My version that I can take notes on and keep track of my progress

Pre-requisites

For UG/MS students to conduct research in my team, you **MUST** have the following skills and backgrounds: (7/24/2024)

Coding-wise:

Basic language: Python, Linux

Machine learning library: PyTorch, Scikit-learn

Version control and code sharing platform: GitHub, Hugginface

Other recommended skills: Matplotlib, Tensorflow, Keras

Coding platform: Google Colab, Jupyter Notebook

Problem-solving-wise:

Google

ChatGPT

Note: When you face questions about coding or installing packages, most of the time, you can easily find solutions through Google or ChatGPT, rather than getting stuck there. Problem-solving — *for example, resolving problems that block you by searching for solutions yourself* — is an essential skill for doing research.

Knowledge-wise:

Solid math: linear algebra, probability, and calculus

Sufficient knowledge of machine learning, deep learning, and computer vision

What if

If you have solid skills and backgrounds in most if not all of them, great!

If not, the next pages are the materials you **MUST** self-learn before the beginning of the Fall semester — you still have **several weeks**.

The rationale is simple.

1. If you don't have them, you probably are unready for any research projects in my team.

2. If you really want to do research in my team, very likely you will need to spend multiple months in the Fall/Spring semester to learn them — similar to taking multiple courses but without an instructor and official credits.

3. You already have multiple courses and tons of credits in the Fall/Spring semester, and you will likely have low energy to "take these additional courses".

4. In the end, you very likely will not get the research experience you want and you might feel you waste a lot of time.

The Summer is not over yet and it is not too late to learn them!

1. If you are taking summer courses, the courses are ending soon. If you are doing an internship, you likely still have time at night or during the weekend. Compared to the Fall/Spring semester, you likely have more time and energy in the Summer to learn.

2. The amount of time that you can learn in a Summer week might be equal to the amount of time that you can learn in a Fall/Spring month (beyond your already busy semester courses).

Learning materials and assignments

You do not need to complete them in a linear order. Instead, you can mix them, like 50% of a day on deep learning materials and 50% of a day on PyTorch.

You don't need to understand everything the first time but scan through them first to get some basic understanding/sense. These may take you a few weeks or more, and many times, you may get more familiar with them as the semester goes on. For example, you may come back to recheck them after a month.

Coding-wise:

1. **Python:** Please self-learn it or learn it while you are learning PyTorch. One of the best places to start is https://www.learnpython.org/. Other useful links are:

a. http://ai.berkeley.edu/tutorial.html#PythonBasics

b. https://cs231n.github.io/python-numpy-tutorial/

c. https://www.python.org/about/gettingstarted/

You may want to be familiar with how to create and manage Python virtual environments and install and create installation scripts for projects.
https://docs.conda.io/projects/conda/en/latest/user-guide/getting-started.html

https://python.land/virtual-environments/virtualenv#google_vignette

2. **PyTorch:** Most of our algorithms are implemented in PyTorch https://pytorch.org/, which is a machine learning library and platform. PyTorch is built upon Python so you should know basic Python and NumPy. PyTorch has excellent documentation and tutorials (like https://pytorch.org/tutorials/). Many new papers will also release their code implemented in PyTorch (like https://paperswithcode.com/), so you nearly never need to implement an algorithm from scratch.

a. You may begin with this page:
https://pytorch.org/tutorials/beginner/deep_learning_60min_blitz.html

Commented [EB1]: Completed. NOTE: One question to ask Dr. Chao about GPU usage and how CUDA interacts with my machine.

Commented [EB2R1]: NOTE: Answered my own question with the PyTorch Course part b

b. You can then go through this nice 24-hour tutorial: https://www.youtube.com/watch?v=V_xro1bcAuA

c. You may also consider https://github.com/yunjey/pytorch-tutorial?tab=readme-ov-file

d. You may also pick some tutorials here to learn https://pytorch.org/tutorials/, such as

https://pytorch.org/tutorials/intermediate/torchvision_tutorial.html

https://pytorch.org/tutorials/beginner/transfer_learning_tutorial.html

https://pytorch.org/tutorials/beginner/vt_tutorial.html

Requirement: Finish a, and then b OR c + d

3. **Linux Basic:** We mostly use Linux/Ubuntu-based workstations/servers to train our machine-learning models. Thus, you need to know basic commands, permissions, bash scripting, etc., and have an understanding and ability to use our Linux workstations, run and create scripts, check storage, understand permissions, etc.

