What makes an image memorable?

P. Isola, J. Xiao, A. Torralba, A. Oliva. CVPR 2011

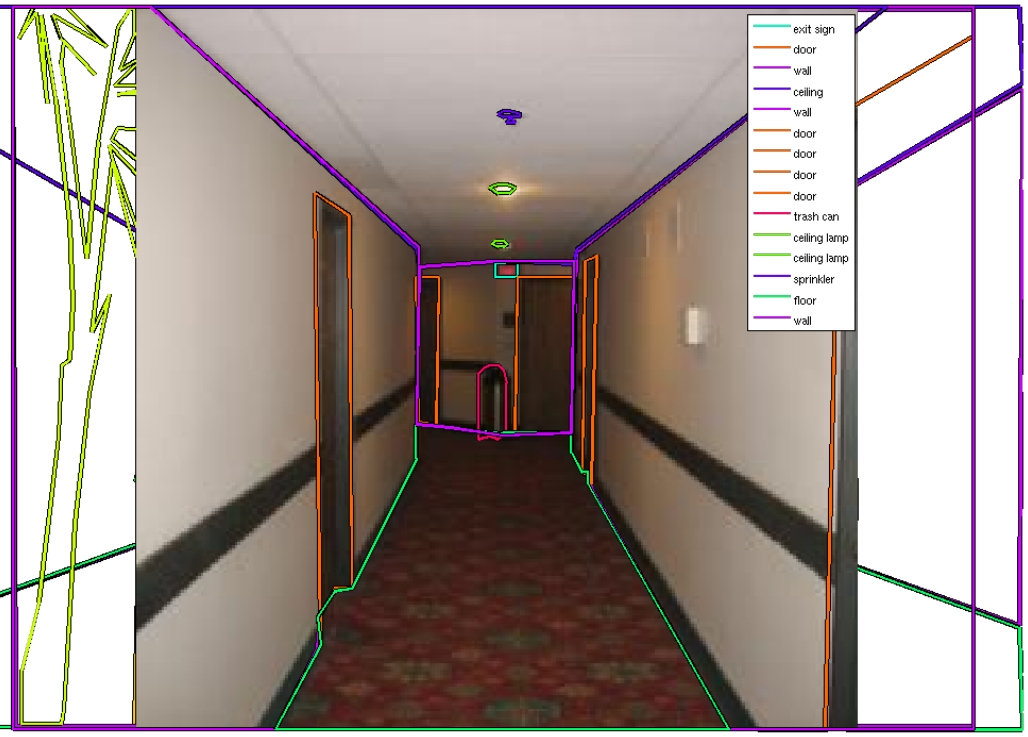
Islam Beltagy

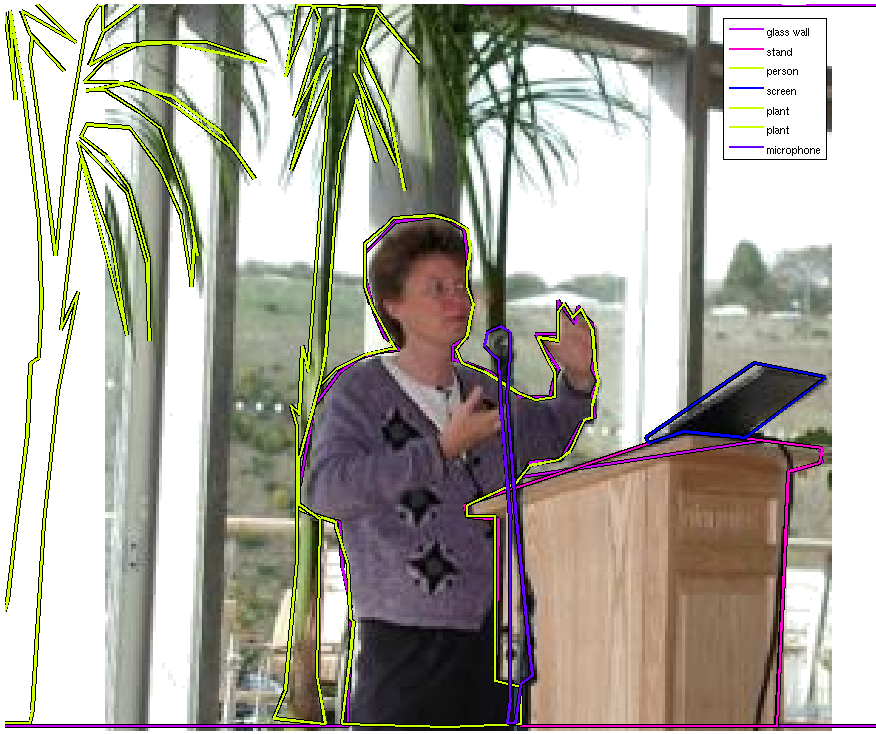
Experiment

- https://picasaweb.google.com/101392440470561716618/CS395TVisualRecognition

LabelMe

- Images database and annotation tool
- A helpful matlab toolbox





Agenda

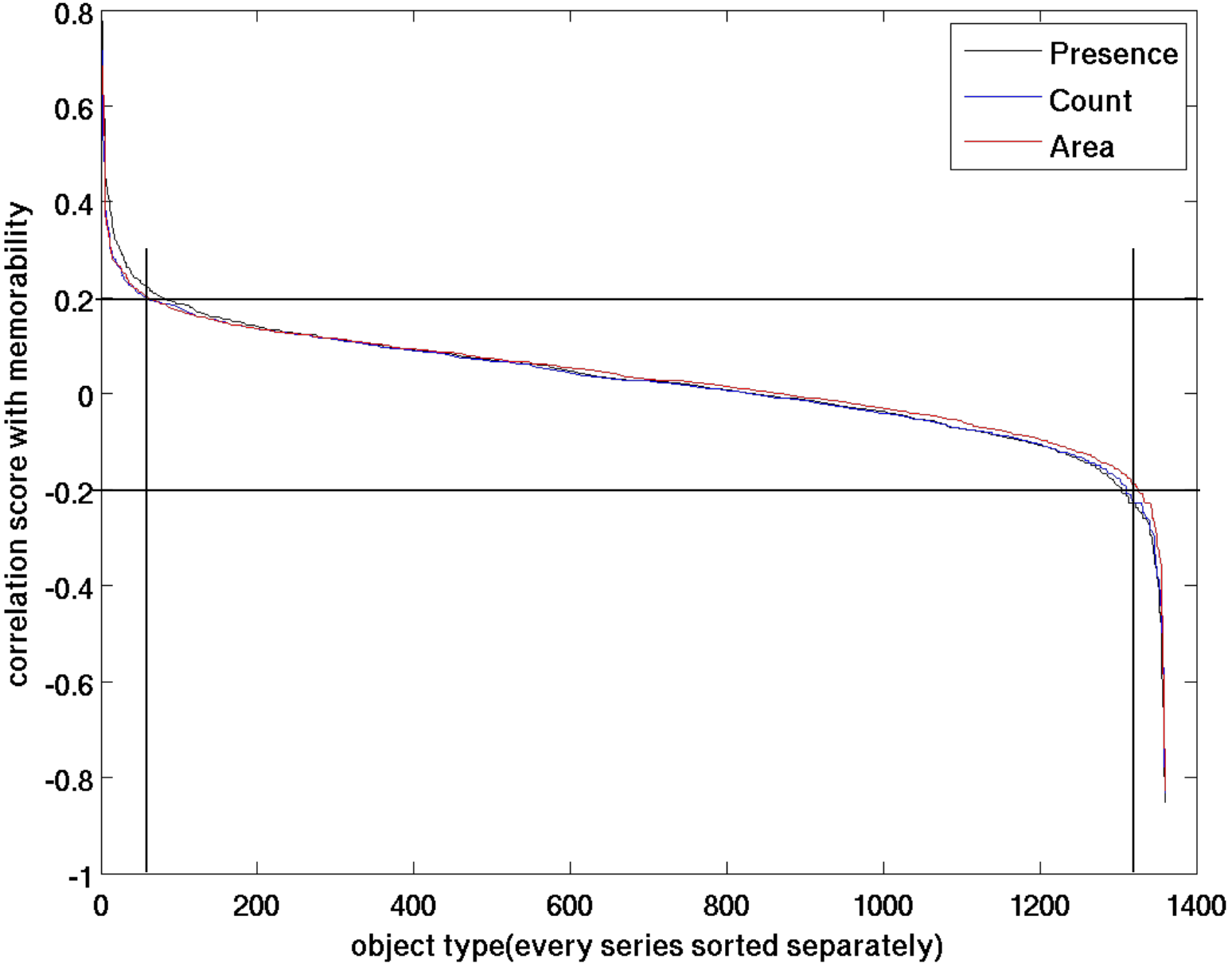
- Memorability vs Object class
- Memorabiliy vs Saliency

