



The Poster Session



Jenny Power
Carmen van-de-l'Isle

What we will discuss

1. What is a Poster Session

2. Making your Poster

3. Presenting your Poster



1.

What is a Poster Session



The Poster Session

- A staple at most conferences
- Purpose is to capture the attention of a passerby and communicate a clear message quickly.
- One page of information.



Why should you go?

... and participate!

- Good opportunity to network!
- Easy way to get your research out there
- You don't have to start the conversation
- Good way to present without being the centre of attention
- You might get feedback and ideas for your future research
- Potential to find friends to sit with at the conference dinner

What is it like?



What is it like?

**Depends where
you're going...**

Intradepartmental



SAMBa Conference, Ada Lovelace Day

- Audience are your peers
- Could be a good time to practice in front of a friendly crowd
- Can get more experimental

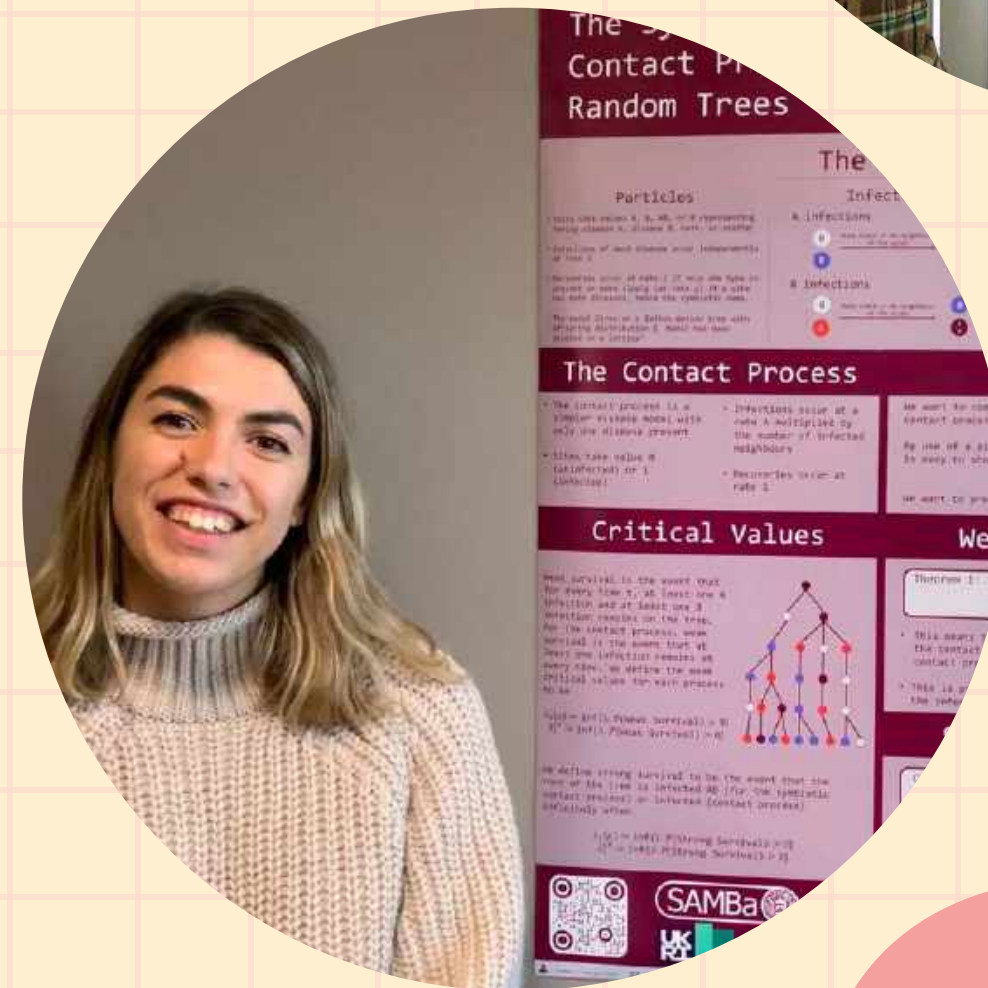
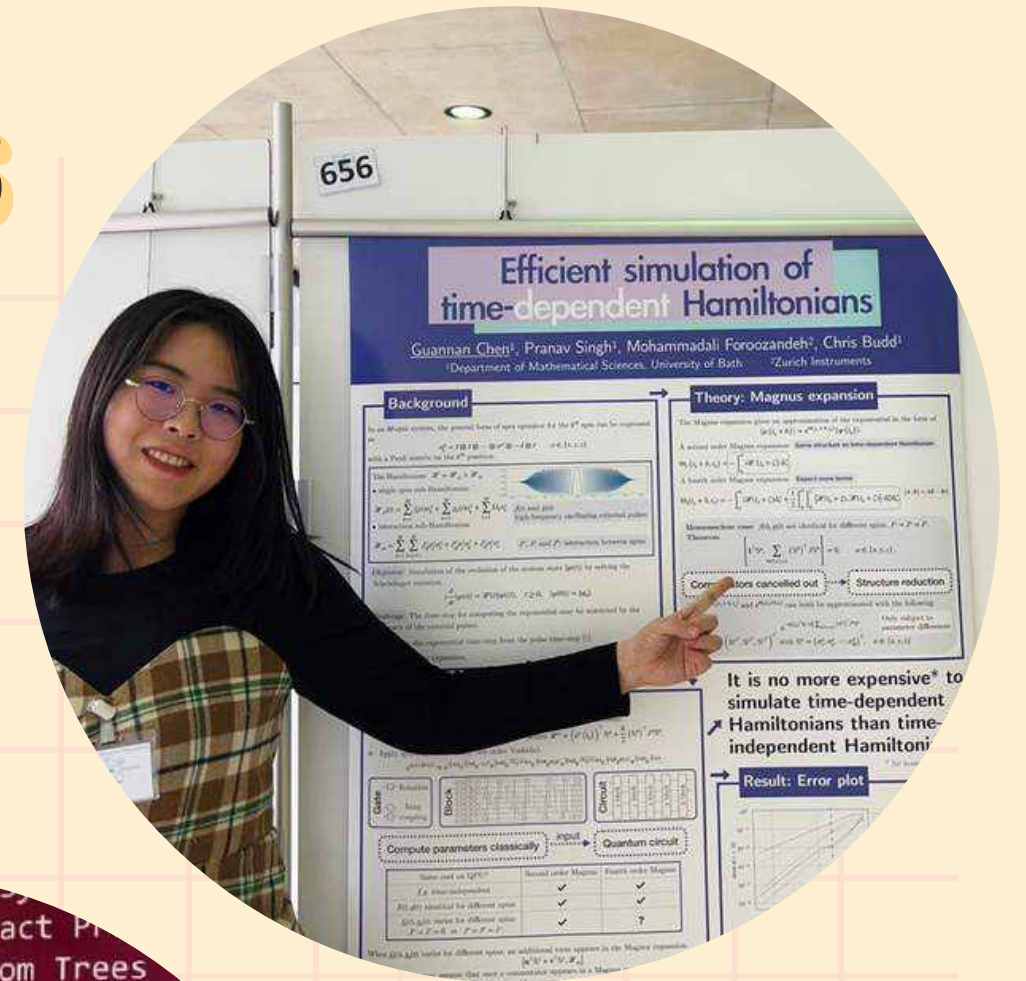


Specialised Conferences



whatever exists in your subfield

- Audience are more likely to be familiar with projects like yours
- Could be a good time to gather feedback and new ideas
- Need to be prepared for specialised questioning

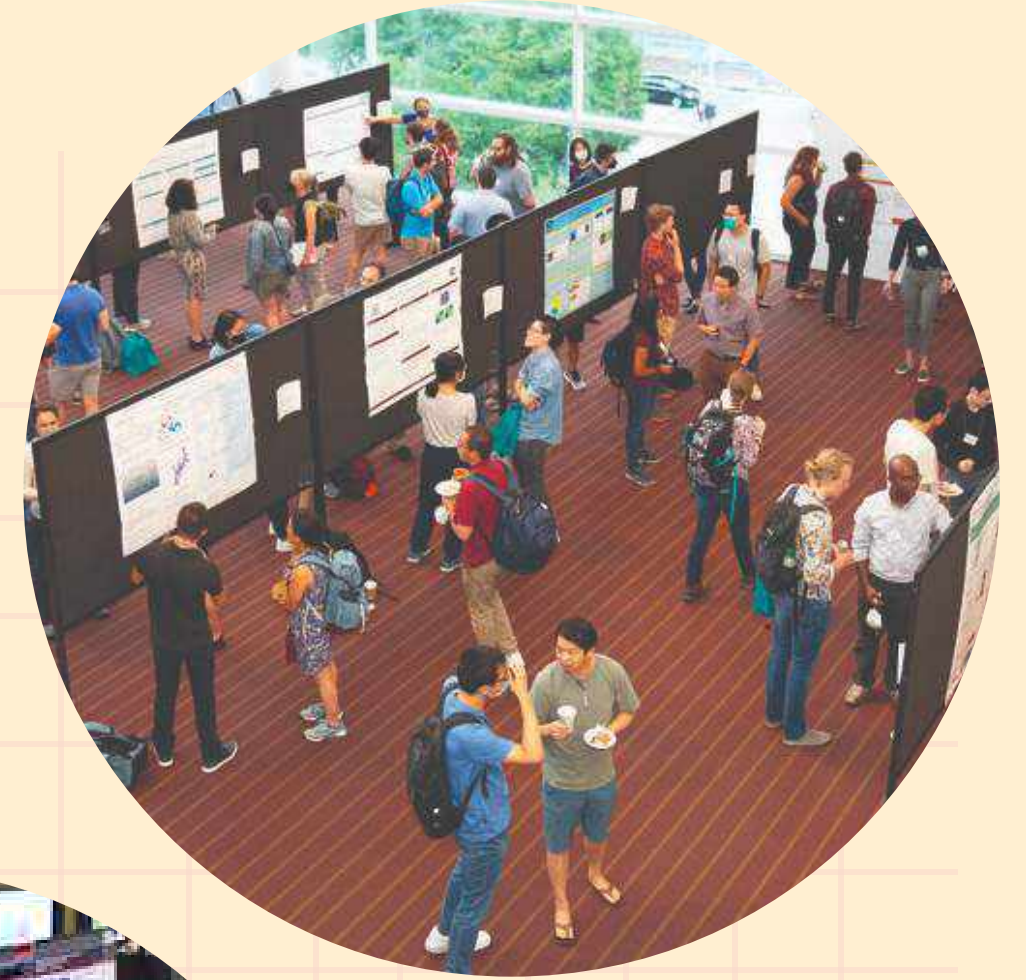


General Conferences



BAMC, BMC, GPSD, SPA, SIAM

- Audience will be mathematical but not necessarily in tune with the specific of your project
- Could be a good time to practice explaining the general concepts
- Needs to appeal to a wide audience

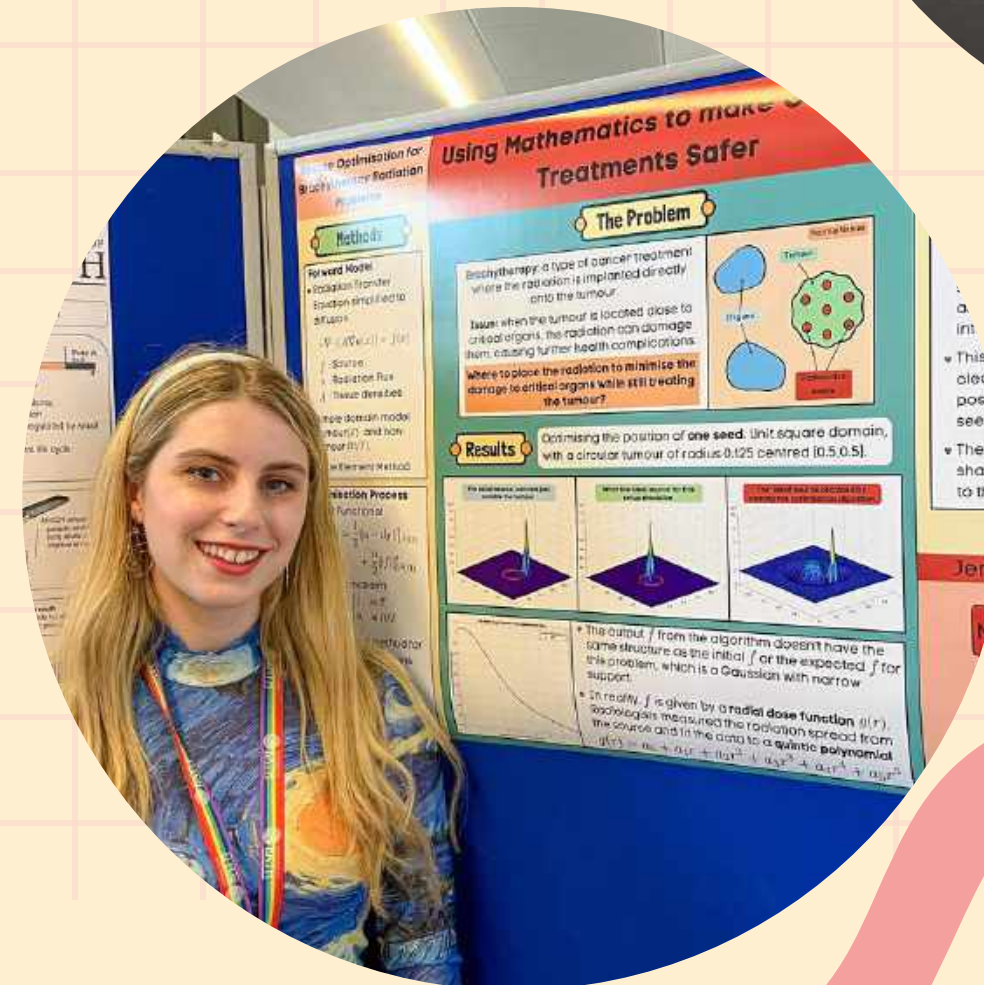


Non-Mathematical Audience



STEM for Britain, Doctoral College, Science Fair

- Audience will not necessarily be mathematical
- Often better to concentrate on impact and application
- Needs to appeal to an even wider audience





What do you want to Say





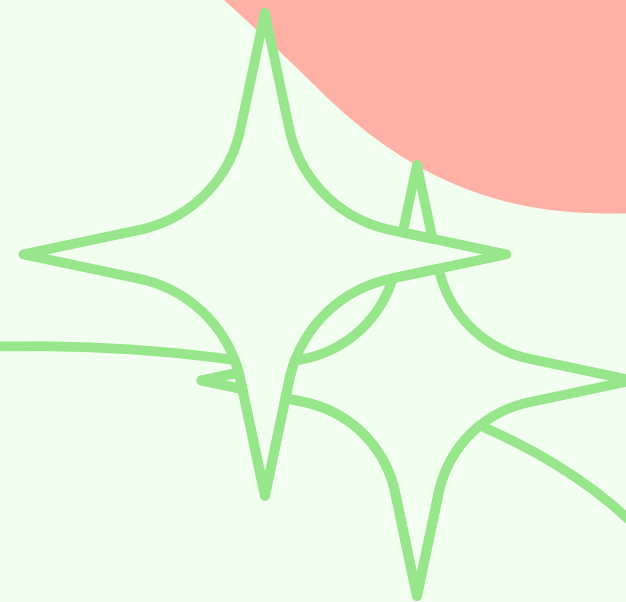
~~**What do you want to Say**~~



**What do you want your
audience to learn**

2.

**Making
your Poster**



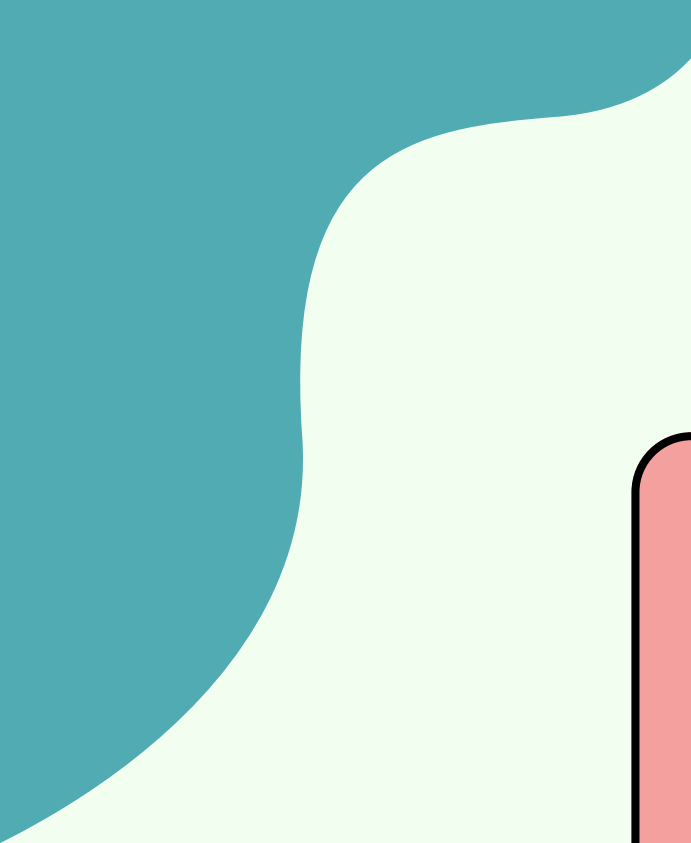


Content



Remember your **One Takeaway**

If your audience are to walk away with **one thing**
from your poster, what is it



Don't put things on your poster that
people will ignore

People will ignore most things



Don't put things on your poster that
people will ignore

People will ignore most things

- Mike Morrison



How to create a better
research poster in less time...

