models_validation_stan_26_set

September 26, 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/25sep_8px_steps_stan_paths')

model1 = tf.keras.models.load_model('IRI_models/25sep_8px_steps_stan_vels')

model2 = tf.keras.models.load_model('IRI_models/25sep_8px_steps_stan_stops')
```

2 Variables definition

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

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)
```

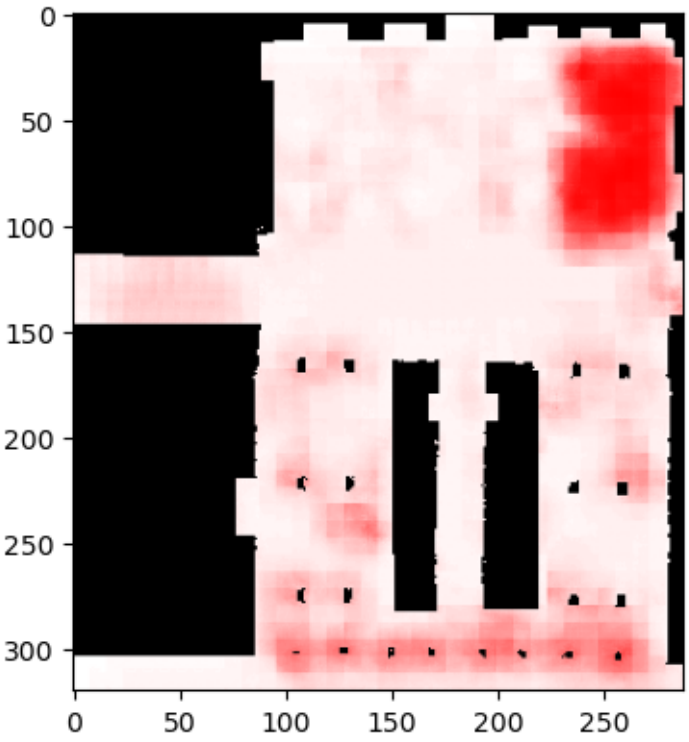
2.1 Testing closed corridors (completely or partially closed)

```
[ ]: 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!!")
```

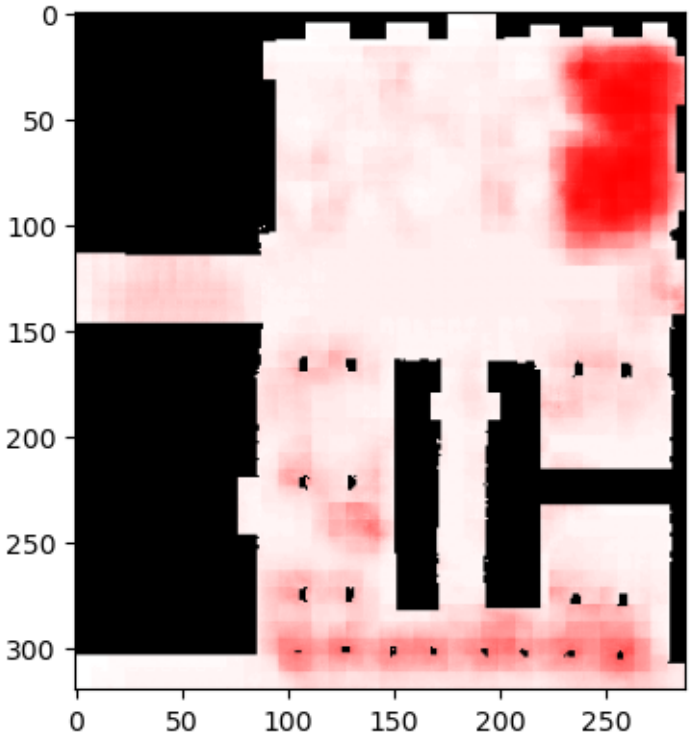
```
    # Converts data to a list of integers
    for line in lines:
      map.extend([int(c) for c in line.split(',')])

  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()
```

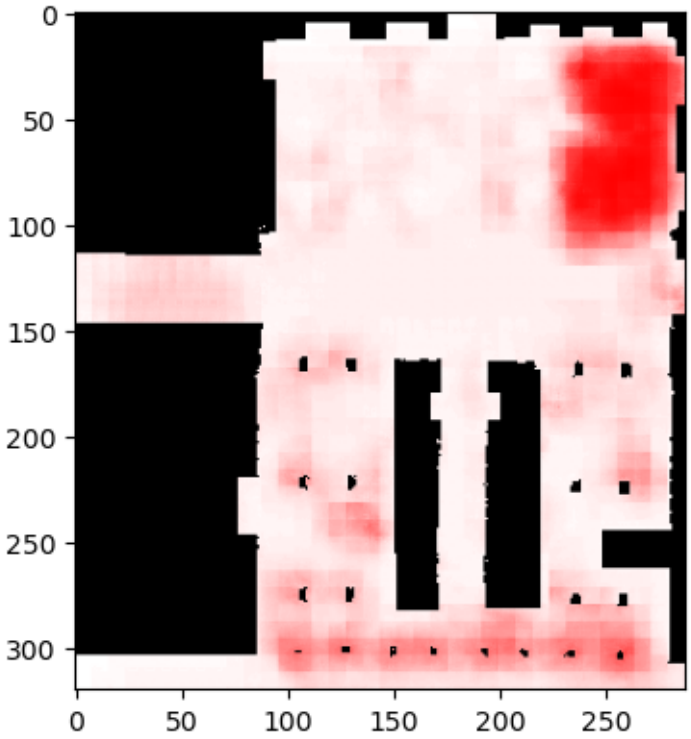
master_big



master_big_closed



master_big_semiclosed



2.2 Model 1 testing

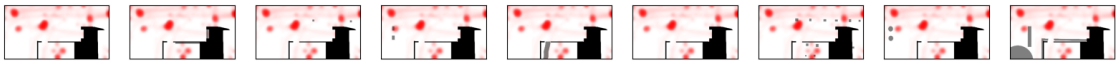
[ ]:
```
map_list = ['stanford_coupa0',␣
 ↪'stanford_coupa3','stanford_hyang1','stanford_hyang10','stanford_gates2','master_big','will
kl1 = []

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])
```

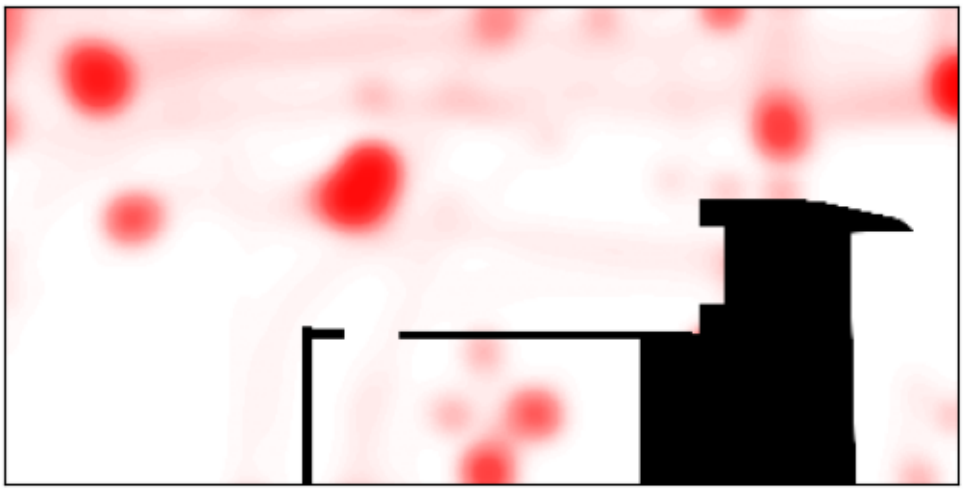
```
  map = np.reshape(map,[chans,h,w])
  map = np.moveaxis(map, 0, -1)
  map = map/255

  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:]
```

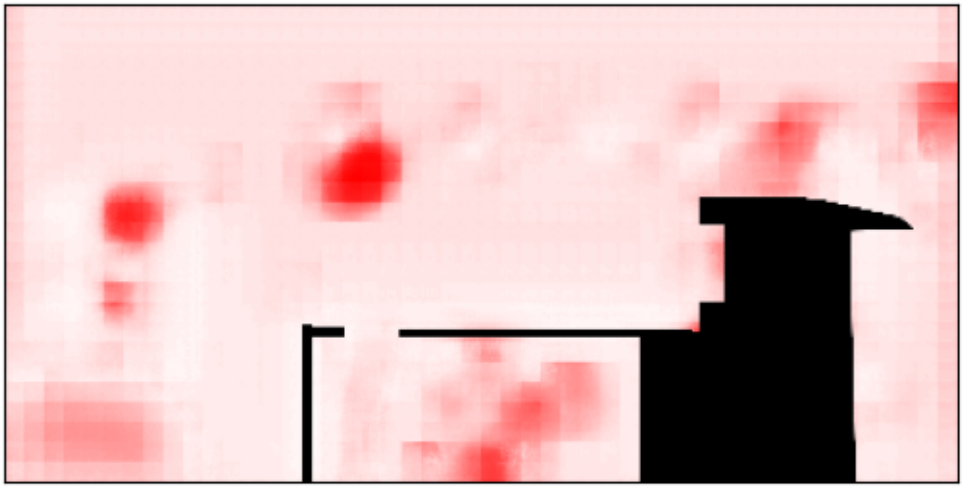
```
data = np.subtract(data, np.full((h, w), np.min(data)))/(np.max(data)-np.
↪min(data))

# 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)}')
```

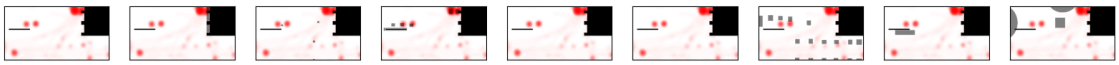
```
stanford_coupa0
['cash', 'entrance', 'light', 'sit', 'stairs', 'trash', 'tree', 'restricted',
'grass']
```

