Differentiable analysis

A lightning overview

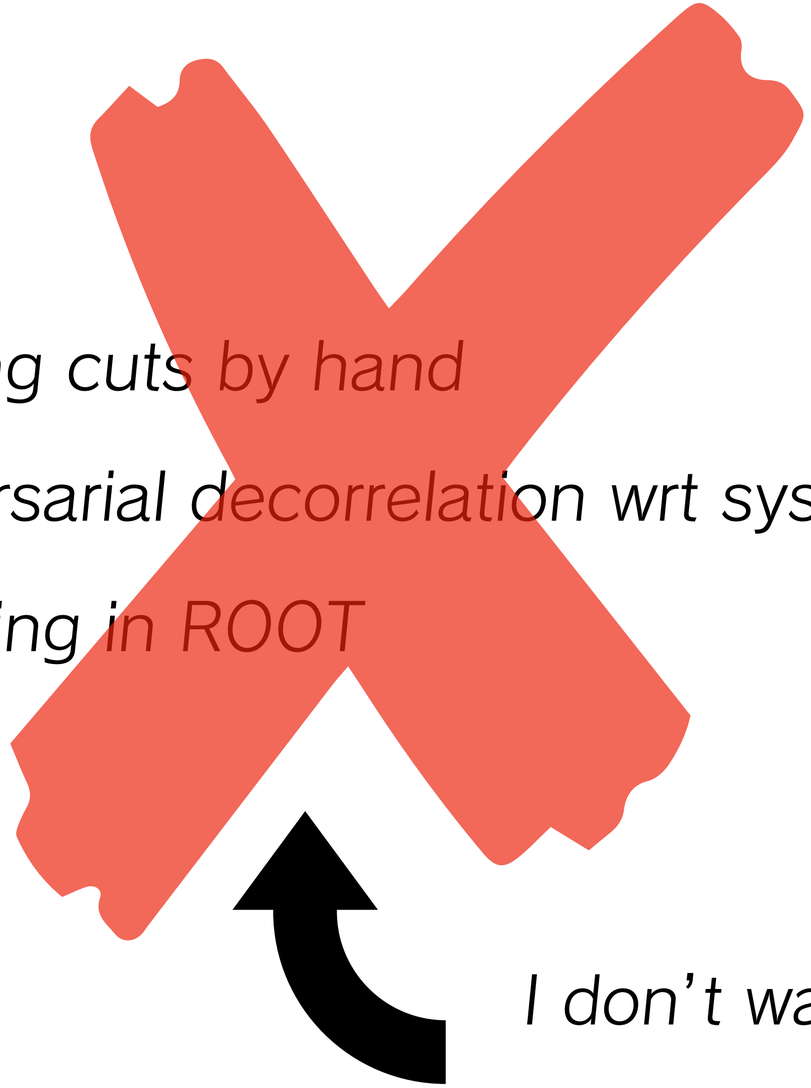
Nathan Simpson, Doktoranddagen, 2020-05-28

I am lazy.

