Introduction to Beamer and TikZ

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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
}
```

Parts

If you like, you can organize your presentation into “parts”.

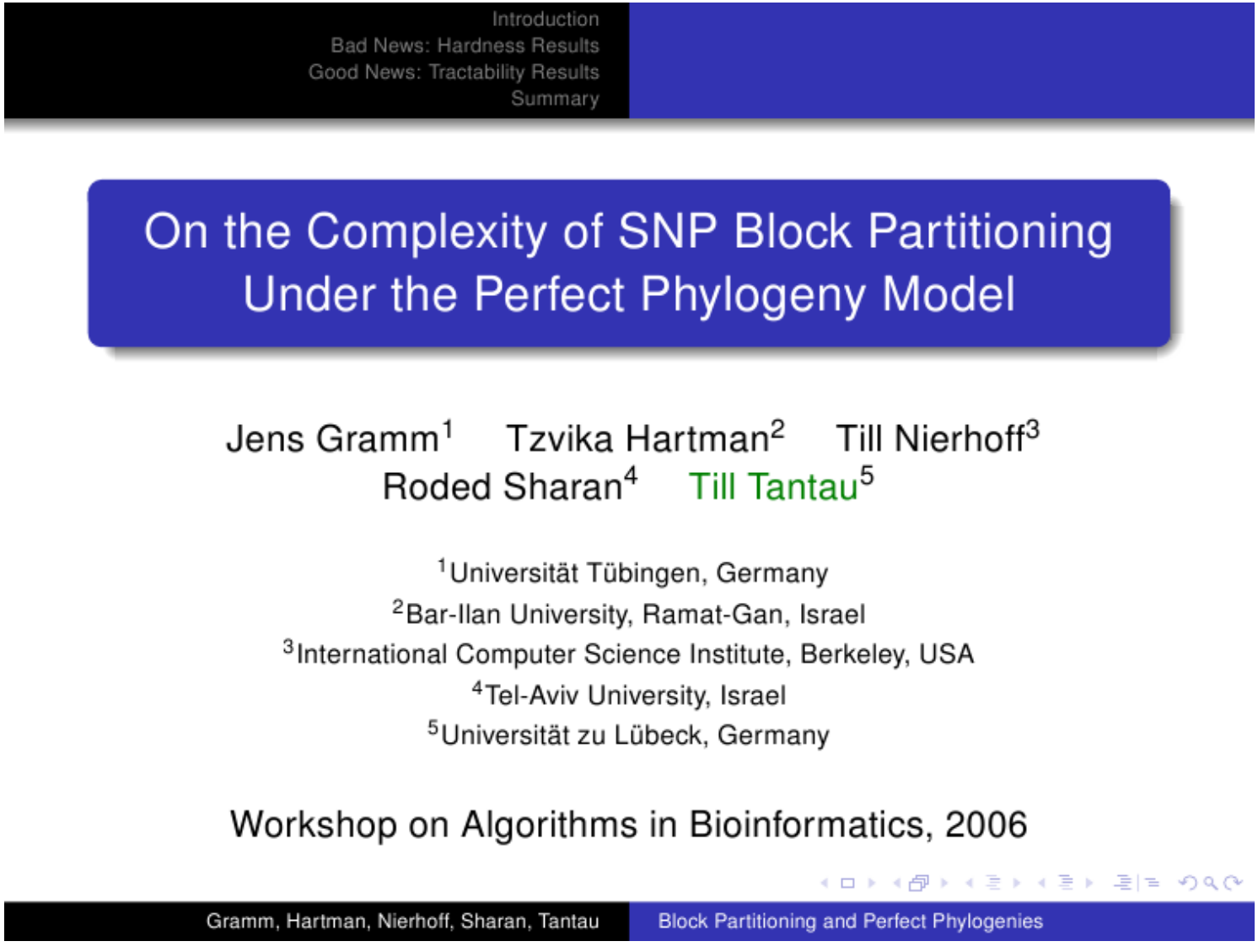
```
\part{My part}

\begin{frame}
\partpage
\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:



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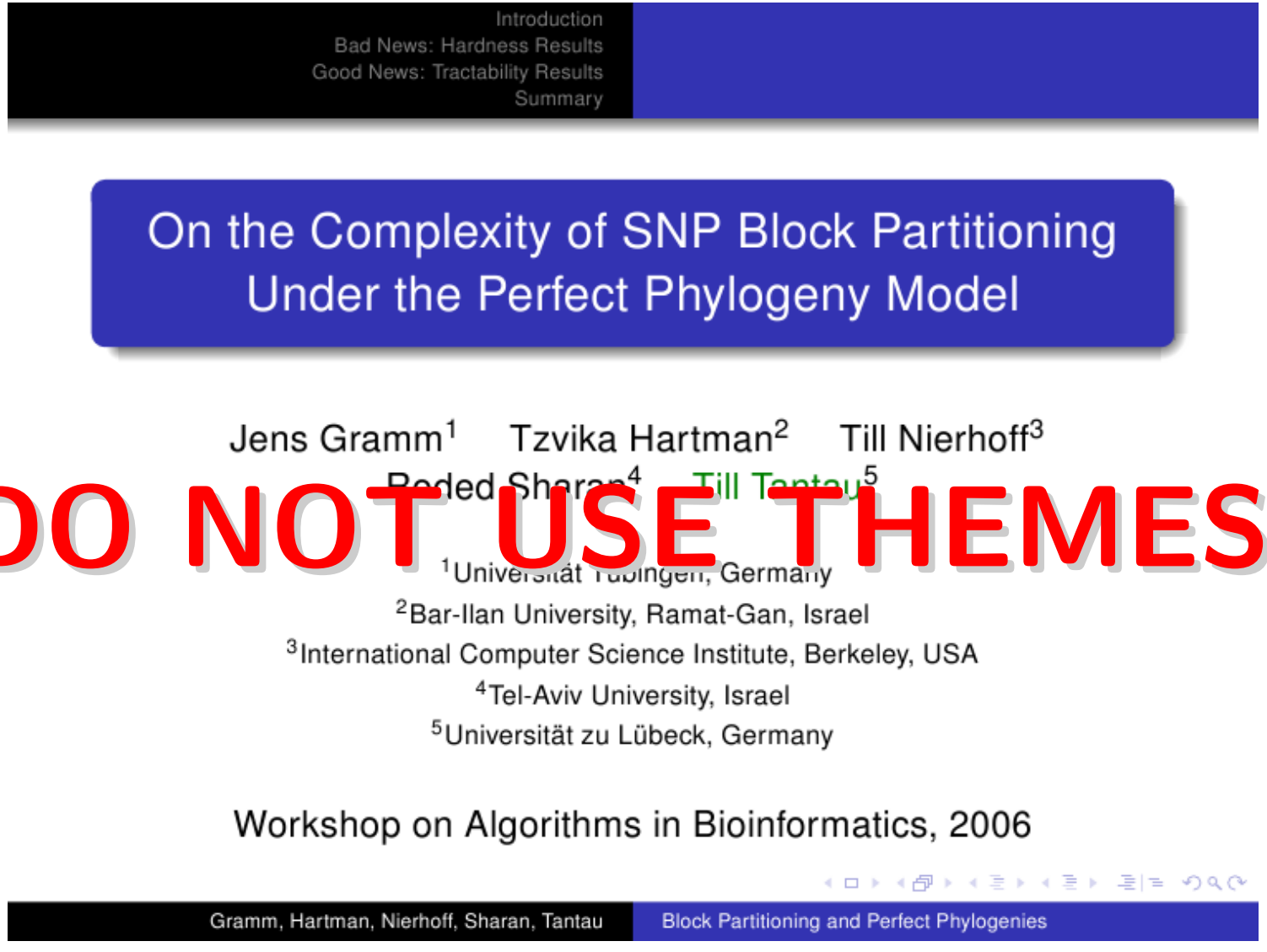

DO NOT USE THEMES!

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:

Implications for pp-partitions of haplotype matrices.

