

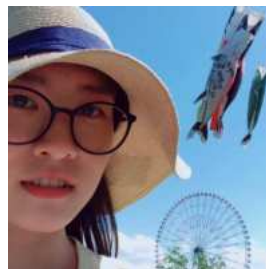
Probabilistic Neural Programmed Networks for Scene Generation



Zhiwei Deng



Jiacheng Chen



Yifang Fu



Greg Mori

Simon Fraser University

Scene generation problem



Semantics to single object

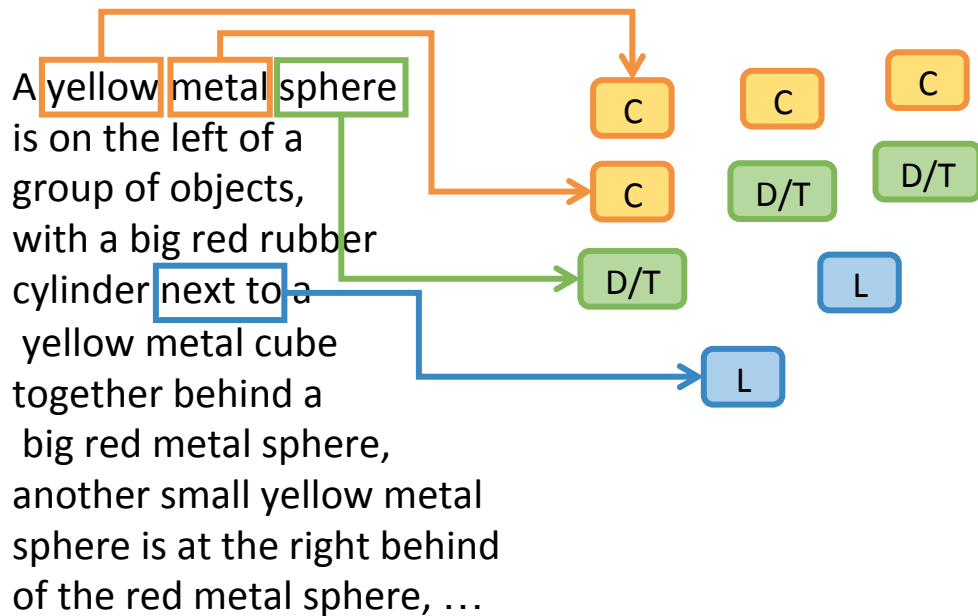


Semantics to complex scenes

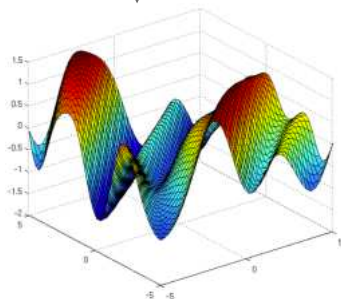
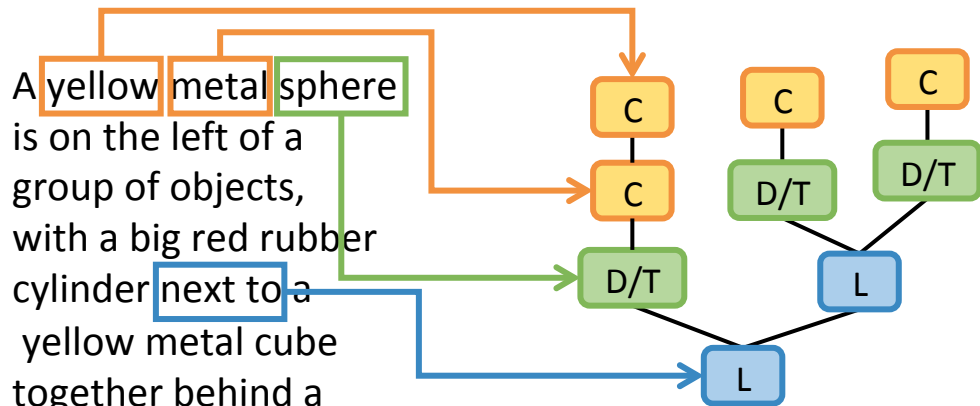
Scene generation problem

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, ...

Scene generation problem



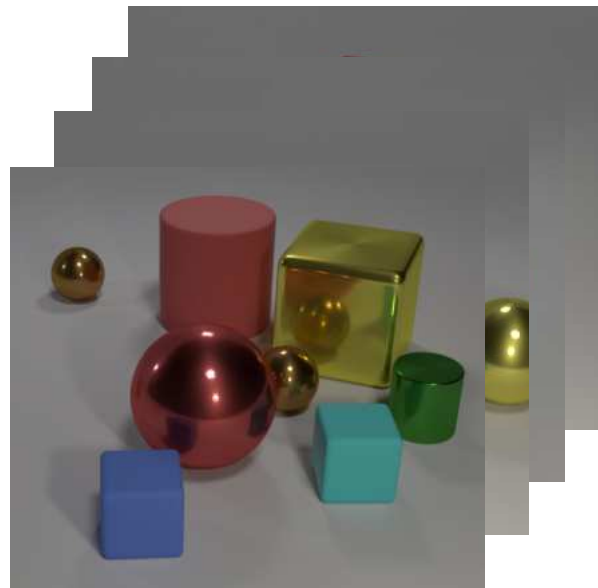
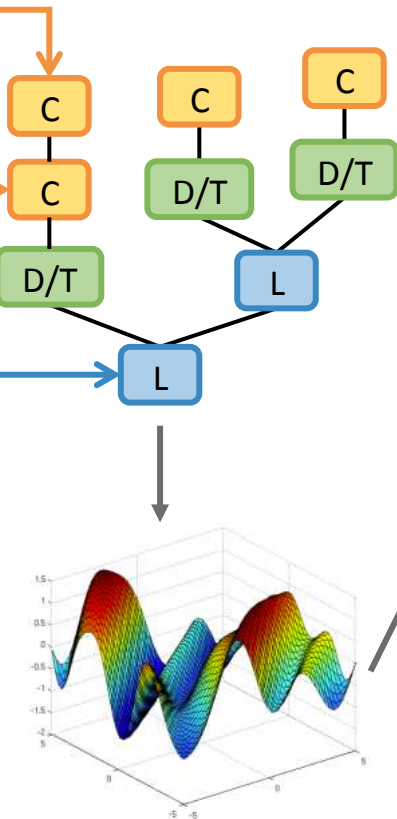
Scene generation problem



