Generative AI with Diffusion Models

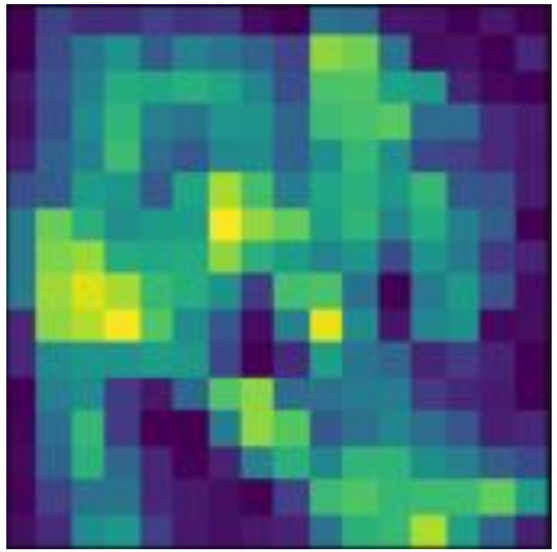
Part 4: Classifier-Free Diffusion Guidance

Agenda

- Part 1: From U-Nets to Diffusion
- Part 2: Denoising Diffusion Probabilistic Models
- Part 3: Optimizations
- Part 4: Classifier-Free Diffusion Guidance
- Part 5: CLIP
- Part 6: Wrap-up & Assessment

