

# Up Computer Vision: from Recognition to Geometry

## HW3

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- Part 1

Include the function `solve_homography(u, v)` in your report.

Sol:

這裡使用的是公式 1，左邊的  $2N \times 8$  矩陣和右邊的  $2N \times 1$  矩陣可以藉由目前位置  $u$  和目標位置  $v$  來計算，再直接將  $2N \times 1$  矩陣左邊乘上  $2N \times 8$  的反矩陣，即可得到單應性矩陣  $H$ 。

- Solve linear system

$$\begin{array}{c}
\textbf{Point 1} \\
\textbf{Point 2} \\
\textbf{Point 3} \\
\textbf{Point 4}
\end{array}
\begin{bmatrix}
u_{x,1} & u_{y,1} & 1 & 0 & 0 & 0 & -u_{x,1}v_{x,1} & -u_{y,1}v_{x,1} \\
0 & 0 & 0 & u_{x,1} & u_{y,1} & 1 & -u_{x,1}v_{y,1} & -u_{y,1}v_{y,1} \\
u_{x,2} & u_{y,2} & 1 & 0 & 0 & 0 & -u_{x,2}v_{x,2} & -u_{y,2}v_{x,2} \\
0 & 0 & 0 & u_{x,2} & u_{y,2} & 1 & -u_{x,2}v_{y,2} & -u_{y,2}v_{y,2} \\
u_{x,3} & u_{y,3} & 1 & 0 & 0 & 0 & -u_{x,3}v_{x,3} & -u_{y,3}v_{x,3} \\
0 & 0 & 0 & u_{x,3} & u_{y,3} & 1 & -u_{x,3}v_{y,3} & -u_{y,3}v_{y,3} \\
u_{x,4} & u_{y,4} & 1 & 0 & 0 & 0 & -u_{x,4}v_{x,4} & -u_{y,4}v_{x,4} \\
0 & 0 & 0 & u_{x,4} & u_{y,4} & 1 & -u_{x,4}v_{y,4} & -u_{y,4}v_{y,4}
\end{bmatrix}
\begin{matrix}
2N \times 8 \\
8 \times 1 \\
2N \times 1
\end{matrix}
\begin{bmatrix}
h_{11} \\
h_{12} \\
h_{13} \\
h_{21} \\
h_{22} \\
h_{23} \\
h_{31} \\
h_{32}
\end{bmatrix}
=
\begin{bmatrix}
v_{x,1} \\
v_{y,1} \\
v_{x,2} \\
v_{y,2} \\
v_{x,3} \\
v_{y,3} \\
v_{x,4} \\
v_{y,4}
\end{bmatrix}$$

然後將目標照片先轉成和 canvas 一樣大小的圖片，然後拿目標照片去乘  $H$ ，然後再貼上去 canvas 上。



- Part 2

Include the QR code and the decoded link in your report.

Sol:

這裡使用的是使用 Backward Warping 得到比較清楚的圖形並解碼。

decoded link: <http://media.ee.ntu.edu.tw/courses/cv/19F/>

QR code: (別太近，距離適中後即可辨識)



### • Part 3

Can you get the parallel bars from the top view?

If not, why? Discuss in your report.

Sol:

如果變換視角後還要有相同解析度的圖片是不可能的，原本拍照不包含的區域，不可能再目標視角中無中生有(目標區的左右馬路)，找不到得像素填黑後結果如下。

原圖/目標/結果



環境設定: (資料夾內附含 conda file:hw3.yml)

absl-py	0.7.0	pypi_0	pypi
alabaster	0.7.12	py36_0	
anaconda-client	1.7.2	py36_0	
anaconda-project	0.8.2	py36_0	
asn1crypto	0.24.0	py36_0	
astor	0.7.1	pypi_0	pypi
astroid	2.1.0	py36_0	
astropy	3.1	py36he774522_0	
atomicwrites	1.2.1	py36_0	
attrs	18.2.0	py36h28b3542_0	
babel	2.6.0	py36_0	
backcall	0.1.0	py36_0	
backports	1.0	py36_1	
backports.os	0.1.1	py36_0	
backports.shutil_get_terminal_size	1.0.0		py36_2
bcrypt	3.1.6	pypi_0	pypi
beautifulsoup4	4.6.3	py36_0	
bitarray	0.8.3	py36hfa6e2cd_0	
bkcharts	0.2	py36h7e685f7_0	
blas	1.0	mk1	
bleach	3.0.2	py36_0	

