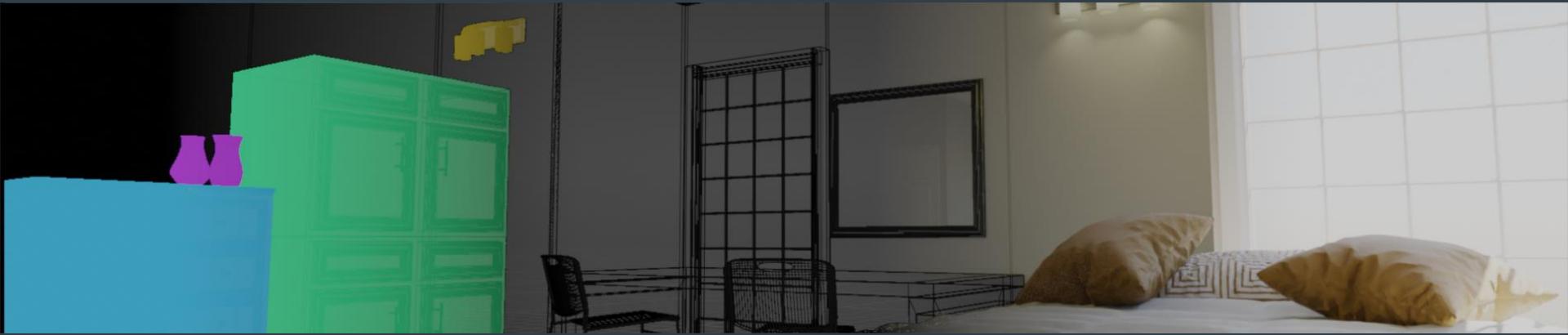


# Custom Image Object Detection- Competition Details



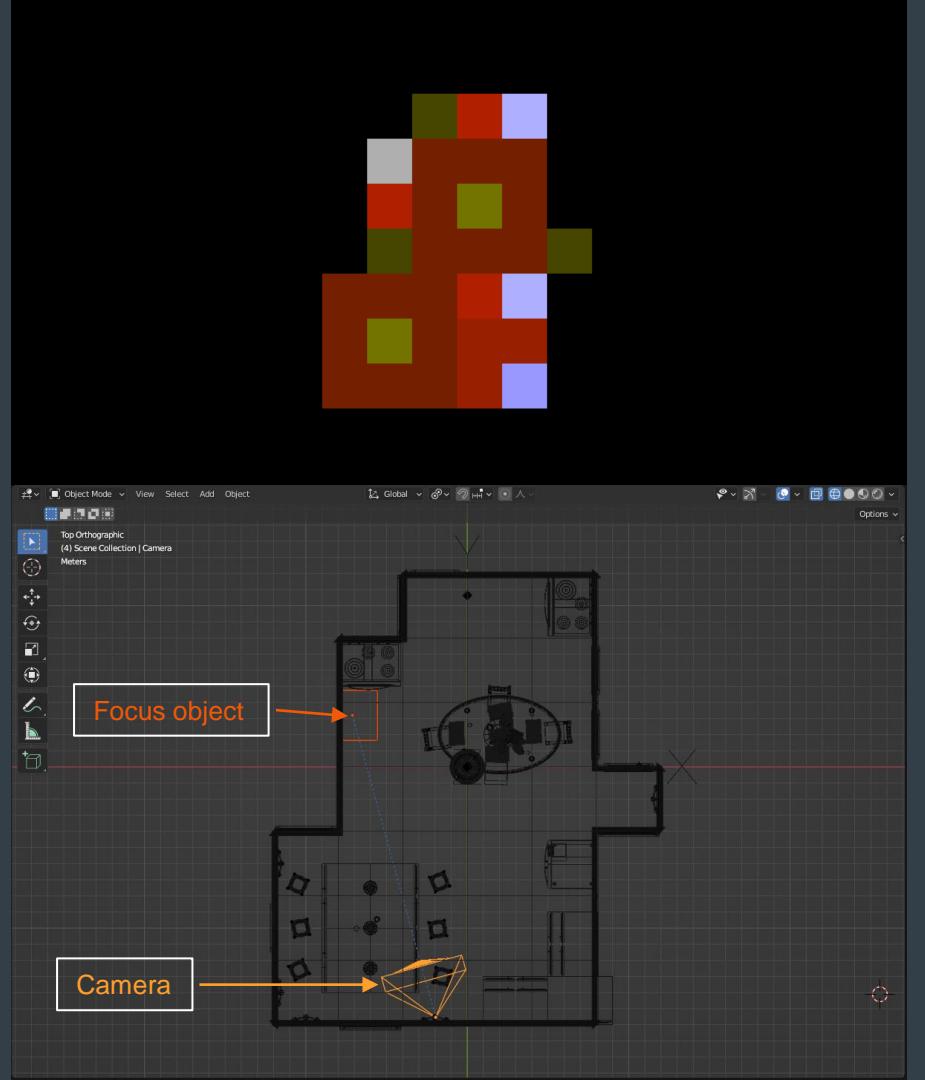
# Overview

1. How scenes are constructed
2. Files included with the dataset
3. How Class labels are made
4. Object Class descriptions



