

## Additional Learning

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Course	:	CSE4019 (Image Processing)
Slot	:	G2+TG2
Date of Submission	:	14 November 2018

## Additional Learning

**Coursera** - Convolutional Neural Networks by deeplearning.ai (Andrew NG)

**Certificate Link:** <https://www.coursera.org/account/accomplishments/verify/SMEDKK2G4BET>

**Course Completed on:** 19th October 2018

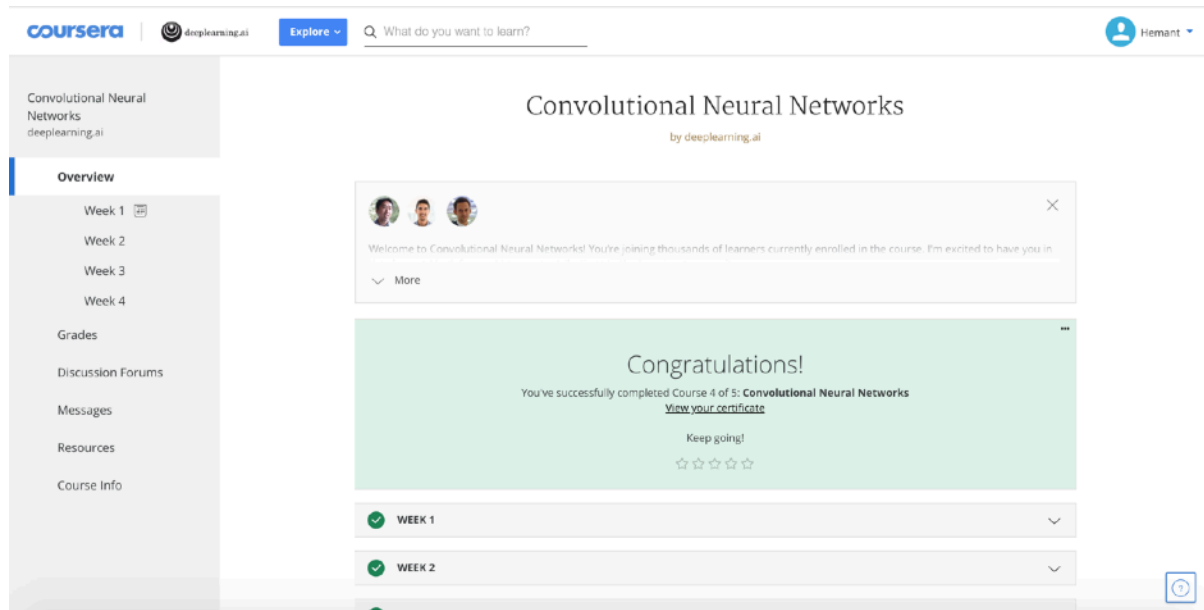
**Grade/Marks Obtained:** 100%

Note: All of the code in the programming assignments is available in my GitHub repo:  
<https://github.com/hhk998402/Convolutional-Neural-Networks-deeplearning.ai>

