models_validation_mix_20_set

September 20, 2023

[ ]:

```
import tensorflow as tf

from tensorflow.keras import datasets, layers, models
import matplotlib.pyplot as plt
import numpy as np
import pandas as pd
import skimage.measure

import random
import copy
import math
import cv2
import os
```

1 TRAINED MODELS

1.1 Loading of the models

[ ]:

```
model = tf.keras.models.load_model('IRI_models/19set_8px_steps_mix_paths')

model1 = tf.keras.models.load_model('IRI_models/19set_8px_steps_mix_vels')

model2 = tf.keras.models.load_model('IRI_models/19set_8px_steps_mix_stops')
```

2 Variables definition

[ ]:

```
div = 32
step = int(32/4)
red = [5,5,2,2,2,2,2,2]

sem_dict = ['cash', 'entrance', 'light', 'sit', 'stairs', 'trash', 'tree',␣
 ↪'restricted', 'grass']
chans = len(sem_dict)+1

lut_in = [0, 20, 50, 100, 150, 255]
lut_out = [0, 100, 180, 220, 240, 255]
lut_8u = np.interp(np.arange(0, 256), lut_in, lut_out).astype(np.uint8)
```

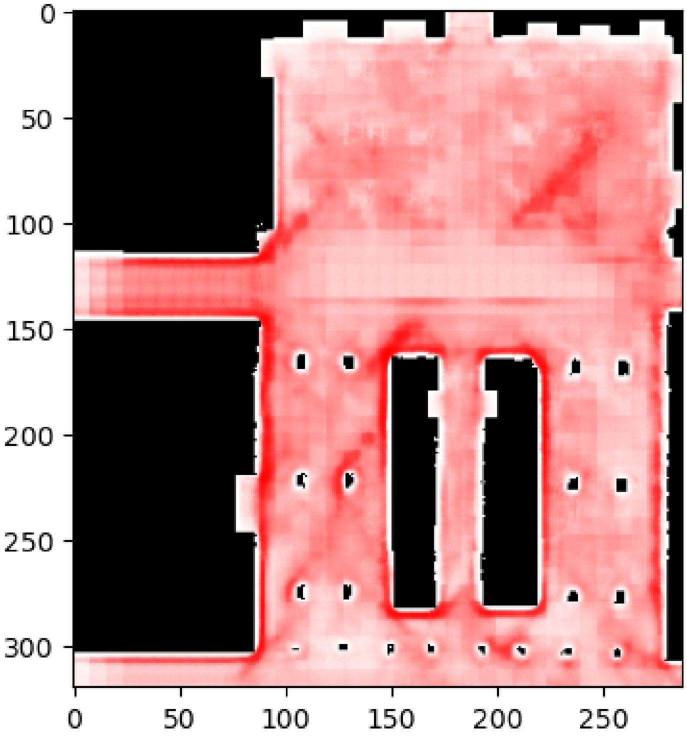
2.1 Testing closed corridors (completely or partially closed)

[ ]:

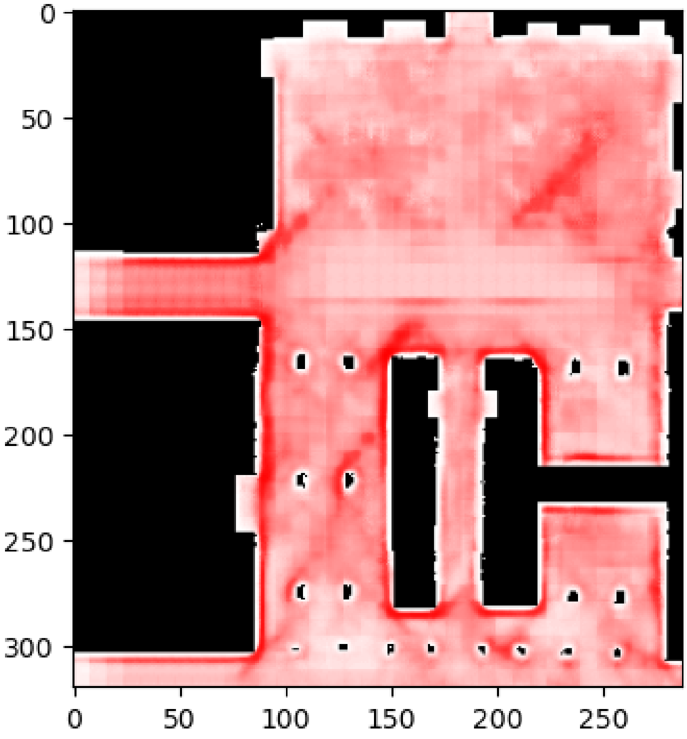
```
map_list = ['master_big','master_big_closed','master_big_semiclosed']
map_root_name = 'master_big'

for map_name in map_list:
  print(map_name)

  lines = 0
  with open('maps/semantics/'+map_root_name+'/'+map_name+'.csv') as f:
    lines = f.readlines()

  h = len(lines)
  w = len(lines[0].split(','))

  # Converts data to a list of integers
  map = []
  for line in lines:
    map.extend([int(c) for c in line.split(',')])

  for lab_class in sem_dict:
    lines = 0
    try:
      with open('maps/semantics/'+map_root_name+'/
 ↪'+map_root_name+'_sem_'+lab_class+'.csv') as f:
        lines = f.readlines()

      hh = len(lines)
      ww = len(lines[0].split(','))

      if hh != h or ww != w:
        print(f'h: {h}\tw: {w}')
        print(f'h: {hh}\tw: {ww}')
        raise SystemExit("ERROR: Different sizes!!")
      # Converts data to a list of integers
      for line in lines:
        map.extend([int(c) for c in line.split(',')])

    except FileNotFoundError:
      for i in range(h):
        for j in range(w):
          map.extend([255])

  map = np.reshape(map,[chans,h,w])
  map = np.moveaxis(map, 0, -1)
  map = map/255

  map_aux = map
  map = np.zeros((int(math.ceil(h/2)),int(math.ceil(w/2)),chans))

  for idx in range(chans):
    map[:,:,idx] = skimage.measure.block_reduce(map_aux[:,:,idx], (2,2), np.max)
  h, w, _ = map.shape

  diff_h = int((h-div*int(h/div))/2)
  r_h = int((h-div*int(h/div))%2) + diff_h
  diff_w = int((w-div*int(w/div))/2)
  r_w = int((w-div*int(w/div))%2) + diff_w
  map = map[r_h:-diff_h:,r_w+diff_w:,:]

  # print(map.shape)
  h, w, _ = map.shape

  #␣
  ↪----------------------------------------------------------------------------------
  # creating subplot and figure
  fig = plt.figure(figsize=(w/70,h/70))
  data_pred = np.zeros((int(math.ceil(h)),int(math.ceil(w))))

  step = int(32/4)
  for i in np.arange((w/step+int(div/step-1))*(h/step+int(div/step-1))):
    c = int(i%(w/step+int(div/step-1))) - int(div/step-1)*0
    r = int(i/(w/step+int(div/step-1))) - int(div/step-1)*0
    submap = map[max(step*r,0):step*r+div, max(step*c,0):step*c+div,:]
    subdata = model.predict(np.expand_dims(submap,axis=0),verbose=0)[:,:,:,0]
    subdata = np.squeeze(subdata,axis=0)
    data_pred[max(step*r,0):step*r+div, max(step*c,0):step*c+div] += subdata*1/
  ↪(int(div/step)*int(div/step))
  contrasted_data = cv2.LUT((data_pred/np.max(data_pred)*255).astype(np.uint8),␣
  ↪lut_8u).astype(float)/255
```

```
plt.imshow(np.multiply(np.stack((map[:,:,0],map[:,:,0],map[:,:,0]),axis=2),np.stack((np.full(contrasted_data.shape,1),1-contrasted_data,1-contrasted_data),axis=2)), vmin=0, vmax=1)
# plt.imshow(np.multiply(np.stack((map[:,:,0],map[:,:,0],map[:,:,0]),axis=2),np.stack((np.full(data_pred.shape,1),1-data_pred,1-data_pred),axis=2)),vmin=0, vmax=1)
plt.show()
```

