Relightable Neural Radiance Fields for Novel View Synthesis

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Introduction

“View synthesis is the problem of rendering new views of a scene from a given set of input images and their respective camera poses.“ [2]

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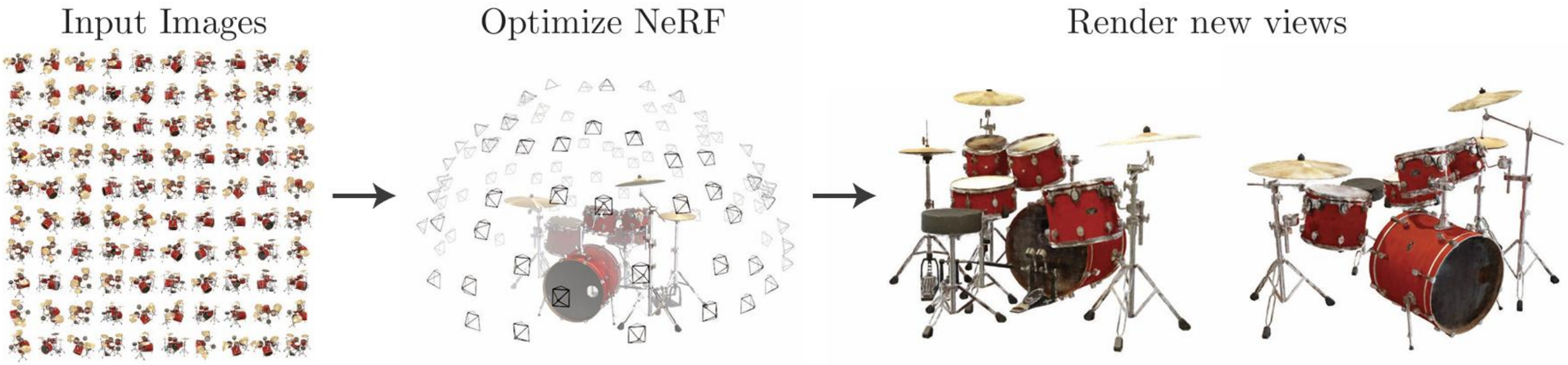
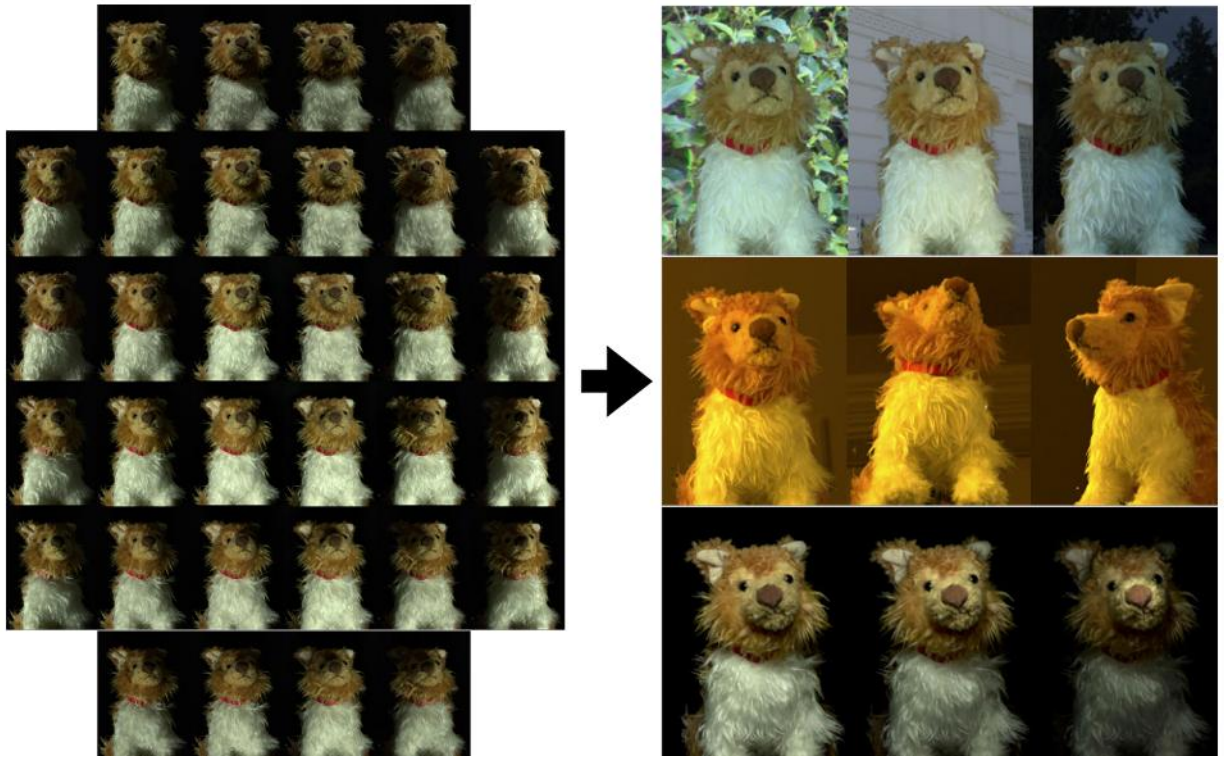
Introduction

- Neural radiance fields (NeRFs)
  - Continuous interactive scene
  - Feature films, video games, and virtual reality
  - Limited in lighting control and novel environments



Introduction

- Relightable neural radiance fields (ReNeRFs)
  - Controllable lighting
  - Novel environments
  - Image-based relighting (IBRL)
  - In-studio photogrammetry



