

Introduction



한양대학교 ERICA
소프트웨어융합대학
COLLEGE OF COMPUTING

인공지능학과
Department of
Artificial Intelligence

정 우 환 (whjung@hanyang.ac.kr)

Fall 2022



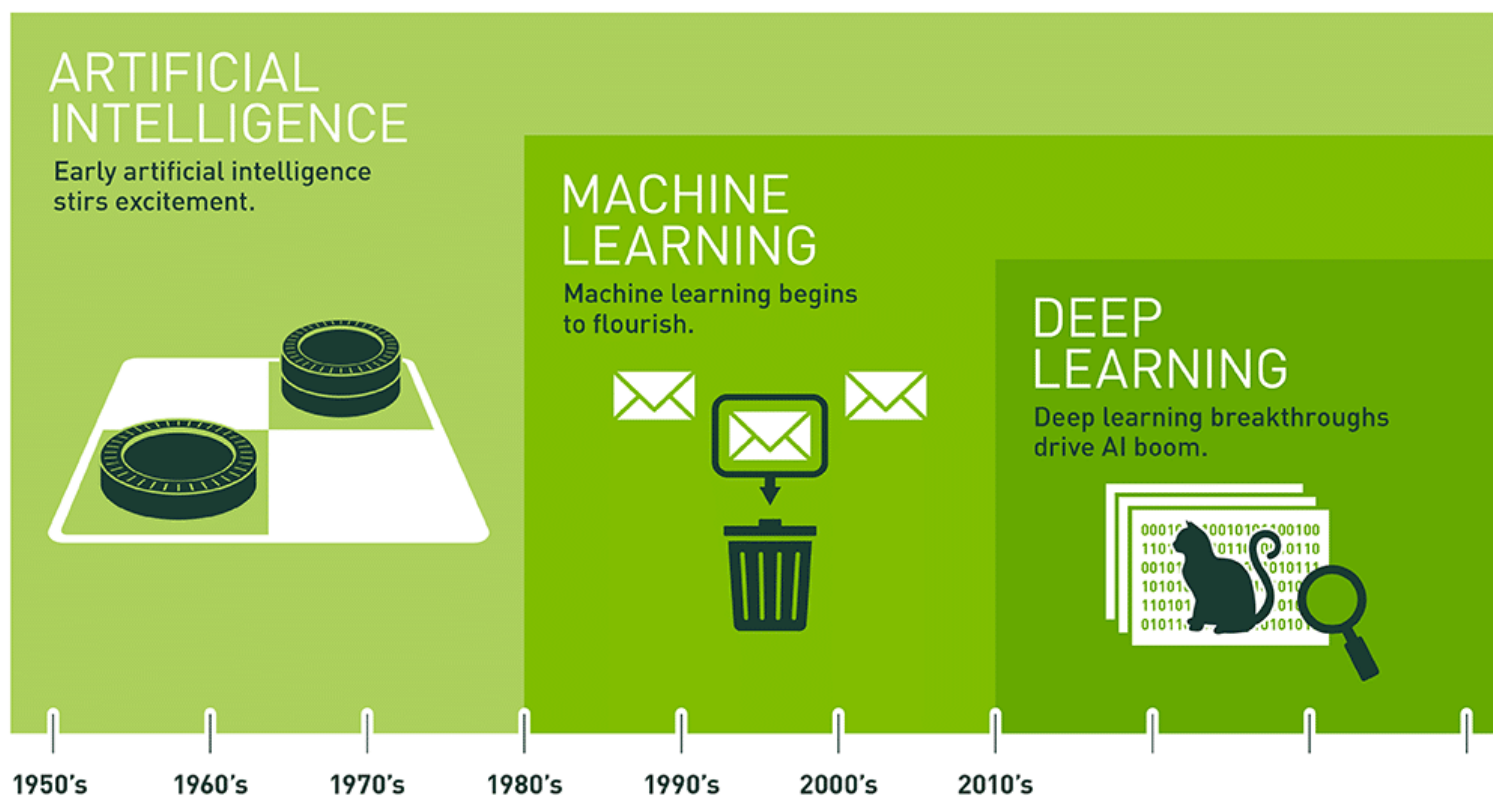
HANYANG UNIVERSITY

Data Science Lab

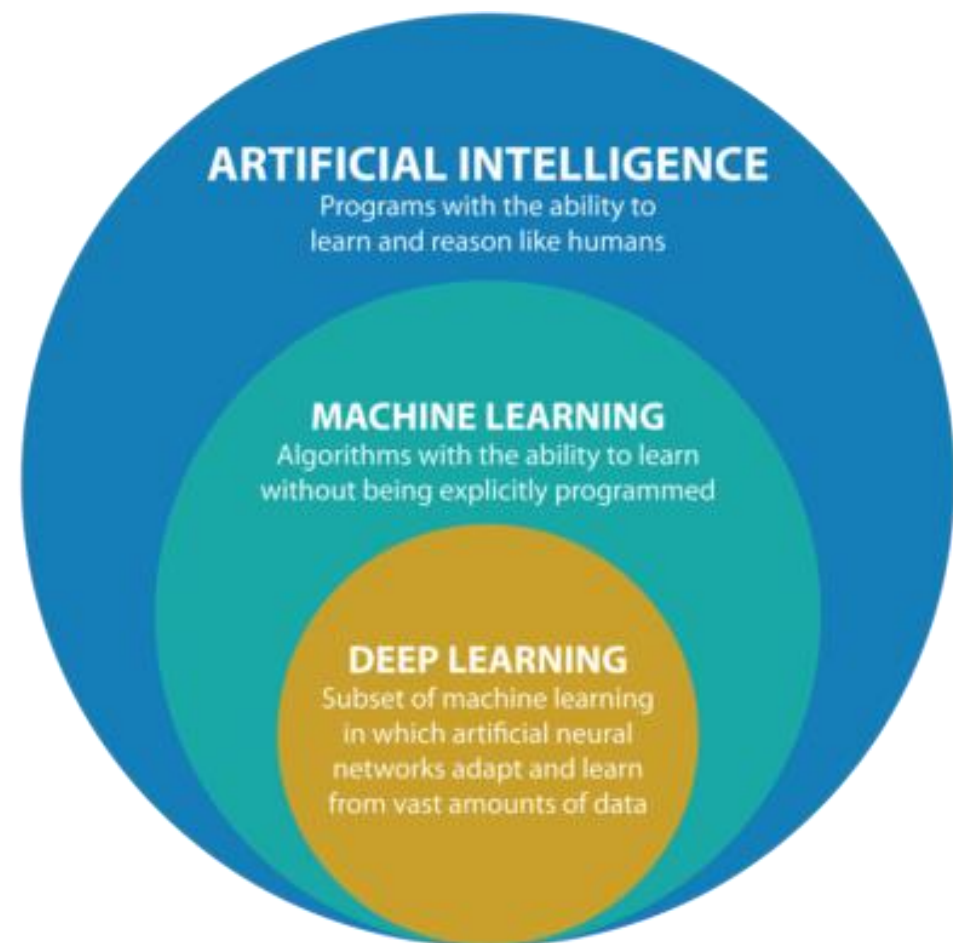


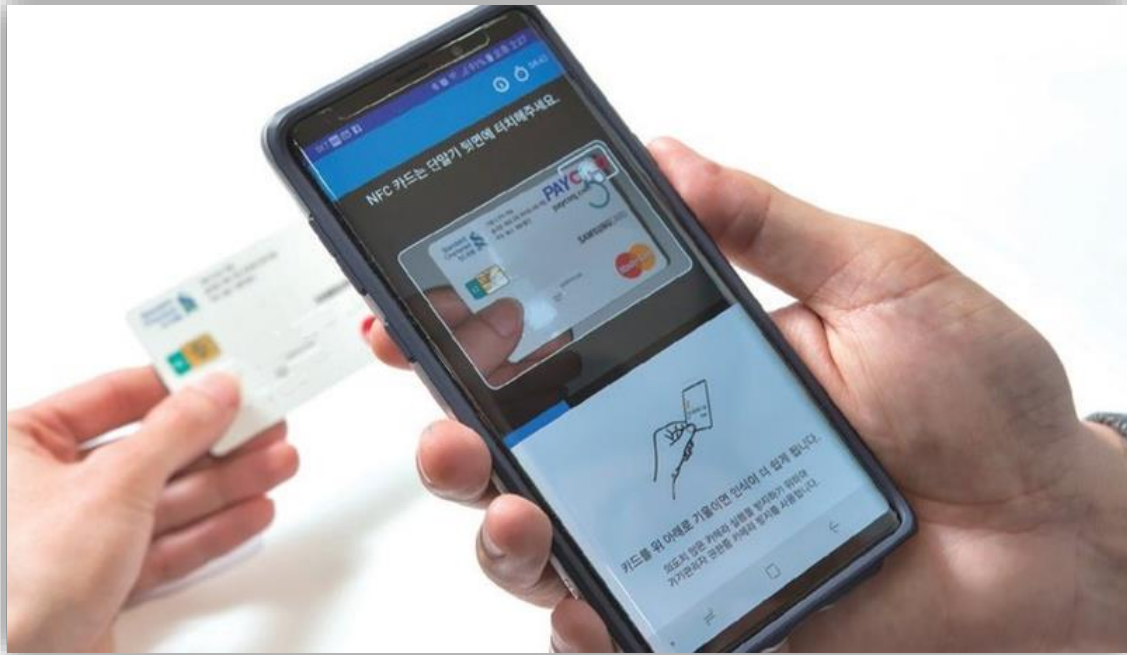
Class overview

- 선수과목
 - Programming
 - Probability theory
 - Linear algebra
- 평가
 - 출석: 10%
 - 과제: 10%
 - 중간: 30%
 - 기말: 30%
 - (개인)프로젝트: 20%
- 조교
 - 이동준 (foldtwice@hanyang.ac.kr)
- 강의시간 및 장소
 - 화 13:00~14:30 제1공학관 **509호**
 - 목 13:00~14:30 제1공학관 **203호**