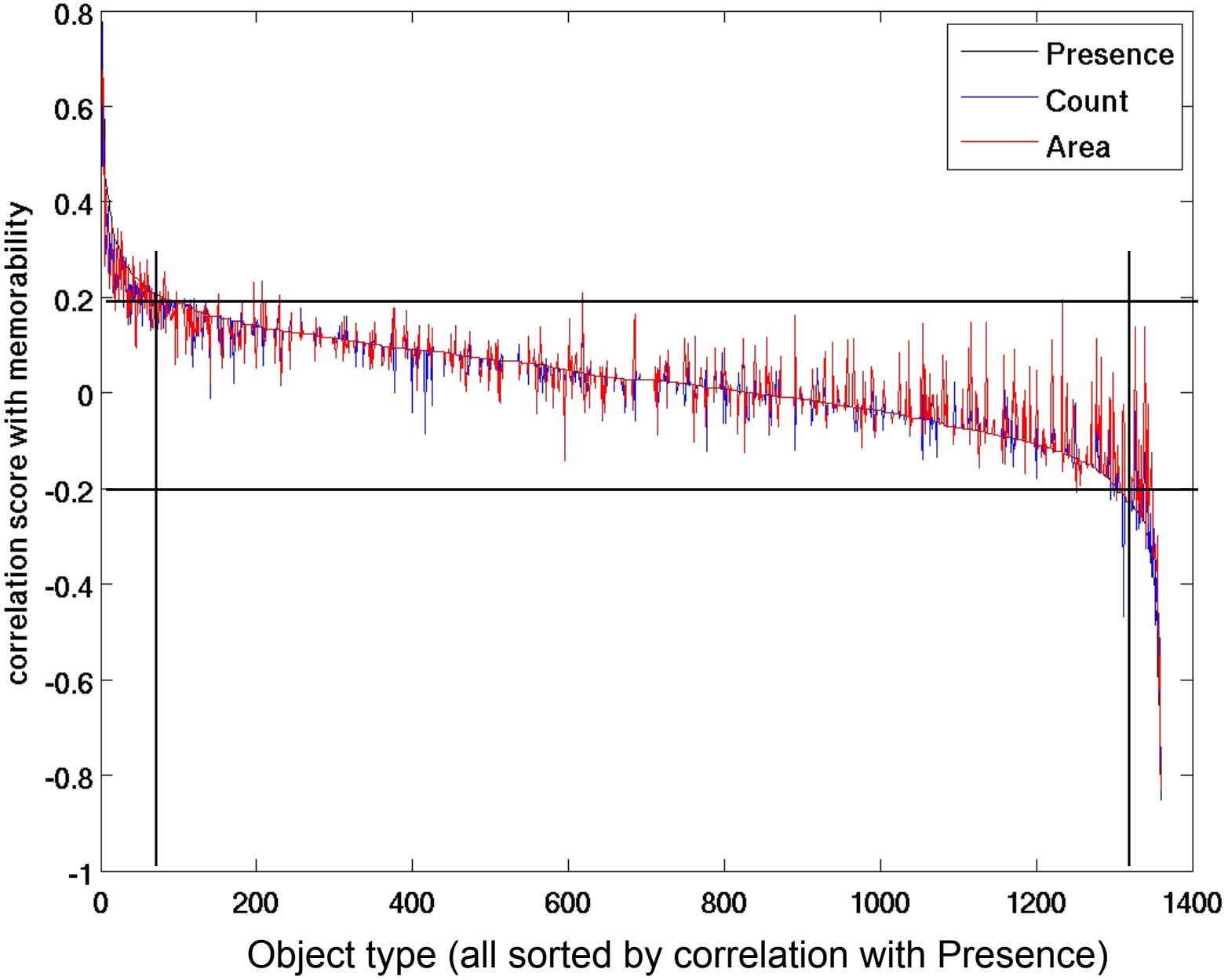
Memorability and object classes

- Task:
  - Find relation between each individual object class and memorability
- Features:
  - Object Presence
  - Object Counts
  - Object Area

Memorability and object classes

- Use Spearmen correlation to find correlation between class features statistics (presence, count, area) and memorability (from ground truth).

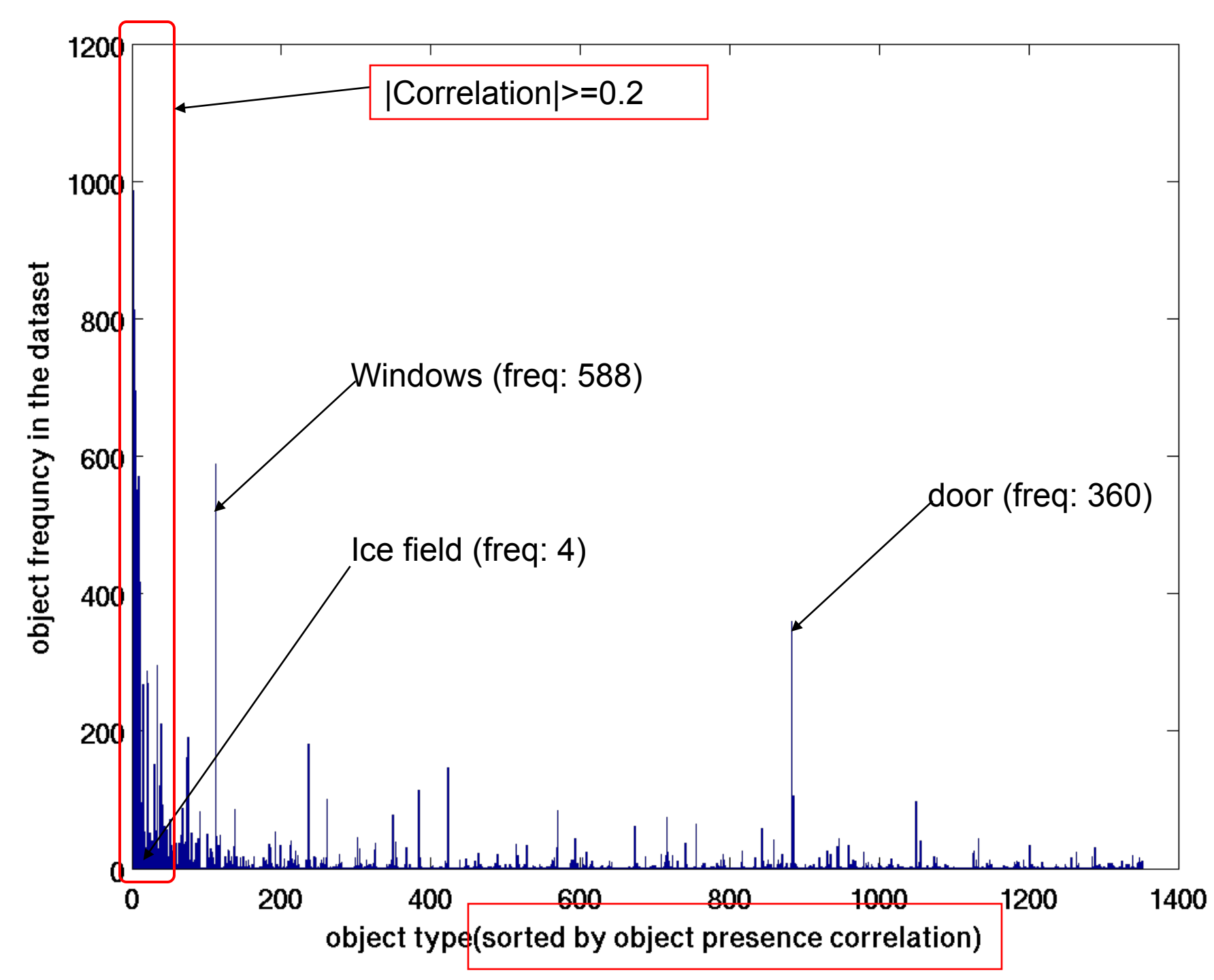

Presence
Count
Area
correlation score with memorability
object type(every series sorted separately)
0.8
0.6
0.4
0.2
0
-0.2
-0.4
-0.6
-0.8
-1
0
200
400
600
800
1000
1200
1400


Presence
Count
Area
correlation score with memorability
0.8
0.6
0.4
0.2
0
-0.2
-0.4
-0.6
-0.8
-1
0
200
400
600
800
1000
1200
1400
Object type (all sorted by correlation with Presence)

correlation score with memorability
0.8
0.6
0.4
0.2
0
-0.2
-0.4
-0.6
-0.8
-1
Presence
Count
Area
wall
floor
person
on sitting
ceiling
shelves
chair
cent tube
screen
ball
iling lamp
keyboard
bag
balls
toilet
stand
bottle
crophone
paper
easel
seats
box
table
fish
dog
palm tree
valley
pavilion
ght goods
chimney
path
forecourt
sand
tower
sea
road
water
attic
rocks
land
ice field
ground
river
field
rock
plant
grass
mountain
building
tree
sky

Memorability and object classes

- Most and Least memorable object classes are 50/1360 class. (|Correlation| >=0.2)
- Most of the object classes are not correlated with memorability, why ?