Outline

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  - Training
  - Loss Functions
- Neural Radiance Fields
  - Scene Representation
  - Volume Rendering
- Relightable Neural Radiance Fields
  - Capturing Input Images
  - Scene Generation
  - Architecture
  - Training
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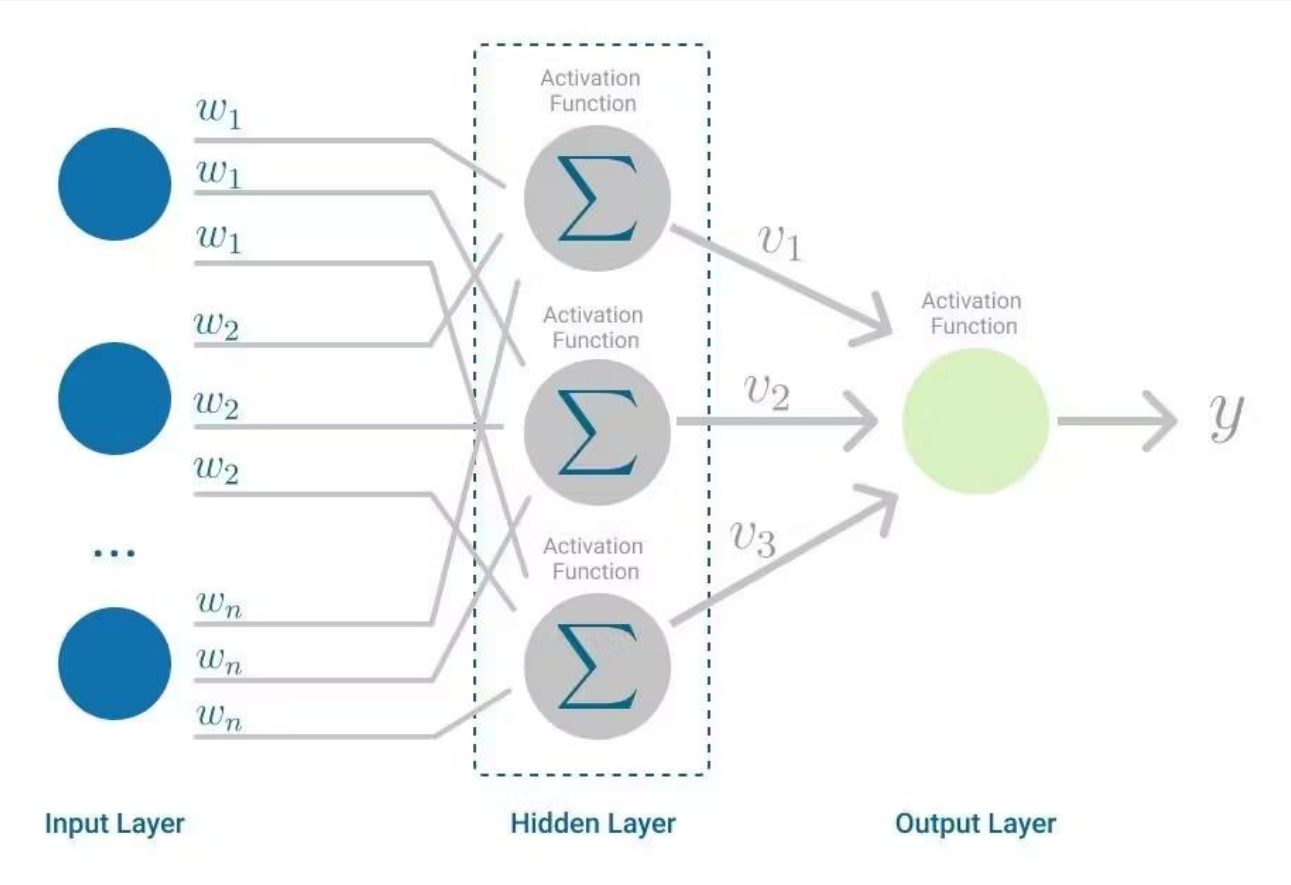
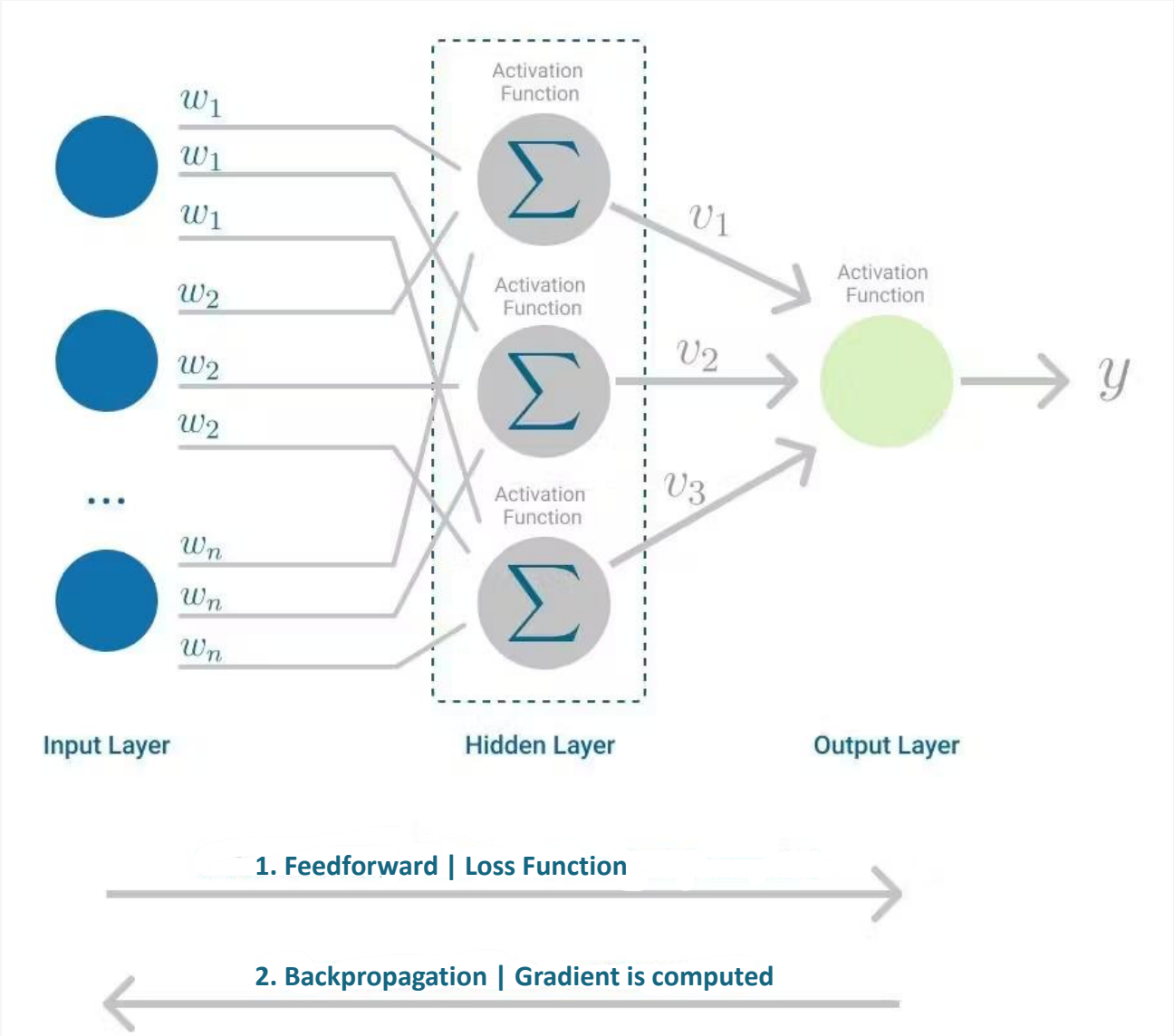
- Conclusion



Multilayer Perceptron Explained with a Real-Life Example and Python Code: Sentiment Analysis | Towards Data Science

Deep Neural Networks

- Multilayer perceptron (MLP)
- Neurons
- Weights
- Activation Function



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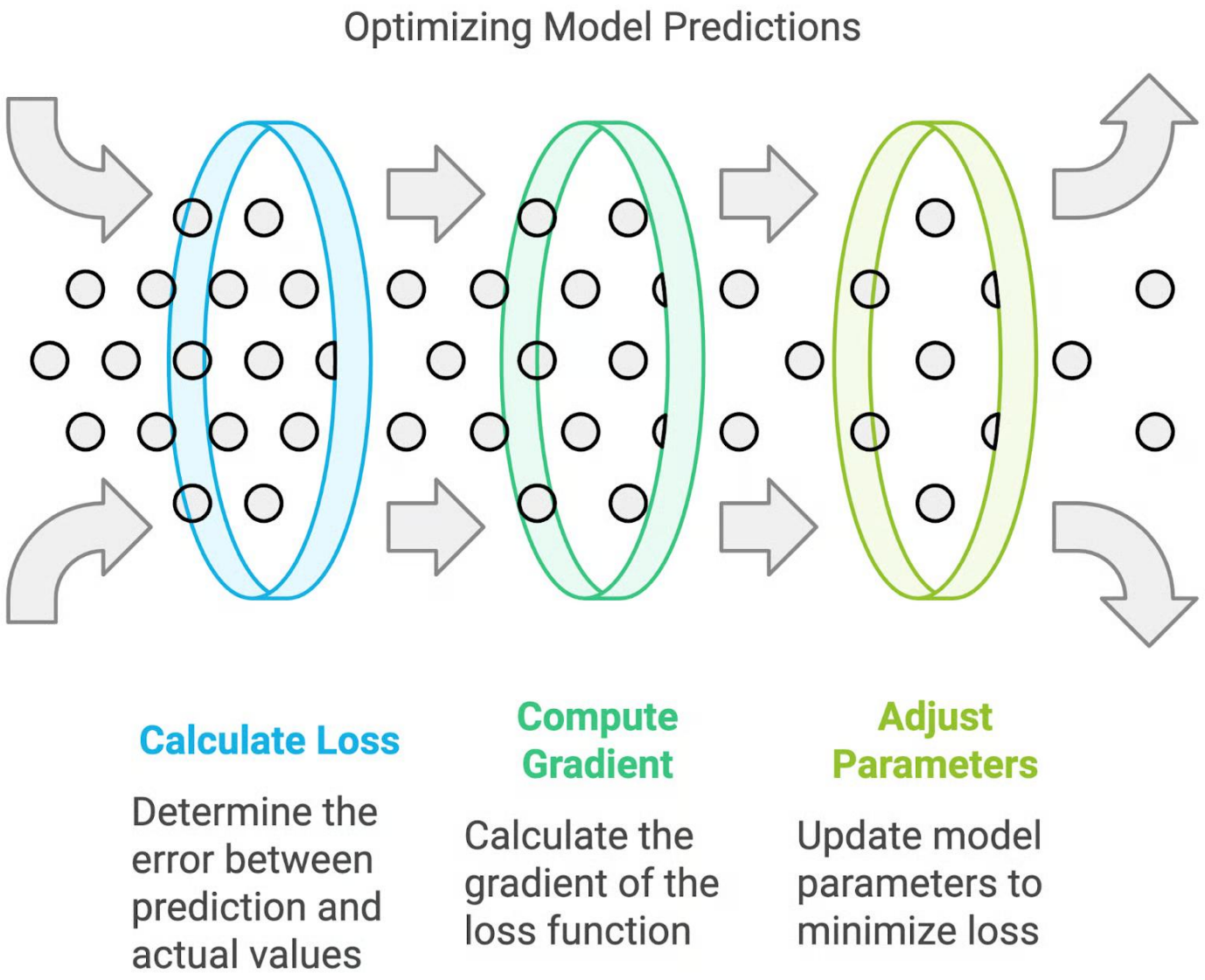
Deep Neural Networks: Training