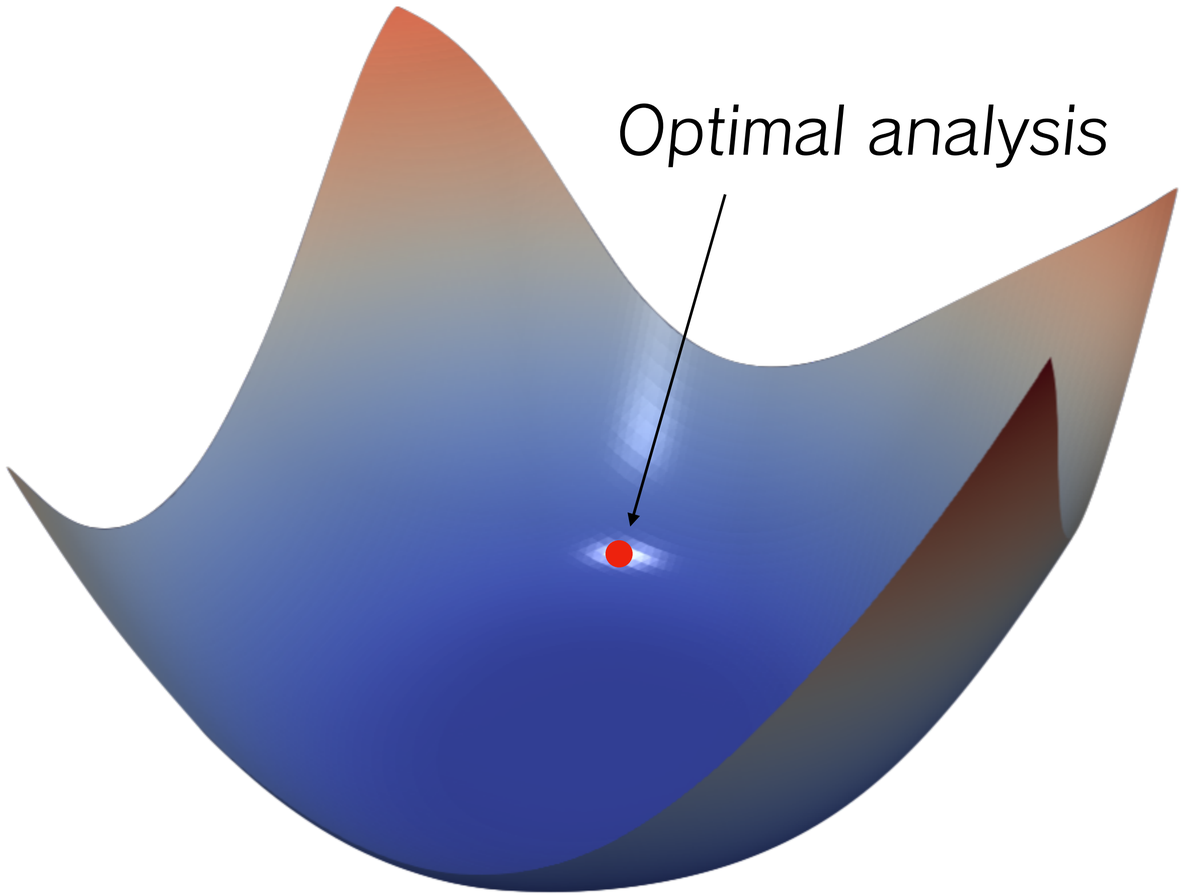
Tuning cuts by hand

Adversarial decorrelation wrt systematics

Working in ROOT

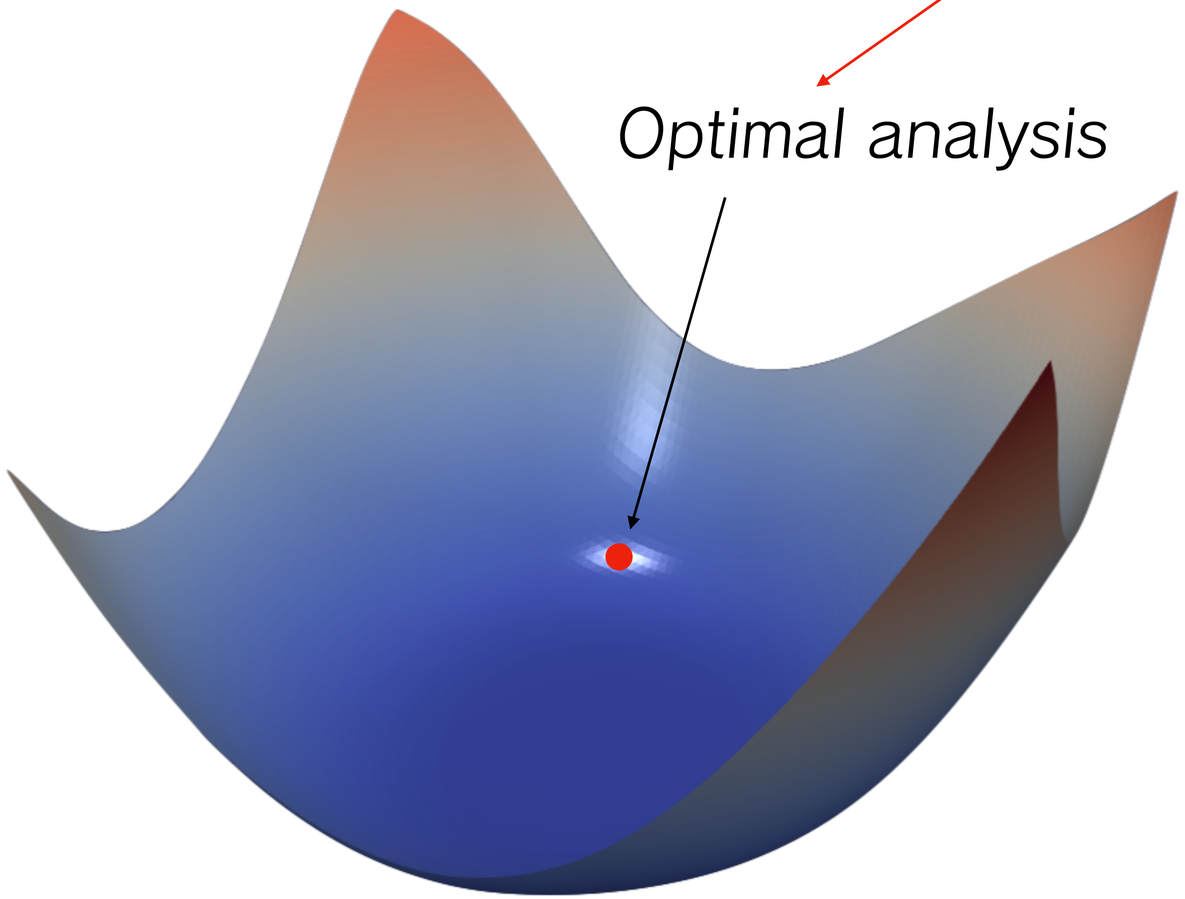


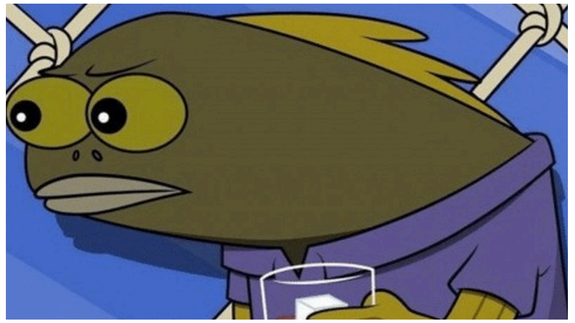
I don't want to do these things



https://www.cs.umd.edu/~tomg/projects/landscapes/

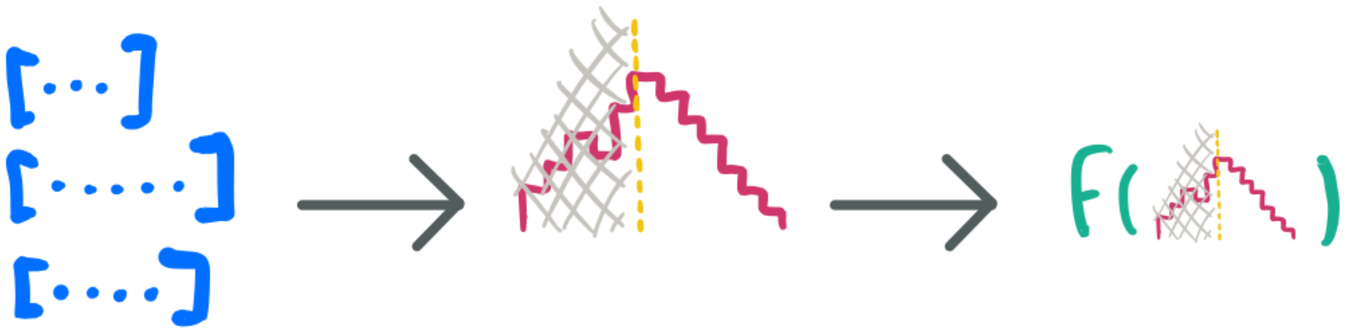
What does that word mean?