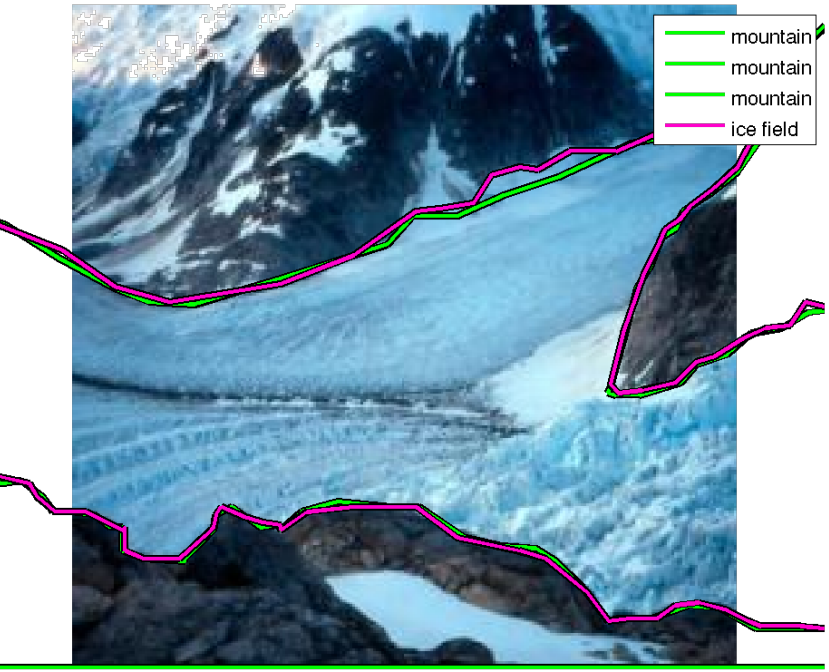

|Correlation|>=0.2
Windows (freq: 588)
door (freq: 360)
Ice field (freq: 4)
object frequncy in the dataset
object type(sorted by object presence correlation)
0
200
400
600
800
1000
1200
1400

Memorability and object classes

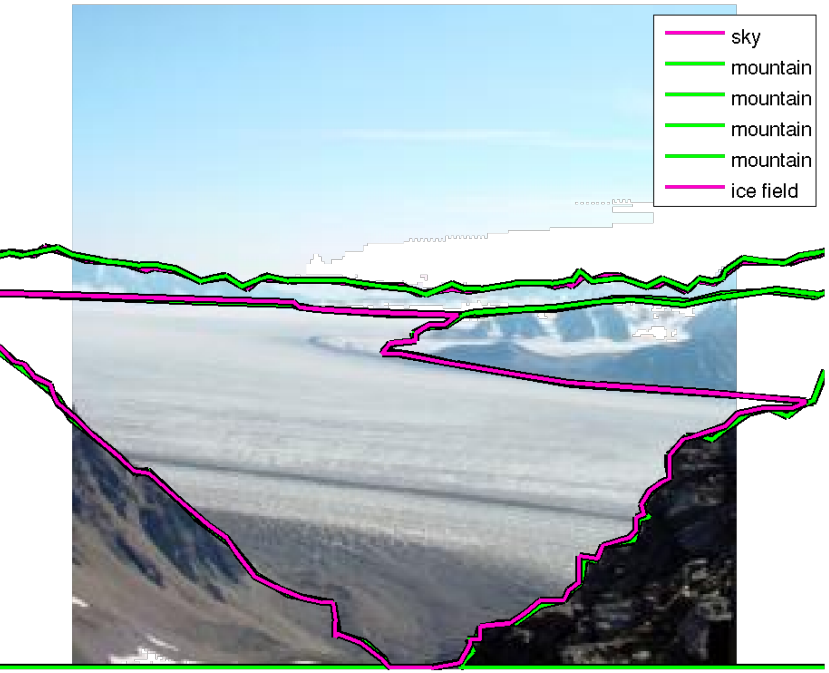
- Most of the object classes are not correlated with memorability, why ? Because:
  - Not frequent enough to find a correlation pattern (dataset limitation)
  - Very common on all memorability levels
  - Correlated with medium levels of memorability

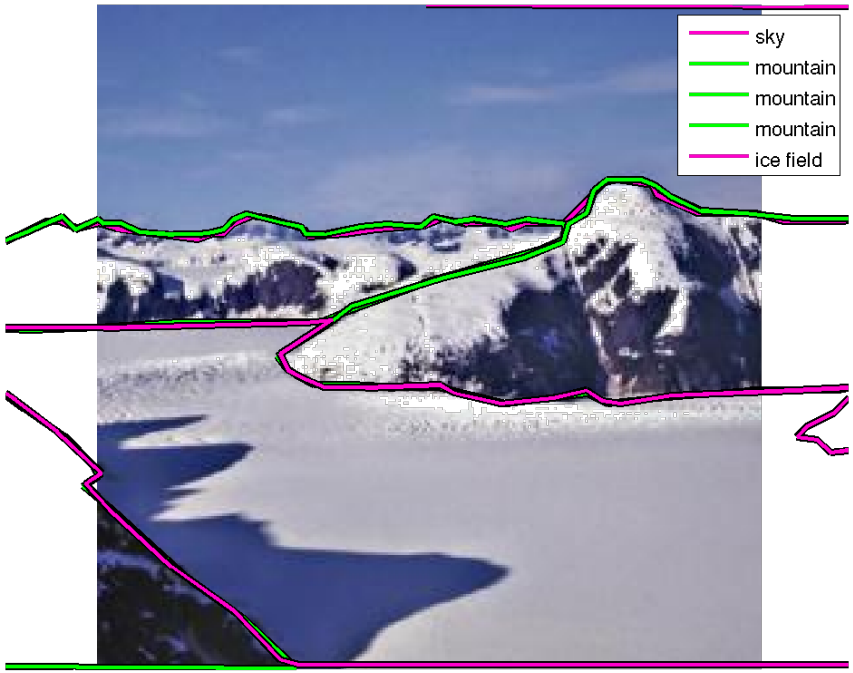
Memorability and object classes

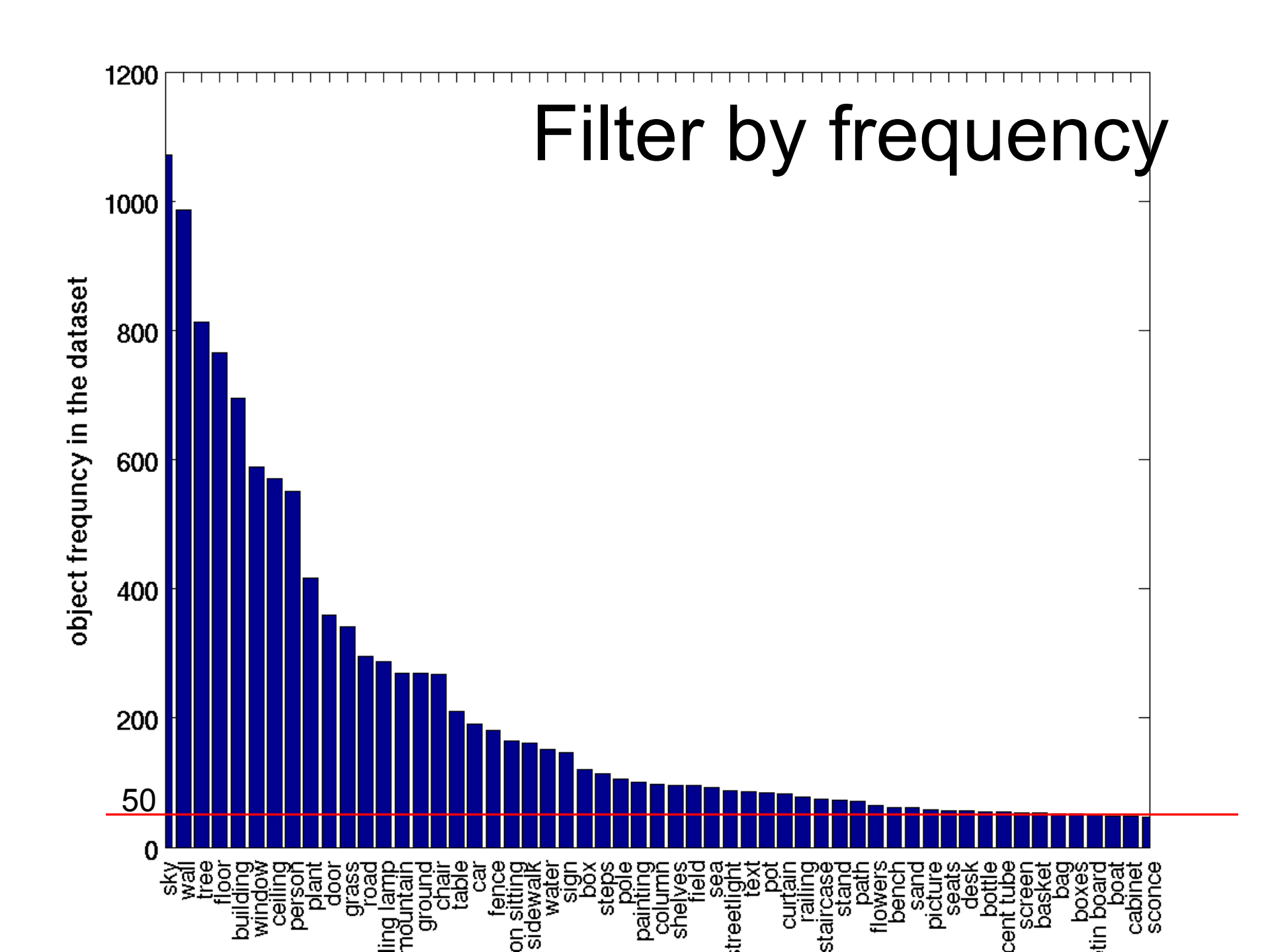
- What about high correlation with very low frequency ? (like “ice field”)