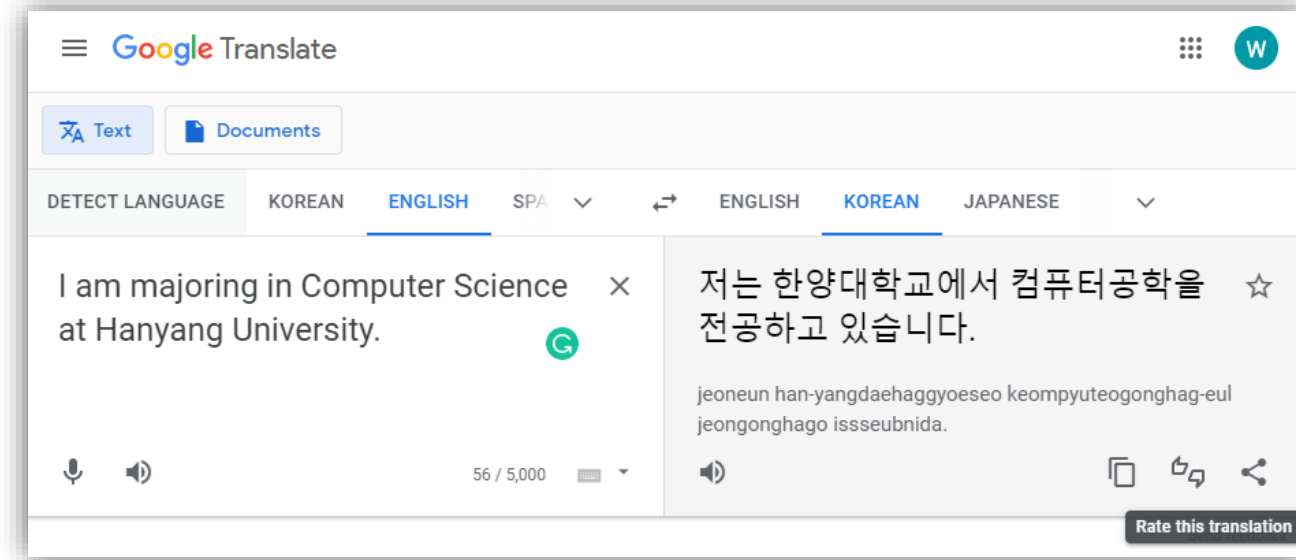


Since an early flush of optimism in the 1950s, smaller subsets of artificial intelligence – first machine learning, then deep learning, a subset of machine learning – have created ever larger disruptions.





Computer vision



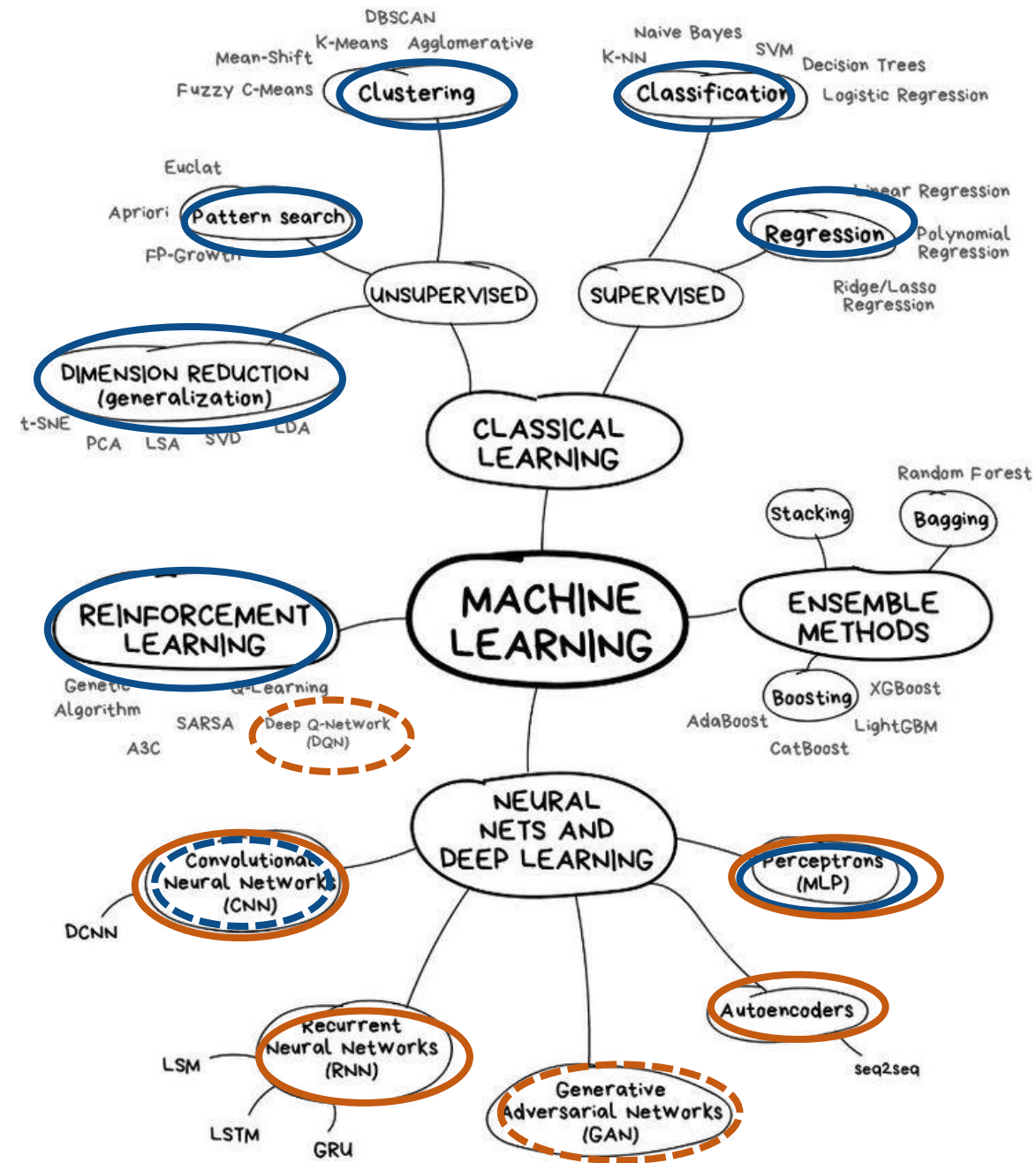
Natural language processing

3학년 인공지능

- K-NN
- Naïve bayes
- Apriori
- K-means
- PCA
- SVM
- Reinforcement learning

4학년 딥러닝

- Linear regression
- Logistic regression
- MLP
- CNN
- RNN
- Seq2Seq
- Transformer
- ViT
- GAN
- Deep Q-learning



강의계획서

- 순서, 범위 바뀔 수 있음

주별 강의계획 및 과제	주(회)차	주제	활동사항
	1주(회)차	강좌 오리엔테이션/ 인공지능 개요	오리엔테이션
	2주(회)차	이론적 기초	확률/선형대수
	3주(회)차	회귀	선형회귀, Gradient descent
	4주(회)차	분류	Naive Bayes/K-NN
	5주(회)차	분류	로지스틱 회귀
	6주(회)차	커널 기법	-Kernel density estimation, kernel 회귀
	7주(회)차	중간 프로젝트	중간 프로젝트
	8주(회)차	뉴럴 네트워크	Backpropagation
	9주(회)차	정규화	L1,L2 regularization
	10주(회)차	비지도학습	클러스터링/PCA
	11주(회)차	비지도학습	클러스터링/PCA
	12주(회)차	강화학습	강화학습
	13주(회)차	강화학습	강화학습
	14주(회)차	기말 프로젝트 발표	프로젝트 발표
	15주(회)차	기말 고사	기말고사
	16주(회)차	예비일	예비일