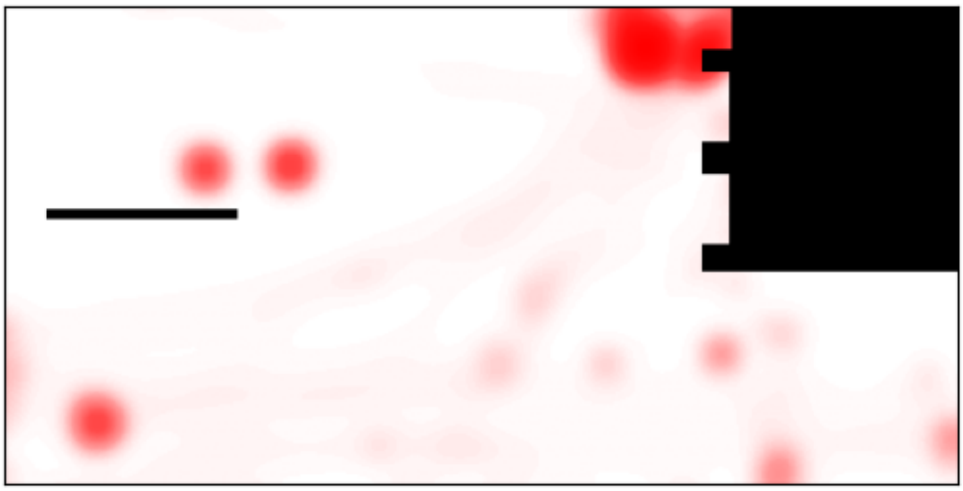


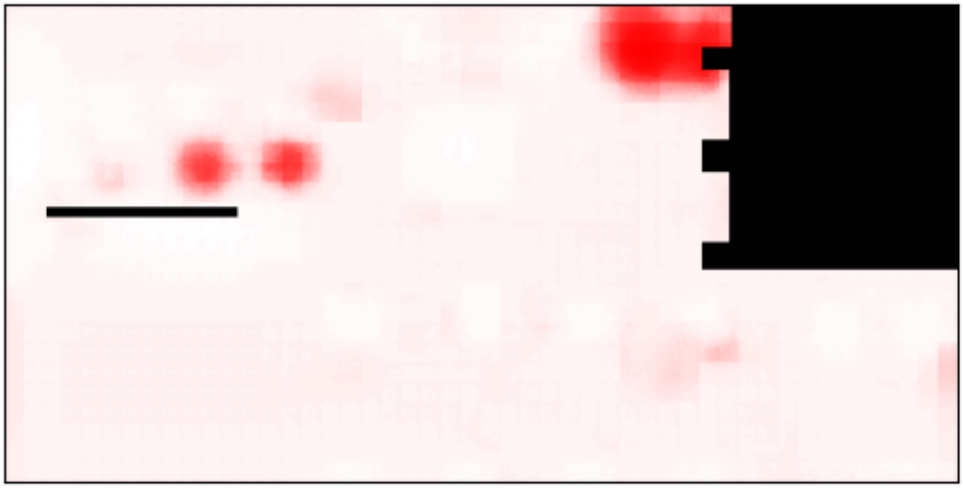




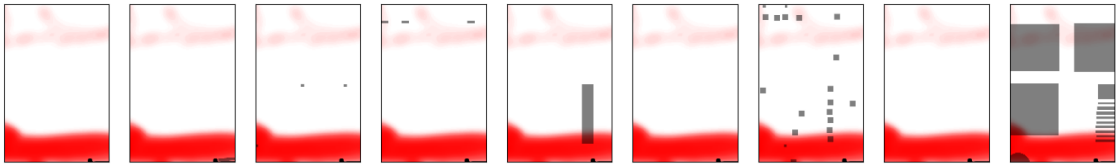
KL-divergence: 1.072607924268056
stanford_coupa3
['cash', 'entrance', 'light', 'sit', 'stairs', 'trash', 'tree', 'restricted', 'grass']

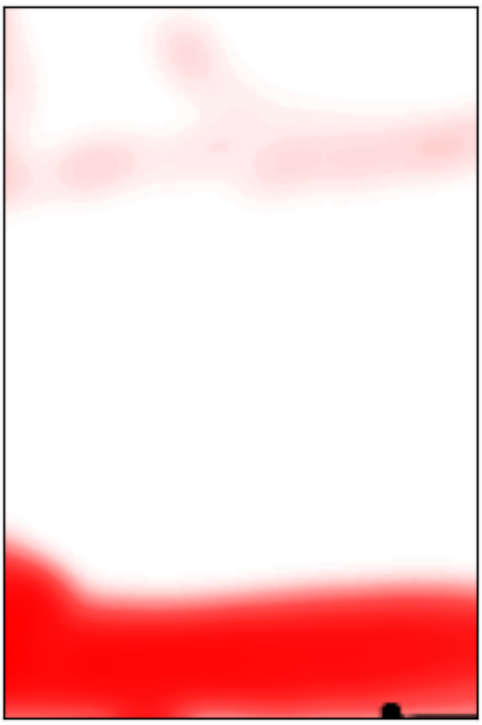


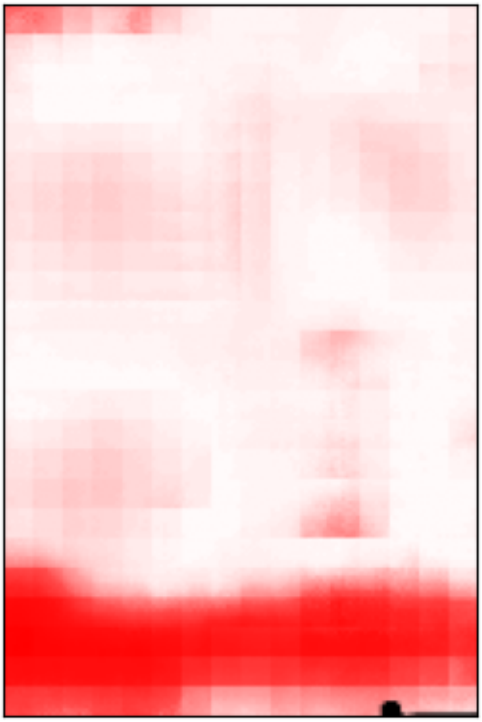




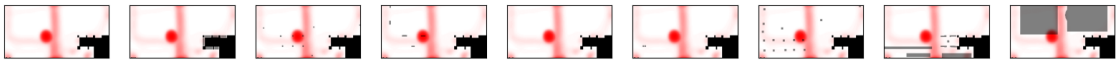
KL-divergence: 0.6876122646587225
stanford_hyang1
['cash', 'entrance', 'light', 'sit', 'stairs', 'trash', 'tree', 'restricted', 'grass']

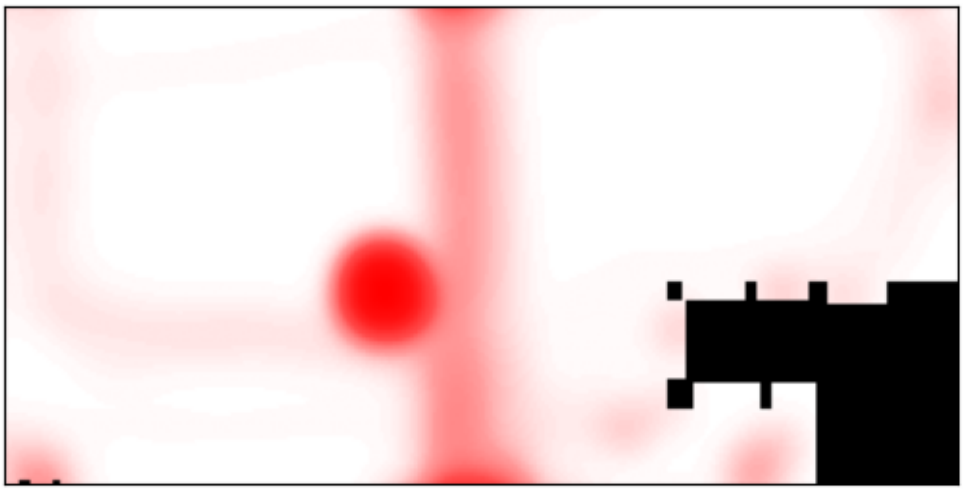


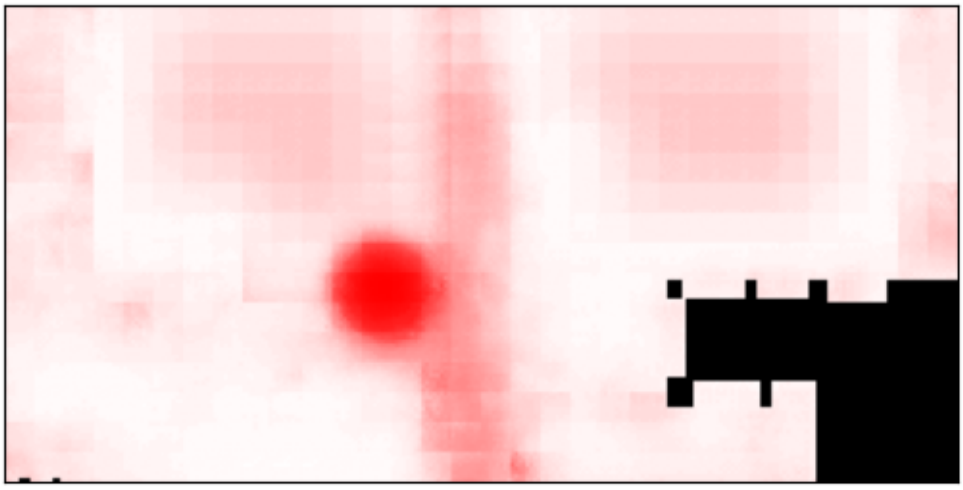




KL-divergence: 0.3142602086815893
stanford_hyang10
['cash', 'entrance', 'light', 'sit', 'stairs', 'trash', 'tree', 'restricted',
'grass']

