MONARCHS AND WIND (WORKING TITLE)

A Thesis

presented to

the Faculty of California Polytechnic State University,

San Luis Obispo

In Partial Fulfillment

of the Requirements for the Degree

Master of Science in Biological Sciences

by

Kyle Nessen

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TITLE: Monarchs and Wind (working title)

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DATE SUBMITTED: June 2025

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ABSTRACT

Monarchs and Wind (working title)

Kyle Nessen

Your abstract goes in here. Lorem ipsum dolor sit amet, consectetuer adipiscing elit. Ut purus elit, vestibulum ut, placerat ac, adipiscing vitae, felis. Curabitur dictum gravida mauris. Nam arcu libero, nonummy eget, consectetuer id, vulputate a, magna. Donec vehicula augue eu neque. Pellentesque habitant morbi tristique senectus et netus et malesuada fames ac turpis egestas. Mauris ut leo. Cras viverra metus rhoncus sem. Nulla et lectus vestibulum urna fringilla ultrices. Phasellus eu tellus sit amet tortor gravida placerat. Integer sapien est, iaculis in, pretium quis, viverra ac, nunc. Praesent eget sem vel leo ultrices bibendum. Aenean faucibus. Morbi dolor nulla, malesuada eu, pulvinar at, mollis ac, nulla. Curabitur auctor semper nulla. Donec varius orci eget risus. Duis nibh mi, congue eu, accumsan eleifend, sagittis quis, diam. Duis eget orci sit amet orci dignissim rutrum.

Nam dui ligula, fringilla a, euismod sodales, sollicitudin vel, wisi. Morbi auctor lorem non justo. Nam lacus libero, pretium at, lobortis vitae, ultricies et, tellus. Donec aliquet, tortor sed accumsan bibendum, erat ligula aliquet magna, vitae ornare odio metus a mi. Morbi ac orci et nisl hendrerit mollis. Suspendisse ut massa. Cras nec ante. Pellentesque a nulla. Cum sociis natoque penatibus et magnis dis parturient montes, nascetur ridiculus mus. Aliquam tincidunt urna. Nulla ullamcorper vestibulum turpis. Pellentesque cursus luctus mauris.

Keywords: Select descriptive keywords and separate terms with a comma and a space.

ACKNOWLEDGMENTS

This page is optional, but if you have received funding for your research or assistance or guidance that you feel should be noted, it belongs on this page. If you are not including acknowledgments, remove the contents of the acknowledgments file. If you are acknowledging only one person, change the title to ACKNOWLEDGMENT by removing commented line in acknowledgments file.

Thanks to:

- Andrew Guenther, for uploading the original template, and
- Someone Else, so that I do not have to rename this page.

DEDICATION

This is optional, but can be included if desired. If no dedication, delete the contents of the dedication file.

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Chapter 1

EXAMPLE USAGE

This chapter is an introduction to the various elements of a thesis that might need to be created. Any additional packages beyond what is already included in the main LaTeX file should be put into the preamble.tex file located in the frontmatter directory.

1.1 Math

Displaying math relations is one of the areas that LaTeX shines. While this is not a complete presentation of the capabilities, there are a few uses that are worth presenting as a starting point.

1.1.1 General Equations

This section shows how to create a variety of equations and cite them. Equation (1.1) is an example of a simple equation.

$$x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a} \tag{1.1}$$

For equations that are not to be numbered, then can use the "*" version of the math commands, such as

$$y = mx + b$$

Note that since this equation is not numbered, it cannot be referenced in the text because it has no label.

For one equation that splits over multiple lines, eq. (1.2) can be used as a reference

$$\begin{aligned} x &= \frac{-b \pm \sqrt{b^2 - 4ac}}{2a} = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a} \left(\frac{-b \mp \sqrt{b^2 - 4ac}}{-b \mp \sqrt{b^2 - 4ac}} \right) \\ &= \frac{b^2 - (b^2 - 4ac)}{2a \left(-b \mp \sqrt{b^2 - 4ac} \right)} = \frac{4ac}{2a \left(-b \mp \sqrt{b^2 - 4ac} \right)} \\ &= -\frac{2c}{b \pm \sqrt{b^2 - 4ac}} \end{aligned} \tag{1.2}$$

If you have multiple equations that are related then can use the following

$$\begin{aligned} q(x) &\coloneqq \frac{6x^2}{2x} \\ &= 3x \end{aligned} \tag{1.3a}$$

$$q(1) = 3 \cdot 1 = 3 \tag{1.3b}$$

$$q(0) = \lim_{x \to 0} q = 0 \tag{1.3c}$$

where each sub-equation can referred to individually, such as eq. (1.3b), as a collection, such as eqs. (1.3a) to (1.3c), or as the entire set of equations, such as eq. (1.3). In the case that some of the equations should not be numbered, then can use the \notag command on the equations that should not be numbered

$$\begin{aligned} q(x) &\coloneqq \frac{6x^2}{2x} \\ &= 3x \end{aligned} \tag{1.4a}$$

$$q(1) = 3 \cdot 1 = 3$$

$$q(0) = \lim_{x \to 0} q = 0 \tag{1.4b}$$

1.1.2 Functions and Their Names

It is important to remember that math functions, such as sine and cosine, have their own definitions, and are typeset differently compared to variables.

$$\sin(2\alpha) = 2\sin(\alpha)\cos(\alpha) \tag{1.5}$$

Any math function that is represented by multiple characters should follow the same formatting. To create custom math functions, use the \DeclareMathOperator command.

1.1.3 Representing Vectors

Vectors are represented a variety of ways in different fields of study. A few of the most common methods are presented here.

1.1.3.1 Vectors as Bold Symbols

A three-dimensional vector has the form

$$\boldsymbol{x} = \begin{bmatrix} x_0 \\ x_1 \\ x_2 \end{bmatrix} \tag{1.6}$$

while a row vector looks like

$$\boldsymbol{\alpha} = \begin{bmatrix} \alpha_0 & \alpha_1 & \alpha_2 \end{bmatrix} \tag{1.7}$$

The same process can be used to represent a matrix

$$\boldsymbol{\mu} = \begin{bmatrix} \boldsymbol{\mu}_0 & \boldsymbol{\mu}_1 & \boldsymbol{\mu}_2 \end{bmatrix} = \begin{bmatrix} \mu_{0,0} & \mu_{0,1} & \mu_{0,2} \\ \mu_{1,0} & \mu_{1,1} & \mu_{1,2} \\ \mu_{2,0} & \mu_{2,1} & \mu_{2,2} \end{bmatrix} \tag{1.8}$$

1.1.3.2 Vectors with Arrows Above

A three-dimensional vector has the form

$$\vec{x} = \begin{bmatrix} x_0 \\ x_1 \\ x_2 \end{bmatrix} \tag{1.9}$$

while a row vector looks like

$$\vec{\alpha} = \begin{bmatrix} \alpha_0 & \alpha_1 & \alpha_2 \end{bmatrix} \tag{1.10}$$

The same process can be used to represent a matrix

$$\vec{\mu}_i = \begin{bmatrix} \vec{\mu}_0 & \vec{\mu}_1 & \vec{\mu}_2 \end{bmatrix} = \begin{bmatrix} \mu_{0,0} & \mu_{0,1} & \mu_{0,2} \\ \mu_{1,0} & \mu_{1,1} & \mu_{1,2} \\ \mu_{2,0} & \mu_{2,1} & \mu_{2,2} \end{bmatrix} \tag{1.11}$$

1.1.3.3 Vectors with Lines Below

A three-dimensional vector has the form

$$\underline{x} = \begin{bmatrix} x_0 \\ x_1 \\ x_2 \end{bmatrix} \tag{1.12}$$

while a row vector looks like

$$\underline{\alpha} = \begin{bmatrix} \alpha_0 & \alpha_1 & \alpha_2 \end{bmatrix} \tag{1.13}$$

The same process can be used to represent a matrix

$$\underline{\underline{\mu}} = \begin{bmatrix} \underline{\mu_0} & \underline{\mu_1} & \underline{\mu_2} \end{bmatrix} = \begin{bmatrix} \mu_{0,0} & \mu_{0,1} & \mu_{0,2} \\ \mu_{1,0} & \mu_{1,1} & \mu_{1,2} \\ \mu_{2,0} & \mu_{2,1} & \mu_{2,2} \end{bmatrix} \tag{1.14}$$

1.2 Figures

Figures are typically included as either images or drawings. There are a number of image and drawing formats that can be used, however this will only present a few figure format types. If your thesis has no figures, then the list of figures should be removed from the thesis. This is accomplished by removing the code in listings.tex associated with the list of figures.