Corollary

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

Corollary

Computing χ_{PP} for haplotype matrices is

- NP*-hard,*
- *not fixed-parameter tractable, unless* $\mathrm{P} = \mathrm{NP}$,
- *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

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

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1. Change signs to get $a, b \geq 0$.

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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

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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.

Revealing a slide in stages

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 \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 `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 `\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.

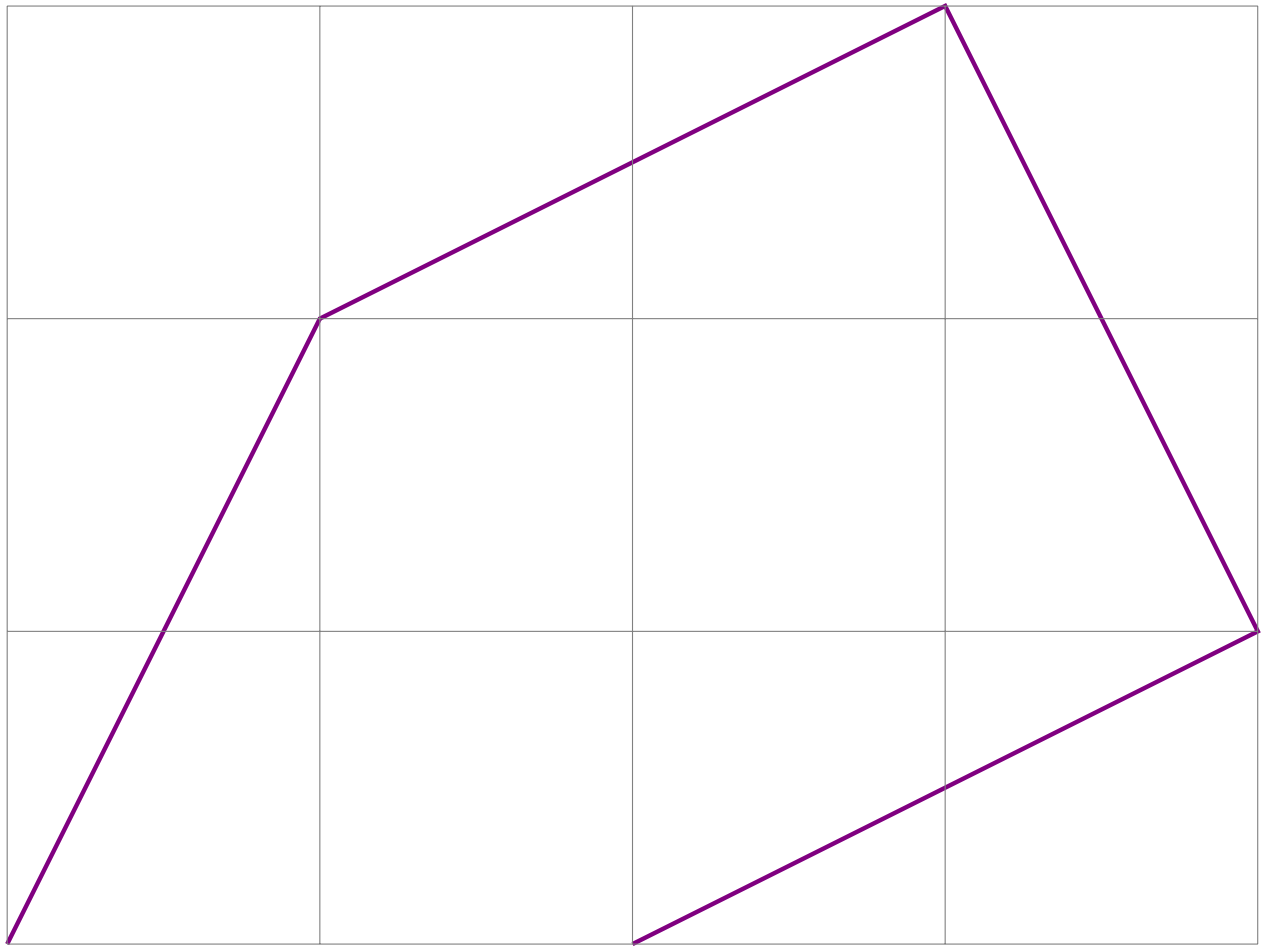
```
\usepackage{tikz}

\begin{tikzpicture}
\end{tikzpicture}
```

There is no need to use an external graphics program.

