TikZ tutorial

How (and why) do I use TikZ to make my figures?

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Why do I use TikZ?

- When I was a student, I used to make my pictures with `xfig`.

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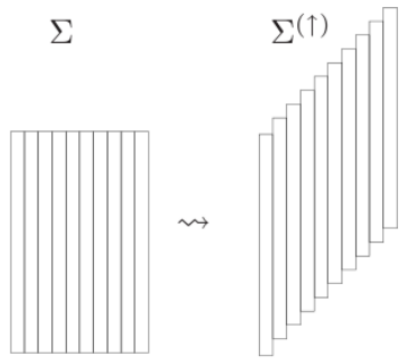
- When I was a student, I used to make my pictures with `xfig`.
- Then I started to use `psfrag` to include LaTeX symbols...

```
\begin{center}
\psfrag{transfo}{$\rightsquigarrow$}
\psfrag{W}{$\Sigma$}
\psfrag{Wfleche}{$\Sigma^{(\uparrow)}$}
\includegraphics[width=3cm]{Wfleche}
\end{center}
```



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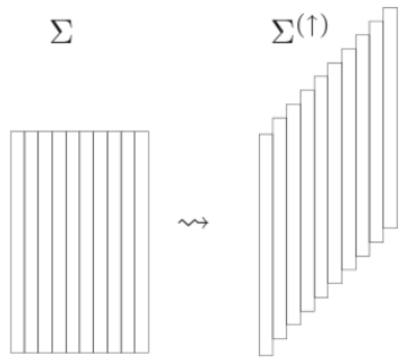


- But I was still not really convinced by the result!

What is TikZ?

TikZ is a LaTeX package for generating vector graphics.

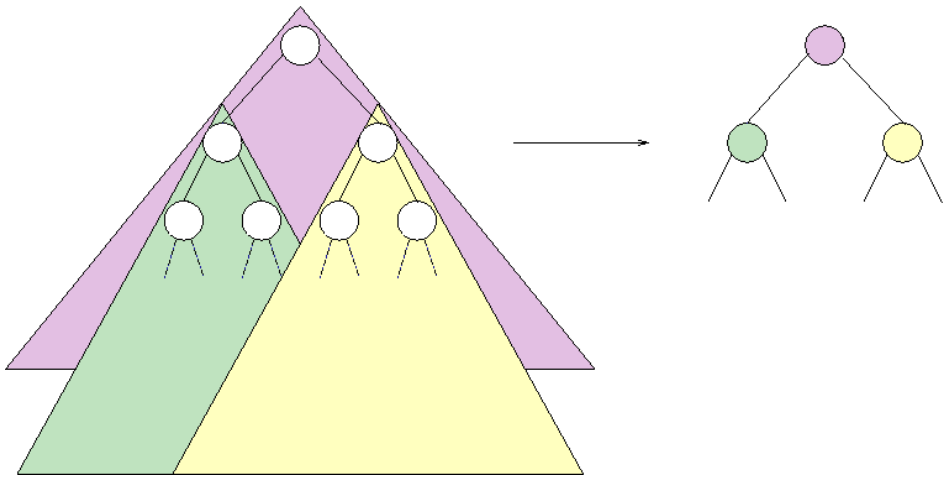
```
\usepackage{tikz}
```

You use commands to program your graphic, using either relative or absolute coordinates.

Many examples on `http://www.texample.net/tikz/`.

Before/After

Sliding block map on the free monoid $\mathbb{M}_2$



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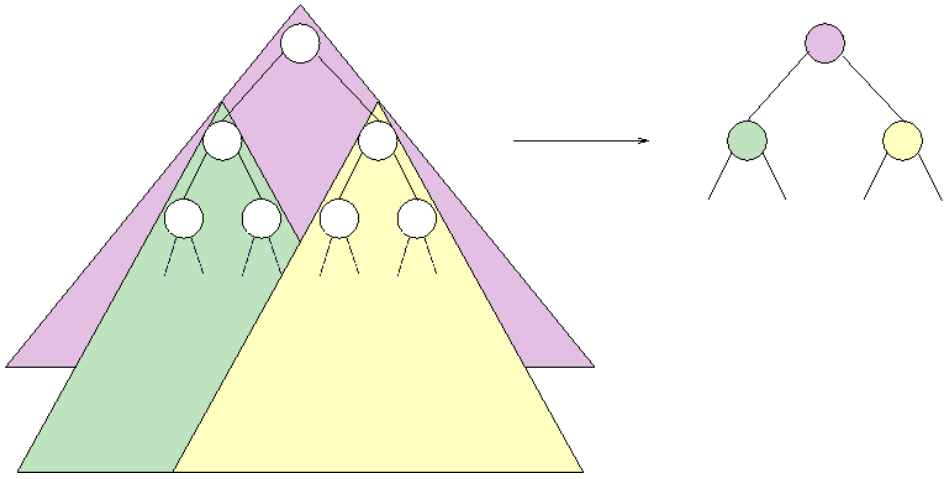
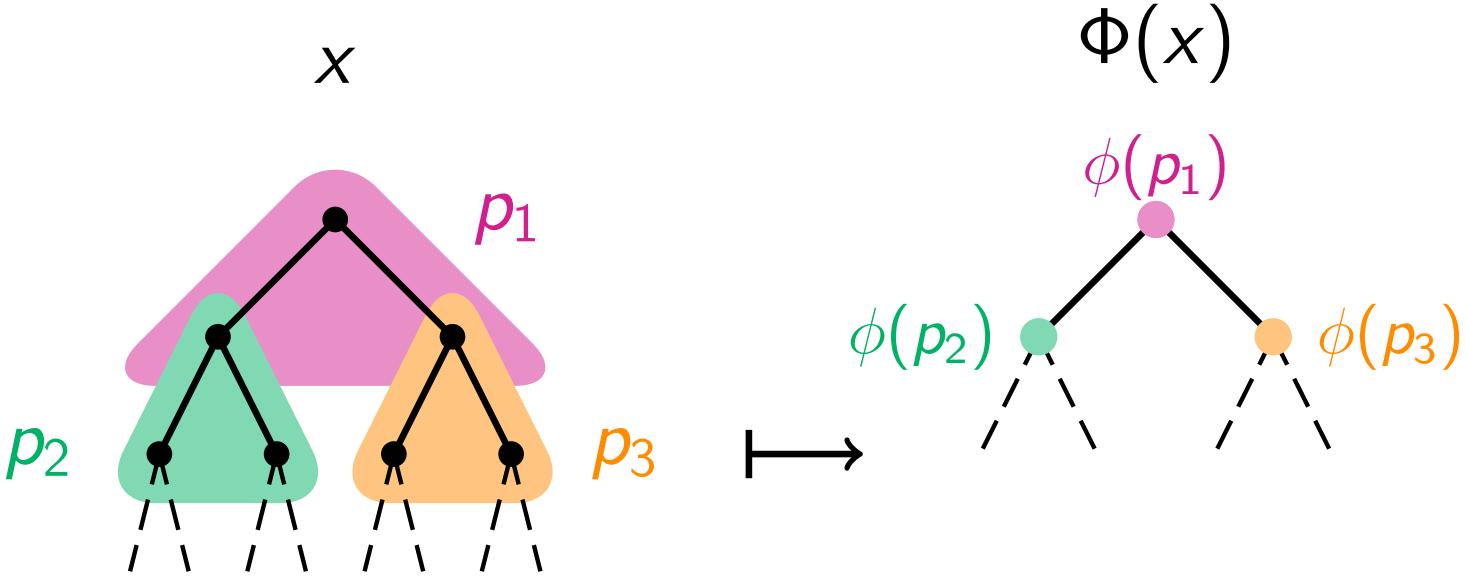
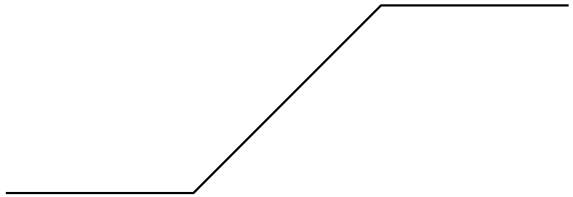