Adding Context

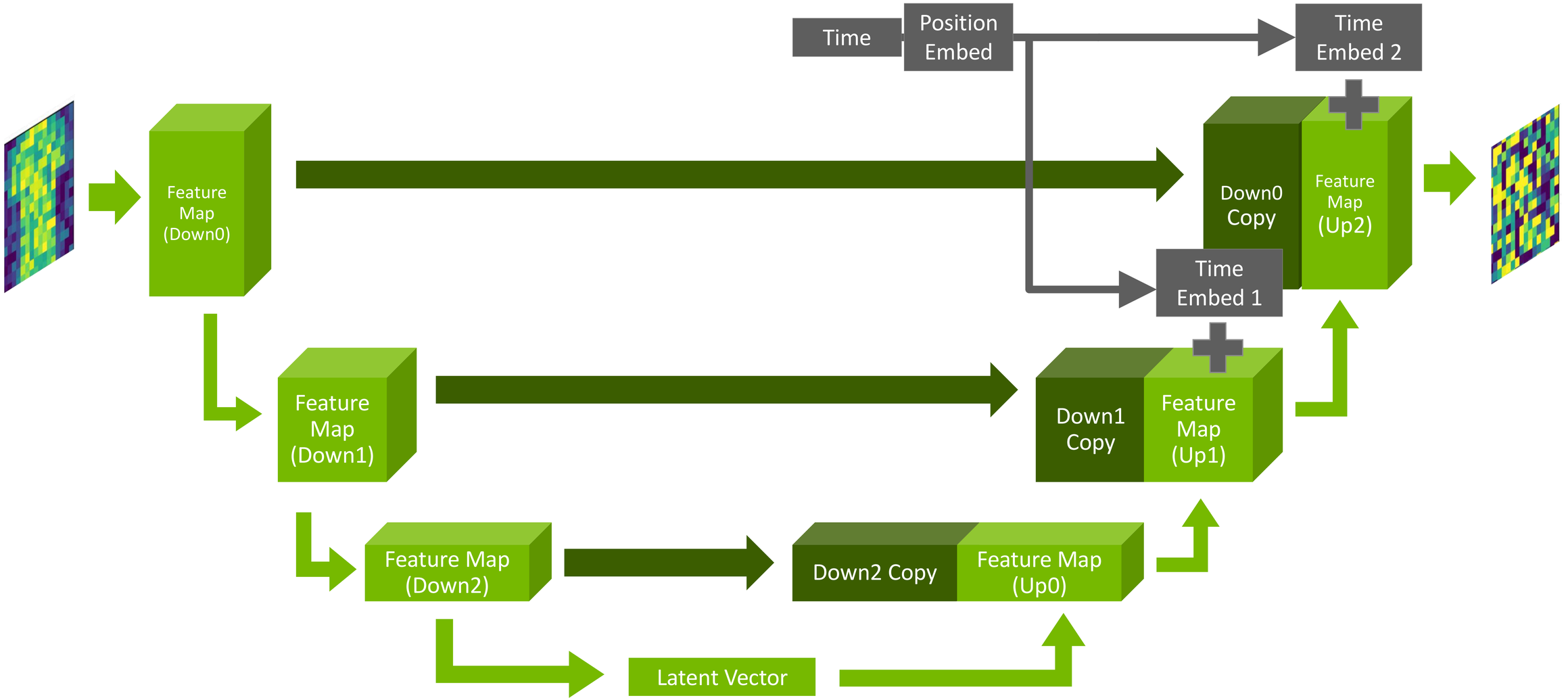
Adding Context



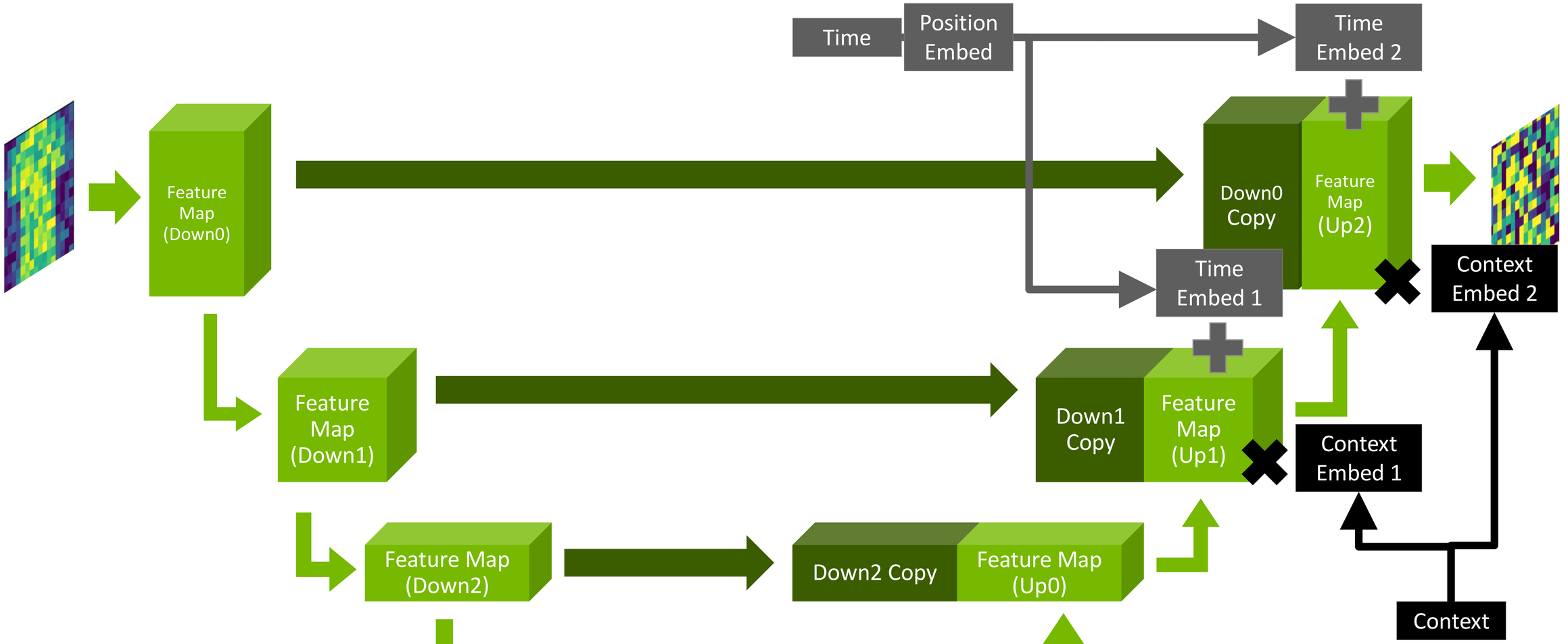
Shirt sleeve?

Shoe heel?

