AI and Deep Learning

Applications

Jeju National University
Yung-Cheol Byun

Security
Prediction
Object recognition
Art, creation
Poet
Drawing
Composition
Healthcare

Assistant

Translation

Unmanned car

Autonomous drone

Robot

Interpretation

other applications …

Object Recognition

Security

Real-time event detection
for video surveillance applications

powered by

Robot, learn to work

Robot moving like human

Humanoid

Learning how to play

Ping-Pong Match

Image Captioning

AI Guide

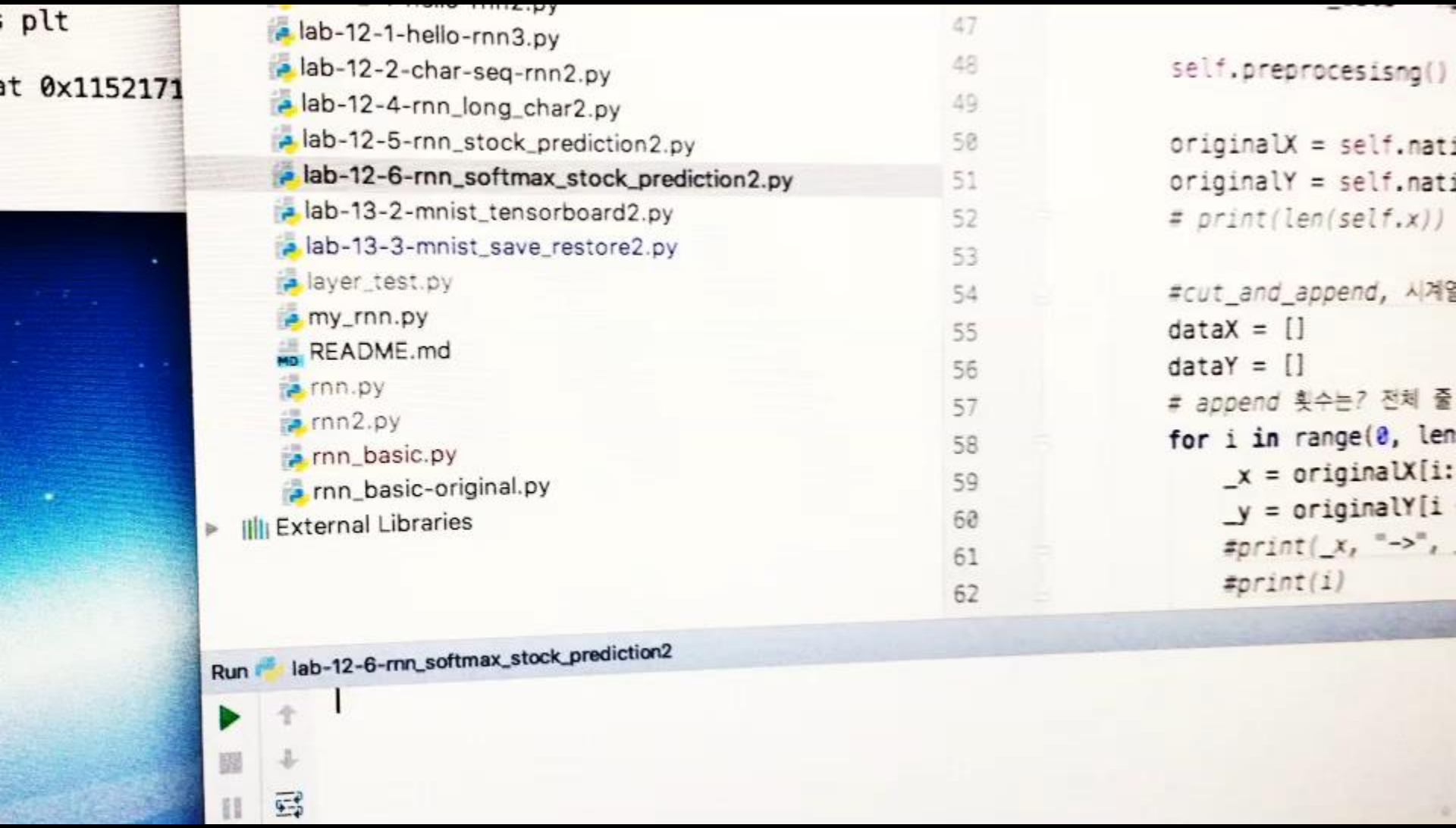
Voice Recognition

Learn from examples and experience.