Easy example

```
\begin{tikzpicture}
\draw (0,0) -- (1,0) -- (2,1) -- (3,1);
\end{tikzpicture}
```



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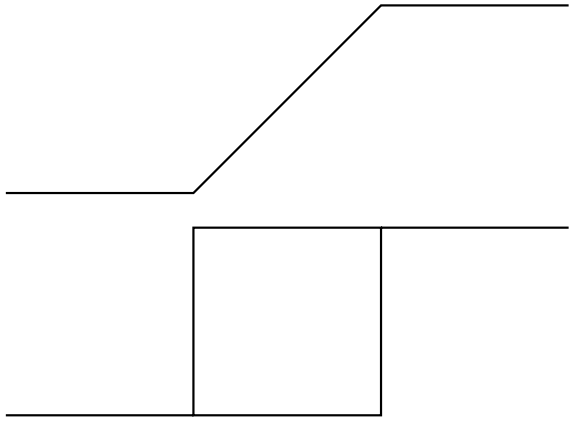
\draw (0,0) -- (1,0) -- (2,1) -- (3,1);
\end{tikzpicture}
```

```
\begin{tikzpicture}
\draw (0,0) -- (1,0) rectangle (2,1) -- (3,1);
\end{tikzpicture}
```



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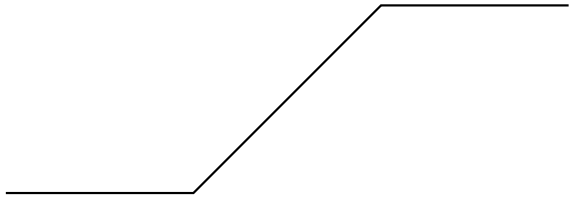

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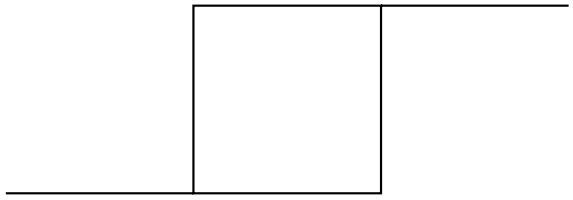
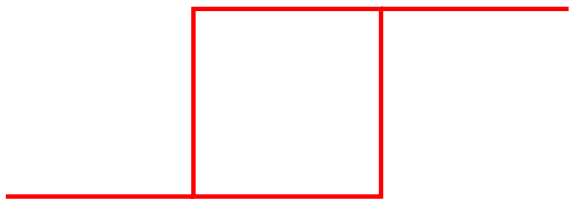


```
\begin{tikzpicture}
\draw[thick,color=red] (0,0) -- (1,0) rectangle (2,1)
-- (3,1);
\end{tikzpicture}
```



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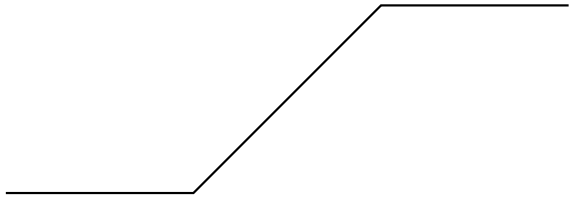

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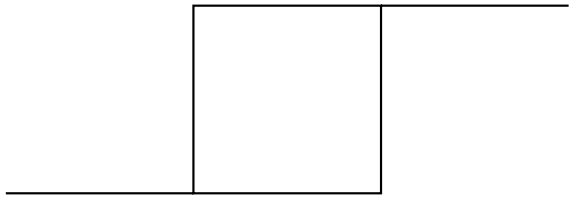

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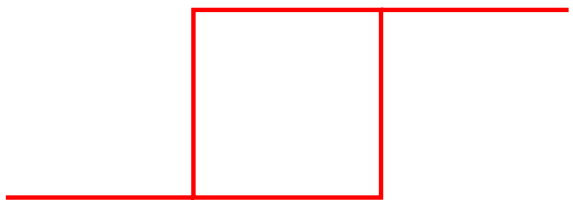
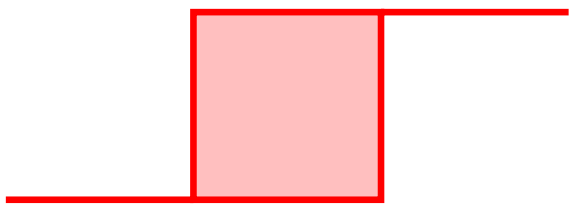


