University of Southampton



Building Digital Accessibility Tools with Generative Al



... ☆

← All projects

Digital Accessibility Projects



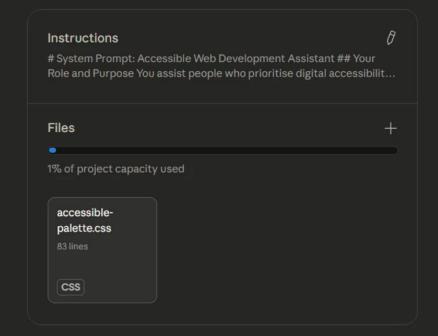
How can I help you today?

+ \$\sigma \overline{\cdots}\$

Opus 4.5 \to \topus 4.5

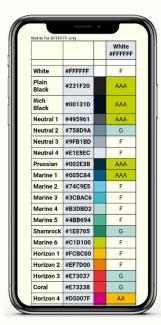
Accessible PDF to HTML text extractor

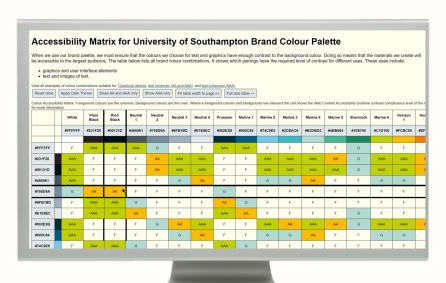
Last message 14 days ago

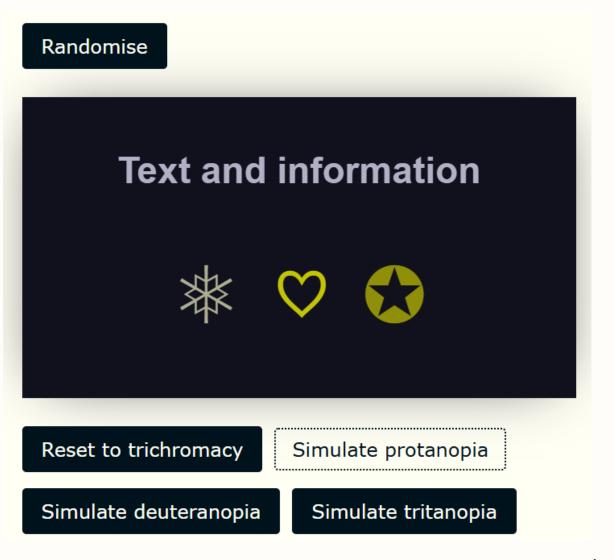


Manually building tools









Why I think this approach works well for me



25 years working in Higher Education IT, but not as a developer

Know how to test for accessibility

Have lots of ideas

Agenda





Show examples of tools I've built with the help of Al



From quick simple tools, to larger projects



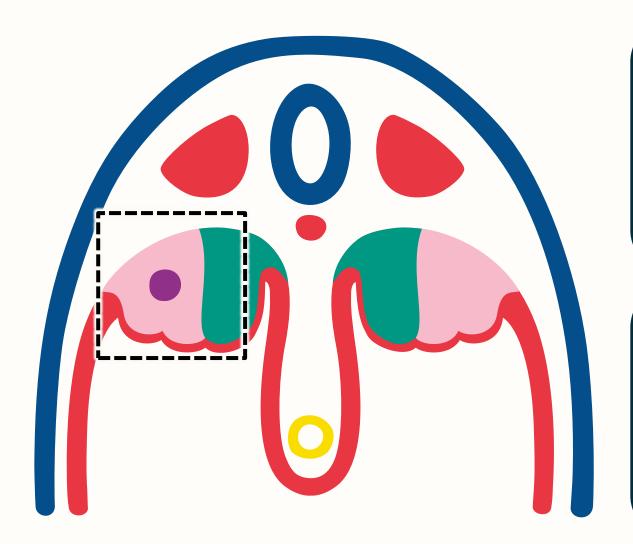
Covering different subject areas



Share resources I've made to help you if you wish to try for yourself

The first step





In a room of 100 students...

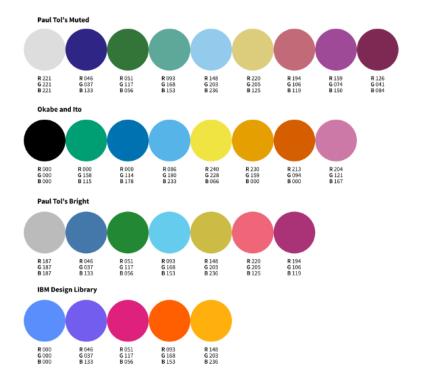
...12 are likely to have a form of colour vision deficiency.

Standing on the shoulders of giants



NCEAS Science Communication Resource Corner Last updated: 6/29/22 Alexandra Phillips

- 2. Use pre-existing colorblind safe palettes
 - There are a lot of color schemes out there already that are tested for color blindness - I've compiled my favorites below



Daltonl ens

Posts Color Blindness Simulator About

Accurate SVG filters for color blindness simulation

Protanopia and deuteranopia are easy to implement with a single matrix multiplication, but tritanopia requires special care and a more subtle pipeline. Let's see how we can still implement the state-of-the-art approach of Brettel et al. with SVG

Nov 25, 2021 • 7 min read

- Introduction
- · Starting easy, implementing the Viénot 1999 filter
- Implementing Brettel 1997
- Conclusion
- Bibliography

Introduction

We have seen in Review of Open Source Color Blindness Simulations and Understanding LMS-based Color Blindness Simulations that a pretty accurate simulation of the 3 main color vision deficiencies (protanopia, deuteranopia and tritanopia) can be achieved by the (Brettel, Viénot, & Mollon, 1997) method, and that a simpler viable algorithm for protanopia and deuteranopia is given by (Viénot, Brettel, & Mollon, 1999).

Being able to do the CVD simulation via SVG filters is very handy to enable efficient browser extension (eg. Colorblindly) or even to implement the developer tools in Google Chrome or Mozilla Firefox. This makes it easy for web developers to check if their design is color blind friendly.

