SFU

Probabilistic Neural Programmed Networks for Scene Generation

Zhiwei Deng

Jiacheng Chen

Yifang Fu

Greg Mori

Simon Fraser University

SFU

Scene generation problem

Semantics to single object

Semantics to complex scenes

Related works: Reed et al. ICML'16, Zhang et al. ICCV'17, etc.

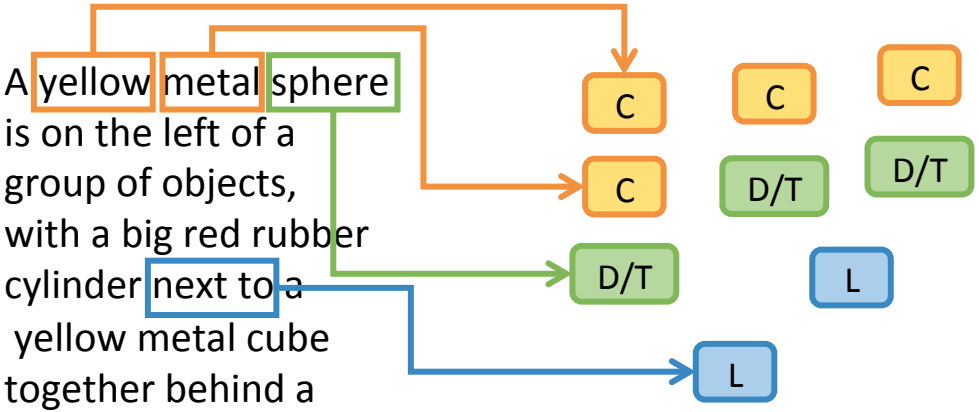
SFU

Scene generation problem

A yellow metal sphere
is on the left of a
group of objects,
with a big red rubber
cylinder next to a
yellow metal cube
together behind a
big red metal sphere,
another small yellow metal
sphere is at the right behind
of the red metal sphere, …

SFU

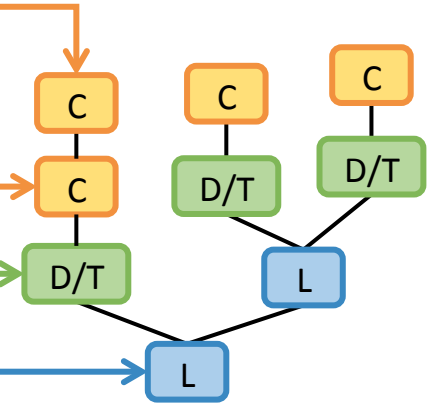
Scene generation problem

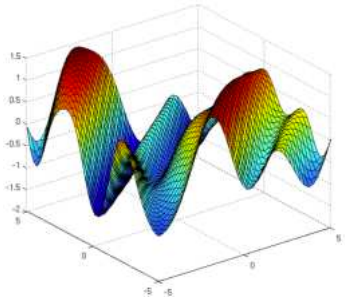


SFU

Scene generation problem

A yellow metal sphere is on the left of a group of objects, with a big red rubber cylinder next to a yellow metal cube together behind a big red metal sphere, another small yellow metal sphere is at the right behind of the red metal sphere, …



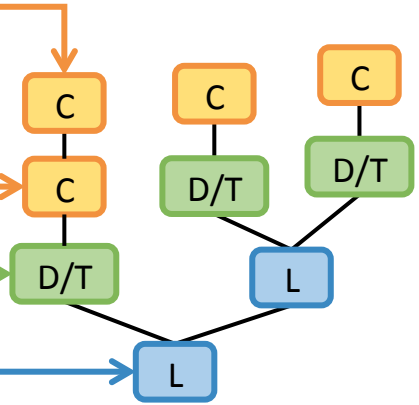


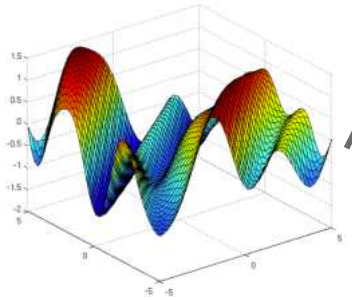
low-dimensional distribution representing the semantic

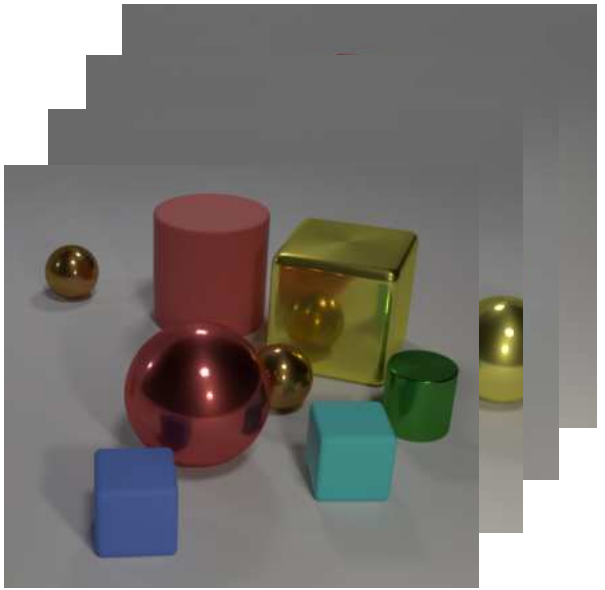
SFU

Scene generation problem

A yellow metal sphere is on the left of a group of objects, with a big red rubber cylinder next to a yellow metal cube together behind a big red metal sphere, another small yellow metal sphere is at the right behind of the red metal sphere, …