1.2.1 Figures from Images

Image files can be inserted using the \includegraphics command. Figure 1.1 shows the import of a JPG file at its original size. The default size of this image is quite

Figure 1.1: *The Cal Poly seal.*

large, and the scale does not add much value. There are a number of ways to scale an image, with fig. 1.2 showing one way to do so. This figure scaled the image to a width of 2 inches.

Beware that scaling images can result in the image looking quite poor. Figure 1.3 shows a small version of the Cal poly seal that was then scaled to a width of 2 inches. Note how pixelated the resulting image is, and it is difficult to determine what the actual image should be.[1] It is best practice to save the image at the resolution that you plan to use in your document. This takes some iterations to get the sizes correct, but it will create much better looking images.

[1]Too many technical documents suffer from the problem of pixelated images in their figures, including textbooks, unfortunately.

Figure 1.2: *The Cal Poly seal from fig. 1.1 scaled to a 2 inch width.*

Figure 1.3: *A small version of the Cal Poly seal scaled to a 2 inch width as an example of a poorly formatted image for a figure.*

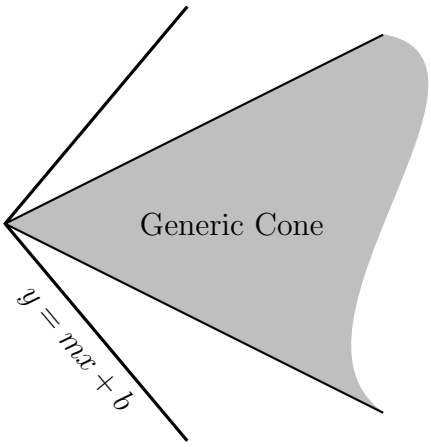


Figure 1.4: *A simple TikZ drawing demonstrating its use.*

1.2.2 Figures from TikZ

Another way to present figures is to use one of the drawing packages compatible with LaTeX. One such solution is TikZ.[2] Figure 1.4 shows a simple drawing made using TikZ. The code for drawing can either be placed in the TeX–file, or it can be included from another file, as this example. One benefit of using TikZ (and other LaTeX–based drawing packages) is that the same fonts are used in the drawing as are used in the rest of the document. So there are no issues with the distraction of each figure having its own fonts (and sizes).

Another example of TikZ usage is fig. 1.5 from [7]. This demonstrates the versatility of TIkZ to produce a wide variety of figures. There are a number of other ways that TikZ can be used to create figures for plots (using pgfplots), circuits (using circuitikz), and structural analysis (using stanli).

[2]TikZ is a drawing package that has many extensions and uses. A good website to start with is https://tikz.dev/.

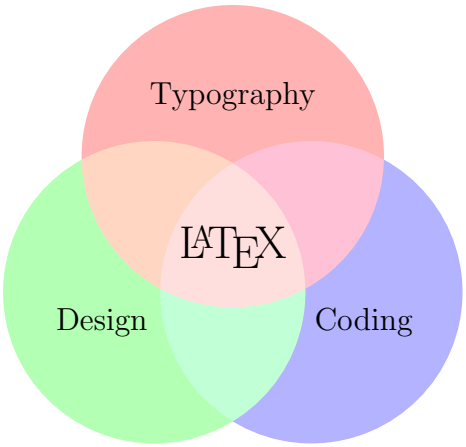
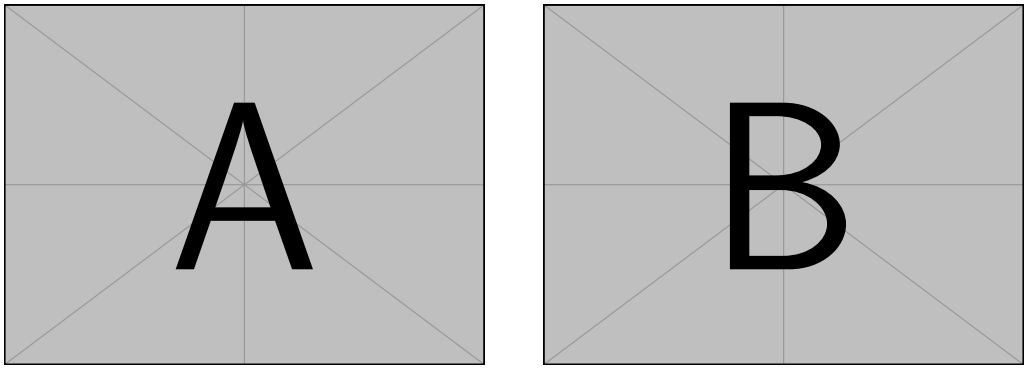


Figure 1.5: *A Venn diagram describing LaTeX created by Stefan Kottwitz[7].*



(a) *First example image that does have a long description.*

(b) *Another example image with a long description that continues on for a while.*

Figure 1.6: *Two figures that together tell a complete story of how sub-figures can be used together to create one coherent figure.*

1.2.3 Sub-Figures

Sometimes there is a need to present the contents of two images/drawing together in one figure. Figure 1.6 shows a figure composed of two sub-figures. Each sub-figure can be referred to separately, such as fig. 1.6a is on the left and fig. 1.6b is on the right. Also, the sub-figures can be cited collectively, such as figs. 1.6a and 1.6b.

Table 1.1: *The formatting of this table is hackish. There are better ways to align numbers. The siunitx package provides this feature.*

Parameter	Ref. Value	Calc. Value	Absolute Difference	Percent Difference (%)
Radius	150.0	150.0	0.000×10^{0}	0.0
Chord	60.00	60.00	0.000×10^{0}	0.0
Thickness	6.000	6.061	6.123×10^{-2}	1.021
$\theta_{\text{l.e.}}$ (°)	11.33	11.54	2.036×10^{-1}	1.797
$\theta_{\text{t.e.}}$ (°)	-11.33	-11.54	-2.036×10^{-1}	1.797

1.3 Tables

Tables are handled similarly to figures within LaTeX. If your thesis has no tables, then the list of tables should be removed from the thesis. This is accomplished by removing the code in listings.tex associated with the list of tables.

One exception is that the caption for a table should be above the table, while the caption for figures should be below the figure. Table 1.1 shows a floating table with a variety of column types. The formatting for these columns (such as aligning floating point numbers on the decimal, scientific notation, and unit labels) can be accomplished using the siunitx package, however that is beyond the scope of this introduction.

While there are a number of formatting options for tables, be careful that the resulting formatting still adheres to the thesis formatting guidelines. In addition, a general rule for horizontal and vertical lines is the fewer the better. In particular, vertical lines should be used on the rarest of occasions. Horizontal lines should be used sparingly as well, but should be used to delineate the column headings. Adding horizontal lines at the top and bottom of the table are up to your discretion. Whatever formatting you adopt, be sure to be consistent throughout the entire thesis.

Table 1.2: *Temperature ranges recorded in the first two weeks of July at the first station in study.*

(a) *First week temperatures.*

Day	Min. (°C)	Max. (°C)
Mon	13	20
Tue	14	22
Wed	12	23
Thurs	13	25
Fri	7	18
Sat	13	15
Sun	13	20

(b) *Second week temperatures.*

Day	Min. (°C)	Max. (°C)
Mon	11	17
Tue	10	16
Wed	8	14
Thurs	5	12
Fri	7	15
Sat	12	16
Sun	9	15

1.3.1 Sub-Tables

Just as the case with figures in section 1.2, there are some occasions that might necessitate the need for two tables to be presented in one table. Note that this is a rarer need than with sub-figures, so be judicious with the usage of sub-tables. Table 1.2 is a table composed of two sub-tables. Each sub-table can be referred to separately, such as table 1.2a is for the first week and table 1.2b is for the second week. These sub-tables can be cited collectively as well, such as tables 1.2a and 1.2b.

1.4 Cross-References

There are many ways that cross-references can be created in the document. The package that this document uses is cleveref. The \cref, cross-reference in a sentence, and \Cref, cross-reference to start a sentence, commands have already been used throughout this chapter. As an example, chapter 1 has a section titled Figures from Images, located inside section 1.2 on page 5. The chapter and number, the section title, the section and number, and the page number were all created using cleveref

cross-references. If in the future the chapter number, section title, section number, and/or page number change these will be updated automatically. There should be no reason to ever manually cross-reference an item in this document.

