Making accessible materials

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This guide is intended to serve as a jumping off point to give more resources about where to look for increasing accessibility of presentations, posters, and papers.

There is also a GitHub repository with a few examples:
https://github.com/jessiethw/accessible_examples

Why make accessible content?

Accessibility refers to making content of any type usable by people with disabilities - either making it directly possible for people with disabilities to access, or ensuring that assistive technology (e.g. screen readers, wheelchairs) can use the same resources. Up to 26% of people in the US have some sort of disability, and many people may not choose to disclose their disability.

Normalizing access is essential for closing the achievement gap for STEM professionals with disabilities. Making accessible materials is important in both equity and inclusion efforts for people with disabilities.

The idea of accessible design is the idea that **all** materials should be accessible for **everyone**, as the rule and not the exception. Making accessible content benefits everyone involved, not only those with disabilities [1].

Visual accessibility

Templates and general guidelines

In general, it is good practice to make all plots, presentations, and materials visually accessible to people with disabilities. This may look slightly different depending on the type of materials being used, but we've tried to collect here good guidelines to follow in general.

There are also some programs that have built-in accessible templates that can be used for presentations. For example, in Microsoft PowerPoint, you can use an accessible template, found by clicking "New From Template" and searching "accessible" or "accessible science".

Fonts

For presentations (and posters), it is important to make sure that a person standing/sitting at the back of the room can still read your slides. When it is feasible it is good to test this in the room the presentation will take place, but as this is not always possible a good starting point for font sizes is to have titles no smaller than size 24, and content no smaller than size 18. [2]

Sans Serif fonts are easier for people with dyslexia to read. In general, avoid serif fonts, as they can make text difficult to read. Suggestions for some of the most accessible fonts include Verdana, Arial, or Helvetica. [3]

Examples of recommended fonts:

Font	**Comments**
Verdana	Highly recommended as an accessible font.
Georgia	Another highly recommended font
Arial	Reasonable legibility
Helvetica	Reasonable legibility, but some letters can be confused

Colors (text or plots) [4]

It is important to note that many people have issues seeing colors, so when at all possible, choose a color scheme that is colorblind-accessible. Here are some ways to implement colorblind-accessible plots (CTA has an EXTENSIVE guide for this [4]).

All plots made in this section can be found in examples on GitHub: https://github.com/jessiethw/accessible_examples if you would like to know how these were made or how to implement them yourself.

1. **Varying linestyle and/or linewidth for any plots**. This can include using different markers for data points (circle, square, triangle, etc) and/or different linestyles (solid, dashed, dotted, etc), or in the case of stacked histograms, patterns can be added as well.

   Using large shapes and thick lines also improves readability and visibility. This will also help to avoid issues of colors that are too similar or a projector that changes colors in a presentation setting.

   In addition to this, when writing or orally presenting one of these plots, reference linestyle over color (“the dashed line” rather than “the green line”).

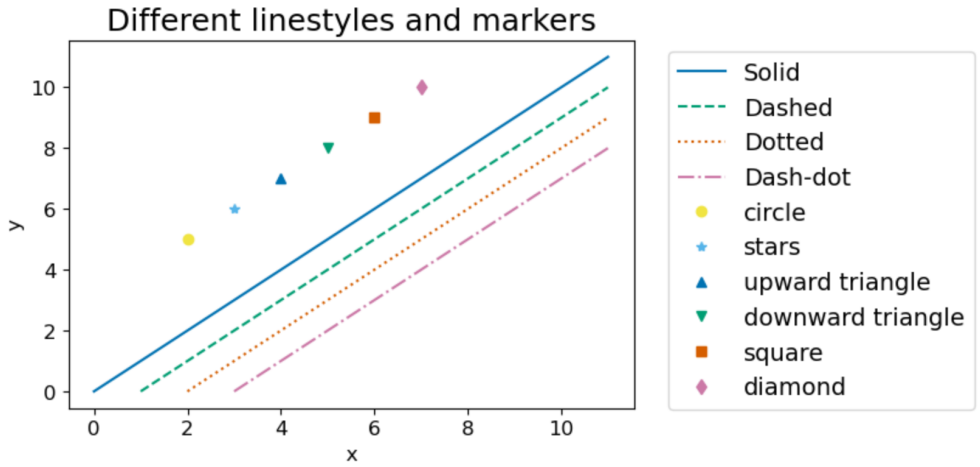


Fig. 1: Examples of marker styles and line styles available in Matplotlib.

