100 Days of Computer Vision Coursework

Motivation

From warning sleep deprived drivers to helping in early prognosis of life-threatening ailments like Cancer, computer vision is quite prominent in the field of Artificial Intelligence. With applications in field of education, transportation, military and many more, computer vision is set to be the moving power of changing the machines as we know it. As a community person, it is important for us to give back something worthwhile to the community and what's better than applying the most lucrative field of AI. ***100 Days of CV*** code is a commitment to ourselves of getting to know about this field a bit more and work on this field in the near future.

Eligibility

This field needs prior understandings of basics of Machine Learning and the Python language. If you have applied the concepts, that is a plus.

Pledge

1. I pledge to dedicate at a minimum of one hour of everyday towards coding and/or learning the concepts of Computer Vision and move a step closer to the goal of this coursework.
2. I pledge to write about my progress in any social media of my choice with the hashtag #100DaysofCV
3. If and when applicable, I will post all relevant codes to the public repository on Github and also the notes that I maintain while working in the coursework, for helping others in their journey.

My Goals

Every motive has some feasible outcome and I would like to state my goals from this initiative of mine.

By the end of this 100 Days of CV code journey, I would like to be able to show rich code containing my applications of the concepts of Computer Vision.

I'd also like to document my journey and explain the mathematics concepts under Computer Vision, though to the bare minimum.

The most important of all – I want to provide a free coursework and add to all the resources of Computer Vision already present over the internet. This would help anyone wanting to work in this amazing field, a dedicated curriculum and help them achieve their own goals from this.

Coursework

100 Days of CV

To anyone trying this,

The coursework is compiled keeping in mind the variety of people and their ability to grasp the concepts. This is an independent coursework and has the deadlines are highly modifiable depending on the person taking part in this concept. You are free to move at your own pace and finish this coursework at your own pace. Deadlines are only meant to stick to the timeline of 100 days of going from beginner to expert in the field of computer vision.

You may be anyone, professional or student, hence, it may be difficult to complete this coursework in the stipulated time or commit the needed hours per day from you work. Just know that you are not alone and the best of the bests also slacks off sometime, it's the coming back at it what matters. The main goal of this initiative is to **COMMIT AND RESPECT THE COMMITMENT TO YOURSELF.** It is very important to reach the end goal nonetheless the time you take.

This initiative and coursework is inspired by Ayon Roy's and Avik Jain's work in 100 Days of Machine Learning code. A special thanks to Ayon Roy for helping me in this initiative of mine.

If you need any help, feel free to reach me at any social media platforms. If you have any doubts, feel free to contact me; before that, do consider giving a Google search for the same.

The deadlines are only to create a timeline.
Be sure you understand all the topics well.

Regards

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100 DAYS OF COMPUTER VISION CODE COURSEWORK

Prerequisite: Machine Learning – Follow #100DaysofML code by Ayon Roy

Month 1

Computer Vision – Introduction

> **"Stay hungry. Stay foolish."**
>
> **— Steve Jobs**

In here we will have introduction of computer vision and a refresher on Deep Learning along with ways to represent any image or group of images.

[M] – Miscellaneous Resources for additional reading.

Week 1: Introduction and review

- Introduction to CV:
  - https://machinelearningmastery.com/what-is-computer-vision/
- Multilayer Perceptron:
  - https://www.youtube.com/watch?v=u5GAVdLQyIg
- Convolutional Neural Network:
  - https://deeplizard.com/learn/video/YRhxdVk_sIs
- CNN vs MLP:
  - https://medium.com/analytics-vidhya/cnn-convolutional-neural-network-8d0a292b4498
- Image filtering:
  - Full resource:
    - https://ai.stanford.edu/~syyeung/cvweb/tutorial1.html
  - **[M]**Convolution vs Correlation filtering:
    - https://towardsdatascience.com/convolution-vs-correlation-af868b6b4fb5
  - **[M]**Image filtering in spatial domain:
    - https://in.mathworks.com/help/images/what-is-image-filtering-in-the-spatial-domain.html
- Edge Detection:
  - Part 1: https://youtu.be/XuD4C8vJzEQ
  - Part 2: https://youtu.be/am36dePheDc
  - **[M]**Comparing different edge detection methods:
    - https://medium.com/@nikatsanka/comparing-edge-detection-methods-638a2919476e

