UNIVERSITÀ DI PAVIA

Collegio Alessandro Volta
Via Adolfo Ferrata, 17, Pavia (PV)

LaTeX

Lecture 5 – Mastering TikZ for Sciences & Engineering

Giovanni Nicola D'Aloisio

Department of Physics – University of Pavia
Classe di Scienze, Tecnologie e Società – IUSS Pavia

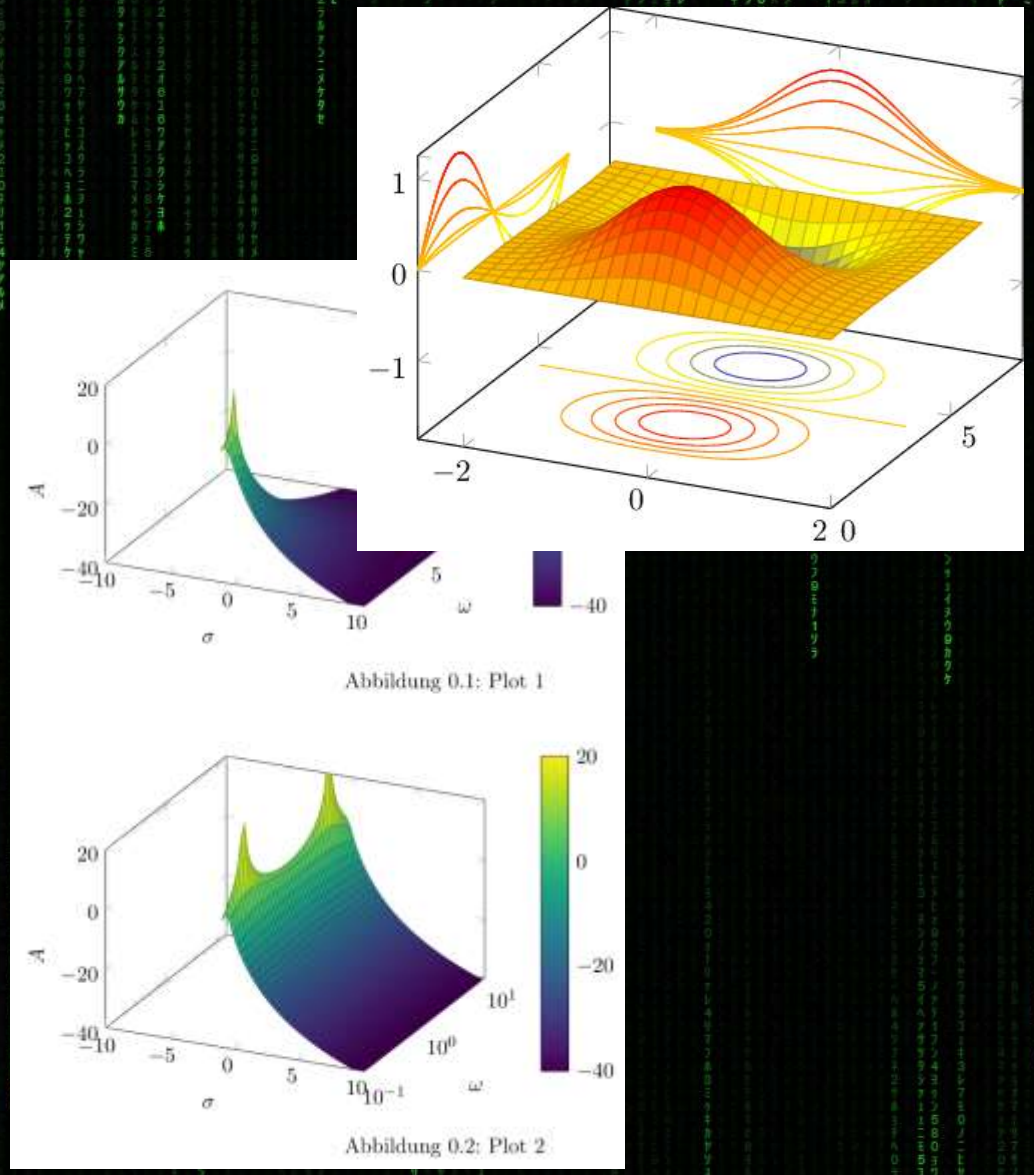
E-Mail: giovanninicola.daloisio01@universitadipavia.it

Pgfplots package

- The pgfplots package, which is based on TikZ, is a powerful visualization tool and ideal for creating scientific/technical graphics.
- The basic idea is that you provide the input data/formula and pgfplots does the rest.
- Usage:

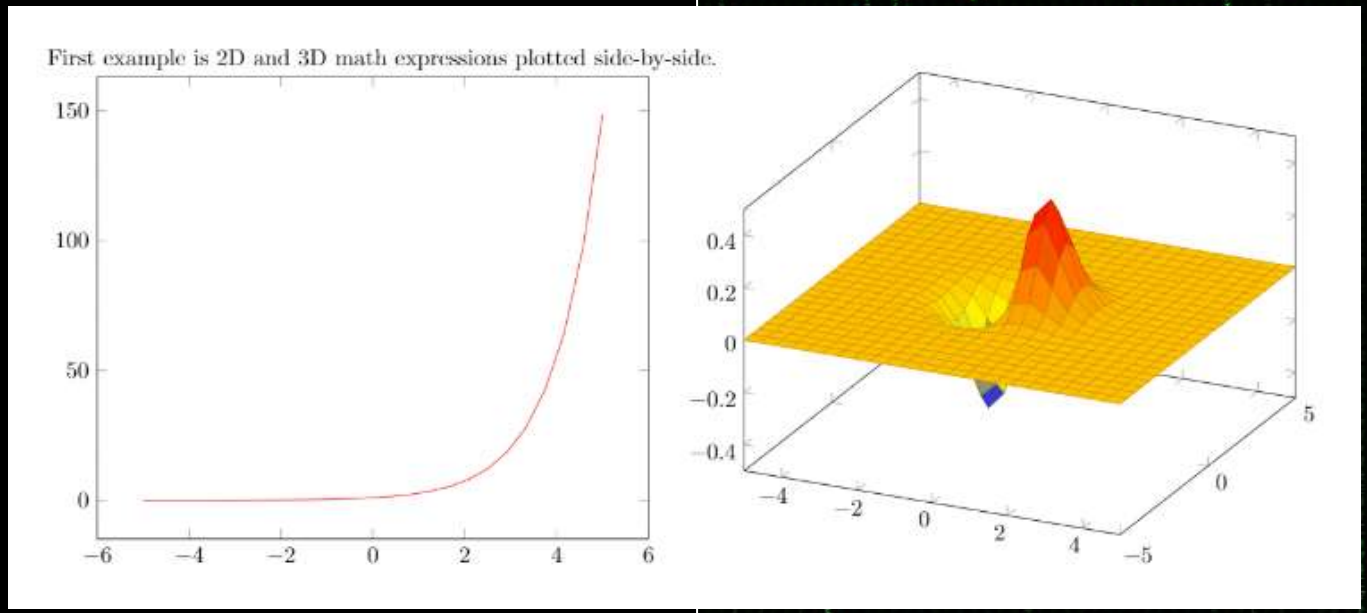
```
\usepackage{pgfplots}
\pgfplotsset{width=10cm,compat=1.9}
```

- This changes the size of each pgfplot figure to 10 centimeters, which is huge; you may use different units (pt, mm, in). The compat parameter is for the code to work on the package version 1.9 or later.



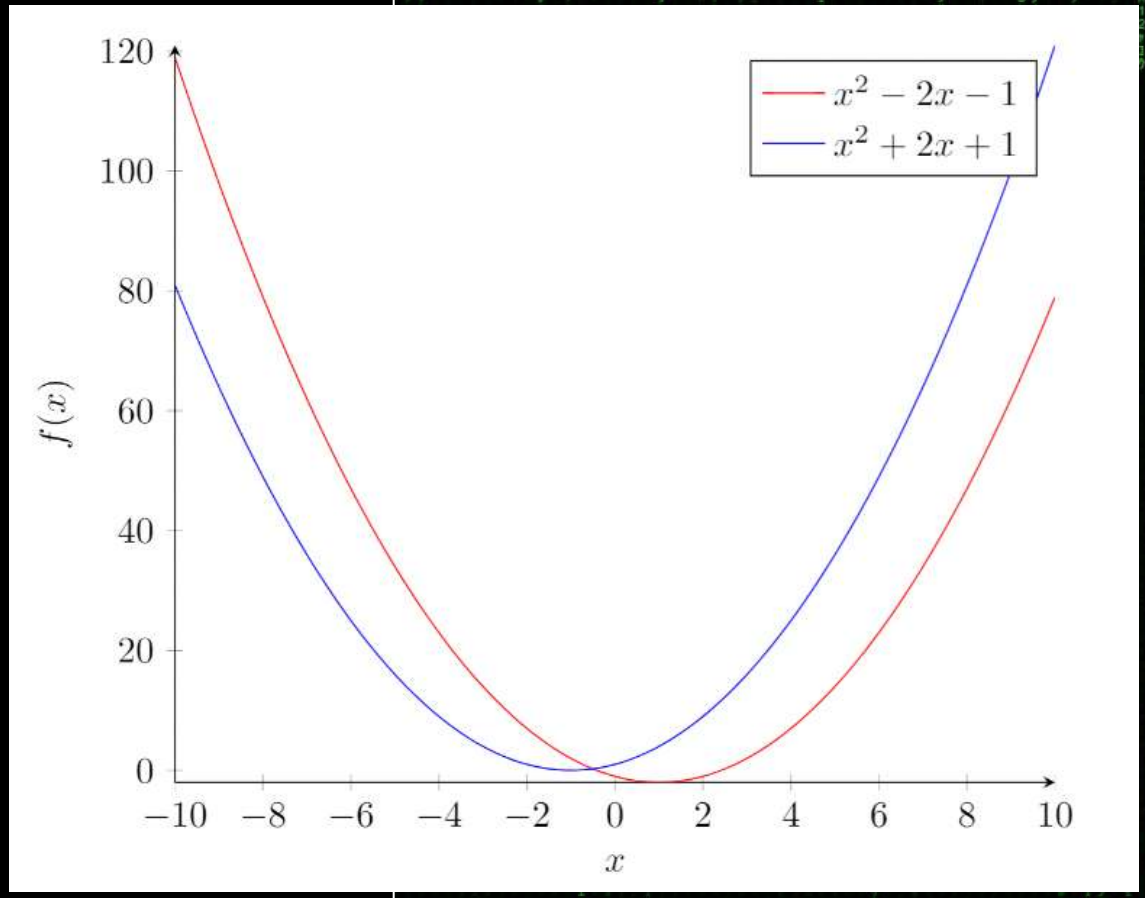
First basic example

```
\documentclass{article}
\usepackage[margin=0.25in]{geometry}
\usepackage{pgfplots}
\pgfplotsset{width=10cm,compat=1.9}
\usepgfplotslibrary{external}
\tikzexternalize

\begin{document}

% 2D plot

\begin{tikzpicture}
     \begin{axis}
          \addplot[color=red]{exp(x)};
     \end{axis}
\end{tikzpicture}

\hskip 5pt

% 3D plot

\begin{tikzpicture}
     \begin{axis}
          \addplot3[surf,]{exp(-x^2-y^2)*x};
     \end{axis}
\end{tikzpicture}

\end{document}
```



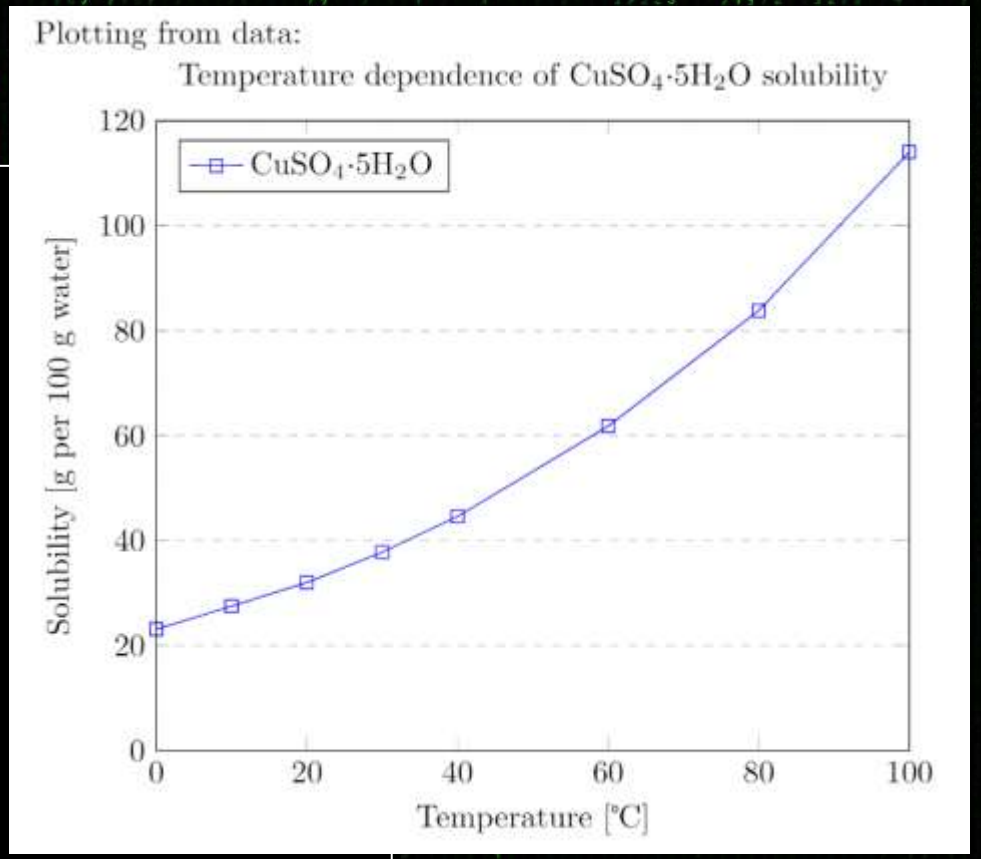
Plotting 2D maps

```
\begin{tikzpicture}
    \begin{axis}[
            axis lines = left,
            xlabel = \(x\),
            ylabel = {\(f(x)\)},
        ]

        %Below the red parabola is defined
        \addplot [
            domain=-10:10,
            samples=100,
            color=red,
        ]
        {x^2 - 2*x - 1};

        \addlegendentry{\(x^2 - 2x - 1\)}

        %Here the blue parabola is defined
        \addplot [
            domain=-10:10,
            samples=100,
            color=blue,
            ]
            {x^2 + 2*x + 1};
        \addlegendentry{\(x^2 + 2x + 1\)}

    \end{axis}
\end{tikzpicture}
```