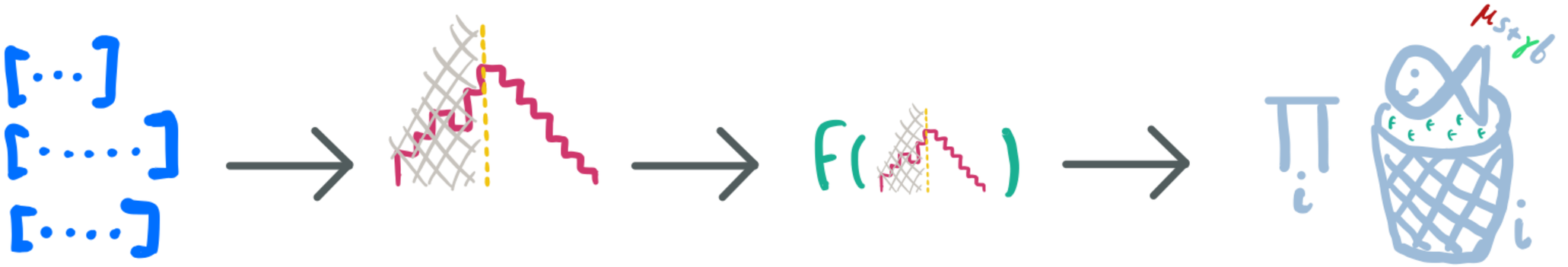


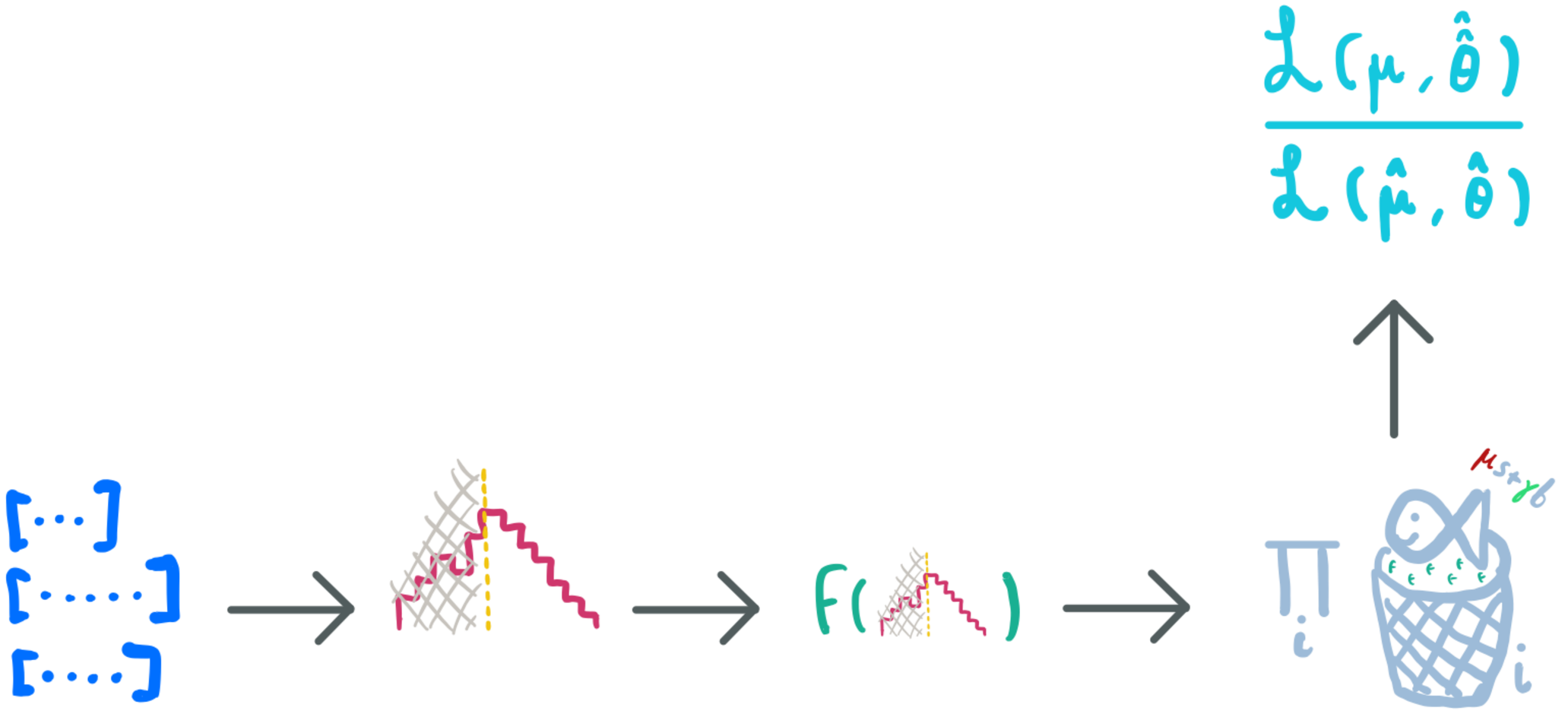


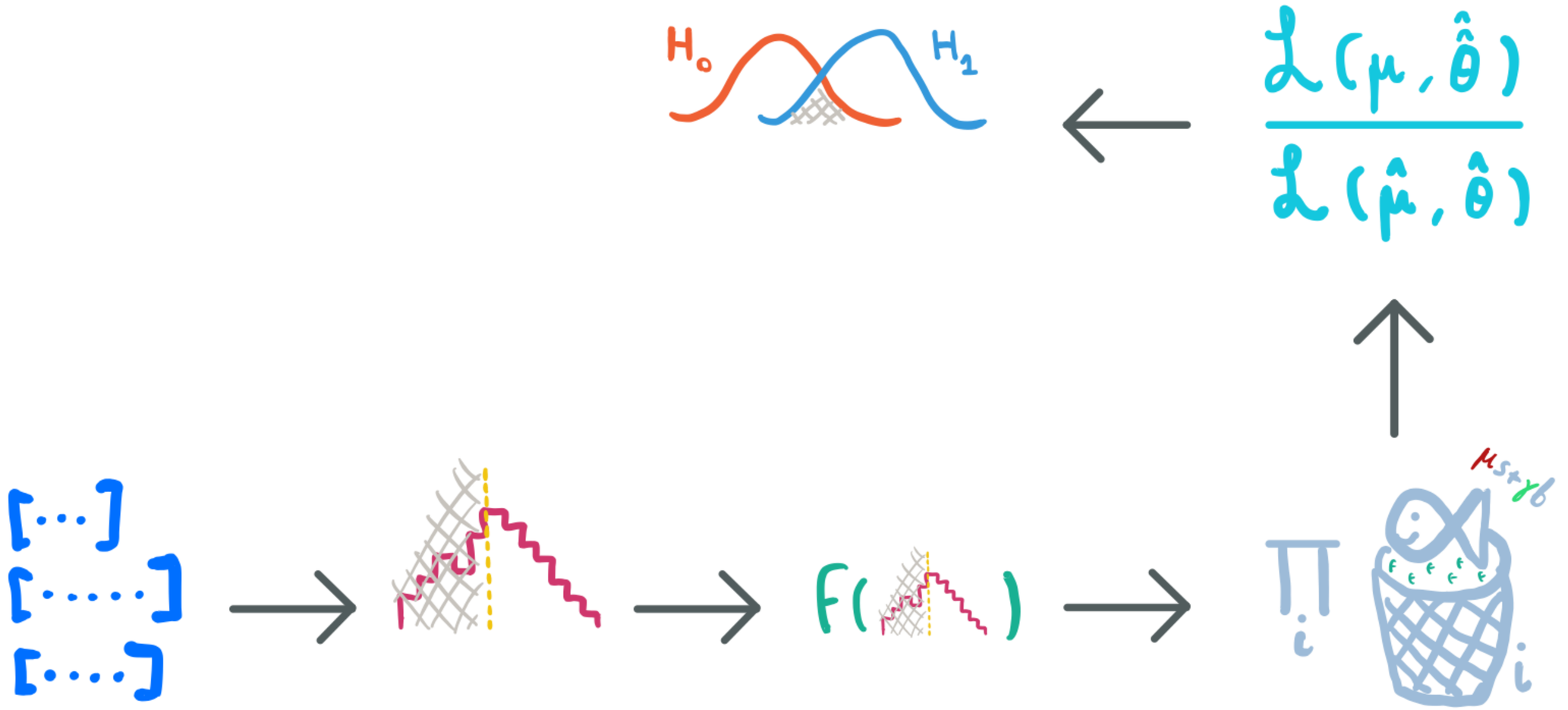
https://knowyourmeme.com/memes/when-you-see-a-repost-tom-hd

https://www.cs.umd.edu/~tomg/projects/landscapes/

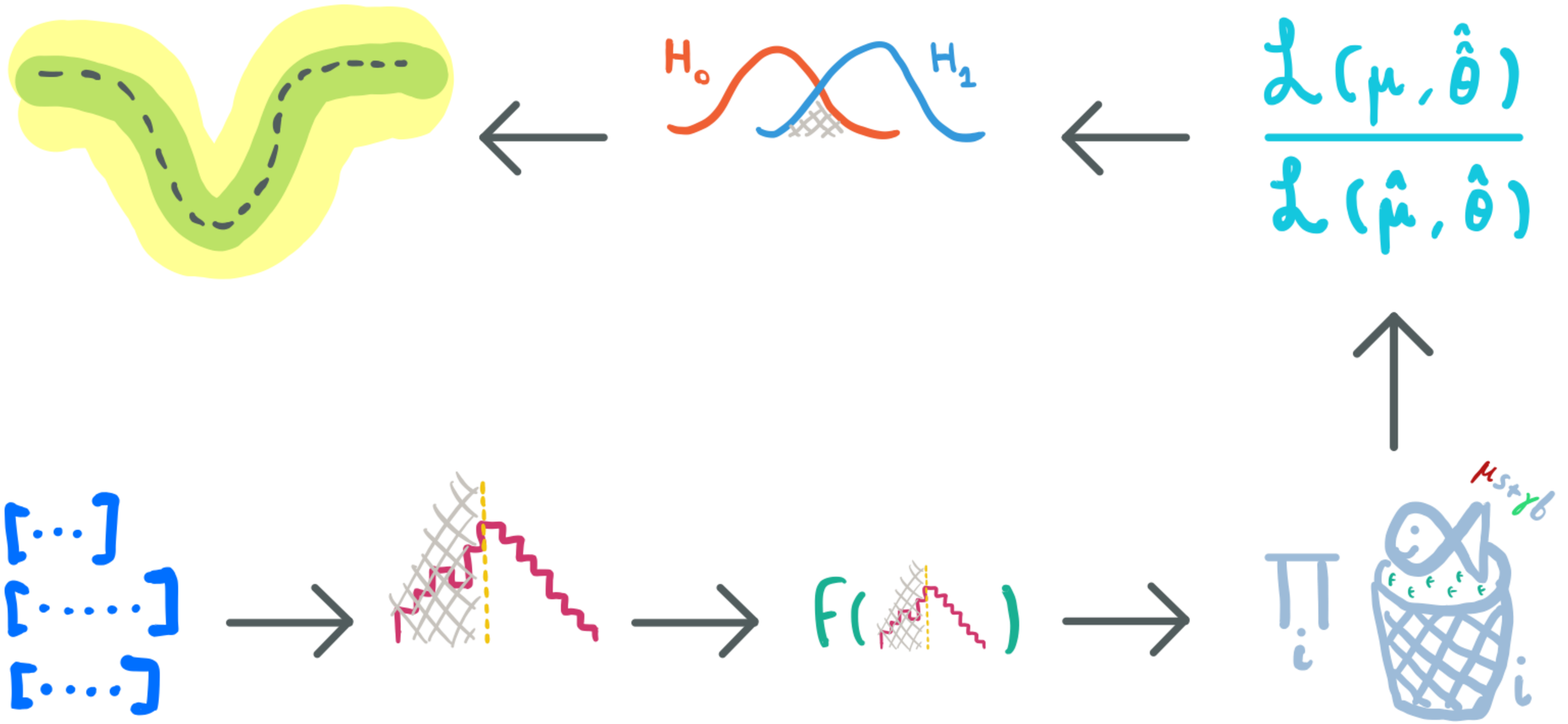



μstyle


$\frac{\mathcal{L}(\mu, \hat{\hat{\theta}})}{\mathcal{L}(\hat{\mu}, \hat{\theta})}$
μ_{strb}
$\prod_i$
i



H_0
H_1
$\frac{\mathcal{L}(\mu, \hat{\hat{\theta}})}{\mathcal{L}(\hat{\mu}, \hat{\theta})}$
$\mu_{s+\gamma b}$
$\prod_i$
$f($ $)$