Python Environment Setup for Deep Learning

Anaconda

PyTorch

Jupyter Notebook

Pycharm

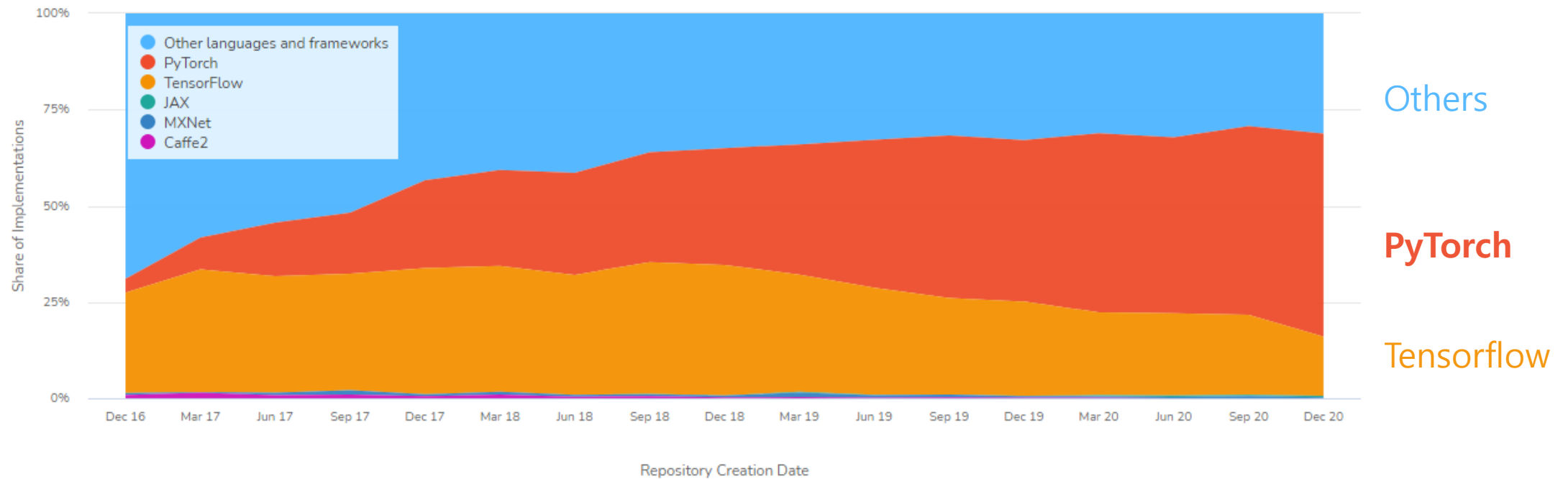
Installation order

- Anaconda
 - Installation: <https://www.anaconda.com/products/individual>
- PyTorch
 - Deep learning framework
 - Download: <https://pytorch.org/get-started/locally/>
- PyCharm
 - IDE
 - Download: <https://www.jetbrains.com/ko-kr/pycharm/download>
- Jupyter
 - A powerful tool for interactively developing and presenting data science projects
 - Installation: <https://jupyter.org/install>

Why PyTorch?

Frameworks

Paper Implementations grouped by framework



Anaconda

- 가상 환경 (가상머신X) 구축
- 데이터과학에 특화
- 패키지 설치 및 관리가 쉬움

- 터미널 접속
 - Windows
 - 작업표시줄 검색 → Anaconda Prompt
 - 기타 OS는 일반 terminal로 바로 접속

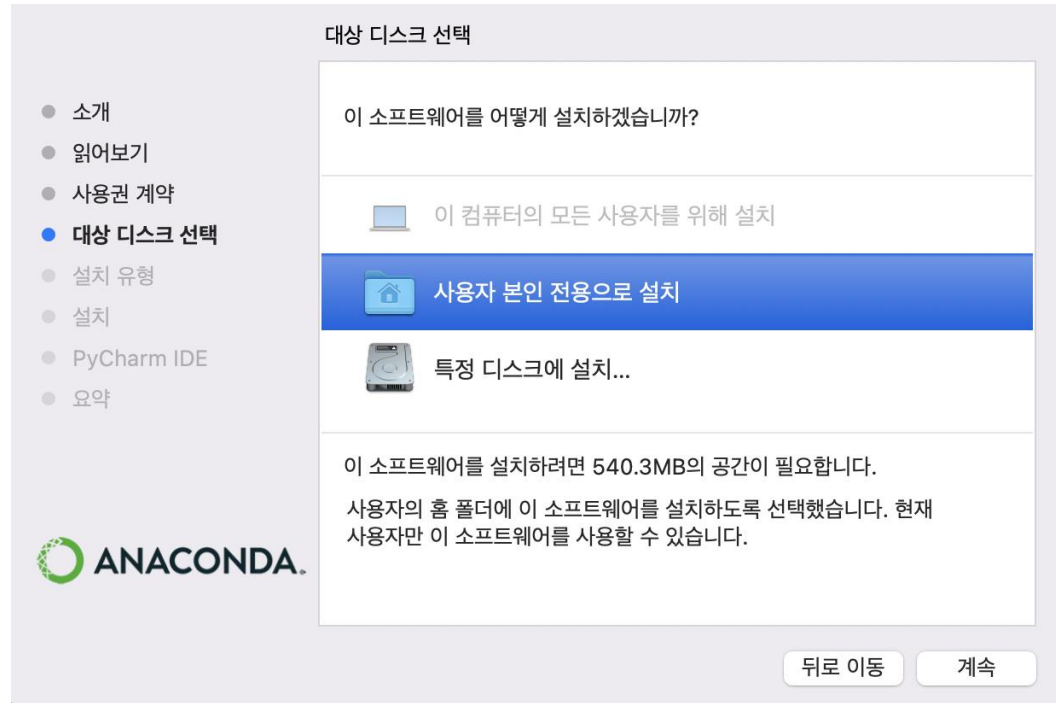


Anaconda Install



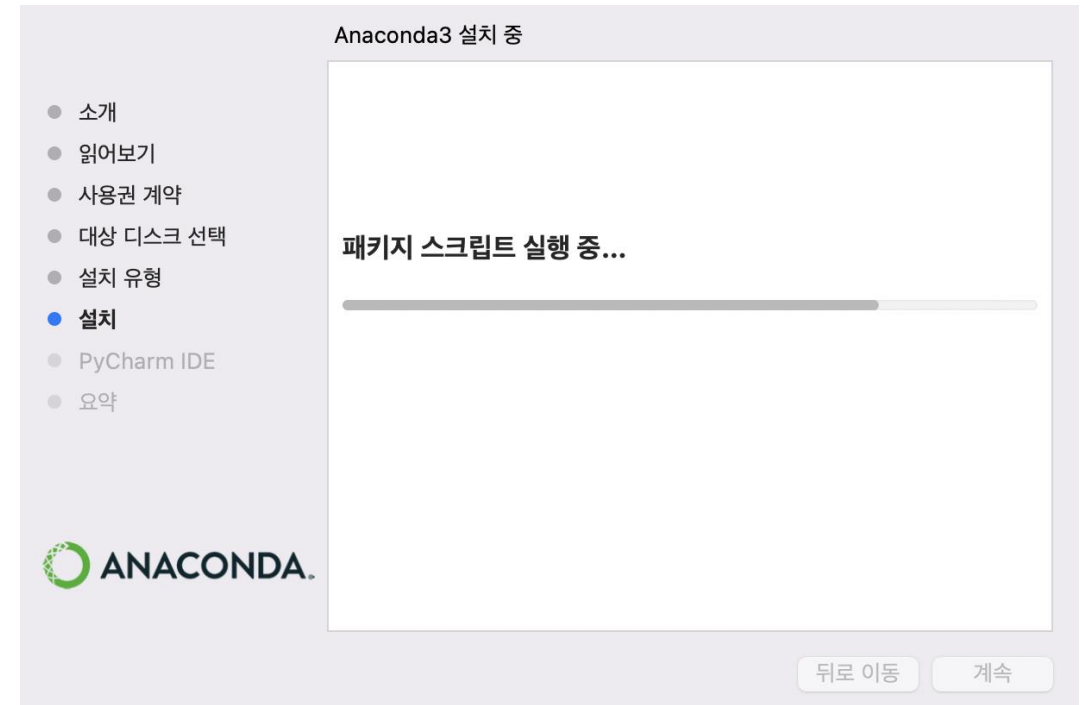
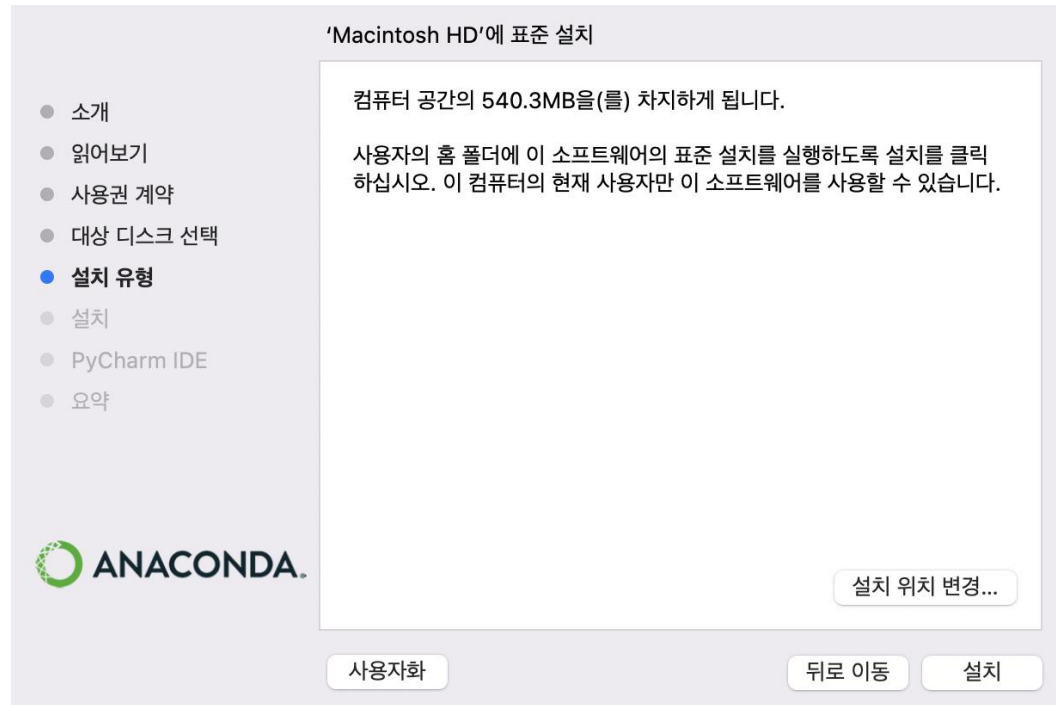
OS, 하드웨어에 맞게 다운로드