- Blob Detection:
  - https://scikit-image.org/docs/dev/auto_examples/features_detection/plot_blob.html
  - https://www.learnopencv.com/blob-detection-using-opencv-python-c/
- Corner detection:
  - HARRIS corner detection:
    - https://youtu.be/KH8Mq9FPVPw
  - Harris vs shi-tomasi corner detection:
    - https://medium.com/pixel-wise/detect-those-corners-aba0f034078b
  - **[M]**Harris corner detection in OPENCV:
    - https://opencv-python-tutroals.readthedocs.io/en/latest/py_tutorials/py_feature2d/py_features_harris/py_features_harris.html
- Scale space
  - https://en.wikipedia.org/wiki/Scale_space
    - No need to go in deep, just a light read would do.

Week 2: Introduction (Contd…)

- Scale selection
  - SIFT:
    - https://youtu.be/U0wqePj4Mx0
    - **[M]**https://aishack.in/tutorials/sift-scale-invariant-feature-transform-introduction/ - WHOLE SERIES
  - SURF:
    - https://youtu.be/0nyh4hwTrog
    - **[M]**https://opencv-python-tutroals.readthedocs.io/en/latest/py_tutorials/py_feature2d/py_surf_intro/py_surf_intro.html
  - HoG:
    - https://youtu.be/4ESLTAd3IOM
  - LBP:
    - https://en.wikipedia.org/wiki/Local_binary_patterns (up to CONCEPTS)

- Bag of Visual Words:
    - https://towardsdatascience.com/bag-of-visual-words-in-a-nutshell-9ceea97ce0fb
- Hough Transform:
    - https://youtu.be/6yVMpaIoxIU
    - https://docs.opencv.org/3.4/d9/db0/tutorial_hough_lines.html
    - **[M]**For in detail reading: https://en.wikipedia.org/wiki/Hough_transform
- Pyramid Matching:
    - In detail tutorial: https://youtu.be/-s4D_QTzpuo
    - **[M]**Hands on Tutorial: https://youtu.be/8yvln2atFkA
- Optical Flow:
    - https://nanonets.com/blog/optical-flow/
    - Lucas – Kanade OpenCV example: https://youtu.be/7soIa95QNDk
    - **[M]**https://docs.opencv.org/3.4/d4/dee/tutorial_optical_flow.html

Week 3: Review of Deep Learning

- Deep Learning revision: https://youtu.be/6M5VXKLf4D4
- Gradient Descent: https://youtu.be/IHZwWFHWa-w
    - Alternative source: https://youtu.be/sDv4f4s2SB8
- Backpropagation:
    - Introduction: https://youtu.be/Ilg3gGewQ5U
    - Backprop mathematics: https://youtu.be/tIeHLnjs5U8
    - **[M]**Blog post: https://towardsdatascience.com/understanding-backpropagation-algorithm-7bb3aa2f95fd

Week 4: Intro to Convolutional Neural Network

- Complete the following tutorials within this week.
    - Stanford University – Intro to CNN: https://youtu.be/bNb2fEVKeEo
    - Stanford University – CNN Arch (Case Studies):
        - Different Architectures like AlexNet, VGGNet, GoogleNet, ResNet, etc.
            - https://youtu.be/DAOcjicFr1Y
    - Training a NN:
        - Part 1: https://youtu.be/wEoyxE0GP2M
        - Part 2: https://youtu.be/_JB0AO7QxSA

Month 2

"Deep" Understanding of CNNs

> **"If you want to live a happy life, tie it to a goal, not to people or things."**
>
> **— Albert Einstein**

Week 5: Visualization and Understanding CNNs:

- Detection and Segmentation:
  - https://youtu.be/nDPWywWRIRo
- Visualizing CNNs:
  - https://youtu.be/6wcs6szJWMY
- Coding a neural network in Pytorch:
  - Total video tutorials: https://www.youtube.com/playlist?list=PLQVvvaa0QuDdeMyHEYc0gxFpYwHY2Qfdh
    - You can skip the first video which is introduction; but, it can be seen as a review.
  - **Miscellaneous for better understanding!**
    - If you are a beginner in PyTorch start with the 60 min Blitz on pytorch.org:
      - https://pytorch.org/tutorials/beginner/deep_learning_60min_blitz.html

Week 6: First Project and Miscellaneous Topics:

- **Project: Building a ConvNet and classify CIFAR – 10 dataset.**
  - Dataset can be found in the Pytorch *dataset* module.
- **Miscellaneous Topics for better understanding:**
  - Deconvolution method (or Transposed Convolution): https://medium.com/@naokishibuya/up-sampling-with-transposed-convolution-9ae4f2df52d0
    - In Pytorch: (see ***nn.ConvTranspose1d, 2d* & *3d***) https://pytorch.org/docs/stable/nn.html#convolution-layers
  - **[M]**Google Deep Dream: https://youtu.be/BsSmBPmPeYQ
  - Neural Style Transfer: https://youtu.be/R39tWYYKNcI

Week 7: CNNs for Recognition, Detection & Segmentation

- **Recognition:**
  - Siamese Network: https://towardsdatascience.com/illustrated-guide-to-siamese-network-3939da1b0c9d
    - Video Tutorial: https://youtu.be/6jfw8MuKwpI
  - Triplet Loss: https://youtu.be/d2XB5-tuCWU
    - **[M]**Blog: http://datahacker.rs/siamese-network-triplet-loss/
  - Contrastive Loss: https://towardsdatascience.com/contrastive-loss-explaned-159f2d4a87ec
    - **[M]**Blog: https://www.analyticsvidhya.com/blog/2020/09/a-detailed-study-of-self-supervised-contrastive-loss-and-supervised-contrastive-loss/
- Object Detection:
  - Playlist: (Videos 22 to 36, skip the ones already done):
    - https://www.youtube.com/playlist?list=PLkDaE6sCZn6Gl29AoE31iwdVwSG-KnDzF
  - Different Object detection algorithms:
    - https://towardsdatascience.com/r-cnn-fast-r-cnn-faster-r-cnn-yolo-object-detection-algorithms-36d53571365e
    - **[M]**SSD: https://towardsdatascience.com/review-ssd-single-shot-detector-object-detection-851a94607d11
    - **[M]**RetinaNet: https://developers.arcgis.com/python/guide/how-retinanet-works/
- Segmentation:
  - Image Segmentation: https://www.analyticsvidhya.com/blog/2019/04/introduction-image-segmentation-techniques-python/
  - FCN: https://towardsdatascience.com/review-fcn-semantic-segmentation-eb8c9b50d2d1
  - **[M]**Segnet: https://towardsdatascience.com/review-segnet-semantic-segmentation-e66f2e30fb96
  - **[M]**U-Net: https://towardsdatascience.com/biomedical-image-segmentation-u-net-a787741837fa
  - Mask R-CNN: https://medium.com/@alittlepain833/simple-understanding-of-mask-rcnn-134b5b330e95
    - **[M]**Pytorch Implementation: https://pytorch.org/tutorials/intermediate/torchvision_tutorial.html

    - **[M]**Other Pytorch implementation: https://github.com/trypag/pytorch-unet-segnet

Week 8: Recurrent Neural Networks & Attention Models

- RNNs Review
    - Video link: https://youtu.be/WCUNPb-5EYI
- CNN + RNN, Video Analysis:
    - https://www.youtube.com/watch?v=oluw16wExDY
    - **[M]**Intro Blog: https://www.datasciencecentral.com/profiles/blogs/combining-cnns-and-rnns-crazy-or-genius
- Attention Models in Vision:
    - https://towardsdatascience.com/learn-to-pay-attention-trainable-visual-attention-in-cnns-87e2869f89f1
- Image Captioning:
    - Blog: https://www.analyticsvidhya.com/blog/2018/04/solving-an-image-captioning-task-using-deep-learning/
        - Hands on Pytorch video: https://www.youtube.com/watch?v=y2BaTt1fxJU
- Spatial Transformer Networks:
    - Video: https://youtu.be/T5k0GnBmZVI
    - **[M]**Stanford Video: https://youtu.be/Sb3b0ocD8mI?t=3583
    - Hands on tutorial: https://pytorch.org/tutorials/intermediate/spatial_transformer_tutorial.html
- Transformers:
    - Intro: https://towardsdatascience.com/transformer-neural-network-step-by-step-breakdown-of-the-beast-b3e096dc857f
    - **[M]**Vision Transformer(ViT): https://towardsdatascience.com/are-you-ready-for-vision-transformer-vit-c9e11862c539

Week 9: Deep Generative Models:

- Review of Generative Models:
    - Video Tutorial (MIT class lecture): https://youtu.be/yFBFl1cLYx 8
    - **[M]**Blog: https://towardsdatascience.com/deep-generative-models-25ab2821afd3
- Hands on GANs in Pytorch tutorial: https://youtu.be/ABaZ_tecZ3U?t=523

- **[M]**VAEs: https://towardsdatascience.com/what-the-heck-are-vae-gans-17b86023588a

Week 10: Miscellaneous topics for newer trends in Computer Vision

All the below topics are added just to add some clarity of the recent trends in this humongous field of Deep Learning and is purely optional.