One good starting point is the Linux/Unix tutorial https://www.geeksforgeeks.org/linux-tutorial/.

4. **GitHub, Hugginface:** People nowadays use GitHub to do version control when writing code, and GitHub or Hugginface to share their code and trained models. You MUST get familiar with them unless you want to code everything from scratch.

One good starting point is Git and GitHub Tutorial for Beginners: https://www.youtube.com/watch?app=desktop&v=tRZGeaHPoaw

Requirement: Please self-search materials to learn basic GitHub and Hugginface

Math-wise:

Commented [EB3]: Done 4/16-4/23

Commented [EB4]: Done 3/24/2025 (NOTE: I am currently taking Systems 1 so my Linux environment experience is recent.)

Commented [EB5]: Done 4/3

5. **Linear algebra** is a MUST in my research.

a. You may learn it or review it using my slide decks: https://drive.google.com/drive/folders/1QFyAcxkdl4REQJhlqixTbJYjLBqNjq3Y

b. You may find this review material useful: https://cs229.stanford.edu/summer2020/cs229-linalg.pdf

c. You may read through https://www.deeplearningbook.org/contents/linear_algebra.html and chapters B.3 - B.5 of the book here https://udlbook.github.io/udlbook/

d. You may also consider chapter 2 of this book https://mml-book.github.io/book/mml-book.pdf

Requirement: You MUST take a), b), c), or d), one of them that you feel the most comfortable with.

Commented [EB6]: Done 4/15

6. **Probability** is also a MUST in my research.

a. You may learn it or review it from https://cs229.stanford.edu/summer2020/cs229-prob.pdf

b. You may read through https://www.deeplearningbook.org/contents/prob.html and chapters C of the book here https://udlbook.github.io/udlbook/

c. You may also consider chapter 6 of this book https://mml-book.github.io/book/mml-book.pdf

Requirement: You MUST take a), b), or c), one of them that you feel the most comfortable with.

Commented [EB7]: Done 3/20

7. **Other skills:** calculus, for example.

This is not a must for now but you may find the book https://mml-book.github.io/book/mml-book.pdf useful, and the book https://www.math.uwaterloo.ca/~hwolkowi/matrixcookbook.pdf a useful reference.

Machine learning and deep learning:

8. This is one of my main research topics, so you MUST have sufficient understanding. There are many good online courses/tutorials/or materials. You may begin with these videos https://www.youtube.com/playlist?list=PLZHQObOWTQDNU6R1_67000Dx_ZCJB-3pi and **move on to**:

a. Read the online book https://d2l.ai/index.html through Chapters 1 - 8 and 11 - 12.

b. Take this online course and do the homework if there is any: https://www.coursera.org/specializations/deep-learning

c. Read this book https://udlbook.github.io/udlbook/ through **Chapters 1 - 12**

Requirement: You MUST take a), b), or c), one of them that you feel the most comfortable with.

Computer vision:

9. This is one of my main research topics, so you MUST have sufficient understanding.

a. Do the online course https://web.eecs.umich.edu/~justincj/teaching/eecs498/WI2022/. There are Fall 2019 Lecture videos. Compete **lectures 1 - 14, 17 - 18** https://web.eecs.umich.edu/~justincj/teaching/eecs498/WI2022/schedule.html. Do homework **1 - 3**.

b. Do the course https://advances-in-vision.github.io/schedule.html, specifically **lecture 6 - 13**.

c. Do the course https://cs231n.github.io/convolutional-networks/

Requirement: You MUST take a), b), or c), one of them that you feel the most comfortable with.

====== Some other useful information and online materials =======

Deep object detection tutorial: https://www.dropbox.com/s/rakgo35h6b8p7uv/cvpr2019_tutorial_ross_girshick.pptx?dl=0

Commented [EB8]: Done (watched the entire playlist back in high school and I get notifications when he uploaded the new video in the playlist back in January)

Commented [EB9]: Done 4/6

Commented [EB10]: Done 4/17/2025

Deep segmentation tutorial:
https://www.dropbox.com/s/t6tg87t78pdq6v3/cvpr19_tutorial_alexander_kirillov.pdf?dl=0

Stanford machine learning course: https://cs229.stanford.edu/

Matplotlib tutorial: https://matplotlib.org/stable/users/explain/quick_start.html#quick-start