Huy Doan

In this project, I am using a technique called Grad-CAM saliency algorithm to generate class-discrimitative saliency maps for an input image. I am using a pretrained VGG-16 architecture for this exercise. Then I input an image, calculate gradient decent of particular predicted class, then use it to calculate saliency map for that class and create saliency heatmap superimposed of the input image.

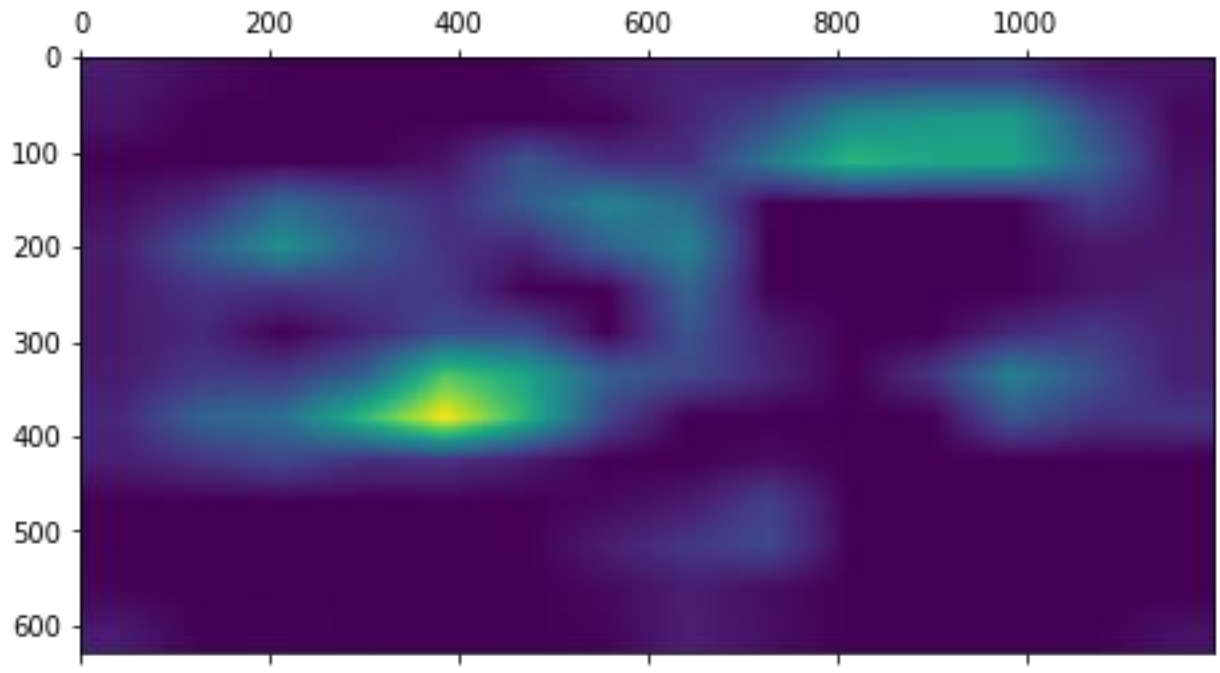
Image 1:

Top 3:

```
[[('n02106662', 'German_shepherd', 0.13195911), ('n02129604', 'tiger', 0.12158568), ('n02096051', 'Airedale', 0.09637665)]]
```

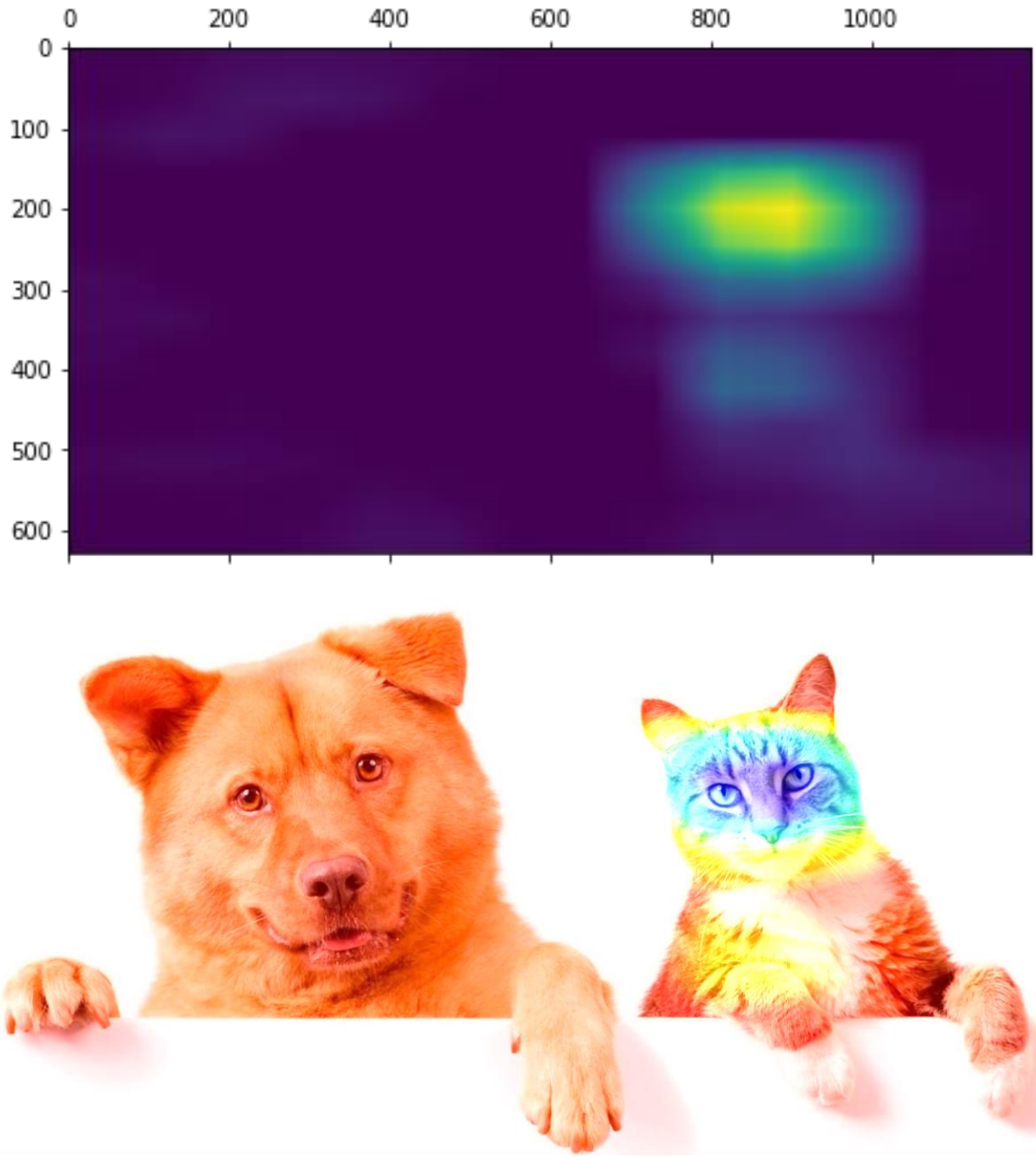
From the image above, the model predicts top 3 classification from the input in order: German shepherd, tiger, Airedale.