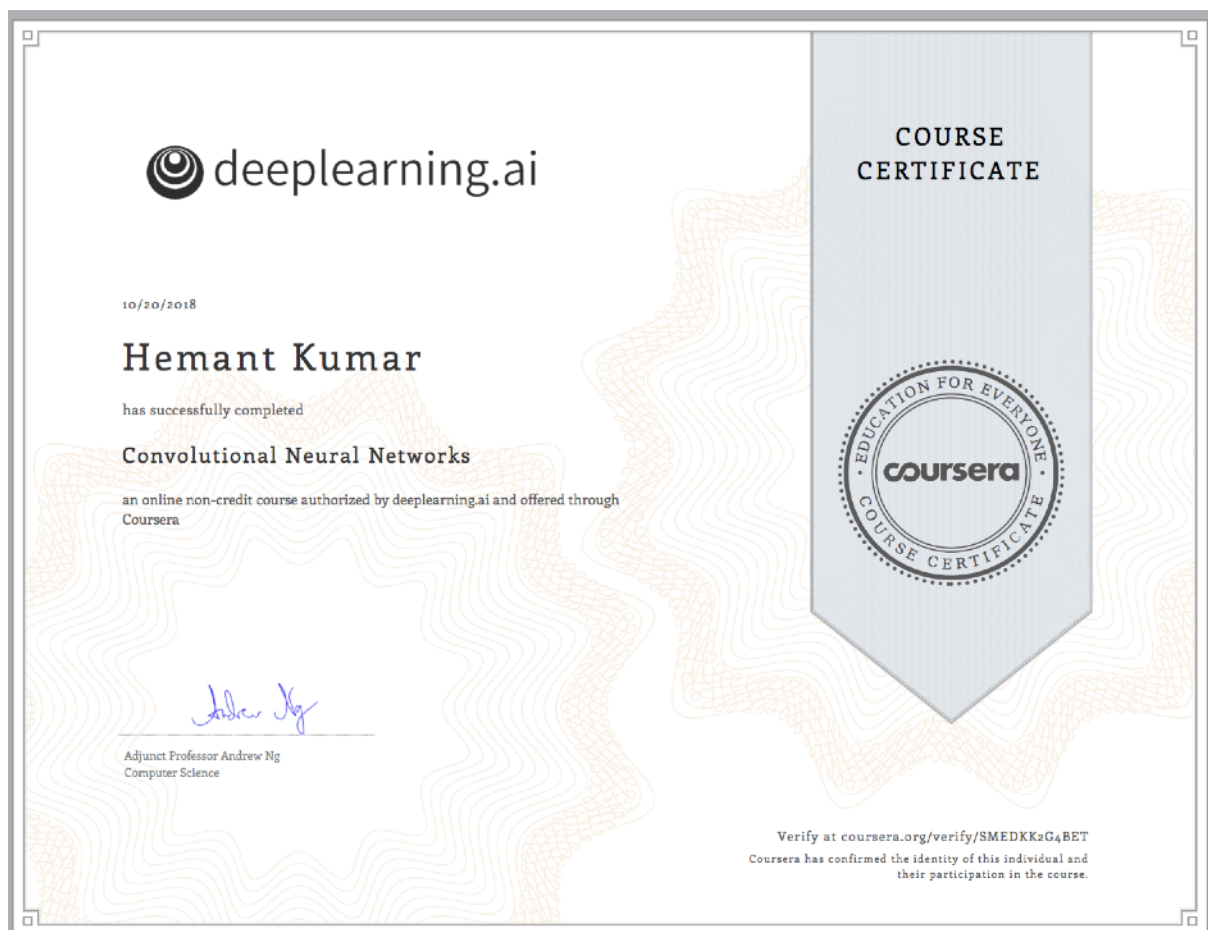
## Index

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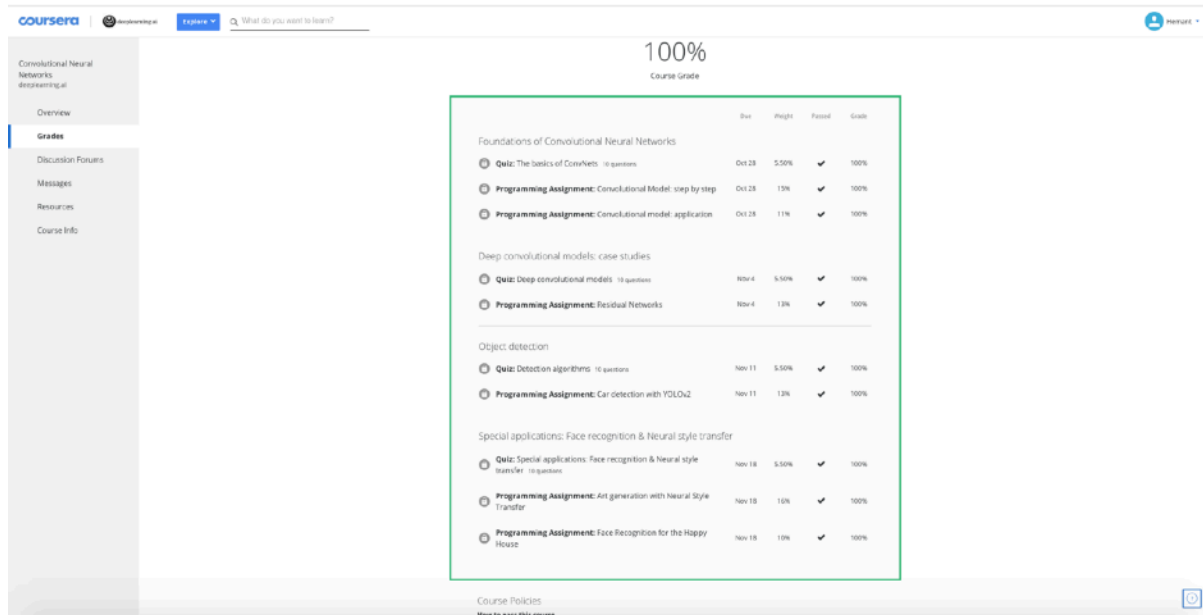
## 1. Course Home Page



## 2. Certificate



### 3. Grades/Marks List



The screenshot shows the 'Grades' section of a Coursera course titled 'Foundations of Convolutional Neural Networks'. The overall course grade is 100%. The table below lists the individual assignments and their scores.

