Introduction to Beamer and TikZ

Christian Schnell

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For people with bad memory...

In case you forgot today’s date...
Part I

Computer presentations with Beamer
What is Beamer?

Beamer is a \LaTeX-package for making computer presentations. Here is a minimal example:

\documentclass[12pt,compress]{beamer}
\title{The Title}
\author{The Author}
\date{The Date}
\begin{document}
\frame{\titlepage}
\end{document}

This produces a single slide with title, author, and date on it.
Frames

Slides are called “frames” in Beamer.

\begin{frame}{My frame}
My text
\end{frame}

\begin{frame}
\frametitle{My frame}
My text
\end{frame}

\frame{
\frametitle{My frame}
My text
}
If you like, you can organize your presentation into “parts”.

\begin{frame}
\partpage
\part{My part}
\end{frame}

The command \partpage creates a title page for this part. Parts are numbered automatically.
Themes

Beamer has many “themes”, such as this one:

On the Complexity of SNP Block Partitioning Under the Perfect Phylogeny Model

Jens Gramm\textsuperscript{1} Tzvika Hartman\textsuperscript{2} Till Nierhoff\textsuperscript{3} Roded Sharan\textsuperscript{4} Till Tantau\textsuperscript{5}

\textsuperscript{1}Universität Tübingen, Germany
\textsuperscript{2}Bar-Ilan University, Ramat-Gan, Israel
\textsuperscript{3}International Computer Science Institute, Berkeley, USA
\textsuperscript{4}Tel-Aviv University, Israel
\textsuperscript{5}Universität zu Lübeck, Germany

Workshop on Algorithms in Bioinformatics, 2006
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Workshop on Algorithms in Bioinformatics, 2006
How to change the theme?

The theme on the previous slide is called “Warsaw”.

\usetheme{Warsaw}
\usecolortheme{default}

Most themes waste a lot of space on each slide. Solution:

\documentclass[12pt,compress]{beamer}
\setbeamertemplate{navigation symbols}{}
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Moral
Use a plain white background instead of a fancy theme!
Highlight important things using \alert{important}. 


Theorems, Definitions, Corollaries, etc.

Most themes will put a box around statements:

**Corollary**

If $\chi_{PP}(M) = 2$ for a haplotype matrix $M$, we can find an optimal pp-partition in polynomial time.

**Corollary**

Computing $\chi_{PP}$ for haplotype matrices is

- NP-hard,
- *not* fixed-parameter tractable, unless P = NP,
- very hard to approximate.
How to state a theorem?

On a white background, this effect can be achieved like this:

\usecolortheme{orchid}
\begin{theorem}
Statement of my theorem.
\end{theorem}

To get a “block” of text, do this:

\begin{block}{My block}
Content of my block.
\end{block}
Including graphics

Graphics can be included as usual:

\begin{center}
\includegraphics[height=4cm]{clipboard.jpg}
\end{center}
Revealing a slide in stages

Euclid’s algorithm
Euclid’s algorithm

To find $\gcd(a, b)$, do the following:
Euclid’s algorithm

To find $\gcd(a, b)$, do the following:

1. Change signs to get $a, b \geq 0$. 
Euclid’s algorithm

To find $\gcd(a, b)$, do the following:

1. Change signs to get $a, b \geq 0$.
2. Divide with remainder $a = q \cdot b + r$. 

Revealing a slide in stages
Euclid’s algorithm

To find $\text{gcd}(a, b)$, do the following:

1. Change signs to get $a, b \geq 0$.
2. Divide with remainder $a = q \cdot b + r$.
3. Replace $(a, b)$ by $(b, r)$ and repeat.
Euclid’s algorithm

To find $\gcd(a, b)$, do the following:

1. Change signs to get $a, b \geq 0$.
2. Divide with remainder $a = q \cdot b + r$.
3. Replace $(a, b)$ by $(b, r)$ and repeat.
4. The last nonzero remainder is the gcd.
Revealing a slide in stages

The easiest way to achieve this effect is to use \textbackslash pause:

\begin{block}{Euclid’s algorithm} \\pause
To find $\gcd(a,b)$, do the following: \\pause
\begin{enumerate}
\item Change signs to get $a,b \geq 0$. \\pause
\item Divide with remainder $a = q \cdot b + r$. \\pause
\item Replace $(a,b)$ by $(b,r)$ and repeat. \\pause
\item The last nonzero remainder is the gcd.
\end{enumerate}
\end{block}
Revealing a slide in stages

There is a more compact notation for \texttt{itemize} etc.

\begin{enumerate}[<+->]
\item Change signs to get \(a, b \geq 0\).
\item Divide with remainder \(a = q \cdot b + r\).
\item Replace \((a, b)\) by \((b, r)\) and repeat.
\item The last nonzero remainder is the gcd.
\end{enumerate}

You can also use the notation \texttt{\item<1,3-4>} to tell Beamer on which slide(s) a specific item should appear.
Revealing a slide in stages
Revealing a slide in stages

Only
Revealing a slide in stages

Only use
Revealing a slide in stages

Only use this
Revealing a slide in stages

Only use this technique
Revealing a slide in stages

Only use this technique when
Revealing a slide in stages

Only use this technique when it
Revealing a slide in stages

Only use this technique when it is
Revealing a slide in stages

Only use this technique when it is really
Revealing a slide in stages

Only use this technique when it is really necessary!
Part II

Graphics with TikZ
What is TikZ?

