Supplementary materials for SCOUT: Self-aware Discriminant Counterfactual Explanation

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1. Comparison to attributive explanations on segmentation datasets

In the paper, we mainly showed the results on CUB200 [7] due to limited space. The results on ADE20K [8] are shown here in Table 1. The same conclusions as those in the paper can be obtained.

2. More visualization comparison to state of the art

Please see Figure 1.

3. More Visualizations of SCOUT

Please see Figure 2 on CUB200 and Figure 3 on ADE20K.

4. Implementation details

Both datasets were subject to standard normalizations. Training images were first resized to 224×224 and then randomly flipped, whereas test images were first resized to 256×256 and then center-cropped to 224×224 . All images were also first converted to [0.0, 1.0] from [0, 255] and then normalized by subtracting the mean ([0.471, 0.460, 0.454]) and dividing by the standard deviation ([0.267, 0.266, 0.271]) of each RGB color channel. All results are presented on the standard CUB200 test set and the official validation set of ADE20K. Experiments were ran three times. Used classifiers and predictors are trained by standard strategies [3, 1, 2, 6, 4].

5. Attribute Assignment

The parts and attributes of the CUB200 dataset [7] are listed in Table 2 following [5].

References

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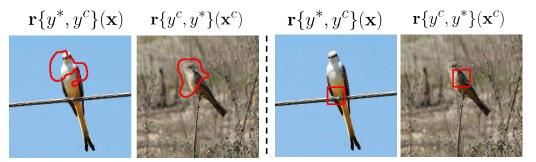
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- [6] Xin Wang, Yujia Luo, Daniel Crankshaw, Alexey Tumanov, Fisher Yu, and Joseph E Gonzalez. Idk cascades: Fast deep learning by learning not to overthink. *arXiv preprint arXiv:1706.00885*, 2017.
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Beginners							
Explanation maps	10%	20%	30%	40%	50%	Avg.	
$\mathbf{a}(h_{y^*}(\mathbf{x}))$	8.31(0.02)	15.41(0.01)	21.75(0.02)	27.64(0.03)	33.19(0.04)	21.25(0.02)	
$\mathbf{a}(h_{y^*}(\mathbf{x})) \cdot \mathbf{a}(h_{y^c}(\mathbf{x}))$	8.39(0.04)	15.43(0.08)	21.79(0.11)	27.70(0.13)	33.28(0.15)	21.32(0.10)	
$\mathbf{a}(h_{y^*}(\mathbf{x})) \cdot \mathbf{a}(h_{y^c}(\mathbf{x})) \cdot \mathbf{a}(s^s(\mathbf{x}))$	8.30(0.05)	15.40(0.06)	21.82(0.09)	27.81(0.11)	33.45(0.15)	21.36(0.09)	
$\mathbf{a}(h_{y^*}(\mathbf{x})) \cdot \mathbf{a}(h_{y^c}(\mathbf{x})) \cdot \mathbf{a}(s^c(\mathbf{x}))$	8.31(0.04)	15.39(0.06)	21.83(0.09)	27.81(0.12)	33.45(0.14)	21.36(0.09)	
$\mathbf{a}(h_{y^*}(\mathbf{x})) \cdot \mathbf{a}(h_{y^c}(\mathbf{x})) \cdot \mathbf{a}(s^e(\mathbf{x}))$	8.35(0.02)	15.42(0.00)	21.82(0.02)	27.78(0.02)	33.38(0.03)	21.35(0.01)	
Advanced users							
Explanation maps	10%	20%	30%	40%	50%	Avg.	
$\mathbf{a}(h_{y^*}(\mathbf{x}))$	5.56(0.03)	8.89(0.11)	11.36(0.11)	13.32(0.21)	14.98(0.24)	10.82(0.14)	
$\mathbf{a}(h_{y^*}(\mathbf{x})) \cdot \mathbf{a}(h_{y^c}(\mathbf{x}))$	5.54(0.18)	8.95(0.32)	11.55(0.41)	13.63(0.45)	15.35(0.54)	11.00(0.38)	
$\mathbf{a}(h_{y^*}(\mathbf{x})) \cdot \mathbf{a}(h_{y^c}(\mathbf{x})) \cdot \mathbf{a}(s^s(\mathbf{x}))$	5.60(0.12)	9.04(0.25)	11.72(0.32)	13.82(0.42)	15.57(0.49)	11.15(0.32)	
$\mathbf{a}(h_{y^*}(\mathbf{x})) \cdot \mathbf{a}(h_{y^c}(\mathbf{x})) \cdot \mathbf{a}(s^c(\mathbf{x}))$	5.57(0.11)	9.05(0.26)	11.72(0.34)	13.83(0.44)	15.56(0.49)	11.15(0.33)	
$\mathbf{a}(h_{y^*}(\mathbf{x})) \cdot \mathbf{a}(h_{y^c}(\mathbf{x})) \cdot \mathbf{a}(s^e(\mathbf{x}))$	5.57(0.15)	9.08(0.22)	11.73(0.35)	14.01(0.50)	15.62(0.58)	11.20(0.36)	

