**CR�NE** 2018
*Conference Proceedings*

# A Comparison of Stochastic Gradient MCMC using Multi-Core and GPU Architectures

**Firstname Middlename Surname**[1*]**, Firstname Middlename Familyname**[1,2†]**,**
**Firstname Initials Surname**[2‡]**, Firstname Surname**[2*]

[1]Institution 1; [2]Institution 2

**\*For correspondence:**
email1@example.com (FMS);
email2@example.com (FS)

**Present address:** [†]Centro de Innovación en Ingeniería Aplicada, Universidad Católica del Maule, Chile.

**Abstract**   Please provide an abstract of no more than 1500 characters. Your abstract should explain the main contributions of your article, and should not contain any material that is not included in the main text.

## Introduction (Level 1 heading)

This is a detailed template for paper submissions to the 4th Congress on Robotics and Neuroscience. This files are based on the *eLife* template for journal submissions authored by Overleaf and eLife, accessed and downloaded at June 9, 2018, from https://www.overleaf.com/latex/templates/elife-latex-template/csqxykvsnyxm#.WxxIbxzathF.

Some examples of commonly used commands and features are listed below, to help you get started.

Here's a second paragraph to test paragraph indents. 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.

## Results (Level 1 heading)

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.

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.

**Table 1.** Automobile Land Speed Records (GR 5-10).

| Speed (mph) | Driver | Car | Engine | Date |
|---|---|---|---|---|
| 407.447 | Craig Breedlove | Spirit of America | GE J47 | 8/5/63 |
| 413.199 | Tom Green | Wingfoot Express | WE J46 | 10/2/64 |
| 434.22 | Art Arfons | Green Monster | GE J79 | 10/5/64 |
| 468.719 | Craig Breedlove | Spirit of America | GE J79 | 10/13/64 |
| 526.277 | Craig Breedlove | Spirit of America | GE J79 | 10/15/65 |
| 536.712 | Art Arfons | Green Monster | GE J79 | 10/27/65 |
| 555.127 | Craig Breedlove | Spirit of America, Sonic 1 | GE J79 | 11/2/65 |
| 576.553 | Art Arfons | Green Monster | GE J79 | 11/7/65 |
| 600.601 | Craig Breedlove | Spirit of America, Sonic 1 | GE J79 | 11/15/65 |
| 622.407 | Gary Gabelich | Blue Flame | Rocket | 10/23/70 |
| 633.468 | Richard Noble | Thrust 2 | RR RG 146 | 10/4/83 |
| 763.035 | Andy Green | Thrust SSC | RR Spey | 10/15/97 |

Source: https://www.sedl.org/afterschool/toolkits/science/pdf/ast_sci_data_tables_sample.pdf

**Table 1–source data 1.** This is a description of a data source.

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.

**Level 2 Heading**

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.

### Level 3 Heading

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.

#### Level 4 Heading

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.

### Discussion

Morbi luctus, wisi viverra faucibus pretium, nibh est placerat odio, nec commodo wisi enim eget quam. Quisque libero justo, consectetuer a, feugiat vitae, porttitor eu, libero. Suspendisse sed mauris vitae elit sollicitudin malesuada. Maecenas ultricies eros sit amet ante. Ut venenatis velit. Maecenas sed mi eget dui varius euismod. Phasellus aliquet volutpat odio. Vestibulum ante ipsum primis in faucibus orci luctus et ultrices posuere cubilia Curae; Pellentesque sit amet pede ac sem eleifend consectetuer. Nullam elementum, urna vel imperdiet sodales, elit ipsum pharetra ligula, ac pretium ante justo a nulla. Curabitur tristique arcu eu metus. Vestibulum lectus. Proin mauris. Proin eu nunc eu urna hendrerit faucibus. Aliquam auctor, pede consequat laoreet varius, eros tellus scelerisque quam, pellentesque hendrerit ipsum dolor sed augue. Nulla nec lacus.

### Methods and Materials

Guidelines can be included for standard research article sections, such as this one.

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.

### Some LaTeX Examples

Use section and subsection commands to organize your document. LaTeX handles all the formatting and numbering automatically. Use ref and label commands for cross-references.