Stock Prediction

- Stock Price Data from Yahoo
- Open, Highest, Lowest, Volume, Close
- 734 daily
- 70% for training, 30% for test

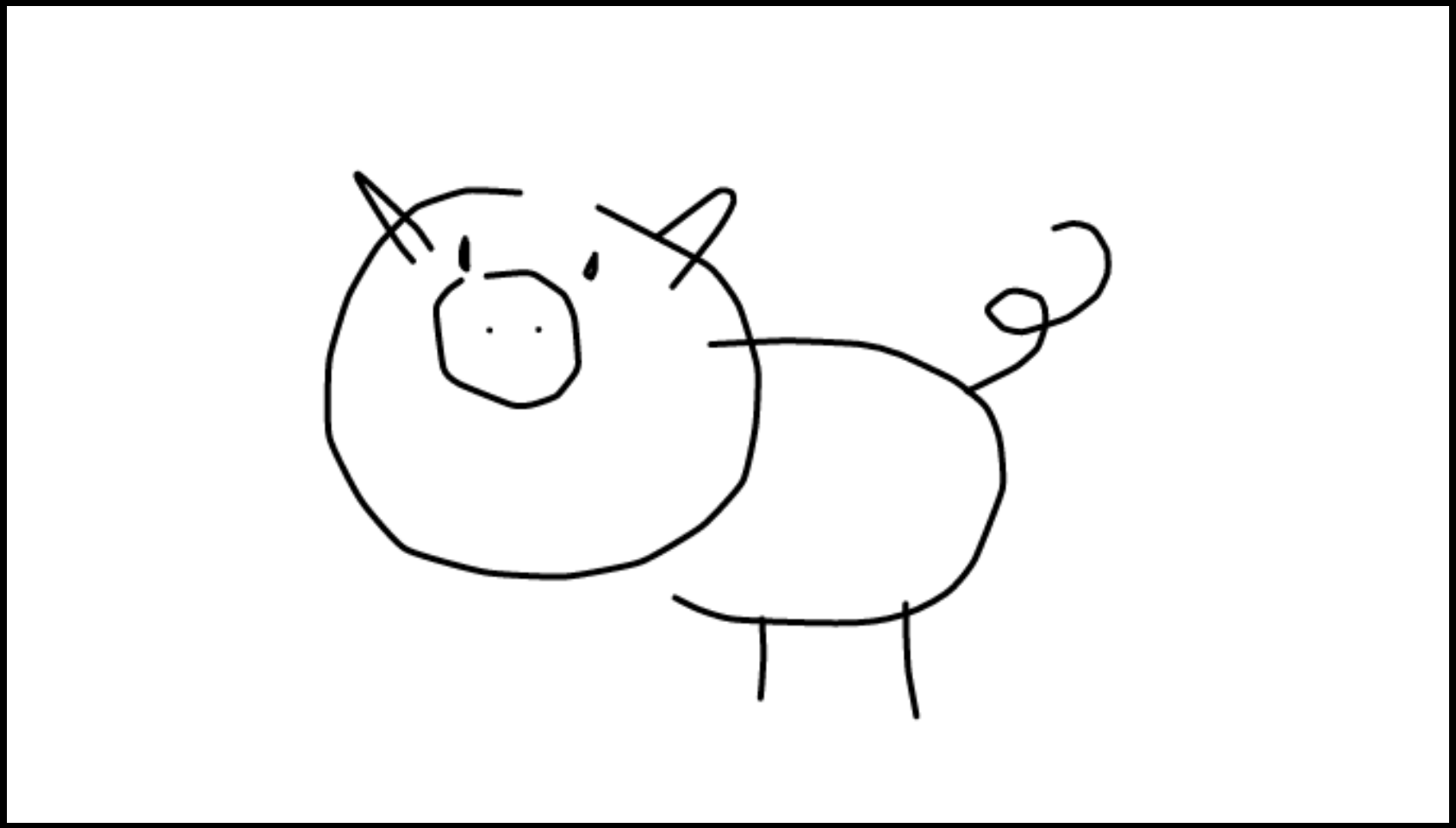
