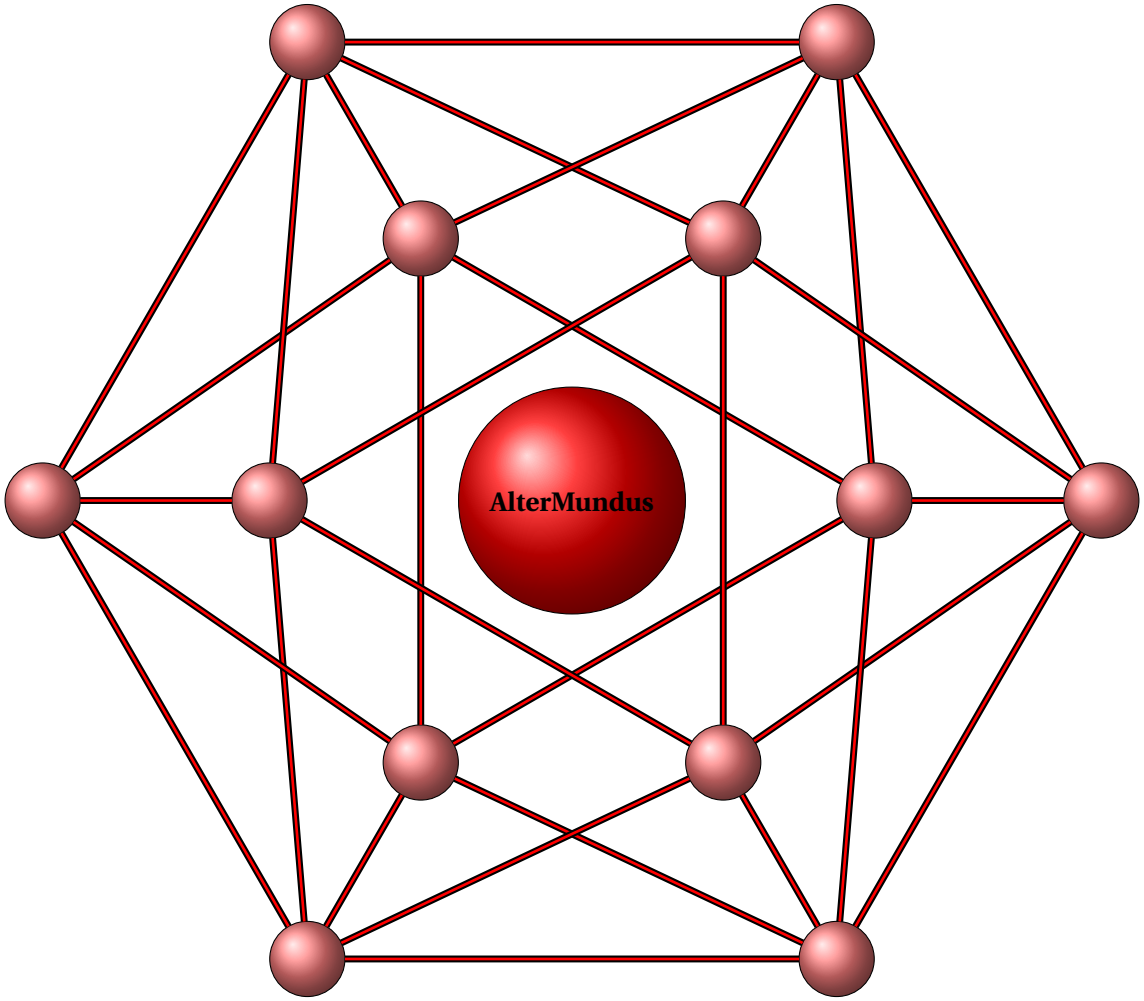
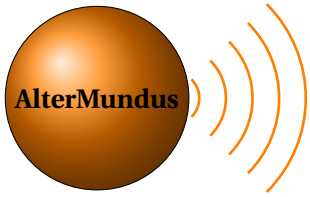
tkz-berge.sty

by Alain Matthes





Alain Matthes

tkz-berge.sty v2.7c

AlterMundus

The package tkz-berge.sty is a collection of some useful macros if you want to draw some classic graphs of the graph theory or to make others graphs. The kind of graphs that I will present, are sometimes called combinatorial graphs to distinguish them from the graphs of functions. Often, the word graph is short for graph of a function. A combinatorial graph is a very simple structure, a bunch of dots, some of which are connected by lines. Some of graphs have names, sometimes inspired by the graph's topology, and sometimes after their discoverer.
Why tkz-berge.sty ?
Claude Berge (1926 – 2002) was a French mathematician, recognized as one of the modern founders of combinatorics and graph theory. He played a major role in the renaissance of combinatorics and he is remembered for his famous conjecture on perfect graphs, solved some months after his death.
[doc-tkz-berge v 2.00 25/05/2008]

- Firstly, I would like to thank **Till Tantau** for the beautiful LATEX package, namely TikZ.
- I am grateful to **Michel Bovani** for providing the `fourier` font.
- I received much valuable advice and guidance on Graph Theory from **Rafael Villarroel** `http://graphtheoryinlatex.blogspot.com/`.
- The names of graphs can be found here MathWorld by E.Weisstein

Contents

List of macros :

- \grEmptyCycle
- \grEmptyPath
- \grEmptyStar
- \grEmptyGrid
- \grEmptyLadder
- \EdgeInGraphFromOneToComp
- \EdgeInGraphLoop
- \EdgeInGraphSeq
- \EdgeInGraphMod
- \EdgeInGraphMod*
- \grCompleteBipartite
- \EdgeInGraphModLoop
- \EdgeIdentity
- \EdgeIdentity*
- \EdgeFromOneToAll
- \EdgeFromOneToSeq
- \EdgeFromOneToSel
- \EdgeFromOneToComp
- \EdgeMod
- \EdgeMod*
- \EdgeDoubleMod
- \grPath
- \grCycle
- \grComplete
- \grCirculant
- \grStar
- \grSQCycle
- \grWheel
- \grLadder
- \grPrism
- \grCompleteBipartite
- \grTriangularGrid
- \grLCF
- \grHeawood
- \grGeneralizedPetersen
- \grPetersen
- \grTetrahedral
- \grOctahedral
- \grCubicalGraph
- \grIcosahedral
- \grDodecahedral
- \grMobiusKantor
- \grMobiusLadder
- \grCocktailParty
- \grCrown
- \grMcGee
- \grRobertson
- \grRobertsonWegner
- \grDoyle
- \grDesargues
- \grKonisberg

- \grWong
- \grTutteCoxeter
- \grFoster
- \grFolkman
- \grFranklin
- \grAndrasfai
- \grGrotzsch
- \grLevi
- \grPappus
- \grChvatal
- \grBalaban
- \grWriteExplicitLabels
- \grWriteExplicitLabel
- \AssignVertexLabel

See the document "NamedGraph" for all the classic named graphs that you can draw with the package tkz-berge.sty.

I . Installation

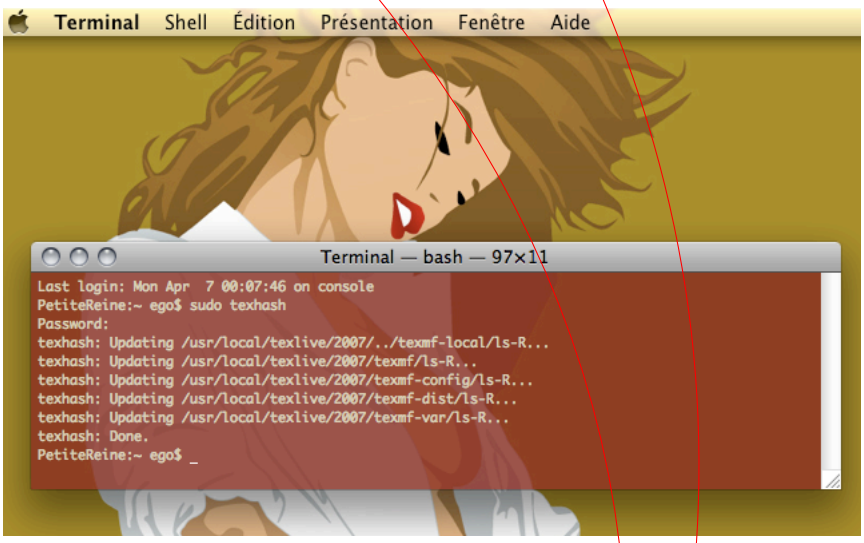
You could simply create a folder (directory) prof which path is : texmf/tex/latex/prof . texmf is generally the personnal folder, here ways of this folder on my two computers :

- sous OS X : `/Users/ego/Library/texmf` ;
- sous Ubuntu : `/home/ego/texmf` .

If you choose a custom location for your files, I suppose that you know why! The installation that I propose, is valid only for one user.

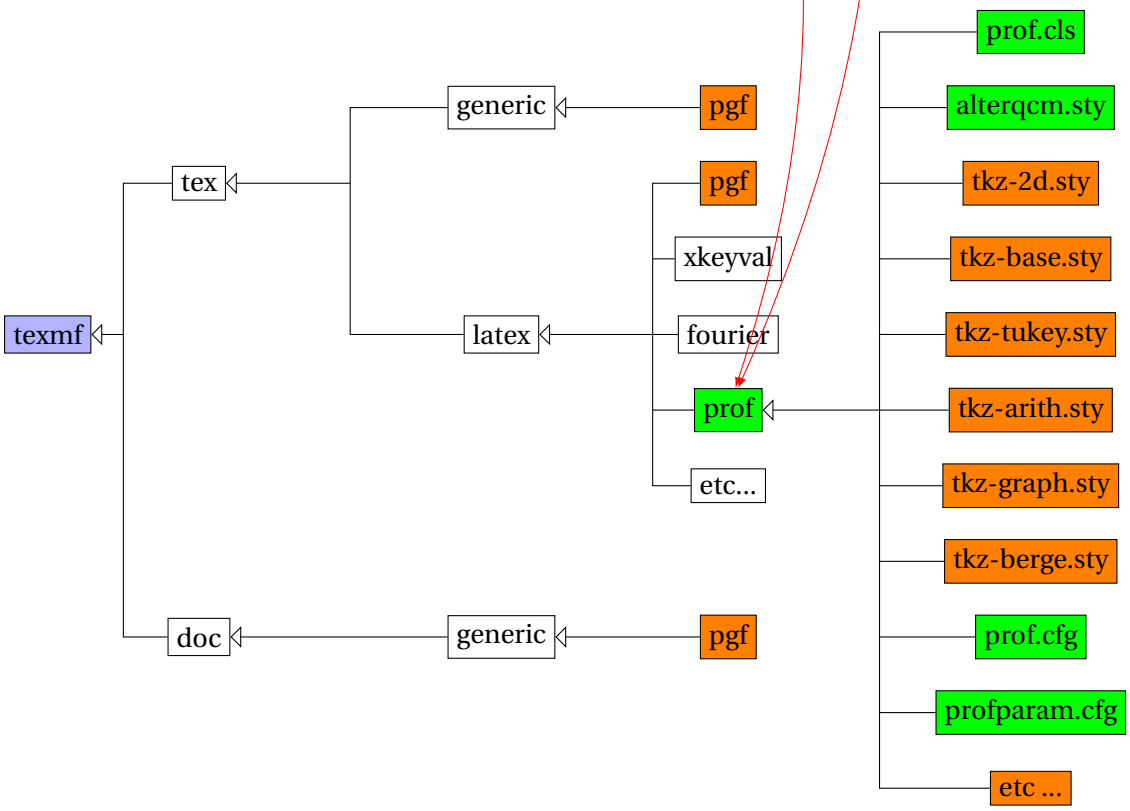
1/ Store the files tkz-arith.sty, tkz-graph.sty et tkz-berge.sty in the folder prof .

2/ Open a terminal, then type `sudo texhash`



3/ Check that `xkeyval >= 2.5, ifthen, et tikz 2.0` are installed because they are obligatory.

My folder texmf is structured as in the diagram below :



II . Macros and Vertices

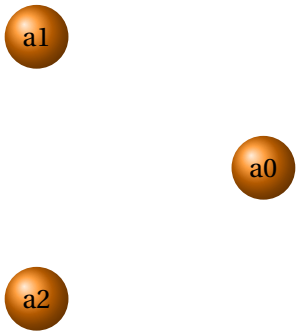
macro n° 1 Empty Cycle \grEmptyCycle

\grEmptyCycle[⟨*options*⟩]{⟨*order*⟩}

options	default	definition
RA	4	radius circle
prefix	a	prefix for vertices
Math	false	math mode

The number of nodes in a graph is called its order. The argument "order" is an integer superior to 1. RA *defines the radius of the circle.*

Example n° 1 Empty Cycle

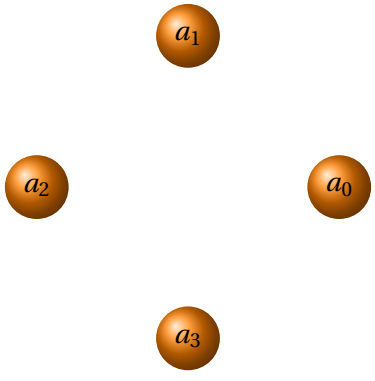



```
\begin{tikzpicture}
\GraphInit[vstyle=Shade]
\grEmptyCycle[RA=2]{3}
\end{tikzpicture}
```

Example n° 2 Empty Cycle and \SetVertexNoLabel

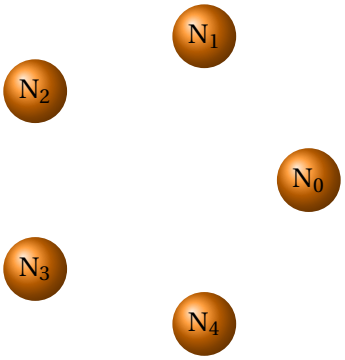
```
\begin{tikzpicture}
\SetVertexNoLabel
\GraphInit[vstyle=Shade]
\grEmptyCycle[RA=2]{2}
\end{tikzpicture}
```

Example n° 3 Empty Cycle and Math



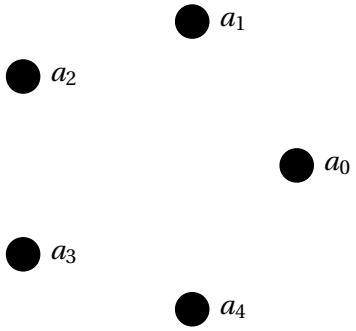
```
\begin{tikzpicture}
\GraphInit[vstyle=Shade]
\grEmptyCycle[Math,RA=2]{4}
\end{tikzpicture}
```

Example n° 4 Empty Cycle, `\SetVertexMath` and `prefix`



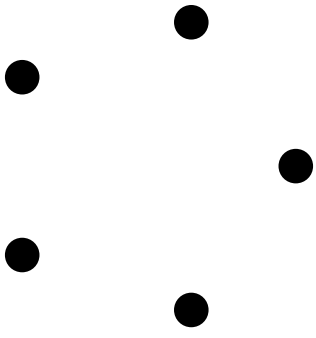

```
\begin{tikzpicture}
\SetVertexMath
\GraphInit[vstyle=Shade]
\grEmptyCycle[prefix=N,RA=2]{5}
\end{tikzpicture}
```