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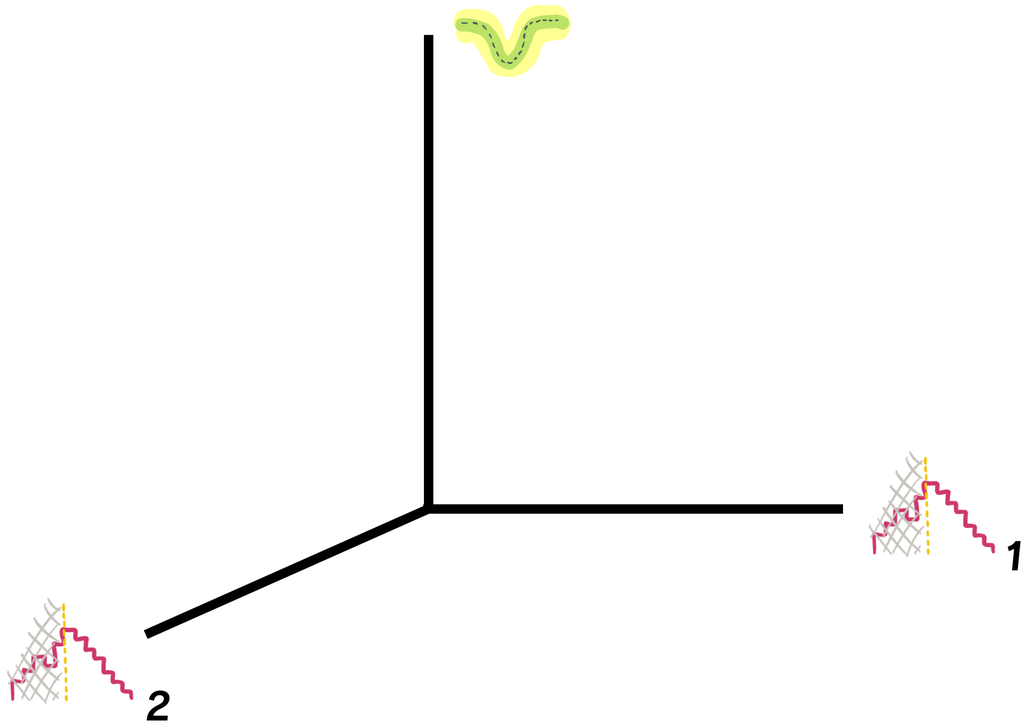
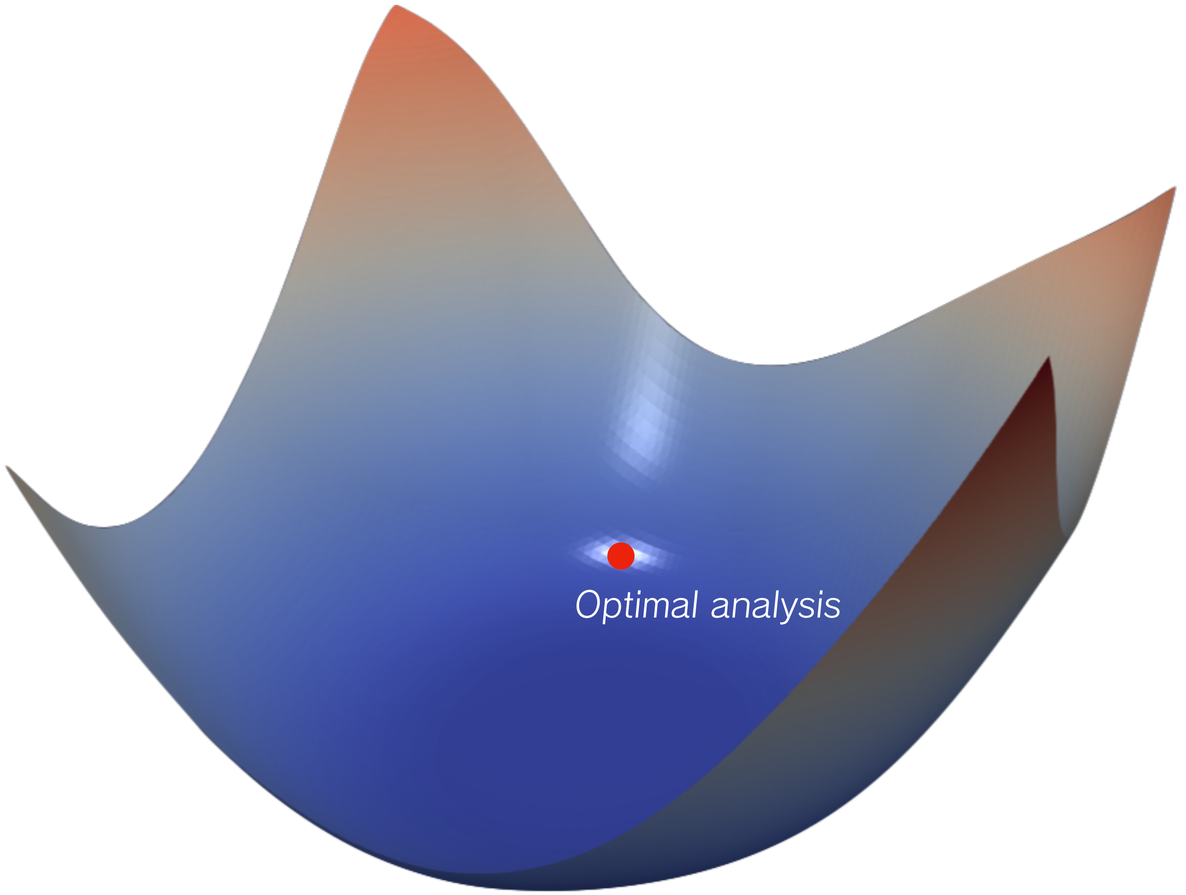
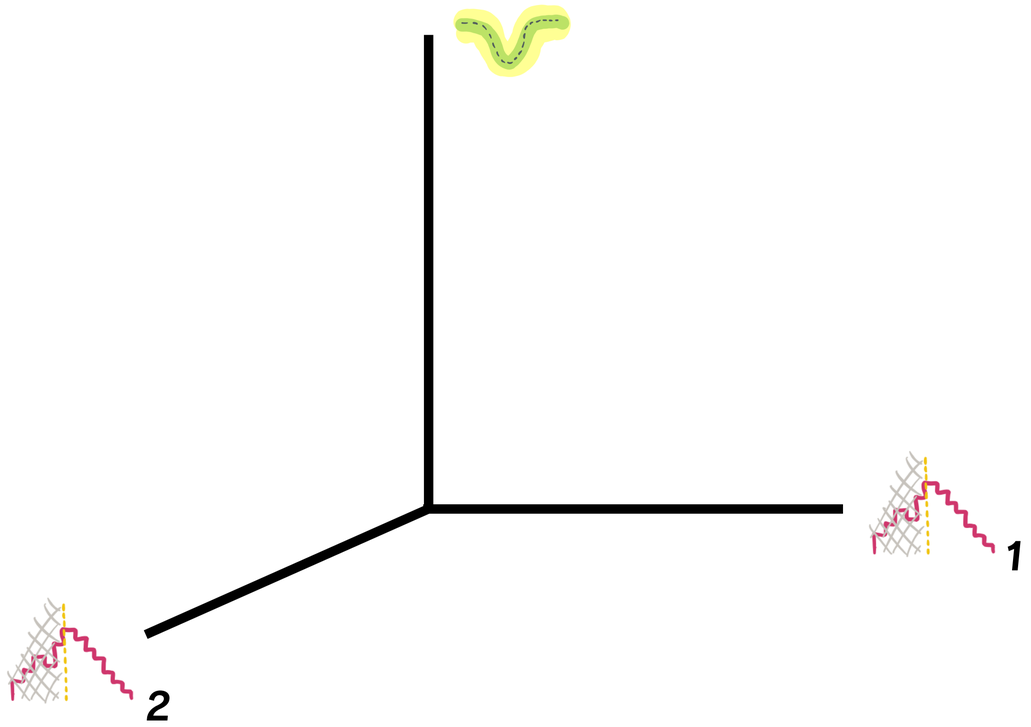

1
2


Optimal analysis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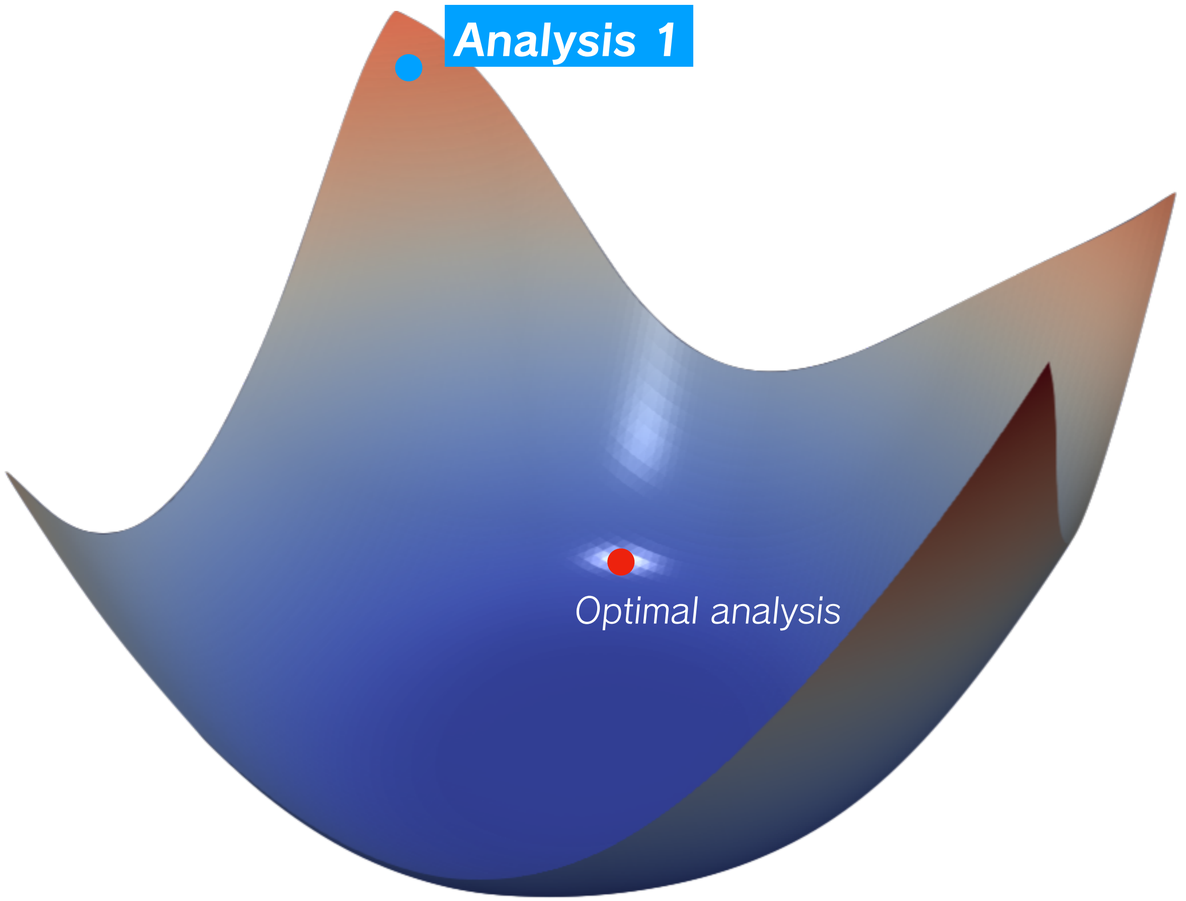
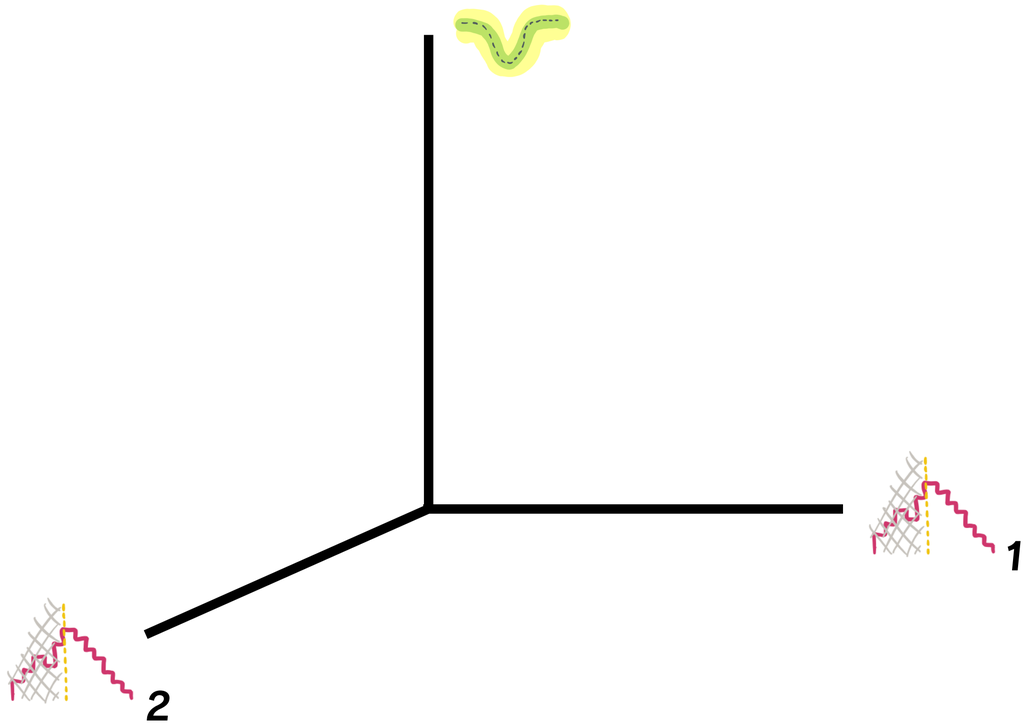
2