mountain
mountain
mountain
ice field

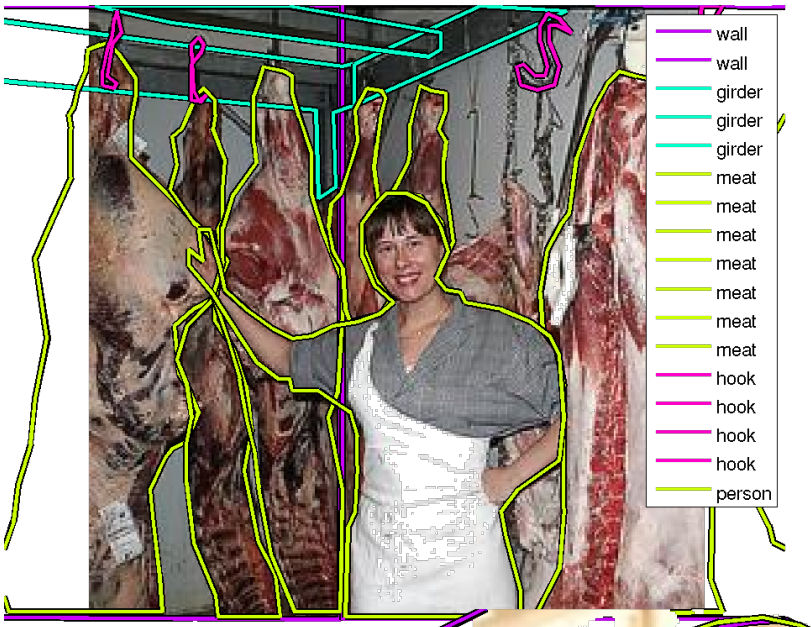

sky
ice field

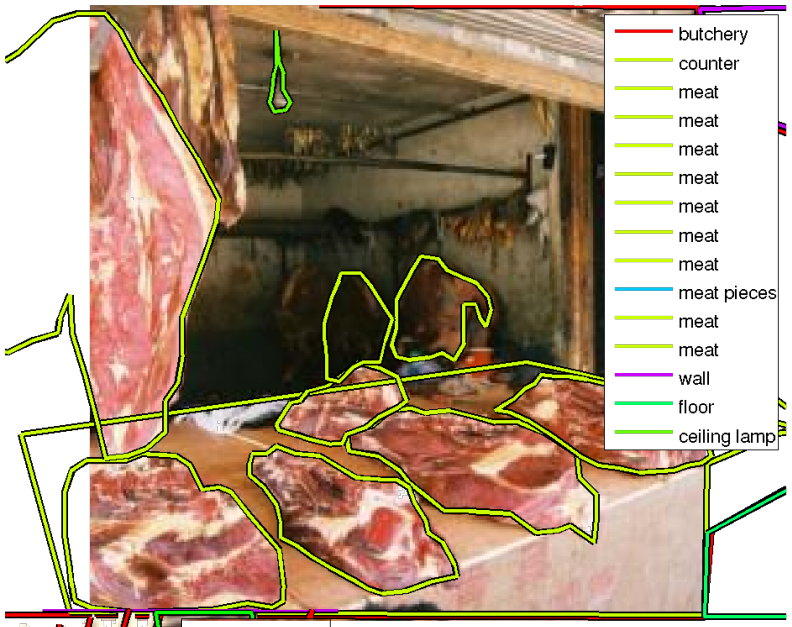

sky
mountain
mountain
mountain
mountain
ice field


sky
mountain
mountain
mountain
ice field

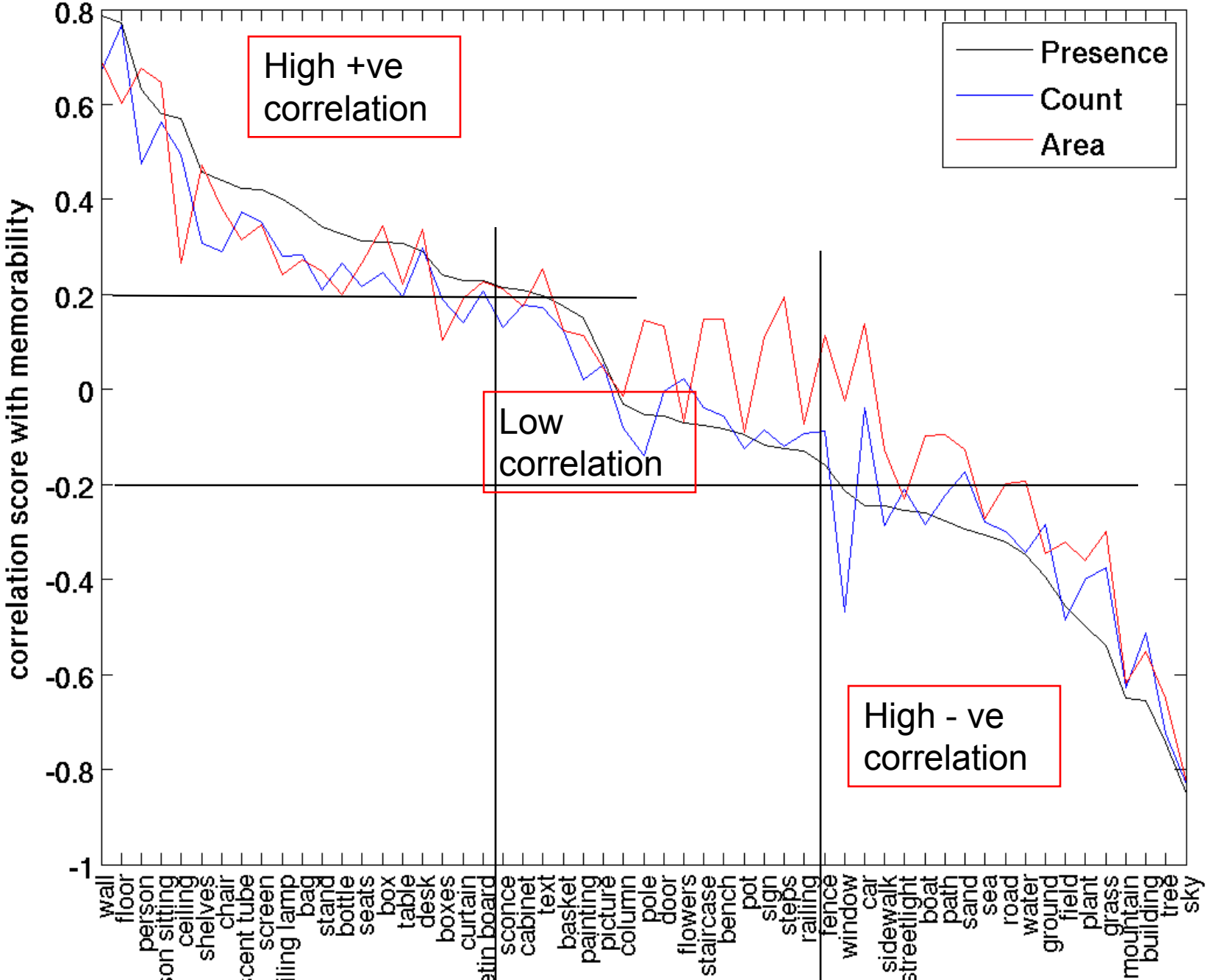

Filter by frequency
object frequncy in the dataset
1200
1000
800
600
400
200
50
0
sky
wall
tree
floor
building
window
ceiling
person
plant
door
grass
road
ling lamp
mountain
ground
chair
table
car
fence
on sitting
sidewalk
water
sign
box
steps
pole
painting
column
shelves
field
sea
treetlight
text
pot
curtain
railing
staircase
stand
path
flowers
bench
sand
picture
seats
desk
bottle
cent tube
screen
basket
bag
boxes
tin board
boat
cabinet
sconce