- Training ensures accurate predictions and results
- Backpropagation

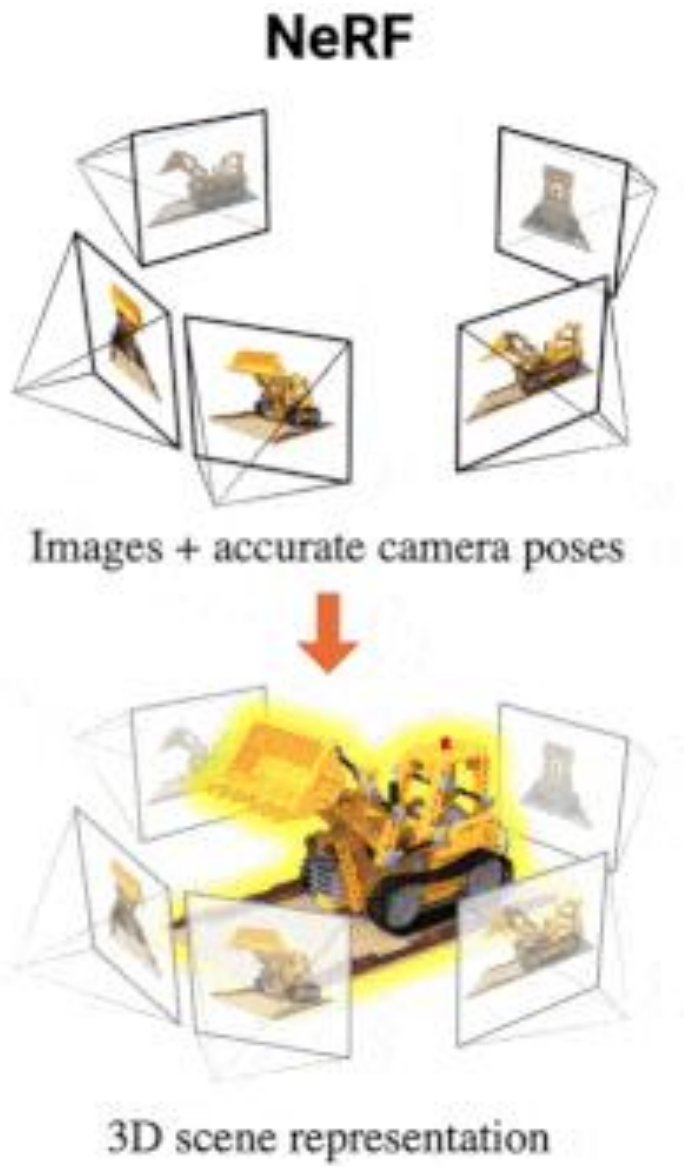
Deep Neural Networks: Loss Functions



https://www.datacamp.com/tutorial/loss-function-in-machine-learning

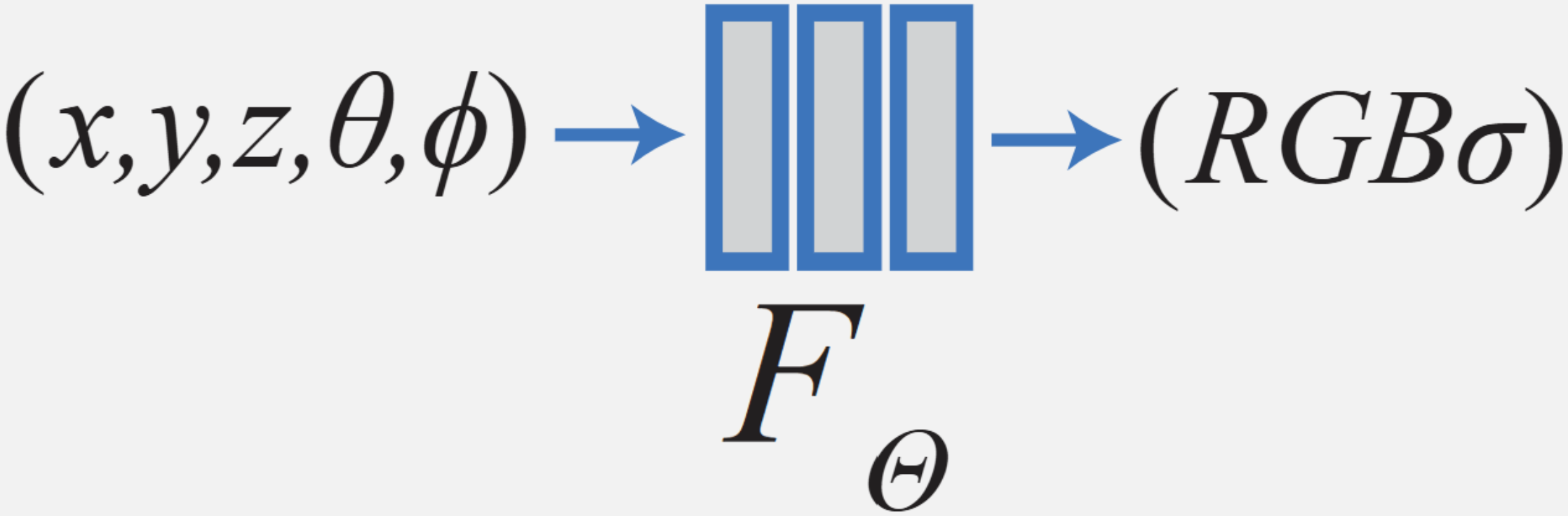
Neural Radiance Fields

- 3D view synthesis
- Continuous photorealistic scenes generated by a MLP



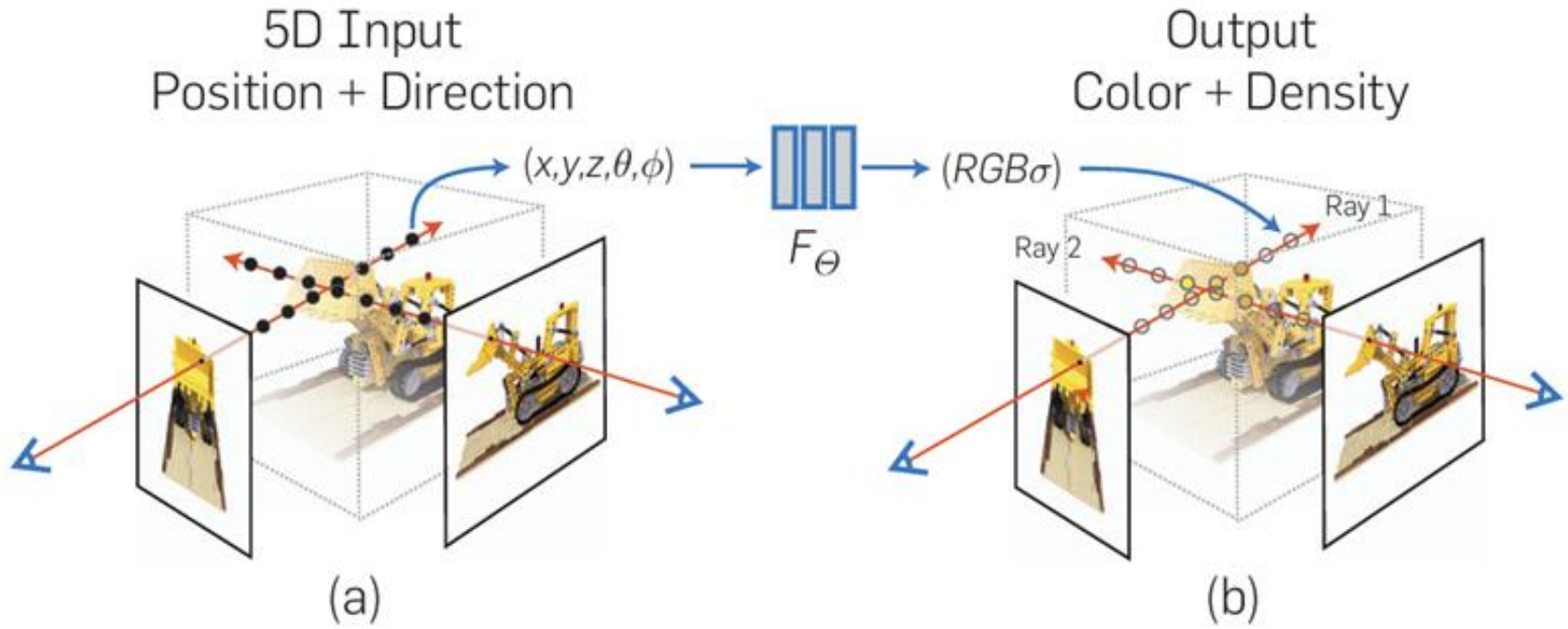
https://www.deeplearning.ai/the-batch/3d-scene-synthesis-for-the-real-world/