The SVG filters primitives are quite limited though, mostly matrix multiplication, convolution and blending.

The good news is that these CVD algorithms are pretty simple to implement, especially the Viénot 1999 one. It ends up being a single 3x3 matrix multiplication of the linear rgb values.

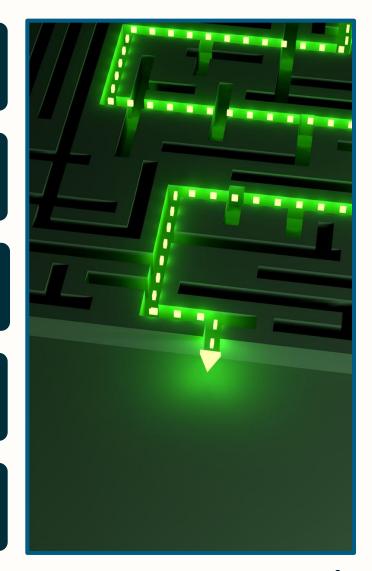
colourblind Safe colour Schemes

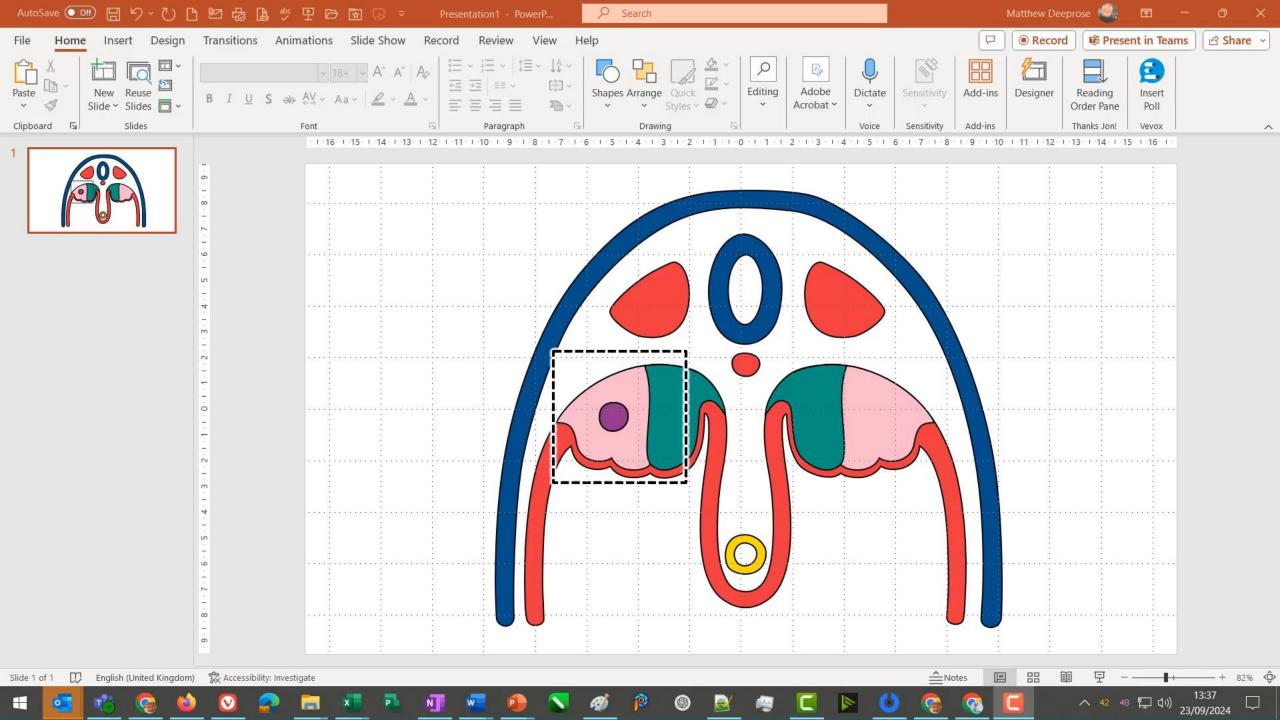
Accurate SVG filters for color blindness simulation

Outline for a tool



- Load SVG file.
- Preview it with different types of colour vision deficiency.
- Identify the colours in the SVG file.
- Swap them with colours from a colour vision deficiency friendly palette.
- Save updated SVG file.





Other small tools





Image CVD tool



Colour Vision Deficiency Image Tester

▶ Information and Instructions

Adjust image size

Current width: 250 pixels

200px

800px

Original (Trichromacy)



