The Models of London Bike Sharing Prediction

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Abstract

The aim of this study is to create a predictive model for bike-sharing counts in a n hour in the city of London in United Kingdom. The model makes use of regular neural network. And the main features affecting the bike counts include weather conditions and time. The model root mean square is 210, with a mean of 1124 counts in an hour compared to 1138 counts in an hour in the training data. The model provides enough accuracy for planning a new station and scheduling bike redistribution schedules.

Introduction

Bike-sharing system is an important mode in sustainable transportation modes. Great attention is put to improve such systems to increase their demand and maximize their environmental benefits along with other societal benefits. To study the demand of this system, London Bike-sharing system sis explored. The purpose of this study is to predict ranges of new bike counts each hour based on certain factors provided in the dataset. The aim of this report is to create a predictive model using machine learning to predict bike counts in a given hour in London city which is useful for planning and operation forecasting of bike-sharing system. The exploratory data analysis using graphical and statistical tools in Python were used to derive preliminary conclusions about the dataset by analyzing the results of the tools used. The dataset provided was acquired from three sources, to include the new bike counts in each hour, the weather conditions, and the holidays. The data from cycling dataset is grouped by "start time", and it represents the count of new bike shares grouped by hour. The long duration shares are not taken in the count." The data sample analyzed in this project is collected between January 1st, 2015 to January 1st, 2017 in London, UK and it includes the following parameters: - Timestamp (year, month, day, hour) - Cnt: the count of a new bike shares - T1: temperature measure taken in degree Celsius - T2: temperature feels - Hum: humidity percentage - Wind_speed: in Km/hr
- Weather_code: 1 = Clear ; mostly clear but have some values with haze/fog/patches of fog/ fog in vicinity 2 = scattered clouds / few clouds 3 = Broken clouds 4 = Cloudy 7 = Rain/ light Rain shower/ Light rain 10 = rain with thunderstorm 26 = snowfall 94 = Freezing Fog - Is_holiday: 1 if it is a holiday, 0 if it is not. - Is_weekend: 1 if it is a weekend, 0 if it is not.
- Season: 0: Spring, 1: Summer, 2: Fall, 3: Winter The sections below include literature review, description of methods, results, discussion and conclusion.

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Referencing figures, tables, equations

Figure 21

Figure 22

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Figure 24

Table 10

Equation 9

Equation 10

Quotes and code

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Figures

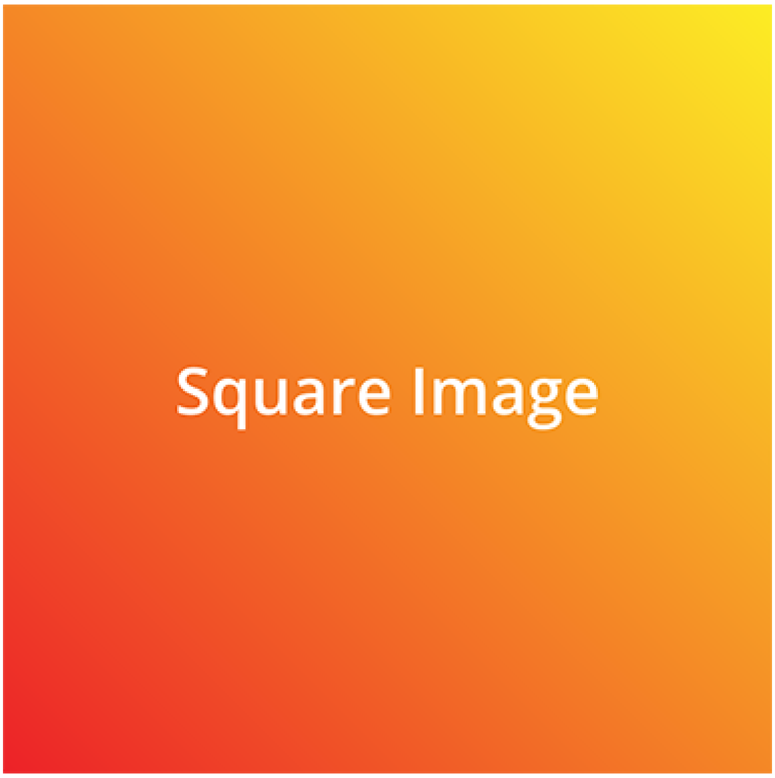
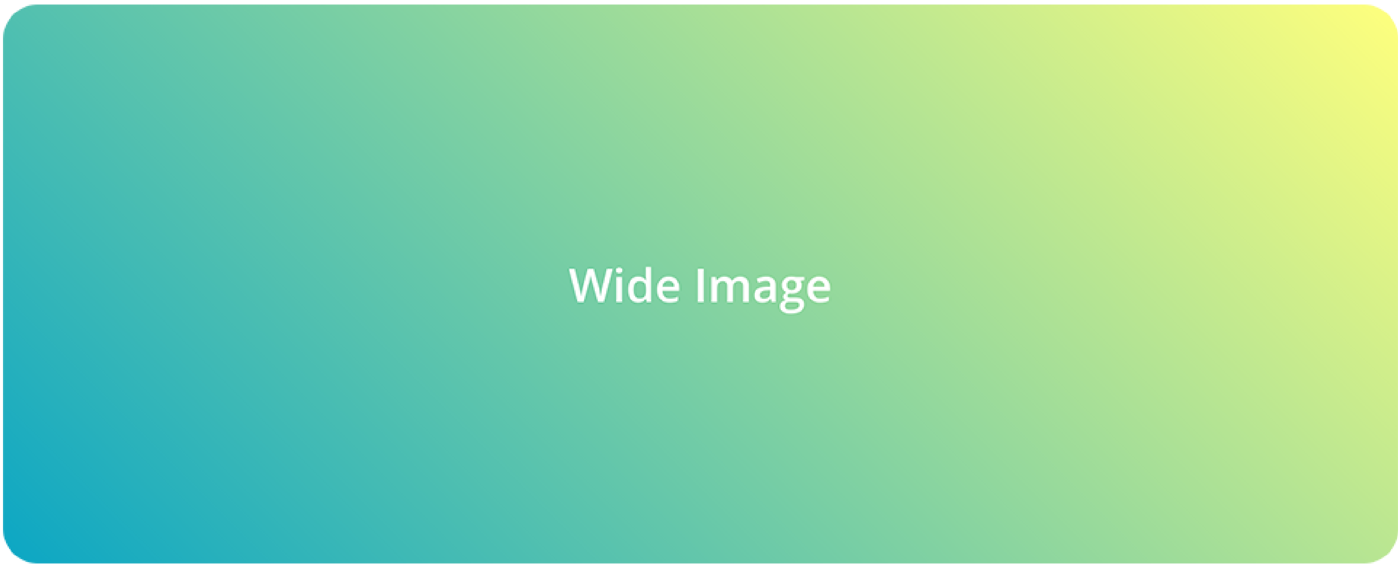