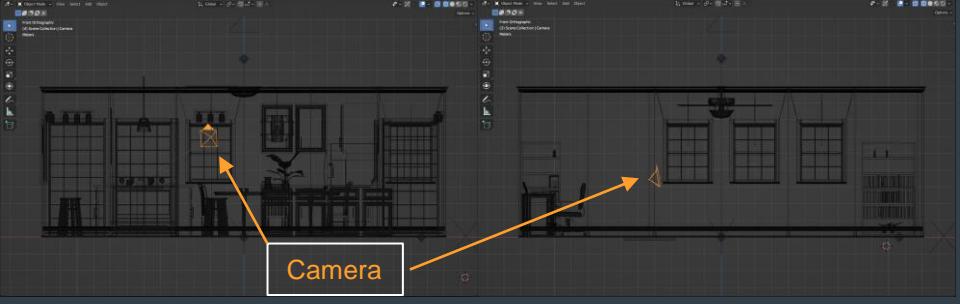
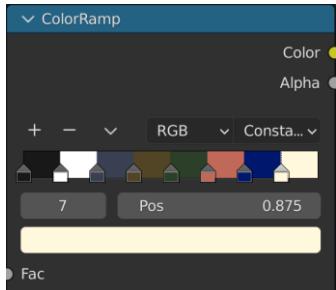
# Scene Construction

- Scene layouts are randomly generated in 4\*4 foot blocks, as specified by a random generator
- Camera is placed randomly throughout scene
- Focus object is placed for camera to track too and set its focal distance too.
- Rooms can fall into one of 5 categories
- Predicting categories will help infer which objects may also occur in the scene
- Scenes are rendered in blender with the cycles pathtrace and INTEL AI denoiser.



# Scene Construction

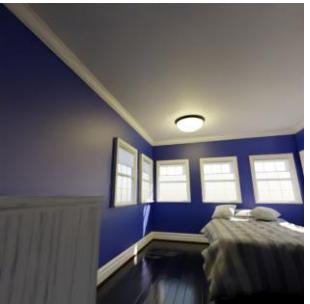
- Camera and Camera Focus Take random heights as well
- Walls are 9 ft in construction
- Walls come with ceiling and floor trims
- Floor trim has extra bottom wood trim. Trim is modified for doors/windows
- Walls come in 8 colors, as shown below:



Living Room



Bedroom



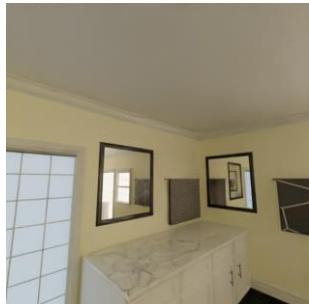
Kitchen



Office

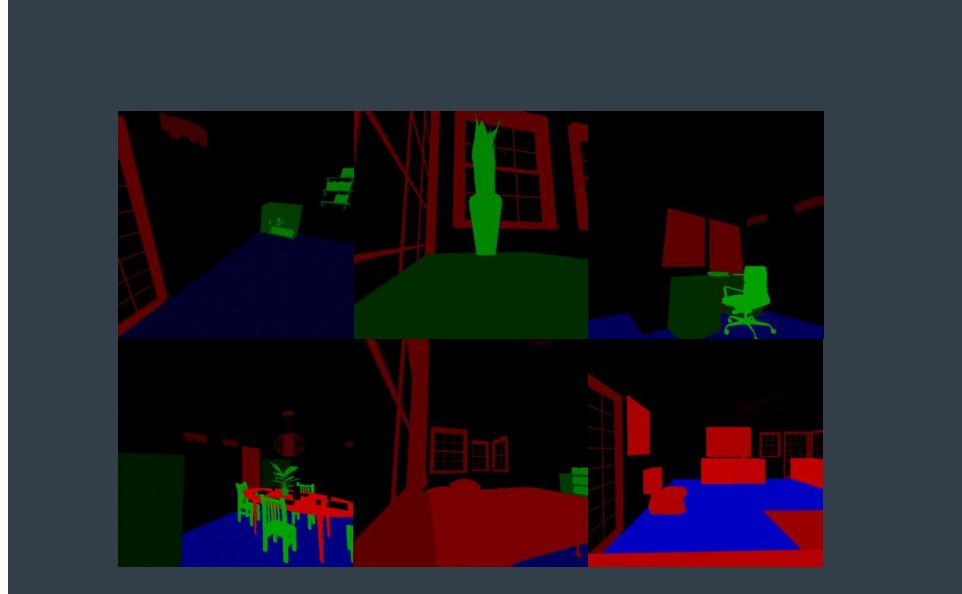


Bathroom



# Class labeling

- Images are rendered in standard pass and then object pass (labels each object).
- Class labels are only set to true if they are **Visible From the Camera**
- The object data is stored in red,green, and blue channels of images and they are stored in metadata.zip
- The python file class\_estimator shows how the data is then estimated. You can use this file to help understand data from metadata.zip (get the rgb value that correspond to classes).



Files included:  
Training.csv,  
Training\_wide.csv

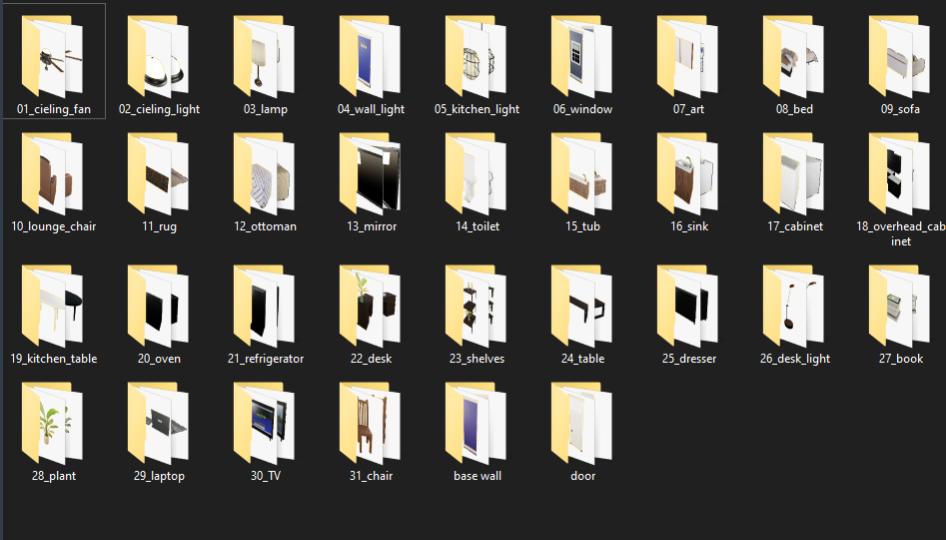
- Training contains 1<sup>st</sup> 10000 samples in format submissions need to be in.
  - Format is scene\_class. Scene number is zero padded to always have 5 digits