Protanopia



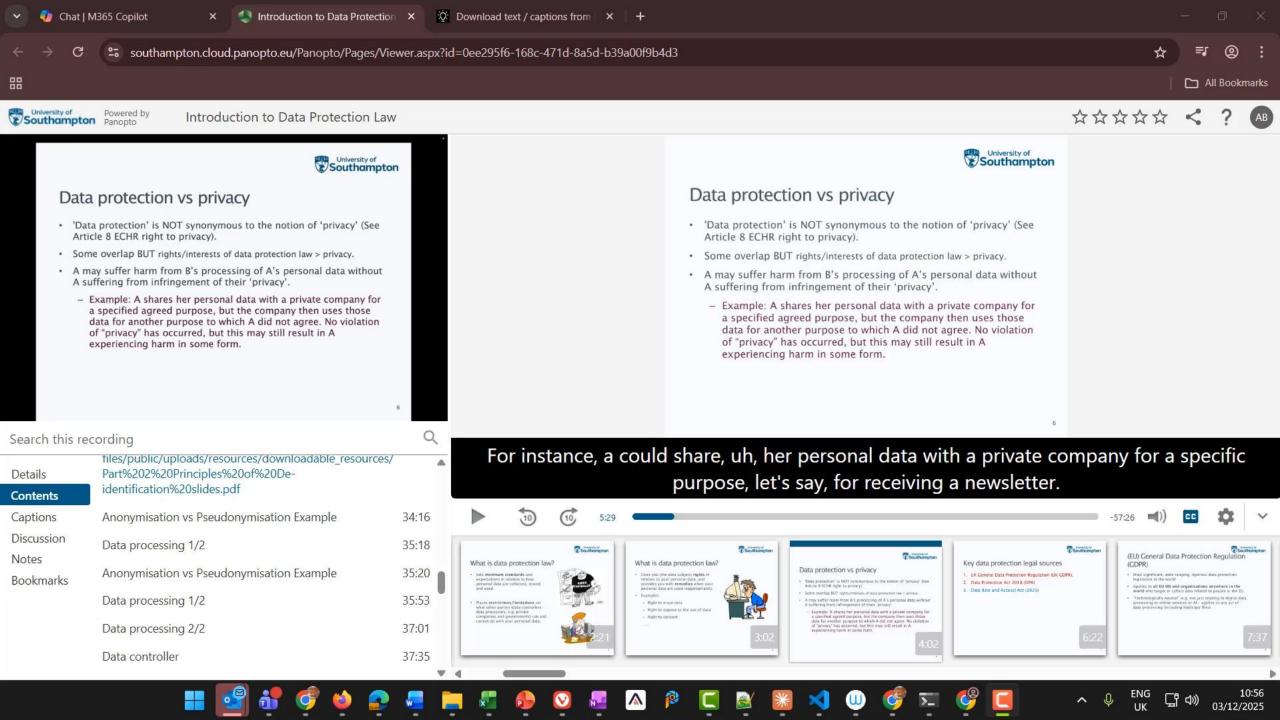
Deuteranopia



Tritanopia



Image CVD tool



View the conversation



 Full unedited copy of the conversation I had with Claude to build the tool.

 May be of interest to anyone looking for examples of my workflow and what I asked and the problems I encountered along the way.

Panopto Text: The prompt

This is a copy of the whole conversation where Claude built <u>PanoptoText</u> for me. I'm sharing this as an example for those who find it interesting to read prompts and how we can develop a very simple tool using LLM assistance. This conversation is completely unedited, including spelling and grammar mistakes, red herrings and other issues. It's provided only as a resource for those who may find it useful.

Conversation with Claude *∂*

Human: ∂

I'm looking for a way to download captions from a panopto video

i can go in to settings and download the captions using either of these l-inks

https://southampton.cloud.panopto.eu/Panopto/Pages/Transcription/ GenerateSRT.ashx?id=aa49c3bd-ddbb-44da-9d9cb3980071547b&language=1

https://southampton.cloud.panopto.eu/Panopto/Pages/Transcription/

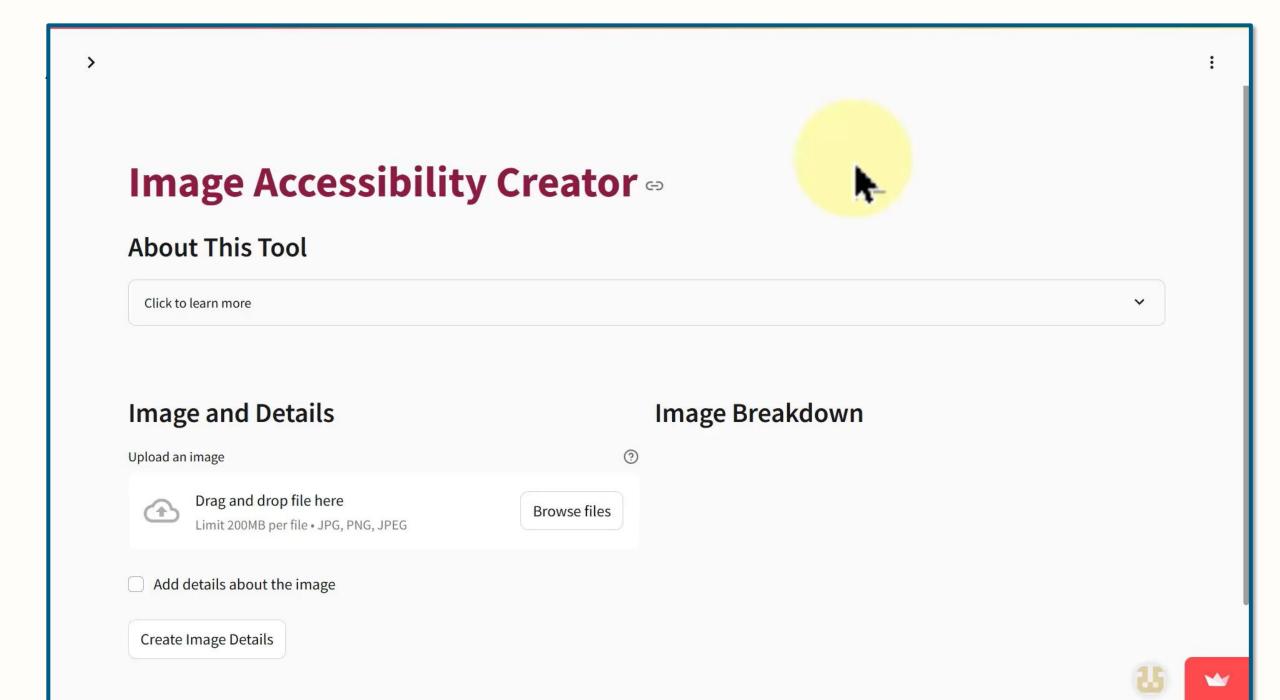
Larger projects





Where it began





Challenge: Can I use AI to help me make a tool like ASUs?



Image Describer

Generate accessible alt text descriptions for images using AI.

