

How to give a mathematics talk

A meditation on the sentence

Buffalo buffalo Buffalo buffalo buffalo buffalo Buffalo buffalo

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THE BIG NO-NOS!!!

i.e. common mistakes when you give your first talks

- ▶ Don't speak faster just because you want to say more! make suitable choices about what to say and what not
- ▶ Don't overrun
- ▶ Don't speak towards the board
- ▶ Don't whisper
- ▶ Don't number formulas in slides, rather write it on the board and keep it there or rewrite it
- ▶ Don't read from notes (or learn it by heart)
- ▶ Biggest mistake of all: lack of appropriate intro ...
- ▶ ...which is related to: don't assume too much of your audience
- ▶ No crowded slides (Not too many formulas)

$$\begin{aligned}
 k &= \frac{1}{4\pi\epsilon_0\epsilon_r} \quad Z = Z_0 \cdot \frac{\mu_r}{\epsilon_r} = \frac{\Delta \cdot d \cdot \Delta t}{f \cdot \frac{f}{c} \cdot \frac{d}{c}} = \frac{\Delta t}{f} \cdot \frac{c}{d} \cdot \frac{d}{c} = d \cdot m = N \cdot m_0 = \frac{Q}{f} \cdot \frac{M_m \cdot \phi_e}{\Delta t} \cdot \omega = 2\pi f \\
 \log \frac{L}{L_0} &= 4 \log \frac{T_{\text{eff}}}{K} + 2 \log \frac{R}{R_0} - 4 \log \frac{T_0}{T_0} \quad \frac{\sin \alpha}{\sin \beta} = \frac{v_2 \cdot m_2 \cdot \lambda}{v_1 \cdot m_1} = \frac{M_m}{M_m} \cdot \frac{v_2}{v_1} = \frac{M_r \cdot 10^3}{M_r} \cdot \frac{\Delta M_e}{\Delta \lambda} \\
 v_e &= \sqrt{\frac{3kT}{m_0}} = \sqrt{\frac{3R_m T}{M_m}} = \sqrt{\frac{3R_m T}{M_m \cdot 10^3}} \cdot \rho = \frac{E}{c} = \frac{hf}{c} = \frac{h}{\lambda} \cdot v = v_1 (1 + \beta \Delta t) \quad v_{\text{eff}} = \frac{U_m}{f} \int_0^1 \frac{1}{2\pi KL} \quad I = \frac{U_e}{R + R_i} \\
 I_m^2 &= U_m^2 \left[\frac{1}{R_c} + \left(\frac{1}{X_c} - \frac{1}{X_L} \right)^2 \right] \quad X_L = \frac{U_m}{I_m} = \omega L = 2\pi f L \quad \vec{F}_m = \vec{B} I L = \mu_0 I_1 I_2 \vec{z} \quad \vec{F}_z = \frac{m_1 m_2}{r^2} \vec{z} \\
 R &= R_0 \sqrt{A} \quad E = mc^2 \quad E_k = \frac{1}{2} m v^2 \quad \beta = \frac{\Delta I_c}{\Delta I_s} \cdot \rho = \frac{F}{\Delta S} = \frac{m \Delta v}{\Delta S \Delta t} \quad \vec{B} = \mu_0 \frac{NI}{L} \quad R = \rho \frac{L}{S} \quad M = \vec{F} d \cos \alpha \\
 M_0 &= \frac{4\pi^2 r^3}{3} \quad v = \frac{m \hbar}{8mL^2} \quad \phi_e = \frac{L}{\phi} \quad U = W_{AB} = |E_{PA} - E_{PB}| = |E_A - E_B| = |E_A - E_B| \quad \rho = m \cdot c \Delta t \quad P = nRT \\