low-dimensional distribution
representing the semantic

Scene generation problem

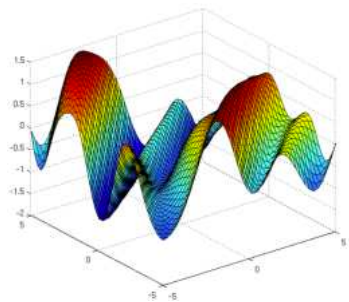
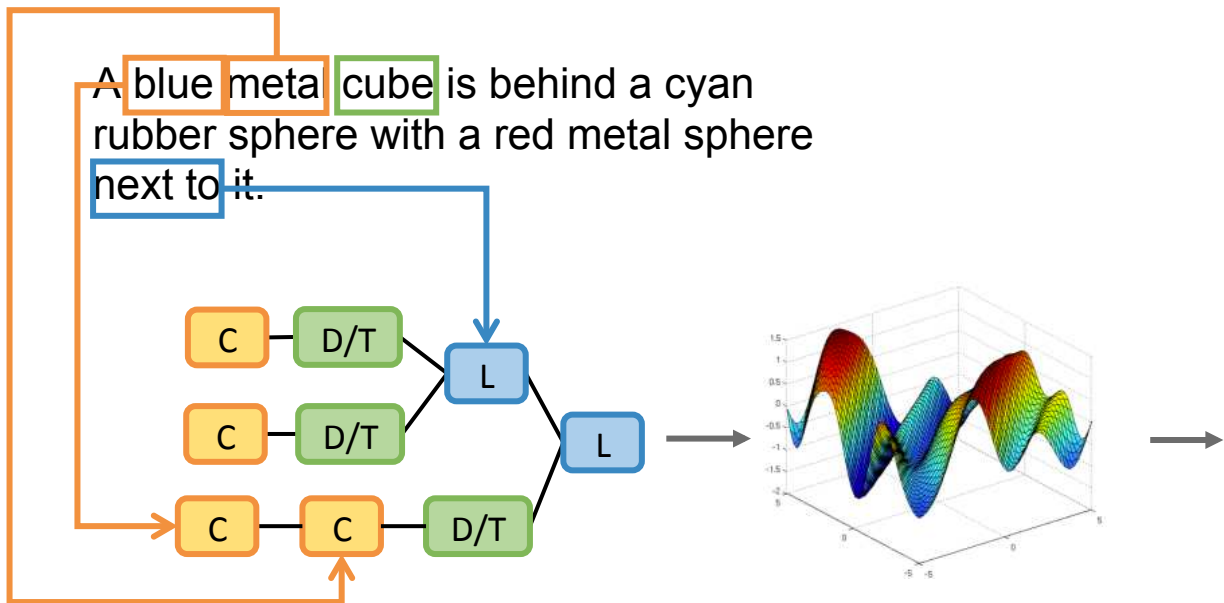
A yellow metal sphere is on the left of a group of objects, with a big red rubber cylinder next to a yellow metal cube together behind a big red metal sphere, another small yellow metal sphere is at the right behind of the red metal sphere, ...



low-dimensional distribution representing the semantic

Scene generation problem

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



low-dimensional distribution representing the semantic



Scene generation problem

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



Scene generation problem

Semantics:

Attributes

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



Scene generation problem

Semantics:

Attributes, Objects

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



Scene generation problem

Semantics:

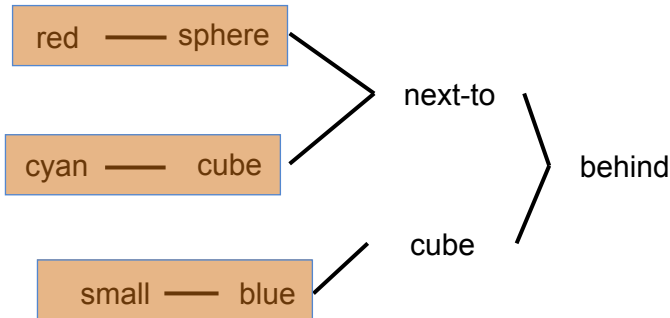
Attributes, Objects, Relations

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



Our Proposed Model

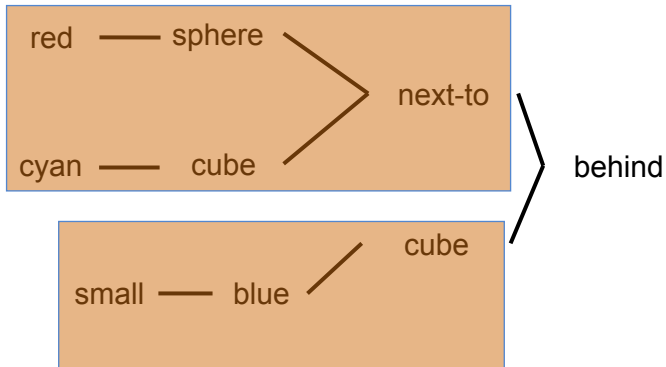
y = “a red metal sphere next to a cyan rubber sphere with a blue metal cube behind”



Primitive concepts

Our Proposed Model

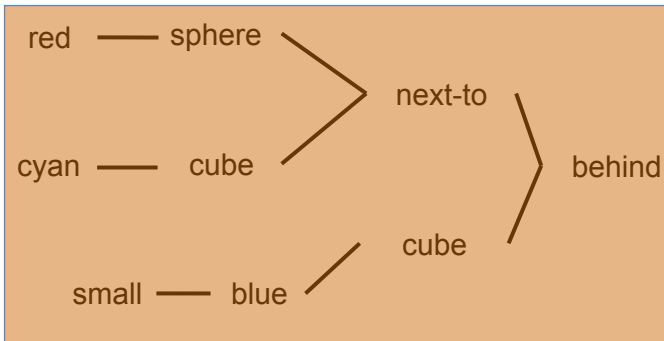
y = “a red metal sphere next to a cyan rubber sphere with a blue metal cube behind”



Primitive concepts

Our Proposed Model

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



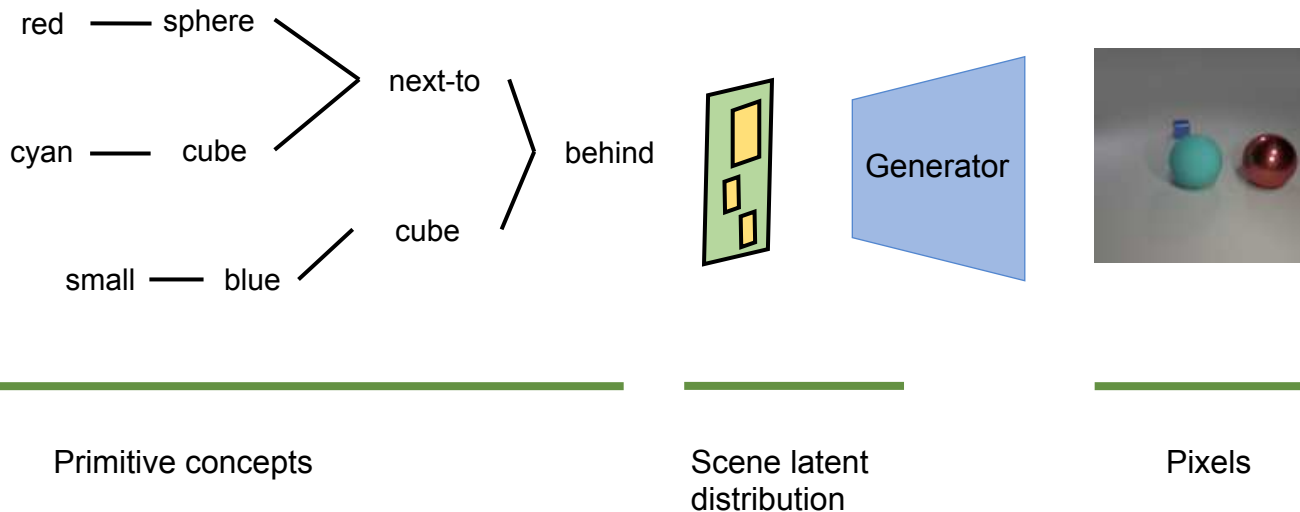
Primitive concepts



Scene latent distribution

Our Proposed Model

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



Reusable neural operators

Concept
mapping

Combine

Describe

Transform

Layout

Reusable neural operators

Concept
mapping

Combine

Describe

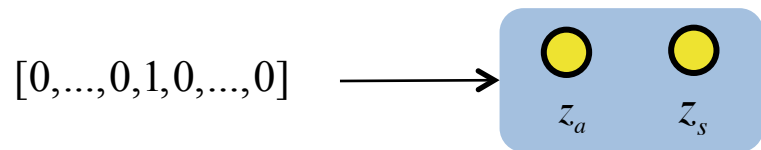
Transform

Layout

Reusable neural operators – map concept

Concept mapping

- E.g. sphere, cube, cylinder



Concept one hot encoding

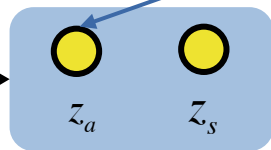
$$N(\mu_a, \sigma_a) \quad N(\mu_s, \sigma_s)$$

Reusable neural operators – map concept

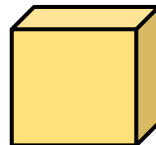
Concept mapping

- E.g. sphere, cube, cylinder

$[0, \dots, 0, 1, 0, \dots, 0]$



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



Concept one hot encoding

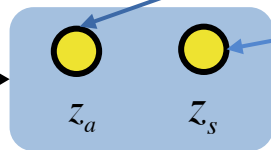
$N(\mu_a, \sigma_a)$ $N(\mu_s, \sigma_s)$