Anaconda Install - Mac

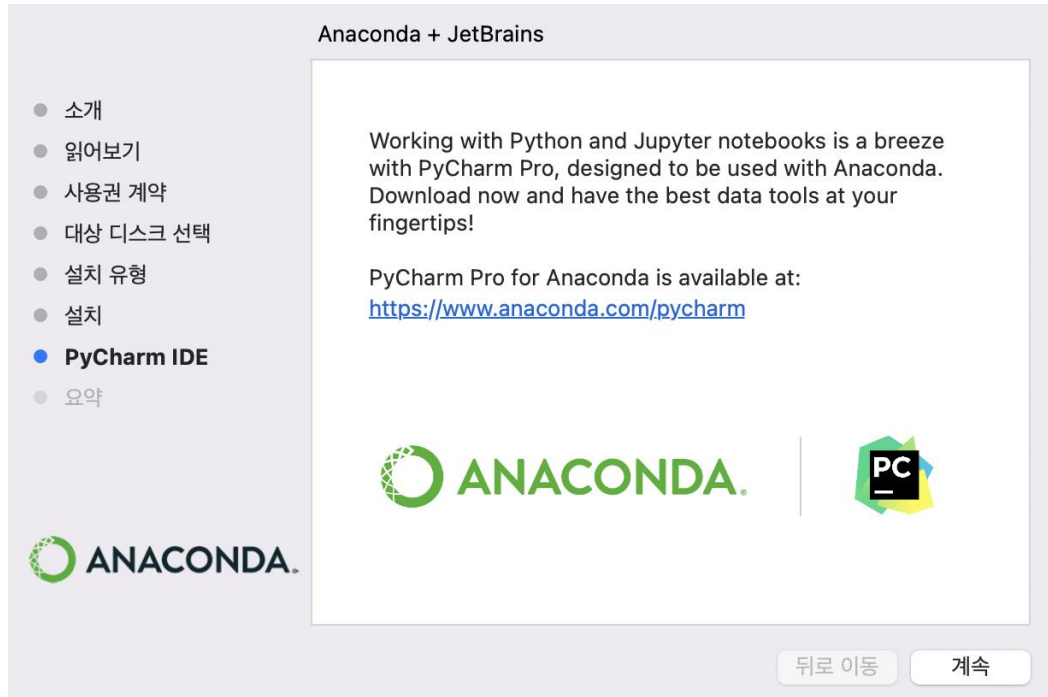


- 사용권 계약에서 '계속'을 눌러 동의
- 설치하고자 하는 디스크 선택

Anaconda Install - Mac



Anaconda Install - Mac

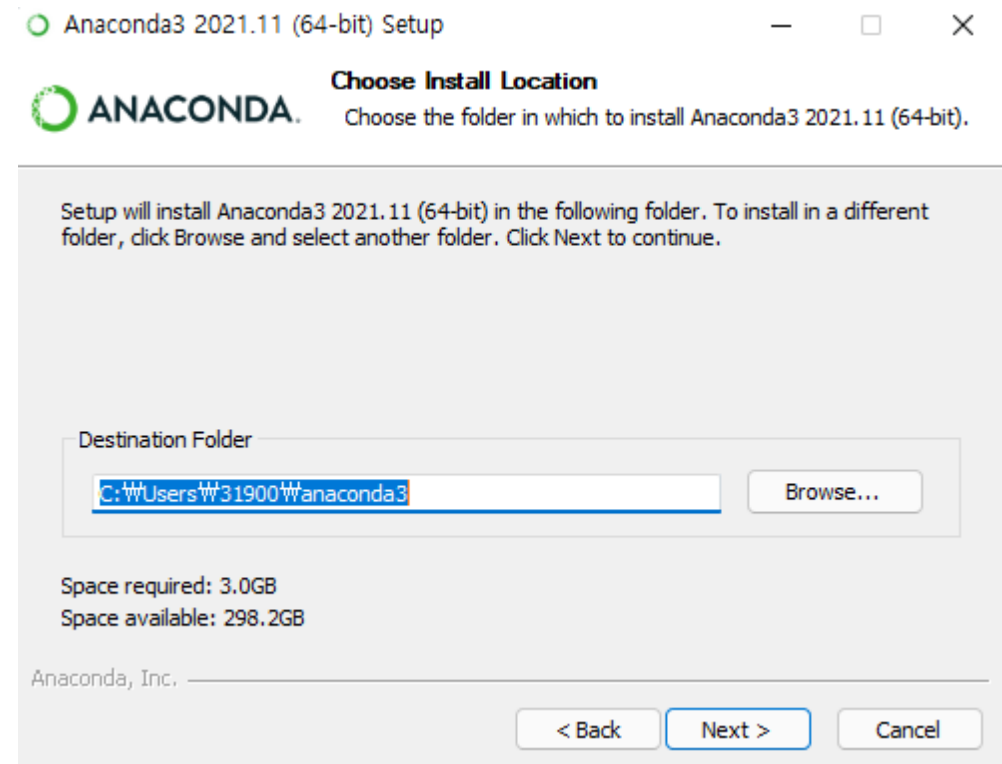
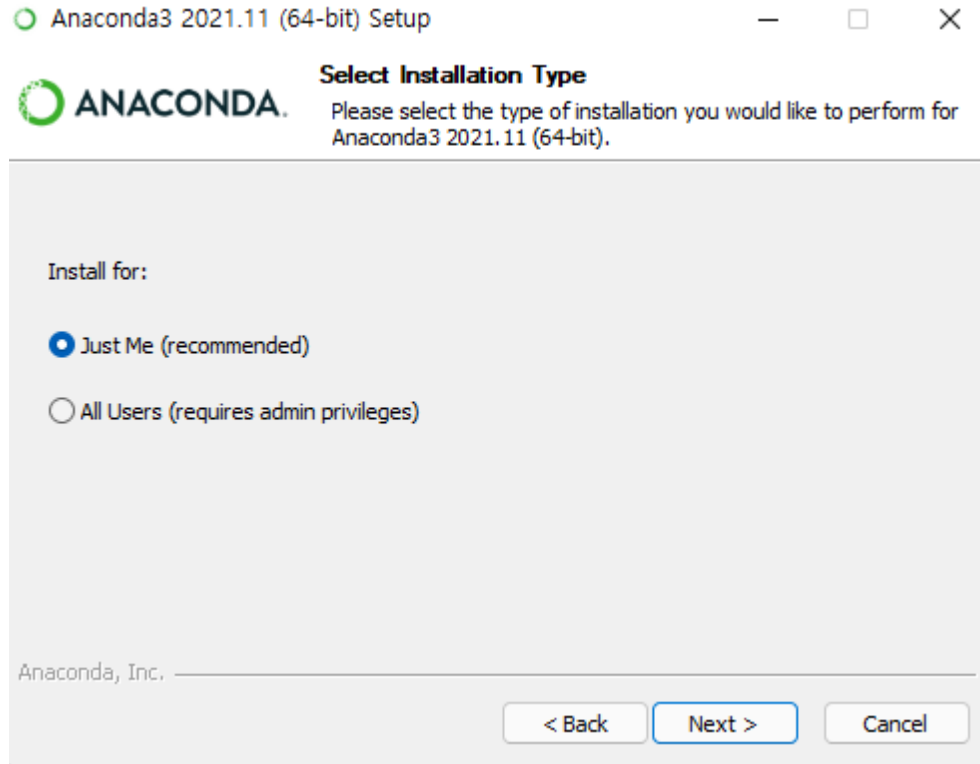


