Introdução ao TikZ

Primeiros passos

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October 23, 2025

O que é TikZ?

- **TikZ** = "TikZ ist *kein* Zeichenprogramm" (Alemão para "TikZ não é um programa de desenho")
- Pacote LaTeX para criar gráficos vetoriais **programaticamente**
- Usa comandos simples para desenhar formas, diagramas e ilustrações complexas
- Características principais:
  - Gráficos independentes de resolução
  - Integração nativa com LaTeX
  - Sistema de coordenadas com suporte a matemática
  - Sistema de camadas para desenho

O Criador: Till Tantau

- **Nome:** Till Tantau
- **Nacionalidade:** Alemã
- **Formação:**
  - Doutorado em Ciência da Computação
  - Universidade de Lübeck, Alemanha
- **Contribuições:**
  - Criador do pacote TikZ (2005)
  - Desenvolvedor do Beamer (classe para apresentações)
  - Membro do Grupo LaTeX3
- **Atuação:**
  - Professor de Algoritmos e Complexidade
  - Pesquisador em Teoria dos Grafos

Por que Usar TikZ?

- **Integração perfeita** com documentos
- Fontes e estilo consistentes
- Ideal para diagramas científicos
- Numeração/legendas automáticas
- Cria gráficos complexos a partir de comandos simples
- Melhor que imagens externas para:
  - Fluxogramas
  - Gráficos/Diagramas
  - Esquemas técnicos
  - Visualizações matemáticas

Estrutura de comandos

Comando para carregar o pacote

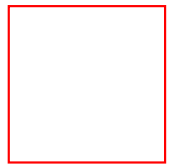
```
\usepackage{tikz}
```

Linhas

```
\begin{tikzpicture}[scale=0.5]
    \draw (0,0) -- (2,0);
\end{tikzpicture}
```



```
\begin{tikzpicture}[scale=0.5]
        \draw[red] (0,0) -- (2,0) -- (2,2) -- (0,2) -- cycle;
\end{tikzpicture}
```

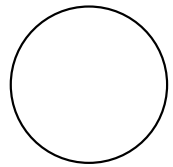


```
\begin{tikzpicture}[scale=0.5]
    \draw[->,thick,dashed] (0,0) -- (2,0);
\end{tikzpicture}
```

Estrutura de comandos

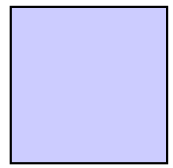
Círculo com centro em $(0, 0)$ e raio 1cm

```
\begin{tikzpicture}[scale=0.5]
\draw (0,0) circle (1cm);
\end{tikzpicture}
```



Retângulo com cantos $(3, 0)$ e $(5, 2)$

```
\begin{tikzpicture}[scale=0.5]
\draw[fill=blue!20] (3,0) rectangle (5,2);
\end{tikzpicture}
```



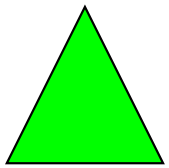
Estrutura de comandos

Elipse com centro em $(1, 1.5)$, raio maior 1cm e menor 0.5 cm

```
\begin{tikzpicture}[scale=0.5]
\draw[red] (1,1.5) ellipse (1cm and 0.5cm);
\end{tikzpicture}
```

Triângulo com vértices $(7, 0)$, $(8, 2)$ e $(9, 0)$

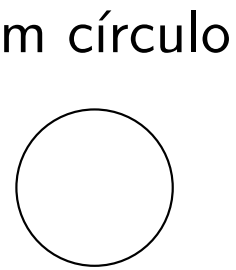
```
\begin{tikzpicture}[scale=0.5]
\draw[fill=green] (7,0) -- (8,2) -- (9,0) -- cycle;
\end{tikzpicture}
```



Estrutura de comandos

Posicionando texto em figuras

```
\begin{tikzpicture}[scale=0.5]
\draw (0,0) circle (1cm);
\node at (0,2) {Um círculo};
\end{tikzpicture}
```



Nó com caixa

```
\begin{tikzpicture}[scale=0.5]
\node[draw] at (2,2) {Texto};
\end{tikzpicture}
```

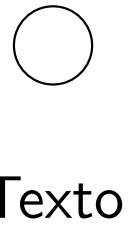
Estrutura de comandos

Texto ao longo de setas

```
\begin{tikzpicture}[scale=0.5]
\draw[->, thick] (0.5,0.5)
-- node[above] {Linha} (3.5,0.5);
\end{tikzpicture}
```

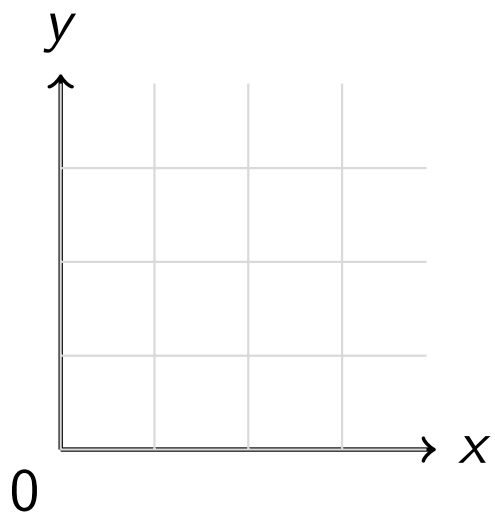
Mais um exemplo de node

```
\begin{tikzpicture}[scale=0.5]
\draw (1,2) circle (0.5)
node[below=0.7cm] {Legenda};
\end{tikzpicture}
```



Exemplo - Sistema de Coordenadas

```
\begin{tikzpicture}[scale=0.8]
  % Eixos coordenados
  \draw[thick, ->] (0,0) -- (4,0) node[right] {$x$};
  \draw[thick, ->] (0,0) -- (0,4) node[above] {$y$};

  % Grades
  \draw[gray!30] (0,0) grid (3.9,3.9);

  % Origem
  \node[below left] at (0,0) {0};
\end{tikzpicture}
```