Example n° 5 Empty Cycle and Classic style




```
\begin{tikzpicture}
\SetVertexMath
\GraphInit[vstyle=Classic]
\grEmptyCycle[RA=2]{5}
\end{tikzpicture}
```

Example n° 6 Empty Cycle and Simple style



```
24  \begin{tikzpicture}
25  \GraphInit[vstyle=Simple]
26  \grEmptyCycle[RA=2]{5}
27  \end{tikzpicture}
```

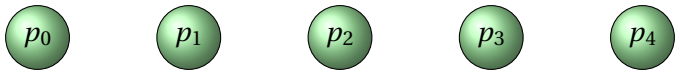
macro n° 2 Empty Path \grEmptyPath

\grEmptyPath[⟨options⟩]{⟨order⟩}

options	default	definition
RA	4	distance between two vertices
RS	0	distance between the first line and the new one
form	1	1 horizontal path ; 2 vertical path
prefix	a	prefix for vertices
Math	false	math mode

For the options, see above. Order is the number of nodes. RA *defines the radius of the circle.*

Example n° 7 Empty Path

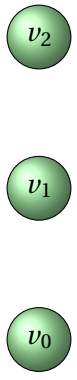



```
\begin{tikzpicture}
   \grEmptyPath[Math,prefix=p,RA=2]{5}
\end{tikzpicture}
```

Example n° 8 Empty Path

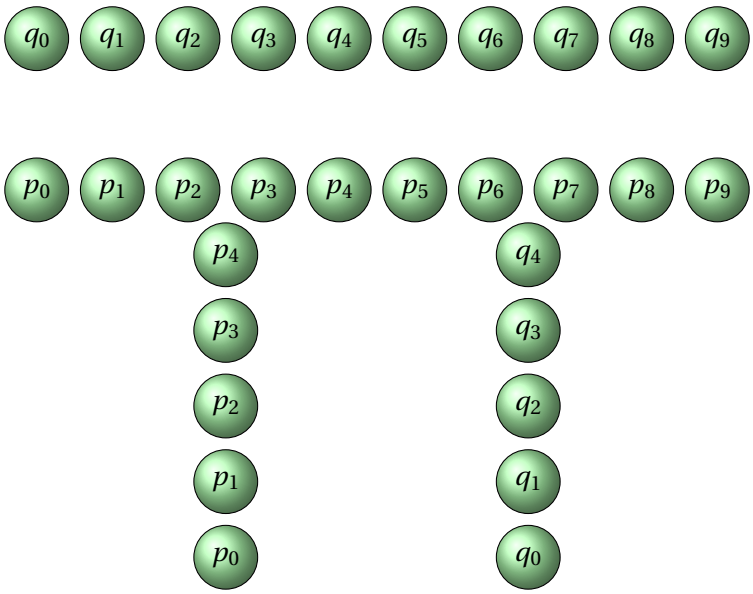

```
\begin{tikzpicture}
   \grEmptyPath[prefix=h,RA=2]{6}
\end{tikzpicture}
```

Example n° 9 Empty Path

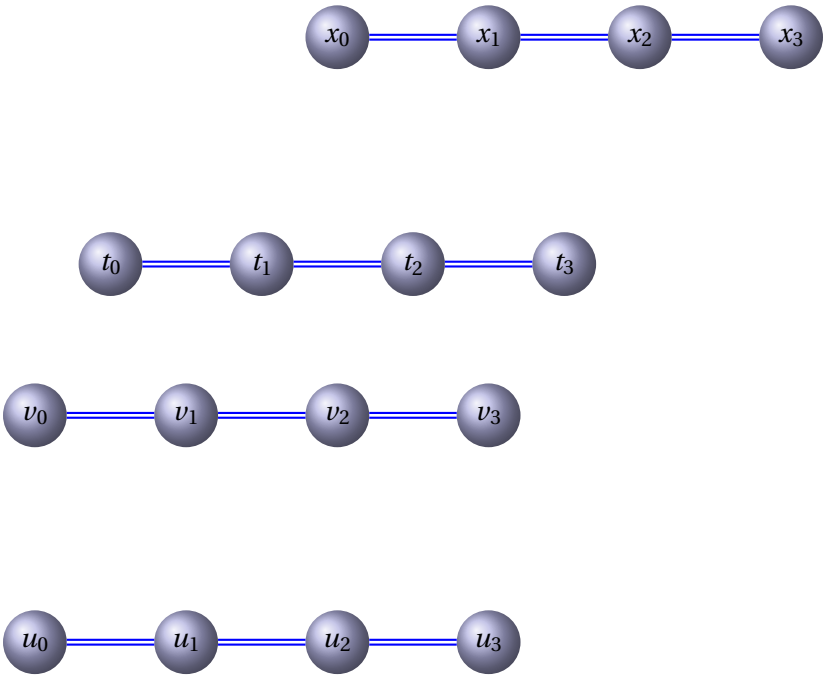



```
  \begin{tikzpicture}
   \grEmptyPath[form=2,prefix=v,RA=2]{3}
  \end{tikzpicture}
```

Example n° 10 Two Empty Paths


q_0 q_1 q_2 q_3 q_4 q_5 q_6 q_7 q_8 q_9
p_0 p_1 p_2 p_3 p_4 p_5 p_6 p_7 p_8 p_9
p_4 p_3 p_2 p_1 p_0
q_4 q_3 q_2 q_1 q_0

Example n° 11 How to move a graph ?




```
37    \begin{tikzpicture}
38        \grPath[Math,prefix=u,RA=2,RS=0]{4}
39        \grPath[Math,prefix=v,RA=2,RS=3]{4}
40        \begin{scope}[xshift=1 cm]
41         \grPath[Math,prefix=t,RA=2,RS=5]{4}
42        \end{scope}
43        \begin{scope}[shift={(4 cm,8cm)}]
44         \grPath[Math,prefix=x,RA=2,RS=0]{4}
45        \end{scope}
46      \end{tikzpicture}
47
```

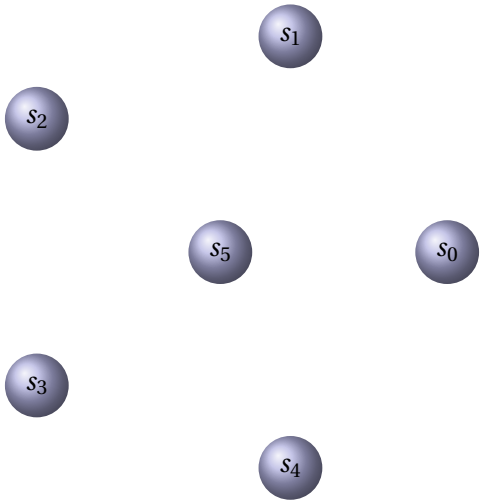
macro n° 3 Empty Star \grEmptyStar

\grEmptyStar[⟨*options*⟩]{⟨*order*⟩}

options	default	definition
RA	4	radius circle
prefix	a	prefix for vertices
Math	false	math mode

For the options, see the first macro. Order is the number of nodes. RA *defines the radius of the circle.*

Example n° 12 Empty Star



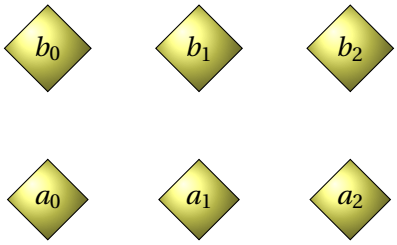

```
\begin{tikzpicture}
  \SetVertexMath
  \grEmptyStar[prefix=s,RA=3]{6}
\end{tikzpicture}
```

macro n° 4 Empty Grid \grEmptyGrid

\grEmptyGrid[⟨*options*⟩]{⟨*c*⟩}{⟨*l*⟩}

options	default	definition
RA	4	radius circle n°1
RB	3	radius circle n°2
prefix	a	prefix for vertices
Math	false	math mode

For the options, see the first macro. Order is the number of nodes. c *and* l *are integers.*




```
52 \begin{tikzpicture}
53    \tikzstyle{VertexStyle}=[shape          = diamond,
54                             shading        = ball,
55                             ball color     = yellow!60,%
56                             minimum size = 24pt,%
57                             draw]
58    \SetVertexMath
59    \grEmptyLadder[RA=2,RS=2]{3}{5}
60 \end{tikzpicture}
```

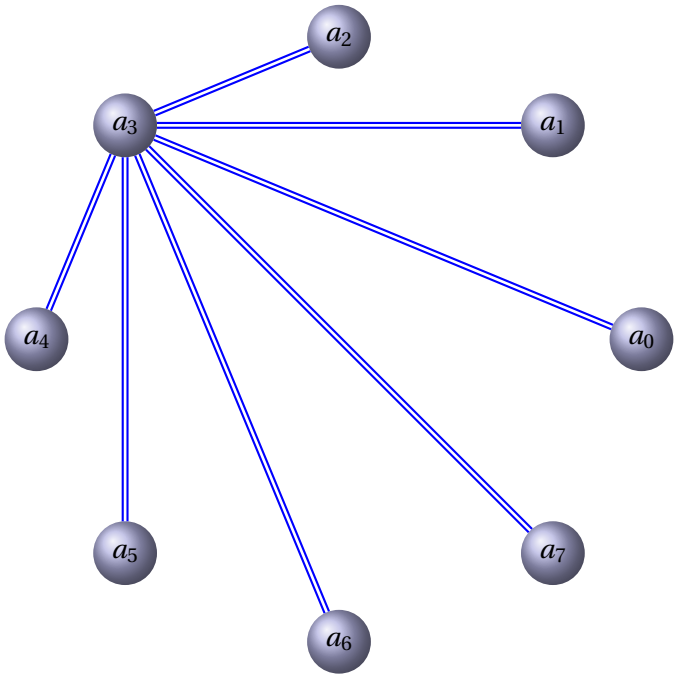
III . Macros and Edges in a graph

macro n° 5 Edge in a graph from one vertex \EdgeInGraphFromOneToComp

\EdgeInGraphFromOneToComp{⟨*prefix*⟩}{⟨*order*⟩}{⟨*from*⟩}

This macro is useful with vertices on a circle . `from` *and* `order` *are integers.*

Example n° 13 Empty Cycle



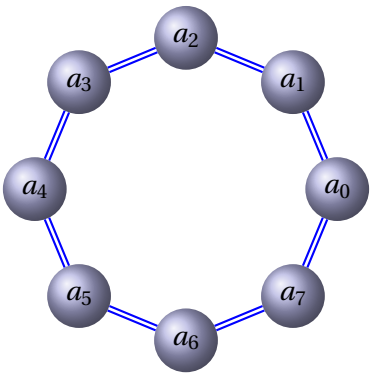

```
61  \begin{tikzpicture}
62  \GraphInit[vstyle=Shade]
63  \grEmptyCycle[RA=4,prefix=a]{8}%
64  \EdgeInGraphFromOneToComp{a}{8}{3}
65  \end{tikzpicture}
```

macro n° 6 Edges in a graph from one vertex \EdgeInGraphLoop

\EdgeInGraphLoop{⟨*prefix*⟩}{⟨*order*⟩}

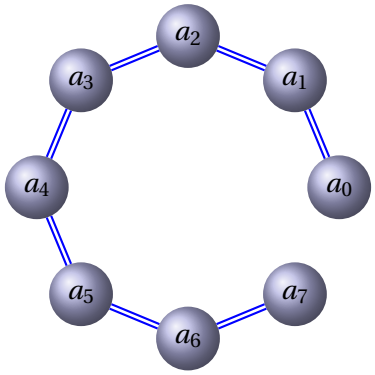
This macro is useful with vertices on a circle . `from` *and* `order` *are integers.*

Example n° 14 Empty Cycle



```
\begin{tikzpicture}
\GraphInit[vstyle=Shade]
\grEmptyCycle[RA=2,prefix=a]{8}%
\EdgeInGraphLoop{a}{8}
\end{tikzpicture}
```

Example n° 15 Empty Cycle




```
\begin{tikzpicture}
\GraphInit[vstyle=Shade]
\grEmptyCycle[RA=2,prefix=a]{8}%
\EdgeInGraphLoop*{a}{8}
\end{tikzpicture}
```

Example n° 16 Empty Path

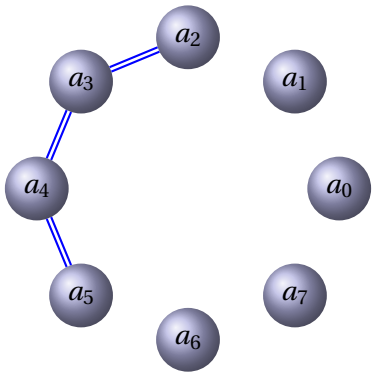

```
\begin{tikzpicture}
   \grEmptyPath[prefix=h,RA=2,RS=2]{6}
   \EdgeInGraphLoop*{h}{6}
\end{tikzpicture}
```

macro n° 7 Edges in a graph from one vertex \EdgeInGraphSeq

\EdgeInGraphSeq{⟨*prefix*⟩}{⟨*order*⟩}

This macro is useful with vertices on a circle . `from` *and* `order` *are integers.*

Example n° 17 EdgeInGraphSeq



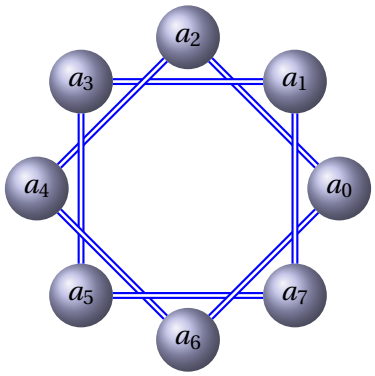

```
\begin{tikzpicture}
\GraphInit[vstyle=Shade]
\grEmptyCycle[RA=2,prefix=a]{8}%
\EdgeInGraphSeq{a}{2}{5}
\end{tikzpicture}
```

macro n° 8 Edges in a graph from one vertex \EdgeInGraphMod

\EdgeInGraphMod{⟨*prefix*⟩}{⟨*order*⟩}{⟨*add*⟩}

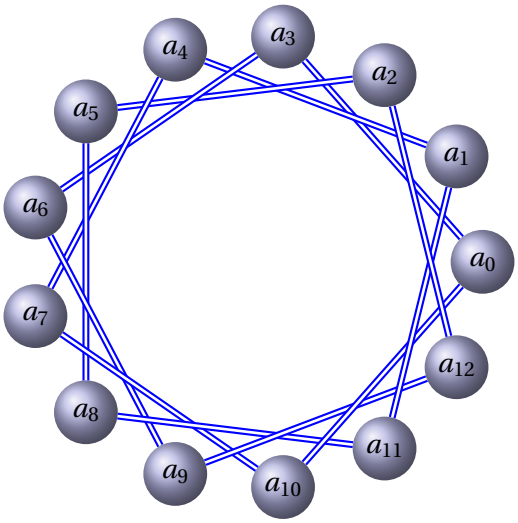
This macro is useful with vertices on a circle . `from` *and* `order` *are integers.*

Example n° 18 EdgeInGraphMod




```
\begin{tikzpicture}
\GraphInit[vstyle=Shade]
\grEmptyCycle[RA=2,prefix=a]{8}%
\EdgeInGraphMod{a}{8}{2}
\end{tikzpicture}
```