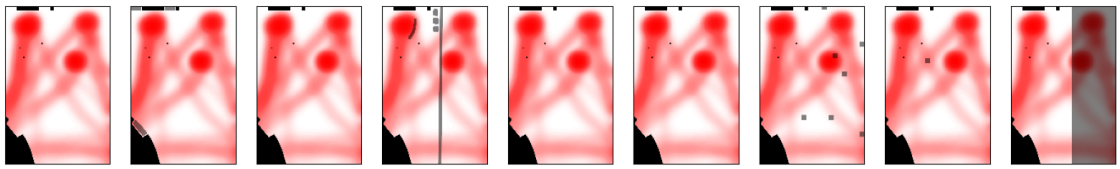


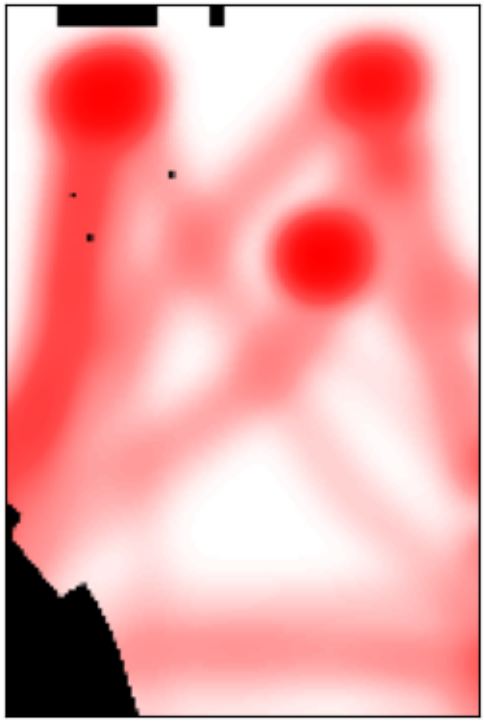


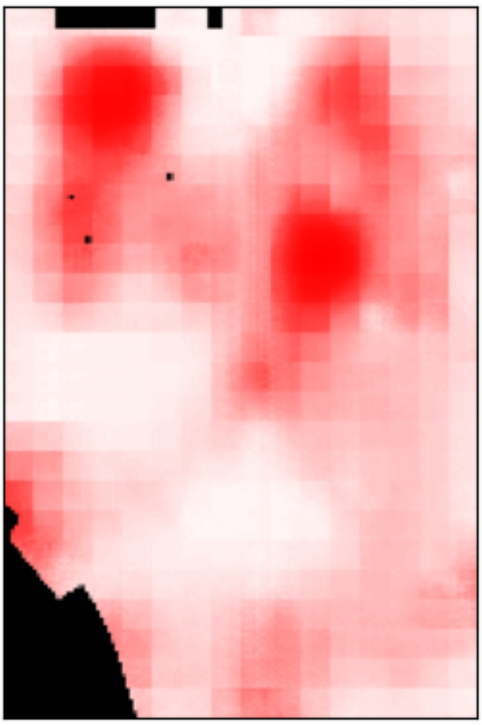


KL-divergence: 0.6305918706263673
stanford_gates2
['cash', 'entrance', 'light', 'sit', 'stairs', 'trash', 'tree', 'restricted',

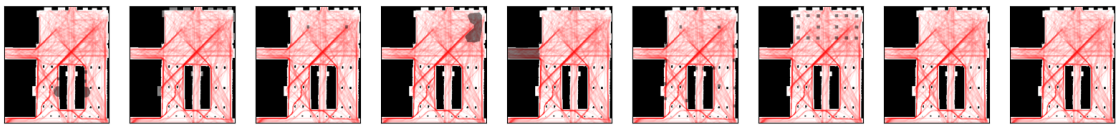
'grass']

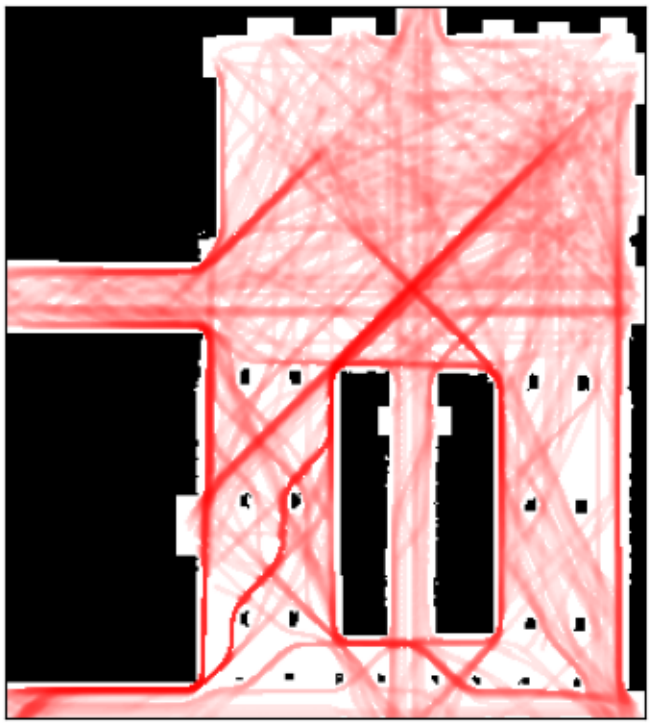




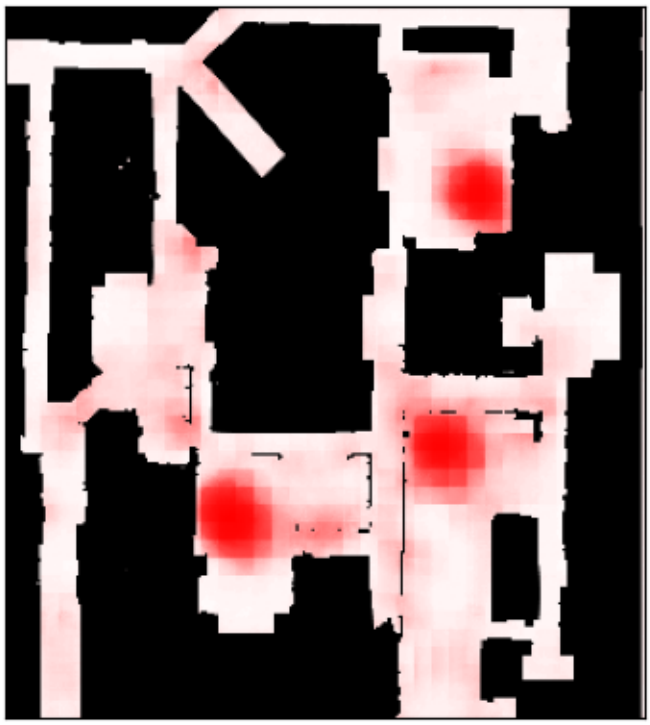


KL-divergence: 0.3944154993758236
master_big
['cash', 'entrance', 'light', 'sit', 'stairs', 'trash', 'tree', 'restricted', 'grass']

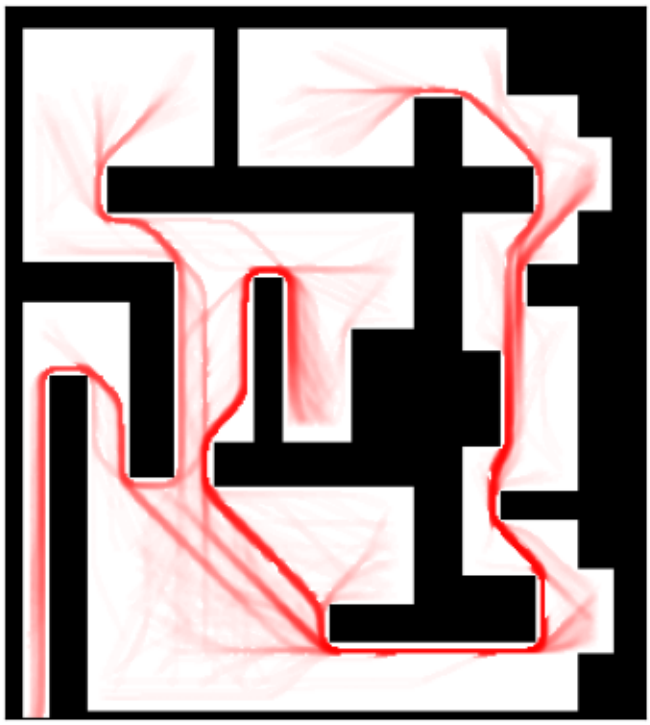


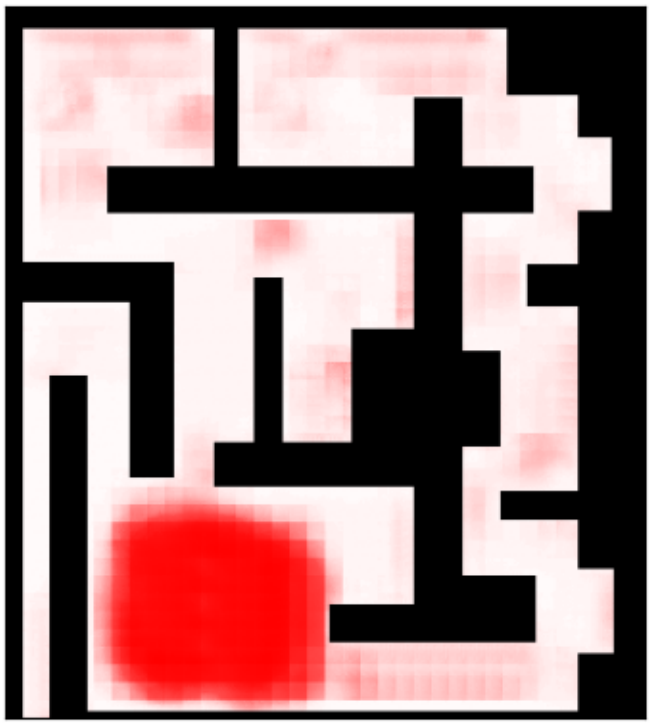


KL-divergence: 2.4771091311325493
willow
['cash', 'entrance', 'light', 'sit', 'stairs', 'trash', 'tree', 'restricted', 'grass']

