Generative Models

Definition of "Generative Model"

As a probabilistic expression

X = State variable
Y = Observable variable

Discriminative model:
P(X|Y)

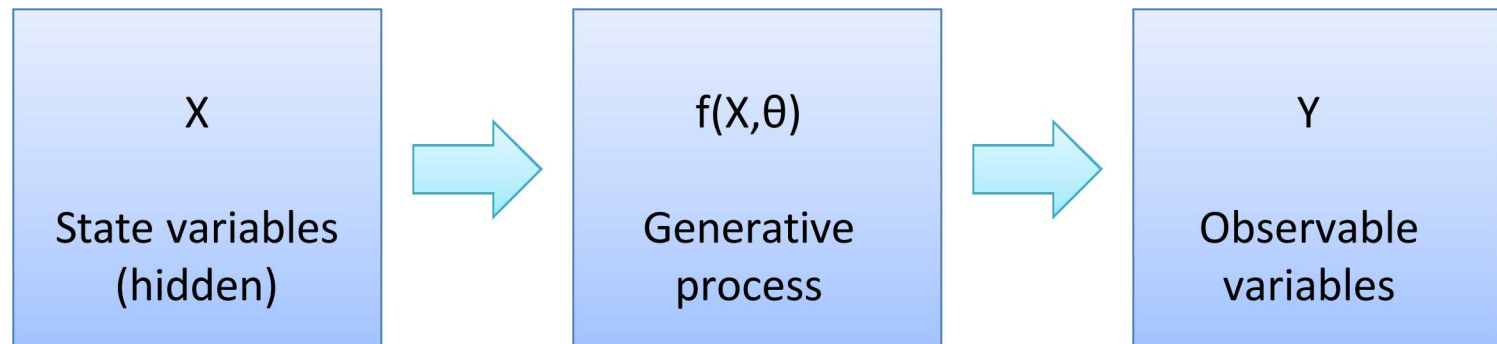Generative model:
P(X,Y)
or P(Y|X), where P(X) is known or estimated

Definition of "Generative Model"

As a procedure

Assumes a chain of causality from X, through mechanisms f(θ), to Y.