Example n° 19 EdgeInGraphMod 2



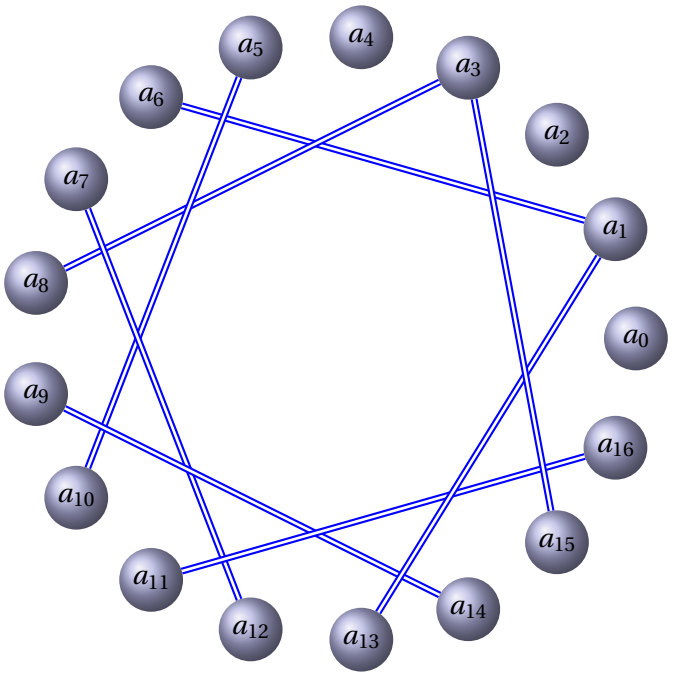

```
\begin{tikzpicture}
\GraphInit[vstyle=Shade]
\grEmptyCycle[RA=3,prefix=a]{13}%
\EdgeInGraphMod{a}{13}{3}
\end{tikzpicture}
```

macro n° 9 Edges in a graph from one vertex \EdgeInGraphMod*

\EdgeInGraphMod*{⟨*prefix*⟩}{⟨*order*⟩}{⟨*add*⟩}{⟨*start*⟩}{⟨*step*⟩}

This macro is useful with vertices on a circle . `from` *and* `order` *are integers.*

Example n° 20 EdgeInGraphMod*



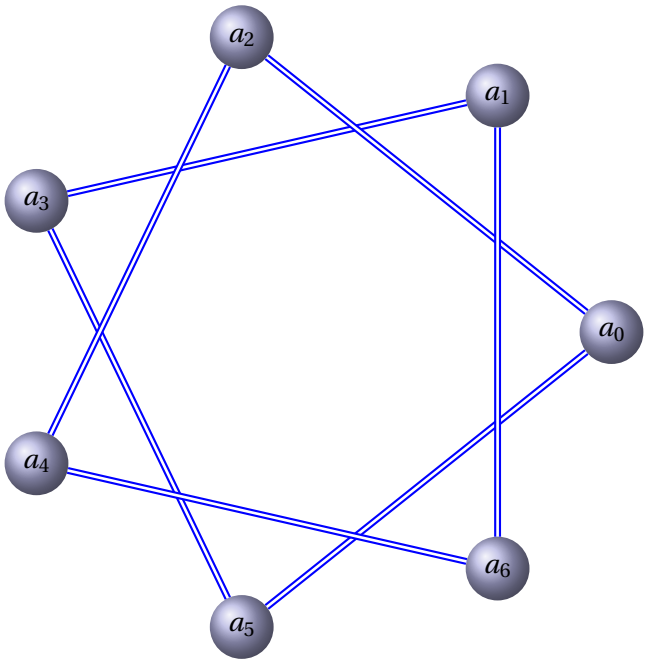

```
95  \begin{tikzpicture}
96  \GraphInit[vstyle=Shade]
97  \grEmptyCycle[prefix=a]{17}%
98  \EdgeInGraphMod*{a}{17}{5}{1}{2}
99  \end{tikzpicture}
```

macro n° 10 Edges in a graph from one vertex \EdgeInGraphModLoop

\EdgeInGraphModLoop{⟨*prefix*⟩}{⟨*order*⟩}{⟨*add*⟩}{⟨*start*⟩}

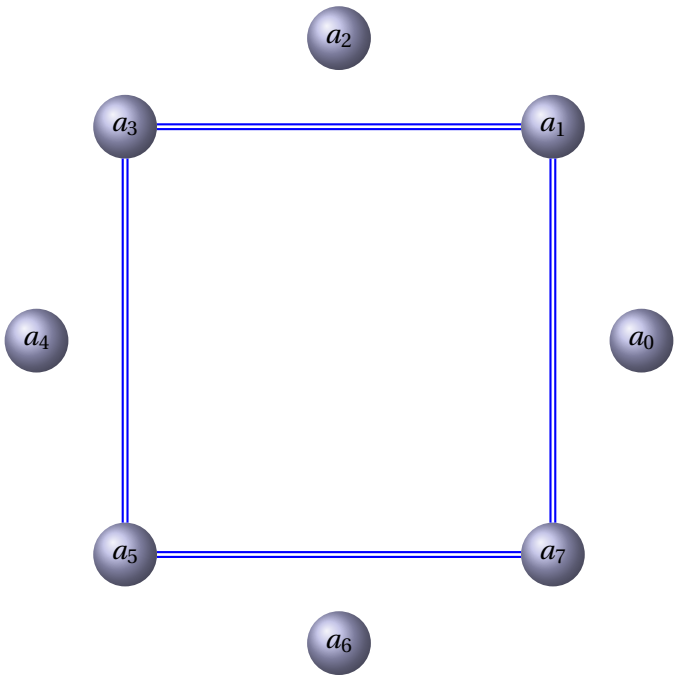
This macro is useful with vertices on a circle . `from` *and* `order` *are integers.*

Example n° 21 EdgeInGraphModLoop




```
\begin{tikzpicture}
\GraphInit[vstyle=Shade]
\grEmptyCycle[RA=4]{7}
\EdgeInGraphModLoop{a}{7}{2}{1}
\end{tikzpicture}
```

Example n° 22 EdgeInGraphModLoop



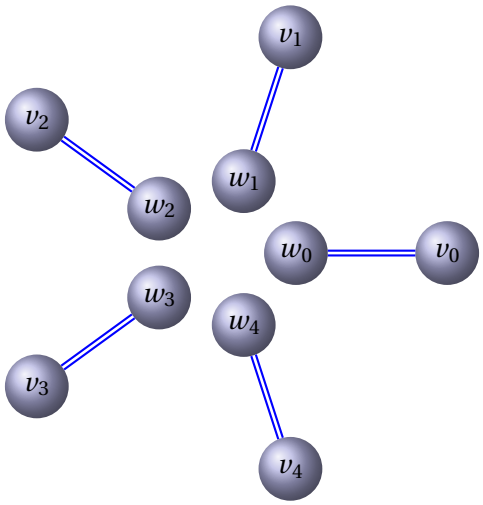

```
105  \begin{tikzpicture}
106  \GraphInit[vstyle=Shade]
107  \grEmptyCycle[RA=4]{8}
108  \EdgeInGraphModLoop{a}{8}{2}{1}
109  \end{tikzpicture}
```

macro n° 11 Edges in a graph from one vertex \EdgeIdentity

\EdgeIdentity{⟨*prefix1*⟩}{⟨*prefix2*⟩}{⟨*order*⟩}

This macro is useful with vertices on a circle . `from` *and* `order` *are integers.*

Example n° 23 EdgeIdentity



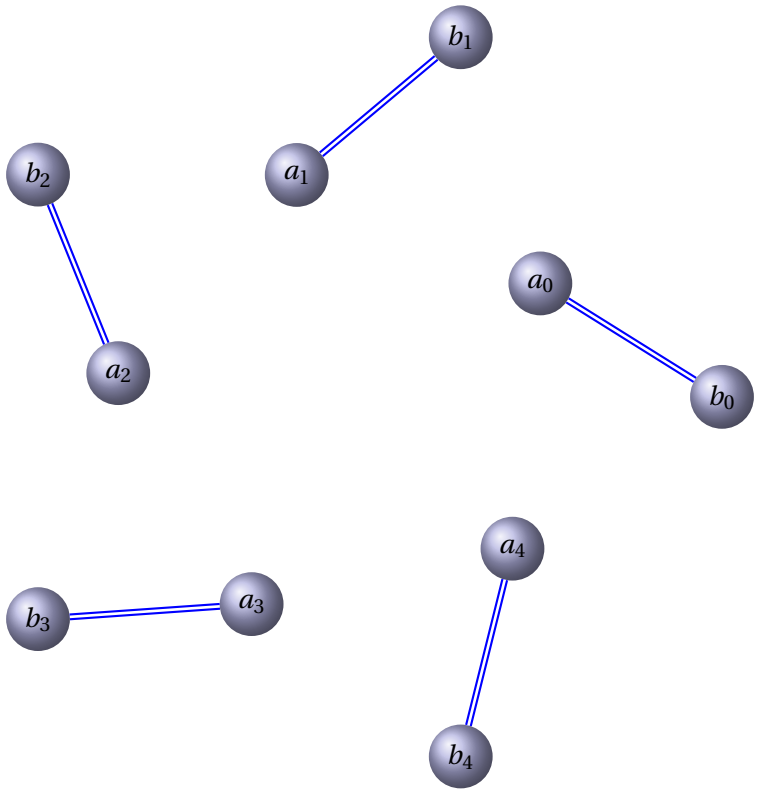

```
\begin{tikzpicture}
\GraphInit[vstyle=Shade]
  \grEmptyCycle[prefix=v,RA=3]{5}
  \grEmptyCycle[prefix=w,RA=1]{5}
  \EdgeIdentity{v}{w}{5}
\end{tikzpicture}
```

macro n° 12 Edges in a graph from one vertex \EdgeIdentity*

\EdgeIdentity*{⟨*prefix1*⟩}{⟨*prefix2*⟩}{⟨*list*⟩}

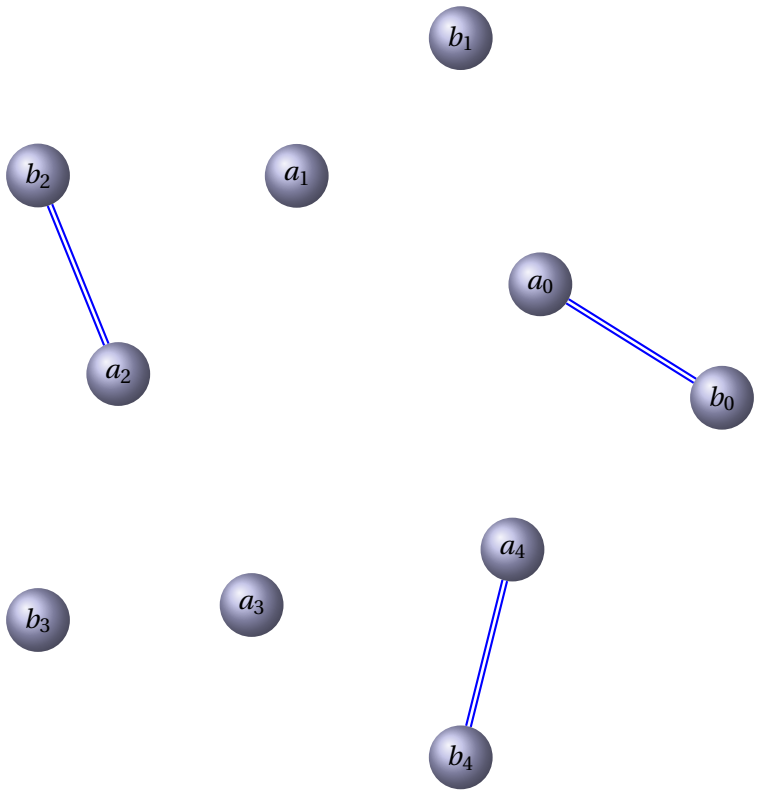
This macro is useful with vertices on a circle . `from` *and* `order` *are integers.*

Example n° 24 EdgeIdentity*




```
\begin{tikzpicture}
   \GraphInit[vstyle=Shade]
  \begin{scope}[rotate=30]
  \grEmptyCycle[RA=3,prefix=a]{5}%
  \end{scope}
  \grEmptyCycle[RA=5,prefix=b]{5}%
   \EdgeIdentity*{a}{b}{0,...,4}
\end{tikzpicture}
```

Example n° 25 EdgeIdentity*



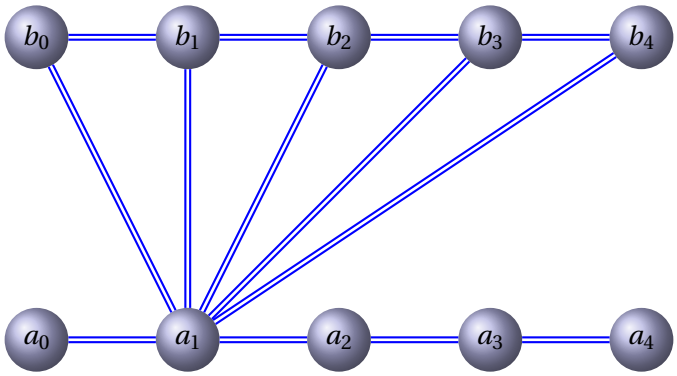

```
\begin{tikzpicture}
 \GraphInit[vstyle=Shade]
  \begin{scope}[rotate=30]
  \grEmptyCycle[RA=3,prefix=a]{5}%
  \end{scope}
  \grEmptyCycle[RA=5,prefix=b]{5}%
   \EdgeIdentity*{a}{b}{0,2,4}
\end{tikzpicture}
```

macro n° 13 Edges in a graph from one vertex `\EdgeFromOneToAll`

`\EdgeFromOneToAll{⟨prefix1⟩}{⟨prefix2⟩}{⟨list⟩}`

This macro is useful with vertices on a circle . `from` *and* `order` *are integers.*

Example n° 26 EdgeFromOneToAll



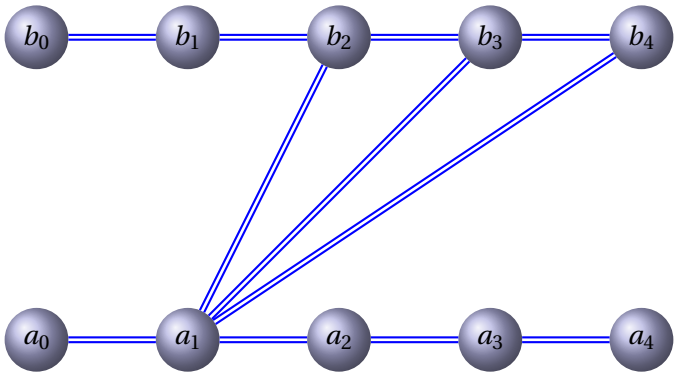

```
\begin{tikzpicture}
\GraphInit[vstyle=Shade]
  \grPath[form=1,RA=2,RS=0]{5}
  \grPath[form=1,prefix=b,RA=2,RS=4]{5}
  \EdgeFromOneToAll{a}{b}{1}{5}
\end{tikzpicture}
```

macro n° 14 Edges in a graph from one vertex \EdgeFromOneToSeq

\EdgeFromOneToSeq{⟨*prefix1*⟩}{⟨*prefix2*⟩}{⟨*list*⟩}

This macro is useful with vertices on a circle . `from` *and* `order` *are integers.*