Stock Prediction



Motion Prediction

Given an initial still frame,

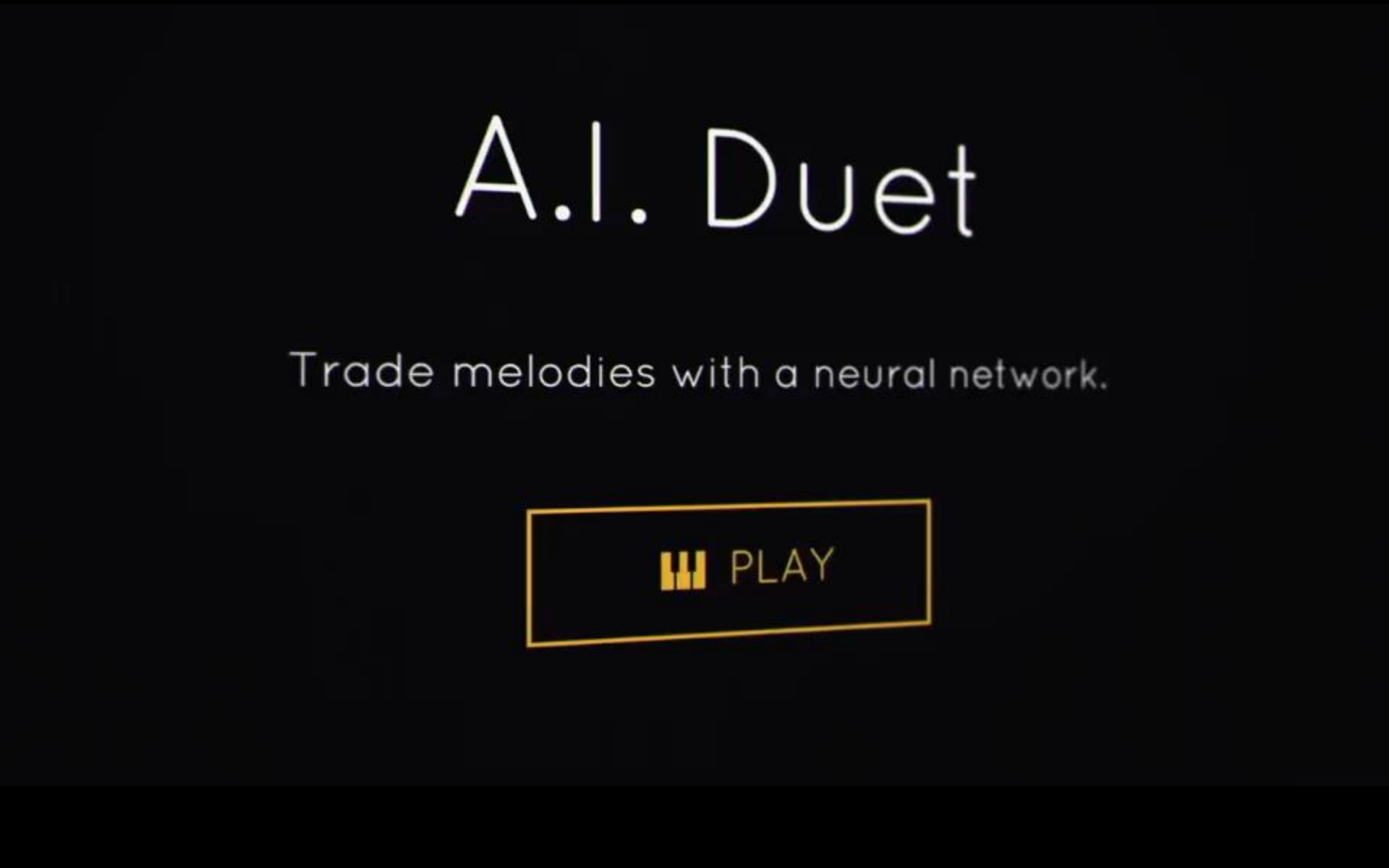
Drawing by Machine



https://magenta.tensorflow.