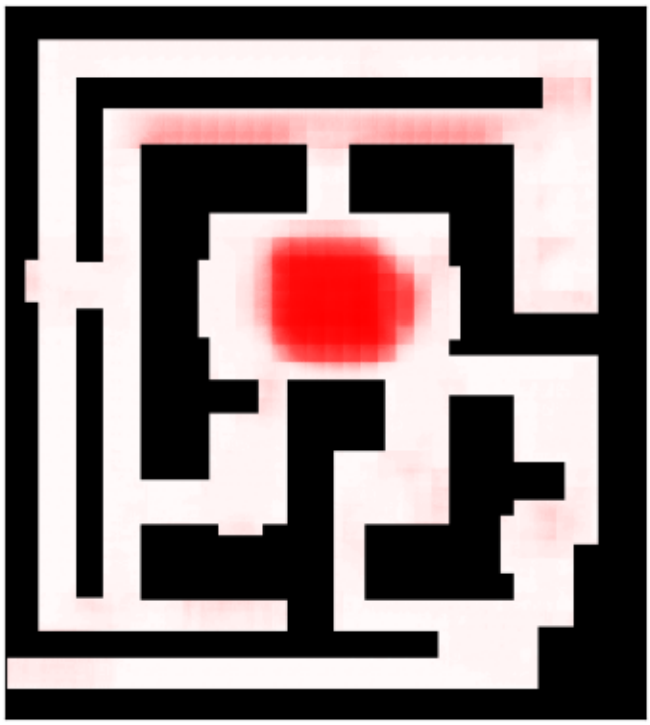


```
KL-divergence: 3.9016317152212574
map1
['cash', 'entrance', 'light', 'sit', 'stairs', 'trash', 'tree', 'restricted',
'grass']
```

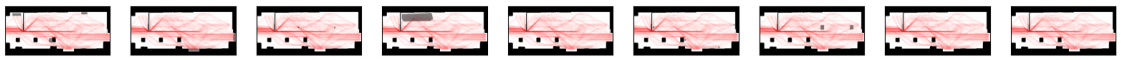


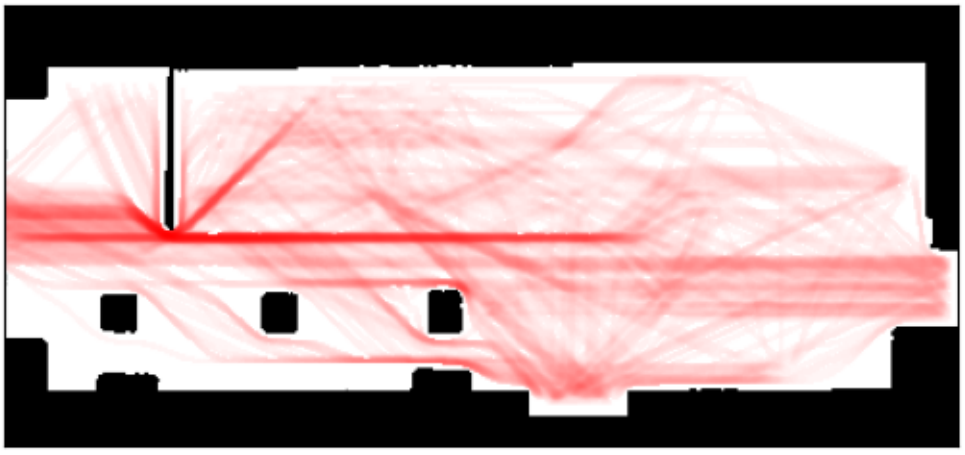


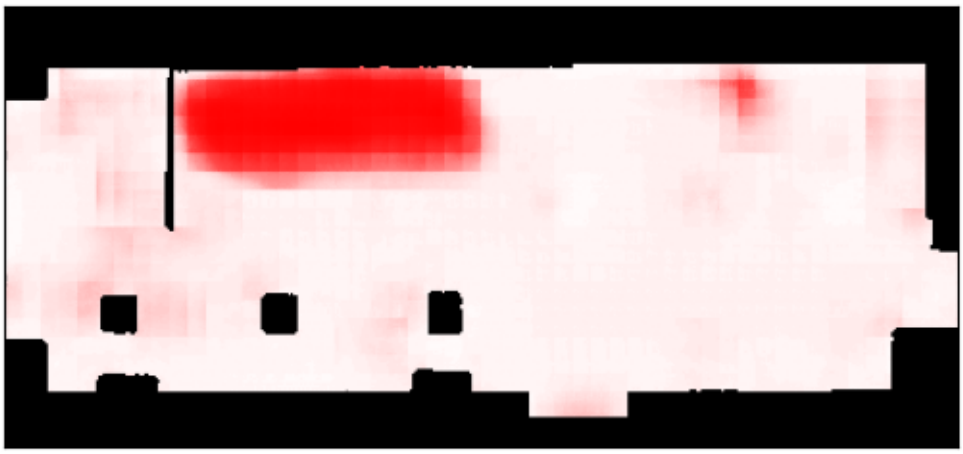
KL-divergence: 4.607696012938018
map2
['cash', 'entrance', 'light', 'sit', 'stairs', 'trash', 'tree', 'restricted', 'grass']



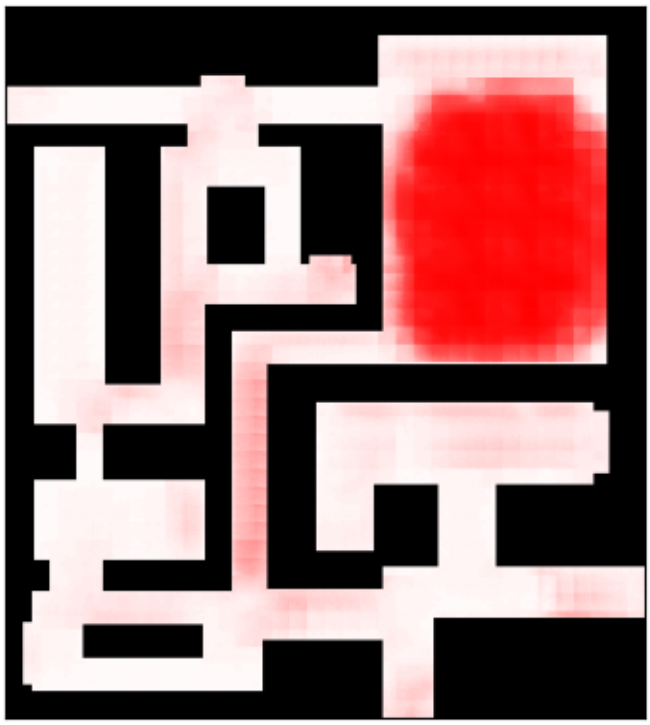
KL-divergence: 3.793548673088451
costacafe
['cash', 'entrance', 'light', 'sit', 'stairs', 'trash', 'tree', 'restricted', 'grass']







KL-divergence: 3.0831014254980444
map3
['cash', 'entrance', 'light', 'sit', 'stairs', 'trash', 'tree', 'restricted', 'grass']



```
KL-divergence: 4.1419191043526835
Mean KL-divergence: 2.2822267118037782
```

2.3 Model 2 testing

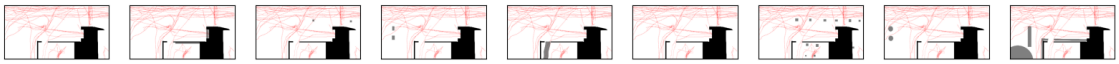
[ ]:
```python
kl1 = []

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])
```

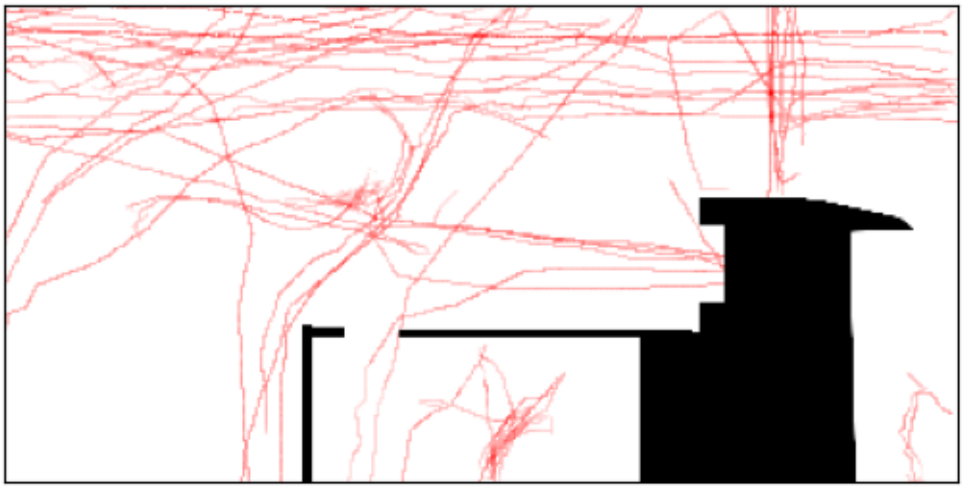
```
  map = np.moveaxis(map, 0, -1)
  map = map/255

  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))
```

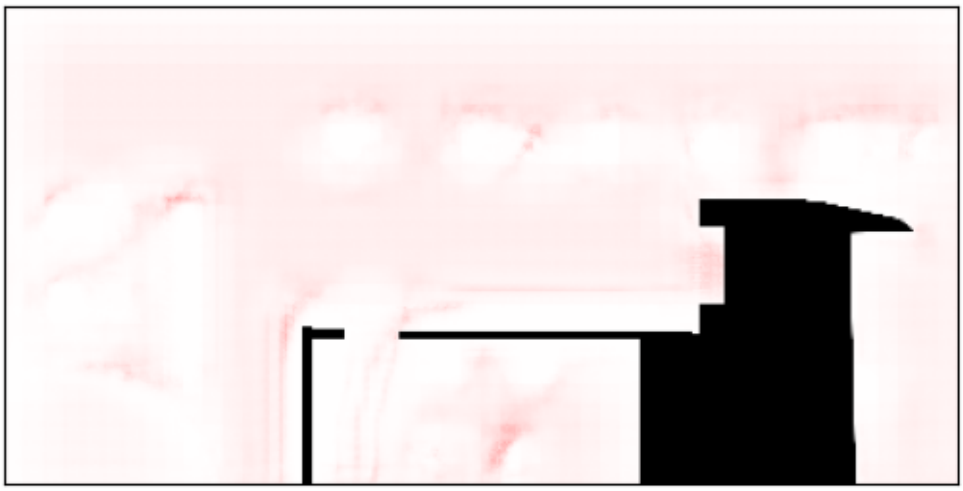
```
# print(data.shape)
hd, wd = data.shape

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)}')
```