Pré-definições

```
\begin{tikzpicture}[node distance=1.5cm,
    estilo1/.style={rectangle, rounded corners, fill=red!30, draw},
    estilo2/.style={rectangle, fill=blue!30, draw}]

    % Cria nós com os estilos pré-definidos
    \node[estilo1] at (0,0) {Texto};
    \node[estilo2] at (1,1) {Texto};

\end{tikzpicture}
```

ou podemos definir no cabeçalho do arquivo com

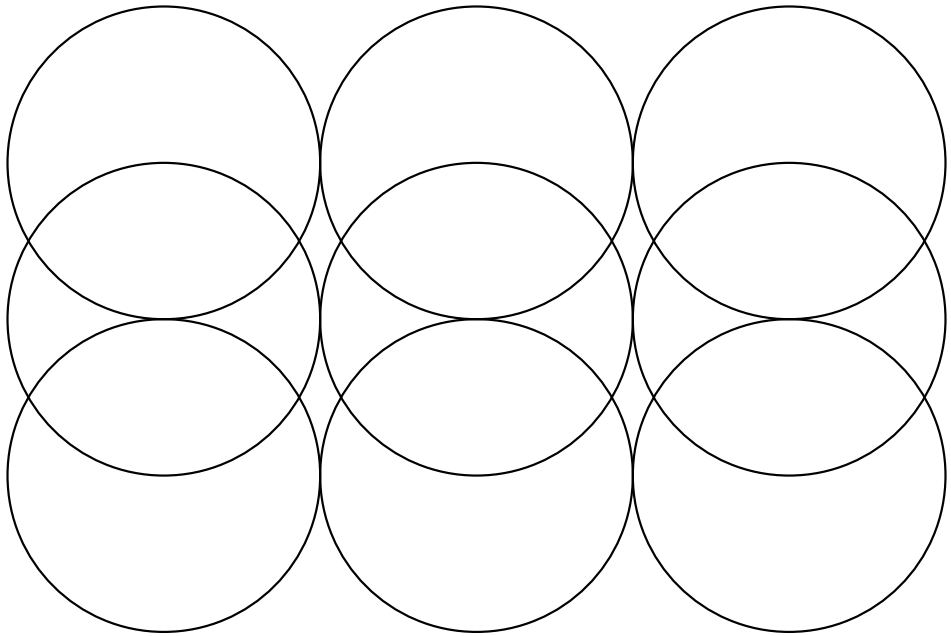
```
\tikzset{estilo1/.style={rectangle, rounded corners, fill=red!30, draw}}
\tikzset{estilo2/.style={rectangle, fill=blue!30, draw}}
```

ou com

```
\tikzstyle{estilo1} = [rectangle, rounded corners, fill=red!30, draw]
```

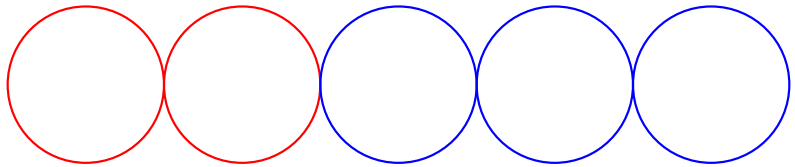
Iteradores

```
\begin{tikzpicture}
    \foreach \x in {1,3,5}
    {
          \foreach \y in {1,...,3}
          {
             \draw (\x,\y) circle (1 cm);
          }
    }
    \end{tikzpicture}
```



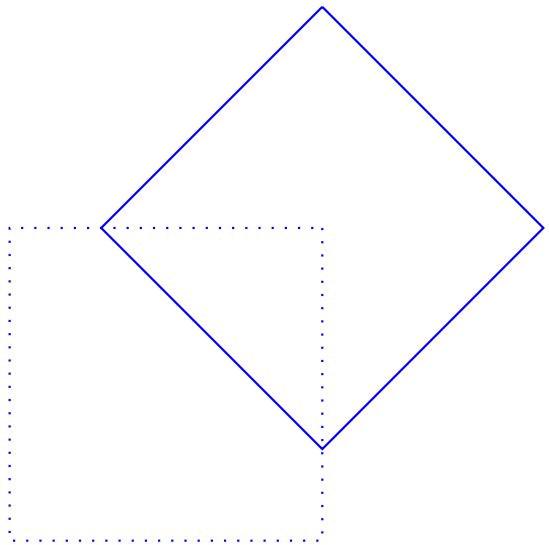
Condicional

```
\usepackage{tikz,ifthen}
\begin{tikzpicture}
    \foreach \i in {1, ..., 5}{
        \ifthenelse{\i < 3}{\draw[red] (\i, 0) circle (0.5cm);}
                           {\draw[blue] (\i, 0) circle (0.5cm);}
    }
\end{tikzpicture}
```



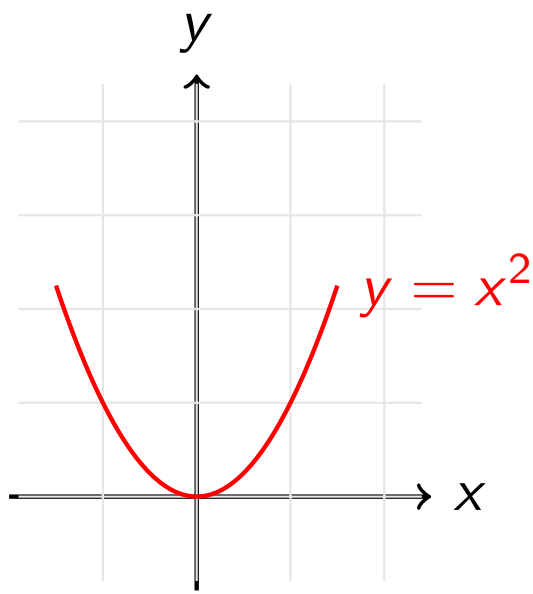
Translação e rotação

```
\begin{tikzpicture}
\draw[blue,dotted] (1,1) -- (1,-1) -- (-1,-1) -- (-1,1) -- (1,1);
\draw[blue,shift={(3 cm,5 cm)},rotate=45]
(1,1) -- (1,-1) -- (-1,-1) -- (-1,1) -- (1,1);
\end{tikzpicture}
```