```
\begin{tikzpicture}
\draw [very thick,color=red, fill=red!25] (0,0) --
(1,0) rectangle (2,1) -- (3,1);
\end{tikzpicture}
```



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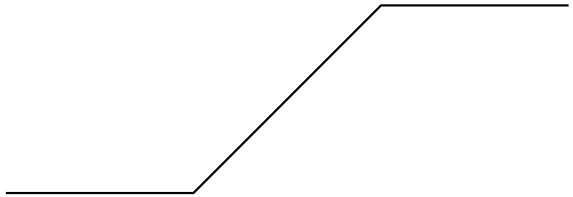

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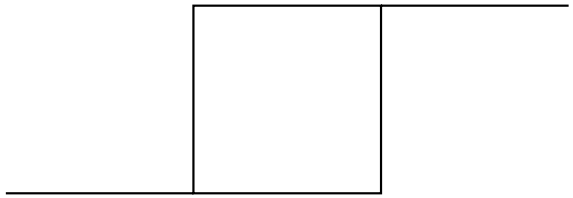

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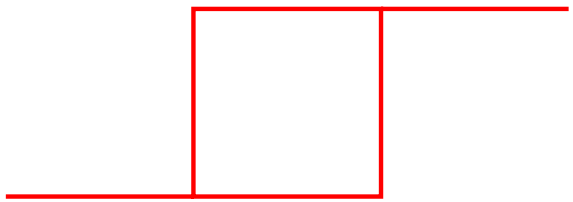

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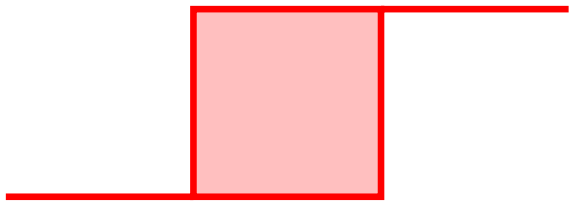
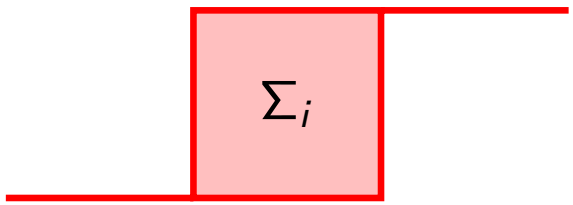


```
\begin{tikzpicture}
\draw[very thick,color=red, fill=red!25] (0,0) --
(1,0) rectangle (2,1) -- (3,1);
\draw (1.5,0.5) node{$\Sigma_i$};
\end{tikzpicture}
```



Colors

Create your own colors !

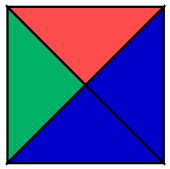
```
\definecolor{orange}{RGB}{255,140,0}
```

This is **blue**.
This is **red**.
This is **yellow**.
This is **green**.

This is **bleu**.
This is **rouge**.
This is **orange**.
This is **vert**.

Wang tiles

```
\draw [black,fill=vert] (0,0)--(0.5,0.5)--(0,1)--cycle;
\draw [black,fill=bleu] (0,0)--(0.5,0.5)--(1,0)--cycle;
\draw [black,fill=bleu] (1,1)--(0.5,0.5)--(1,0)--cycle;
\draw [black,fill=rouge] (1,1)--(0.5,0.5)--(0,1)--cycle;
```



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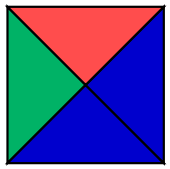

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\draw [black,fill=bleu] (1,1)--(0.5,0.5)--(1,0)--cycle;
\draw [black,fill=rouge] (1,1)--(0.5,0.5)--(0,1)--cycle;
\draw [black,fill=vert] (0,1)--(0.5,1.5)--(0,2)--cycle;
\draw [black,fill=bleu] (0,1)--(0.5,1.5)--(1,1)--cycle;
\draw [black,fill=bleu] (1,2)--(0.5,1.5)--(1,1)--cycle;
\draw [black,fill=rouge] (1,2)--(0.5,1.5)--(0,2)--cycle;
```
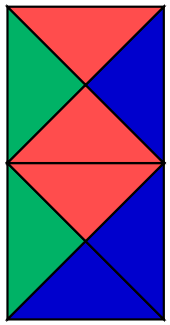
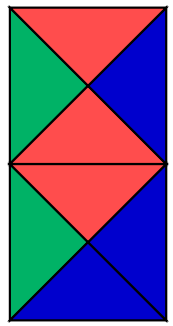



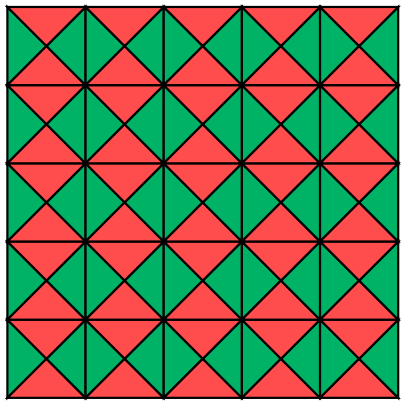
Wang tiles with a dedicated command

```
\newcommand{\wang}[6]{
\draw [black,fill=#3] (#1,#2)--(#1+0.5,#2+0.5)--(#1,#2+1)--cycle;
\draw [black,fill=#4] (#1,#2)--(#1+0.5,#2+0.5)--(#1+1,#2)--cycle;
\draw [black,fill=#5] (#1+1,#2+1)--(#1+0.5,#2+0.5)--(#1+1,#2)--cycle;
\draw [black,fill=#6] (#1+1,#2+1)--(#1+0.5,#2+0.5)--(#1,#2+1)--cycle;
}

...

\begin{document}

 \wang{0}{0}{vert}{bleu}{bleu}{rouge}
 \wang{0}{1}{vert}{rouge}{bleu}{rouge}

\end{document}
```