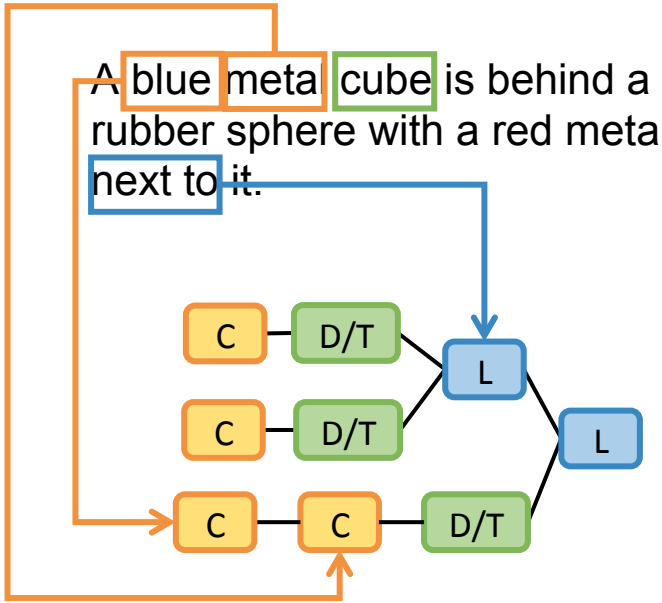


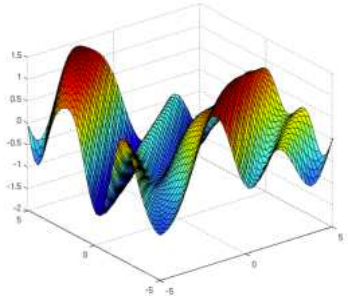




low-dimensional distribution representing the semantic

Scene generation problem





low-dimensional distribution representing the semantic

SFU

Scene generation problem

A blue metal cube is behind a cyan rubber sphere with a red metal sphere next to it.

SFU

Scene generation problem

Semantics:

Attributes

A blue metal cube is behind a cyan rubber sphere with a red metal sphere next to it.

SFU

Scene generation problem

Semantics:

Attributes, Objects

A blue metal cube is behind a cyan rubber sphere with a red metal sphere next to it.

SFU

Scene generation problem

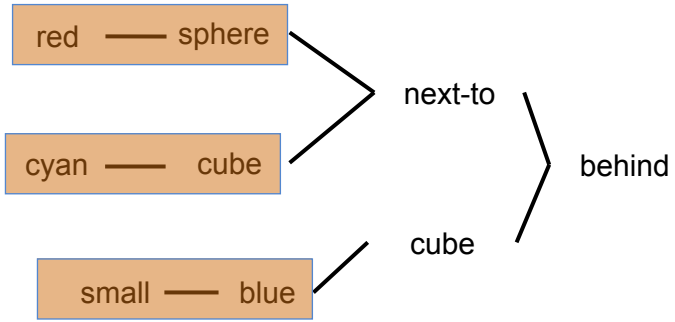
Semantics:

Attributes, Objects, Relations

A blue metal cube is behind a cyan rubber sphere with a red metal sphere next to it.

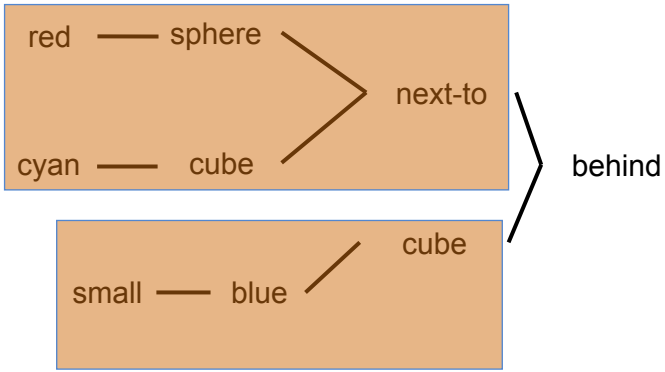
Our Proposed Model

y = “a red metal sphere next to a cyan rubber sphere with a blue metal cube behind”



Our Proposed Model

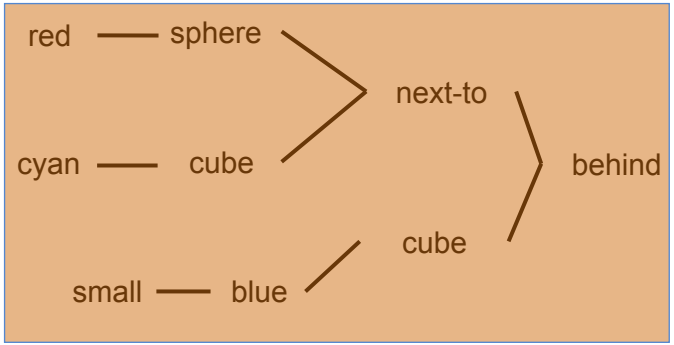
y = “a red metal sphere next to a cyan rubber sphere with a blue metal cube behind”

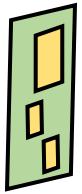


SFU

Our Proposed Model

y = “a red metal sphere next to a cyan rubber sphere with a blue metal cube behind”