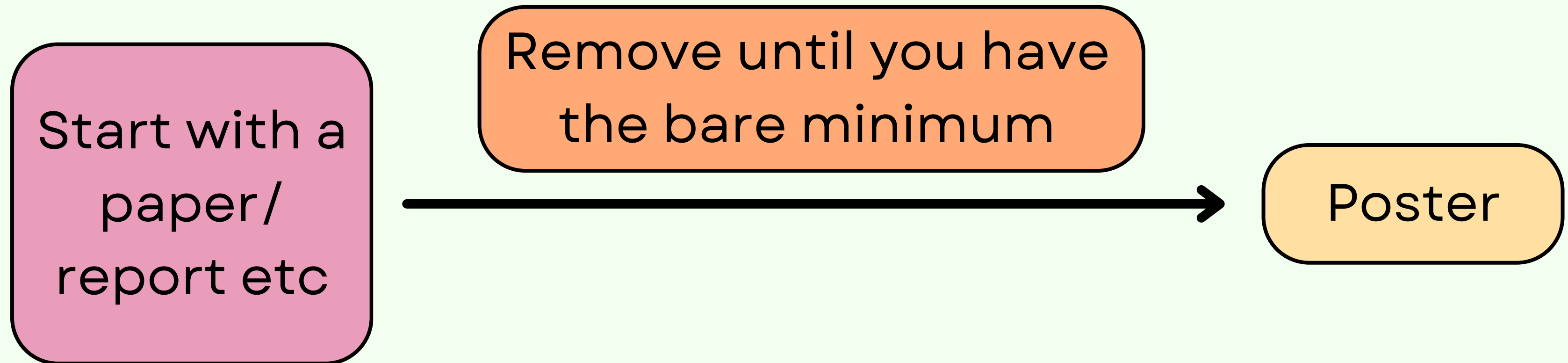
146K views • 2 years ago



The background features decorative wavy lines in pink and teal colors, positioned in the top right and bottom left corners.

How to choose what goes on your poster

Method 1: Removing Content



Method 1: Removing Content

Start with a
paper/
report etc

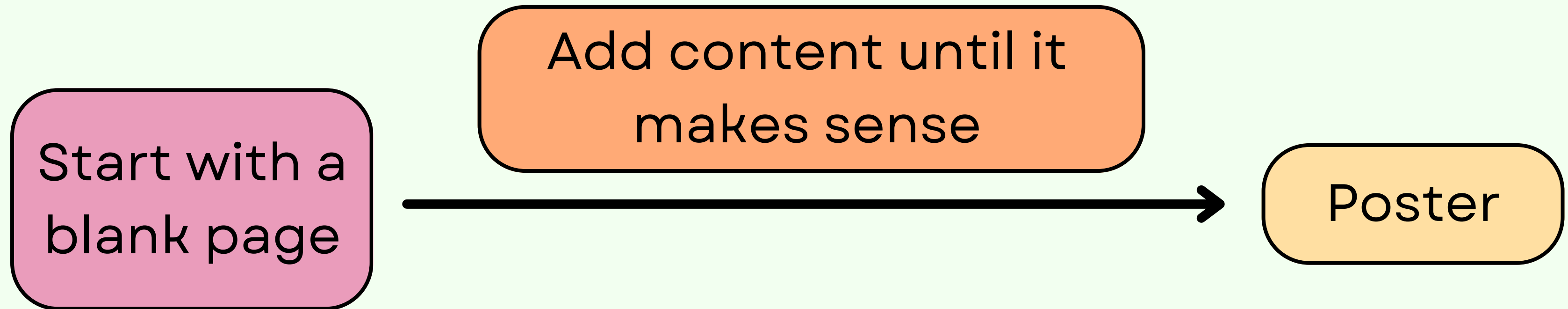
Remove until you have
the bare minimum

Poster



Can lead to clunkier
posters

Method 1: Adding Content



Checklist of Must Haves



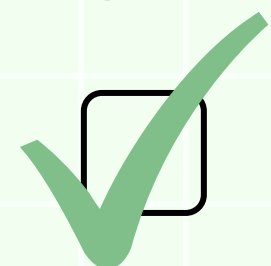
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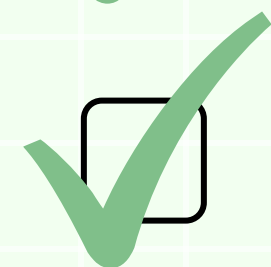
Sponsors Logos (e.g EPSRC, SAMBa, Uni of Bath)



Supervisors name(s)



References




QR code



Website
Paper
Linktree

Link-Tree



@thejennypowerhour

Mathematician | PhD student University of Bath

My Research

Social Media

LinkedIn

Instagram

Twitter

References

- [1] Arridge, S. R., et al. "A finite element approach for modeling photon transport in tissue." Medical physics 20.2 (1993): 299-309.
- [2] Antil, Harbir, et al., eds. Frontiers in PDE-constrained Optimization. Vol. 163. Springer, 2018.
- [3] Nath, R., et al. "AAPM Technical Report 51: Dosimetry of Interstitial Brachytherapy Sources: Recommendations of the AAPM Radiation Therapy Committee Task Group No. 43." Med. Phys 22 (1995): 209-34.
- [4] Manzoni, et al. "Optimal Control of Partial Differential Equations." Springer, 2021.
- [5] Wang, Lihong V., and Hsin-I. Wu. Biomedical optics: principles and imaging. John Wiley & Sons, 2012.

How to make a QR code

Can make a free one with chrome!



← → ↺ ⌂

jip30.github.io/pages/research.html

⌵ ☆

Contact Me

✉ Email

📷 Instagram

🐦 Twitter

🏠 Github

My 1

My research focuses on "Mathematical modelling of radiotherapy c
radiation treatment consisting of placing sealed, radioactive sources c
treat cervical and prostate cancer. It has proven to be an efficient form
can be quite high, while limiting dose exposure of the surrounding no
is close to a critical organ. In this instance, the radiation emitted from
problems and complications. A challenge lies in positioning the source

Jenny Power Research

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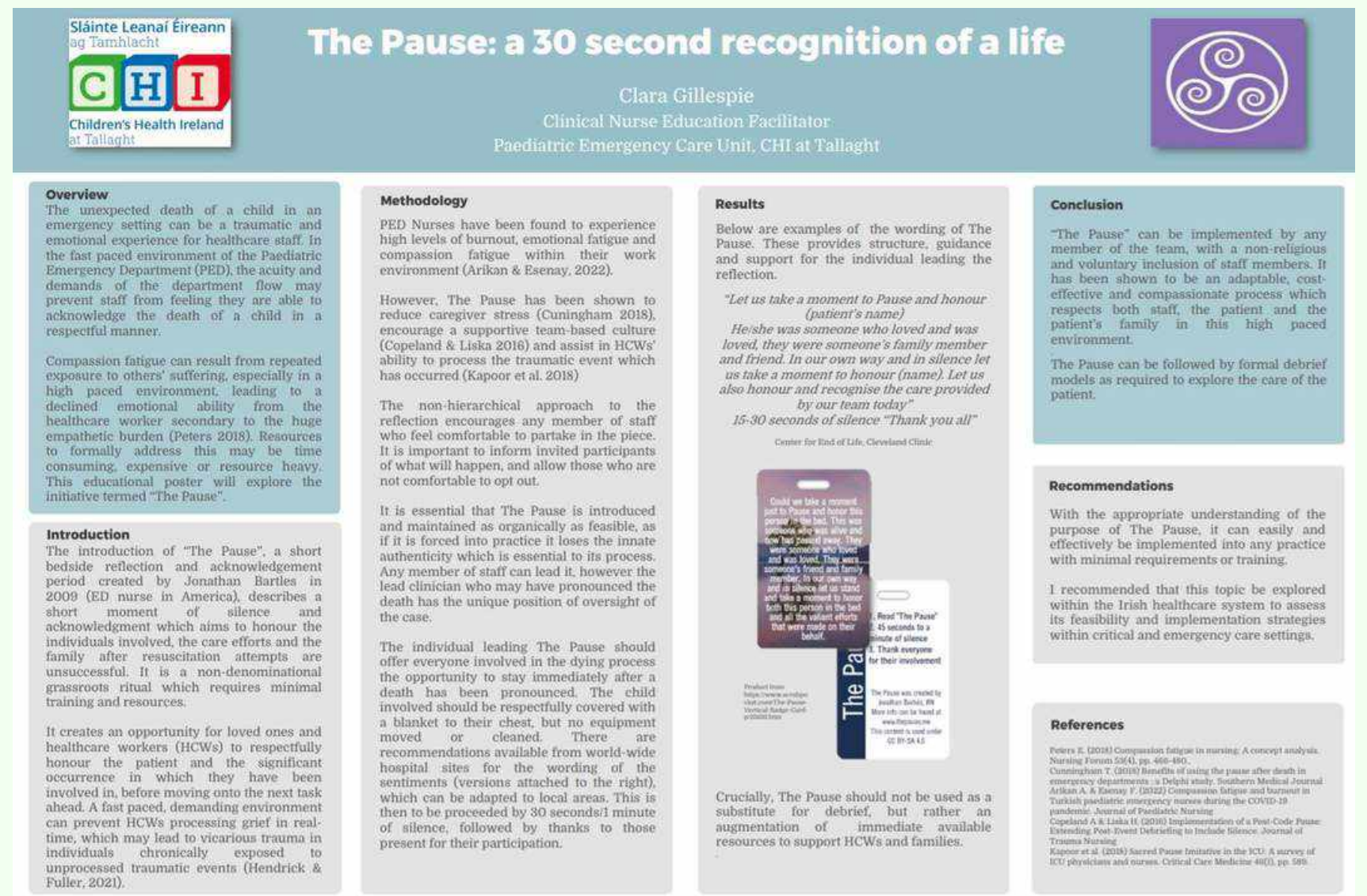
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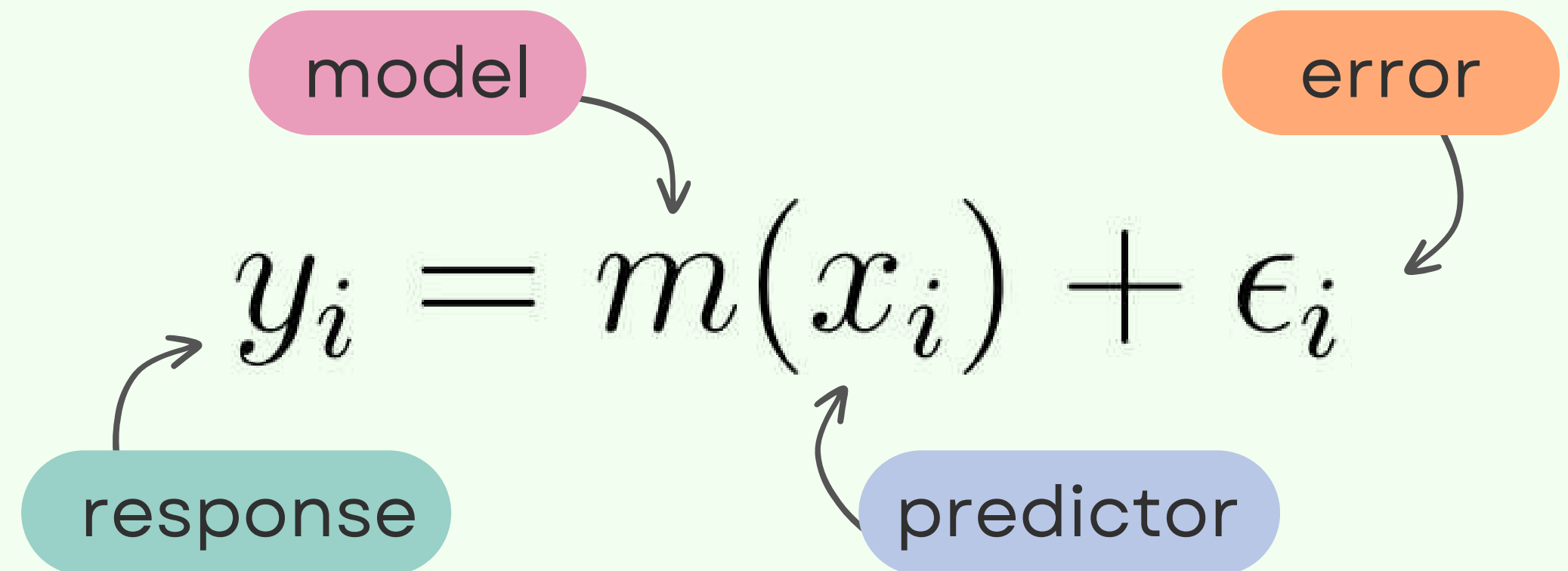