Item	Due	Weight	Passed	Grade
<b>Foundations of Convolutional Neural Networks</b>				
Quiz: The basics of Convnets - 10 questions	Oct 28	5.50%	✓	100%
Programming Assignment: Convolutional Model: step by step	Oct 28	13%	✓	100%
Programming Assignment: Convolutional model: application	Oct 28	11%	✓	100%
<b>Deep convolutional models: case studies</b>				
Quiz: Deep convolutional models - 10 questions	Nov 4	5.50%	✓	100%
Programming Assignment: Residual Networks	Nov 4	13%	✓	100%
<b>Object detection</b>				
Quiz: Detection algorithms - 10 questions	Nov 11	5.50%	✓	100%
Programming Assignment: Car detection with YOLOv2	Nov 11	13%	✓	100%
<b>Special applications: Face recognition &amp; Neural style transfer</b>				
Quiz: Special applications: Face recognition & Neural style transfer - 10 questions	Nov 18	5.50%	✓	100%
Programming Assignment: Art generation with Neural Style Transfer	Nov 18	13%	✓	100%
Programming Assignment: Face Recognition for the Happy House	Nov 18	10%	✓	100%

Course Policies  
[How to pass this course](#)

## 4. Each Quiz and Programming Assignment Attempts

### Week 1: Quiz 1: The Basics of ConvNets

← The basics of ConvNets  
 Quiz, 10 questions

✓ Congratulations! You passed!
 [Next Item](#)

- ✓ 1. What do you think applying this filter to a grayscale image will do?  
 1 / 1 point
 
$$\begin{bmatrix} 0 & 1 & -1 & 0 \\ 1 & 3 & -3 & -1 \\ 1 & 3 & -3 & -1 \\ 0 & 1 & -1 & 0 \end{bmatrix}$$
- ✓ 2. Suppose your input is a 300 by 300 color (RGB) image, and you are not using a convolutional network. If the first hidden layer has 100 neurons, each one fully connected to the input, how many parameters does this hidden layer have (including the bias parameters)?  
 1 / 1 point
- ✓ 3. Suppose your input is a 300 by 300 color (RGB) image, and you use a convolutional layer with 100 filters that are each 5x5. How many parameters does this hidden layer have (including the bias parameters)?  
 1 / 1 point
- ✓ 4. You have an input volume that is 63x63x16, and convolve it with 32 filters that are each 7x7, using a stride of 2 and no padding. What is the output volume?  
 1 / 1 point
- ✓ 5. You have an input volume that is 15x15x8, and pad it using "pad=2." What is the dimension of the resulting volume (after padding)?  
 1 / 1 point
- ✓ 6. You have an input volume that is 63x63x16, and convolve it with 32 filters that are each 7x7, and stride of 1. You want to use a "same" convolution. What is the padding?  
 1 / 1 point
- ✓ 7. You have an input volume that is 32x32x16, and apply max pooling with a stride of 2 and a filter size of 2. What is the output volume?  
 1 / 1 point
- ✓ 8. Because pooling layers do not have parameters, they do not affect the backpropagation (derivatives) calculation.  
 1 / 1 point
- ✓ 9. In lecture we talked about "parameter sharing" as a benefit of using convolutional networks. Which of the following statements about parameter sharing in ConvNets are true? (Check all that apply.)  
 1 / 1 point
- ✓ 10. In lecture we talked about "sparsity of connections" as a benefit of using convolutional layers. What does this mean?  
 1 / 1 point

**convolution model - Step by Step - v2** Last Checkpoint: 10/19/2018 (autosaved)

```

In [ ]: np.random.seed(1)
A_prev = np.random.randn(5, 5, 3, 2)
hparameters = {"stride": 1, "f": 2}
A, cache = pool_forward(A_prev, hparameters)
dA = np.random.randn(5, 4, 2, 2)

dA_prev = pool_backward(dA, cache, mode = "max")
print("mode = max")
print('mean of dA = ', np.mean(dA))
print('dA_prev[1,1] = ', dA_prev[1,1])
print()
dA_prev = pool_backward(dA, cache, mode = "average")
print("mode = average")
print('mean of dA = ', np.mean(dA))
print('dA_prev[1,1] = ', dA_prev[1,1])

```

**Expected Output:**

mode = max:

```

mean of dA = 0.145713902729
dA_prev[1,1] = [[ 0. 0.]
                [ 5.05844394 -1.68282702]
                [ 0. 0.]]