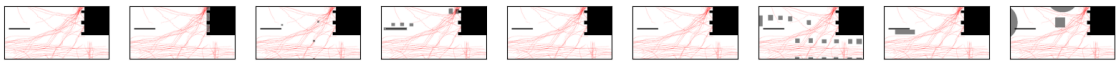
```
stanford_coupa0
['cash', 'entrance', 'light', 'sit', 'stairs', 'trash', 'tree', 'restricted',
'grass']
```

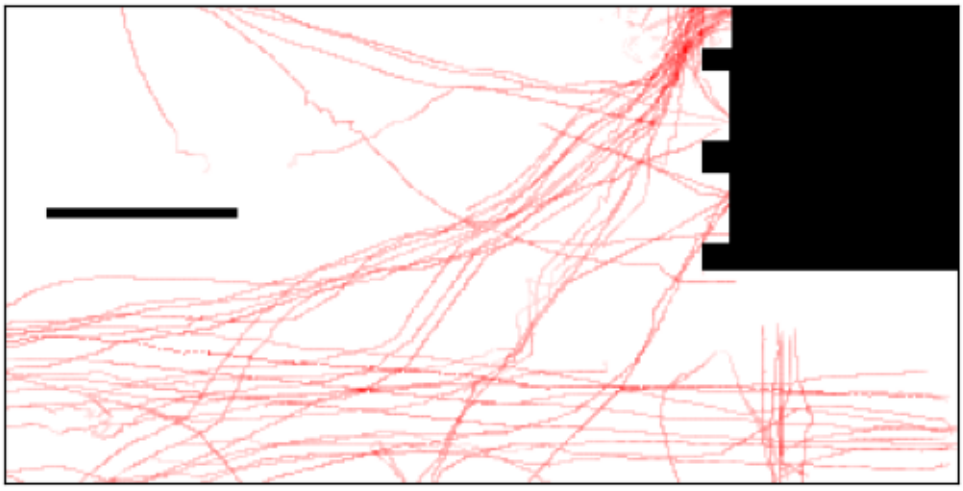




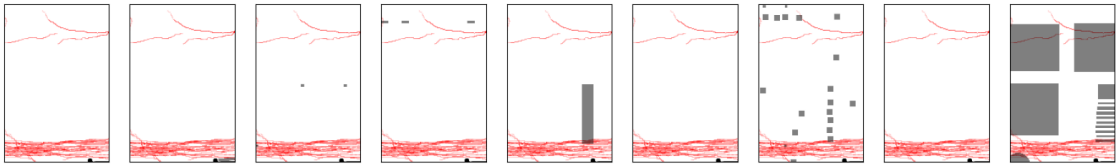


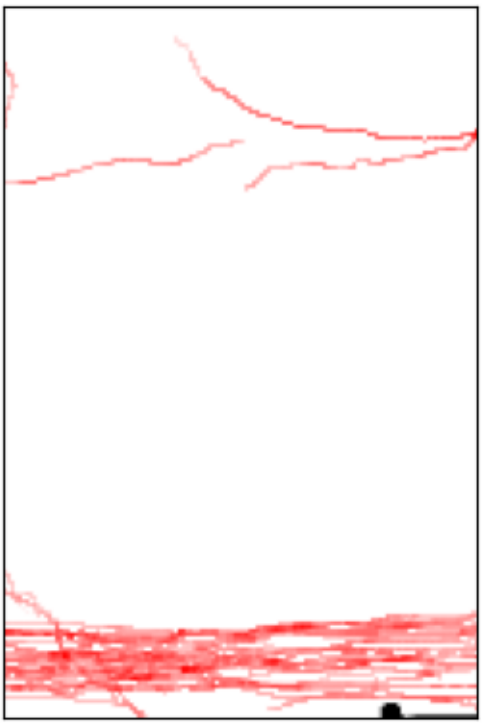
KL-divergence: 2.476740167134309
stanford_coupa3
['cash', 'entrance', 'light', 'sit', 'stairs', 'trash', 'tree', 'restricted', 'grass']



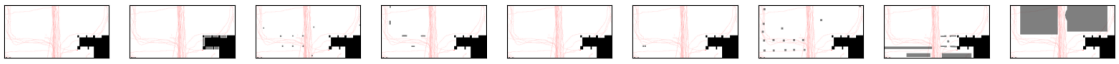


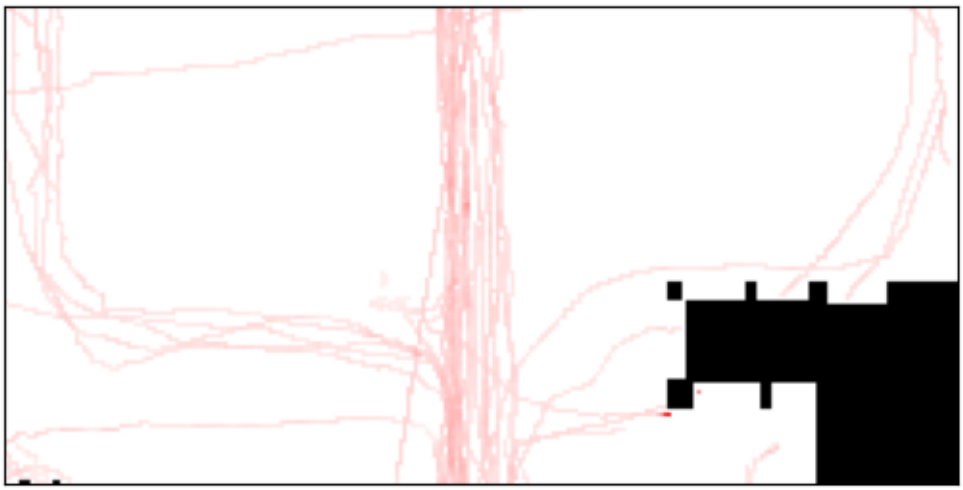
KL-divergence: 1.9079656248668833
stanford_hyang1
['cash', 'entrance', 'light', 'sit', 'stairs', 'trash', 'tree', 'restricted', 'grass']

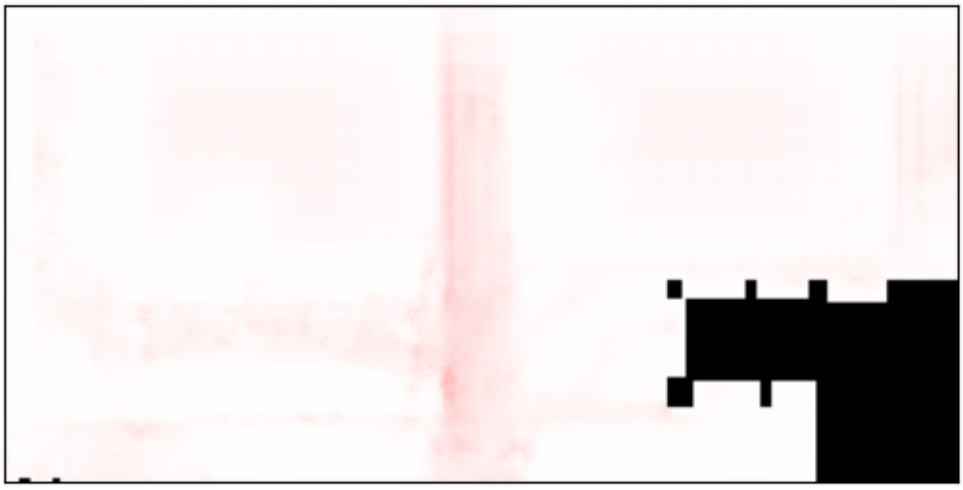




KL-divergence: 1.2730410124740728
stanford_hyang10
['cash', 'entrance', 'light', 'sit', 'stairs', 'trash', 'tree', 'restricted',
'grass']

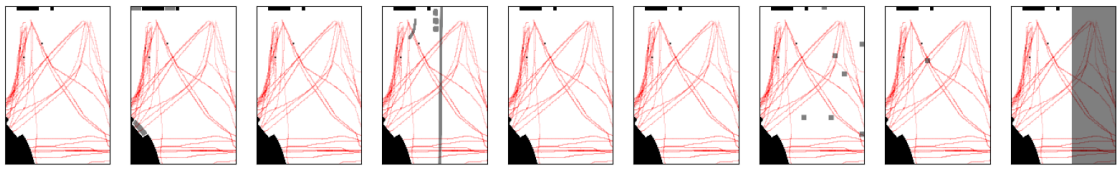


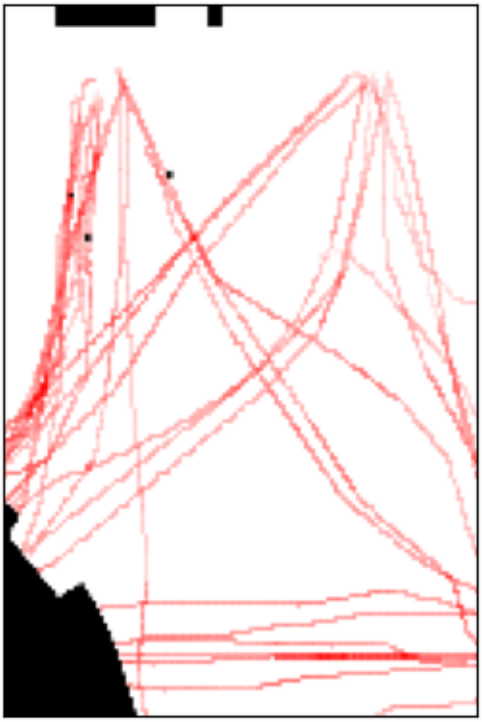


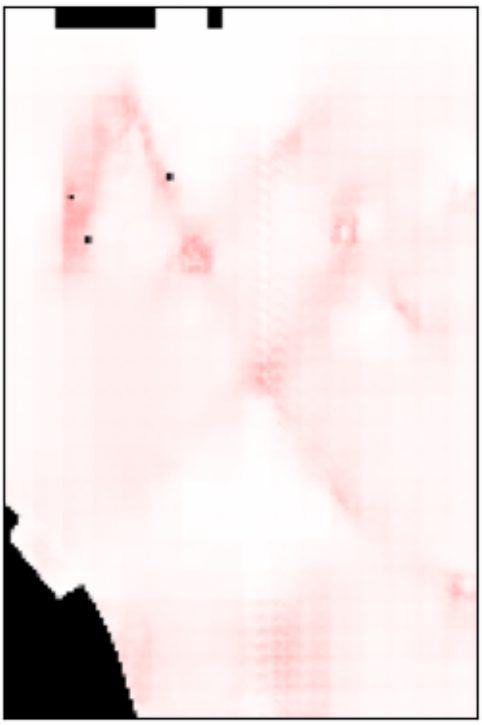


KL-divergence: 1.987841771873973
stanford_gates2
['cash', 'entrance', 'light', 'sit', 'stairs', 'trash', 'tree', 'restricted',