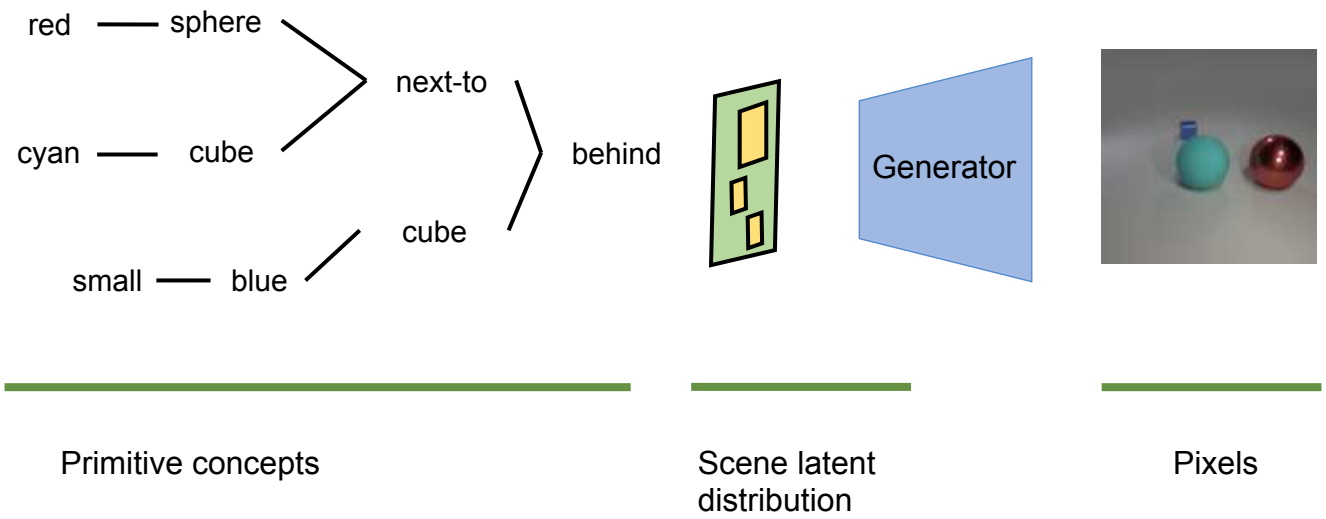


Primitive concepts

Scene latent distribution

Our Proposed Model

y = “a red metal sphere next to a cyan rubber sphere with a blue metal cube behind”



SFU

Reusable neural operators

Concept mapping

Combine

Describe

Transform

Layout

SFU

Reusable neural operators

Concept mapping

Combine

Describe

Transform

Layout

SFU

Reusable neural operators – map concept

Concept mapping

- E.g. sphere, cube, cylinder

Concept one hot encoding

$N(\mu_a,\sigma_a)$ $N(\mu_s,\sigma_s)$

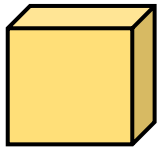
SFU

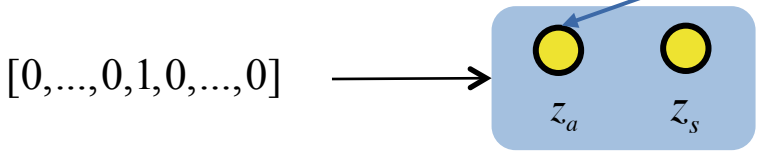
Reusable neural operators – map concept

Concept mapping

- E.g. sphere, cube, cylinder

C x H x W tensor
(**appearance**)





Concept one hot encoding

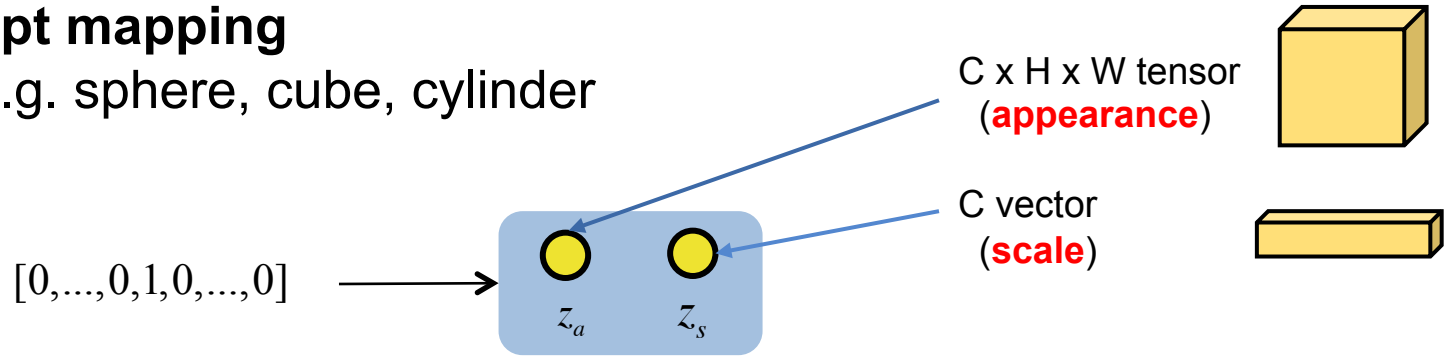
$N(\mu_a, \sigma_a)$ $N(\mu_s, \sigma_s)$