Analysis 1
Optimal analysis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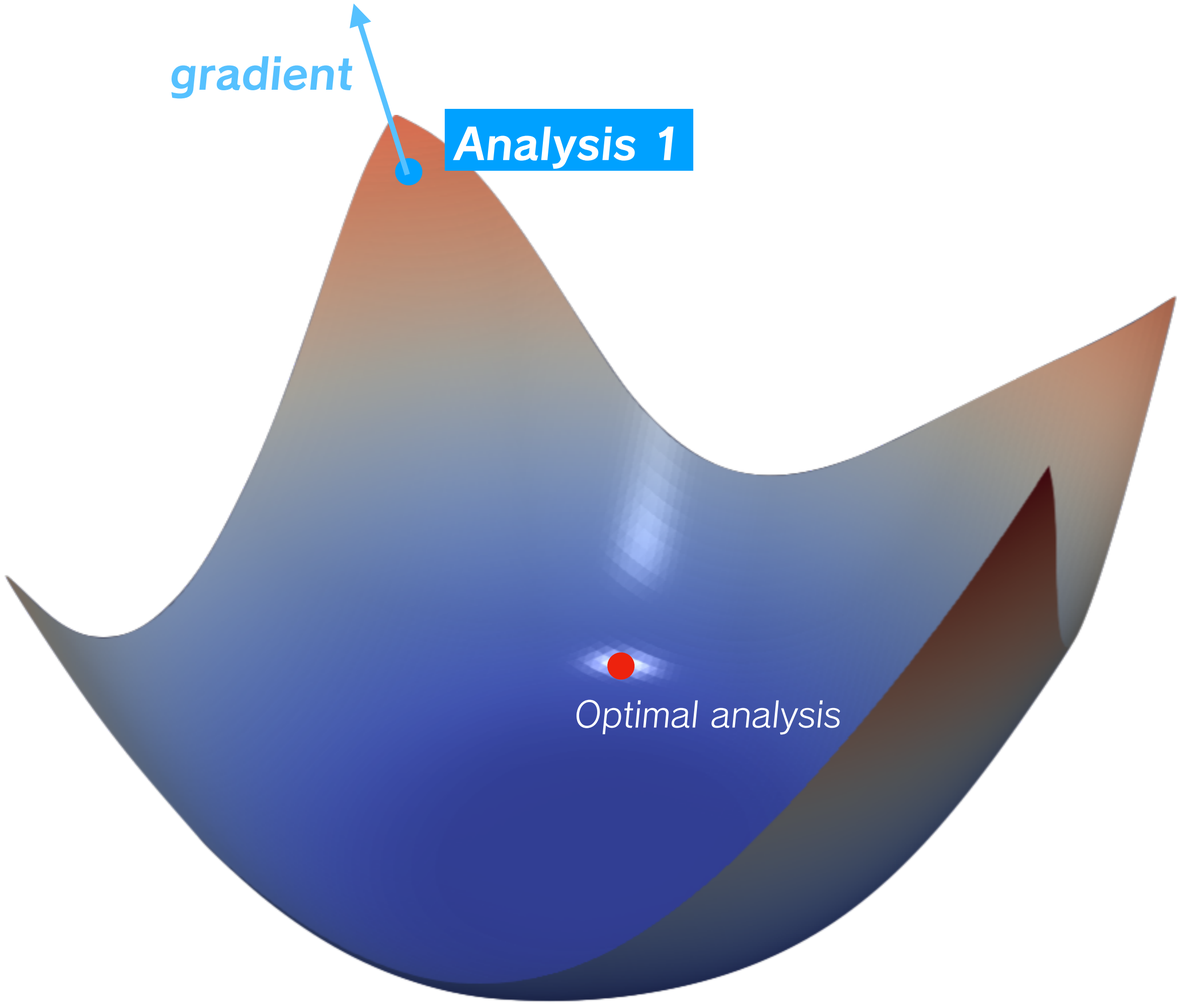
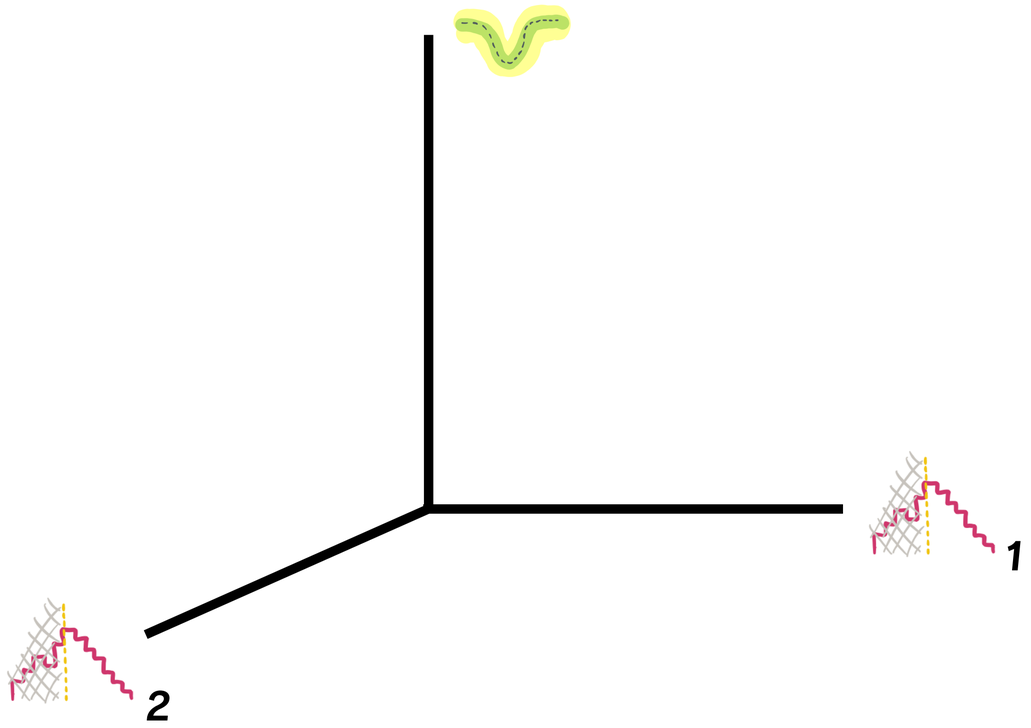