Figure 1: A square image at actual size and with a bottom caption. Loaded from the latest version of image on GitHub.



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Tables

Table 1: A table with a top caption and specified relative column widths.

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Game 1	150	187	210	105
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Table 3: A table with merged cells using the `attributes` plugin.

	Colors	
Size	**Text Color**	**Background Color**
big	blue	orange
small	black	white

Equations

A LaTeX equation:

$$\int_0^\infty e^{-x^2} dx = \frac{\sqrt{\pi}}{2} \tag{1}$$

An equation too long to fit within page:

$$x = a + b + c + d + e + f + g + h + i + j + k + l + m + n + o + p + q + r + s + t \\ + u + v + w + x + y + z + 1 + 2 + 3 + 4 + 5 + 6 + 7 + 8 + 9 \tag{2}$$

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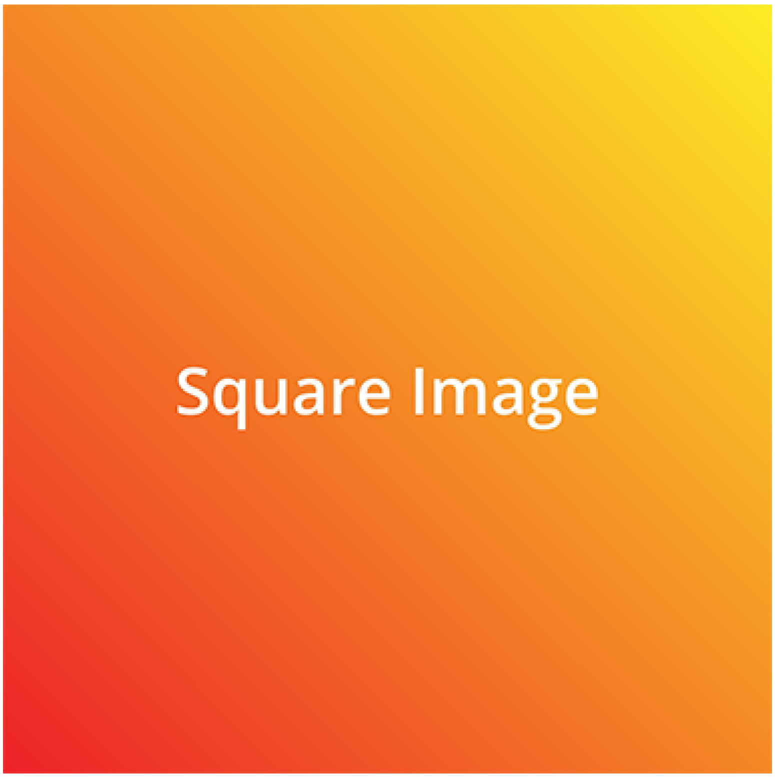

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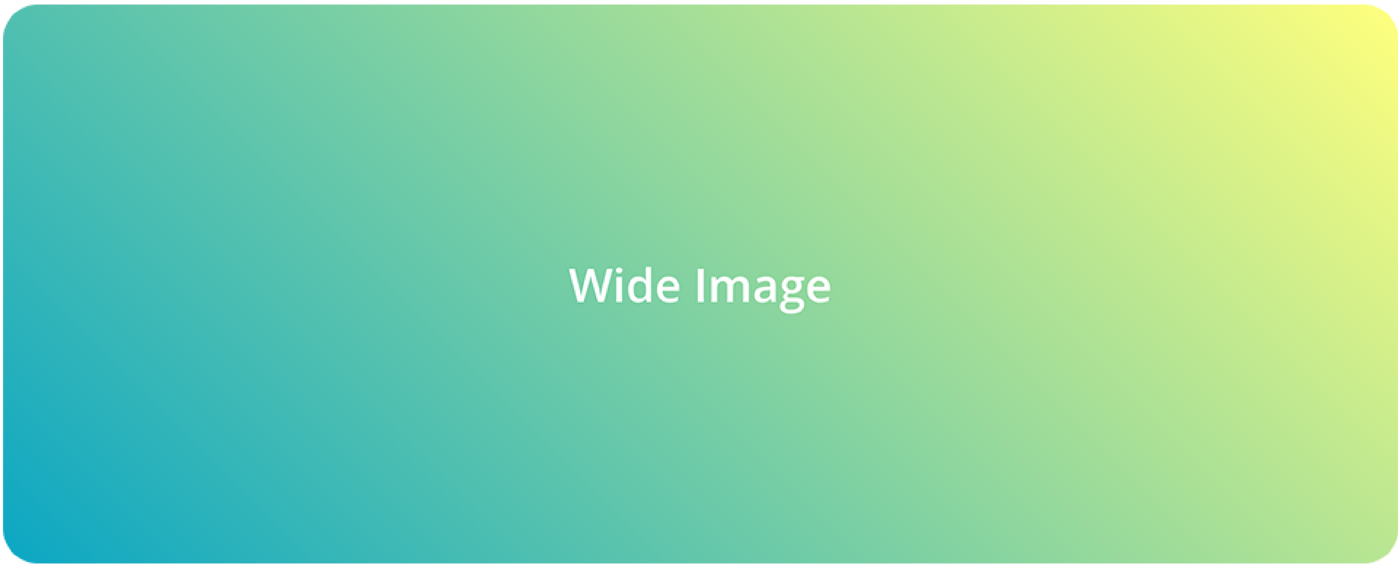

