Generative AI with Diffusion Models

Part 5: CLIP

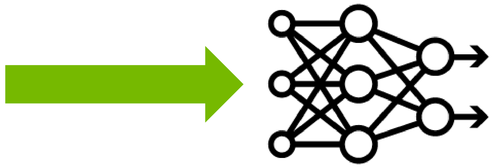
Agenda

- 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

Contrastive Language-Image Pre-Training (CLIP)

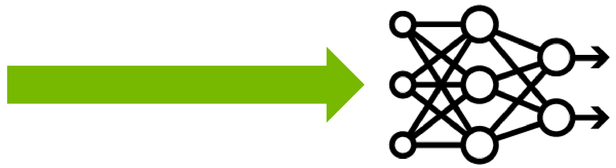
Matching Text to Image

Is it Possible?

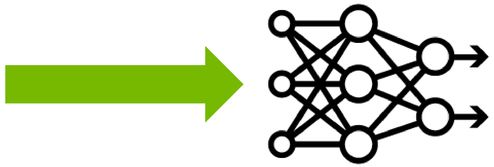


[0.8, -0.6, 0.7]

“A bunch of different marbles”



Cosine Similarity



[0.0, 1.0]

“A bunch of different marbles”

[1.0, 1.0]

Cosine Similarity

[0.0, 1.0]

[1.0, 1.0]

"A bunch of different marbles"

45°

$cos(45^{\circ}) = \frac{\sqrt{2}}{2}$

$cos(90^{\circ}) = 0$

$cos(270^{\circ}) = 0$

$cos(0^{\circ}) = 1$

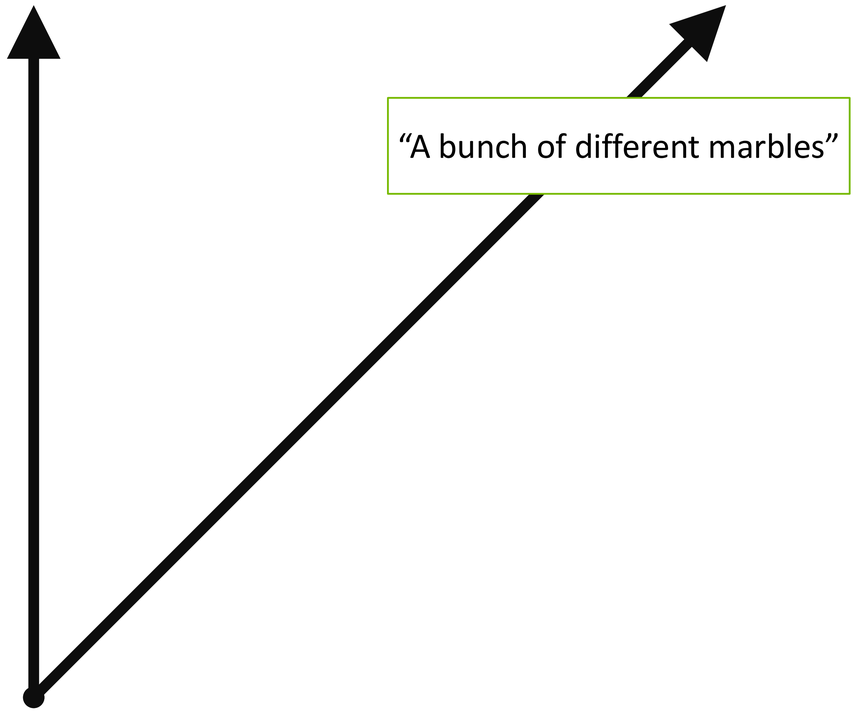
$cos(180^{\circ}) = -1$

Dot Product

[0.0, 1.0]