Example n° 27 EdgeFromOneToSeq



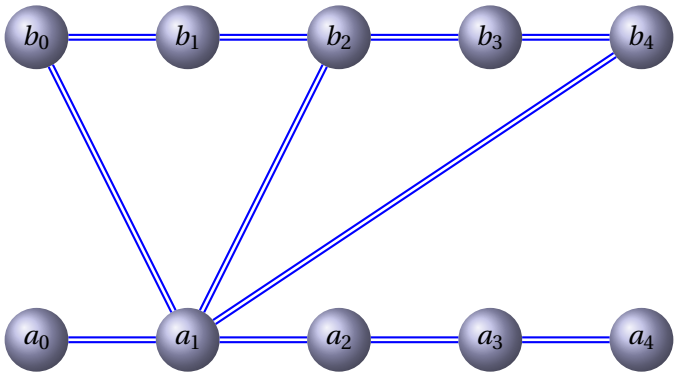

```
\begin{tikzpicture}
  \GraphInit[vstyle=Shade]
  \grPath[form=1,RA=2,RS=0]{5}
  \grPath[form=1,prefix=b,RA=2,RS=4]{5}
  \EdgeFromOneToSeq{a}{b}{1}{2}{4}
\end{tikzpicture}
```

macro n° 15 Edges in a graph from one vertex \EdgeFromOneToSel

\EdgeFromOneToSel{⟨*prefix1*⟩}{⟨*prefix2*⟩}{⟨*list*⟩}

This macro is useful with vertices on a circle . `from` *and* `order` *are integers.*

Example n° 28 EdgeFromOneToSel



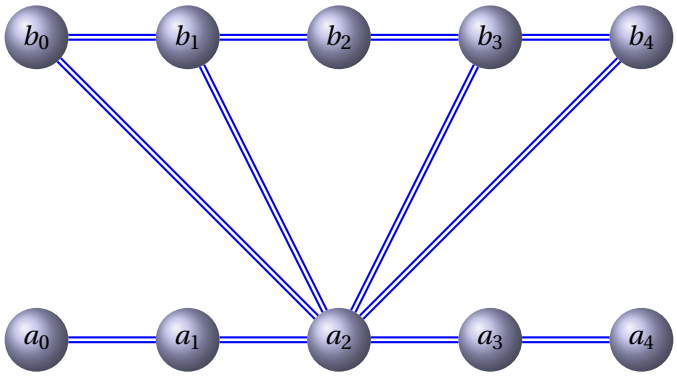

```
\begin{tikzpicture}
  \GraphInit[vstyle=Shade]
  \grPath[form=1,RA=2]{5}
  \grPath[form=1,prefix=b,RA=2,RS=4]{5}
  \EdgeFromOneToSel{a}{b}{1}{0,2,4}
\end{tikzpicture}
```

macro n° 16 Edges in a graph from one vertex \EdgeFromOneToComp

\EdgeFromOneToComp{⟨*prefix1*⟩}{⟨*prefix2*⟩}{⟨*list*⟩}

This macro is useful with vertices on a circle . `from` *and* `order` *are integers.*

Example n° 29 EdgeFromOneToComp



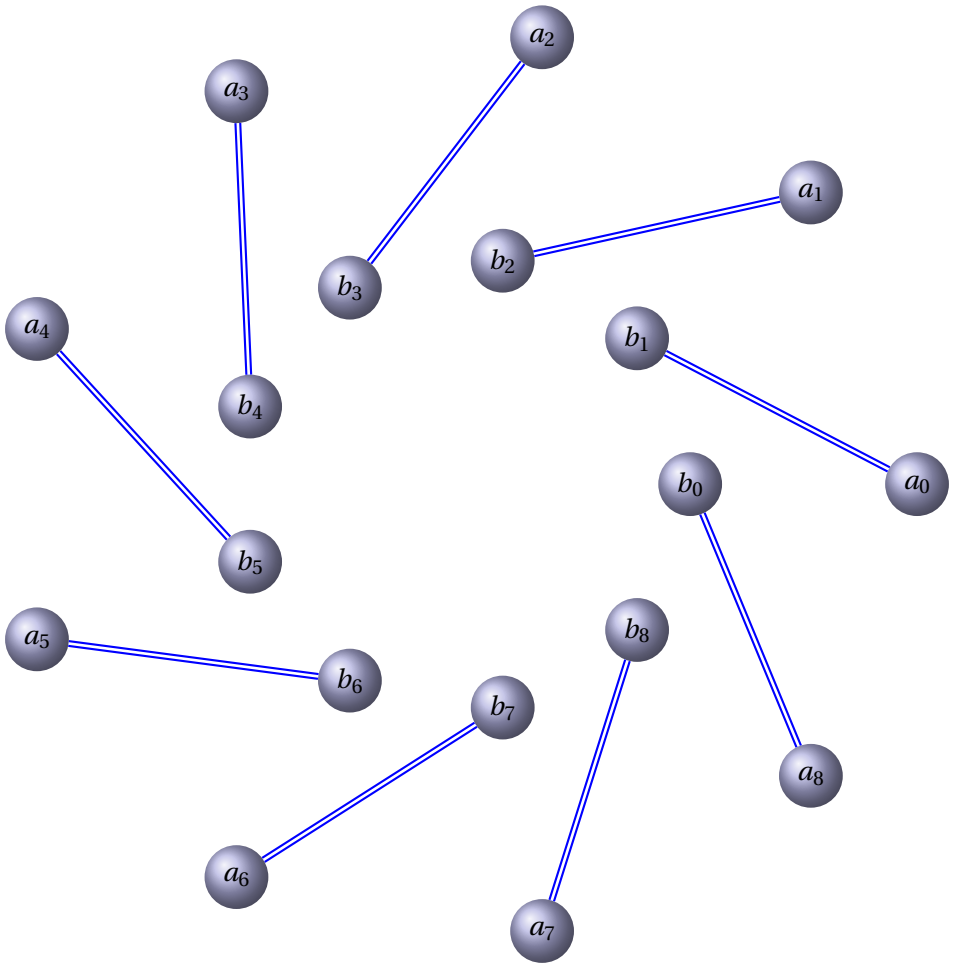

```
150   \begin{tikzpicture}
151       \GraphInit[vstyle=Shade]
152     \grPath[form=1,RA=2,RS=0]{5}
153     \grPath[form=1,prefix=b,RA=2,RS=4]{5}
154     \EdgeFromOneToComp{a}{b}{2}{5}
155   \end{tikzpicture}
```

macro n° 17 Edges in a graph from one vertex \EdgeMod

\EdgeMod{⟨*prefix1*⟩}{⟨*prefix2*⟩}{⟨*list*⟩}

This macro is useful with vertices on a circle . `from` *and* `order` *are integers.*

Example n° 30 EdgeMod



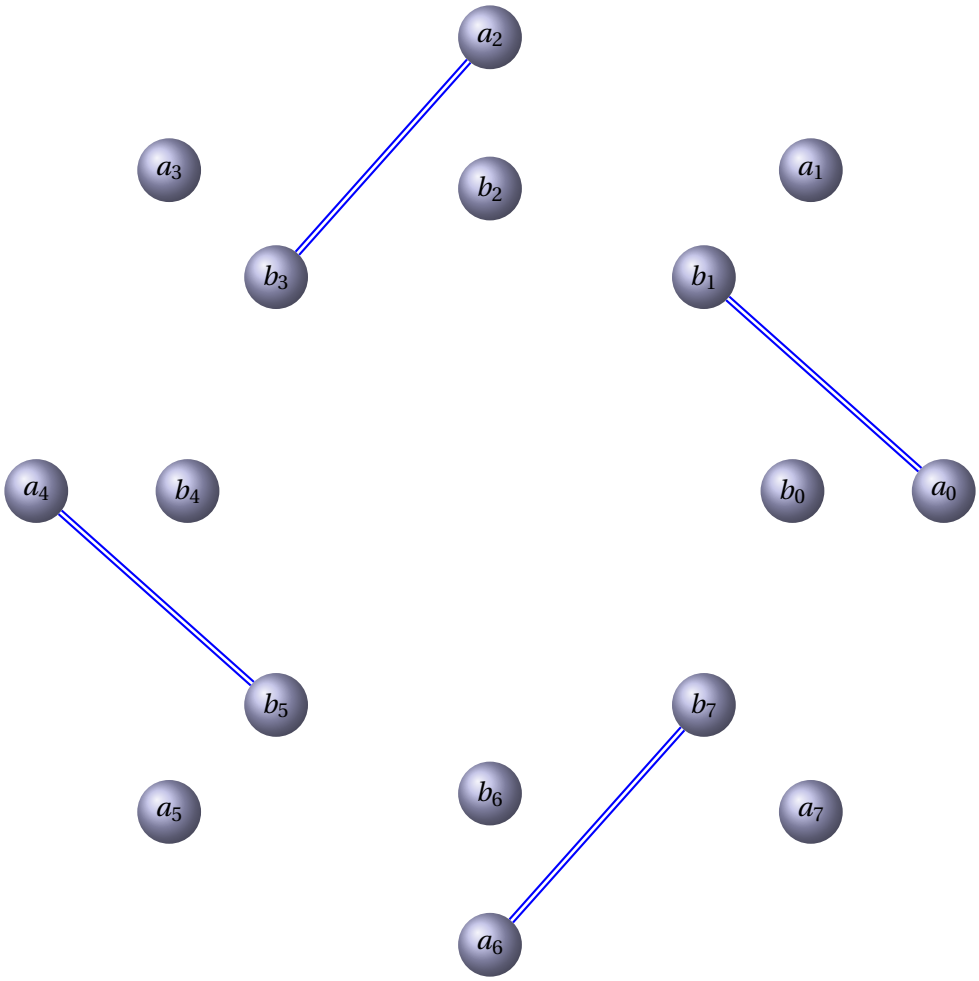

```
156   \begin{tikzpicture}
157       \GraphInit[vstyle=Shade]
158 \grEmptyCycle[prefix=a,RA=6]{9}
159 \grEmptyCycle[prefix=b,RA=3]{9}
160 \EdgeMod{a}{b}{9}{1}
161   \end{tikzpicture}
```

macro n° 18 Edges in a graph from one vertex \EdgeMod*

\EdgeMod*{⟨*prefix1*⟩}{⟨*prefix2*⟩}{⟨*list*⟩}

This macro is useful with vertices on a circle . `from` *and* `order` *are integers.*

Example n° 31 EdgeMod*



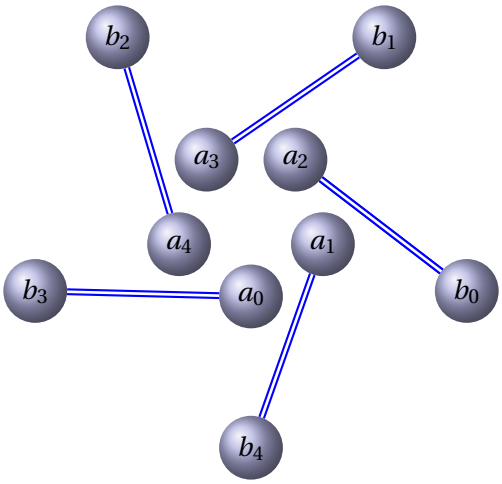

```
162   \begin{tikzpicture}
163       \GraphInit[vstyle=Shade]
164 \grEmptyCycle[prefix=a,RA=6]{8}
165 \grEmptyCycle[prefix=b,RA=4]{8}
166 \EdgeMod*{a}{b}{8}{1}{2}
167   \end{tikzpicture}
```

macro n° 19 Edges in a graph from one vertex \EdgeDoubleMod

\EdgeDoubleMod{⟨*prefix1*⟩}{⟨*prefix2*⟩}{⟨*list*⟩}

This macro is useful with vertices on a circle . `from` *and* `order` *are integers.*

Example n° 32 EdgeDoubleMod




```
168  \begin{tikzpicture}
169      \GraphInit[vstyle=Shade]
170   \begin{scope}[rotate=-90]
171     \grEmptyCycle[RA=1,prefix=a]{5}{2}
172   \end{scope}
173   \begin{scope}[rotate=-18]
174     \grEmptyCycle[RA=3,prefix=b]{5}{2}
175   \end{scope}
176   \EdgeDoubleMod{b}{5}{0}{1}%
177                 {a}{5}{2}{1}{5}
178  \end{tikzpicture}
```

IV . Classic Graphs

macro n° 20 \grCycle Cycle Graph

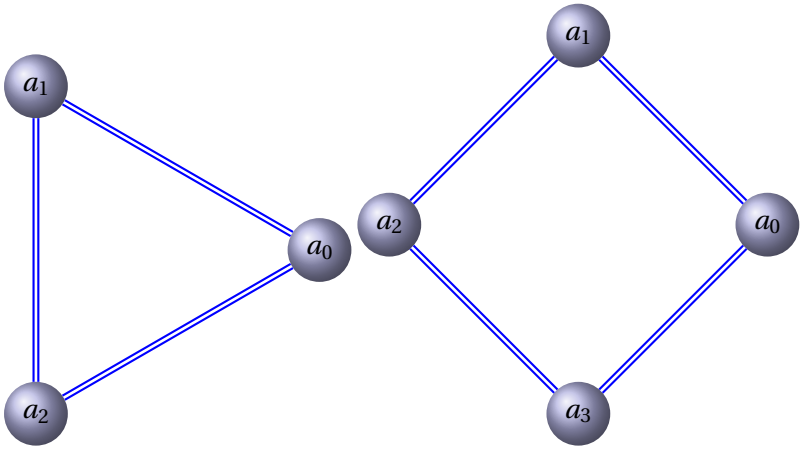
\grCycle[⟨local options⟩]{⟨order⟩}

A cycle graph C_n is a graph on n nodes containing a single cycle through all nodes. Cycle graphs can be generated using \grCycle in the tkz-berge.sty package. Special cases include the triangle graph and the square graph.