gradient
Analysis 1
Optimal analysis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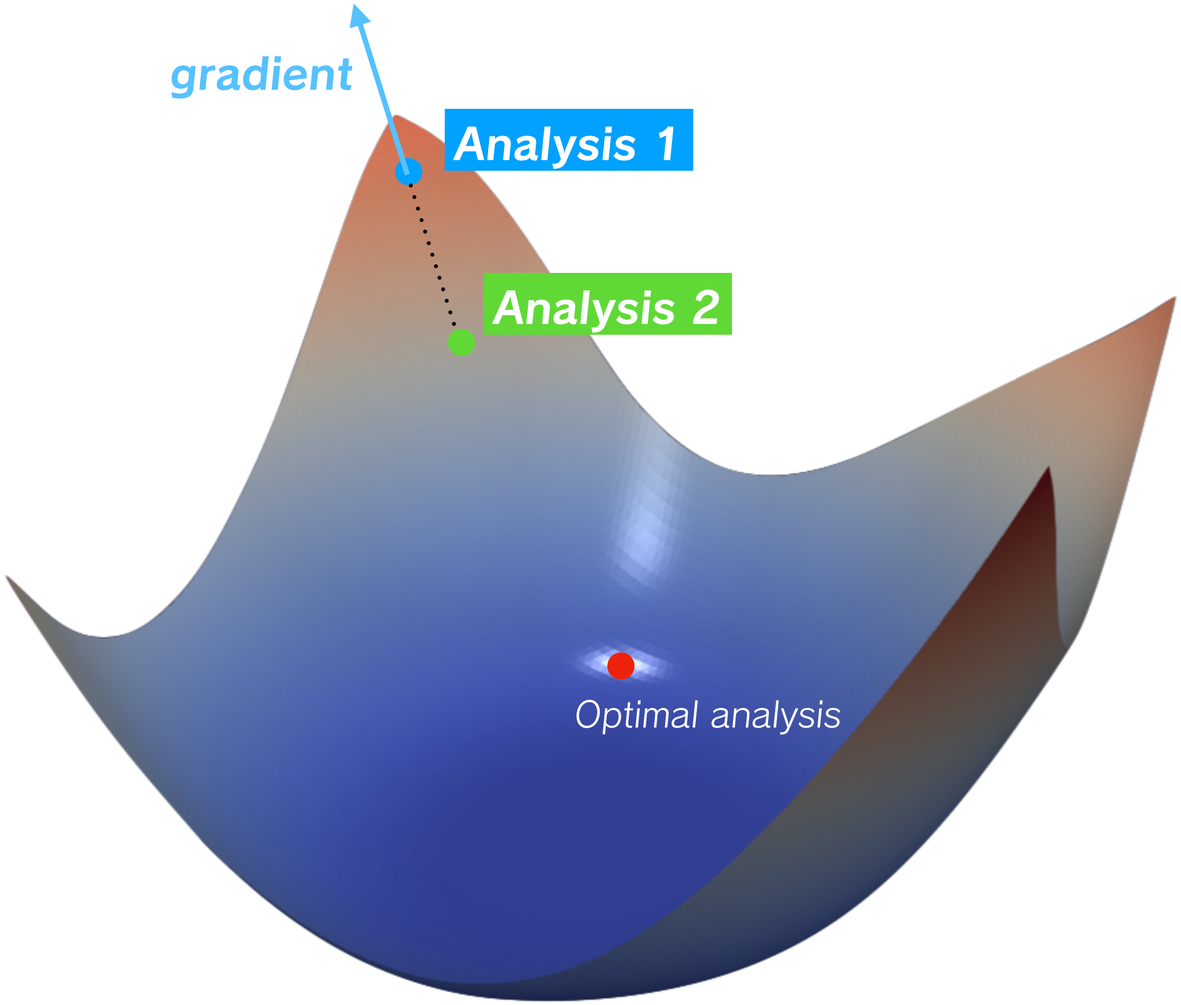
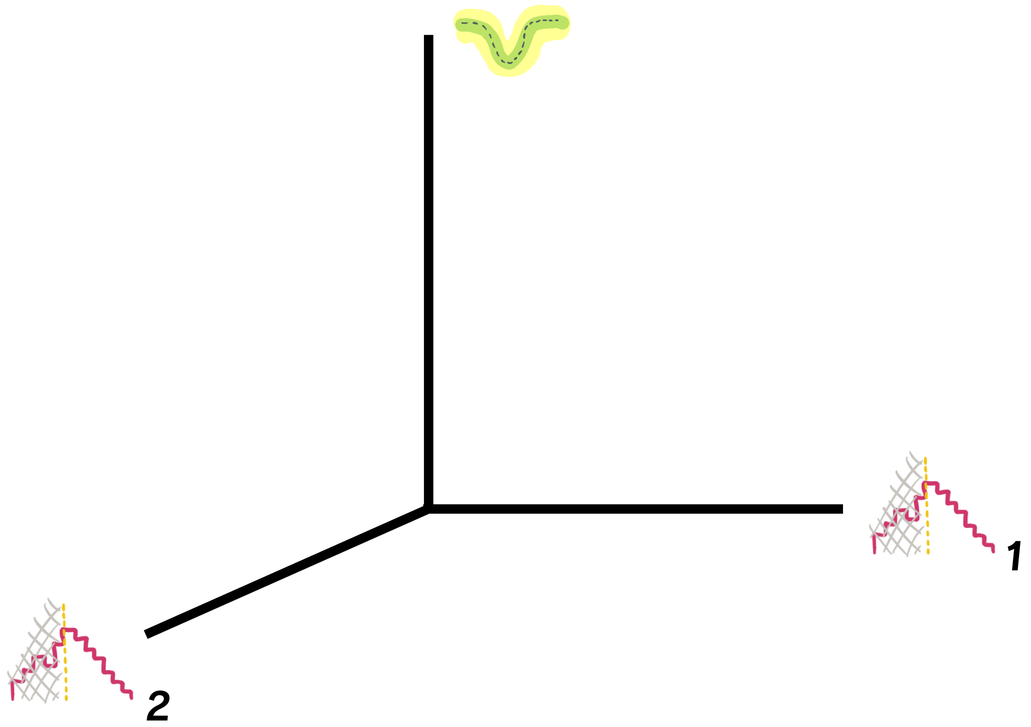

