



Improving figures using TikZ/PGF for LATEX: An Introduction

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Improving figures using TikZ/PGF for \LaTeX : An Introduction

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BCAM
Bilbao, Spain

Resources

- Examples and “short” tutorials online.
 - en.wikipedia.org/wiki/PGF/TikZ
 - www.texample.net/tikz/resources/
 - www.texample.net/tikz/examples/
- List of packages TikZ/PGF:
 - www.ctan.org/topic/pgf-tikz
- PGF Manual:
 - mirrors.ctan.org/graphics/pgf/base/doc/pgfmanual.pdf
- Pgfplots manual:
 - mirrors.ctan.org/graphics/pgf/contrib/pgfplots/doc/pgfplots.pdf

Learning process

- ① Working from already existing files.
- ② Generation of TiKZ examples from software: Geogebra, Matlab, R, inkscape...
- ③ Understand and adapt the examples.
- ④ Make your own pictures

Introduction

```
\usepackage{pgfplots} % loads TiKZ/PGF and pgfplots
\usepgfplotslibrary{library_name}
\usetikzlibrary{library_name}
```

```
\begin{figure}
\begin{tikzpicture}
```

```
:
```

Here is the code for your picture

```
:
```

```
\end{tikzpicture}
\caption{my caption}
\end{figure}
```

Overview

1 Algorithm

2 Computational domain sketch

3 Data plot

Algorithm

Algorithm related graph: algo_example.tex

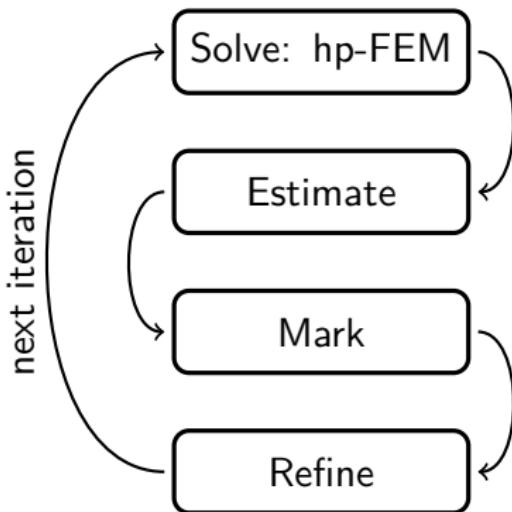


Figure: Algorithm related graph

Algorithm

```
\node [box0ptions]  
(sol){Solve: hp-FEM};
```

Solve: hp-FEM

Algorithm

```
\node [boxOptions]
(sol){Solve: hp-FEM};
```

Solve: hp-FEM

```
\tikzset{boxOptions/.style={
rectangle,
rounded corners,
draw=black, very thick,
text width=6.5em,
minimum height=2em,
text centered}
}
```

Algorithm

```
\node [box0ptions]  
(sol){Solve: hp-FEM};
```

Solve: hp-FEM

```
\node [box0ptions, below=of  
sol]  
(estim){Estimate};
```

Estimate

Algorithm

```
\node[boxOptions]  
(sol){Solve: hp-FEM};
```

Solve: hp-FEM

```
\node[boxOptions,below=of  
sol]  
(estim){Estimate};
```

Estimate

```
\node[boxOptions,below=of  
estim]  
(mark){Mark};
```

Mark

Algorithm

```
\node[boxOptions]
(sol){Solve: hp-FEM};
```

Solve: hp-FEM


```
\node[boxOptions,below=of
sol]
(estim){Estimate};
```

Estimate


```
\node[boxOptions,below=of
estim]
(mark){Mark};
```

Mark

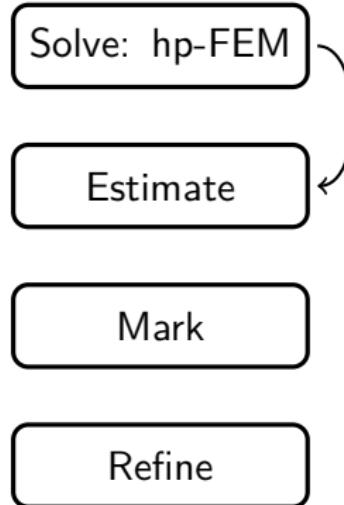

```
\node[boxOptions,below=of
mark]
(ref)Refine;
```