Rank 1: German_shepherd



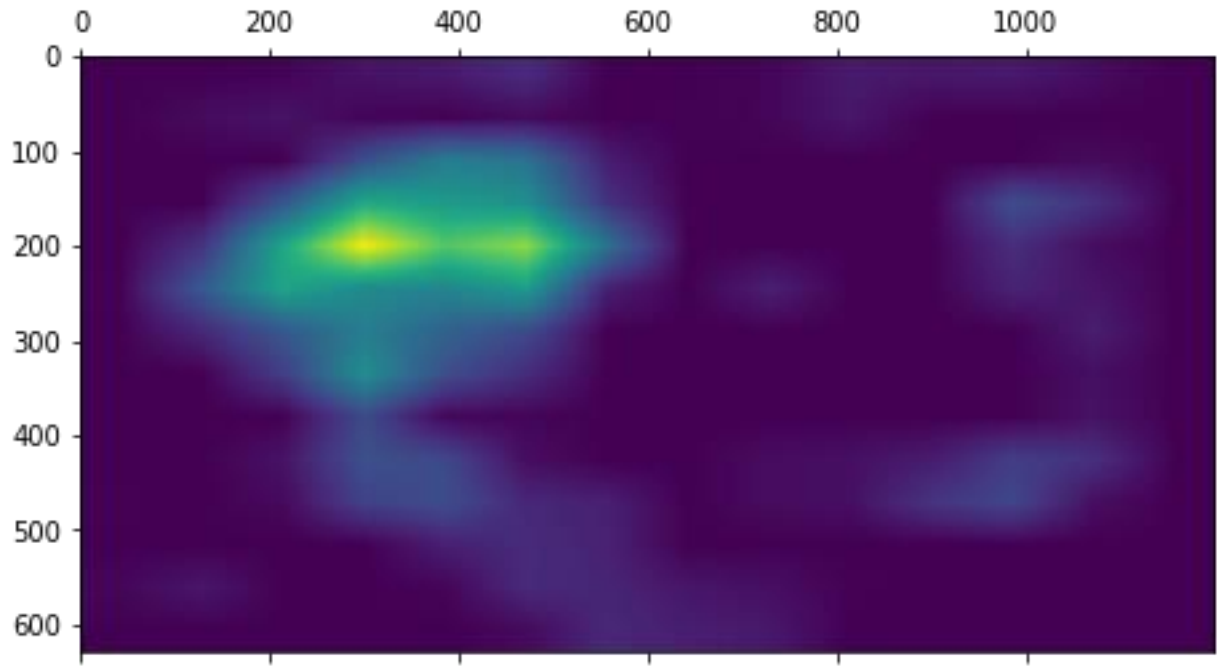
The heatmap mostly focus on a dog on the left of the image and a little on a cat. The dog on the left is not quite german shepherd as predicted but looks similar.

Rank 2: Tiger



The heatmap focus on the cat to the right. However, the model predicts this is a tiger. Cat is related to tiger but they are not the same. Maybe that's why the model misclassify the cat.

Rank 3: Airedale



Airedale is a breed of dog. Then the heatmap focus on the dog on the left. But obviously, this dog is not Airedale.

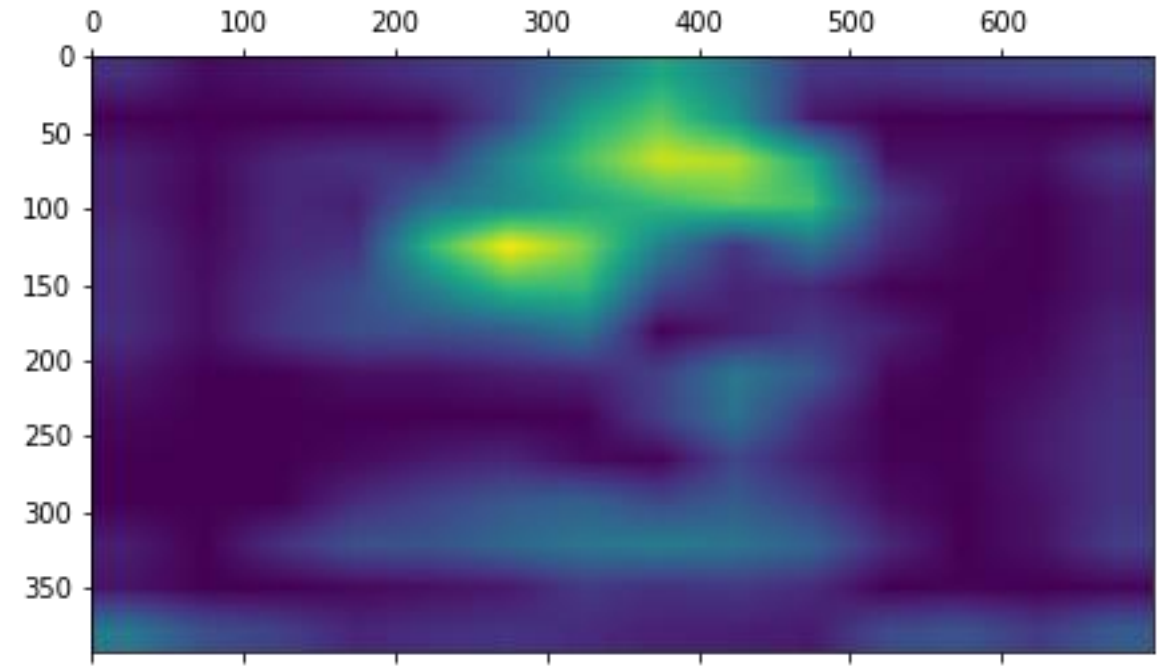
Image 2:

