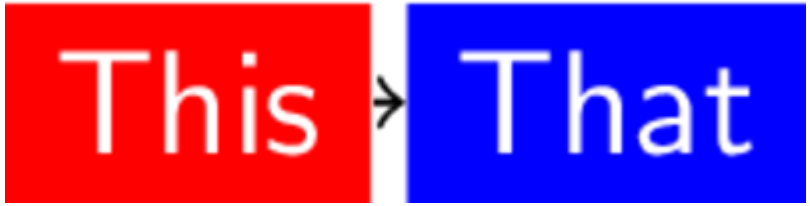
In [11]:
```
%%tikz
\draw (-1,-1) -- (1,1);
\path[fill=green!80!blue,draw=red] (0,0) circle (7mm);
```



In [12]:
```
%%tikz
\tikzset{every node/.style={font=\sffamily,white}}
\node[fill=red] at (0,0) (a) {This};
\node[fill=blue] at (2,0) (b) {That};
\draw[->] (a) -- (b);
```

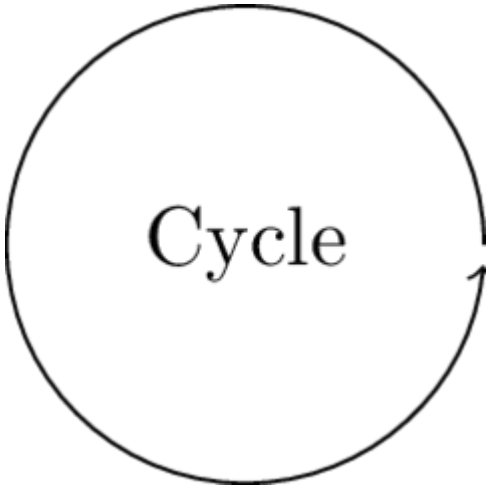


In [13]:
```
%%tikz --scale=0.5
\tikzset{every node/.style={font=\sffamily,white}}
\node[fill=red] at (0,0) (a) {This};
\node[fill=blue] at (2,0) (b) {That};
\draw[->] (a) -- (b);
```



In [14]:
```
%%tikz --scale=3
\tikzset{every node/.style={font=\sffamily,white}}
\node[fill=red] at (0,0) (a) {This};
\node[fill=blue] at (2,0) (b) {That};
\draw[->] (a) -- (b);
```

In [15]:
```
%%tikz
\draw[->] (1,0) arc(0:355:1);
\node {Cycle};
```



In [16]:
```
%%tikz
\draw (0,0) [fill=blue!10!white] ellipse (2cm and 1cm);
\node at (0,0) {\sffamily DSPIllustrations.com};
```


```
## collapsible markdown?

<details>
<summary>CLICK ME</summary>

<p>

#### yes, even hidden code blocks!

```python
print("hello world!")
```
</p>
</details>
```

collapsible markdown?

▶ CLICK ME

In [20]:

```
from IPython.display import display, Math, Latex

display(Math(r'F(k) = \int_{-\infty}^{\infty} f(x) e^{2\pi i k} dx'))
t = """
\\rho(x,y)\left[
\\begin{array}{cc|c}
1&2&3 \\\\
4&5&6 \\\\
\\end{array}
\\right]"""
display(Math(t))

t1 ="""
\\left[
\\begin{array}{c}
x_1 \\\\
x_2
\\end{array}
\\right]
=
\\begin{bmatrix}
A & B \\\\
C & D
\\end{bmatrix}
\\times
\\left[
\\begin{array}{c}
y_1 \\\\
y_2
\\end{array}
\\right]
"""
display(Math(t1))

t2="""
\\begin{bmatrix}
\\Phi_{11} & \\Phi_{12} \\\\
\\Phi_{21} & \\Phi_{22}
\\end{bmatrix}
=
\\frac{1}{\\det(X)}
\\begin{bmatrix}
```

```
X_{22} Y_{11} - X_{12} Y_{21} & X_{22} Y_{12} - X_{12} Y_{22} \\\\
X_{11} Y_{21} - X_{21} Y_{11} & X_{11} Y_{22} - X_{21} Y_{12}
\\end{bmatrix}
"""
display(Math(t2))

t3="""
\\begin{matrix} & \\begin{matrix}A&C&G&T\end{matrix} \\\\
\\begin{matrix}A\\\\C\\\\G\\\\T
\\end{matrix} & \\begin{pmatrix}
1&2&3&4\\\\
3&4&5&6\\\\
3&4&5&6\\\\
3&4&5&6
\\end{pmatrix}\\\\
\\end{matrix}"""
display(Math(t2),Math(t3))
hideMe="Yes" # hide this cell from show in Jupyter notebook
```

$$F(k) = \int_{-\infty}^{\infty} f(x) e^{2\pi i k} \, dx$$

$$\rho(x, y) \left[\begin{array}{cc|c} 1 & 2 & 3 \\ 4 & 5 & 6 \end{array}\right]$$

$$\begin{bmatrix} x_1 \\ x_2 \end{bmatrix} = \begin{bmatrix} A & B \\ C & D \end{bmatrix} \times \begin{bmatrix} y_1 \\ y_2 \end{bmatrix}$$

$$\begin{bmatrix} \Phi_{11} & \Phi_{12} \\ \Phi_{21} & \Phi_{22} \end{bmatrix} = \frac{1}{\det(X)} \begin{bmatrix} X_{22}Y_{11} - X_{12}Y_{21} & X_{22}Y_{12} - X_{12}Y_{22} \\ X_{11}Y_{21} - X_{21}Y_{11} & X_{11}Y_{22} - X_{21}Y_{12} \end{bmatrix}$$