Plotting from data

```
Plotting from data:

\begin{tikzpicture}
    \begin{axis}[
        title={Temperature dependence of
          CuSO\(_4\cdot\)5H\(_2\)O solubility},
        xlabel={Temperature [\textcelsius]},
        ylabel={Solubility [g per 100 g water]},
        xmin=0, xmax=100,
        ymin=0, ymax=120,
        xtick={0,20,40,60,80,100},
        ytick={0,20,40,60,80,100,120},
        legend pos=north west,
        ymajorgrids=true,
        grid style=dashed,
    ]
    \addplot[
        color=blue,
        mark=square,
        ]
        coordinates {
        (0,23.1)(10,27.5)(20,32)(30,37.8)(40,44.6)(60,61.8)(80,83.8)(100,114)
        };
        \legend{CuSO\(_4\cdot\)5H\(_2\)O}

    \end{axis}
\end{tikzpicture}
```

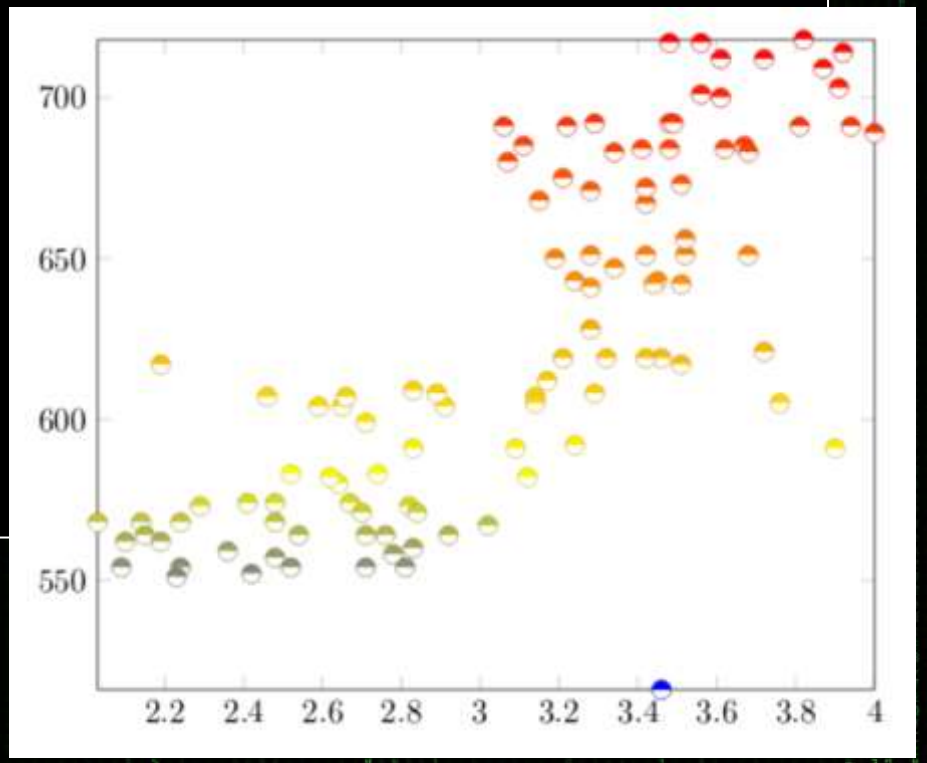


Scatter plots

scattered_example.dat

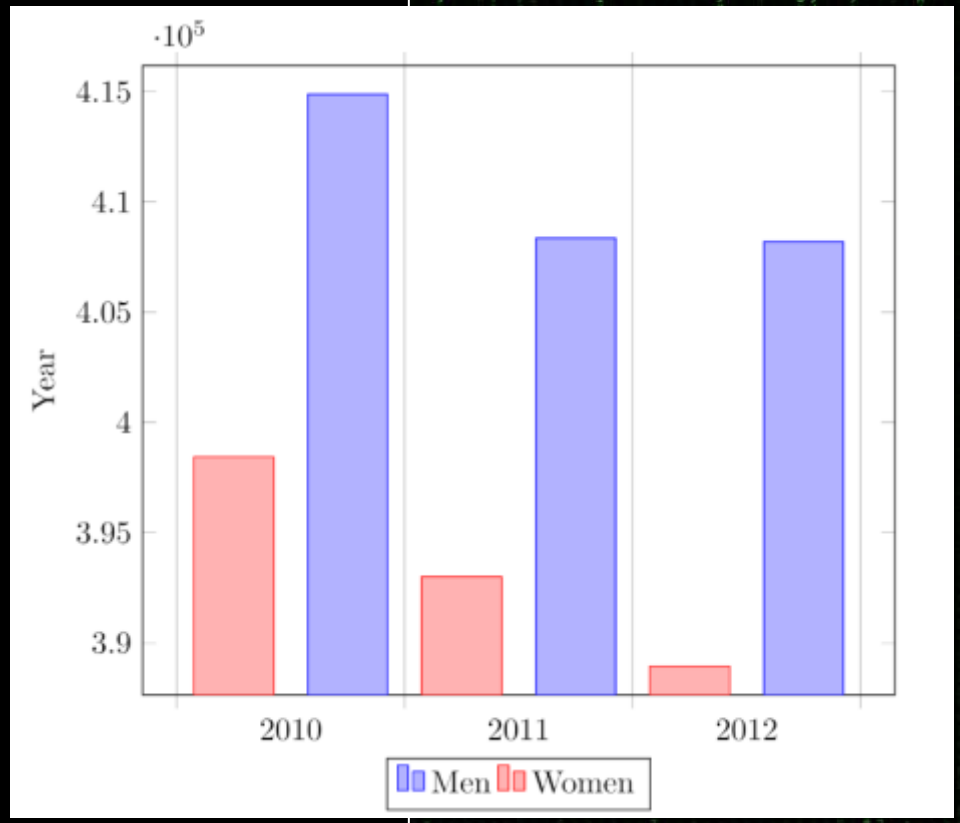
```
GPA  ma  ve  co   un
3.45 643 589 3.76 3.52
2.78 558 512 2.87 2.91
2.52 583 503 2.54 2.4
3.67 685 602 3.83 3.47
3.24 592 538 3.29 3.47
2.1  562 486 2.64 2.37
...
```

```
\begin{tikzpicture}

    \begin{axis}[
        enlargelimits=false,
    ]

    \addplot+[
        only marks,
        scatter,
        mark=halfcircle*,
        mark size=2.9pt]

    table[meta=ma]

    {scattered_example.dat};

    \end{axis}

\end{tikzpicture}
```



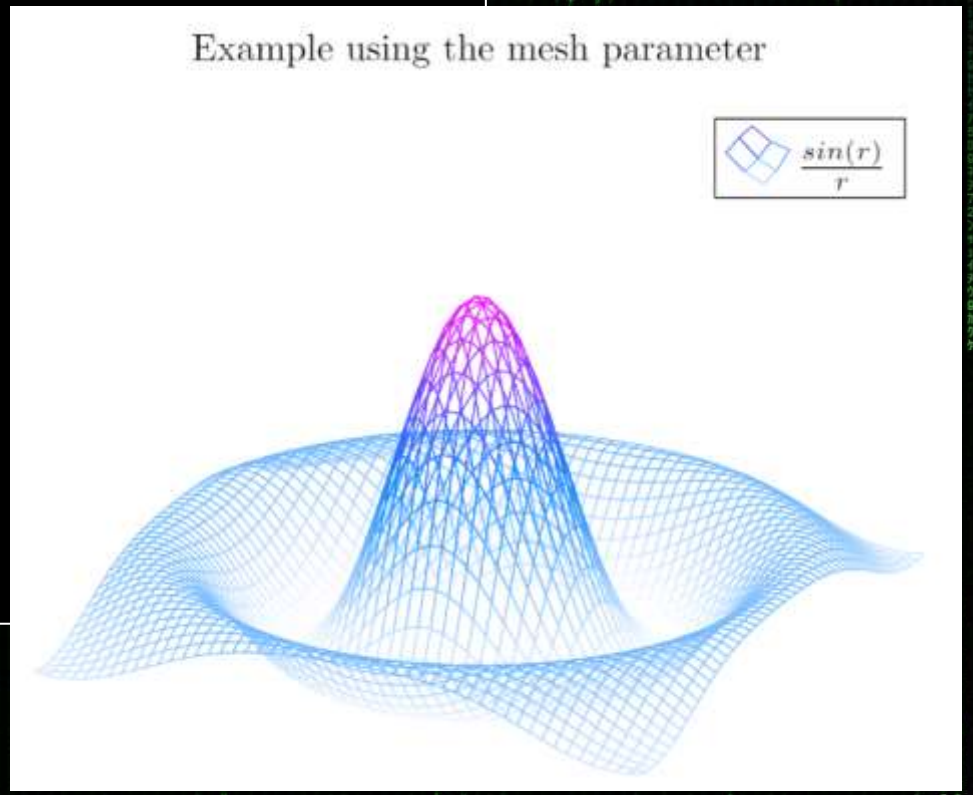
Bar graphs

```
\begin{tikzpicture}

    \begin{axis}[
            x tick label style={
                    /pgf/number format/1000 sep=},
            ylabel=Year,
            enlargelimits=0.05,
            legend style={at={(0.5,-0.1)},
            anchor=north,legend columns=-1},
            ybar interval=0.7,
    ]

        \addplot
            coordinates {(2012,408184) (2011,408348)
                         (2010,414870) (2009,412156)};

        \addplot
            coordinates {(2012,388950) (2011,393007)
                        (2010,398449) (2009,395972)};

        \legend{Men,Women}

    \end{axis}

\end{tikzpicture}
```



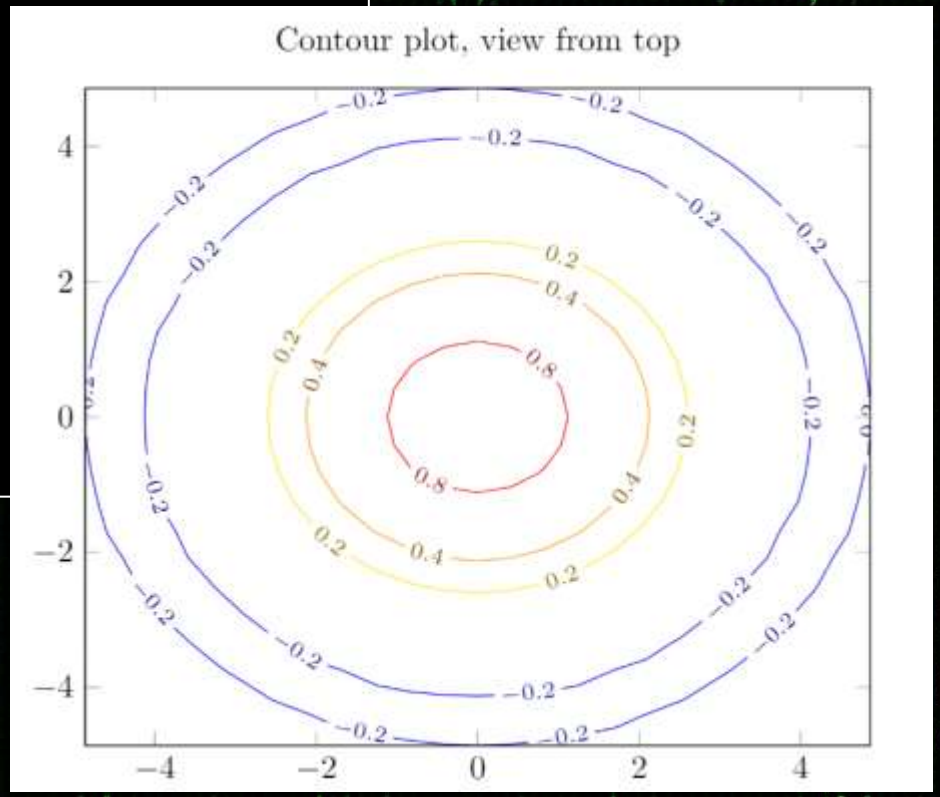
Fancy 3D plots

```
\begin{tikzpicture}

    \begin{axis}[
        title=Example using the mesh parameter,
        hide axis,
        colormap/cool,
    ]

        \addplot3[
            mesh,
            samples=50,
            domain=-8:8,
        ]
        {sin(deg(sqrt(x^2+y^2)))/sqrt(x^2+y^2)};

        \addlegendentry{\(\frac{sin(r)}{r}\)}

    \end{axis}

\end{tikzpicture}
```