blosc	1.14.4	he51fdeb_0
boto	2.49.0	py36_0
bottleneck	1.2.1	py36h452e1ab_1
bzip2	1.0.6	hfa6e2cd_5
ca-certificates	2019.1.23	0
certifi	2019.3.9	py36_0
cffi	1.11.5	py36h74b6da3_1
chardet	3.0.4	py36_1
click	7.0	py36_0
cloudpickle	0.6.1	py36_0
clyent	1.2.2	py36_1
cmake	3.13.3	pypi_0 pypi
colorama	0.4.1	py36_0
comtypes	1.1.7	py36_0
conda	4.6.4	py36_0
conda-build	3.17.6	py36_0
conda-env	2.6.0	1
console_shortcut	0.1.1	3
contextlib2	0.5.5	py36he5d52c0_0
cryptography	2.4.2	py36h7a1dbc1_0
cudatoolkit	9.0	1
curl	7.63.0	h2a8f88b_1000
cycler	0.10.0	py36h009560c_0
cython	0.29.2	py36ha925a31_0
cytoolz	0.9.0.1	py36hfa6e2cd_1
dask-core	1.0.0	py36_0
datashape	0.5.4	py36_1
decorator	4.3.0	py36_0
defusedxml	0.5.0	py36_1
distributed	1.25.1	py36_0
dlib	19.17.0	pypi_0 pypi
docutils	0.14	py36h6012d8f_0
entrypoints	0.2.3	py36_2
et_xmlfile	1.0.1	py36h3d2d736_0
fastcache	1.0.2	py36hfa6e2cd_2
filelock	3.0.10	py36_0
flask	1.0.2	py36_1
flask-cors	3.0.7	py36_0
freetype	2.9.1	ha9979f8_1
gast	0.2.2	pypi_0 pypi
get_terminal_size	1.0.0	h38e98db_0
gevent	1.3.7	py36he774522_1
glob2	0.6	py36_1
greenlet	0.4.15	py36hfa6e2cd_0

grpcio	1.18.0	pypi_0 pypi
h5py	2.8.0	py36h3bdd7fb_2
hdf5	1.10.2	hac2f561_1
heapdict	1.0.0	py36_2
html5lib	1.0.1	py36_0
icc_rt	2019.0.0	h0cc432a_1
icu	58.2	ha66f8fd_1
idna	2.8	py36_0
imagesize	1.1.0	py36_0
importlib_metadata	0.6	py36_0
intel-openmp	2019.1	144
ipykernel	5.1.0	py36h39e3cac_0
ipython	7.2.0	py36h39e3cac_0
ipython_genutils	0.2.0	py36h3c5d0ee_0
ipywidgets	7.4.2	py36_0
isort	4.3.4	py36_0
itsdangerous	1.1.0	py36_0
jdcal	1.4	py36_0
jedi	0.13.2	py36_0
jinja2	2.10	py36_0
jpeg	9b	hb83a4c4_2
jsonschema	2.6.0	py36h7636477_0
jupyter	1.0.0	py36_7
jupyter_client	5.2.4	py36_0
jupyter_console	6.0.0	py36_0
jupyter_core	4.4.0	py36_0
jupyterlab	0.35.3	py36_0
jupyterlab_server	0.2.0	py36_0
keras	2.2.4	pypi_0 pypi
keras-applications	1.0.7	pypi_0 pypi
keras-preprocessing	1.0.9	pypi_0 pypi
keyring	17.0.0	py36_0
kiwisolver	1.0.1	py36h6538335_0
krb5	1.16.1	hc04afaa_7
lazy-object-proxy	1.3.1	py36hfa6e2cd_2
libarchive	3.3.3	h0643e63_5
libcurl	7.63.0	h2a8f88b_1000
libiconv	1.15	h1df5818_7
libpng	1.6.35	h2a8f88b_0
libsodium	1.0.16	h9d3ae62_0
libssh2	1.8.0	h7a1dbc1_4
libtiff	4.0.9	h36446d0_2
libxml2	2.9.8	hadb2253_1
libxslt	1.1.32	hf6f1972_0