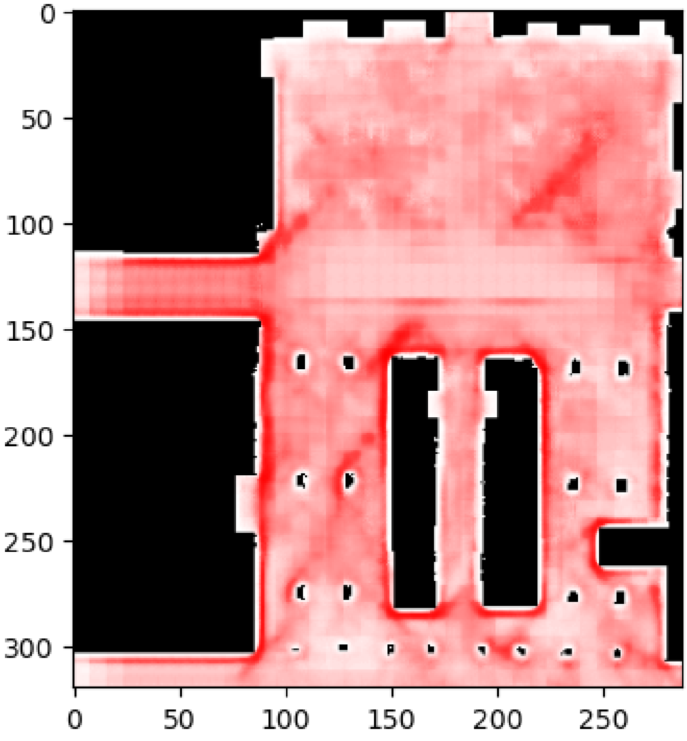
master_big



master_big_closed



`master_big_semiclosed`

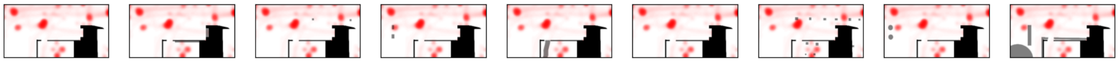


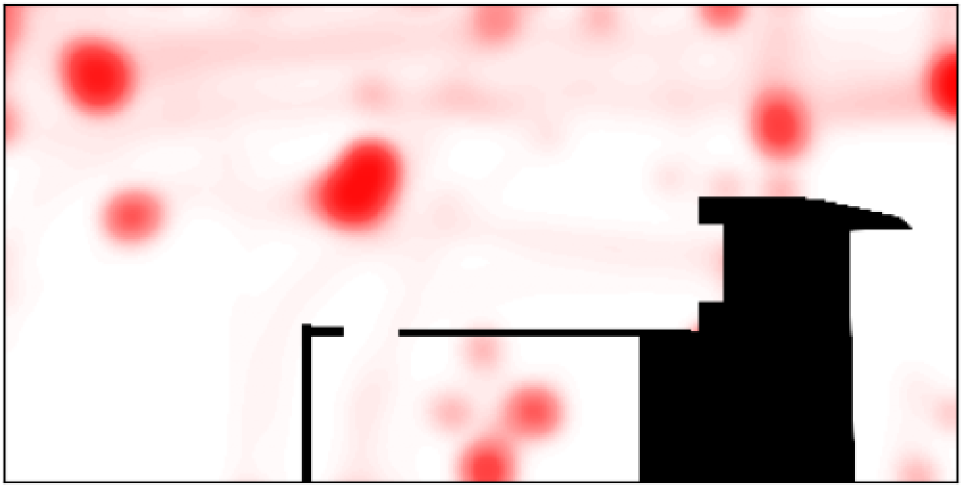
2.2 Model 1 testing

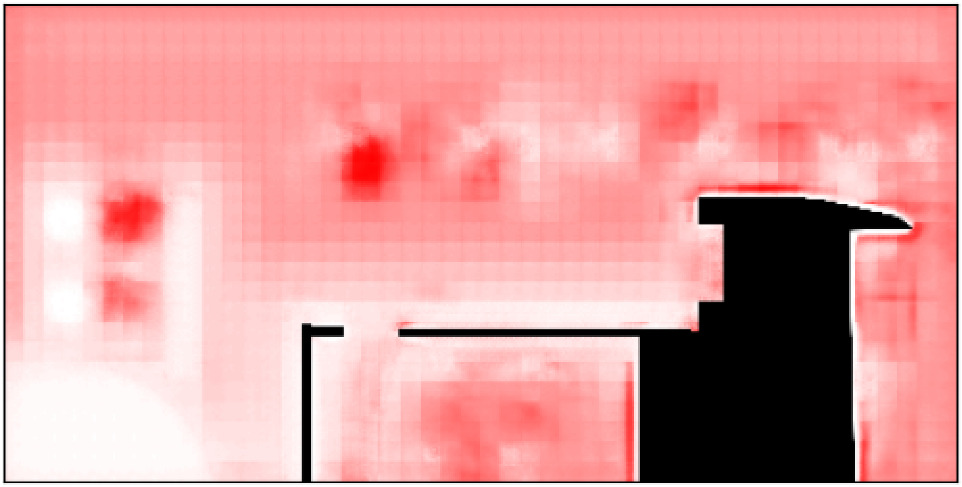
[ ]:

```
map_list = ['stanford_coupa0',␣
 ↪'stanford_coupa3','master_big','willow','map1','map2','costacafe','map3']
kl1 = []

for map_count, map_name in enumerate(map_list):
  print(map_name)

  lines = 0
  with open('maps/semantics/'+map_name+'/'+map_name+'.csv') as f:
    lines = f.readlines()

  h = len(lines)
  w = len(lines[0].split(','))

  # Converts data to a list of integers
  map = []
  for line in lines:
    map.extend([int(c) for c in line.split(',')])

  for lab_class in sem_dict:
    lines = 0
    try:
      with open('maps/semantics/'+map_name+'/'+map_name+'_sem_'+lab_class+'.
 ↪csv') as f:
        lines = f.readlines()

      hh = len(lines)
      ww = len(lines[0].split(','))

      if hh != h or ww != w:
        print(f'h: {h}\tw: {w}')
        print(f'h: {hh}\tw: {ww}')
        raise SystemExit("ERROR: Different sizes!!")

      # Converts data to a list of integers
      for line in lines:
        map.extend([int(c) for c in line.split(',')])

    except FileNotFoundError:
      for i in range(h):
        for j in range(w):
          map.extend([255])
  map = np.reshape(map,[chans,h,w])
  map = np.moveaxis(map, 0, -1)
  map = map/255

  map_aux = map
  map = np.zeros((int(math.ceil(h/red[map_count])),int(math.ceil(w/
 ↪red[map_count])),chans))

  for idx in range(chans):
    map[:,:,idx] = skimage.measure.block_reduce(map_aux[:,:,idx],␣
 ↪(red[map_count],red[map_count]), np.max)
  h, w, _ = map.shape

  diff_h = int((h-div*int(h/div))/2)
  r_h = int((h-div*int(h/div))%2) + diff_h
  diff_w = int((w-div*int(w/div))/2)
  r_w = int((w-div*int(w/div))%2) + diff_w
  map = map[r_h:-diff_h:,r_w+diff_w:,:]

  # print(map.shape)
  h, w, _ = map.shape

#␣
 ↪-----------------------------------------------------------------------------------
  lines = 0
  with open('maps/semantics/'+map_name+'/humandensity-'+map_name+'-new.csv') as␣
 ↪f:
    lines = f.readlines()

  hd = len(lines)
  wd = len(lines[0].split(','))

  # Converts data to a list of integers
  data = []
  for line in lines:
    data.extend([int(c) for c in line.split(',')])

  data = np.reshape(data,[hd,wd])
  sigma = 2.0
  data = skimage.filters.gaussian(data+(data==0), sigma=(sigma, sigma),␣
 ↪channel_axis=-1)*(data>0)
  data = skimage.measure.block_reduce(data, (red[map_count],red[map_count]), np.
 ↪max)
  data = data[r_h:-diff_h,r_w+diff_w:]
data = np.subtract(data, np.full((h, w), np.min(data)))/(np.max(data)-np.
↪min(data))

# print(data.shape)
hd, wd = data.shape

print(sem_dict)
plt.figure(figsize=(20,5))
for i in range(len(sem_dict)):
  i = i+1
  ax = plt.subplot(1, len(sem_dict), i)
  alp = 0.5
  contrasted_data = cv2.LUT((data/np.max(data)*255).astype(np.uint8), lut_8u).
↪astype(float)/255
  ax.imshow(np.multiply(np.stack((map[:,:,0],map[:,:,0],map[:,:
↪,0]),axis=2),np.multiply(np.stack((map[:,:,i],map[:,:,i],map[:,:
↪,i]),axis=2)*alp+(1-alp), np.stack((np.full(contrasted_data.
↪shape,1),1-contrasted_data,1-contrasted_data),axis=2))), vmin=0, vmax=1)
  # ax.imshow(np.multiply(np.stack((map[:,:,0],map[:,:,0],map[:,:
↪,0]),axis=2),np.multiply(np.stack((map[:,:,i],map[:,:,i],map[:,:
↪,i]),axis=2)*alp+(1-alp), np.stack((np.full(data.
↪shape,1),1-data,1-data),axis=2))), vmin=0, vmax=1)
  ax.get_xaxis().set_visible(False)
  ax.get_yaxis().set_visible(False)
plt.show()

ax = plt.subplot(111)
contrasted_data = cv2.LUT((data/np.max(data)*255).astype(np.uint8), lut_8u).
↪astype(float)/255
ax.imshow(np.multiply(np.stack((map[:,:,0],map[:,:,0],map[:,:,0]),axis=2), np.
↪stack((np.full(contrasted_data.
↪shape,1),1-contrasted_data,1-contrasted_data),axis=2)), vmin=0, vmax=1)
# ax.imshow(np.multiply(np.stack((map[:,:,0],map[:,:,0],map[:,:,0]),axis=2),␣
↪np.stack((np.full(data.shape,1),1-data,1-data),axis=2)), vmin=0, vmax=1)
ax.get_xaxis().set_visible(False)
ax.get_yaxis().set_visible(False)
plt.show()

#␣
↪-----------------------------------------------------------------------------------
# creating subplot and figure
ax = plt.subplot(111)
data_pred = np.zeros((int(math.ceil(h)),int(math.ceil(w))))

step = int(32/4)
for i in np.arange((w/step+int(div/step-1))*(h/step+int(div/step-1))):
        c = int(i%(w/step+int(div/step-1))) - int(div/step-1)
        r = int(i/(w/step+int(div/step-1))) - int(div/step-1)
        submap = map[max(step*r,0):step*r+div, max(step*c,0):step*c+div,:]
        subdata = model.predict(np.expand_dims(submap,axis=0),verbose=0)[:,:,:,0]
        subdata = np.squeeze(subdata,axis=0)
        data_pred[max(step*r,0):step*r+div, max(step*c,0):step*c+div] += subdata*1/(int(div/step)*int(div/step))
    contrasted_data = cv2.LUT((data_pred/np.max(data_pred)*255).astype(np.uint8), lut_8u).astype(float)/255
    plt.imshow(np.multiply(np.stack((map[:,:,0],map[:,:,0],map[:,:,0]),axis=2), np.stack((np.full(contrasted_data.shape,1),1-contrasted_data,1-contrasted_data),axis=2)), vmin=0, vmax=1)
    # plt.imshow(np.multiply(np.stack((map[:,:,0],map[:,:,0],map[:,:,0]),axis=2), np.stack((np.full(data_pred.shape,1),1-data_pred,1-data_pred),axis=2)), vmin=0, vmax=1)
    ax.get_xaxis().set_visible(False)
    ax.get_yaxis().set_visible(False)
    plt.show()

    data = data/sum(sum(data))
    data_pred = data_pred/sum(sum(data_pred))
    kl = 0
    for i in range(data.shape[0]):
        for j in range(data.shape[1]):
            if data[i,j] > 0 and data_pred[i,j] > 0:
                kl = kl + data[i,j]*math.log2(data[i,j]/data_pred[i,j])
    print(f'KL-divergence: {kl}')
    kl1 = np.append(kl1,kl)

print(f'Mean KL-divergence: {np.mean(kl1)}')
```

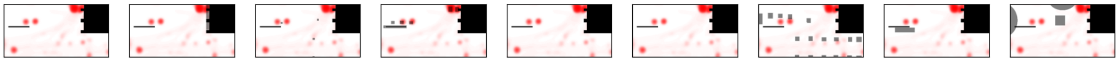
```
stanford_coupa0
['cash', 'entrance', 'light', 'sit', 'stairs', 'trash', 'tree', 'restricted',
'grass']
```

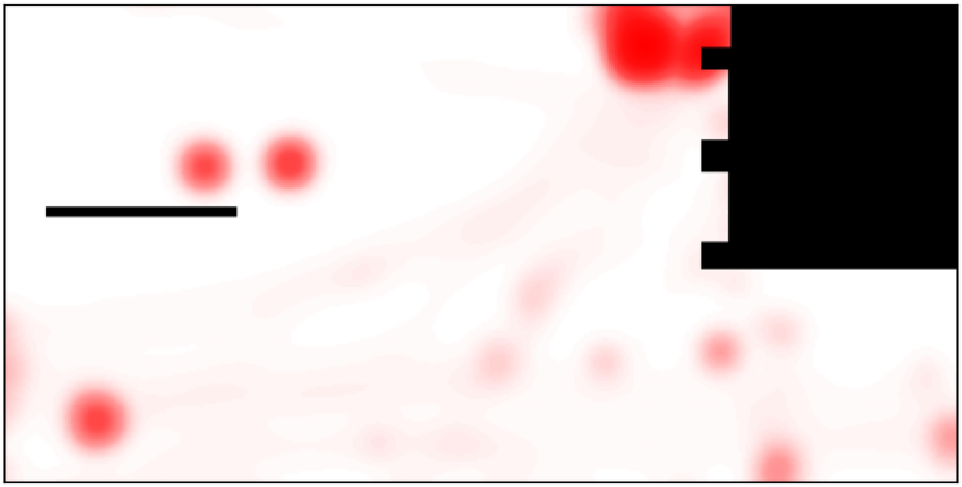


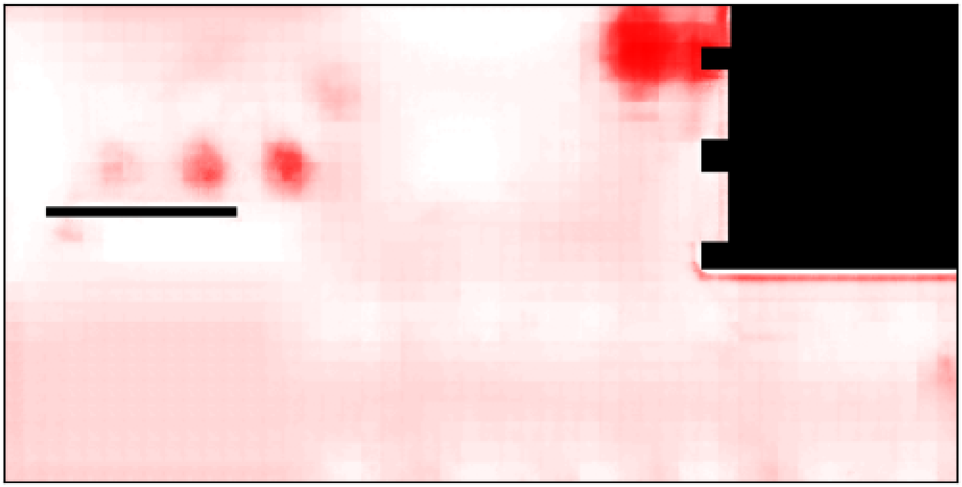




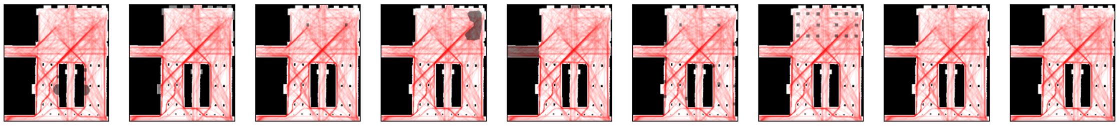
```
KL-divergence: 1.2152750361553484
stanford_coupa3
['cash', 'entrance', 'light', 'sit', 'stairs', 'trash', 'tree', 'restricted',
'grass']
```

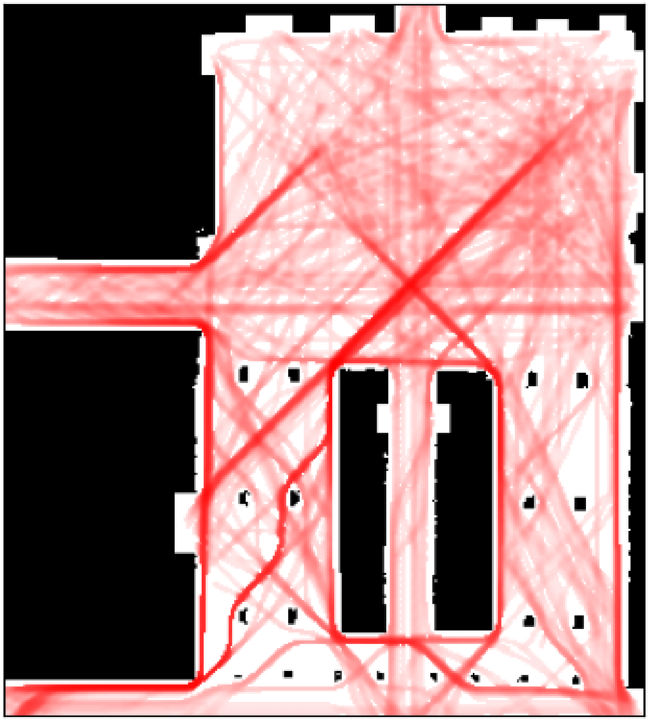


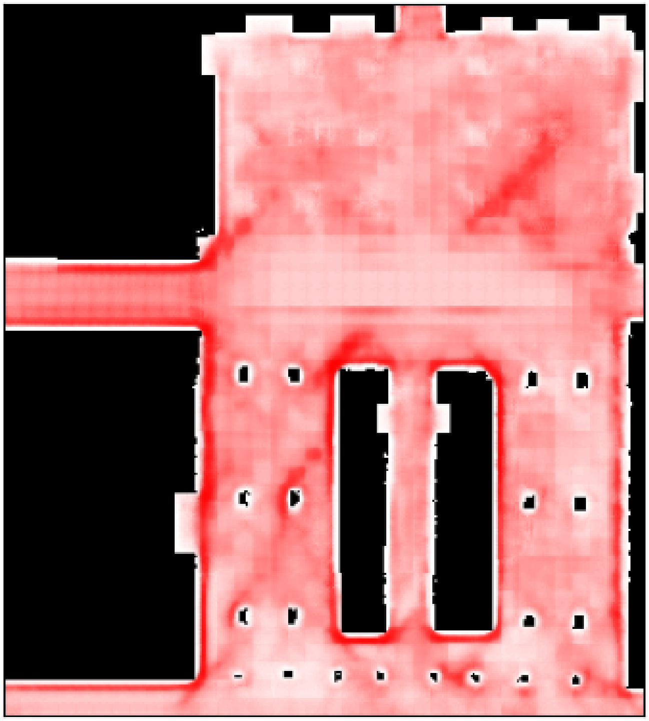




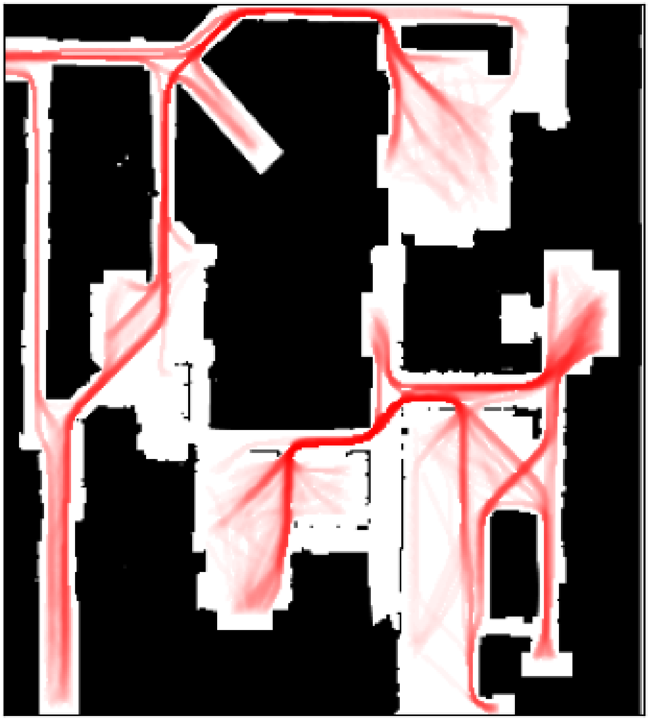
```
KL-divergence: 0.7654383618321384
master_big
['cash', 'entrance', 'light', 'sit', 'stairs', 'trash', 'tree', 'restricted',
'grass']
```