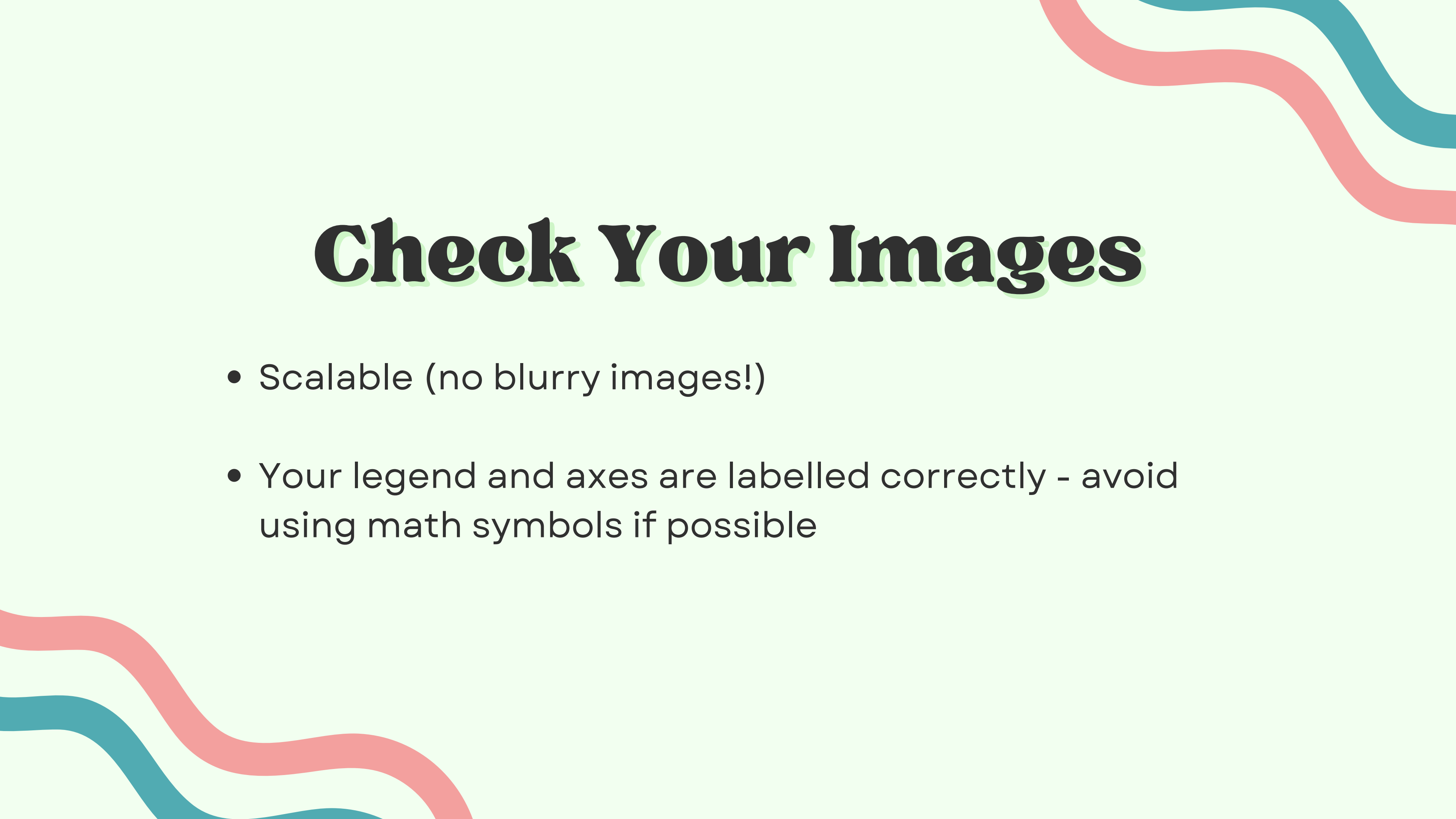
Minimise Equations

Nonparametric regression setting	Sampling algorithm																																																																				
<p>Let \mathbf{y} and \mathbf{x} be the response and predictor vectors, whose observations are denoted as y_i and \mathbf{x}_i. The nonparametric regression model is</p> $y_i = m(\mathbf{x}_i) + \epsilon_i, \quad i = 1, 2, \dots, n$ <p>where ϵ_i is assumed to be i.i.d. with an unknown density denoted by $f(\epsilon)$. It is assumed that $\text{cor}(\epsilon_i, \mathbf{x}_i) = 0$.</p>	<p>A MCMC algorithm, such as random-walk Metropolis, is used to sample \mathbf{h} and b. The ergodic averages of the sample values of $\{(\mathbf{h}^{(i)}, b^{(i)}), i = 1, \dots, 10,000\}$ are used as the estimates of \mathbf{h} and b.</p>																																																																				
Nadaraya-Watson kernel estimator	Simulation																																																																				
<p>The unknown $m(\mathbf{x}_i)$ is estimated by the Nadaraya-Watson (NW) kernel estimator</p> $\hat{m}(\mathbf{x}_i; \mathbf{h}) = \sum_{j=1}^n w_j(\mathbf{x}) y_j, \quad w_j(\mathbf{x}) = \frac{\frac{1}{h} K(\frac{\mathbf{x} - \mathbf{x}_j}{h})}{\sum_{j=1}^n \frac{1}{h} K(\frac{\mathbf{x} - \mathbf{x}_j}{h})},$ <p>where $K(\cdot)$ is a kernel function, and the bandwidth vector \mathbf{h} is treated as a parameter. The NW estimator $\hat{m}(\mathbf{x}_i; \mathbf{h})$ includes an undesirable term, $K(0)/h$. Therefore, we use the leave-one-out NW kernel estimator,</p> $\hat{m}_i(\mathbf{x}_i; \mathbf{h}) = \frac{(n-1)^{-1} \sum_{j=1, j \neq i}^n \frac{1}{h} K(\frac{\mathbf{x}_i - \mathbf{x}_j}{h}) y_j}{(n-1)^{-1} \sum_{j=1, j \neq i}^n \frac{1}{h} K(\frac{\mathbf{x}_i - \mathbf{x}_j}{h})},$	<p>Consider the relationship between \mathbf{y} and $\mathbf{x} = (x_1, x_2, x_3)'$ given by</p> $y_i = \sin(2\pi x_{1,i}) + 4(1 - x_{2,i})(1 + x_{2,i}) + \frac{2x_{3,i}}{1 + 0.8x_{3,i}^2} + \epsilon_i,$ <p>for $i = 1, 2, \dots, 1000$. A sample was generated by drawing $x_{1,i}, x_{2,i}, x_{3,i}$ independently from $U(0, 1)$, and ϵ_i from the mixture of two Gaussian densities defined as $0.7N(0, 0.7^2) + 0.3N(0, 1.5^2)$.</p> <p>The following table presents the parameters estimated by the Bayesian algorithms with the assumptions of unknown, Student t and Gaussian error densities.</p> <table> <tr> <th>Error density</th><th>Parameter</th><th>Estimate</th><th>95% Bayesian credible intervals</th><th>SIF</th></tr> <tr> <td rowspan="5">Unknown</td><td>b</td><td>0.2387</td><td>(0.1691, 0.3187)</td><td>5.64</td></tr> <tr> <td>h_1</td><td>0.0874</td><td>(0.0693, 0.1070)</td><td>21.41</td></tr> <tr> <td>h_2</td><td>0.0594</td><td>(0.0339, 0.0879)</td><td>30.54</td></tr> <tr> <td>h_3</td><td>0.2008</td><td>(0.1611, 0.2481)</td><td>13.24</td></tr> <tr> <td>LML</td><td>-1444.19</td><td></td><td></td></tr> <tr> <td rowspan="5">Student t</td><td>ν</td><td>10.0169</td><td>(7.1201, 14.0821)</td><td>6.66</td></tr> <tr> <td>h_1</td><td>0.0827</td><td>(0.0622, 0.1048)</td><td>8.86</td></tr> <tr> <td>h_2</td><td>0.0701</td><td>(0.0401, 0.0989)</td><td>12.69</td></tr> <tr> <td>h_3</td><td>0.1908</td><td>(0.1448, 0.2459)</td><td>9.81</td></tr> <tr> <td>LML</td><td>-1457.07</td><td></td><td></td></tr> <tr> <td rowspan="5">Gaussian</td><td>σ</td><td>1.0523</td><td>(1.0109, 1.0983)</td><td>1.16</td></tr> <tr> <td>h_1</td><td>0.0773</td><td>(0.0544, 0.0924)</td><td>14.49</td></tr> <tr> <td>h_2</td><td>0.0797</td><td>(0.0572, 0.1121)</td><td>17.36</td></tr> <tr> <td>h_3</td><td>0.1879</td><td>(0.1438, 0.2333)</td><td>16.21</td></tr> <tr> <td>LML</td><td>-1485.72</td><td></td><td></td></tr> </table> <p>Note: LML refers to log marginal likelihood, and SIF refers to simulation inefficient factor.</p>	Error density	Parameter	Estimate	95% Bayesian credible intervals	SIF	Unknown	b	0.2387	(0.1691, 0.3187)	5.64	h_1	0.0874	(0.0693, 0.1070)	21.41	h_2	0.0594	(0.0339, 0.0879)	30.54	h_3	0.2008	(0.1611, 0.2481)	13.24	LML	-1444.19			Student t	ν	10.0169	(7.1201, 14.0821)	6.66	h_1	0.0827	(0.0622, 0.1048)	8.86	h_2	0.0701	(0.0401, 0.0989)	12.69	h_3	0.1908	(0.1448, 0.2459)	9.81	LML	-1457.07			Gaussian	σ	1.0523	(1.0109, 1.0983)	1.16	h_1	0.0773	(0.0544, 0.0924)	14.49	h_2	0.0797	(0.0572, 0.1121)	17.36	h_3	0.1879	(0.1438, 0.2333)	16.21	LML	-1485.72		
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Estimation of an unknown error density	Conclusion																																																																				
<p>We propose to approximate $f(\epsilon_i)$ by a kernel density given by</p> $\hat{f}(\epsilon_i; b) = \frac{1}{n-1} \sum_{j=1, j \neq i}^n \frac{1}{b} K\left(\frac{\hat{\epsilon}_i - \hat{\epsilon}_j}{b}\right),$ <p>where b is the bandwidth. Efromovich (2005) justified that residuals are proxies of errors.</p>	<p>Based on Bayes factors, the Bayesian algorithm with an unknown error density performs better than the wrongly specified error distributions, although it performs slightly worse than the correctly specified error distributions in other simulations.</p>																																																																				
Likelihood	Reference																																																																				
<p>The likelihood of \mathbf{y} given $(\mathbf{h}, b)'$ is approximated by</p> $L(\mathbf{y} \mathbf{h}, b) = \prod_{i=1}^n \left\{ \frac{1}{n-1} \sum_{j=1, j \neq i}^n \frac{1}{b} K\left(\frac{\hat{\epsilon}_i - \hat{\epsilon}_j}{b}\right) \right\}$	<p>Efromovich, S. (2005), 'Estimation of the density of regression errors', <i>The Annals of Statistics</i>, 33(5), 2194-2227.</p>																																																																				
Prior																																																																					
<p>Let $\pi(\mathbf{h})$ and $\pi(b)$ denote the priors of \mathbf{h} and b, which are assumed to follow a Cauchy distribution</p> $\pi(h_i) = \frac{1}{\pi(1 + h_i^2)}, \quad \pi(b) = \frac{1}{\pi(1 + b^2)}.$																																																																					
Posterior																																																																					
<p>The posterior of $(\mathbf{h}', b)'$ is approximated as (up to a normalising constant)</p> $\pi(\mathbf{h}, b \mathbf{y}) \propto \pi(\mathbf{h})\pi(b)L(\mathbf{y} \mathbf{h}, b).$																																																																					
	<p>*Contact Author C@edu for the draft</p>																																																																				

*Contact Author C@edu for the draft

- Try to avoid 'maths talk' - *"let y be the response vector and x be the predictor vector"*
- You will be with your poster, you can explain what things are





Check Your Images

- Scalable (no blurry images!)
- Your legend and axes are labelled correctly - avoid using math symbols if possible



Tools



Tools: Canva

Source Optimisation for Brachytherapy Radiation Problems

Methods

- Forward Model
 - Radiation Transfer Equation simplified to diffusion.
$$-\nabla \cdot (A \nabla u(x)) = f(x)$$
$$f$$
 : Source
 u : Radiation Flux
 A : Tissue densities
 - Simple domain model: tumour (T) and non-tumour (Ω/T).
 - Finite Element Method
- Optimisation Process
 - Cost Functional
$$J(u, f) = \frac{1}{2} \|u - d_T\|_{L^2(\Omega)}^2 + \frac{\alpha}{2} \|f\|_{L^2(\Omega)}^2$$
 - Dose constraint:
$$d_T = \begin{cases} 1, & \text{in } T \\ 0, & \text{in } \Omega/T \end{cases}$$
 - Lagrangian method for optimality conditions.
 - Gradient Descent.
 - Output: 'ideal' source function.

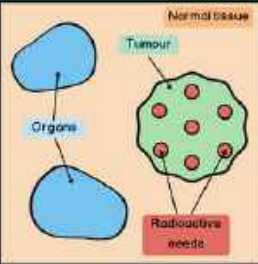
Using Mathematics to make Cancer Treatments Safer

The Problem

Brachytherapy: a type of cancer treatment where the radiation is implanted directly onto the tumour.

Issue: when the tumour is located close to critical organs, the radiation can damage them, causing further health complications.

Where to place the radiation to minimise the damage to critical organs while still treating the tumour?



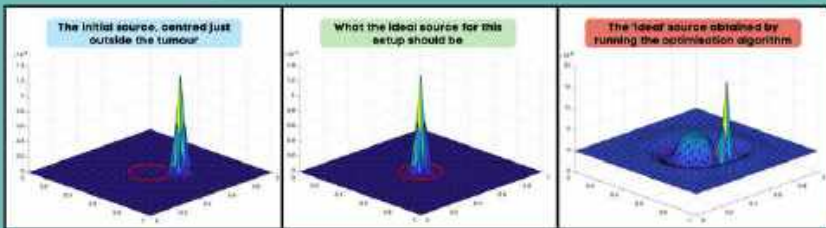
Results

Optimising the position of **one seed**. Unit square domain, with a circular tumour of radius 0.125 centred [0.5, 0.5].

The initial source, centred just outside the tumour.

What the ideal source for this setup should be.

The 'ideal' source obtained by running the optimisation algorithm.



The output f from the algorithm doesn't have the same structure as the initial f or the expected f for this problem, which is a Gaussian with narrow support.

In reality, f is given by a **radial dose function** $g(r)$. Radiologists measured the radiation spread from the source and fit the data to a **quintic polynomial**
$$g(r) = a_0 + a_1 r + a_2 r^2 + a_3 r^3 + a_4 r^4 + a_5 r^5$$

Key Tool


PDE Constrained Optimisation

What's Next?

- The radiation source term has a certain shape that the current algorithm doesn't take into account.
- This shape would clearly give the position where the seed should go.
- The next step is to add shape constraints for f to this process.


Jennifer Power

More Info!



Making Cancer Treatments Safer with Mathematics

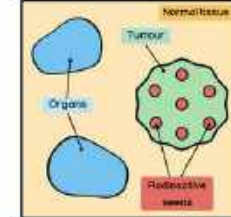
Jennifer Power, University of Bath



THE PROBLEM

Brachytherapy: a radiation treatment where radioactive seeds are placed directly on the tumour.

Issue: when the tumour is located close to organs, the radiation can damage them, causing further health complications.



Where to place the radiation to minimise the damage to healthy tissue while still treating the tumour?

THE IMPACT

Currently, clinicians do not have a tool to create treatment plans for brachytherapy. This would provide them with one.

1. Patient gets a CT scan
2. The relevant information is taken from the scan
3. This information is fed into the algorithm
4. Outputs the optimal radiation seeds for treating the patient
5. Information is given to the clinician to help them create their treatment plan

The Process

METHODS

Key Tool: PDE Constrained Optimisation

Optimisation Problem

d required dose for the tumour + d target dose for everywhere else + Physical Laws of Radiation Emission

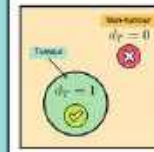
Method: minimize a function that will enforce required constraints

* Find the f that minimizes
$$J(u, f) = \frac{1}{2} \|u - d_T\|_{L^2(\Omega)}^2 + \frac{\alpha}{2} \|f\|_{L^2(\Omega)}^2$$

* While making sure this is true
$$\frac{\partial u}{\partial t} + \mu_a u - \nabla \cdot \left(\frac{1}{3\mu_a} \nabla u \right) = f$$


u : dose
Want target dose $u = d_T$

f : source
Want to find this

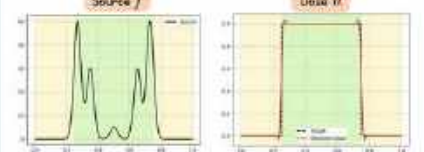


SIMULATIONS

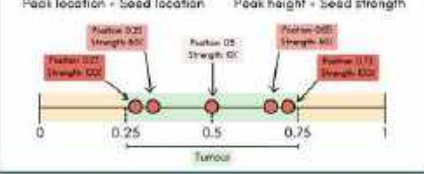
A simplified 1D problem:




Output the source for the needed dose:




Peak location - Seed location Peak height - Seed strength





Scan for more info



Tools: Canva



- Makes things look very pretty
- Lots of graphics that you can utilise
- What you see is what you get
- Nice fonts
- Very flexible



- No built in LaTeX support
- Some features behind a paywall
- Can lead to major procrastination
- New tool - new learning curve

Tools: Powerpoint

The HIV-1 Glycan Shield as a Target for Vaccine Design
Laura K. Pittsford¹, Camille Bonnet¹, Gemma Sawbridge¹, Dan Rupp², Sergey Menis³, Louise Royle³, Daniel I. R. Spencer¹, D. Cameron Dunkley¹, Christopher A. Scanlan¹, William R. Scheff¹, Katie J. Doores¹, Max Crispin¹
¹Medical Biophysics Institute, Department of Immunology, Oxford Centre for Immunology, Centre for HIV/AIDS Research, and Immunology Division, The Scripps Research Institute, CA, United States of America; ²Immunology, College of Medicine, University of Kentucky, Lexington, United Kingdom; ³Immunology, The College London School of Medicine, Guy's Hospital, London, United Kingdom

Background
The gp120 envelope spike of HIV-1 is coated in N-linked glycans, which shield the underlying protein epitopes from recognition by neutralising antibodies. However, many of the glycans are of the oligomannose type, which are rarely observed on secreted mammalian glycoproteins. The emergence of a number of broadly neutralising antibodies (bnAbs)^{1,2}, which target these 'non-self' glycans, suggests that the oligomannose patch on gp120 represents an immunogenic region that could be targeted in a vaccine context. The main aims of this work were the following:
• Determine the conservation of the oligomannose patch across different HIV-1 clades.
• Investigate the stability of the oligomannose patch in response to deletion of individual glycan sites.
• Explore the sensitivity of N332-specific bnAbs to glycan site deletion.

Results
Fig. 1 - Cross-clade conservation of oligomannose.
An effective HIV-1 vaccine depends upon conservation of the target epitope across diverse strains. How variable is the oligomannose population?
A - Normal phase LysC profile of gp120% linear glycans. Glycans were released from recombinant gp120 (expressed in HEK293T cells) by treatment with LysC. A characteristic 'Y' shape (representing released oligomannose-type glycans) is highlighted in blue. B - Cross-clade analysis of oligomannose-type glycans. Abundances of individual oligomannose-type glycans were measured across a panel of 28 isolates. Overall abundances varied between 24-12%.

Fig. 2 - Effect of glycan-site deletion on glycosylation.
Escape mutations by HIV-1 often result in deletion of glycan sites. How does loss of a glycan site impact glycosylation and the oligomannose population?
A - Glycosylation sites of gp120. Predicted sites of complex-type glycans (based on published reports) and observed predicted sites of oligomannose-type glycans (from this work). B - Conservation of glycan sites across clades. Data derived from N332-published isolates. C - Effect of glycan site deletion on overall abundance of oligomannose-type glycans (Mean ± SD and range). Glycans (Mean ± SD) are only deleted by site-directed mutagenesis. Arrows indicate changes in abundance predicted upon loss of a fully occupied glycan site.