'grass']



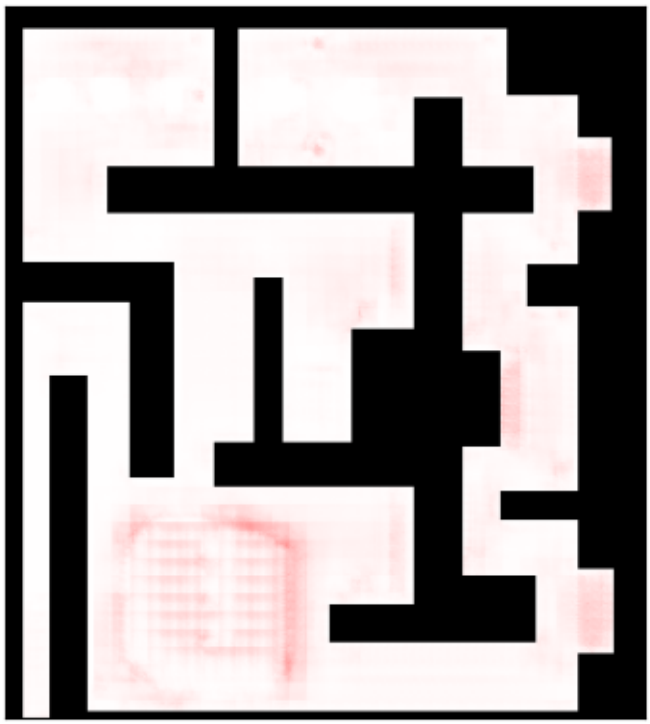




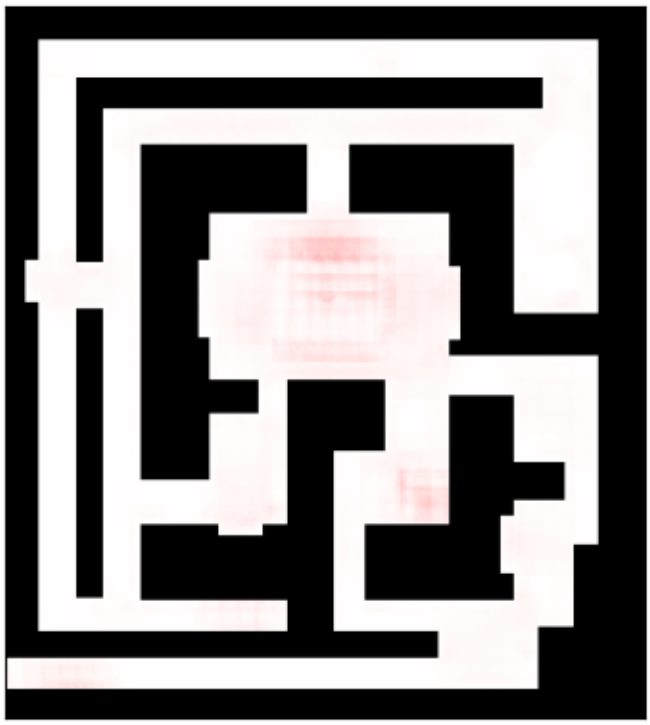
KL-divergence: 2.268049959084096
master_big
['cash', 'entrance', 'light', 'sit', 'stairs', 'trash', 'tree', 'restricted',
'grass']

```
KL-divergence: 1.09191902419697
willow
['cash', 'entrance', 'light', 'sit', 'stairs', 'trash', 'tree', 'restricted',
'grass']
```

```
KL-divergence: 2.599891336533849
map1
['cash', 'entrance', 'light', 'sit', 'stairs', 'trash', 'tree', 'restricted',
'grass']
```

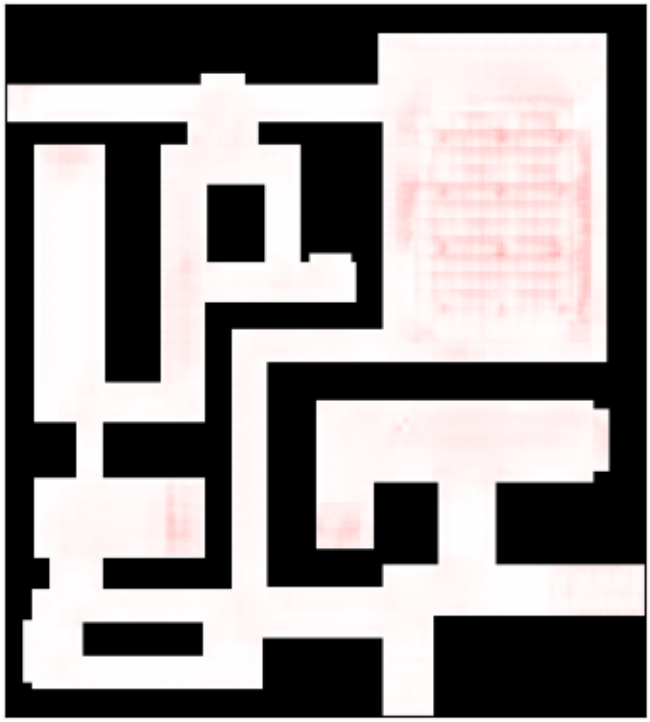


KL-divergence: 2.080882492731697
map2
['cash', 'entrance', 'light', 'sit', 'stairs', 'trash', 'tree', 'restricted', 'grass']



KL-divergence: 2.156038531696969
costacafe
['cash', 'entrance', 'light', 'sit', 'stairs', 'trash', 'tree', 'restricted', 'grass']

KL-divergence: 0.7125218827924448
map3
['cash', 'entrance', 'light', 'sit', 'stairs', 'trash', 'tree', 'restricted', 'grass']



```
KL-divergence: 1.8425647273922992
Mean KL-divergence: 1.8543142300706876
```

2.4 Model 3 testing

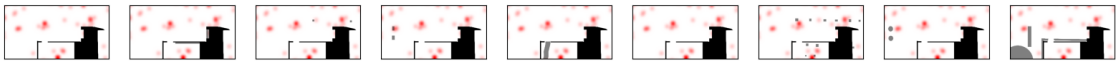
[ ]:
```
kl1 = []

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])
```

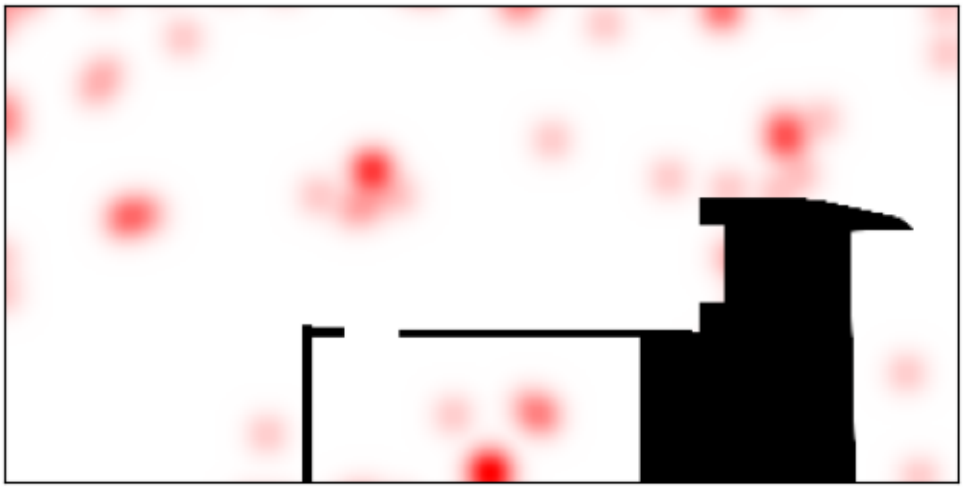
```
  map = np.moveaxis(map, 0, -1)
  map = map/255

  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)
```

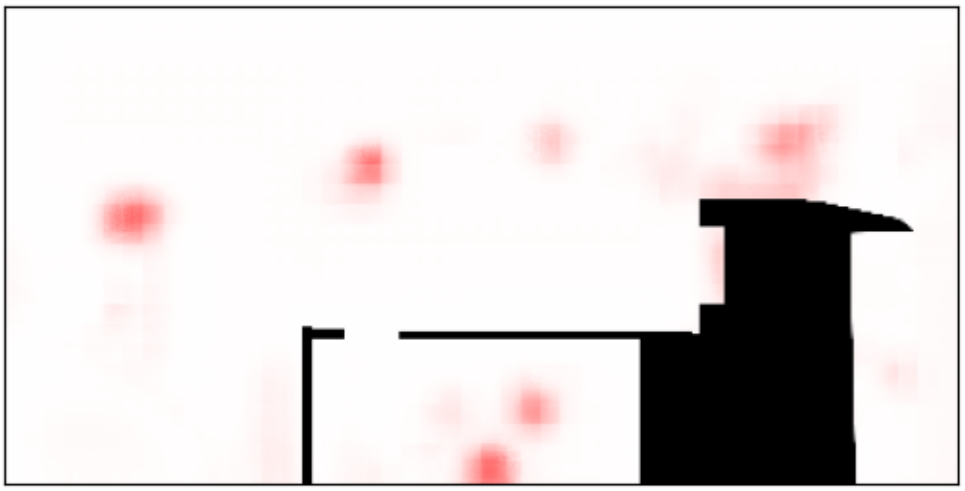
```
hd, wd = data.shape

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)}')
```