Plotando Funções

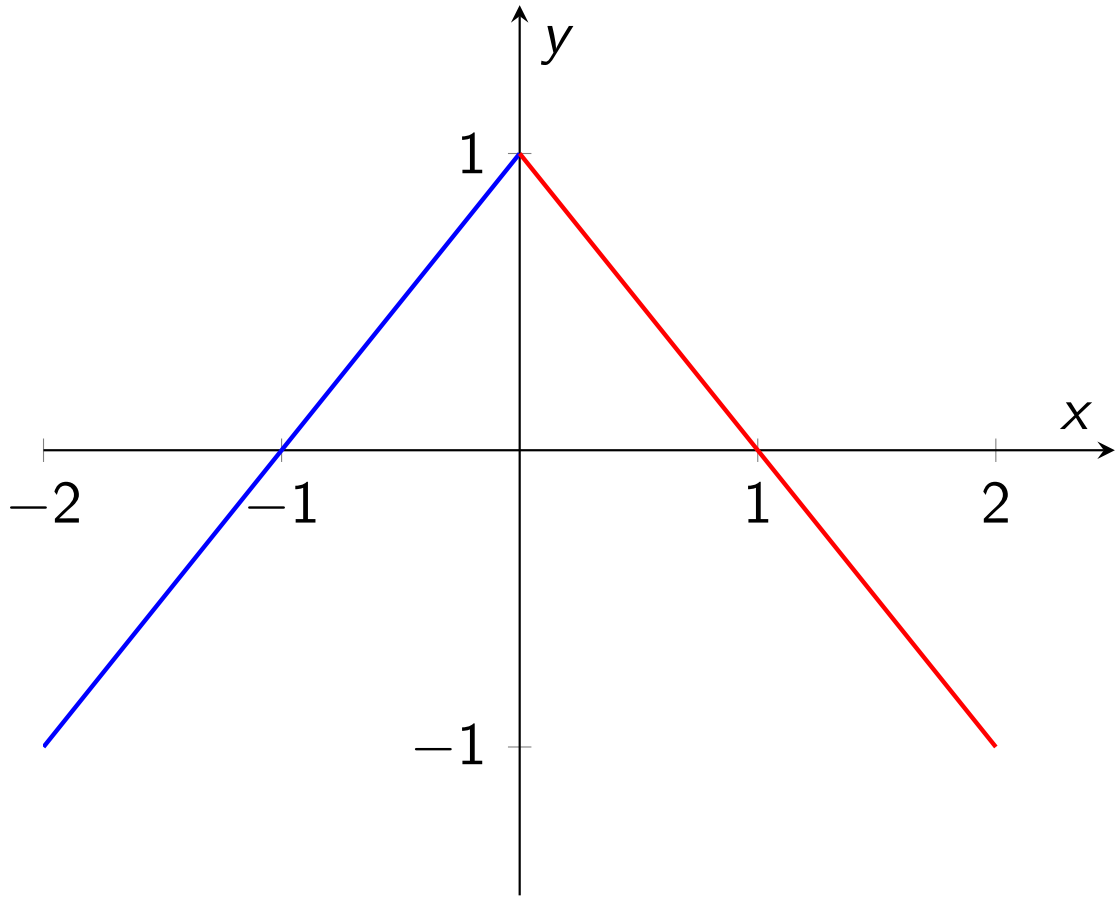
```
\begin{tikzpicture}[scale=0.8]
  % Sistema de coordenadas
  \draw[thick, ->] (-
2,0) -- (2.5,0) node[right] {$x$};
  \draw[thick, ->] (0,-
1) -- (0,4.5) node[above] {$y$};

  % Grade
  \draw[gray!20] (-
1.9,-
0.9) grid (2.4,4.4);

  % Função quadrática
  \draw[red, thick, domain=-
1.5:1.5, samples=50]
    plot (\x, {\x*\x}) node[right] {$y = x^2$};
\end{tikzpicture}
```



Plotando Funções com diferentes x

```
\begin{tikzpicture}
  \begin{axis}[
      axis lines = middle,
      xlabel = {$x$},
      ylabel = {$y$},
      xmin = -2.0, xmax = 2.5,
      ymin = -1.5, ymax = 1.5,
      legend style={at={(0.5,-0.15)},anchor=north},
  ]
   \addplot[name path=y1,
      thick,
      blue,
      domain=-2:0,
      samples=200
    ] {1+x};
    \addplot[name path=y2,
      thick,
      red,
      domain=0:2,
      samples=200
    ] {1-x};
  \end{axis}
\end{tikzpicture}
```

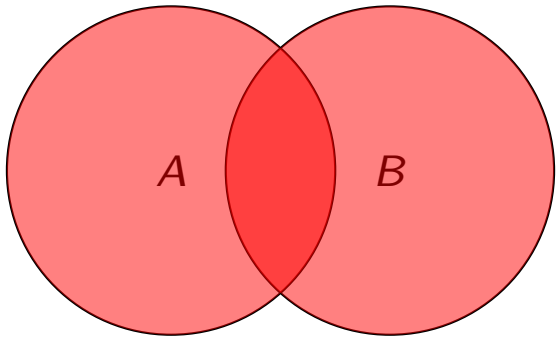
Plotando Funções com diferentes x



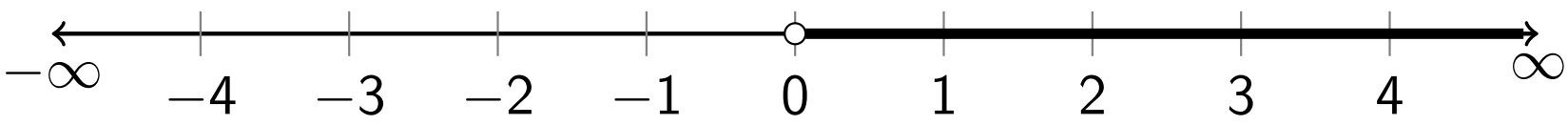
Exemplo - Diagramas de Venn

```
\def\firstcircle{(0,0) circle (1.5cm)}
\def\secondcircle{(0:2cm) circle (1.5cm)}
\begin{tikzpicture}[scale=0.5]
    \draw \firstcircle node {$A$};
    \draw \secondcircle node  {$B$};
    \begin{scope}[fill opacity=0.5]
      \fill[red] \firstcircle;
      \fill[red] \secondcircle;
    \end{scope}
\end{tikzpicture}
```

