Scientific Writing with LaTeX

Part 4: Special Classes

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The exam Class — Overview

Why exam?

- Purpose-built for exams and quizzes
- Automatic point counting
- Grade tables
- Answer blanks and fill-in
- Solutions toggle (show/hide)
- Custom headers and footers

```
\documentclass[
  12pt,
  addpoints
]{exam}
```

Minimal example

```
\documentclass[12pt,addpoints]{exam}
\begin{document}

\begin{questions}
  \question[5] What is $2+2$?
  \begin{solution}
    $2 + 2 = 4$
  \end{solution}

  \question[10] Explain gravity.
  \begin{solution}
    Gravity is a fundamental
    force...
  \end{solution}
\end{questions}

\end{document}
```

The [5] assigns 5 points.

Student Info Header

```
\begin{center}
  {\Large\textbf{Midterm --- Intro to Economics}}\\[0.3cm]
  {\large February 2026}
\end{center}

\vspace{0.3cm}
\makebox[\textwidth]{Name:\enspace\hrulefill}\\[0.4cm]
\makebox[\textwidth]{Student ID:\enspace\hrulefill}\\[0.4cm]
\makebox[0.5\textwidth]{Date:\enspace\hrulefill}
\makebox[0.5\textwidth]{Section:\enspace\hrulefill}

\vspace{0.5cm}
\noindent\textbf{Instructions:} Answer all questions.
  Total: \numpoints\ points.
```

`\hrulefill` draws a line that fills available space — perfect for name fields.

Multiple Choice and True/False

Multiple choice

```
\question[3] Capital of Portugal:
\begin{choices}
  \choice Madrid
  \choice Barcelona
  \CorrectChoice Lisbon
  \choice Porto
\end{choices}
```

True / False

```
\question[2] The Earth is flat.
\begin{oneparcheckboxes}
  \choice True
  \CorrectChoice False
\end{oneparcheckboxes}
```

Fill in the blank

```
\question[3] Water boils at
  \fillin[100\textdegree C][2cm].
```

Parts and subparts

```
\question Consider $f(x) = x^2$.
\begin{parts}
  \part[5] Find the roots.
  \begin{solution}
    $x = 0$.
  \end{solution}

  \part[5] Find the vertex.
  \begin{solution}
    Vertex at $(0, 0)$.
  \end{solution}
\end{parts}
```

Writing Space for Answers

```
% Fixed vertical space
\vspace{5cm}

% Fill rest of page
\vspace{\stretch{1}}

% Empty box
\makeemptybox{5cm}

% Lined space
\fillwithlines{3cm}

% Dotted lines
\fillwithdottedlines{3cm}

% Answer line
\answerline
\answerline[$x = $]
```

Even distribution

Use `\vspace{\stretch{1}}` between questions to distribute them evenly across the page.

New page per question

Add `\newpage` between questions if each should get its own page.

Points and Grade Table

Point display options

```
% Points in right margin
\pointsinrightmargin

% Customize label
\pointname{ pts}
\pointpoints{point}{points}

% Bonus question
\bonusquestion[5]
  Extra credit question.

% Total points
Total: \numpoints\ points.
```

Grade table

```
\begin{center}
  \gradetable[h][questions]
\end{center}
```

Options: [h] horizontal, [v] vertical. Index by [questions] or [pages].

Customize columns

```
\cellwidth{1.5em}
\hpword{Points:}
\hsword{Score:}
```

Headers, Footers, and Rules

```
% First page header
% (left)(center)(right)
\firstpageheader
  {Economics 101}
  {Midterm Exam}
  {February 2026}

% Running header (other pages)
\runningheader
  {Economics 101}
  {}
  {Page \thepage\ of \numpages}

% Footers
\firstpagefooter{}{}{}
\runningfooter
  {}{}
  {Page \thepage\ of \numpages}

% Show line under header
\runningheadrule
```

Solutions toggle

```
% Show solutions (answer key)
\printanswers

% Hide (student version)
% \printanswers  <-- comment out
```

```
\begin{solution}
  The answer is 42.
\end{solution}

% Conditional content
\ifprintanswers
  \textbf{Answer:} 42
\fi
```

Workflow

One source file. Compile with `\printanswers` for the key, without for students.