1.5 Nomenclature Usage

The **??** in the preamble on **??** shows the nomenclature for this document. This uses the nomencl package, and you should consult the documentation for that package to see how it can be customized. The simplest way to implement the nomenclature/list of symbols information is how this document has created the nomenclature. All of the nomenclature information is contained within the nomenclature.tex file in the frontmatter directory. If no nomenclature is desired, then simply remove all of the content in this file and remove the list of symbols code in the listings.tex file.

There are ways to sort/organize the nomenclature. A simple grouping is done with the code in the preamble.tex file. If a different sorting/grouping is desired, then this code needs to be changed. If no grouping or sorting is desired, then this code can be removed.

1.6 Citations

This document uses biblatex and the biber bibliography parser to generate the bibliography/references section. The bibliography data is located in the bib-file, references.bib, located in the bibliography directory. This file provides a small selection of sample source types. There are a large number of source types that can be found in the documentation for biblatex. *Note that since not every item in the bib-file was*

cited, this document has a Bibliography after the last chapter (instead of a References section if all items had been cited).

There are also a number of other resources that can help create source entries. Many publishers offer the ability to export a citation in bibtex format, and this can easily be included into the references.bib file (sometimes without any modifications). There are also more sophistical reference management systems, such as Zotero[3] and Mandeley[4], that can export citations. No matter where the citation source was generated, it will probably take some fine tuning of the bib-file contents to make the cited work correctly formatted.

The other file in the bibliography directory is the bib_info.tex file. This file needs to be edited depending on whether your thesis will have a bibliography or reference section. A reference section contains just the items that the thesis cites. A bibliography includes both the cited items as well as any other valuable resources related to topics within your thesis.

To cite an entry can be done using the \cite command, such as [5]. Multiple entries can be cited as well [2, 3, 4, 9]. Sometimes it is necessary to append some text to the citation as in [3, p. 135] and [6, section 2]. You can also prepend text [such as 8, p. 120]. To refer to the author(s) and cite the \textcite command can be used as in Dirac [1]. Finally, other parts of the citation can also be referenced: Einstein wrote "Zur Elektrodynamik bewegter Körper" in 1905 with the citation found in [4].

[3]https://www.zotero.org

[4]https://www.mendeley.com

1.7 Algorithms

When there is a need to demonstrate an algorithm the algorithmic package can be used. Algorithm 1.1 shows a simple example of an algorithm. This one does not contain comments and is a more stripped-down example of the features of the algorithmic package.

Algorithm 1.1: *Another algorithm.*

Require: $x \in \{0, 1\}$
Ensure: $y \in \{1, 2\}$
  $y \leftarrow x + 1$
  return y

Another algorithm is shown as a simple implementation of Heun's Method in algorithm 1.2. This computes solutions to $y' = f(x, y)$ at N locations with step-size h, and initial value of x_0, y_0. References can be made to specific lines in the algorithm. In this case, line 5 shows the predictor step.

Algorithm 1.2: *Heun's Method for given step-size.*

Require: $f(x, y)$, $N \in \mathbb{N}$
  procedure HeunMethod(f, x_0, y_0, h, N)
    for $n \leftarrow 0, N - 1$ **do** ▷ *looping through N evaluations*
      $x_{n+1} \leftarrow x_n + h$ ▷ *Setting the next x*
      $K_1 \leftarrow hf(x_n, y_n)$ ▷ *Store the evaluation of f*
      $y^* \leftarrow y_n + K_1$ ▷ *Predictor Calculation*
      $K_2 \leftarrow hf(x_{n+1}, y^*)$ ▷ *Store second evaluation of f*
      $y_{n+1} \leftarrow y_n + \frac{1}{2}[K_1 + K_2]$ ▷ *Corrector Calculation*
    return x, y ▷ *return the x and y vectors*

1.8 Code and Code Listings

When code needs to be included in the document, it is important to use a mono-spaced font because many programming languages use spaces to indicate subordinate

code. The listing package automatically selects the appropriate font so that the monospaced font is not jarringly different from the rest of the text font, similarly to how the math font is chosen to work well with the text font. Ideally, it would be nice to differentiate inline code so that it is clear that \incmatrix is a function defined in code, however the thesis format requires the same font for all text. Listing 1.1, shows an example python code originally from Overleaf.[5] This code is in a floating environment (note the usage of the float option).[6] Without that option the code listing will appear exactly in the text where the code listing is.

[5]Complete example can be found at https://www.overleaf.com/learn/latex/Code_listing

[6]To enforce the placement of the listing in this example, the "h" parameter is used. In general no placement parameters are needed, and the "float" option is all that is needed to be used.

Code Listing 1.1: *Example from Overleaf demonstrating python code using a monospaced font. The use of this font is important to see what statement the return lines up with.*

```
import numpy as np

def incmatrix(genl1,genl2):
    m = len(genl1)
    n = len(genl2)
    M = None #to become the incidence matrix
    VT = np.zeros((n*m,1), int)  #dummy variable

    #compute the bitwise xor matrix
    M1 = bitxormatrix(genl1)
    M2 = np.triu(bitxormatrix(genl2),1)

    for i in range(m-1):
        for j in range(i+1, m):
            [r,c] = np.where(M2 == M1[i,j])
            for k in range(len(r)):
                VT[(i)*n + r[k]] = 1;
                VT[(i)*n + c[k]] = 1;
                VT[(j)*n + r[k]] = 1;
                VT[(j)*n + c[k]] = 1;

                if M is None:
                    M = np.copy(VT)
                else:
                    M = np.concatenate((M, VT), 1)

                VT = np.zeros((n*m,1), int)

    return M
```

Chapter 2

GENERIC CONTENT

Lorem ipsum dolor sit amet, consectetuer adipiscing elit. Ut purus elit, vestibulum ut, placerat ac, adipiscing vitae, felis. Curabitur dictum gravida mauris. Nam arcu libero, nonummy eget, consectetuer id, vulputate a, magna. Donec vehicula augue eu neque. Pellentesque habitant morbi tristique senectus et netus et malesuada fames ac turpis egestas. Mauris ut leo. Cras viverra metus rhoncus sem. Nulla et lectus vestibulum urna fringilla ultrices. Phasellus eu tellus sit amet tortor gravida placerat. Integer sapien est, iaculis in, pretium quis, viverra ac, nunc. Praesent eget sem vel leo ultrices bibendum. Aenean faucibus. Morbi dolor nulla, malesuada eu, pulvinar at, mollis ac, nulla. Curabitur auctor semper nulla. Donec varius orci eget risus. Duis nibh mi, congue eu, accumsan eleifend, sagittis quis, diam. Duis eget orci sit amet orci dignissim rutrum. Nam dui ligula, fringilla a, euismod sodales, sollicitudin vel, wisi. Morbi auctor lorem non justo. Nam lacus libero, pretium at, lobortis vitae, ultricies et, tellus. Donec aliquet, tortor sed accumsan bibendum, erat ligula aliquet magna, vitae ornare odio metus a mi. Morbi ac orci et nisl hendrerit mollis. Suspendisse ut massa. Cras nec ante. Pellentesque a nulla. Cum sociis natoque penatibus et magnis dis parturient montes, nascetur ridiculus mus. Aliquam tincidunt urna. Nulla ullamcorper vestibulum turpis. Pellentesque cursus luctus mauris.