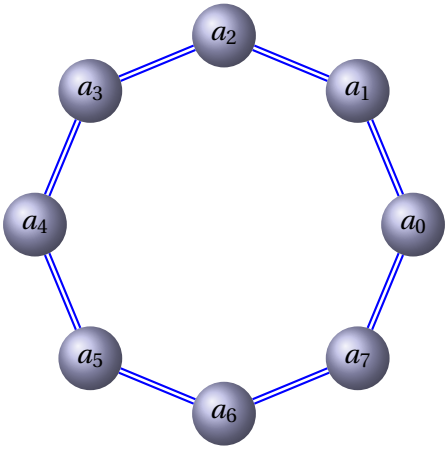
External links :

- MathWorld - CycleGraph by E.Weisstein
- Wikipedia

Example n° 33 Special cases : the triangle graph and the square graph



Example n° 34 Complete Graph order 4




```
\begin{tikzpicture}
  \GraphInit[vstyle=Shade]
  \grCycle[RA=2.5]{8}
\end{tikzpicture}
```

macro n° 21 \grComplete Complete Graph

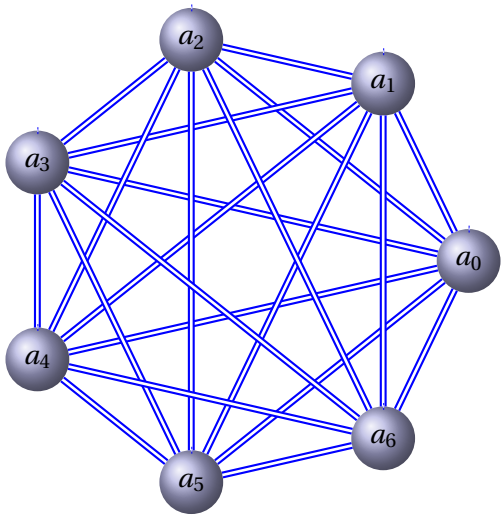
\grComplete[⟨local options⟩]{⟨order⟩}

The more simple definition is "an undirected graph with an edge between every pair of vertices" or a complete graph is a simple graph in which each pair of graph vertices is connected by an edge. The complete graph with n graph vertices is denoted K_n. *This graph has* $\frac{n(n-1)}{2}$ *undirected edges.*
Geometrically, K_3 *relates to a triangle,*K_4 *a tetrahedron is the tetrahedral graph as well as the wheel graph ,* K_5 *a pentachoron, etc . . .*

External links :

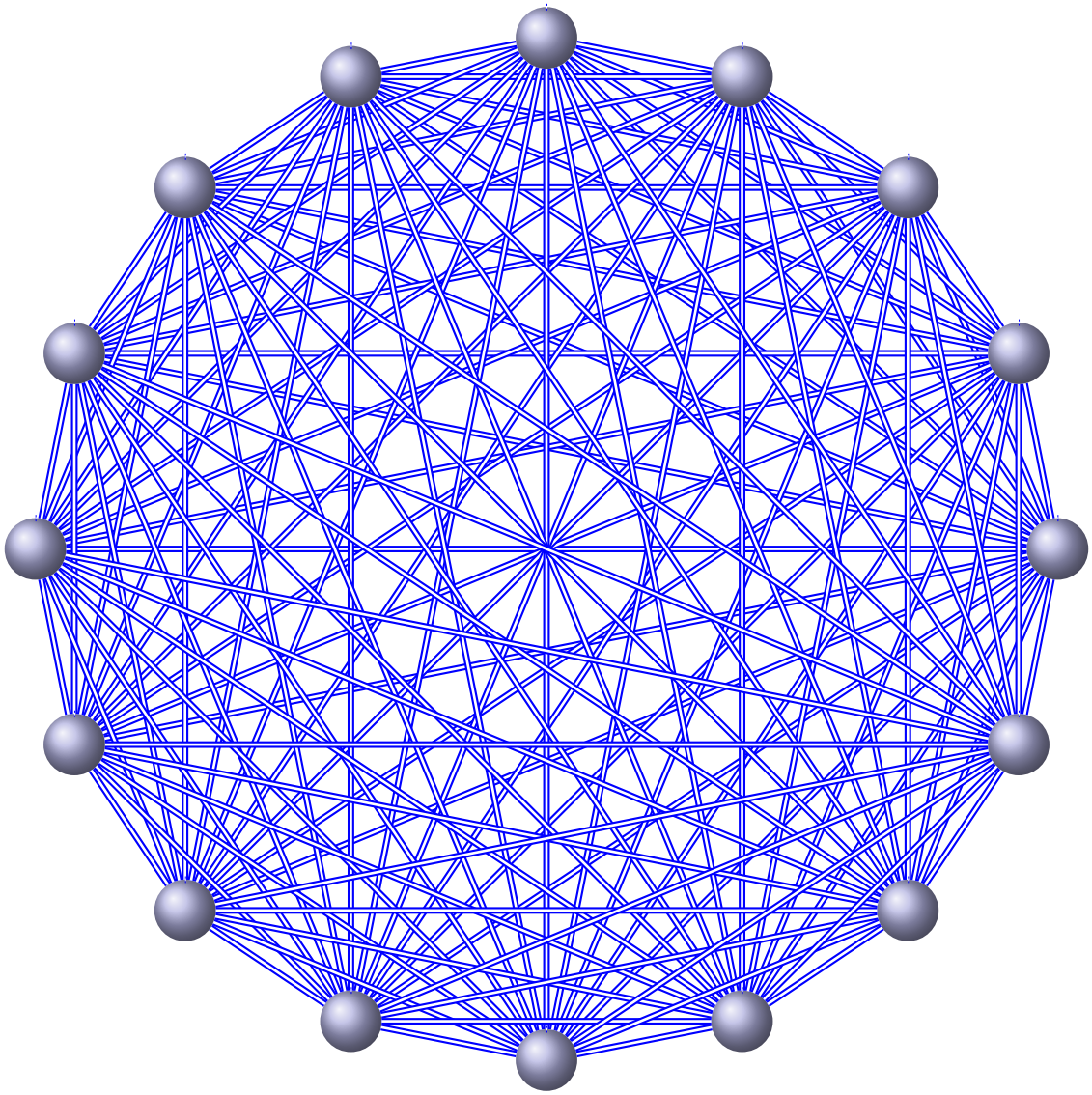
- Wikipedia
- MathWorld - Complete graph by E.Weisstein

Example n° 35 Complete Graph order 4




```
\begin{tikzpicture}
  \renewcommand*{\VertexBallColor}{green!50!black}
  \GraphInit[vstyle=Shade]
  \grComplete[RA=3]{7}
\end{tikzpicture}
```

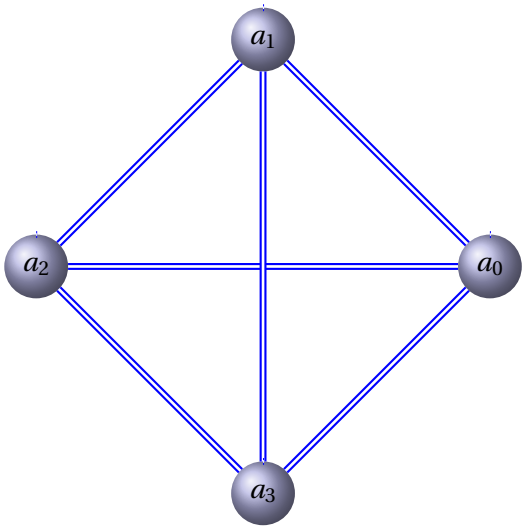
Example n° 36 Complete Graph order 4



```
\begin{tikzpicture}
  \renewcommand*{\VertexBallColor}{green!50!black}
  \GraphInit[vstyle=Shade]
  \SetVertexNoLabel
  \grComplete[RA=7]{16}
\end{tikzpicture}
```

Example n° 37 How to build a graph

1/ Step 1

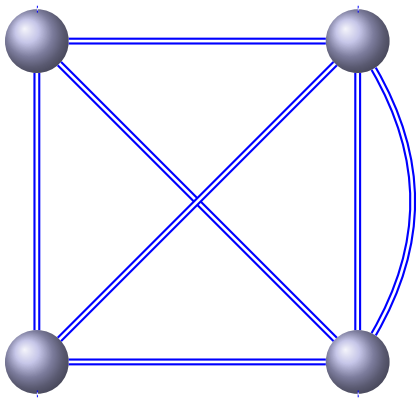



```
\begin{tikzpicture}
 \GraphInit[vstyle=Shade]
 \grComplete[RA=3]{4}
\end{tikzpicture}
```

2/ Step 2

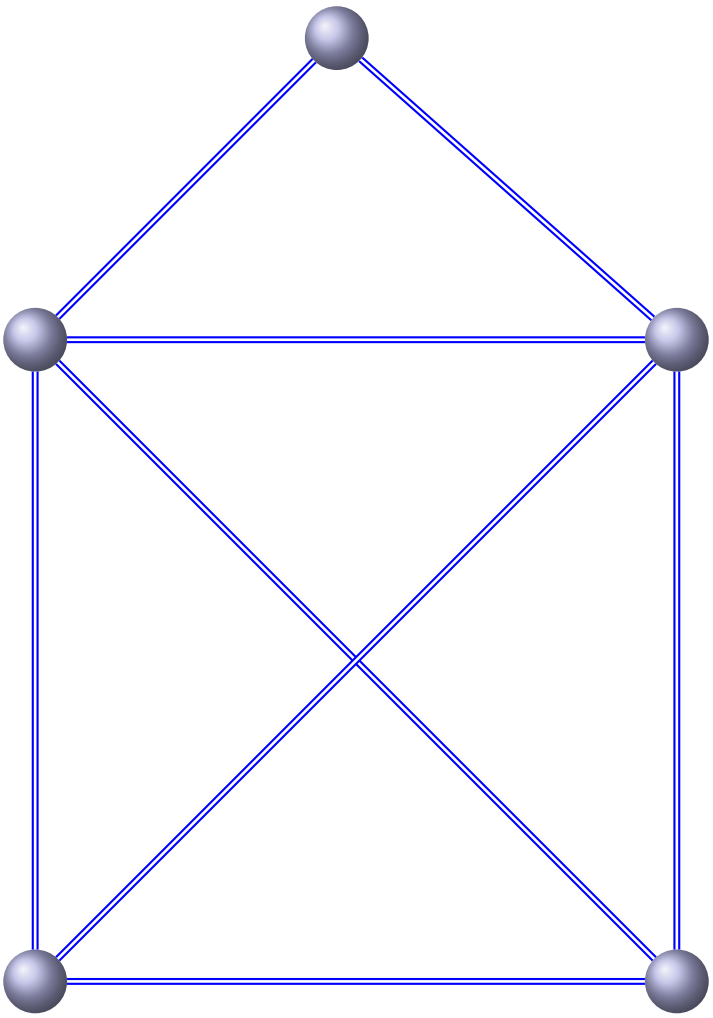
We had an edge

Example n° 38 Classic



or we had a vertex

Example n° 39 Classic



```
198 \begin{tikzpicture}
199  \SetVertexNoLabel
200    \GraphInit[vstyle=Shade]
201  \begin{scope}[rotate=-45]
202     \grComplete[RA=6]{4}
203  \end{scope}
204 {\tikzstyle{every node}=[node distance=5.64 cm]
205  \NOEA(a2){a5}}
206  \Edge(a2)(a5)
207  \Edge(a1)(a5)
208 \end{tikzpicture}
```

macro n° 22 \grCirculant Circulant Graph

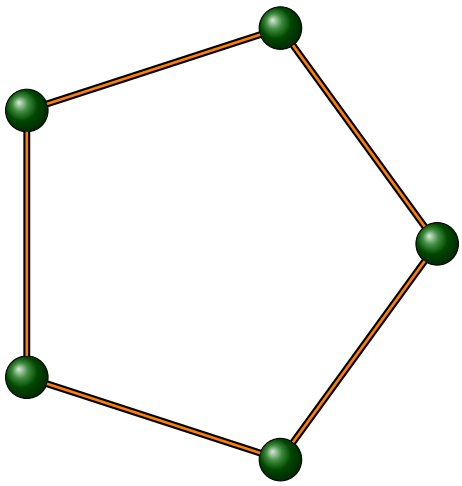
\grCirculant[⟨local options⟩]{⟨order⟩}

The circulant graph is defined for any order n at least 3, and every subset L *of integers which are less than or equal to* $n/2$*. A circulant graph is a graph in which the* i*th graph vertex is adjacent to the* $(i+j)$*th and* $(i-j)$*th graph vertices for each* j *in a list* L *. The circulant graphs with* $L=\{1;\ldots;\lfloor n/2\rfloor\}$ *gives the complete graphs and the circulant graph with* $L=\{1\}$ *gives the cyclic graphs. The Möbius ladders are examples of circulant graphs.*
In graph theory, a graph whose adjacency matrix is circulant is called a circulant graph.
The circulant graph on vertices on a list of nodes is implemented as \grCirculant *in the* tkz-berge.sty *package.*

External links :
MathWorld - CirculantGraph by E.Weisstein

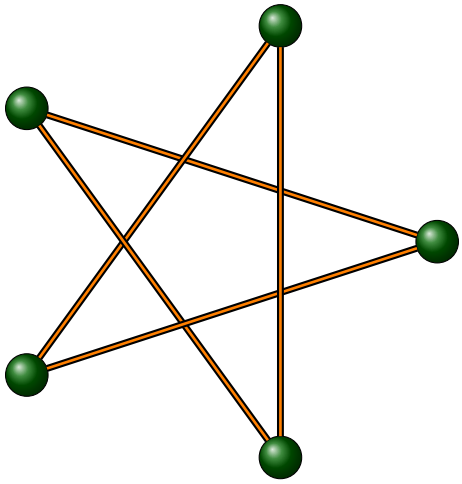
Example n° 40 Graphe d'ordre 5 avec L={1}

This is a cycle graph.



```
\begin{tikzpicture}
  \grCirculant[RA=3]{5}{1}%
\end{tikzpicture}
```

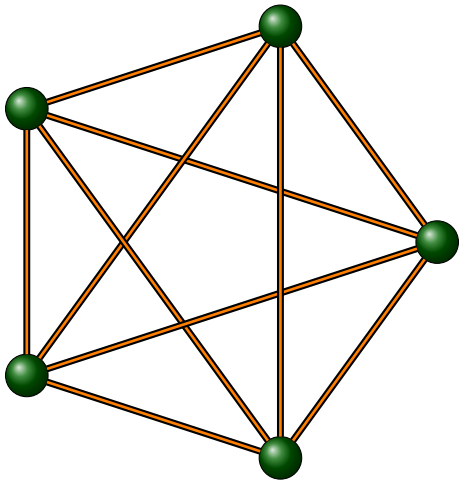
Example n° 41 Graphe d'ordre 5 avec L={2}



```
\begin{tikzpicture}
  \grCirculant[RA=3]{5}{2}%
\end{tikzpicture}
```

Example n° 42 Graphe d'ordre 5 avec L={1,2}

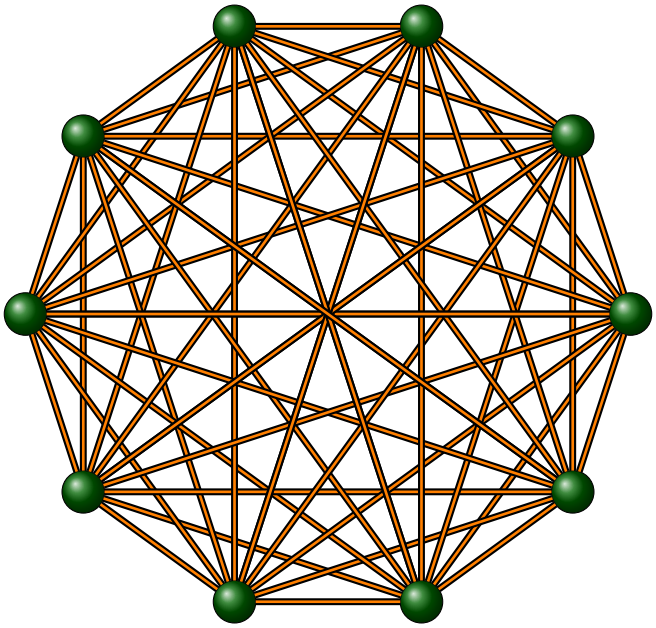
This graph is complete with an order 5.



```
\begin{tikzpicture}
  \grCirculant[RA=3]{5}{1,2}%
\end{tikzpicture}
```