 \vec{F}_d &= M_{1z} \frac{v^2}{r} = M_{2z} \frac{v^2}{r} \quad \vec{F}_x = \frac{1}{2} C_x \rho \int_0^{2\pi} \int_0^{\Delta L} \nabla \times \left(\frac{\partial \vec{B}}{\partial t} \right) = \frac{\partial}{\partial t} (\text{rot } \vec{B}) = -\mu_0 \frac{\partial}{\partial t} \left(\frac{\partial \vec{B}}{\partial t} \right) = \epsilon_0 \mu_0 \frac{\partial^2 \vec{E}}{\partial t^2} \int_0^{\Delta L} \vec{e} = \frac{1}{2\pi} \frac{\mu_0}{L} \\
 v_k &= \sqrt{\frac{R M_z}{\rho_a}} \quad F_x = \frac{1}{2} C_x \rho \int_0^{2\pi} \int_0^{\Delta L} \nabla \times \left(\frac{\partial \vec{B}}{\partial t} \right) = \frac{\partial}{\partial t} (\text{rot } \vec{B}) = -\mu_0 \frac{\partial}{\partial t} \left(\frac{\partial \vec{B}}{\partial t} \right) = \epsilon_0 \mu_0 \frac{\partial^2 \vec{E}}{\partial t^2} \int_0^{\Delta L} \vec{e} = \frac{1}{2\pi} \frac{\mu_0}{L} \\
 F_y &= \int_0^{\Delta L} \frac{F_x}{R} \frac{1}{r} \frac{1}{\rho} \int_0^{2\pi} \int_0^{\Delta L} \sin(\omega t + \phi) dy \cdot \phi \cdot \vec{H} d\vec{l} = \int_0^{\Delta L} \left(\vec{J} + \frac{\partial \vec{D}}{\partial t} \right) \cdot d\vec{S} \quad \lambda = \frac{m \cdot c}{T} \quad L = 10 \log \frac{I}{I_0} \\
 u &= U_m \sin \omega(t - \tau) = U_m \sin 2\pi \left(\frac{t}{T} - \frac{x}{\lambda} \right) \quad E_k = \frac{1}{2} m v^2 \quad S = \frac{1}{A} \frac{dW}{dt} \quad F_g = \frac{M_0 M_2}{r^2} \quad v = \frac{1}{\sqrt{\epsilon_r \mu_r}} \\
 \int \vec{E} d\vec{l} &= - \int \frac{\partial \vec{B}}{\partial t} \cdot d\vec{S} \quad E_x = k \frac{Q_1 Q_2}{r^2} \quad \vec{\Psi} = \iint \vec{B} d\vec{S} = AD \quad \left(\frac{E_c}{E_0} \right)_{\parallel} = \frac{2 \cos \theta_1 \cos \theta_2}{\cos(\theta_1 - \theta_2) \sin(\theta_1 + \theta_2)} \\
 E &= \frac{F_e}{Q} = k \frac{Q}{r^2} \quad \oint \vec{B} d\vec{l} = \mu_0 \iint \vec{J} d\vec{S} \quad \vec{f}' = \frac{m_1 \cdot v_1}{(m_1 - 1)(v_1 - v_2)} \cdot \frac{m_2}{x} + \frac{m_2}{x'} = \frac{m_1 v_1}{r} \quad \vec{s} = \frac{1}{r} (\vec{E} \times \vec{B}) \\
 E_y &= E_0 \sin(kx - \omega t) \quad \beta = \frac{v_2}{v_1} (\alpha + \tau) + \vec{J} \cdot \vec{\phi} = \frac{2\pi \sin 2\alpha}{\lambda} \cdot y \quad B_t = \sqrt{\epsilon_0 \mu_0} E_0 \sin(kx - \omega t)
 \end{aligned}$$