Reusable neural operators – map concept

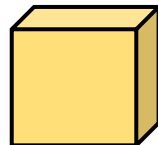
Concept mapping

- E.g. sphere, cube, cylinder

$[0, \dots, 0, 1, 0, \dots, 0]$



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



C vector
(**scale**)



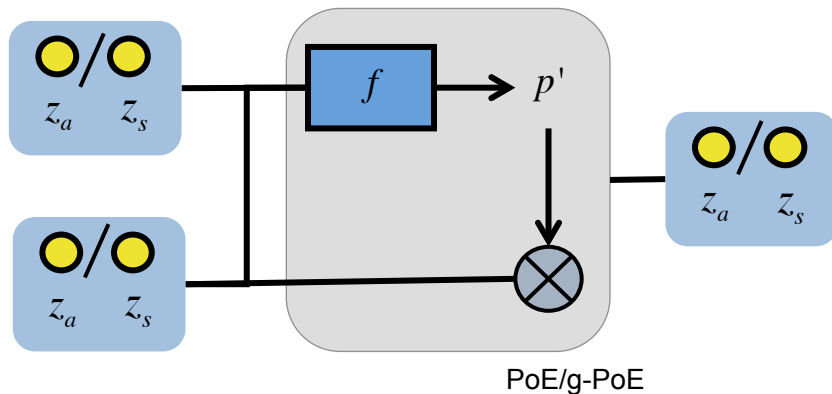
Concept one hot encoding

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

Reusable neural operators – Describe

Describe operator (object-dependent combination)

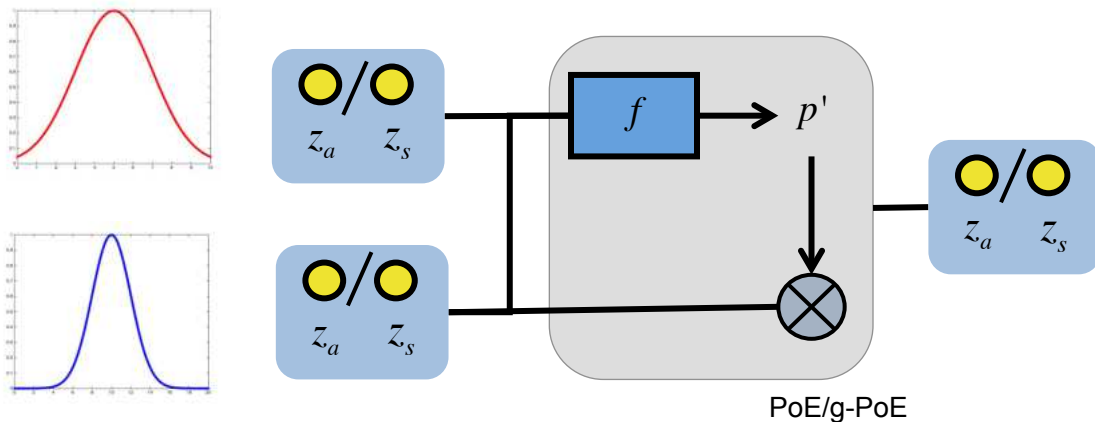
- E.g. red sphere, blue shiny cube



Reusable neural operators – Describe

Describe operator (object-dependent combination)

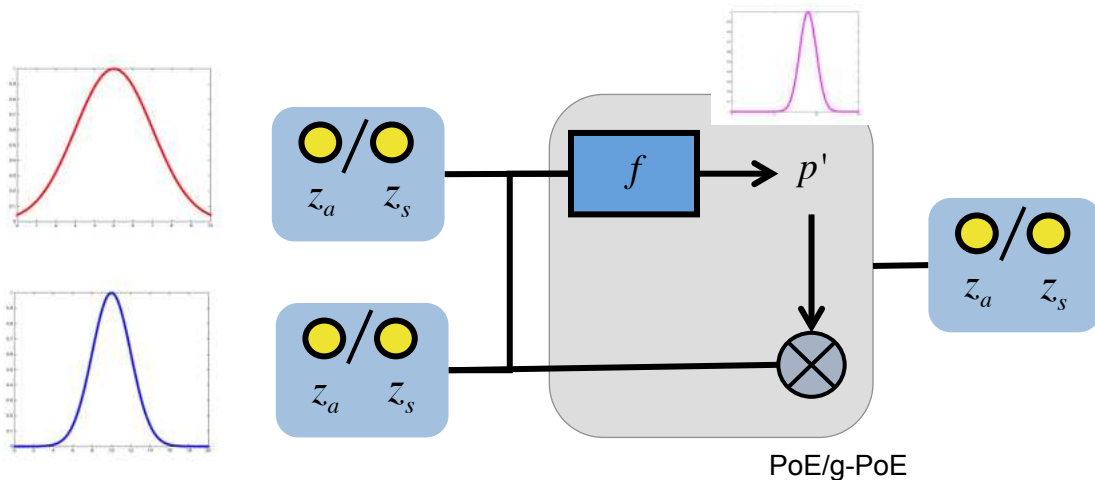
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Reusable neural operators – Describe