org/assets/sketch_rnn_demo/index.html

AI Poet

Music Composition



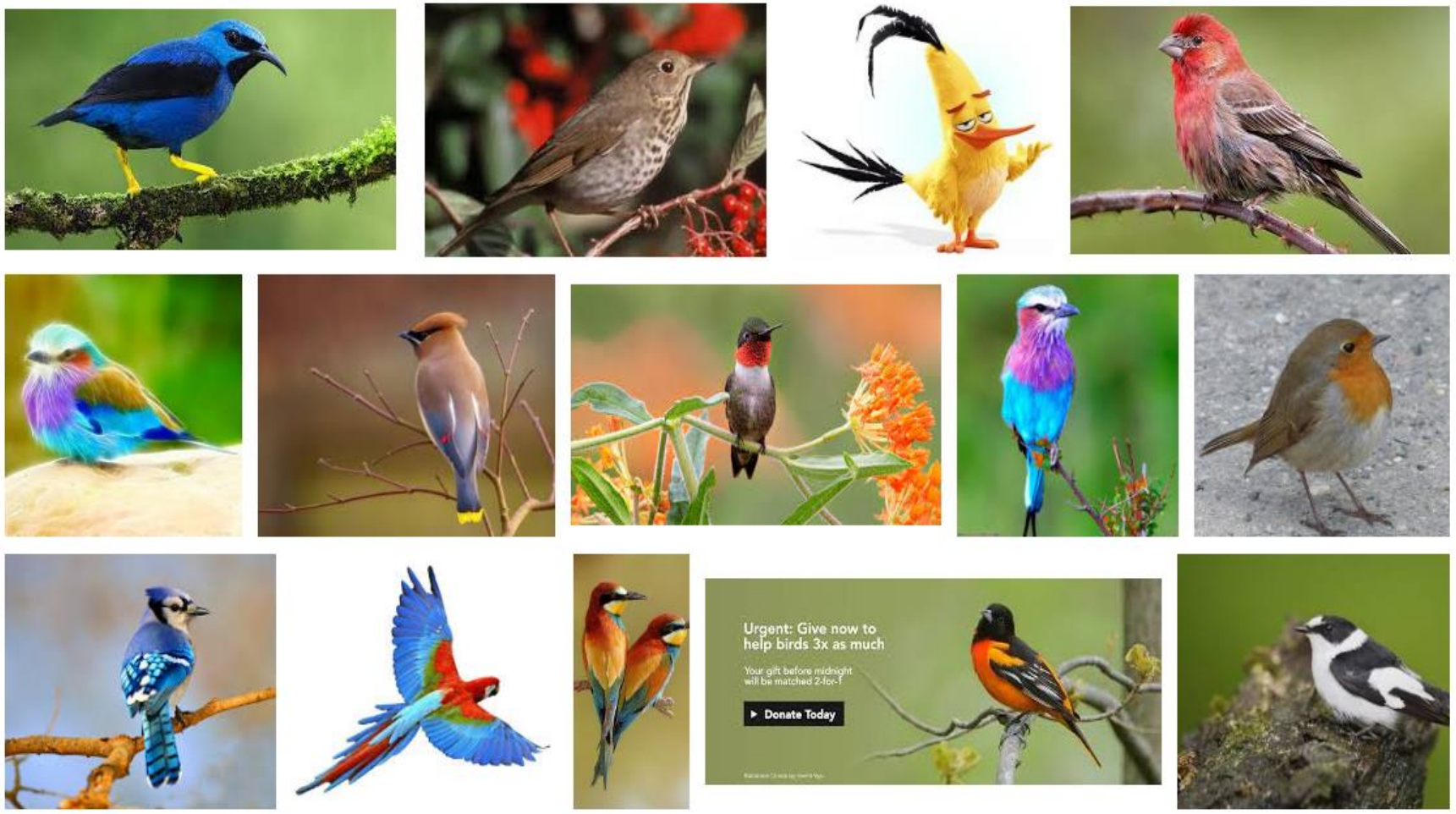
Music by Machine

Music by Machine

TECHINASIA