Fig. 3 - Stabilising interactions of individual glycans.
Loss of certain glycan sites were found to have larger than expected destabilising effects on the oligomannose population. Could involvement in particular molecular interactions explain this?
A - Disruption of glycosylation upon loss of the N332 glycan site. The panel shows the WT glycan profile (black) compared with the glycan profile of the N332A mutant (blue). The bottom panel shows the difference plot. B - Molecular modelling of the glycosylated spike. Model based on crystal structure from [3]. The N332 glycan is coloured with the N332A glycan. C - Disruption of glycosylation upon loss of the N332 glycan site. A solution 3D-NMR binding data. N332 is a conformation-dependent epitope that binds the CD4-binding site of gp120.

Fig. 4 - Glycan promiscuity of N332-specific bnAbs.
Several bnAbs target the glycan at the N332 site. How does removal of nearby glycans affect the processing at this site? What is the effect of recognition by bnAbs?
A - Location of the N332 glycan site. The N332 glycan lies in the outer domain of gp120 and is well shielded by a 'high' density of glycans. B - Glycosylation in the N332 site upon deletion of neighbouring glycans. A variety of glycosylation sites were deleted, and their abundances were determined by MS/MS. C - ESI-MS data of a panel of N332-specific bnAbs. bnAbs targeting the N332 glycan were analysed for their tolerance of glycan site deletion mutants. P1C2100 indicates additional contacts for N332A-P1C2100 and contacts N332A.

Conclusions
• The oligomannose patch is a highly conserved, cross-clade feature of HIV-1, which is stable upon deletion of individual glycan sites.
• The extremely high density of glycans on gp120 contributes to their limited processing, and reduction of this density can influence processing at nearby glycan sites.
• Broadly neutralising antibodies display a degree of promiscuity in their glycan recognition, recognising more than one particular glycoform.
• The conservation and stability of the glycan shield validates it as a target for vaccine design.

References
[1] Walker, L. M. et al. Broad neutralisation coverage of HIV by multiple highly potent antibodies. *Nature* 477, 466-470 (2011).
[2] Walker, L. M. et al. Broad and potent neutralising antibodies from an African donor reveal a new HIV-2 vaccine target. *Science* 326, 104-107 (2009).
[3] Adams, J. P. et al. Crystal structure of a soluble classed HIV-1 envelope trimer. *Science* 302, 1271-1275 (2003).

CHAVI ID

The Symbiotic Contact Process on Random Trees
Carmen C. van-de-l'Isle
Supervised by Marcel Oetglese and Sarah Penington
UNIVERSITY OF BATH

The Model
Particles
• Sites take values A, 0, AB, or B representing having disease A, disease B, both, or neither.
• Infections of each disease occur independently at rate 1.
• Recoveries occur at rate 1 if only one type is present or more slowly (at rate p) if a site has both diseases, hence the symbiotic name.
• The model lives on a Galton-Watson tree with offspring distribution ξ . Model has been studied on a lattice.
Infections
A infections: Site A infects its neighbours at rate 1.
B infections: Site B infects its neighbours at rate 1.
Deaths
Site A dies at rate 1.
Site B dies at rate 1.
Symbiotic Deaths
Site AB dies at rate p.

The Contact Process
• The contact process is a simpler disease model with only one disease present.
• Sites take value 0 (uninfected) or 1 (infected).
• Infections occur at a rate λ multiplied by the number of infected neighbours.
• Recoveries occur at rate 1.

Our Aims
We want to compare the critical values of the symbiotic contact process with those of the contact process.
By use of a simple coupling with the contact process, it is easy to show that for all $\mu < 1$
 $\lambda_1(\mu) \leq \lambda_1^C$ and $\lambda_2(\mu) \leq \lambda_2^C$
We want to prove that this inequality is strict.

Critical Values
Weak survival is the event that for every time t, at least one A infection and at least one B infection remains on the tree. For the contact process, weak survival is the event that at least one infection remains at every time. We define the weak critical values for each process to be:
 $\lambda_1(\mu) = \inf\{\lambda: P(\text{Weak Survival}) > 0\}$
 $\lambda_2^C = \inf\{\lambda: P(\text{Weak Survival}) > 0\}$
We define strong survival to be the event that the root of the tree is infected AB (for the symbiotic contact process) or infected (contact process) infinitely often.
 $\lambda_1^S(\mu) = \inf\{\lambda: P(\text{Strong Survival}) > 0\}$
 $\lambda_2^S(\mu) = \inf\{\lambda: P(\text{Strong Survival}) > 0\}$

Weak Survival
Theorem 1: Let ξ have an exponential tail. For small values of μ ,
 $\lambda_1(\mu) < \lambda_1^C$
• This means that there exists an infection rate where the contact process doesn't survive but the symbiotic contact process does.
• This is proved by looking at a modified process where the infection can only be passed away from the root.

Strong Survival
Conjecture 1: Let ξ have an exponential tail. For small values of μ ,
 $\lambda_2(\mu) < \lambda_2^C$
• We conjecture that a similar result holds for the strong survival parameter.
• Our aim is to prove this by analysing the survival time on a star. We then show that this infection can spread to a star further down the tree which can in turn reinfect the root. This is based on methods used by Huang and Durrett¹.

References
[1] J. Huang and R. Durrett. The symbiotic contact process. *Electronic Journal of Probability*, 20(2005):1-10, 2005.
[2] J. Huang and R. Durrett. The Contact Process on Random Graphs and Galton-Watson Trees, 2006.

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Tools: Powerpoint



- What you see is what you get
- Very flexible
- Easy - you've probably used it before



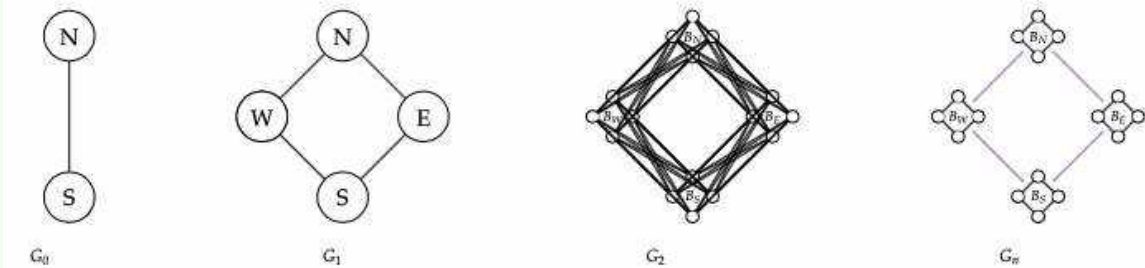
- Ugly
- Less equation support than beamer
- No tikzpictures :(
- Fewer in-app graphics
- Harder to align things

Tools: Beamer

You can make it look like this....

THE GRAPHS OF WRATH: KINETICALLY CONSTRAINED MODELS ON HIERARCHICAL GRAPHS

Carmen C. van-de-l'Isle & Paul Chleboun



Kinetically Constrained Spin Models

- We model glassy systems with kinetically constrained models (KCMs) to portray the concept of molecules being hindered by the presence of too many surrounding molecules represented by the kinetic constraint.
- The chain attempts to update with continuous time Glauber dynamics, but updates are ignored unless the kinetic constraint is satisfied. This models dynamics which are non-stationary on the time scales available to human observation.
- The key features of interest of these systems is the relaxation to equilibrium and the fluctuations in a stationary state. We will be looking into the former.

Hierarchical Model

- We define a hierarchical KCM on the hierarchical graphs above, with the n^{th} model having state space $\Omega^{\wedge n}$.
- We can split these graphs into four blocks N , E , S , and W .
- The constraint is such that in order for a node x to update there must be a zero in a block connected to the block containing x , and a node with occupation zero connected to x in the block containing x .
- We suggest an update for a node with rate 1, and assuming the constraint is satisfied, refresh the chosen node according to a Bernoulli(p) measure [2].

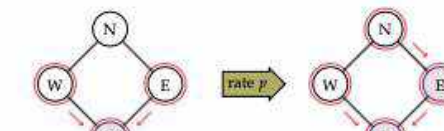


Figure 1: An accepted update at rate p .

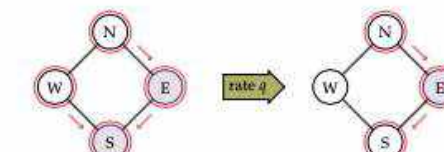


Figure 2: An accepted update at rate q .



Figure 3: A rejected update at rate q .

We illustrate the Glauber-like dynamics for the graph G_1 in Figures 1, 2, and 3. Note that here our blocks are just the single nodes $\{N, E, S, W\}$. We show that the constraint is satisfied for a node by drawing a red ring around it, a node is shown to have spin 1 if it is purple, and spin 0 if it is white. The facilitating nodes which impact the constraint of a given node are shown by the red arrows pointing towards them.

Main Results

We are interested in the dynamics as the process relaxes to equilibrium i.e. the smallest positive non-zero eigenvalue of the generator (rates matrix Q). The relaxation time is also the inverse of the spectral gap.

The Relaxation time for G_1

We can bound the spectral gap of the process on G_1 above by $1 - \sqrt{1 - q}$ for all $q \in (0, 1)$.

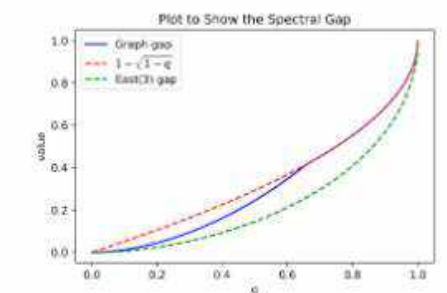


Figure 4: A plot showing the spectral gap.

We can compare this result with the results found by Cancrini et. al. [1].

Iterative Bound for the n^{th} Relaxation Time

We have also used the hierarchical nature of the process to find an iterative bound for the n^{th} relaxation time.

Take the process on the graph G_n . For all $q \in [0, 1]$, define $p_n^* = (1 - q)^{\wedge n}$ and $q_n^* = 1 - p_n^*$. We can bound the relaxation time on the graph G_n above by the product of relaxation times on the graph G_1

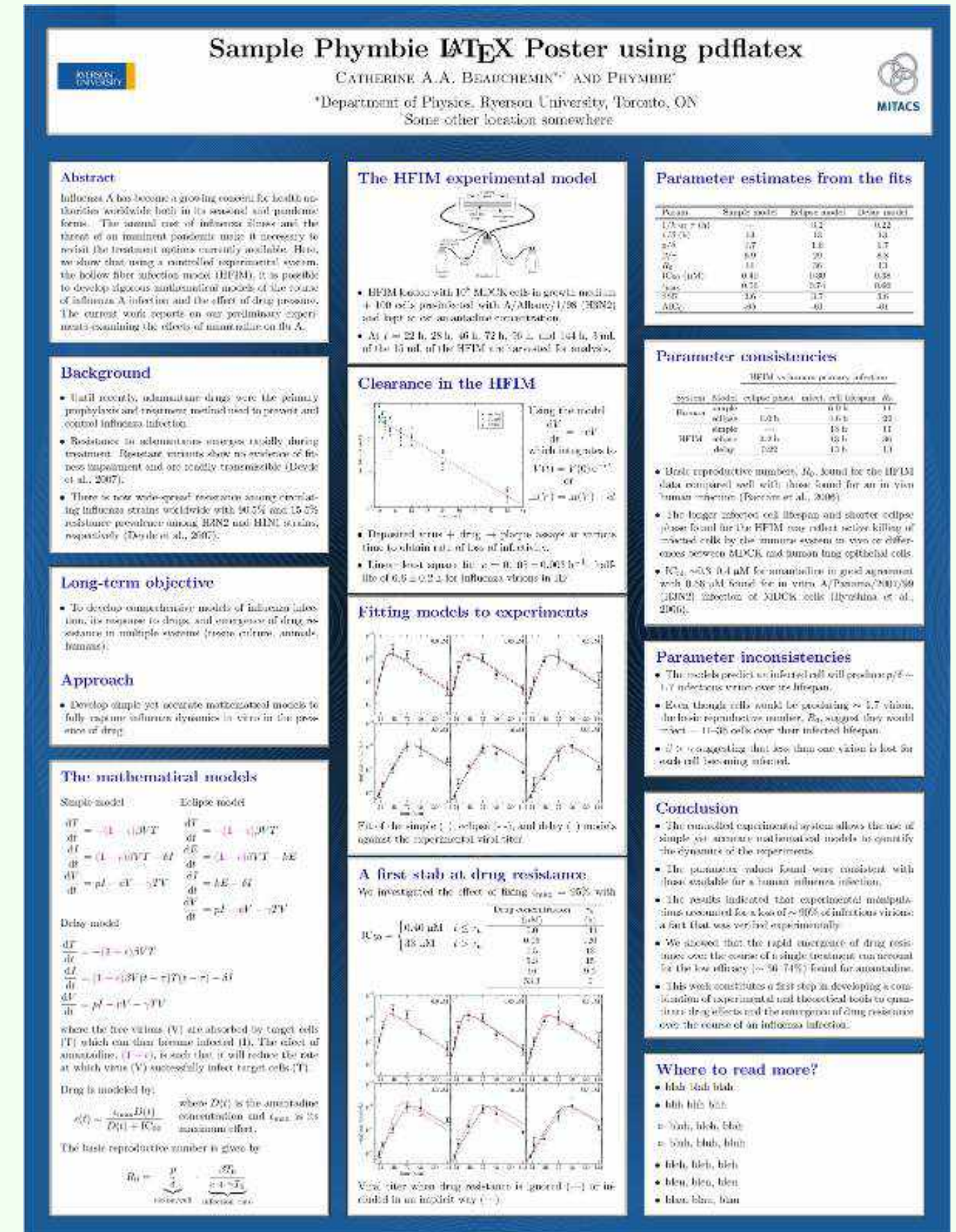
$$T_{\text{rel}}(G_n; q) \leq T_{\text{rel}}(G_1; q) \prod_{k=2}^n T_{\text{rel}}(G_1; q_k^*).$$

References

- [1] N. Cancrini, F. Martinelli, C. Roberto, and C. Toninelli. Kinetically constrained spin models. *Probab. Theory Relat. Fields*, 140(3):349–364, 2006.
- [2] F. Chleboun, A. Faggionato, and F. Martinelli. Relaxation to equilibrium of generalised east processes on \mathbb{Z}^d : Renormalisation group analysis and energy entropy competition. *The Annals of Probability*, 44(3):1517–1565, 2016.

Tools: Beamer

But it will probably look like this....