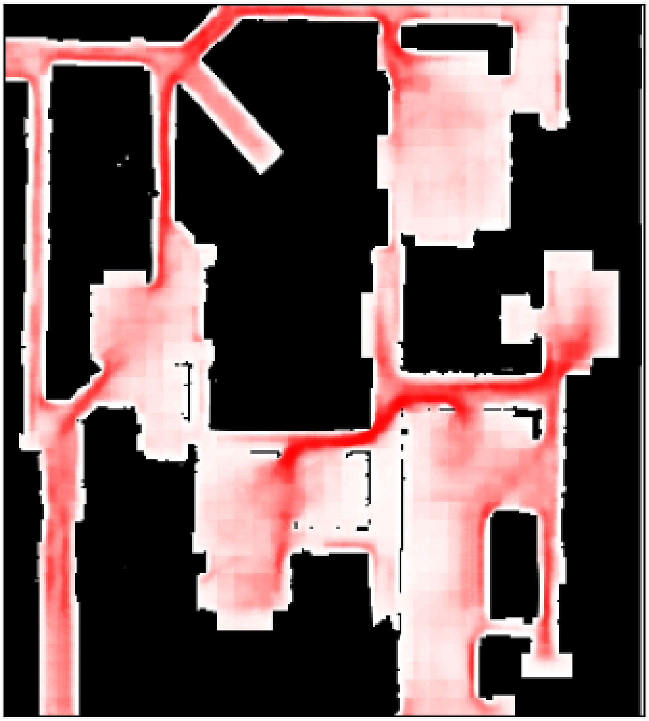




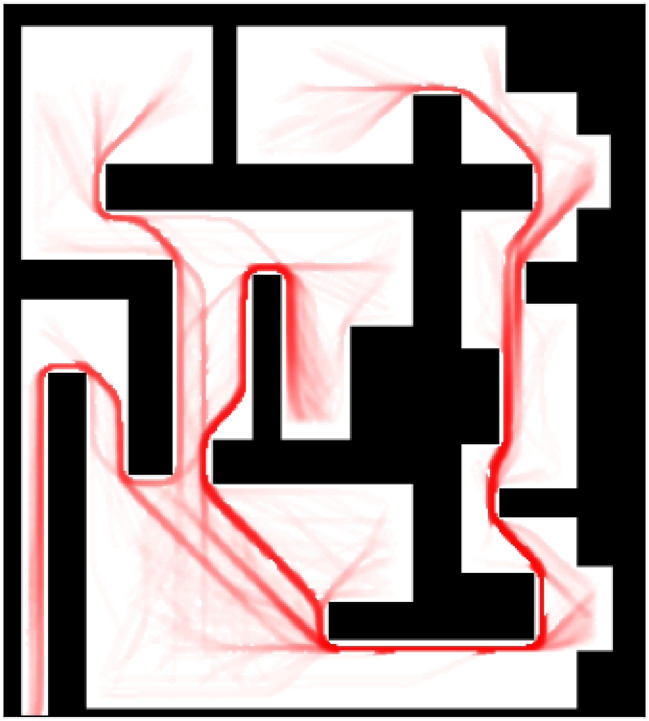


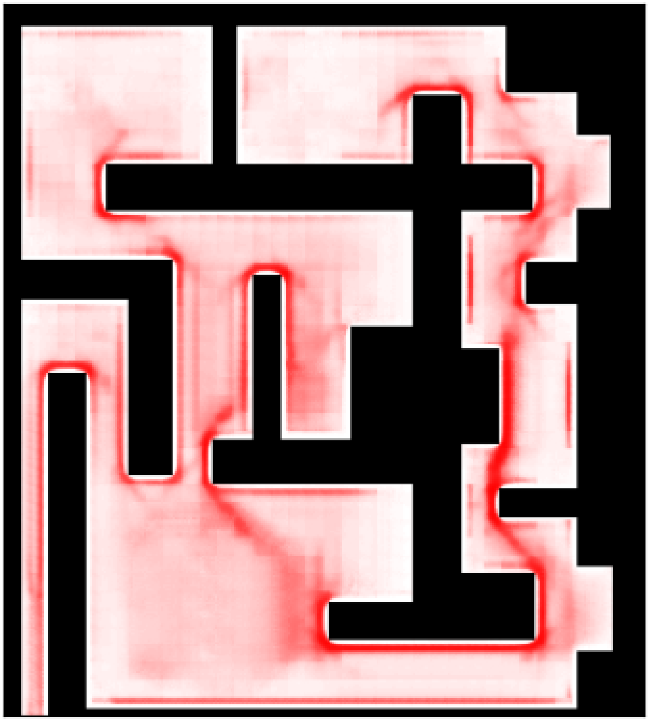
```
KL-divergence: 0.5463666482596429
willow
['cash', 'entrance', 'light', 'sit', 'stairs', 'trash', 'tree', 'restricted',
'grass']
```



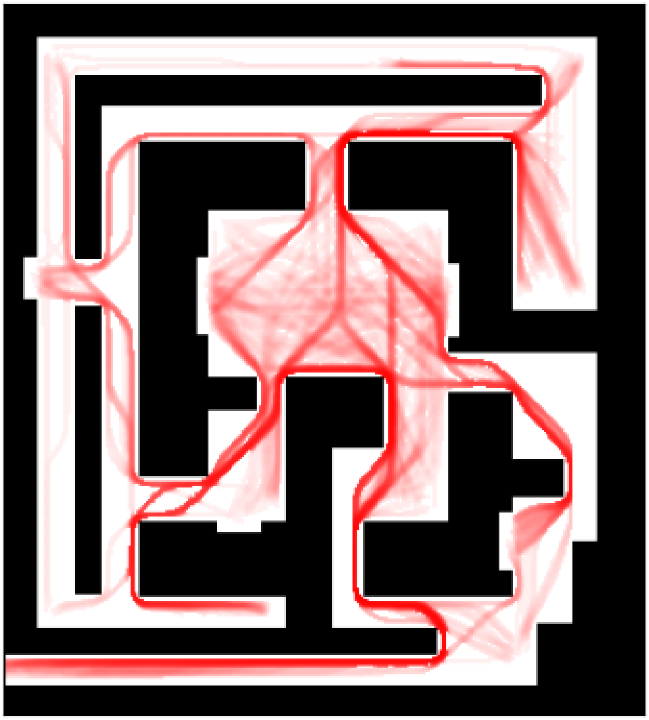


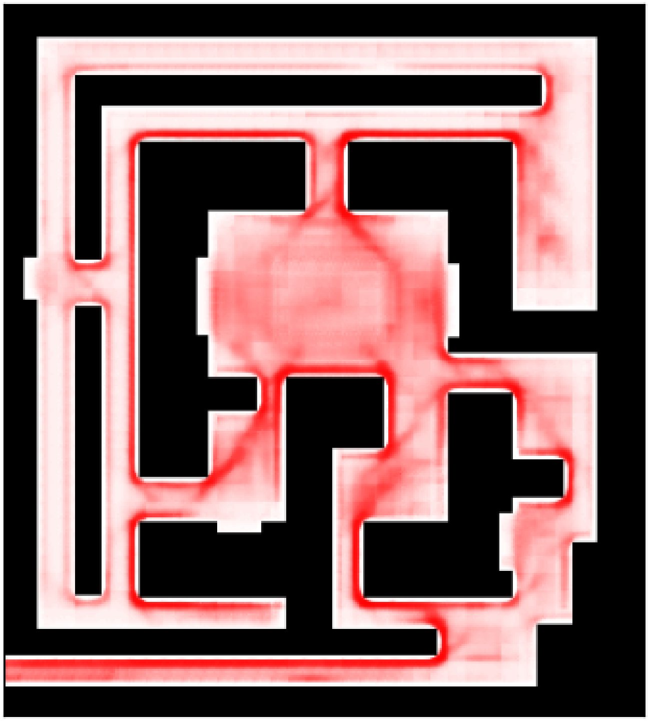
```
KL-divergence: 0.7707705090932734
map1
['cash', 'entrance', 'light', 'sit', 'stairs', 'trash', 'tree', 'restricted',
'grass']
```



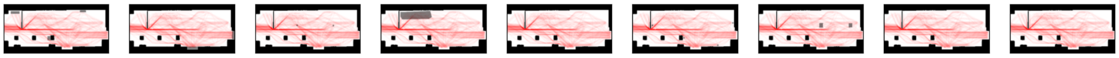


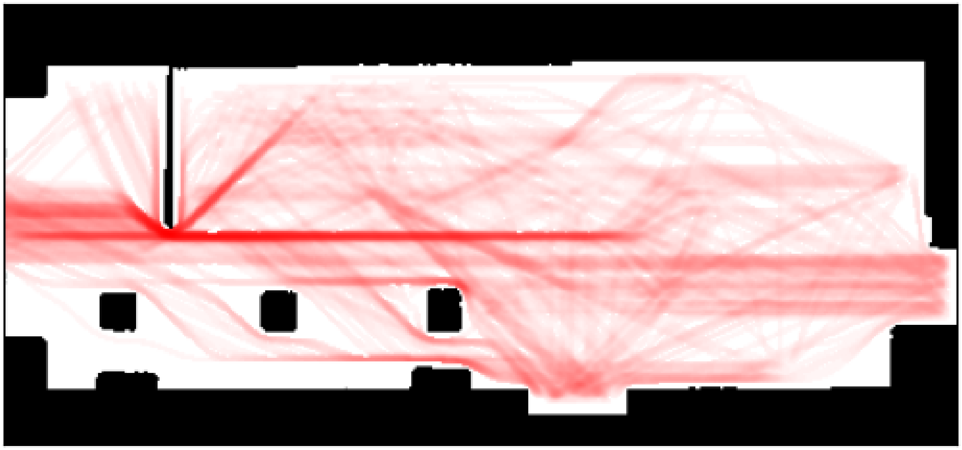
```
KL-divergence: 0.9392241203355021
map2
['cash', 'entrance', 'light', 'sit', 'stairs', 'trash', 'tree', 'restricted',
'grass']
```

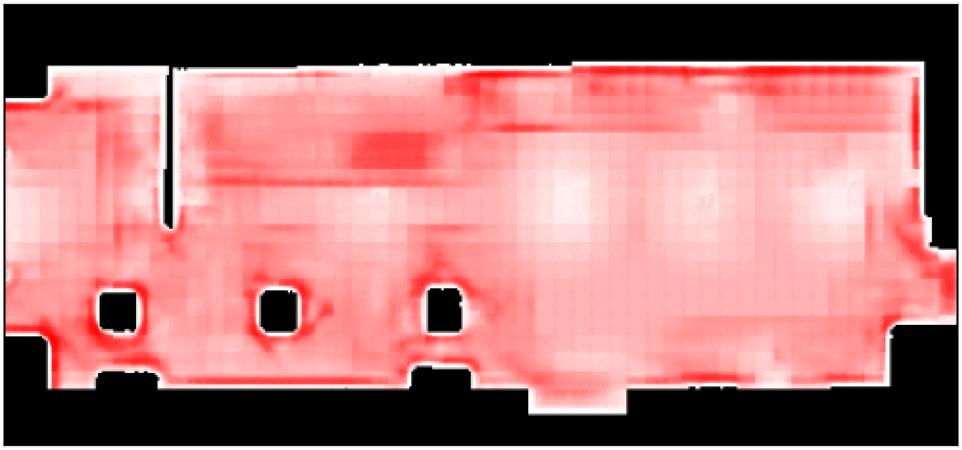




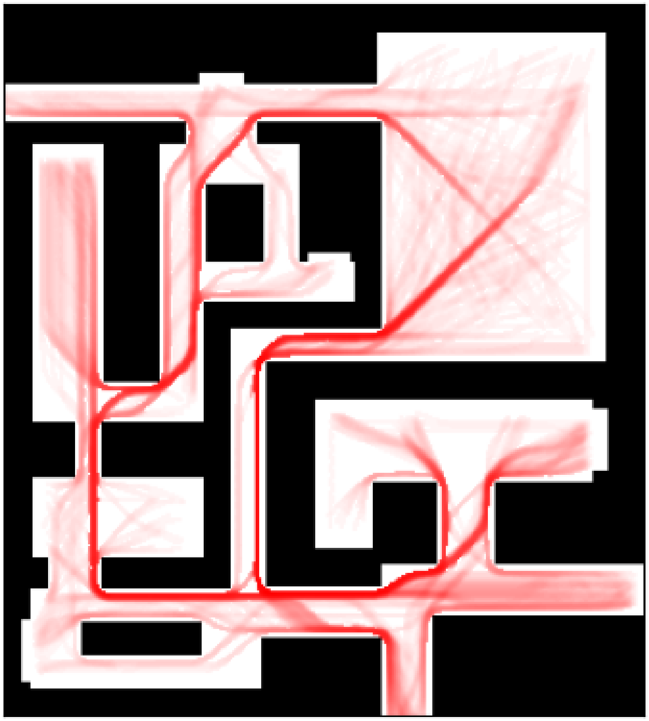
```
KL-divergence: 0.5801992617800475
costacafe
['cash', 'entrance', 'light', 'sit', 'stairs', 'trash', 'tree', 'restricted',
'grass']
```