Refine

Algorithm

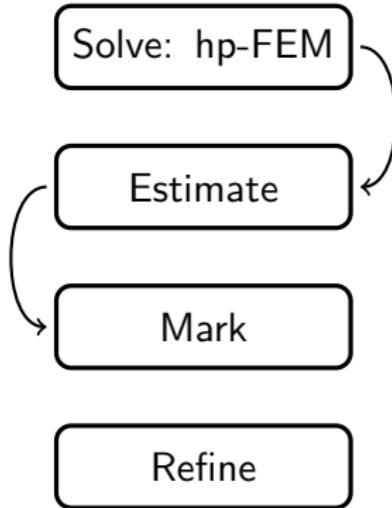
```
\draw[arrowStyle]
(sol.east) to[out=0,in=0]
(estim.east);

\tikzset{arrowStyle/.style={
->,
thick,
shorten <=2pt,
shorten >=2pt},
```



Algorithm

```
\draw[arrowStyle]  
(sol.east) to[out=0,in=0]  
(estim.east);  
  
\draw[arrowStyle]  
(estim.west) to[out=180,  
in=180] (mark.west);
```

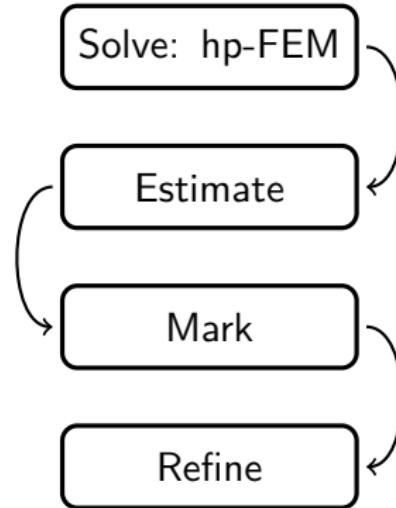


Algorithm

```
\draw[arrowStyle]
(sol.east) to[out=0,in=0]
(estim.east);

\draw[arrowStyle]
(estim.west) to[out=180,
in=180] (mark.west);

\draw[arrowStyle]
(mark.east) to[out=0,in=0]
(ref.east);
```



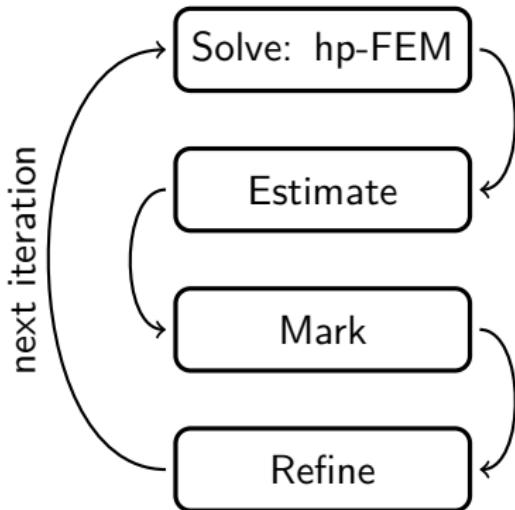
Algorithm

```
\draw[arrowStyle]
(sol.east) to[out=0,in=0]
(estim.east);

\draw[arrowStyle]
(estim.west) to[out=180,
in=180] (mark.west);

\draw[arrowStyle]
(mark.east) to[out=0,in=0]
(ref.east);

\draw[arrowStyle]
(ref.west) to[out=180,in=180]
node[sloped, anchor=south]
{next iteration}(sol.west);
```