NeRFs: Scene Generation



NeRFs: Volume Rendering

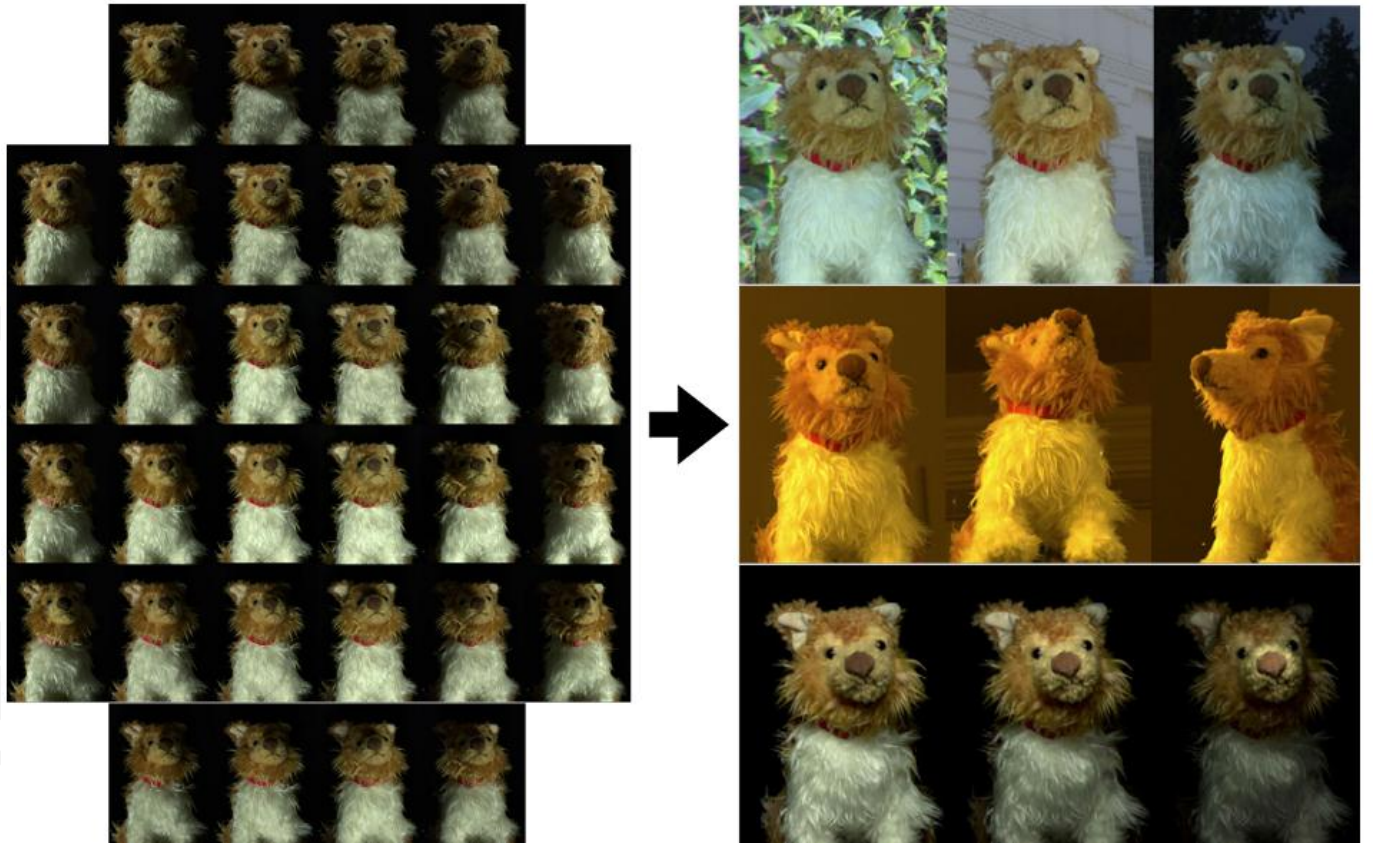
- Uses model outputs
- Estimates the light emitted at each camera angle



[1]

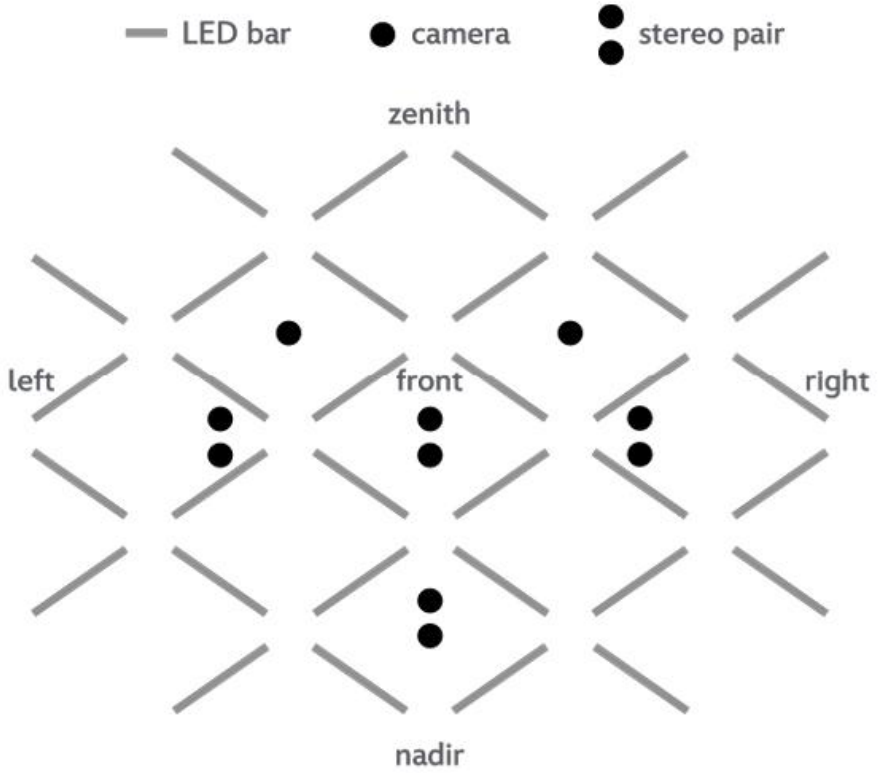
Relightable Neural Radiance Fields

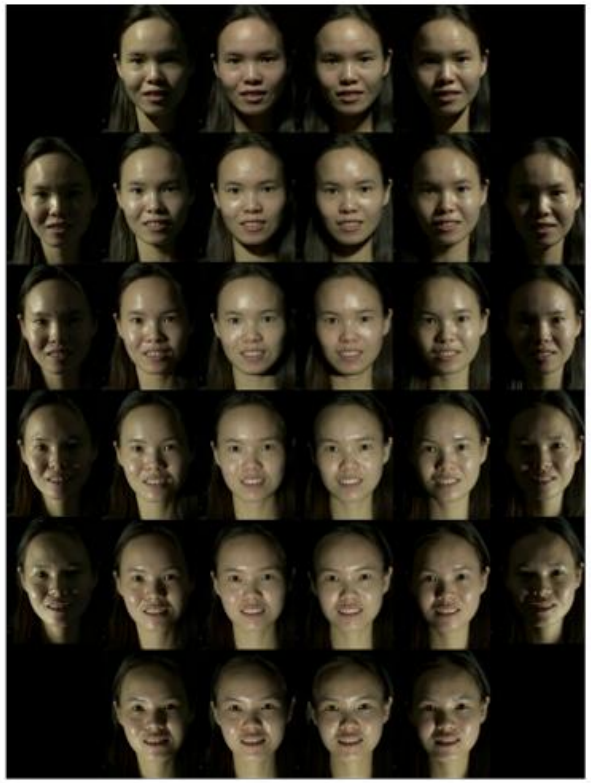
- A type of NeRF that allows control over lighting and novel environments
- Uses techniques such as image-based relighting and in-studio photogrammetry