- 설치 완료 후 새 터미널에서 다음을 입력

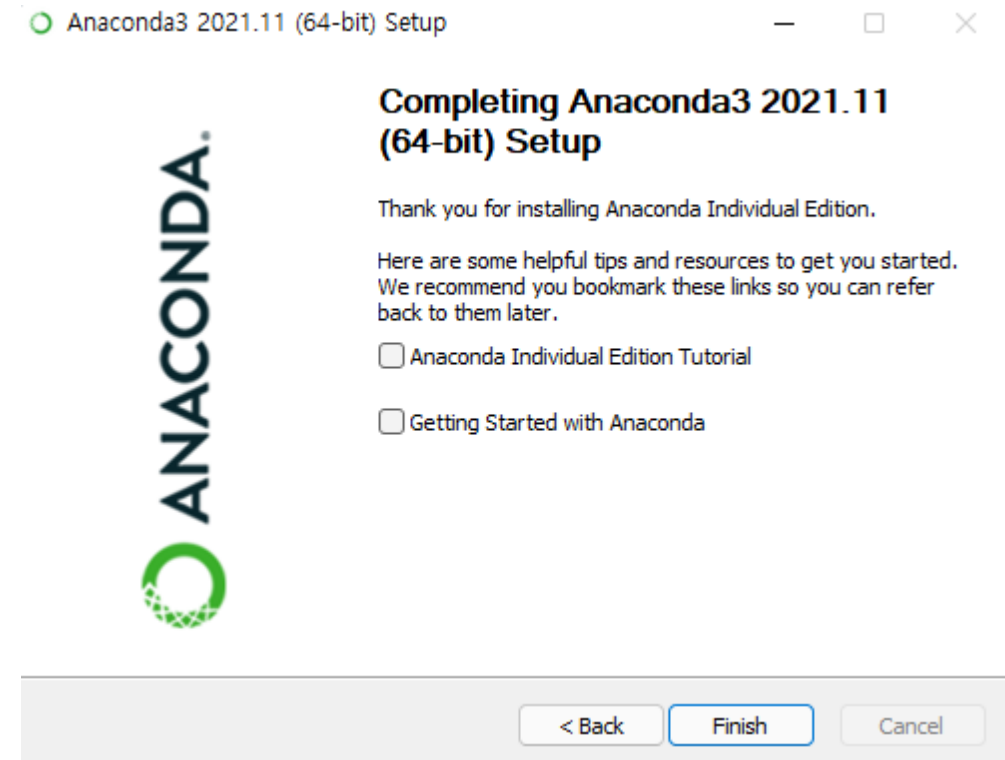
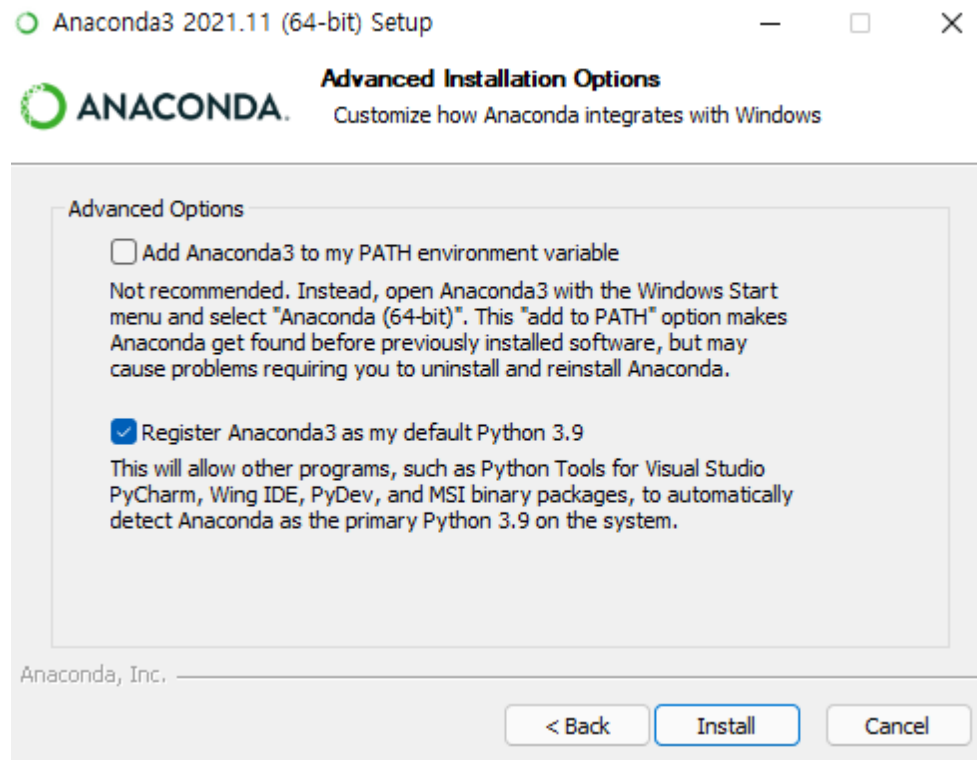
`conda --version`

`conda update conda`

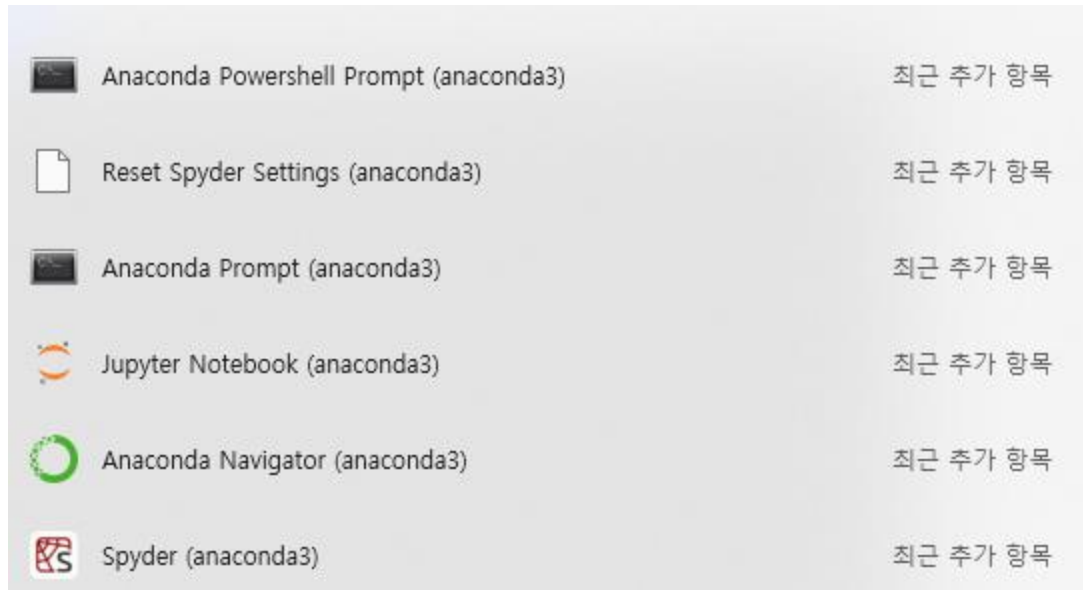
Anaconda Install - Windows



Anaconda Install - Windows



Anaconda Install - Windows



- 설치 완료 후 Anaconda Prompt에서 다음을 입력

`conda --version`

`conda update conda`

Anaconda

- 가상환경 확인

conda env list

```
[(base) nykim@gimnayeon-ui-MacBookAir ~ % conda env list]
# conda environments:
#
base                *  /Users/nykim/opt/anaconda3
finbert             /Users/nykim/opt/anaconda3/envs/finbert
pythonProject       /Users/nykim/opt/anaconda3/envs/pythonProject
pytorch             /Users/nykim/opt/anaconda3/envs/pytorch
warc                /Users/nykim/opt/anaconda3/envs/warc
```

Anaconda

- 가상환경 생성 (version 설정은 optional)

```
conda create -n <ENV_NAME> (python=3.8)
```

```
[(base) nykim@gimnayeon-ui-MacBookAir ~ %] conda create -n test python=3.7
Collecting package metadata (current_repodata.json): done
Solving environment: done

==> WARNING: A newer version of conda exists. <==
  current version: 4.10.3
  latest version: 4.12.0

Please update conda by running

  $ conda update -n base -c defaults conda

## Package Plan ##
```

Anaconda

- 가상환경 접속

`conda activate <ENV_NAME>`

```
[(base) nykim@gimnayeon-ui-MacBookAir ~ % conda activate test  
(test) nykim@gimnayeon-ui-MacBookAir ~ %
```

- 접속 중인 가상환경에서 나오기

`conda deactivate`

```
[(test) nykim@gimnayeon-ui-MacBookAir ~ % conda deactivate  
(base) nykim@gimnayeon-ui-MacBookAir ~ %
```

Anaconda

- 가상환경 삭제

```
conda env remove -n <ENV_NAME>
```

```
[(base) nykim@gimnayeon-ui-MacBookAir ~ % conda env remove -n test]

Remove all packages in environment /Users/nykim/opt/anaconda3/envs/test:

[(base) nykim@gimnayeon-ui-MacBookAir ~ % conda env list]
# conda environments:
#
base                *  /Users/nykim/opt/anaconda3
finbert              /Users/nykim/opt/anaconda3/envs/finbert
pythonProject        /Users/nykim/opt/anaconda3/envs/pythonProject
pytorch              /Users/nykim/opt/anaconda3/envs/pytorch
warc                  /Users/nykim/opt/anaconda3/envs/warc
```

PyTorch

PyTorch Build	Stable (1.11.0)		Preview (Nightly)		LTS (1.8.2)	
Your OS	Linux		Mac		Windows	
Package	Conda	Pip		LibTorch		Source
Language	Python			C++ / Java		
Compute Platform	CUDA 10.2	CUDA 11.3	ROCm 4.5.2 (beta)		CPU	
Run this Command:	<pre># MacOS Conda binaries are for x86_64 only, for M1 please use wheels conda install pytorch torchvision torchaudio -c pytorch</pre>					

conda 가상환경 접속 후 OS, Compute Platform 등에 맞게 설치

PyTorch – GPU

1. Nvidia-smi로 설치된 그래픽 드라이버 확인 : 커맨드 창에 nvidia-smi

NVIDIA-SMI 497.09				Driver Version: 497.09			CUDA Version: 11.5		
GPU	Name	TCC/WDDM	Bus-Id	Disp.A	Volatile	Uncorr.	ECC		
Fan	Temp	Perf	Pwr:Usage/Cap	Memory-Usage	GPU-Util	Compute M.	MIG M.		
0	NVIDIA GeForce ...	WDDM	00000000:01:00.0	On			N/A		
0%	30C	P8	15W / 170W	395MiB / 12288MiB	9%	Default	N/A		

nvidia-smi 없으면 그래픽 드라이버 설치

→ <https://www.nvidia.com/Download/index.aspx?lang=kr>

설치할 CUDA 버전 확인

PyTorch – GPU

2. CUDA 설치

<https://developer.nvidia.com/cuda-toolkit-archive>

자신의 컴퓨터와 맞는 CUDA toolkit 다운로드

Select Target Platform

Click on the green buttons that describe your target platform. Only supported platforms will be shown. By downloading and using the software, you agree to fully comply with the terms and conditions of the [CUDA EULA](#).