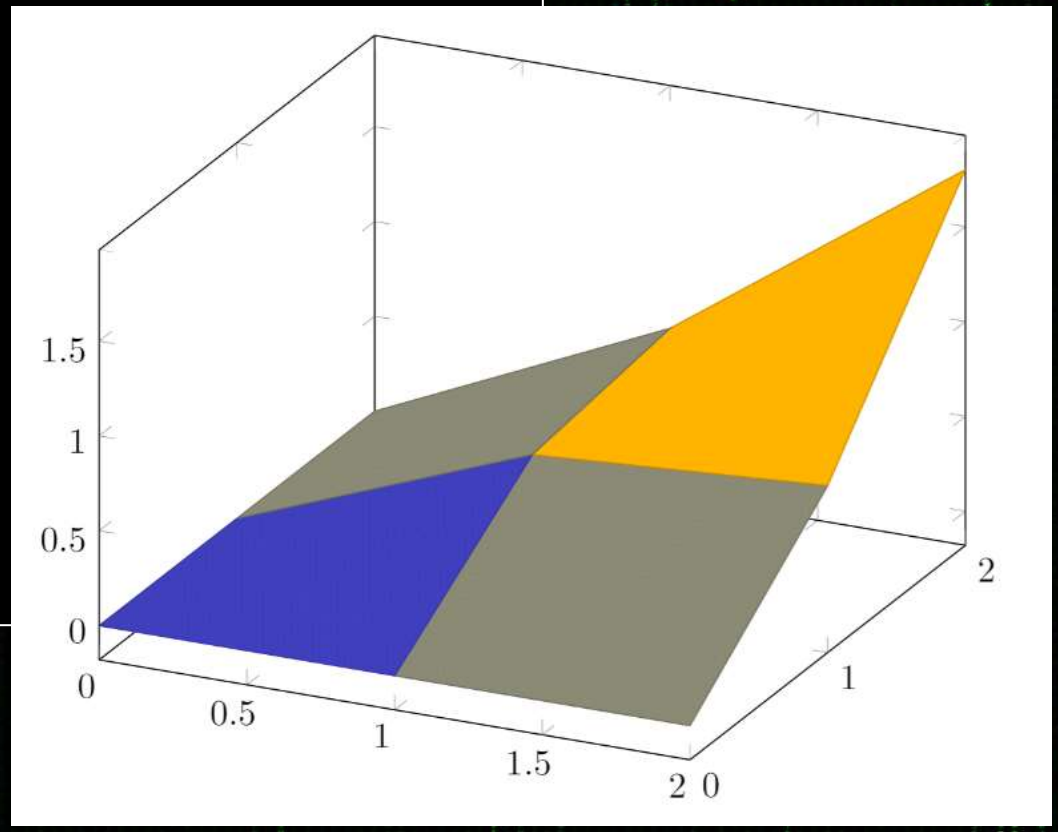
Contour plots

```
\begin{tikzpicture}

    \begin{axis}
    [
        title={Contour plot, view from top},
        view={0}{90}
    ]

    \addplot3[
        contour gnuplot={levels={0.8, 0.4, 0.2, -0.2}}
    ]
    {sin(deg(sqrt(x^2+y^2)))/sqrt(x^2+y^2)};

    \end{axis}

\end{tikzpicture}
```



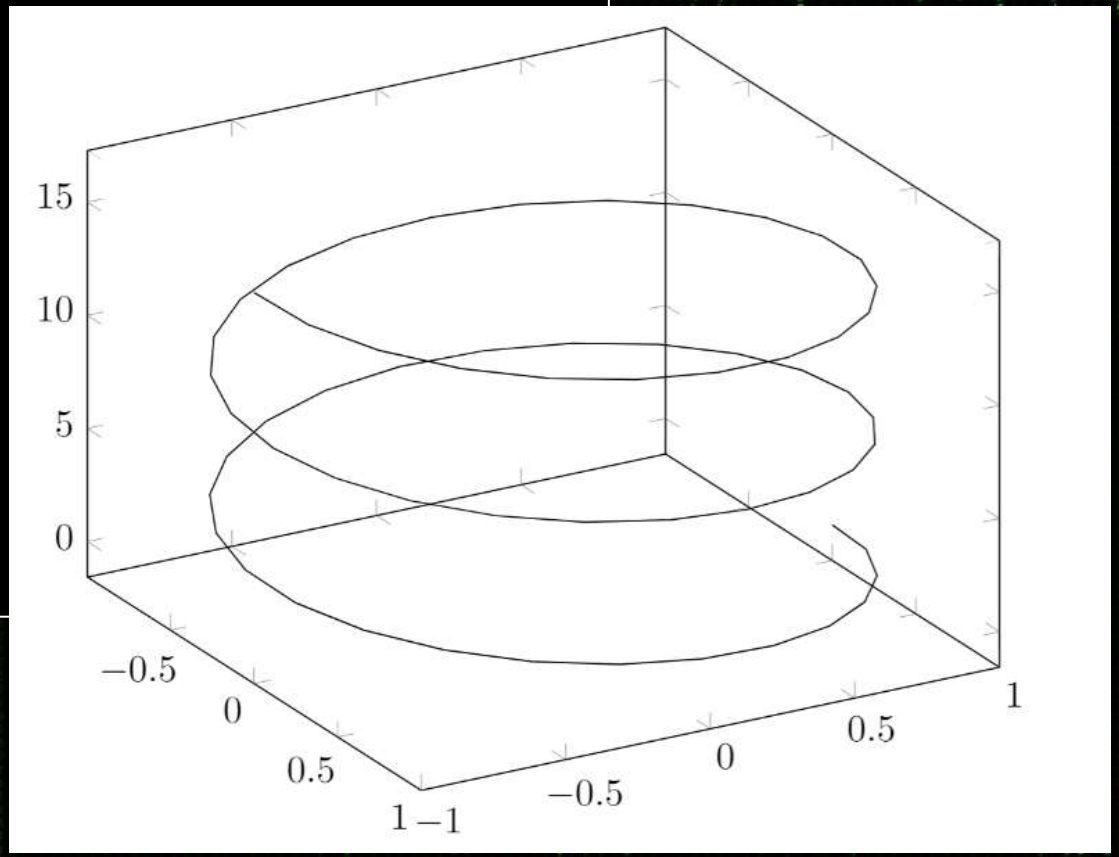
Plotting a surface from data

```
\begin{tikzpicture}

    \begin{axis}

        \addplot3[
            surf,
        ]

        coordinates {
        (0,0,0) (0,1,0) (0,2,0)

        (1,0,0) (1,1,0.6) (1,2,0.7)

        (2,0,0) (2,1,0.7) (2,2,1.8)
        };

    \end{axis}

\end{tikzpicture}
```



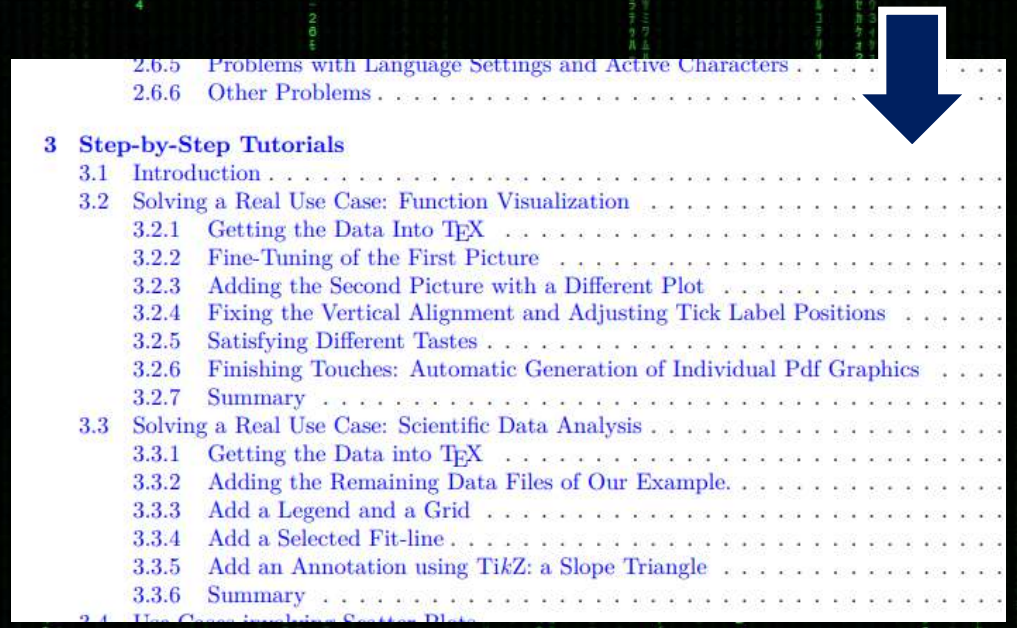
Parametric plot

```
\begin{tikzpicture}

    \begin{axis}[
        view={60}{30},
        ]

          \addplot3[
              domain=0:5*pi,
              samples = 60,
              samples y=0,
          ]

          ({sin(deg(x))},
          {cos(deg(x))},
          {x});

    \end{axis}

\end{tikzpicture}
```



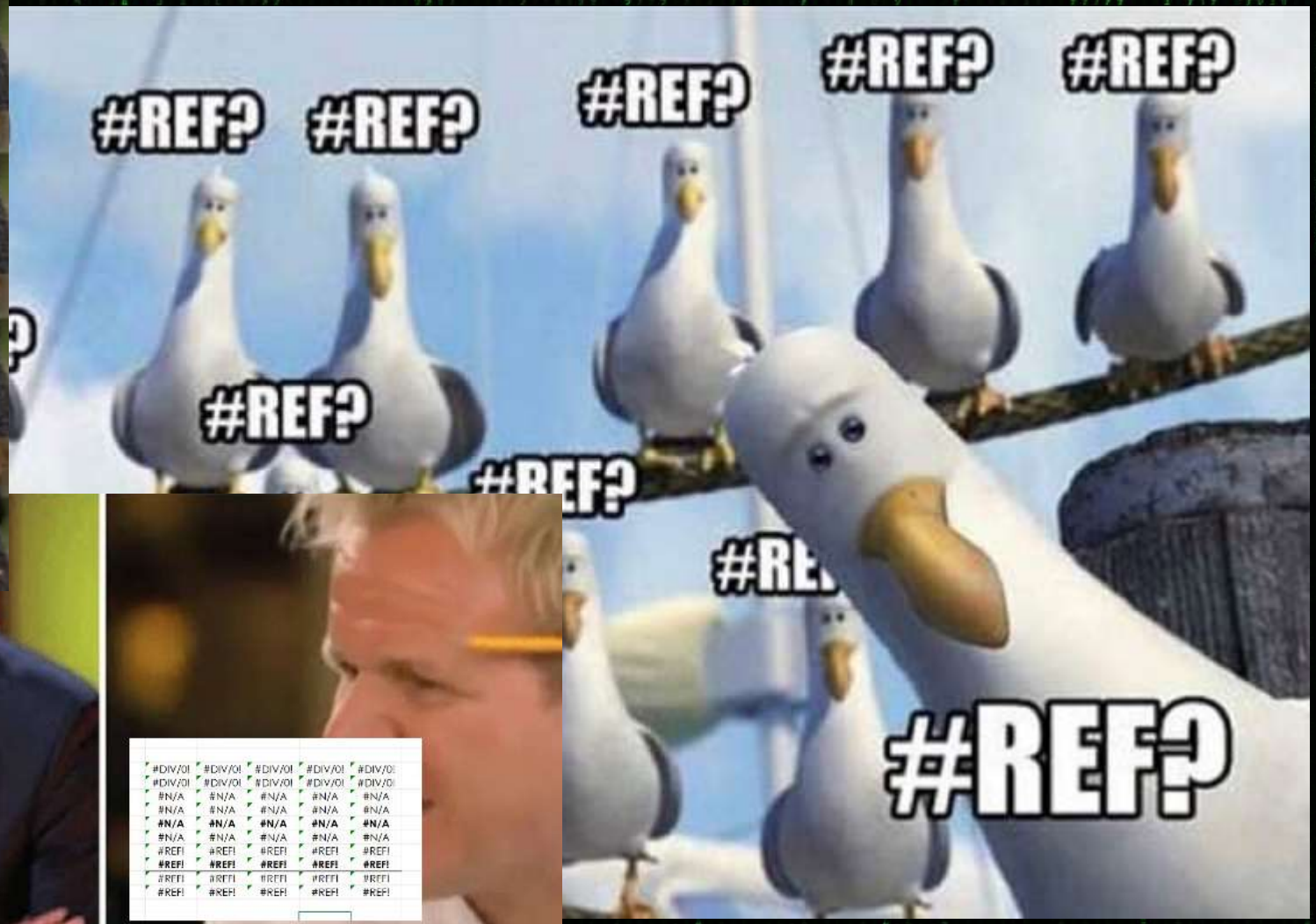
Further information

You can find futher information about this package inside the pgfplots package documentation. Anyway, here you can find some other interesting commands and environments, some of the most used ones.



Command/Option/ Environment	Description	Possible Values
axis	Normal plots with linear scaling	
semilogxaxis	logarithmic scaling of x and normal scaling for y	
semilogyaxis	logarithmic scaling for y and normal scaling for x	
loglogaxis	logarithmic scaling for the x and y axes	
axis lines	changes the way the axes are drawn. default is 'box	box, left, middle, center, right, none
legend pos	position of the legend box	south west, south east, north west, north east, outer north east
mark	type of marks used in data plotting. When a single-character is used, the character appearance is very similar to the actual mark.	*, x , +, |, o, asterisk, star, 10-pointed star, oplus, oplus*, otimes, otimes*, square, square*, triangle, triangle*, diamond, halfdiamond*, halfsquare*, right*, left*, Mercedes star, Mercedes star flipped, halfcircle, halfcircle*, pentagon, pentagon*, cubes. (cubes only work on 3d plots).
colormap	colour scheme to be used in a plot, can be personalized but there are some predefined colormaps	hot, hot2, jet, blackwhite, bluered, cool, greenyellow, redyellow, violet.