Example: 3D graphics (such as video games or special effects in movies)
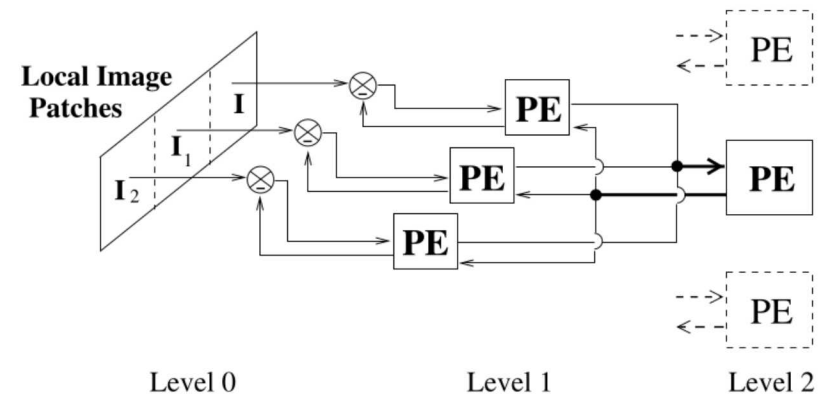   X = Position/orientation of various objects in scene
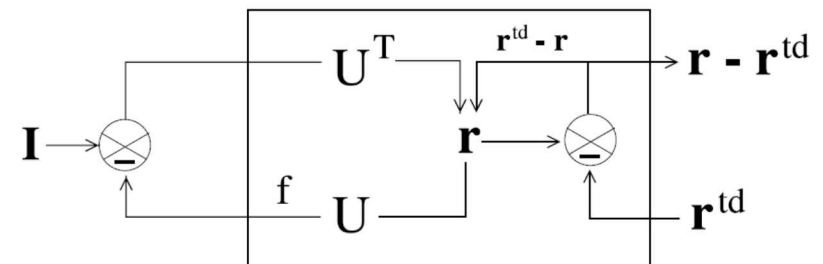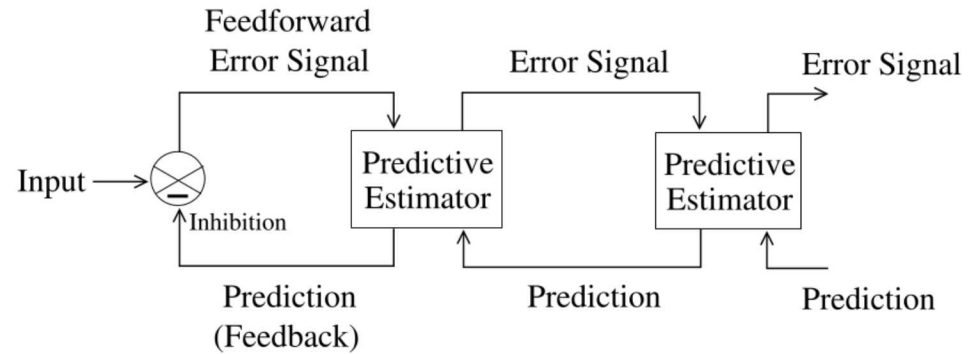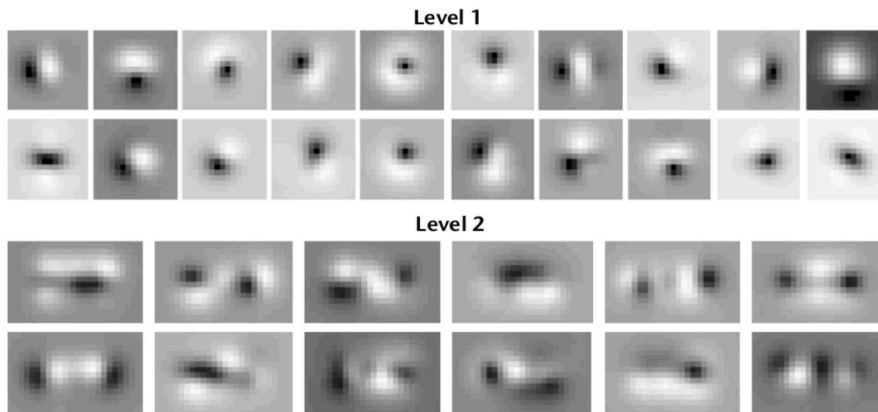   θ = Shape/surface material of objects
    f = Projection process. In the real world, it is reflected light reaching your eye.
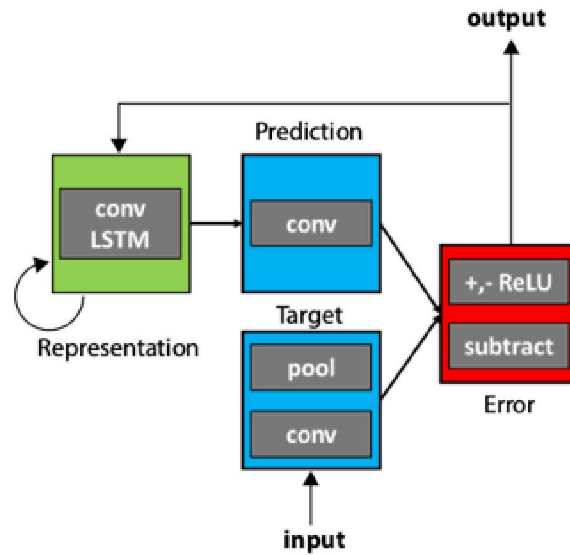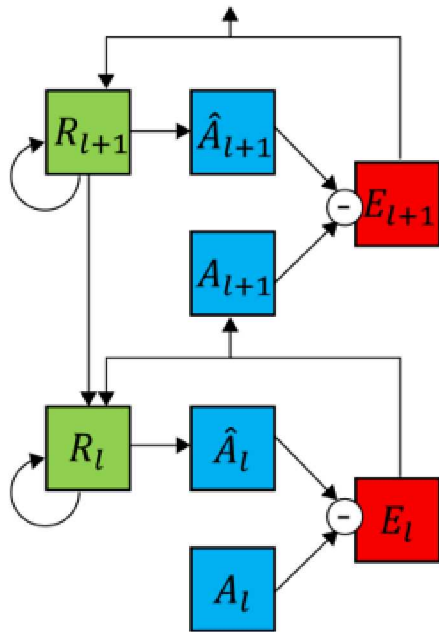   Ray-tracing and other 3D rendering methods simulate this.
    Y = Resulting pixels on the movie screen.
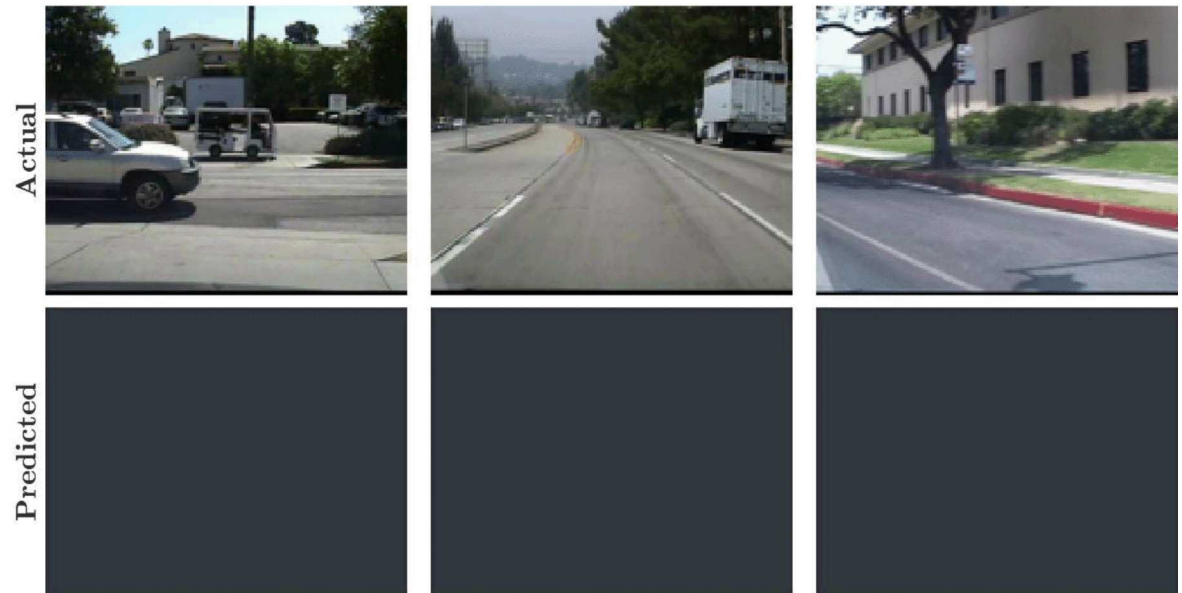
Example: Rao & Ballard