Example 1

Here is a very basic example:



Example 1

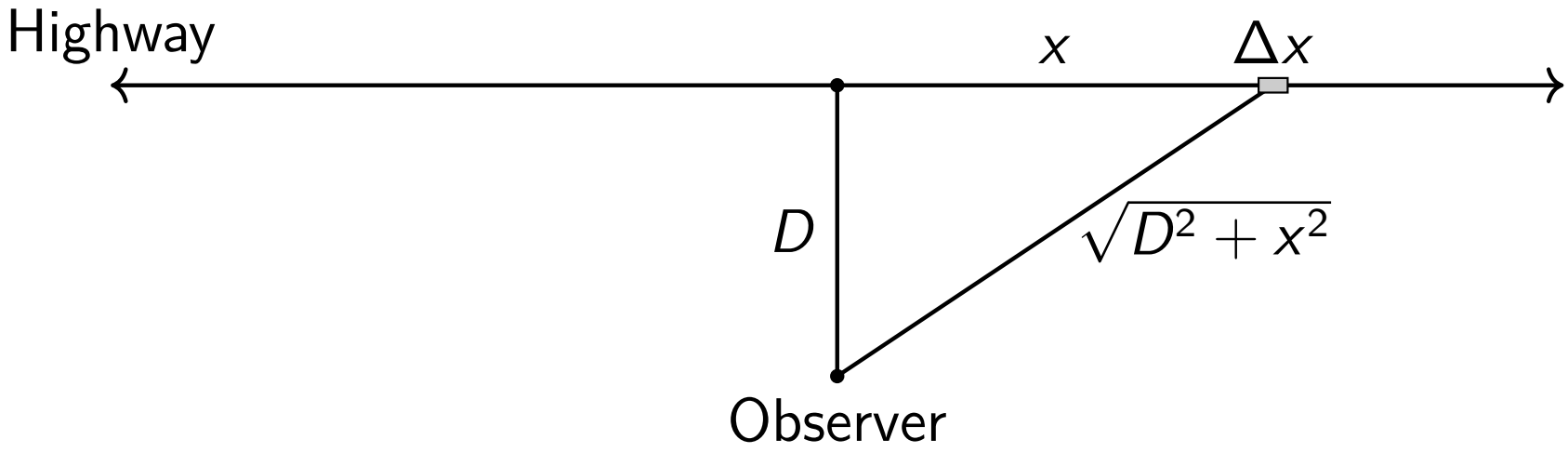
The basic drawing command is `\draw`.

```
\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:

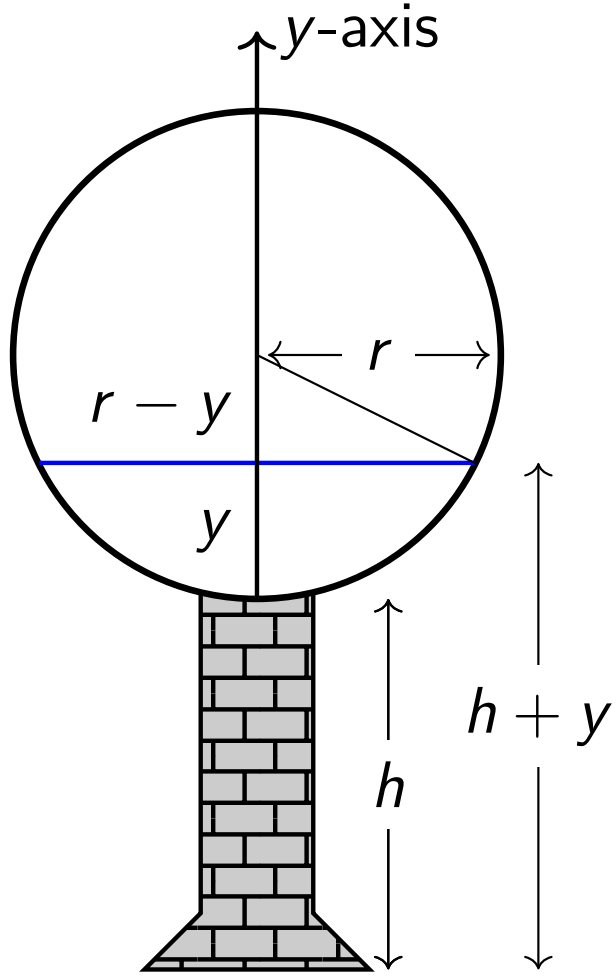


Example 2