Computational domain sketch

Computational Domain: sketch_example.tex

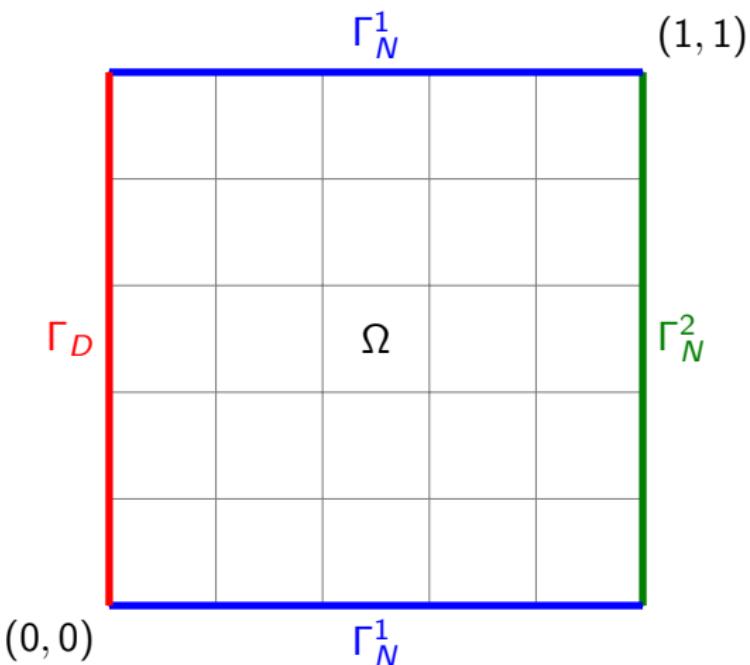
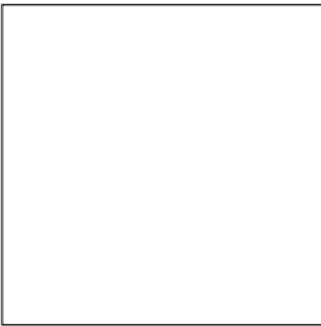


Figure: 2D Computational domain

Computational Domain: Step by step

```
\draw [color=black] (0,0)  
rectangle (1,1);
```

(1, 1)



```
\node [anchor=north east]  
at (0,0){(0,0)};  
\node [anchor=south west]  
at (1,1){(1,1)};
```

(0, 0)

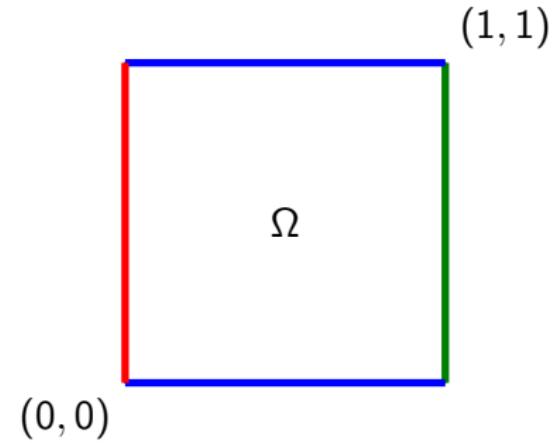
Computational Domain: Step by step

```
\draw[color=black] (0,0)  
rectangle (1,1);  
\node at (0.5,0.5) {\Omega};
```



Computational Domain: Step by step

```
\draw[border_style,  
color=green!50!black](1,0)  
- (1,1);  
\draw[border_style,  
color=blue](0,1) - (1,1);  
  
\draw[border_style,  
color=blue](0,0) - (1,0);  
  
\draw[border_style,  
color=red](0,0) - (0,1);  
  
\tikzset{border_style/.style  
= {line width=2pt}}
```



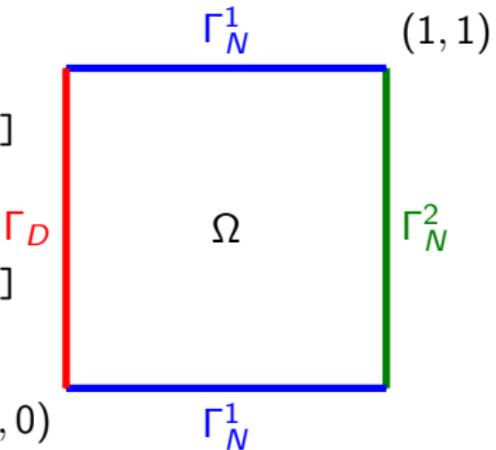
Computational Domain: Step by step

```
\node[anchor=east, color=red]  
at (0,1/2) {\(\Gamma_D\)};
```

```
\node[anchor=south, color=blue]  
at (1/2,1) {\(\Gamma_N^1\)};
```