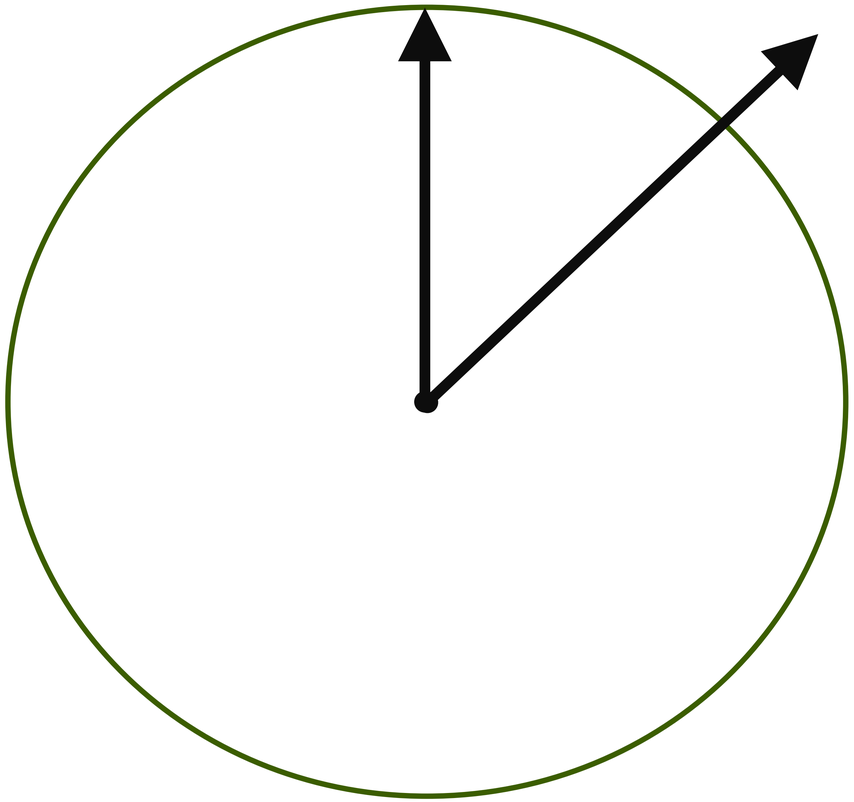
[1.0, 1.0]

“A bunch of different marbles”



[0.0, 1.0]

[1.0, 1.0]

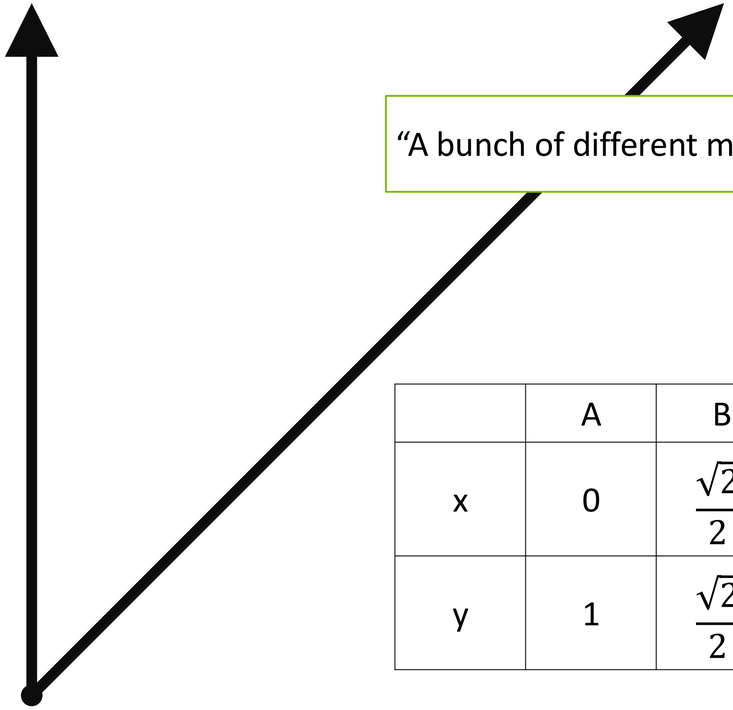


Dot Product

[0.0, 1.0]

[1.0, 1.0]

“A bunch of different marbles”



	A	B	A x B
x	0	$\frac{\sqrt{2}}{2}$	0
y	1	$\frac{\sqrt{2}}{2}$	$\frac{\sqrt{2}}{2}$