Operating System

Linux

Windows

Architecture

x86_64

Version

10

11

Server 2016

Server 2019

Server 2022

Installer Type

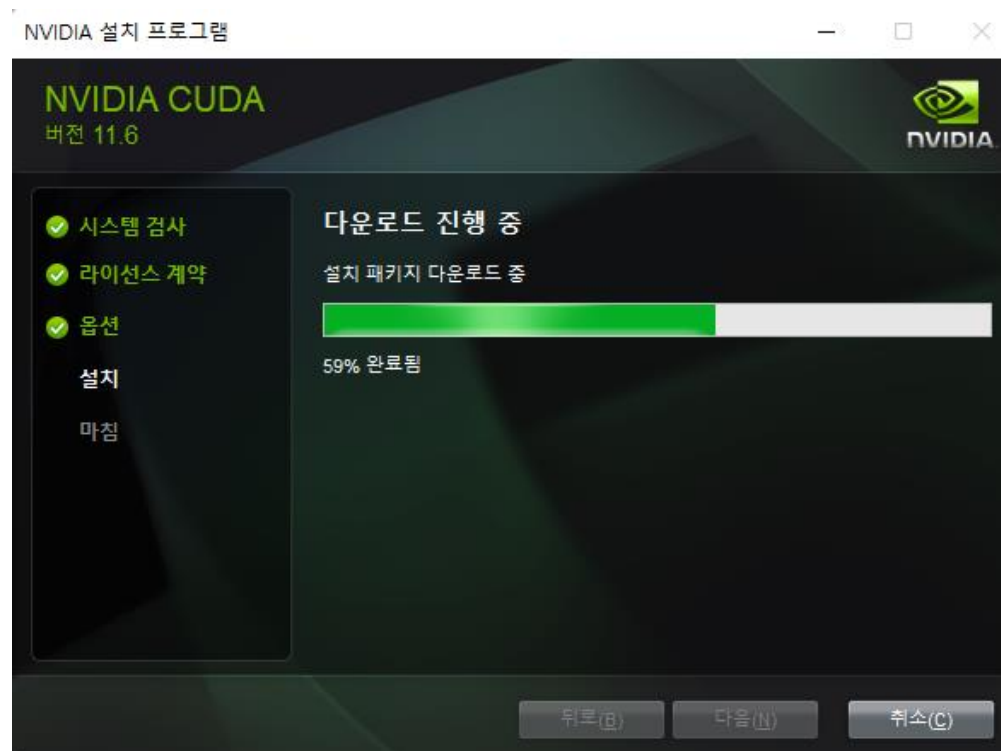
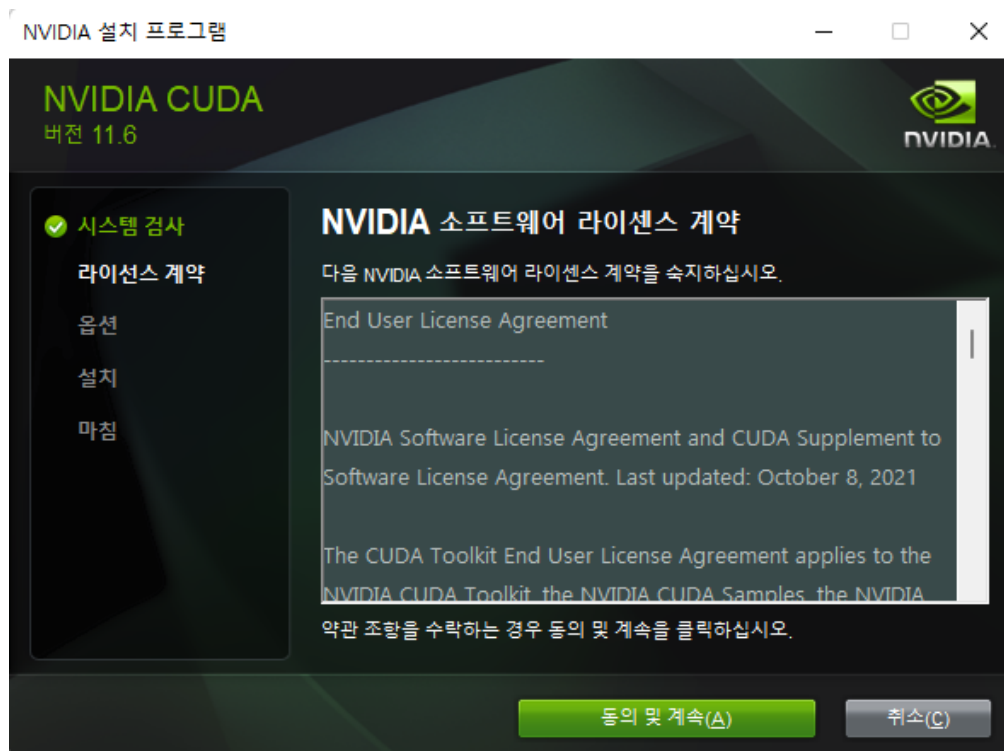
exe (local)

exe (network)

Download Installer for Windows 11 x86_64

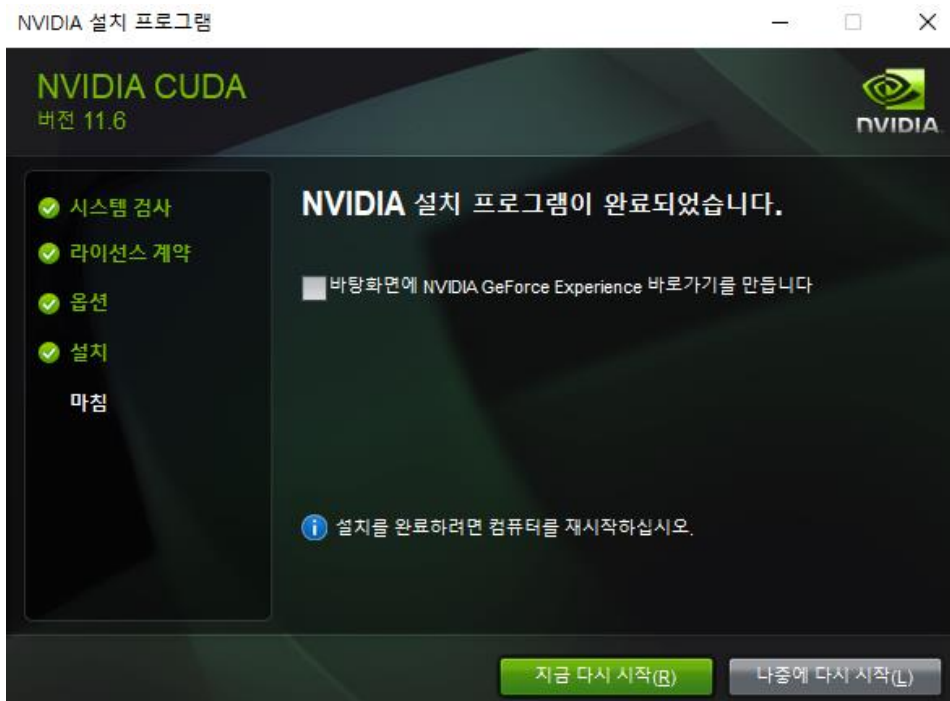
PyTorch – GPU

3. 설치 시작(다시 시작 필요)



PyTorch – GPU

4. 설치 완료 후 다시 시작



```
C:\Users\31900>nvcc --version
nvcc: NVIDIA (R) Cuda compiler driver
Copyright (c) 2005-2022 NVIDIA Corporation
Built on Tue_Mar__8_18:36:24_Pacific_Standard_Time_2022
Cuda compilation tools, release 11.6, V11.6.124
Build cuda_11.6.r11.6/compiler.31057947_0
```

터미널 열어 `nvcc --version`으로 설치 확인

PyTorch – GPU

5. cuDNN 설치(nvidia 로그인 필요) : <https://developer.nvidia.com/cudnn>
컴퓨터, CUDA 버전에 맞는 cuDNN 다운로드

cuDNN Download

NVIDIA cuDNN is a GPU-accelerated library of primitives for deep neural networks.

☒ I Agree To the Terms of the [cuDNN Software License Agreement](#)

Note: Please refer to the [Installation Guide](#) for release prerequisites, including supported GPU architectures and compute capabilities, before downloading.

For more information, refer to the cuDNN Developer Guide, Installation Guide and Release Notes on the [Deep Learning SDK Documentation](#) web page.