Upload Image

Choose an image or drag and drop
Supports: JPEG, PNG, WebP (max 10MB)

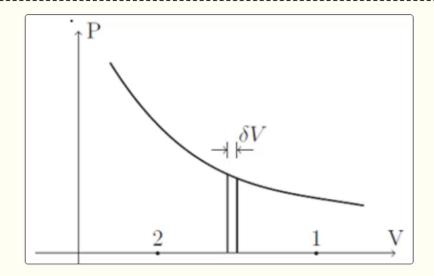


image.png (22 KB)

○ Fullscreen

→ Generate Description

Add Context

► Educational Context

► Additional Context (Optional)

Configure Options

▼ Description Style

Brief

Concise, 1-2 sentences

Detailed

Comprehensive description

Technical

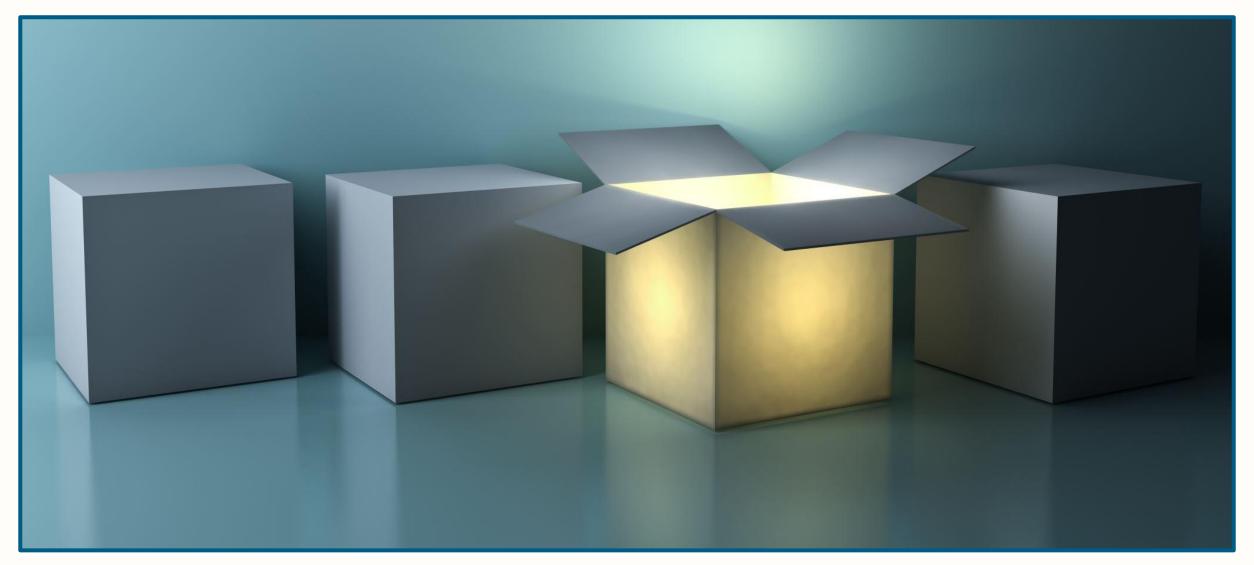
For technical/scientific images

► Audience Level

► Additional Options

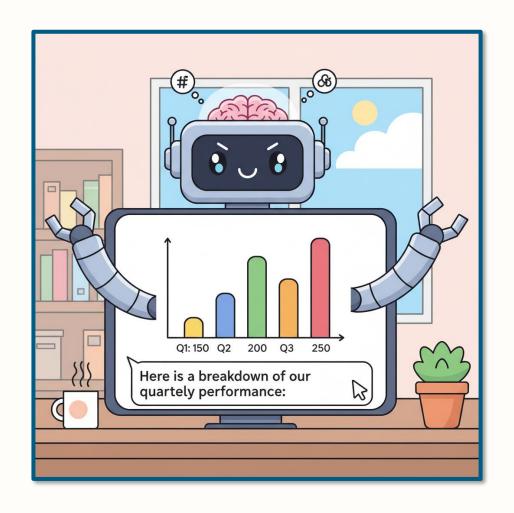
Serendipitous learnings on the way





A discovery



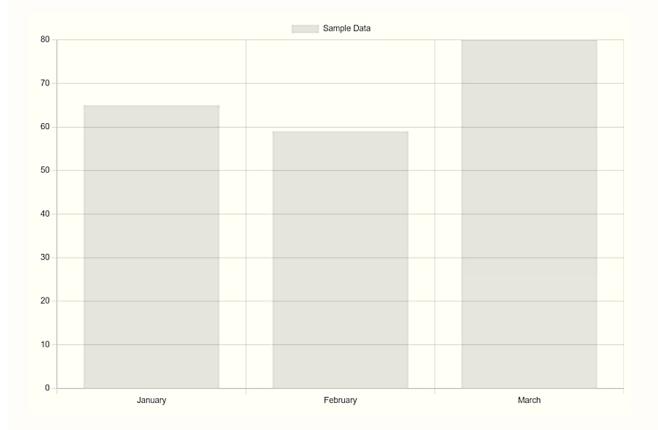


LLMs can create charts in "chart.js" format as part of their responses.

Example

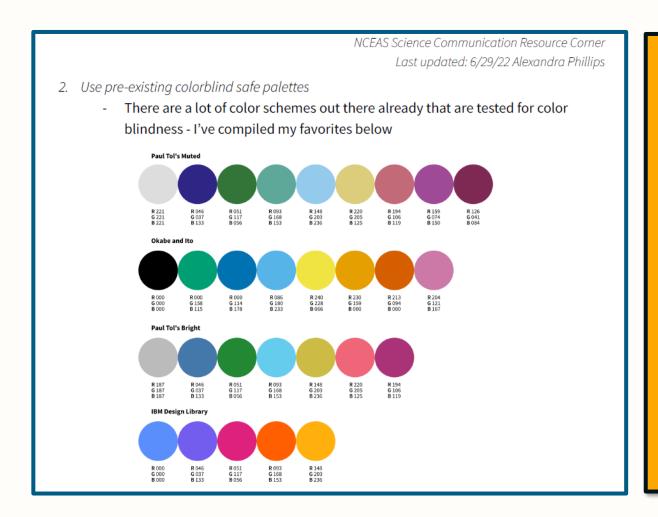


```
"type": "bar",
"data": {
 "labels": ["January", "February", "March"],
 "datasets": [
    "label": "Sample Data",
    "data": [65, 59, 80]
```