Wang tiles and loops

```
\begin{tikzpicture}
\foreach \x in {0,...,4} {
 \foreach \y in {0,...,4} {
  \wang{\x}{\y}{vert}{rouge}{vert}{rouge}
  }
 }
\end{tikzpicture}
```



Nested foreach loops in TikZ

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\begin{tikzpicture}
\foreach \x in {0,...,4} {
 \foreach \y in {0,...,4} {
   ...
  }
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\end{tikzpicture}
```

is allowed!

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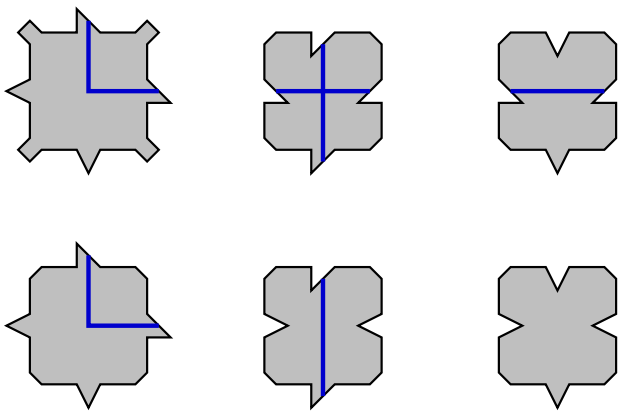
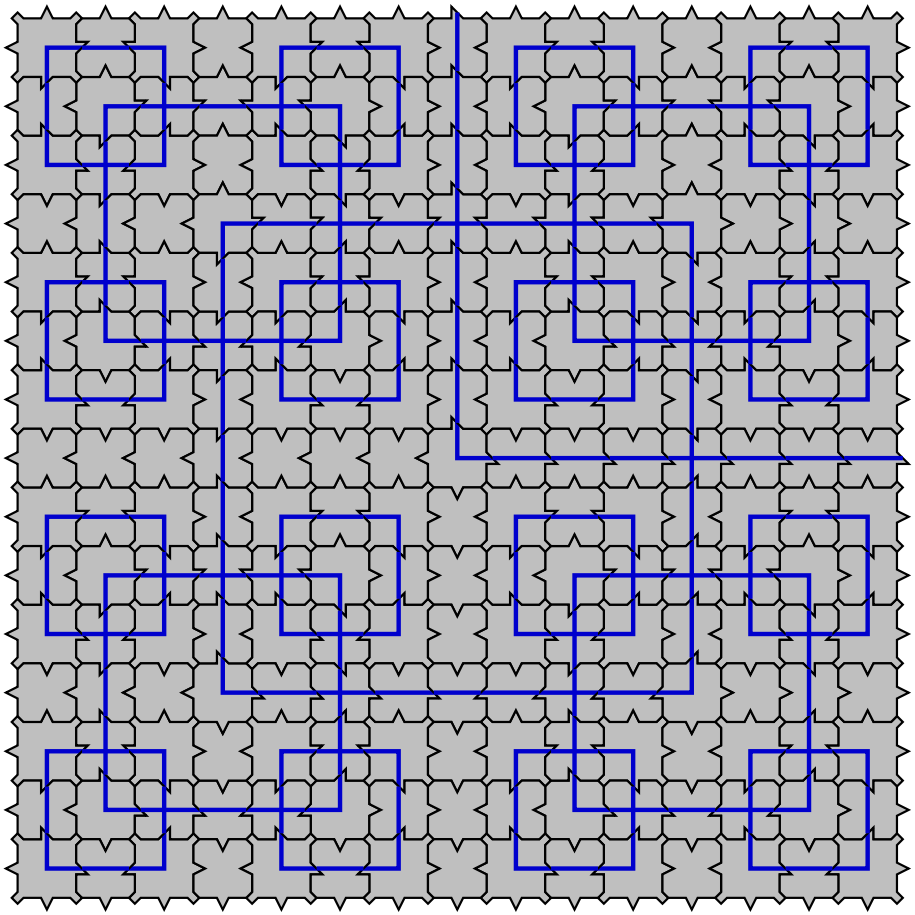
Better solution: generate TikZ commands with an external program

Robinson tileset in TikZ





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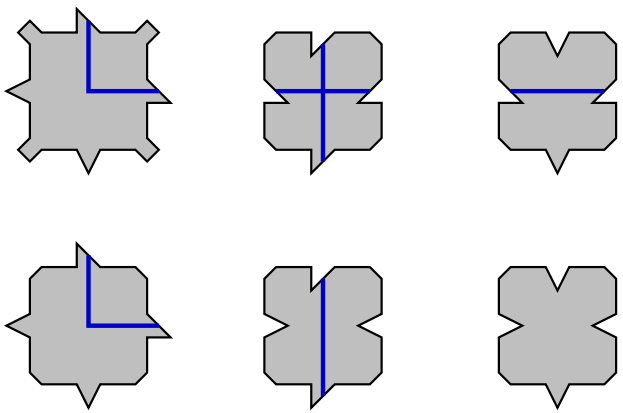
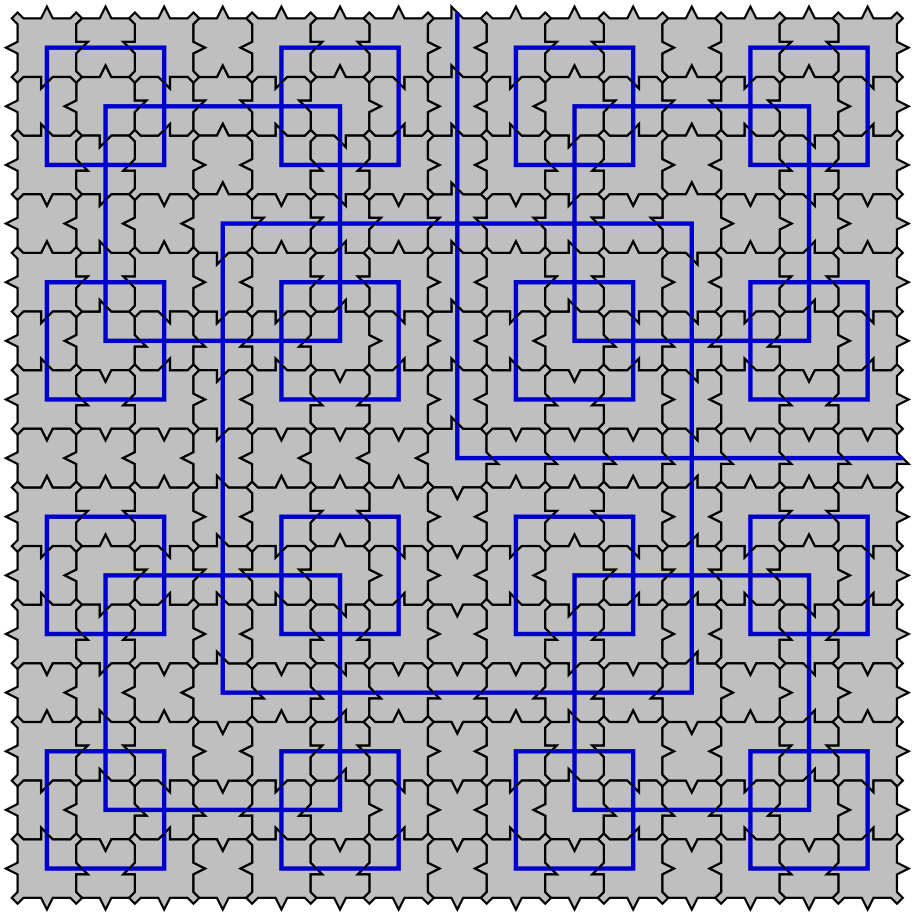
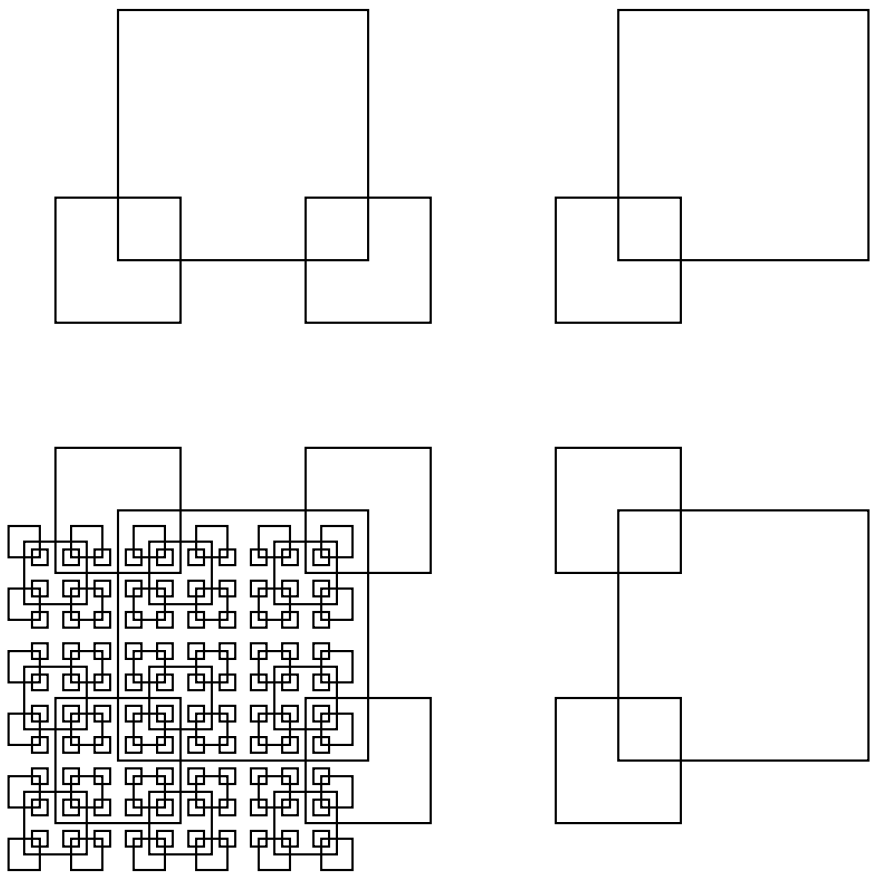




