**OP Notes**

**All Rights Reserved. © Copyright 2019-2022** [**Jinn-Liang Liu**](http://www.nhcue.edu.tw/~jinnliu/)

**2019.8.28 - 2022.12.28**

**230103**: **台灣** [**openpilot**](https://github.com/commaai/openpilot)[**同樂會**](https://saber422.blogspot.com/) **邀訪**

**a.** [**End-to-End Deep Learning System for Autonomous Driving**](https://docs.google.com/presentation/d/1fK9cWndIZFutdRP8JkcZ5PxDsoiiT-MT/edit#slide=id.p1)

**b.** [**AI abc An Introduction to Machine Learning**](http://mx.nthu.edu.tw/~jlliu/teaching/AI17/AI_1801.pdf)

**c.** [**OP coding**](http://mx.nthu.edu.tw/~jlliu/teaching/AI17/AI17.htm)

**d. GitHub Projects:** [**B5**](https://github.com/JinnAIGroup/B5)**,** [**OPNet**](https://github.com/JinnAIGroup/OPNet)**,** [**tinygrad**](https://github.com/geohot/tinygrad) **(**[**micrograd**](https://github.com/karpathy/micrograd)**)**

**221210**: [**2022openpilot同樂會年終聚會**](https://saber422.blogspot.com/2022/12/sabercord-openpilot.html)

**Road**: [**200527v**](https://drive.google.com/file/d/174K4ZfZS_Yu3EPJj62eo2KzBABAYmadP/view?usp=sharing)**,** [**200527**](https://drive.google.com/file/d/1Q_eOXAMj0LjyI9b0rLBH9s0XDAXWDEC5/view?usp=sharing)**,** [**211125v**](https://drive.google.com/file/d/1-zcj3OI0LnaWJ5-L8DH1wtu5mUbn9OeJ/view?usp=sharing)**,** [**220208**](https://drive.google.com/file/d/1z84Mc0vYiwnmqQztx5vnIdeOJwrYUW9b/view?usp=sharing)

**211011**: [**OPNet**](https://github.com/JinnAIGroup/OPNet): [**main.py**](https://github.com/JinnAIGroup/OPNet/blob/main/main.py)**,** [**video\_to\_yuvB3.py**](https://github.com/JinnAIGroup/OPNet/blob/main/video_to_yuvB3.py)**,** [**hevc2yuvh5B3.py**](https://github.com/JinnAIGroup/OPNet/blob/main/hevc2yuvh5B3.py)**,**

[**train\_modelB3.py**](https://github.com/JinnAIGroup/OPNet/blob/main/train_modelB3.py)**,** [**Keras UNet**](https://keras.io/examples/vision/oxford_pets_image_segmentation/), [**modelB3A.py**](https://github.com/JinnAIGroup/OPNet/blob/main/modelB3A.py), [**modelB3.py**](https://github.com/JinnAIGroup/OPNet/blob/main/modelB3.py)**, \*B3**

1. **Openpilot (**[**Step 1**](https://docs.google.com/document/d/1tH6coTWyIQ3QZUrmNFav6xfYn9PV-mGk2FiN3yYW_IY/edit?usp=sharing)**,** [**Step 2**](https://docs.google.com/document/d/1x1OMnGbGKDapQEBx4xNi2VEwYRL0_XFLZZZDvE8Vefo/edit?usp=sharing)**).**

* [陳思豪2101](https://drive.google.com/file/d/1OvhEWfiWtZUyOwEV4rRL4Tct_QYb0lbf/view?usp=sharing) ([HC2](https://docs.google.com/document/d/1coL5n6w_xZIt5pacUbTJMT4aRIdA7zGRQor0ndaRpPw/edit),[Leon](https://github.com/littlemountainman/modeld)), [陳思豪2106](https://drive.google.com/file/d/1ks6jSeDZWi9ewHmAzYu2pIjLHrGd2sS_/view) ([HC1](https://www.youtube.com/watch?v=jZv_qnbcq0I)), [陳思豪2108](https://docs.google.com/presentation/d/1S0xFpluCefNjDe3FC8mo8uWeP91X2v7C/edit?usp=sharing&ouid=117467329867185057226&rtpof=true&sd=true),[陳思豪2012](https://drive.google.com/file/d/1DNfXLRK82RHAfvZJ-j-r59tWwkEz0IDQ/view?usp=sharing),
* [劉宜朋2107](https://docs.google.com/presentation/d/1OJFmMvTPaOjxENFwGND-xTmQhV05Seaq/edit?usp=sharing&ouid=117467329867185057226&rtpof=true&sd=true)**,** [runyp](https://docs.google.com/document/d/1wvvn8vGDVqvP8TmAo-jQWAfzJejTZAYfvz2uYxwszVY/edit?usp=sharing)**,** [劉宜朋1909](https://drive.google.com/file/d/1OV_-8B1xnasvMHdnRnAZtdOP7a2mbrvf/view?usp=sharing)
* [**OPnote2**](https://docs.google.com/document/d/1dNucr0tBHpdjNWnrMVM6yBRxpH2QvBP6DGWDDORjJsE/edit?usp=sharing), [Server2101](https://drive.google.com/file/d/1kNwWhDpnPnuvkF7LHwQRjBp4p7kQii7X/view?usp=sharing)**,** [**cData**](https://github.com/commaai/comma2k19), [**TData-Label**](https://drive.google.com/drive/folders/1aCTcxRUsA2WE6tQoQOVkOg5IVOWplMJa?usp=sharing)

1. **Neural Networks**

* [**OPNet\***](https://drive.google.com/file/d/1L8sWgYKtH77K6Kr3FQMETtAWeQNyyb8R/view?usp=sharing) **(**[**OPNet**](http://www.nhcue.edu.tw/~jinnliu/teaching/AI17/supercombo.html)**),** [**YPN**](https://github.com/JinnAIGroup) **(**[YPNet1](http://www.nhcue.edu.tw/~jinnliu/teaching/AI17/YPNet1.html)**) OPPN, OPAN**
* [李碧寒2107](https://drive.google.com/file/d/1GCCTNTHWkwElb0mtvXPgw5sCg-5flf1w/view?usp=sharing)**,** [runbh](https://docs.google.com/document/d/1YadAs2m0VJy3TtYzhLiLcL8i7MWB4xvvlY_9fMFtHYw/edit?usp=sharing)**,** [**Demo**](https://drive.google.com/file/d/1zs98Ofjr9onaoDmHgGZ54BjnNWsSaNfd/view?usp=sharing)**, YolaMT**

1. **Comma Two**

* [**C2Notes**](https://docs.google.com/document/d/1-ePnGSarXL8naq7xIV0DHWQ4a2GM_RQavnk0XZkTaFQ/edit?usp=sharing)**,** [李德浩2105](https://drive.google.com/file/d/1BRr6OZWn1dS_MMz5Afnkn2IbNIhEFNer/view?usp=sharing)**,** [**SNPE-AIMET**](https://developer.qualcomm.com/blog/neural-network-optimization-aimet?mkt_tok=Mzg1LVRXUy04MDMAAAF_1nJKvp44KyBSimQDSDYTCQ7Lbj3wH05QB_vWwH-BNsb1E0sVqYsOusTiD6B3I_--QCs2-M8JR9QuAw6vUf2c8lT48uwFNwWhDU05zEPZG1d_jA)
* Read[劉晉良2011](https://drive.google.com/file/d/1HvQ8B25cUMK2IgFEGn93jSiSkF7os4v6/view?usp=sharing)**,\***[**openpilot**](http://www.nhcue.edu.tw/~jinnliu/teaching/AI17/191031_openpilot.pdf), [**comma Coding**](http://www.nhcue.edu.tw/~jinnliu/teaching/AI17/commaCoding.htm).
* The links here to various notes and code examples can help you to **install**, **run**, **read**, and **write** code for deploying **Self-Driving Software** on [**openpilot (Git)**](https://github.com/commaai/openpilot) to [**comma.ai**](https://comma.ai/)’s [**comma two**](https://comma.ai/shop/products/comma-two-devkit) that drives a [**Toyota**](https://www.youtube.com/watch?v=KeUOMaPe3v0) car autonomously at Level 2 (in 2021).
* The code, links, and notes are constantly changing subject to our ongoing research activities.
* Do not make the code, links, and notes public or any use without permission. These are copyrights of Jinn-Liang Liu and his students and associates.