ReNeRFs: Capturing and Preprocessing Input Images

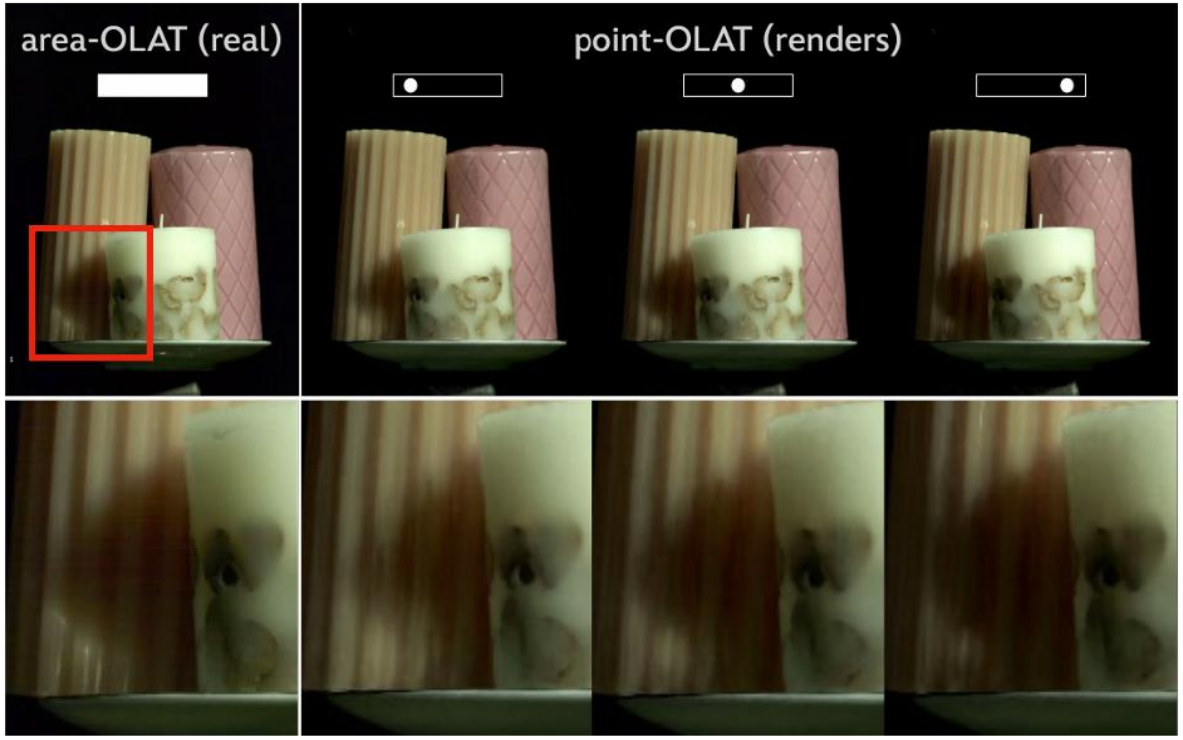
- Input images are collected using in-studio photogrammetry
  - 32 area light sources
  - 10 video cameras
  - 34 lighting conditions captured
  - One-light-at-a-time (OLAT)





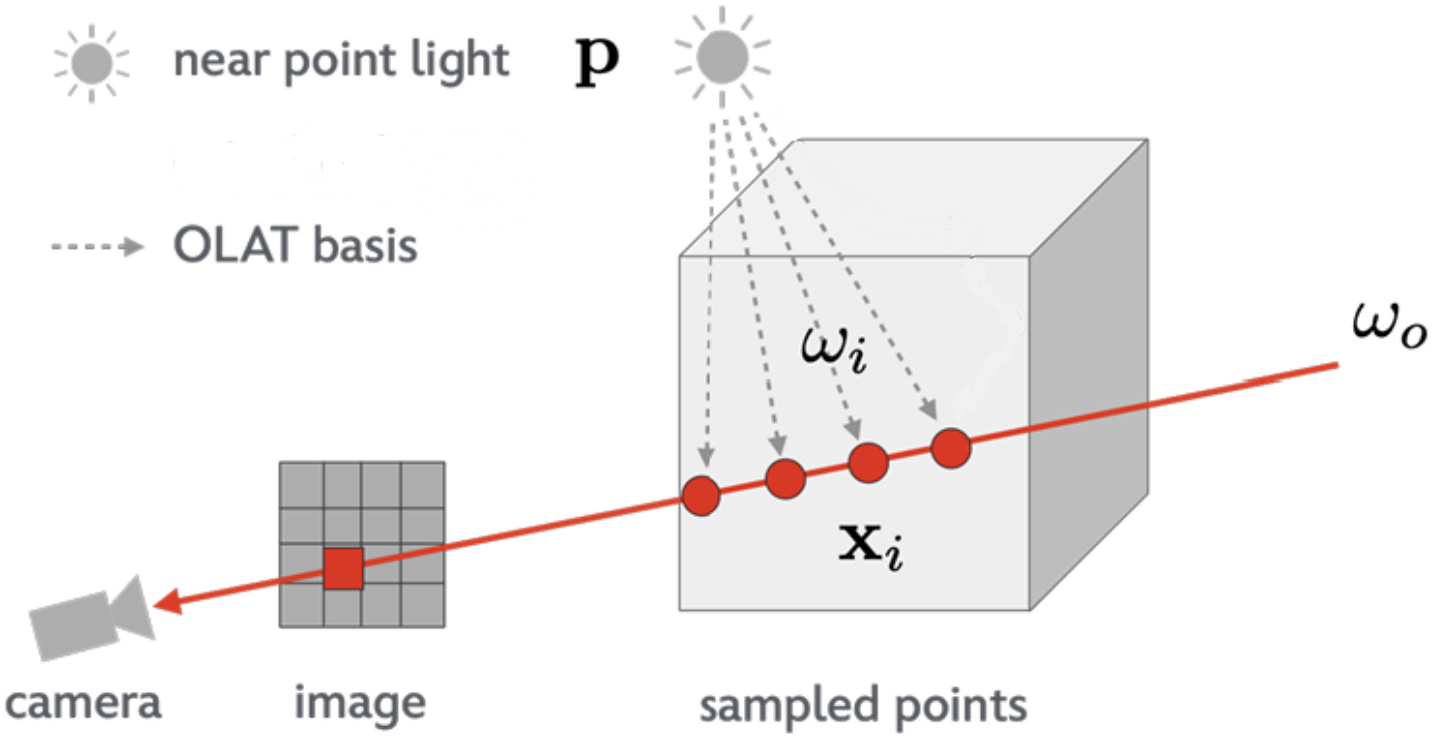
ReNeRFs: Scene Generation

- MLP with NeRF inputs plus point lights
- Calculates radiance
- Models light interaction at each point in the scene



ReNeRFs: Scene Generation

- ω_o: pixel ray
- x_i: points along the pixel ray
- ω_i: lighting direction
- p: point light source