Adding Context

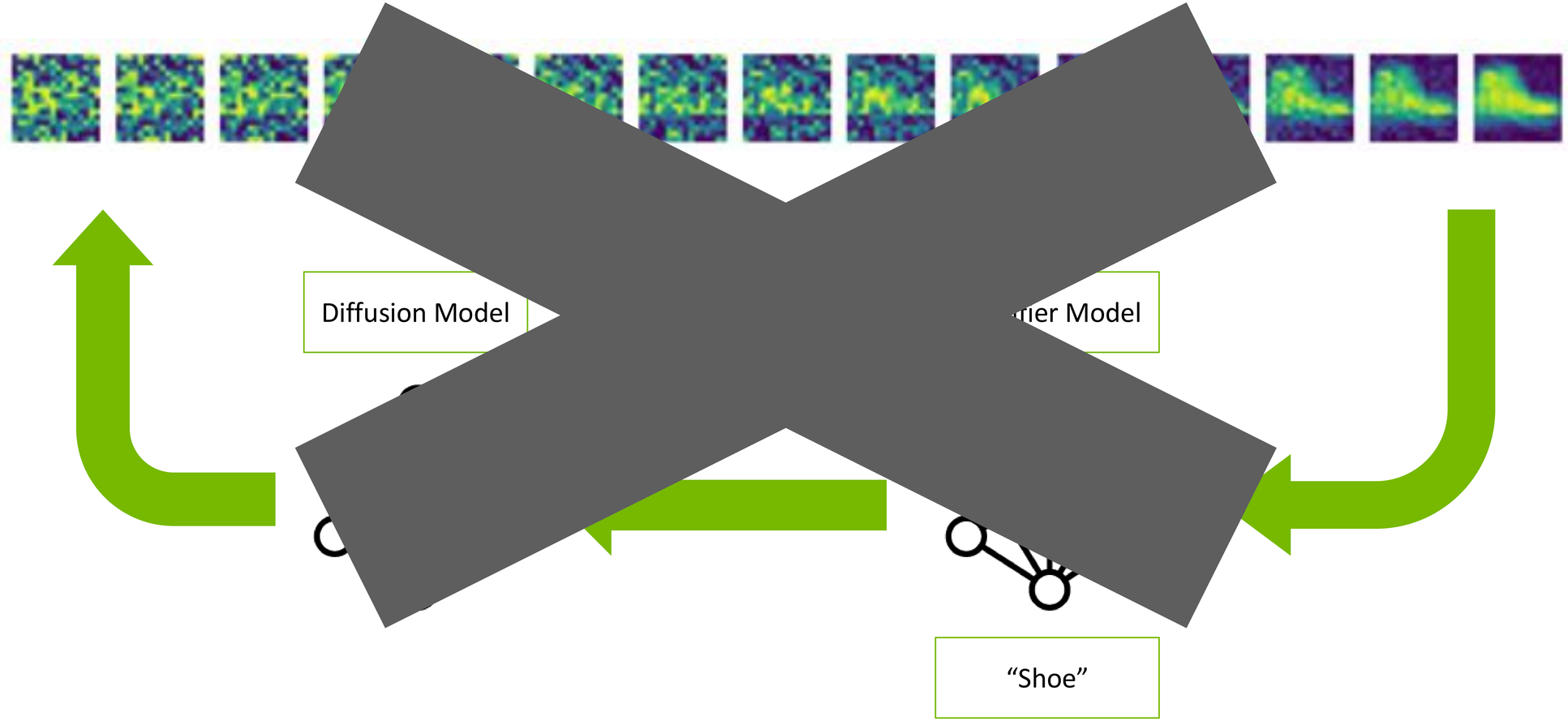


Adding Context



Classifier-Free Diffusion Guidance

Make a Classifier Model?