Tools: Beamer

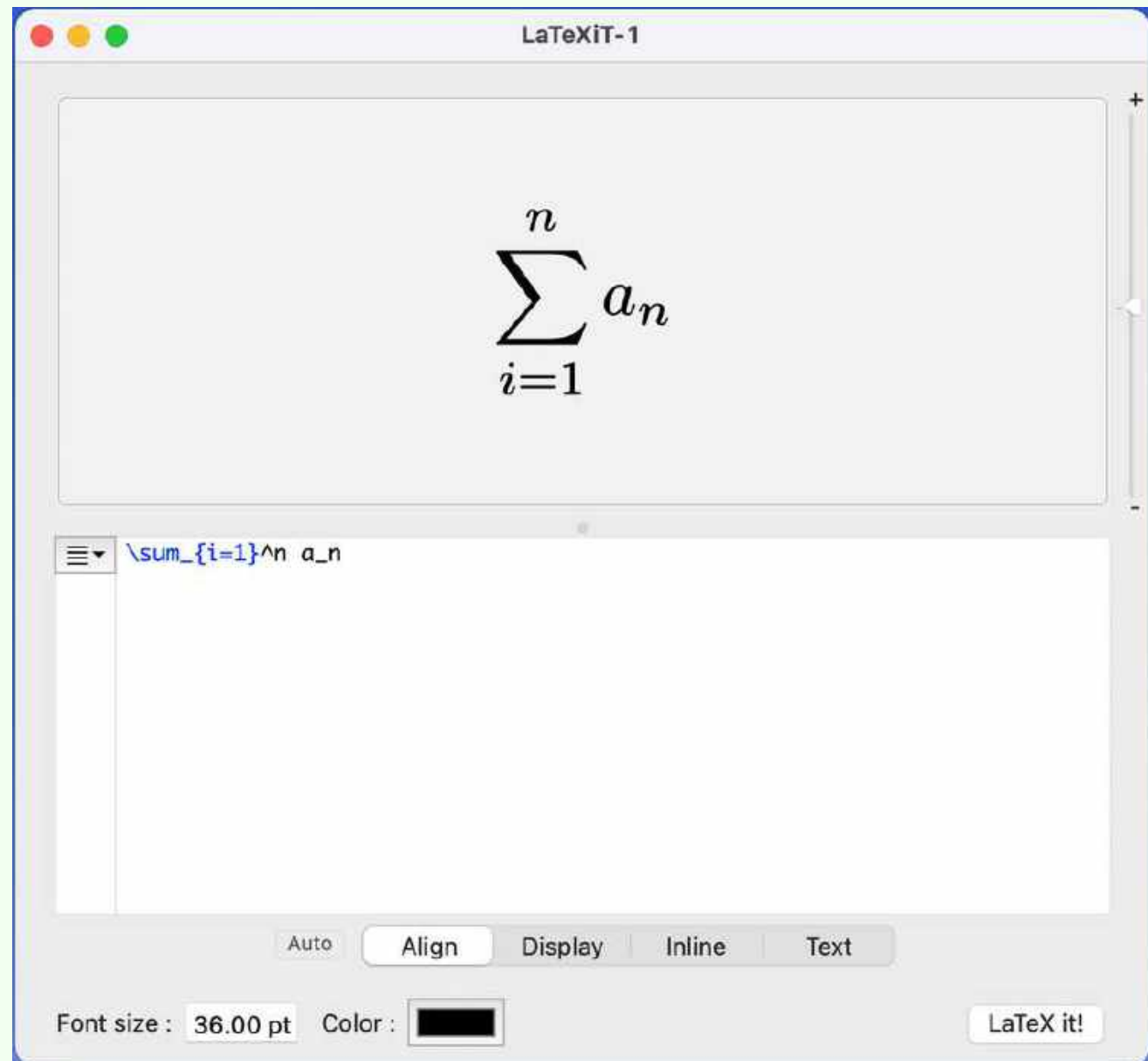


- Makes things look very pretty if you're a pro
- Can be coded to be exactly as you want it
- Easy to add equations
- Lots of templates available
- You'll fit in



- Makes things very ugly if you're not a pro
- Too easy to add too many equations
- Difficult to get the hang of
- You'll fit in

Tools: Extra

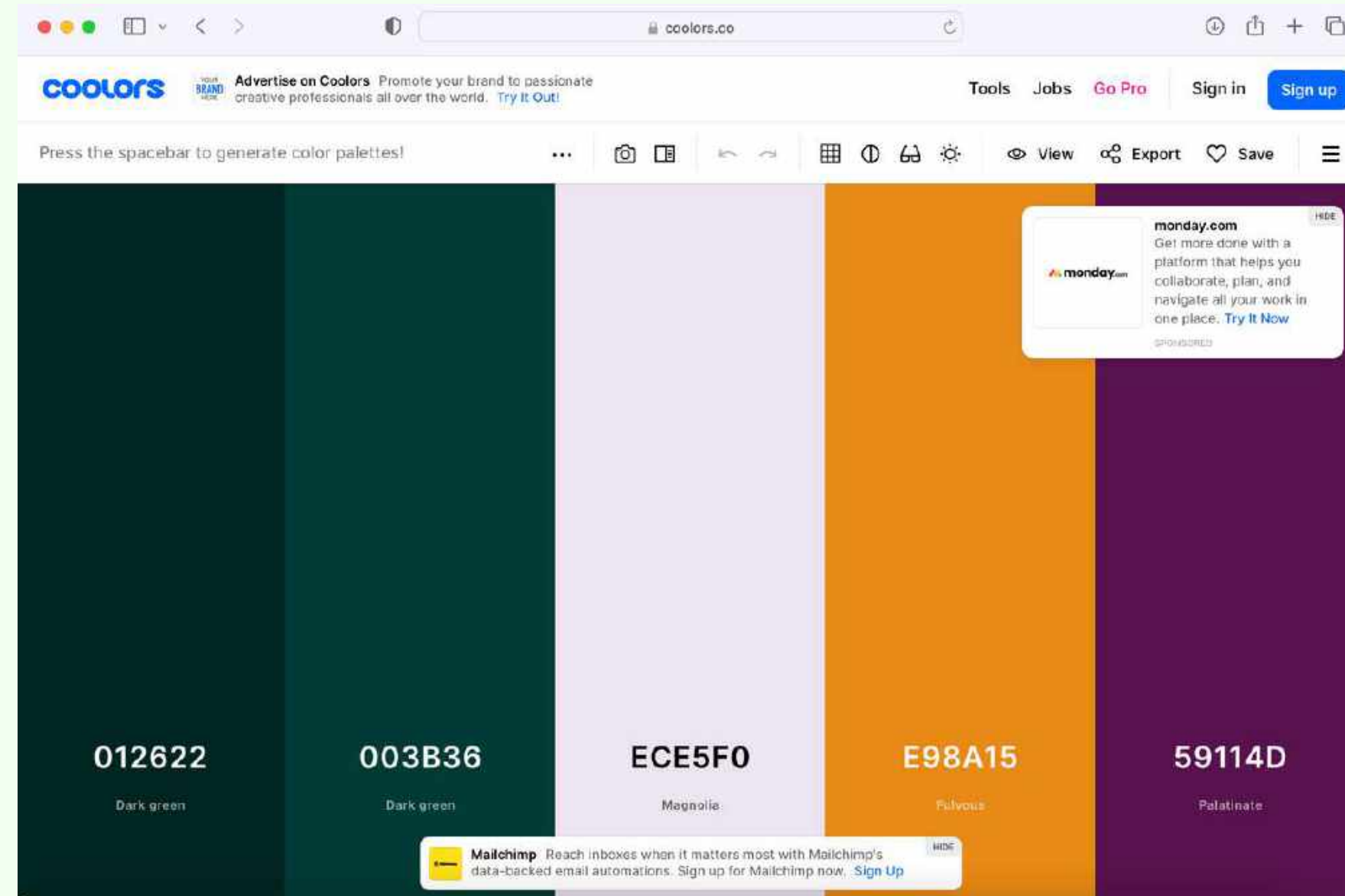


LaTeXiT (mac only)



latex2png.com

Tools: Extra



coolors.co

 **Design** 

Poster Size

- Check the conference requirements!
- If in doubt, go for A1

Accessibility

- Not an exhaustive list!
- Lots of resources linked in the end slide
- Some things to consider...

Accessibility



Use good colour contrasts and a readable font size

Contrast Checker

[Home](#) > [Resources](#) > Contrast Checker

Foreground Color

#FFFFFF

Lightness



Background Color

#000000

Lightness



Contrast Ratio

21:1

[permalink](#)

Normal Text

WCAG AA: **Pass**

WCAG AAA: **Pass**

The five boxing wizards jump quickly.

Large Text

WCAG AA: **Pass**

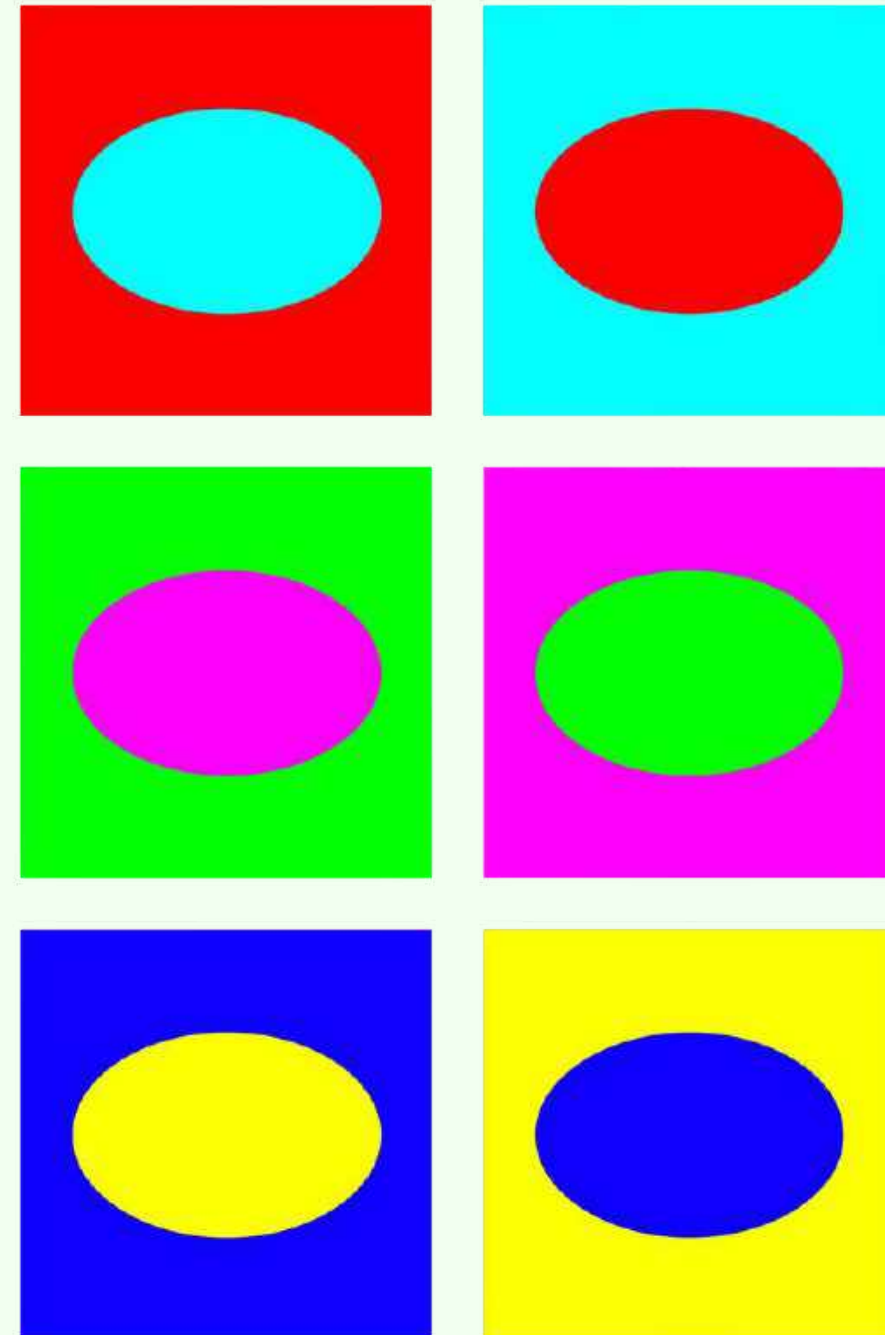
WCAG AAA: **Pass**

The five boxing wizards jump quickly.

Accessibility



Avoid using **bright**
contrasting
colours



Accessibility



Avoid only using
colour to convey
meaning



Use a combination
of colour, shapes
and text

Accessibility




Check what your
poster looks like
for colourblind
people

Choose File: [Upload Image](#) No File Chosen


Simulate your image by using the options below

DEUTAN	PROTAN	TRITAN	BLACK/WHITE
Green-Weak/Deuteranomaly	Red-Weak/Protanomaly	Blue-Weak/Tritanomaly	Monochromacy/Achromatopsia
Green-Blind/Deuteranopia	Red-Blind/Protanopia	Blue-Blind/Tritanopia	Blue Cone Monochromacy

Original



Simulated



Accessibility



Use large, bold, sans serif fonts on plain backgrounds



Don't underline words.

Orientation

- Requirements of the conference
- Not as simple as you'd think
- Stressing your main point

Source Optimisation for Brachytherapy Radiation Problems

Methods

Forward Model

- Radiation Transfer Equation simplified to diffusion.

$$-\nabla \cdot (A \nabla u(x)) = f(x)$$

f : Source
 u : Radiation Flux
 A : Tissue densities

- Simple domain model: tumour (T) and non-tumour (Ω/T).
- Finite Element Method

Optimisation Process

- Cost Functional

$$J(u, f) = \frac{1}{2} \|u - d_T\|_{L^2(\Omega)}^2 + \frac{\alpha}{2} \|f\|_{L^2(\Omega)}^2$$

- Dose constraint:

$$d_T = \begin{cases} 1, & \text{in } T \\ 0, & \text{in } \Omega/T \end{cases}$$

- Lagrangian method for optimality conditions.
- Gradient Descent.
- Output: 'ideal' source function.

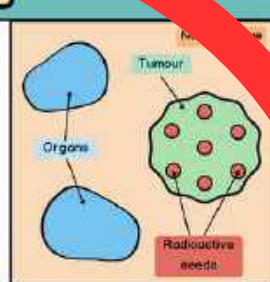
Using Mathematics to make Cancer Treatments Safer

The Problem

Brachytherapy: a type of cancer treatment where the radiation is implanted directly onto the tumour.

Issue: when the tumour is located close to critical organs, the radiation can damage them, causing further health complications.

Where to place the radiation to minimise the damage to critical organs while still treating the tumour?



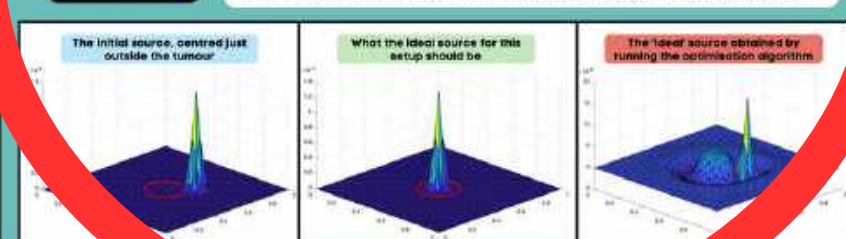
Results

Optimising the position of **one seed**. Unit square domain, with a circular tumour of radius 0.125 centred [0.5, 0.5].

The initial source, centred just outside the tumour

What the ideal source for this setup should be

The ideal source obtained by running the optimisation algorithm



The output f from the algorithm should have the same structure as the initial source. The expected f for a source with narrow

In reality, f is given by a **radial dose function** $g(r)$. Radiologists measured the radiation spread from the source and fit the data to a **quintic polynomial**

$$g(r) = a_0 + a_1 r + a_2 r^2 + a_3 r^3 + a_4 r^4 + a_5 r^5$$

Key Tool


PDE Constrained Optimisation

What's Next?

- The radiation source term has a certain shape that the current algorithm doesn't take into account.
- This shape would clearly give the position where the seed should go.
- The next step is to add shape constraints for f to this process.

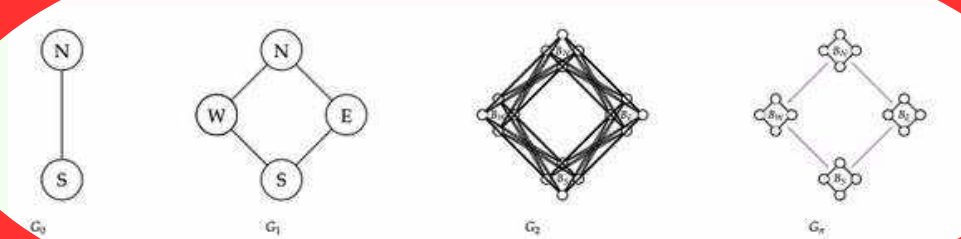
Jennifer Power

More Infol



THE GRAPHS OF WEATHER MODELS ON METEOROLOGICAL GRAPHS

Camille D. Harris & Paul Chleboun



Kinetically Constrained Spin Models

- We use graphs with kinetically constrained models (KCMs) to portray the dynamics of a system hindered by the presence of too many surrounding occupied sites.
- The chain attempts to update with rate 1, but updates are ignored unless the kinetic constraint is satisfied.
- The key features of interest of these systems is the relaxation to equilibrium and the fluctuations in a stationary state. We will be looking into the former.

Main Results

We are interested in the dynamics as the process relaxes to equilibrium i.e. the smallest positive non-zero eigenvalue of the generator (rates matrix Q). The relaxation time is also the inverse of the spectral gap.

The Relaxation time for G_1

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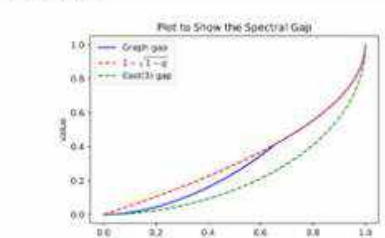


Figure 4: A plot showing the spectral gap.

We can compare this result with the results found by Cancrini et. al. [1].

Iterative Bound for the n^{th} Relaxation Time

We have also used the hierarchical nature of the process to find an iterative bound for the n^{th} relaxation time.

Take the process on the graph G_n . For all $q \in [0, 1]$, define $p_n^* = (1-q)^{4n}$ and $q_n^* = 1 - p_n^*$. We can bound the relaxation time on the graph G_n above by the product of relaxation times on the graph G_1

$$\tau_{rel}(G_n; q) \leq \tau_{rel}(G_1; q) \prod_{k=2}^n \tau_{rel}(G_1; q_k^*)$$

References

[1] N. Cancrini, F. Martinelli, C. Roberto, and C. Tonasso. Kinetically constrained spin models. *Probab. Theory Stat.* 19(4):431-454, 2004.

[2] F. Chleboun, A. Faggionato, and F. Martinelli. Relaxation to equilibrium of generalized east processes on \mathbb{Z}^d : Renormalisation group analysis and energy entropy competition. *The Annals of Probability*, 48(5):1817-1860, 2020.