Palettes again

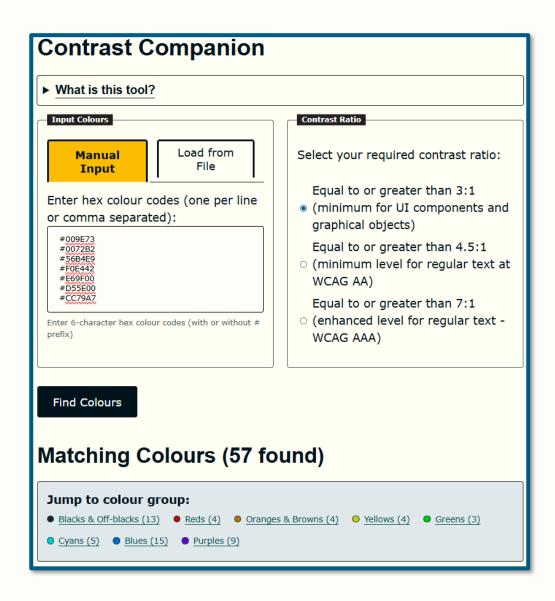




Challenge: can we find a background colour with sufficient contrast with each of these palette colours?

Creating a bespoke tool: contrast companion Southampton

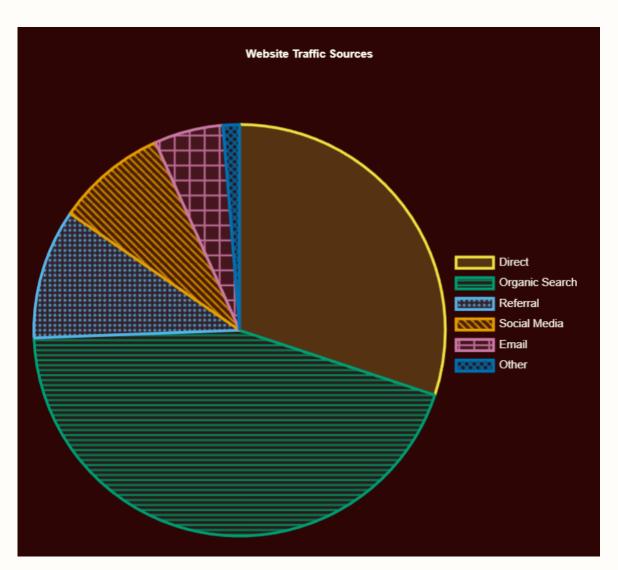


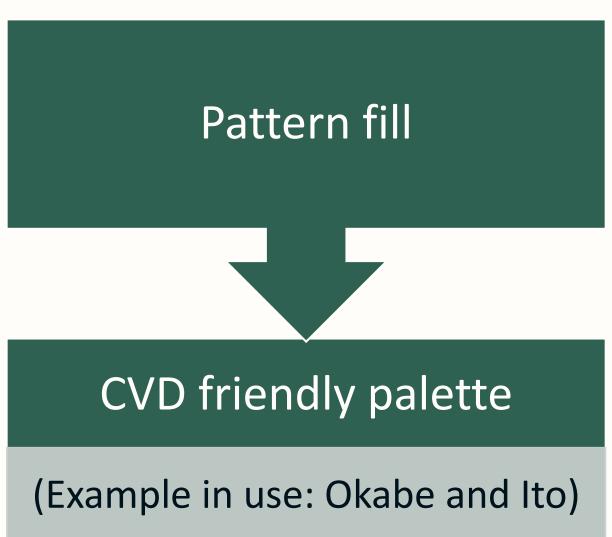


 Contrast Companion demo with Okabe and Ito palette.

Result







The challenge: describing graphs





Good practice



Short description

 Briefly describe the type of chart and state the title of the chart.

Long description

- Describe the structure of the chart
 - X / Y axis
 - Number of datapoints
- Provide a summary or overview
 - The path through the graph in relation to each labelled element
- Provide the data
 - Data points and or data table



```
'type": "bar'
 "data":
  "labels": ["2014/15", "2015/16", "2016/17", "2017/18", "2018/19",
          "2019/20", "2020/21", "2021/22", "2022/23", "2023/24"],
  "datasets":
    "label": "Students who disclosed a disability",
    "data": [228865, 246210, 267810, 290745, 316425, 341570,
          386625, 415960, 441600, 468830]
 "options": {"plugins": { "title": {"display": true,
     "text": "Number of disabled students at UK Universities (HESA)"
"scales":
     x": {"title": {"display": true,"text": "Academic Year"}}
    "y": {"title": {"display": true, "text": "Number of Students"}}}}
```