$$\begin{aligned}
Q(x_k, \xi_{k+1}) &\simeq -\frac{\ell^2}{N} \sum_{i=1}^N |\xi_{k+1}^{i,N}|^2 - \sqrt{\frac{2\ell^2}{N}} \sum_{i=1}^N \frac{x_k^{i,N} \xi_{k+1}^{i,N}}{\lambda_i} + \left\{ \sum_{i=1}^k S_k^{i,N} \right\}^{1/2} \\
&\simeq -\ell^2 - \sqrt{\frac{2\ell^2}{N}} \sum_{i=1}^N \frac{x_k^{i,N} \xi_{k+1}^{i,N}}{\lambda_i} \sim \mathcal{N}(-\ell^2, 2\ell^2 S_k^N) \\
&\rightarrow [-z(t) - C\nabla\Psi(z(t))]d_\ell(S(t)) dt + \sqrt{g_\ell(S(t))} dW(t) \\
&= [z^2(t)f(t) - d_\ell(\sqrt{S(t)})] dt + \sqrt{g_\ell} dW_t \\
&\sim [f^3(t) - d_\ell^2(\sqrt{S(t)})]dt - \left(\sum_{i=1}^k e^{x_k^i} \lambda_i |\xi_{i,k}^N|^2 \right) dM_t
\end{aligned}$$

where

$$S^{(N)}(t) = (Nt - k)S_{k+1}^N + (k + 1 - Nt)S_k^N, \quad \frac{k}{N} \leq t < \frac{k+1}{N}.$$

converges to the solution of the system

$$dS(t) = A_\ell(S(t)) dt,$$

$$dz(t) = [-z(t) - C\nabla\Psi(z(t))]d_\ell(1) dt + \sqrt{g_\ell(1)} dW(t)$$

A basic frame for Bayesian statistics

- ▶ Bayes formula

$$\mathbb{P}(A|B) \propto \mathbb{P}(B|A) \mathbb{P}(A)$$

...probably this slide is a bit too existentialist

Variables of your problem

- ▶ Audience
- ▶ Content of talk
- ▶ Tools : slides, pointer, board etc (don't forget the underrated friend... the **VISUALISER!!!**)

Tools at your disposal

▶ Slides

- ▶ Role of slides: aid to your voice. People are not meant to listen and read at the same time!
- ▶ Slides are not there to remind you of what you want to say
- ▶ Aesthetics of slides doesn't matter too much when you talk to mathematicians. However, use of colours can be helpful

▶ Board

- ▶ If you are using the board then possibly write something on it beforehand
- ▶ Divide the board at the beginning to keep it tidy

▶ Visualiser Particularly useful when projecting on two screens

Audience

- ▶ Specialists in your area (rare occurrence)
- ▶ People from different communities → stating what is obvious to you is CRUCIAL
- ▶ **Industry**

Gather information about your audience before the talk

Content

- ▶ Think about what you really want to say, what is the message?
- ▶ Give it structure
 - ▶ Overview
 - ▶ Keep reminding audience of where you are with your plan of the talk
 - ▶ Summary / Take-home message
- ▶ Don't underestimate the value of telling people what they already know
- ▶ Give background, maybe some history, examples and *motivation*
- ▶ link the topic to other research areas/mention various points of view
- ▶ Be *clear*
 - ▶ clear vs precise/correct

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The technical part

Conveying technical aspects effectively requires **deep understanding**

Deep understanding relies on your ability to ask the questions
why? and **what if?**

- ▶ Present ideas (not necessarily proofs, to an extent. Ideas don't come with a proof).
- ▶ Explain why it should be true
 - ▶ give examples and counterexamples
 - ▶ prove it in a simplified case

Miscellaneous facts

- ▶ *Entertaining*: if you are enthusiastic about it, your enthusiasm will come across. Emphasize the aspects that you are most excited about
- ▶ Jokes ????
- ▶ Never give the *same* talk twice
- ▶ Repetita iuvant (the fact that you said it does not imply that it has been heard or understood)
- ▶ Locate clock (and don't be afraid to ask the chair how much time you have left)
- ▶ Have a USB with you
- ▶ slides = min / 2 (depending on slides...)

Why should I make the effort?

- ▶ Collaborations
- ▶ Multidisciplinarity
- ▶ To be cited
- ▶ Because it will be useful for interviews even when/ if you leave academia
- ▶ If you don't communicate it properly it is a dry exercise for personal entertainment

White on darker background

**Close your talk with references
vs “Thank you for your attention”**