Describe operator (object-dependent combination)

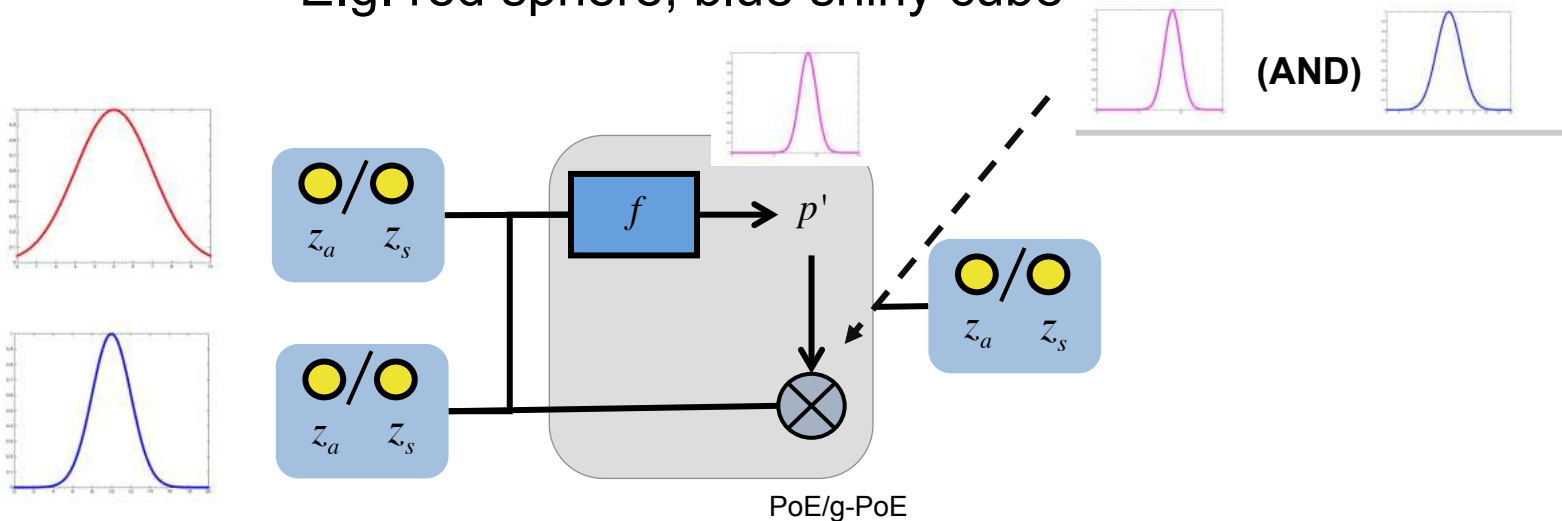
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Reusable neural operators – Describe

Describe operator (object-dependent combination)

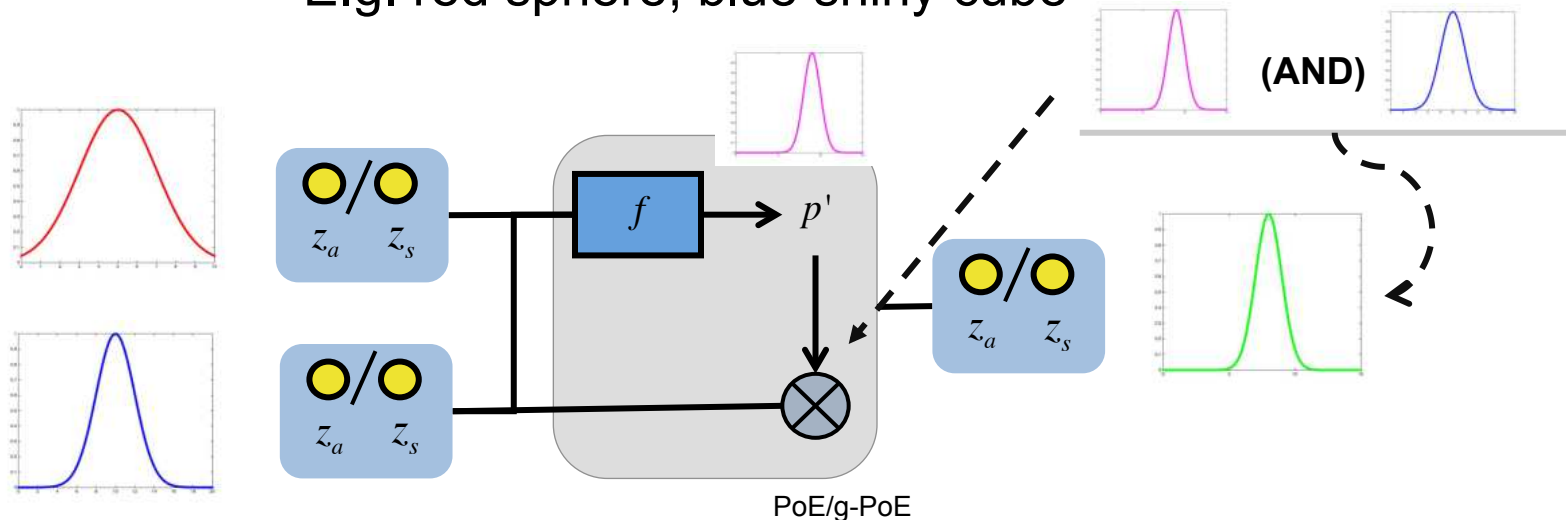
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Reusable neural operators – Describe