$$A \cup B = \{x : x \in A \vee x \in B\}$$

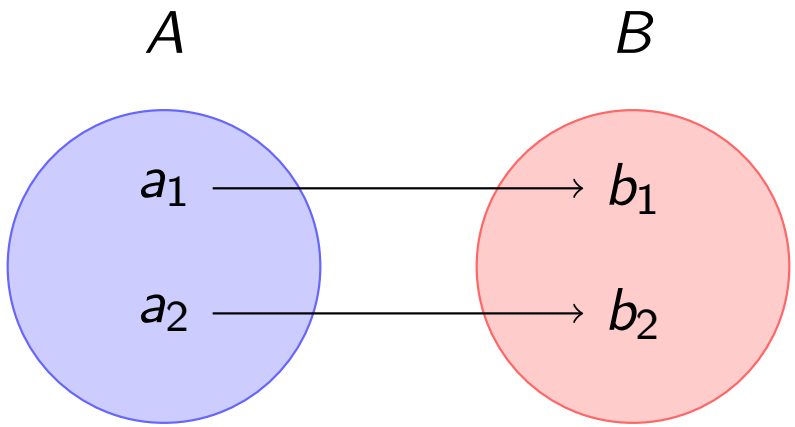


Exemplo - Reta dos reais positivos




```
% Linha <->
\draw[<->, thick] (-5,0) -- (5,0);

% Desenha linhas verticais de 0.3 pts
 \foreach \i in {-4,-3,...,4}
   \draw[gray] (\i,0.15) -- ++ (0,-0.3)    node[below,text=black] {$\i$};

% Coloca os \infty
\node[below] at (-5,0) {$-\infty$};
\node[below] at (5,0) {$\infty$};

 % Círculo em zero
\draw[black,fill=white] (0,0) circle (2pt);

% Linha mais grossa de (0,\infty)
\draw[line width = 2pt]  (2pt,0) -- (4.9,0);
```

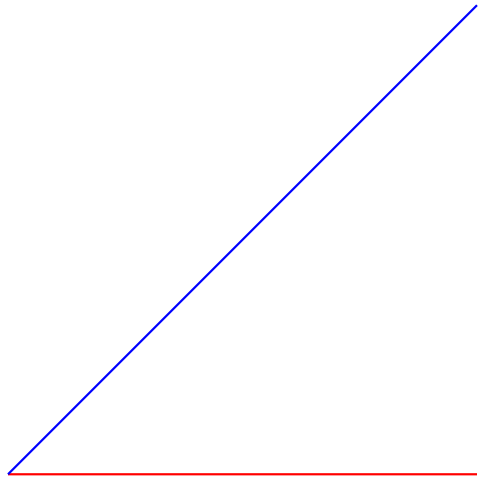
Exemplo - Mapeamento




```
% Desenha os conjuntos
\draw[fill=blue!20, draw=blue!60] (-1.5,0) circle (1cm);
\draw[fill=red!20, draw=red!60] (1.5,0) circle (1cm);

% Textos
\node at (-1.5,1.5) {$A$};   \node at (1.5,1.5) {$B$};

% Cria os nós
\node (x1) at (-1.5,0.5) {$a_1$};   \node (x2) at (-1.5,-0.3) {$a_2$};
\node (y1) at (1.5,0.5) {$b_1$};    \node (y2) at (1.5,-0.3) {$b_2$};

% Liga com as setas
\draw[->] (x1) -- (y1);
\draw[->] (x2) -- (y2);
```

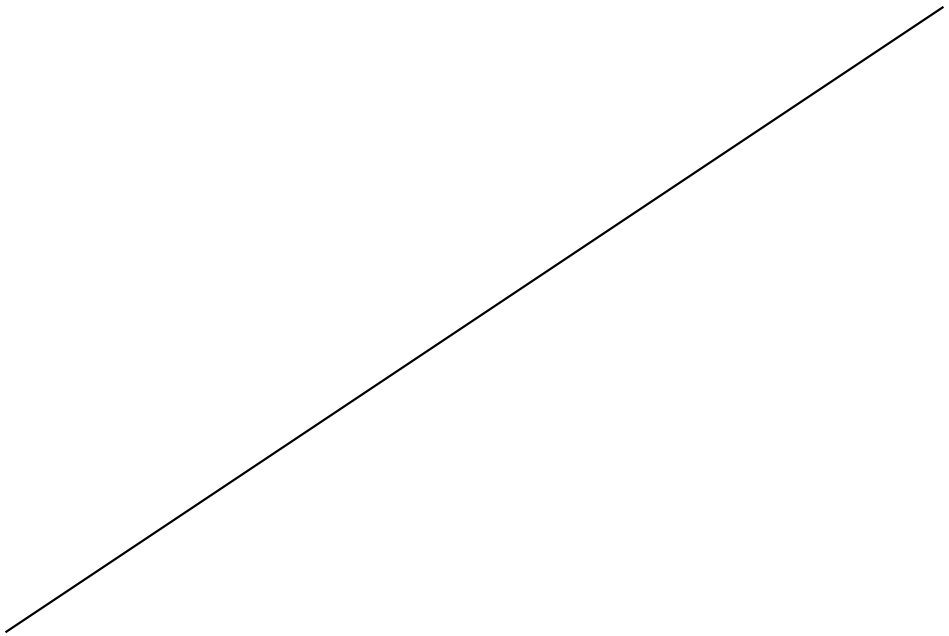
Cálculos simples

```
% soma (2,1) com (1,-1)
\draw[red] (0,0) -- ($(2,1) + (1,-1)$);

% Multiplica (1,1) por 3
\draw[blue] (0,0) -- ($3*(1,1)$);
```



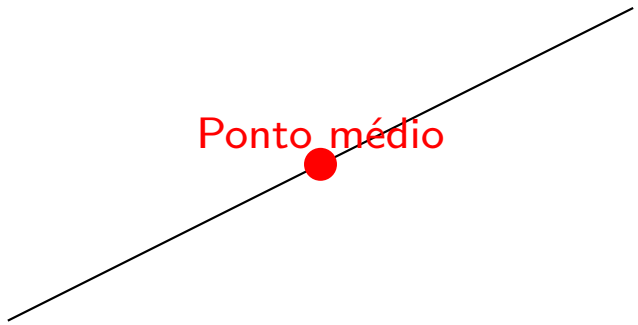
Constantes

```
\begin{tikzpicture}
  % Define duas variáveis
  \def\x{3}
  \def\y{2}
  % Faz uma linha
  \draw (-\x,-\y) -- (\x,\y);
\end{tikzpicture}
```