Example n° 43 Graphe d'ordre 10 avec L={1,2,3,4,5}

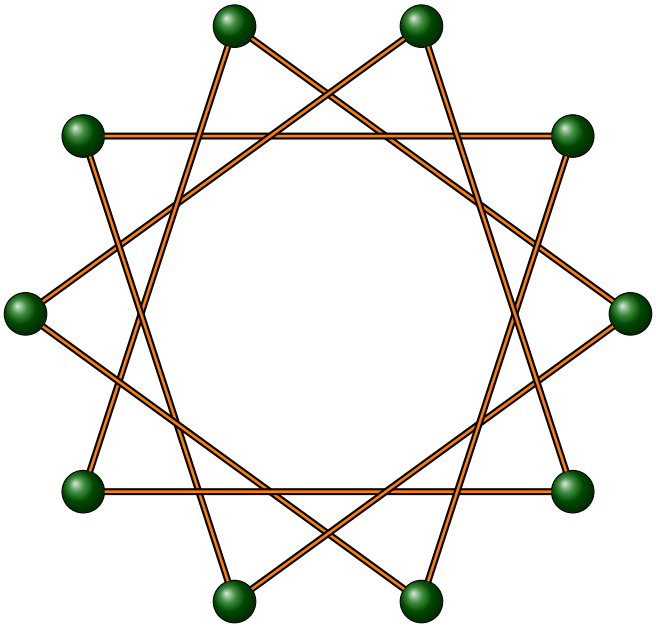
This graph is also complete



```
218   \begin{tikzpicture}
219     \grCirculant[RA=4]{10}{1,2,3,4,5}%
220   \end{tikzpicture}
```

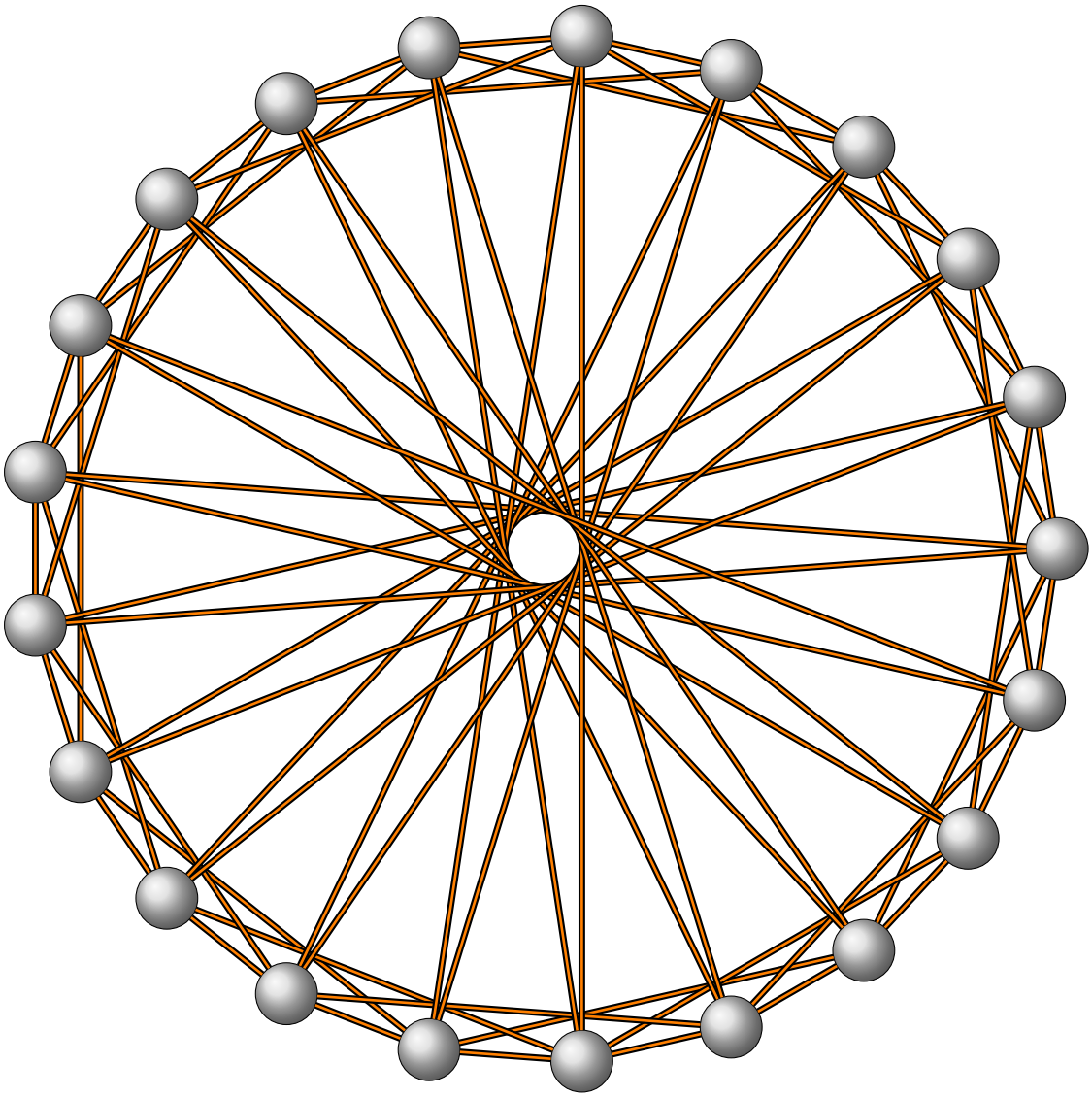
It's interesting to remark that the numbers 3 and 10 are primer, so if L = {3} the graph is containing an Eulerian circuit.

Example n° 44 Graphe d'ordre 10 avec L={3}



```
221   \begin{tikzpicture}
222     \grCirculant[RA=4]{10}{3}%
223   \end{tikzpicture}
```

Example n° 45 Graphe d'ordre 21 avec L={1,3,10}



macro n° 23 \grStar Star Graph

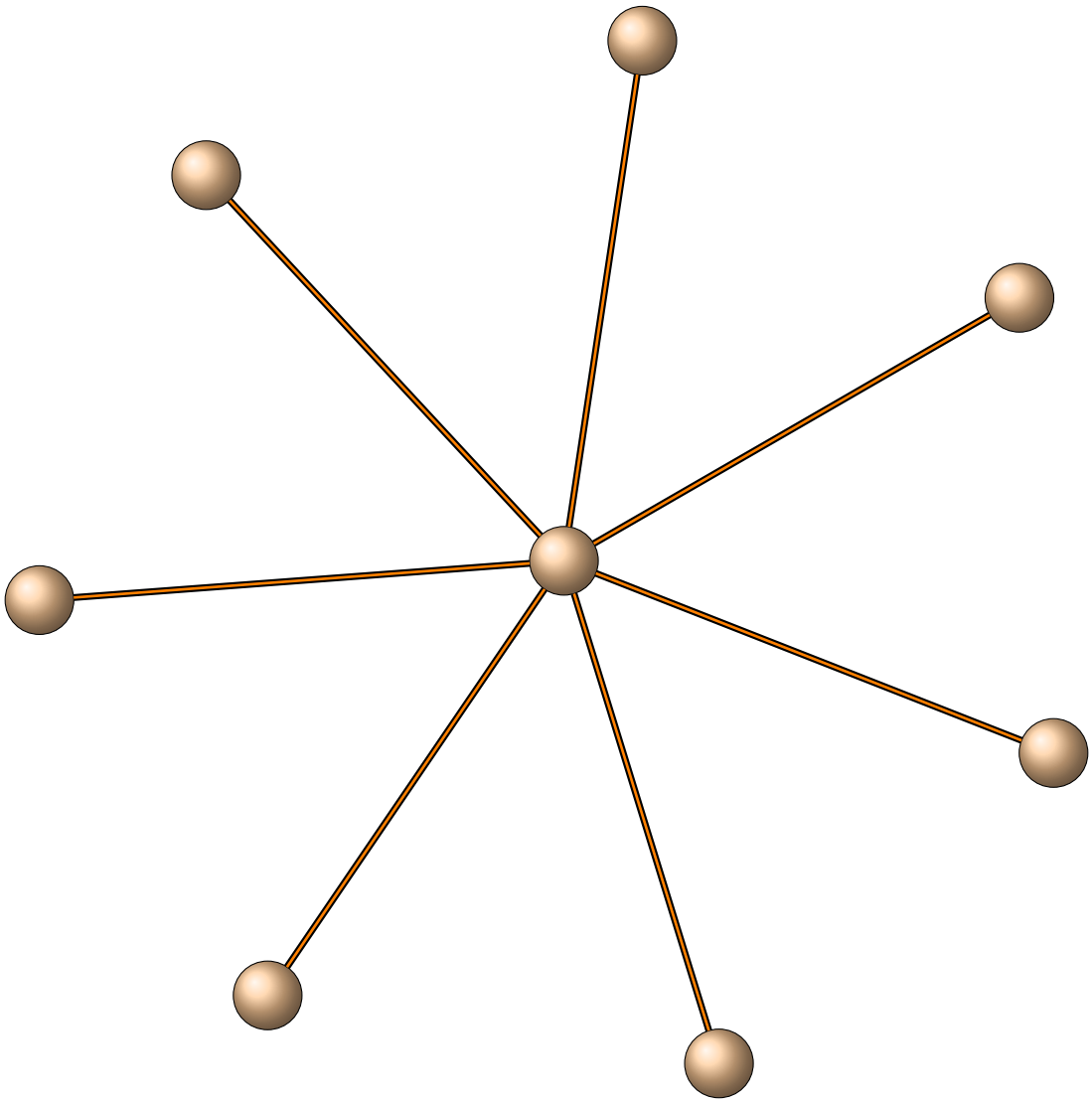
\grStar[⟨local options⟩]{⟨order⟩}

A star graph S_n *is a n-graph with one node having vertex degree* $n-1$ *and the other* $n-1$ *having vertex degree* 1. *Star graphs can be generated using* \grStar *in the* tkz-berge.sty *package.*

External links :

- MathWorld - StarGraph by Weisstein

Example n° 46 Star graph



```
\begin{tikzpicture}[rotate=30]
  \grStar[RA=7]{8}%
\end{tikzpicture}
```

macro n° 24 Square Cycle graph \grSQCycle

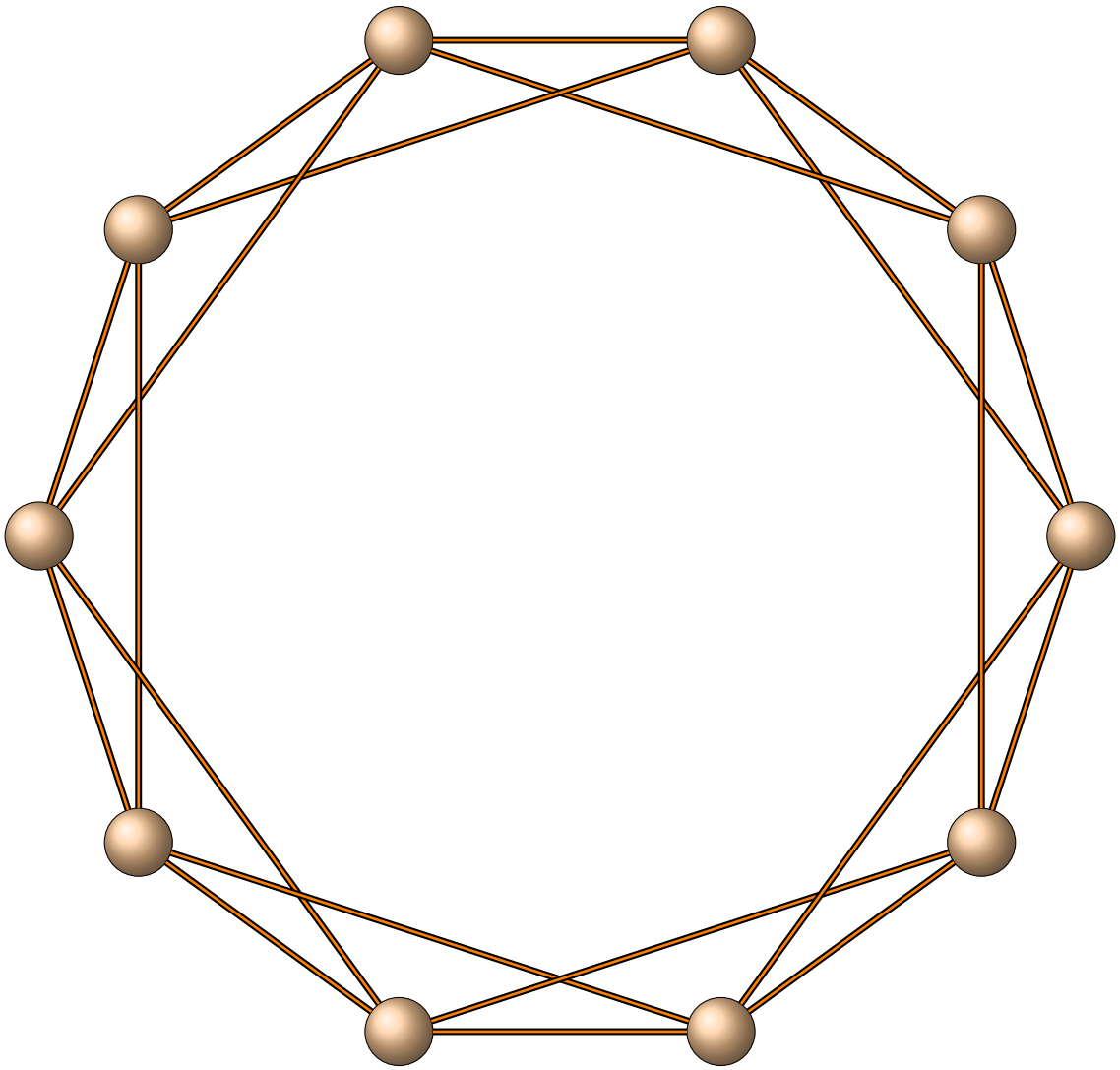
\grSQCycle[⟨local options⟩]{⟨Number⟩}

A star graph S_n *is a n-graph with one node having vertex degree* $n-1$ *and the other* $n-1$ *having vertex degree* 1. *Star graphs can be generated using* \grStar *in the* tkz-berge.sty *package.*

External links :