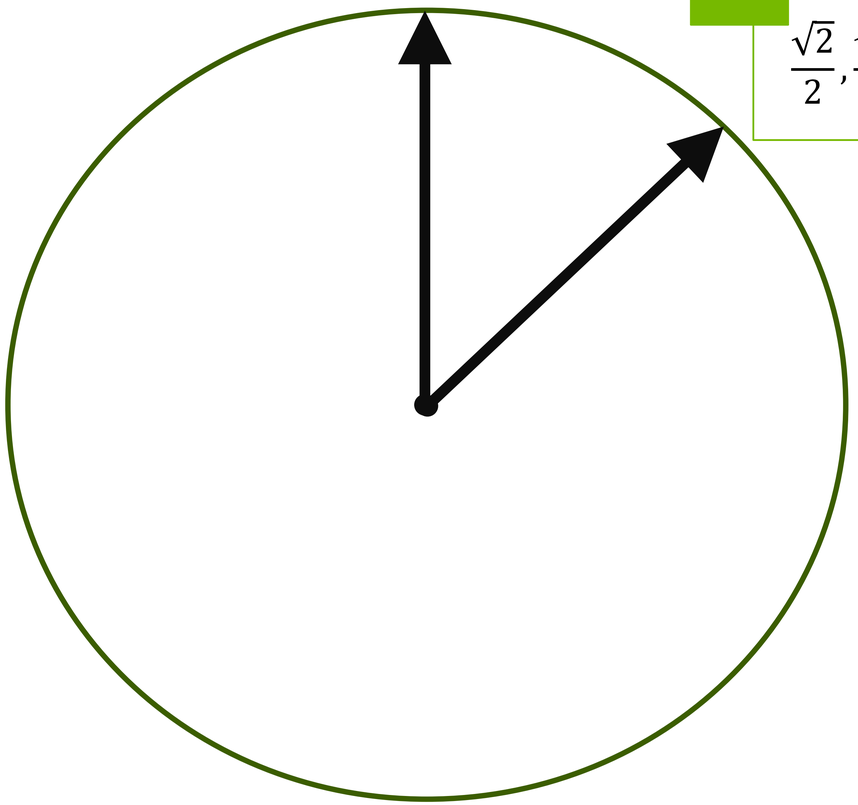
$$cos(45^{\circ}) = \frac{\sqrt{2}}{2}$$

A

[0.0, 1.0]