```

mode = average

```

mean of dA = 0.145713902729
dA_prev[1,1] = [[ 0.08485462 0.2787552 ]
                [ 0. 0.]]

```

**Programming Assignment: Convolutional Model: step by step**

✓ Passed · 60/60 points

**Deadline** The assignment was due on October 28, 11:59 PM PDT  
You can still pass this assignment before the course ends.

Instructions **My submission** Discussions

[Upgrade to submit](#)

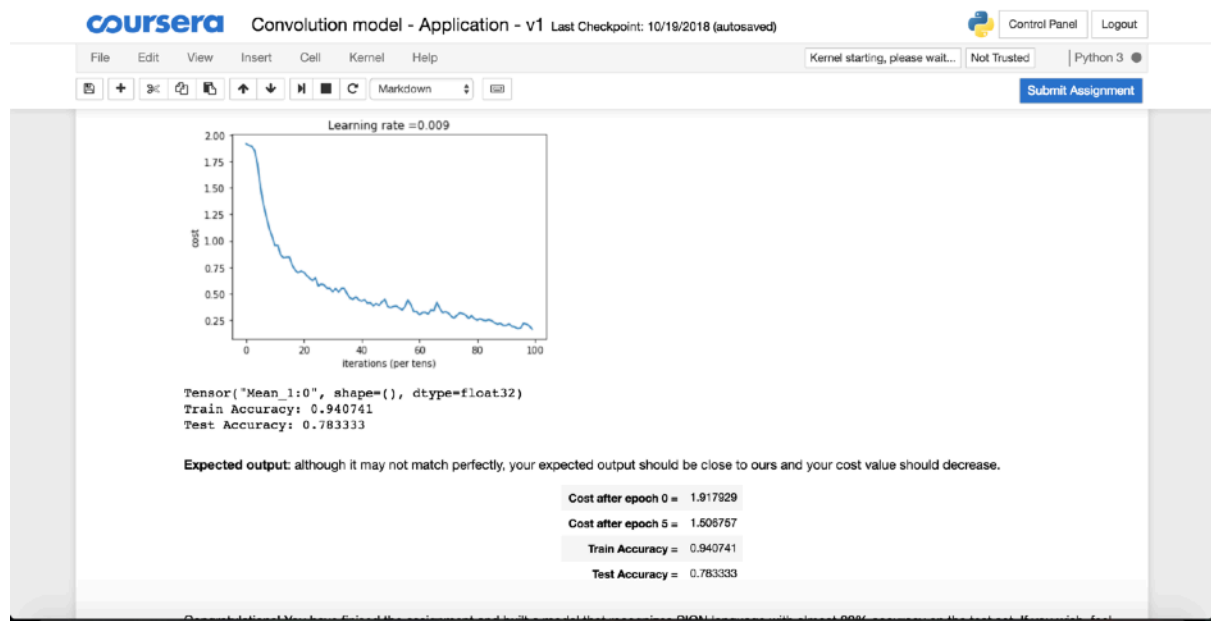
**Your Submissions**

Date	Score	Passed?
✓ 19 October 2018 at 2:19 PM	60/60	Yes
Pad with zeros	10/10	<a href="#">Show grader output</a>
Convolve single step	20/20	<a href="#">Show grader output</a>
Convolve forward	10/10	<a href="#">Show grader output</a>
pool forward	20/20	<a href="#">Show grader output</a>
➤ 19 October 2018 at 2:13 PM	0/60	No

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## Week 1:

### Programming Assignment 1: Convolution model - Step by Step - v2



**Programming Assignment: Convolutional model: application**  
 ✓ Passed · 50/50 points

**Deadline** The assignment was due on October 28, 11:59 PM PDT  
 You can still pass this assignment before the course ends.

Instructions **My submission** Discussions

[Upgrade to submit](#)

**Your Submissions**

Date	Score	Passed?
✓ 20 October 2018 at 2:36 AM	50/50	Yes
create_placeholders	10/10	<a href="#">Show grader output</a>
initialize_parameters	10/10	<a href="#">Show grader output</a>
forward_propagation	10/10	<a href="#">Show grader output</a>
compute_cost	10/10	<a href="#">Show grader output</a>
model	10/10	<a href="#">Show grader output</a>

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### Week 1:

### Programming Assignment 2: Convolution model: Application

← Deep convolutional models  
 Quiz, 10 questions

✓ Congratulations! You passed!
 [Next Item](#)