Top 3:

```
[[('n07734744', 'mushroom', 0.9786856), ('n12998815', 'agaric', 0.012714254), ('n13054560', 'bolete', 0.0039986954)]]
```

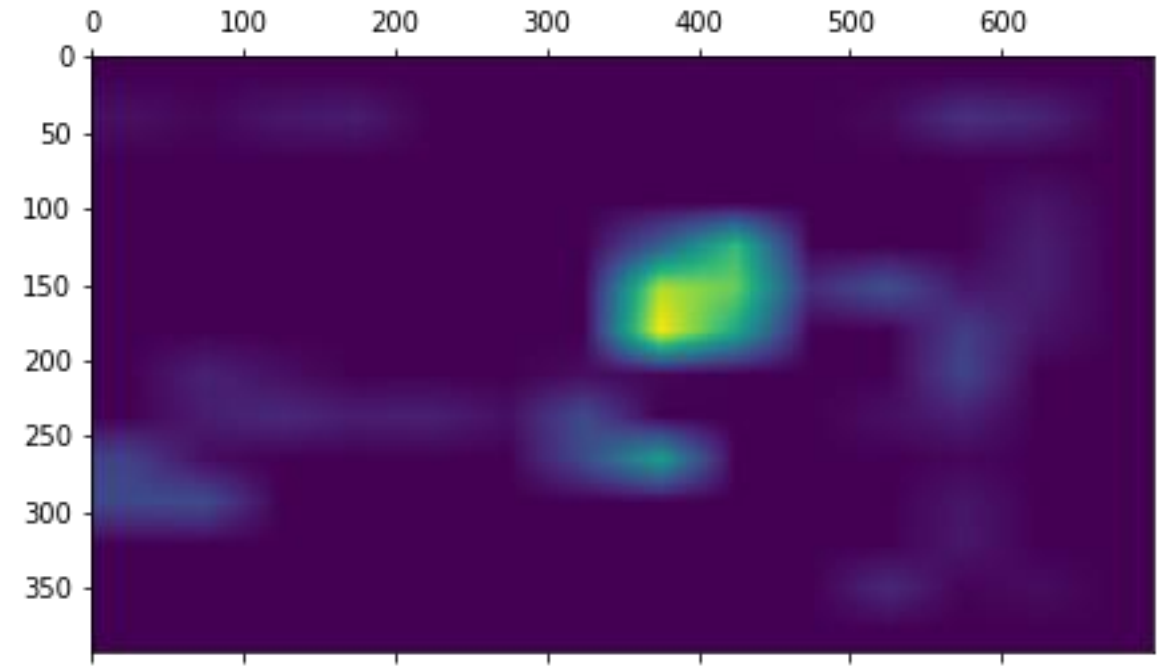
From the image above, the model predicts top 3 classification from the input in order: Mushroom, agaric, bolete.

Rank 1: Mushroom



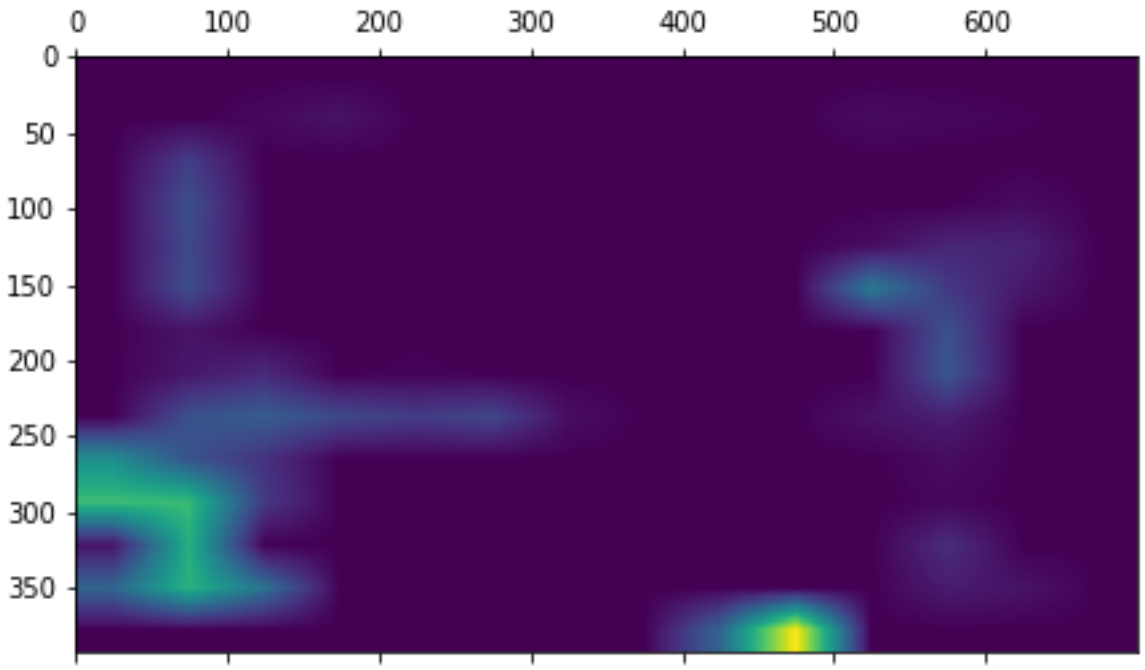
The heat map focus on the mushroom at the center of the image. This is quietly expected result. And the model predicted it correctly.