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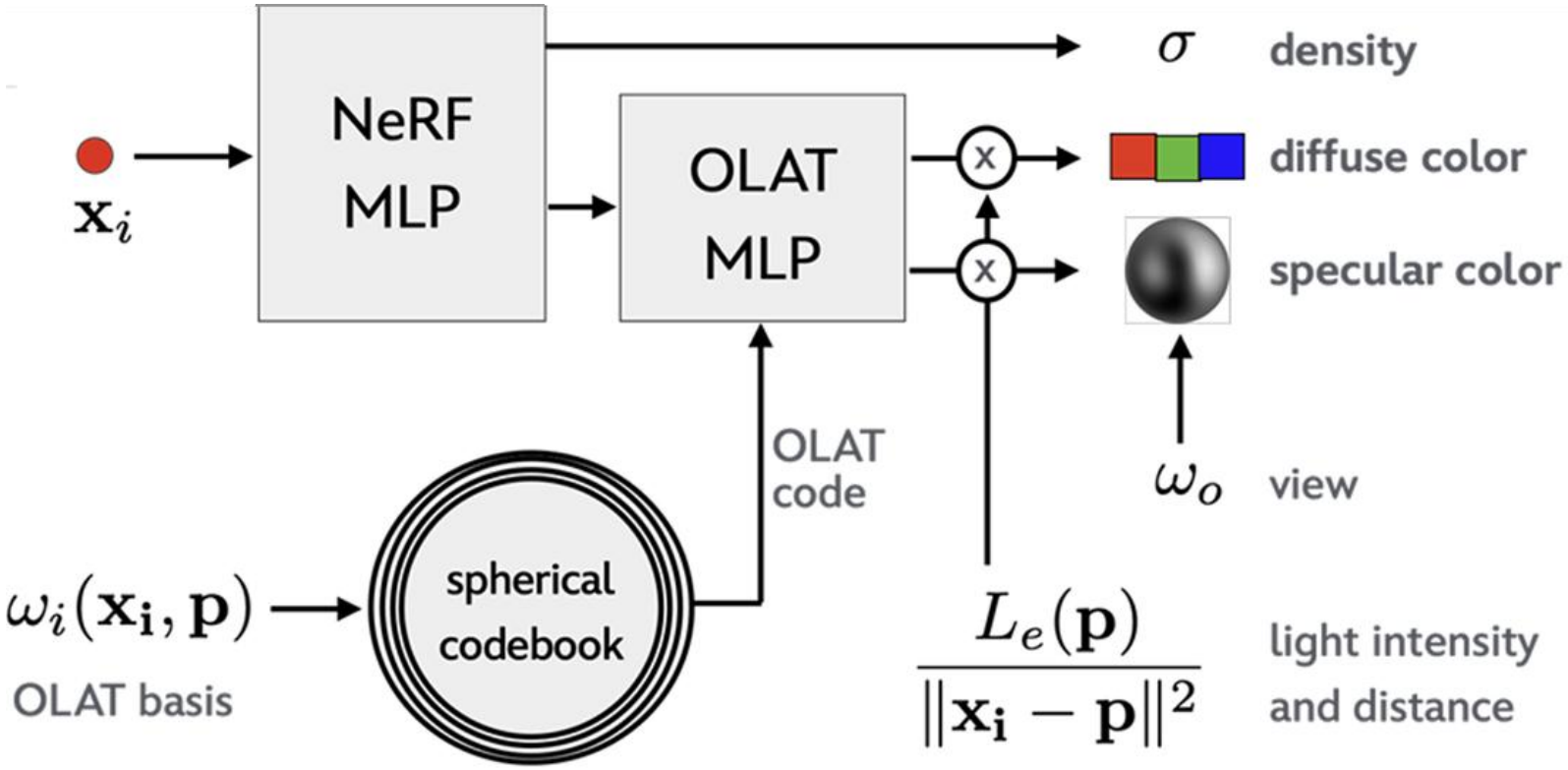
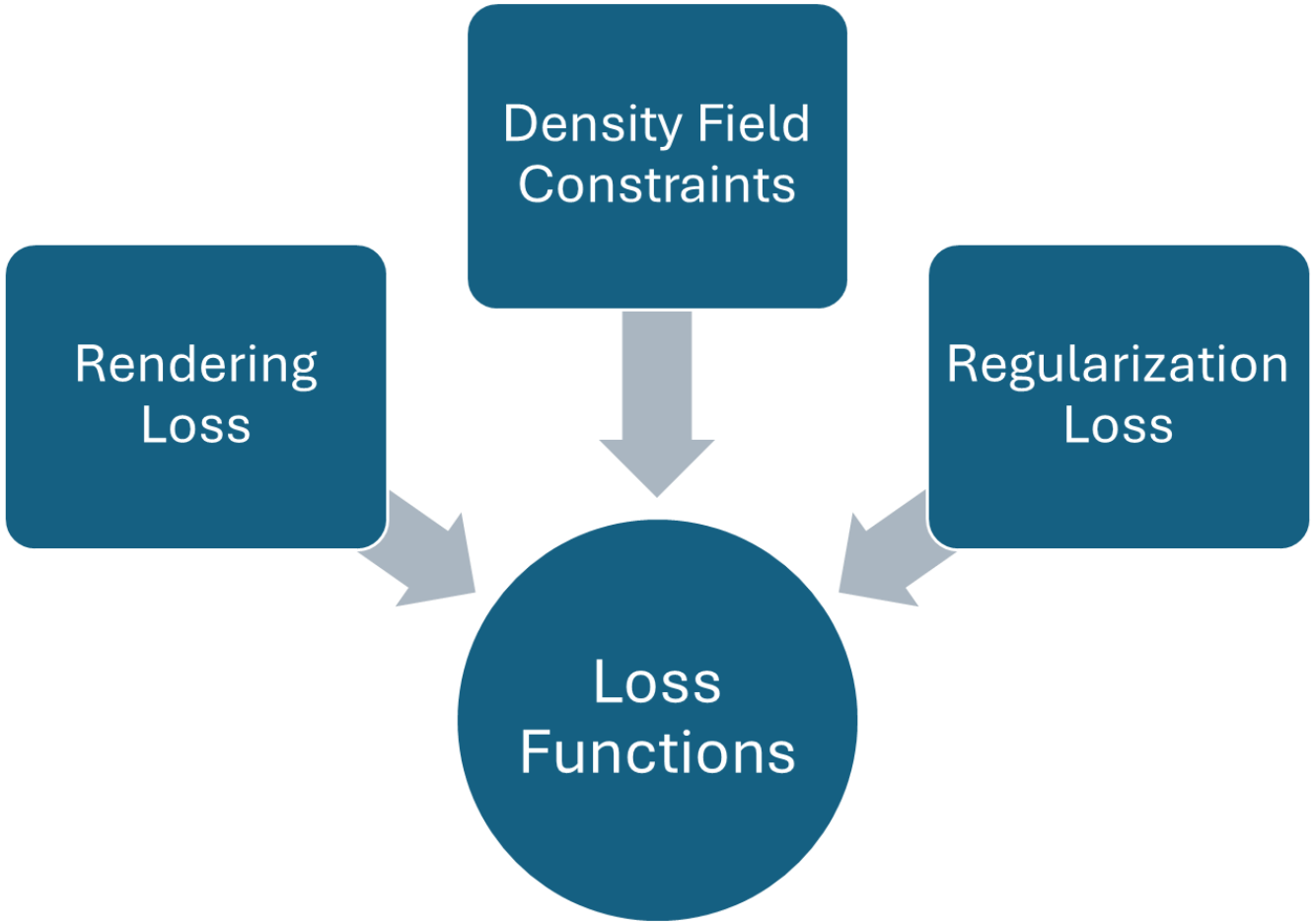
ReNeRF Architecture