Table 2.1: *This is the caption for the first table.*

Col1	Col2	Col3	Col4	Col1	Col2	Col3	Col4
1	676	8837	787	544	22	908	229
2	732	78	5415	887	343	1112	870
3	545	778	7507	5554	5432	9867	9
4	545	1874	7560	102	562	223	792
5	88	788	6344	45	998	776	2

Table 2.2: *This is the caption for another table.*

Col1	Col2	Col3	Col4	Col1	Col2	Col3	Col4
1	676	8837	787	544	22	908	229
2	732	78	5415	887	343	1112	870
3	545	778	7507	5554	5432	9867	9
4	545	1874	7560	102	562	223	792
5	88	788	6344	45	998	776	2

2.1 A Section

Nulla malesuada porttitor diam. Donec felis erat, congue non, volutpat at, tincidunt tristique, libero. Vivamus viverra fermentum felis. Donec nonummy pellentesque ante. Phasellus adipiscing semper elit. Proin fermentum massa ac quam. Sed diam turpis, molestie vitae, placerat a, molestie nec, leo. Maecenas lacinia. Nam ipsum ligula, eleifend at, accumsan nec, suscipit a, ipsum. Morbi blandit ligula feugiat magna. Nunc eleifend consequat lorem. Sed lacinia nulla vitae enim. Pellentesque tincidunt purus vel magna. Integer non enim. Praesent euismod nunc eu purus. Donec bibendum quam in tellus. Nullam cursus pulvinar lectus. Donec et mi. Nam vulputate metus eu enim. Vestibulum pellentesque felis eu massa. Quisque ullamcorper placerat ipsum. Cras nibh. Morbi vel justo vitae lacus tincidunt ultrices. Lorem ipsum dolor sit amet, consectetuer adipiscing elit. In hac habitasse platea dictumst. Integer tempus convallis augue. Etiam facilisis. Nunc elementum fermentum wisi. Aenean placerat. Ut imperdiet, enim sed gravida sollicitudin, felis odio placerat quam, ac pulvinar elit purus eget enim. Nunc vitae tortor. Proin tempus nibh sit amet nisl. Vivamus quis tortor vitae risus porta vehicula.

Fusce mauris. Vestibulum luctus nibh at lectus. Sed bibendum, nulla a faucibus semper, leo velit ultricies tellus, ac venenatis arcu wisi vel nisl. Vestibulum diam. Aliquam pellentesque, augue quis sagittis posuere, turpis lacus congue quam, in hendrerit risus eros eget felis. Maecenas eget erat in sapien mattis porttitor. Vestibulum

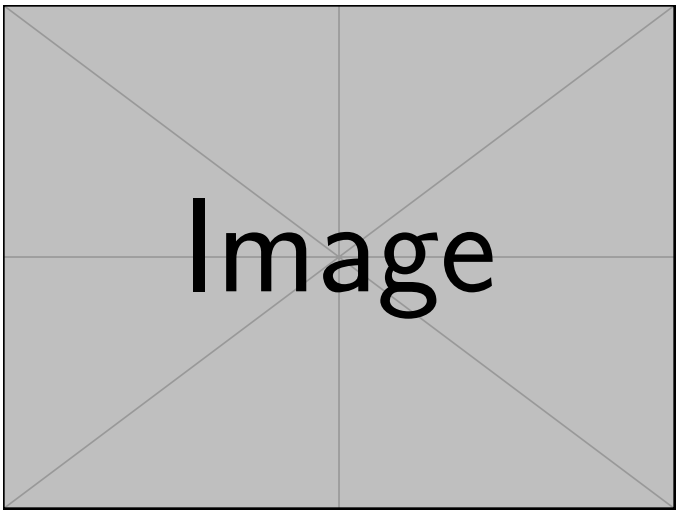


Figure 2.1: *This is the caption for first image.*

porttitor. Nulla facilisi. Sed a turpis eu lacus commodo facilisis. Morbi fringilla, wisi in dignissim interdum, justo lectus sagittis dui, et vehicula libero dui cursus dui. Mauris tempor ligula sed lacus. Duis cursus enim ut augue. Cras ac magna. Cras nulla. Nulla egestas. Curabitur a leo. Quisque egestas wisi eget nunc. Nam feugiat lacus vel est. Curabitur consectetuer.

2.1.1 A Subsection

Suspendisse vel felis. Ut lorem lorem, interdum eu, tincidunt sit amet, laoreet vitae, arcu. Aenean faucibus pede eu ante. Praesent enim elit, rutrum at, molestie non, nonummy vel, nisl. Ut lectus eros, malesuada sit amet, fermentum eu, sodales cursus, magna. Donec eu purus. Quisque vehicula, urna sed ultricies auctor, pede lorem egestas dui, et convallis elit erat sed nulla. Donec luctus. Curabitur et nunc. Aliquam dolor odio, commodo pretium, ultricies non, pharetra in, velit. Integer arcu est, nonummy in, fermentum faucibus, egestas vel, odio.

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

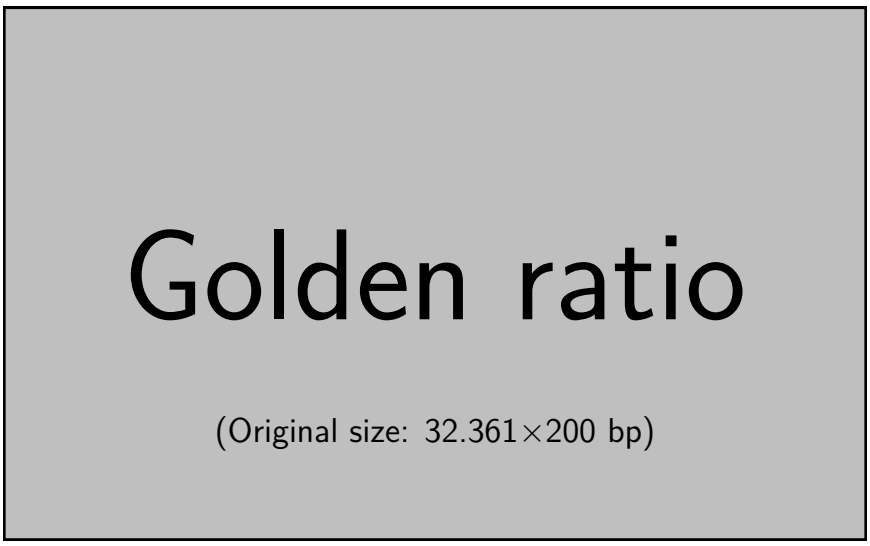


Figure 2.2: *This is the caption for another image where the description is rather long and will probably go beyond one line.*

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.

Pellentesque habitant morbi tristique senectus et netus et malesuada fames ac turpis egestas. Donec odio elit, dictum in, hendrerit sit amet, egestas sed, leo. Praesent feugiat sapien aliquet odio. Integer vitae justo. Aliquam vestibulum fringilla lorem. Sed neque lectus, consectetuer at, consectetuer sed, eleifend ac, lectus. Nulla facilisi. Pellentesque eget lectus. Proin eu metus. Sed porttitor. In hac habitasse platea dictumst. Suspendisse eu lectus. Ut mi mi, lacinia sit amet, placerat et, mollis vitae, dui. Sed ante tellus, tristique ut, iaculis eu, malesuada ac, dui. Mauris nibh leo, facilisis non, adipiscing quis, ultrices a, dui.

Table 2.3: *This is the caption for yet another table.*

Col1	Col2	Col3	Col4	Col1	Col2	Col3	Col4
1	676	8837	787	544	22	908	229
2	732	78	5415	887	343	1112	870
3	545	778	7507	5554	5432	9867	9
4	545	1874	7560	102	562	223	792
5	88	788	6344	45	998	776	2

2.2 Another Section

Lorem ipsum dolor sit amet, consectetuer adipiscing elit. Ut purus elit, vestibulum ut, placerat ac, adipiscing vitae, felis. Curabitur dictum gravida mauris. Nam arcu libero, nonummy eget, consectetuer id, vulputate a, magna. Donec vehicula augue eu neque. Pellentesque habitant morbi tristique senectus et netus et malesuada fames ac turpis egestas. Mauris ut leo. Cras viverra metus rhoncus sem. Nulla et lectus vestibulum urna fringilla ultrices. Phasellus eu tellus sit amet tortor gravida placerat. Integer sapien est, iaculis in, pretium quis, viverra ac, nunc. Praesent eget sem vel leo ultrices bibendum. Aenean faucibus. Morbi dolor nulla, malesuada eu, pulvinar at, mollis ac, nulla. Curabitur auctor semper nulla. Donec varius orci eget risus. Duis nibh mi, congue eu, accumsan eleifend, sagittis quis, diam. Duis eget orci sit amet orci dignissim rutrum.

Nam dui ligula, fringilla a, euismod sodales, sollicitudin vel, wisi. Morbi auctor lorem non justo. Nam lacus libero, pretium at, lobortis vitae, ultricies et, tellus. Donec aliquet, tortor sed accumsan bibendum, erat ligula aliquet magna, vitae ornare odio metus a mi. Morbi ac orci et nisl hendrerit mollis. Suspendisse ut massa. Cras nec ante. Pellentesque a nulla. Cum sociis natoque penatibus et magnis dis parturient montes, nascetur ridiculus mus. Aliquam tincidunt urna. Nulla ullamcorper vestibulum turpis. Pellentesque cursus luctus mauris.