**210917**: [**Project A**](https://github.com/JinnAIGroup/YPNetA):

1. [fcamera.hevc](https://drive.google.com/file/d/1GOOD4IhagzsaB_HsC6cvavKj1lLcD0nb/view?usp=sharing) ([rlog.bz2](https://drive.google.com/file/d/1GOOD4IhagzsaB_HsC6cvavKj1lLcD0nb/view?usp=sharing)) => [hevctoh5.py](https://github.com/JinnAIGroup/YPNetA/blob/main/hevctoh5.py) ([bz2toh5.py](https://github.com/JinnAIGroup/YPNetA/blob/main/bz2toh5.py)) => camera.h5

(radar.h5)

2. [modelA1.py](https://github.com/JinnAIGroup/YPNetA/blob/main/modelA1.py) => [train\_modelA1.py](https://github.com/JinnAIGroup/YPNetA/blob/main/train_modelA1.py) => opUNet.h5

3. [main.py](https://github.com/JinnAIGroup/OPNet/blob/main/main.py) => [Horace](https://docs.google.com/presentation/d/1S0xFpluCefNjDe3FC8mo8uWeP91X2v7C/edit?usp=sharing&ouid=117467329867185057226&rtpof=true&sd=true) => [h5topbA1.py](https://github.com/JinnAIGroup/YPNetA/blob/main/h5topbA1.py) => opUNet.pb

4. [SNPE](https://docs.google.com/document/d/1x1OMnGbGKDapQEBx4xNi2VEwYRL0_XFLZZZDvE8Vefo/edit) => opUNet.dlc => [Run on C2](https://github.com/JinnAIGroup/CAN/blob/main/zcCS7.py) => [Self-Driving](https://drive.google.com/file/d/10Rp19QgbRTYRh1dflaPtOj72Tc1aB7pv/view?usp=sharing)

[**Project B**](https://github.com/JinnAIGroup/YPNetB):

1. [fcamera.hevc](https://drive.google.com/file/d/1GOOD4IhagzsaB_HsC6cvavKj1lLcD0nb/view?usp=sharing) ([rlog.bz2](https://drive.google.com/file/d/1GOOD4IhagzsaB_HsC6cvavKj1lLcD0nb/view?usp=sharing)) => [hevctoh5.py](https://github.com/JinnAIGroup/YPNetA/blob/main/hevctoh5.py) ([bz2toh5.py](https://github.com/JinnAIGroup/YPNetA/blob/main/bz2toh5.py)) => camera.h5 (radar.h5)

2. [modelB1.py](https://github.com/JinnAIGroup/YPNetB/blob/main/modelB1.py) => [train\_modelB1.py](https://github.com/JinnAIGroup/YPNetB/blob/main/train_modelB1.py) => opUNet.h5

3. [main.py](https://github.com/JinnAIGroup/OPNet/blob/main/main.py) => [Horace](https://docs.google.com/presentation/d/1S0xFpluCefNjDe3FC8mo8uWeP91X2v7C/edit?usp=sharing&ouid=117467329867185057226&rtpof=true&sd=true) => [h5topbA1.py](https://github.com/JinnAIGroup/YPNetA/blob/main/h5topbA1.py) => opUNet.pb

4. [SNPE](https://docs.google.com/document/d/1x1OMnGbGKDapQEBx4xNi2VEwYRL0_XFLZZZDvE8Vefo/edit) => opUNet.dlc => [Run on C2](https://github.com/JinnAIGroup/CAN/blob/main/zcCS7.py) => [Self-Driving](https://drive.google.com/file/d/10Rp19QgbRTYRh1dflaPtOj72Tc1aB7pv/view?usp=sharing)

**210906**: [modelA1.py](https://github.com/JinnAIGroup/YPNetA/blob/main/modelA1.py) => [train\_modelA1.py](https://github.com/JinnAIGroup/YPNetA/blob/main/train_modelA1.py) (OK) => opUNet1.h5 (OK) => Leon's [main.py](https://github.com/JinnAIGroup/OPNet/blob/main/main.py) (OK) => [h5topbA1.py](https://github.com/JinnAIGroup/YPNetA/blob/main/h5topbA1.py) => opUNet1.pb (OK) => opUNet1.dlc (Failed)

**210804**: C2: 6. rename opeffA.dlc as ypreg.dlc (oppn) => 7. run opeffA.dlc by /selfdrive/debug/uiview.py

**210803**: PC: 6. rename opeffA.dlc as supercombo.dlc => 7. run opeffA.dlc by /selfdrive/debug/uiview.py

**210723**: 1. train\_modelA.py => 2. weights-opeffA.best.hdf5 => 3. opeffA.pb => 4. opeffA.dlc => 5. opeffA.html (29MB) =>

**Appendices**

1. **Taiwan Road Data TData** (THD: Taiwan Highway Day; THN: TH Night; THRD: TH Raining D; THRN; TP: T Parking; TUD: T Urban D; TUN; TURD; TURN)
   1. THD 12.8G/322M; THN 3.73G/ 93M; THRD 2.22G/56M; THRN 0.29G/7M; TP 2.47G/65M; TUD 10G/256M; TUN 14.5G/364M; TURD 4.73G/120M; TURN 2.53G/64M; **1 video = 4.3M/min**
   2. Collected Dates:  
      2020-05-04; 2020-05-11; 2020-06-07; 2020-07-18; 2020-11-24;
   3. **Data**: [Servers](https://drive.google.com/file/d/1kNwWhDpnPnuvkF7LHwQRjBp4p7kQii7X/view?usp=sharing), [TDataLBH](https://drive.google.com/drive/folders/1aCTcxRUsA2WE6tQoQOVkOg5IVOWplMJa?usp=sharing), [TDataLTT](https://drive.google.com/drive/folders/1d6o7AMuY6h4uskuDBwGiYVy0lLOcQYrd?usp=sharing), [TDataLZC](https://drive.google.com/drive/folders/1WCFqBaAWdy2KDzwYAzC8No4ot5IiFYB4?usp=sharing), TData (3,663 items/78.1 GB)
   4. THD--2020-05-04--00-37-33--46

THD--2020-06-05--03-26-13--61

THN--2020-05-04--04-37-11--30

THN--2020-05-04--04-37-11--36

THN--2020-06-05--09-04-02--122

TUD--2020-05-11--03-00-57--17

TUD--2020-06-17--05-01-25--9

TUD--2020-08-03--08-18-14--38 (dog)

TUN--2020-05-11--03-00-57--59

TUN--2020-05-11--03-00-57--60

TUN--2020-05-11--03-00-57--61\*

TUN--2020-05-06--06-10-49--17\*

* 1. Install HDFView (.h5 viewer) on Ubuntu 20.04:

1. sudo apt-get install hdfview 2. click on .h5 file to view it

* 1. Install [VLC player](https://geeksterminal.com/install-h265-hevc-codec-ubuntu/1900/) for viewing .hevc files.

1. 2021.7.15 Old Links:

[**YPNets**](https://github.com/JinnAIGroup):[OPNet](https://drive.google.com/file/d/1L8sWgYKtH77K6Kr3FQMETtAWeQNyyb8R/view?usp=sharing),

[**CAN & Control**](https://github.com/JinnAIGroup):

**Yolact**: Labeled Data?, [TDataLBH](https://drive.google.com/drive/folders/1aCTcxRUsA2WE6tQoQOVkOg5IVOWplMJa?usp=sharing), [TDataLTT](https://drive.google.com/drive/folders/1d6o7AMuY6h4uskuDBwGiYVy0lLOcQYrd?usp=sharing), [TDataLZC](https://drive.google.com/drive/folders/1WCFqBaAWdy2KDzwYAzC8No4ot5IiFYB4?usp=sharing).