Rank 2: Agaric



The heatmap focus on a portion of mushroom at the center of the image. The model predicted this is agaric which is a type of mushroom. This is mushroom but it is not agaric obviously. But the model is till recognize the appearance of mushroom from the input.

Rank 3: Bolete



The heatmap in this case does not focus on the mushroom but the ground and the model predicted it is bolete. The ground is not quite similar to bolete as well. So the third ranked class in this case is not quite correct.

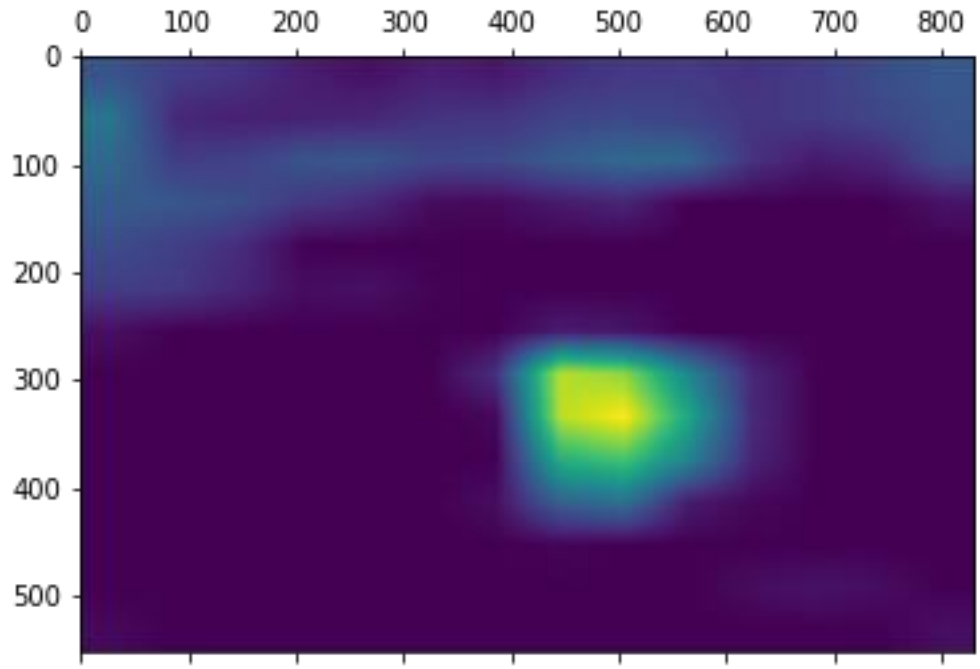
Image 3:

Top 3:

```
[[('n04467665', 'trailer_truck', 0.32379746), ('n04037443', 'racer', 0.24647827), ('n03930630', 'pickup', 0.15145892)]]
```

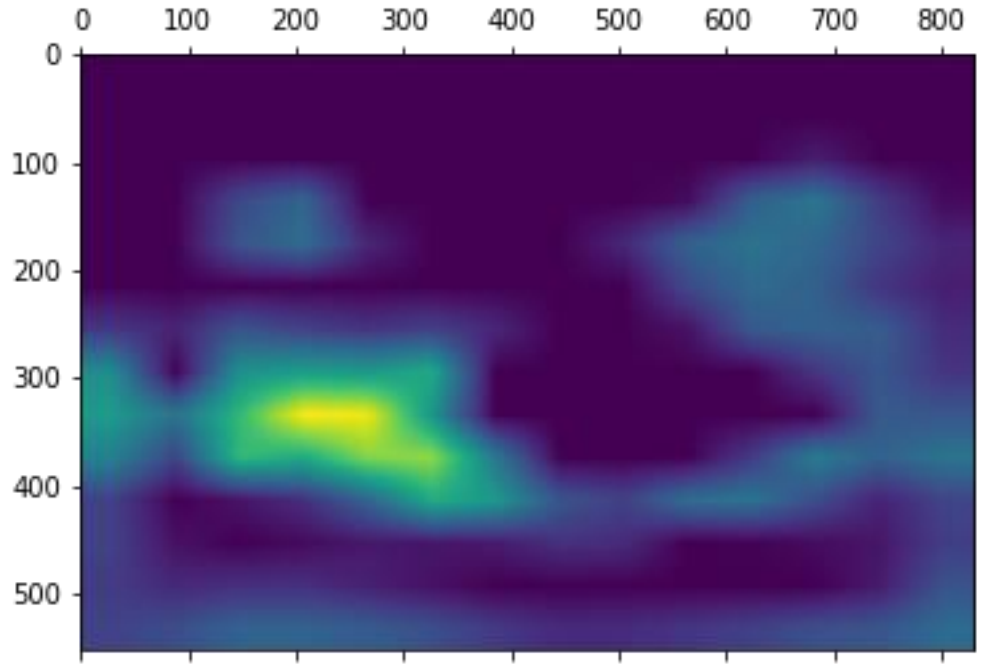
From the image above, the model predicts top 3 classification from the input in order: trailer truck, racer, pickup