2.2.1 Another Subsection

Nulla malesuada porttitor diam. Donec felis erat, congue non, volutpat at, tincidunt tristique, libero. Vivamus viverra fermentum felis. Donec nonummy pellentesque ante. Phasellus adipiscing semper elit. Proin fermentum massa ac quam. Sed diam turpis, molestie vitae, placerat a, molestie nec, leo. Maecenas lacinia. Nam ipsum ligula, eleifend at, accumsan nec, suscipit a, ipsum. Morbi blandit ligula feugiat magna. Nunc eleifend consequat lorem. Sed lacinia nulla vitae enim. Pellentesque tincidunt purus vel magna. Integer non enim. Praesent euismod nunc eu purus. Donec bibendum quam in tellus. Nullam cursus pulvinar lectus. Donec et mi. Nam vulputate metus eu enim. Vestibulum pellentesque felis eu massa.

Quisque ullamcorper placerat ipsum. Cras nibh. Morbi vel justo vitae lacus tincidunt ultrices. Lorem ipsum dolor sit amet, consectetuer adipiscing elit. In hac habitasse platea dictumst. Integer tempus convallis augue. Etiam facilisis. Nunc elementum fermentum wisi. Aenean placerat. Ut imperdiet, enim sed gravida sollicitudin, felis odio placerat quam, ac pulvinar elit purus eget enim. Nunc vitae tortor. Proin tempus nibh sit amet nisl. Vivamus quis tortor vitae risus porta vehicula.

Fusce mauris. Vestibulum luctus nibh at lectus. Sed bibendum, nulla a faucibus semper, leo velit ultricies tellus, ac venenatis arcu wisi vel nisl. Vestibulum diam. Aliquam pellentesque, augue quis sagittis posuere, turpis lacus congue quam, in hendrerit risus eros eget felis. Maecenas eget erat in sapien mattis porttitor. Vestibulum porttitor. Nulla facilisi. Sed a turpis eu lacus commodo facilisis. Morbi fringilla, wisi in dignissim interdum, justo lectus sagittis dui, et vehicula libero dui cursus dui. Mauris tempor ligula sed lacus. Duis cursus enim ut augue. Cras ac magna. Cras nulla. Nulla egestas. Curabitur a leo. Quisque egestas wisi eget nunc. Nam feugiat lacus vel est. Curabitur consectetuer.

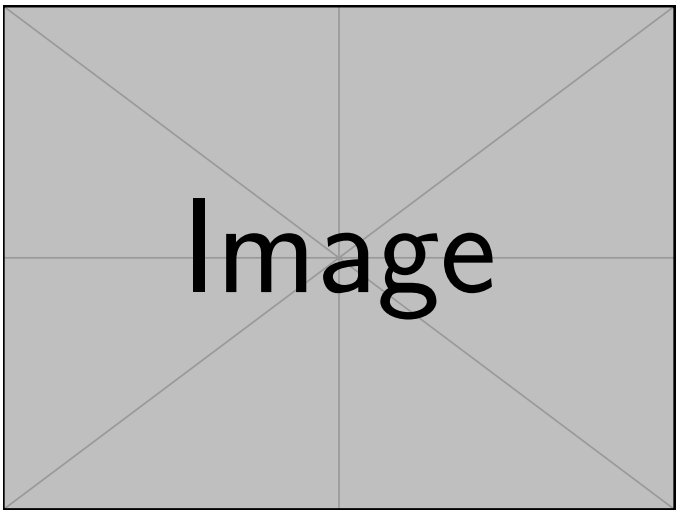


Figure 2.3: *This is the caption for another image.*

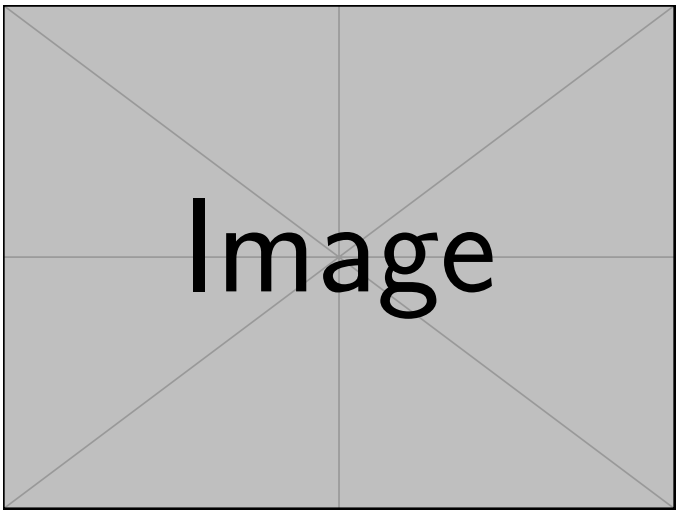


Figure 2.4: *This is the caption for another image.*

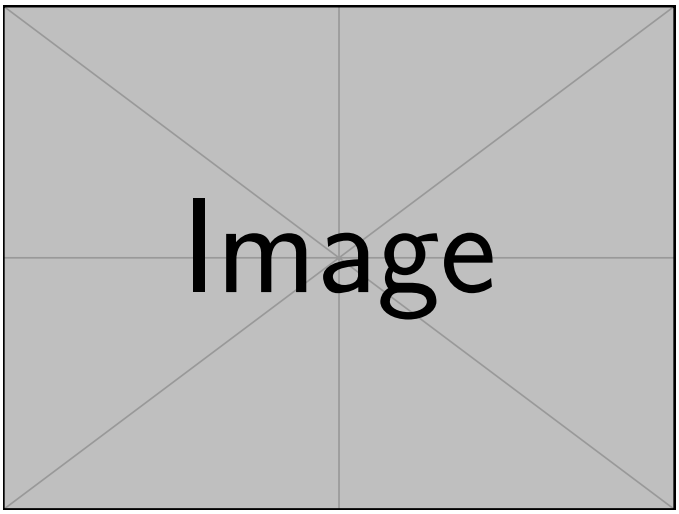


Figure 2.5: *This is the caption for another image.*

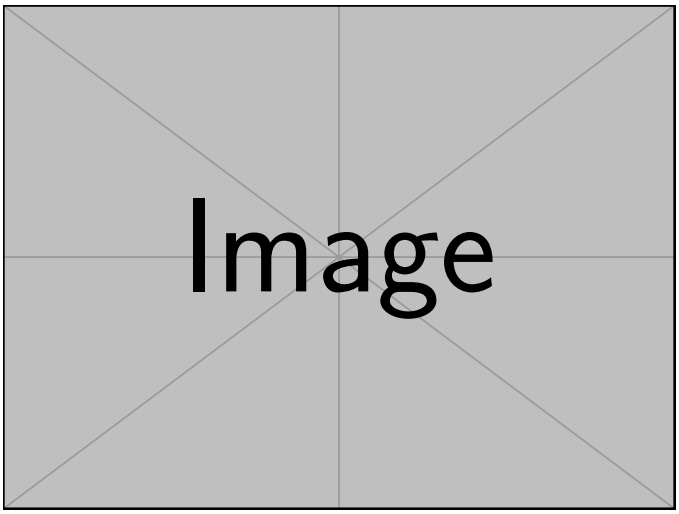


Figure 2.6: *This is the caption for another image.*

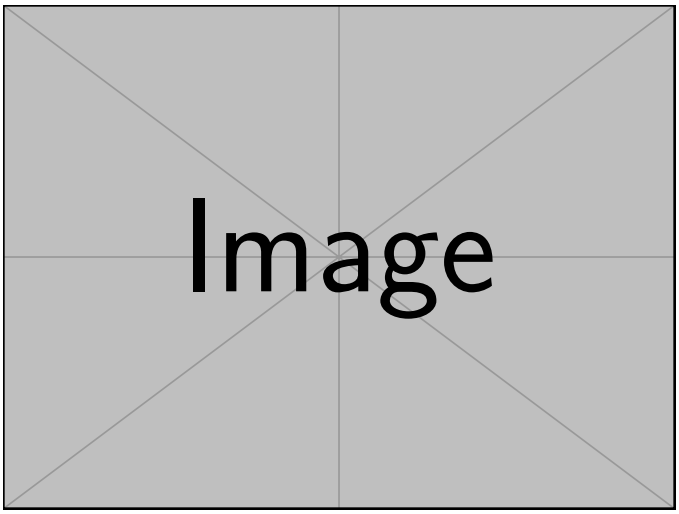


Figure 2.7: *This is the caption for another image.*

2.2.1.1 A Sub-Subsection

Suspendisse vel felis. Ut lorem lorem, interdum eu, tincidunt sit amet, laoreet vitae, arcu. Aenean faucibus pede eu ante. Praesent enim elit, rutrum at, molestie non, nonummy vel, nisl. Ut lectus eros, malesuada sit amet, fermentum eu, sodales cursus, magna. Donec eu purus. Quisque vehicula, urna sed ultricies auctor, pede lorem egestas dui, et convallis elit erat sed nulla. Donec luctus. Curabitur et nunc. Aliquam dolor odio, commodo pretium, ultricies non, pharetra in, velit. Integer arcu est, nonummy in, fermentum faucibus, egestas vel, odio.