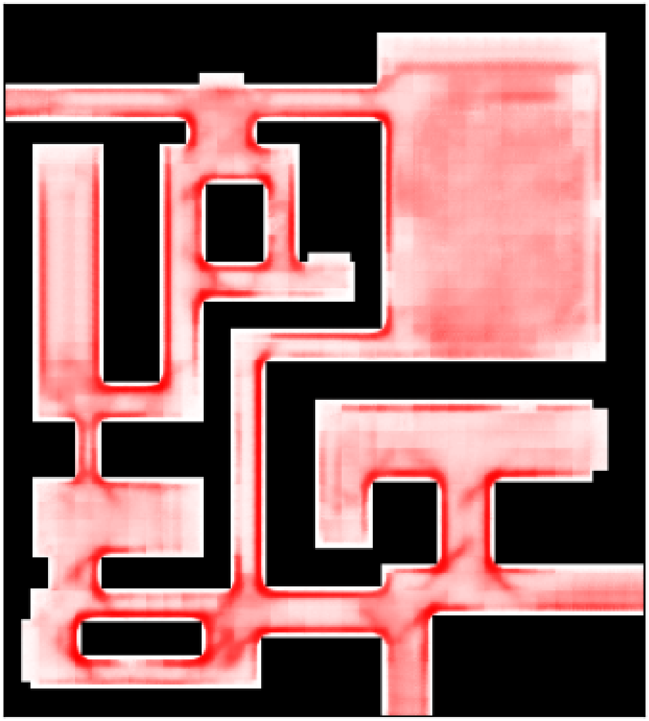






```
KL-divergence: 1.2598072266858964
map3
['cash', 'entrance', 'light', 'sit', 'stairs', 'trash', 'tree', 'restricted',
'grass']
```





```
KL-divergence: 1.1478036250021357
Mean KL-divergence: 0.9031105986429981
```

2.3 Model 2 testing

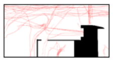
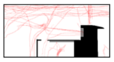
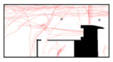
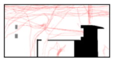
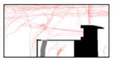
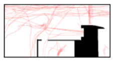
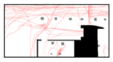
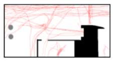
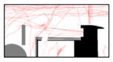
```
[ ]: kl1 = []

     for map_count, map_name in enumerate(map_list):
       print(map_name)

       lines = 0
       with open('maps/semantics/'+map_name+'/'+map_name+'.csv') as f:
         lines = f.readlines()

       h = len(lines)
       w = len(lines[0].split(','))

       # Converts data to a list of integers
       map = []
       for line in lines:
         map.extend([int(c) for c in line.split(',')])

       for lab_class in sem_dict:
         lines = 0
         try:
           with open('maps/semantics/'+map_name+'/'+map_name+'_sem_'+lab_class+'.
      ↪csv') as f:
             lines = f.readlines()

           hh = len(lines)
           ww = len(lines[0].split(','))

           if hh != h or ww != w:
             print(f'h: {h}\tw: {w}')
             print(f'h: {hh}\tw: {ww}')
             raise SystemExit("ERROR: Different sizes!!")

           # Converts data to a list of integers
           for line in lines:
             map.extend([int(c) for c in line.split(',')])

         except FileNotFoundError:
           for i in range(h):
             for j in range(w):
               map.extend([255])

       map = np.reshape(map,[chans,h,w])
```

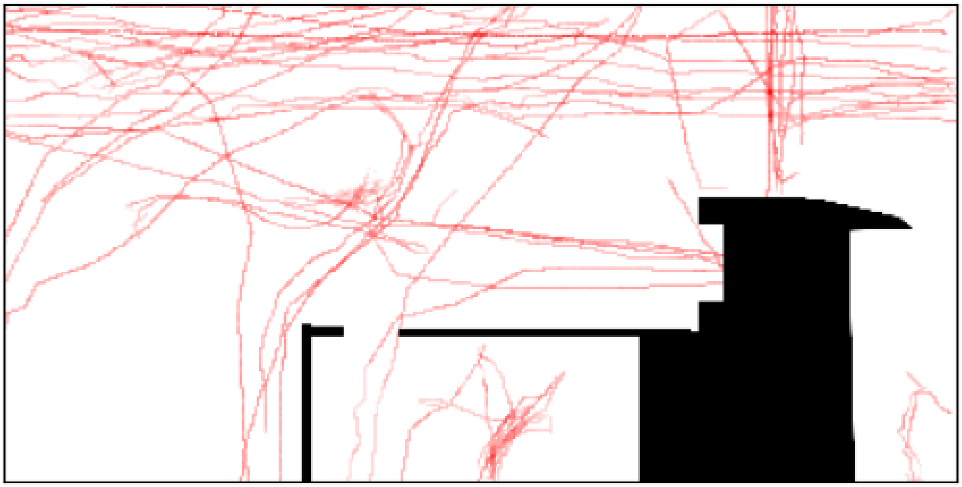
```
  map = np.moveaxis(map, 0, -1)
  map = map/255

  map_aux = map
  map = np.zeros((int(math.ceil(h/red[map_count])),int(math.ceil(w/
 ↪red[map_count])),chans))

  for idx in range(chans):
    map[:,:,idx] = skimage.measure.block_reduce(map_aux[:,:,idx],␣
 ↪(red[map_count],red[map_count]), np.max)
  h, w, _ = map.shape

  diff_h = int((h-div*int(h/div))/2)
  r_h = int((h-div*int(h/div))%2) + diff_h
  diff_w = int((w-div*int(w/div))/2)
  r_w = int((w-div*int(w/div))%2) + diff_w
  map = map[r_h:-diff_h:,r_w+diff_w:,:]

  # print(map.shape)
  h, w, _ = map.shape

#␣
 ↪----------------------------------------------------------------------------------
  lines = 0
  with open('maps/semantics/'+map_name+'/humandensity-'+map_name+'-vel.csv') as␣
 ↪f:
    lines = f.readlines()

  hd = len(lines)
  wd = len(lines[0].split(','))

  # Converts data to a list of integers
  data = []
  for line in lines:
    data.extend([float(c) for c in line.split(',')])

  data = np.reshape(data,[hd,wd])
  sigma = 2.0
  data = skimage.filters.gaussian(data+(data==0), sigma=(sigma, sigma),␣
 ↪channel_axis=-1)*(data>0)
  data = skimage.measure.block_reduce(data, (red[map_count],red[map_count]), np.
 ↪max)
  data = data[r_h:-diff_h,r_w+diff_w:]
  data = np.subtract(data, np.full((h, w), np.min(data)))/(np.max(data)-np.
 ↪min(data))
```

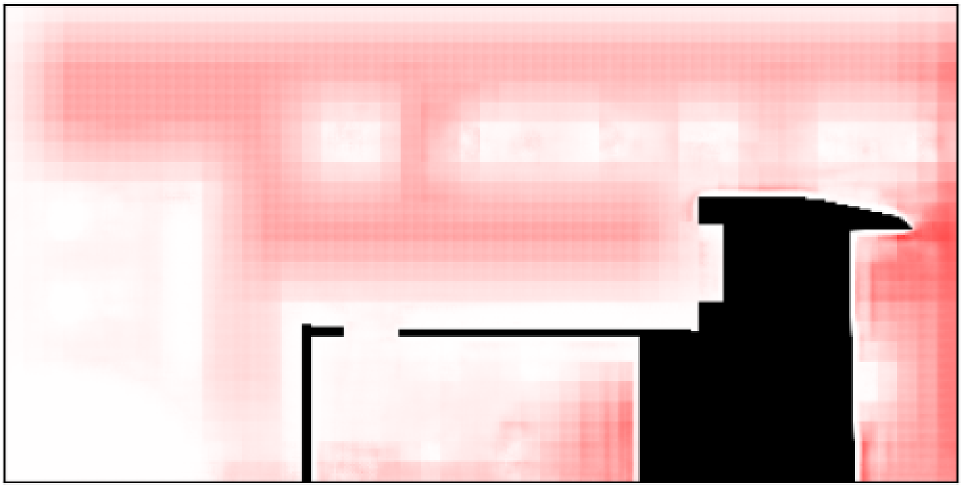
```
# print(data.shape)
hd, wd = data.shape

print(sem_dict)
plt.figure(figsize=(20,5))
for i in range(len(sem_dict)):
  i = i+1
  ax = plt.subplot(1, len(sem_dict), i)
  alp = 0.5
  ax.imshow(np.multiply(np.stack((map[:,:,0],map[:,:,0],map[:,:
↪,0]),axis=2),np.multiply(np.stack((map[:,:,i],map[:,:,i],map[:,:
↪,i]),axis=2)*alp+(1-alp), np.stack((np.full(data.
↪shape,1),1-data,1-data),axis=2))), vmin=0, vmax=1)
  ax.get_xaxis().set_visible(False)
  ax.get_yaxis().set_visible(False)
plt.show()

ax = plt.subplot(111)
ax.imshow(np.multiply(np.stack((map[:,:,0],map[:,:,0],map[:,:,0]),axis=2), np.
↪stack((np.full(data.shape,1),1-data,1-data),axis=2)), vmin=0, vmax=1)
ax.get_xaxis().set_visible(False)
ax.get_yaxis().set_visible(False)
plt.show()

#␣
↪-----------------------------------------------------------------------------------
# creating subplot and figure
ax = plt.subplot(111)
data_pred = np.zeros((int(math.ceil(h)),int(math.ceil(w))))

step = int(32/4)
for i in np.arange((w/step+int(div/step-1))*(h/step+int(div/step-1))):
  c = int(i%(w/step+int(div/step-1))) - int(div/step-1)*0
  r = int(i/(w/step+int(div/step-1))) - int(div/step-1)*0
  submap = map[max(step*r,0):step*r+div, max(step*c,0):step*c+div,:]
  subdata = model1.predict(np.expand_dims(submap,axis=0),verbose=0)[:,:,:,0]
  subdata = np.squeeze(subdata,axis=0)
  data_pred[max(step*r,0):step*r+div, max(step*c,0):step*c+div] += subdata*1/
↪(int(div/step)*int(div/step))
plt.imshow(np.multiply(np.stack((map[:,:,0],map[:,:,0],map[:,:,0]),axis=2),␣
↪np.stack((np.full(data_pred.shape,1),1-(data_pred),1-(data_pred)),axis=2)),␣
↪vmin=0, vmax=1)
ax.get_xaxis().set_visible(False)
ax.get_yaxis().set_visible(False)
plt.show()

data = data/sum(sum(data))
```

```
  data_pred = data_pred/sum(sum(data_pred))
  kl = 0
  for i in range(data.shape[0]):
      for j in range(data.shape[1]):
          if data[i,j] > 0 and data_pred[i,j] > 0:
              kl = kl + data[i,j]*math.log2(data[i,j]/data_pred[i,j])
  print(f'KL-divergence: {kl}')
  kl1 = np.append(kl1,kl)

print(f'Mean KL-divergence: {np.mean(kl1)}')
```

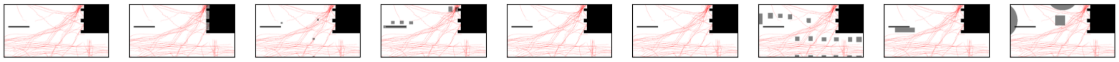
```
stanford_coupa0
['cash', 'entrance', 'light', 'sit', 'stairs', 'trash', 'tree', 'restricted',
'grass']
```