2. **Color contrast** makes text more readable. Check the contrast ratio on your text to ensure it is readable. Black on white is a 21:1 contrast ratio, and you should in general have colors that are at minimum a contrast ratio of 4.5:1. Here is a link to a contrast checker tool.

3. **Color choice** [4]**:** for plots where changing linestyle or markers is not possible (e.g. skymaps), colorblind friendly color palettes should be used.

   Generally the best to use are those that Matplotlib identifies as “Sequential”: those where the lightness value increases monotonically, so the gradient is always visible even if the colors are not. (A list of all default color maps can be found in the Matplotlib documentation.) These include the maps that are sequential of a single color (e.g. “Blues”) or even a few colors (“YlOrBr” or yellow-orange-brown).

   There are also a few identified as “Perceptually Uniform Sequential”, which are also visible. (Examples of those are “viridis” or “cividis”, as in the figures below).

   Colormaps which are “Diverging” are not good accessible choices, as they have a pivot point in lightness and then change colors, making them very difficult to see for people who cannot see their color. These (and the rainbow) maps are generally less accessible.

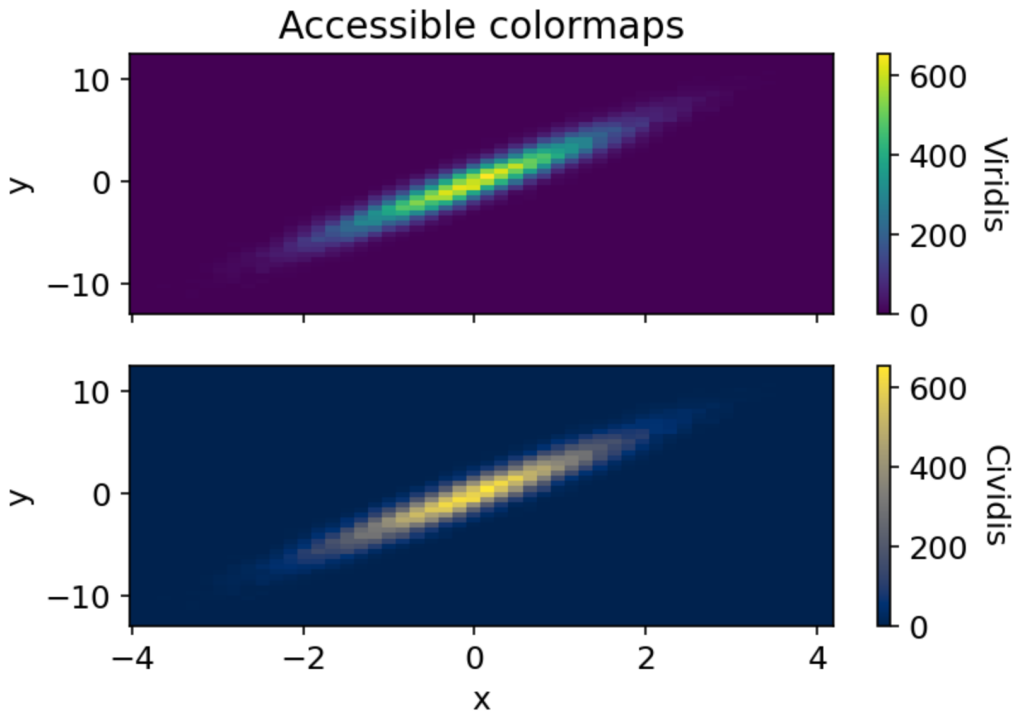


Fig. 2: Examples of colorblind friendly colormaps that can easily be implemented in Matplotlib.