- ✓ 1. Which of the following do you typically see as you move to deeper layers in a ConvNet?  
 1 / 1 point
- ✓ 2. Which of the following do you typically see in a ConvNet? (Check all that apply.)  
 1 / 1 point
- ✓ 3. In order to be able to build very deep networks, we usually only use pooling layers to downsize the height/width of the activation volumes while convolutions are used with "valid" padding. Otherwise, we would downsize the input of the model too quickly.  
 1 / 1 point
- ✓ 4. Training a deeper network (for example, adding additional layers to the network) allows the network to fit more complex functions and thus almost always results in lower training error. For this question, assume we're referring to "plain" networks.  
 1 / 1 point
- ✓ 5. The following equation captures the computation in a ResNet block. What goes into the two blanks above?  

$$a^{[l+2]} = \text{g}(W^{[l+2]} \text{g}(W^{[l+1]} I^{[l]} + b^{[l+1]} + \text{_____}) + \text{_____})$$
 1 / 1 point
- ✓ 6. Which ones of the following statements on Residual Networks are true? (Check all that apply.)  
 1 / 1 point
- ✓ 7. Suppose you have an input volume of dimension 64x64x16. How many parameters would a single 1x1 convolutional filter have (including the bias)?  
 1 / 1 point
- ✓ 8. Suppose you have an input volume of dimension  $n_H \times n_W \times n_C$ . Which of the following statements you agree with? (Assume that "1x1 convolutional layer" below always uses a stride of 1 and no padding.)  
 1 / 1 point
- ✓ 9. Which ones of the following statements on Inception Networks are true? (Check all that apply.)  
 1 / 1 point
- ✓ 10. Which of the following are common reasons for using open-source implementations of ConvNets (both the model and/or weights)? Check all that apply.  
 1 / 1 point

## Week 2:

### Quiz 1: Deep Convolutional Models



**coursera** Residual Networks - v2 Last Checkpoint: 10/20/2018 (autosaved) Control Panel Logout

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You can also print a summary of your model by running the following code.

```
In [16]: model.summary()
```

activation_7 (Activation)	(None, 15, 15, 256)	0	add_2[0][0]
res2b_branch2a (Conv2D)	(None, 15, 15, 64)	16448	activation_7[0][0]
bn2b_branch2a (BatchNormalizatio	(None, 15, 15, 64)	256	res2b_branch2a[0][0]
activation_8 (Activation)	(None, 15, 15, 64)	0	bn2b_branch2a[0][0]
res2b_branch2b (Conv2D)	(None, 15, 15, 64)	36928	activation_8[0][0]
bn2b_branch2b (BatchNormalizatio	(None, 15, 15, 64)	256	res2b_branch2b[0][0]
activation_9 (Activation)	(None, 15, 15, 64)	0	bn2b_branch2b[0][0]
res2b_branch2c (Conv2D)	(None, 15, 15, 256)	16640	activation_9[0][0]
bn2b_branch2c (BatchNormalizatio	(None, 15, 15, 256)	1024	res2b_branch2c[0][0]
add_3 (Add)	(None, 15, 15, 256)	0	bn2b_branch2c[0][0] activation_7[0][0]

Finally, run the code below to visualize your ResNet50. You can also download a .png picture of your model by going to "File -> Open...-> model.png".

```
In [17]: plot_model(model, to_file='model.png')
         SVG(model_to_dot(model).create(prog='dot', format='svg'))
```

Out[17]: <IPython.core.display.SVG object>

**Programming Assignment: Residual Networks**

✓ Passed · 100/100 points

**Deadline** The assignment was due on November 4, 10:59 PM PST  
You can still pass this assignment before the course ends.

Instructions **My submission** Discussions

[Upgrade to submit](#)

Your Submissions

Date	Score	Passed?
▼ 20 October 2018 at 3:03 AM	100/100	Yes
identity_block	30/30	<a href="#">Show grader output</a>
convolutional_block	40/40	<a href="#">Show grader output</a>
ResNet50	30/30	<a href="#">Show grader output</a>

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## Week 2:

### Programming Assignment 1: Residual Networks

← Detection algorithms  
Quiz, 10 questions

✓ Congratulations! You passed!