- Training\_wide is same data in wide format to make easier for analysis
  - Remember each cell corresponds to whether the specified class is visible in the specified scene

	A	B	C
1	id	value	
2	00001_1	0	36 00001_35
3	00001_2	1	37 00001_36
4	00001_3	0	38 00001_37
5	00001_4	0	39 00001_38
6	00001_5	0	40 00001_39
7	00001_6	0	41 00002_1
8	00001_7	0	42 00002_2
9	00001_8	0	43 00002_3
10	00001_9	0	44 00002_4
11	00001_10	0	45 00002_5
12	00001_11	0	46 00002_6
13	00001_12	0	47 00002_7
14	00001_13	1	48 00002_8
15	00001_14	0	49 00002_9
16	00001_15	0	50 00002_10
17	00001_16	1	51 00002_11
18	00001_17	1	52 00002_12
19	00001_18	0	53 00002_13
20	00001_19	0	54 00002_14
21	00001_20	0	55 00002_15
22	00001_21	0	56 00002_16
23	00001_22	0	57 00002_17
24	00001_23	0	58 00002_18
25	00001_24	0	59 00002_19
26	00001_25	0	60 00002_20
27	00001_26	0	61 00002_21
28	00001_27	0	

# Files Included: folder: classes/

- Folder contains list of pictures from each class. Each picture is rendered on empty background. These may possibly be used to improve models for specific classes



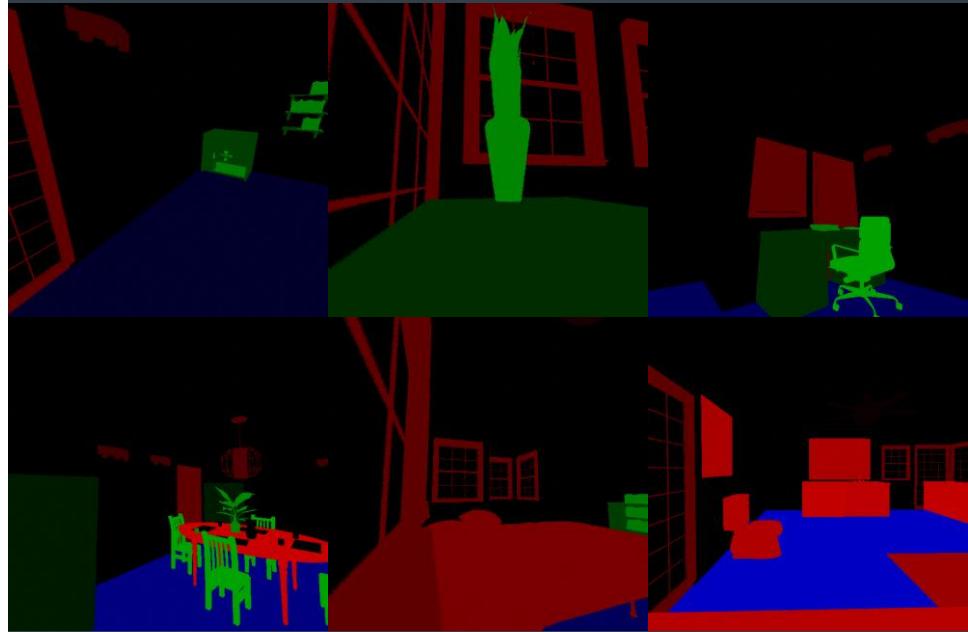
# Files included: class locations

- Csv with all classes.
- 1 if that class can occur in that room type
- 0 otherwise

class num	class	Can Occur?				
		Living roor	Bedroom	Kitchen	Office	Bathroom
1	ceiling fan	1	1	1	1	1
2	standard light	1	1	1	1	1
3	lamp	1	1	1	1	1
4	wall_light	1	1	1	1	1
5	kitchen fauncy light	0	0	1	0	0
6	window	1	1	1	1	1
7	art	1	1	1	1	1
8	bed	0	1	0	0	0
9	sofa	1	1	0	0	0
10	ottoman	1	0	0	0	0
11	rug	1	1	0	0	1
12	lounge chair	1	0	0	0	0
13	mirror	1	1	1	1	1
14	toilet	0	0	0	0	1
15	tub	0	0	0	0	1
16	sink	0	0	1	0	1
17	cabinet	0	0	1	0	1
18	overhead cabinet	0	0	1	0	0
19	kitchen table	0	0	1	0	0
20	oven	0	0	1	0	0
21	refrigerator	0	0	1	0	0
22	desk	0	1	0	1	0
23	shelves	1	1	0	1	0
24	table	1	1	0	1	0
25	dresser	0	1	0	1	0
26	desk light	0	1	0	1	0
27	book	1	1	0	1	1