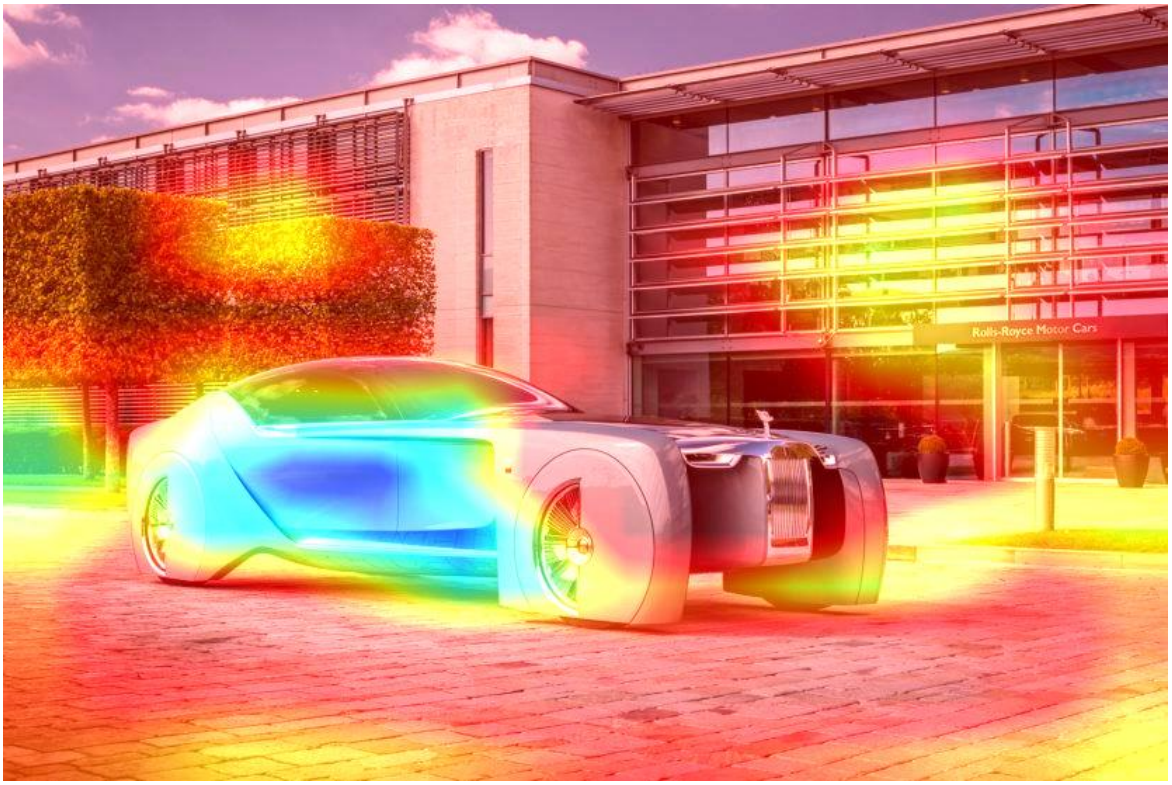
Rank 1: Trailer truck



The heat map focus on the head of the car and the model predicted this is a trailer truck. But we all know this is not a correct prediction. The model misclassifies in this case maybe because it focuses on the grill of the car seems like truck bed/tailgate.

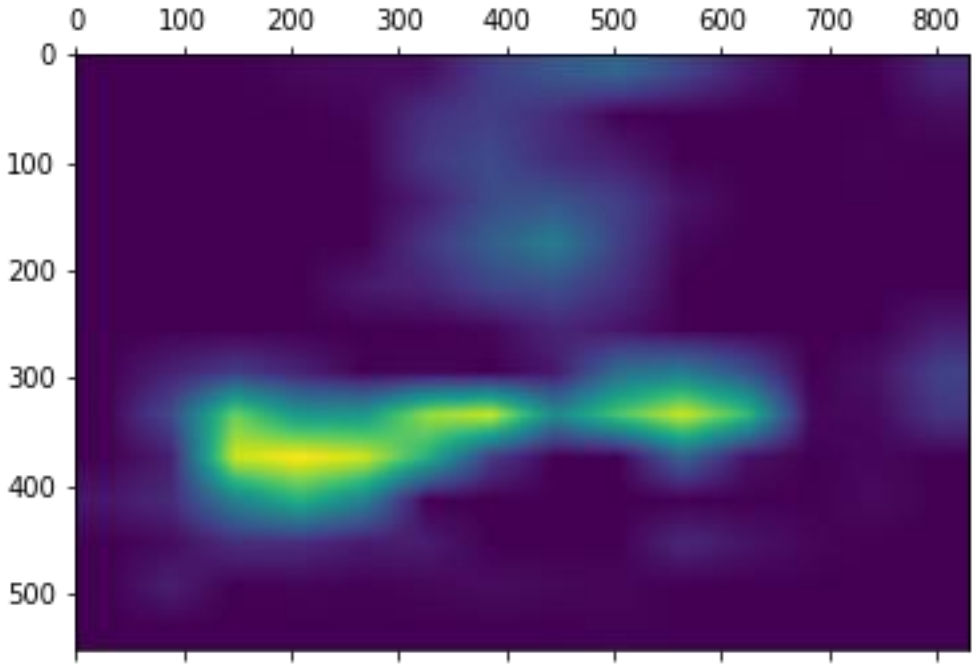
Rank 2: Racer





In second ranked class, the heat map focus on the body of the car not only the grill in first ranked class. And the model predicted this is a racer. It is quite correct in this case. Maybe because the model does not only focus on the grill car like the first ranked class but almost entire a car.

Rank 3: Pickup



The heatmap in third ranked class still focus on body of the car. And it predicted this is a pickup. The portion that heatmap focuses on looks like pickup truck body to the model. Maybe that's why the model predicted this is a pickup.