### Figures and Tables

Use the table and tabular commands for basic tables — see *Table 1*, for example.

You can upload a figure (JPEG, PNG or PDF) using the project menu. To include it in your document, use the `\includegraphics` command as in the code for *Figure 3*.

For a half-width figure or table with text wrapping around it, use

```
\begin{wrapfigure}{l}{.46\textwidth}
  \includegraphics[width=\hsize]{...}
  \caption{...}\label{...}
\end{wrapfigure}
```

as in *Figure 1*. For tables:

```
\begin{wraptable}{l}{.46\textwidth}{
  \begin{tabular}{...}
  ...
  \end{tabular}}
  \caption{...}\label{...}
\end{wraptable}
```

Be careful with these, though, as they may behave strangely near page boundaries, sectional headings, or in the neighbourhood of lists or too many floats.

Labels for main videos can be added with `\video` e.g.

**Video 1.** Ths is a description of a main video.

**Video 2.** Another!

Labels for video supplements can be added within `figure` environments, after the `caption`, using the `\videosupp` command: see *Figure 3–video 1* for an example.

If you use the following prefixes for your `\label`:

**Figures** `fig:`, e.g. `\label{fig:view}`

**Figure Supplements** `figsupp:`, e.g. `\label{figsupp:sf1}`

(we'll assume `figsupp:sf1` is a figure supplement of `fig:view` in our example)

**Figure source data** `figdata:`, e.g. `\label{figdata:first}`

**Videos** `video:`, e.g. `\label{video:mv1}`

**Video supplements** `videosupp:`, e.g. `\label{videosupp:sv1}`

**Tables** `tab:`, e.g. `\label{tab:example}`

**Equations** `eq:`, e.g. `\label{eq:CLT}`

**Boxes** `box:`, e.g. `\label{box:simple}`

you can then use the convenience commands `\FIG{view}`, `\FIGSUPP[view]{sf1}`, `\TABLE{example}`, `\EQ{CLT}`, `\BOX{simple}`, `\FIGDATA[view]{first}`, `\VIDEO{mv1}` and `{\VIDEOSUPP}[view]{sv1}` *without* the label prefixes, to generate cross-references *Figure 3*, *Figure 3–Figure Supplement 1*, *Table 1*, *Equation 1*, *Box 1*, *Figure 3–source data 1*, *Video 1* and *Figure 3–video 1*. Alternatively, use `\autoref` with the full label, e.g. *Appendix 1* (although this may not work correctly for figures and tables in the appendices or boxes nor supplements at present).