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The Models to Predict the Amount of Bike Sharing

Regular Neural Network

Based on the exploratory data analysis, regular neural network is used to figure out the project.

Neural network is a model that optimize the parameters through learning process to recognize hidden relationships between different data.

Because of the low correlation between given features, regular neural network probably is the most appropriate model to solve the project. The architecture of regular neural network is shown in Figure 9.

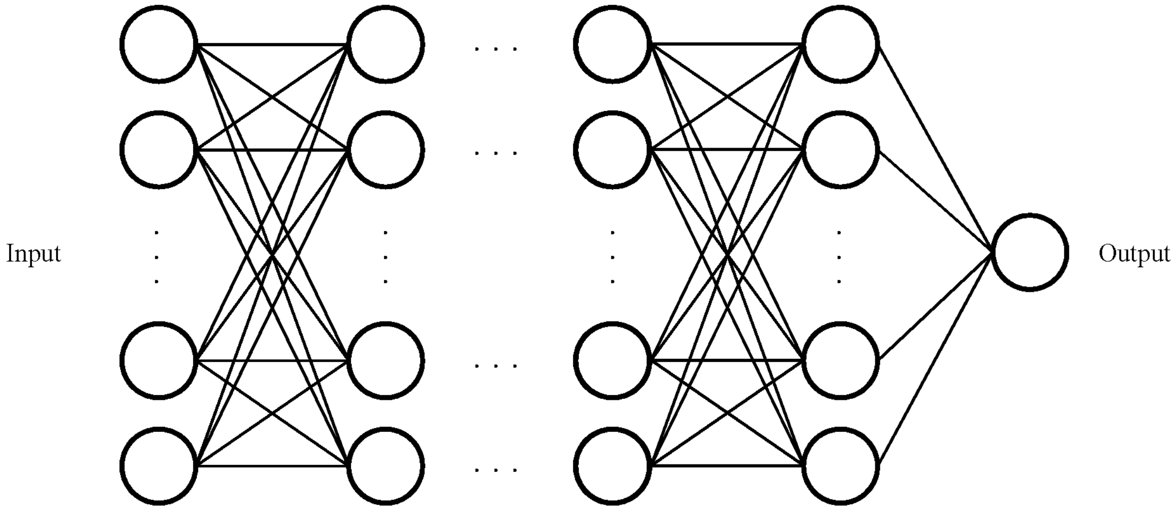

Figure 9: The Architecture of Regular Neural Network

There are 4 steps to build and train neural network, including:

- Selecting features;
- Data preprocessing;
- Designing layers and parameters;
- Determining training methods.

We used different features, epochs, hidden layers, units and learning rates in this project. The evaluation of the models' performances are based on the root mean squared error(RMSE) between the test data and predictions. The architectures of our models are shown in Figure 10, 11 and 12.