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.

Table 2.4: *This is the caption for yet another table.*

Col1	Col2	Col3	Col4	Col1	Col2	Col3	Col4
1	676	8837	787	544	22	908	229

Table 2.5: *This is the caption for yet another table.*

Col1	Col2	Col3	Col4	Col1	Col2	Col3	Col4
1	676	8837	787	544	22	908	229

Pellentesque habitant morbi tristique senectus et netus et malesuada fames ac turpis egestas. Donec odio elit, dictum in, hendrerit sit amet, egestas sed, leo. Praesent feugiat sapien aliquet odio. Integer vitae justo. Aliquam vestibulum fringilla lorem. Sed neque lectus, consectetuer at, consectetuer sed, eleifend ac, lectus. Nulla facilisi. Pellentesque eget lectus. Proin eu metus. Sed porttitor. In hac habitasse platea dictumst. Suspendisse eu lectus. Ut mi mi, lacinia sit amet, placerat et, mollis vitae, dui. Sed ante tellus, tristique ut, iaculis eu, malesuada ac, dui. Mauris nibh leo, facilisis non, adipiscing quis, ultrices a, dui.

Table 2.6: *This is the caption for yet another table.*

Col1	Col2	Col3	Col4	Col1	Col2	Col3	Col4
1	676	8837	787	544	22	908	229

Table 2.7: *This is the caption for yet another table.*

Col1	Col2	Col3	Col4	Col1	Col2	Col3	Col4
1	676	8837	787	544	22	908	229

Table 2.8: *This is the caption for yet another table.*

Col1	Col2	Col3	Col4	Col1	Col2	Col3	Col4
1	676	8837	787	544	22	908	229

Table 2.9: *This is the caption for yet another table.*

Col1	Col2	Col3	Col4	Col1	Col2	Col3	Col4
1	676	8837	787	544	22	908	229

Table 2.10: *This is the caption for yet another table.*

Col1	Col2	Col3	Col4	Col1	Col2	Col3	Col4
1	676	8837	787	544	22	908	229

Chapter 3

MORE GENERIC CONTENT

Lorem ipsum dolor sit amet, consectetuer adipiscing elit. Ut purus elit, vestibulum ut, placerat ac, adipiscing vitae, felis. Curabitur dictum gravida mauris. Nam arcu libero, nonummy eget, consectetuer id, vulputate a, magna. Donec vehicula augue eu neque. Pellentesque habitant morbi tristique senectus et netus et malesuada fames ac turpis egestas. Mauris ut leo. Cras viverra metus rhoncus sem. Nulla et lectus vestibulum urna fringilla ultrices. Phasellus eu tellus sit amet tortor gravida placerat. Integer sapien est, iaculis in, pretium quis, viverra ac, nunc. Praesent eget sem vel leo ultrices bibendum. Aenean faucibus. Morbi dolor nulla, malesuada eu, pulvinar at, mollis ac, nulla. Curabitur auctor semper nulla. Donec varius orci eget risus. Duis nibh mi, congue eu, accumsan eleifend, sagittis quis, diam. Duis eget orci sit amet orci dignissim rutrum. Nam dui ligula, fringilla a, euismod sodales, sollicitudin vel, wisi. Morbi auctor lorem non justo. Nam lacus libero, pretium at, lobortis vitae, ultricies et, tellus. Donec aliquet, tortor sed accumsan bibendum, erat ligula aliquet magna, vitae ornare odio metus a mi. Morbi ac orci et nisl hendrerit mollis. Suspendisse ut massa. Cras nec ante. Pellentesque a nulla. Cum sociis natoque penatibus et

Table 3.1: *This is the caption for a table that has a long description that does not add much to the understanding and should be shortened.*

Col1	Col2	Col3	Col4	Col1	Col2	Col3	Col4
1	676	8837	787	544	22	908	229
2	732	78	5415	887	343	1112	870
3	545	778	7507	5554	5432	9867	9
4	545	1874	7560	102	562	223	792
5	88	788	6344	45	998	776	2

Table 3.2: *This is the caption for a table.*

Col1	Col2	Col3	Col4	Col1	Col2	Col3	Col4
1	676	8837	787	544	22	908	229
2	732	78	5415	887	343	1112	870
3	545	778	7507	5554	5432	9867	9
4	545	1874	7560	102	562	223	792
5	88	788	6344	45	998	776	2

magnis dis parturient montes, nascetur ridiculus mus. Aliquam tincidunt urna. Nulla ullamcorper vestibulum turpis. Pellentesque cursus luctus mauris.

3.1 A Section

Nulla malesuada porttitor diam. Donec felis erat, congue non, volutpat at, tincidunt tristique, libero. Vivamus viverra fermentum felis. Donec nonummy pellentesque ante. Phasellus adipiscing semper elit. Proin fermentum massa ac quam. Sed diam turpis, molestie vitae, placerat a, molestie nec, leo. Maecenas lacinia. Nam ipsum ligula, eleifend at, accumsan nec, suscipit a, ipsum. Morbi blandit ligula feugiat magna. Nunc eleifend consequat lorem. Sed lacinia nulla vitae enim. Pellentesque tincidunt purus vel magna. Integer non enim. Praesent euismod nunc eu purus. Donec bibendum quam in tellus. Nullam cursus pulvinar lectus. Donec et mi. Nam vulputate metus eu enim. Vestibulum pellentesque felis eu massa. Quisque ullamcorper placerat ipsum. Cras nibh. Morbi vel justo vitae lacus tincidunt ultrices. Lorem ipsum dolor sit amet, consectetuer adipiscing elit. In hac habitasse platea dictumst. Integer tempus convallis augue. Etiam facilisis. Nunc elementum fermentum wisi. Aenean placerat. Ut imperdiet, enim sed gravida sollicitudin, felis odio placerat quam, ac pulvinar elit purus eget enim. Nunc vitae tortor. Proin tempus nibh sit amet nisl. Vivamus quis tortor vitae risus porta vehicula.

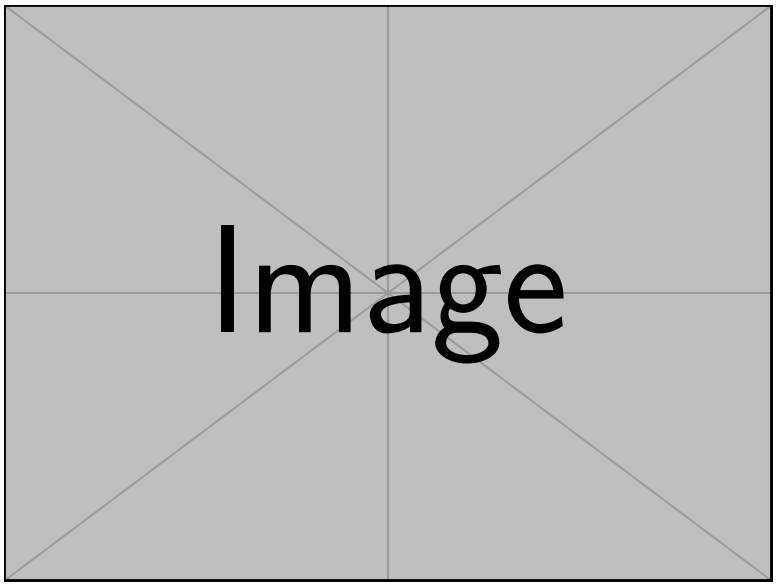


Figure 3.1: *This is the caption for an image.*

Fusce mauris. Vestibulum luctus nibh at lectus. Sed bibendum, nulla a faucibus semper, leo velit ultricies tellus, ac venenatis arcu wisi vel nisl. Vestibulum diam. Aliquam pellentesque, augue quis sagittis posuere, turpis lacus congue quam, in hendrerit risus eros eget felis. Maecenas eget erat in sapien mattis porttitor. Vestibulum porttitor. Nulla facilisi. Sed a turpis eu lacus commodo facilisis. Morbi fringilla, wisi in dignissim interdum, justo lectus sagittis dui, et vehicula libero dui cursus dui. Mauris tempor ligula sed lacus. Duis cursus enim ut augue. Cras ac magna. Cras nulla. Nulla egestas. Curabitur a leo. Quisque egestas wisi eget nunc. Nam feugiat lacus vel est. Curabitur consectetuer.

