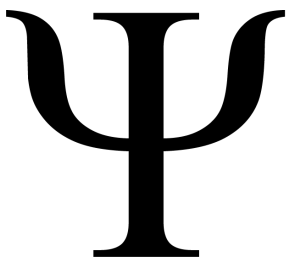

Your PSI Essay Title

Your name

An essay submitted
for partial fulfillment of
Perimeter Scholars International

June, 2024

Contents

Your PSI Essay Title

Your name

Supervisor: Your Supervisor's name/s

The abstract is an important component of your essay. It is likely the first substantive description of your work read by an external examiner. You should view it as an opportunity to set accurate expectations. The abstract is a summary of the whole thesis. It presents all the major elements of your work in a highly condensed form. An abstract is not merely an introduction in the sense of a preface, preamble, or advance organizer that prepares the reader for the thesis. It must also be capable of substituting for the whole thesis when there is insufficient time and space for the full text.

Statement of original research

Chapters 1 and 2 of this essay contain literature review; Chapter 3 is based on original code that reproduces the results in Ref. [17]; Chapter 4 reproduces the results in Ref. [8] and also describes original work, whose results are summarized in Chapter 5.

Climate impact

Numerical simulations	
Total Kernel Hours [h]	8260
Thermal Design Power Per Kernel [W]	5.75
Total Energy Consumption Simulations [kWh]	82
Average Emission Of CO_2 In Germany [kg/kWh]	0.56
Total CO_2-Emission For Numerical Simulations [kg]	45
Were The Emissions Offset?	**Yes**
Transport	
Total CO_2-Emission For Transport [kg]	1050
Were The Emissions Offset?	**Yes**
Total CO_2-Emission [kg]	1095

Table 1: Example of a CO_2-table that can be included towards the end of a scientific publication. Please also consider referencing scientific-conduct.github.io to enhance visibility in your community.

1 Introduction

You can cite books [?] and papers [?] like this, and they appear in the references section toward the end of the document. (Click on the reference number and it will take you there!)

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Sed commodo posuere pede. Mauris ut est. Ut quis purus. Sed ac odio. Sed vehicula hendrerit sem. Duis non odio. Morbi ut dui. Sed accumsan risus eget odio. In hac habitasse platea dictumst. Pellentesque non elit. Fusce sed justo eu urna porta tincidunt. Mauris felis odio, sollicitudin sed, volutpat a, ornare ac, erat. Morbi quis dolor. Donec pellentesque, erat ac sagittis semper, nunc dui lobortis purus, quis congue purus metus ultricies tellus. Proin et quam. Class aptent taciti sociosqu ad litora torquent per conubia nostra, per inceptos hymenaeos. Praesent sapien turpis, fermentum vel, eleifend faucibus, vehicula eu, lacus.

You can also include and reference figures, for example, see Figure 1.

Figure 1: Here is a comic from PhDComics. (The previous word is also a clickable link! But if you click it, don't fall down the rabbit hole reading comics rather than writing your essay!). If you get stuck procrastinating, read this article as an antidote: Why procrastinators procrastinate.

2 LaTeX Mathematics Examples

These math examples are courtesy of Prof Tony Roberts from The University of Adelaide. See here.

2.1 Delimiters

See how the delimiters are of reasonable size in these examples

$$(a+b)\left[1-\frac{b}{a+b}\right]=a\,,$$

$$\sqrt{|xy|}\leq\left|\frac{x+y}{2}\right|,$$

even when there is no matching delimiter

$$\int_a^b u\frac{d^2v}{dx^2}\,dx=u\frac{dv}{dx}\bigg|_a^b-\int_a^b\frac{du}{dx}\frac{dv}{dx}\,dx.$$

2.2 Spacing

Differentials often need a bit of help with their spacing as in

$$\iint xy^2\,dx\,dy=\frac{1}{6}x^2y^3,$$

whereas vector problems often lead to statements such as

$$u=\frac{-y}{x^2+y^2}\,,\quad v=\frac{x}{x^2+y^2}\,,\quad\text{and}\quad w=0\,.$$

Occasionally one gets horrible line breaks when using a list in mathematics such as listing the first twelve primes $2,3,5,7,11,13,17,19,23,29,31,37$. In such cases, perhaps include `\mathcode‘\,="213B` inside the inline maths environment so that the list breaks: $2\,,3\,,5\,,7\,,11\,,13\,,17\,,19\,,23\,,29\,,31\,,37$. Be discerning about when to do this as the spacing is different.

2.3 Arrays

Arrays of mathematics are typeset using one of the matrix environments as in

$$\begin{bmatrix} 1 & x & 0 \\ 0 & 1 & -1 \end{bmatrix} \begin{bmatrix} 1 \\ y \\ 1 \end{bmatrix} = \begin{bmatrix} 1+xy \\ y-1 \end{bmatrix}.$$

Case statements use cases:

$$|x| = \begin{cases} x, & \text{if } x \geq 0\,, \\ -x, & \text{if } x < 0\,. \end{cases}$$

Many arrays have lots of dots all over the place as in

$$\begin{array}{cccccc} -2 & 1 & 0 & 0 & \cdots & 0 \\ 1 & -2 & 1 & 0 & \cdots & 0 \\ 0 & 1 & -2 & 1 & \cdots & 0 \\ 0 & 0 & 1 & -2 & \ddots & \vdots \\ \vdots & \vdots & \vdots & \ddots & \ddots & 1 \\ 0 & 0 & 0 & \cdots & 1 & -2 \end{array}$$