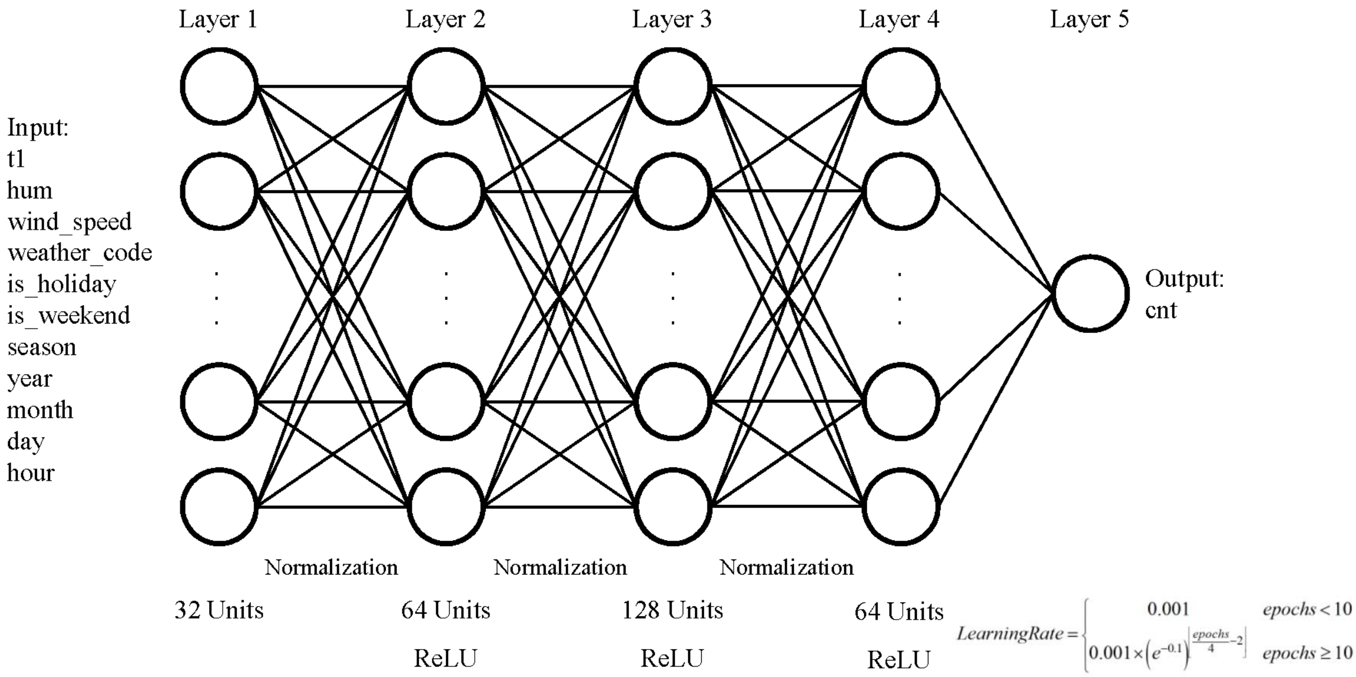

Figure 10: The Architecture of Jingzi’s Model

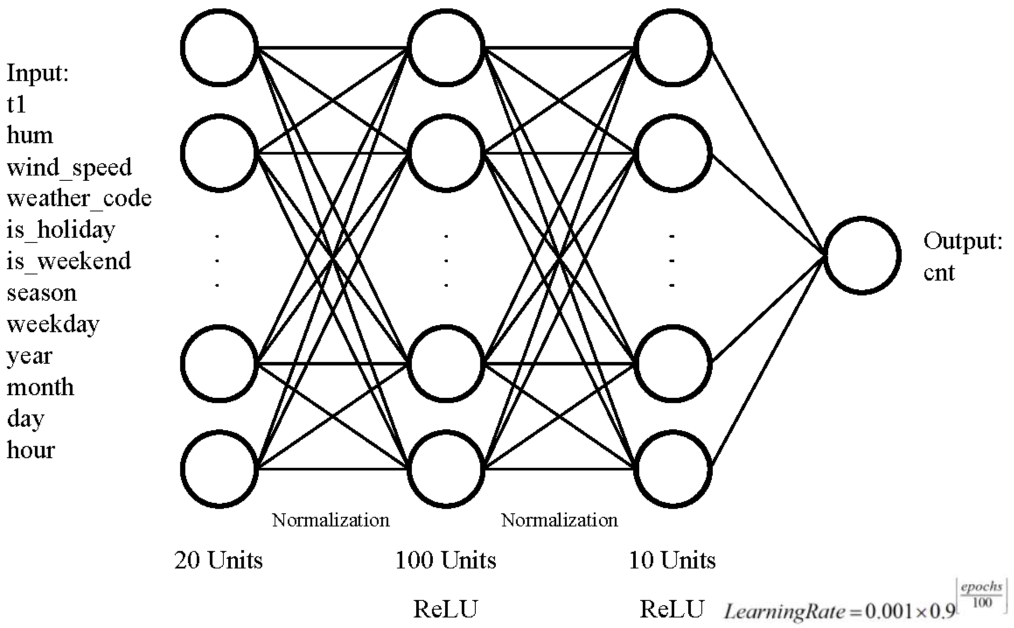

Figure 11: The Architecture of Anye's Model

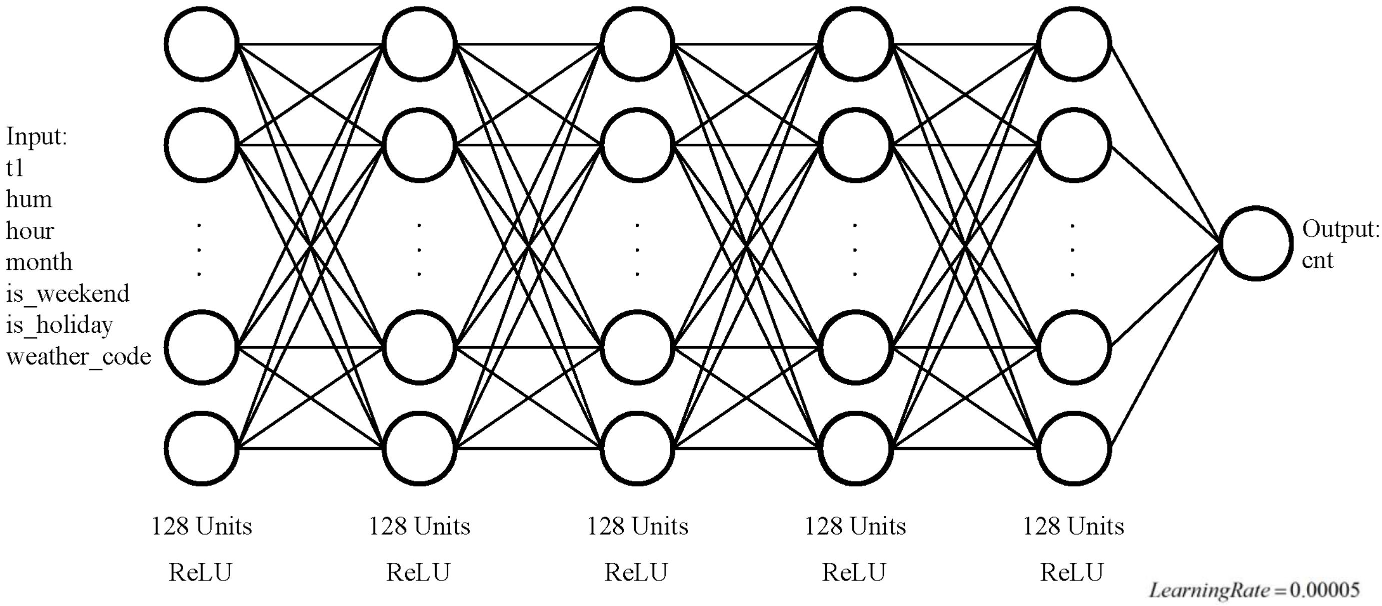

Figure 12: The Architecture of Dana's Model

Sensitivity Analysis

To evaluate and optimize our models, we analyzed the sensitivity of different parameters.