[**Simulator**](https://docs.google.com/document/d/1-ePnGSarXL8naq7xIV0DHWQ4a2GM_RQavnk0XZkTaFQ/edit?usp=sharing): [劉宜朋2008](https://drive.google.com/file/d/1QC2ooygEgj55hro3KDqyuGPc6vFBPrOY/view?usp=sharing) ([code1](https://github.com/commaai/openpilot/blob/master/selfdrive/debug/uiview.py), [co2](https://github.com/commaai/openpilot/blob/master/selfdrive/ui/paint.cc)), [劉宜朋2008a](https://drive.google.com/file/d/1_AvuPlxsyP1KEWjNHGXIttyl1Jz9cIcP/view?usp=sharing) ([co3](https://github.com/commaai/openpilot/blob/master/selfdrive/modeld/modeld.cc)),

**I. Ubuntu** (**HW1:** [陳思豪2012](https://drive.google.com/file/d/1DNfXLRK82RHAfvZJ-j-r59tWwkEz0IDQ/view?usp=sharing))

* **HW1: (A) Install** [**Ubuntu**](https://itsfoss.com/install-ubuntu/) **20.04 or** [**Reinstall**](https://drive.google.com/file/d/1QE3Kx0aweEocT9HLuPyiEacT85XPUEnP/view?usp=sharing) **(B) Write, compile, and run** [**C++/C code on Ubuntu**](https://drive.google.com/file/d/12D3xTnjXbHdvOUy5J-HH15c7SUBVK4pl/view?usp=sharing)**,** [**cpp1.cxx**](https://drive.google.com/file/d/1WHDmJShYdSj4IN1qyZwW6JhyZlAhNxro/view?usp=sharing) **(C)** [**Server施威宇2101**](https://drive.google.com/file/d/1kNwWhDpnPnuvkF7LHwQRjBp4p7kQii7X/view?usp=sharing)

**II. openpilot and OPNet (**[陳思豪2101](https://drive.google.com/file/d/1OvhEWfiWtZUyOwEV4rRL4Tct_QYb0lbf/view?usp=sharing)**,** [**OPnote1**](https://drive.google.com/file/d/1VznxlVXSCHjoE2KAUZfuYJfpnoNQQjuG/view?usp=sharing)**,** [**OPnote2**](https://docs.google.com/document/d/1dNucr0tBHpdjNWnrMVM6yBRxpH2QvBP6DGWDDORjJsE/edit?usp=sharing)**)**

* **HW2: (A) Install and run** [**openpilot**](https://github.com/commaai/openpilot) **(**[**UI**](http://www.nhcue.edu.tw/~jinnliu/teaching/AI17/comma_ui.jpg)**,** [**Step 1**](https://drive.google.com/file/d/1YjU2MmdytoCeE5B-tqTf6icpWKVS4Q41/view?usp=sharing)**) (B) Run** [**unlogger.py**](https://github.com/commaai/openpilot/blob/master/tools/replay/unlogger.py)**,** [**ui.py**](https://github.com/commaai/openpilot/blob/master/tools/replay/ui.py)**.**
* **HW3: Read (A)** [**view\_steering\_model.py**](https://github.com/commaai/research/blob/master/view_steering_model.py) ([劉宜朋1911](https://drive.google.com/file/d/1XG2w9dD6I6xylPBfW9SyB8A1Ug9e8LHv/view?usp=sharing)**,** [劉宜朋1912](https://drive.google.com/file/d/1CqKOj8gmEsJiquDwbnsXZjXYmCZ9nYX7/view?usp=sharing)**,** [李碧寒2004](https://drive.google.com/file/d/1ebanUshI_qMZ2ufK6j7WrHs-WUdOnY9P/view?usp=sharing)) **(B)** [**train\_steering\_model.py**](https://github.com/commaai/research/blob/master/train_steering_model.py) ([唐旭蓮2005](https://drive.google.com/file/d/1CangBPkAWiOAlq1ZvUYR2dDJQ41FgUlU/view?usp=sharing)) **(C)** [**comma Data**](https://github.com/commaai/comma2k19) **(**[**TDataLBH**](https://drive.google.com/drive/folders/1aCTcxRUsA2WE6tQoQOVkOg5IVOWplMJa?usp=sharing)**,** [**code**](https://github.com/commaai/comma2k19/blob/master/notebooks/raw_readers.ipynb)**,** [劉宜朋1909](https://drive.google.com/file/d/1OV_-8B1xnasvMHdnRnAZtdOP7a2mbrvf/view?usp=sharing)**,** [李德浩1908](https://drive.google.com/file/d/156IIPQX9sZIDgfhzVUxfA7tKi0Ta5KjJ/view?usp=sharing)**)**
* **HW4: (A) Run and read** [**OPNet.py**](https://colab.research.google.com/drive/1_YOsAJo671ACMU7HTYWXt_TJI-dsUqVK) ([**main.py**](https://drive.google.com/file/d/1uT-kVBSVVfCqAECFF3hrZcrAkYRJuzBc/view?usp=sharing), [**notes**](https://drive.google.com/file/d/1V7qvn6bZTdrkcDZfynNH5kFbc0skQVAv/view?usp=sharing)**,** [**OPNet**](http://www.nhcue.edu.tw/~jinnliu/teaching/AI17/supercombo.html) **(supercombo.**[**dlc**](https://static.linaro.org/connect/hkg18/presentations/hkg18-306.pdf)**),** [**OPNet\*\***](https://drive.google.com/file/d/1L8sWgYKtH77K6Kr3FQMETtAWeQNyyb8R/view?usp=sharing)**,** [**Leon**](https://github.com/littlemountainman/modeld)**,** [**Shen**](http://www.nhcue.edu.tw/~jinnliu/teaching/AI17/Decode.pdf)**) (B) Read** [**driving.cc**](https://github.com/commaai/openpilot/blob/master/selfdrive/modeld/models/driving.cc) **(**[李碧寒2006](https://drive.google.com/file/d/1f-mLf1c0z0QQptqq0h1GbCNSSzlYtk0z/view?usp=sharing)**)**

**III. Instance Segmentation**

* **HW5: Run and read** [**yola1**](https://colab.research.google.com/drive/1NYoKk_jO86GLFWRZy45kmQt7qVerNhLM) **(**[**Yolact**](https://github.com/dbolya/yolact)**,** [**Tsang1**](https://towardsdatascience.com/review-deepmask-instance-segmentation-30327a072339)**,** [**2019**](https://arxiv.org/pdf/1904.02689.pdf)**),** [**yola2**](https://colab.research.google.com/drive/1LLEhE1in5D6o3RKUh2Nhl5Tb_DTazL5o?usp=sharing) **(**[**yola2a**](https://colab.research.google.com/drive/1AaJ1HQkQxAaM2WrPrxOA4w9kW0xfKOcx?usp=sharing)**) (**[**output**](https://drive.google.com/file/d/1mZZAUSjOt8RbLFTD4YH0zsHrQyzjOL_T/view?usp=sharing)**),**
* **Project 2: Segmentation: (A)** [**yola2**](https://colab.research.google.com/drive/1LLEhE1in5D6o3RKUh2Nhl5Tb_DTazL5o?usp=sharing) **->** [**Labeling**](https://medium.com/tektorch-ai/best-image-labeling-tools-for-computer-vision-393e256be0a0) **(**[**MOTS**](https://github.com/VisualComputingInstitute/mots_tools)**) ->** [**TData**](https://drive.google.com/file/d/1mZZAUSjOt8RbLFTD4YH0zsHrQyzjOL_T/view?usp=sharing) **-> new yolact**

**IV. Deployment and** [**SNPE**](https://static.linaro.org/connect/hkg18/presentations/hkg18-306.pdf)

* **HW6: Install and run** [**SNPE**](https://developer.qualcomm.com/docs/snpe/index.html) **(**[**Step 2**](https://drive.google.com/file/d/1QkGW6D6ltJ02UoALc1k2OQ3_psaUIorK/view?usp=sharing)**). Read** [**OPNet\*\***](https://drive.google.com/file/d/1L8sWgYKtH77K6Kr3FQMETtAWeQNyyb8R/view?usp=sharing)**,** [劉宜朋2006](https://drive.google.com/file/d/1yhr5wl1SXTscrOhtB0hxD-5hcxHI2hC4/view?usp=sharing)**,** [唐旭蓮2008](https://drive.google.com/file/d/1Ixlrprh6eVO0iGAv7kd1Pgza6fIOleso/view?usp=sharing)**,** [劉宜朋2008](https://drive.google.com/file/d/1IRmCOzB68ezXuKHCpBh71ay1tbOmnkNC/view?usp=sharing)**,** [施威宇2011](https://drive.google.com/file/d/1mgDcAfB4jNmILhOA-K2z-7GmYMp8EAlq/view?usp=sharing).
* **HW7: Run and read** [**yolo3.py to h5**](https://colab.research.google.com/drive/1LBLhs0w6yPPXyXecGQ3zd-yHeCpGPqxU?usp=sharing)**,** [**yolo3.h5 to pb**](https://colab.research.google.com/drive/18KvxBnN0SwKnKhlWKF8tfkPcx1qQd3Jw?usp=sharing)**,** [**yolo4.py to h5 to pb**](https://colab.research.google.com/drive/1Z-7jQmLVUCBWOF5QNG1Hv0Vlpr4M-X1p?usp=sharing) **(**[**yolo4.h5**](https://drive.google.com/file/d/1J2KleoWh7NAg7hqkwKd9Db30vnE-UtY1/view?usp=sharing)**),** [**(h5topb\_YP**](https://drive.google.com/file/d/12hbxygrMu1d3YyeFENVpF4PD51G0uY7t/view?usp=sharing)**)**
* **Project 2: Segmentation: (A)** [**yola2.py**](https://colab.research.google.com/drive/1LLEhE1in5D6o3RKUh2Nhl5Tb_DTazL5o?usp=sharing) **-> .h5 (= .keras) -> frozen.pb -> .**[**dlc**](https://static.linaro.org/connect/hkg18/presentations/hkg18-306.pdf) **(B) new yolact +** [**opnet**](https://colab.research.google.com/drive/1_YOsAJo671ACMU7HTYWXt_TJI-dsUqVK) **+** [**snpe**](https://static.linaro.org/connect/hkg18/presentations/hkg18-306.pdf) **+** [**Shen**](http://www.nhcue.edu.tw/~jinnliu/teaching/AI17/Decode.pdf) **-> .h5 -> .pb -> .dlc**
* **Project 3: Deployment: (A) HW4 +** [**Shen**](http://www.nhcue.edu.tw/~jinnliu/teaching/AI17/Decode.pdf) **+ dlc**