Create a short description

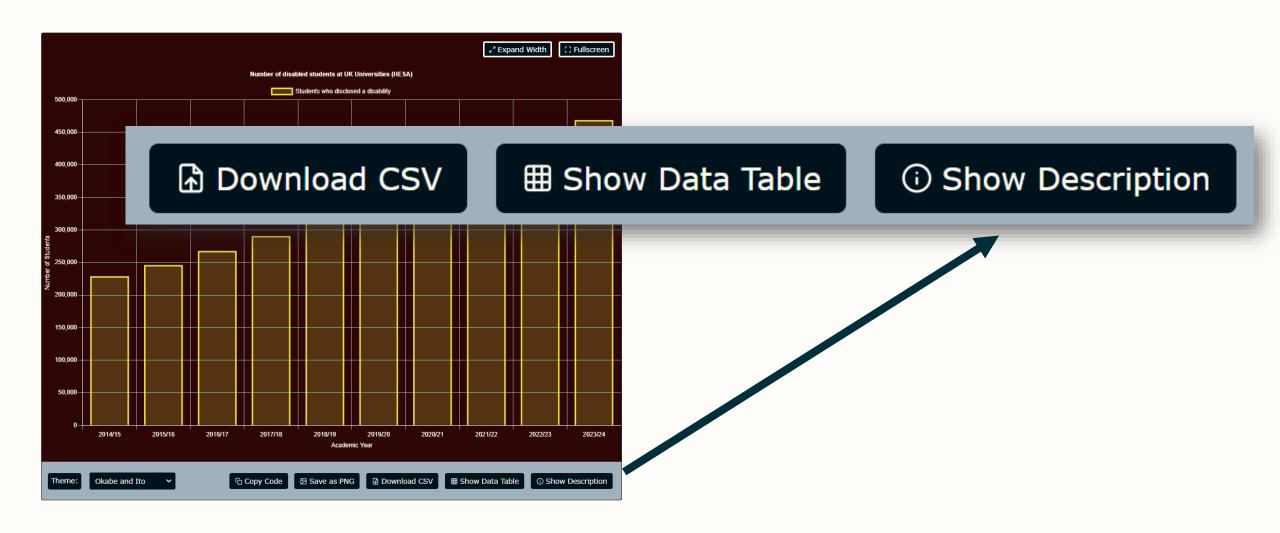


- getChartTitle()
 - Number of disabled students at UK Universities (HESA)"
- getAxisLabel(chartInstance, "x")
 - Academic Year
- getAxisLabel(chartInstance, "y", true)
 - number of students
- datasetCount = 1
- dataPointCount = 10
- valueDescriptor = "students who disclosed a disability"
- xAxisDescriptor = pluralize(10, "Academic Year".toLowerCase()) → FUNCTION CALL: pluralize(10, "academic year") → Since count !== 1, and word ends in consonant + adds "s" → Returns: "academic years"

- basicDescription = `A bar chart titled "\${title}" showing \${valueDescriptor} for \${formatNumberToWord(dataPointCount)} \${xAxisDescriptor}.`
- formatNumberToWord(10)→ Since 10 >= 10, returns "10" (as numeral)
- basicDescription = "A bar chart titled "Number of disabled students at UK Universities (HESA)" showing students who disclosed a disability for 10 academic years.

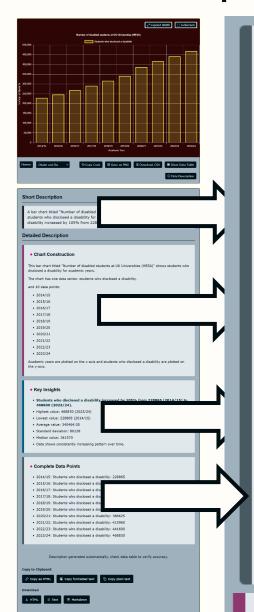
How does it look?





The description





Complete Data Points

- 2014/15: Students who disclosed a disability: 228865
- 2015/16: Students who disclosed a disability: 246210
- 2016/17: Students who disclosed a disability: 267810
- 2017/18: Students who disclosed a disability: 290745
- 2018/19: Students who disclosed a disability: 316425
- 2019/20: Students who disclosed a disability: 341570
- 2020/21: Students who disclosed a disability: 386625
- 2021/22: Students who disclosed a disability: 415960
- 2022/23: Students who disclosed a disability: 441600
- 2023/24: Students who disclosed a disability: 468830

Data table



Academic Year ↑	Students who disclosed a disability ‡
2014/15	228865
2015/16	246210
2016/17	267810
2017/18	290745
2018/19	316425
2019/20	341570
2020/21	386625
2021/22	415960
2022/23	441600
2023/24	468830

Next steps





Building a "graph builder" tool to enable creating graph js graphs using a simple UI.



Will allow anyone to generate CVD friendly graphs with automated descriptions



OpenRouter Testing

Select an AI Model: Claude Haiku 4.5 (anthropic)

▶ More information about Claude Haiku 4.5

Advanced Model Filters

Showing all 188 models

Accessiblity Tools - BETA

Enter your prompt:

Write a very short overview of the impact of inflation on a modern economy. Use one mermaid timeline, one chart js graph and one data table and one latex equation

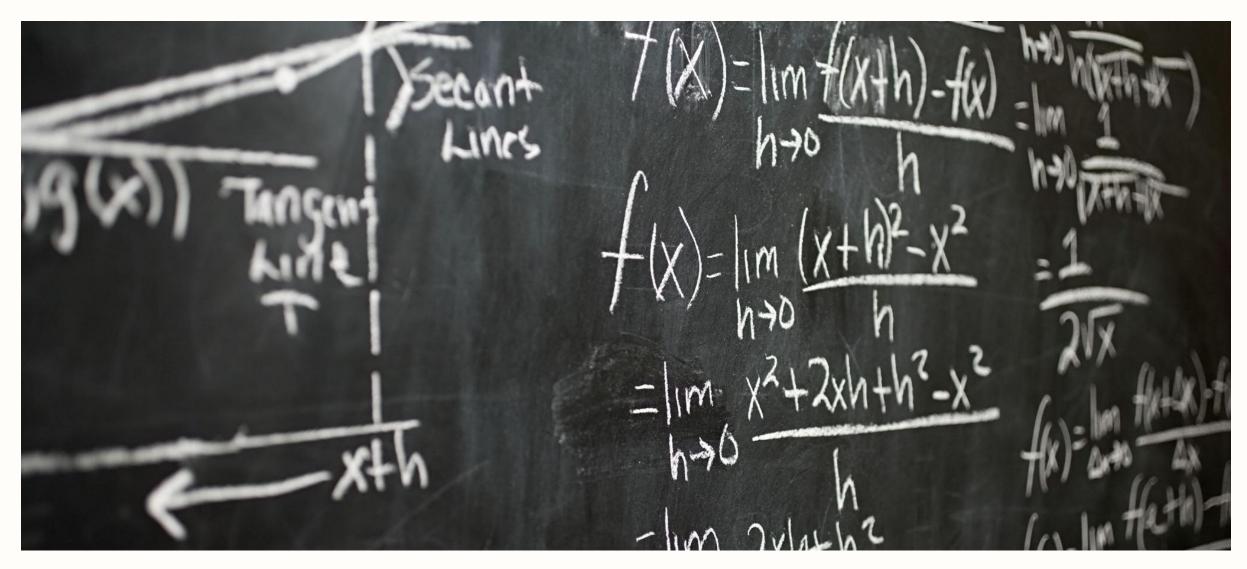
You are an expert content creator who uses advanced markdown features to create accessible, engaging, and interactive content. Your responses leverage the full power of our markdown-it system with 15+ plugins.