Units of Layers, Layers, Normalization and Learning Rates are analyzed. To avoid the influence of randomization, the evaluation of the performances is according to the average RMSE of 3 separate training with same initial parameters.

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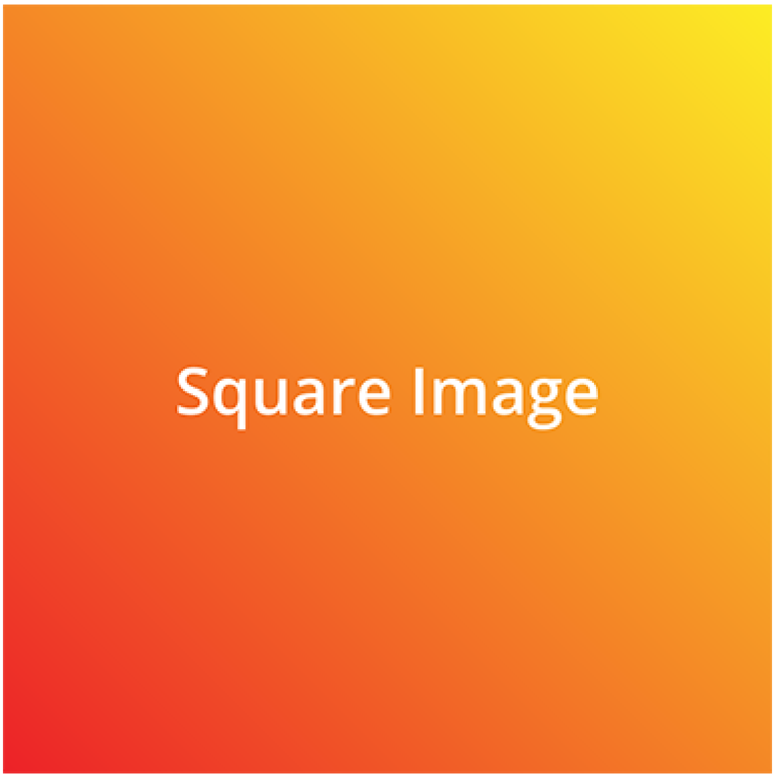

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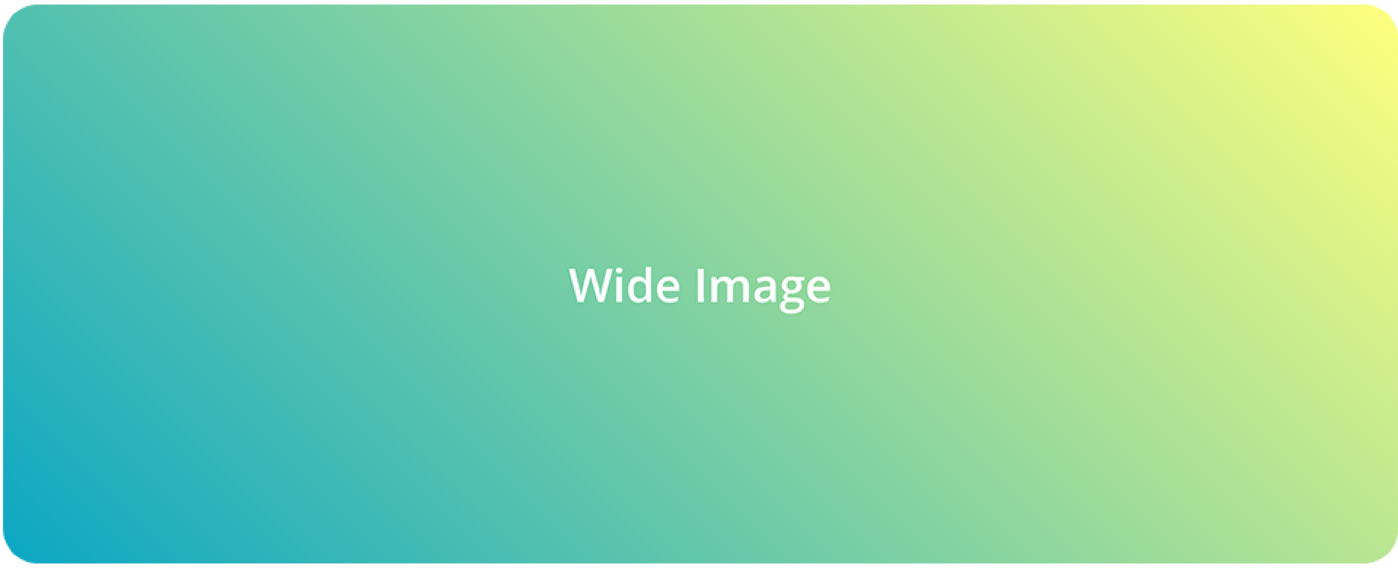

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unicode superscripts^{0123456789}

unicode subscripts$_{0123456789}$

A long paragraph of text. Lorem ipsum dolor sit amet, consectetur adipiscing elit, sed do eiusmod tempor incididunt ut labore et dolore magna aliqua. Ut enim ad minim veniam, quis nostrud exercitation ullamco laboris nisi ut aliquip ex ea commodo consequat. Duis aute irure dolor in reprehenderit in voluptate velit esse cillum dolore eu fugiat nulla pariatur. Excepteur sint occaecat cupidatat non proident, sunt in culpa qui officia deserunt mollit anim id est laborum.