Describe operator (object-dependent combination)

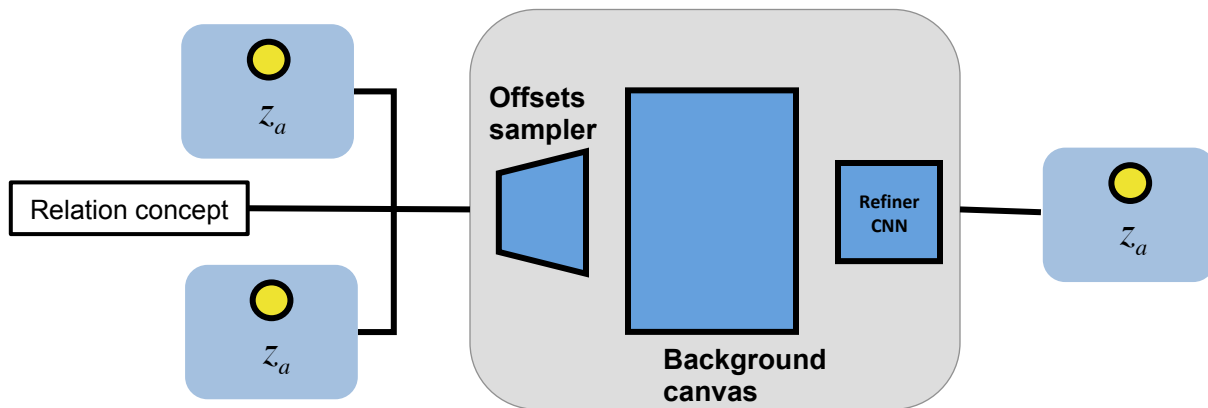
- E.g. red sphere, blue shiny cube



Reusable neural operators – Layout

Layout operator (arrange positions for objects)

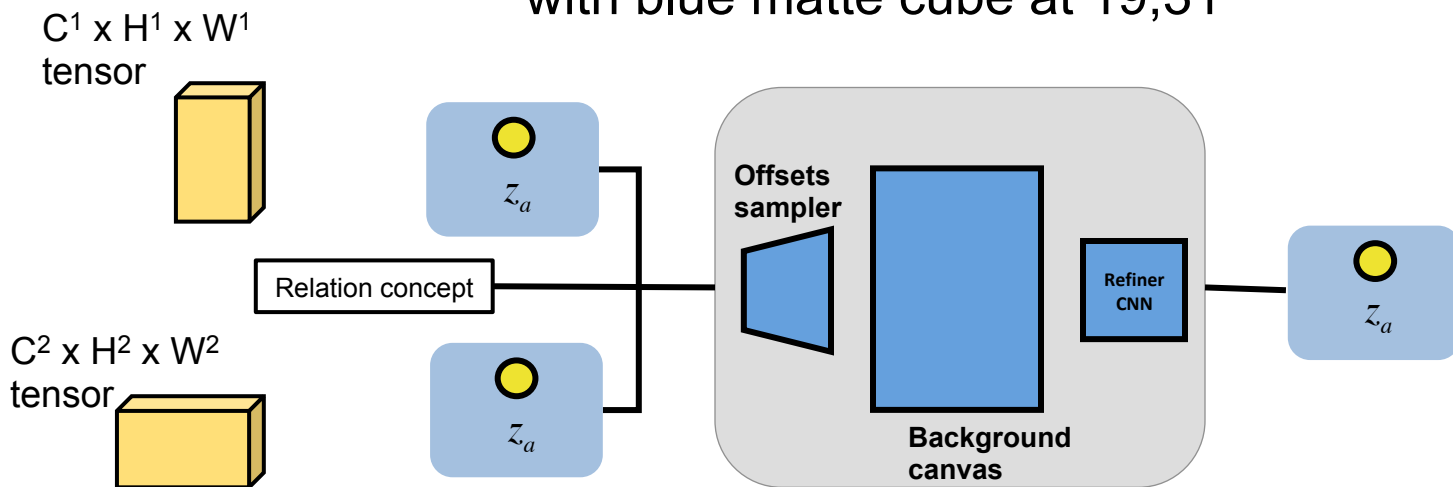
- E.g. red shiny sphere at location 41,28
with blue matte cube at 19,31



Reusable neural operators – Layout

Layout operator (arrange positions for objects)