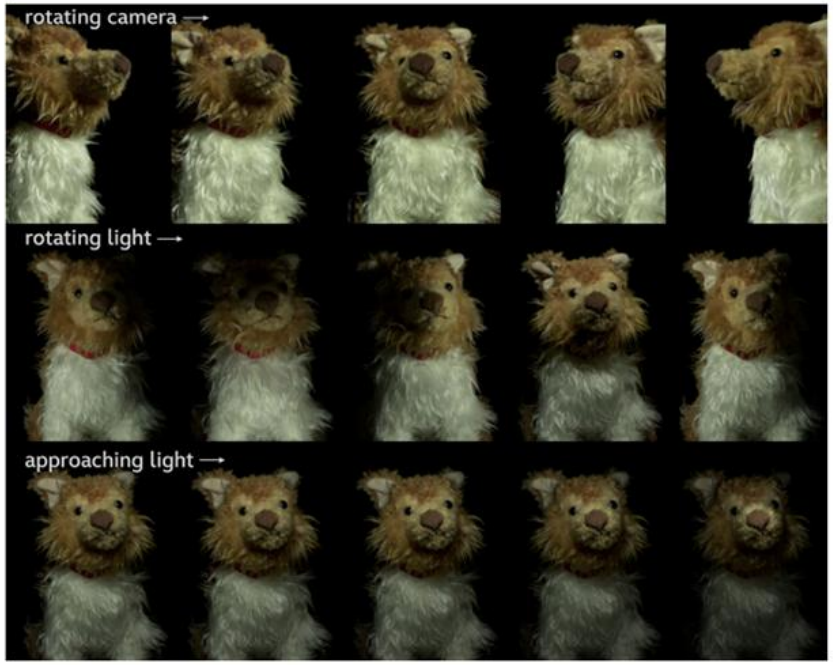
ReNeRF Training

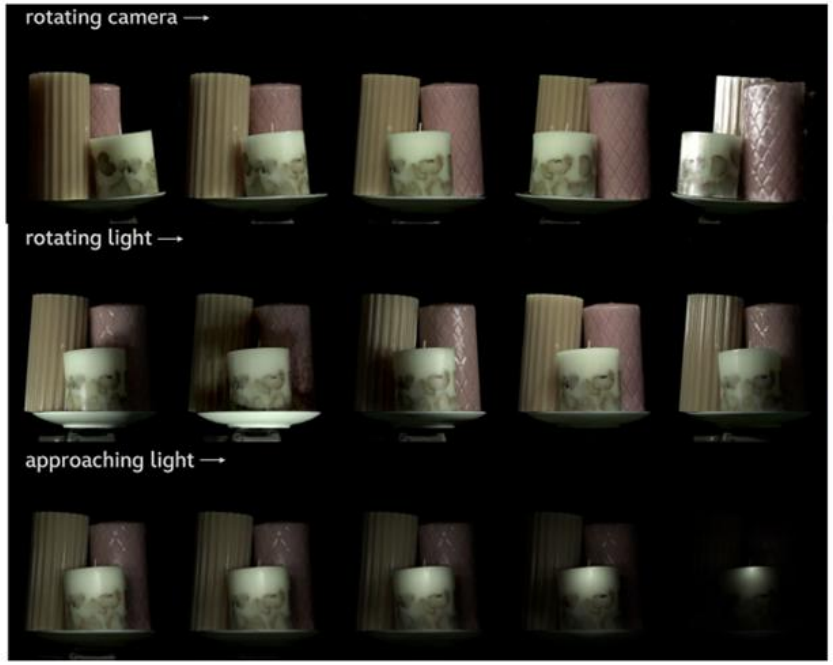
- Training data
  - 32 area-OLAT images
  - 10 camera angle each
  - 320 total images