Side effect of filtration by frequency



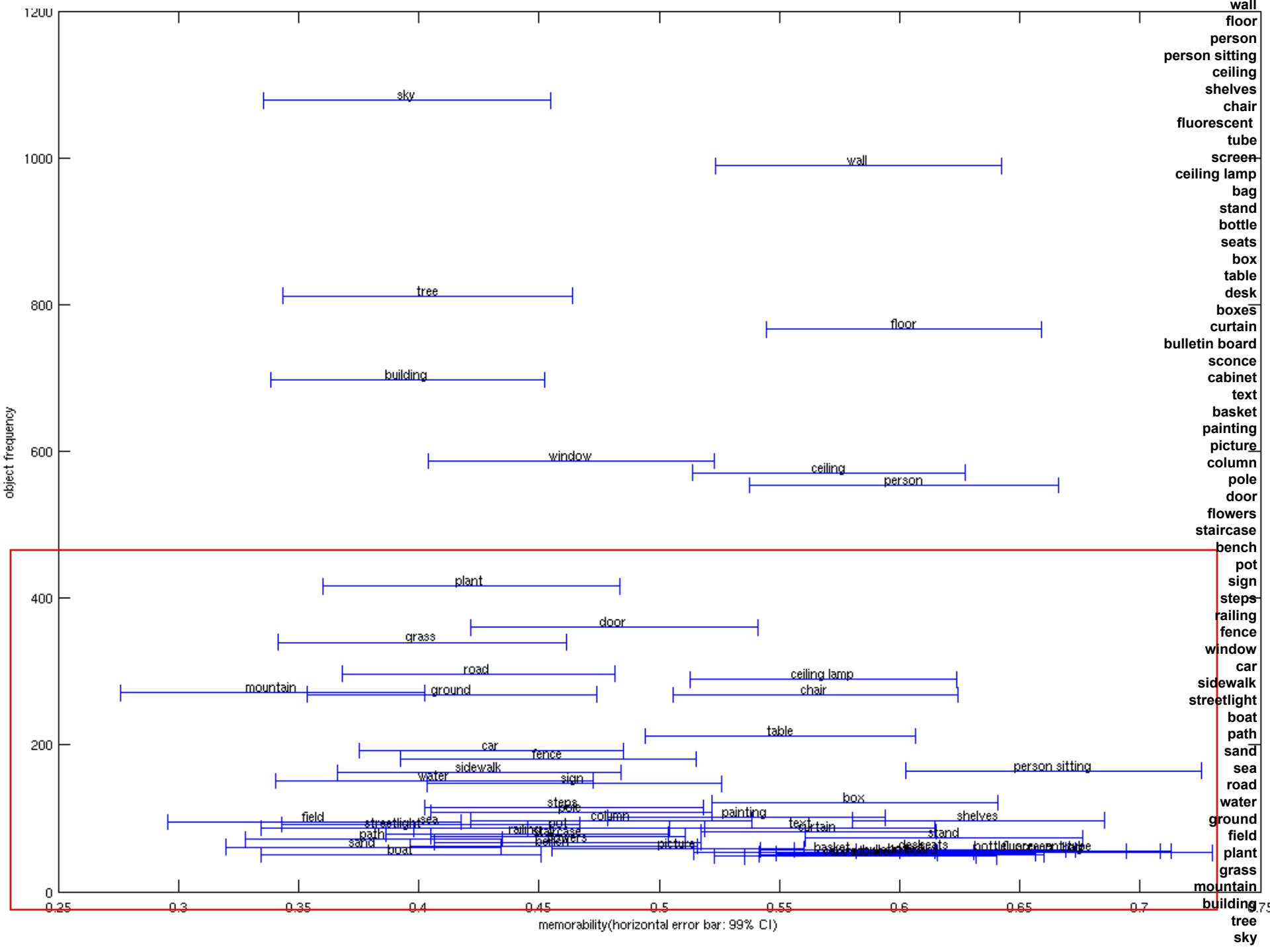


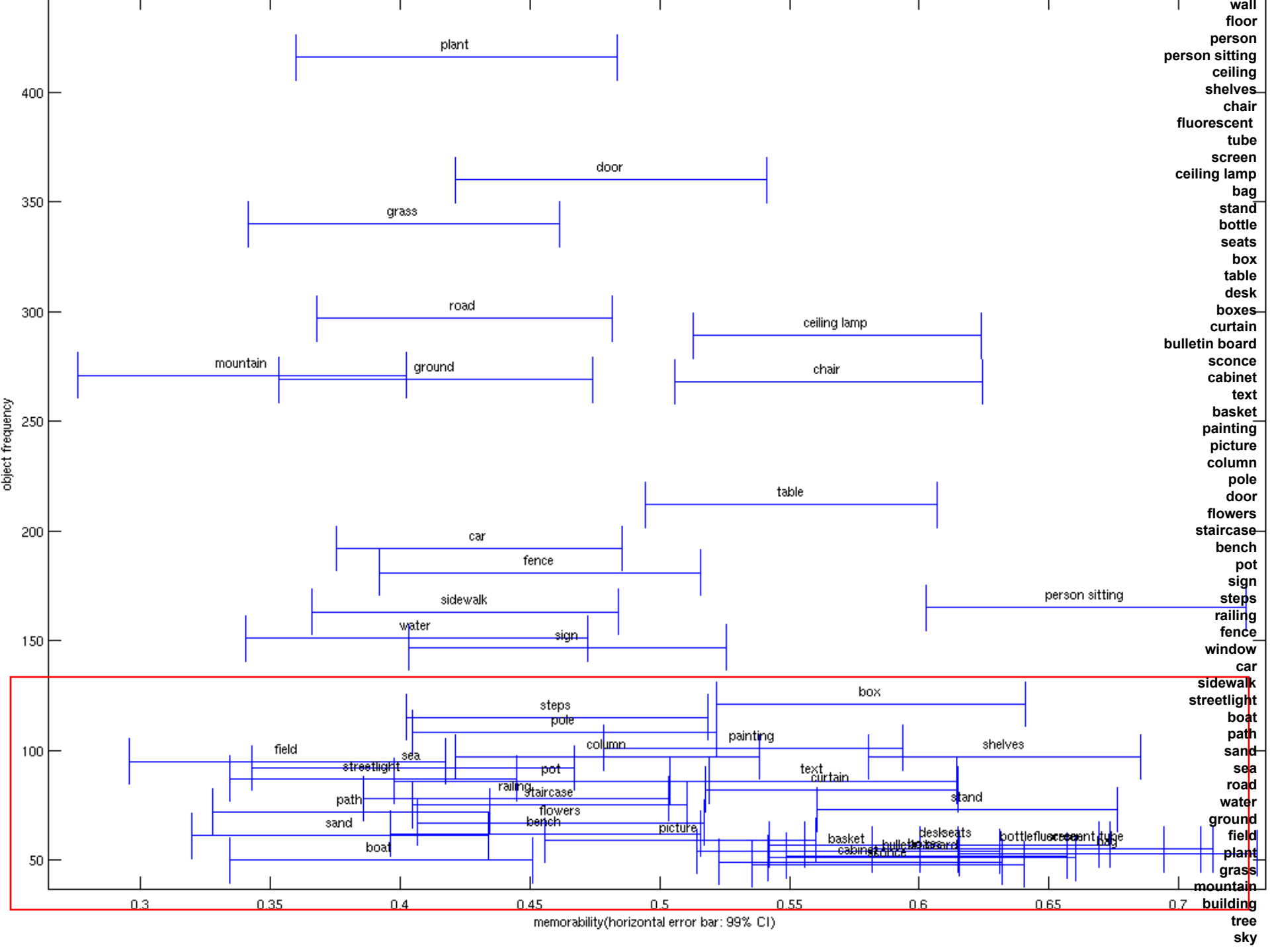
Correlation after filtration



Memorability and object classes

- Most of the object classes are not correlated with memorability, why ? Because:
  - Not frequent enough to find a correlation pattern (filter infrequent images)
  - Very common on all memorability levels
  - Correlated with medium levels of memorability