Figure 1: An accepted update at rate p .

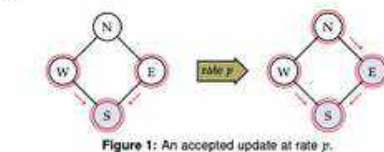


Figure 2: An accepted update at rate q .

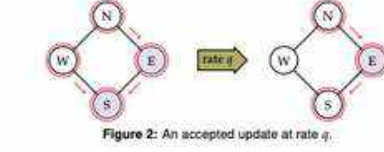
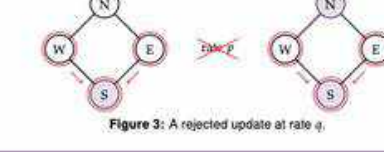


Figure 3: A rejected update at rate q .



Horizontal

	Title	
	Main Takeaway: What you want to emphasise	

Additional Nice
to Have info

Title	Main finding translated into plain English, important words in bold
Problem setup + methods	

Vertical

Title	
Model	
Info	Info

Title	
Info	Info
Info	Info

Template dangers



If you start with a rigid template you can get stuck into a specific design



Instead, start on paper, and find a template that matches you

Template dangers



Using Beamer
templates can be
confusing



Make sure you fully
understand the
template and change
templates if you can't

Template dangers



Sometimes canva and powerpoint templates aren't appropriate for a scientific poster



Avoid these templates and find one that's more appropriate



**Get a friend to
check your poster!**



**You should be ready at
this point but you can
always add...**





Sparkle



Sparkle

Colour scheme:

- Do you have a personal brand?

The Symbiotic Contact Process on Random Trees

Carmen C. van-de-l'Isle
Supervised by Marcel Octelese,
and Sarah Penington

UNIVERSITY OF BATH

The Model

Particles

- Sites take values A , B , AB , or \emptyset representing having disease A , disease B , both, or neither.
- Infections of each disease occur independently at rate λ .
- Recoveries occur at rate 1 if only one type is present or more slowly (at rate μ) if a site has both diseases, hence the symbiotic name.
- The model lives on a Galton-Watson tree with offspring distribution L . Model has been studied on a lattice.

Infections

A infections

B infections

Deaths

Symbiotic Deaths

The Contact Process

- The contact process is a simpler disease model with only one disease present.
- Sites take value \emptyset (uninfected) or 1 (infected).
- Infections occur at rate λ multiplied by the number of infected neighbours.
- Recoveries occur at rate 1.

Our Aims

We want to compare the critical values of the symbiotic contact process with those of the contact process. By use of a simple coupling with the contact process, it is easy to show that for all $\mu < 1$

$$\lambda_1(\mu) \leq \lambda_1^c \quad \text{and} \quad \lambda_2(\mu) \leq \lambda_2^c$$

We want to prove that this inequality is strict.

Critical Values

Weak survival is the event that for every time t , at least one A infection and at least one B infection remains on the tree. For the contact process, weak survival is the event that at least one infection remains at every time. We define the weak critical values for each process to be

$$\lambda_1(\mu) = \inf\{\lambda: P(\text{Weak Survival}) > 0\}$$
$$\lambda_1^c = \inf\{\lambda: P(\text{Weak Survival}) > 0\}$$

We define strong survival to be the event that the root of the tree is infected Δ_n (for the symbiotic contact process) or infected (contact process) infinitely often.

$$\lambda_2(\mu) = \inf\{\lambda: P(\text{Strong Survival}) > 0\}$$
$$\lambda_2^c = \inf\{\lambda: P(\text{Strong Survival}) > 0\}$$

Weak Survival

Theorem 1: Let ξ have an exponential tail. For small values of μ ,

$$\lambda_1(\mu) < \lambda_1^c$$

- This means that there exists an infection rate where the contact process doesn't survive but the symbiotic contact process does.
- This is proved by looking at a modified process where the infection can only be passed away from the root.

Strong Survival

Conjecture 1: Let ξ have an exponential tail. For small values of μ ,

$$\lambda_2(\mu) < \lambda_2^c$$

- We conjecture that a similar result holds for the strong survival parameter.
- Our aim is to prove this by analysing the survival time on a star. We then show that this infection can spread to a star further down the tree which can in turn reinfect the root. This is based on methods used by Huang and Durrett.

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Engineering and
Digital Sciences
Research Support

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[1] P. Huang and R. Tan, The symbiotic contact process, *Electronic Journal of Probability*, 2008(13): 1-10.

[2] X. Huang and A. Sennett, The Contact Process on Binary Graphs and Galton-Watson Trees, 2010.

people.bath.ac.uk

Carmen C. van-de-l'Isle
Integrated PhD Statistical Applied Mathematics

HOME WHAT I'M UP TO POSTERS CONTACT

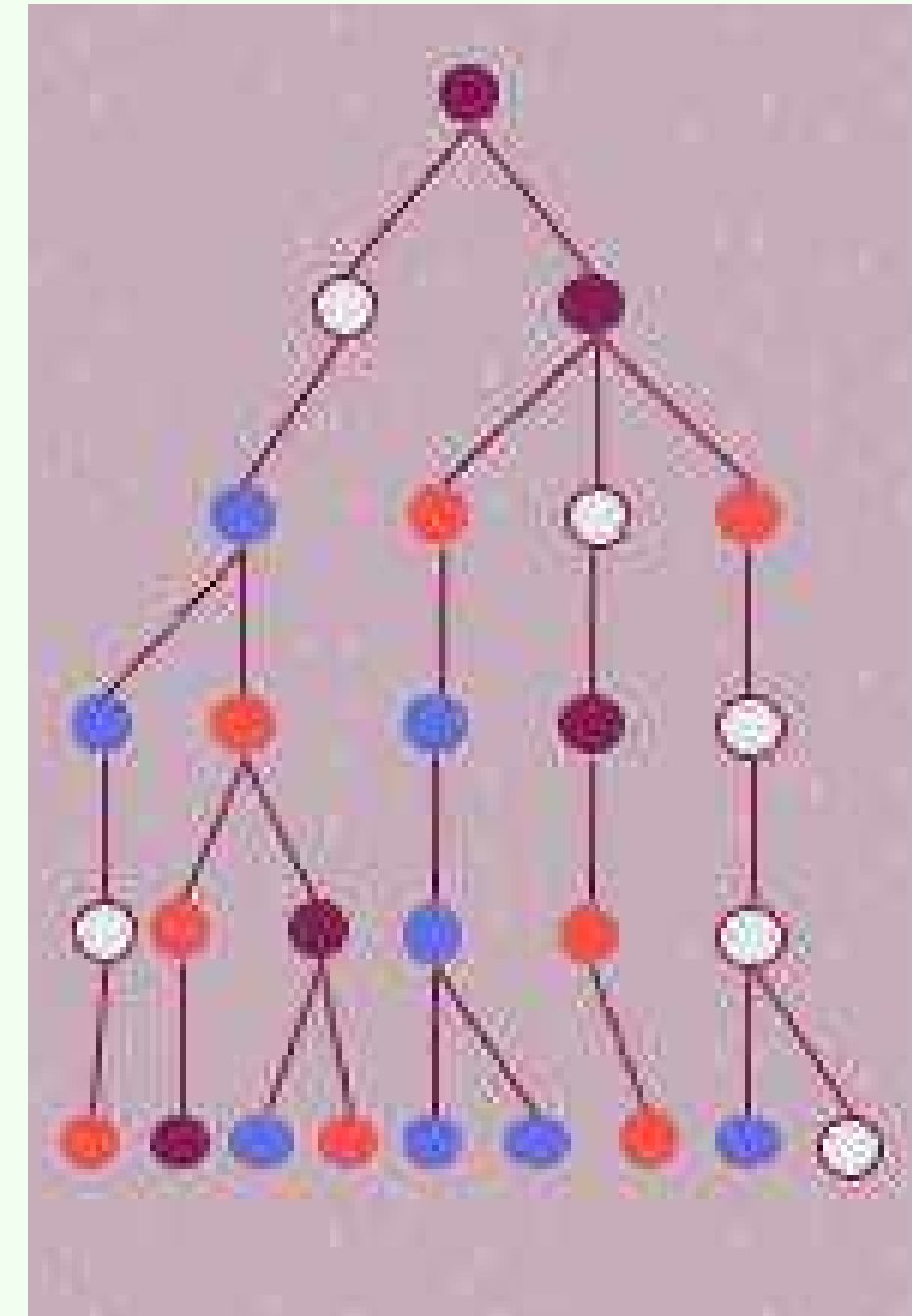
The Symbiotic Contact Process on Random Trees

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Sparkle

Colour scheme:

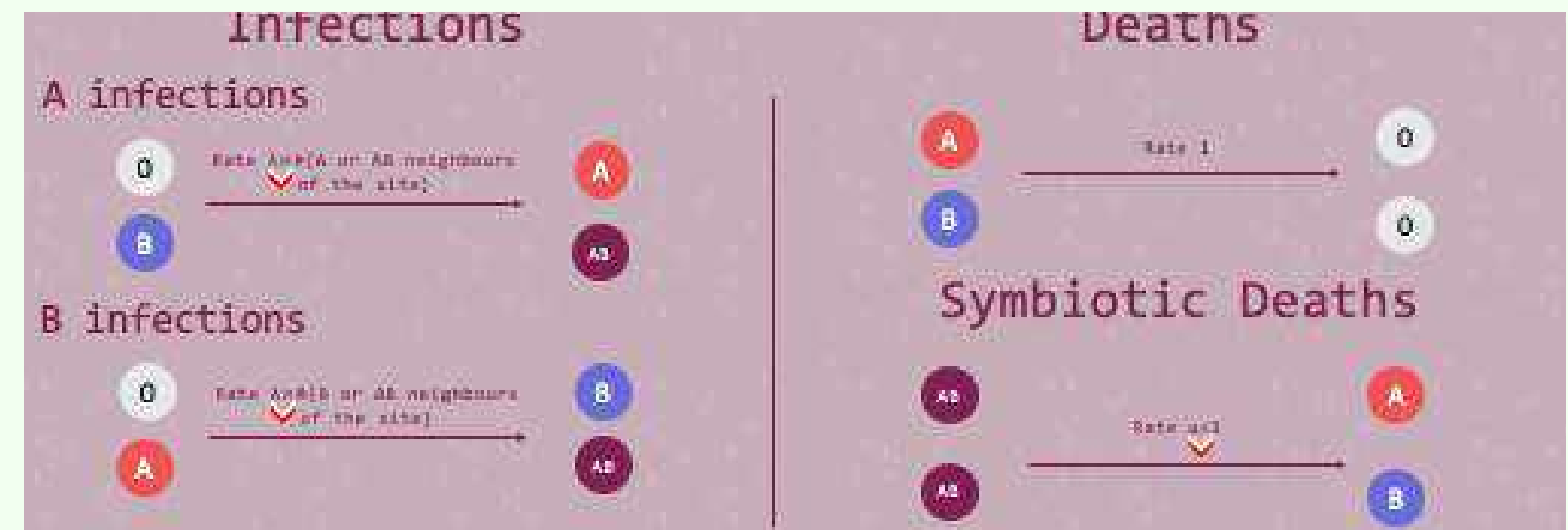
- Do you have a personal brand?
- Did you match your plots with your colour scheme?



Sparkle

Colour scheme:

- Do you have a personal brand?
- Did you match your plots with your colour scheme?
- Do your small icons match?



Sparkle

Funky things:

- Can you have alternative bullet points?

- ☢ The radiation source term has a certain shape that the current algorithm doesn't take into account.

Sparkle

Funky things:

- Can you have alternative bullet points?
- Could you add any cute cartoons/icons?

Optimising embryo freezing

Vitrification (freezing) preserves embryos using liquid nitrogen for rapid cooling.

Faster cooling correlates with **better survival rates**.

However, vitrification protocol is open to interpretation. Clinicians can freeze **variable numbers** of embryos together, in **different arrangements**.

Is there an optimal setup for vitrification?



Key Tool

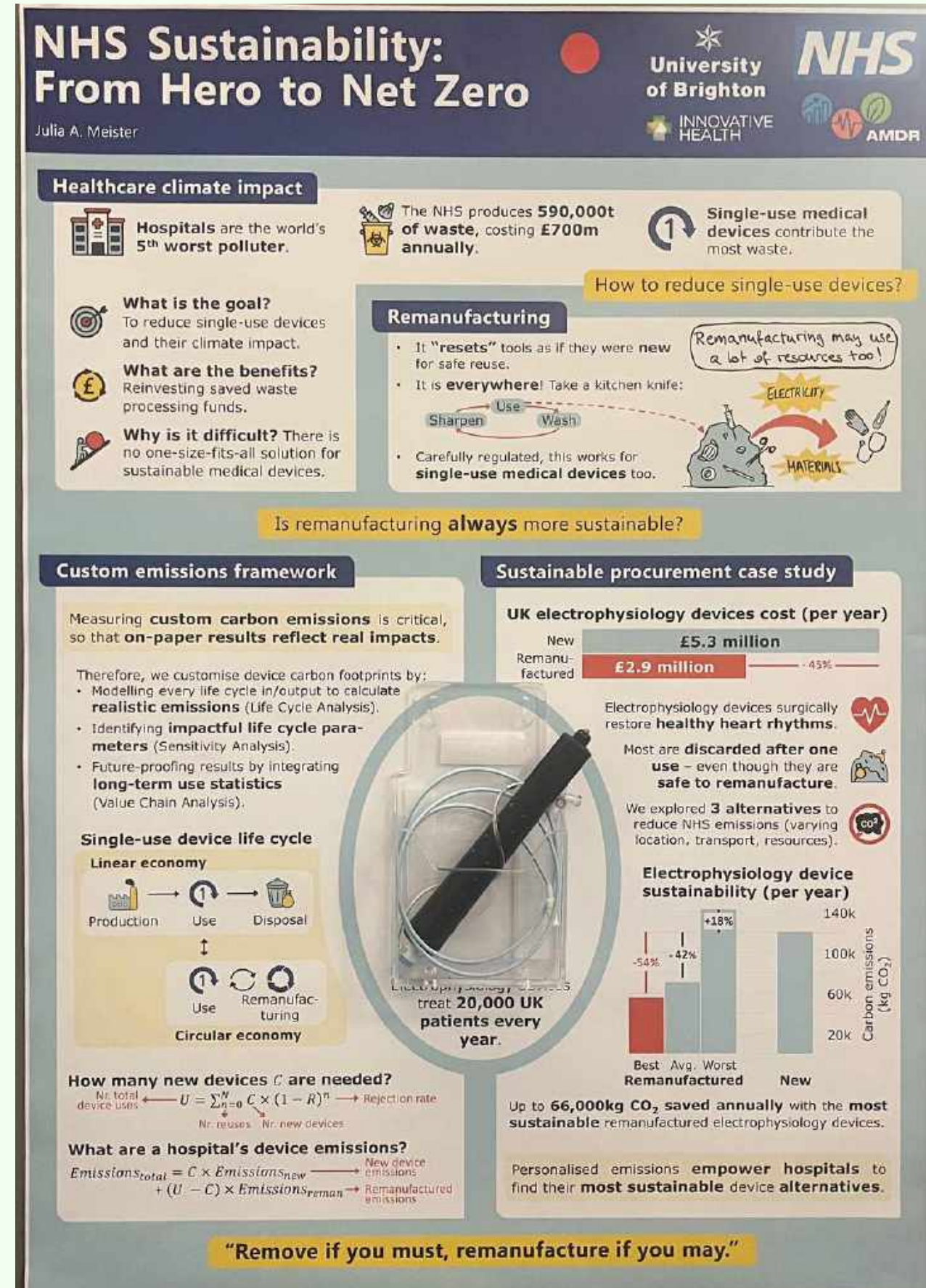


PDE Constrained
Optimisation

Sparkle

Funky things:

- Can you have alternative bullet points?
- Could you add any cute cartoons/icons?
- Could you bring a prop?



3.

**Presenting
your Poster**




How to Print your Poster

Full Info: www.bath.ac.uk/guides/printing-a-poster/

Email print@bath.ac.uk and include

- PDF of your poster
- The size you want
- How many copies
- Paper type (200gsm, 90gsm or fabric)
- When you need it by
- Agresso purchase order



If using your TSF to pay for the poster, you will need an Agresso PO. Only Lou can raise this. She will need to know the price.