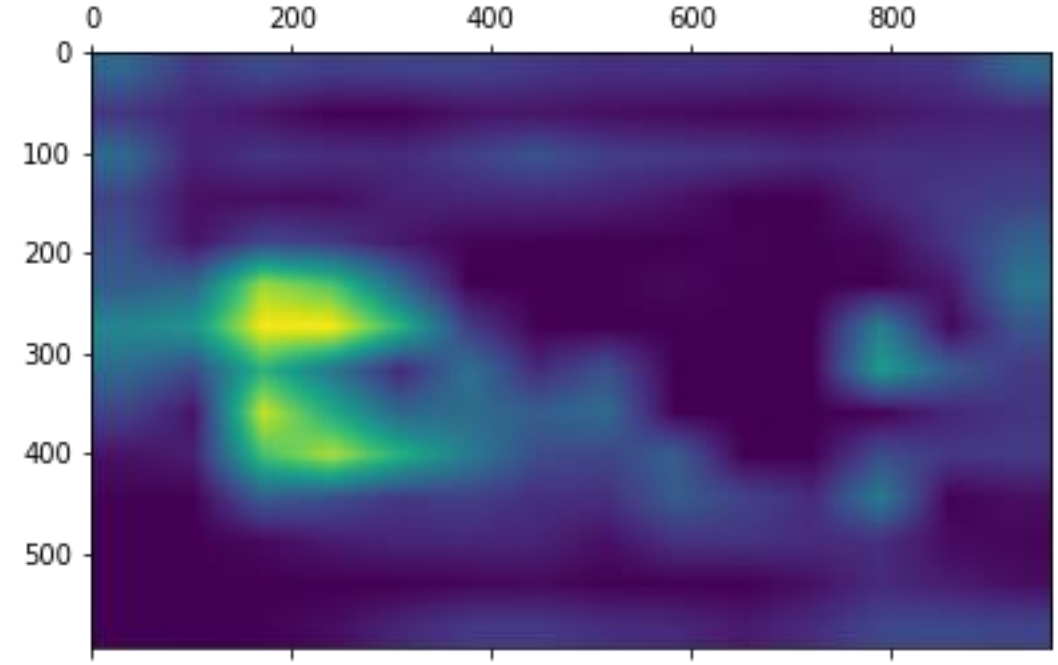
Image 4:

Top 3:

```
[[('n03590841', "jack-o'-lantern", 0.8195345), ('n07717410', 'acorn_squash', 0.07469447), ('n07716906', 'spaghetti_squash', 0.016359635)]]
```

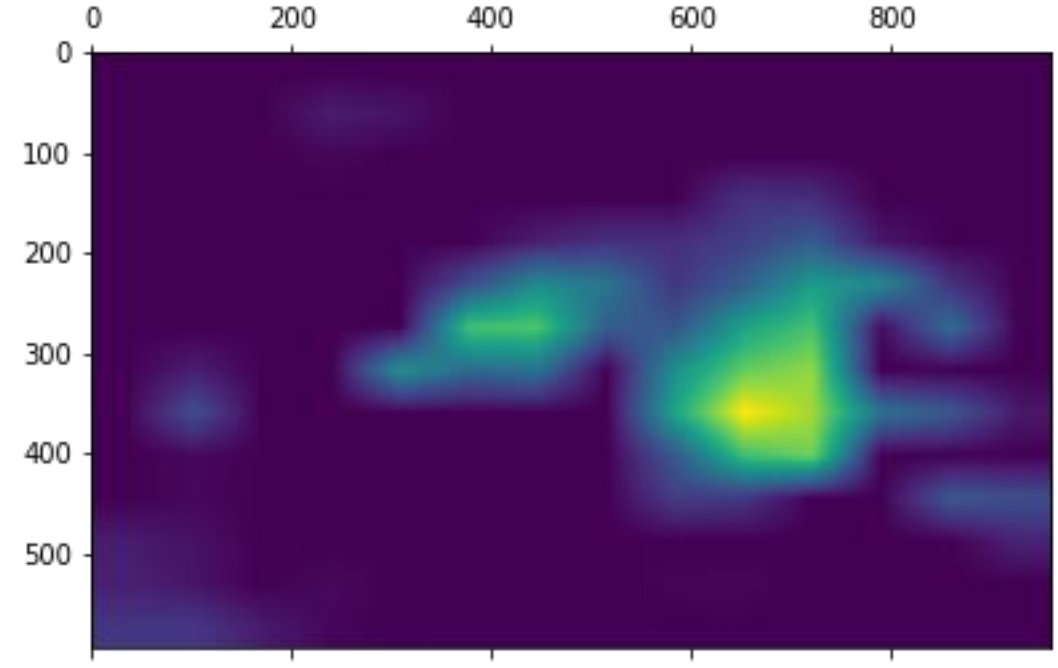
From the image above, the model predicts top 3 classification from the input in order: jack o lantern, acorn squash, spaghetti squash.

Rank 1: Jack o’ lantern



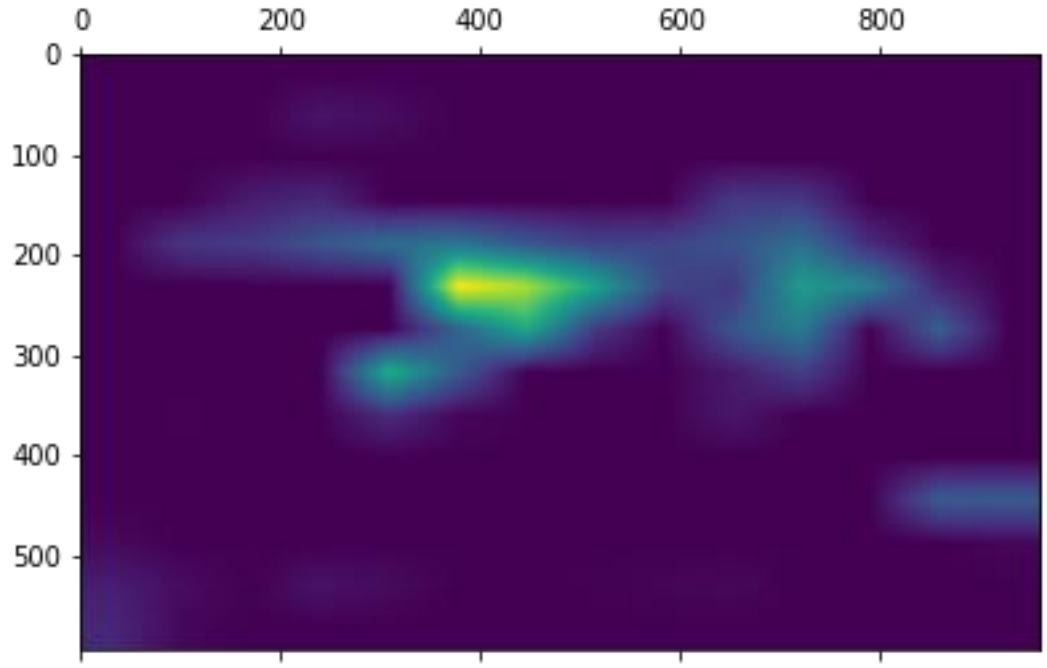
The heatmap focus on pumpkins on the left and predicted this is jack o lantern. These pumpkins are not carved anyway. But this result is still close to the recognition of human.