object frequency
memorability(horizontal error bar: 99% CI)
0
200
400
600
800
1000
1200
0.25
0.3
0.35
0.4
0.45
0.5
0.55
0.6
0.65
0.7
0.75
sky
wall
tree
floor
building
window
ceiling
person
plant
door
grass
road
mountain
ground
ceiling lamp
chair
table
car
fence
sidewalk
water
sign
person sitting
steps
pole
box
field
column
painting
shelves
streetlight
sea
pot
text
curtain
railing
staircase
stand
path
flowers
sand
bench
picture
basket
boat
wall
floor
person
person sitting
ceiling
shelves
chair
fluorescent
tube
screen
ceiling lamp
bag
stand
bottle
seats
box
table
desk
boxes
curtain
bulletin board
sconce
cabinet
text
basket
painting
picture
column
pole
door
flowers
staircase
bench
pot
sign
steps
railing
fence
window
car
sidewalk
streetlight
boat
path
sand
sea
road
water
ground
field
plant
grass
mountain
building
tree
sky


plant
door
grass
road
ceiling lamp
mountain
ground
chair
table
car
fence
sidewalk
person sitting
water
sign
box
steps
pole
painting
field
column
shelves
sea
streetlight
pot
text
curtain
railing
staircase
stand
path
flowers
sand
bench
picture
basket
deskseats
boat
wall
floor
person
person sitting
ceiling
shelves
chair
fluorescent
tube
screen
ceiling lamp
bag
stand
bottle
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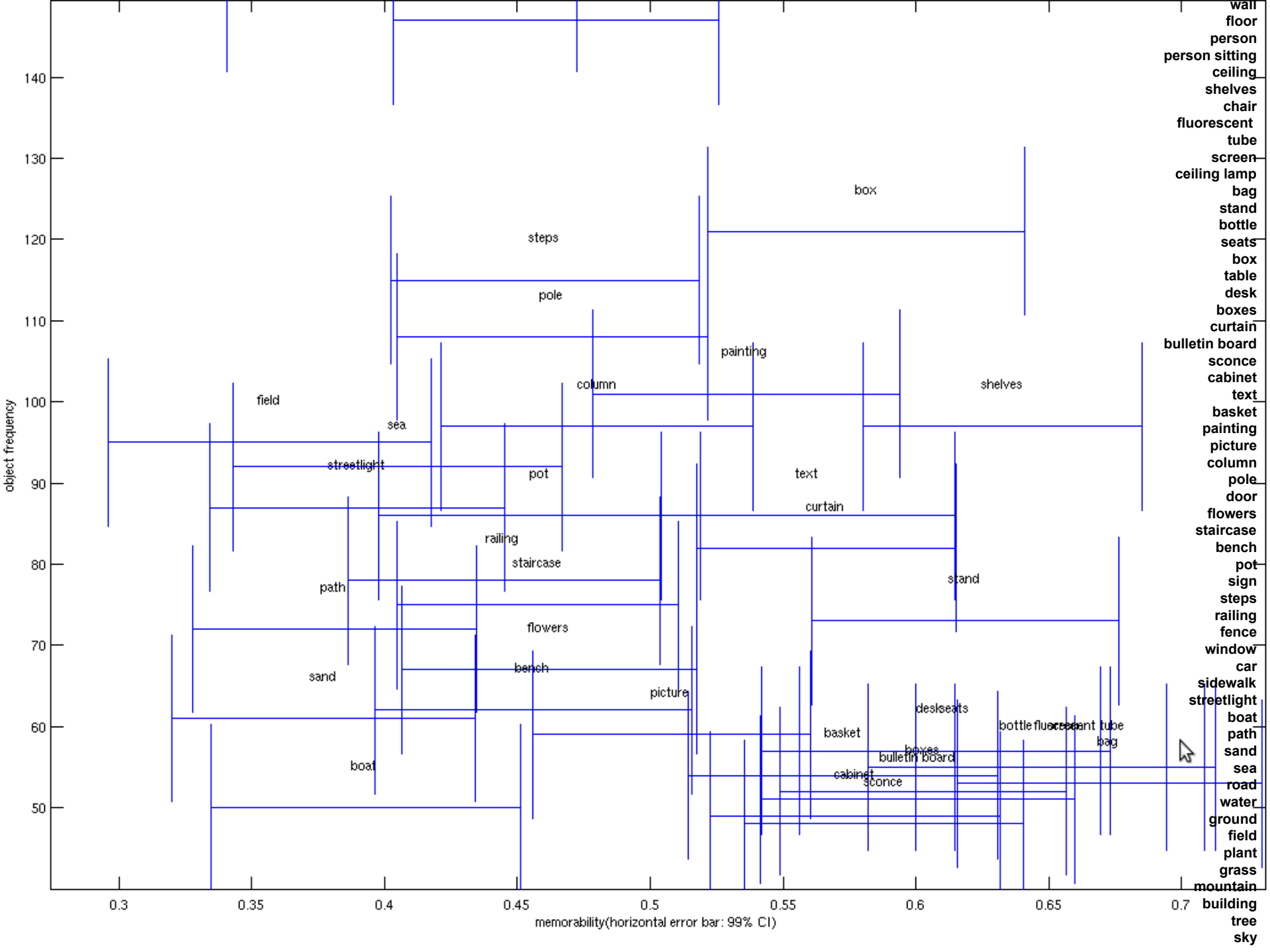
box
table
desk
boxes
curtain
bulletin board
sconce
cabinet
text
basket
painting
picture
column
pole
door
flowers
staircase
bench
pot
sign
steps
railing
fence
window
car
sidewalk
streetlight
boat
path
sand
sea
road
water
ground
field
plant
grass
mountain
building
tree
sky
400
350
300
250
200
150
100
50
object frequency
0.3
0.35
0.4
0.45
0.5
0.55
0.6
0.65
0.7
memorability(horizontal error bar: 99% CI)


object frequency
memorability(horizontal error bar: 99% CI)
0.3
0.35
0.4
0.45
0.5
0.55
0.6
0.65
0.7
140
130
120
110
100
90
80
70
60
50
wall
floor
person
person sitting
ceiling
shelves
chair
fluorescent
tube
screen
ceiling lamp
bag
stand
bottle
seats
box
table
desk
boxes
curtain
bulletin board
sconce
cabinet
text
basket
painting
picture
column
pole
door
flowers
staircase
bench
pot
sign
steps
railing
fence
window
car
sidewalk
streetlight
boat
path
sand
sea
road
water
ground
field
plant
grass
mountain
building
tree
sky
box
steps
pole
painting
column
shelves
field
sea
streetlight
pot
text
curtain
railing
staircase
stand
path
flowers
bench
sand
picture
deskseats
basket
bottle
bag
boxes
bulletin board
cabinet
sconce
boat

Agenda

- Memorability vs Object class

- Memorabiliy vs Saliency

Saliency vs Memorability

- Experiment Design
  - Run Saliency algorithm (T. Liu et al. CVPR 2007) on the memorability dataset.
  - Find correlation between area of salient region and memorability score
  - Find correlation between location of Salient block and memorability score
  - Study object classes statistics on salient regions

Saliency vs Memorability

- Corr (memorability score, salient region area) = -3.01%
- Corr (memorability score, salient region location) = 4.87%
- Why ?