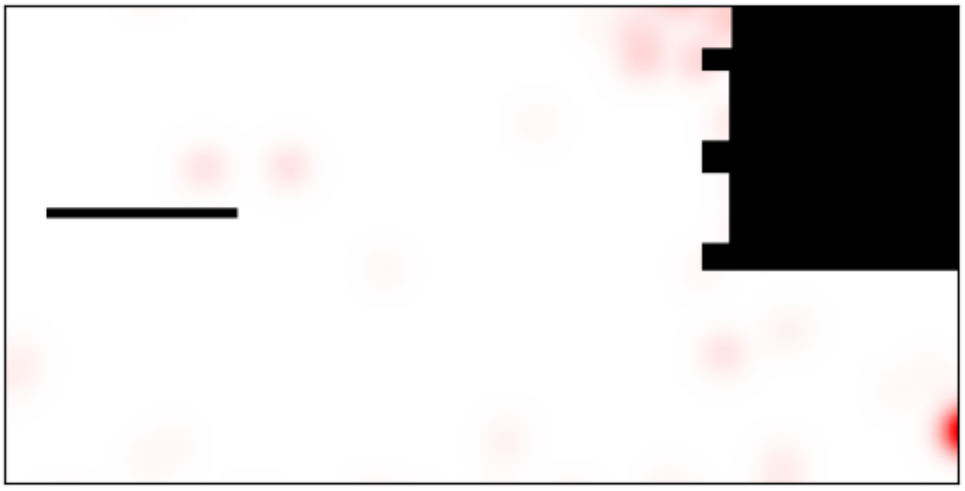
```
stanford_coupa0
['cash', 'entrance', 'light', 'sit', 'stairs', 'trash', 'tree', 'restricted',
'grass']
```

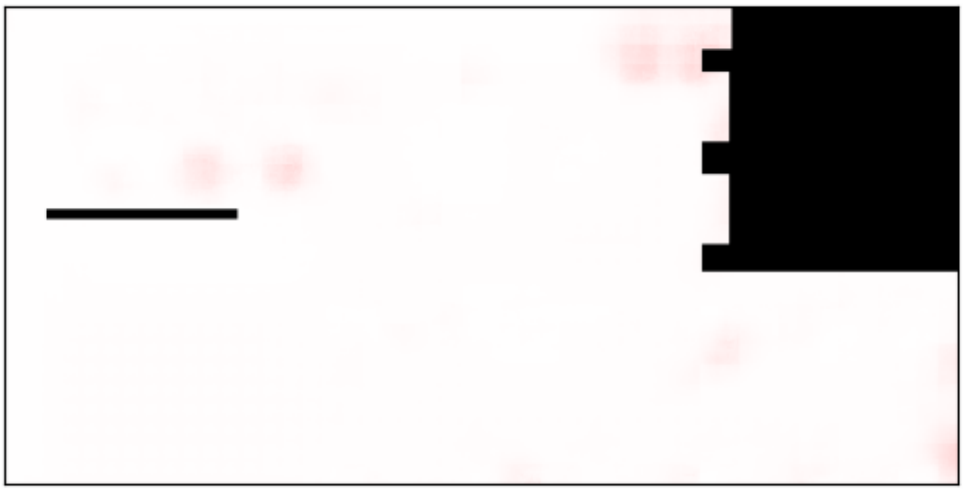




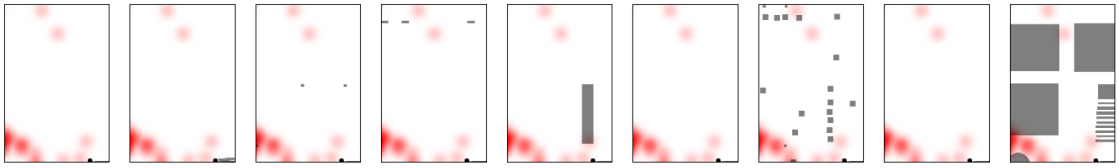


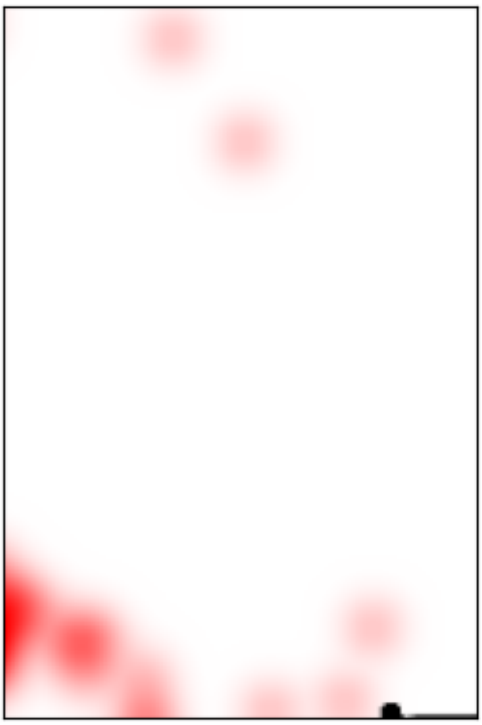
KL-divergence: 1.4211187817073827
stanford_coupa3
['cash', 'entrance', 'light', 'sit', 'stairs', 'trash', 'tree', 'restricted', 'grass']

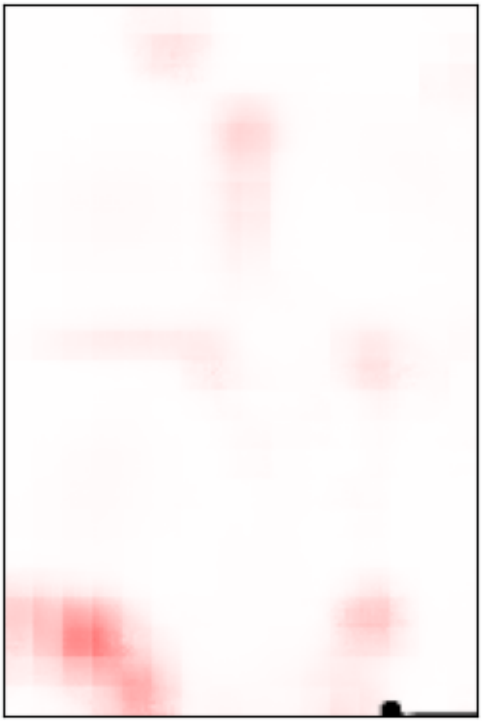




KL-divergence: 1.8521962020470746
stanford_hyang1
['cash', 'entrance', 'light', 'sit', 'stairs', 'trash', 'tree', 'restricted', 'grass']







KL-divergence: 0.9323071030653334
stanford_hyang10
['cash', 'entrance', 'light', 'sit', 'stairs', 'trash', 'tree', 'restricted',
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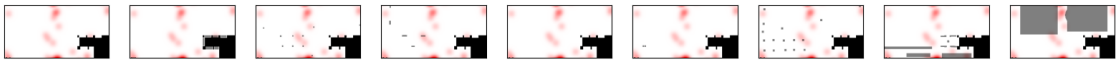
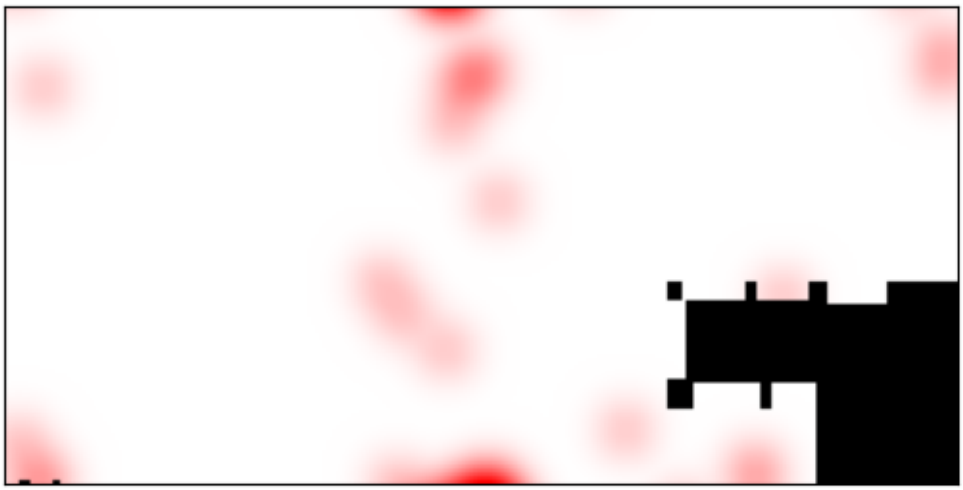
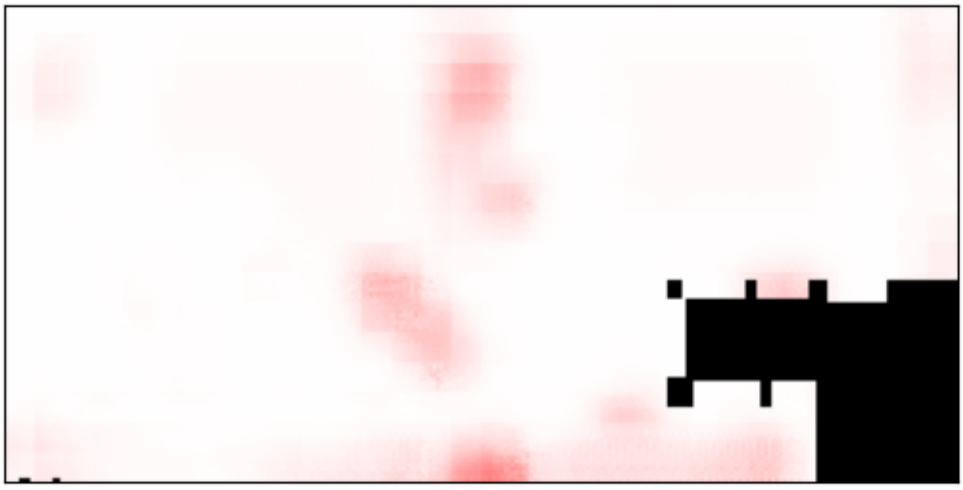
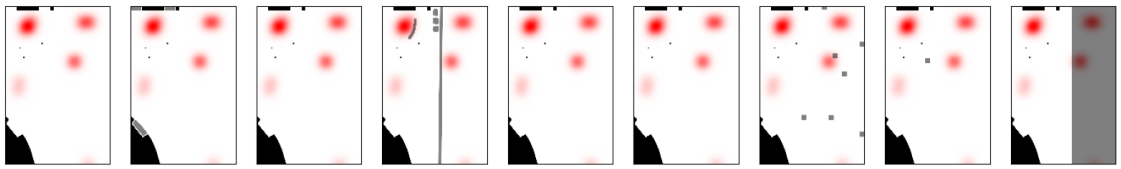