It is on the practitioner's will to go with the below resources or to add this week as a project week!

- **[M]**Applications of GANs: https://www.analyticsvidhya.com/blog/2019/04/top-5-interesting-applications-gans-deep-learning/
    - **[TIP]***If you want to implement any papers that you think is interesting you can always check Papers with code for a subsequent implementation.*
- **[M]**CycleGAN: https://machinelearningmastery.com/what-is-cyclegan/
    - Pytorch Implementation: https://github.com/aitorzip/PyTorch-CycleGAN
- **[M]**Pix2Pix: https://www.youtube.com/watch?v=u7kQ5lNfUfg
- **[M]**CycleGAN and Pix2Pix Pytorch implantation:
    - https://github.com/junyanz/pytorch-CycleGAN-and-pix2pix
- **[M]**StackGAN: https://youtu.be/rAbhypxs1qQ
- **[M]**StyleGAN: https://youtu.be/AQBti_wN414
- **[M]**Zero shot learning: https://youtu.be/jBnCcr-3bXc
- **[M]**Few shot learning/ Meta - Learning: https://www.kdnuggets.com/2020/03/few-shot-image-classification-meta-learning.html
- **[M]**Self – Supervised Learning: https://www.fast.ai/2020/01/13/self_supervised/

Month 3

Projects

> **“I could either watch it happen or be a part of it.”**
>
> **— Elon Musk**

This month consists the last four weeks and some days remaining in this commitment and I urge you to see this through to achieve your goal. Remember, **it is very easy to quit, but the outcome of it is at par with your decision!**

So, push through and complete this commitment and feel satisfied.

Week 11, 12, 13 & 14: Weeks of Projects

Under this create multiple small or a single big project, it your decision to make.

Be sure to brush your knowledge about the concepts and codebase that you have created.

Some example projects* are:

1. Face recognition
2. Face Detection
3. Dog/Cat classifier
4. Generate paintings using GANs

***Note:**
1. It is not mandatory to do all the projects or choose from the above project only.
2. Choose any project depending on your expertise and see it through, updating on your Github profile or somewhere, where it can be easily accessible.
3. Choosing a single big project is very critical and chosen in such a manner that it suffices your time and resources for a whole month and looks good in your bio.

What now?

APPLY YOUR KNOWLEDGE!

> **"The present is theirs; the future, for which I really worked, is mine."**
>
> **- Nikola Tesla**

- **How to start?**
  Grab a dataset, start solving problems! Whenever you hit a snag, search deliberately on the internet → go to GitHub issues → rummage StackOverflow → ask your peers or any community or groups; after all this if you don't find your answer, ASK your question on suitable forums!
- **Projects are not really a challenge to you anymore?**
  Find suitable competition on Kaggle Competitions or Hackathons
- **Can't find motivation or stuck somewhere?**
  - ✓ Find a buddy to work on the project with you.
  - ✓ Pen down the plan of action on a paper and stick it somewhere you can see daily.
  - ✓ Remember what your goal is!
  - ✓ Fight till the end and stay true to your goal, it is life and it is meant to be hard! Be the stronger version of yourself every day.
- **If you are coming back after a certain time or break -**
  Be sure to start slow and small, give one hour a day at first and gradually increase your timings and keep the plan of action in mind.
- **Comb your surroundings!**
  It is very necessary who you follow, hence, be wary of wasting your time on social media, follow the right kind of people who gives you inspiration and knowledge.
- **Acknowledge your skills.**
  Don't take on projects which are beyond your skillset, start small and then reach the level. *Specialize and not generalize.*

KEEP LEARNING!

> **"Life is like riding a bicycle. To keep your balance, you must keep moving."**
>
> **— Albert Einstein**