4. Matplotlib also has built-in colorblind friendly color styles. Two examples are “tableau-colorblind10” or “seaborn-colorblind”, which can be implemented easily with two lines:

```
import matplotlib.style as style
style.use('tableau-colorblind10')
```
or
```
import matplotlib.style as style
style.use('seaborn-colorblind')
```

Here are a few helpful resources for choosing color schemes:

- Color choices, from Paul Tol’s notes: this gives suggestions for a few color schemes, depending on the lightness you want and the number of colors you need.
- Sim Daltonsim, an app to help you visualize how plots will look with various types of colorblindness
- Interactive visual tool, to put in your own color scheme, and check how accessible it is
- Colorblindness simulator, to visualize how your material would look by someone who is colorblind
- ColorBrewer2.0: this is a resource to find an appropriate color palette

Making visuals accessible to blind and visually impaired people

When creating materials for a wider audience (for example, a conference like APS or AAS, talks for a general audience, or outreach materials with a broad audience), it is important to make sure your materials are accessible to everyone, including those who cannot see them.

In general, visuals are not accessible to people who are blind and visually impaired (BVI). Graphs and plots, which we use to show our data, cannot be interpreted by BVI people, who must instead rely on others to describe them. But there are some ways that materials can be made more accessible to a broad audience, including those who are BVI.

Accessibility on the ArXiv [10]

ArXiv has recently announced that every paper submitted will have an HTML version alongside the PDF that is available, to make it more accessible to screen readers. This will help immensely to improve the accessibility of papers on the arXiv to screen readers.

They are asking people to read the HTML versions and report any issues, in order to improve the conversion process (see the link there for how to do this).

Making an accessible PDF

Often, screen readers cannot intuitively determine the best reading order in the way that human eyes can. Things like including a header row on tables, unique slide titles, and checking the reading order, especially on slides, helps screen readers to interpret material correctly.

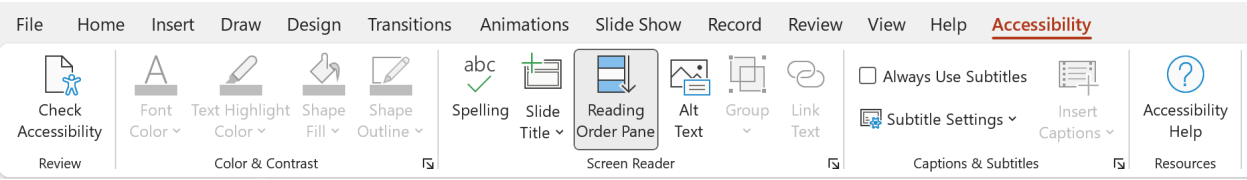


Fig 5: Screenshot of the “Accessibility” tab in Microsoft PowerPoint. The “Reading Order” pane allows the user to set the order that the slide should be read.

Once all of these accessibility considerations are finished, you can export the document as an accessible PDF, either with the option “Create and Share Adobe PDF” or by using “Export” and choosing the “Accessible PDF” options.

Accessibility Checkers

One assistive technology for people who are BVI is a screen reader - a technology that will parse text and read it aloud. There are a few things that are important from an accessibility standpoint to incorporate in order for a screen reader to parse information in the correct order.

Some programs, like Microsoft PowerPoint, have a built in-accessibility checker that will check your presentation before making a PDF. These are great tools to use to ensure that your document is accessible before uploading it.