gradient
Analysis 1
Analysis 2
Optimal analysis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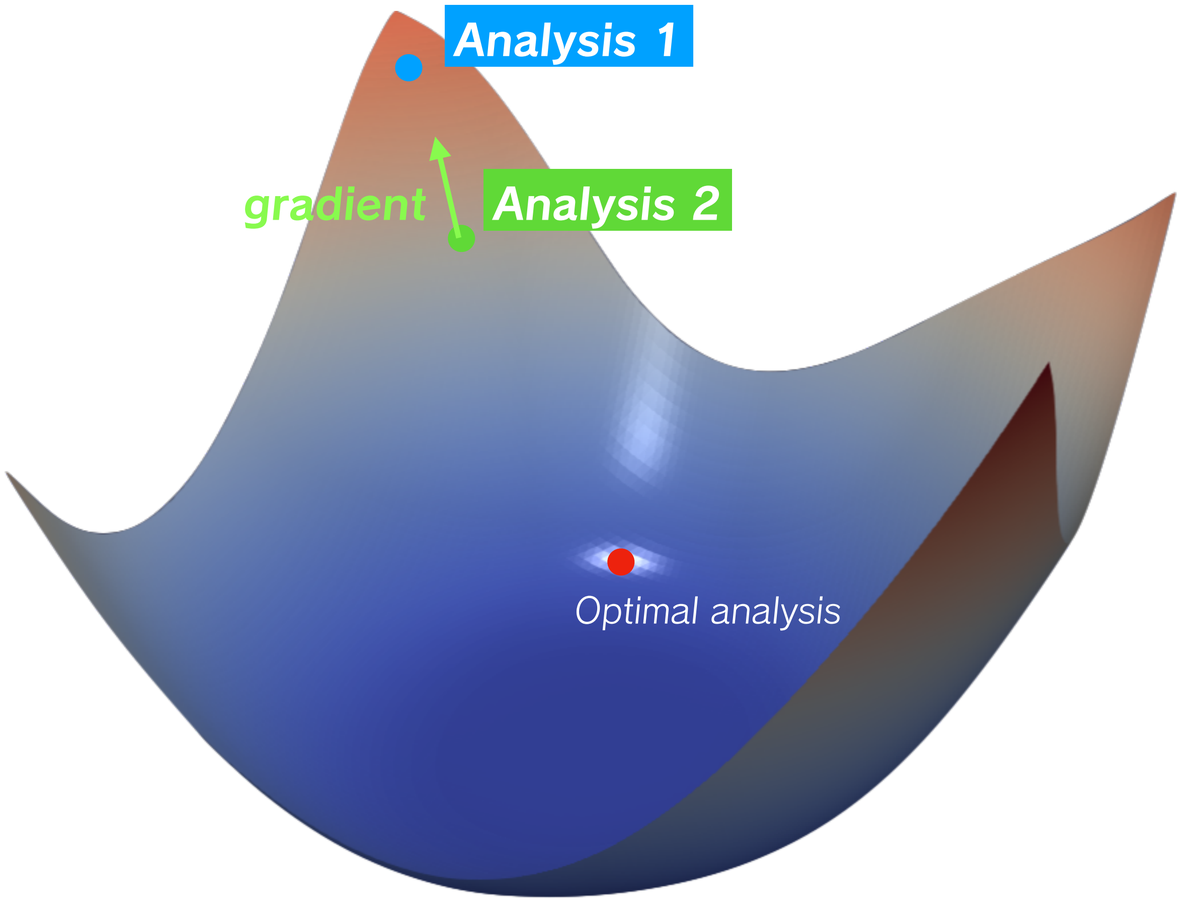
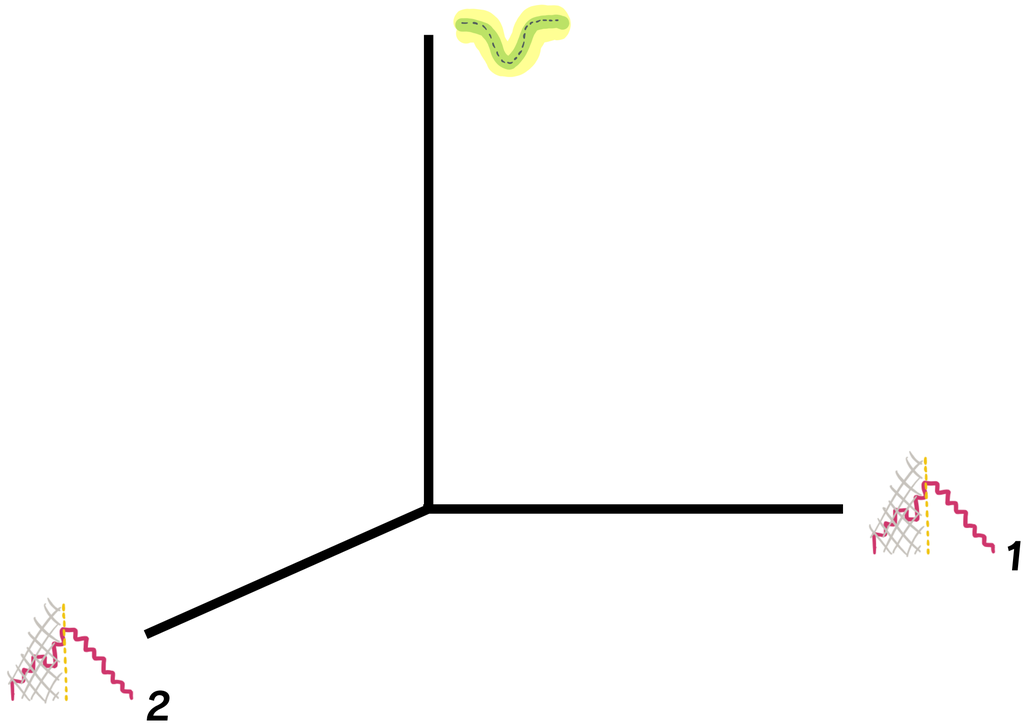
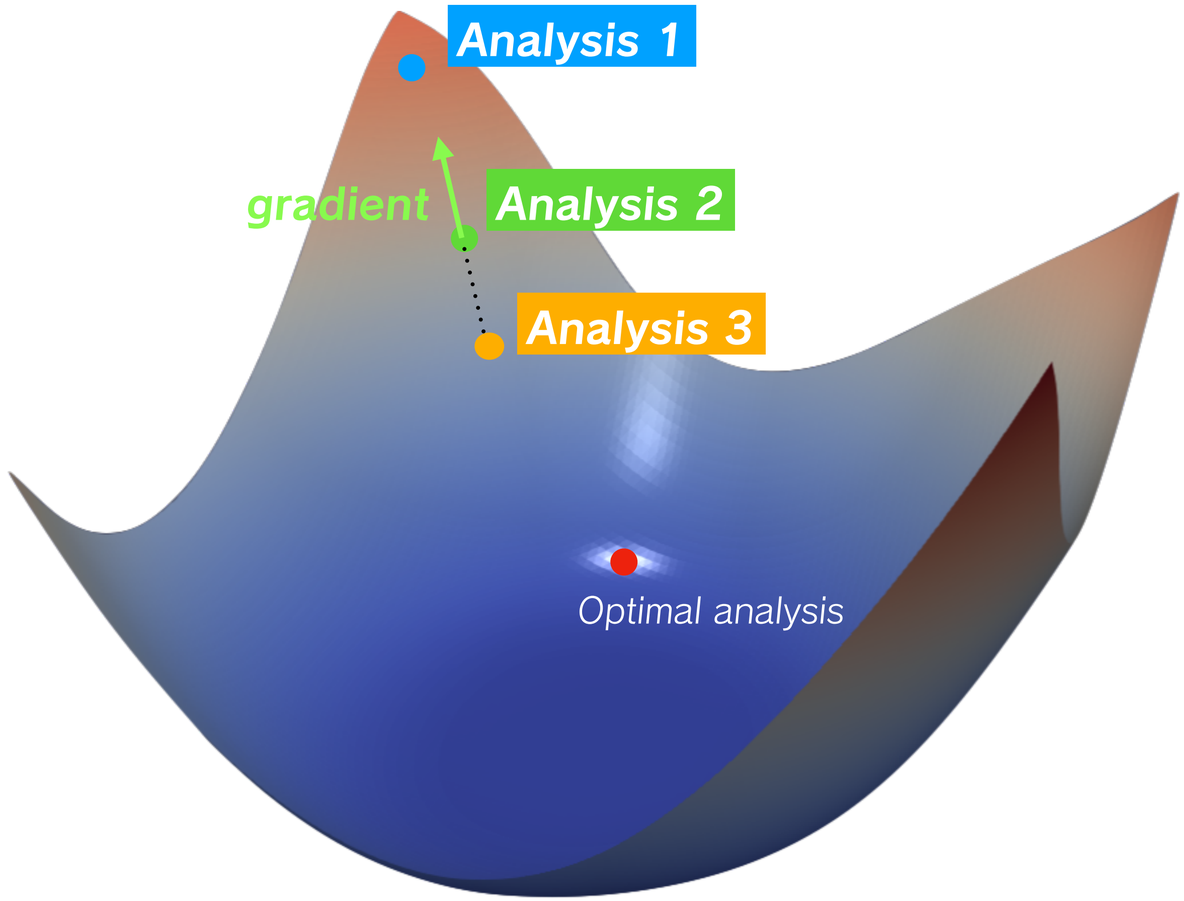
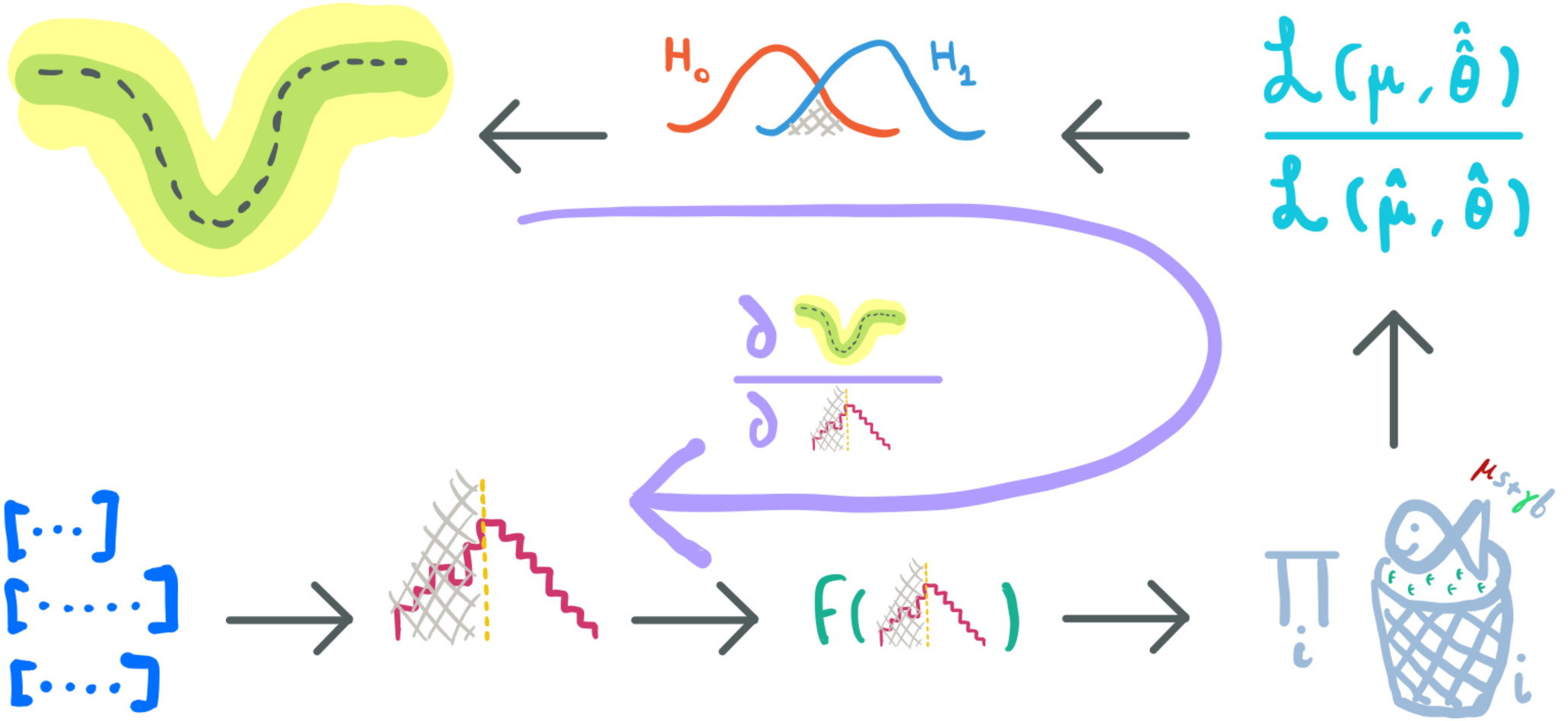
2