Saliency vs Memorability

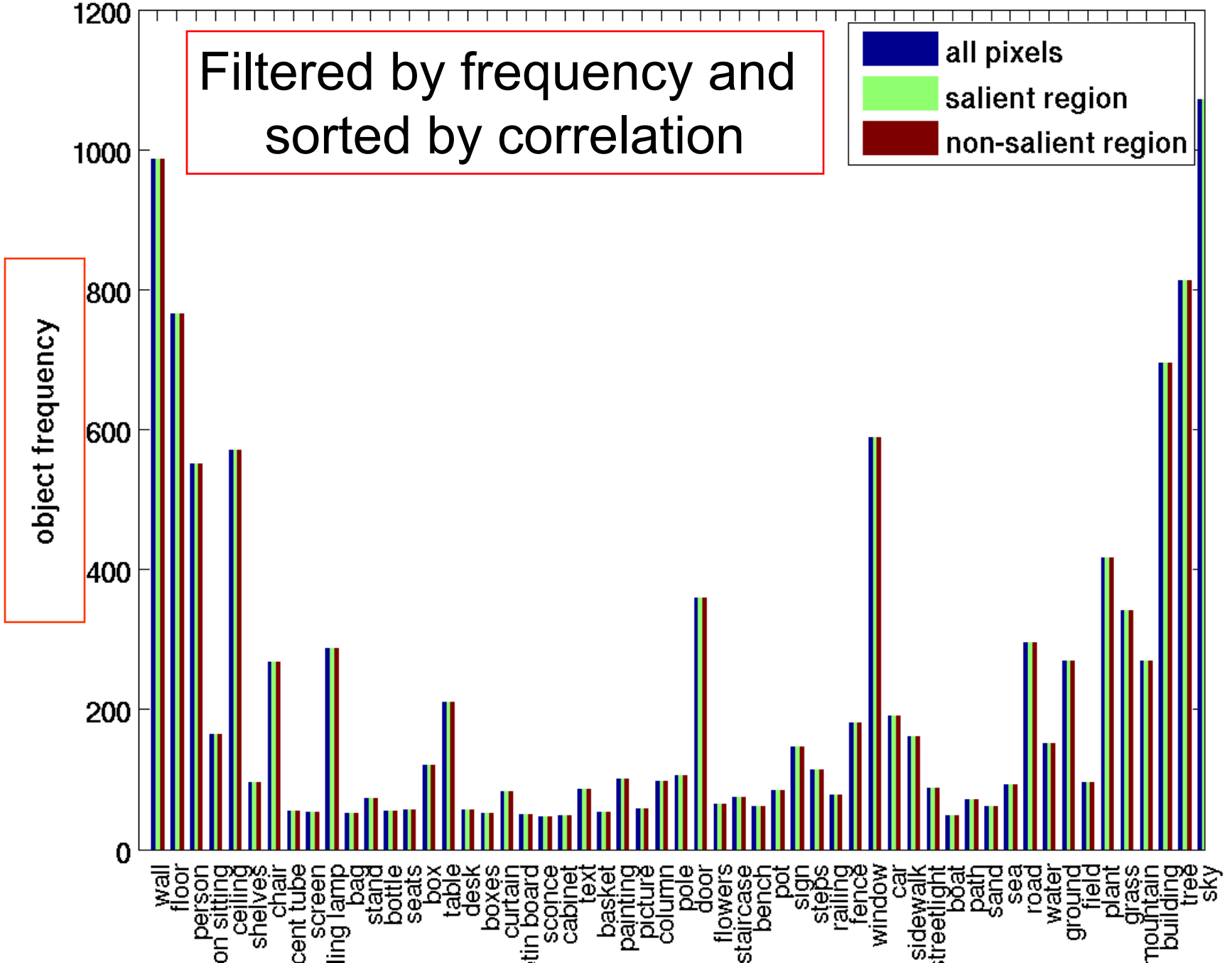
High memorability score

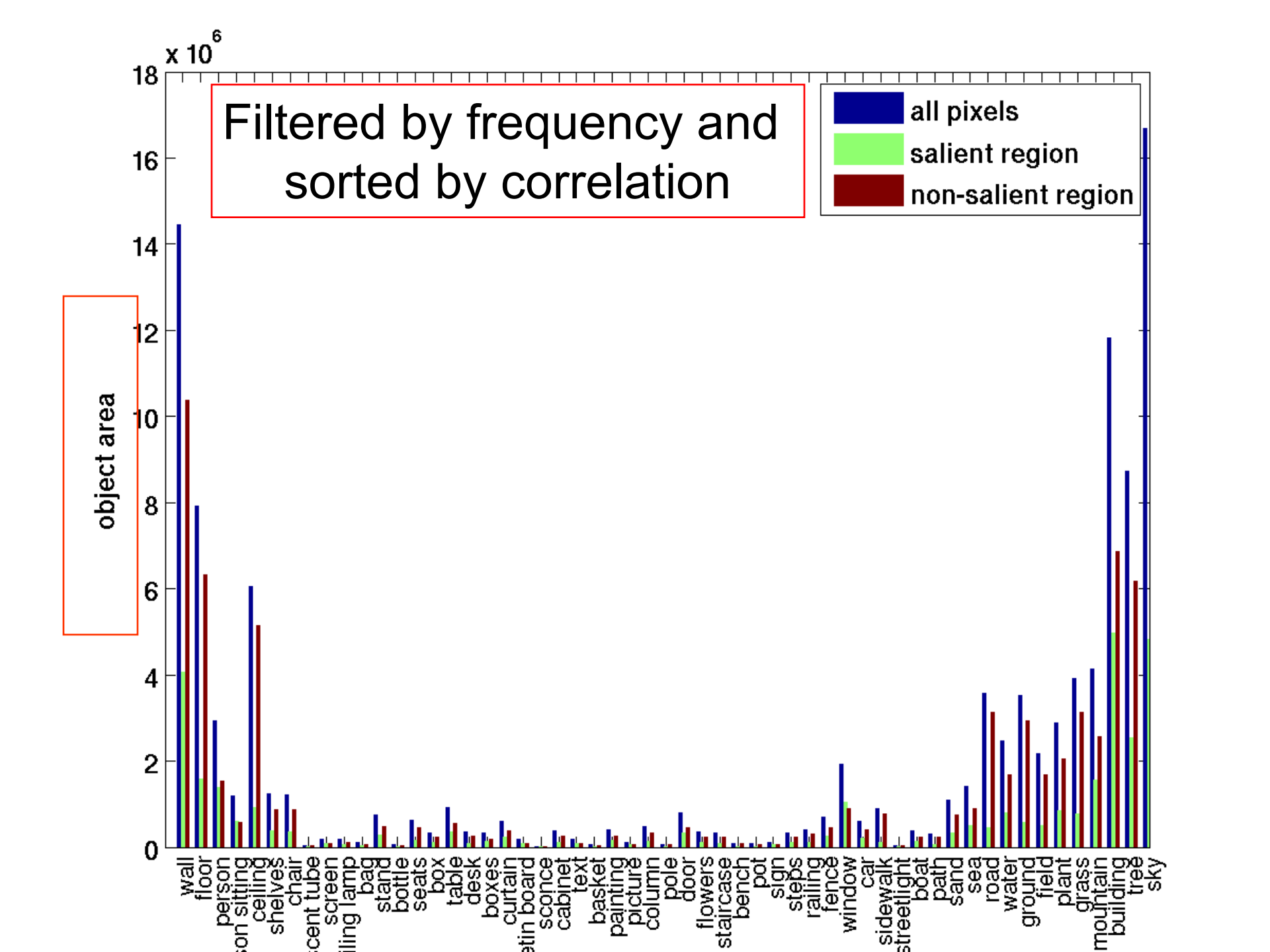
Saliency vs Memorability

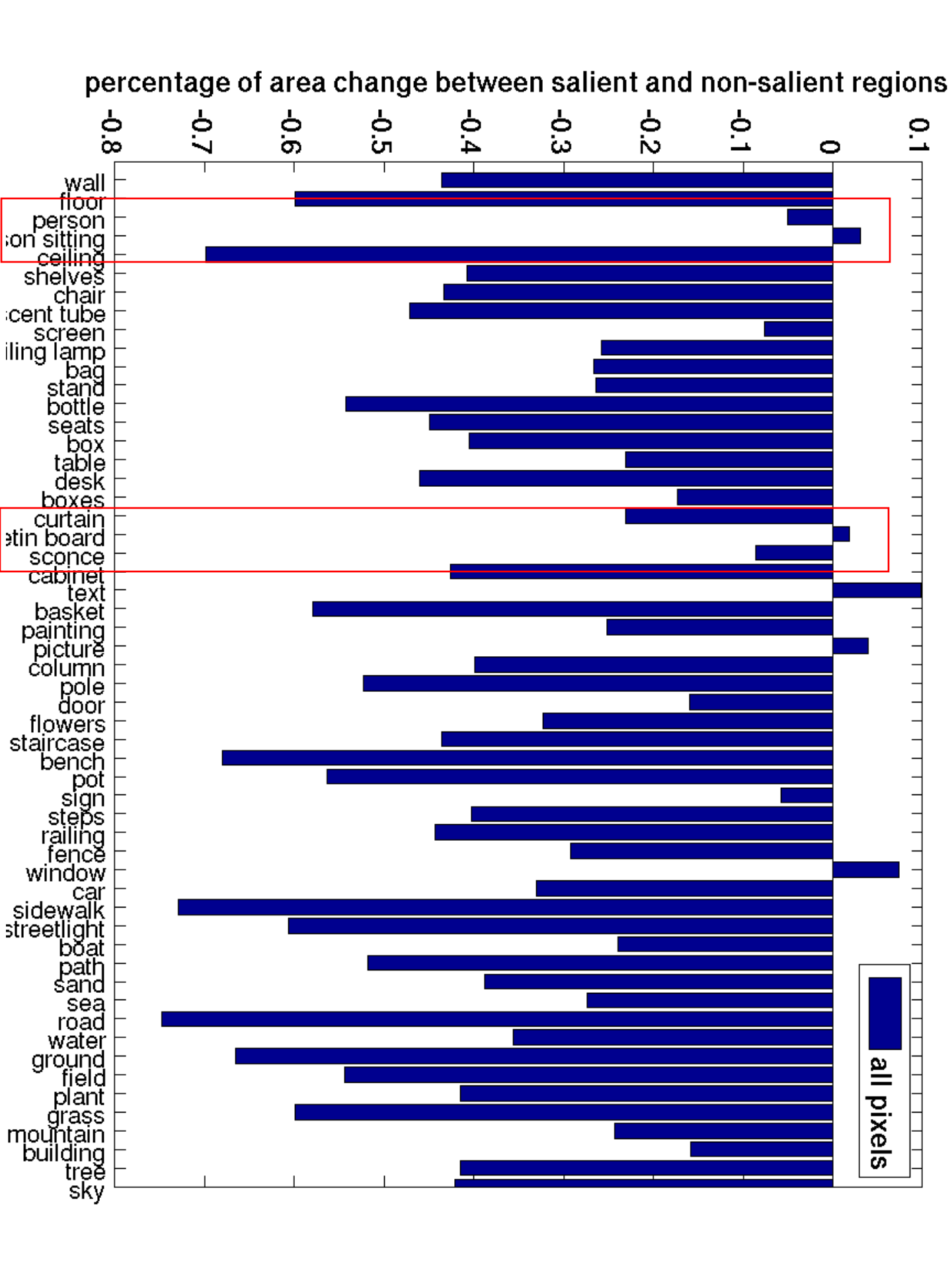
Low memorability score

Saliency and Object classes

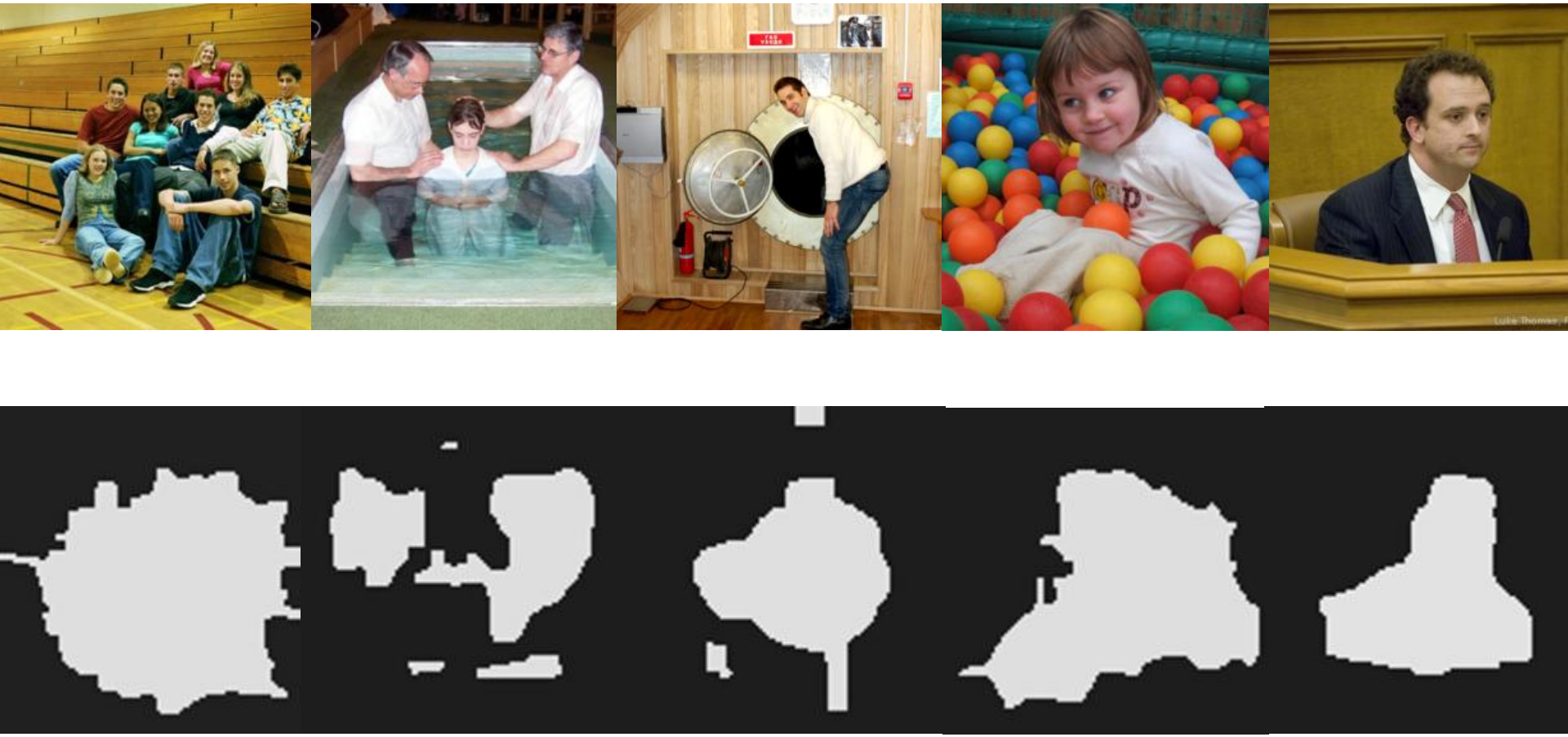
- Compare object class statistics (Presence, Area) for :
  - Full picture
  - Salient region
  - Non-Salient region


Filtered by frequency and sorted by correlation
all pixels
salient region
non-salient region
object frequency
1200
1000
800
600
400
200
0
wall
floor
person
on sitting
ceiling
shelves
chair
cent tube
screen
ling lamp
bag
stand
bottle
seats
box
table
desk
boxes
curtain
tin board
sconce
cabinet
text
basket
painting
picture
column
pole
door
flowers
staircase
bench
pot
sign
steps
railing
fence
window
car
sidewalk
treetlight
boat
path
sand
sea
road
water
ground
field
plant
grass
mountain
building
tree
sky

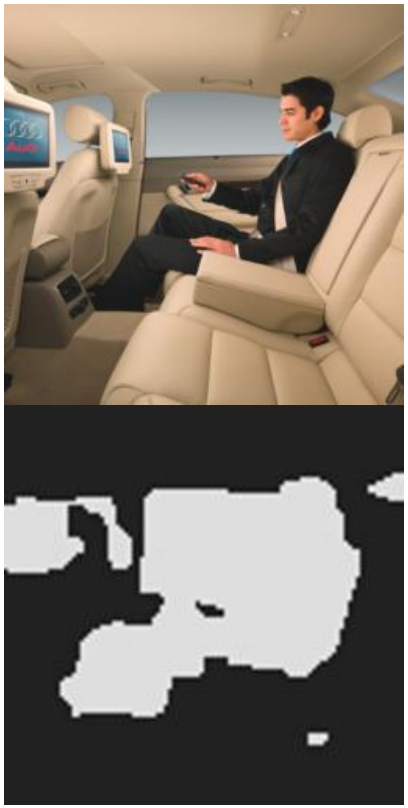

x 10^6
18
16
14
12
10
8
6
4
2
0
object area
Filtered by frequency and sorted by correlation
all pixels
salient region
non-salient region
wall
floor
person
sitting
ceiling
shelves
chair
cent tube
screen
iling lamp
bag
stand
bottle
seats
box
table
desk
boxes
curtain
tin board