SFU

Reusable neural operators – map concept

Concept mapping

- E.g. sphere, cube, cylinder



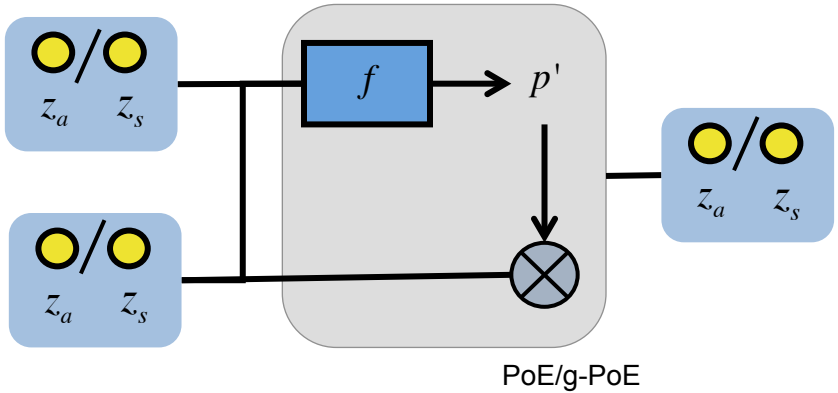
Concept one hot encoding

SFU

Reusable neural operators – Describe

Describe operator (object-dependent combination)

- E.g. red sphere, blue shiny cube



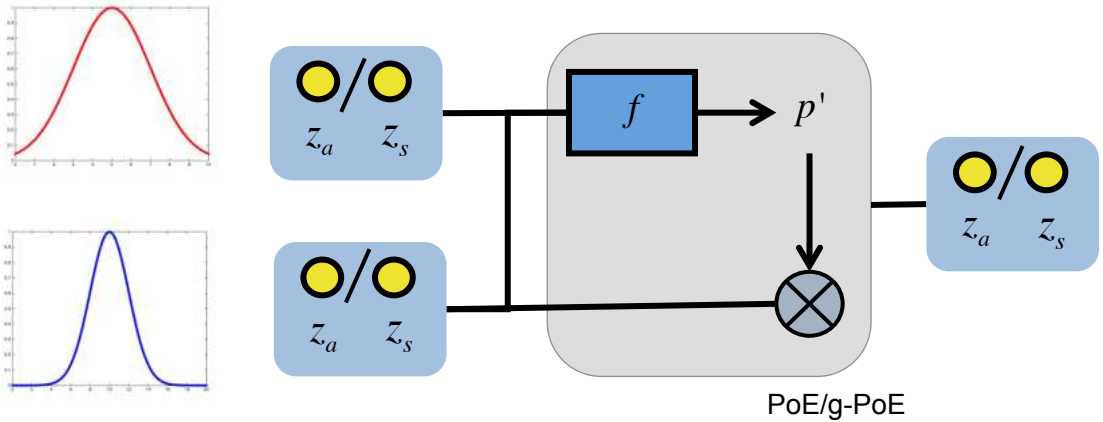
f : *convs / mlp*

SFU

Reusable neural operators – Describe

Describe operator (object-dependent combination)

- E.g. red sphere, blue shiny cube



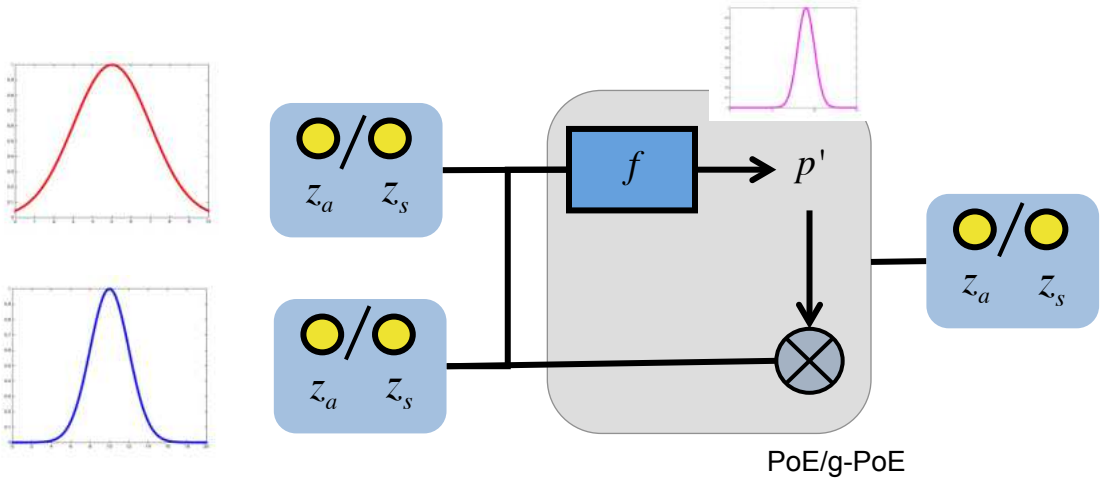
f : *convs / mlp*

SFU

Reusable neural operators – Describe

Describe operator (object-dependent combination)