Level 1
Level 2

Feedforward
Error Signal   Error Signal   Error Signal

Input → ⊗   Predictive   Predictive
Estimator   Estimator

↑ Inhibition

Prediction   Prediction   Prediction
(Feedback)

Level 1

Level 2

U^T $r^{td} - r$ $r - r^{td}$

I → ⊗ r → ⊗

f U r^{td}

Local Image Patches

I

I_1

I_2

PE

PE   **PE**   **PE**

PE

PE

Level 0   Level 1   Level 2

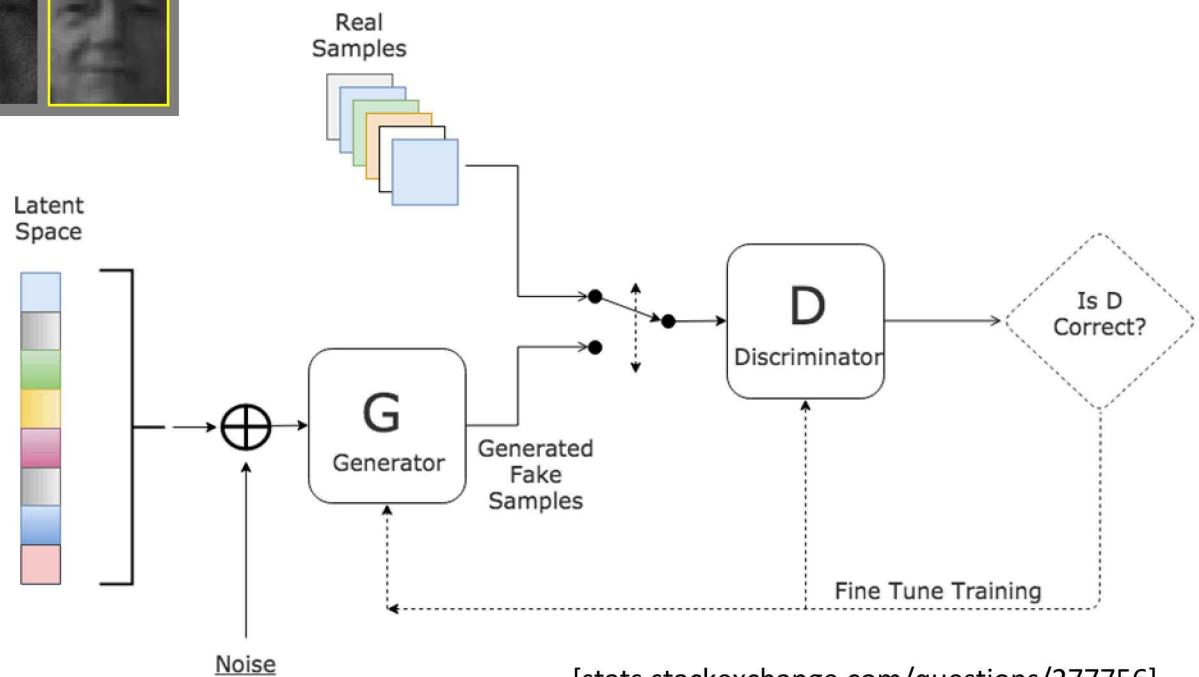# Example: PredNet

[https://coxlab.github.io/prednet]

Example: Generative Adversarial Network (GAN)

[Goodfellow 2014]

[stats.stackexchange.com/questions/277756]

How to learn model structure

- The previous examples use neural networks and associated learning methods. Despite the generality, these have an implicit, hand-crafted structure.
- An alternative is to represent the generative process in a language suitable for genetic algorithm (GA) style random search.