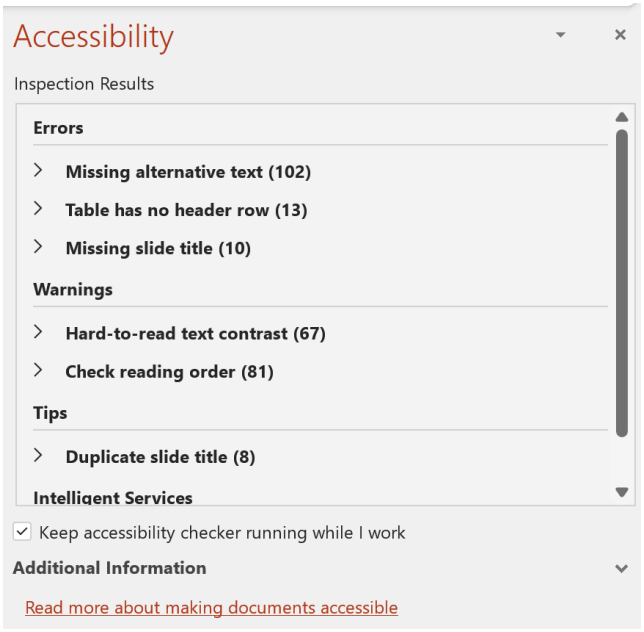


Fig. 3: Screenshot of the accessibility checker on Microsoft PowerPoint. Each error and warning links to its location on the document, allowing you to correct each in turn. It can also continue running as you work.

Alt text [2] [5]

Alt text (also known as “alternative text”, “alt attributes”, or “alt descriptions”) describes the content, appearance, and function of the image. In contrast to captions, which often reference the image or aspects of the plot/image itself to help people understand it, alt text does not assume that a person can see the image.

A screenreader will read out the alt text of an image, allowing people who cannot see the image to understand its purpose. If the image is on a webpage but cannot be loaded for some reason, the alt text will also display.

Here is an example of alt text, with a simple image:

Possible caption: “My spot’s been stolen!”

Okay alt text: “cat on chair”

Better alt text: “black and brown striped cat sitting on a chair stares at the person taking his photo”

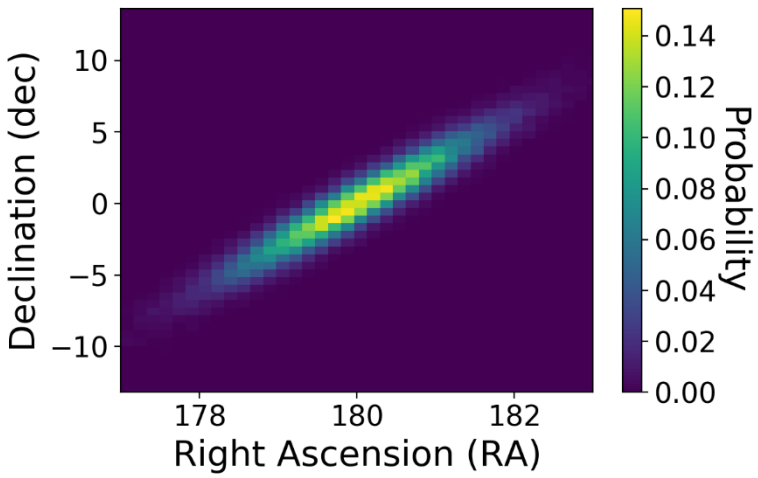
This can be more challenging with a scientific figure (but definitely worth including!), because any important information that can be gleaned from a plot must be described by the person writing the alt text (someone who is BVI cannot interpret a graph themselves *purely* through alt text). One way around this is including the data in a table, or sonification of the data (transforming data into sound).

Some general guidelines for writing alt text [6]:

- Determine which information is critical for the person reading the plot to understand. What are the major takeaways of this plot?
- Be brief and succinct, but also give all of the relevant information in the plot.
- Omit unnecessary information (for example, if color of lines is not important to understanding the meaning of the figure, don't include color in the alt text).
- Consider what level of knowledge your audience has. This will help to inform what is essential description, and what is superfluous information that can be omitted.

A sample formula to follow for your alt text is [7]: "Plot type (e.g. histogram, scatterplot, skymap) of type of data (e.g. zenith, neutrino flavor) where reason for including chart and description of trends"

For example, using the same colormap plot, and pretending it's a probability map for location of a particular source:



Sample alt text using the above formula:

2D histogram probability map of location of a potential source in right ascension and declination, where the highest probability region is centered around 0 degrees RA and dec and the spread in both RA and dec is Gaussian distributed.

LaTeX accessibility packages

Much of the material in this section comes from a great resource written by the MSU Libraries [8].