Classifier-Free Diffusion Guidance

CLASSIFIER-FREE DIFFUSION GUIDANCE

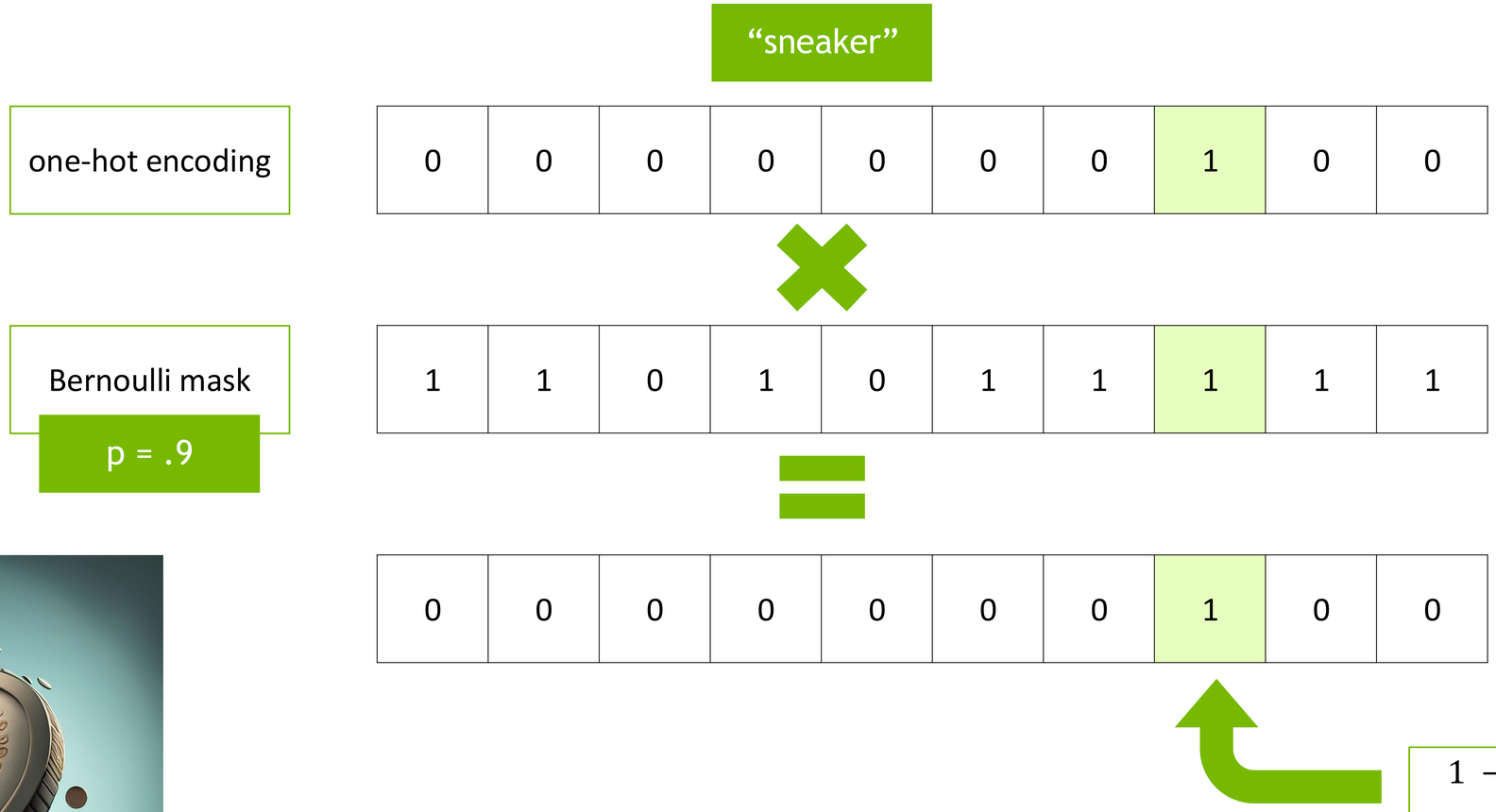
Jonathan Ho & Tim Salimans
Google Research, Brain team
{jonathanho,salimans}@google.com

ABSTRACT

Classifier guidance is a recently introduced method to trade off mode coverage and sample fidelity in conditional diffusion models post training, in the same spirit as low temperature sampling or truncation in other types of generative models. Classifier guidance combines the score estimate of a diffusion model with the gradient of an image classifier and thereby requires training an image classifier separate from the diffusion model. It also raises the question of whether guidance