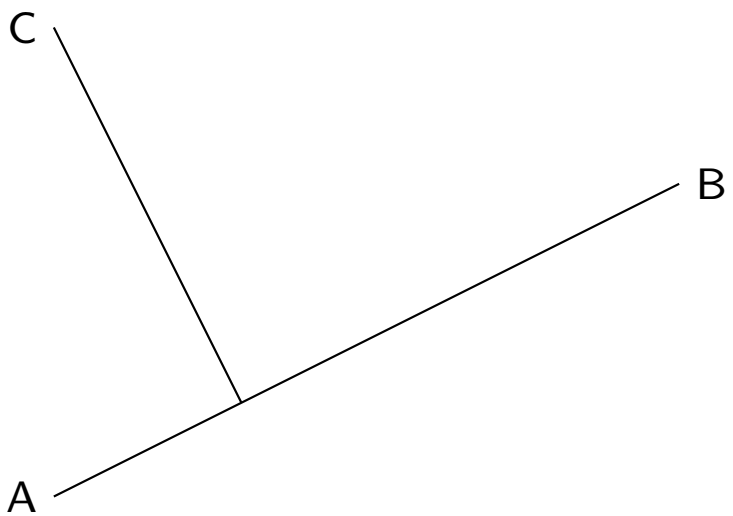
Ponto médio

```
\coordinate (A) at (0,0);
\coordinate (B) at (4,2);
\draw (A) -- (B);
\fill[red] ($(A)!0.5!(B)$) circle (3pt) node[above] {Ponto médio};
```



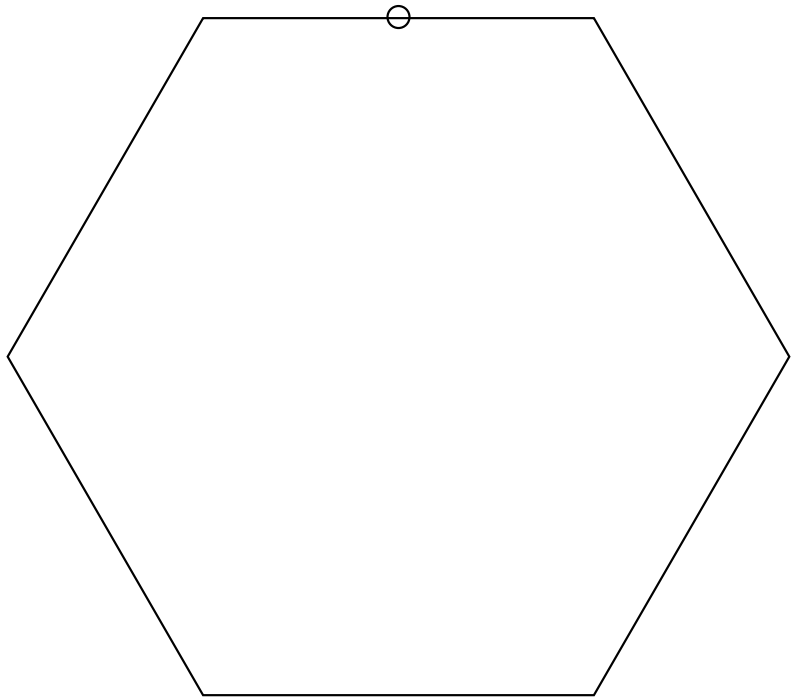
Projeção ortogonal

```
\coordinate (A) at (0,0) ;
\coordinate (B) at (4,2);
\coordinate (C) at (1,3);
\draw (A) -- (B);
\draw (C) -- ($(A)!(C)!(B)$)
\node[left]  at (A) {A};
\node[right] at (B) {B};
\node[left]  at (C) {C};
```



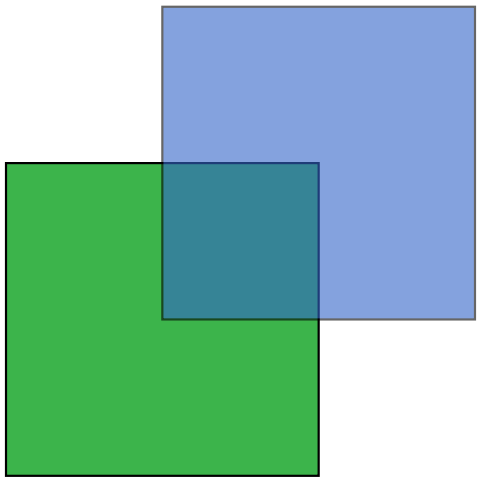
Polígonos e mais contas

```
\usetikzlibrary{shapes.geometric}
\begin{tikzpicture}
\node[regular polygon, regular polygon sides=6, draw,minimum size=5cm]
(hex) at (0,0) {};
\draw ($(hex.corner 1)!0.5!(hex.corner 2)$) circle (2pt);
\end{tikzpicture}
```