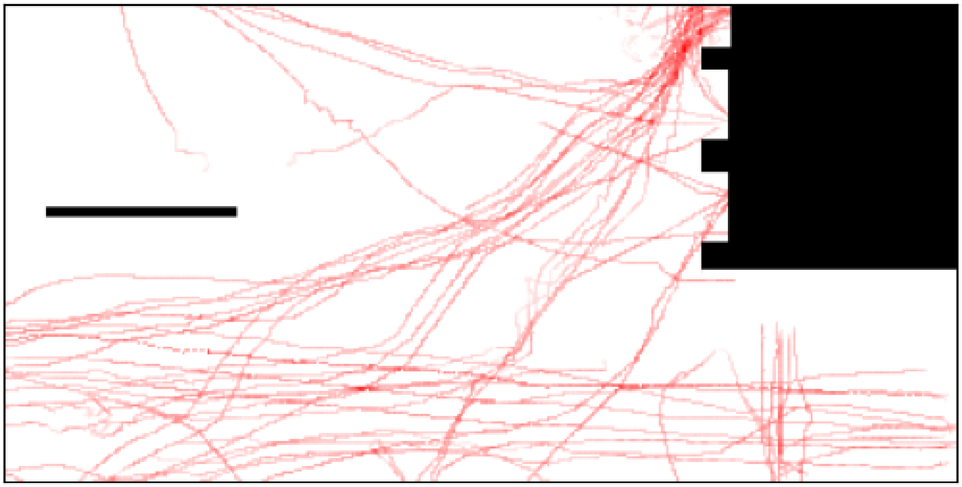










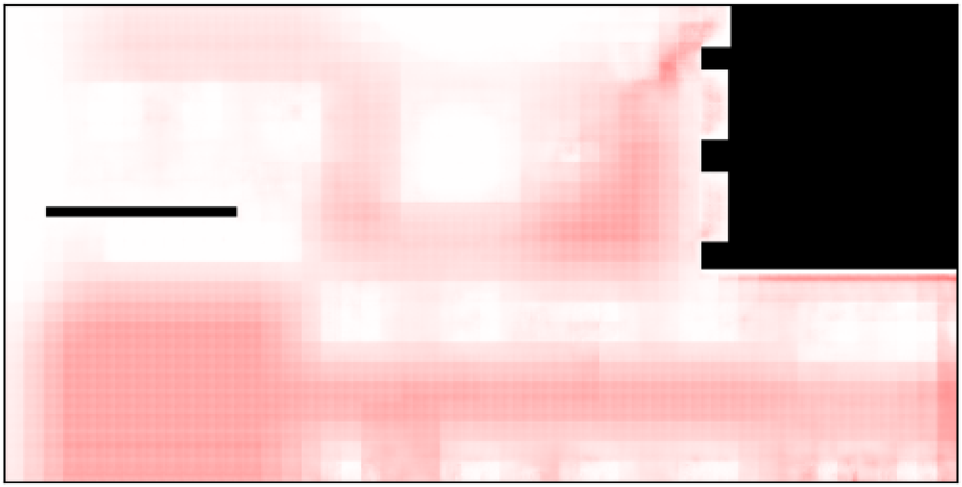




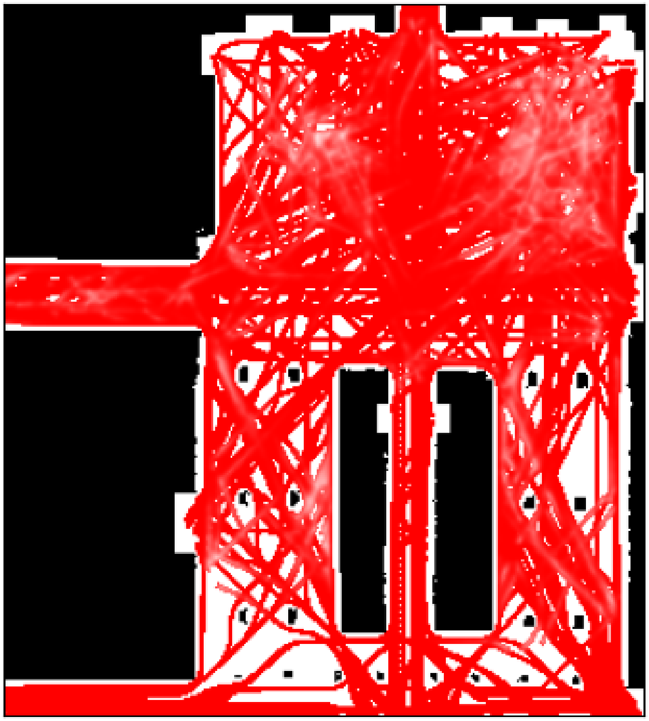
```
KL-divergence: 2.818693457155821
stanford_coupa3
['cash', 'entrance', 'light', 'sit', 'stairs', 'trash', 'tree', 'restricted',
'grass']
```

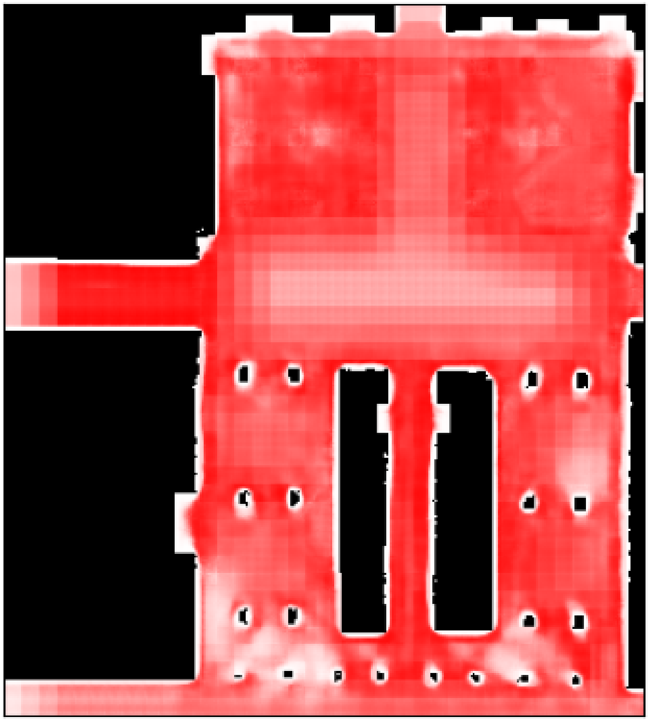




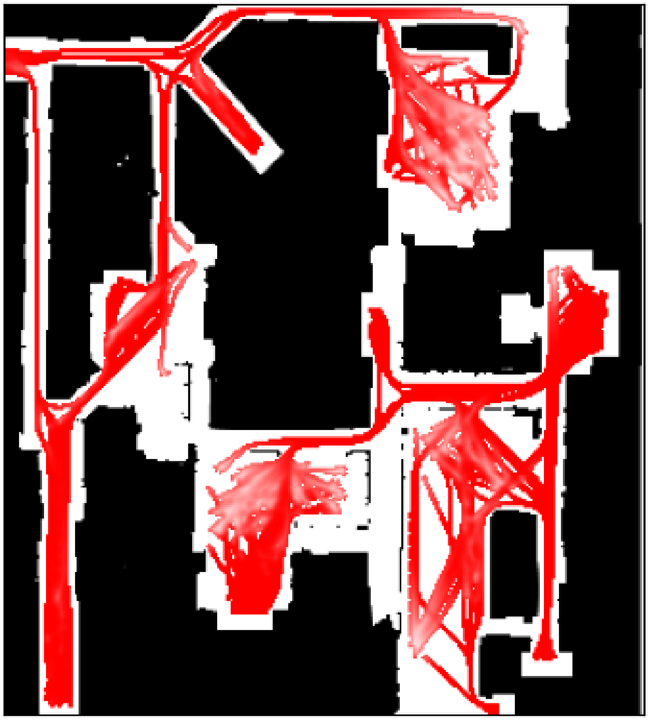


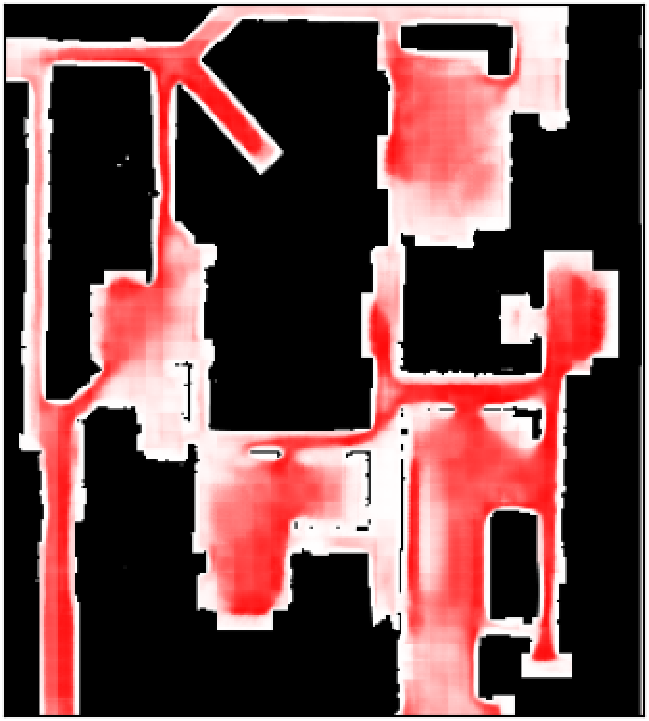
```
KL-divergence: 2.2751279141911875
master_big
['cash', 'entrance', 'light', 'sit', 'stairs', 'trash', 'tree', 'restricted',
'grass']
```



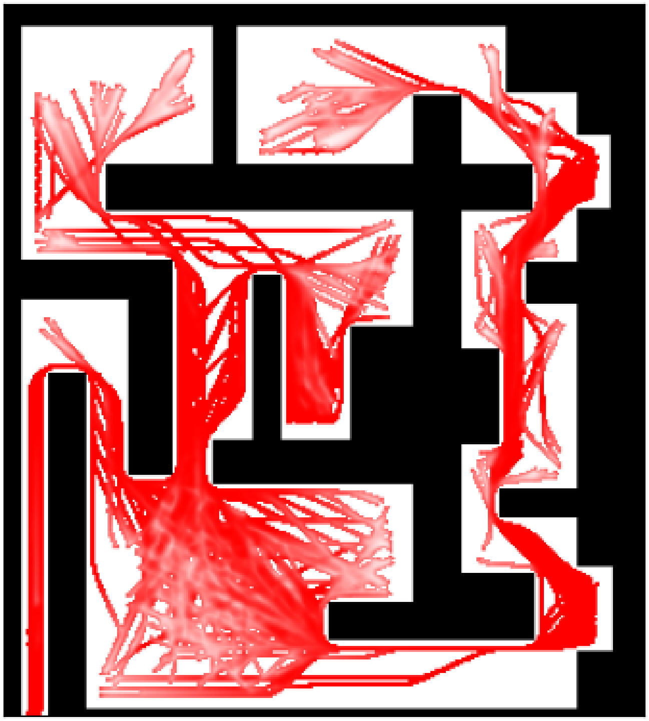


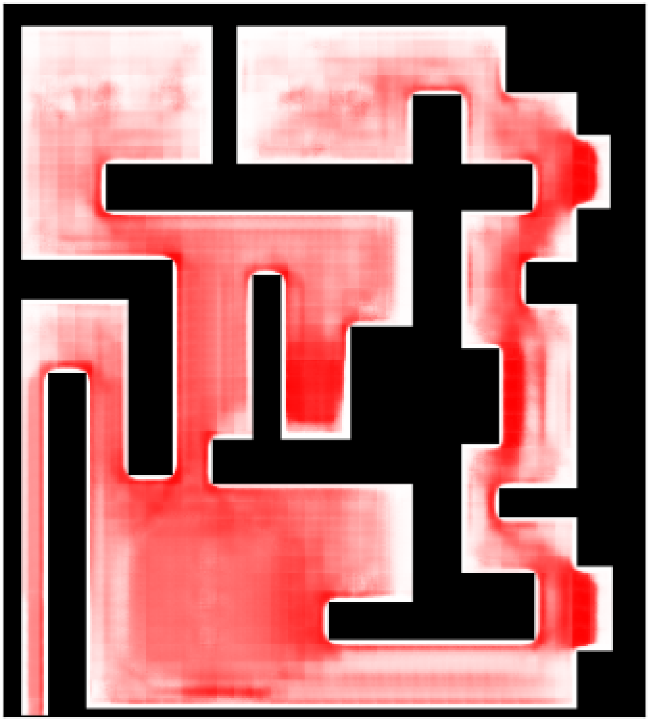
```
KL-divergence: 0.27918779747193534
willow
['cash', 'entrance', 'light', 'sit', 'stairs', 'trash', 'tree', 'restricted',
'grass']
```