Me:
Excel:
12
12
.
.
5
5
12.5
1/12/1900
12:00:00 PM

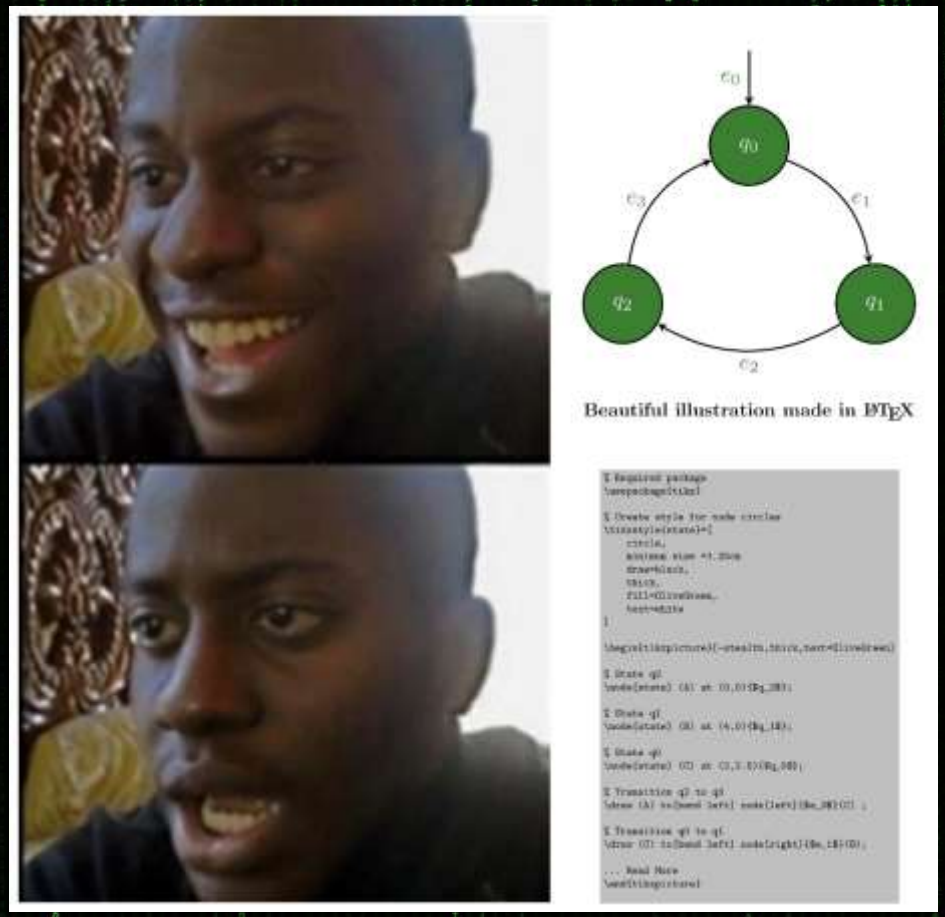

#REF?
#REF?
#REF?
#REF?
#REF?
#REF?
#REF?


date, intersect, setdiff,
> ymd('19-01-2020')
[1] NA
Warning message:
All formats failed to parse. N
> 1+'sd'
Error in 1 + "sd" : non-numeri
>
Oh dear, oh dear. Gorgeous.

#DIV/0!
#N/A
#REF!
You f g donkey.

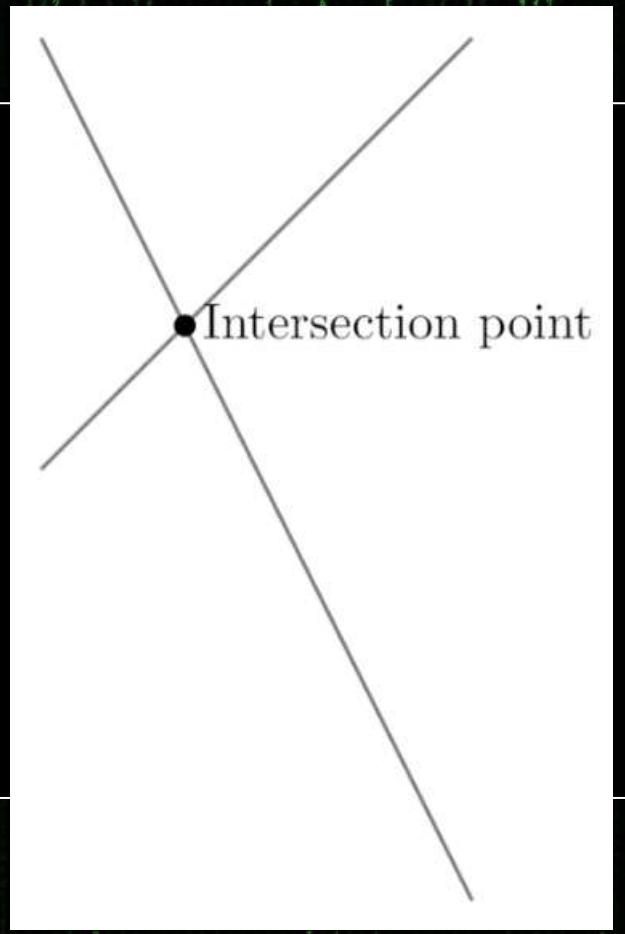
TikZ package

- TikZ is probably the most complex and powerful tool to create graphic elements in LaTeX.
- Starting with a simple example, we will introduce some basic concepts: drawing lines, dots, curves, circles, rectangles etc. Then, we'll focus on how Engineers use it.
- PGF & TikZ are complementary packages. In fact, PGF (Portable Graphics Format) is the basic layer, providing a set of basic commands for producing graphics, and TikZ (TikZ ist kein Zeichenprogramm) is the frontend layer with a special syntax, making the use of PGF easier.



Try it by yourself

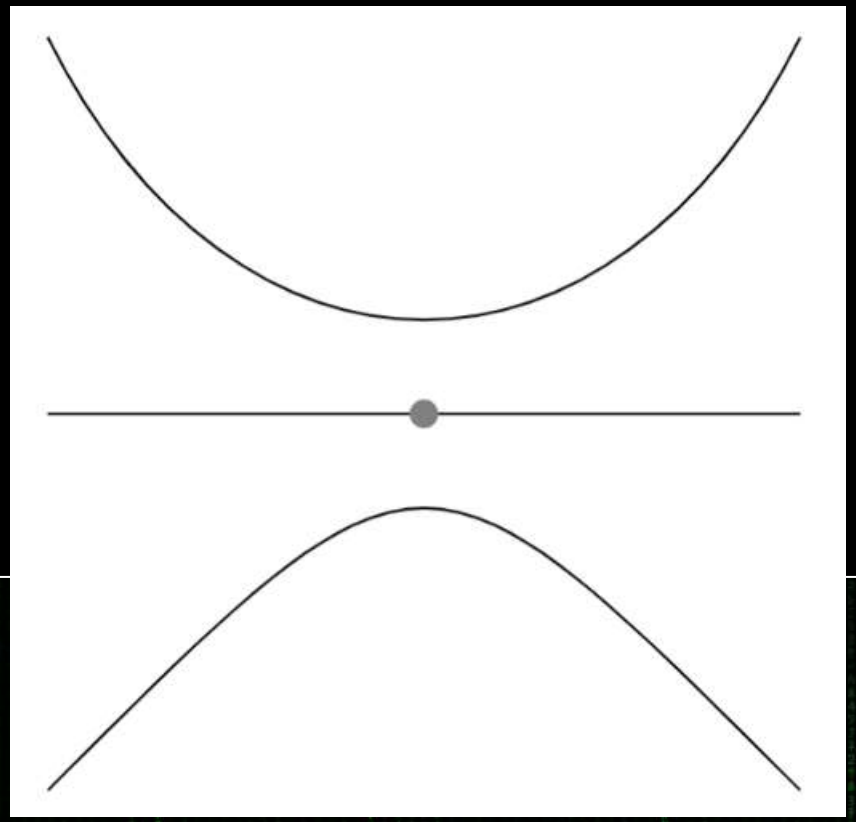
```
\documentclass{article}
\usepackage{tikz}

\begin{document}

\begin{tikzpicture}

    \draw[gray, thick] (-1,2) -- (2,-4);

    \draw[gray, thick] (-1,-1) -- (2,2);

    \filldraw[black] (0,0) circle (2pt) node[
    anchor=west]{Intersection point};

\end{tikzpicture}

\end{document}
```



Basic elements: points, lines and paths

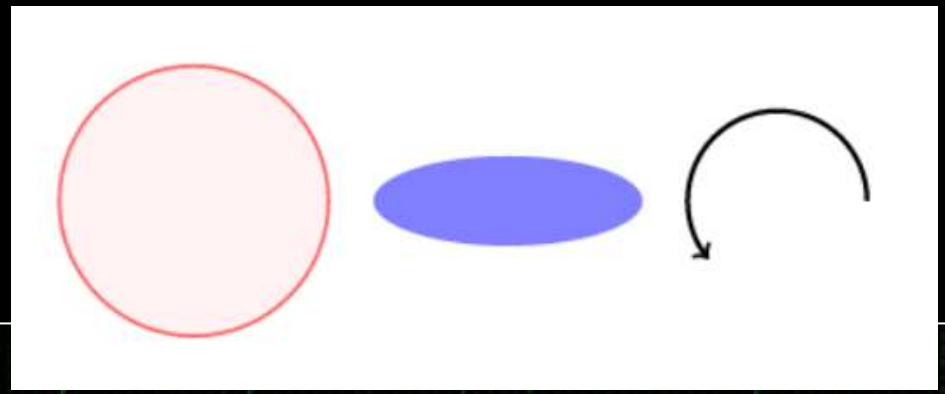
```
\documentclass{article}
\usepackage{tikz}

\begin{document}

\begin{tikzpicture}

    \draw (-2,0) -- (2,0);
    \filldraw [gray] (0,0) circle (2pt);
    \draw (-2,-2) .. controls (0,0) .. (2,-2);
    \draw (-2,2) .. controls (-1,0) and (1,0) .. (2,2);

\end{tikzpicture}

\end{document}
```

Notice the different curvature!



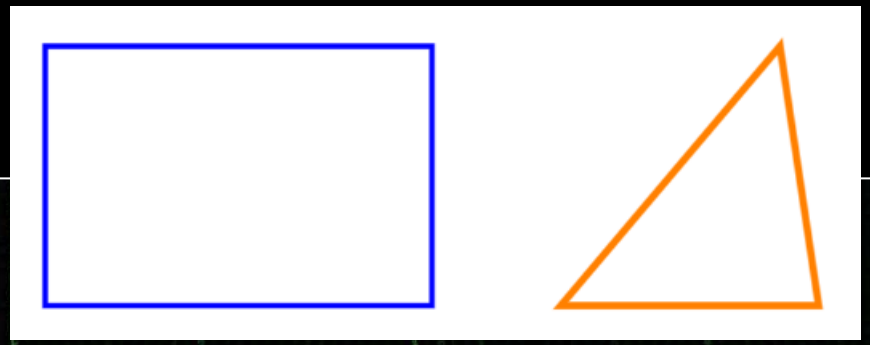
Basic geometric shapes: ellipses, polygons

```
\documentclass{article}
\usepackage{tikz}

\begin{document}

\begin{tikzpicture}

    \filldraw[color=red!60, fill=red!5, very thick](-1,0) circle (1.5);

    \fill[blue!50] (2.5,0) ellipse (1.5 and 0.5);

    \draw[ultra thick, ->] (6.5,0) arc (0:220:1);

\end{tikzpicture}

\end{document}
```



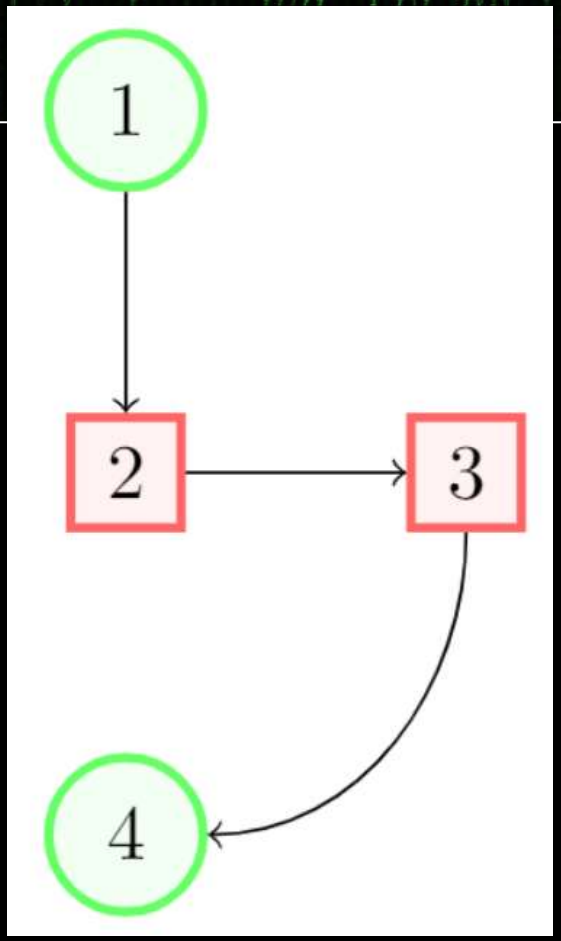
Basic geometric shapes: ellipses, polygons

```
\documentclass{article}
\usepackage{tikz}

\begin{document}

\begin{tikzpicture}

    \draw[blue, very thick] (0,0) rectangle (3,2);

    \draw[orange, ultra thick] (4,0) -- (6,0) -- (5.7,2) -- cycle;

\end{tikzpicture}

\end{document}
```



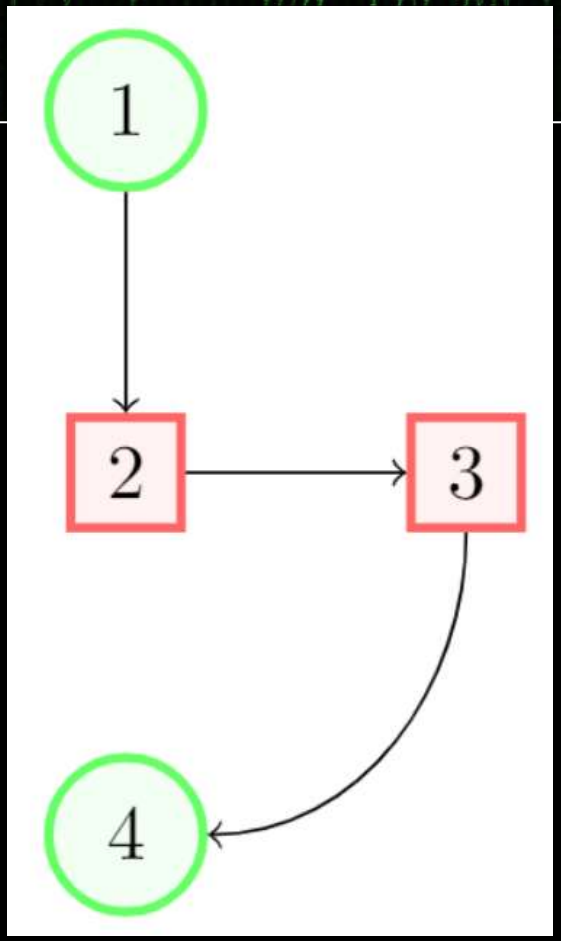
Diagrams

```
\documentclass{article}
\usepackage{tikz}
\usetikzlibrary{positioning}

\begin{document}
     \begin{tikzpicture}[roundnode/.style={
                circle, draw=green!60,
                fill=green!5,
                very thick,
                minimum size=7mm},
                squarednode/.style={rectangle,
                draw=red!60,
                fill=red!5,
                very thick,
                minimum size=5mm},]

          \node[squarednode]   (maintopic)                          {2};
          \node[roundnode]     (uppercircle)   [above=of maintopic] {1};
          \node[squarednode]   (rightsquare)   [right=of maintopic] {3};
          \node[roundnode]     (lowercircle)   [below=of maintopic] {4};

          \draw[->] (uppercircle.south) -- (maintopic.north);
          \draw[->] (maintopic.east) -- (rightsquare.west);
          \draw[->] (rightsquare.south) .. controls +(down:7mm) and +(right:7mm) .. (lowercircle.east);

     \end{tikzpicture}
\end{document}
```