- MathWorld - SquareGraph by Weisstein

Example n° 47 Square Cycle graph



```
\begin{tikzpicture}
  \grSQCycle[RA=7]{10}%
\end{tikzpicture}
```

macro n° 25 Wheel graph \grWheel

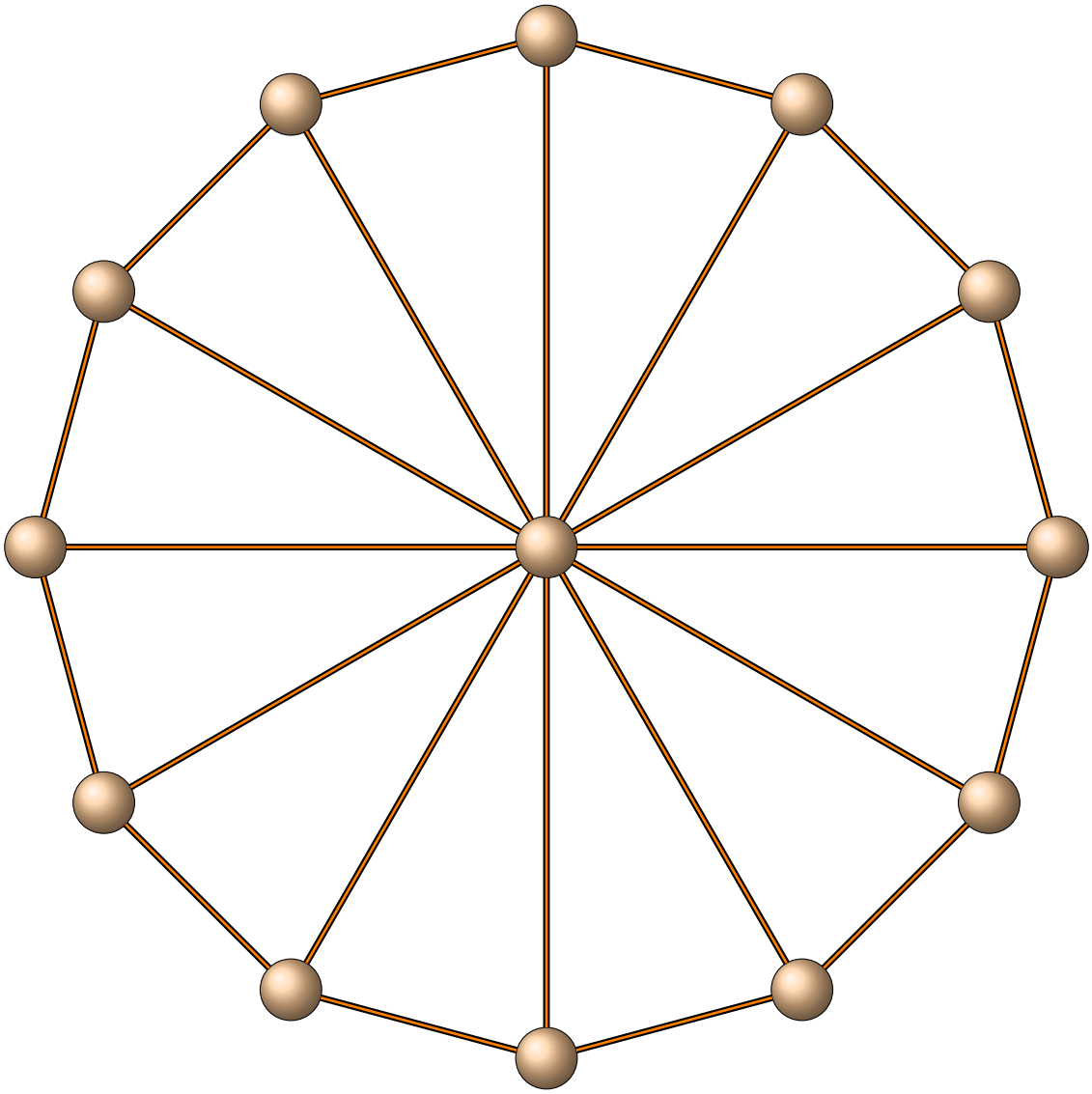
\grWheel[⟨local options⟩]{⟨Number⟩}

A wheel graph of order n is a graph that contains a cycle of order n − 1, and for which every vertex in the cycle is connected to one other vertex. The wheel can be defined as the graph , where is the singleton graph and is the cycle graph.

External links :

- MathWorld - WheelGraph by Weisstein

Example n° 48 Wheel graph



```
\begin{tikzpicture}
  \grWheel[RA=7]{13}%
\end{tikzpicture}
```

macro n° 26 \grLadder Ladder graph

\grLadder[⟨*local options*⟩]{⟨*Number*⟩}

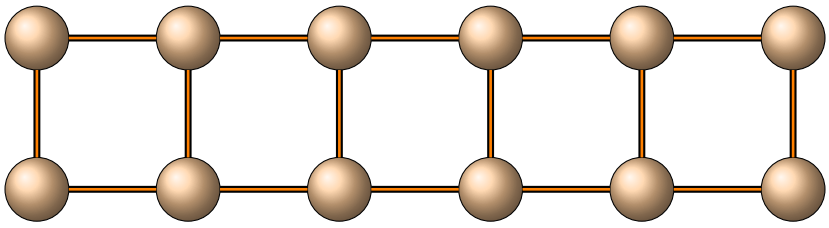
options	default	definition
RA	4	radius circle n°1
RS	0	distance between two lines
prefix	a	prefix for vertices
prefixx	b	prefix for vertices
Math	false	math mode

The ladder graph L_n *or cyclic ladder graph is equivalent to the grid graph having two rails and n rungs between them.*

External links :

- MathWorld - LadderGraph by Weisstein

Example n° 49 Ladder graph



```
\begin{tikzpicture}
  \grLadder[RA=2,RS=2]{6}%
\end{tikzpicture}
```

macro n° 27 Cycle Ladder graph

\grPrism[⟨*local options*⟩]{⟨*Number*⟩}

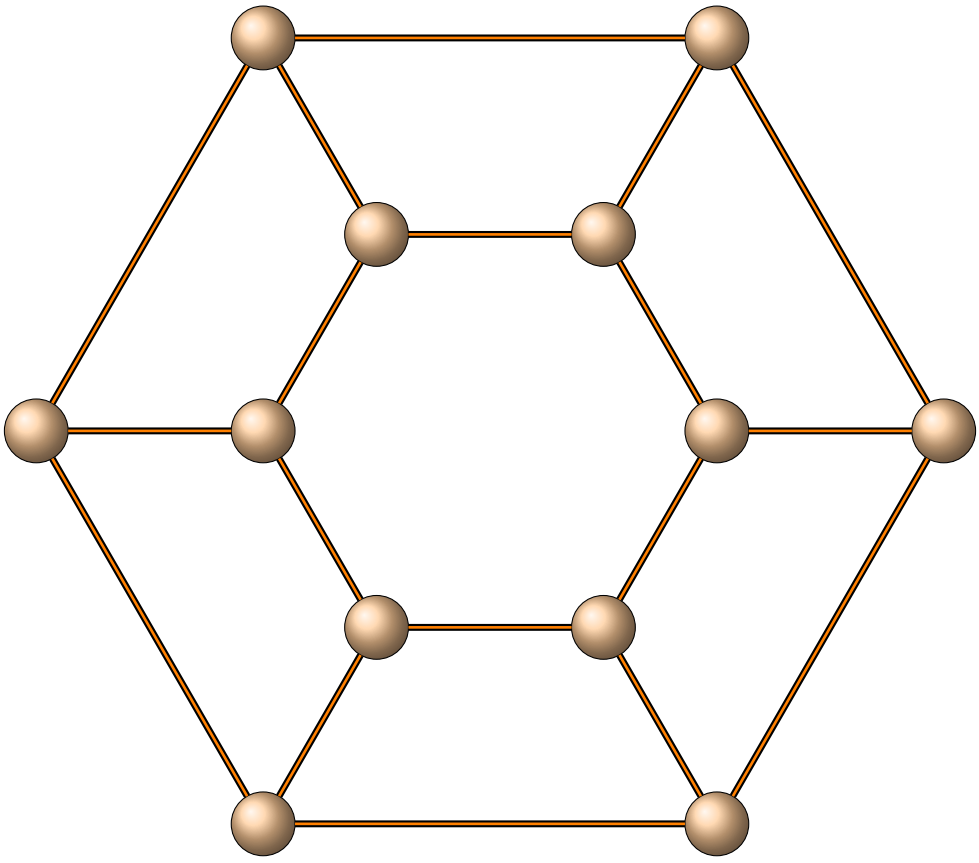
options	default	definition
RA	4	radius circle n°1
RB	3	radius circle n°2
prefix	a	prefix for vertices
prefixx	b	prefix for vertices
Math	false	math mode

An n-prism graph has $2n$ nodes and $3n$ edges, and is equivalent to the generalized Petersen graph with arguments n and 1. For odd n, the n-prism is isomorphic to the circulant graph with an order $2n$ and with arguments 2 and n.
The 3-prism graph is the line graph of the complete bipartite graph with arguments 2 and 3 . The 4-prism graph is isomorphic with the cubical graph.

External links :

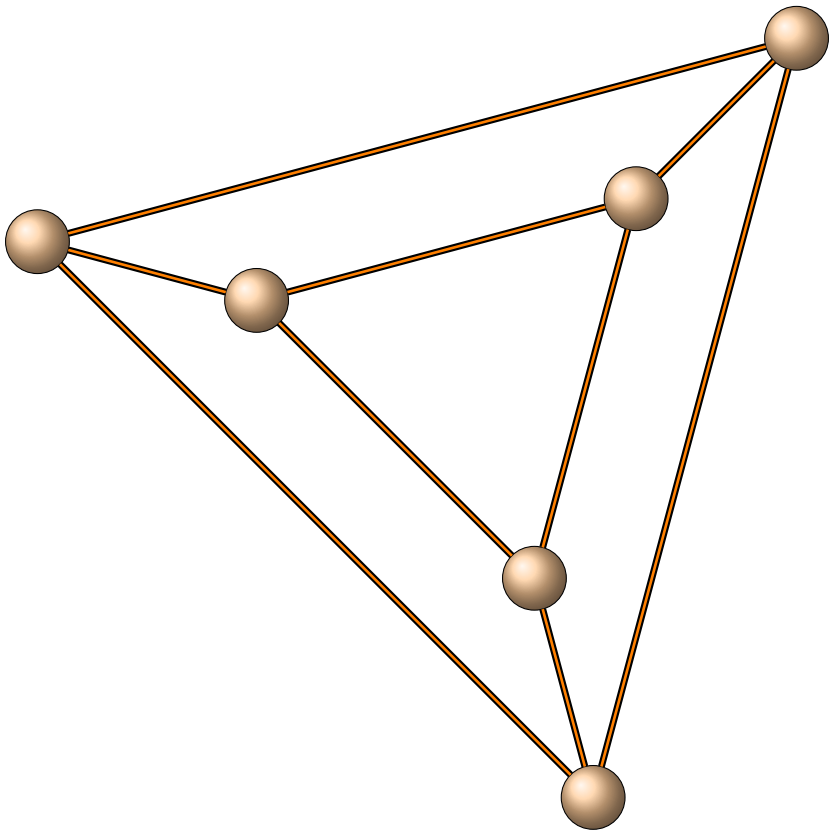
- MathWorld - Prism Graph by Weisstein

Example n° 50 Cycle Ladder graph



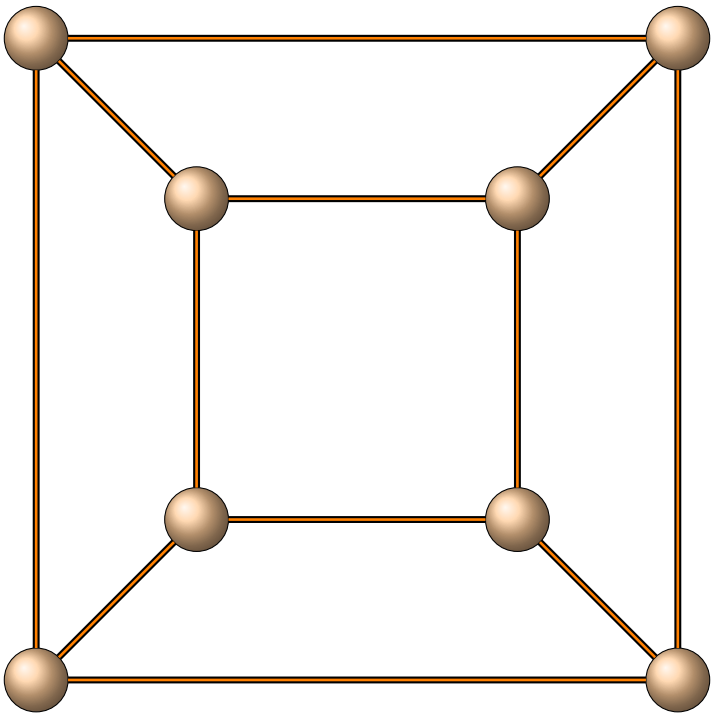
```
\begin{tikzpicture}[rotate=15]
\grPrism[RA=6,RB=3]{6}%
\end{tikzpicture}
```

Example n° 51 Cycle Ladder graph number 3



```
\begin{tikzpicture}
\grPrism[RA=6,RB=3]{3}%
\end{tikzpicture}
```

Example n° 52 Cycle Ladder graph number 4



```
\begin{tikzpicture}
\grPrism[RA=6,RB=3]{4}%
\end{tikzpicture}
```

macro n° 28 A complete bipartite graph

\grCompleteBipartite[⟨*local options*⟩]{⟨*Number 1*⟩}{⟨*Number 2*⟩}

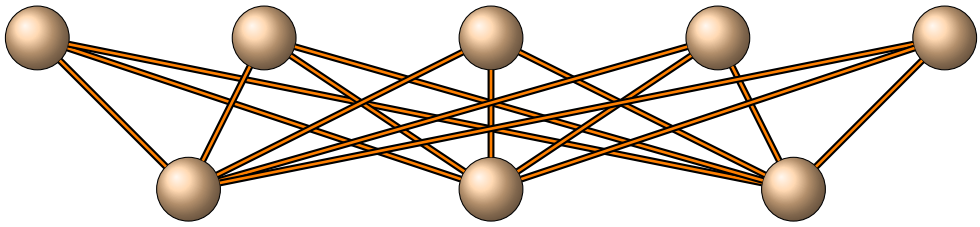
options	default	definition
RA	4	radius circle n°1
RB	3	radius circle n°2
RS	0	distance between two lines
form	1	integer to obtain a new embedding of a graph
prefix	a	prefix for vertices
prefixx	b	prefix for vertices
Math	false	math mode

A complete bipartite graph is a bipartite graph (i.e., a set of graph vertices decomposed into two disjoint sets such that no two graph vertices within the same set are adjacent) such that every pair of graph vertices in the two sets are adjacent.