**Control and comma Two (**[**C2Notes**](https://docs.google.com/document/d/1-ePnGSarXL8naq7xIV0DHWQ4a2GM_RQavnk0XZkTaFQ/edit?usp=sharing)**)**

* **HW8: Install** [**Workbench**](https://docs.google.com/document/d/1un_OKvzBNlTzJjle5fU-84RznOWFegNAg1vsKoNNVOg/edit?usp=sharing) **(**[**WB1**](https://medium.com/@jfrux/introducing-workbench-for-openpilot-1bd60053dc9)**). Run C2. Read** [李德浩2004](https://drive.google.com/file/d/1Oz8kjfbRYOtkYEhdr4BzTuCzzGWTv3PL/view?usp=sharing)**,** [李德浩2007](https://drive.google.com/file/d/1KXEhJeXvIgDOY6PNPJn5q5PRtpJ159cH/view?usp=sharing)**.**
* **Project 3: Deployment: (B)** [**YPNet1劉宜朋2101**](https://drive.google.com/file/d/1waQgfmnXYFCMgFrKl84SxrC0FE-nSNuv/view?usp=sharing) **+** [**YPNet2劉宜朋2101**](https://drive.google.com/file/d/1JWVxoRX4NiBk9JQN--vQJQYyWoH3XQJi/view?usp=sharing) **+ Project 2 +** [**Shen**](http://www.nhcue.edu.tw/~jinnliu/teaching/AI17/Decode.pdf) **+ dlc +** [**C2**](https://comma.ai/shop/products/comma-two-devkit) **+** [**WB1**](https://medium.com/@jfrux/introducing-workbench-for-openpilot-1bd60053dc9)
* **Project 4: Control: (A)** [**YPNet**](http://www.nhcue.edu.tw/~jinnliu/teaching/AI17/ANet.html) **+**[**Shen**](http://www.nhcue.edu.tw/~jinnliu/teaching/AI17/Decode.pdf) **+** [**OPC**](https://medium.com/@comma_ai/how-does-openpilot-work-c7076d4407b3) **+** [**OPT**](https://github.com/commaai/openpilot/tree/master/tools) **(**[**OPT1**](https://medium.com/@comma_ai/open-sourcing-openpilot-development-tools-a5bc427867b6)**) +** [**OPNet**](http://www.nhcue.edu.tw/~jinnliu/teaching/AI17/supercombo.html) **(B) Project 2 +** [**Tune**](https://github.com/commaai/openpilot/wiki/Tuning) **+** [**Panda**](https://github.com/commaai/panda) **(**[**PD1**](https://medium.com/@comma_ai/a-panda-and-a-cabana-how-to-get-started-car-hacking-with-comma-ai-b5e46fae8646)**) +** [**CAN**](https://www.youtube.com/watch?v=FqLDpHsxvf8) **(**[**CAN1**](https://news.voyage.auto/an-introduction-to-the-can-bus-how-to-programmatically-control-a-car-f1b18be4f377)**,** [**CAN2**](https://www.ti.com/lit/an/sloa101b/sloa101b.pdf?ts=1593573635649&ref_url=https%253A%252F%252Fwww.google.com%252F)**,** [**isotp**](https://github.com/hartkopp/can-isotp)**,** [**PyCAN**](https://python-can.readthedocs.io/en/master/) **,** [**2020**](https://web.cse.ohio-state.edu/~lin.3021/file/NDSS20.pdf)**) (C) Project 2 +** [**S&G**](https://www.youtube.com/watch?v=NUpF73ezON8) **(**[**OP5**](http://www.nhcue.edu.tw/~jinnliu/teaching/AI17/port1.pdf)**,** [**OP**](https://github.com/commaai/openpilot/wiki)**,** [**forkS**](https://github.com/ShaneSmiskol/openpilot#dynamic-gas)**) +** [**CP**](https://store.shulerent.com/products/comma-pedal) **(**[**CP1**](https://github.com/commaai/openpilot/wiki/comma-pedal)**,** [**CP2**](https://medium.com/@jfrux/comma-pedal-installing-in-your-vehicle-5f3592eff9ed)**,** [**CP3**](https://medium.com/@jfrux/comma-pedal-building-with-macrofab-6328bea791e8)**,** [**CP4**](https://www.google.com/search?sxsrf=ALeKk007Rpagr69ksVtNT9iN5psWL8ag7w%3A1593575767105&ei=Vwn8Xvv_BdaTr7wP3oKV-AQ&q=install+comma+pedal&oq=install+comma+pedal&gs_lcp=CgZwc3ktYWIQAzIFCCEQoAE6BAgjECc6BQgAEJECOgIIADoECAAQQzoHCAAQFBCHAjoGCAAQFhAeOggIABAWEAoQHjoECCEQFToHCCEQChCgAVCgnYQBWNLlhAFg2O2EAWgAcAB4AIABXogBggmSAQIxOZgBAKABAaoBB2d3cy13aXo&sclient=psy-ab&ved=0ahUKEwi7h5WslKvqAhXWyYsBHV5BBU8Q4dUDCAw&uact=5#kpvalbx=_2BH8XuDDONiIr7wP1OW3kAw26)**) +** [**DBC**](https://github.com/commaai/opendbc)
* **Results:** [**C2RunNotes**](https://docs.google.com/document/d/1-ePnGSarXL8naq7xIV0DHWQ4a2GM_RQavnk0XZkTaFQ/edit?usp=sharing) **(**[劉宜朋2008](https://drive.google.com/file/d/1QC2ooygEgj55hro3KDqyuGPc6vFBPrOY/view?usp=sharing)**,** [劉宜朋2008a](https://drive.google.com/file/d/1_AvuPlxsyP1KEWjNHGXIttyl1Jz9cIcP/view?usp=sharing)**, out3 (YPNet))**

**Papers (**[**OPGit**](https://github.com/commaai/openpilot), [**OPNet**](http://www.nhcue.edu.tw/~jinnliu/teaching/AI17/supercombo.html)**,** [**OPNet\***](https://drive.google.com/file/d/1L8sWgYKtH77K6Kr3FQMETtAWeQNyyb8R/view?usp=sharing)**,** [**YPNet1**](http://www.nhcue.edu.tw/~jinnliu/teaching/AI17/YPNet1.html)**,** [**YPNet2**](http://www.nhcue.edu.tw/~jinnliu/teaching/AI17/YPNet2.html)**)**