# Files included: metadata.zip

- Class label images for 1<sup>st</sup> 10,000 images
- 0-19 classes in red channel
- 20-32 classes in green channel
- 33-38 classes in blue channel  
(describe the floor type)



# Files included: class\_estimator.py

- Used to generate classes based on metadata
- Can be used if you wish to use metadata to locate specific objects within scenes

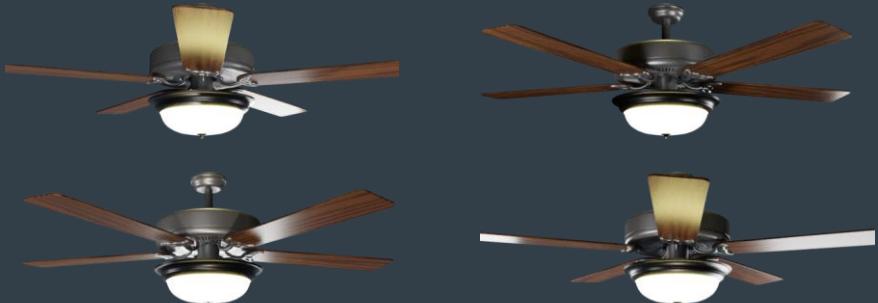
```
1 #-*- coding: utf-8 -*-
2 """
3 Created on Tue Feb  8 12:46:51 2022
4
5 @author: dailerob
6 """
7
8 import numpy as np
9 from PIL import Image
10 import pandas as pd
11 import os
12
13 path = r'C:\Users\rwtx\Desktop\MLDS_comp_2021\animations\metadata\' 
14 path_list = os.listdir(path)
15
16
17
18 def get_vals(meta_image):
19     meta_image = np.array(meta_image)
20
21     save_array_r = np.zeros(256)
22     save_array_g = np.zeros(256)
23     save_array_b = np.zeros(256)
24
25     num, count = np.unique(np.array(meta_image)[:,:,:0], return_counts = True)
26     save_array_r[num] = count
27
28     num, count = np.unique(np.array(meta_image)[:,:,:1], return_counts = True)
29     save_array_g[num] = count
30
31     num, count = np.unique(np.array(meta_image)[:,:,:2], return_counts = True)
32     save_array_b[num] = count
33
34     save_array =np.stack([save_array_r, save_array_g, save_array_b], axis = 1)
35
36     return save_array
37
38
39
40 def get_class(meta_image, threshold = 15):
41     meta_image = np.array(meta_image)
42
43     save_array_r = np.zeros(256)
44     save_array_g = np.zeros(256)
45     save_array_b = np.zeros(256)
46
47     num, count = np.unique(np.array(meta_image)[:,:,:0], return_counts = True)
48     save_array_r[num] = count
49
50     num, count = np.unique(np.array(meta_image)[:,:,:1], return_counts = True)
51     save_array_g[num] = count
52
53     num, count = np.unique(np.array(meta_image)[:,:,:2], return_counts = True)
54     save_array_b[num] = count
55
56     save_array =np.stack([save_array_r, save_array_g, save_array_b], axis = 1)
57
58     class_array = np.arange(38)
59
60     class_array[0] = np.sum(save_array[9:11,0]) > threshold
61     class_array[1] = np.sum(save_array[25:28,0]) > threshold
62     class_array[2] = np.sum(save_array[43:46,0]) > threshold
63     class_array[3] = np.sum(save_array[61:64,0]) > threshold
64     class_array[4] = np.sum(save_array[78:81,0]) > threshold
65     class_array[5] = np.sum(save_array[94:96,0]) > threshold
```

# Class 01 – ceiling Fan

- Appears in:

Living room	Bedroom	Kitchen	Office	Bathroom
1	1	1	1	1

- Always appears in center of room
- The center of the room has an 85% chance of spawning a light. Given a light is spawned, it spawns a Ceiling fan 50% of the time. Any part of the ceiling fan can appear for the class label to be true.



# Class 02 – ceiling light

- Appears in:

Living room	Bedroom	Kitchen	Office	Bathroom
1	1	1	1	1

- Always appears in center of room
- The center of the room has an 85% chance of spawning a light. Given a light is spawned, it spawns a Ceiling light 50% of the time.



# Class 03 – Lamp

- Appears in:

Living room	Bedroom	Kitchen	Office	Bathroom
1	1	1	1	1

- Can spawn on desks, tables, and cabinets

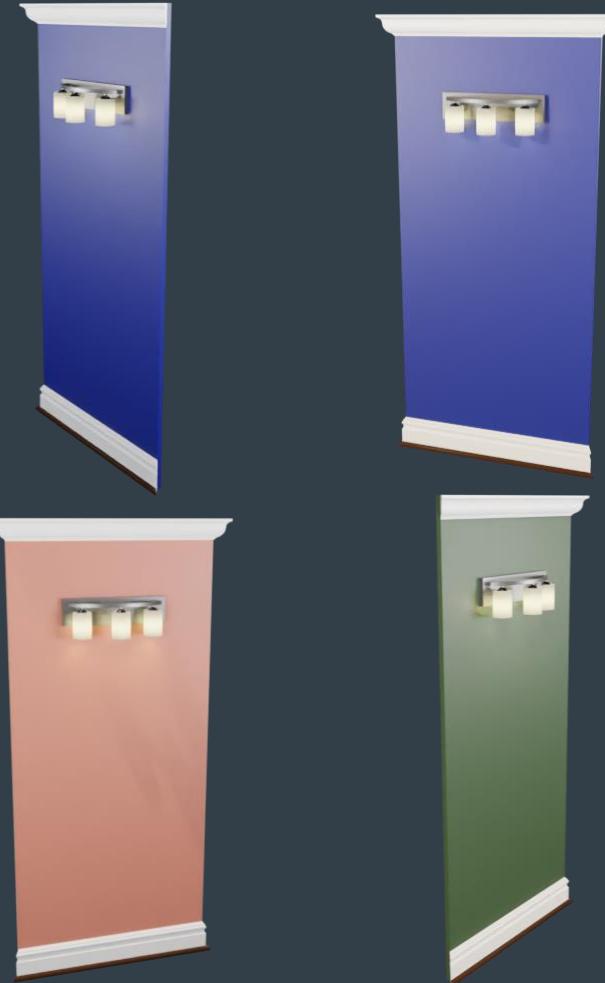


# Class 04 – Wall Lamp

- Appears in:

Living room	Bedroom	Kitchen	Office	Bathroom
1	1	1	1	1

- Spawns on walls
- Class is only recognized if some portion of the lamp is visible from the camera (rest of wall doesn't count)



# Class 05 – Kitchen Lamp

- Appears in:

Living room	Bedroom	Kitchen	Office	Bathroom
0	0	1	0	0

- Spawns above kitchen table 40% of the time in orientation shown to the right



# Class 06 – Window

- Appears in:

Living room	Bedroom	Kitchen	Office	Bathroom
1	1	1	1	1

- Comes in 2 variants: Small window and tall window
- Each window has 3 shades orientations: All the way up, half way up, and all the way down.
- Outside window is empty – renders nishita sky model at random sun orientations
- Bathroom windows are frosted

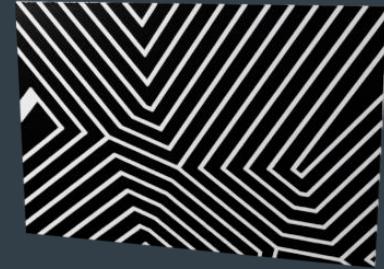


# Class 07 – art

- Appears in:

Living room	Bedroom	Kitchen	Office	Bathroom
1	1	1	1	1

- Comes in 2 variants: tall, wide
- Can display one of 4 generated styles of art



# Class 08 – bed

- Appears in:

Living room	Bedroom	Kitchen	Office	Bathroom
0	1	0	0	0

- Comes in 5 fabric styles

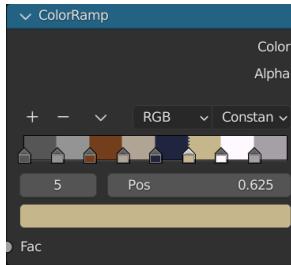


# Class 09 – sofa

- Appears in:

Living room	Bedroom	Kitchen	Office	Bathroom
1	1	0	0	0

- Type 1: always in light grey
- Type 2: randomly chooses a color from this pallet:



- Occurs in nearly every Living room
- Sparingly occurs in Bedroom ~1 in 10 bedrooms

Type 1



Type 2

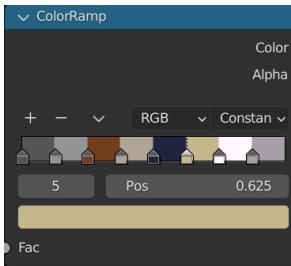


# Class 10 – ottoman

- Appears in:

Living room	Bedroom	Kitchen	Office	Bathroom
1	0	0	0	0

- Comes in same fabric styles as type 2 couch:

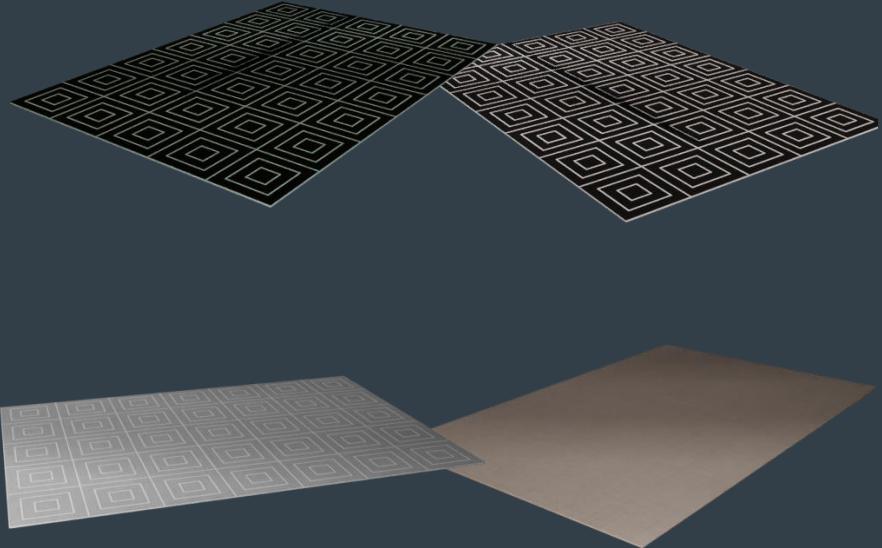


# Class 11 – rug

- Appears in:

Living room	Bedroom	Kitchen	Office	Bathroom
0	1	0	0	1

- Random colors/styles



# Class 12 – Lounge Chair

- Appears in:

Living room	Bedroom	Kitchen	Office	Bathroom
1	0	0	0	0

- Two styles: cloth, leather



# Class 13 – Mirror

- Appears in:

Living room	Bedroom	Kitchen	Office	Bathroom
1	1	1	1	1

- Items in mirror are **NOT** counted in class labels



# Class 14 – Toilet

- Appears in:

Living room	Bedroom	Kitchen	Office	Bathroom	
0	0	0	0	0	1



# Class 15 – tub

- Appears in:

Living room	Bedroom	Kitchen	Office	Bathroom	
0	0	0	0	0	1

- Comes in tiled and porcelain



# Class 16 – SINK

- Appears in:

Living room	Bedroom	Kitchen	Office	Bathroom
0	0	1	0	1

- Countertop comes in white marble, black marble, red granite, grey granite
- Material comes in white, grey, brown, and black painted wood.