```
\newcommand{\robinsonempty}[4]{
\begin{scope}[shift={(#1,#2)},rotate=#3]
\draw[fill=#4] (0,0.1)--(0.1,0)--(0.4,0)-- "blabla" --cycle ;
\end{scope}
}
```

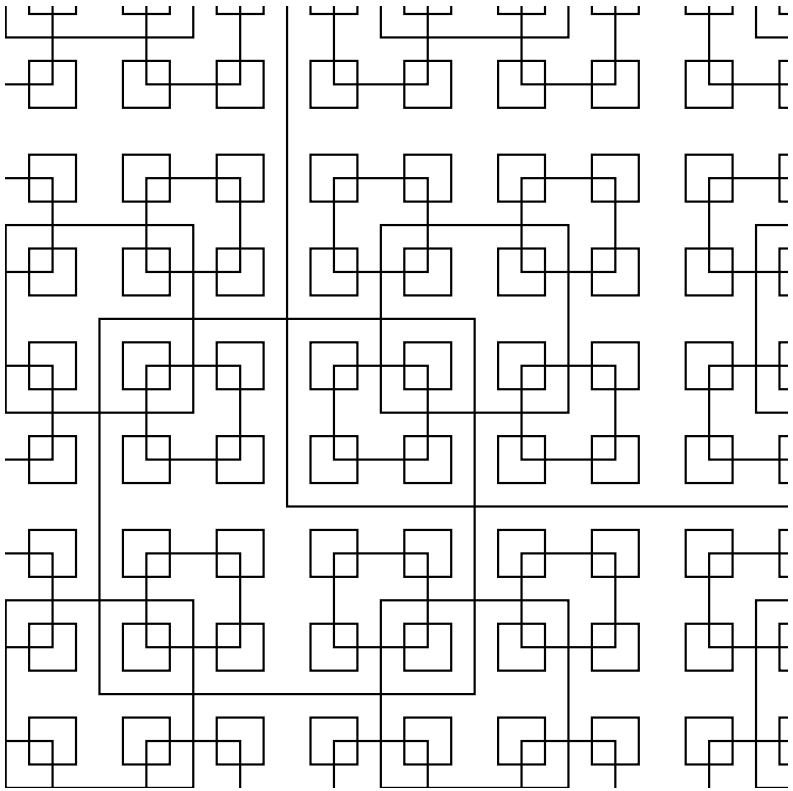
The clip command

```
\begin{tikzpicture}
...
"blabla"
...
\end{tikzpicture}
}
```



The clip command

```
\begin{tikzpicture}
\clip (0,0) rectangle (5,5);
...
"blabla"
...
\end{tikzpicture}
}
```



Pentagonal Wang tiles in the hyperbolic plane

```
\newcommand{\hypertilecolored}[4]{
\begin{scope}[shift={(#1,#2)}]
\draw[fill=#4] (0,0) -- (0,1) to
[controls=+(45:0.75) and +(135:0.75)] (2,1) -- (2,0) to
[controls=+(135:0.375) and +(45:0.375)] (1,0) to
[controls=+(135:0.375) and +(45:0.375)] (0,0) -- cycle ;
\draw (1,0.625) node{#3};
\end{scope}
}
```

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[controls=+(135:0.375) and +(45:0.375)] (0,0) -- cycle ;
\draw (1,0.625) node{#3};
\end{scope}
}
```
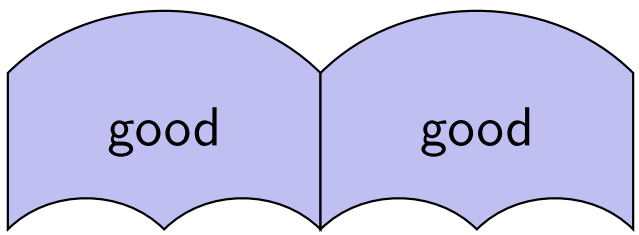

```
\begin{tikzpicture}
 \hypertilecolored{0}{0}{good}{bleu!25}
 \hypertilecolored{2}{0}{good}{bleu!25}
\end{tikzpicture}
```



Scale and scalebox

```
\newcommand{\hypertilecolored}[5]{
\begin{scope}[shift={(#1,#2)},scale=#3]
\draw[fill=#5] (0,0) -- (0,1) to
[controls=+(45:0.75) and +(135:0.75)] (2,1) -- (2,0) to
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\draw (1,0.625) node{#4};
\end{scope}
}
```

```
\begin{tikzpicture}
 \hypertilecolored{0}{0}{1}{big}{bleu!25}
 \hypertilecolored{2}{0}{1}{big}{bleu!25}
 \hypertilecolored{0}{-0.5}{0.5}{small}{bleu!25}
 \hypertilecolored{0}{-0.75}{0.25}{tiny}{bleu!25}
\end{tikzpicture}
```

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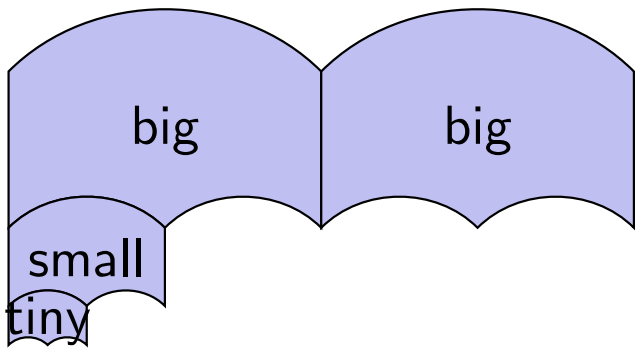
 \hypertilecolored{0}{-0.75}{0.25}{tiny}{bleu!25}
\end{tikzpicture}
```



Scale and scalebox

```
\newcommand{\hypertilecolored}[5]{
\begin{scope}[shift={(#1,#2)},scale=#3]
\draw[fill=#5] (0,0) -- (0,1) to
[controls=+(45:0.75) and +(135:0.75)] (2,1) -- (2,0) to
[controls=+(135:0.375) and +(45:0.375)] (1,0) to
[controls=+(135:0.375) and +(45:0.375)] (0,0) -- cycle ;
\draw (1,0.625) node{\scalebox{#3}{#4}};
\end{scope}
}
```