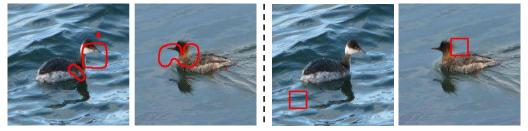
Table 1: Comparison to attributive explanations (ADE20K): Upper: on beginners, lower: on advanced users.

Parts	Attributes
back	back color, back pattern
beak	bill shape, bill length, bill color
belly	belly color, belly pattern
breast	breast color, breast pattern
crown	crown color, forehead color, head pattern
forehead	forehead color, head pattern
left/right eye	eye color, head pattern
left/right leg	leg color
left/right wing	wing color, wing shape, wing pattern
nape	nape color
tail	tail shape, upper tail color, under tail color, tail pattern
throat	throat color, head pattern

Table 2: Attributes assignments on CUB200 [7]



True: Scissor tailed Flycatcher (white breast, white forehead, white crown) Counter: Sayornis (buff breast, brown forehead, brown crown)



True: Horned Grebe (black bill, white breast) Counter: Red Breasted Merganser (orange bill, red breast)



True: Cape May Warbler (striped back pattern, black wing, eyeline head pattern) Counter: Yellow Warbler (solid back pattern, yellow wing, plain head pattern)



True: Rock Wren (buff forehead) Counter: Winter Wren (brown forehead)

Ours



Figure 1: Comparison of counterfactual explanations (true and counter classes shown below each example, and ground truth class-specific part attributes in parenthesis).

 $\mathbf{r}\{y^*, y^c\}(\mathbf{x})$ $\mathbf{r}\{y^{\scriptscriptstyle C},y^*\}(\mathbf{x}^{\scriptscriptstyle C})$





True: Yellow breasted Chat (grey forehead) Counter: Blue winged Warbler (yellow forehead)



True: Eared Grebe (grey throat, black nap, grey wing) Counter: Horned Grebe (black throat, buff nap, brown wing)



True: Ovenbird (buff bill, buff forehead) Counter: Northern Waterthrush (brown bill, brown forehead)



True: Northern Fulmar (grey bill, plain head pattern, white forehead) Counter: Pomarine Jaeger (black bill, capped head pattern, black forehead)

$$y^c$$
}(\mathbf{x}) \mathbf{r} { y^c ,

 $\mathbf{r}\{y^*$



True: Red eyed Vireo (eyeline head pattern) Counter: Warbling Vireo (plain head pattern)



True: Blue Jay (malar head pattern) Counter: Florida Jay (eyering head pattern)



True: Brewer Sparrow (brown forehead) Counter: Harris Sparrow (black forehead)



True: Golden winged Warbler (eyeline head pattern, yellow forehead) Counter: Myrtle Warbler (eyering head pattern, grey forehead)

Figure 2: Counterfactual explanations on CUB200 (true and counter classes shown below each example, and ground truth class-specific part attributes in parenthesis).

$\mathbf{r}\{y^*, y^c\}(\mathbf{x}) \quad \mathbf{r}\{y^c, y^*\}(\mathbf{x}^c)$





True: Barrel storage interior (barrel cask) Counter: Bomb shelter indoor (shelf box)





True: Conference room (screen, projection screen) Counter: Dining room (pillow)



True: Bayou (land, ground, soil) Counter: Motel (trade name, marque)



True: Cloister indoor (column, pillar) Counter: Bow window indoor (curtain, drape, mantle)

$\mathbf{r}\{y^*, y^c\}(\mathbf{x}) \quad \mathbf{r}\{y^c, y^*\}$





 \mathbf{x}^{c}

True: Bookstore (book) Counter: Videostore (placard, card)

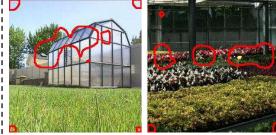




True: Auditorium (ceiling, curtain, seat) Counter: Tower (sky)



True: Backseat (seat, door) Counter: Escalator indoor (escalator, moving staircase)



True: Greenhouse outdoor (sky, tree, fence) Counter: Greenhouse indoor (ceiling)

Figure 3: Counterfactual explanations on ADE20K.