Really wide figures or tables, that take up the entire page, including the gutter space: use `\begin{fullwidth}...\end{fullwidth}` as in *Figure 2*. And sometimes you may want to use feature boxes like *Box 1*.
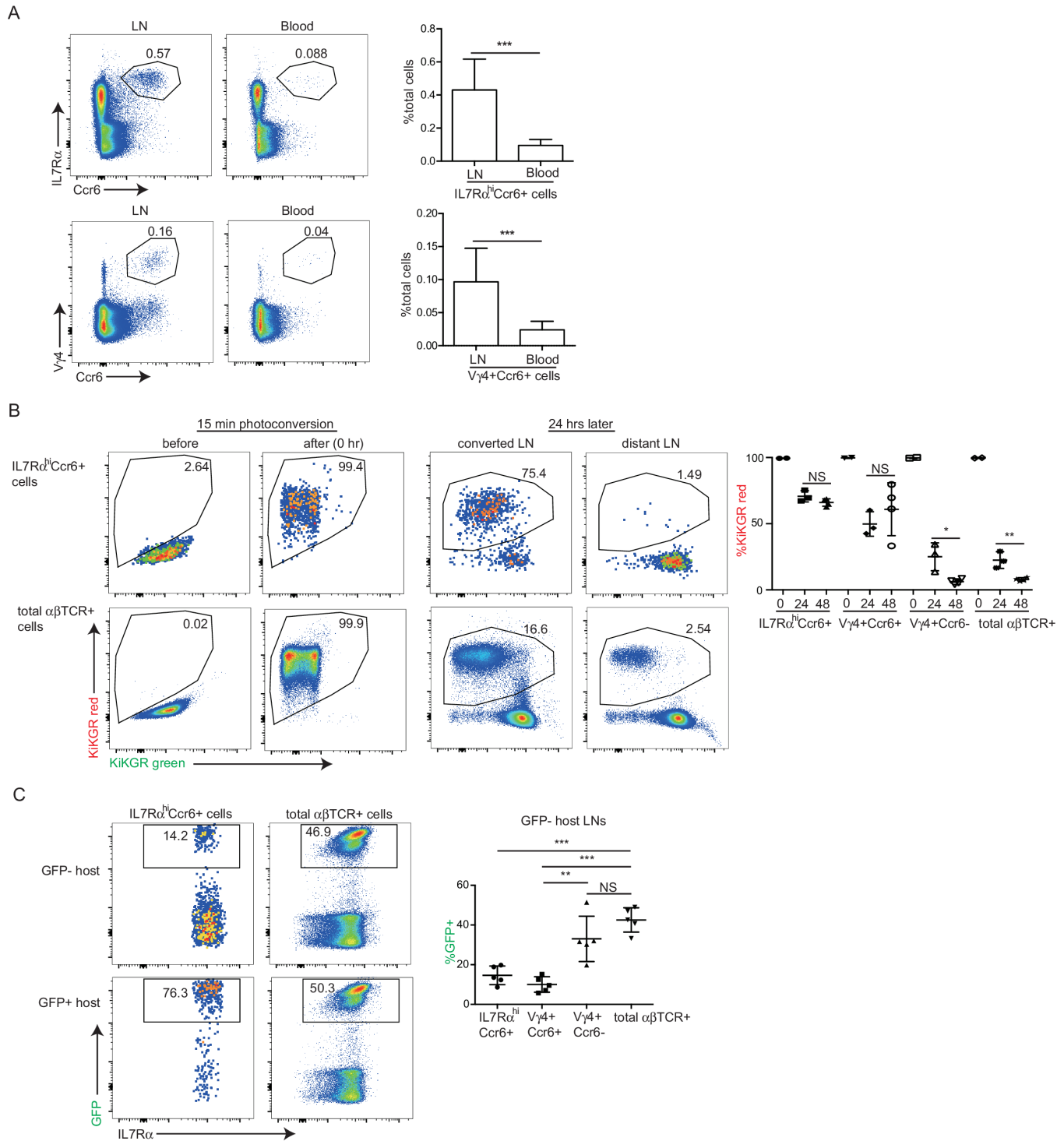


**Figure 1.** A half-columnwidth image using wrapfigure, to be used sparingly. Note that using a wrapfigure before a sectional heading, near other floats or page boundaries is not recommended, as it may cause interesting layout issues. Use the optional argument to wrapfigure to control how many lines of text should be set half-width alongside it.

Some filler text to sit alongside the half-width figure. 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.
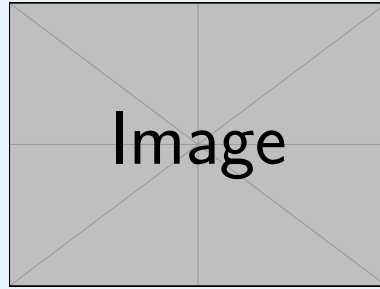
**Figure 2.** A very wide figure that takes up the entire page, including the gutter space.

**Figure 2–Figure supplement 1.** There is no limit on the number of Figure Supplements for any one primary figure. Each figure supplement should be clearly labelled, Figure 1–Figure Supplement 1, Figure 1–Figure Supplement 2, Figure 2–Figure Supplement 1 and so on, and have a short title (and optional legend). Figure Supplements should be referred to in the legend of the associated primary figure, and should also be listed at the end of the article text file.

**Box 1. This is an example feature box**

This is a feature box. It floats!



**Box 1 Figure 1.** 'Figure' and 'table' captions in feature boxes should be entered with `\featurefig` and `\featuretable`. They're not really floats.

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.