- E.g. red sphere, blue shiny cube



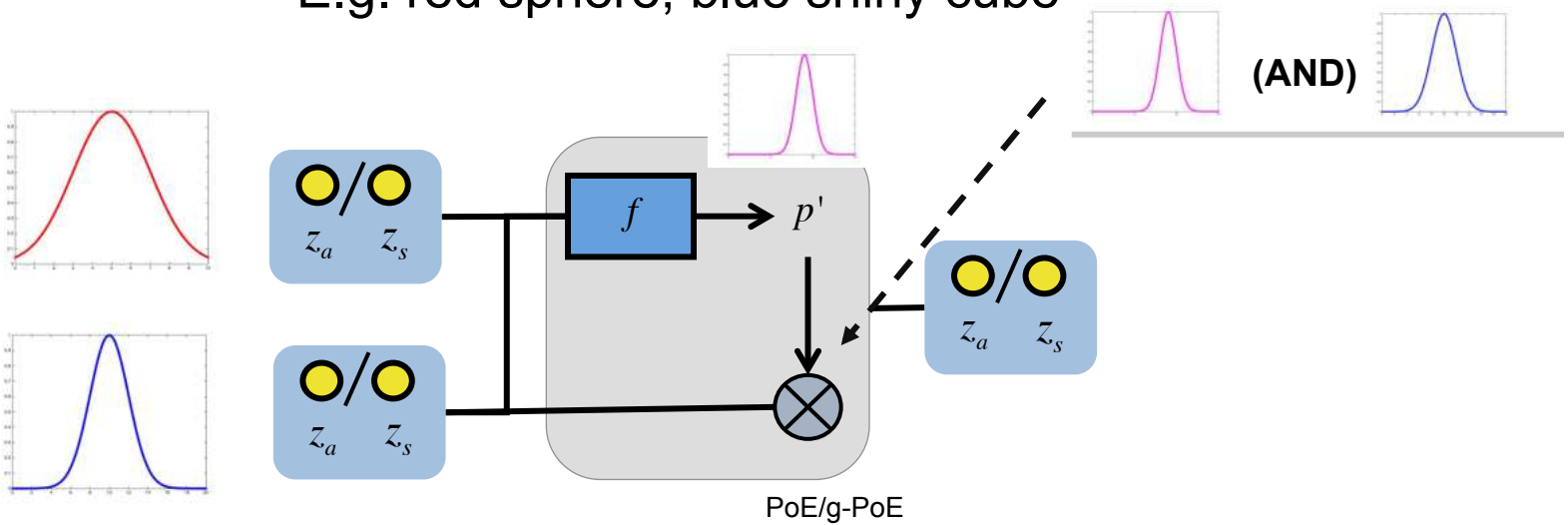
f : *convs / mlp*

SFU

Reusable neural operators – Describe

Describe operator (object-dependent combination)

- E.g. red sphere, blue shiny cube



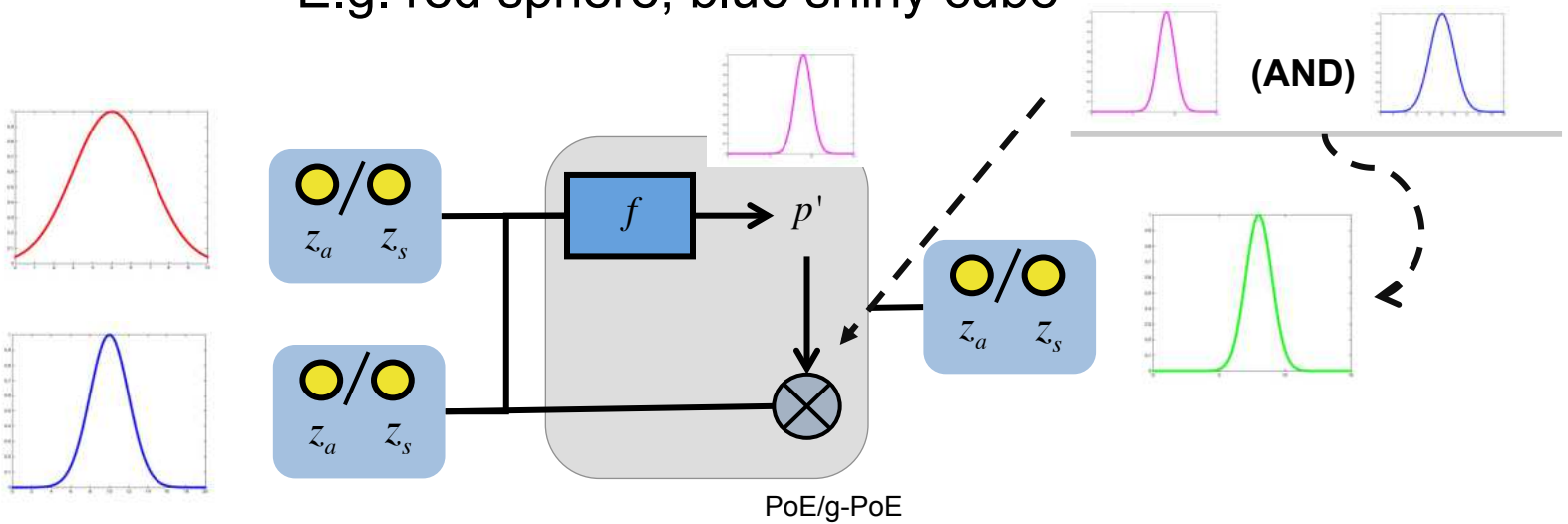
f : *convs / mlp*

SFU

Reusable neural operators – Describe

Describe operator (object-dependent combination)