Rank 2: Acorn Squash



The heatmap of second ranked class focus on the pumpkins on the right and the model predicted this is acorn squash which is not right. But maybe because of the structure of pumpkins look alike acorn squash so that's why the model misclassifies in this case.

Rank 3: Spaghetti Squash



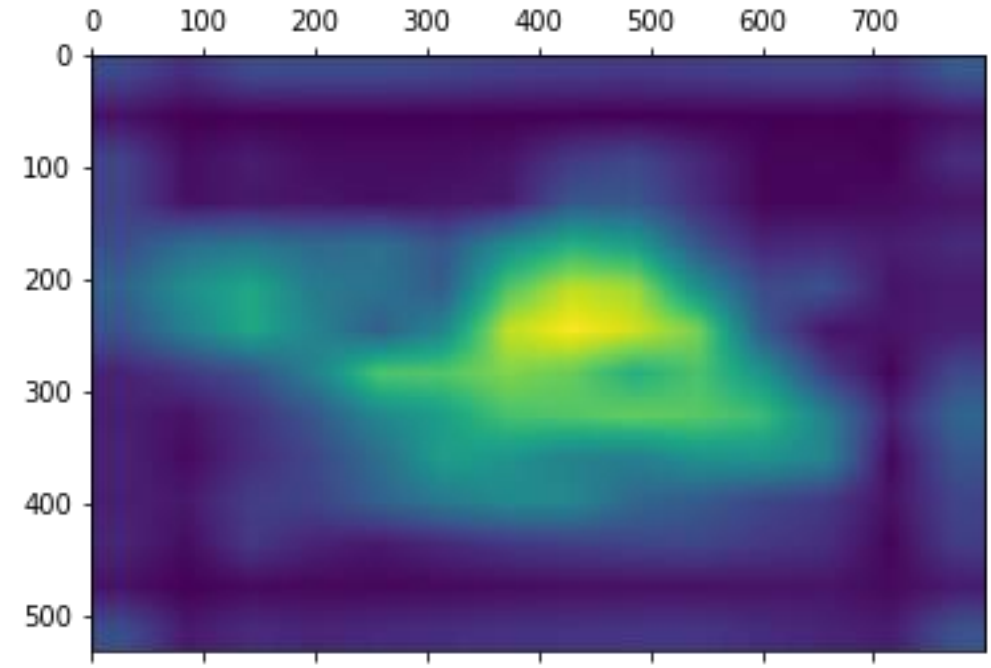
Similarly, The heatmap of third ranked class focus on the leaves in the middle of image and the model predicted this is spaghetti squash which is not right.

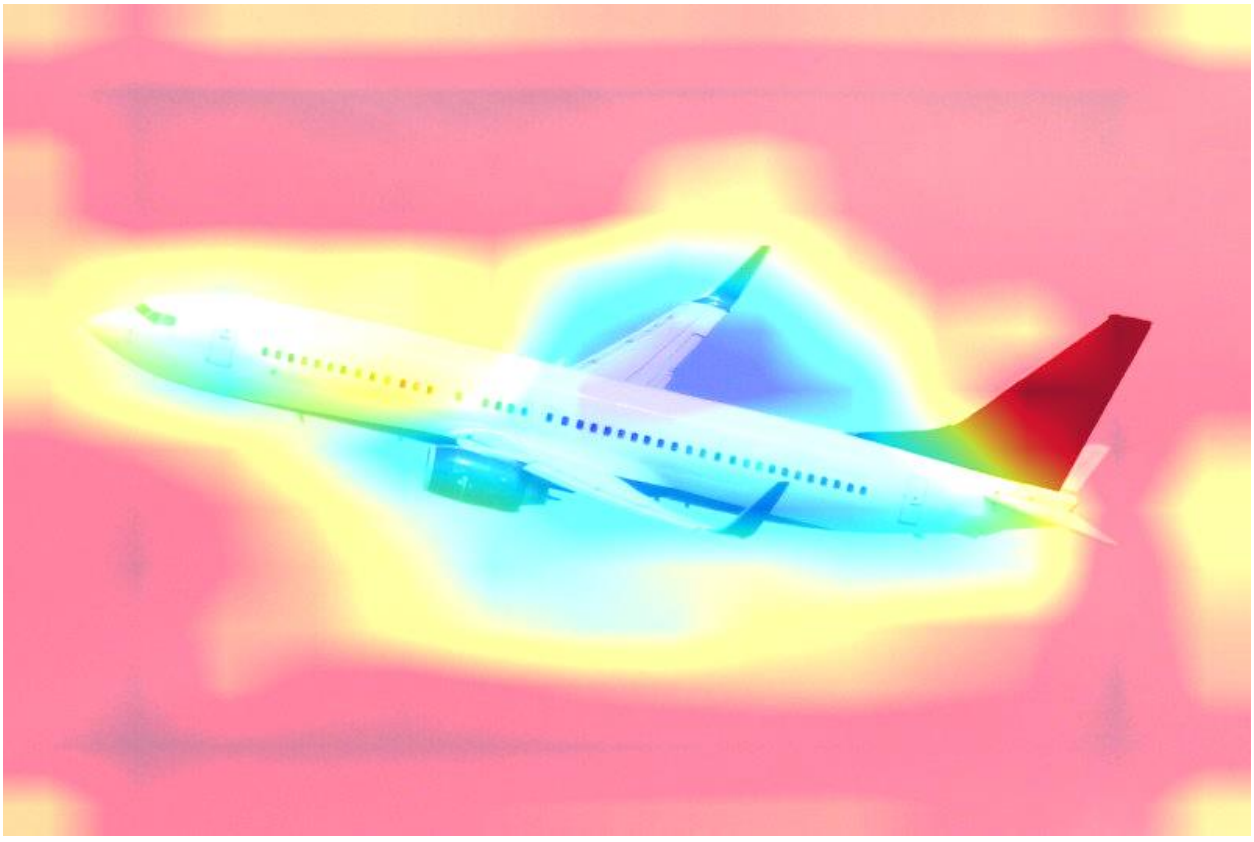
Image 5:

Top 3:

```
[('n02690373', 'airliner', 0.99102134), ('n04592741', 'wing', 0.008615654), ('n04266014', 'space_shuttle', 0.00017329847)]]
```

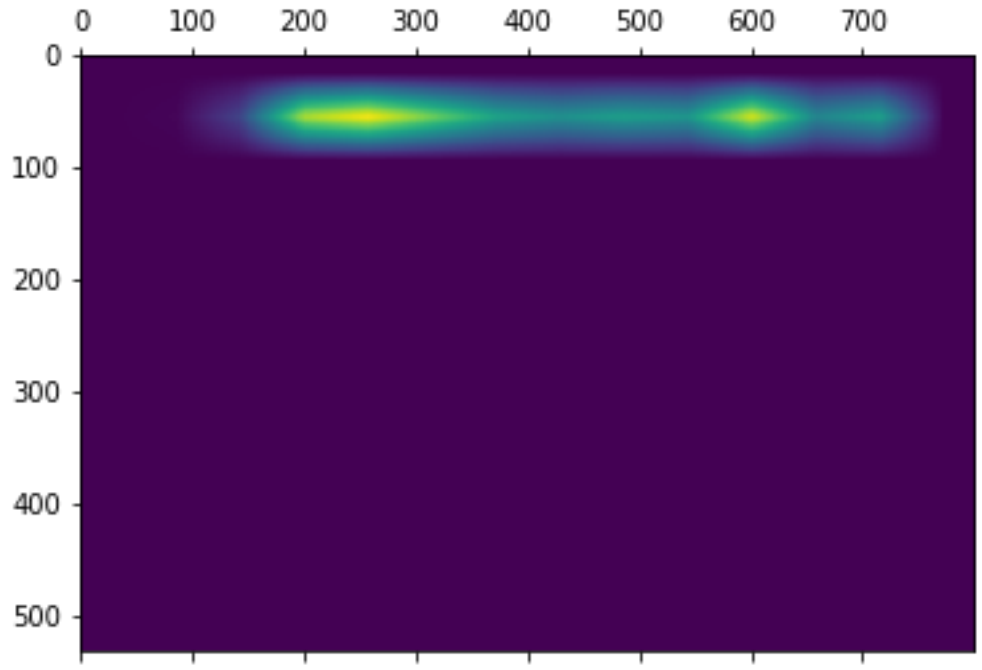
Rank 1: Airliner





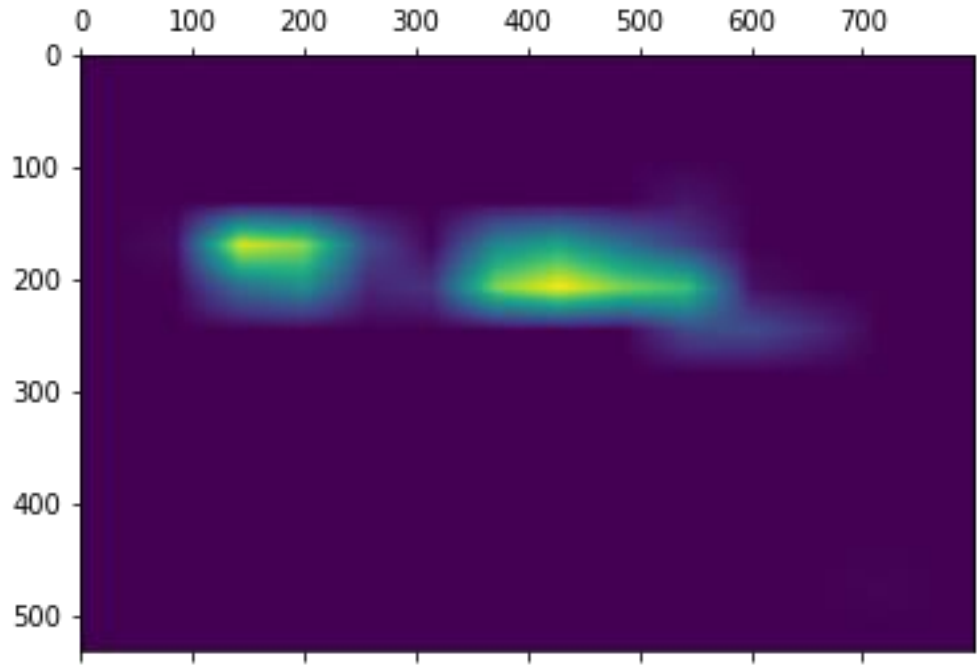
The heatmap focus on the whole plane and the model predicted this is an airliner which is correct.

Rank 2: Wing



Regrading the second ranked class, the heatmap focus on the sky, I think it is cloud. And the model predicted this is wing. The cloud may seem similar to the wing to the model. But this is not correct class.

Rank 3: Space Shuttle



In third ranked class, the model predicted this is space shuttle. The heatmap focus on portion of the plane. This is not quite a space shuttle but the plane looks alike to the space shuttle to the model. So that's why it misclassifies in this case.