* **Paper 1 (Project 1): Steering**
* [劉宜朋1912](https://drive.google.com/file/d/1ism55nRN8KYc9rHpr_nyiwBMDwYgoz2U/view?usp=sharing) ([code1](https://github.com/commaai/comma2k19/blob/master/notebooks/processed_readers.ipynb), [c2](https://github.com/commaai/research)), [劉宜朋1911](https://drive.google.com/file/d/1XG2w9dD6I6xylPBfW9SyB8A1Ug9e8LHv/view?usp=sharing)**,** [李德浩1908](https://drive.google.com/file/d/156IIPQX9sZIDgfhzVUxfA7tKi0Ta5KjJ/view?usp=sharing), [李碧寒2004](https://drive.google.com/file/d/1ebanUshI_qMZ2ufK6j7WrHs-WUdOnY9P/view?usp=sharing), [唐旭蓮2005](https://drive.google.com/file/d/1CangBPkAWiOAlq1ZvUYR2dDJQ41FgUlU/view?usp=sharing), PP ([yp2](https://drive.google.com/drive/folders/1U3CYP9t_wXwjfUanI1EHTyo9sGZFuYi4?usp=sharing), [2k19](https://github.com/commaai/comma2k19)): [c2](https://github.com/commaai/openpilot/blob/master/selfdrive/modeld/models/driving.cc), [c3](https://github.com/commaai/openpilot/blob/master/selfdrive/controls/lib/pathplanner.py), [c4](https://github.com/commaai/openpilot/blob/master/selfdrive/controls/lib/lateral_mpc/lateral_mpc.c), [c5](https://github.com/commaai/openpilot/blob/master/selfdrive/controls/lib/latcontrol_pid.py), [Ref1](https://arxiv.org/pdf/1604.07316.pdf), [R2](https://arxiv.org/pdf/1802.05591.pdf), [R3](https://ieeexplore.ieee.org/stamp/stamp.jsp?arnumber=8332138),
* **Paper 2 (Project 3): Simulator**
* [劉宜朋2008](https://drive.google.com/file/d/1QC2ooygEgj55hro3KDqyuGPc6vFBPrOY/view?usp=sharing) ([code1](https://github.com/commaai/openpilot/blob/master/selfdrive/debug/uiview.py), [co2](https://github.com/commaai/openpilot/blob/master/selfdrive/ui/paint.cc)), [劉宜朋2008a](https://drive.google.com/file/d/1_AvuPlxsyP1KEWjNHGXIttyl1Jz9cIcP/view?usp=sharing) ([co3](https://github.com/commaai/openpilot/blob/master/selfdrive/modeld/modeld.cc)),[Ref1](https://ieeexplore.ieee.org/stamp/stamp.jsp?arnumber=8723564&casa_token=RCGdOoCC0pcAAAAA:jvFPrfefn5QDWFvlEOnxw2j4jCV4oTz8qd_srkJo51hvN0v0ySuSOwML9o8-Gw31BGbI6B-A&tag=1), [R2](https://ieeexplore.ieee.org/stamp/stamp.jsp?tp=&arnumber=8723561),
* **Paper 3 (Project 3): Deployment**
* [YPNet1](http://www.nhcue.edu.tw/~jinnliu/teaching/AI17/YPNet1.html)([劉宜朋2101](https://drive.google.com/file/d/1Z9eu_MW3nyrVHin0lTPSWdE9f66eHPm3/view?usp=sharing), [GitCode](https://github.com/JinnAIGroup/YPNet1)), [OPNet\*\*](https://drive.google.com/file/d/1L8sWgYKtH77K6Kr3FQMETtAWeQNyyb8R/view?usp=sharing), [Shen](http://www.nhcue.edu.tw/~jinnliu/teaching/AI17/Decode.pdf), [劉宜朋2006](https://drive.google.com/file/d/1yhr5wl1SXTscrOhtB0hxD-5hcxHI2hC4/view?usp=sharing), [唐旭蓮2008](https://drive.google.com/file/d/1Ixlrprh6eVO0iGAv7kd1Pgza6fIOleso/view?usp=sharing), [施威宇2011](https://drive.google.com/file/d/1_BtFYyE95qpld3qr6ekM1F5a57MpjzUr/view?usp=sharing), [Ref1](https://arxiv.org/pdf/1807.06172.pdf), [R2](https://arxiv.org/pdf/1810.01109.pdf), [R3](https://arxiv.org/pdf/1806.08616.pdf), [R4](https://arxiv.org/pdf/1910.07738.pdf), [R5](http://www.nhcue.edu.tw/~jinnliu/teaching/AI17/Auto1.pdf) ([R6](https://ieeexplore.ieee.org/stamp/stamp.jsp?arnumber=7368032&casa_token=VnHpU4O_2ggAAAAA:licIk7gxWKOSugWOMQgJPgyeS5vAtHXYeZACQDdBkQcGhHfh7mQ1KY_GlfWEXKU3nbolqA&tag=1)),
* **Paper 4 (Project 2): Segmentation**
* [李碧寒2010](https://drive.google.com/file/d/1MQpep5PXT4efBvH-BYs4a7pTqmTCw7DT/view?usp=sharing) ([eval.py](https://drive.google.com/file/d/1_CxYZO2sfqcP6fX6S288cuE3Gn65YMF5/view?usp=sharing), [label.json](https://drive.google.com/file/d/1rDYnns6Y62572-P5l5XP86n8DnvOXITL/view?usp=sharing)), [李碧寒2011](https://drive.google.com/file/d/1H44-QL46fsheKARjSi5JGr69IHCKcsq5/view?usp=sharing), [李碧寒2101](https://drive.google.com/file/d/1gg5LWV6hTurw0KnZwoJ7h5JnaUFdxNnp/view?usp=sharing) ([ReptRefs](https://drive.google.com/file/d/18mj2Dhvr-wZYjEB-ivVEpyeBMGHXlV-c/view?usp=sharing)), [Stan2012](https://drive.google.com/file/d/1Mjxzi-8xaAF0_RWXBMG09ry9zP0g1x7_/view?usp=sharing) ([code](https://colab.research.google.com/drive/1dgWsHWDPN0sbq_tMMyNwH-rhYyY5TpGv?usp=sharing)),

1. 210316 **YPNet1**: **A**. /home/jinn/yp-Efficient/**train\_model.py**, /data1G/**camera.h5** (**1.1G**) **B**. /openpilot/tools/lib/**hevctoh5.py**, /home/jinn/**data1** **C**.
2. 201111 Quora: **Tesla** Dojo AI Training program is going **4D.** HW3 includes **a** custom Tesla-designed system on **a** chip. Tesla claimed that the new system would process **2,300** frames per second (fps), which is **a** 21x improvement **in** image processing compared to HW2.5, which is capable of 110 fps.

200222 OP: Openpilot’s neural network expects consecutive frames with natural movement, so it is recommended for the graphics to be running at at least **60**FPS.

1. 201116 [Consumer Reports ranks comma Two the best](https://data.consumerreports.org/wp-content/uploads/2020/11/consumer-reports-active-driving-assistance-systems-november-16-2020.pdf); [Radar Detection](https://www.youtube.com/watch?v=h3y_vS4_vq4), [Losses](https://heartbeat.fritz.ai/5-regression-loss-functions-all-machine-learners-should-know-4fb140e9d4b0): [Huber Loss](https://en.wikipedia.org/wiki/Huber_loss); NN Math: [Hebb](https://en.wikipedia.org/wiki/Hebbian_theory), [matrix](https://link.springer.com/article/10.1007/s40747-020-00186-9), [PINN](https://www.brown.edu/research/projects/crunch/sites/brown.edu.research.projects.crunch/files/uploads/Physics-informed%20neural%20networks_A%20deep%20learning%20framwork%20fir%20solving%20forward%20and%20inverse%20probelms%20involving%20nonlinear%20partial%20differential%20equations.pdf), [4DCNN](https://openaccess.thecvf.com/content_CVPR_2019/papers/Choy_4D_Spatio-Temporal_ConvNets_Minkowski_Convolutional_Neural_Networks_CVPR_2019_paper.pdf); [Setup Ubuntu 16.04 with CUDA, GPU](https://medium.com/@kapilvarshney/how-to-setup-ubuntu-16-04-with-cuda-gpu-and-other-requirements-for-deep-learning-f547db75f227)
2. 2020.7: Old Links:

* [**comma.ai**](https://github.com/commaai)
  + [**research**](https://github.com/commaai/research)**: 2016 OP Code and Data**
  + [**comma2k19**](https://github.com/commaai/comma2k19) **(**[**李德浩1908**](https://drive.google.com/file/d/156IIPQX9sZIDgfhzVUxfA7tKi0Ta5KjJ/view?usp=sharing)**)**
    - [**raw\_readers.ipynb**](https://github.com/commaai/comma2k19/blob/master/notebooks/raw_readers.ipynb)
    - **Data Type: Pose (Time, Position, Speed:** [**ECEF**](https://en.wikipedia.org/wiki/ECEF)**,** [**Euler and Tait-Bryan Angles**](https://en.wikipedia.org/wiki/Euler_angles)**,** [**Local Tangent Plane**](https://en.wikipedia.org/wiki/Local_tangent_plane_coordinates)**,** [**Quaternion**](http://www.nhcue.edu.tw/~jinnliu/teaching/AI17/Quaternion)**), Steering, Path, Logs, Frame Reader.**
    - **Data Source:** [**Camera**](https://en.wikipedia.org/wiki/Camera)**,** [**Radar**](https://en.wikipedia.org/wiki/Radar)**,** [**GPS**](https://en.wikipedia.org/wiki/Global_Positioning_System)**,** [**IMU**](https://en.wikipedia.org/wiki/Inertial_measurement_unit)**,** [**GNSS**](https://en.wikipedia.org/wiki/Satellite_navigation)**,** [**CAN**](https://en.wikipedia.org/wiki/CAN_bus)
  + **Laika: Python GNSS processing library** 
    - [**GNSS Processing**](https://en.wikipedia.org/wiki/GNSS_positioning_calculation)**,** [**Trilateration**](https://en.wikipedia.org/wiki/True_range_multilateration)**,** [**Least Squares**](https://en.wikipedia.org/wiki/Weighted_least_squares)**, Kalman Filter,**
  + [**comma10k**](https://github.com/commaai/comma10k)**: Data for** [**SegNets**](https://mi.eng.cam.ac.uk/projects/segnet/)
* [**comma two**](https://www.youtube.com/watch?v=zmuWNfJ-wDQ&t=7s)**:** [**comma Q&A**](https://community.comma.ai/wiki/index.php/Main_Page)**,** [**medium**](https://medium.com/@comma_ai)
  + **A)** [**com1**](https://www.youtube.com/watch?v=RbD1X6luc0Q)**,** [**com2**](https://www.youtube.com/watch?v=zmuWNfJ-wDQ&t=7s)**,** [**com3**](https://www.youtube.com/watch?v=ZHtCYYLM4UM) **(B)** [**com4**](https://medium.com/@comma_ai/openpilot-port-guide-for-toyota-models-e5467f4b5fe6) **(**[**port1**](http://www.nhcue.edu.tw/~jinnliu/teaching/AI17/port1.pdf)**,** [**port1K**](https://community.comma.ai/wiki/index.php/Creating_Fingerprints)**):** [**WB1**](https://medium.com/@jfrux/introducing-workbench-for-openpilot-1bd60053dc9) **(run),** [**WB2**](https://github.com/jfrux/workbench/releases) **(download),** [**WB3**](https://github.com/jfrux/workbench) **(install,** [**WB4**](https://opc.ai/wordpress/index.php/workbench-2/)**),** [**SSH**](https://community.comma.ai/wiki/index.php/Configuring_OpenPilot) **(key),** [**port2**](https://medium.com/@comma_ai/how-to-write-a-car-port-for-openpilot-7ce0785eda84)**, (C)** [**fork1B**](https://medium.com/@jfrux/installing-a-fork-of-openpilot-with-workbench-de35e9388021)**,** [**fork2B**](https://medium.com/@jfrux/comma-eon-installing-a-fork-of-openpilot-5c2b5c134b4b)**,** [**fork3G**](https://github.com/commaai/openpilot/issues/83) **(D)** [**add1**](https://medium.com/@energee/add-support-for-your-car-to-comma-ai-openpilot-3d2da8c12647)
  + **Toyota Car:** [**TSS18**](https://www.youtube.com/watch?v=KeUOMaPe3v0)**,** [**TSS16**](https://www.youtube.com/watch?v=uPfQHQsT7Wc)**,** [**Sensors**](https://www.machinedesign.com/mechanical-motion-systems/article/21836344/saved-by-the-sensor-vehicle-awareness-in-the-selfdriving-age)
* [**openpilot**](https://github.com/commaai/openpilot)**: Open Source Driving Agent,** [**OP5**](https://medium.com/@comma_ai/bringing-forward-collision-warnings-to-our-open-source-self-driving-car-7545b6e398cd)**,** [**OP6**](https://medium.com/@comma_ai/our-road-to-self-driving-victory-603a9ed20204)**,** [**OP Q&A**](https://github.com/commaai/openpilot/issues)**,** [**FAQ**](https://community.comma.ai/wiki/index.php/FAQ)
  + [**openpilot/tools**](https://github.com/commaai/openpilot/tree/master/tools)**: OP Tools**
  + [**opendbc**](https://github.com/commaai/opendbc)**: Car Decoder**
  + [**panda**](https://github.com/commaai/panda)**: Car Interface**
    - [**Introduction to embedded systems**](https://www.slideshare.net/amraldo/introduction-to-embedded-systems-7790553)
    - [**STM32CubeIDE**](https://www.youtube.com/watch?v=hyZS2p1tW-g) **(15 m);** [**STM32 Slides-Part1**](https://www.slideshare.net/amraldo/introduction-to-stm32part1)**,** [**Part 2**](https://www.slideshare.net/amraldo/introduction-to-stm32part2)**;** [**STM32 Book1**](https://riptutorial.com/Download/stm32.pdf) **(25 p); STM32 Book2 (125 p);** [**STM32 Book3**](https://electrovolt.ir/wp-content/uploads/2018/04/Programming-with-Stm32-Getting-Started-with-the-Nucleo.pdf) **(416 p)**
    - [**CMSIS Step 1**](https://www.youtube.com/watch?v=4Ph0KrjwYPc) **(8 m);** [**STM32 Arduino IDE**](https://www.youtube.com/watch?v=MLEQk73zJoU) **(4 m);** [**STM32 MDK-ARM IDE**](https://www.youtube.com/watch?v=VXIvYPzfLFo) **(8 m)**
    - [**CNN on STM32**](https://www.youtube.com/watch?v=EkYp0glSenE) **(6 m),** [**Github**](https://github.com/ARM-software/ML-examples)**,** [**Guide**](https://developer.arm.com/-/media/Arm%20Developer%20Community/PDF/Image%20recognition%20on%20Arm%20Cortex-M%20with%20CMSIS-NN.pdf?revision=724c1b4b-0d32-4261-ad68-d428687e7af6)**;** [**STM32a**](https://www.st.com/content/ccc/resource/sales_and_marketing/presentation/product_presentation/group0/69/82/bf/ae/5a/8b/40/91/STM32CubeAI_press_pres/files/STM32CubeAI_press_pres.pdf/jcr:content/translations/en.STM32CubeAI_press_pres.pdf)**;** [**STM32b (CMSIS-NN)**](https://www.dlology.com/blog/how-to-run-deep-learning-model-on-microcontroller-with-cmsis-nn/)**;** [**STM32c (Deploying)**](https://community.arm.com/developer/ip-products/processors/b/processors-ip-blog/posts/deploying-convolutional-neural-network-on-cortex-m-with-cmsis-nn)**;** [**Paper**](https://arxiv.org/abs/1801.06601)
* **OP:** [**Makefile**](https://www.cs.colby.edu/maxwell/courses/tutorials/maketutor/)**,** [**package**](https://packaging.python.org/tutorials/packaging-projects/)**,** [**wheel**](https://pythonwheels.com/)**,** [**docker**](https://hasura.io/blog/how-to-write-dockerfiles-for-python-web-apps-6d173842ae1d/)**,** [**\_\_init\_\_**](https://micropyramid.com/blog/understand-self-and-__init__-method-in-python-class/)**,**
* **Python:** [**Code1**](https://www.python.org/)**,** [**Tutor**](https://pymotw.com/3/)**,** [**argparse**](https://docs.python.org/3/library/argparse.html)**,** [**collections**](https://docs.python.org/3/library/collections.html?highlight=collections#module-collections)**,** [**datetime**](https://docs.python.org/3/library/datetime.html?highlight=datetime#module-datetime)**,** [**gc**](https://docs.python.org/3/library/gc.html?highlight=gc#module-gc)**,** [**h5py**](http://docs.h5py.org/en/stable/quick.html)**,** [**json**](https://www.w3schools.com/js/js_json_intro.asp)**,** [**multiprocessing**](https://docs.python.org/3/library/multiprocessing.html?highlight=multiprocessing#module-multiprocessing)**,** [**numpy**](https://docs.scipy.org/doc/numpy/reference/)**,** [**os**](https://docs.python.org/3/library/os.html?highlight=os#module-os)**,** [**pygame**](https://realpython.com/pygame-a-primer/)**,** [**scikit-image**](https://scikit-image.org/)**,** [**signal**](https://docs.python.org/3/library/signal.html?highlight=signal#module-signal)**,** [**sys**](https://docs.python.org/3/library/sys.html?highlight=sys#module-sys)**,** [**threading**](https://docs.python.org/3/library/threading.html?highlight=threading#module-threading)**,** [**time**](https://docs.python.org/3/library/time.html?highlight=time#module-time)**,** [**uuid**](https://en.wikipedia.org/wiki/Universally_unique_identifier)**,** [**zmq**](https://www.digitalocean.com/community/tutorials/how-to-work-with-the-zeromq-messaging-library)**,**

Training Source: <https://github.com/commaai/research/blob/master/SelfSteering.md>

Follow the instructions to train a deep neural network for self-steering cars. This experiment is similar to [End to End Learning for Self-Driving Cars](https://arxiv.org/abs/1604.07316).