```
\begin{tikzpicture}
 \hypertilecolored{0}{0}{1}{big}{bleu!25}
 \hypertilecolored{2}{0}{1}{big}{bleu!25}
 \hypertilecolored{0}{-0.5}{0.5}{small}{bleu!25}
 \hypertilecolored{0}{-0.75}{0.25}{tiny}{bleu!25}
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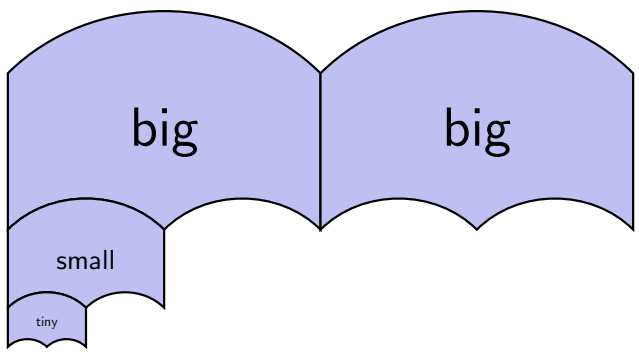
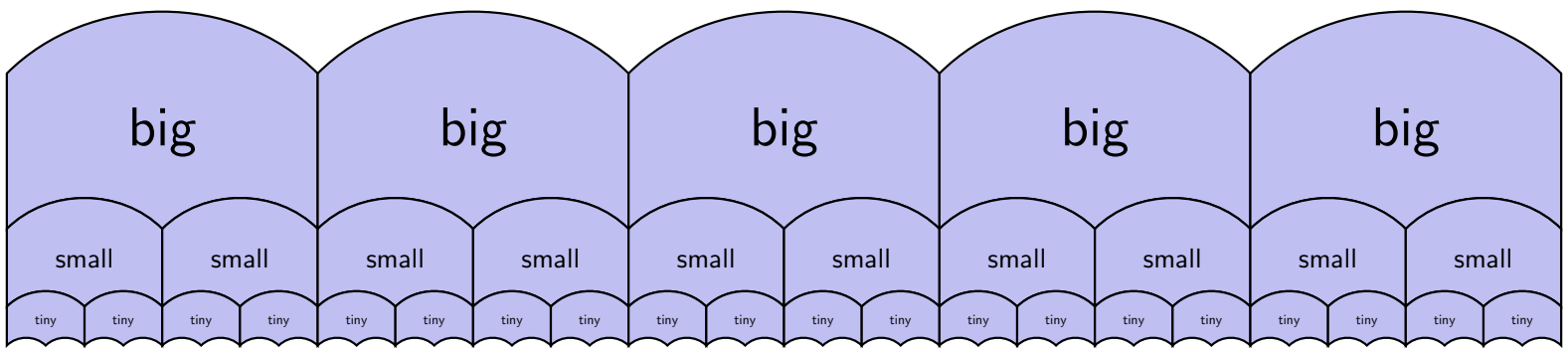
```



Scale and loops