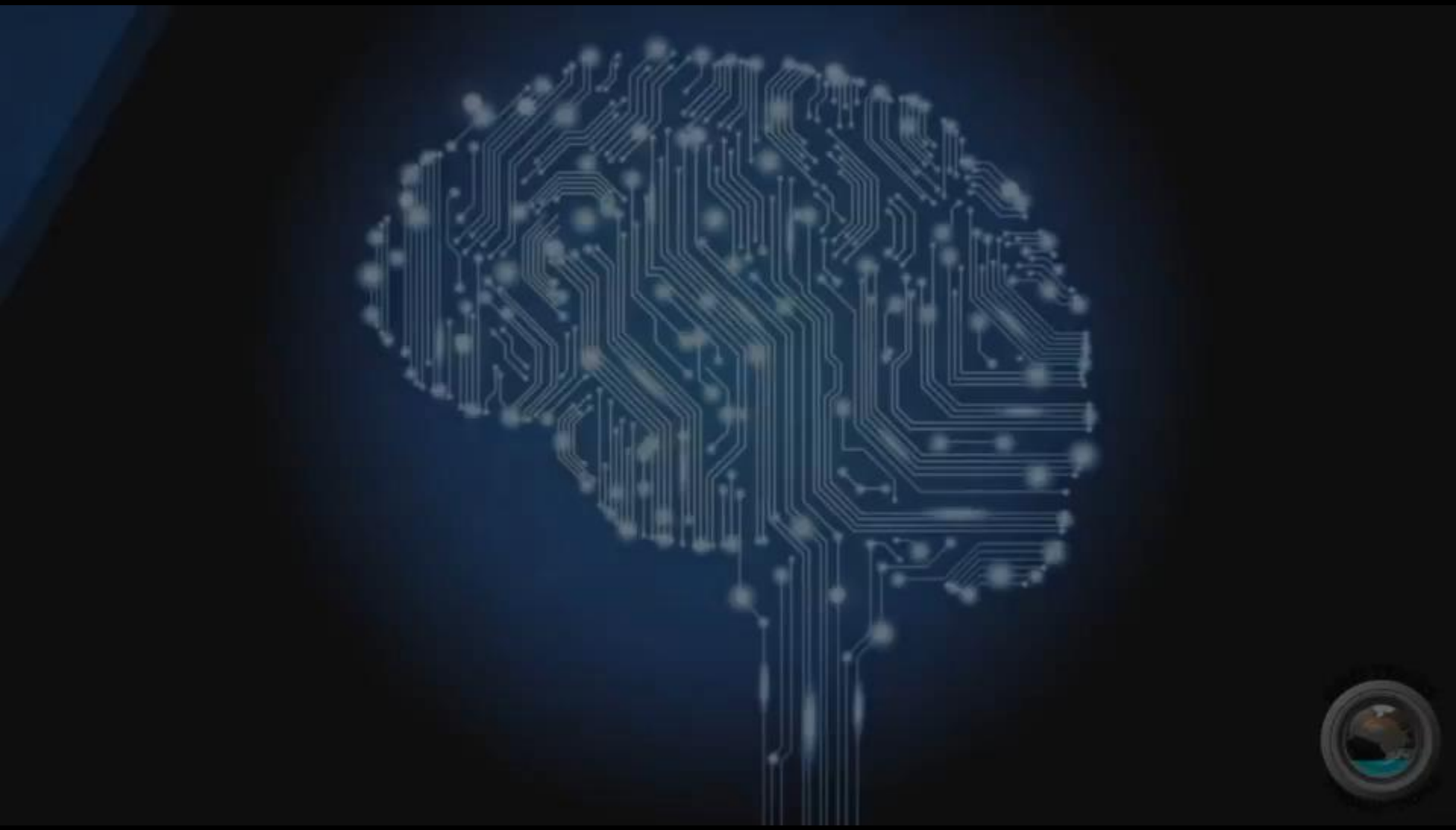
Music (Beatles' style)

Song of birds



https://aiexperiments.withgoogle.com/bird-sounds/view/

Human an AI



Which ML Frameworks?