Size	Dimension	1-10
A0	841mm x 1189mm	£30.00
A1	594mm x 841mm	£20.00
A2	420mm x 594mm	£12.50
A3	297mm x 420mm	£5.00

We recommend:

A Poster Tube



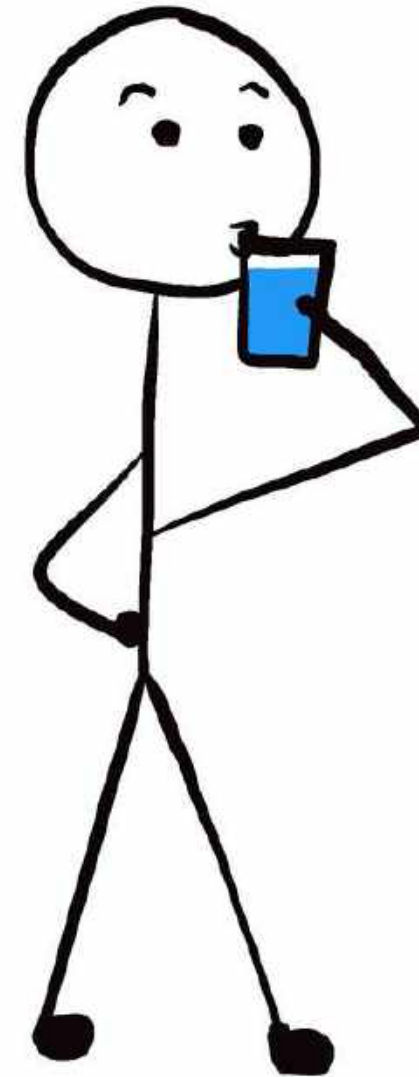


Carmen and Jenny's Top Tips

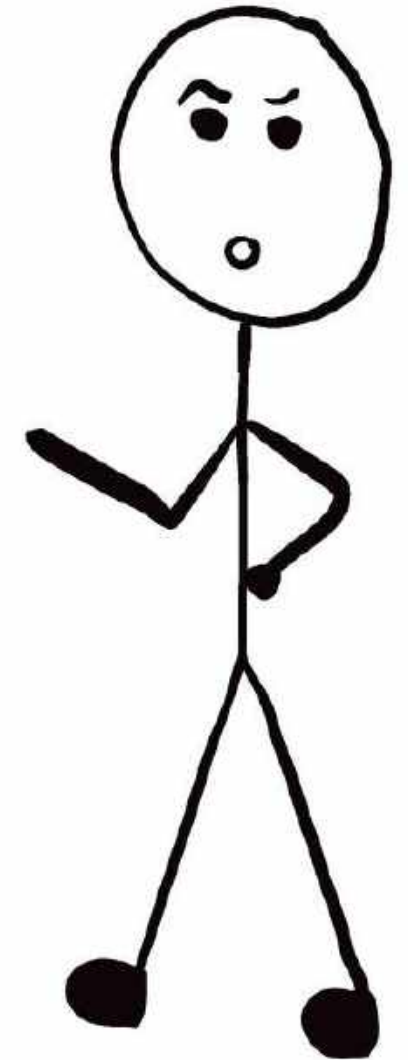


**Have a drink with
you**

Brain Processing



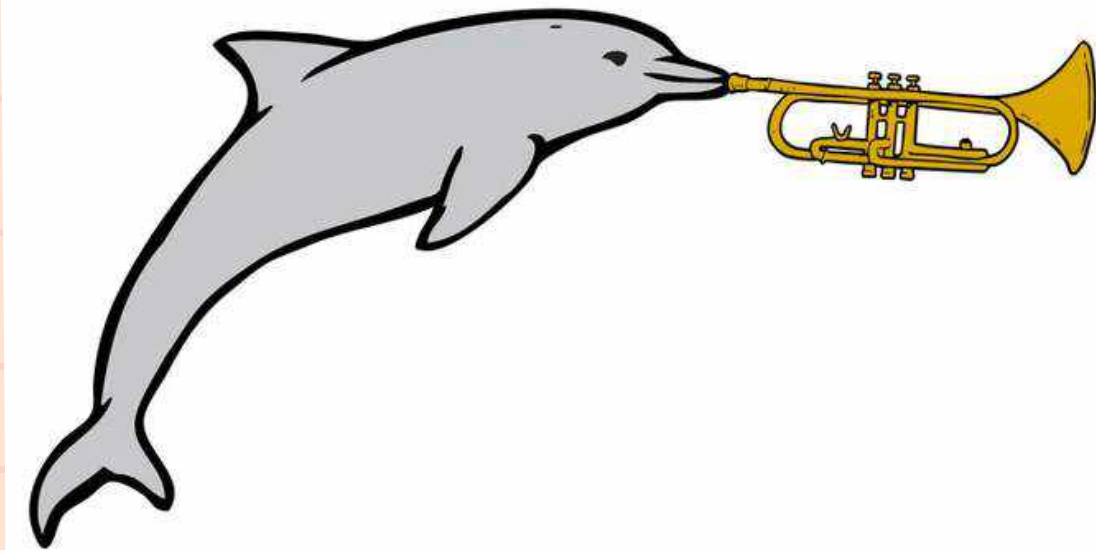
A question I need
to think about



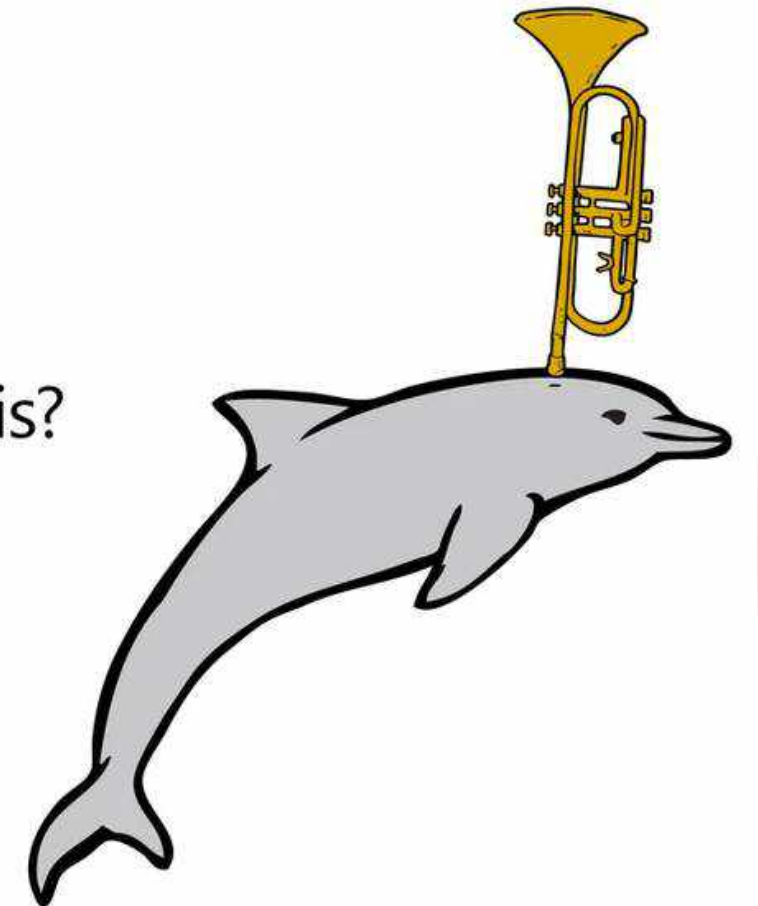


Have conversation starters

Would a dolphin play the trumpet like this:



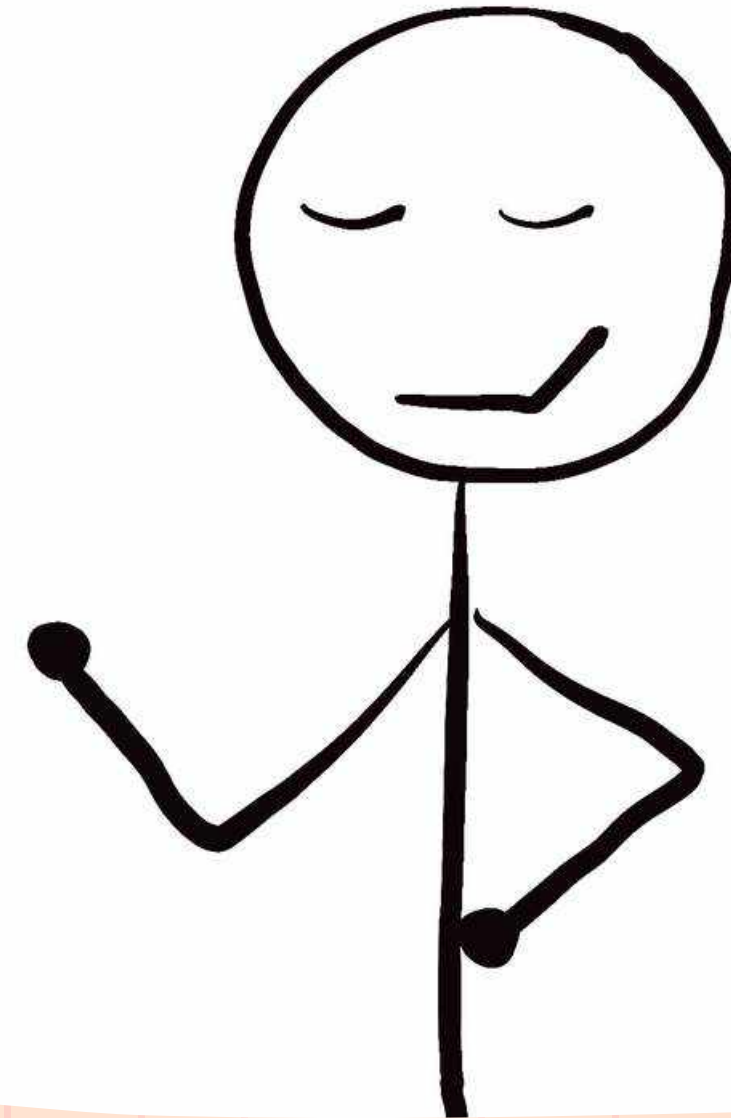
...or like this?





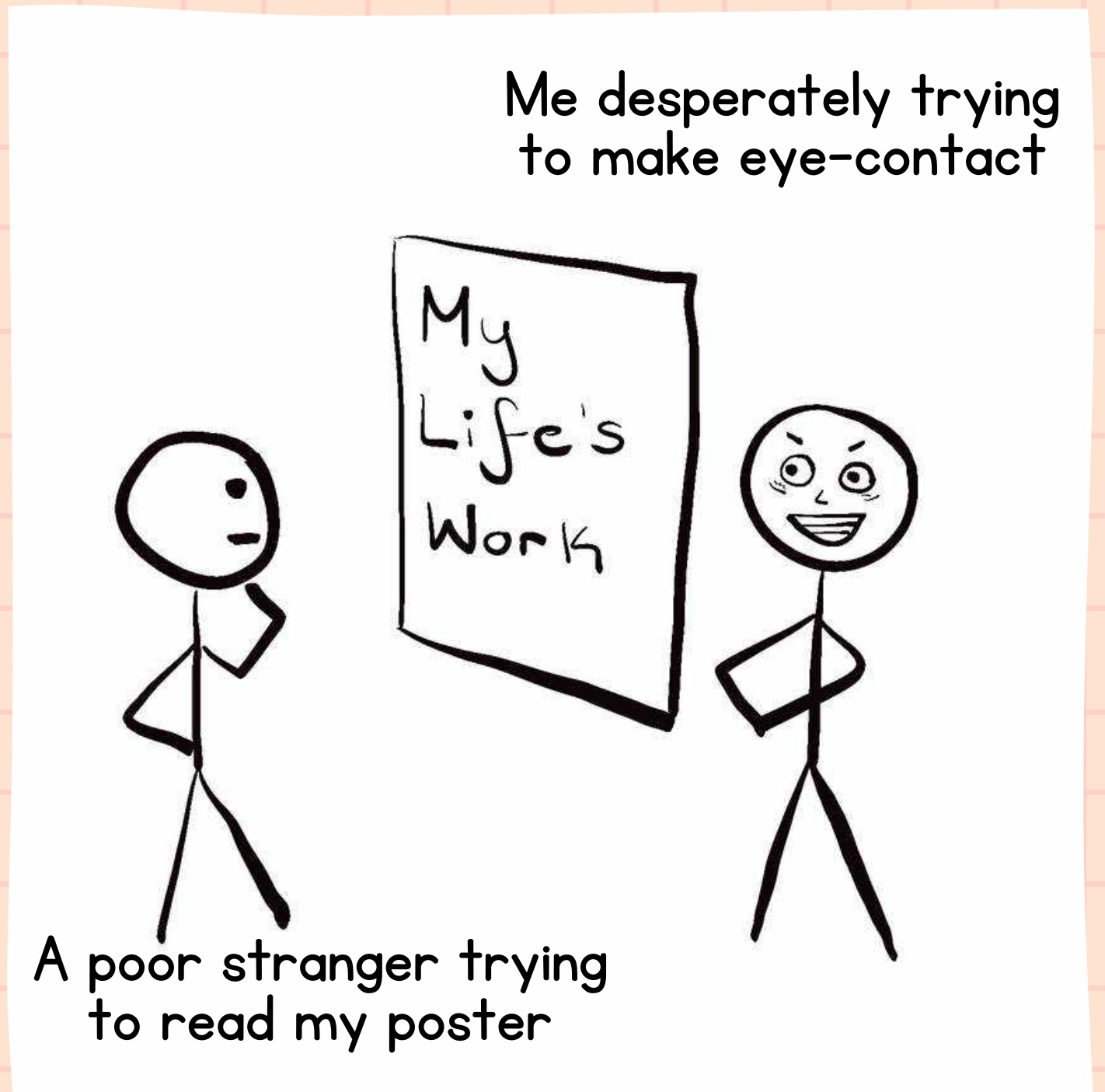
**Prep the
Tell me about
your poster
question**

Well I'm so glad you
asked





Don't be a creepy!