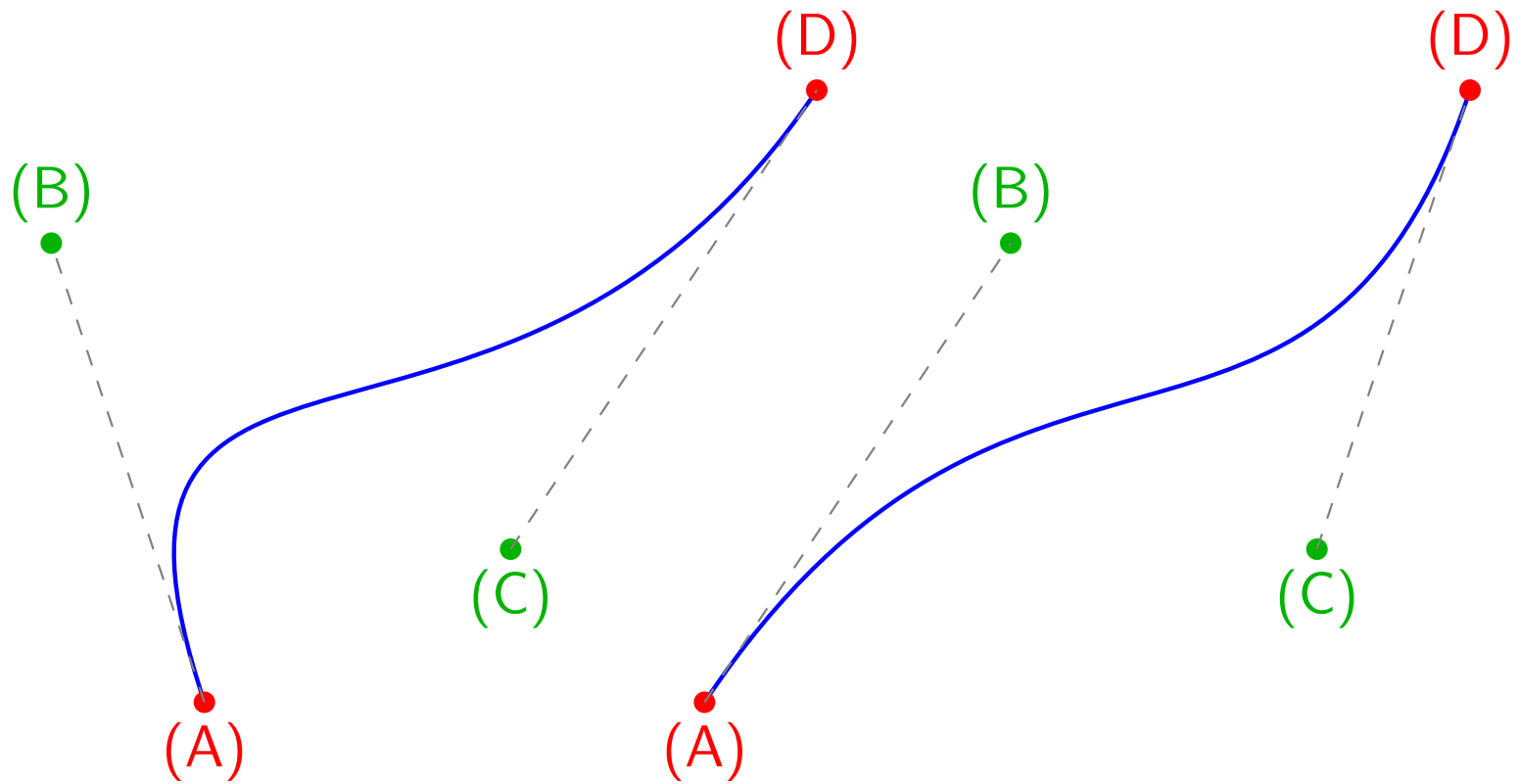


Definição de cores

```
\definecolor{azul}{RGB}{50,100,200}
\definecolor{verde}{RGB}{60,180,75}
\definecolor{vermelho}{RGB}{180,60,75}
\draw[fill=verde]  (0,0) rectangle (2,2);
\draw[fill=azul,opacity=0.6]   (1,1) rectangle (3,3);
```



Bezier (cúbica)

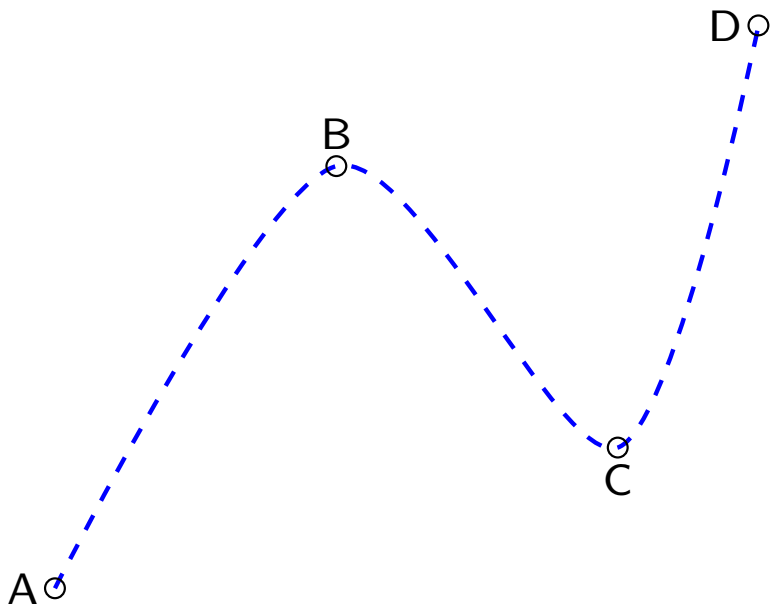


Bezier

```
\begin{tikzpicture}
    % Pontos: inicio, controle 1, controle 2 e final
    \coordinate (A) at (0,0);
    \coordinate (B) at (2,3);
    \coordinate (C) at (4,1);
    \coordinate (D) at (5,4);

    % Desenha a curva
    \draw[blue, thick] (A) .. controls (B) and (C) .. (D);

    % Colca os pontos
    \fill[red] (A) circle (2pt) node[below]{(A)};
    \fill[red] (D) circle (2pt) node[above]{(D)};
    \fill[green!70!black] (B) circle (2pt) node[above]{(B)};
    \fill[green!70!black] (C) circle (2pt) node[below]{(C)};

    % Linhas de controle (só para visualização)
    \draw[dashed, gray] (A) -- (B);
    \draw[dashed, gray] (C) -- (D);

\end{tikzpicture}
```

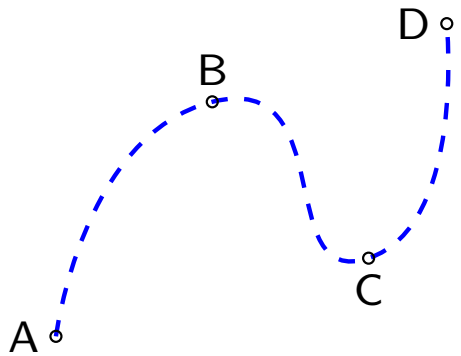
Interpolar pontos

```
\begin{tikzpicture}
\coordinate (A) at (0,0);
\coordinate (B) at (2,3);
\coordinate (C) at (4,1);
\coordinate (D) at (5,4);
\draw[blue,thick, smooth, dashed] plot coordinates {(A) (B) (C) (D)};
\draw (A) circle (2pt) node [left] {A};
\draw (B) circle (2pt) node [above] {B};
\draw (C) circle (2pt) node [below] {C};
\draw (D) circle (2pt) node [left] {D};
\end{tikzpicture}
```