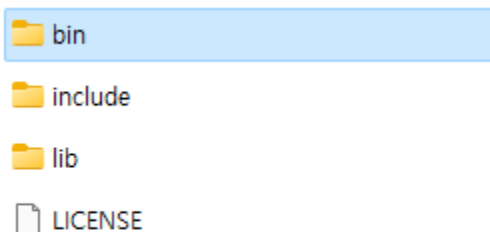
[Download cuDNN v8.4.0 \[April 1st, 2022\], for CUDA 11.x](#)

[Download cuDNN v8.4.0 \[April 1st, 2022\], for CUDA 10.2](#)

[Archived cuDNN Releases](#)

PyTorch – GPU

6. 다운받은 파일 압축 해제



7. bin, include 폴더 안의 파일들을 각각 (버전은 다를 수 있음)

C:\Program Files\NVIDIA GPU Computing Toolkit\CUDA\v11.6\include

C:\Program Files\NVIDIA GPU Computing Toolkit\CUDA\v11.6\bin

에 복사하기

8. Lib 폴더 안의 파일들은

C:\Program Files\NVIDIA GPU Computing Toolkit\CUDA\v11.6\extras\CUPTI\lib64 에 복사하기

PyTorch – GPU

9. 버전에 맞는 커맨드 복사하기

PyTorch Build	Stable (1.11.0)		Preview (Nightly)		LTS (1.8.2)		
Your OS	Linux		Mac		Windows		
Package	Conda		Pip		LibTorch		Source
Language	Python				C++ / Java		
Compute Platform	CUDA 10.2		CUDA 11.3		ROCm 4.5.2 (beta)		CPU
Run this Command:	<code>conda install pytorch torchvision torchaudio cudatoolkit=11.3 -c pytorch</code>						

PyTorch – GPU

9. 설치하고자 하는 conda environment에 접속하고 해당 커맨드 붙여 넣기 하여 설치

```
(pytorch) C:\Users\#31900>conda install pytorch torchvision torchaudio cudatoolkit=11.3 -c pytorch
```

10. 다음을 입력하여 오류가 나지 않는지 확인

```
>>> import torch
>>> device = torch.device("cuda:0")
>>> device
device(type='cuda', index=0)
```

PyCharm

다운로드 PyCharm

Windows

macOS

Linux

Professional

과학 및 웹 Python 개발용. HTML, JS, SQL 지원.

다운로드

.dmg (Intel) ▼

30일 무료 평가 이용 가능

Community

순수 Python 개발용

다운로드

.dmg (Intel) ▼

무료, 오픈 소스

OS, 하드웨어에 맞는 것으로 다운로드/설치

PyCharm

JETBRAINS COMMUNITY EDITION TERMS

IMPORTANT! READ CAREFULLY:

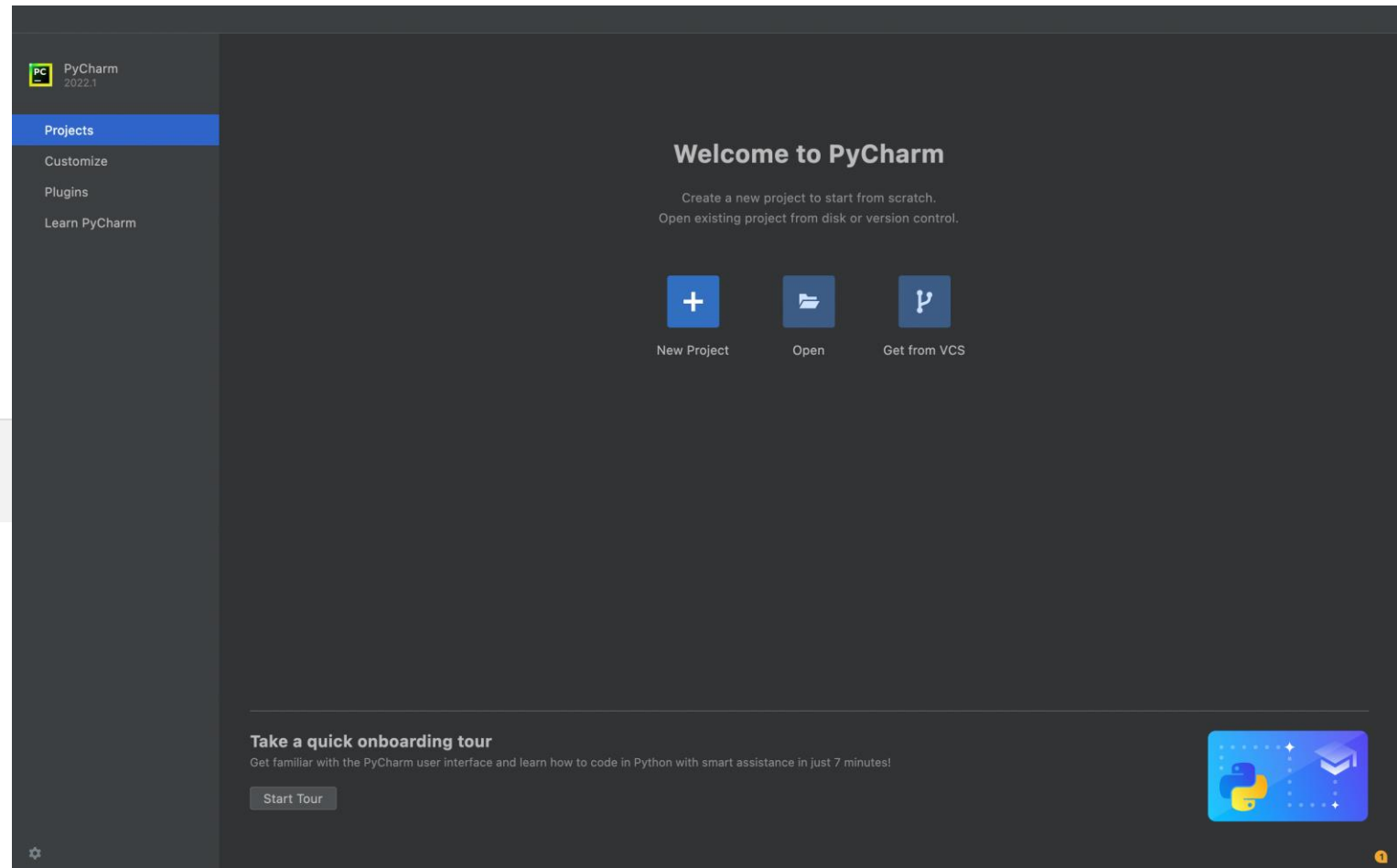
THESE TERMS APPLY TO THE JETBRAINS INTEGRATED DEVELOPMENT ENVIRONMENT TOOLS CALLED 'INTELLIJ IDEA COMMUNITY EDITION' AND 'PYCHARM COMMUNITY EDITION' (SUCH TOOLS, "COMMUNITY EDITION" PRODUCTS) WHICH CONSIST OF 1) OPEN SOURCE SOFTWARE SUBJECT TO THE APACHE 2.0 LICENSE (AVAILABLE HERE: <https://www.apache.org/licenses/LICENSE-2.0>), AND 2) JETBRAINS PROPRIETARY SOFTWARE PLUGINS PROVIDED IN FREE-OF-CHARGE VERSIONS WHICH ARE SUBJECT TO TERMS DETAILED HERE: <https://www.jetbrains.com/legal/community-bundled-plugins>.

"JetBrains" or "we" means JetBrains s.r.o., with its principal place of business at Na Hrebenech II 1718/10, Prague, 14000, Czech Republic, registered in the Commercial Register maintained by the Municipal Court of Prague, Section C, File 86211, ID No.: 265 02 275.

☒ I confirm that I have read and accept the terms of this User Agreement

Exit

Continue



Jupyter notebook

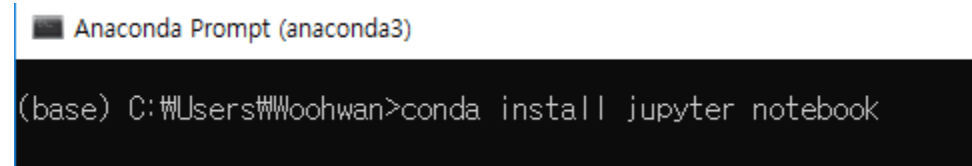
- A powerful tool for interactively developing and presenting data science projects

- 설치

- `conda install jupyter notebook`

- 실행

- `jupyter notebook`
 - 자동으로 브라우저가 뜨지 않는 경우: 127.0.0.1:8888 로 접속



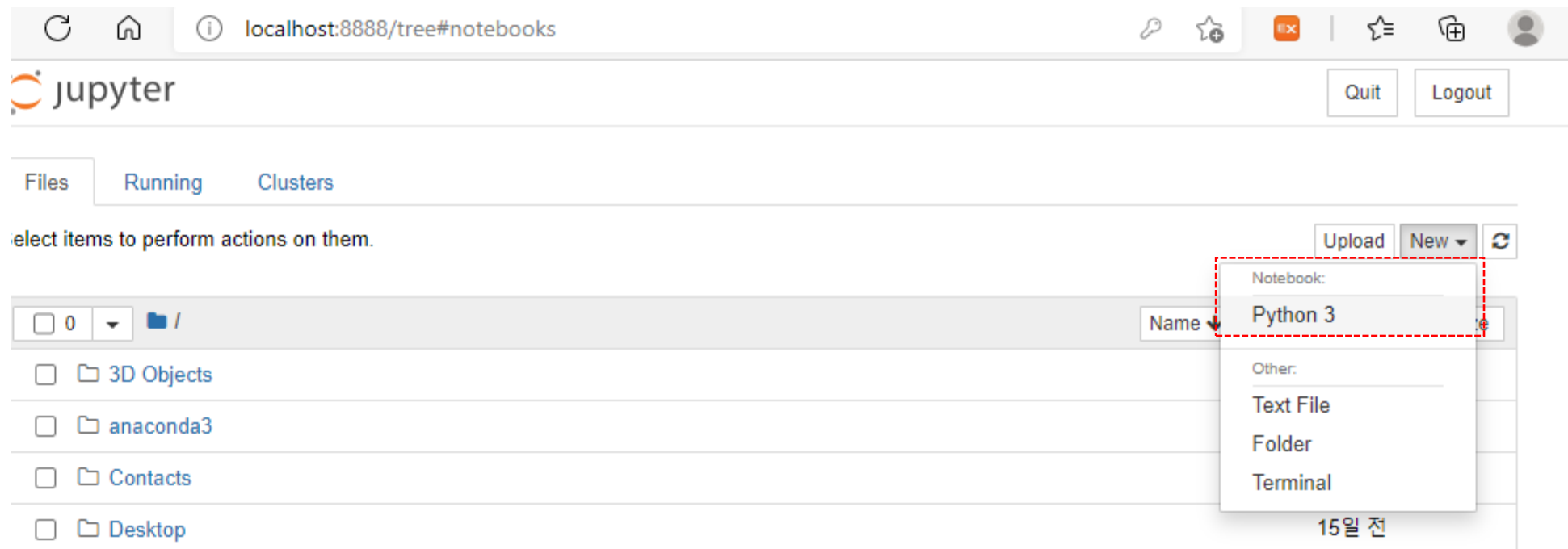
```
Anaconda Prompt (anaconda3)  
(base) C:\Users\woohwan>conda install jupyter notebook
```