**Don't be on your
phone**



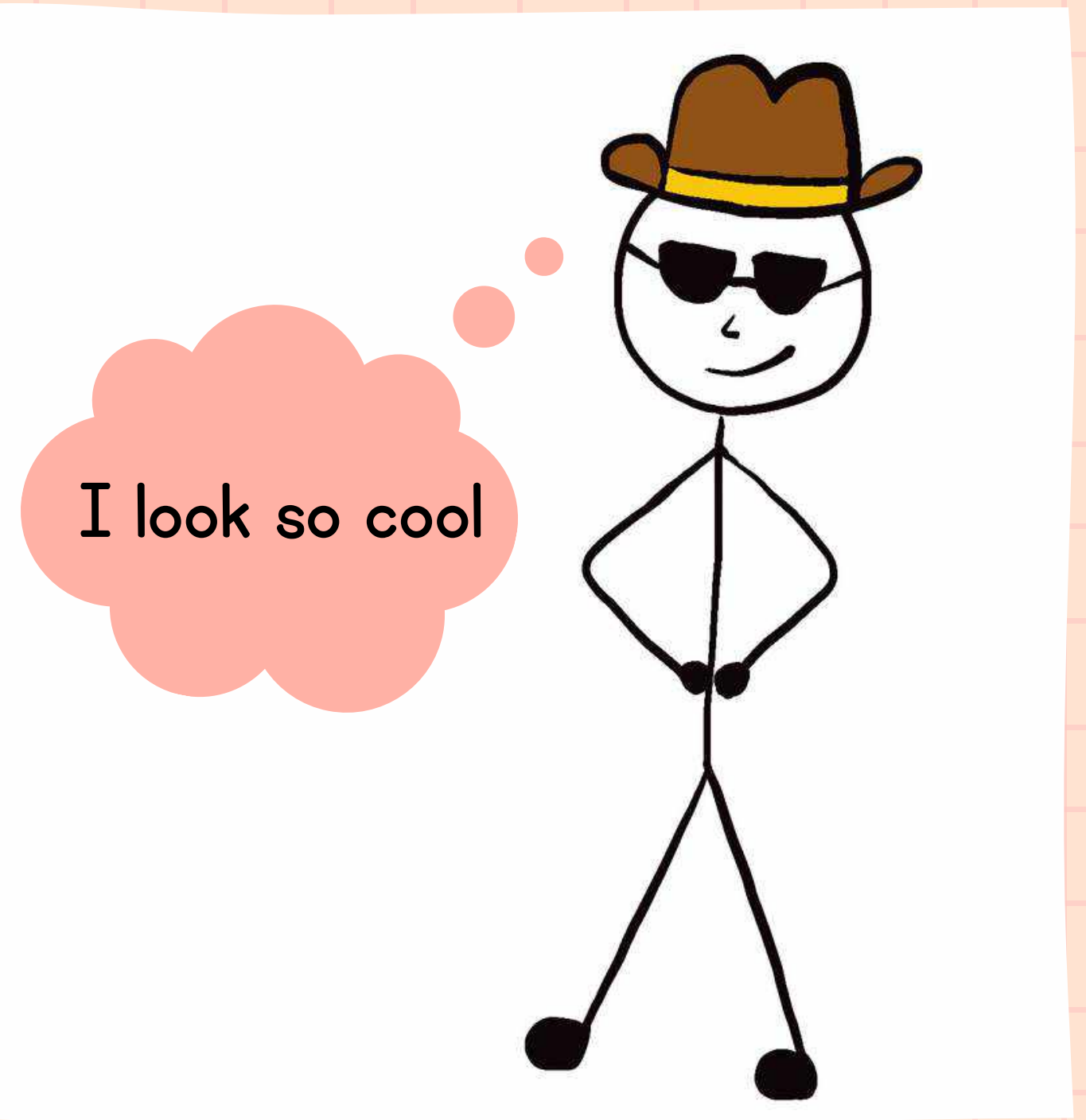
**Remember you're
the expert!**



**Don't be afraid of
questions ~ it's okay to
answer a question
with an I don't know**

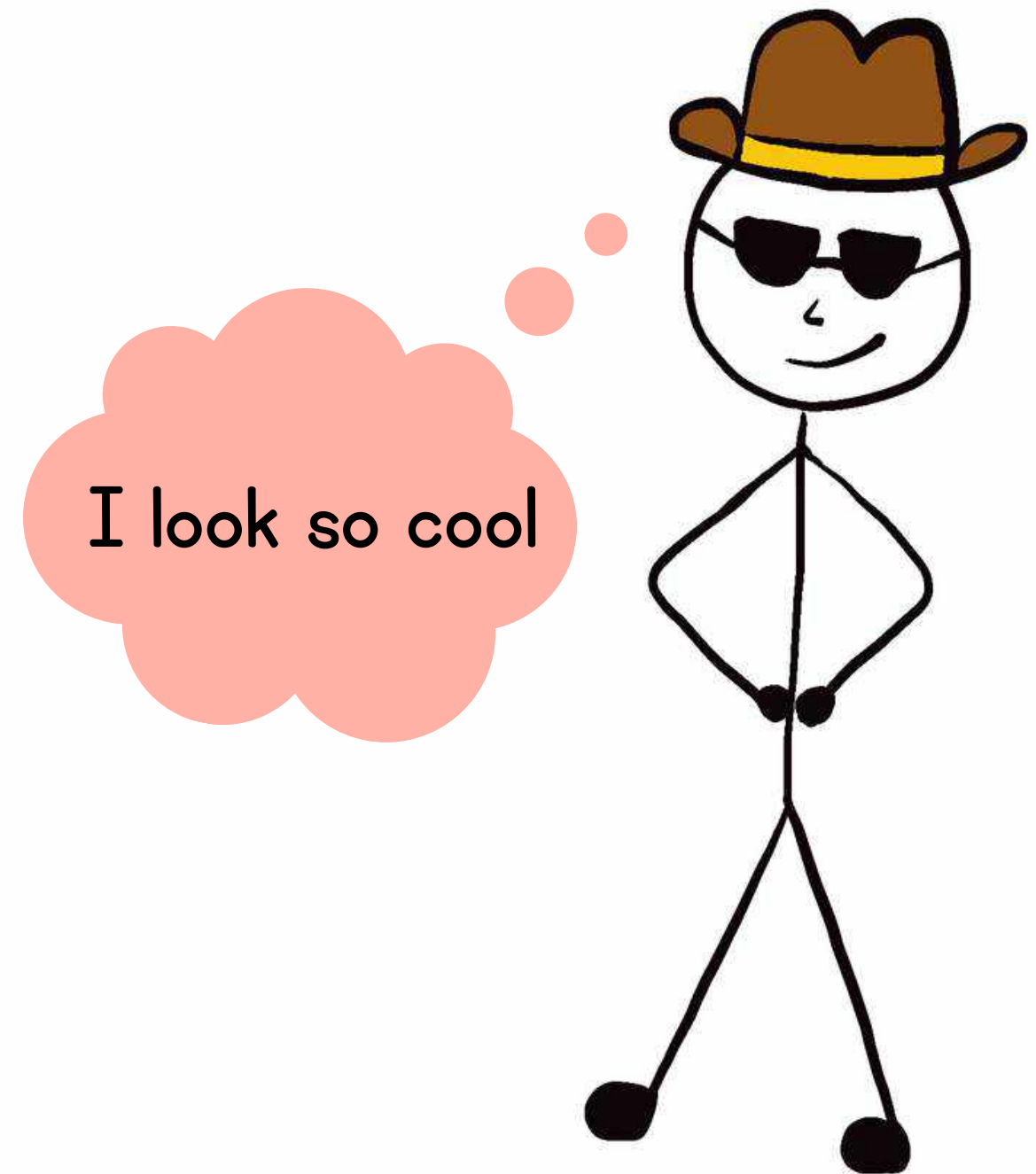


**Wear something
you feel
confident in**





**Wear something
you feel
confident in**

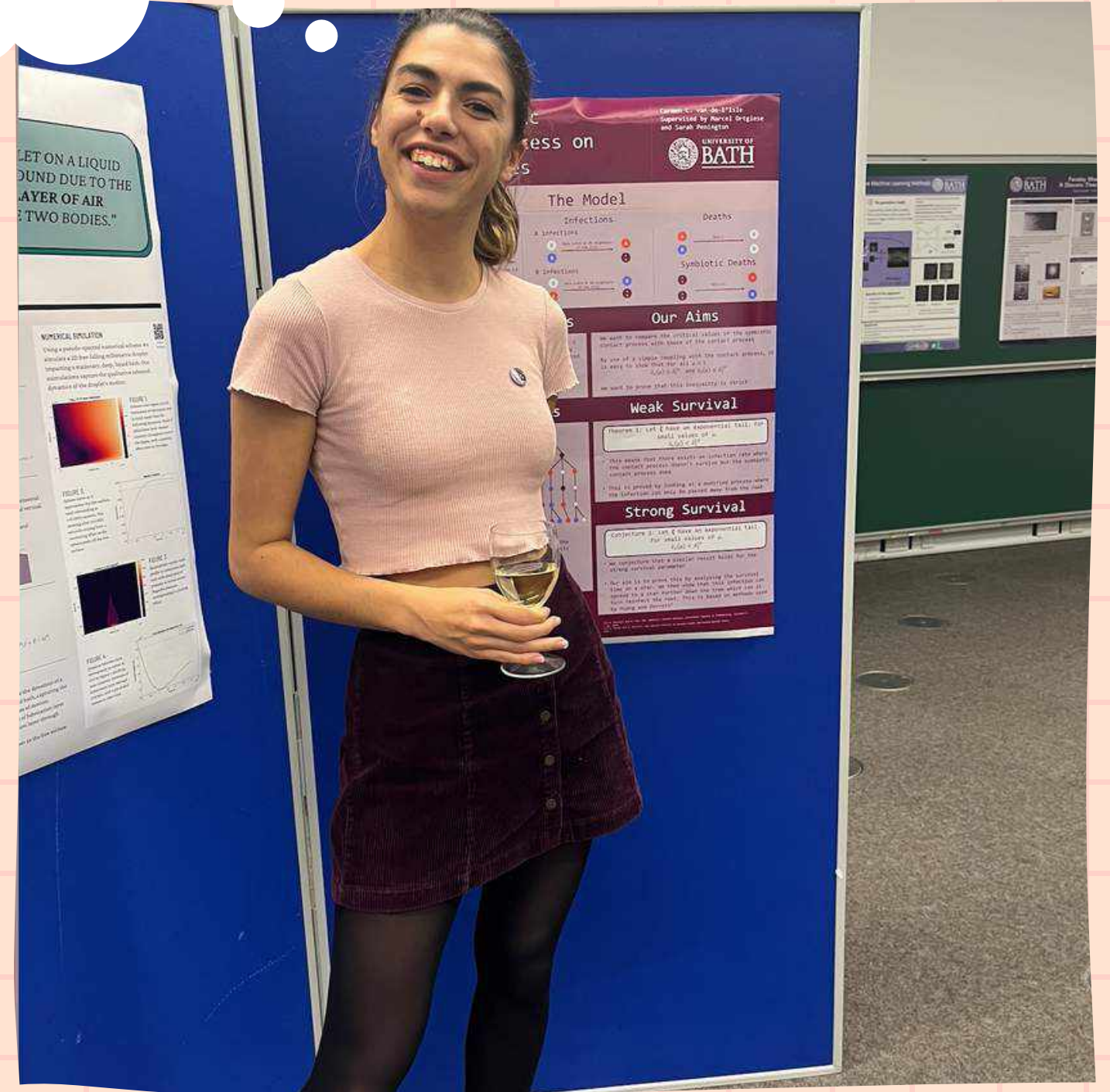


or even better...



Match your poster!

I look so cool





Do not patronise



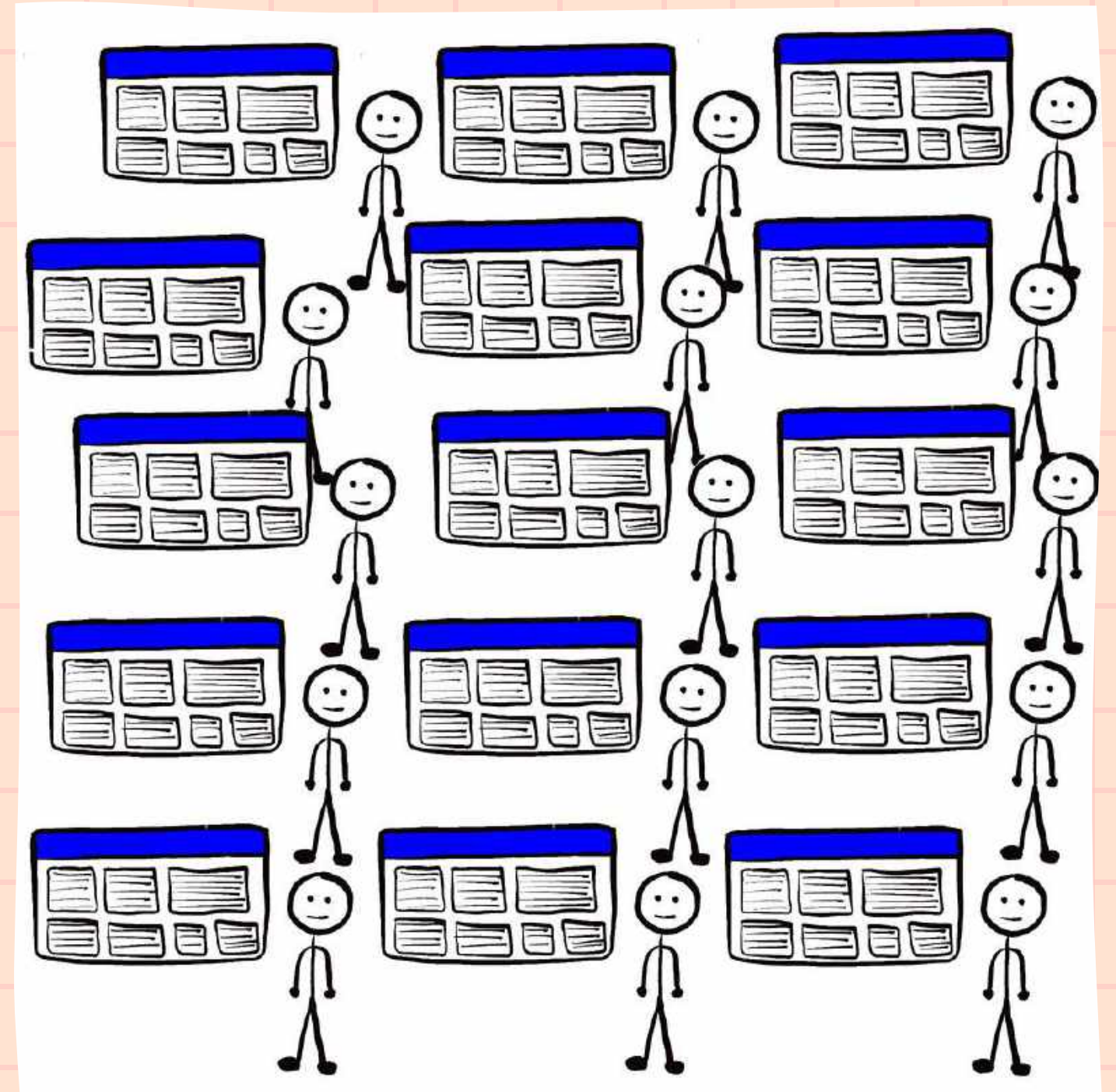
Don't get frustrated

WHEN YOU'VE GOT A DEEP RAGE
BURNING INSIDE YOU BUT YOU'VE
GOT TO ACT NICE BECAUSE YOU'RE AT WORK...





**Remember Bath
maths has a high
standard of posters**



So much Beamer Blue...

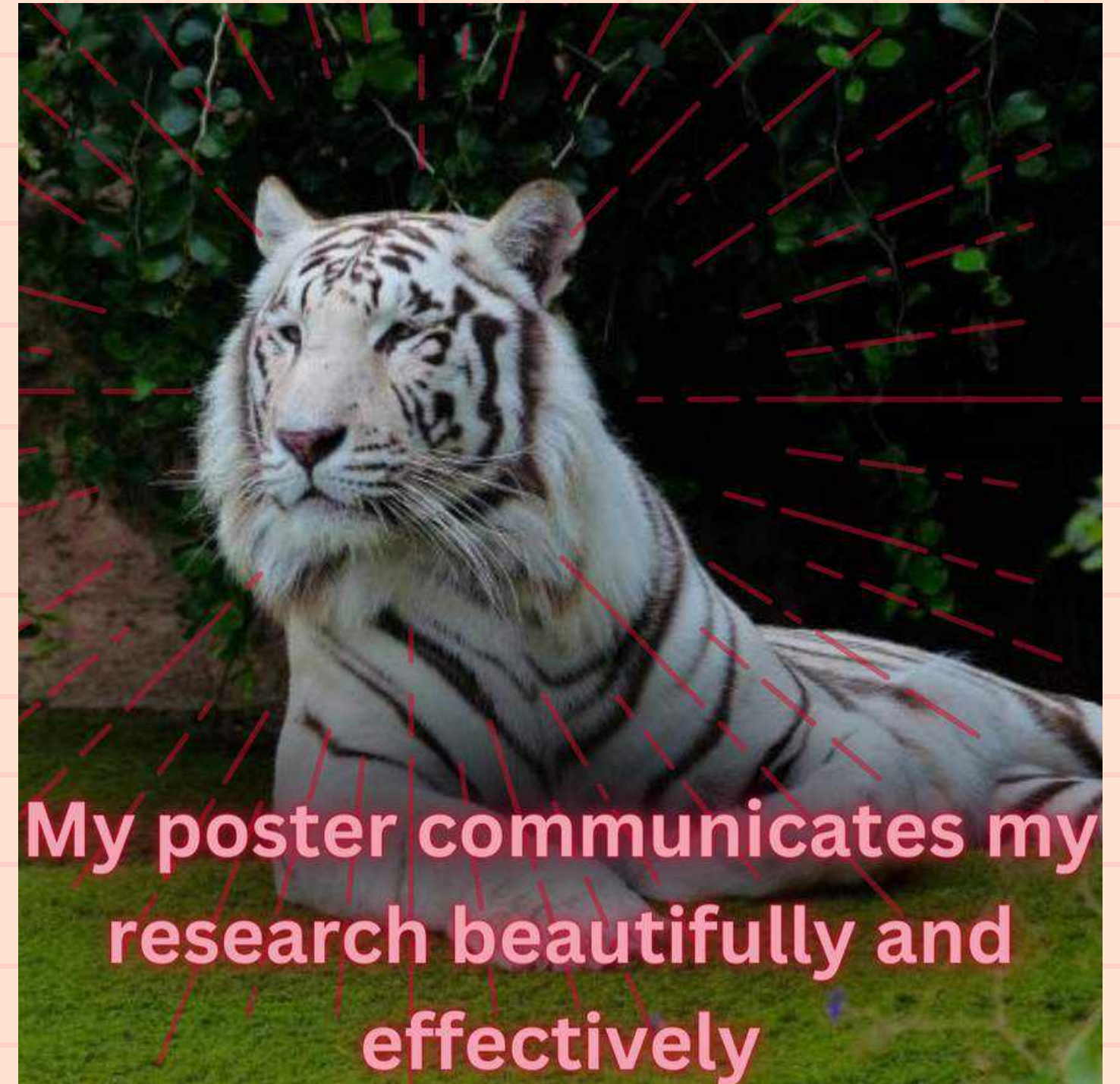


**Try to reuse your
poster**





Enjoy yourself!



**My poster communicates my
research beautifully and
effectively**

Resources

- **Colourblind simulator:** <https://pilestone.com/pages/color-blindness-simulator-1>
- **Designing for Accessibility Gov:**
<https://accessibility.blog.gov.uk/2016/09/02/dos-and-donts-on-designing-for-accessibility/>
- **Diverse Learning:** <https://www.cla.co.uk/blog/higher-education/practical-steps-for-accessible-content-designing-for-diverse-learners>
- **Mike Morrison:** <https://www.youtube.com/watch?v=SYk29tnxASs>
- **Latex to Image:** <https://latex2image.joeraut.com/>
- **Colour Contrast Checker:** <https://webaim.org/resources/contrastchecker/>