Caffe

No need to write code!

1. Convert data (run a script)
2. Define net (edit prototxt)
3. Define solver (edit prototxt)
4. Train (with pretrained weights)

Torch

```lua
require 'torch'
require 'nn'
require 'optim'

-- Batch size, input dim, hidden dim, num classes
local N, D, H, C = 100, 1000, 100, 10

-- Build a one-layer ReLU network
local net = nn.Sequential()
net:add(nn.Linear(D, H))
net:add(nn.ReLU())
net:add(nn.Linear(H, C))

-- Collect all weights and gradients in a single Tensor
local weights, grad_weights = net:getParameters()

-- Loss functions are called "criterions"
local crit = nn.CrossEntropyCriterion()  -- Softmax loss

-- Calback to interface with optim methods
local function f(w)
  assert(w == weights)

  -- Generate some random input data
  local x = torch.randn(N, D)
  local y = torch.Tensor(N):random(C)

  -- Forward pass: Compute scores and loss
  local scores = net:forward(x)
  local loss = crit:forward(scores, y)

  -- Backward pass: compute gradients
  grad_weights:zero()
  local dscores = crit:backward(scores, y)
  local dx = net:backward(x, dscores)

  return loss, grad_weights
end

-- Make a step using Adam
local state = {learningRate=1e-3}
optim.adam(f, weights, state)
```

2,3

TensorFlow

```python
import tensorflow as tf
import numpy as np

N, D, H, C = 64, 1000, 100, 10

x = tf.placeholder(tf.float32, shape=[None, D])
y = tf.placeholder(tf.float32, shape=[None, C])

w1 = tf.Variable(1e-3 * np.random.randn(D, H).astype(np.float32))
w2 = tf.Variable(1e-3 * np.random.randn(H, C).astype(np.float32))

a = tf.matmul(x, w1)
a_relu = tf.nn.relu(a)
scores = tf.matmul(a_relu, w2)
probs = tf.nn.softmax(scores)
loss = -tf.reduce_sum(y * tf.log(probs))

learning_rate = 1e-2
train_step = tf.train.GradientDescentOptimizer(learning_rate).minimize(loss)

xx = np.random.randn(N, D).astype(np.float32)
yy = np.zeros((N, C)).astype(np.float32)
yy[np.arange(N), np.random.randint(C, size=N)] = 1

with tf.Session() as sess:
  sess.run(tf.initialize_all_variables())

  for t in xrange(100):
    _, loss_value = sess.run([train_step, loss],
                             feed_dict={x: xx, y: yy})
    print loss_value
```

Theano

```python
import theano
import theano.tensor as T

# Batch size, input dim, hidden dim, num classes
N, D, H, C = 64, 1000, 100, 10

x = T.matrix('x')
y = T.vector('y', dtype='int64')
w1 = T.matrix('w1')
w2 = T.matrix('w2')

# Forward pass: Compute scores
a = x.dot(w1)
a_relu = T.nnet.relu(a)
scores = a_relu.dot(w2)

# Forward pass: compute softmax loss
probs = T.nnet.softmax(scores)
loss = T.nnet.categorical_crossentropy(probs, y).mean()

# Backward pass: compute gradients
dw1, dw2 = T.grad(loss, [w1, w2])

f = theano.function(
      inputs=[x, y, w1, w2],
      outputs=[loss, scores, dw1, dw2],
    )
```

1

Mxnet
chainer
Nervana's Neon
Microsoft's CNTK

Lasagne

```python
import numpy as np
import theano
import theano.tensor as T
import lasagne

N, D, H, C = 64, 1000, 100, 10

x = T.matrix('x')
y = T.vector('y', dtype='int64')

relu = lasagne.nonlinearities.rectify
softmax = lasagne.nonlinearities.softmax
net = lasagne.layers.InputLayer(shape=(None, D), input_var=x)
net = lasagne.layers.DenseLayer(net, H, nonlinearity=relu)
net = lasagne.layers.DenseLayer(net, C, nonlinearity=softmax)

probs = lasagne.layers.get_output(net)
loss = lasagne.objectives.categorical_crossentropy(probs, y).mean()

params = lasagne.layers.get_all_params(net, trainable=True)
updates = lasagne.updates.nesterov_momentum(loss, params,
                                            learning_rate=1e-2, momentum=0.0)

train_fn = theano.function([x, y], loss, updates=updates)

xx = np.random.randn(N, D)
yy = np.random.randint(C, size=N).astype(np.int64)

for t in xrange(100):
  loss_val = train_fn(xx, yy)
  print loss_val
```