B

$\frac{\sqrt{2}}{2}, \frac{\sqrt{2}}{2}$



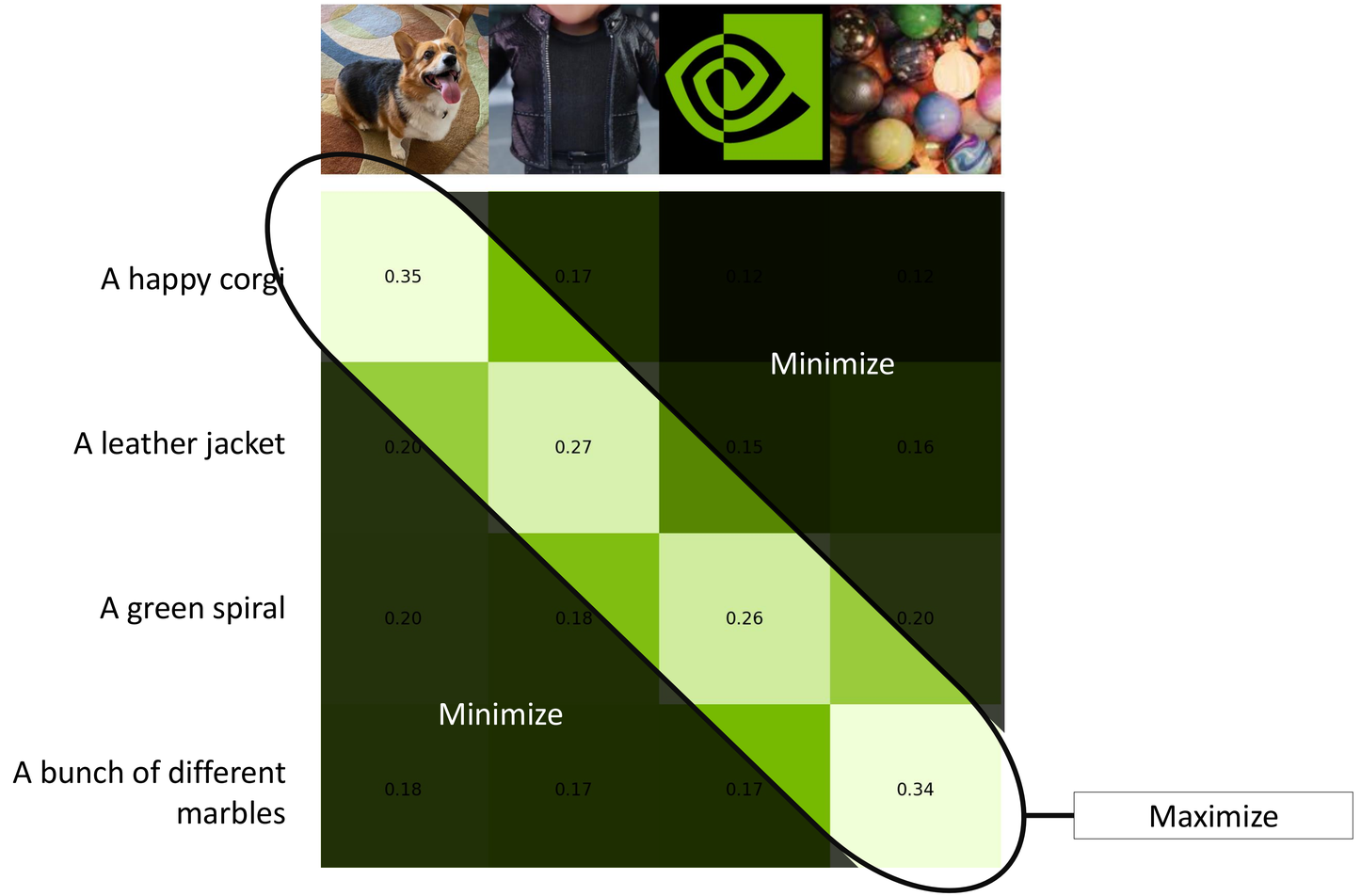
CLIP Training

A happy corgi	0.35	0.17	0.12	0.12
A leather jacket	0.20	0.27	0.15	0.16
A green spiral	0.20	0.18	0.26	0.20
A bunch of different marbles	0.18	0.17	0.17	0.34

Cosine similarity between encoding for “A happy corgi” and encoding for each image

Cosine similarity between encoding for the NVIDIA logo and encoding for each text