- E.g. red sphere, blue shiny cube



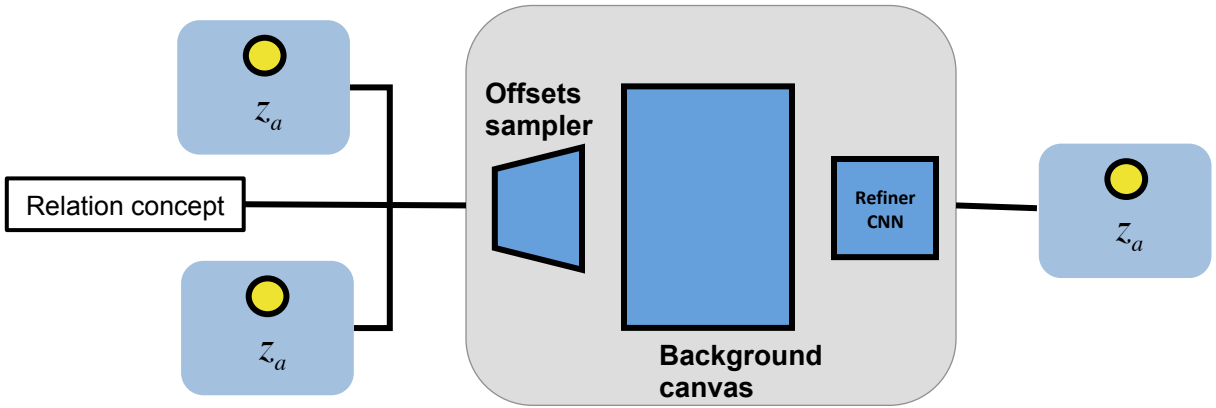
f : *convs / mlp*

SFU

Reusable neural operators – Layout

Layout operator (arrange positions for objects)

- E.g. red shiny sphere at location 41,28
  with blue matte cube at 19,31

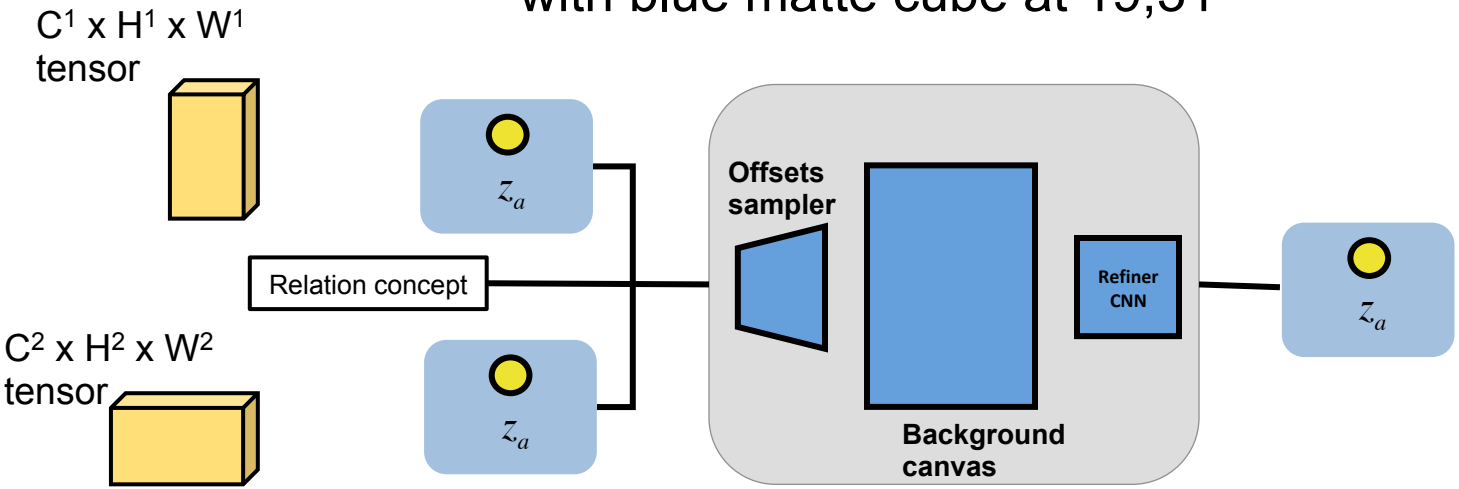


SFU

Reusable neural operators – Layout

Layout operator (arrange positions for objects)