Putting each sentence on its own line has numerous benefits with regard to editing and version control.

Line break without starting a new paragraph by putting
two spaces at end of line.

Heading 3

Heading 4

Heading 5

Heading 6

A heading centered on its own printed page

Horizontal rule:

`Heading 3`'s and `Heading 4`'s are recommended for sub-sections.

Links

Bare URL link: https://manubot.org

Long link with lots of words and stuff and junk and bleep and blah and stuff and other stuff and more stuff yeah

Link with text

Link with hover text

Link by reference

Citations

Citation by DOI [1].

Citation by PubMed Central ID [2].

Citation by PubMed ID [3].

Citation by Wikidata ID [4].

Citation by ISBN [5].

Citation by URL [6].

Citation by alias [7].

Multiple citations can be put inside the same set of brackets [1,5,7]. Manubot plugins provide easier, more convenient visualization of and navigation between citations [2,3,7,8].

Citation tags (i.e. aliases) can be defined in their own paragraphs using Markdown's reference link syntax:

Referencing figures, tables, equations

Figure 21

Figure 22

Figure 23

Figure 24

Table 10

Equation 9

Equation 10

Quotes and code

> Quoted text

> Quoted block of text
>
> Two roads diverged in a wood, and I—
> I took the one less traveled by,
> And that has made all the difference.

Code `in the middle` of normal text, aka `inline code`.

Code block with Python syntax highlighting:

```python
from manubot.cite.doi import expand_short_doi

def test_expand_short_doi():
    doi = expand_short_doi("10/c3bp")
    # a string too long to fit within page:
    assert doi == "10.25313/2524-2695-2018-3-vliyanie-enhansera-copia-i-
        insulyatora-gypsy-na-sintez-ernk-modifikatsii-hromatina-i-
        svyazyvanie-insulyatornyh-belkov-vtransfetsirovannyh-geneticheskih-
        konstruktsiyah"
```

Code block with no syntax highlighting:

```
Exporting HTML manuscript
Exporting DOCX manuscript
Exporting PDF manuscript
```

Figures

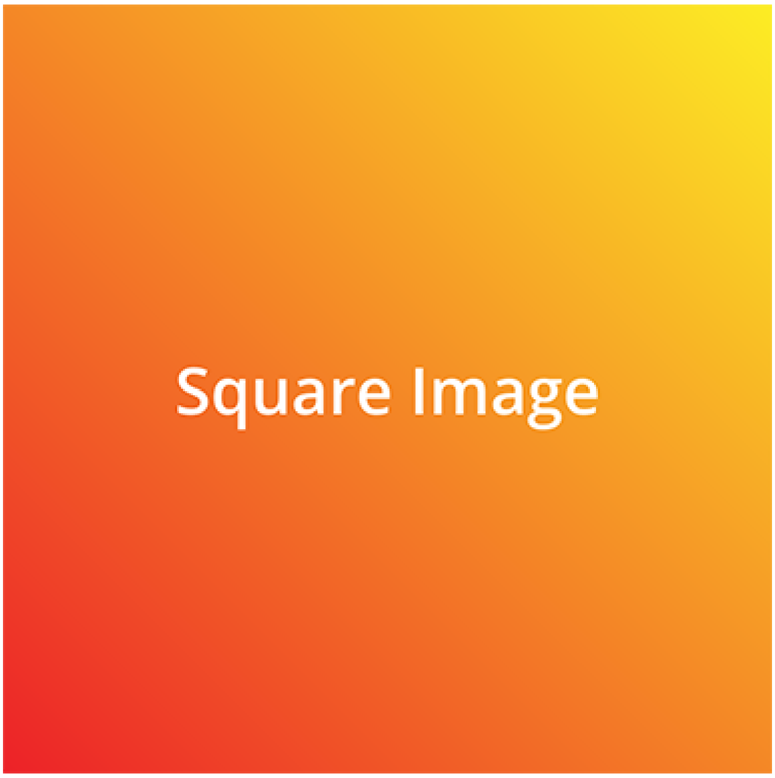

Figure 17: A square image at actual size and with a bottom caption. Loaded from the latest version of image on GitHub.