Next item

✓  
1 / 1  
point

1. You are building a 3-class object classification and localization algorithm. The classes are: pedestrian ( $c=1$ ), car ( $c=2$ ), motorcycle ( $c=3$ ). What would be the label for the following image? Recall  $y = [p_c, b_x, b_y, b_h, b_w, c_1, c_2, c_3]$



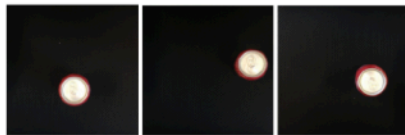
✓  
1 / 1  
point

2. Continuing from the previous problem, what should  $y$  be for the image below? Remember that "?" means "don't care", which means that the neural network loss function won't care what the neural network gives for that component of the output. As before,  $y = [p_c, b_x, b_y, b_h, b_w, c_1, c_2, c_3]$ .



✓  
1 / 1  
point

3. You are working on a factory automation task. Your system will see a can of soft-drink coming down a conveyor belt, and you want it to take a picture and decide whether (i) there is a soft-drink in the image, and if so (ii) its bounding box. Since the soft-drink can is round, the bounding box is always square, and the soft-drink can always appears as the same size in the image. There is at most one soft-drink can in each image. Here're some typical images in your training set:



What is the most appropriate set of output units for your neural network?

✓  
1 / 1  
point

10. Suppose you are using YOLO on a  $19 \times 19$  grid, on a detection problem with 20 classes, and with 5 anchor boxes. During training, for each image you will need to construct an output volume  $y$  as the target value for the neural network; this corresponds to the last layer of the neural network. ( $y$  may include some "?", or "don't cares"). What is the dimension of this output volume?

✓  
1 / 1  
point

4. If you build a neural network that inputs a picture of a person's face and outputs  $N$  landmarks on the face (assume the input image always contains exactly one face), how many output units will the network have?

✓  
1 / 1  
point

5. When training one of the object detection systems described in lecture, you need a training set that contains many pictures of the object(s) you wish to detect. However, bounding boxes do not need to be provided in the training set, since the algorithm can learn to detect the objects by itself.

✓  
1 / 1  
point

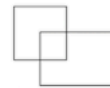
6. Suppose you are applying a sliding windows classifier (non-convolutional implementation). Increasing the stride would tend to increase accuracy, but decrease computational cost.

✓  
1 / 1  
point

7. In the YOLO algorithm, at training time, only one cell—the one containing the center/midpoint of an object—is responsible for detecting this object.

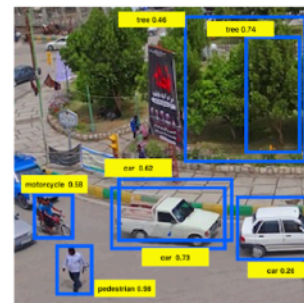
✓  
1 / 1  
point

8. What is the IoU between these two boxes? The upper-left box is  $2 \times 2$ , and the lower-right box is  $2 \times 3$ . The overlapping region is  $1 \times 1$ .



✓  
1 / 1  
point

9. Suppose you run non-max suppression on the predicted boxes above. The parameters you use for non-max suppression are that boxes with probability  $\leq 0.4$  are discarded, and the IoU threshold for deciding if two boxes overlap is 0.5. How many boxes will remain after non-max suppression?



## Week 3:

### Quiz 1: Detection Algorithms


**coursera** Autonomous driving application - Car detection - v3 Last Checkpoint: 10/20/2018 (autosaved) Control Panel Logout

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Run the following cell on the "test.jpg" image to verify that your function is correct.

```
In [18]: out_scores, out_boxes, out_classes = predict(sess, "test.jpg")
```

Found 7 boxes for test.jpg  
 car 0.60 (925, 285) (1045, 374)  
 car 0.66 (706, 279) (786, 350)  
 bus 0.67 (5, 266) (220, 407)  
 car 0.70 (947, 324) (1280, 705)  
 car 0.74 (159, 303) (346, 440)  
 car 0.80 (761, 282) (942, 412)  
 car 0.89 (367, 300) (745, 648)



**Expected Output:**

**Programming Assignment: Car detection with YOLOv2**  
 ✓ Passed · 40/40 points

**Deadline** The assignment was due on November 11, 10:59 PM PST  
 You can still pass this assignment before the course ends.