$$\begin{bmatrix} \Phi_{11} & \Phi_{12} \\ \Phi_{21} & \Phi_{22} \end{bmatrix} = \frac{1}{\det(X)} \begin{bmatrix} X_{22}Y_{11} - X_{12}Y_{21} & X_{22}Y_{12} - X_{12}Y_{22} \\ X_{11}Y_{21} - X_{21}Y_{11} & X_{11}Y_{22} - X_{21}Y_{12} \end{bmatrix}$$

$$\begin{matrix} & \begin{matrix} A & C & G & T \end{matrix} \\ \begin{matrix} A \\ C \\ G \\ T \end{matrix} & \begin{pmatrix} 1 & 2 & 3 & 4 \\ 3 & 4 & 5 & 6 \\ 3 & 4 & 5 & 6 \\ 3 & 4 & 5 & 6 \end{pmatrix} \end{matrix}$$

In [1]:

```
hideMe="Yes" # hide this cell from show in Jupyter notebook
from IPython.display import display
from IPython.display import HTML
import IPython.core.display as di # Example: di.display_html('<h3>%s:</h3>' % str, raw=True)

# This line will hide code by default when the notebook is exported as HTML
#www='<script>jQuery(function() {if (jQuery("body.notebook_app").length == 0) { jQuery(".input_area").toggle();
www="""<script>
jQuery(function()
{if(jQuery("body.notebook_app").length == 0)
   {jQuery(".input_area").toggle();
    jQuery(".prompt").toggle();
   }
});
</script>"""
di.display_html(www, raw=True)

# This line will add a button to toggle visibility of code blocks, for use with the HTML export version
di.display_html('''<button onclick="jQuery('.input_area').toggle(); jQuery('.prompt').toggle();">Everything hide

"""
from IPython.display import HTML

HTML('''<script>
code_show=true;
function code_toggle() {
 if (code_show){
 $('div.input').hide();
 } else {
 $('div.input').show();
 }
 code_show = !code_show
}
$( document ).ready(code_toggle);
</script>
<form action="javascript:code_toggle()"><input type="submit" value="Click here to toggle on/off the raw code."><
"""

print("Markdown not work")
```

Everything hide

Markdown not work

```
$$
\begin{array}{c}
\begin{array}{ccccc}\phantom{-1}& H_1 &\phantom{-1}&\phantom{-1}& H_2\end{array} \\
\left[\begin{array}{rrrr|rr}
A &  0 &  0 &  0 & -1 & B \\
0 &  0 & -1 &  0 &  1 & 0 \\
\hline
0 &  0 &  0 & -1 &  1 & 0 \\
0 & -1 &  C &  D &  0 & 0
\end{array}\right] \\
\begin{array}{ccccc}\phantom{-1}& H_3 &\phantom{-1}&\phantom{-1}& H_4\end{array} \\
\end{array}
\begin{array}{cc}
\left[\begin{array}{l}
x_1 \\
x_{10} \\
x_5 \\
x_7 \\
\hline
x_9 \\
x_3
\end{array}\right] &
\!\!\!\!\!\begin{array}{c}\mathstrut \\ X_1 \\ \mathstrut \\ \mathstrut \\ X_2 \end{array}\!\!\!\!\!
\end{array}
=0$$

$$
\begin{matrix} %This is the super matrix
    %(1,1) cell: Empty
  &
    %(1,2) cell: Brace spanning columns
    \begin{matrix}   %One-row matrix to hold the brace
      \hphantom{a} & %Blank space to skip over first column
      \overbrace{
        \hphantom{\begin{matrix}b & c & d\end{matrix}}
      }^{\text{Final three columns}}
    \end{matrix}
  \\
    %(2,1) cell: Brace spanning rows
```

```
    \begin{matrix}    %One-column matrix to hold a brace
      \vphantom{a} \\ %Blank space to skip first row
      \text{Middle two rows}
        \left\{\vphantom{\begin{matrix} e \\ i \end{matrix}}\right. \\
      \vphantom{m}
    \end{matrix}
    %The inter-column spacing of the super matrix looks too big by default
    \mspace{-33mu}
  &
    %(2,2) cell: Actual matrix
    \begin{pmatrix}
      a & b & c & d \\
      e & f & g & h \\
      i & j & k & l \\
      m & n & o & p
    \end{pmatrix}
\end{matrix}
$$
```

$$
\begin{matrix}
 & & H_1 & & & H_2 & \\
\left[\begin{array}{cccc|cc}
A & 0 & 0 & 0 & -1 & B \\
0 & 0 & -1 & 0 & 1 & 0 \\
\hline
0 & 0 & 0 & -1 & 1 & 0 \\
0 & -1 & C & D & 0 & 0
\end{array}\right] & & & & & & \left[\begin{array}{c} x_1 \\ x_{10} \\ x_5 \\ x_7 \\ \hline x_9 \\ x_3 \end{array}\right] \begin{matrix} X_1 \\ \\ \\ \\ \\ X_2 \end{matrix} = 0 \\
 & & H_3 & & & H_4 &
\end{matrix}
$$

$$
\begin{matrix}
 & & & & & \overbrace{}^{\text{Final three columns}} \\
\text{Middle two rows} & \left\{\begin{matrix} \\ \\ \end{matrix}\right. & \left(\begin{matrix} a & b & c & d \\ e & f & g & h \\ i & j & k & l \\ m & n & o & p \end{matrix}\right) &
\end{matrix}
$$