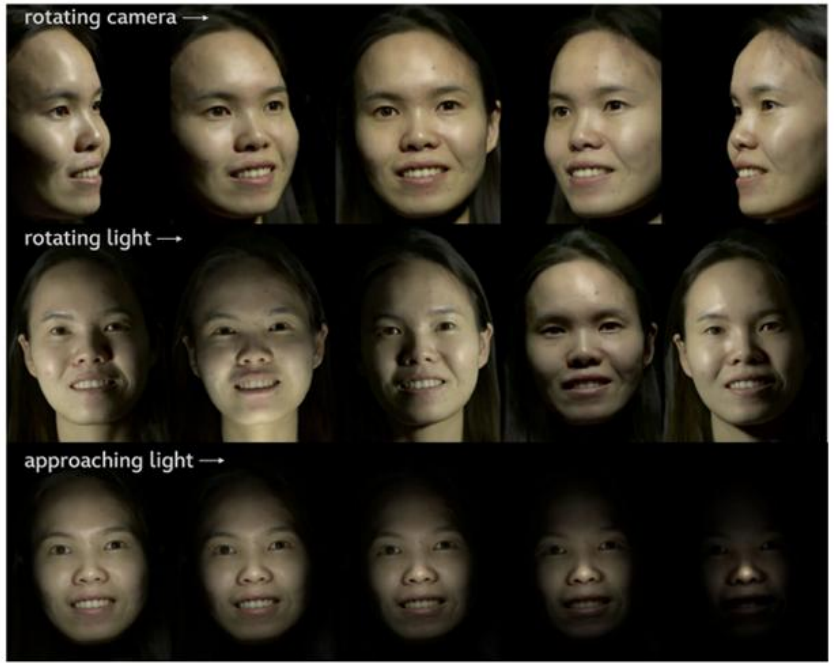


Results

Novel views and lighting control

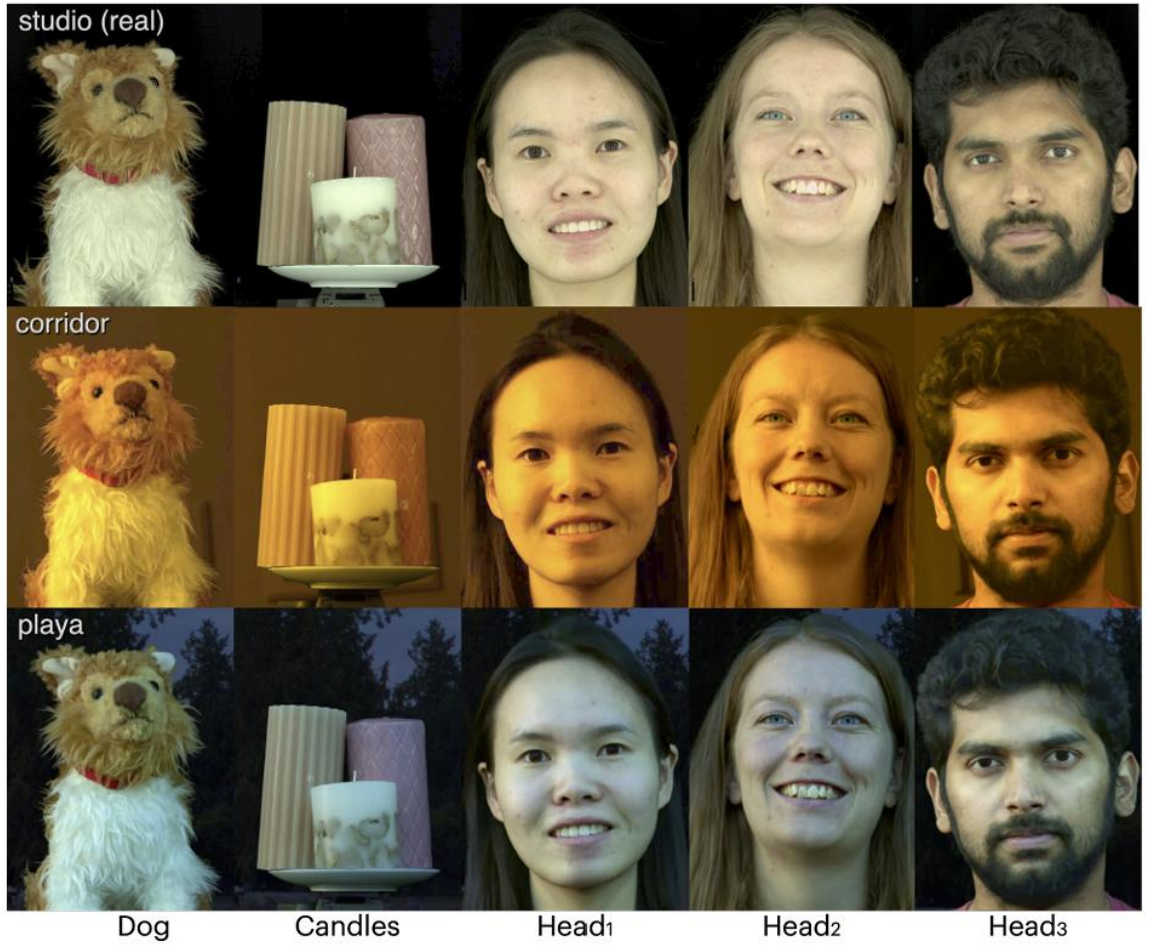






Results

Novel Environments



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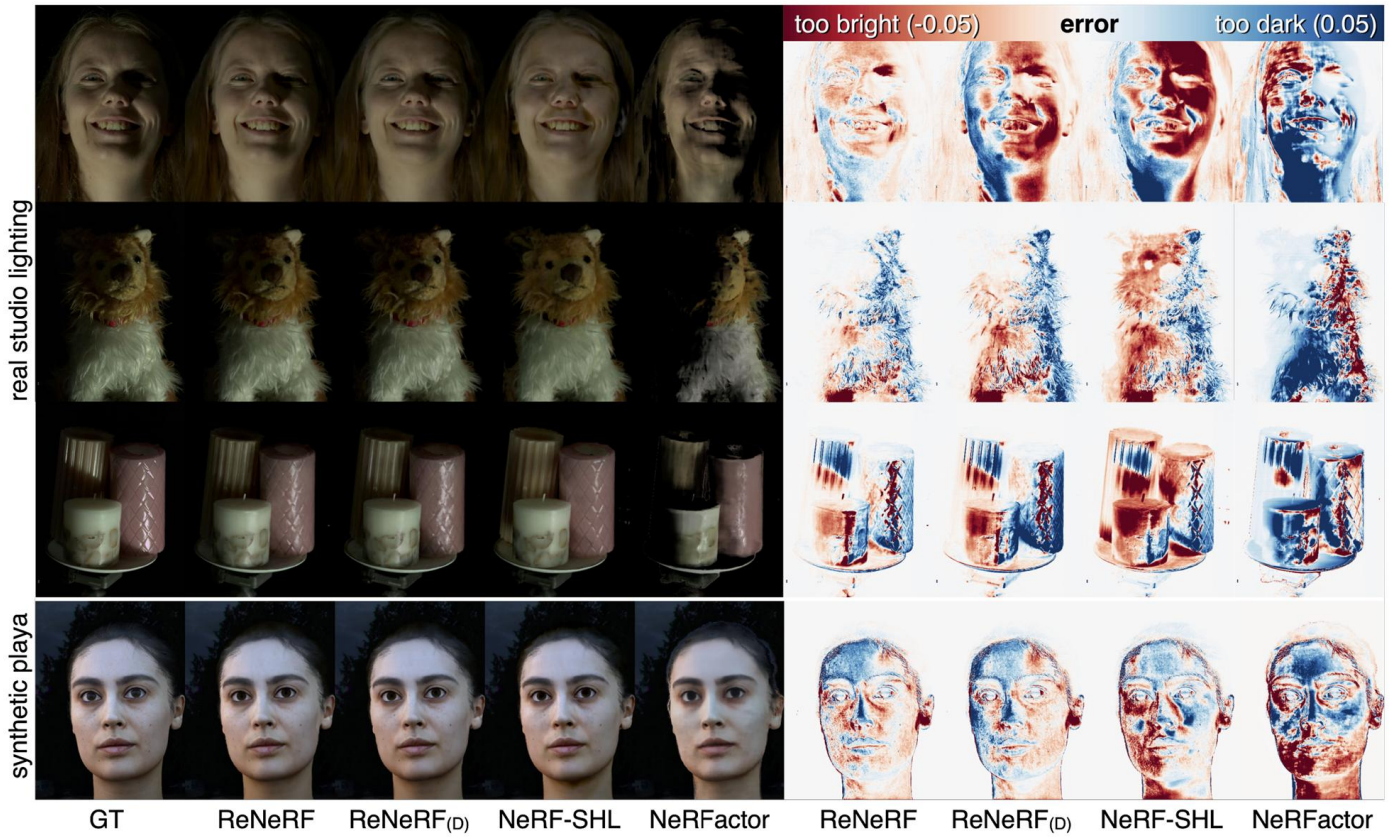
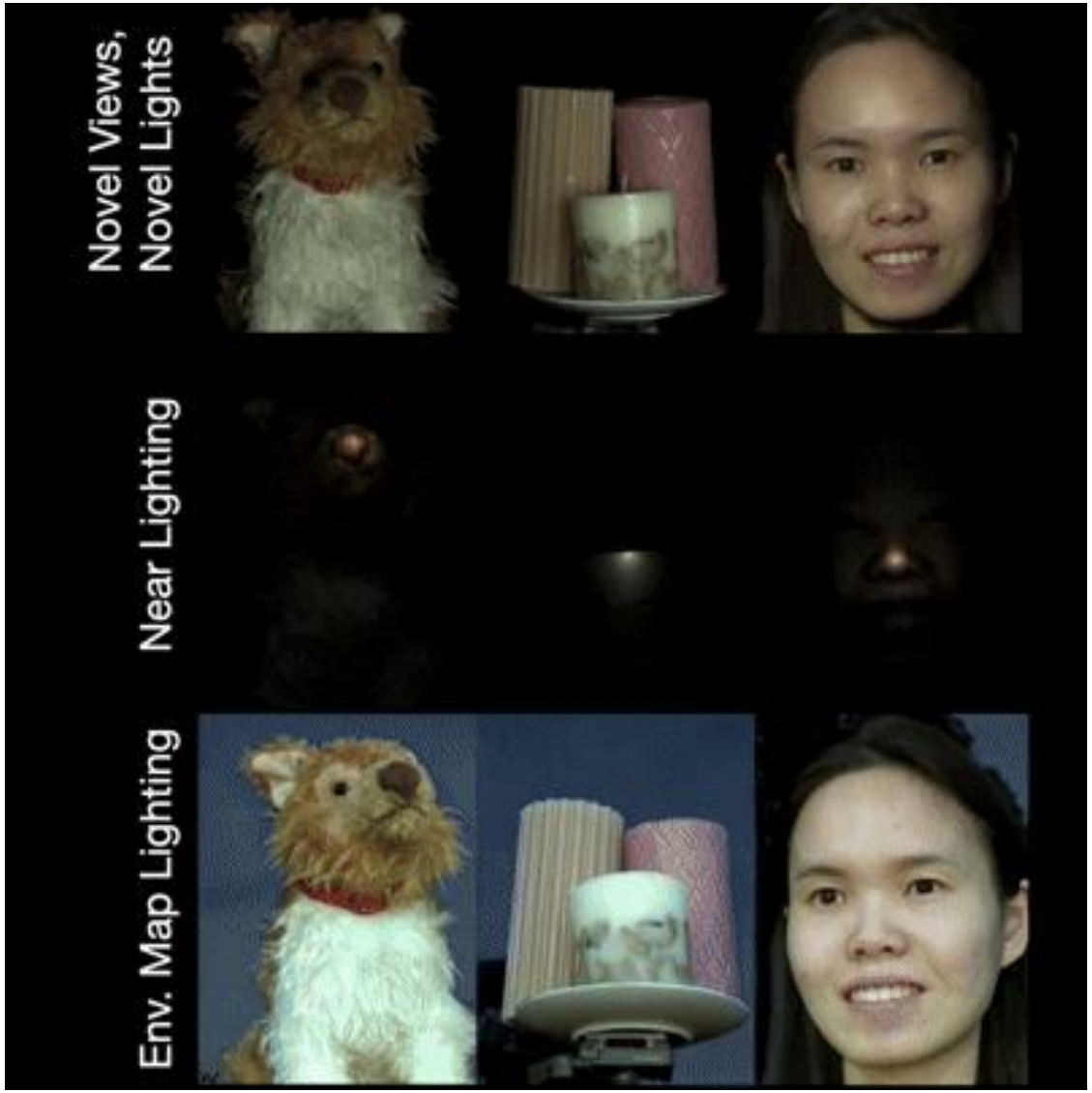
Results


too bright (-0.05)
error
too dark (0.05)
real studio lighting
synthetic playa
GT
ReNeRF
ReNeRF(D)
NeRF-SHL
NeRFactor
ReNeRF
ReNeRF(D)
NeRF-SHL
NeRFactor

[3]

Conclusion

Relightable neural radiance fields



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Questions?

References

[1] Yingyan Xu, Gaspard Zoss, Prashanth Chandran, Markus Gross, Derek Bradley, and Paulo Gotardo. 2023. ReNeRF: Relightable Neural Radi ance Fields with Nearfield Lighting. In 2023 IEEE/CVF International Conference on Computer Vision (ICCV). 22524–22534. https://doi.org/ 10.1109/ICCV51070.2023.02064

[2] Ben Mildenhall, Pratul P. Srinivasan, Matthew Tancik, Jonathan T. Barron, Ravi Ramamoorthi, and Ren Ng. 2021. NeRF: representing scenes as neural radiance fields for view synthesis. Commun. ACM 65, 1 (Dec. 2021), 99–106. https://doi.org/10.1145/3503250

[3] DisneyResearchHub. 2023. ReNeRF:Relightable Neural Radiance Fields with Nearfield Lighting. Youtube. https://www.youtube.com/watch?v=iPBesfjNVXM&t=3s

[4] Ben Mildenhall, Pratul P. Srinivasan, Matthew Tancik, Jonathan T. Barron, Ravi Ramamoorthi, and Ren Ng. 2020. Representing Scenes as Neural Radiance Fields for View Synthesis https://www.matthewtancik.com/nerf