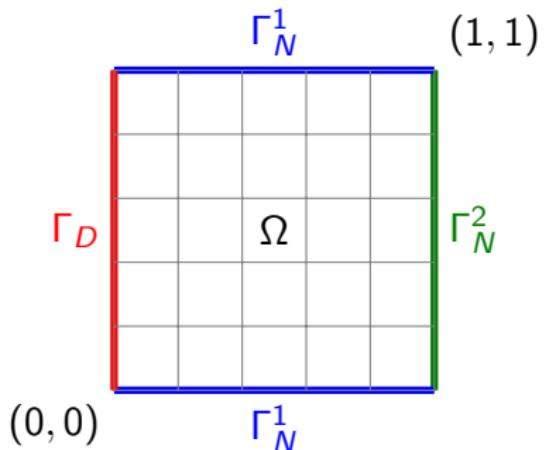
```
\node[anchor=north, color=blue]  
at (1/2,0) {\(\Gamma_N^1\)};
```

```
\node[anchor=west,  
color=green!50!black] at  
(1,1/2) {\(\Gamma_N^2\)};
```



Computational Domain: Step by step

```
\draw[step=0.2,gray]  
(0,0) grid (1,1);
```



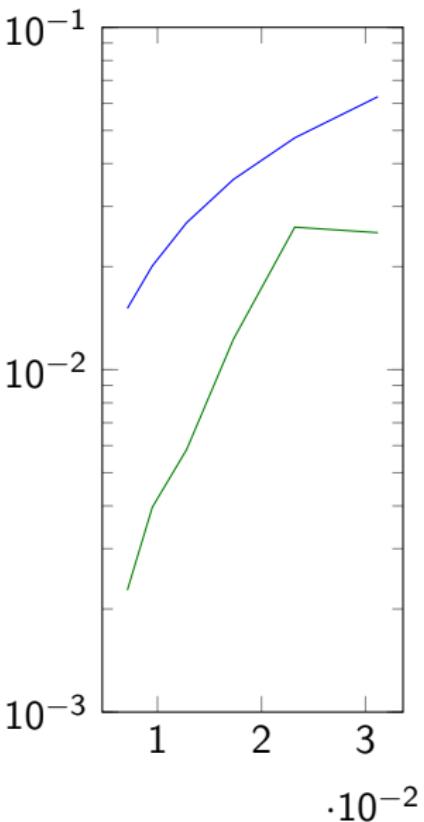
Data plot

Raw Data: data.txt, data_plot_example.tex

epsilon	error1	error2
$7.1 \cdot 10^{-3}$	$1.51 \cdot 10^{-2}$	$2.27 \cdot 10^{-3}$
$9.5 \cdot 10^{-3}$	$2.01 \cdot 10^{-2}$	$3.96 \cdot 10^{-3}$
$1.28 \cdot 10^{-2}$	$2.69 \cdot 10^{-2}$	$5.84 \cdot 10^{-3}$
$1.73 \cdot 10^{-2}$	$3.6 \cdot 10^{-2}$	$1.23 \cdot 10^{-2}$
$2.32 \cdot 10^{-2}$	$4.76 \cdot 10^{-2}$	$2.61 \cdot 10^{-2}$
$3.12 \cdot 10^{-2}$	$6.28 \cdot 10^{-2}$	$2.51 \cdot 10^{-2}$