`exam` — Complete Template

```
\documentclass[12pt, addpoints, a4paper]{exam}
\usepackage[utf8]{inputenc}
\usepackage{amsmath}

% \printanswers  % uncomment for answer key

\pointsinrightmargin
\pointname{ pts}
\firstpageheader{Course}{Midterm}{Spring 2026}
\runningheader{Course}{}{Page \thepage\ of \numpages}
\firstpagefooter{}{}{}\runningfooter{}{}{Total: \numpoints\ pts}
\runningheadrule

\begin{document}
\begin{center}
  \fbox{\fbox{\parbox{0.9\textwidth}{\centering
    \vspace{2mm}
    \makebox[\textwidth]{Name:\enspace\hrulefill}\\[4mm]
    \makebox[\textwidth]{Student ID:\enspace\hrulefill}\\[2mm]
  }}}
\end{center}
\vspace{0.3cm}
\begin{center} \gradetable[h][questions] \end{center}
\vspace{0.5cm}

\begin{questions}
  \question[10] Define supply and demand.
  \question
    \begin{parts}
      \part[5] Find the derivative of $f(x) = x^3$.
      \part[5] Evaluate at $x = 2$.
    \end{parts}
\end{questions}
\end{document}
```

Minimal Beamer document

```
\documentclass[aspectratio=169]{beamer}
\usetheme{Madrid}

\title{My Presentation}
\author{Alice Smith}
\institute{University of Lisbon}
\date{\today}

\begin{document}

\begin{frame}
  \titlepage
\end{frame}

\section{Introduction}
\begin{frame}{Introduction}
  Hello, Beamer!
\end{frame}

\end{document}
```

Key differences from articles

- Class: `\documentclass{beamer}`
- Content in `frame` environments
- Frame title via `\begin{frame}{Title}`
- Sections create navigation structure
- No `\maketitle`, use `\titlepage`

Aspect ratio

```
% Widescreen (recommended)
\documentclass[aspectratio=169]
  {beamer}
% Classic 4:3 (default)
\documentclass{beamer}
```

Themes

Presentation themes

```
\usetheme{Madrid}
```

Popular options:

`default`	Minimal, no decoration
`Madrid`	Professional
`Berlin`	Sidebar navigation
`Boadilla`	Clean, compact
`CambridgeUS`	Classic
`metropolis`	Modern (separate pkg)

Theme gallery

`https://deic.uab.cat/~iblanes/beamer_gallery/`

Color themes

```
\usecolortheme{seahorse}
```

Options: `default`, `beaver`, `crane`, `dolphin`, `dove`, `seahorse`, `whale`

Custom institutional colors

```
\definecolor{ULisbon}{RGB}
  {0,102,153}

\setbeamercolor{structure}
  {fg=ULisbon}
\setbeamercolor{frametitle}
  {fg=white, bg=ULisbon}
```

Title Page and Metadata

```
\title[Short]{Full Title}
\subtitle{A Subtitle}
\author[A. Smith]{Alice Smith}
\institute[ULisbon]{
  Department of Economics\\
  University of Lisbon\\[2pt]
  \texttt{alice@ulisbon.pt}
}
\date{February 2026}
```

The `[Short]` versions appear in the footer bar.

Section separator pages

```
\AtBeginSection[]{
  \begin{frame}
    \vfill
    \centering
    \insertsectionhead
    \vfill
  \end{frame}
}
```

Automatically inserts a section title slide before each `\section{}`.

Overlays — \pause

The simplest animation

```
\begin{frame}{Step by Step}
  First point.
  \pause
  Second point appears next.
  \pause
  Third point last.
\end{frame}
```

Each \pause creates a new sub-slide.