4 Counter top styles



4 base material styles



# Class 17 – Cabinet

- Appears in:

Living room	Bedroom	Kitchen	Office	Bathroom
0	0	1	0	1

- Countertop comes in white marble, black marble, red granite, grey granite
- Material comes in white, grey, brown, and black painted wood.



# Class 18 – Overhead Cabinet

- Appears in:

Living room	Bedroom	Kitchen	Office	Bathroom
0	0	1	0	0

- Material comes in white, grey, brown, and black painted wood.
- Always placed in a corner of the room
- Always placed above set of standard cabinets



# Class 19 – Kitchen Table

- Appears in:

Living room	Bedroom	Kitchen	Office	Bathroom
0	0	1	0	0

- Comes in rectangular variant and Oval Variant
- Material comes in white, grey, brown, and black painted wood.
- Comes with utensils, placemats, and sometimes a plant placed on top



# Class 20 – Oven

- Appears in:

Living room	Bedroom	Kitchen	Office	Bathroom
0	0	1	0	0

- Comes with stovetop – 2 in 1!
- Clock always displays 12:51, because it's a good strokes song.



# Class 21 – Refrigerator

- Appears in:

Living room	Bedroom	Kitchen	Office	Bathroom
0	0	1	0	0

- Always closed
- Not energy efficient – these buildings are not LEED certified.

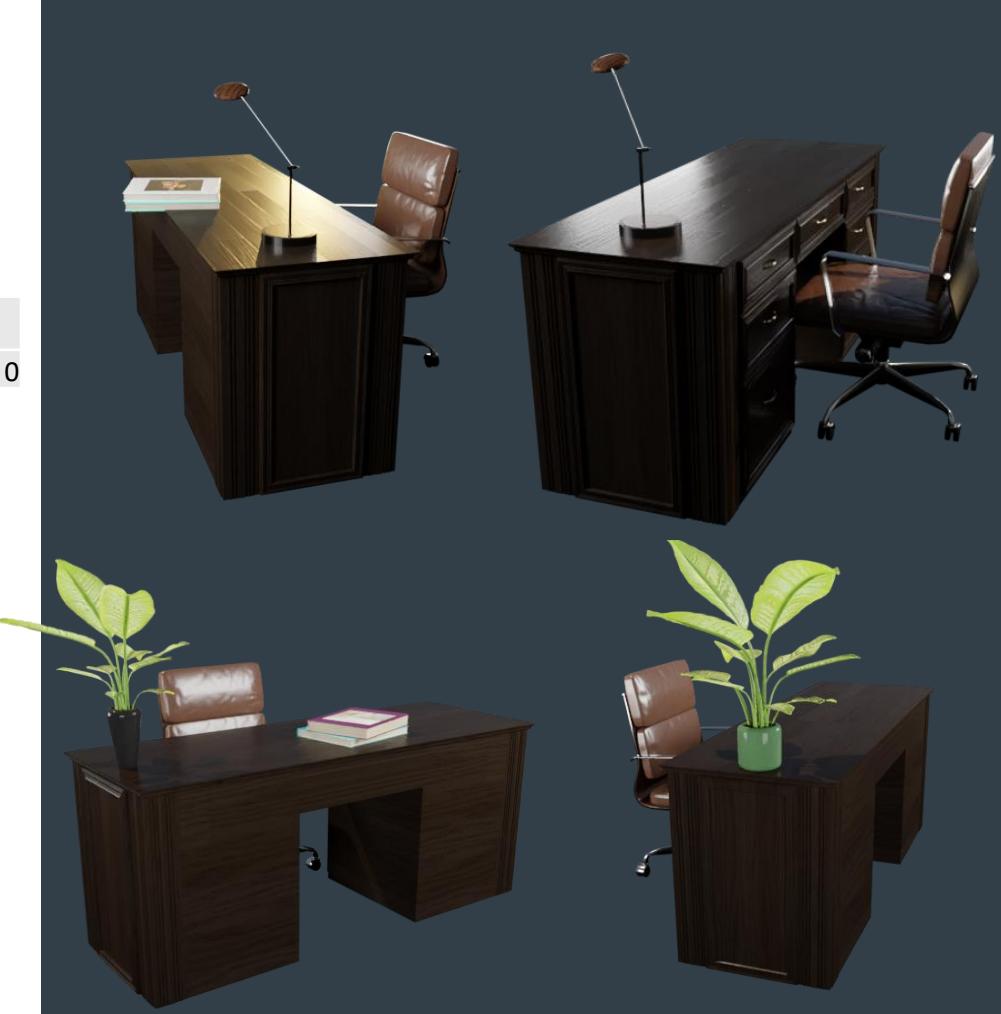


# Class 22 – Desk

- Appears in:

Living room	Bedroom	Kitchen	Office	Bathroom
0	1	0	1	0

- Always placed with a chair
- Can have various items placed on top – books, plants, lamps
- Each placed object still counts a separate class
- Desk itself is only one that counts for classification
- Desk always has same wood finish



# Class 23 – Shelves

- Appears in:

Living room	Bedroom	Kitchen	Office	Bathroom
1	1	0	1	0

- 3 configurations: 3 shelves, 6 shelves, or hanging on wall
- Material comes in white, grey, brown, and black painted wood.
- Books or small plants can appear on every shelf



# Class 24 – table

- Appears in:

Living room	Bedroom	Kitchen	Office	Bathroom
1	1	0	1	0

- Two Configurations: Wooden table with black steel frame, and glass table with grey steel frame.
- Each table is placed with four chairs.
- 3 items can appear at the side of each table: a plant, a lamp, or a desk lamp
- 3 items can appear near the center of the table: a vase, a pair of books, or a laptop
- Does **not** include kitchen tables



# Class 25 – dresser

- Appears in:

Living room	Bedroom	Kitchen	Office	Bathroom
0	1	0	1	0

- Comes in 3 variants
- Dressers 2 and 3 come in white, grey, brown, and black painted wood
- Dresser 1 only comes in the dark wood color shown.



1



2



3

# Class 26 – dresser

- Appears in:

Living room	Bedroom	Kitchen	Office	Bathroom
0	1	0	1	0

- Can be placed on top of tables/desks



# Class 27 – book

- Appears in:

Living room	Bedroom	Kitchen	Office	Bathroom
1	1	0	1	1

- Can appear on shelves, on top of desks, and on top of cabinets in the bathroom
- Covers are a random assortment of pictures. Book sides are a random line of lyrics from the hit song “Mr. Brightside”
- Cover colors random



# Class 28 – plant

- Appears in:

Living room	Bedroom	Kitchen	Office	Bathroom
1	1	1	1	1

- Can either be snake plant or Dieffenbachia
- Can either come in large (approx. 2.5 ft tall) or small (6in tall)
- Appears on desks, tables, kitchen tables, cabinets



# Class 29 – laptop

- Appears in:

Living room	Bedroom	Kitchen	Office	Bathroom
0	1	0	1	0

- Can either be open or closed
- Always displays the Wikipedia page for a Hidden Markov Model
- Appears on desks and tables



# Class 30 – TV

- Appears in:

Living room	Bedroom	Kitchen	Office	Bathroom
1	0	0	0	0

- Always watching an episode of two-minute papers.
- Appears on a dresser.



# Class 31 – chair

- Appears in:

Living room	Bedroom	Kitchen	Office	Bathroom
1	0	0	0	0

4 types:

1. **Office Chair** – appears in front of desk, around wooden table
2. **School chair** – appears around glass table
3. **Kitchen chair 1**: appears around kitchen table
4. **Kitchen chair 2**: appears around kitchen table

Note this doesn't include the sofas/lounge chairs

Office chair



School Chair



Kitchen Chair 1



Kitchen Chair 2



# Class 32 – door

- Appears in:

Living room	Bedroom	Kitchen	Office	Bathroom	
1	1	1	1	1	1

- Always closed. An introvert lives here.  
They don't want visitors.



# Class 33 – hardwood floor

- Appears in:

Living room	Bedroom	Kitchen	Office	Bathroom
1	1	1	1	0

- Whether the floor is made of standard hardwood.
- This is only true **IF** the floor is visible from the camera



# Class 34 – dark hardwood floor

- Appears in:

Living room	Bedroom	Kitchen	Office	Bathroom
1	1	1	1	0

- Whether the floor is made of dark hardwood.
- This is only true **IF** the floor is visible from the camera