Classifier Free Diffusion Guidance

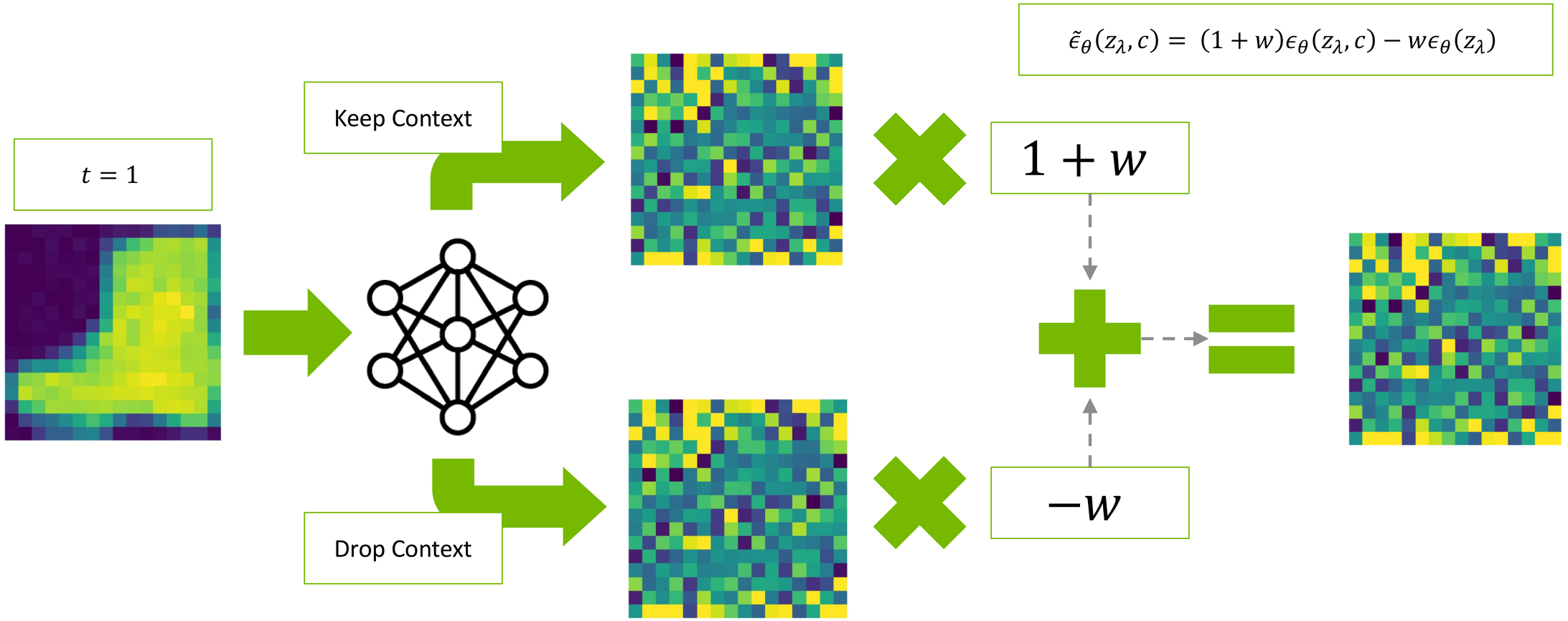
Bernoulli Masks



A weighted coin flipping through the air like a cartoon

Classifier Free Diffusion Guidance

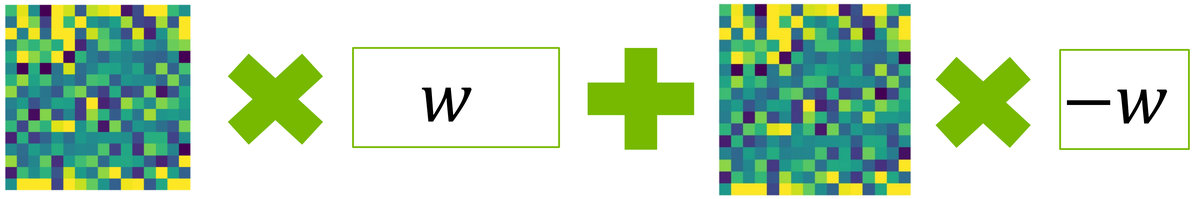
Weighted Reverse Diffusion



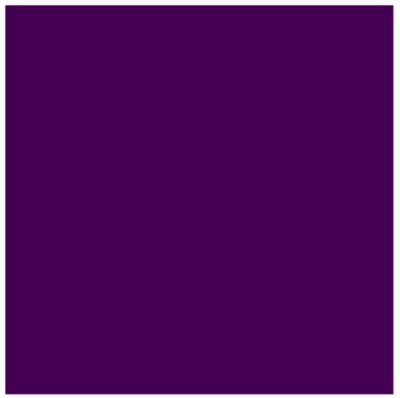
Classifier Free Diffusion Guidance

Weighted Reverse Diffusion

$$(\blacksquare w)\epsilon_\theta(z_\lambda, c) - w\epsilon_\theta(z_\lambda)$$

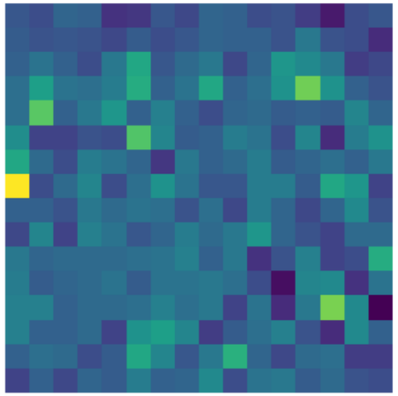


w = 0



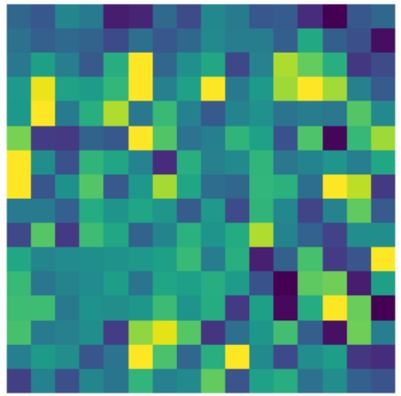
No context feature exaggeration

w = 1



Some context feature exaggeration

w = 10