CRITICAL FORMATTING RULES:

- NEVER start responses with ``` or ```markdown
- NEVER wrap tables in code blocks
- Use British English spelling throughout
- Write for accessibility and screen reader compatibility

Maths / STEM





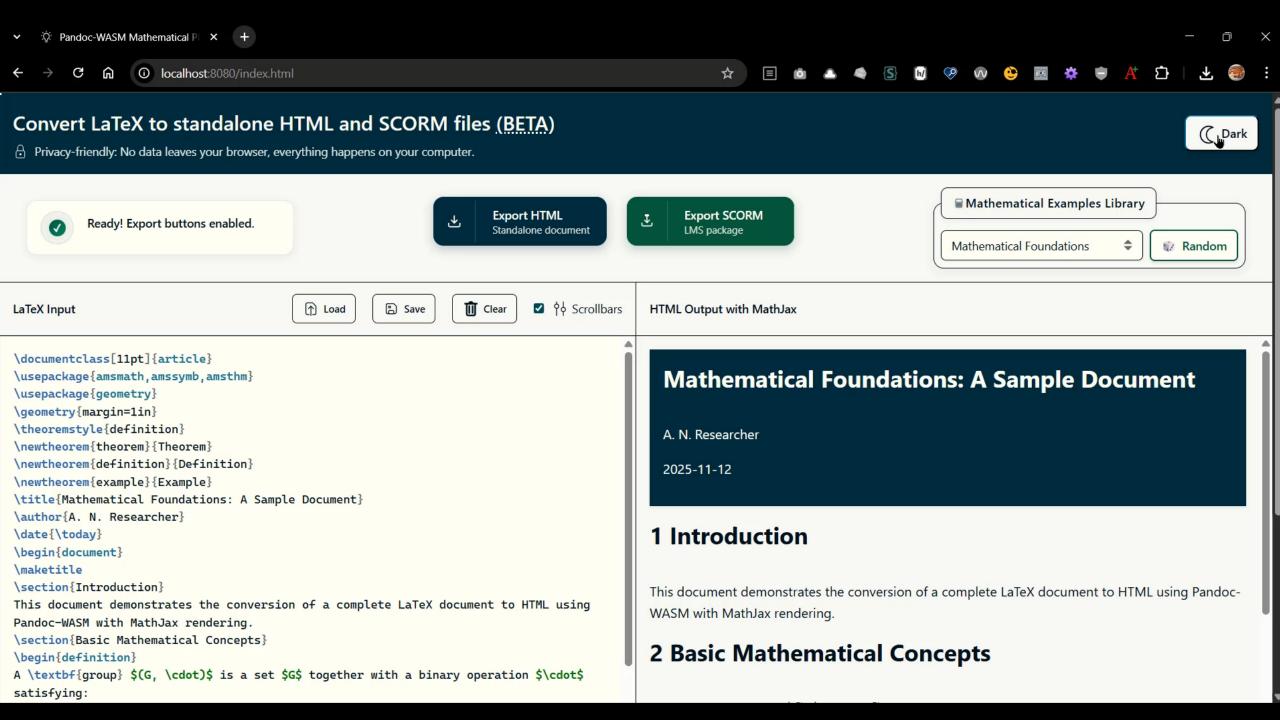
LaTeX Solutions



```
rac{x_1-x_2}{2} \cos \frac{x_1+x_2}{2}=
ws that $\cos \frac{x_1+x_2}{2}=0$ or
rac{x_1-x_2}{2}=0$. Suppose first that
rac{x 1+x 2}{2}=0$.
$\frac{x_1+x_2}{2} \in [-\frac{\pi}{2},
ces in that interval where the cosine v
1+x 2}{2}=-\frac{\pi}{2}$
tnote{Both $x 1$ and $x 2$ are in $[-\f
$-\frac{\pi}{2}$. The only way this ca
ial one, i.e. $x 1=x 2=-\frac{\pi}{2}$,
1$ and $x 2$ are equal to $-\frac{\pi}{
2\left(=-\frac{\pi}{2}\right)$.
_1+x_2}{2}=\frac{\pi}{2}$ then both $x_
pi}{2}$ as before, therefore they are e
2\left(=\frac{\pi}{2}\right)$.
ther hand, if
ac{x_1-x_2}{2}=0$ then $\frac{x_1-x_2}{
rse function $g^{-1}$
 the \emph{inverse sine} and is denote
```

PDF: Even the latest techniques have weaknesses, and the current best solution is only compatible with NVDA.

HTML: More flexible with assistive technologies, but solutions are not intuitive.