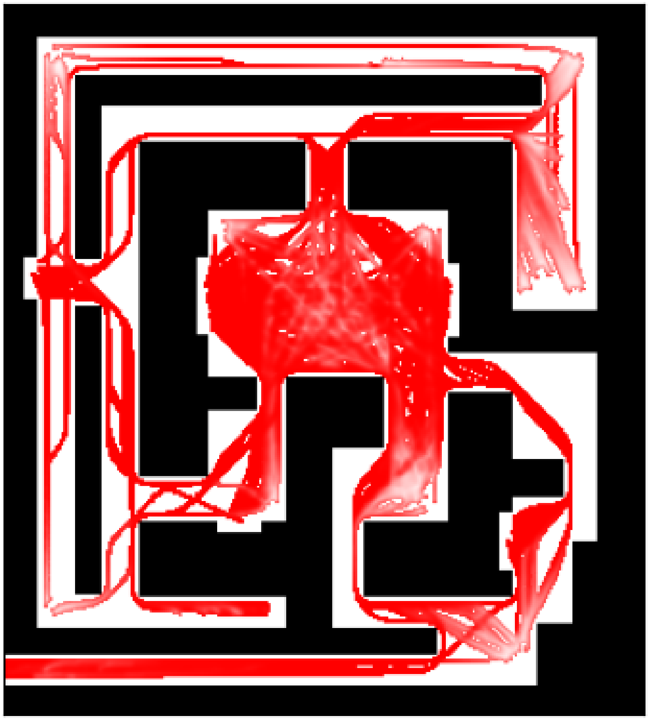


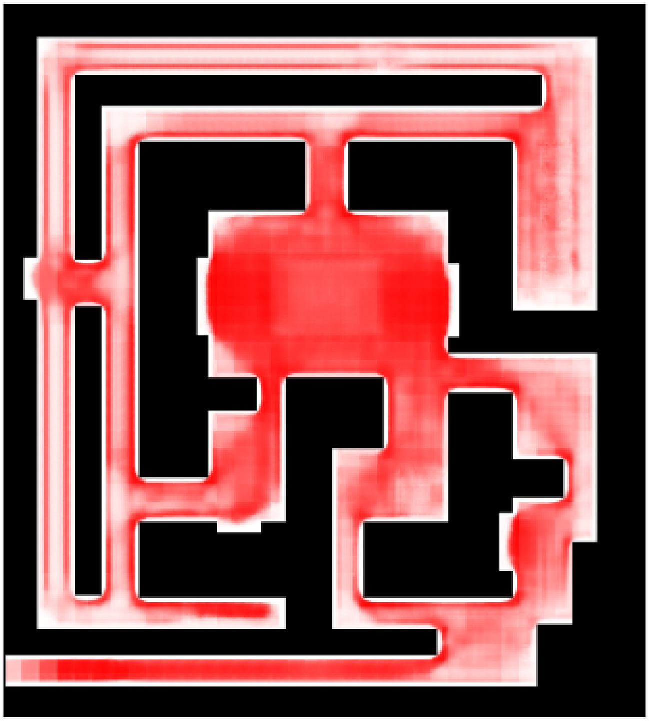
```
KL-divergence: 0.49494258495459004
map1
['cash', 'entrance', 'light', 'sit', 'stairs', 'trash', 'tree', 'restricted',
'grass']
```



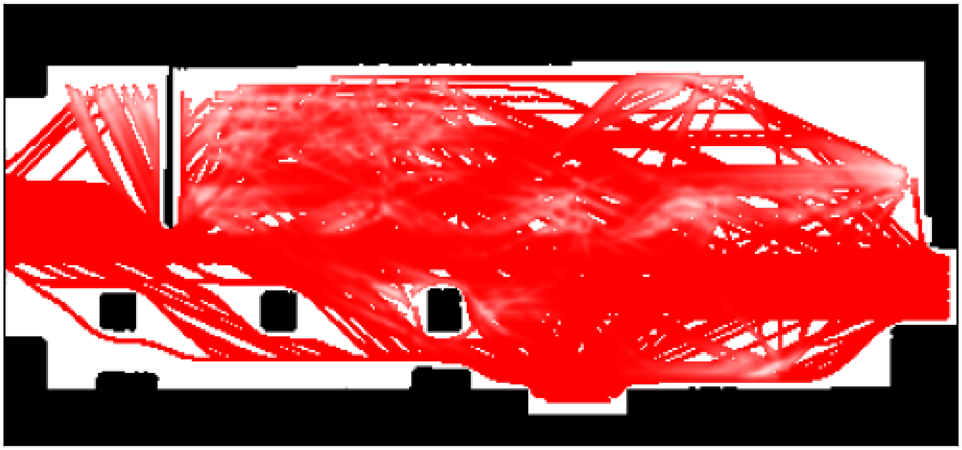


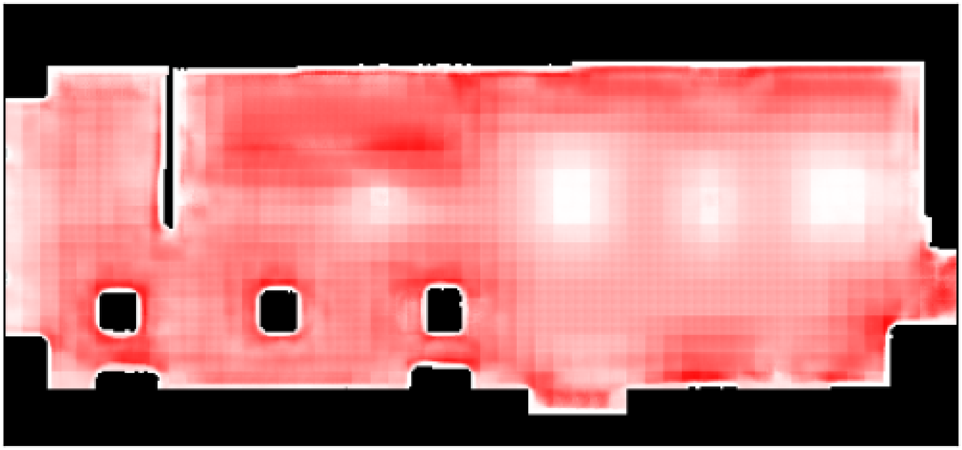
```
KL-divergence: 0.5794509703310574
map2
['cash', 'entrance', 'light', 'sit', 'stairs', 'trash', 'tree', 'restricted',
'grass']
```



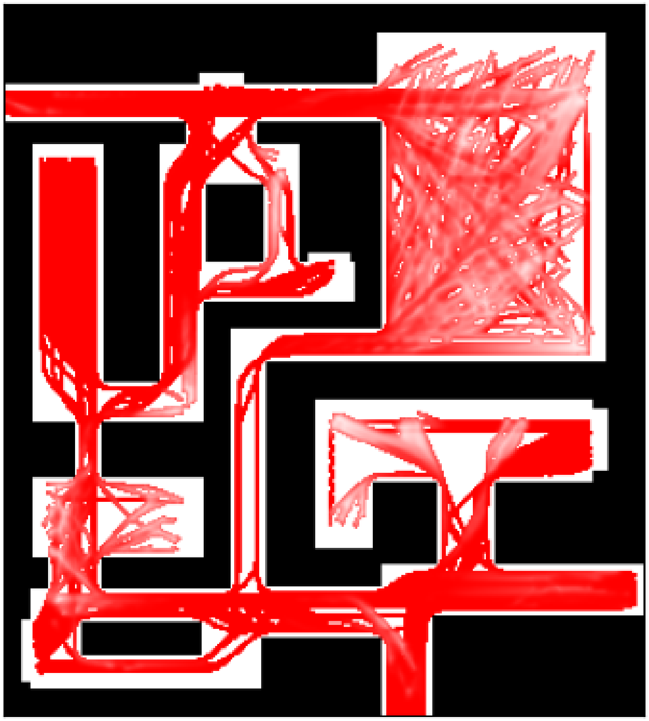


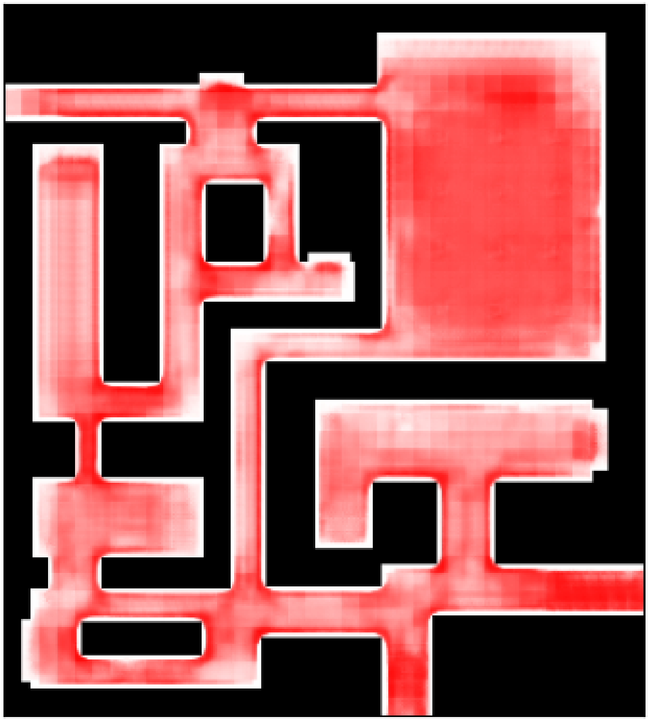
```
KL-divergence: 0.44982344886467934
costacafe
['cash', 'entrance', 'light', 'sit', 'stairs', 'trash', 'tree', 'restricted',
'grass']
```





```
KL-divergence: 0.663286119300496
map3
['cash', 'entrance', 'light', 'sit', 'stairs', 'trash', 'tree', 'restricted',
'grass']
```





```
KL-divergence: 0.533502267674805
Mean KL-divergence: 1.0117518199930715
```

2.4 Model 3 testing

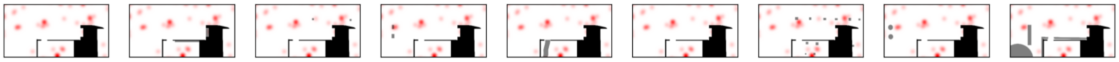
[ ]:

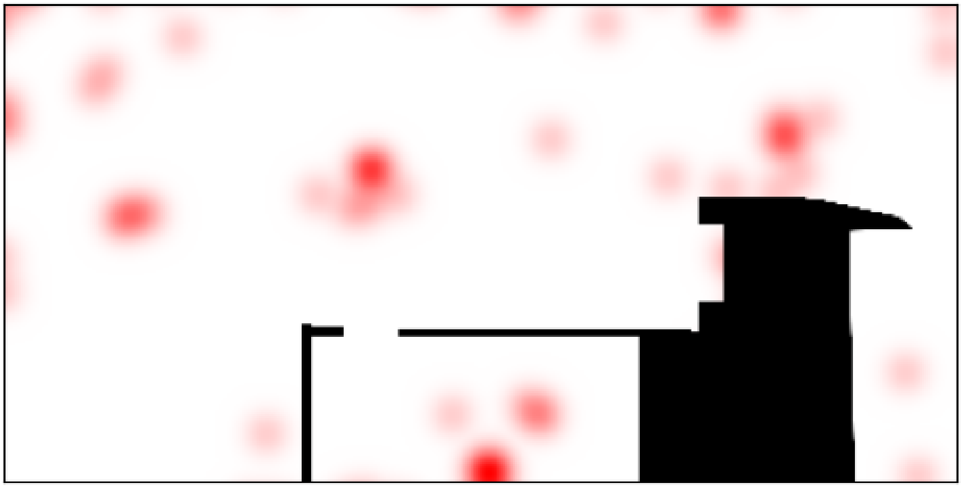
```
kl1 = []

for map_count, map_name in enumerate(map_list):
  print(map_name)

  lines = 0
  with open('maps/semantics/'+map_name+'/'+map_name+'.csv') as f:
    lines = f.readlines()

  h = len(lines)
  w = len(lines[0].split(','))

  # Converts data to a list of integers
  map = []
  for line in lines:
    map.extend([int(c) for c in line.split(',')])

  for lab_class in sem_dict:
    lines = 0
    try:
      with open('maps/semantics/'+map_name+'/'+map_name+'_sem_'+lab_class+'.
↪csv') as f:
        lines = f.readlines()

      hh = len(lines)
      ww = len(lines[0].split(','))

      if hh != h or ww != w:
        print(f'h: {h}\tw: {w}')
        print(f'h: {hh}\tw: {ww}')
        raise SystemExit("ERROR: Different sizes!!")

      # Converts data to a list of integers
      for line in lines:
        map.extend([int(c) for c in line.split(',')])

    except FileNotFoundError:
      for i in range(h):
        for j in range(w):
          map.extend([255])

  map = np.reshape(map,[chans,h,w])
  map = np.moveaxis(map, 0, -1)
  map = map/255

  map_aux = map
  map = np.zeros((int(math.ceil(h/red[map_count])),int(math.ceil(w/
 ↪red[map_count])),chans))

  for idx in range(chans):
    map[:,:,idx] = skimage.measure.block_reduce(map_aux[:,:,idx],␣
 ↪(red[map_count],red[map_count]), np.max)
  h, w, _ = map.shape

  diff_h = int((h-div*int(h/div))/2)
  r_h = int((h-div*int(h/div))%2) + diff_h
  diff_w = int((w-div*int(w/div))/2)
  r_w = int((w-div*int(w/div))%2) + diff_w
  map = map[r_h:-diff_h:,r_w+diff_w:,:]

  # print(map.shape)
  h, w, _ = map.shape

#␣
 ↪-----------------------------------------------------------------------------------
  lines = 0
  with open('maps/semantics/'+map_name+'/humandensity-'+map_name+'-stop.csv')␣
 ↪as f:
    lines = f.readlines()

  hd = len(lines)
  wd = len(lines[0].split(','))

  # Converts data to a list of integers
  data = []
  for line in lines:
    data.extend([float(c) for c in line.split(',')])

  data = np.reshape(data,[hd,wd])
  sigma = 4.0
  data = skimage.filters.gaussian(data, sigma=(sigma, sigma), channel_axis=-1)
  data = skimage.measure.block_reduce(data, (red[map_count],red[map_count]), np.
 ↪max)
  data = data[r_h:-diff_h,r_w+diff_w:]
  data = np.subtract(data, np.full((h, w), np.min(data)))/(np.max(data)-np.
 ↪min(data))

  # print(data.shape)
```