3.1.1 A Subsection

Suspendisse vel felis. Ut lorem lorem, interdum eu, tincidunt sit amet, laoreet vitae, arcu. Aenean faucibus pede eu ante. Praesent enim elit, rutrum at, molestie non, nonummy vel, nisl. Ut lectus eros, malesuada sit amet, fermentum eu, sodales cursus, magna. Donec eu purus. Quisque vehicula, urna sed ultricies auctor, pede lorem

Table 3.3: *This is the caption for one more table.*

Col1	Col2	Col3	Col4	Col1	Col2	Col3	Col4
1	676	8837	787	544	22	908	229
2	732	78	5415	887	343	1112	870
3	545	778	7507	5554	5432	9867	9
4	545	1874	7560	102	562	223	792
5	88	788	6344	45	998	776	2

egestas dui, et convallis elit erat sed nulla. Donec luctus. Curabitur et nunc. Aliquam dolor odio, commodo pretium, ultricies non, pharetra in, velit. Integer arcu est, nonummy in, fermentum faucibus, egestas vel, odio.

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.

Pellentesque habitant morbi tristique senectus et netus et malesuada fames ac turpis egestas. Donec odio elit, dictum in, hendrerit sit amet, egestas sed, leo. Praesent feugiat sapien aliquet odio. Integer vitae justo. Aliquam vestibulum fringilla lorem. Sed neque lectus, consectetuer at, consectetuer sed, eleifend ac, lectus. Nulla facilisi. Pellentesque eget lectus. Proin eu metus. Sed porttitor. In hac habitasse platea dictumst. Suspendisse eu lectus. Ut mi mi, lacinia sit amet, placerat et, mollis vitae, dui. Sed ante tellus, tristique ut, iaculis eu, malesuada ac, dui. Mauris nibh leo, facilisis non, adipiscing quis, ultrices a, dui.

3.2 Another Section

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Nam dui ligula, fringilla a, euismod sodales, sollicitudin vel, wisi. Morbi auctor lorem non justo. Nam lacus libero, pretium at, lobortis vitae, ultricies et, tellus. Donec aliquet, tortor sed accumsan bibendum, erat ligula aliquet magna, vitae ornare odio metus a mi. Morbi ac orci et nisl hendrerit mollis. Suspendisse ut massa. Cras nec ante. Pellentesque a nulla. Cum sociis natoque penatibus et magnis dis parturient montes, nascetur ridiculus mus. Aliquam tincidunt urna. Nulla ullamcorper vestibulum turpis. Pellentesque cursus luctus mauris.

3.2.1 Another Subsection

Nulla malesuada porttitor diam. Donec felis erat, congue non, volutpat at, tincidunt tristique, libero. Vivamus viverra fermentum felis. Donec nonummy pellentesque ante. Phasellus adipiscing semper elit. Proin fermentum massa ac quam. Sed diam

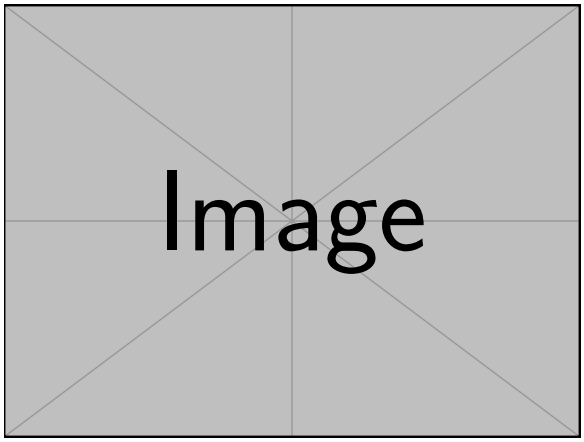

Figure 3.2: *This is the caption for yet another image.*

turpis, molestie vitae, placerat a, molestie nec, leo. Maecenas lacinia. Nam ipsum ligula, eleifend at, accumsan nec, suscipit a, ipsum. Morbi blandit ligula feugiat magna. Nunc eleifend consequat lorem. Sed lacinia nulla vitae enim. Pellentesque tincidunt purus vel magna. Integer non enim. Praesent euismod nunc eu purus. Donec bibendum quam in tellus. Nullam cursus pulvinar lectus. Donec et mi. Nam vulputate metus eu enim. Vestibulum pellentesque felis eu massa. Quisque ullamcorper placerat ipsum. Cras nibh. Morbi vel justo vitae lacus tincidunt ultrices. Lorem ipsum dolor sit amet, consectetuer adipiscing elit. In hac habitasse platea dictumst. Integer tempus convallis augue. Etiam facilisis. Nunc elementum fermentum wisi. Aenean placerat. Ut imperdiet, enim sed gravida sollicitudin, felis odio placerat quam, ac pulvinar elit purus eget enim. Nunc vitae tortor. Proin tempus nibh sit amet nisl. Vivamus quis tortor vitae risus porta vehicula.

Fusce mauris. Vestibulum luctus nibh at lectus. Sed bibendum, nulla a faucibus semper, leo velit ultricies tellus, ac venenatis arcu wisi vel nisl. Vestibulum diam. Aliquam pellentesque, augue quis sagittis posuere, turpis lacus congue quam, in hendrerit risus eros eget felis. Maecenas eget erat in sapien mattis porttitor. Vestibulum porttitor. Nulla facilisi. Sed a turpis eu lacus commodo facilisis. Morbi fringilla, wisi in dignissim interdum, justo lectus sagittis dui, et vehicula libero dui cursus dui.

Mauris tempor ligula sed lacus. Duis cursus enim ut augue. Cras ac magna. Cras nulla. Nulla egestas. Curabitur a leo. Quisque egestas wisi eget nunc. Nam feugiat lacus vel est. Curabitur consectetuer.

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Appendix A

FIRST APPENDIX

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Table A.1: *This is the caption for the first table.*

Col1	Col2	Col3	Col4	Col1	Col2	Col3	Col4
1	676	8837	787	544	22	908	229
2	732	78	5415	887	343	1112	870
3	545	778	7507	5554	5432	9867	9
4	545	1874	7560	102	562	223	792
5	88	788	6344	45	998	776	2

Table A.2: *This is the caption for another table.*

Col1	Col2	Col3	Col4	Col1	Col2	Col3	Col4
1	676	8837	787	544	22	908	229
2	732	78	5415	887	343	1112	870
3	545	778	7507	5554	5432	9867	9
4	545	1874	7560	102	562	223	792
5	88	788	6344	45	998	776	2

A.1 A Section

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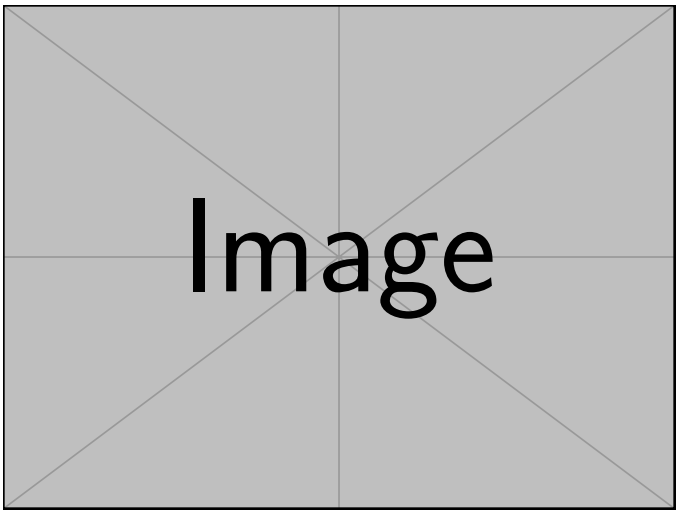