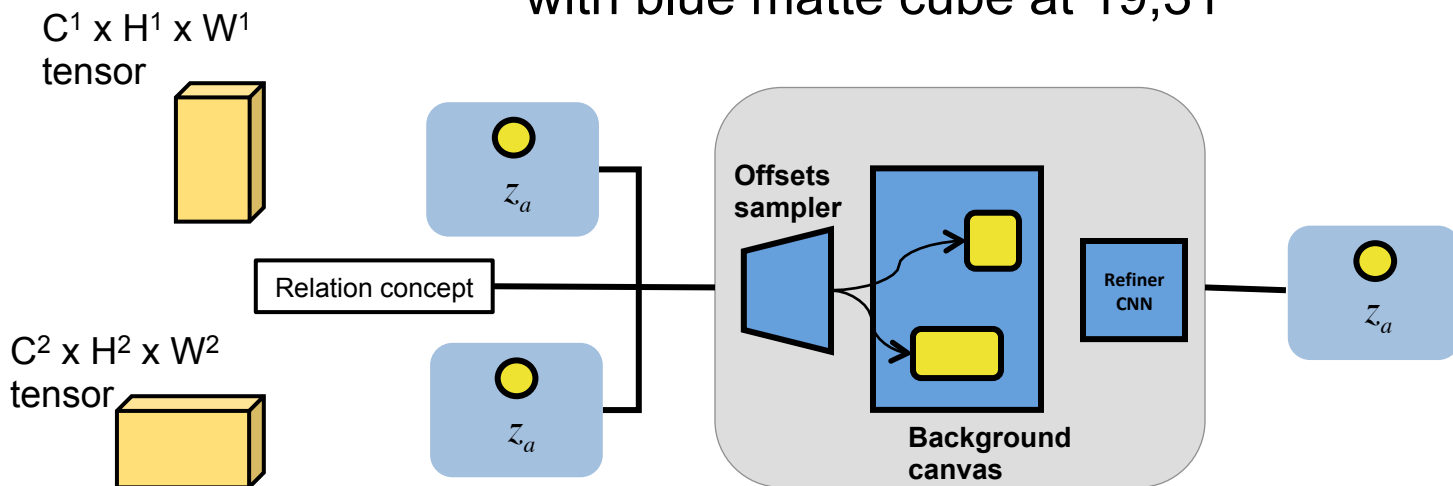
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Reusable neural operators – Layout

Layout operator (arrange positions for objects)

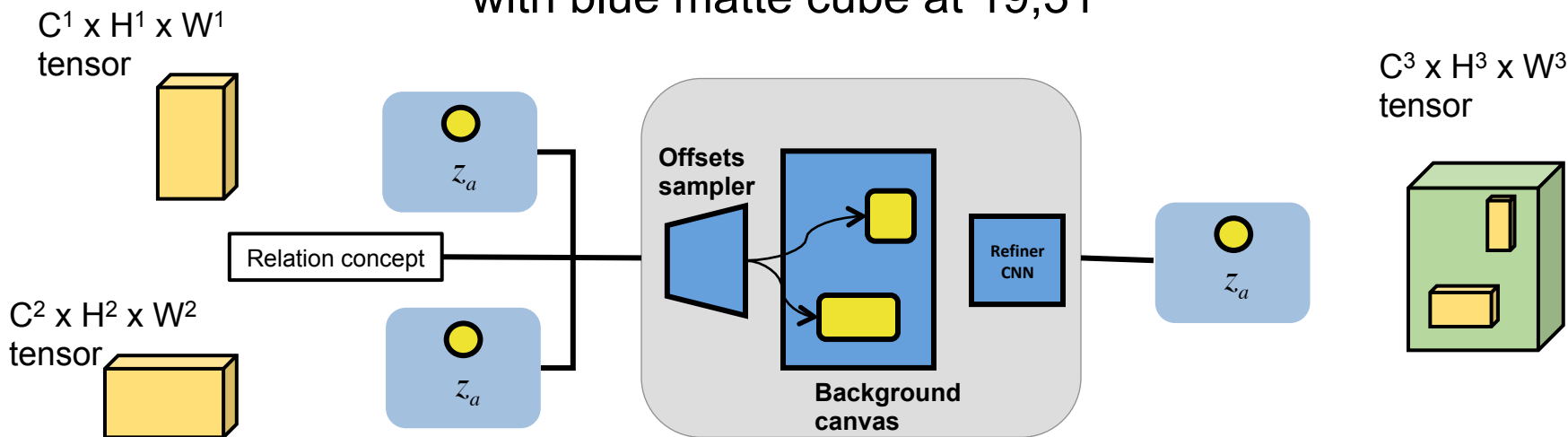
- E.g. red shiny sphere at location 41,28
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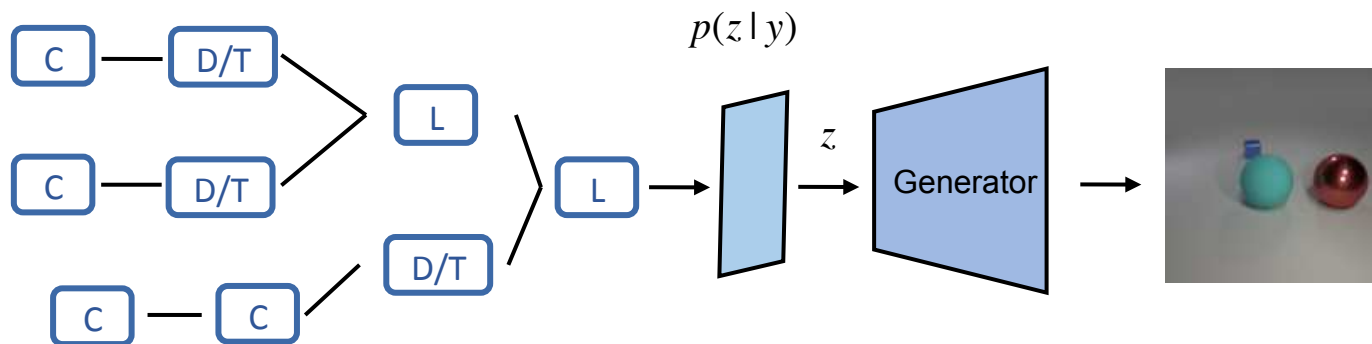
Reusable neural operators – Layout