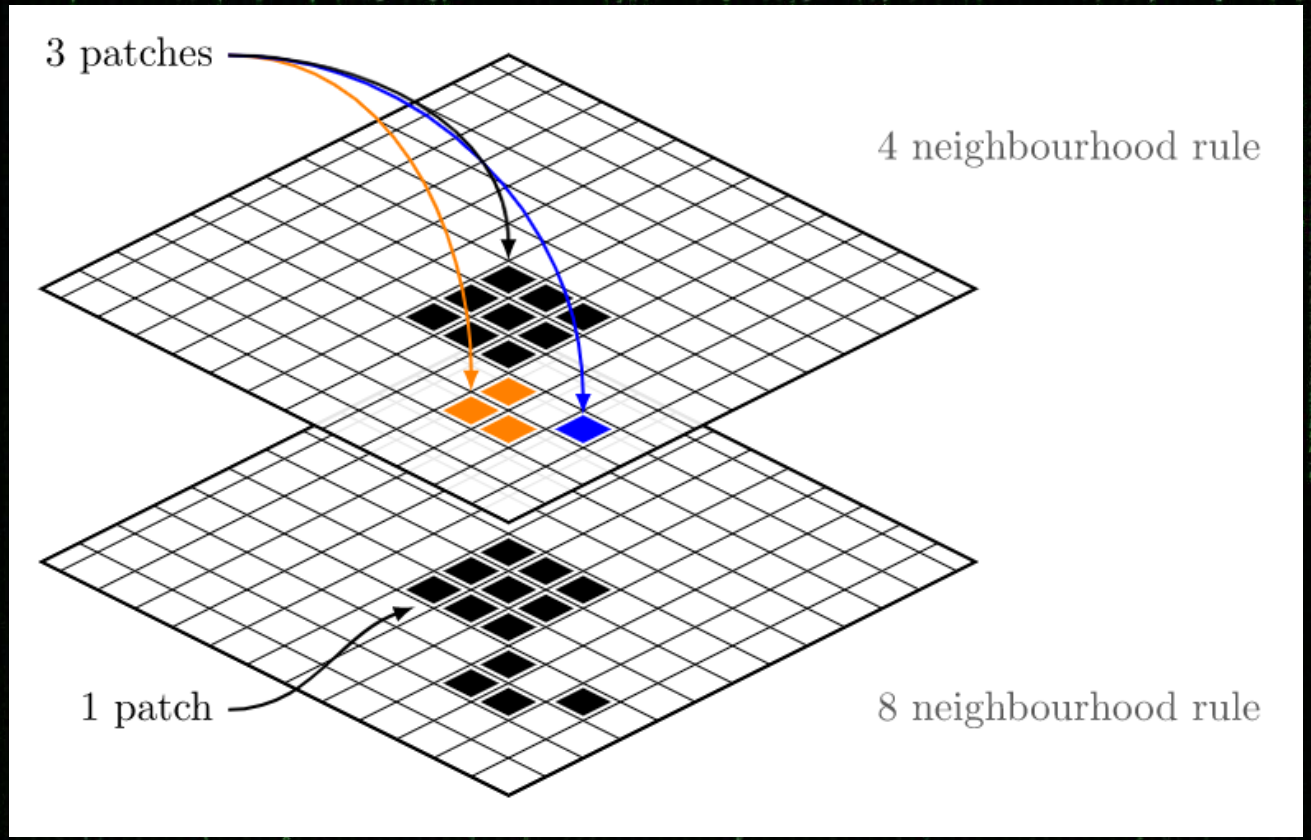


Diagrams

```
\documentclass{article}
\usepackage{tikz}
\usetikzlibrary{positioning}

\begin{document}
     \begin{tikzpicture}[roundnode/.style={
                circle, draw=green!60,
                fill=green!5,
                very thick,
                minimum size=7mm},
                squarednode/.style={rectangle,
                draw=red!60,
                fill=red!5,
                very thick,
                minimum size=5mm},]

          \node[squarednode]   (maintopic)                          {2};
          \node[roundnode]     (uppercircle)   [above=of maintopic] {1};
          \node[squarednode]   (rightsquare)   [right=of maintopic] {3};
          \node[roundnode]     (lowercircle)   [below=of maintopic] {4};

          \draw[->] (uppercircle.south) -- (maintopic.north);
          \draw[->] (maintopic.east) -- (rightsquare.west);
          \draw[->] (rightsquare.south) .. controls +(down:7mm) and +(right:7mm) .. (lowercircle.east);

     \end{tikzpicture}
\end{document}
```



A tricky example



A tricky example – Code, Part 1/3

```
\documentclass{article}
\usepackage{tikz}
\usetikzlibrary{positioning}

\begin{document}
     \begin{tikzpicture}[scale=.8,every node/.style={minimum size=1cm},on grid]
     %
        \begin{scope}[
                yshift=-83,every node/.append style={
                yslant=0.5,xslant=-1},yslant=0.5,xslant=-1
                ]
            \draw[step=4mm, black] (0,0) grid (5,5);
            \draw[black,thick] (0,0) rectangle (5,5);%borders
            \fill[greenMW] (2.05,2.05) rectangle (2.35,2.35); % center pixel
            \fill[greenMW] (1.65,2.05) rectangle (1.95,2.35); %left
            \fill[greenMW] (2.45,2.05) rectangle (2.75,2.35); %right
            \fill[greenMW] (2.05,2.45) rectangle (2.35,2.75); %top
            \fill[greenMW] (2.05,1.95) rectangle (2.35,1.65); %bottom
     % 8 -pixel setting
            \fill[greenMW] (1.65,2.45) rectangle (1.95,2.75); %top-left
            \fill[greenMW] (2.45,2.45) rectangle (2.75,2.75); %top-right
            \fill[greenMW] (2.75,1.95) rectangle (2.45,1.65); %bottom-right
            \fill[greenMW] (1.65,1.95) rectangle (1.95,1.65); %bottom-left


     ...
```

A tricky example – Code, Part 2/3

```
...

% 2. ring
        \fill[greenMW] (1.25,1.55) rectangle (1.55,1.25); %bottom-left
        \fill[greenMW] (0.85,1.55) rectangle (1.15,1.25); %bottom-left
        \fill[greenMW] (0.85,1.15) rectangle (1.15,0.85); %bottom-left
        \fill[greenMW] (1.25,0.75) rectangle (1.55,0.45); %bottom-left
    \end{scope}
%
    \begin{scope}[
            yshift=0,every node/.append style={
            yslant=0.5,xslant=-1},yslant=0.5,xslant=-1
            ]
        \fill[white,fill opacity=0.9] (0,0) rectangle (5,5);
        \draw[step=4mm, black] (0,0) grid (5,5); %grid definition
        \draw[black,thick] (0,0) rectangle (5,5);%borders
        \fill[greenMW] (2.05,2.05) rectangle (2.35,2.35); % center pixel
        \fill[greenMW] (1.65,2.05) rectangle (1.95,2.35); %left
        \fill[greenMW] (2.45,2.05) rectangle (2.75,2.35); % right
        \fill[greenMW] (2.05,2.45) rectangle (2.35,2.75); % top
        \fill[greenMW] (2.05,1.95) rectangle (2.35,1.65); % bottom


...
```

A tricky example – Code, Part 3/3

```
...

% 4 -pixel setting
       \fill[greenMW] (1.65,2.45) rectangle (1.95,2.75); %top-left
       \fill[greenMW] (2.45,2.45) rectangle (2.75,2.75); %top-right
       \fill[greenMW] (2.75,1.95) rectangle (2.45,1.65); %bottom-right
       \fill[greenMW] (1.65,1.95) rectangle (1.95,1.65); %bottom-left
% 2. ring
       \fill[orange] (1.25,1.55) rectangle (1.55,1.25);
       \fill[orange] (0.85,1.55) rectangle (1.15,1.25);
       \fill[orange] (0.85,1.15) rectangle (1.15,0.85);
       \fill[blue] (1.25,0.75) rectangle (1.55,0.45);
   \end{scope}
% draw annotations
   \draw[-latex,thick,orange](-3,5)node[left]{ }
       to[out=0,in=90] (-.4,1.4);
   \draw[-latex,thick,blue](-3,5)node[left]{ }
       to[out=0,in=90] (0.8,1.15);
   \draw[-latex,thick,greenMW](-3,5)node[left]{3 patches}
       to[out=0,in=90] (0,2.8);
   \draw[-latex,thick,greenMW](-3,-2)node[left]{1 patch}
       to[out=0,in=200] (-1,-.9);
   \draw[thick,gray!70!black](6,4) node {4 neighbourhood rule};
   \draw[thick,gray!70!black](6,-2) node {8 neighbourhood rule};

\end{tikzpicture}
```

PGF / TikZ & Engineering

The increasing popularity of TikZ suggested to the developers to create dedicated editors, such as:

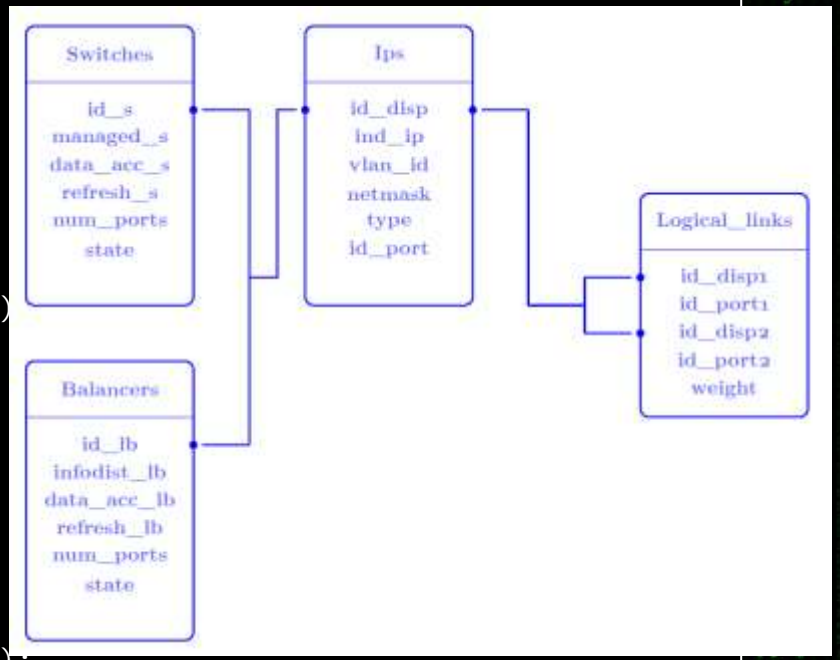
- Inkscape, MATLAB, Octave and GeoGebra, which can draw vectorial graphics and then export it in TikZ format;
- TikzEdit, Ktikz and Qtikz, which work in a way similar to Overleaf's.

At this stage, why should you learn another coding language if here are many valid editors for drawings and plots?

- Precision;
- Variation;
- Repetition.

Databases – Part 1/3

```
\documentclass { article }
\usepackage { tikz }
\newcommand { \mysize }[1]{ \footnotesize { \textbf {#1}}}
\begin { document }
     \begin { tikzpicture }[blue ,thick , text = blue !60 , scale =0.9 ]
     % Load Balancers
          \draw [ rounded corners , blue ] ( -0. ,6) rectangle (3 ,11);
          \node at (1.5 ,10.5){ \mysize { Balancers }};
          \draw [ thin ] (0 ,10) - -(3 ,10);
          \node at (1.5 ,9.5){ \mysize {id \_ lb }};
          \node at (1.5 ,9){ \mysize { infodist \_ lb }};
          \node at (1.5 ,8.5){ \mysize { data \_ acc \_ lb }};
          \node at (1.5 ,8){ \mysize { refresh \_ lb }};
          \node at (1.5 ,7.5){ \mysize { num \_ ports }};
          \node at (1.5 ,7){ \mysize { state }};
          % Switches
          \draw [ rounded corners , blue ] (0 ,12) rectangle (3 ,17);
          \node at (1.5 ,16.5){ \mysize { Switches }};
          \draw [thin , blue ] (0 ,16) - -(3 ,16);
          \node at (1.5 ,15.5){ \mysize {id \_s }};
          \node at (1.5 ,15){ \mysize { managed \_s }};
          \node at (1.5 ,14.5){ \mysize { data \_ acc \_s }};
          \node at (1.5 ,14){ \mysize { refresh \_s }};
          \node at (1.5 ,13.5){ \mysize { num \_ ports }};
          \node at (1.5 ,13){ \mysize { state }};
          % Ips
          \draw [ rounded corners , blue ] (5 ,12) rectangle (8 ,17);

          ...
```