Analysis 1
gradient
Analysis 2
Optimal analysis


1
2


Analysis 1
gradient
Analysis 2
Analysis 3
Optimal analysis

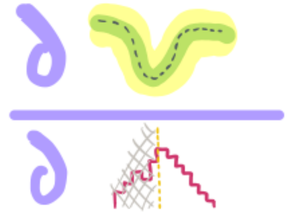
etc...

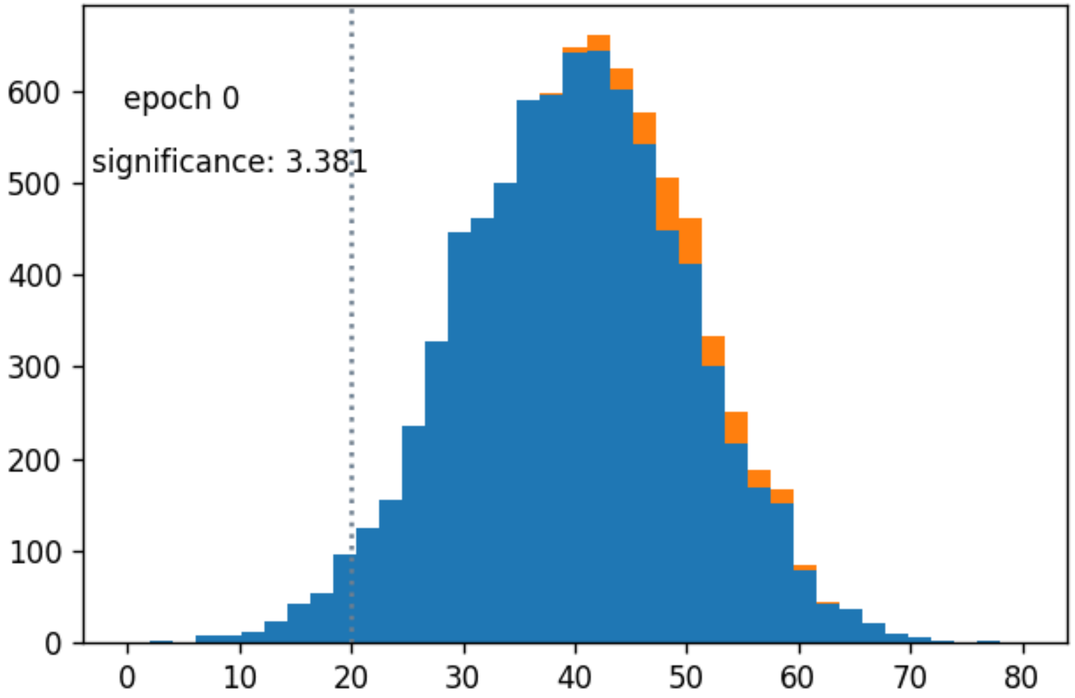


H_0
H_1
$\frac{\mathcal{L}(\mu, \hat{\hat{\theta}})}{\mathcal{L}(\hat{\mu}, \hat{\theta})}$
$\frac{\partial}{\partial}$
$f(\quad)$
$\prod_i$
$\mu_{s+\gamma b}$

In practice: *1D cut*

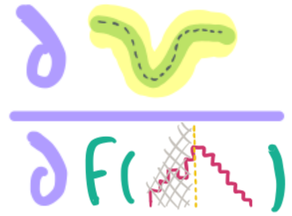
Takes steps with

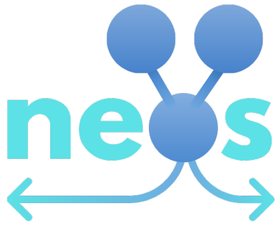




In practice: *nn-based observable*

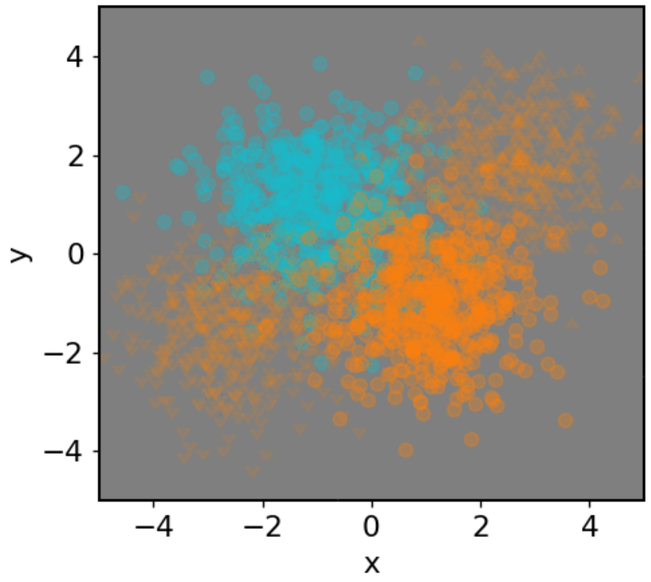
Takes steps with



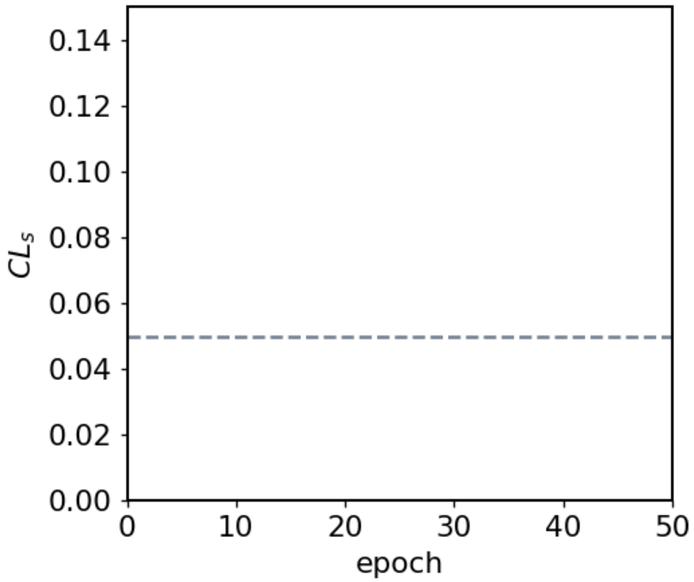


github.com/pyhf/neos

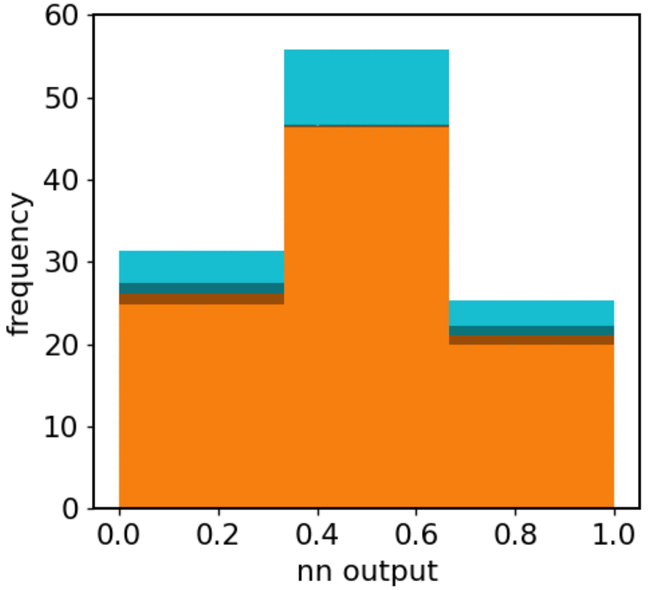
Decision contours



Expected CLs



Binned model



Why should you care?

- *Train stuff directly on the physics goals instead of compromising with other loss functions*
- *‘Systematics-aware’ learning*
- *Automated optimization means more time for physics! (and fika)*

https://www.countryliving.com/uk/wildlife/pets/advice/a2899/buying-puppy-tips/

also, do it for the puppy.

Wanna join for the ride? *You can* ***:)***

New effort to make this more general has just started!

All contributions welcome!

Browse the issues & material here:

github.com/gradhep/center/
github.com/gradhep/smooth/