Figure A.1: *This is the caption for first image.*

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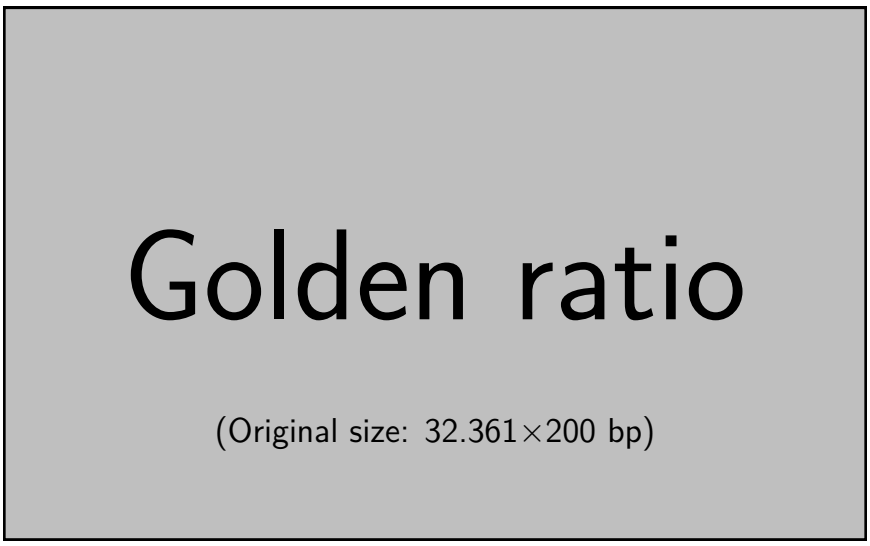

Figure A.2: *This is the caption for another image where the description is rather long and will probably go beyond one line.*

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Table A.3: *This is the caption for yet another table.*

Col1	Col2	Col3	Col4	Col1	Col2	Col3	Col4
1	676	8837	787	544	22	908	229
2	732	78	5415	887	343	1112	870
3	545	778	7507	5554	5432	9867	9
4	545	1874	7560	102	562	223	792
5	88	788	6344	45	998	776	2

A.2 Another Section

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Appendix B

SECOND APPENDIX

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Table B.1: *This is the caption for the first table.*

Col1	Col2	Col3	Col4	Col1	Col2	Col3	Col4
1	676	8837	787	544	22	908	229
2	732	78	5415	887	343	1112	870
3	545	778	7507	5554	5432	9867	9
4	545	1874	7560	102	562	223	792
5	88	788	6344	45	998	776	2

Table B.2: *This is the caption for another table.*

Col1	Col2	Col3	Col4	Col1	Col2	Col3	Col4
1	676	8837	787	544	22	908	229
2	732	78	5415	887	343	1112	870
3	545	778	7507	5554	5432	9867	9
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5	88	788	6344	45	998	776	2

B.1 A Section

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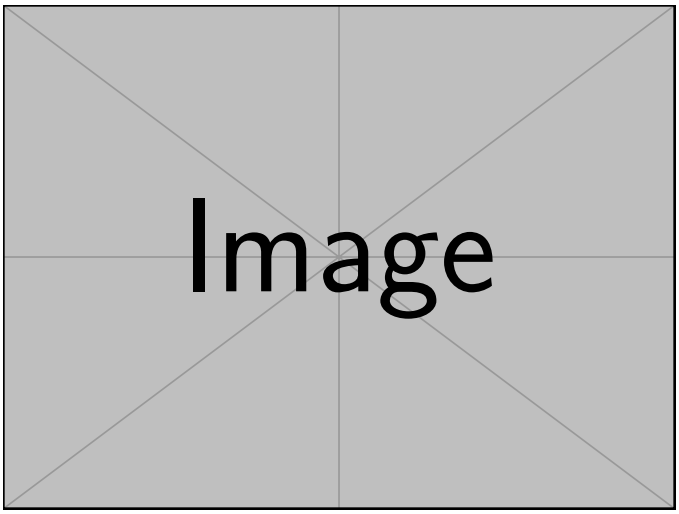

Figure B.1: *This is the caption for first image.*

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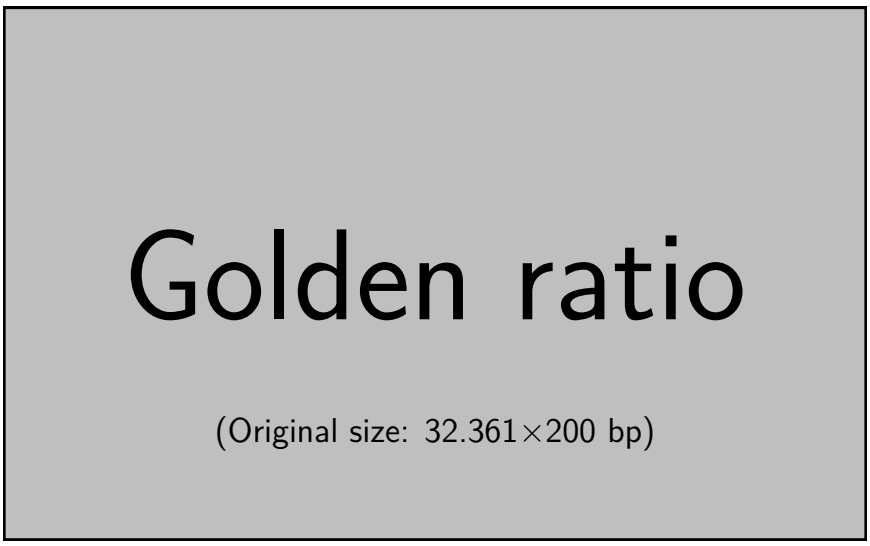

Figure B.2: *This is the caption for another image where the description is rather long and will probably go beyond one line.*

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Table B.3: *This is the caption for yet another table.*

Col1	Col2	Col3	Col4	Col1	Col2	Col3	Col4
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2	732	78	5415	887	343	1112	870
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4	545	1874	7560	102	562	223	792
5	88	788	6344	45	998	776	2

B.2 Another Section

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B.2.1 Another Subsection

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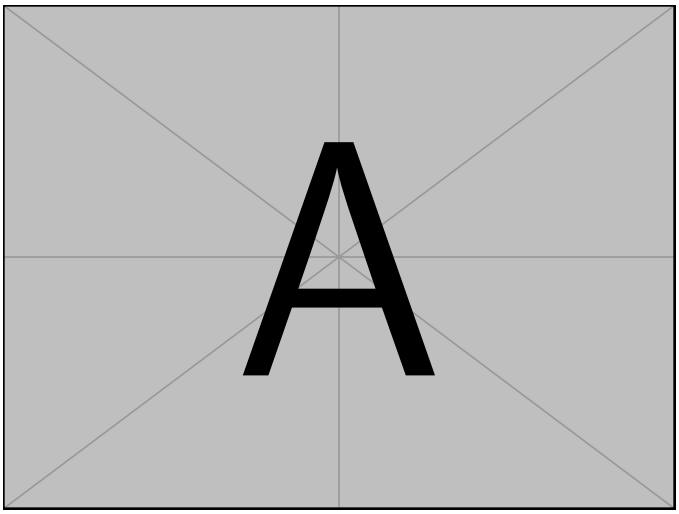

Figure B.3: *This is the caption for an image.*

B.2.1.1 A Sub-Subsection

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Appendix C

CODE EXAMPLES

The following code listings are to demonstrate how code could be included in an appendix.

Code Listing C.1: *fibonacci.py*

```
def fibonacci(n: int) -> int:
"""This function returns the nth Fibonacci number."""
    if n == 0 or n == 1:
        return n
    else:
        return fibonacci(n-1) + fibonacci(n-2)
```

Code Listing C.2: *incmatrix.py*

```
import numpy as np

def incmatrix(genl1,genl2):
    m = len(genl1)
    n = len(genl2)
    M = None #to become the incidence matrix
    VT = np.zeros((n*m,1), int)  #dummy variable

    #compute the bitwise xor matrix
    M1 = bitxormatrix(genl1)
    M2 = np.triu(bitxormatrix(genl2),1)

    for i in range(m-1):
        for j in range(i+1, m):
            [r,c] = np.where(M2 == M1[i,j])
            for k in range(len(r)):
                VT[(i)*n + r[k]] = 1;
                VT[(i)*n + c[k]] = 1;
                VT[(j)*n + r[k]] = 1;
                VT[(j)*n + c[k]] = 1;

                if M is None:
                    M = np.copy(VT)
```

```
                else:
                    M = np.concatenate((M, VT), 1)

                VT = np.zeros((n*m,1), int)

    return M
```