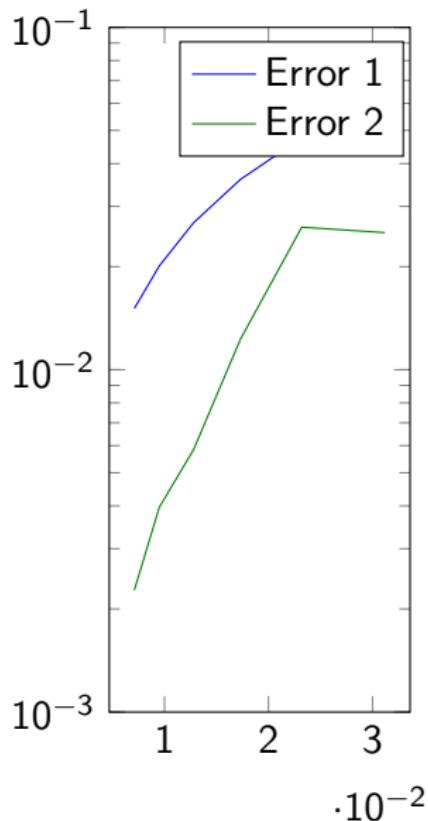
Data Plots: a simple example

```
\begin{axis}[axis options]  
  
      
  
\addplot [color=blue]  
table [x=epsilon,y=error1]  
{./data.txt};  
  
\addplot [color=green!50!black]  
table [x=epsilon,y=error2]  
{./data.txt};  
  
\end{axis}
```



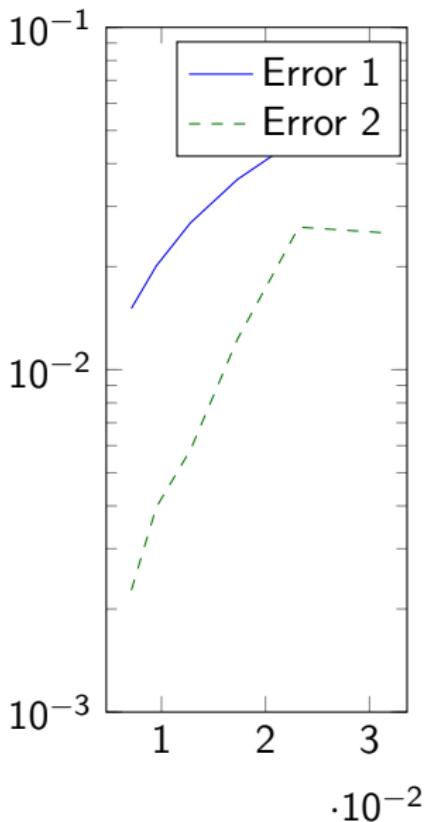
Data Plots: a simple example

```
\begin{axis}[axis options]  
  
    \addplot [color=blue]  
    table[x=epsilon,y=error1]  
    {./data.txt};  
    \addlegendentry{error 1};  
  
    \addplot [color=green!50!black]  
    table[x=epsilon,y=error2]  
    {./data.txt};  
    \addlegendentry{error 2};  
  
\end{axis}
```



Data Plots: a simple example

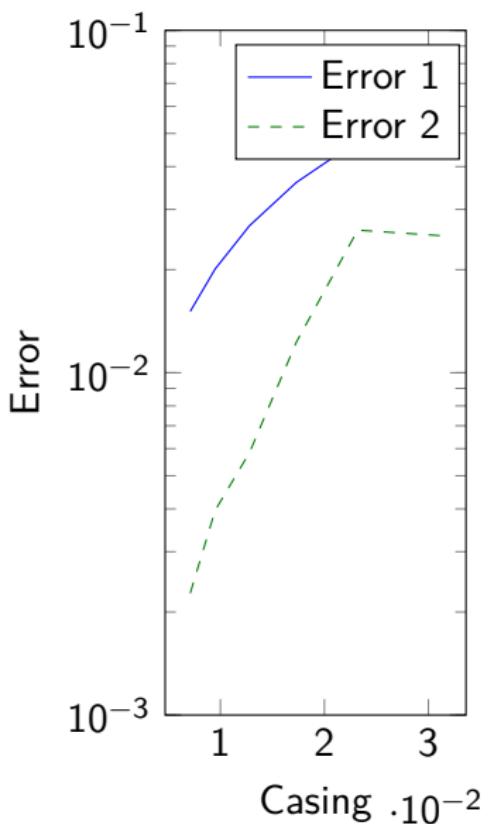
```
\begin{axis}[axis options]  
  
    \addplot [color=blue]  
    table[x=epsilon,y=error1]  
    {./data.txt};  
    \addlegendentry{error 1};  
  
    \addplot [color=green!50!black,  
    dashed] table[x=epsilon,y=error2]  
    {./data.txt};  
    \addlegendentry{error 2};  
  
    \end{axis}
```