```
\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);
\draw (0,-2) node[anchor=north] {Observer};
\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

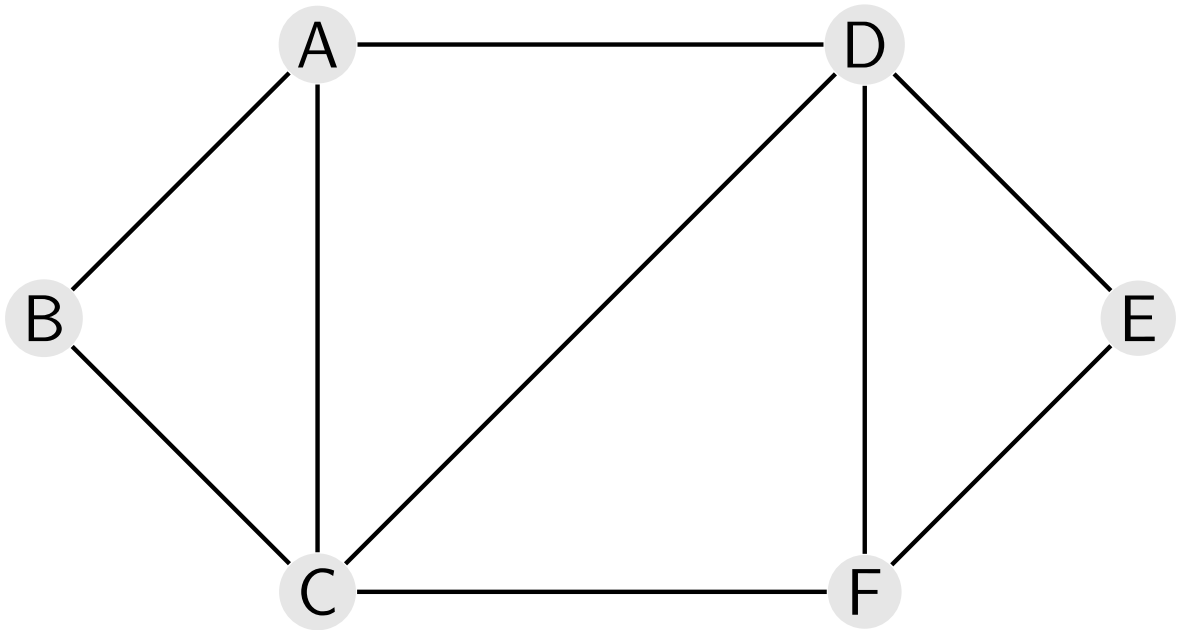
The base of the tower is drawn in the following way:

```
\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}
```

Example 4

Here is an example from graph theory:



Example 4

Here is how to draw the vertices:

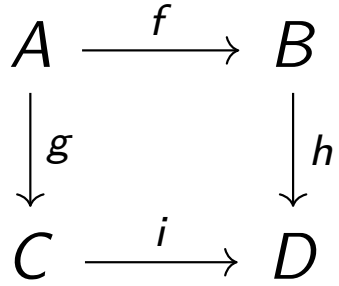
```
\begin{tikzpicture}
\tikzstyle{vertex}=[circle,fill=black!10,minimum
    size=12pt,inner sep=1pt]
\node[vertex](A) at ( 5,10){A};
\node[vertex](D) at (15,10){D};
\path[draw,thick,-] (D) --  (A);
\end{tikzpicture}
```