llvmlite	0.26.0	py36ha925a31_0	
locket	0.2.0	py36hfed976d_1	
lxml	4.2.5	py36hef2cd61_0	
lz4-c	1.8.1.2	h2fa13f4_0	
lzo	2.10	h6df0209_2	
m2w64-gcc-libgfortran	5.3.0		6
m2w64-gcc-libs	5.3.0		7
m2w64-gcc-libs-core	5.3.0		7
m2w64-gmp	6.1.0		2
m2w64-libwinpthread-git	5.0.0.4634.697f757		2
markdown	3.0.1	pypi_0	pypi
markupsafe	1.1.0	py36he774522_0	
matplotlib	3.0.2	py36hc8f65d3_0	
mccabe	0.6.1	py36_1	
menuinst	1.4.14	py36hfa6e2cd_0	
mistune	0.8.4	py36he774522_0	
mk1	2019.1	144	
mk1-service	1.1.2	py36hb782905_5	
mk1_fft	1.0.6	py36h6288b17_0	
mk1_random	1.0.2	py36h343c172_0	
more-itertools	4.3.0	py36_0	
mpmath	1.1.0	py36_0	
msgpack-python	0.5.6	py36he980bc4_1	
msys2-conda-epoch	20160418		1
multipledispatch	0.6.0	py36_0	
munkres	1.1.2	pypi_0	pypi
nbconvert	5.4.0	py36_1	
nbformat	4.4.0	py36h3a5bc1b_0	
networkx	2.2	py36_1	
ninja	1.8.2	py36he980bc4_1	
nltk	3.4	py36_1	
nose	1.3.7	py36_2	
notebook	5.7.4	py36_0	
numba	0.41.0	py36hf9181ef_0	
numexpr	2.6.8	py36hdce8814_0	
numpy	1.14.5	pypi_0	pypi
numpydoc	0.8.0	py36_0	
olefile	0.46	py36_0	
opencv-contrib-python	4.1.1.26	pypi_0	pypi
opencv-python	4.1.1.26	pypi_0	pypi
openpyxl	2.5.12	py36_0	
openssl	1.1.1b	he774522_1	
packaging	18.0	py36_0	
pandas	0.23.4	py36h830ac7b_0	

pandoc	1.19.2.1	hb2460c7_1
pandocfilters	1.4.2	py36_1
paramiko	2.4.2	pypi_0 pypi
parso	0.3.1	py36_0
partd	0.3.9	py36_0
path.py	11.5.0	py36_0
pathlib2	2.3.3	py36_0
patsy	0.5.1	py36_0
pep8	1.7.1	py36_0
pickleshare	0.7.5	py36_0
pillow	5.4.1	pypi_0 pypi
pip	19.3.1	pypi_0 pypi
pkginfo	1.4.2	py36_1
pluggy	0.8.0	py36_0
ply	3.11	py36_0
prometheus_client	0.5.0	py36_0
prompt_toolkit	2.0.7	py36_0
protobuf	3.6.1	pypi_0 pypi
psutil	5.4.8	py36he774522_0
py	1.7.0	py36_0
pyasn1	0.4.5	pypi_0 pypi
pycodestyle	2.4.0	py36_0
pycosat	0.6.3	py36hfa6e2cd_0
pycparser	2.19	py36_0
pycrypto	2.6.1	py36hfa6e2cd_9
pycurl	7.43.0.2	py36h7a1dbc1_0
pyflakes	2.0.0	py36_0
pygments	2.3.1	py36_0
pylint	2.2.2	py36_0
pynacl	1.3.0	pypi_0 pypi
pyodbc	4.0.25	py36ha925a31_0
pyopenssl	18.0.0	py36_0
pyparsing	2.3.0	py36_0
pyqt	5.9.2	py36h6538335_2
pysocks	1.6.8	py36_0
pytables	3.4.4	py36he6f6034_0
pytest	4.0.2	py36_0
pytest-arraydiff	0.3	py36h39e3cac_0
pytest-astropy	0.5.0	py36_0
pytest-doctestplus	0.2.0	py36_0
pytest-openfiles	0.3.1	py36_0
pytest-remotedata	0.3.1	py36_0
python	3.6.7	h9f7ef89_2
python-dateutil	2.7.5	py36_0