Databases – Part 2/3

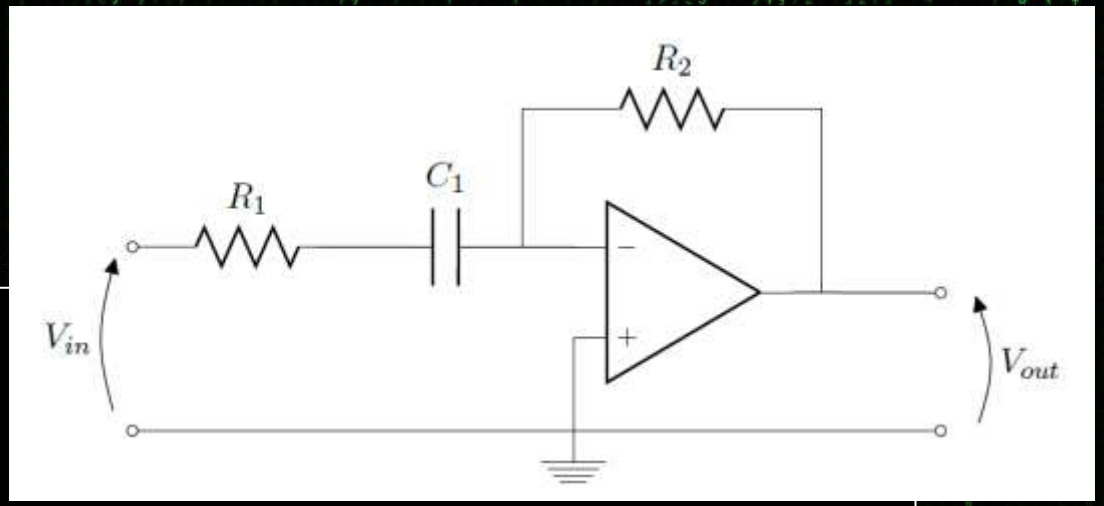
```
...

\node at (6.5 ,16.5){ \mysize { Ips }};
\draw [ thin ] (5 ,16) - -(8 ,16);
\node at (6.5 ,15.5){ \mysize {id \_ disp }};
\node at (6.5 ,15){ \mysize { ind \_ ip }};
\node at (6.5 ,14.5){ \mysize { vlan \_ id }};
\node at (6.5 ,14){ \mysize { netmask }};
\node at (6.5 ,13.5){ \mysize { type }};
\node at (6.5 ,13){ \mysize {id \_ port }};
% Links Table
\draw [ rounded corners , blue ] (11 ,10) rectangle (14 ,14);
\node at (12.5 ,13.5){ \mysize { Logical \_ links }};
\draw [ thin ] (11 ,13) - -(14 ,13);
\node at (12.5 ,12.5){ \mysize {id \_ disp 1}};
\node at (12.5 ,12){ \mysize {id \_ port 1}};
\node at (12.5 ,11.5){ \mysize {id \_ disp 2}};
\node at (12.5 ,11){ \mysize {id \_ port 2}};
\node at (12.5 ,10.5){ \mysize { weight }};
% %%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%
% Collegamenti
% %%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%

...
```

Databases – Part 3/3

```
            ...

            % Punti
            \fill [ blue ] (3 ,9.5) circle (2 pt );
            \node (lb) at (3 ,9.5){};
            \fill [ blue ] (3 ,15.5) circle (2 pt );
            \node (s) at (3 ,15.5){};
            \fill [ blue ] (8 ,15.5) circle (2 pt );
            \node (ip) at (8 ,15.5){};
            \fill [ blue ] (5 ,15.5) circle (2 pt );
            \node (ip 2) at (5 ,15.5){};
            \fill [ blue ] (11 ,12.5) circle (2 pt );
            \node ( log _id_ disp 1) at (11 ,12.5){};
            \fill [ blue ] (11 ,11.5) circle (2 pt );
            \node ( log _id_ disp 2) at (11 ,11.5){};
            % %%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%
            % Linee
            \draw (lb ) - -(4 ,9.5);
            \draw (s ) - -(4 ,15.5) - -(4 ,9.5);
            \draw (4 ,12.5) - -(4.5 ,12.5) - -(4.5 ,15.5) - -( ip 2);
            \draw (ip ) - -(9 ,15.5);
            \draw (9 ,12) - -(9 ,15.5);
            \draw (10 ,11.5) - -(10 ,12.5);
            \draw (9 ,12) - -(10 ,12);
            \draw ( log _id_ disp 1) - -(10 ,12.5);
            \draw ( log _id_ disp 2) - -(10 ,11.5);
        \end {tikzpicture}
    \end {document}
```

Electronics

```
\documentclass { article }
\usepackage { circuitikz }

\begin { document }
     \begin { circuitikz }
          \draw ( -1 ,0) to[R,l ^=$ R_1$ ,o-] (1.5 ,0);
          \draw (1 ,0) to [C,l ^=$ C _1$ ] (3.82 , -0.005);
          \draw (3.25 ,0) to[ short ] (3.25 ,1.5);
          \draw (5 , -0.495) node [op amp ] {};
          \draw (3.8 , -0.995) - -(3.8 , -2);
          \node [ ground ]at (3.8 , -2){};
          \draw (3.25 ,1.5) to [R,l ^=$ R _2$ ] (6.5 ,1.5);
          \draw (6.5 ,1.5) - -(6.5 , -0.5);
          \draw (6.19 , -0.495) to[short ,-o] (7.8 , -0.5){};
          \draw (8.1 , -0.55) to [open ,v^ <=$\, V_{ out }\,$] (8.1 , -2);
          \draw ( -1.1 ,0) to [open ,v_ <=$\,V_{ in}\,$] ( -1.1 , -2);
          \draw ( -1 , -2) to [short , o-o] (7.8 , -2);
     \end { circuitikz }
\end { document }
```



Try it by yourself

```
\documentclass { article }
\usepackage { circuitikz }
\definecolor { burntorange }{ cmyk }{0 ,0.51 ,1 ,0}

\begin { document }

    \begin { circuitikz }[ scale =0.7 ]

        \filldraw [ burntorange , very thick , dashed , fill = orange !8](5.4 , -0.6) - -
        (5.6 , -0.6) - -(5.6 , -1) - -(7.1 , -1) - -(7.1 , -4.2) - -(16.5 , -4.2) - -(16.5 ,3) - -
        (5.4 ,3) - -(5.4 , -0.6);
        \node [ rounded corners ,draw , fill = orange !8] at (10 ,4)
        { \small { Blocco non invertente }};
        \draw [-stealth ] (10 ,3.5) - -(11 ,2.5);
        % ------------------------------------------------
        \draw ( -0.8 ,0) to[R,l ^=$ R_1$ ,o-] (2 ,0);
        \draw (2 ,0) - -(2.8 ,0);
        \node [ scale =0.7 , op amp ] at (4 , -0.5){};
        \draw (5.2 , -0.5) to[R,l ^=$ R_1$ ,* -*] (7.8 , -0.5);
        \node [ scale =0.7 , op amp ] at (9 , -1){};
        \draw (10.2 , -1) to[R,l ^=$ R_4$ ,* -*] (12.3 , -1);
        \node [ scale =0.7 , op amp ] at (13.5 , -1.5){};
        \draw (14.7 , -1.5) to [short ,-o] (15.5 , -1.5);
        % ------------------------------------------------
        % morsetti a ground
        \draw (12.3 , -2) - -(12.3 , -3);

        ...
```

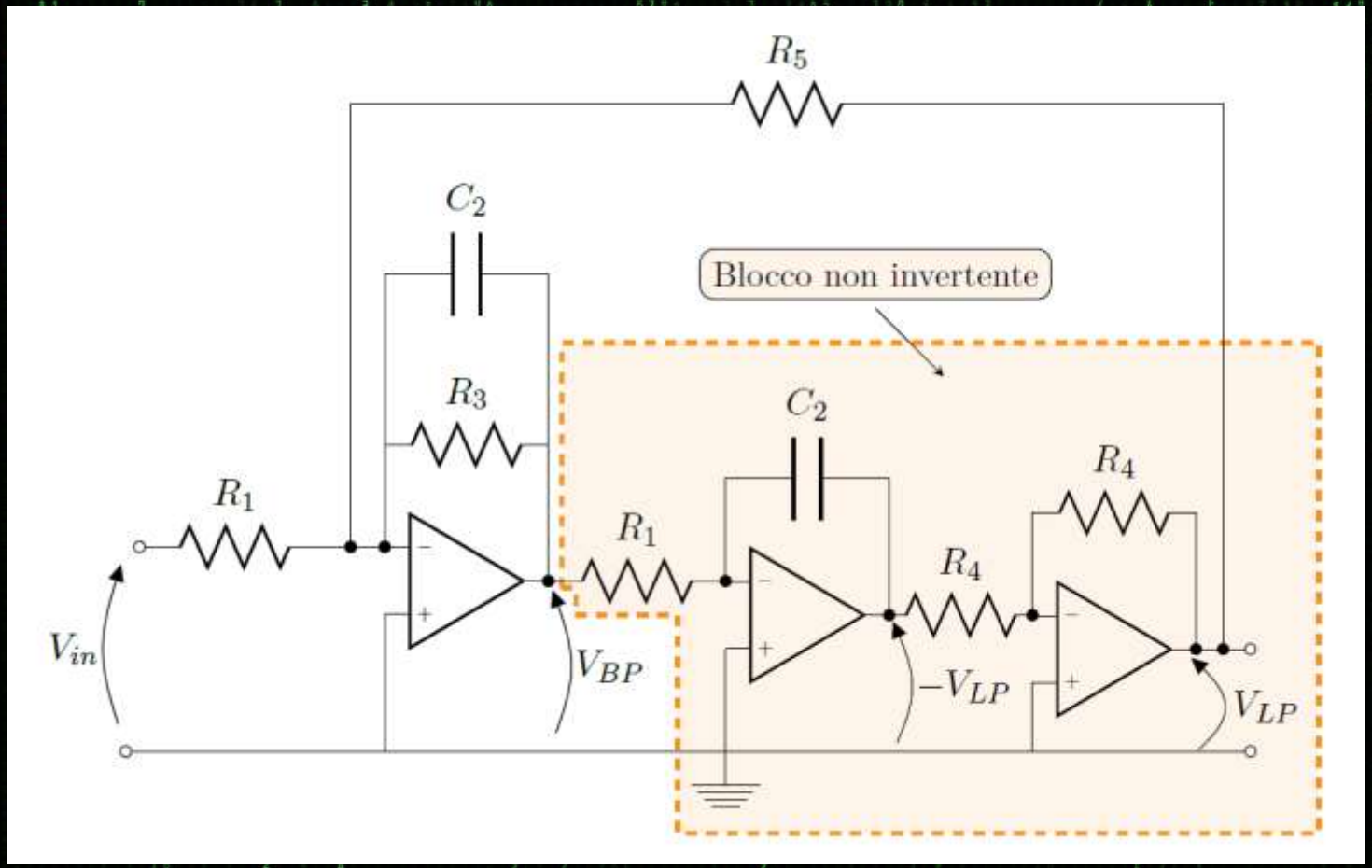
Try it by yourself

```
...

\draw (7.8 , -1.5) - -(7.8 , -3);
\draw (2.8 , -1) - -(2.8 , -3);
\draw ( -1 , -3) to [short ,o-o] (15.5 , -3);
\node [ ground ] at (7.8 , -3) {};
% ------------------------------------------------------
% invertente finale
\draw (12.3 , -1) - -(12.3 ,0.5);
\draw (14.7 , -1.5) to[short ,*-] (14.7 ,0.5);
\draw (12.3 ,0.5) to[R,l ^=$ R _4$ ] (14.7 ,0.5);
% ------------------------------------------------------
% invertente di mezzo
\draw (7.8 , -0.5) - -(7.8 ,1);
\draw (10.2 , -1) - -(10.2 ,1);
\draw (7.8 ,1) to[C,l ^=$ C _2$ ] (10.2 ,1);
% ------------------------------------------------------
% invertente iniziale
\draw (2.8 ,0) to[short ,*-] (2.8 ,4);
\draw (5.2 , -0.5) - -(5.2 ,4);
\draw (2.8 ,1.5) to[R,l ^=$ R _3$ ] (5.2 ,1.5);
\draw (2.8 ,4) to[C,l ^=$ C _2$ ] (5.2 ,4);
% ------------------------------------------------------
% resistenza R_5

...
```

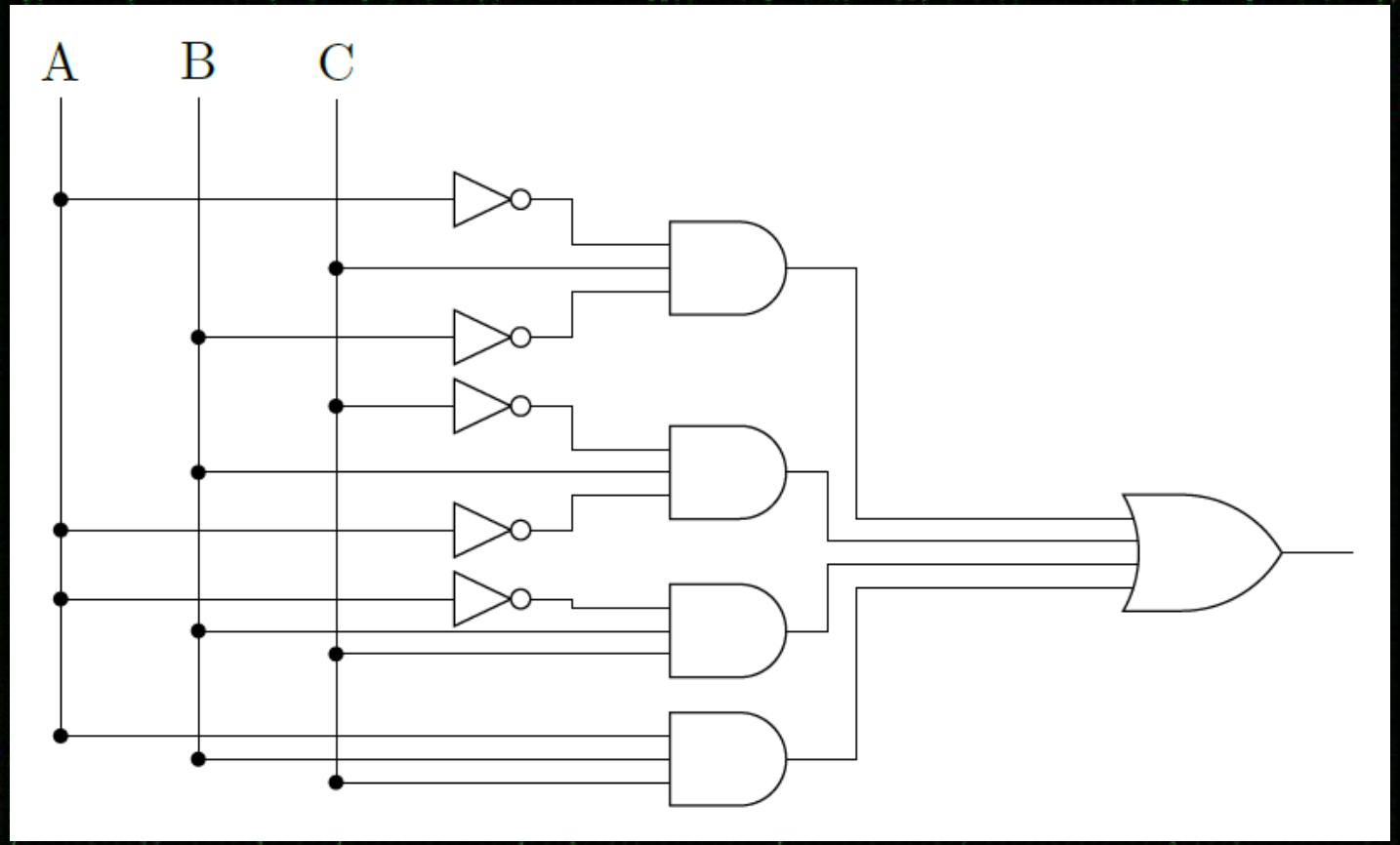
Try it by yourself

```
            ...

            \draw (15.1 , -1.5) to [short ,*-] (15.1 ,6.5);
            \draw (2.3 ,0) to [short ,*-] (2.3 ,6.5);
            \draw (2.3 ,6.5) to[R,l ^=$ R _5$ ] (15.1 ,6.5);
            % ------------------------------------------------------
            % tensioni
            \draw ( -1 , -2.9) to [open , v^ >=$V_{ in }$] ( -1 , -0.1);
            \draw (5.2 , -2.9) to [open , v >=$ V_{ BP }$] (5.2 , -0.6);
            \draw (10.2 , -2.9) to [open , v >=$ -V_{ LP }$] (10.2 , -1.2);
            \draw (14.85 , -2.8) to [open , v >=$ V_{ LP }$] (14.85 , -1.9);

      \end { circuitikz }

\end { document }
```