Libraries

- Conda 가상환경에 접속하여 다음을 입력
 - `conda install scipy`

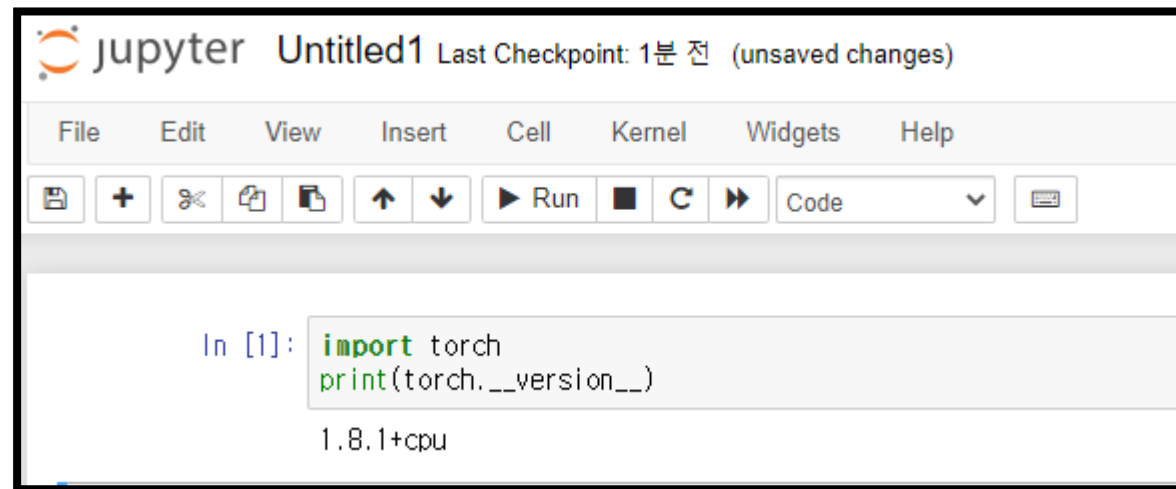
설치 확인

- 1. jupyter notebook 실행
- 2. 새 notebook file 열기 (New -> Python 3)



설치 확인

- 3. 오른쪽 코드 입력 후 실행
 - 실행 (shift + enter)
 - 줄바꿈 (enter)
- 4. Torch version이 출력되면 정상



The image shows a Jupyter Notebook window titled 'Untitled1' with a status bar indicating 'Last Checkpoint: 1분 전 (unsaved changes)'. The menu bar includes File, Edit, View, Insert, Cell, Kernel, Widgets, and Help. The toolbar contains icons for saving, adding, deleting, and running code. The code cell contains the following Python code:

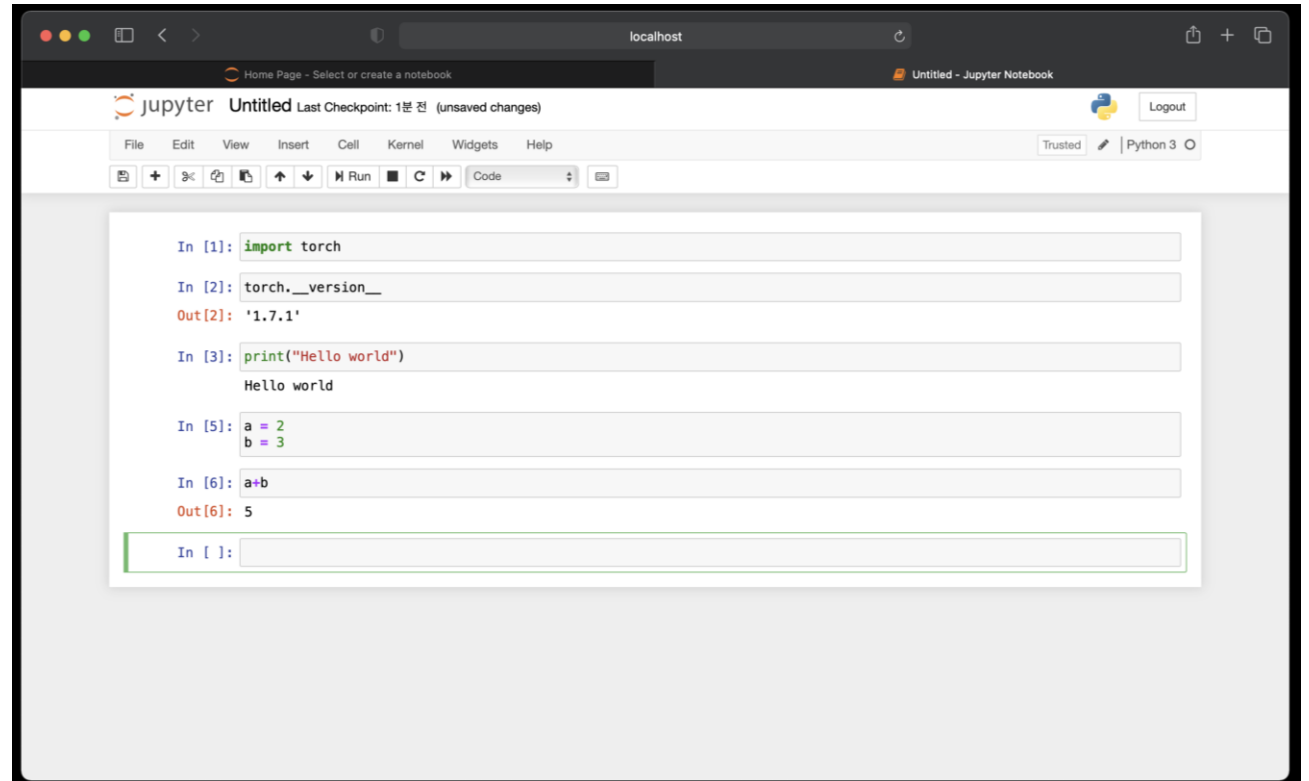
```
In [1]: import torch
        print(torch.__version__)
```

The output of the code is displayed below the cell:

```
1.8.1+cpu
```

공지1: Homework 1

- 1) Open jupyter notebook
- 2) Import torch
- 3) Print torch version
- 4) Do some operations
 - E.g.) Assign, add, print
- 제출: 2022/9/5



The screenshot shows a Jupyter Notebook interface in a web browser. The browser address bar shows 'localhost'. The notebook title is 'Untitled - Jupyter Notebook'. The interface includes a menu bar (File, Edit, View, Insert, Cell, Kernel, Widgets, Help) and a toolbar with icons for file operations, running, and saving. The code area contains the following cells:

```
In [1]: import torch
```

```
In [2]: torch.__version__
```

```
Out[2]: '1.7.1'
```

```
In [3]: print("Hello world")
```

```
Hello world
```

```
In [5]: a = 2
```

```
b = 3
```

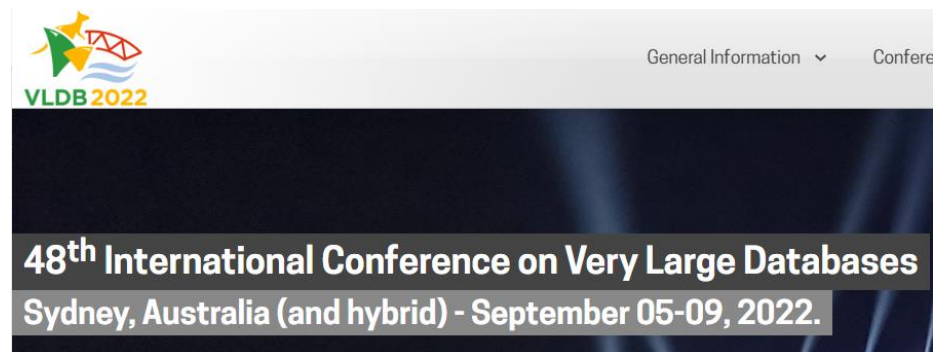
```
In [6]: a+b
```

```
Out[6]: 5
```

```
In [ ]:
```

공지2: 휴강

- 학회출장으로 다음주 화, 목 휴강
- 보강은 녹화강의 또는 16주차수업으로 대체



35.57 Cardinality Estimation of Approximate Substring Queries using Deep Learning [\[Download Paper\]](#)

Suyong Kwon (Seoul National University), **Woohwan Jung** (Hanyang University)*, Kyuseok Shim (Seoul National University)

▼ Cardinality estimation of an approximate substring query is an important problem in database systems. Traditional appro