- E.g. red shiny sphere at location 41,28
  with blue matte cube at 19,31

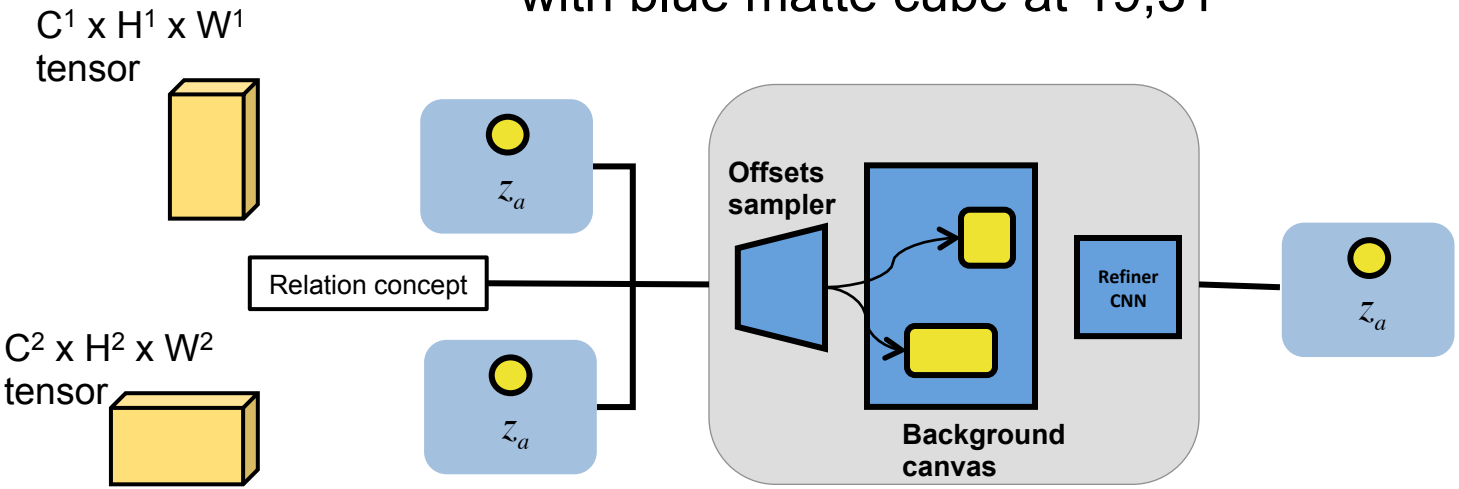


SFU

Reusable neural operators – Layout

Layout operator (arrange positions for objects)

- E.g. red shiny sphere at location 41,28
  with blue matte cube at 19,31

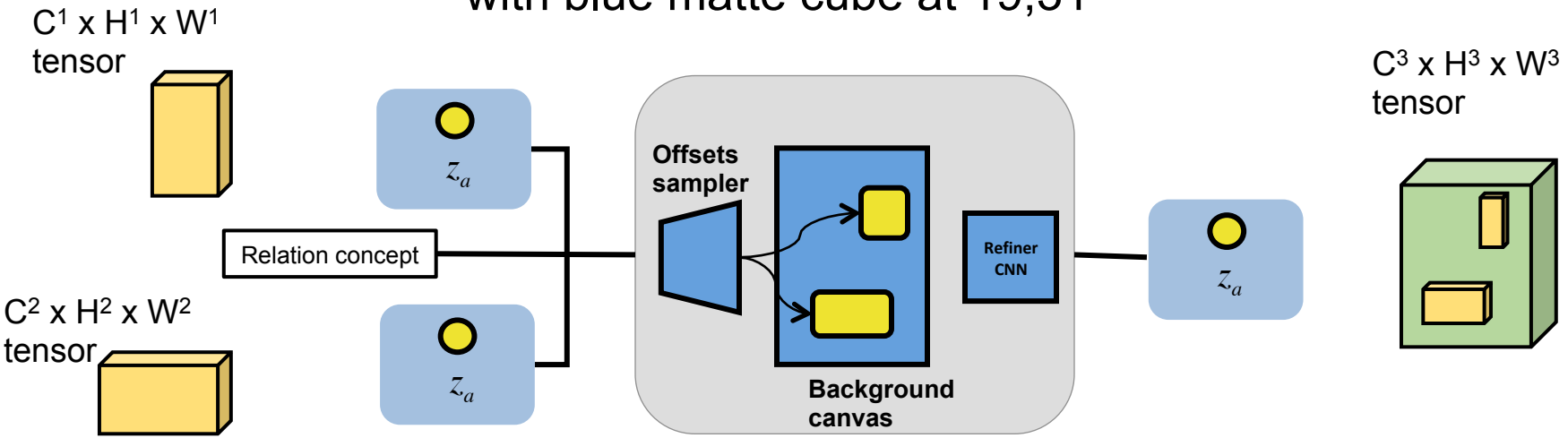


SFU

Reusable neural operators – Layout

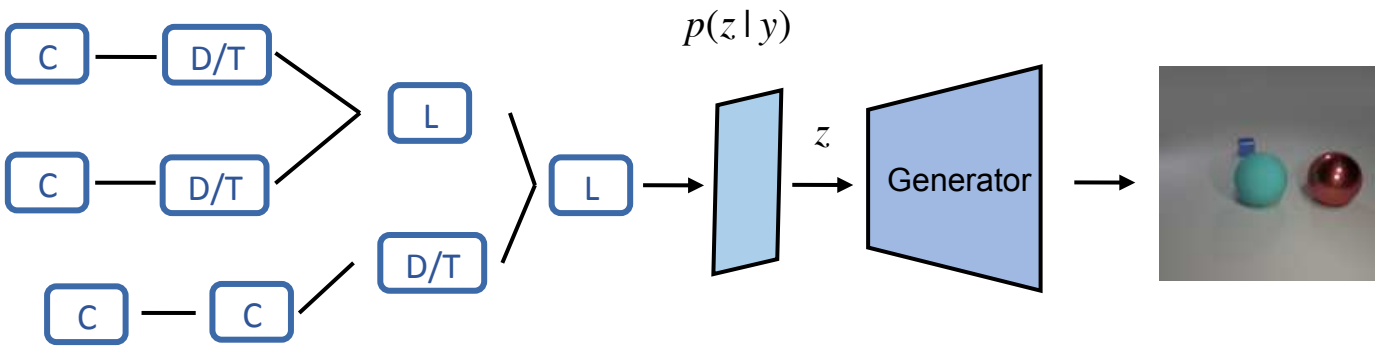
Layout operator (arrange positions for objects)