As scientists, we write a large amount of our work using LaTeX. However, LaTeX was designed as a typesetting program, and generally does not include tags or structure that are needed to make a PDF accessible. Unfortunately, there isn't a clear answer yet - while a few packages exist, coding a package to determine logical structure or tagging is difficult without human

intervention (like the manual process described in the section above). Overleaf has a (quite long) discussion of the process and challenges in a guide [9] which I won't go into here, as well as several packages that attempt to improve the accessibility of the compiled PDFs.

However, there are a few packages that have been developed to attempt to make a PDF more accessible, and two of them are described here. A latex code example can be found in the same example repository described above.

"Accessibility"

This package allows you to create a document with tags, structure, and alt text. All of these are needed for a truly accessible document. The way to do this is to add

```
\usepackage[tagged, highstructure]{accessibility}
```

To the preamble of your document. The options here create the tags and structure needed. To add alt text to an image, you would use `\alt` inside of the figure. For example:

Code:

```
\begin{figure}
    \centering
    \includegraphics[]{skymap.png}
    \alt{2D histogram probability
map of location of a potential
source in right ascension and
declination, where the highest
probability region is centered
around 0 degrees RA and dec and the
spread in both RA and dec is
Gaussian distributed.}
    \caption{Skymap showing the
probability of the source location
on the sky.}
    \label{fig:skymap}
\end{figure}
```

PDF:

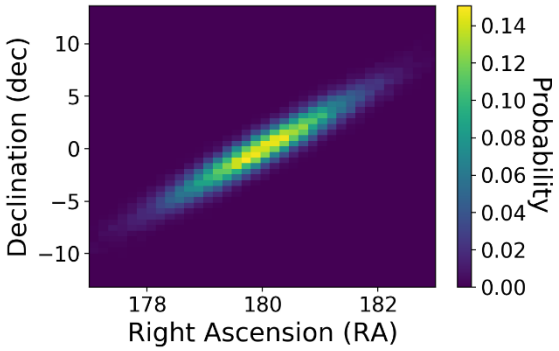


Fig. 1: Skymap showing the probability of the source location on the sky, in RA and dec (degrees).

Where the alt text you include in the Figure environment should be included in the rendered pdf as alt text.

"Axessibility"

This package makes your equations accessible, as well as your figures. This one has nothing different to include inside of the equations themselves, and can just be added to the preamble of your document:

```
\usepackage[accsup]{axessibility}
```

It should be able to read both the equation environment (`\begin{equation}...\end{equation}`) and the inline math mode (`$...$`).

Summary

Writing accessible content is important to ensure that all materials are accessible by everyone reading and using them. By using accessible design principles, everyone who looks and uses the materials benefits from them [1].

Making these materials accessible is a learning process, and this document aims to act as a jumping-off point to help make materials more accessible. Many of the References linked here have excellent additional information, so people are encouraged to check those out for more information.

References

[1] "Benefits of Accessible Design". University of Minnesota (2022). Web.

[2] K. Gozman. "Astrobites at SciAccess 2021: Making your Poster Presentations Accessible for All". Astrobites (2021). Web.

[3] "Accessibility at Penn State". IT Accessibility Group, PennState University (2021). Web.

[4] "Best Practices for colourblind friendly publications & descriptions". CTAO Astrodiversity Project (2020). Web.

[5] "Alt Text: Why it's important for Accessibility & SEO" Moz, Inc. (2022). Web.

[6] T. Lewis and C.J. Woods. "Alt Text for Scientific Graphics: Balancing between Accessibility and Giving the Answers." ASU School of Life Sciences Teaching Innovation Center. (2021) Web.

[7] A. Cesal. "Writing alt text for data visualization". Nightingale: Journal of the Data Visualization Society. (2020) Web.

[8] "Creating Accessible LaTeX Documents". Libguides at Michigan State University Libraries. Web.

[9] "An introduction to tagged PDF files: internals and the challenges of accessibility". Overleaf, Online LaTeX Editor. (2023) Web.

[10] "HTML as an Accessible format for papers". ArXiv. (2023) Web.

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