The result



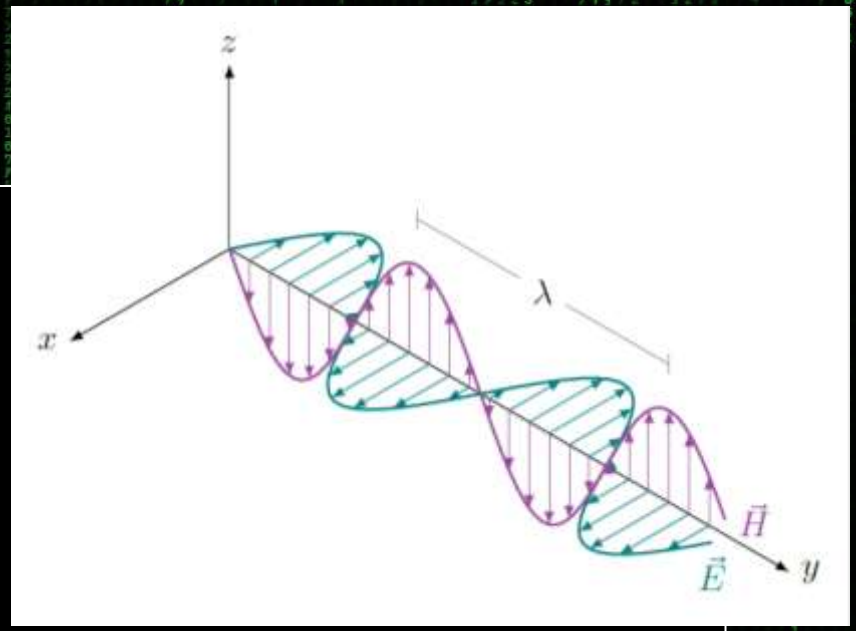
Assessment



Solution here (p. 22)

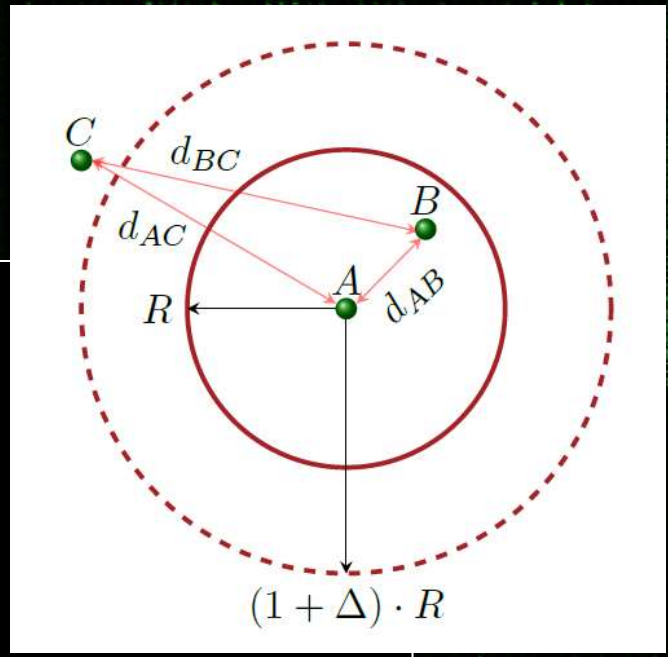
Electromagnetism

```
\documentclass [a4paper ,11 pt]{ article }
\usepackage { tikz }
\begin { document }
     \begin { tikzpicture }[
     x ={( -0.866 cm , -0.5 cm )},
     y ={(0.866 cm , -0.5 cm )},
     z ={(0 cm ,1 cm )}]
          \coordinate (O) at (0, 0, 0);
          \draw [-latex ] (O) -- +(2 , 0, 0) node [ left ] {$x $};
          \draw [-latex ] (O) -- +(0 , 7, 0) node [ right ] {$y $};
          \draw [-latex ] (O) -- +(0 , 0, 2) node [ above ] {$z $};
          % onde e vettori che indicano l' intensita ' dei campi
          \draw [thick , color =teal , variable =\x , samples at ={0 ,0.1 ,... ,6.3} ]
          plot ({- sin (2* \x r)},\x ,0) node [ anchor = north ]{$ \vec {E }$};
          \foreach \x in {0.25 , 0.5 ,... ,6}
          \draw [ color =teal ,- latex ] (0,\x ,0) -- ({- sin (2* \x r)},\x ,0);
          \draw [thick , color = purple , variable =\x , samples at ={0 ,0.1 ,... ,6.3} ]
          plot (0,\x ,{- sin (2* \x r )}) node [ anchor = west ]{$ \vec {H }$};
          \foreach \x in {0.25 , 0.5 ,... ,6}
          \draw [ color = purple ,- latex ] (0,\x ,0) -- (0,\x ,{- sin (2* \x r )});
          % lambda - " lunghezza d' onda " dell ' onda
          \draw [ help lines ] (0 ,2.35 ,1.4) -- (0 ,2.35 ,1.6);
          \draw [ help lines ] (0 ,5.49 ,1.4) -- (0 ,5.49 ,1.6);
          \draw [ help lines ] (0 ,2.35 ,1.5) -- (0 ,5.49 ,1.5)
          node [ pos =0.5 , fill =white , text = black ] {$ \lambda $};
     \end { tikzpicture }
\end { document }
```



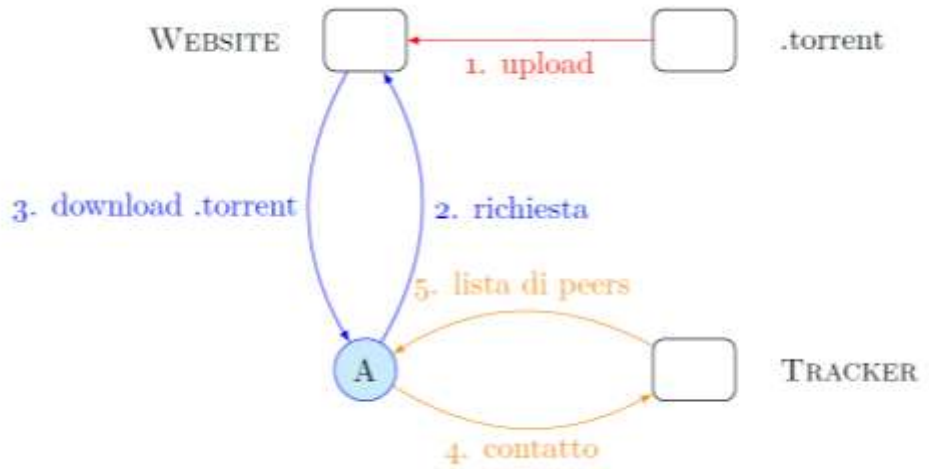
Networks

```
\documentclass { article }
\usepackage { tikz }
\definecolor { Eored }{ rgb }{.647 ,.129 ,.149}
\definecolor { Eogreen }{ rgb }{0 ,0.53 ,0}

\begin { document }
     \begin { center }
          \begin { tikzpicture }
               \draw [ very thick , Eored ] (0 ,0) circle [ radius =1.5 cm];
               \draw [ very thick , Eored , dashed ] (0 ,0) circle [ radius =2.5 cm];
               \draw [-stealth ] (0 ,0) - -( -1.5 ,0) node [ left ] {$R $};
               \draw [-stealth ] (0 ,0) - -(0 , -2.5) node [ below ] {$(1+ \Delta ) \cdot R $};
               \foreach \x/\y in {0/0 ,0.75/0.75/ , -2.5/1.4}
               \shade [ ball color = Eogreen ] (\x ,\y ) circle (0.1 cm );
               \node [ above ] at (0 ,0) {$A $};
               \node [ above ] at (0.75 ,0.75) {$B $};
               \node [ above ] at ( -2.5 ,1.4) {$C $};
               % --
               \path [ stealth - stealth ,red , opacity =0.5 ] (0.1 ,0.05) edge
               node [ sloped ,below , text =black , opacity =1]{$d_{ AB }$} (0.71 ,0.67);
               \path [ stealth - stealth ,red , opacity =0.5 ] ( -0.1 ,0.05) edge
               node [ near end ,below , text =black , opacity =1]{$d_{ AC }$} ( -2.4 ,1.4);
               \path [ stealth - stealth ,red , opacity =0.5 ] (0.68 ,0.73) edge
               node [ pos =0.65 , above , text =black , opacity =1]{$d_{ BC }$} ( -2.4 ,1.4);
          \end { tikzpicture }
     \end { center }
\end { document }
```

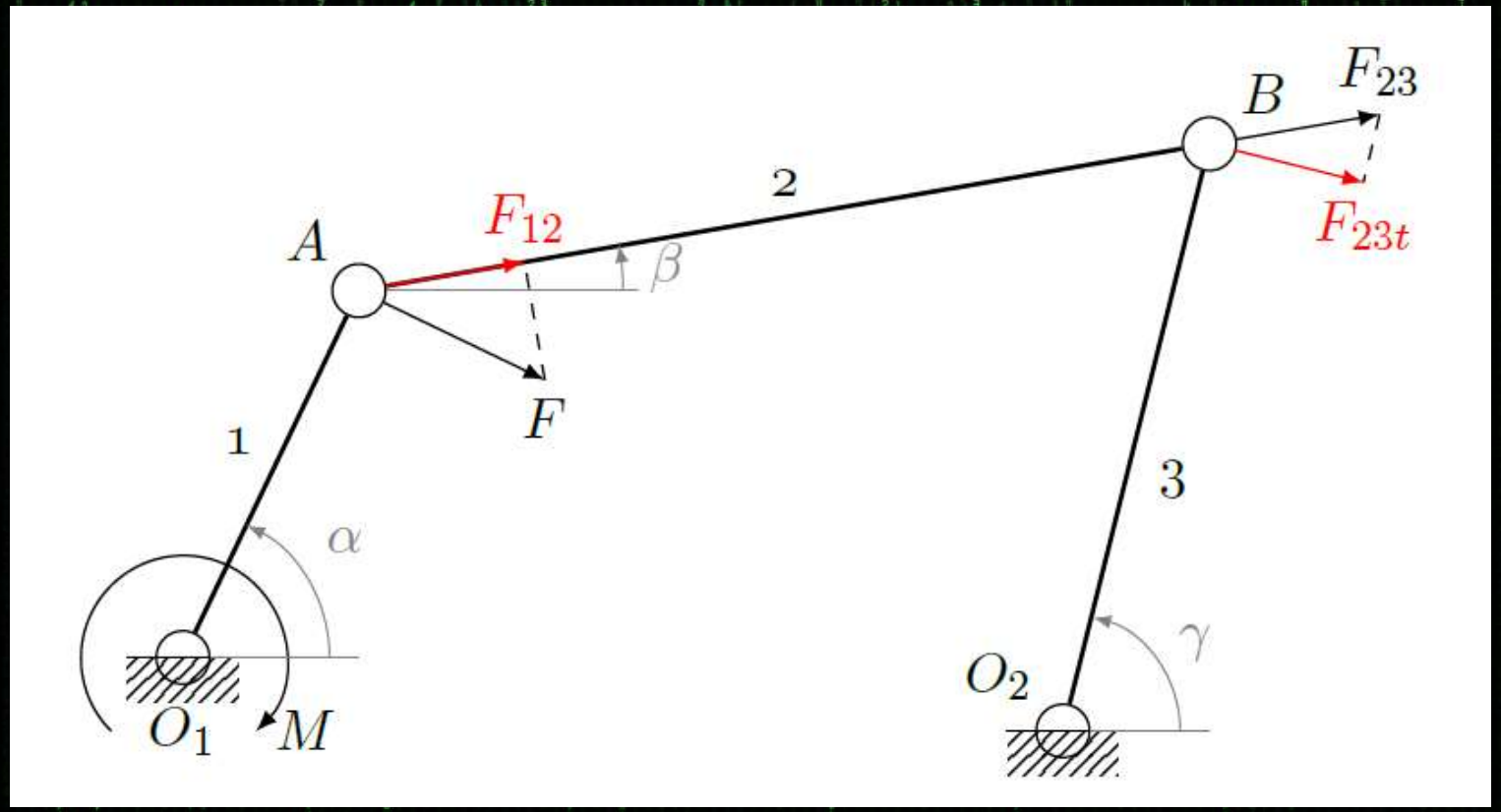


P2P Networks - Torrents

```
\documentclass { article }
\usepackage { tikz }
\usetikzlibrary { positioning }
\definecolor { burntorange }{ cmyk }{0 ,0.51 ,1 ,0}
\definecolor { processblue }{ cmyk }{0.96 ,0 ,0 ,0}

\begin { document }
     \begin { center }
          \begin { tikzpicture }[
          peer /. style ={
          circle, draw =blue, fill = processblue !20,
          minimum width =0.05 cm},
          mynode /. style ={
          rectangle, draw, rounded corners,
          minimum width =1cm, minimum height =0.75 cm},
          auto, node distance = 4cm]
          \node [ mynode ] (A) at (0 ,0) {};
          \node [peer , below of= A] (B) {A};
          \node [ mynode , right of=A] (C) {};
          \node [ mynode , below of =C] (D) {};
          \node [ right = 0.4 cm of C] {. torrent };
          \node [ left = 0.4 cm of A] {
               \textsc { Website }};
          \node [ right = 0.4 cm of D] { \textsc {
               Tracker }};
          \path [-latex , red ] (C) edge []
          node {1. upload } (A);
          \path [-latex , blue ] (B) edge [ bend right ]
          node [ swap ] {2. richiesta } (A);
          \path [-latex , blue ] (A) edge [ bend right ]
          node [ swap ] {3. download . torrent } (B);
          \path [-latex , burntorange ] (B) edge [ bend right ]
          node [ swap ] {4. contatto } (D);
          \path [-latex , burntorange ] (D) edge [ bend right ]
          node [ swap ] {5. lista di peers } (B);
          \end { tikzpicture }
     \end { center }
\end { document }
```