CLIP Training



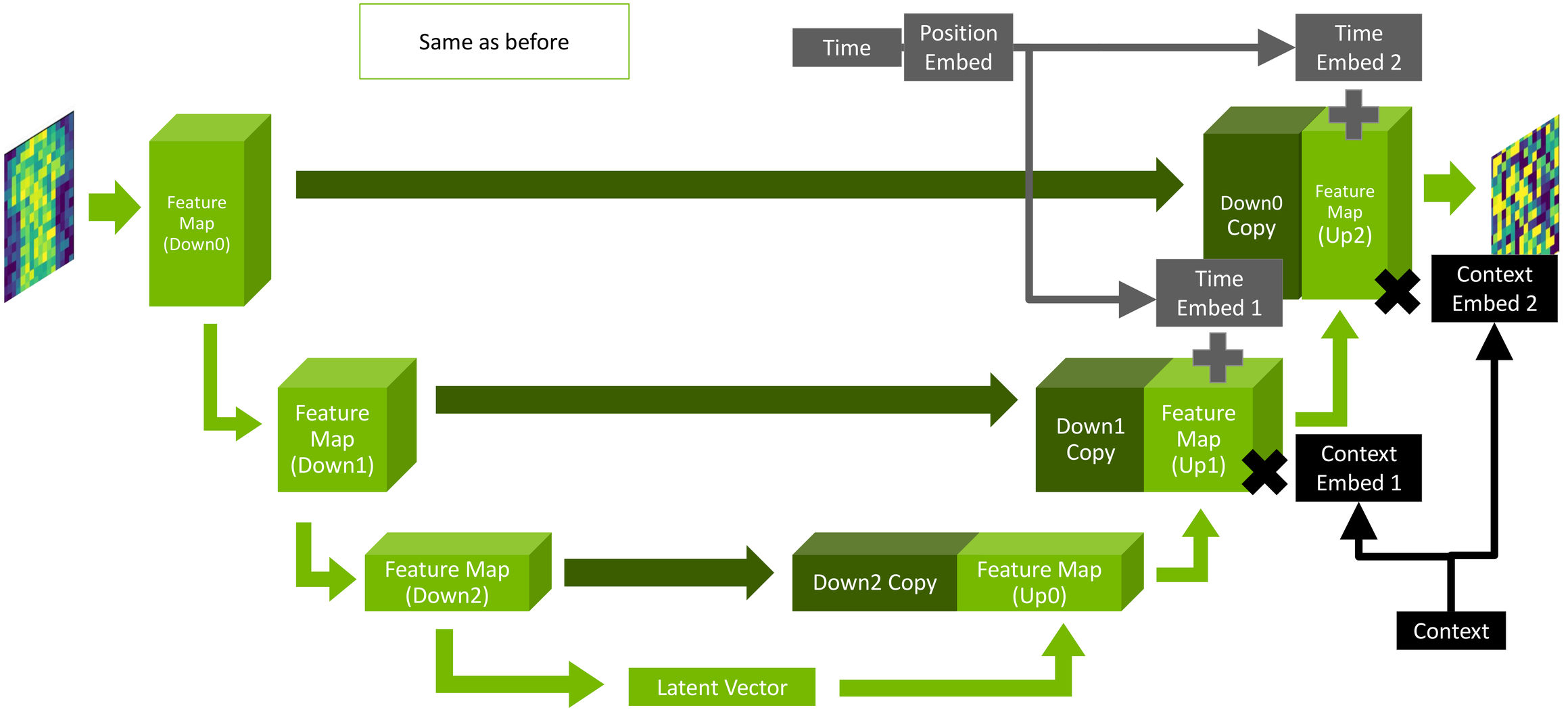
An Experiment

“

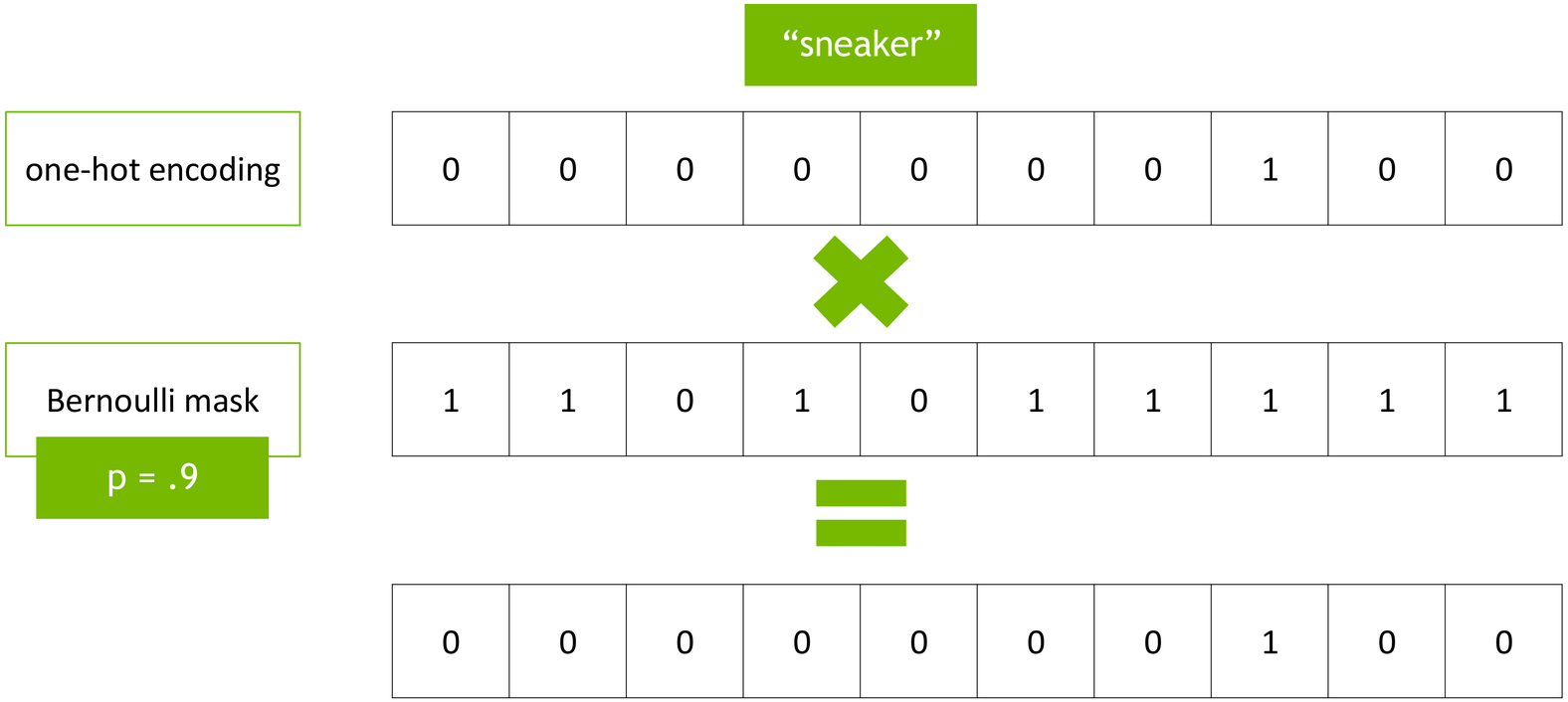
If CLIP is a pretrained model, do we need text labels to make a text-to-image model?