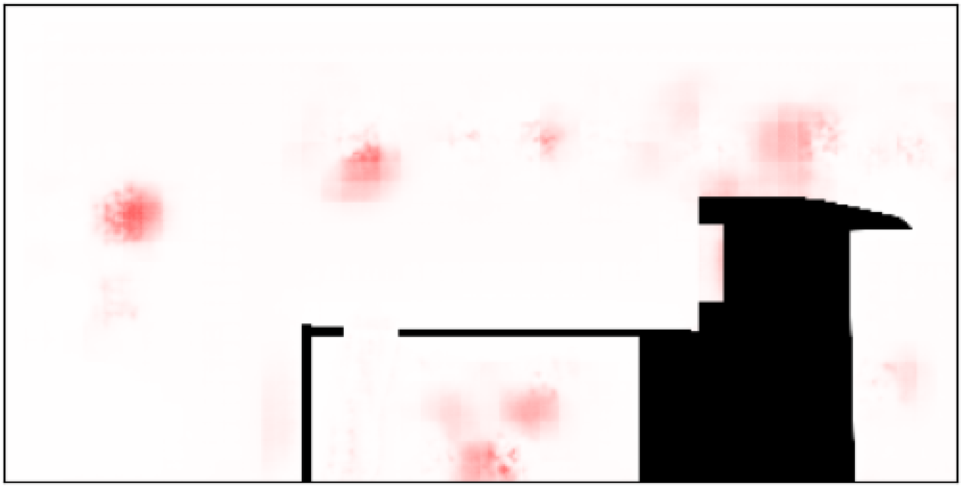
```
hd, wd = data.shape

print(sem_dict)
plt.figure(figsize=(20,5))
for i in range(len(sem_dict)):
  i = i+1
  ax = plt.subplot(1, len(sem_dict), i)
  alp = 0.5
  ax.imshow(np.multiply(np.stack((map[:,:,0],map[:,:,0],map[:,:
↪,0]),axis=2),np.multiply(np.stack((map[:,:,i],map[:,:,i],map[:,:
↪,i]),axis=2)*alp+(1-alp), np.stack((np.full(data.
↪shape,1),1-data,1-data),axis=2))), vmin=0, vmax=1)
  ax.get_xaxis().set_visible(False)
  ax.get_yaxis().set_visible(False)
plt.show()

ax = plt.subplot(111)
ax.imshow(np.multiply(np.stack((map[:,:,0],map[:,:,0],map[:,:,0]),axis=2), np.
↪stack((np.full(data.shape,1),1-data,1-data),axis=2)), vmin=0, vmax=1)
ax.get_xaxis().set_visible(False)
ax.get_yaxis().set_visible(False)
plt.show()

#␣
↪-----------------------------------------------------------------------------------
# creating subplot and figure
ax = plt.subplot(111)
data_pred = np.zeros((int(math.ceil(h)),int(math.ceil(w))))

step = int(32/4)
for i in np.arange((w/step+int(div/step-1))*(h/step+int(div/step-1))):
  c = int(i%(w/step+int(div/step-1))) - int(div/step-1)*0
  r = int(i/(w/step+int(div/step-1))) - int(div/step-1)*0
  submap = map[max(step*r,0):step*r+div, max(step*c,0):step*c+div,:]
  subdata = model2.predict(np.expand_dims(submap,axis=0),verbose=0)[:,:,:,0]
  subdata = np.squeeze(subdata,axis=0)
  data_pred[max(step*r,0):step*r+div, max(step*c,0):step*c+div] += subdata*1/
↪(int(div/step)*int(div/step))
plt.imshow(np.multiply(np.stack((map[:,:,0],map[:,:,0],map[:,:,0]),axis=2),␣
↪np.stack((np.full(data_pred.shape,1),1-(data_pred),1-(data_pred)),axis=2)),␣
↪vmin=0, vmax=1)
ax.get_xaxis().set_visible(False)
ax.get_yaxis().set_visible(False)
plt.show()

data = data/sum(sum(data))
data_pred = data_pred/sum(sum(data_pred))
```

```
  kl = 0
  for i in range(data.shape[0]):
      for j in range(data.shape[1]):
          if data[i,j] > 0 and data_pred[i,j] > 0:
              kl = kl + data[i,j]*math.log2(data[i,j]/data_pred[i,j])
  print(f'KL-divergence: {kl}')
  kl1 = np.append(kl1,kl)


print(f'Mean KL-divergence: {np.mean(kl1)}')
```

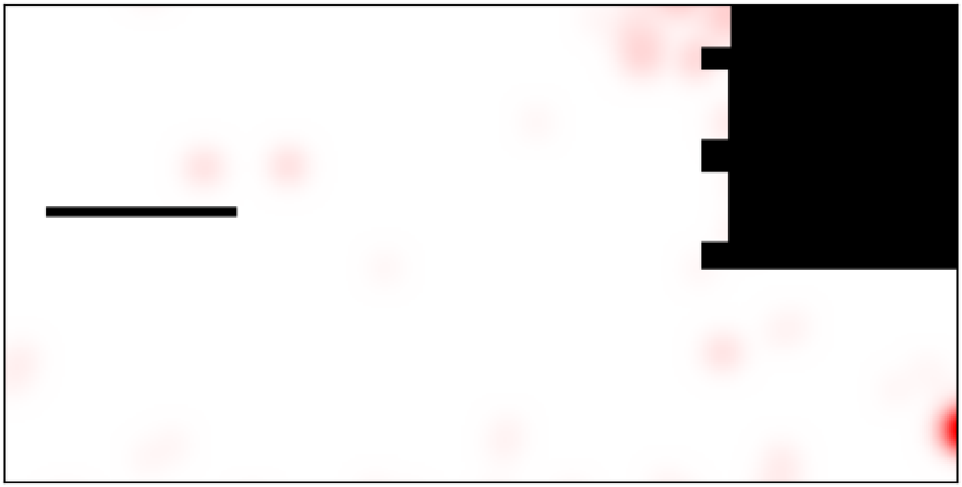
```
stanford_coupa0
['cash', 'entrance', 'light', 'sit', 'stairs', 'trash', 'tree', 'restricted',
'grass']
```

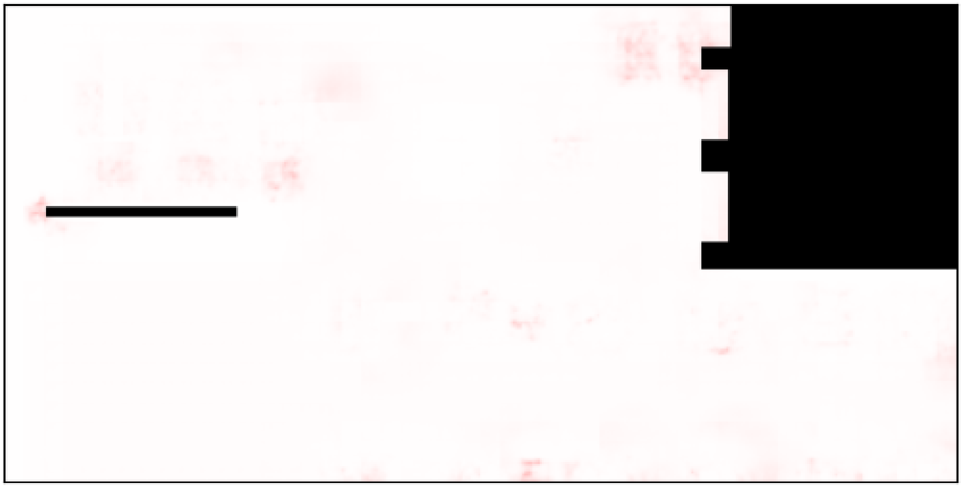




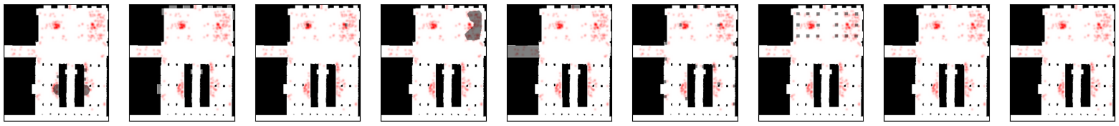


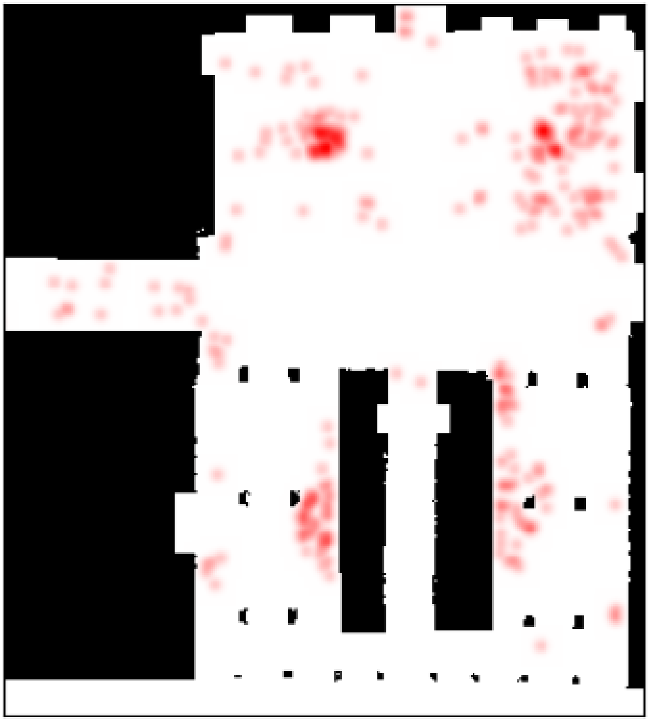
```
KL-divergence: 1.3712054547816144
stanford_coupa3
['cash', 'entrance', 'light', 'sit', 'stairs', 'trash', 'tree', 'restricted',
'grass']
```

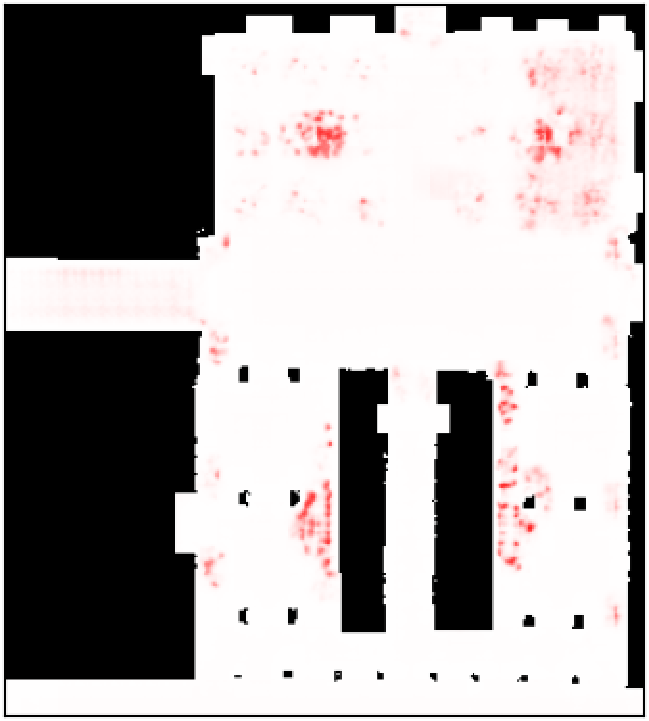




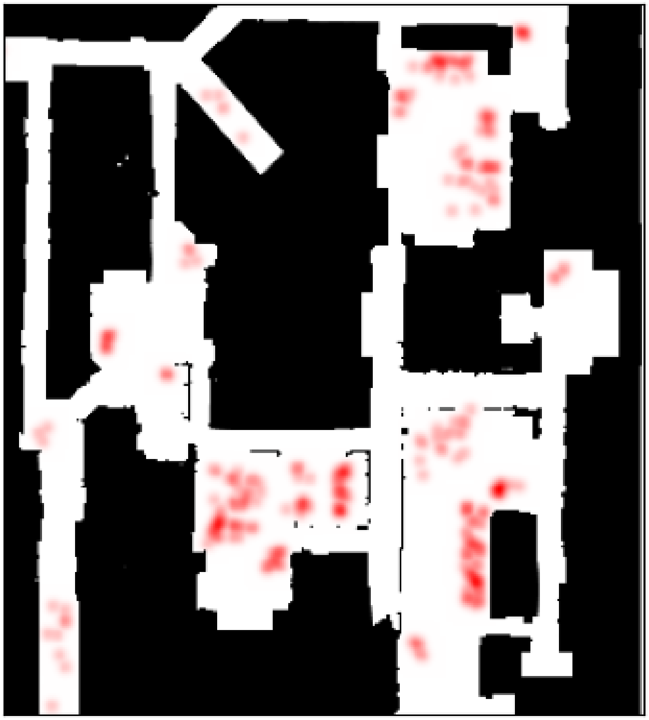
```
KL-divergence: 2.3830850581829344
master_big
['cash', 'entrance', 'light', 'sit', 'stairs', 'trash', 'tree', 'restricted',
'grass']
```