Layout operator (arrange positions for objects)

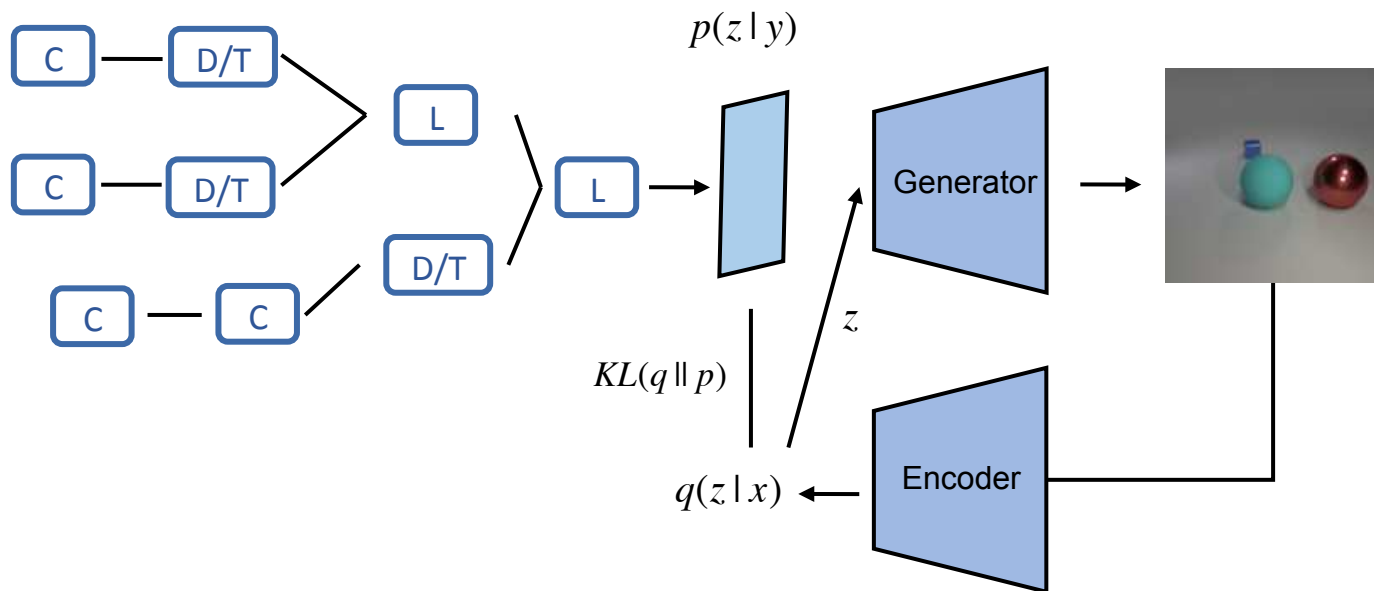
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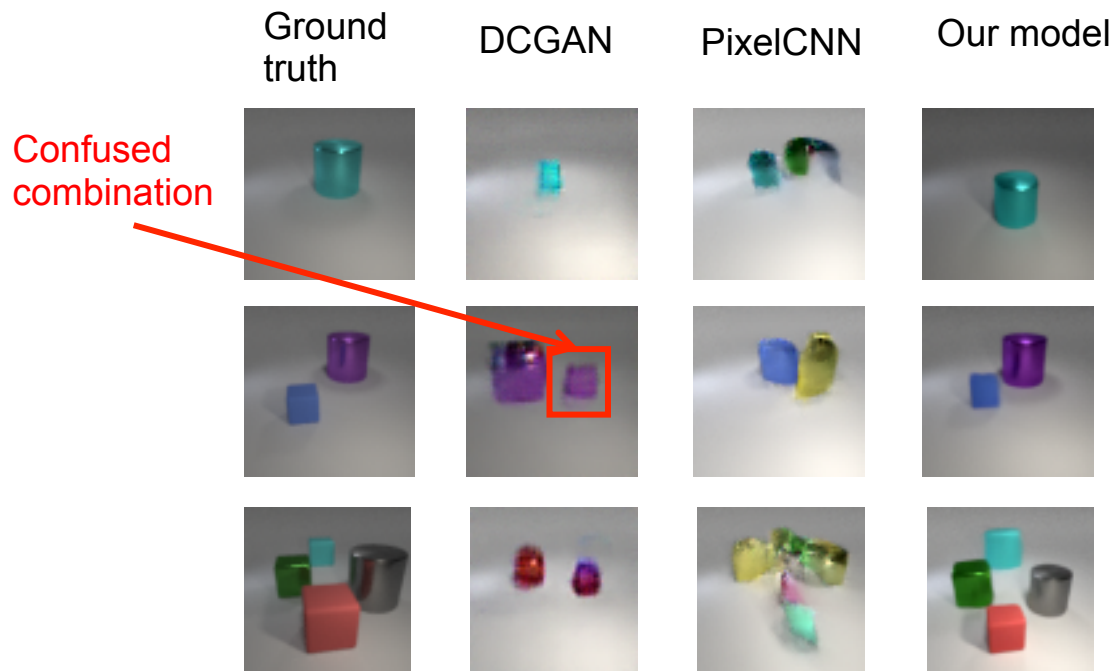
Apply modules into generation process



Learning process



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

Our poster

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