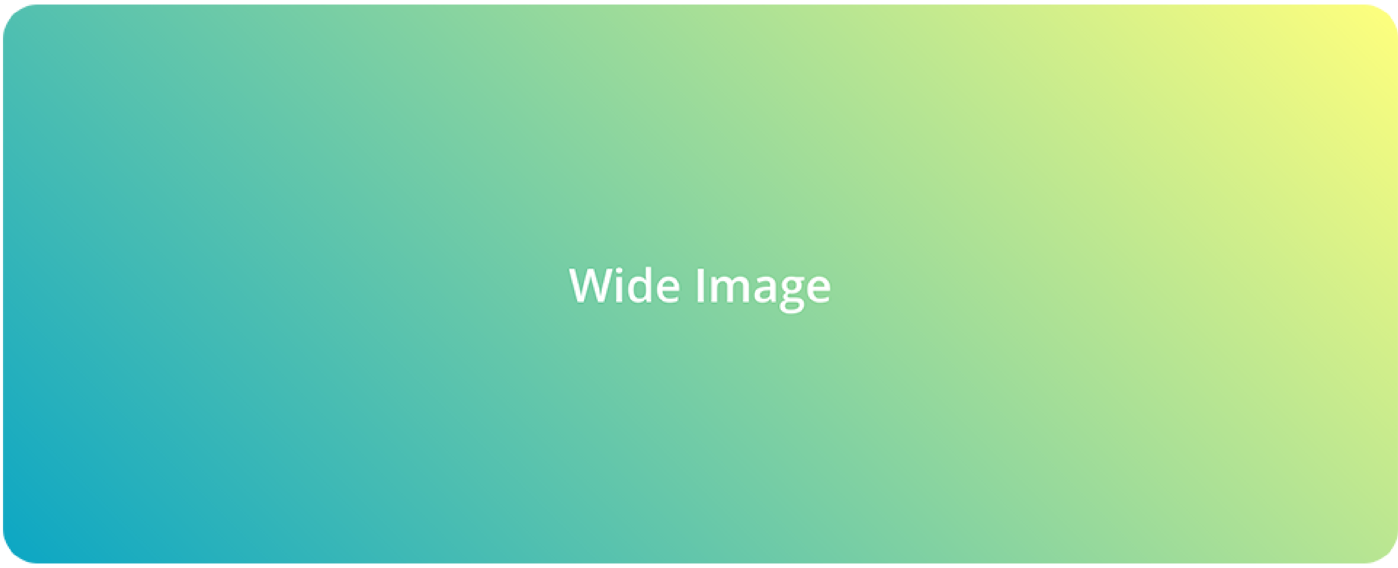

Figure 18: An image too wide to fit within page at full size. Loaded from a specific (hashed) version of the image on GitHub.

Figure 19: A tall image with a specified height. Loaded from a specific (hashed) version of the image on GitHub.

Figure 20: A vector `.svg` image loaded from GitHub. The parameter `sanitize=true` is necessary to properly load SVGs hosted via GitHub URLs. White background specified to serve as a backdrop for transparent sections of the image.

Tables

Table 10: A table with a top caption and specified relative column widths.

Bowling Scores	**Jane**	**John**	**Alice**	**Bob**
Game 1	150	187	210	105
Game 2	98	202	197	102
Game 3	123	180	238	134

Table 11: A table too wide to fit within page.

	Digits 1-33	**Digits 34-66**	**Digits 67-99**	**Ref.**
pi	3.14159265358979323 846264338327950	28841971693993751 0582097494459230	78164062862089986 2803482534211706	[`piday.org`]
e	2.71828182845904523 536028747135266	24977572470936999 5957496696762772	40766303535475945 7138217852516642	[`nasa.gov`]

Table 12: A table with merged cells using the `attributes` plugin.

	Colors	
Size	**Text Color**	**Background Color**
big	blue	orange
small	black	white

Equations

A LaTeX equation:

$$\int_0^\infty e^{-x^2} dx = \frac{\sqrt{\pi}}{2} \tag{7}$$

An equation too long to fit within page:

$$\begin{split} x = a + b + c + d + e + f + g + h + i + j + k + l + m + n + o + p + q + r + s + t \\ + u + v + w + x + y + z + 1 + 2 + 3 + 4 + 5 + 6 + 7 + 8 + 9 \end{split} \tag{8}$$

Special

⚠ WARNING *The following features are only supported and intended for `.html` and `.pdf` exports. Journals are not likely to support them, and they may not display correctly when converted to other formats such as `.docx`.*

LINK STYLED AS A BUTTON

Adding arbitrary HTML attributes to an element using Pandoc's attribute syntax:

> Manubot Manubot Manubot Manubot Manubot. Manubot Manubot Manubot Manubot. Manubot Manubot Manubot. Manubot Manubot. Manubot.

Adding arbitrary HTML attributes to an element with the Manubot `attributes` plugin (more flexible than Pandoc's method in terms of which elements you can add attributes to):

> Manubot Manubot Manubot Manubot Manubot. Manubot Manubot Manubot Manubot. Manubot Manubot Manubot. Manubot Manubot. Manubot.

Available background colors for text, images, code, banners, etc:

`white` `lightgrey` `grey` `darkgrey` `black` `lightred` `lightyellow` `lightgreen` `lightblue` `lightpurple` `red` `orange` `yellow` `green` `blue` `purple`

Using the Font Awesome icon set:

✔ ? ★ 🔔 ⊗ ⋯

Light Grey Banner
useful for *general information* - manubot.org

Blue Banner
useful for *important information* - manubot.org

Light Red Banner
useful for *warnings* - manubot.org

Discussion

Plot of the actual and predicted bike counts with respect to month. Loaded from the latest version of image on GitHub.

Conclusion

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[2] F. Lin, S. Wang, J. Jiang, W. Fan and Y. Sun, "Predicting public bicycle rental number using multi-source data," 2017 International Joint Conference on Neural Networks (IJCNN), Anchorage, AK, 2017, pp. 1502-1509, doi: 10.1109/IJCNN.2017.7966030.

[3] J. Huang, X. Wang and H. Sun, "Central Station Based Demand Prediction in a Bike Sharing System," 2019 20th IEEE International Conference on Mobile Data Management (MDM), Hong Kong, Hong Kong, 2019, pp. 346-348, doi: 10.1109/MDM.2019.00-38.

[4] https://www.kaggle.com/hmavrodiev/london-bike-sharing-dataset

[5] Ashqar, H. I., Elhenawy, M., Rakha, H. A., Road, V. P., & Qld, K. G. "Case Studies on Transport Policy Modeling bike counts in a bike-sharing system considering the e ff ect of weather conditions," 2019. Case Studies on Transport Policy, 7(2), 261–268. https://doi.org/10.1016/j.cstp.2019.02.011

[6] F. Lin, S. Wang, J. Jiang, W. Fan and Y. Sun, "Predicting public bicycle rental number using multi-source data," 2017 International Joint Conference on Neural Networks (IJCNN), Anchorage, AK, 2017, pp. 1502-1509, doi: 10.1109/IJCNN.2017.7966030.