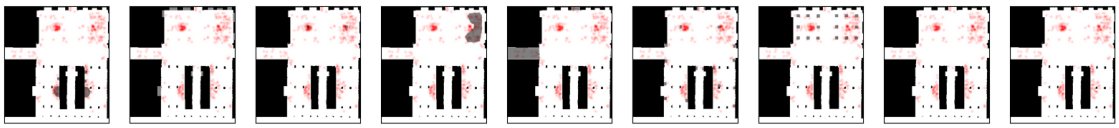


KL-divergence: 0.8467748422836926
stanford_gates2
['cash', 'entrance', 'light', 'sit', 'stairs', 'trash', 'tree', 'restricted',

'grass']



KL-divergence: 0.8552739498921831
master_big
['cash', 'entrance', 'light', 'sit', 'stairs', 'trash', 'tree', 'restricted', 'grass']



KL-divergence: 3.6457432495269377
willow
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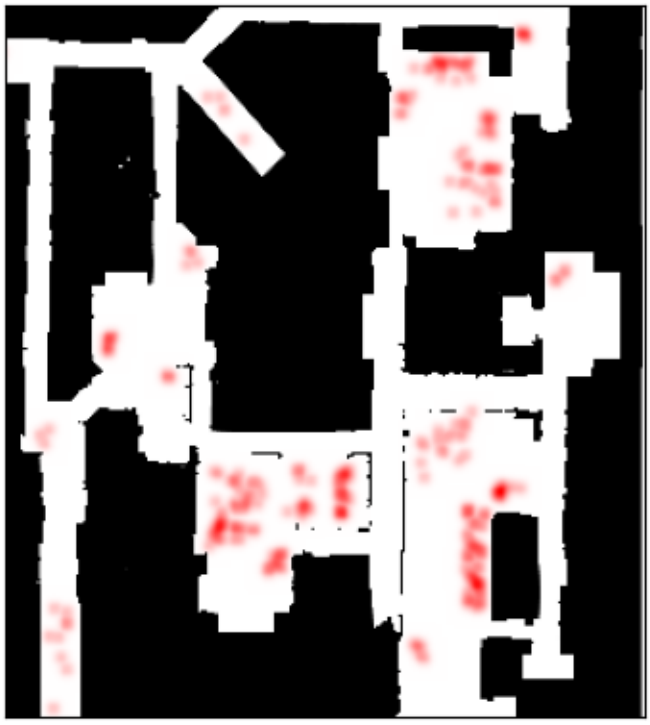
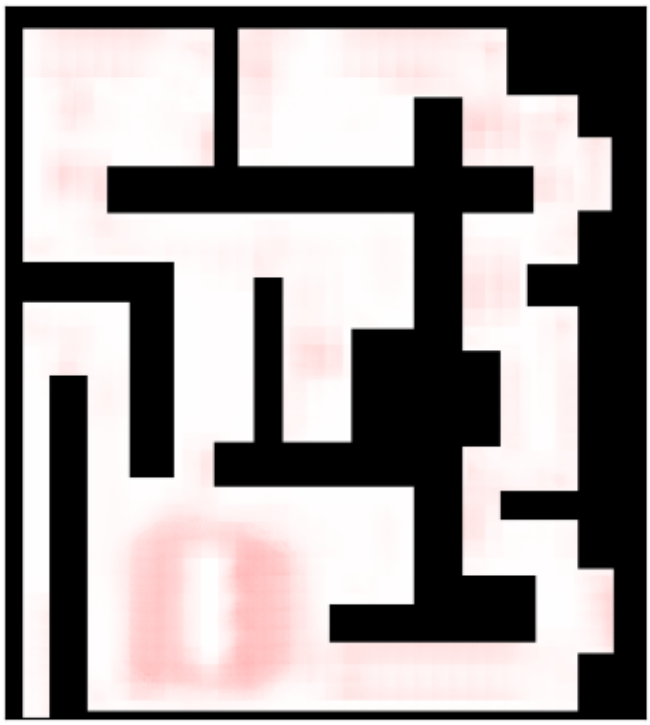
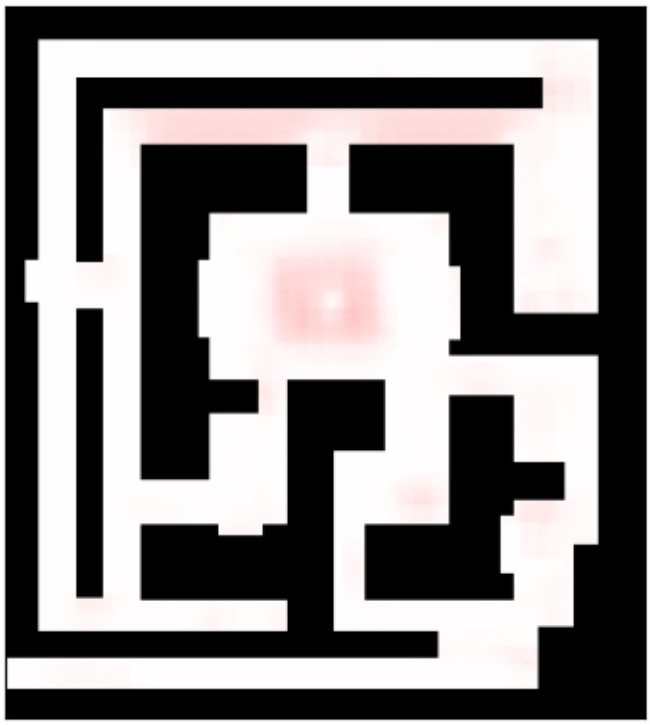


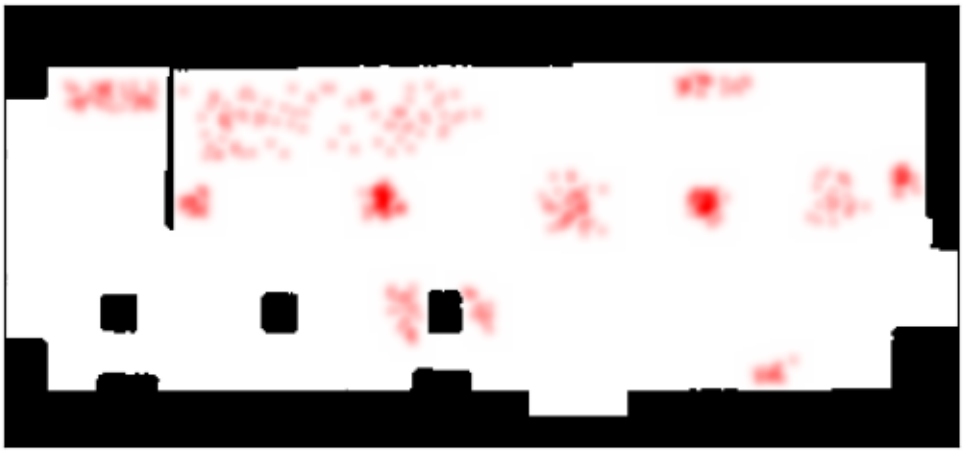
KL-divergence: 3.7936747934498705
map1
['cash', 'entrance', 'light', 'sit', 'stairs', 'trash', 'tree', 'restricted', 'grass']



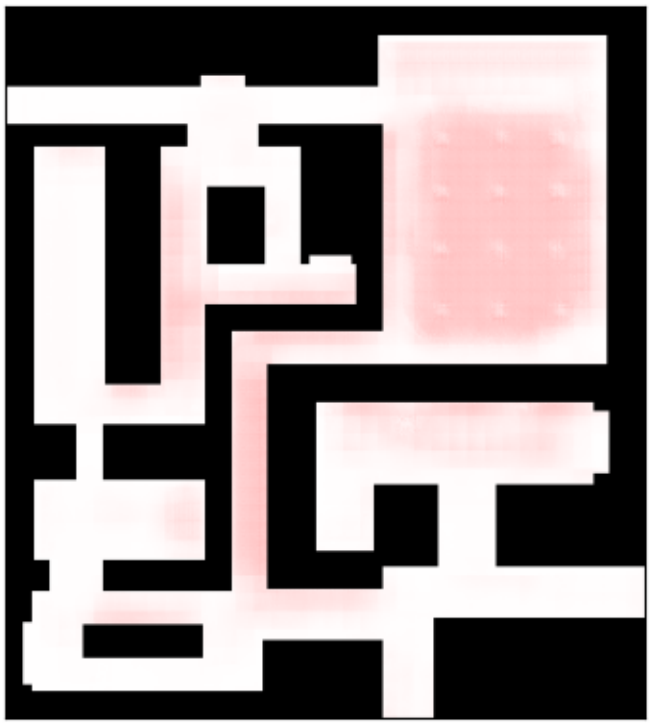
KL-divergence: 4.190531508996889
map2
['cash', 'entrance', 'light', 'sit', 'stairs', 'trash', 'tree', 'restricted', 'grass']



KL-divergence: 3.639582951495805
costacafe
['cash', 'entrance', 'light', 'sit', 'stairs', 'trash', 'tree', 'restricted', 'grass']



KL-divergence: 3.112875053846931
map3
['cash', 'entrance', 'light', 'sit', 'stairs', 'trash', 'tree', 'restricted', 'grass']



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KL-divergence: 3.024823618027837
Mean KL-divergence: 2.483172914030903
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