2.4 Equation arrays

In the flow of a fluid film we may report

$$\begin{aligned} u_\alpha &= \epsilon^2 \kappa_{xxx} \left(y - \frac{1}{2} y^2 \right), && (1) \\ v &= \epsilon^3 \kappa_{xxx} y\,, && (2) \\ p &= \epsilon \kappa_{xx}\,. && (3) \end{aligned}$$

Alternatively, the curl of a vector field (u, v, w) may be written with only one equation number:

$$\begin{aligned} \omega_1 &= \frac{\partial w}{\partial y} - \frac{\partial v}{\partial z}\,, \\ \omega_2 &= \frac{\partial u}{\partial z} - \frac{\partial w}{\partial x}\,, \\ \omega_3 &= \frac{\partial v}{\partial x} - \frac{\partial u}{\partial y}\,. \end{aligned} \qquad (4)$$

Whereas a derivation may look like

$$\begin{aligned}(p \wedge q) \vee (p \wedge \neg q) &= p \wedge (q \vee \neg q) \quad \text{by distributive law} \\ &= p \wedge T \quad \text{by excluded middle} \\ &= p \quad \text{by identity}\end{aligned}$$

2.5 Functions

Observe that trigonometric and other elementary functions are typeset properly, even to the extent of providing a thin space if followed by a single letter argument:

$$\exp(i\theta) = \cos\theta + i\sin\theta\,, \quad \sinh(\log x) = \frac{1}{2}\left(x - \frac{1}{x}\right).$$

With sub- and super-scripts placed properly on more complicated functions,

$$\lim_{q\to\infty} \|f(x)\|_q = \max_x |f(x)|,$$

and large operators, such as integrals and

$$\begin{aligned}e^x &= \sum_{n=0}^{\infty} \frac{x^n}{n!} \quad \text{where } n! = \prod_{i=1}^{n} i\,, \\ \overline{U_\alpha} &= \bigcap_\alpha U_\alpha\,.\end{aligned}$$

In inline mathematics the scripts are correctly placed to the side in order to conserve vertical space, as in $1/(1-x) = \sum_{n=0}^{\infty} x^n$.

2.6 Accents

Mathematical accents are performed by a short command with one argument, such as

$$\tilde{f}(\omega) = \frac{1}{2\pi}\int_{-\infty}^{\infty} f(x) e^{-i\omega x}\,dx\,,$$

or

$$\dot{\vec{\omega}} = \vec{r} \times \vec{I}.$$

2.7 Command definition

The Airy function, $\mathrm{Ai}(x)$, may be incorrectly defined as this integral

$$\mathrm{Ai}(x) = \int \exp\bigl(s^3 + isx\bigr)\, ds\,.$$

This vector identity serves nicely to illustrate two of the new commands:

$$\boldsymbol{\nabla} \times \boldsymbol{q} = \boldsymbol{i}\left(\frac{\partial w}{\partial y} - \frac{\partial v}{\partial z}\right) + \boldsymbol{j}\left(\frac{\partial u}{\partial z} - \frac{\partial w}{\partial x}\right) + \boldsymbol{k}\left(\frac{\partial v}{\partial x} - \frac{\partial u}{\partial y}\right).$$

Recall that typesetting multi-line mathematics is an art normally too hard for computer recipes. Nonetheless, if you need to be automatically flexible about multi-line mathematics, and you do not mind some rough typesetting, then perhaps invoke `\parbox` to help as follows:

$$u_1 = -2\gamma\epsilon^2 s_2 + \mu\epsilon^3\bigl(\tfrac{3}{8}s_2 + \tfrac{1}{8}s_1 i\bigr) + \epsilon^3\bigl(-\tfrac{81}{32}s_4 s_2^2 - \tfrac{27}{16}s_4 s_2 s_1 i + \tfrac{9}{32}s_4 s_1^2 + \tfrac{27}{32}s_3 s_2^2 i - \tfrac{9}{16}s_3 s_2 s_1 - \tfrac{3}{32}s_3 s_1^2 i\bigr) + \textstyle\int_a^b 1 - 2x + 3x^2 - 4x^3\, dx$$

Also, sometimes use `\parbox` to typeset multiline entries in tables.

2.8 Theorems et al.

Definition 1 (right-angled triangles) *A* right-angled triangle *is a triangle whose sides of length* a, b *and* c, *in some permutation of order, satisfies* $a^2 + b^2 = c^2$.

Lemma 2 *The triangle with sides of length* 3, 4 *and* 5 *is right-angled.*

This lemma follows from the Definition 1 as $3^2 + 4^2 = 9 + 16 = 25 = 5^2$.

Theorem 3 (Pythagorean triplets) *Triangles with sides of length* $a = p^2 - q^2$, $b = 2pq$ *and* $c = p^2 + q^2$ *are right-angled triangles.*

Prove this Theorem 3 by the algebra $a^2 + b^2 = (p^2 - q^2)^2 + (2pq)^2 = p^4 - 2p^2q^2 + q^4 + 4p^2q^2 = p^4 + 2p^2q^2 + q^4 = (p^2 + q^2)^2 = c^2$.

3 Results

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3.1 These are the things that I learnt

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4 Conclusion

In conclusion, here are some more references [**?**, **?**, **?**, **?**].

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5 Acknowledgements

Acknowledgements aren't mandatory, but it is always nice to thank people that helped you with your project (both, directly and indirectly).

A One appendix

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A.1 And a subappendix

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B Another appendix

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