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:



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:

$$A \qquad B$$

$$C \qquad D$$

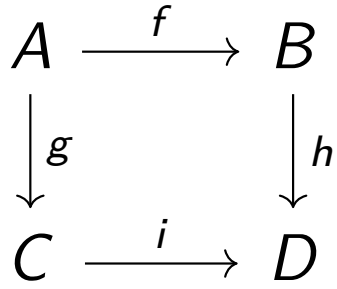
The objects form an array, separated with & and \\.

```
\usepackage{tikz,tikz-cd}

\begin{equation*}
\begin{tikzcd}
A & B \\
C & D
\end{tikzcd}
\end{equation*}
```

How to create a basic diagram?

Here is the diagram again, this time with arrows:

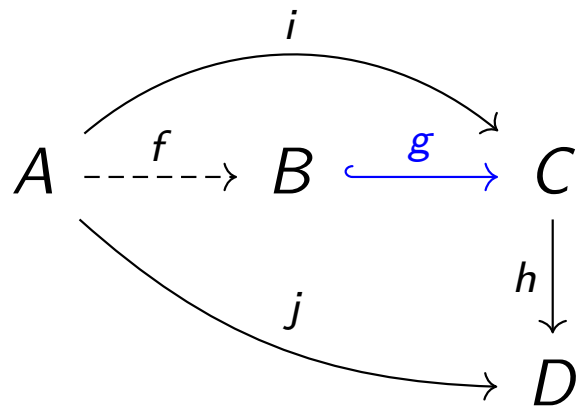


The arrows, in shorthand notation, are `\dar`, `\uar`, etc.

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

Arrow commands come after the object where the arrow starts.

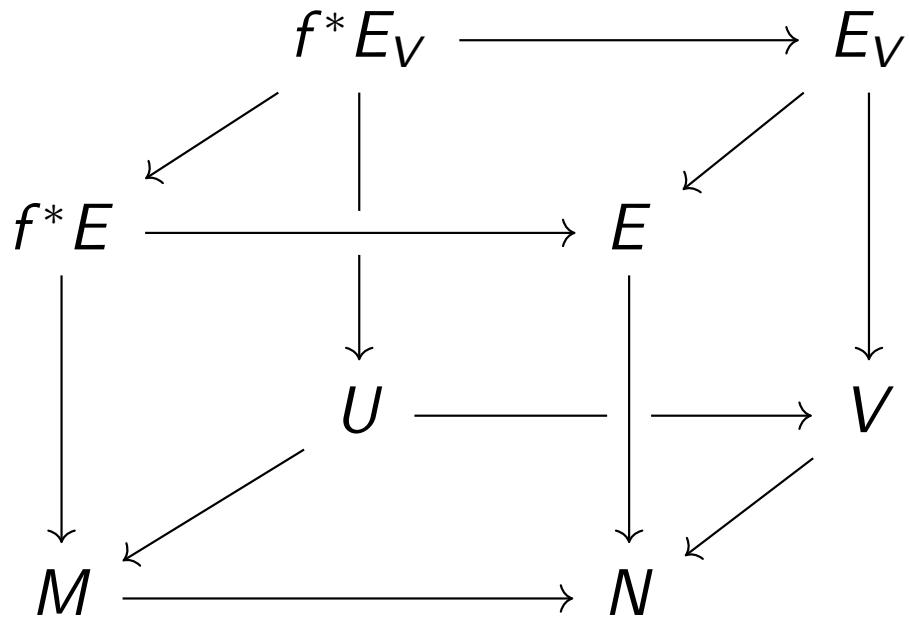
More complicated arrows




```
\begin{tikzcd}
A \rar[dashed]{f} \arrow[bend right=20]{drr}{j}
    \arrow[bend left=40]{rr}{i} &
B \rar[hook,color=blue]{g} & C \dar[swap]{h} \\
& & D
\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[crossing over]{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!