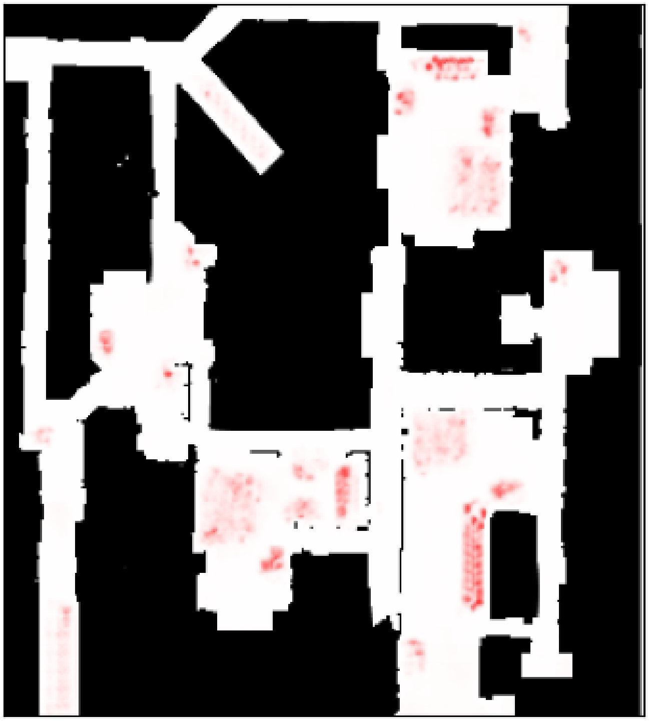




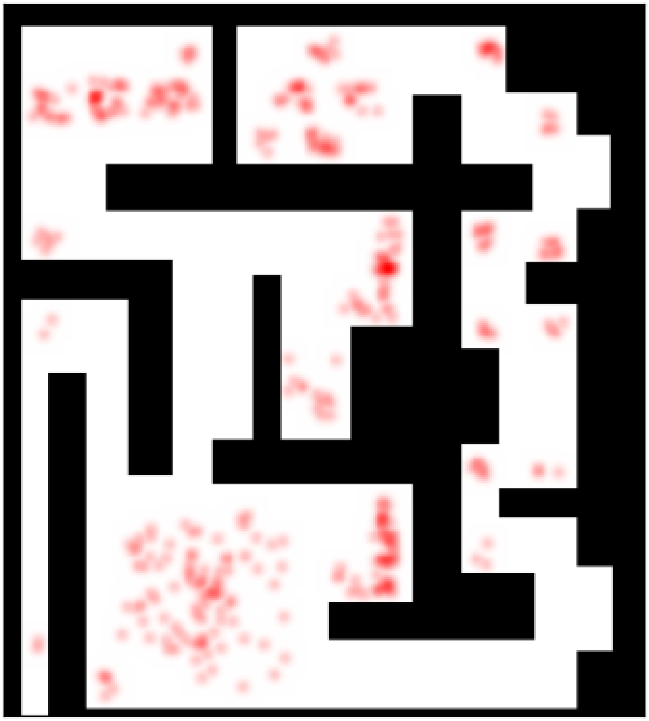


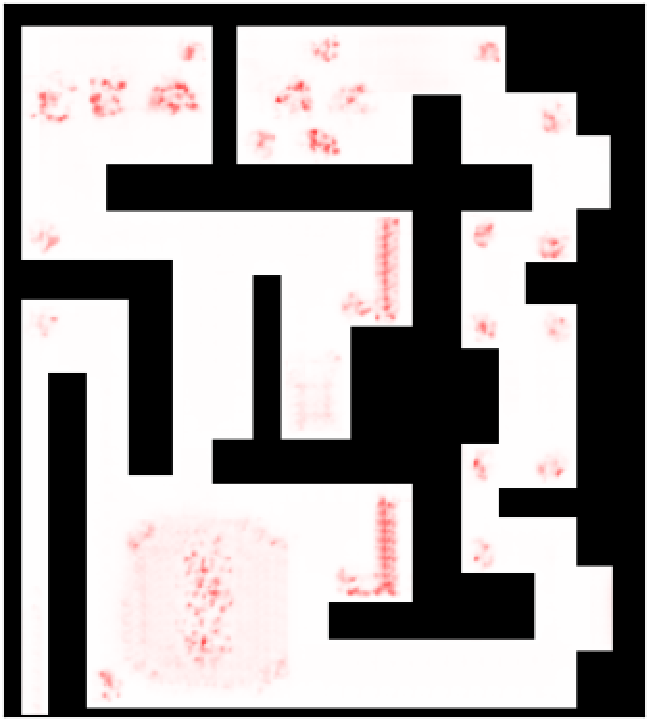
```
KL-divergence: 1.134208908828949
willow
['cash', 'entrance', 'light', 'sit', 'stairs', 'trash', 'tree', 'restricted',
'grass']
```



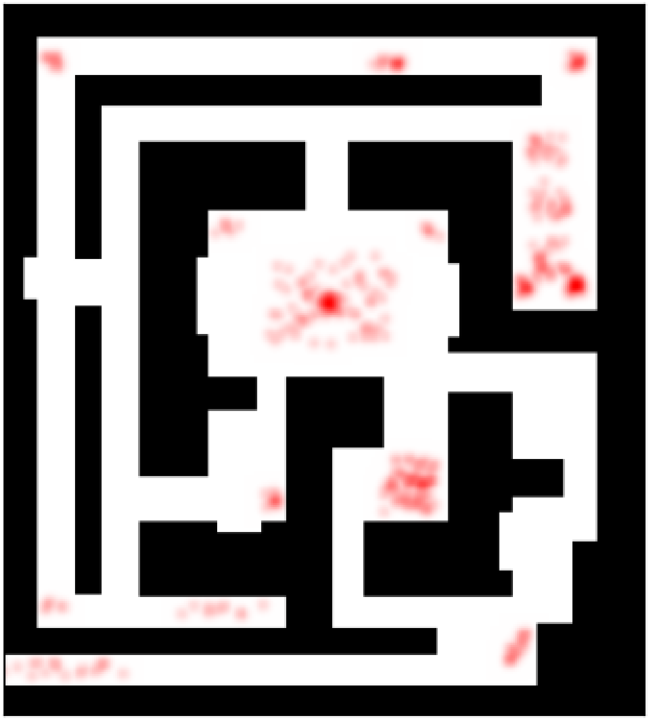


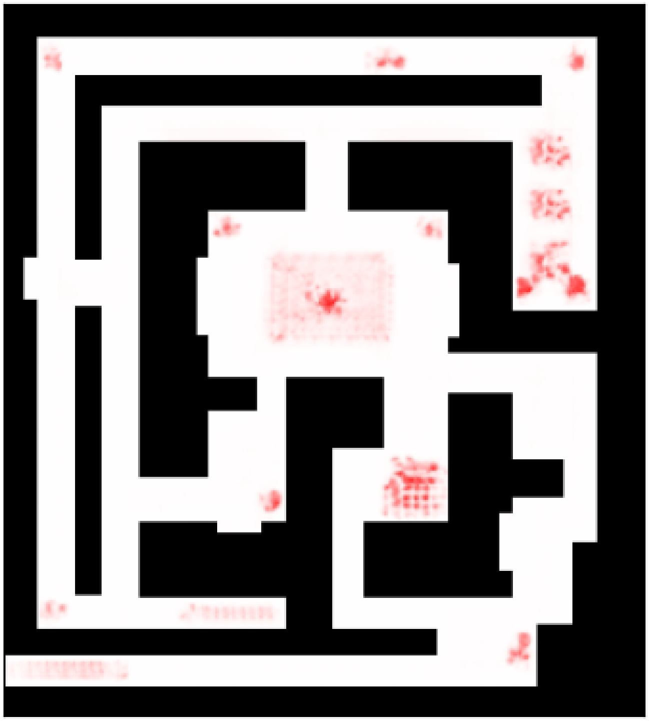
```
KL-divergence: 1.1991076217695174
map1
['cash', 'entrance', 'light', 'sit', 'stairs', 'trash', 'tree', 'restricted',
'grass']
```



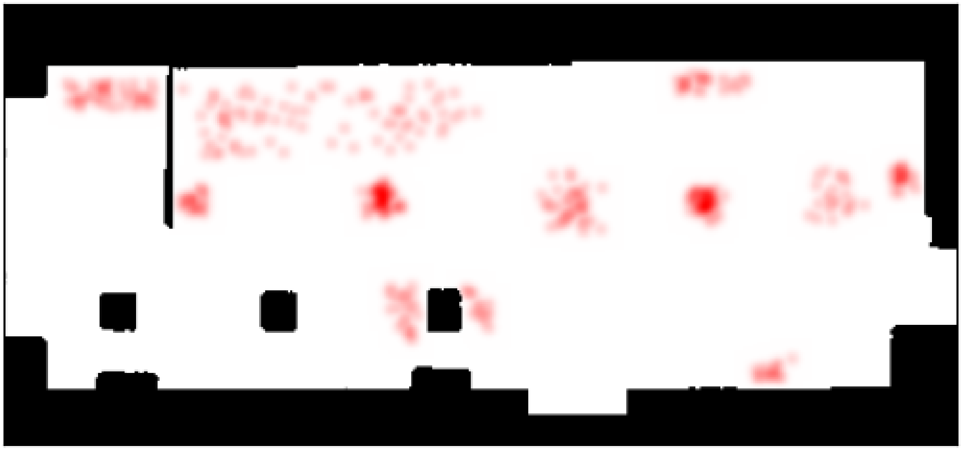


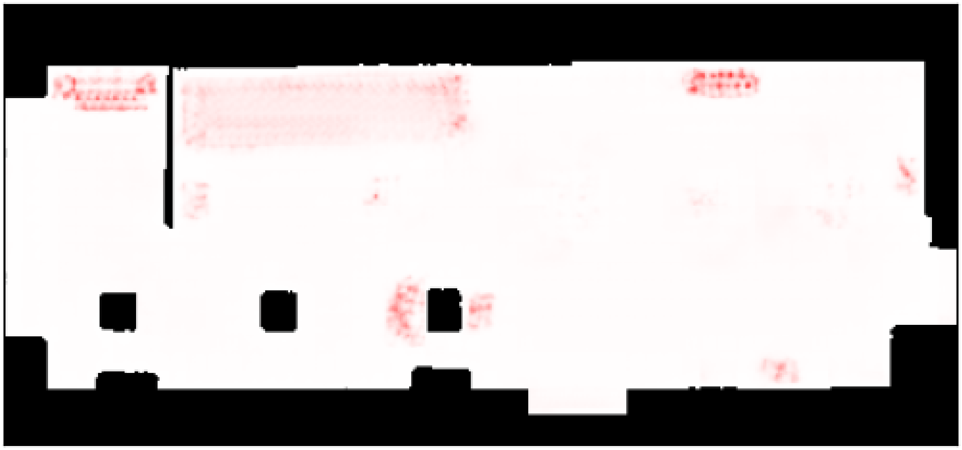
```
KL-divergence: 0.8687192116146883
map2
['cash', 'entrance', 'light', 'sit', 'stairs', 'trash', 'tree', 'restricted',
'grass']
```



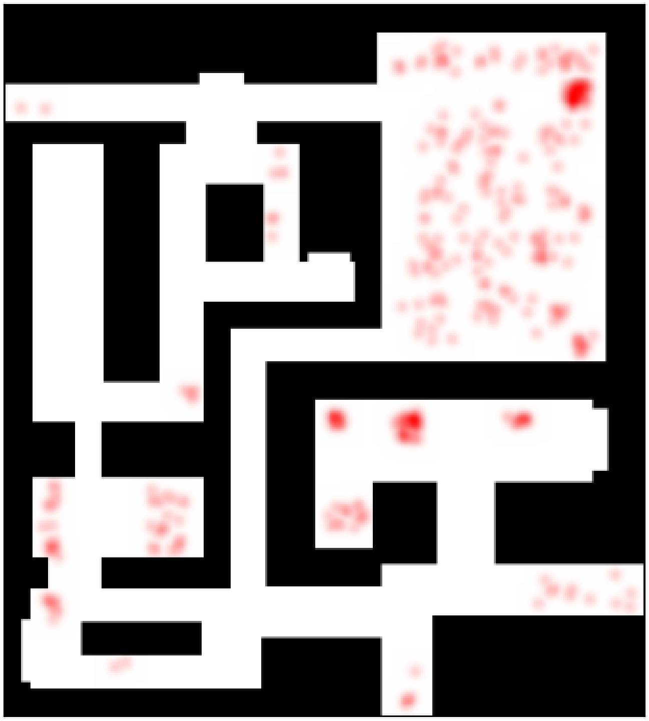


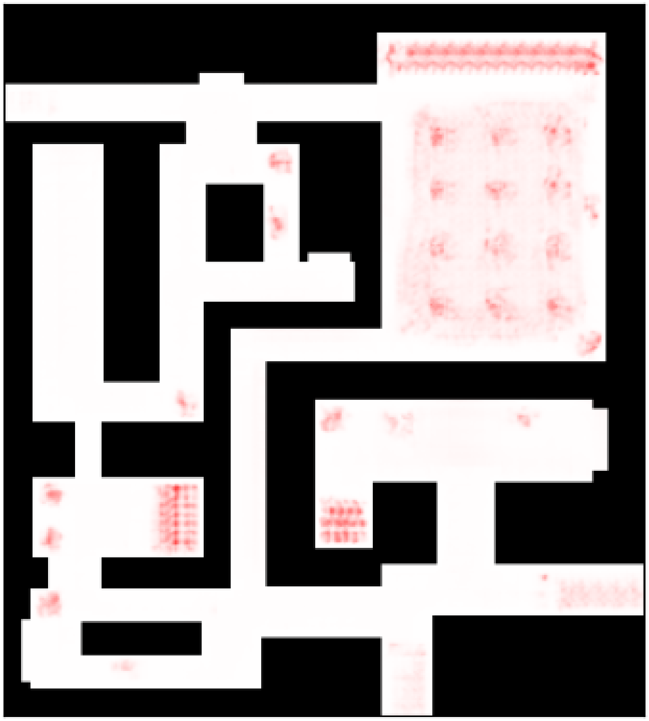
```
KL-divergence: 0.7269453355207015
costacafe
['cash', 'entrance', 'light', 'sit', 'stairs', 'trash', 'tree', 'restricted',
'grass']
```





```
KL-divergence: 2.1765574295630103
map3
['cash', 'entrance', 'light', 'sit', 'stairs', 'trash', 'tree', 'restricted',
'grass']
```





```
KL-divergence: 1.651367006616475
Mean KL-divergence: 1.4388995033597363
```