Instructions **My submission** Discussions

[Upgrade to submit](#)

**Your Submissions**

Date	Score	Passed?
▼ 20 October 2018 at 4:27 AM	40/40	Yes
yolo_filter_boxes	10/10	<a href="#">Show grader output</a>
iou .	10/10	<a href="#">Show grader output</a>
yolo_non_max_suppression	10/10	<a href="#">Show grader output</a>
yolo_eval	10/10	<a href="#">Show grader output</a>
➤ 20 October 2018 at 3:40 AM	30/40	No
➤ 20 October 2018 at 3:25 AM	30/40	No
➤ 20 October 2018 at 3:17 AM	30/40	No

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### Week 3:

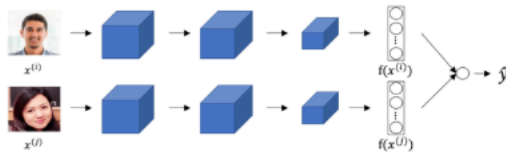
#### Programming Assignment 1: Autonomous driving application - Car detection - v3

← Special applications: Face recognition & Neural style transfer  
Quiz, 10 questions

✓ **Congratulations! You passed!**

Next Item

1. Face verification requires comparing a new picture against one person's face, whereas face recognition requires comparing a new picture against K person's faces.  
1 / 1 point
2. Why do we learn a function  $d(img1, img2)$  for face verification? (Select all that apply.)  
1 / 1 point
3. In order to train the parameters of a face recognition system, it would be reasonable to use a training set comprising 100,000 pictures of 100,000 different persons.  
1 / 1 point
4. Which of the following is a correct definition of the triplet loss? Consider that  $\alpha > 0$ . (We encourage you to figure out the answer from first principles, rather than just refer to the lecture.)  
1 / 1 point
5. Consider the following Siamese network architecture:  
1 / 1 point



The upper and lower neural networks have different input images, but have exactly the same parameters.

6. You train a ConvNet on a dataset with 100 different classes. You wonder if you can find a hidden unit which responds strongly to pictures of cats. (I.e., a neuron so that, of all the input/training images that strongly activate that neuron, the majority are cat pictures.) You are more likely to find this unit in layer 4 of the network than in layer 1.  
1 / 1 point
7. Neural style transfer is trained as a supervised learning task in which the goal is to input two images ( $x$ ), and train a network to output a new, synthesized image ( $y$ ).  
1 / 1 point
8. In the deeper layers of a ConvNet, each channel corresponds to a different feature detector. The style matrix  $G^{(l)}$  measures the degree to which the activations of different feature detectors in layer  $l$  vary (or correlate) together with each other.  
1 / 1 point
9. In neural style transfer, what is updated in each iteration of the optimization algorithm?  
1 / 1 point
10. You are working with 3D data. You are building a network layer whose input volume has size  $32 \times 32 \times 32 \times 16$  (this volume has 16 channels), and applies convolutions with 32 filters of dimension  $3 \times 3 \times 3$  (no padding, stride 1). What is the resulting output volume?  
1 / 1 point

### Week 4:

### Quiz 1: Special applications: Face recognition & Neural style transfer


**coursera** Art Generation with Neural Style Transfer - v2 Last Checkpoint: 10/20/2018 (autosaved)

File Edit View Insert Cell Kernel Widgets Help Not Trusted Python 3 Submit Assignment

You're done! After running this, in the upper bar of the notebook click on "File" and then "Open". Go to the "/output" directory to see all the saved images. Open "generated\_image" to see the generated image! :)

You should see something like the image presented below on the right:


**content image**



louvre museum

+


**style image**



impressionist style painting

=

**generated image**



louvre painting with impressionist style

We didn't want you to wait too long to see an initial result, and so had set the hyperparameters accordingly. To get the best looking results, running the optimization algorithm longer (and perhaps with a smaller learning rate) might work better. After completing and submitting this assignment, we encourage you to come back and play more with this notebook, and see if you can generate even better looking images.

Typesetting math: 0%

**Programming Assignment: Art generation with Neural Style Transfer**

✓ Passed · 40/40 points

**Deadline** Pass this assignment by November 18, 10:59 PM PST

Instructions **My submission** Discussions

[Upgrade to submit](#)

**Your Submissions**

Date	Score	Passed?
▼ 20 October 2018 at 6:07 AM	40/40	Yes
compute_content_cost	10/10	<a href="#">Show grader output</a>
gram_matrix	10/10	<a href="#">Show grader output</a>
compute_layer_style_cost	10/10	<a href="#">Show grader output</a>
total_cost	10/10	<a href="#">Show grader output</a>
➤ 20 October 2018 at 6:07 AM	40/40	Yes
➤ 20 October 2018 at 6:07 AM	40/40	Yes
➤ 20 October 2018 at 6:07 AM	40/40	Yes
➤ 20 October 2018 at 6:07 AM	40/40	Yes
➤ 20 October 2018 at 6:06 AM	40/40	Yes

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### Week 4:

### Programming Assignment 1: Art generation with Neural Style Transfer

**coursera** Face Recognition for the Happy House - v3 Last Checkpoint: 10/20/2018 (autosaved) Control Panel Logout

File Edit View Insert Cell Kernel Widgets Help Not Trusted Python 3 Submit Assignment

```
In [9]: verify("images/camera_0.jpg", "younes", database, FRmodel)
```


