Practical Work 7: Advanced Document Features 2

Author: Your Name

Date: `\today`.

1. Triangle Inequality

For any two vectors (or real numbers) x and y, the following holds:

$$\|x+y\| \leq \|x\| + \|y\| \,.$$

This inequality is a fundamental property of norms and absolute values.

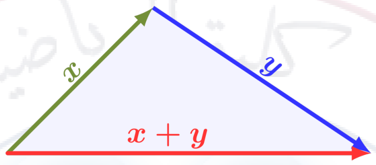

Figure 2: Visual representation of the triangle inequality in vector space

2. The Heat Equation

Consider the IVP for the heat equation on a bounded domain $\Omega \subset \mathbb{R}^n$:

$$\begin{cases} \dfrac{\partial u}{\partial t} = \Delta u + f(x,t) & \text{in } \Omega \times (0,T], \\ u(x,0) = u_0(x) & \text{for } x \in \Omega, \\ u(x,t) = 0 & \text{on } \partial\Omega \times [0,T] \end{cases}$$

where:

- $u(x,t)$ represents the temperature distribution
- $f(x,t)$ is a heat source term
- $u_0(x)$ is the initial temperature distribution
- Δ is the Laplacian operator

Theorem 1 (Existence and Uniqueness). *For $u_0 \in L^2(\Omega)$ and $f \in L^2(0,T;H^{-1}(\Omega))$, there exists a unique weak solution:*

$$u \in L^2(0,T;H^1_0(\Omega)) \cap C([0,T];L^2(\Omega))$$

with $\dfrac{\partial u}{\partial t} \in L^2(0,T;H^{-1}(\Omega))$.

For more resources on LaTeX, visit `https://www.latex-project.org/` or the Overleaf documentation here.

Bibliography

[1] L. C. Evans, *Partial Differential Equations*, AMS, Providence, RI, 2010.

[2] A. Sengouga, *Course on Measure and Integration*, Univ. of M'sila, 2012.

Good LaTeX Practice!

Displaying LaTeX Code

Here is the LaTeX code used in this document.

```
\documentclass[a4paper,11pt]{article}
\usepackage[utf8]{inputenc}
\usepackage{amsmath, amssymb, geometry}
\geometry{a4paper, top=1cm, bottom=1.9cm, left=3cm, right=3cm}
\usepackage{graphicx}
\usepackage{hyperref} % For clickable links

\newtheorem{theorem}{Theorem}

\begin{document}

\title{TP 06: Advanced Document Features}
\author{Your Name}    \date{\today}
\maketitle

\section{Triangle Inequality}
For any two vectors (or real numbers) $x$
and $y$, the following holds:
\begin{equation*}
 \left\Vert x+y\right\Vert \leq \left\Vert x\right\Vert +\left\Vert y\right\Vert.
\end{equation*}
This inequality is a fundamental property of norms and absolute values.%
\begin{figure}[h]
 \centering
 \includegraphics[width=0.3\textwidth]{triangle_inequality.png}
 \caption{Visual representation of the triangle inequality in vector space}
 \label{fig11}
```

```latex
\end{figure}
\section{The Heat Equation}
Consider the IVP for the heat equation on a bounded domain
$\Omega \subset \mathbb{R}^n$:

\begin{equation*}
 \begin{cases}
  \dfrac{\partial u}{\partial t} = \Delta u + f(x,t) & \text{in }%
  \Omega \times (0,T], \\
  u(x,0) = u_0(x) & \text{for } x \in \Omega, \\
  u(x,t) = 0 & \text{on } \partial\Omega \times [0,T]
 \end{cases}
\end{equation*}
where:
\begin{itemize}
 \item $u(x,t)$ represents the temperature distribution
 \item $f(x,t)$ is a heat source term
 \item $u_0(x)$ is the initial temperature distribution
 \item $\Delta$ is the Laplacian operator
\end{itemize}

\begin{theorem}[Existence and Uniqueness]
 For $u_0 \in L^2(\Omega)$ and $f \in L^2(0,T;H^{-1}(\Omega))$, there exists a
 unique weak solution:
 \begin{equation*}
  u \in L^2(0,T;H^1_0(\Omega)) \cap C([0,T];L^2(\Omega))
 \end{equation*}
 with $\dfrac{\partial u}{\partial t} \in L^2(0,T;H^{-1}(\Omega))$.
\end{theorem}

For more resources on \LaTeX, visit \url{https://www.latex-project.org/}
or the Overleaf documentation \href{https://www.overleaf.com/learn}{here}.

\begin{thebibliography}{9}
 \bibitem{Evans} L. C. Evans, \textit{Partial Differential Equations}, AMS,
 Providence, RI, 2010.
 \bibitem{Sengouga} A. Sengouga, \textit{Course on Measure and Integration},
 Univ. of M’sila, 2012.
\end{thebibliography}

\begin{flushright}
 Good \LaTeX\ Practice!
\end{flushright}
\end{document}
```