## Citations

LaTeX formats citations and references automatically using the bibliography records in your .bib file, which you can edit via the project menu. Use the `\cite` command for an inline citation, like *Aivazian et al.* (*2006*), and the `\citep` command for a citation in parentheses (*Aivazian et al., 2006*). The LaTeX template uses a slightly-modified Vancouver bibliography style. Please also remember to **delete the line** `\nocite{*}` in the template just before `\bibliography{...}`; otherwise *all* entries from your .bib file will be listed!
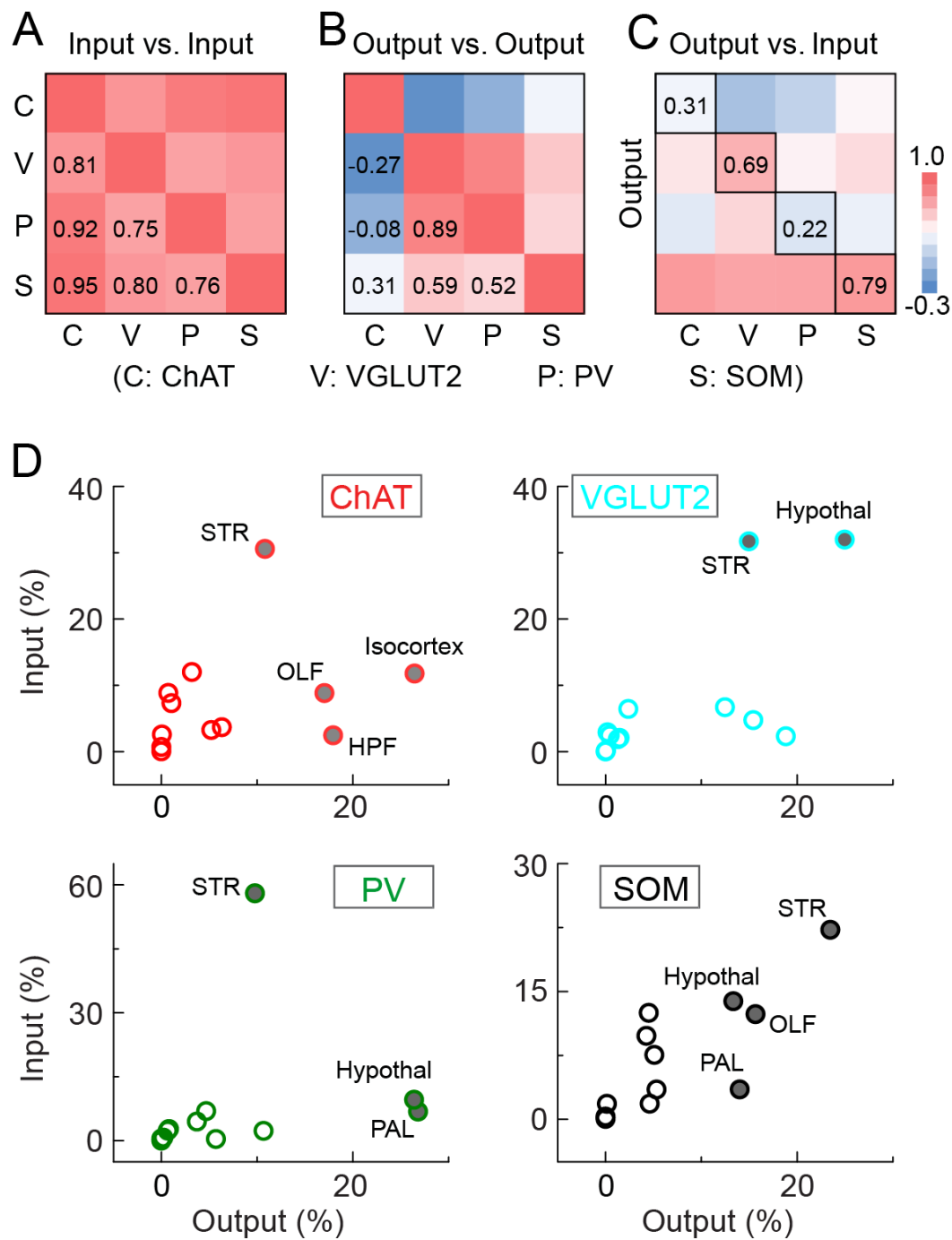
## Mathematics

LaTeX is great at typesetting mathematics. Let $X_1, X_2, \ldots, X_n$ be a sequence of independent and identically distributed random variables with $E[X_i] = \mu$ and $\text{Var}[X_i] = \sigma^2 < \infty$, and let

$$S_n = \frac{X_1 + X_2 + \cdots + X_n}{n} = \frac{1}{n}\sum_i^n X_i \tag{1}$$

denote their mean. Then as $n$ approaches infinity, the random variables $\sqrt{n}(S_n - \mu)$ converge in distribution to a normal $\mathcal{N}(0, \sigma^2)$.