Data Plots: a simple example

Axis options:

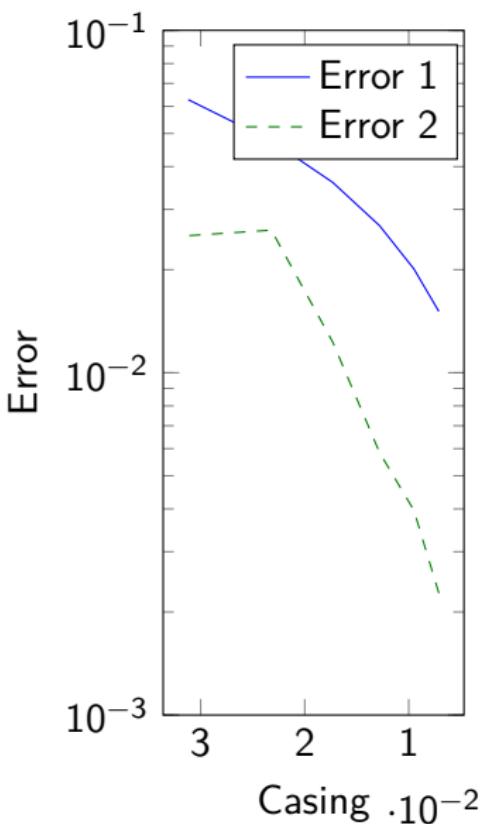
```
ymode=log,  
ymin=1e-3,  
ymax=1e-1,  
xlabel=Casing,  
ylabel>Error,
```



Data Plots: a simple example

Axis options:

```
ymode=log,  
ymin=1e-3,  
ymax=1e-1,  
xlabel=Casing,  
ylabel>Error,  
x dir=reverse,
```



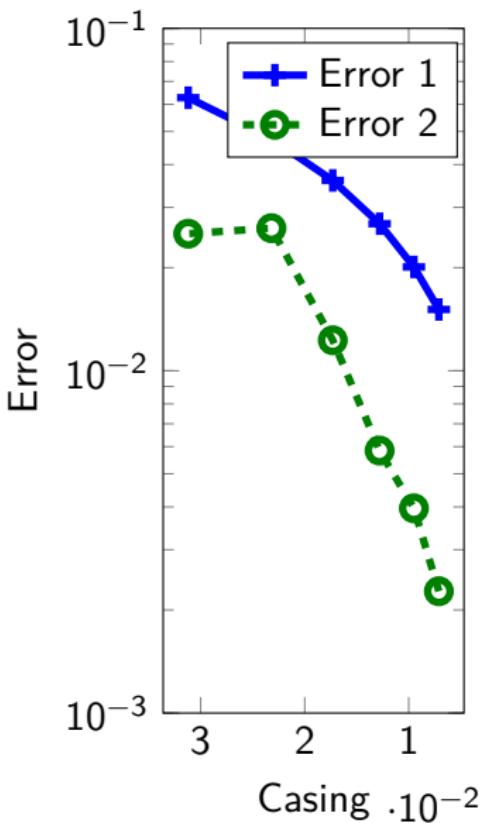
Data Plots: a simple example

Axis options:

```
ymode=log,  
ymin=1e-3,  
ymax=1e-1,  
xlabel=Casing,  
ylabel>Error,  
x dir=reverse,
```

More plot options:

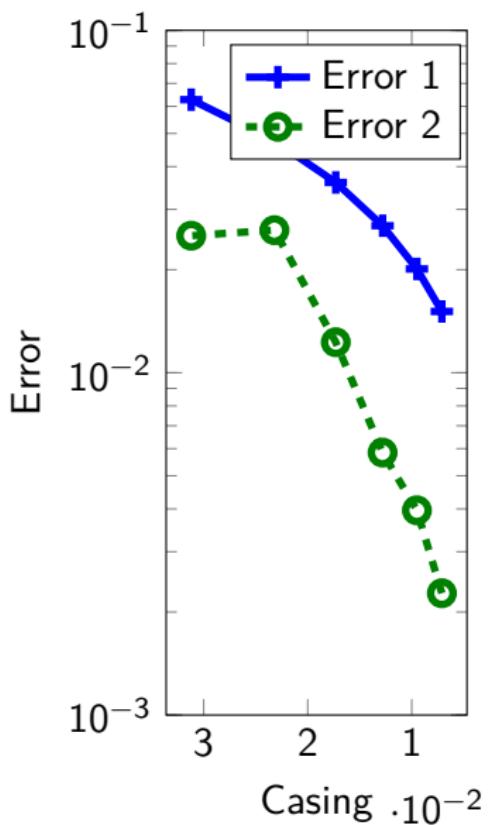
```
mark=+, mark=o,  
mark size=3pt,  
line width=2pt,
```



Data Plots: a simple example

Legend options:

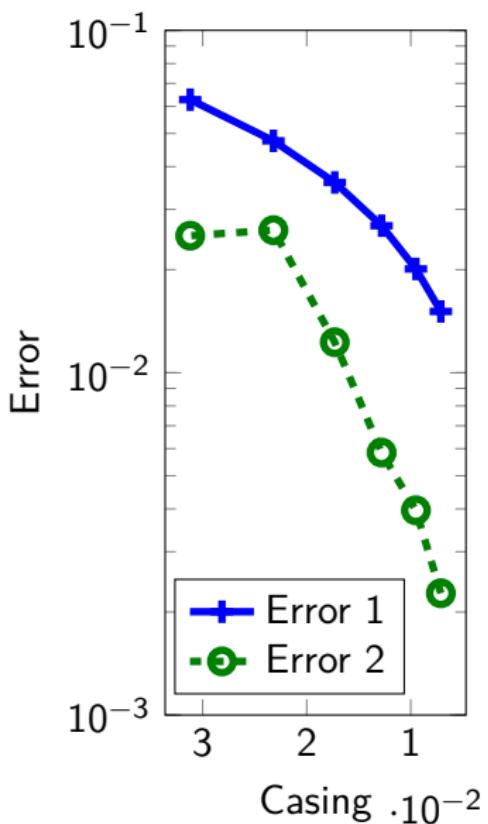
legend pos=north east ,



Data Plots: a simple example

Legend options:

legend pos=north east,
legend pos=south west,



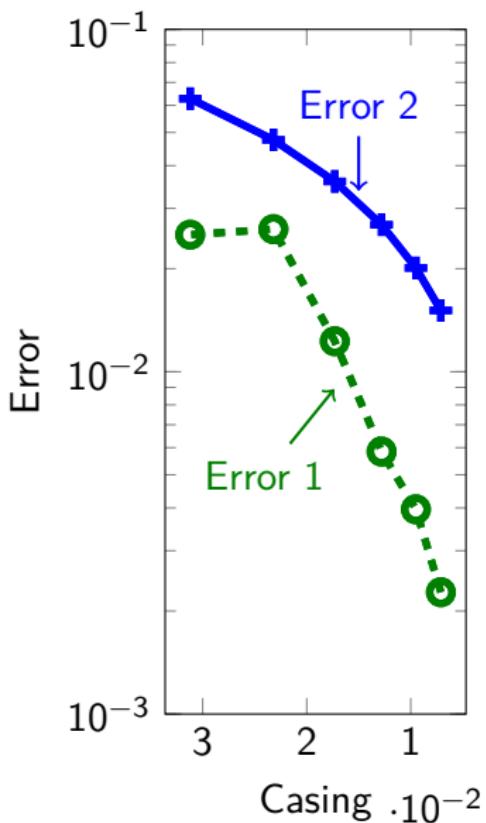
Data Plots: a simple example

Legend options:

```
legend pos=north east,  
legend pos=south west,
```

*Pin point: (after the
\addplot)*

```
node[pin={[pin edge={<-,solid,  
blue, thick}]90: Error2}  
] at (1.5e-2 ,3e-2) {};
```



Many ways and packages to improve your figures