```
\begin{tikzpicture}
\foreach \x in {0,...,4} {
 \hypertilecoloredbis{2*\x}{0}{1}{big}{bleu!25}
 }
\foreach \x in {0,...,9} {
 \hypertilecoloredbis{\x}{-0.5}{0.5}{small}{bleu!25}
 }
\foreach \x in {0,...,19} {
 \hypertilecoloredbis{0.5*\x}{-0.75}{0.25}{tiny}{bleu!25}
 }
\end{tikzpicture}
```



Remark

You can also insert a tiny version of your tile inside some text. This pentagonal Wang tile  is cute and can be included inside a block of text. I am writing this last sentence just to complete the line.

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```
\newcommand{\tuile}{\vbox to 13pt{\hbox{
\begin{tikzpicture}[scale=0.2]
\draw (0,0) -- (0,2) to
[controls=+(45:1.5) and +(135:1.5)] (4,2) -- (4,0) to
[controls=+(135:0.75) and +(45:0.75)] (2,0) to
[controls=+(135:0.75) and +(45:0.75)] (0,0) -- cycle ;
\end{tikzpicture}
}}}
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Write LaTeX on images

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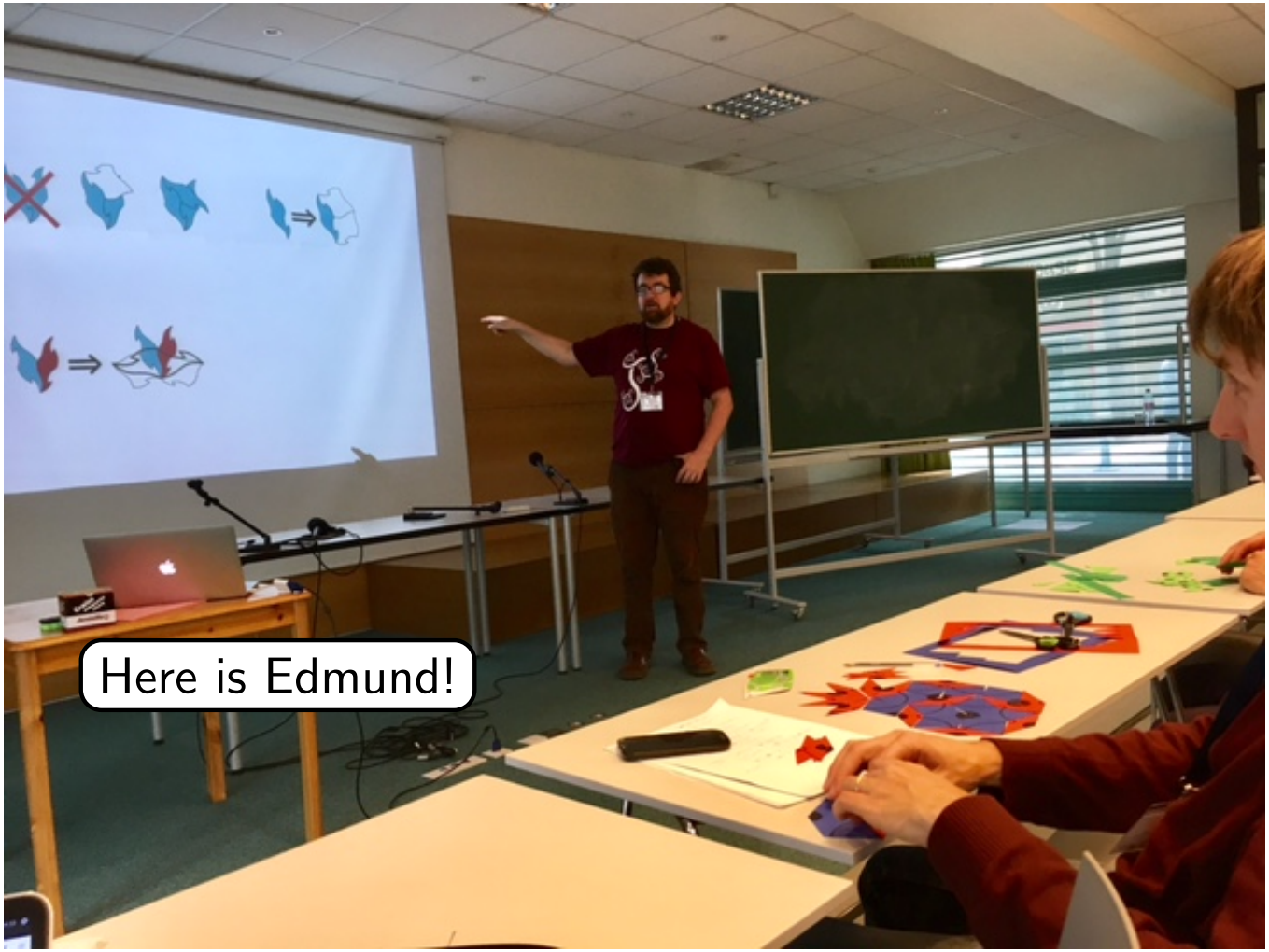
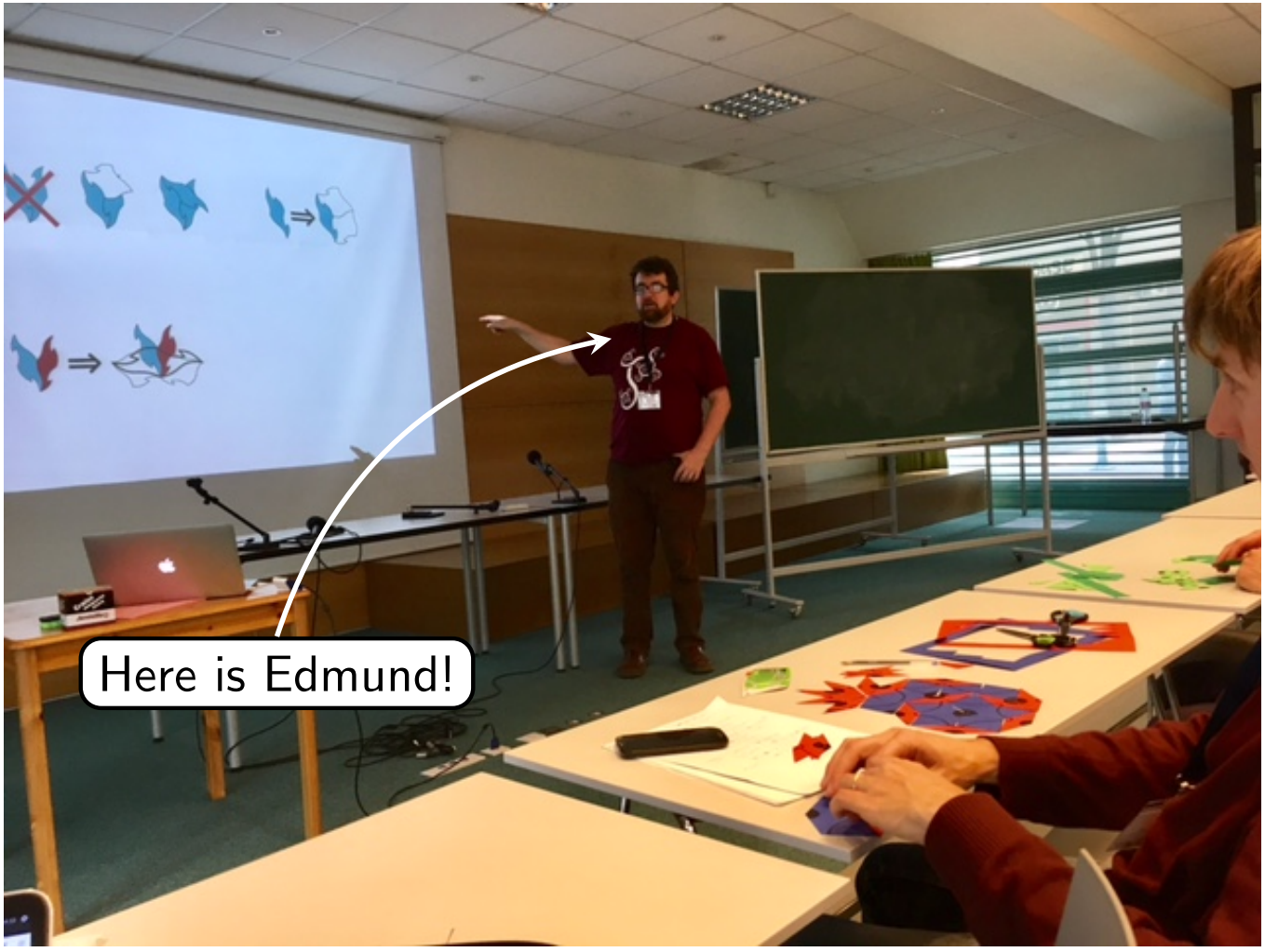


Write LaTeX on images



Write LaTeX on images

```
\begin{tikzpicture}
  \draw (0,0) node[above right]{\includegraphics[width=0.8\linewidth]{edmund.jpg}};
  \pause
  \draw (2,2) node[draw,fill=white,thick,rounded corners] (a) {Here is Edmund!};
  \pause
  \draw[line width=1pt,color=white,-stealth] (a.north) to[bend left] (4.3,4.3);
\end{tikzpicture}
```

Write LaTeX on images

Many other things you can do with TikZ

- graphs, finite state automata
- 3D graphics
- and more artistic graphics!

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Thanks you for your attention!!!