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.

**Figure 3.** A text-width example.
**Figure 3–Figure supplement 1.** Shorter caption for main text.
**Figure 3–Figure supplement 2.** This is another supplementary figure.
**Figure 3–video 1.** This is a description of a video supplement.
**Figure 3–source data 1.** This is a description of a data source.
**Figure 3–source data 2.** This is another description of a data source.

### Other Chemistry Niceties

You can use commands from the `mhchem` and `siunitx` packages. For example: $C_{32}H_{64}NO_7S$; $5\,\mu m$; $30\,°C$; $5 \times 10^{-17}\,M$

### Lists

You can make lists with automatic numbering . . .

1. Like this,
2. and like this.

. . . or bullet points . . .

- Like this,
- and like this.

. . . or with words and descriptions . . .

**Word** Definition
**Concept** Explanation
**Idea** Text

Some filler text, because empty templates look really poorly. 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.

## Acknowledgments

## References

**Aivazian D**, Serrano RL, Pfeffer S. TIP47 is a key effector for Rab9 localization. The Journal of Cell Biology. 2006; 173(6):917–926. http://jcb.rupress.org/content/173/6/917, doi: http://dx.doi.org/10.1083/jcb.200510010.

## Appendix 1

### Firstly

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.



**Appendix 1 Figure 1.** This is a figure in the appendix

### Secondly

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.

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.

261
262
263
264
265
266
267
268
269
270
271
272
273
274

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.



275
276
277

**Appendix 1 Figure 2.** This is a figure in the appendix
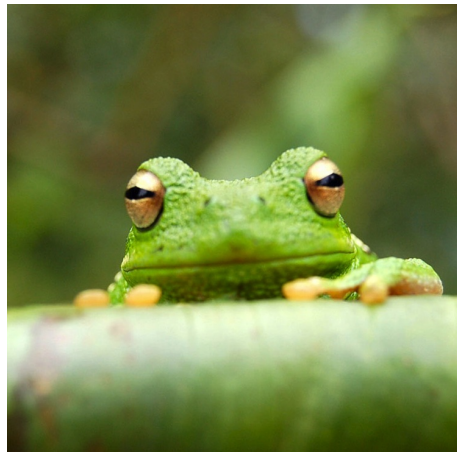
## Appendix 2



**Appendix 2 Figure 1.** This is a figure in the appendix
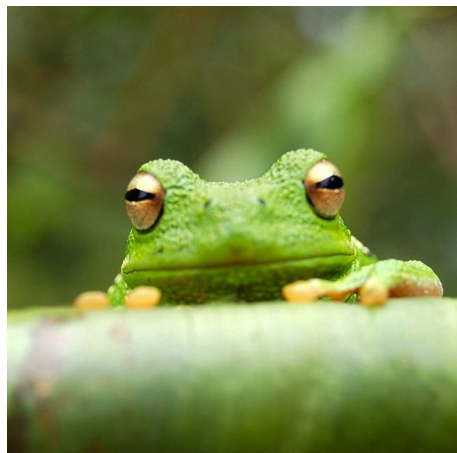
283

**Figure 2–Figure supplement 1.** There is no limit on the number of Figure Supplements for any one primary figure. Each figure supplement should be clearly labelled, Figure 1–Figure Supplement 1, Figure 1–Figure Supplement 2, Figure 2–Figure Supplement 1 and so on, and have a short title (and optional legend). Figure Supplements should be referred to in the legend of the associated primary figure, and should also be listed at the end of the article text file.



284

**Figure 3–Figure supplement 1.** This is a supplementary figure's full caption, which will be used at the end of the manuscript.



285

**Figure 3–Figure supplement 2.** This is another supplementary figure.