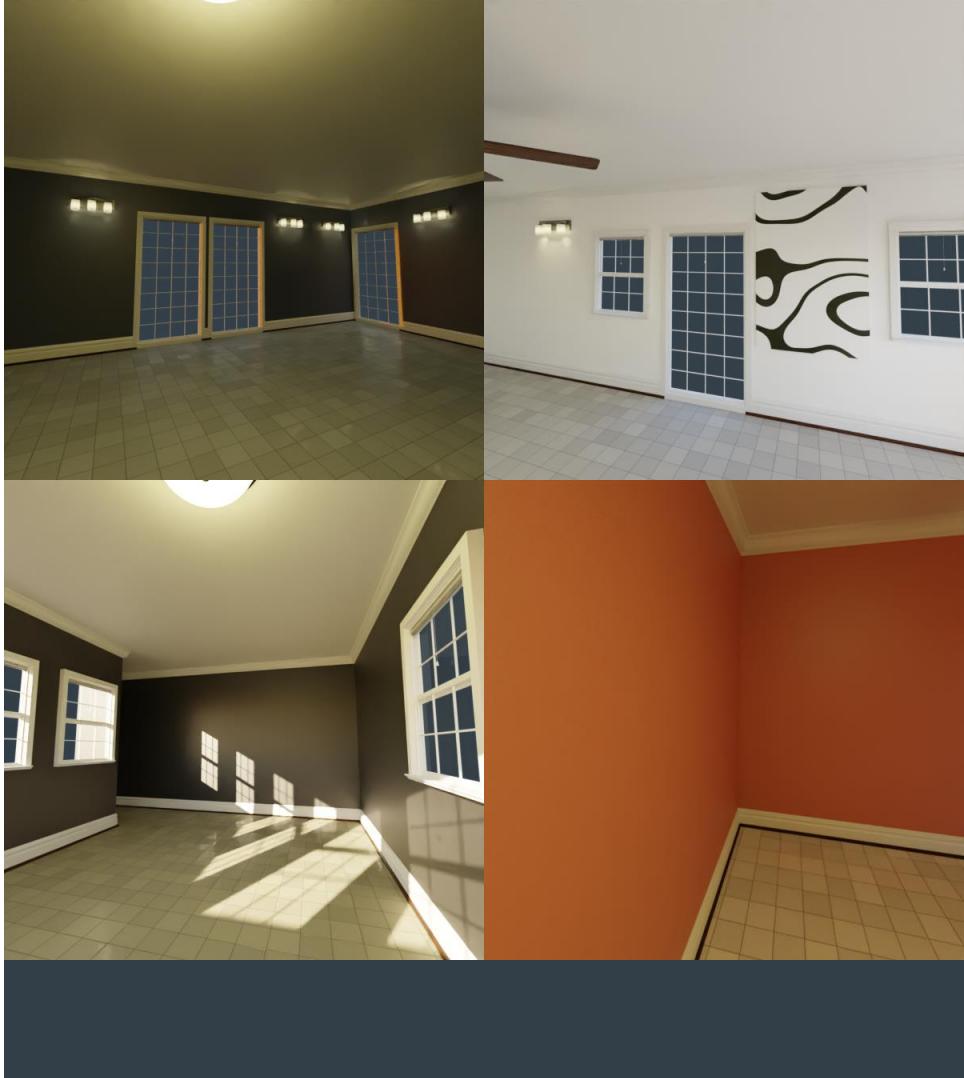


# Class 35 – tile

- Appears in:

Living room	Bedroom	Kitchen	Office	Bathroom	
1	1	1	1	1	0

- Whether the floor is made of plain ceramic tile
- This is only true **IF** the floor is visible from the camera

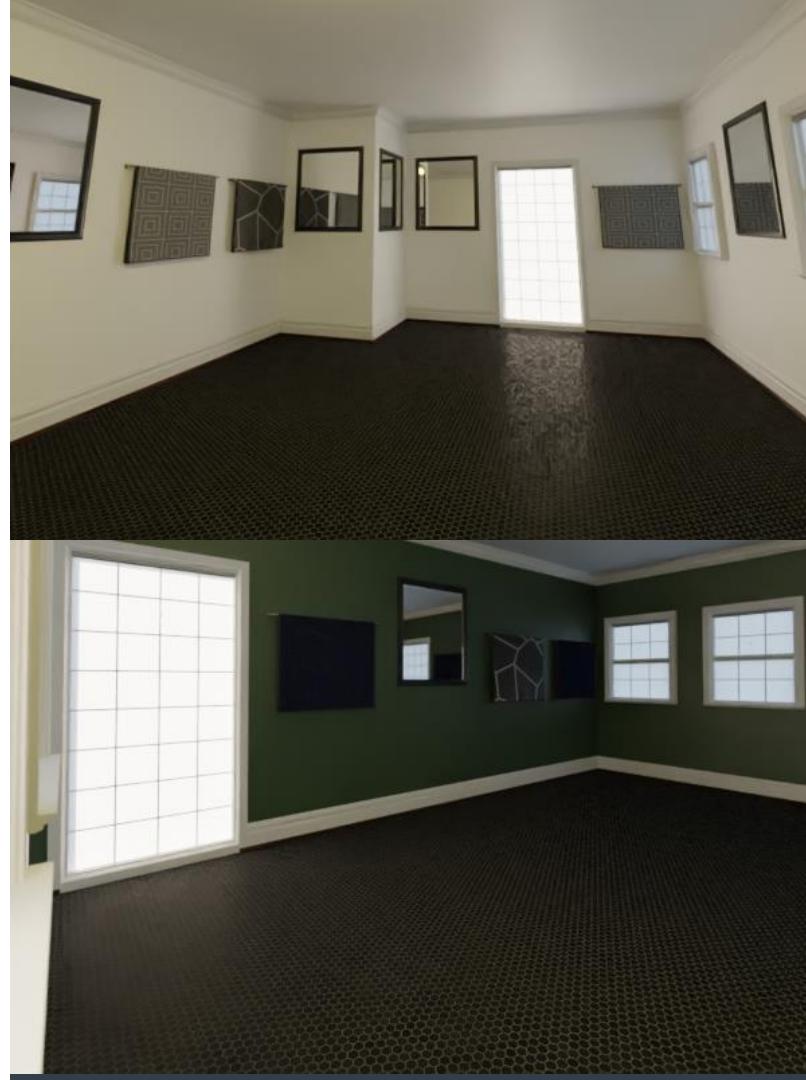


# Class 36 – hex tile

- Appears in:

Living room	Bedroom	Kitchen	Office	Bathroom	
0	0	0	0	0	1

- Whether the floor is made of hexagonal black ceramic tile
- This is only true **IF** the floor is visible from the camera



# Class 37 – hex marble

- Appears in:

Living room	Bedroom	Kitchen	Office	Bathroom	
0	0	0	0	0	1

- Whether the floor is made of hexagonal black marble tile
- This is only true **IF** the floor is visible from the camera



# Class 38 – marble tile

- Appears in:

Living room	Bedroom	Kitchen	Office	Bathroom	
0	0	0	0	0	1

- Whether the floor is made of square marble tile
- This is only true **IF** the floor is visible from the camera



# Class 39 – Bathroom

## Class 40 – Office

## Class 41 – Bedroom

## Class 42 – kitchen

## Class 43 – Living Room

- Classes describe whether we're in the specified room type.
- Order of rooms is indexed: follows a Markov chain with transition matrix shown to the right.

0.1	0.6	0.1	0.1	0.1
0.1	0.1	0.6	0.1	0.1
0.1	0.1	0.1	0.6	0.1
0.1	0.1	0.1	0.1	0.6
0.6	0.1	0.1	0.1	0.1