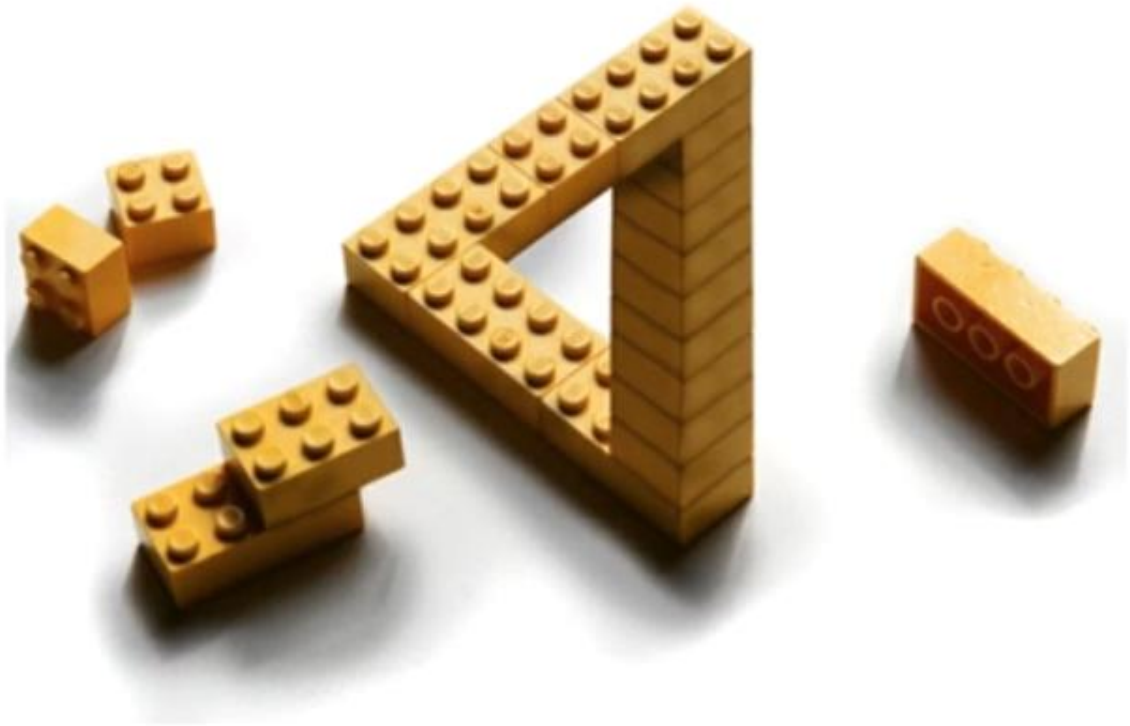
Keras

```python
from keras.models import Sequential
from keras.layers.core import Dense, Activation
from keras.optimizers import SGD
from keras.utils import np_utils

D, H, C = 1000, 100, 10

model = Sequential()
model.add(Dense(input_dim=D, output_dim=H))
model.add(Activation("relu"))
model.add(Dense(input_dim=H, output_dim=C))
model.add(Activation("softmax"))

sgd = SGD(lr=1e-3, momentum=0.9, nesterov=True)
model.compile(loss='categorical_crossentropy', optimizer=sgd)

N, N_batch = 1000, 32
X = np.random.randn(N, D)
y = np.random.randint(C, size=N)
y = np_utils.to_categorical(y)

model.fit(X, y, nb_epoch=5, batch_size=N_batch, verbose=2)
```