1. Download dataset

./get\_data.sh

1. Start training data server in the first terminal session

./server.py --batch 200 --port 5557

1. Start validation data server in a second terminal session

./server.py --batch 200 --validation --port 5556

1. Train steering model in a third terminal

./train\_steering\_model.py --port 5557 --val\_port 5556

1. Visualize results

./view\_steering\_model.py ./outputs/steering\_model/steering\_angle.json

Testing: python view\_steering\_model.py ./outputs/steering\_model/steering\_angle55.json icms

1. 2020.7 [Old OP Notes](https://drive.google.com/file/d/1he0DEE8EUfWNI4tI7xoQmVVfJV-2GvYl/view?usp=sharing) , Old Links:

**HW1: Install Ubuntu 16.04 (must be 16.04):** [**Guide1T**](https://www.linuxtechi.com/how-to-dual-boot-windows-10-ubuntu-16-04/)**,** [**Guide2V**](https://www.youtube.com/watch?v=qNeJvujdB-0)**. Use Ubuntu:** [**Guide3**](https://www.lifewire.com/things-to-do-installing-ubuntu-2200611)**,** [**Guide4**](https://www.howtogeek.com/412055/37-important-linux-commands-you-should-know/)**. (A) Reinstall** [**Ubuntu**](https://itsfoss.com/install-ubuntu/) **(must be) 16.04 from existing Ubuntu (**[**Step 1**](https://drive.google.com/file/d/1QE3Kx0aweEocT9HLuPyiEacT85XPUEnP/view?usp=sharing)**)**

**HW2: Install OP:** [**Step1.txt**](http://www.nhcue.edu.tw/~jinnliu/teaching/AI17/step1.txt) ( [**Step1.m4v**](https://drive.google.com/file/d/13uJOlVJPoDJbIOsJ4IR_lkMaZu9wmtVj/view?usp=drive_web)), [**Step2.txt**](http://www.nhcue.edu.tw/~jinnliu/teaching/AI17/step2.txt) ([**Step2.m4v**](https://drive.google.com/file/d/1QEMY-BIAODKEOeSWPOvUG23KC7JbReOq/view?usp=drive_web)),[**UI**](http://www.nhcue.edu.tw/~jinnliu/teaching/AI17/comma_ui.png)**.**

**HW3: Run** [**view\_steering\_model.py**](https://github.com/commaai/research/blob/master/view_steering_model.py)**: (A) Download** [**research-master0.tar.gz**](https://drive.google.com/file/d/1H_RJsx3ppyFKg1iwF8u2lQK7ndyIuQjd/view) **and** [**Data 10**](https://drive.google.com/file/d/1gBC3wztIQEc1V54FuWwT_GhszdZHv2y6/view) **to “Home” directory. (B) Go to “research-master0”. (C) Do** [**Step3.txt**](http://www.nhcue.edu.tw/~jinnliu/teaching/AI17/step3.txt) **(**[**Step3.m4v**](https://www.youtube.com/watch?v=b9imqKZypJU)**). (D) Read** [**view\_steering\_model.py**](https://github.com/commaai/research/blob/master/view_steering_model.py)**,** [**PTransform()**](https://scikit-image.org/docs/0.13.x/auto_examples/xx_applications/plot_geometric.html)**,** [**PT2**](https://scikit-image.org/docs/dev/api/skimage.transform.html)**,** [**Keras1**](https://web.stanford.edu/class/cs20si/lectures/march9guestlecture.pdf)**.**

**HW4: Run** [**train\_steering\_model.py**](https://github.com/commaai/research/blob/master/train_steering_model.py)**: (A) Move server.py to server1.py. (B) Download server.py. (C) Do** [**Step4.txt**](http://www.nhcue.edu.tw/~jinnliu/teaching/AI17/step4.txt) **(**[**Step4.m4v**](https://www.youtube.com/watch?v=hy3nH5zHV7s)**). (D) Read** [**train\_steering\_model.py**](https://github.com/commaai/research/blob/master/train_steering_model.py)**,** [**Keras2 (Seqtl)**](https://keras.io/getting-started/sequential-model-guide/)**,** [**Keras3 (FAPI)**](https://keras.io/getting-started/functional-api-guide/)**. (E) Read** [**server.py**](https://github.com/commaai/research/blob/master/server.py)**.**

**HW5: Run** [**JinnA**](https://colab.research.google.com/drive/1_YOsAJo671ACMU7HTYWXt_TJI-dsUqVK) **(OPNet,** [**Leon**](https://github.com/littlemountainman/modeld)**). Read** [**LeonB**](https://littlemountainman.github.io/2020/05/12/openpilot/)**, Shen;** [**Keras4**](https://www.tensorflow.org/tutorials/keras/save_and_load) **(**[**KM1**](https://www.tensorflow.org/guide/keras/save_and_serialize)**,** [**KM2**](https://keras.io/getting_started/faq/)**,** [**KM3**](https://keras.io/api/applications/)**);** [**ENets**](https://towardsdatascience.com/complete-architectural-details-of-all-efficientnet-models-5fd5b736142) **(**[**2019**](https://arxiv.org/abs/1905.11946)**).**

**HW6: Run and read (A)** [**TomT1**](https://colab.research.google.com/drive/1NYoKk_jO86GLFWRZy45kmQt7qVerNhLM) **(**[**Yolact**](https://github.com/dbolya/yolact)**,** [**Tsang**](https://towardsdatascience.com/review-deepmask-instance-segmentation-30327a072339)**),** [**TomT2**](https://colab.research.google.com/drive/1LLEhE1in5D6o3RKUh2Nhl5Tb_DTazL5o?usp=sharing) **(**[**output**](https://drive.google.com/file/d/1mZZAUSjOt8RbLFTD4YH0zsHrQyzjOL_T/view?usp=sharing)**) (B)** [**RetinaNet**](https://colab.research.google.com/drive/1WPDL5VFEQUCy73r06NaINbyFe-USutoY?usp=sharing) **(**[**Tsang2**](https://towardsdatascience.com/review-retinanet-focal-loss-object-detection-38fba6afabe4)**) (R)** [**code1**](https://www.dlology.com/blog/how-to-run-object-detection-and-segmentation-on-video-fast-for-free/)**,** [**code2**](https://colab.research.google.com/github/tensorflow/models/blob/master/research/deeplab/deeplab_demo.ipynb) **(**[**DLab**](https://github.com/tensorflow/models/tree/master/research/deeplab)**)**

**Project 1: Steering and Lane Detection: (A) OPN16 +** [**NvidiaNet**](https://github.com/tech-rules/DAVE2-Keras) **(**[**NvdN**](https://github.com/adityaguptai/Self-Driving-Car-)**) + AlexNet + VGG. (R) 3 Data: comma, Nvidia (**[**2016**](https://arxiv.org/pdf/1604.07316.pdf)**), Berkeley (**[**2017**](http://openaccess.thecvf.com/content_cvpr_2017/papers/Xu_End-To-End_Learning_of_CVPR_2017_paper.pdf)**),** [**2018**](https://arxiv.org/pdf/1812.07760.pdf)**,** [**2017**](https://arxiv.org/pdf/1710.03804.pdf)**,** [**2016**](https://www.researchgate.net/publication/301648615_End_to_End_Learning_for_Self-Driving_Cars)**,** [**2018**](https://arxiv.org/pdf/1802.05591.pdf)**,** [**2018**](https://ieeexplore.ieee.org/stamp/stamp.jsp?arnumber=8332138)**,** [**2014**](https://link.springer.com/content/pdf/10.1007/s00138-011-0404-2.pdf)**,**