sconce
cabinet
text
basket
painting
picture
column
pole
door
flowers
staircase
bench
pot
sign
steps
railing
fence
window
car
sidewalk
streetlight
boat
path
sand
sea
road
water
ground
field
plant
grass
mountain
building
tree
sky


percentage of area change between salient and non-salient regions
-0.8
-0.7
-0.6
-0.5
-0.4
-0.3
-0.2
-0.1
0
0.1
wall
floor
person
on sitting
ceiling
shelves
chair
cent tube
screen
iling lamp
bag
stand
bottle
seats
box
table
desk
boxes
curtain
tin board
sconce
cabinet
text
basket
painting
picture
column
pole
door
flowers
staircase
bench
pot
sign
steps
railing
fence
window
car
sidewalk
streetlight
boat
path
sand
sea
road
water
ground
field
plant
grass
mountain
building
tree
sky
all pixels

Person, Person setting



Window



Conclusion

- Found a list of object classes sorted by their relation to memorability
- Memorability is not directly related to saliency
- Saliency is related to specific list of object classes

References

- What Makes an Image Memorable? P. Isola, J. Xiao, A. Torralba, A. Oliva. CVPR 2011.

- Learning to Detect a Salient Object. T. Liu et al. CVPR 2007

- Matlab functions (http://www.mathworks.com/matlabcentral/fileexchange/) : lscatter, herrorbar, rotateticklabel

Thank You