LaTeX Note Template MOD

Author
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Origin project: https://github.com/fenglielie/latexzero

Preface

This template is a remake version of LaTeX Templates for Mathematical Notes without beamer templates.

In this version, we included all theorem styles in one class file (`LaTeXZero.cls`) by using class options:

```
\documentclass[
    lang=en, %en, cn, Please use XeTeX to compile Chinese files.
    counter=section, %chapter,section
    mode=leftsidebox, %box, borderless, leftsidebox, mdframed, simple
    color=summer %origin, summer, winter,
]{LaTeXZero}
```

instead of using seperated `.tex` files. Moreover, we designed three color styles: *origin* (same as that of the original version), *summer* and *winter*.

The option `counter` is used for determining whether to number by *chapter* or by *section*. In the former situation, every section in one chapter is nunbered only by one arabic number without the chapter number, and theorems boxs in one section are numbered directly by chapter without the section number.

Files in this project are well arranged so that users compile successfully the main file (`book.tex`) just after download, decompress and open this project.

Contents

Chapter 1

Mathematical Environments

1.1 Theorem, Proposition, Proof

Theorem 1.1.1. *If $1 < p < \infty$ and $m > n/p$, or $p = 1$ and $m \geq n$, there exist a constant $C = C(m, n, \gamma, p)$, such that*

$$\|R^m u\|_{L^\infty(\Omega)} \leq C d^{m-n/p} |u|_{W_p^m(\Omega)}$$

for all $u \in W_p^m(\Omega)$.

Proof. First, we assume that $u \in C^m(\Omega) \cap W_p^m(\Omega)$. We can use the pointwise representation of $R^m u(x)$.

$$\begin{aligned} |R^m u(x)| &= m \left| \sum_{|\alpha|=m} \int_{C_x} k_\alpha(x,z) D^\alpha u(z)\, dz \right| \\ &\leq C \sum_{|\alpha|=m} \int_\Omega |x-z|^{-n+m} |D^\alpha u(z)|\, dz \\ &\leq C' d^{m-n/p} |u|_{W_p^m(\Omega)}. \end{aligned}$$

The proof can be completed via a density argument. □

Theorem 1.1.2 (xxx). *If $1 < p < \infty$ and $m > n/p$, or $p = 1$ and $m \geq n$, there exist a constant $C = C(m, n, \gamma, p)$, such that*

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The proof can be completed via a density argument. □

Proposition 1.1.3.

$$Q^m u(x) = \sum_{|\lambda|<m} \left(\int_B \psi_\lambda(y) u(y)\, dy \right) x^\lambda$$

where $\psi_\lambda \in C_0^\infty(\mathbb{R}^n)$ and $\operatorname{supp}(\phi_\lambda) \in \overline{B}$.

Proof. This follows from xxx if we define

$$\psi_\lambda(y) = \sum_{\alpha \geq \lambda, |\alpha| < m} \frac{(-1)^{|\alpha|}}{\alpha!} a_{[\lambda, \alpha-\lambda]} D^\alpha (y^{\alpha-\lambda} \phi(y)).$$

□

Proposition 1.1.4 (xxx)**.**

$$Q^m u(x) = \sum_{|\lambda|<m} \left(\int_B \psi_\lambda(y) u(y)\, dy \right) x^\lambda$$

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Proof. This follows from xxx if we define

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1.2 Corollary, Lemma, Claim

Corollary 1.2.1. *Under the assumption of xxx, the following inequality holds*

$$\inf_{v \in P^{m-1}} \|u - v\|_{W_p^k(\Omega)} \leq C_{m,n,\gamma} d^{m-k} |u|_{W_p^k(\Omega)}, \; k = 0, 1, \dots, m,$$

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Lemma 1.2.3. *Let $f \in L^p(\Omega)$ for $p \geq 1$ and $m \geq 1$ and let*

$$g(x) = \int_\Omega |x - z|^{-n+m} |f(z)| \, dz$$

Then

$$\|g\|_{L^p(\Omega)} \leq C_{m,n} d^m \|f\|_{L^p(\Omega)}.$$

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Then

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Claim 1.2.5. *$Q^m u$ is a polynomial of degree less than m in x.*

Claim 1.2.6 (xxx)**.** *$Q^m u$ is a polynomial of degree less than m in x.*

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1.3 Definition

Definition 1.3.1. Ω is star-shaped with respect to the ball B if , for all $x \in \Omega$, the closed convex hull of $\{x\} \cup B$ is a subset of Ω.

Definition 1.3.2 (xxx)**.** Ω is star-shaped with respect to the ball B if , for all $x \in \Omega$, the closed convex hull of $\{x\} \cup B$ is a subset of Ω.

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1.4 Example

Example 1.4.1. The integral form of the Taylor remainder for $f \in C^m([0,1])$ is given by

$$f(s) = \sum_{k=0}^{m-1} \frac{1}{k!} f^{(k)}(0) + \int_0^s \frac{1}{(m-1)!} f^{(m)}(t)(s-t)^{m-1}\, dt.$$

Example 1.4.2 (xxx)**.** The integral form of the Taylor remainder for $f \in C^m([0,1])$ is given by

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1.5 Problem, Solution

Problem 1.5.1. Calculate the integral of the function $g(x) = 3x^2$ with respect to x.

Solution 1.5.1. To calculate the integral of $g(x) = 3x^2$, we use the power rule for integration:

$$\int 3x^2\, dx = x^3 + C$$

where C is the constant of integration. □

Problem 1.5.2 (xxx)**.** Calculate the integral of the function $g(x) = 3x^2$ with respect to x.

Solution 1.5.2 (xxx)**.** To calculate the integral of $g(x) = 3x^2$, we use the power rule for integration:

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where C is the constant of integration. □

1.6 Remark

Remark 1.6.1. Such a polynomial is not unique, due to the choice od cut-off function ϕ.

Remark 1.6.2 (xxx). Such a polynomial is not unique, due to the choice od cut-off function ϕ.

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1.7 Note

Note 1.7.1. The degree of $Q^m u$ is at most $m - 1$.

Note 1.7.2 (xxx). The degree of $Q^m u$ is at most $m - 1$.

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Exercise 1.7

1. One.
2. Two.

Chapter 2

Others

2.1 lstlisting

Listing 2.1: hello world

```python
def hello():
    print("Hello, world!")

hello()
```

Listing 2.2: hanoi.py

```python
step = 1


def hanoi(n, a, b, c, depth=0):
    def move(n, a, c):
        global step
        print("    " * depth, end="")
        print(f"{step=}: move [{n}] from {a} to {c}")
        step += 1

    if n == 1:
        move(n, a, c)
    else:
        hanoi(n - 1, a, c, b, depth=depth + 1)
        move(n, a, c)
        hanoi(n - 1, b, a, c, depth=depth + 1)


if __name__ == "__main__":
    n = int(input("Hanoi Problem, N = "))
    hanoi(n, "A", "B", "C")
```

2.2 algorithm

Algorithm 1: what

```
Input: This is some input
Output: This is some output
/* This is a comment */
some code here;
x ← 0;
y ← 0;
if x > 5 then
    x is greater than 5 ;                    // This is also a comment
else
    x is less than or equal to 5;
end
foreach y in 0..5 do
    y ← y + 1;
end
for y in 0..5 do
    y ← y − 1;
end
while x > 5 do
    x ← x − 1;
end
return Return something here;
```