python-libarchive-c	2.8	py36_6	
pytorch	1.0.1	py3.6_cuda90_cudnn7_1	pytorch
pytz	2018.7	py36_0	
pywavelets	1.0.1	py36h8c2d366_0	
pywin32	223	py36hfa6e2cd_1	
pywinpty	0.5.5	py36_1000	
pyyaml	3.13	py36hfa6e2cd_0	
pyzmq	17.1.2	py36hfa6e2cd_0	
qt	5.9.7	vc14h73c81de_0	
qtawesome	0.5.3	py36_0	
qtconsole	4.4.3	py36_0	
qtpy	1.5.2	py36_0	
requests	2.21.0	py36_0	
rope	0.11.0	py36_0	
ruamel_yaml	0.15.46	py36hfa6e2cd_0	
scikit-learn	0.20.1	py36h343c172_0	
scipy	1.1.0	py36h29ff71c_2	
seaborn	0.9.0	py36_0	
send2trash	1.5.0	py36_0	
setuptools	39.1.0	pypi_0	pypi
simplegeneric	0.8.1	py36_2	
singledispatch	3.4.0.3	py36h17d0c80_0	
sip	4.19.8	py36h6538335_0	
six	1.12.0	py36_0	
sklearn	0.0	pypi_0	pypi
snappy	1.1.7	h777316e_3	
snowballstemmer	1.2.1	py36h763602f_0	
sortedcollections	1.0.1	py36_0	
sortedcontainers	2.1.0	py36_0	
sphinx	1.8.2	py36_0	
sphinxcontrib	1.0	py36_1	
sphinxcontrib-websupport	1.1.0	py36_1	
spyder	3.3.2	py36_0	
spyder-kernels	0.3.0	py36_0	
sqlalchemy	1.2.15	py36he774522_0	
sqlite	3.26.0	he774522_0	
statsmodels	0.9.0	py36h452e1ab_0	
sympy	1.3	py36_0	
tblib	1.3.2	py36h30f5020_0	
tensorboard	1.12.2	pypi_0	pypi
tensorflow-gpu	1.12.0	pypi_0	pypi
termcolor	1.1.0	pypi_0	pypi
terminado	0.8.1	py36_1	
testpath	0.4.2	py36_0	

tk	8.6.8	hfa6e2cd_0
toolz	0.9.0	py36_0
torchfile	0.1.0	pypi_0 pypi
torchvision	0.2.2	py_3 pytorch
tornado	5.1.1	py36hfa6e2cd_0
tqdm	4.28.1	py36h28b3542_0
traitlets	4.3.2	py36h096827d_0
typed-ast	1.1.0	py36hfa6e2cd_0
unicodcsv	0.14.1	py36h6450c06_0
urllib3	1.24.1	py36_0
vc	14.1	h0510ff6_4
visdom	0.1.8.8	pypi_0 pypi
vs2015_runtime	14.15.26706	h3a45250_0
wcwidth	0.1.7	py36h3d5aa90_0
webencodings	0.5.1	py36_1
websocket-client	0.55.0	pypi_0 pypi
werkzeug	0.14.1	py36_0
wheel	0.32.3	py36_0
widetsnbextension	3.4.2	py36_0
win_inet_pton	1.0.1	py36_1
win_unicode_console	0.5	py36hcd4b5_0
wincertstore	0.2	py36h7fe50ca_0
winpty	0.4.3	4
wrapt	1.10.11	py36hfa6e2cd_2
xlrd	1.2.0	py36_0
xlsxwriter	1.1.2	py36_0
xlwings	0.15.1	py36_0
xlwt	1.3.0	py36h1a4751e_0
xz	5.2.4	h2fa13f4_4
yaml	0.1.7	hc54c509_2
zeromq	4.2.5	he025d50_1
zict	0.1.3	py36_0
zlib	1.2.11	h62dcd97_3
zstd	1.3.7	h508b16e_0