Incremental lists

```
% Manual
\begin{itemize}
  \item<1-> First (always)
  \item<2-> Second (from 2)
  \item<3-> Third (from 3)
\end{itemize}

% Automatic shortcut
\begin{itemize}[<+->]
  \item First
  \item Second
  \item Third
\end{itemize}
```

Overlays — Fine Control

Command	Effect
`\onslide<2->{text}`	Visible from slide 2, space always reserved
`\only<2>{text}`	Show only on slide 2, no space when hidden
`\visible<2->{text}`	Same as onslide
`\invisible<1>{text}`	Hidden on slide 1, visible otherwise
`\alt<1>{A}{B}`	A on slide 1, B on all others

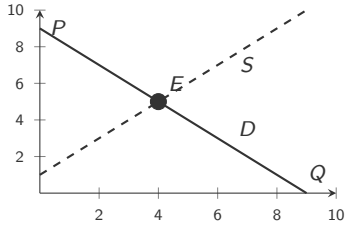
Key difference

`\only` collapses space when hidden (layout shifts). `\onslide` and `\visible` always reserve space (stable layout). Use `\onslide` by default.

Overlays in TikZ/PGFplots

```
\begin{frame}{Demand and Supply}
\begin{tikzpicture}
  \begin{axis}[...]
    \addplot<1->[thick,
      domain=0:9]{9 - x};
    \node<1-> ...{D};
    \addplot<2->[thick, dashed,
      domain=0:9]{1 + x};
    \node<2-> ...{S};
    \addplot<3->[only marks]
      coordinates {(4,5)};
    \node<3-> ...{E};
  \end{axis}
\end{tikzpicture}
\end{frame}
```

All curves revealed (slide 3):



The <1->, <2-> specs work directly on **\addplot** and **\node**.

Columns and Blocks

Columns

```
\begin{columns}[T]
  \begin{column}{0.48\textwidth}
    Left content.
  \end{column}
  \begin{column}{0.48\textwidth}
    Right content.
  \end{column}
\end{columns}

% Alignment: [T]=top [c]=center [b]=bottom
```

Can have 3+ columns. Adjust widths accordingly.

Beamer blocks

```
\begin{block}{Normal Block}
  Default styling.
\end{block}

\begin{alertblock}{Warning}
  Alert/red styling.
\end{alertblock}

\begin{exampleblock}{Example}
  Example/green styling.
\end{exampleblock}
```

Blocks

Normal Block

Default styling.

Warning

Alert/red styling.

Example

Example/green styling.

Customizing the Footer

Remove navigation symbols

```
\setbeamertemplate{navigation
  symbols}{}
```

Useful insert commands

Command	Inserts
\insertshortauthor	Short author
\insertshorttitle	Short title
\insertinstitute	Institute
\insertframenumber	Slide number
\inserttotalframenumber	Total slides
\insertsectionhead	Section name

Add a logo

```
\logo{
  \includegraphics[height=0.7cm]
    {logo.png}
}
```

Appears on every slide.

Useful frame options

```
% No header/footer
\begin{frame}[plain]
  \titlepage
\end{frame}

% For code slides
\begin{frame}[fragile]{Code}
  ...
\end{frame}

% Shrink overflowing content
\begin{frame}[shrink=10]{Dense}
  ...
\end{frame}
```

Beamer Tips

Handout mode

```
% No animations, 1 page/frame
\documentclass[handout]{beamer}
```

Speaker notes

```
\begin{frame}{Topic}
  Content on the slide.
  \note{My private notes.}
\end{frame}
```

Recommended themes

For a modern, clean look: use the `metropolis` theme (`\usetheme{metropolis}`) or build your own minimal theme like this deck does.

Closing Remarks

Thank you!

What to do next:

1. Practice: rewrite an old assignment in LaTeX
2. Explore CTAN: `https://ctan.org/`
3. Read *lshort* (search CTAN)
4. Ask at `https://tex.stackexchange.com/`