It's younes, welcome home!

```
Out[9]: (0.65939283, True)
```

**Expected Output:**

It's younes, welcome home! (0.65939283, True)

Benoit, who broke the aquarium last weekend, has been banned from the house and removed from the database. He stole Kian's ID card and came back to the house to try to present himself as Kian. The front-door camera took a picture of Benoit ("images/camera\_2.jpg). Let's run the verification algorithm to check if benoit can enter.



```
In [10]: verify("images/camera_2.jpg", "kian", database, FRmodel)
```

It's not kian, please go away

```
Out[10]: (0.86224014, False)
```

**Programming Assignment: Face Recognition for the Happy House**

✓ Passed · 30/30 points

**Deadline** Pass this assignment by November 18, 10:59 PM PST

Instructions My submission Discussions

[Upgrade to submit](#)

Your Submissions

Date	Score	Passed?
✓ 20 October 2018 at 6:28 AM	30/30	Yes
triplet_loss	10/10	<a href="#">Show grader output</a>
verify	10/10	<a href="#">Show grader output</a>
who_is_it	10/10	<a href="#">Show grader output</a>

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### Week 4:

### Programming Assignment 2: Face Recognition for the Happy House

## 5. Course Completion (Grade)

The screenshot shows the Coursera interface. At the top, there's a search bar and a user profile for 'Hemant'. Below, under 'My Courses', a card for 'Convolutional Neural Networks' by 'deeplearning.ai' is displayed. It shows 'Grade Achieved: 100.0%'. Under the 'Instructions' section, it lists details for adding a certification to LinkedIn, including the course name, authority (Coursera), license number (5MEDKK2G4BET), time period (October 2018), and a verification URL. An 'Add to LinkedIn' button is at the bottom of the card.

## 6. Syllabus

The screenshot shows the syllabus for the course 'Foundations of Convolutional Neural Networks'. It indicates '6 hours to complete' and lists '12 videos (Total 140 min), 3 quizzes'. A list of video topics with durations is provided: Computer Vision (5m), Edge Detection Example (11m), More Edge Detection (7m), Padding (9m), Strided Convolutions (9m), Convolutions Over Volume (10m), One Layer of a Convolutional Network (16m), Simple Convolutional Network Example (8m), Pooling Layers (10m), CNN Example (12m), Why Convolutions? (9m), and Yann LeCun Interview (27m). There is also one practice exercise, 'The basics of ConvNets' (20m).

WEEK

2

 5 hours to complete

## Deep convolutional models: case studies

Learn about the practical tricks and methods used in deep CNNs straight from the research papers.

 11 videos (Total 99 min), 2 quizzes [SEE LESS](#)

---

### 11 videos

Why look at case studies? 3m

Classic Networks 18m

ResNets 7m

Why ResNets Work 9m

Networks in Networks and 1x1 Convolutions 6m

Inception Network Motivation 10m

Inception Network 8m

Using Open-Source Implementation 4m

Transfer Learning 8m

Data Augmentation 9m

State of Computer Vision 12m

---


### 1 practice exercise

Deep convolutional models 20m

---

WEEK

3

 4 hours to complete

## Object detection

Learn how to apply your knowledge of CNNs to one of the toughest but hottest field of computer vision: Object detection.

 10 videos (Total 85 min), 2 quizzes [SEE LESS](#)

---

### 10 videos

Object Localization 11m

Landmark Detection 5m

Object Detection 5m

Convolutional Implementation of Sliding Windows 11m

Bounding Box Predictions 14m

Intersection Over Union 4m

Non-max Suppression 8m

Anchor Boxes 9m

YOLO Algorithm 7m

(Optional) Region Proposals 6m

---

### 1 practice exercise

Detection algorithms 20m

---



WEEK

4



5 hours to complete

## Special applications: Face recognition & Neural style transfer

Discover how CNNs can be applied to multiple fields, including art generation and face recognition. Implement your own algorithm to generate art and recognize faces!



11 videos (Total 76 min), 3 quizzes

[SEE LESS](#)

11 videos

What is face recognition? 4m

One Shot Learning 4m

Siamese Network 4m

Triplet Loss 15m

Face Verification and Binary Classification 6m

What is neural style transfer? 2m

What are deep ConvNets learning? 7m

Cost Function 3m

Content Cost Function 3m

Style Cost Function 13m

1D and 3D Generalizations 9m



1 practice exercise

Special applications: Face recognition &amp; Neural style transfer 20m