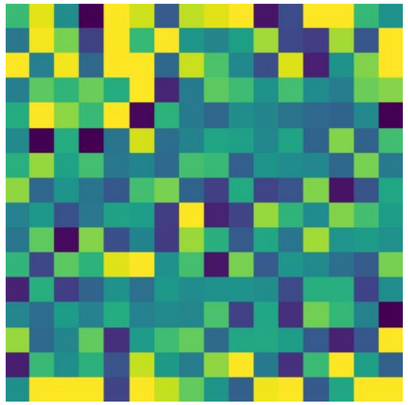
Huge context feature exaggeration

Classifier Free Diffusion Guidance

Weighted Reverse Diffusion

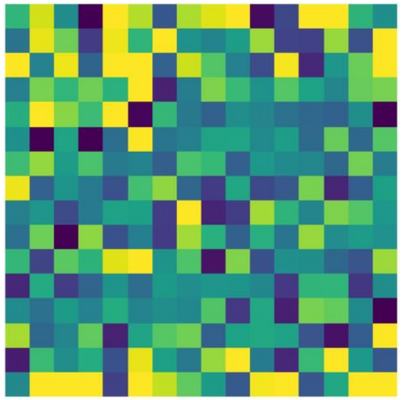
$$(1 + w)\epsilon_\theta(z_\lambda, c) - w\epsilon_\theta(z_\lambda)$$

w = 0



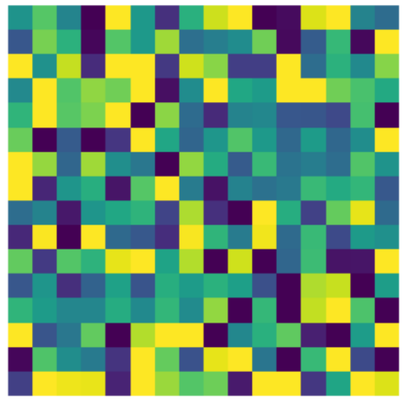
No context feature exaggeration

w = 1



Some context feature exaggeration

w = 10



Huge context feature exaggeration

Classifier Free Diffusion Guidance

Weighted Reverse Diffusion

w = -2.0

w = -1.0

w = -0.5

w = 0.0

w = 0.5

w = 1.0

w = 2.0

Modified TF Flowers

Modified TF Flowers

Modified for Image Generation

Photo by _e.t

Let’s get started!