Handwritten maths



```
(c) Prove by induction that for all n \ge 1
                                                                                                                                                                         \sum_{n=0}^{\infty} 4k^3 = n^2(n+1)^2
                          \frac{n^{2}4h^{3}}{2} = 4 \cdot |^{3} = 4 \qquad n^{2}(n+1)^{2}
= 1^{2} \cdot 2^{2} = 4
Induction step: Suppose that for
                     some n: \frac{2}{2}4k^3 = n^2(n+1)^2 (induction hypo).

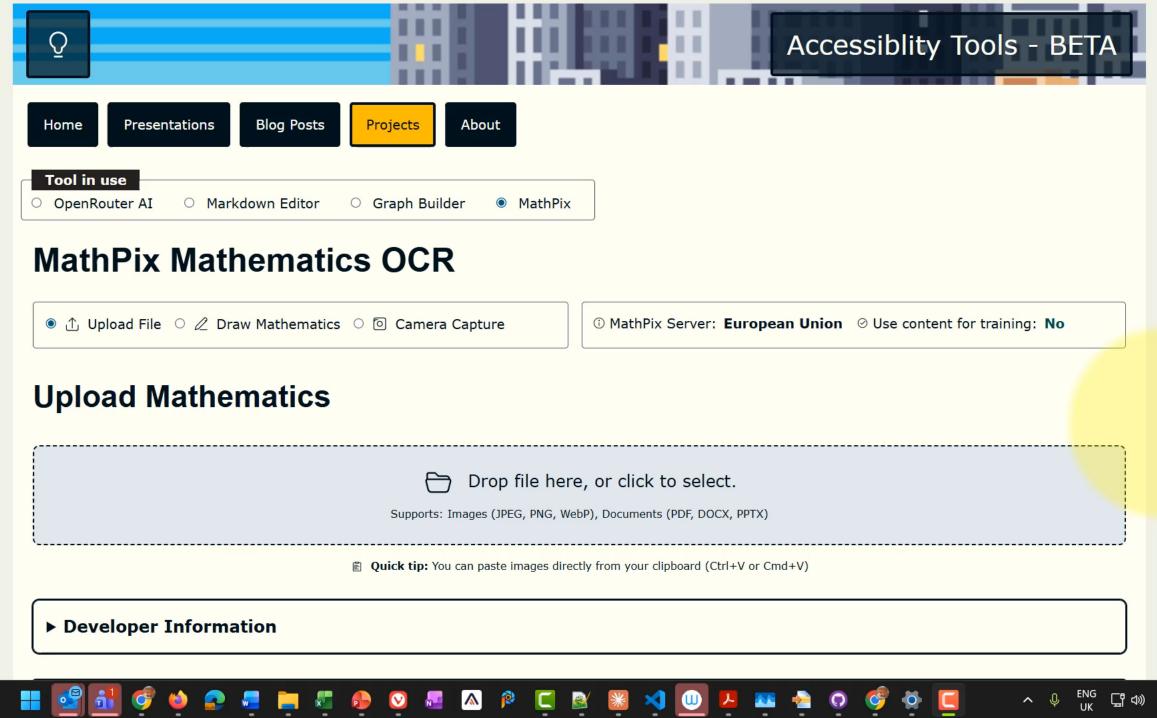
Then \frac{5}{2}4k^3 = \frac{5}{2}4k^3 + 4(n+1)^3 (left)

k=1

                                                                                                                              = (n2+4(n+1)). (n+1)2
                                                                                                                        = (12+4nth) · (nt1)?
                          = (n+1)^2(n+2)^2.

So result holds for n+1.

Hence by industion \sum_{i=1}^{n} (4h^3 - h^2) (m+1)^2
```





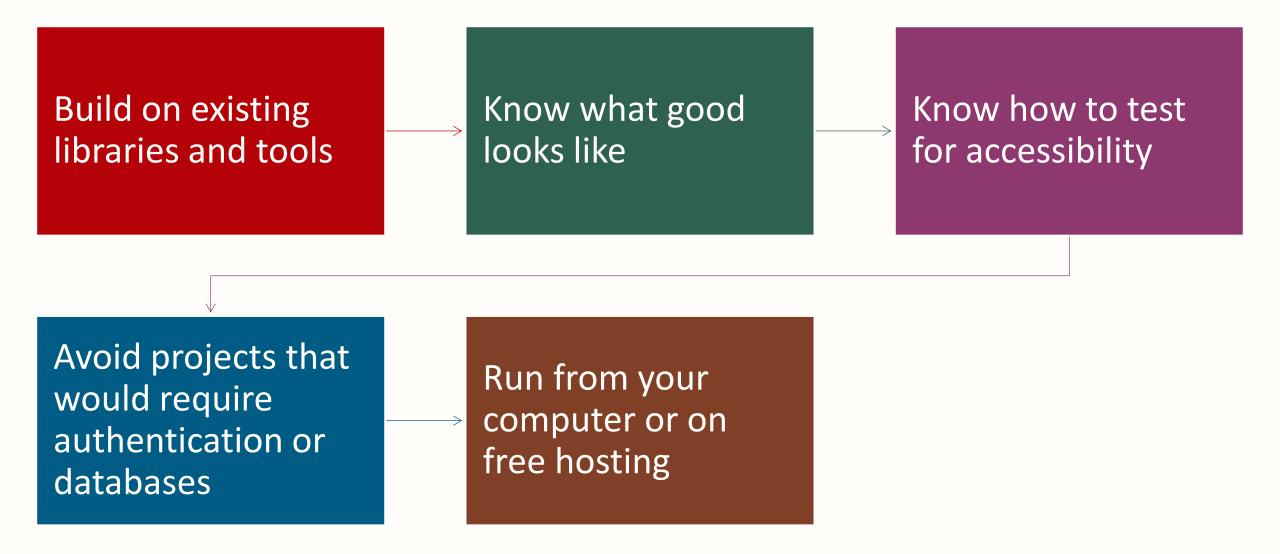
Conclusion





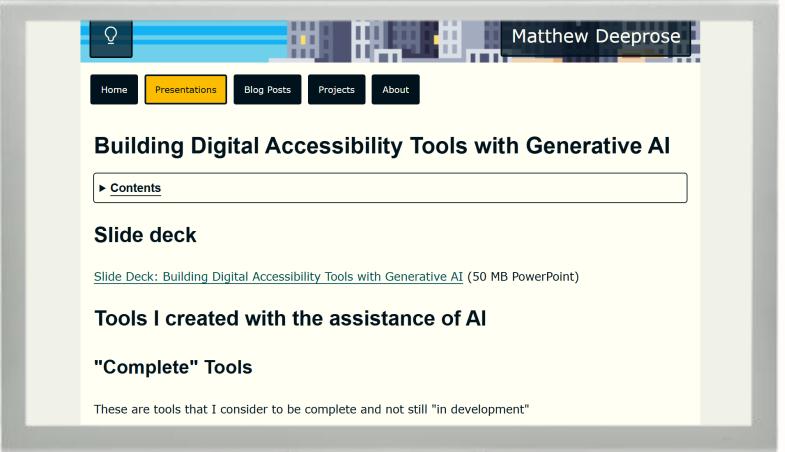
What types of projects and constraints are ideal for this use of AI?





How can others get started?





https://go.soton.ac.uk/hp2



What's included?





Example tools I've made with AI, including estimates of time each took to create.

A "system prompt" to use when creating digital accessibility tools with an LLM.

A commentary on the prompt. And a list of recommended tools.

Verbatim conversation from creating PanoptoText.

Example prompt to create a colour accessibility matrix tool and the result of using that prompt.

An example CSS file to get you started.

Thank you