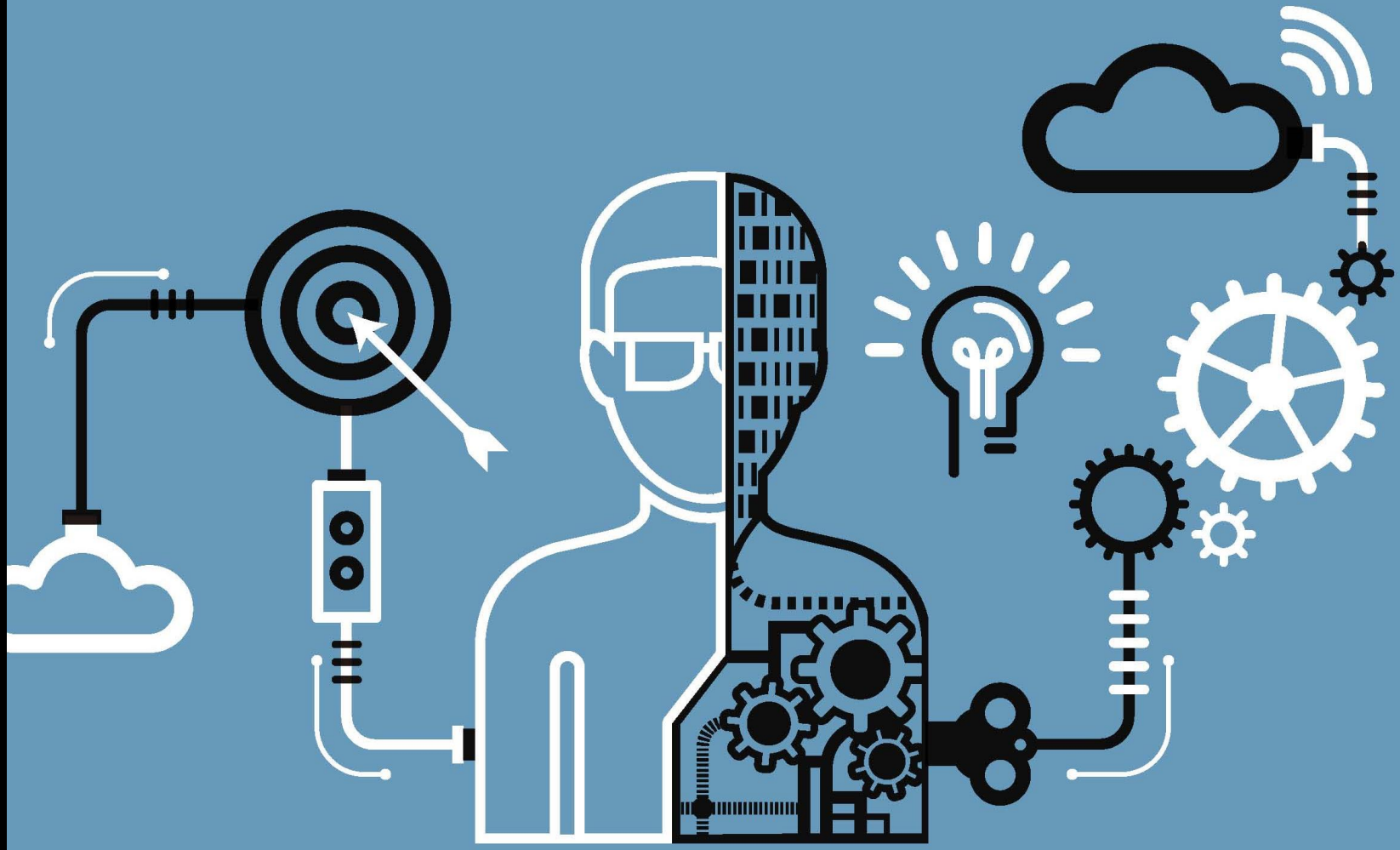
Do it now.

- Python
- TensorFlow / Keras
- GitHub

'The only limit is your imagination'



http://itchyi.squarespace.com/thelatest/2012/5/17/the-only-limit-is-your-imagination.html



MACHINE LEARNING CAMP JEJU 2017

Thank you!

ycb@jejunu.ac.kr