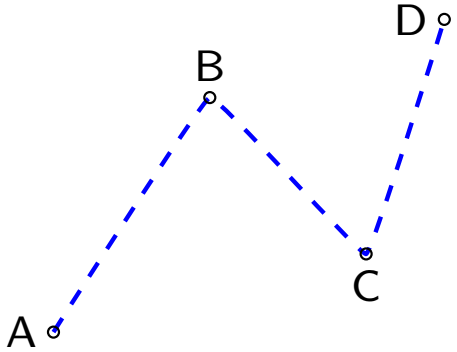


Interpolar pontos - tensão

```
\draw[blue,thick, smooth, dashed, tension=1.5] plot coordinates {(A) (B) (C) (D)};
```

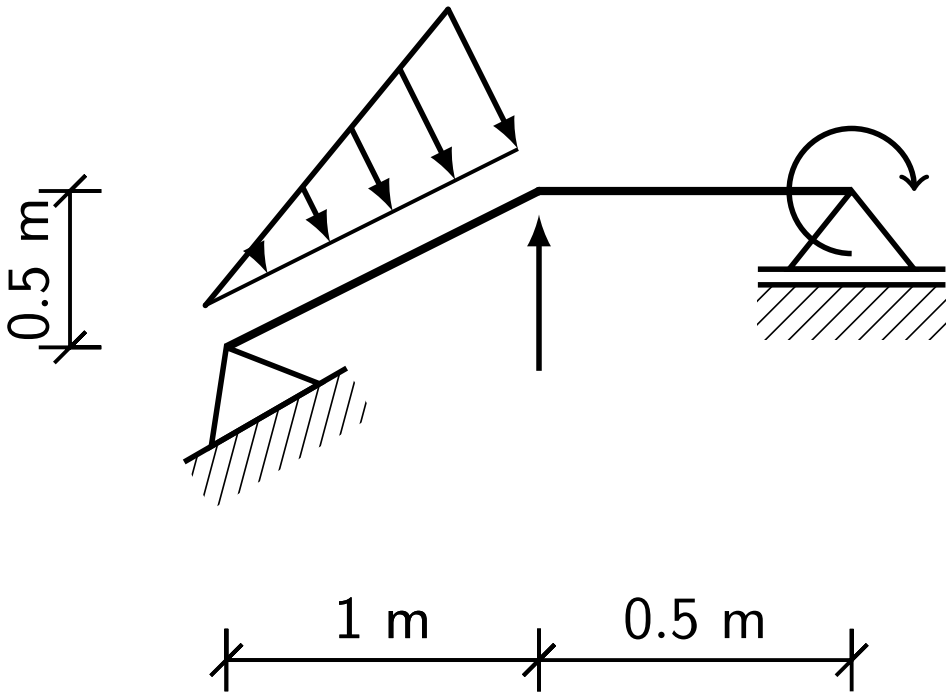



```
\draw[blue,thick, smooth, dashed, tension=0.1] plot coordinates {(A) (B) (C) (D)};
```



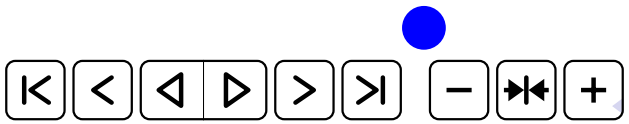
Stanli - Structural Analysis

```
% Define os pontos
\point{A}{0}{0};
\point{B}{2}{1};
\point{C}{4}{1};
% Define  as vigas
\beam{2}{A}{B}[0][1];
\beam{2}{B}{C}[1];
% Força distribuída
\lineload{1}{A}{B}[0];
% Força e momento
\load{1}{B}[-90];
\load{2}{C};
% Apoios
\support{1}{A}[30];
\support{2}{C}[0];
% Cotas
\dimensioning{1}{B}{C}{-2}[$0.5$ m]
\dimensioning{1}{A}{B}{-2}[$1$ m]
\dimensioning{2}{A}{C}{-1}[$0.5$ m]
```



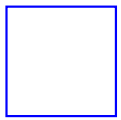
Animações

```
\begin{center}
% 5 frames por segundo
\begin{animateinline}[controls,loop]{5}
  % 20 frames, variável ii começa em 0 e incrementa em 1
  % variável ij começa em 20 e decrementa em 1
  \multiframe{20}{ii=0+1,ij=20+-1}{
     % Imagem a ser gerada
     \begin{tikzpicture}[scale=1.2]
         % Mantém a área de animação igual
         \useasboundingbox (-0.2,-0.2) rectangle  (2.2, 2.2);
         \fill[blue] (\ij/10,\ii/10) circle (0.2);
         \fill[red]  (\ii/10,\ij/10) circle (0.2);
     \end{tikzpicture}
  }
\end{animateinline}
\end{center}
```

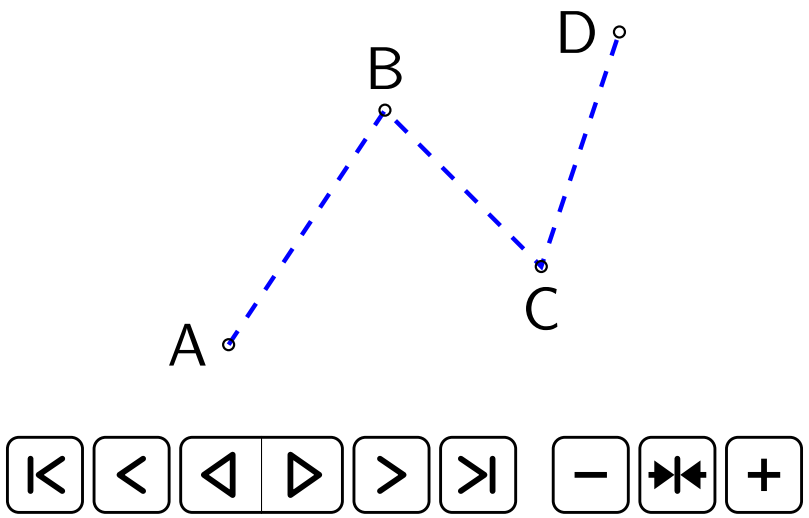


Animações

```
  \begin{center}
  \begin{animateinline}[controls,loop]{10}
    \multiframe{20}{ii=0+15}{
      \begin{tikzpicture}[scale=0.7]
        \draw[blue,rotate=\ii] (0,0) rectangle (2,2)
      \end{tikzpicture}
    }
  \end{animateinline}
\end{center}
```