External links :

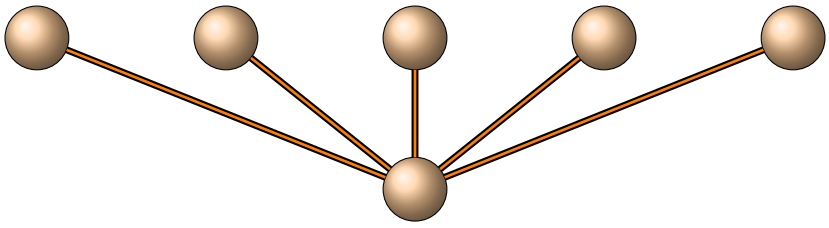
- MathWorld - CompleteBipartite Graph by Weisstein

Example n° 53 Bipartite graph 3,5



```
\begin{tikzpicture}
 \grCompleteBipartite[RA=4,RB=3,RS=2]{3}{5}
\end{tikzpicture}
```

Example n° 54 Bipartite graph 1,5



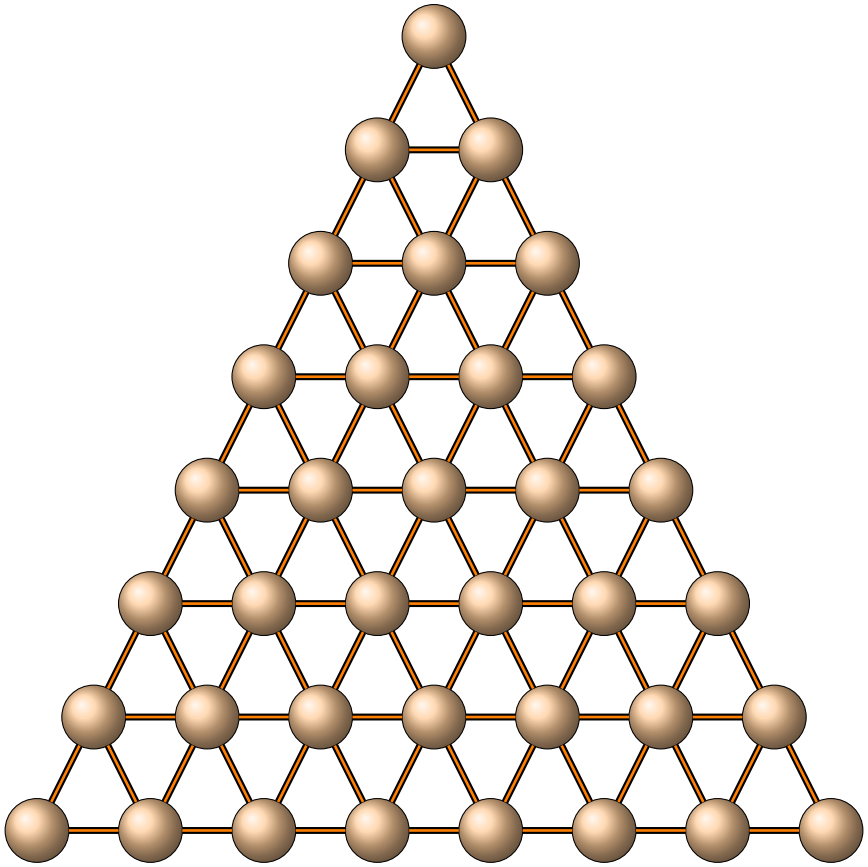
```
\begin{tikzpicture}
 \grCompleteBipartite[RA=4,RB=2.5,RS=2]{1}{5}
\end{tikzpicture}
```

macro n° 29 \grTriangularGrid

\grTriangularGrid[⟨*local options*⟩]{⟨*Number*⟩}

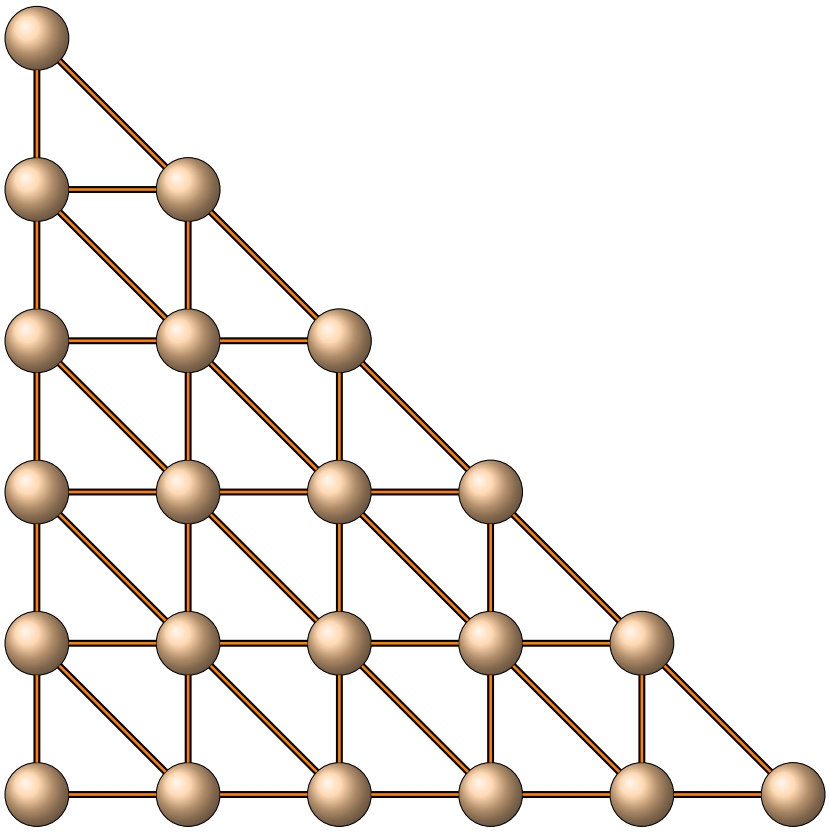
If *Number=n* is the number of vertices of the first row then the graph order is $\frac{n(n-1)}{2}$. There are three embeddings. You can use the option form with an integer between 1 and 3.

Example n° 55 n=8 order=28 form 1



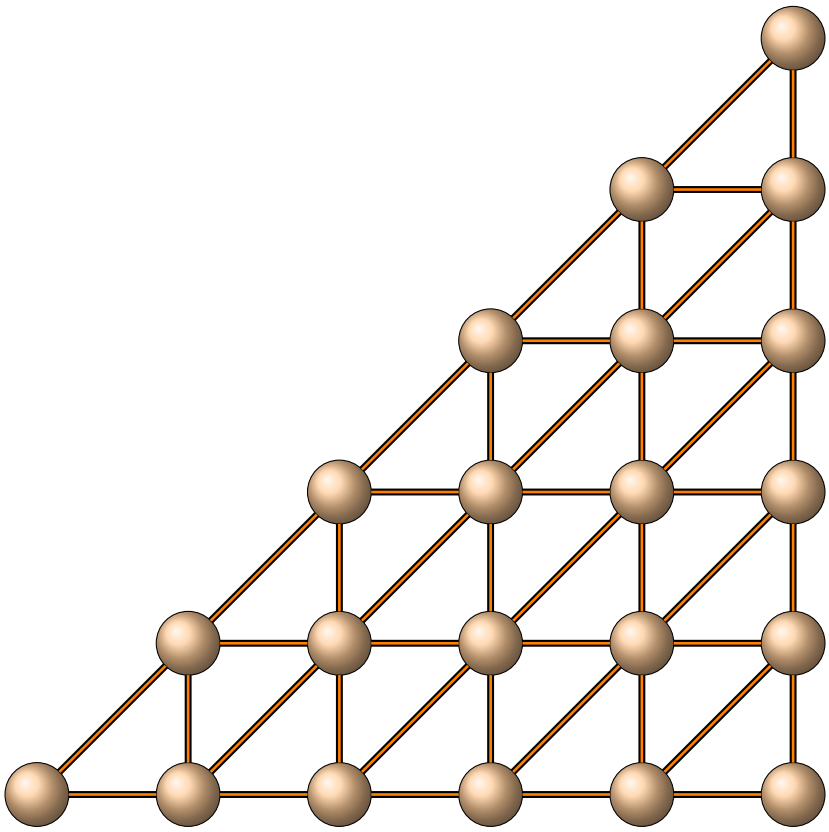
```
\begin{tikzpicture}%
  \grTriangularGrid[RA=1.5]{8}%
\end{tikzpicture}
```

Example n° 56 n=6 order=15 form 2



```
\begin{tikzpicture}%
  \grTriangularGrid[RA=2,form=2]{6}%
\end{tikzpicture}
```

Example n° 57 n=6 order=15 form 3



```
\begin{tikzpicture}%
  \grTriangularGrid[RA=2,form=3]{6}%
\end{tikzpicture}
```

macro n° 30 LCF Notation : \grLCF

\grLCF[RA=⟨Number⟩]{⟨List of numbers⟩}{⟨Number⟩}

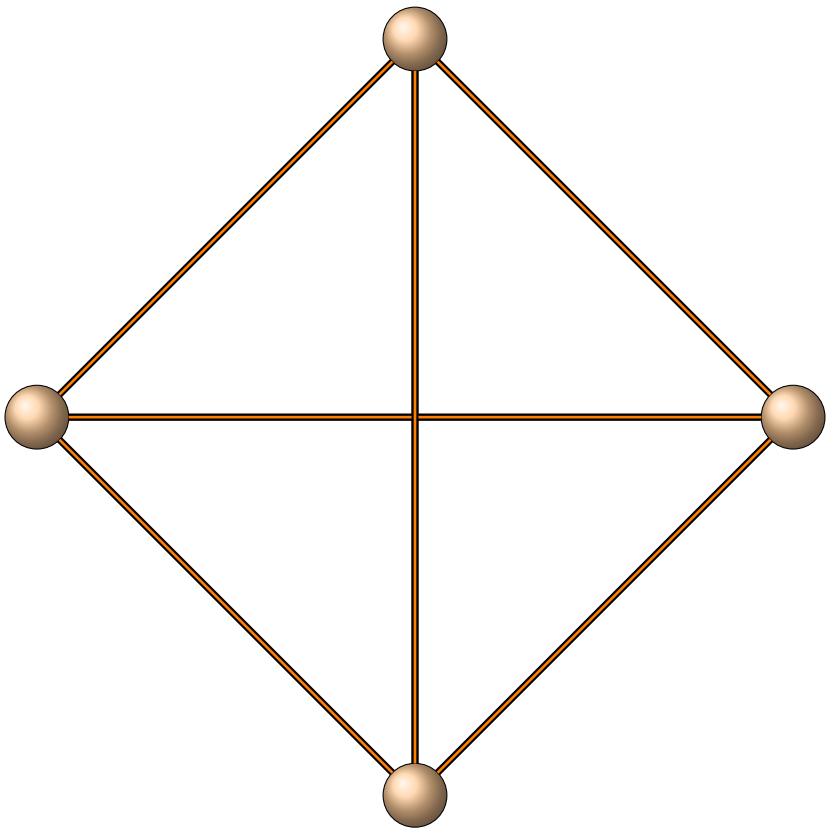
A star graph S_n *is a n-graph with one node having vertex degree* $n-1$ *and the other* $n-1$ *having vertex degree* 1. *Star graphs can be generated using* \grStar *in the* tkz-berge.sty *package.*

External links :

- MathWorld by Weisstein

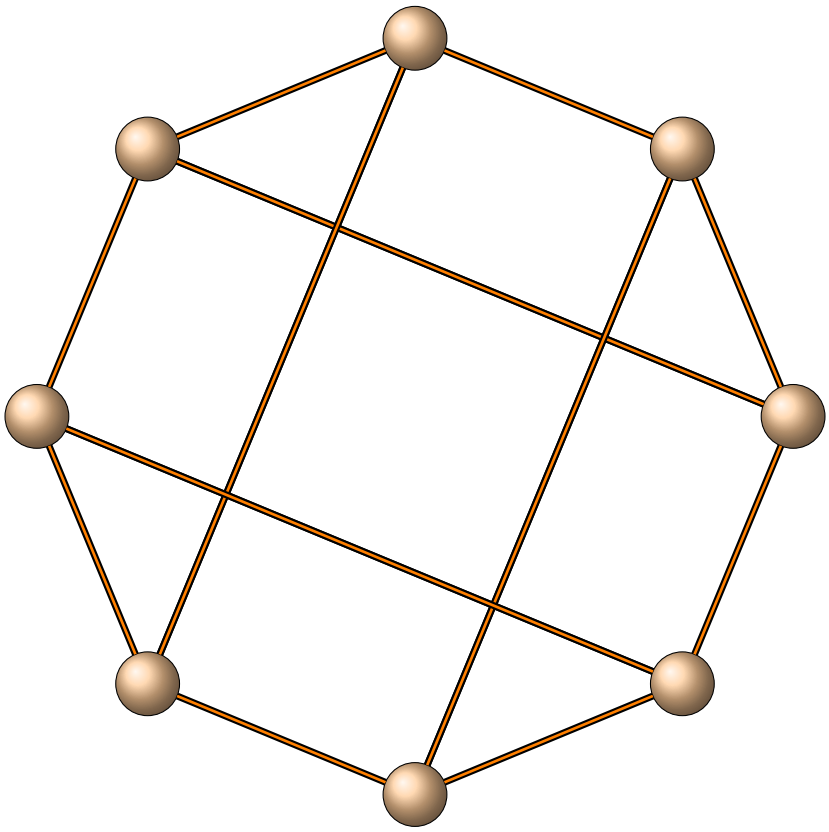
LCF Notation
LCF=Lederberg-Coxeter-Fruchte
LCF notation is a concise and convenient notation devised by Joshua Lederberg (winner of the 1958 Nobel Prize in Physiology and Medicine) for the representation of cubic Hamiltonian graphs (Lederberg 1965). The notation was subsequently modified by Frucht (1976) and Coxeter et al. (1981), and hence was dubbed "LCF notation" by Frucht (1976). Pegg (2003) used the notation to describe many of the cubic symmetric graphs. The notation only applies to Hamiltonian graphs, since it achieves its symmetry and conciseness by placing a Hamiltonian cycle in a circular embedding and then connecting specified pairs of nodes with edges.
The LCF notation for a given graph is not unique, since it may be shifted any number of positions to the left or right, or may be reversed (with a corresponding sign change of the entries to correspond to the fact that the numbering of the outer cycle must be done in the opposite order as well).

Example n° 58 $[2,-2]^2$



```
\begin{tikzpicture}%
   \grLCF[RA=5]{2,-2}{2}%
\end{tikzpicture}
```

Example n° 59 $[3,-3]^4$



```
264     \begin{tikzpicture}%
265        \grLCF[RA=5]{3,-3}{4}%
266     \end{tikzpicture}
```

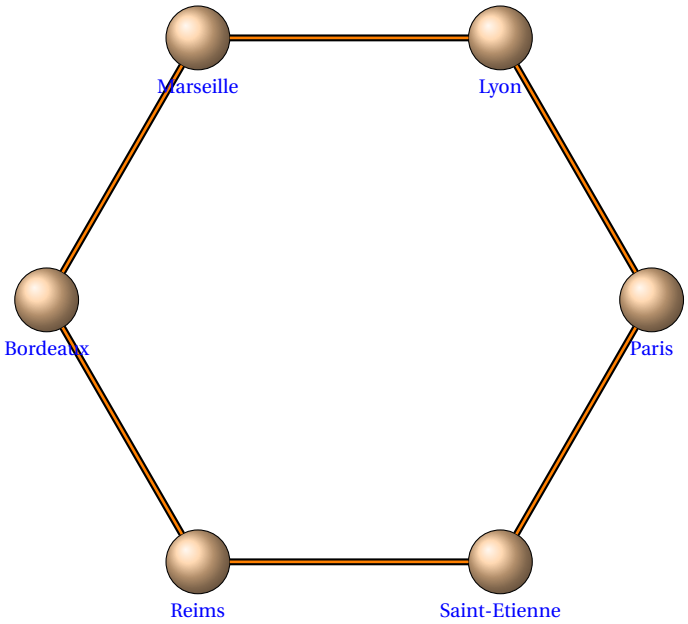
V. Macros and Styles

macro n° 31 Modification of labels \AssignVertexLabel

\AssignVertexLabel[⟨options⟩]

options	default	definition
size	\tkzcname{normalsize}	
color	black	
pos	{}	
Math	false	math mode

Example n° 60 AssignStyle and \AssignVertexLabel




```
\begin{tikzpicture}
  \SetVertexNoLabel
  \grCycle{6}
  \tikzset{AssignStyle/.append style = {below=12pt}}
  \AssignVertexLabel[color = blue,%
                     size  = \footnotesize]{a}{6}{%
   Paris,Lyon,Marseille,Bordeaux,Reims,Saint-Etienne}
\end{tikzpicture}
```