**Project 2: Deployment: (A)** [**OPforkV**](https://www.youtube.com/watch?v=3Oh51mlul44&t=11s) **+** [**forkA**](https://github.com/arne182/ArnePilot) **(ANet) +** [**forkK**](https://github.com/kegman/openpilot) **+** [**forkS**](https://github.com/ShaneSmiskol/openpilot#dynamic-gas) **(B)** [**forkA**](https://github.com/arne182/ArnePilot) **+ Shen + OPNet + ANet + NN.py + .pb + .dlc (**[**2018**](https://arxiv.org/pdf/1807.06172.pdf)**,** [**2018**](https://arxiv.org/pdf/1810.01109.pdf)**) (R)** [**TeslaNetV**](https://www.youtube.com/watch?v=oBklltKXtDE)**,** [**Git1**](https://www.youtube.com/watch?v=SWYqp7iY_Tc)**,** [**Git2**](https://git-scm.com/book/en/v2)**,** [**Atom1**](https://www.youtube.com/watch?v=EyG20hhON6E)**,** [**Atom2**](https://flight-manual.atom.io/)**,** [**2020**](http://www.mit.edu/~amini/pubs/pdf/learning-in-simulation-vista.pdf) **(RL),**

**Project 3: Control: (A)** [**OPT**](https://github.com/commaai/openpilot/tree/master/tools) **(**[**OPT1**](https://medium.com/@comma_ai/open-sourcing-openpilot-development-tools-a5bc427867b6)**) + Shen + OPNet + NN.dlc (B)** [**OP2**](https://medium.com/@comma_ai/how-does-openpilot-work-c7076d4407b3) **+ Shen + ANet +** [**Tune**](https://github.com/commaai/openpilot/wiki/Tuning) **+** [**Panda**](https://github.com/commaai/panda) **(**[**PD1**](https://medium.com/@comma_ai/a-panda-and-a-cabana-how-to-get-started-car-hacking-with-comma-ai-b5e46fae8646)**) +** [**CAN**](https://www.youtube.com/watch?v=FqLDpHsxvf8) **(**[**CAN1**](https://news.voyage.auto/an-introduction-to-the-can-bus-how-to-programmatically-control-a-car-f1b18be4f377)**,** [**CAN2**](https://www.ti.com/lit/an/sloa101b/sloa101b.pdf?ts=1593573635649&ref_url=https%253A%252F%252Fwww.google.com%252F)**,** [**isotp**](https://github.com/hartkopp/can-isotp)**,** [**PyCAN**](https://python-can.readthedocs.io/en/master/) **,** [**2020**](https://web.cse.ohio-state.edu/~lin.3021/file/NDSS20.pdf)**) (C)** [**S&G**](https://www.youtube.com/watch?v=NUpF73ezON8) **(**[**OP**](https://github.com/commaai/openpilot/wiki)**,** [**forkS**](https://github.com/ShaneSmiskol/openpilot#dynamic-gas)**) +** [**CP**](https://store.shulerent.com/products/comma-pedal) **(**[**CP1**](https://github.com/commaai/openpilot/wiki/comma-pedal)**,** [**CP2**](https://medium.com/@jfrux/comma-pedal-installing-in-your-vehicle-5f3592eff9ed)**,** [**CP3**](https://medium.com/@jfrux/comma-pedal-building-with-macrofab-6328bea791e8)**,** [**CP4**](https://www.google.com/search?sxsrf=ALeKk007Rpagr69ksVtNT9iN5psWL8ag7w%3A1593575767105&ei=Vwn8Xvv_BdaTr7wP3oKV-AQ&q=install+comma+pedal&oq=install+comma+pedal&gs_lcp=CgZwc3ktYWIQAzIFCCEQoAE6BAgjECc6BQgAEJECOgIIADoECAAQQzoHCAAQFBCHAjoGCAAQFhAeOggIABAWEAoQHjoECCEQFToHCCEQChCgAVCgnYQBWNLlhAFg2O2EAWgAcAB4AIABXogBggmSAQIxOZgBAKABAaoBB2d3cy13aXo&sclient=psy-ab&ved=0ahUKEwi7h5WslKvqAhXWyYsBHV5BBU8Q4dUDCAw&uact=5#kpvalbx=_2BH8XuDDONiIr7wP1OW3kAw26)**) +** [**DBC**](https://github.com/commaai/opendbc) **(R)** [**PID1**](https://www.youtube.com/watch?v=sFqFrmMJ-sg)**,** [**PID2**](https://www.youtube.com/watch?v=wkfEZmsQqiA)**,** [**Kalman**](http://web.mit.edu/kirtley/kirtley/binlustuff/literature/control/Kalman%20filter.pdf)**; Lane Change:** [**comma**](https://www.youtube.com/watch?v=ynR_2GD8SLo)**,** [**2019**](https://ieeexplore.ieee.org/stamp/stamp.jsp?arnumber=8648365)**,** [**2017**](https://borrelli.me.berkeley.edu/pdfpub/machine-learning-approach.pdf)**,** [**2017**](https://borrelli.me.berkeley.edu/pdfpub/Scenario_MPC_FinalVersion.pdf)**,** [**2017**](https://core.ac.uk/download/pdf/141718123.pdf)**; Localization:** [**comma2k19**](https://github.com/commaai/comma2k19) **(**[**2018**](https://arxiv.org/pdf/1812.05752.pdf)**),** [**Laika**](https://github.com/commaai/laika)**,** [**2019**](https://arxiv.org/pdf/1811.10119.pdf)**,** [**2018**](http://openaccess.thecvf.com/content_ECCV_2018/papers/Simon_Hecker_Learning_to_Drive_ECCV_2018_paper.pdf)**,** [**2017**](https://hal.archives-ouvertes.fr/hal-01615897/document)**,** [**2014**](http://publications.lib.chalmers.se/records/fulltext/201866/local_201866.pdf)**,**

**Project 4: Instance Segmentation: (A)** [**TomT**](https://colab.research.google.com/drive/1NYoKk_jO86GLFWRZy45kmQt7qVerNhLM) **+ NN.py + .pb + .dlc +** [**Yolact**](https://github.com/dbolya/yolact) **+** [**2019**](https://arxiv.org/pdf/1904.02689.pdf) **(**[**retina**](https://colab.research.google.com/drive/1WPDL5VFEQUCy73r06NaINbyFe-USutoY?usp=sharing), [**Tsang2**](https://towardsdatascience.com/review-retinanet-focal-loss-object-detection-38fba6afabe4), [**h52py**](https://github.com/ShaneSmiskol/Konverter)**,** [**retina.py to h5**](https://colab.research.google.com/drive/1H643ap6177zAt6J2lkI_wfGMyf5XE69s?usp=sharing), **) (B)** [**TomT**](https://colab.research.google.com/drive/1NYoKk_jO86GLFWRZy45kmQt7qVerNhLM) **+** [**JinnA**](https://colab.research.google.com/drive/1_YOsAJo671ACMU7HTYWXt_TJI-dsUqVK) **+ Shen +** [**Yolact**](https://github.com/dbolya/yolact) **+ .keras + .dlc (C)** [**MOTS**](https://github.com/VisualComputingInstitute/mots_tools) **(D)** [**comma10k**](https://github.com/commaai/comma10k) **(R)** [**Coco**](https://cocodataset.org/#detection-2020)**,** [**Yolo**](http://csgrad.science.uoit.ca/courses/csci5550g-f18/papers/You%20Only%20Look%20Once%20Unified,%20Real-Time%20Object%20Detection.pdf)**,** [**Feature**](https://en.wikipedia.org/wiki/Feature_detection_(computer_vision))**,** [**Canny**](https://en.wikipedia.org/wiki/Canny_edge_detector)**,** [**2019**](https://arxiv.org/pdf/1902.07830.pdf)**,** [**2016**](https://arxiv.org/pdf/1612.07695.pdf?utm_campaign=affiliate-ir-Optimise%20media%28%20South%20East%20Asia%29%20Pte.%20ltd._156_-99_national_R_all_ACQ_cpa_en&utm_content=&utm_source=%20388939)**,** [**2017**](https://arxiv.org/pdf/1707.02432.pdf)**,** [**2016**](https://www.cv-foundation.org/openaccess/content_cvpr_2016/papers/Chen_Monocular_3D_Object_CVPR_2016_paper.pdf)**,** [**2014**](http://www.cs.cmu.edu/~youngwoo/doc/icra-14-sensor-fusion.pdf)**,** [**2012**](http://www.webmail.cvlibs.net/publications/Geiger2012CVPR.pdf)**,**