- E.g. red shiny sphere at location 41,28
  with blue matte cube at 19,31



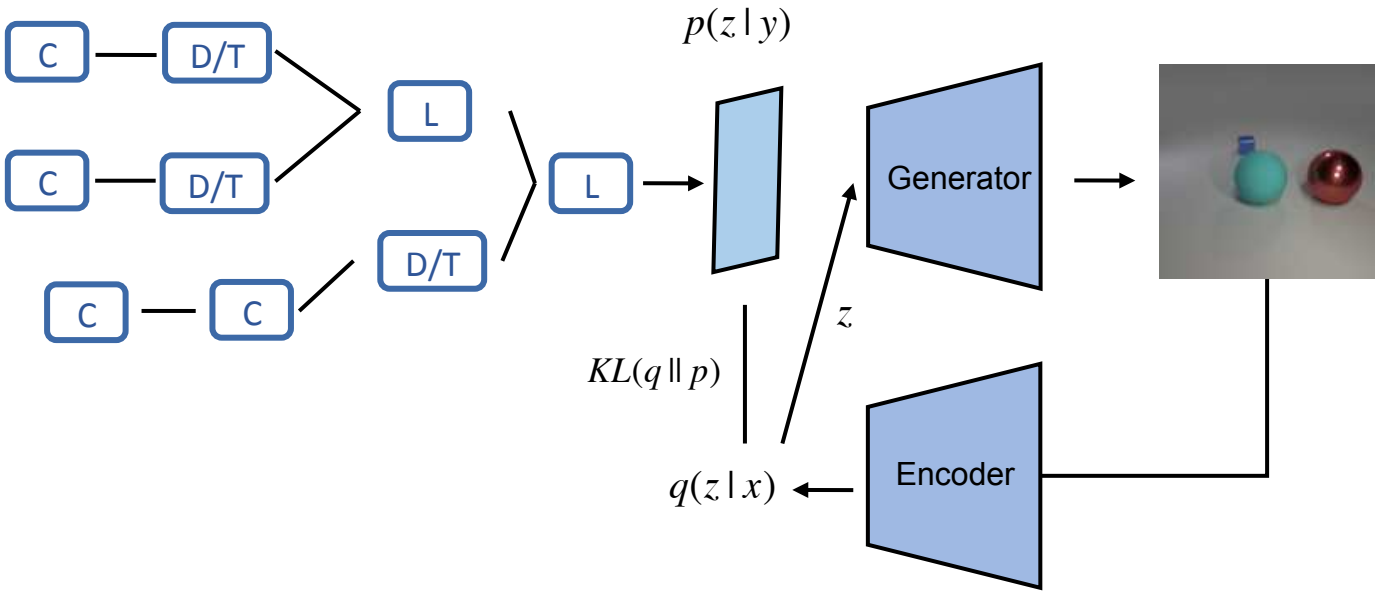
SFU

Apply modules into generation process



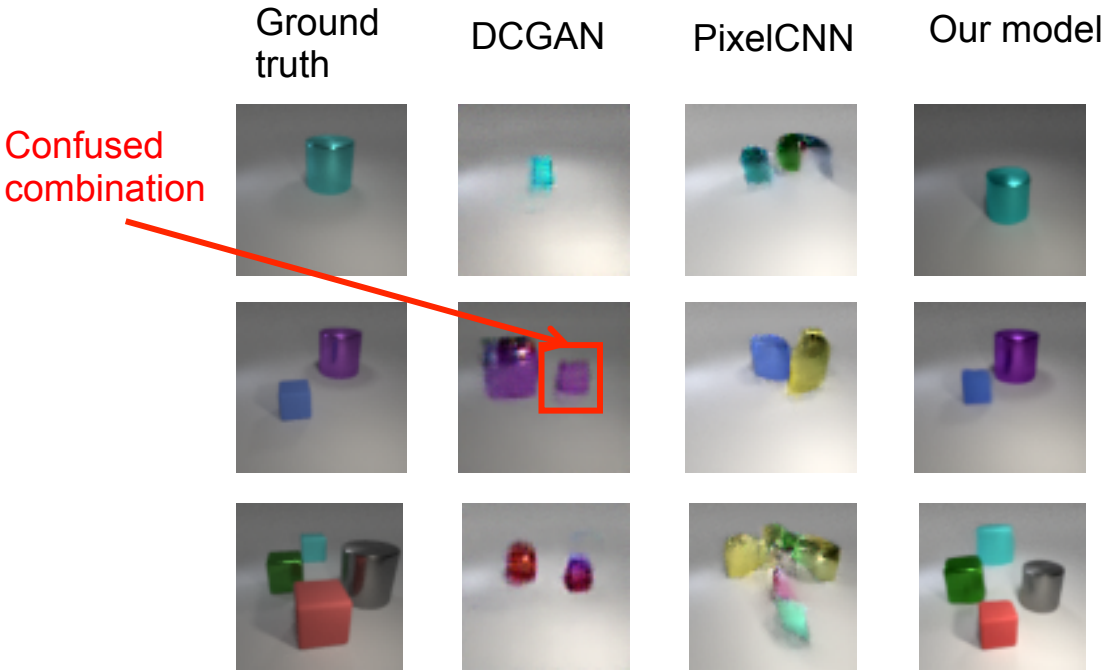
SFU

Learning process



SFU

Experiments: Unseen Object-Attribute Combinations



	Ours	DCGAN	Pixel-CNN
OBJ-N	97.0	98.9	89.9
OBJ	**75.2**	41.8	42.0
OBJ-A	**73.4**	33.2	19.2

SFU

Our poster

Come and check our poster at
Room 210&230 AB #7