Referencing figures, tables, equations

Figure 21

Figure 22

Figure 23

Figure 24

Table 10

Equation 9

Equation 10

Figures

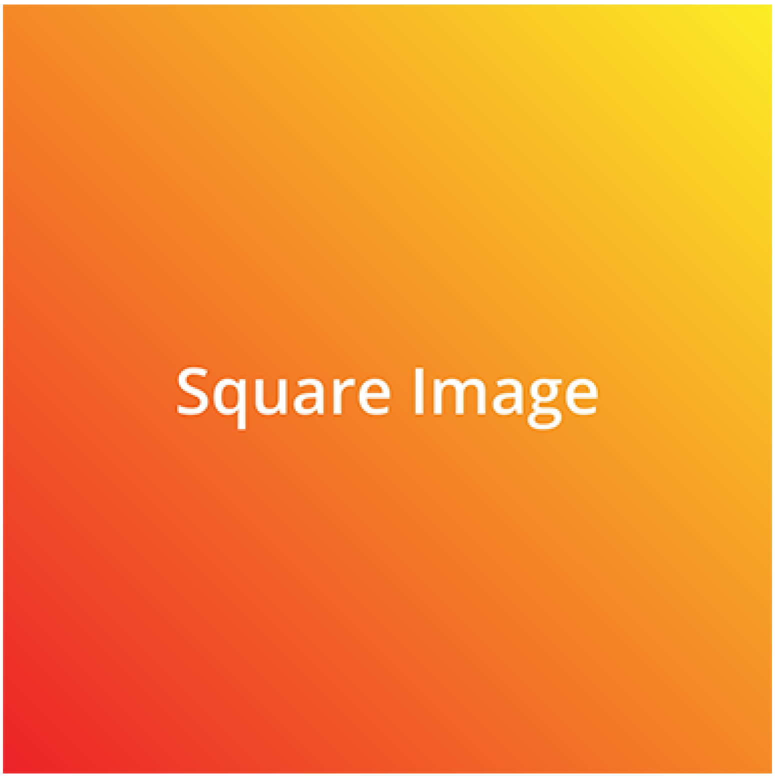

Figure 21: A square image at actual size and with a bottom caption. Loaded from the latest version of image on GitHub.

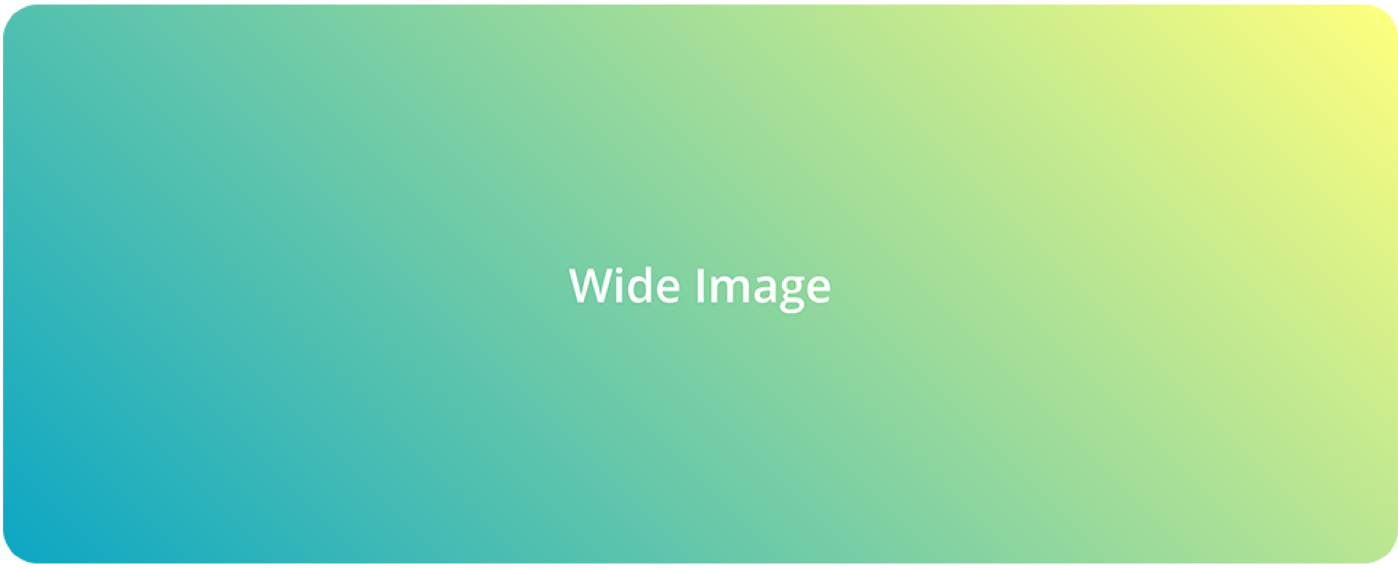

Figure 22: An image too wide to fit within page at full size. Loaded from a specific (hashed) version of the image on GitHub.

Figure 23: A tall image with a specified height. Loaded from a specific (hashed) version of the image on GitHub.

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) |

Equations

A LaTeX equation:

$$\int_0^\infty e^{-x^2} dx = \frac{\sqrt{\pi}}{2} \tag{9}$$

An equation too long to fit within page:

$$\begin{aligned} x = a + b + c + d + e + f + g + h + i + j + k + l + m + n + o + p + q + r + s + t \\ + u + v + w + x + y + z + 1 + 2 + 3 + 4 + 5 + 6 + 7 + 8 + 9 \end{aligned} \tag{10}$$

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