Mechanics – Kinematic schemes



Mechanics – Kinematic schemes, part 1/3

```
\documentclass [a4paper ,11 pt]{ article }
\usepackage { tikz }
\usetikzlibrary {calc , intersections , patterns }

\begin { document }
     \begin { tikzpicture }[ >= latex ]
          %%% struttura
          % telaio :
          % http :// tex . stackexchange . com /a /13952/13304
          \tikzset { ground /. style ={ fill , pattern = north east lines , draw =none ,%
          minimum width =0.75 cm , minimum height =0.3 cm }}
          % punti di riferimento
          \node (A) at (0 ,0) [ circle , draw ] {};
          \node (B) at (1.2 ,2.5) [ circle , draw ] {};
          \node (C) at (7 ,3.5) [ circle , draw ] {};
          \node (D) at (6 , -0.5) [ circle , draw ] {};
          % disegno della struttura e del telaio
          \draw [ thick ] (A) -- (B) node [ pos =0.5 , above left ] {1};
          \draw [thick , name path =AB] (B) -- (C) node [ pos =0.5 , above ] {2};
          \draw [ thick ] (C) -- (D) node [ pos =0.5 , below right ] {3};
          \node (g1) at (A) [ ground , anchor = north ] {};
          \draw (g1. north west ) -- (g1. north east );

          ...
```

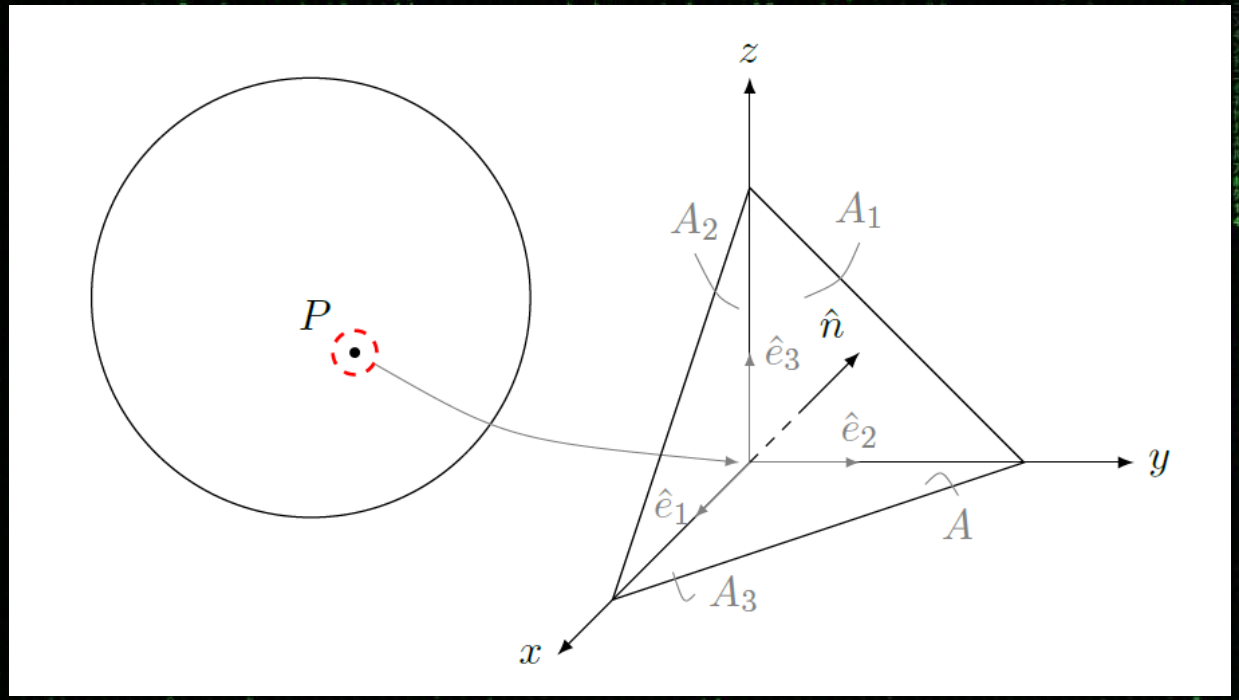
Mechanics – Kinematic schemes, part 2/3

```
...

\node (g2) at (D) [ ground , anchor = north ] {};
\draw (g2. north west ) -- (g2. north east );
% punti
\node [ below =6 pt] at (A) {$O _1$};
\node [ above left =3 pt] at (B) {$A $};
\node [ above right =3 pt] at (C) {$B $};
\node [ above left =3 pt] at (D) {$O _2$};
% momento di ingresso
\draw [ <-] ($( A )+(0.5 cm , -0.5 cm )$)
arc [ start angle = -45 , end angle =225 , radius =0.7 cm]
node [ pos =0, right ]{$M $};
% forza 1
\coordinate (f1) at ($( B )!1.4 cm !90:( A )$);
\draw [ ->] (B) -- (f1) node [ pos =1, below ] {$F $}; % forza
\draw [ dashed , name path =f1p](f1) - -($(B )!( f 1)!( C )$); % proiezione
raw [ name intersections ={ of=AB and f1p},red ,->](B)--( intersection -1)
node [ above ]{$F _{12}$}; % componente di forza
% forza 2
\coordinate (f2) at ($( B )!1.2!( C )$);
\draw [ ->] (C) -- (f2) node [ pos =1, above ] {$F _{23}$};
\coordinate (S) at ($( C )!2 cm !90:( D )$);
\path [ name path =s] (C) -- (S);
\draw [ dashed , name path =f2p] (f2) -- ($( C )!( f 2)!( S )$);
\draw [ name intersections ={ of=s and f2p},red ,->](C)--( intersection -1)
node [ below ]{$F _{23 t }$};

...
```

Mechanics – Kinematic schemes, part 3/3

```
            ...

            %%% angoli
            % alfa ( angolo motore in ingresso )
            \draw [ help lines ] (A) -- ++(1.2 cm ,0);
            \draw [ help lines ,->] ($( A )+(1 ,0)$)
            arc [ start angle =0, end angle =64 , radius =1];
            \node [ help lines ] at (1.1 ,.8) {$ \alpha $};
            % beta
            \draw [ help lines ] (B) -- ++(1.9 cm ,0);
            \draw [ help lines ,->] ($( B) + (1.8 ,0)$)
            arc [ start angle =0, end angle =10 , radius =1.8 ];
            \node [ help lines ] at ($( B) + (2.1 ,.15)$) {$ \beta $};
            % gamma
            \draw [ help lines ] (D) -- ++(1 cm ,0);
            \draw [ help lines ,->] ($( D )+(.8 ,0)$)
            arc [ start angle =0, end angle =75 , radius =0.8 ];
            \node [ help lines ] at ($( D) + (.9 ,.6)$) {$ \gamma $};
      \end { tikzpicture }
\end { document }
```

Mechanics – Cauchy solid



Mechanics – Cauchy solid, Part 1/2

```
documentclass [a4paper ,11 pt]{ article }
\usepackage { tikz }

\begin { document }
     \begin { tikzpicture }[y ={(1 cm ,0 cm )}, x ={( -0.5 cm , -0.5 cm )},
     z ={(0 cm ,1 cm )}] % sistema di riferimento tikz 3d
          %%% corpo ( sfera o forma qualsiasi )
          \draw (0 , -4 ,1.5) circle [ radius =2 cm];
          \draw [ fill ] (0 , -3.6 ,1) circle [ radius =.04 cm]
          node [ above left =.1 cm] {$P $};
          \node [ circle ,draw , dashed ,red ,thick , minimum size =0.4 cm] (o)
          at (0 , -3.6 ,1) {};
          \draw [ help lines ,- latex ] (o) .. controls (0 , -2.2 ,0.2)
          .. (0 , -0.1 ,0);
          %%% disegno sdr e versori di deformazione
          \coordinate (O) at (0, 0, 0);
          \draw [-latex ] (O) -- (3.5 , 0, 0) node [ left ] {$x $};
          \draw [-latex ] (O) -- (0, 3.5 , 0) node [ right ] {$y $};
          \draw [-latex ] (O) -- (0, 0, 3.5) node [ above ] {$z $};
          \draw [ help lines ,- latex ] (O) -- (1 ,0 ,0)
          node [ pos =0.8 , left ] {$ \hat {e }_1$};
          \draw [ help lines ,- latex ] (O) -- (0 ,1 ,0)
          node [ above ] {$ \hat {e }_2$};
          \draw [ help lines ,- latex ] (O) -- (0 ,0 ,1)
          node [ right ] {$ \hat {e }_3$};

          ...
```

Mechanics – Cauchy solid, Part 2/2

```
            %%% tetraedro
            \draw (2.5 ,0 ,0) -- (0 ,2.5 ,0) -- (0 ,0 ,2.5) -- cycle ;
            %%% versore n
            \draw [ dashed ] (0) -- (1 ,1 ,1);
            \draw [-latex ] (1 ,1 ,1) -- (2 ,2 ,2) node [ above left ] {$ \hat {n }$};
            %%% numerazione facce
            \draw [ help lines ] (0 ,0.5 ,1.5) .. controls ( -0.1 ,0.8 ,1.6) ..
            (0 ,1 ,2) node [ above ] {$A _1$};
            \draw [ help lines ] (0.2 ,0 ,1.5) .. controls (0.2 , -0.2 ,1.6) ..
            (0.2 , -0.4 ,2) node [ above ] {$A _2$};
            \draw [ help lines ] (2 ,0.3 ,0) .. controls (2.2 ,0.5 , -0.2) ..
            (2.4 ,0.7 ,0) node [ right ] {$A _3$};
            \draw [ help lines ] (0.4 ,1.8 ,0) .. controls (0.5 ,2 ,0.2) ..
            (0.6 ,2.2 ,0) node [ below ] {$A $};
      \end { tikzpicture }
\end { document }
```

reddit

r/LaTeX

Search Reddit

FEED

Popolari

ARGOMENTI

Gaming

Sports

Business, Economics, a...

Crypto

Television

Celebrity

More Topics

Crea un account per seguire le tue comunità preferite e partecipare alla conversazione.

Unisciti a Reddit

r/LaTeX

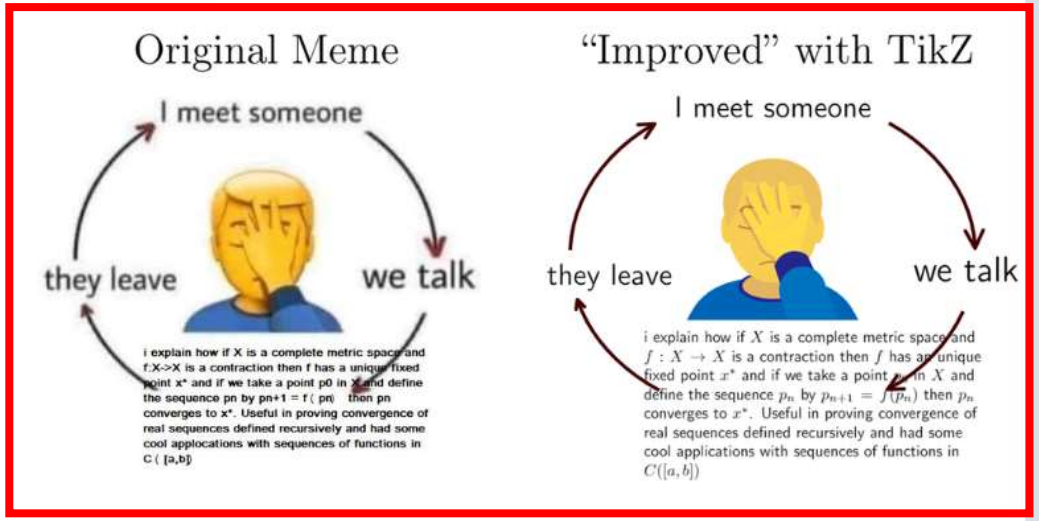
Post

Postato da . u/Arcturiss 2 anni fa

414

Friend complained that a meme (not mine) was not in LaTeX and I took that as a challenge to recreate it entirely in TikZ, poor text arrangement and all

LaTeX Showcase



99% upvotato

23 Commenti Condividi Salva Nascondi Segnalazione