TikZ is a \LaTeX-package for creating graphics.

\usepackage{tikz}
\begin{tikzpicture}
\end{tikzpicture}

There is no need to use an external graphics program.
Example 1

Here is a very basic example:
Example 1

The basic drawing command is `\draw`.

\begin{tikzpicture}[scale=2]
\draw[color=violet,thick] (0,0) -- (1,2) -- (3,3) -- (4,1) -- (2,0);
\draw[help lines] (0,0) grid (4,3);
\end{tikzpicture}

Points are specified by their coordinates, such as (1,2).
Example 2

Here is an example from a calculus test:

\[ D = \sqrt{D^2 + x^2} \]
Example 2

\begin{tikzpicture}[thick]
\draw [<->] (-5,0) -- (5,0);
\draw (0,0) -- (0,-2) -- (3,0);
\draw (1.5,0) node[anchor=south] {$x$};
\draw (0,-1) node[anchor=east] {$D$};
\draw (1.5,-1) node[anchor=west] \( \sqrt{D^2+x^2} \);
\draw (-5,0) node[anchor=south] {Highway};
\filldraw [black] (0,0) circle (1pt);
\filldraw [black] (0,-2) circle (1pt);
\filldraw[thin,fill=gray!40] (2.9,-0.05) -- (2.9,0.05) -- (3.1,0.05) -- (3.1,-0.05) -- cycle;
\draw (3,0) node[anchor=south] {\( \Delta x \)};
\end{tikzpicture}
Example 3

Here is a more complicated example:
Example 3

The base of the tower is drawn in the following way:

\usetikzlibrary{patterns}

\begin{tikzpicture}
\def\tower{ (0.6,4) -- (0.6,0.6) -- (1.2,0) --
           (-1.2,0) -- (-0.6,0.6) -- (-0.6,4)}
\draw[thick,fill=gray!40] \tower;
\pattern[pattern=bricks,pattern color=black] \tower;
\end{tikzpicture}
Here is an example from graph theory:

Example 4
Example 4

Here is how to draw the vertices:

\begin{tikzpicture}
\tikzstyle{vertex}=[circle,fill=black!10,minimum size=12pt,inner sep=1pt]
\node[vertex](A) at (5,10){A};
\node[vertex](D) at (15,10){D};
\path[draw,thick,-] (D) -- (A);
\end{tikzpicture}
Part III

Commutative diagrams with tikz-cd
What is tikz-cd?

tikz-cd is a \LaTeX-package for commutative diagrams. Commutative diagrams are pictures like this one:

\[
\begin{array}{c}
A & \overset{f}{\longrightarrow} & B \\
g \downarrow & & h \downarrow \\
C & \overset{i}{\longrightarrow} & D
\end{array}
\]

They are used a lot in algebraic geometry, category theory, etc.
How to create a basic diagram?

Here is the same diagram without the arrows:

\begin{array}{cc}
A & B \\
C & D
\end{array}

The objects form an array, separated with \& and and \\.

\begin{verbatim}
\usepackage{tikz,tikz-cd}
\begin{equation*}
\begin{tikzcd}
A & B \\
C & D
\end{tikzcd}
\end{equation*}
\end{verbatim}
How to create a basic diagram?

Here is the diagram again, this time with arrows:

\[
\begin{tikzcd}
A \rar{f} & B \\
\dar{g} & \dar{h} \\
C \rar{i} & D
\end{tikzcd}
\]

The arrows, in shorthand notation, are \texttt{\dar{g}}, \texttt{\uar{f}}, etc.

\begin{verbatim}
\begin{tikzcd}
A \dar{g} \rar{f} & B \dar{h} \\
C \rar{i} & D
\end{tikzcd}
\end{verbatim}

Arrow commands come after the object where the arrow starts.
More complicated arrows

\begin{tikzcd}
A \rar[dashed]{f} \arrow[bend right=20]{drr}{j} & B \rar{g} & C \\
& & D \arrow[bend left=40]{rr}{i}
\end{tikzcd}
Arrows that cross each other

Here is a 3-dimensional example:

To get this effect:

- Adjust the spacing between rows and columns.
- Tell tikz-cd which arrows cross over each other.
- Reverse the direction of certain arrows.
Arrows that cross each other

Here is the tikz-cd code for the example:

\begin{tikzcd}[row sep=scriptsize, column sep=scriptsize]
& f^* E_V \arrow{dl} \arrow{rr} \arrow{dd} & & E_V \arrow{dl} \arrow{dd} \\
& f^* E \arrow{rr} \arrow{dd} & & E \\
& U \arrow{dl} \arrow{rr} & & V \arrow{dl} \\
M \arrow{rr} & & N \arrow[crossing over, leftarrow]{uu} \\
\end{tikzcd}
Thank you!