Animações



Fluxogramas

```
\tikzstyle{startstop} = [rectangle, rounded corners,
                         minimum width=3cm,
                         minimum height=1cm,
                         text centered,
                         draw=black,
                         fill=red!30]

\tikzstyle{io} = [trapezium,
                  trapezium stretches=true,
                  trapezium left angle=70,
                  trapezium right angle=110,
                  minimum width=3cm,
                  minimum height=1cm, text centered,
                  draw=black, fill=blue!30]

\tikzstyle{process} = [rectangle,
                  minimum width=3cm,
                  minimum height=1cm,
                  text centered,
                  text width=3cm,
                  draw=black,
                  fill=orange!30]
```

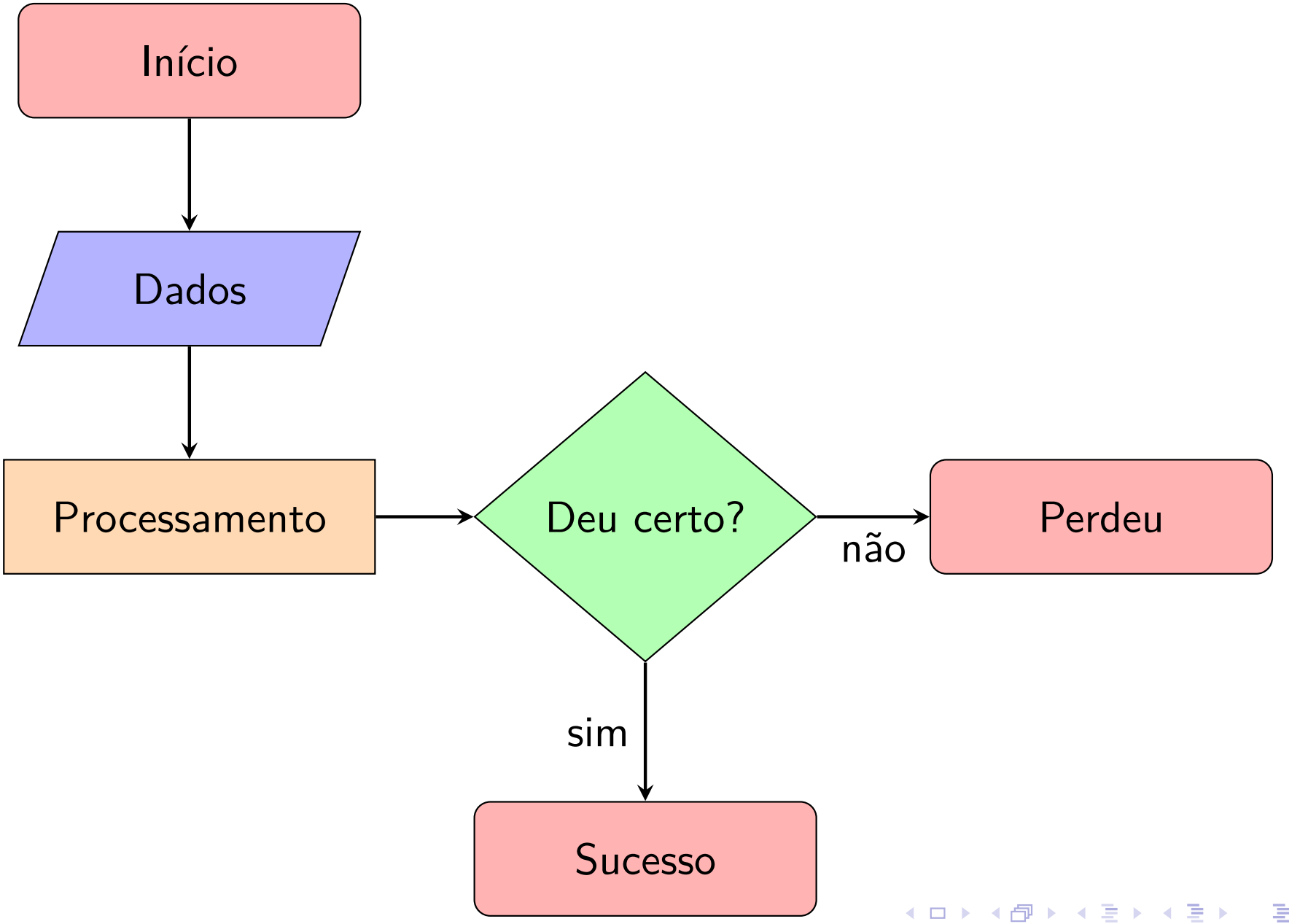
Fluxogramas...cont

```
\tikzstyle{decision} = [diamond,
                  minimum width=3cm,
                  minimum height=1cm,
                  text centered,
                  draw=black,
                  fill=green!30]

\tikzstyle{arrow} = [thick,->,>=stealth]

\begin{tikzpicture}[node distance=2cm]
Fluxograma
\end{tikzpicture}
```

Exemplo de fluxograma

```
\begin{tikzpicture}[node distance=2cm]
% Primeiro nó
\node (inicio) [startstop] {Início};
% io
\node (entrada) [io, below of=inicio] {Dados};
% Etapa 1
\node (etapa1) [process, below of=entrada] {Processamento};
% Decisão
\node (pergunta1) [decision, right of=etapa1, xshift=2cm] {Deu certo?};
% Etapa 2
\node (errado) [startstop, right of = pergunta1, xshift=2cm] {Perdeu};
% Fim
\node (certo) [startstop, below of = pergunta1, yshift=-1cm] {Sucesso};
% Linhas
\draw [arrow] (inicio) -- (entrada);
\draw [arrow] (entrada) -- (etapa1);
\draw [arrow] (etapa1) -- (pergunta1);
\draw [arrow] (pergunta1) -- node[anchor=east] {sim} (certo);
\draw [arrow] (pergunta1) -- node[anchor=north] {não} (errado);
\end{tikzpicture}
```

Exemplo de fluxograma



Sugestões

Recursos de Aprendizado

- Manual oficial: `texdoc tikz` (3500+ páginas!)
- `https://tikz.dev`
- Tutoriais do Overleaf

Ideias para Praticar

- Desenhe formas geométricas simples
- Adicione complexidade
- Recrie diagramas de livros