”

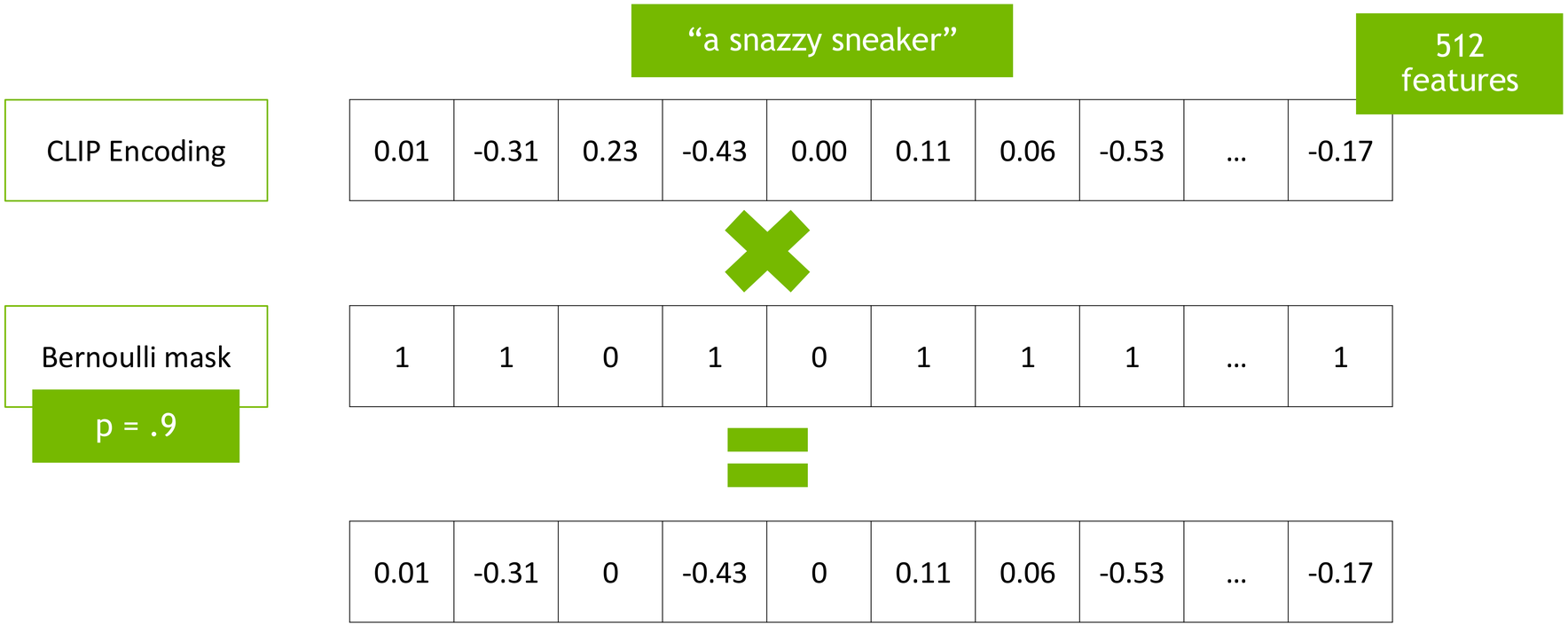
The Final Model



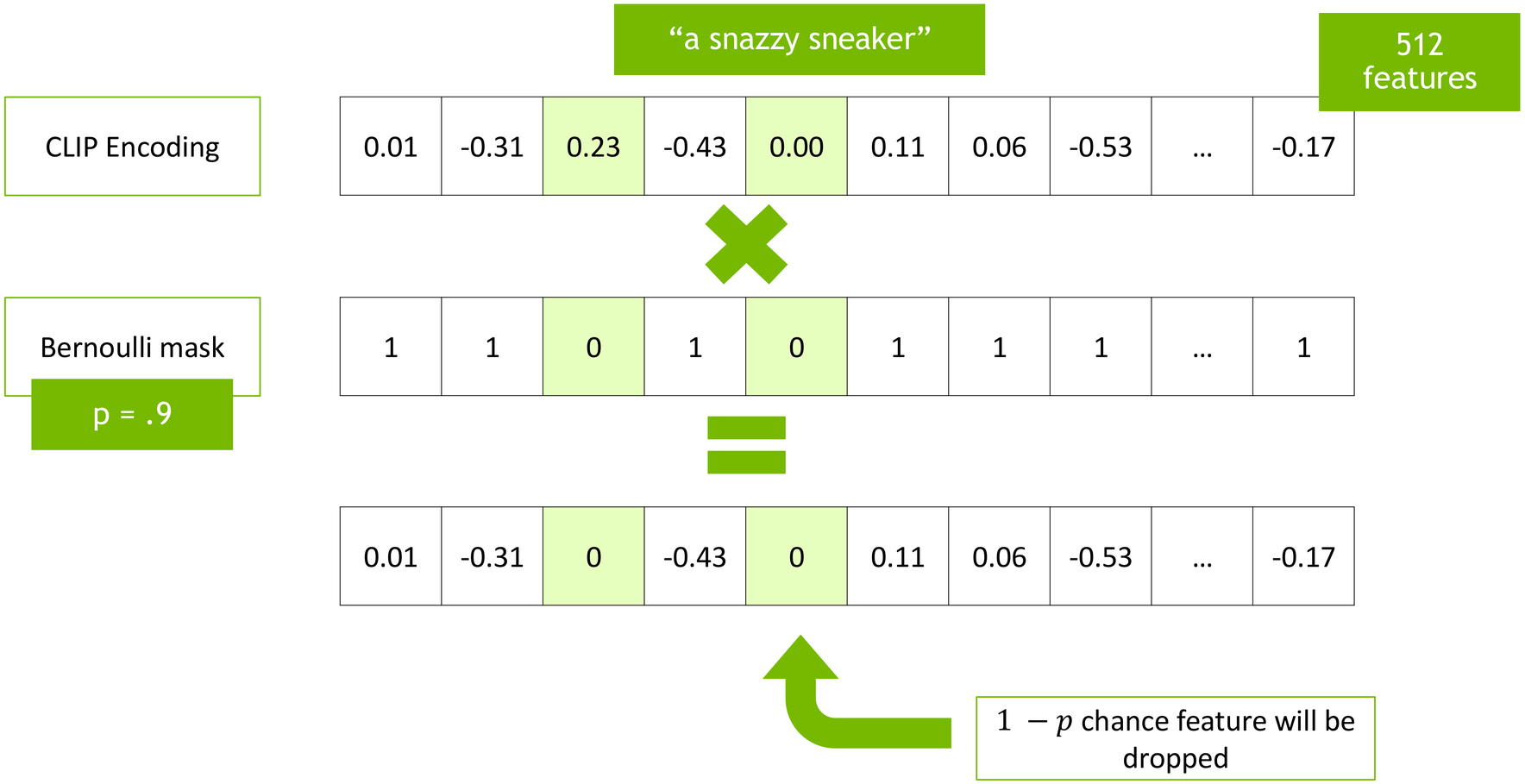
From Class to Context



From Class to Context



From Class to Context



Experimenting with CLIP

Training

CLIP

[-0.13, …, 0.00]

Prediction

“A bunch of different marbles”

CLIP

[-0.17, …, -0.11]

Let’s get started!