ITE4053 Deep Learning course
Practice 5

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Environments

OS	Window 10 edu
Language	Python with jupyter notebook

Quick start

run src/practice_5-1_training.ipynb
run src/practice_5-2_compare_performances.ipynb
run src/practice_5-3_remove_grid.ipynb

Weights of models trained, and the restored images

Weights : src/trained_models/[early-stopping option]/[learning_rate]/[# of model].hdf5
Restored_images : src/trained_models/[early-stopping option]/[learning_rate]/[# of model].png

Code Explanation

- noisy network

Divide the single model to two separated models, one noisy network and the other the core network for restoring noisy image. Noisy network is used on model1, model2 and model3. Differences are the core part.

- Core model

core model is neural network reducing the noisy of input image. Model 1, model2 and model3 have different core model. This part makes difference on performance of recovering noisy image. Model 1 is an simple cnn model, model 2 add a skip connection on model 1 and model3 add normalization layer on model2.

- Build model

In [8]:

```
model_core = tf.keras.models.Sequential([
    tf.keras.layers.Conv2D(64, (3,3), input_shape=(32,32,3), padding='same', activation=tf.nn.relu),
    tf.keras.layers.Conv2D(64, (3,3), padding='same', activation=tf.nn.relu),
    tf.keras.layers.Conv2D(64, (3,3), padding='same', activation=tf.nn.relu),
    tf.keras.layers.Conv2D(64, (3,3), padding='same', activation=tf.nn.relu),
    tf.keras.layers.Conv2D(3, (3,3), padding='same')
])

restored_output = model_core(noisy_input)
model = tf.keras.models.Model(inputs=tensor_input, outputs=restored_output)

model.compile(
    optimizer = tf.keras.optimizers.Adam(lr=learning_rate),
    loss = tf.keras.losses.MeanSquaredError(),
    metrics = [tf.keras.metrics.Accuracy()]
)

model.summary()
```

- Build model

In [11]:

```
model_core = tf.keras.models.Sequential([
    tf.keras.layers.Conv2D(64, (3,3), input_shape=(32,32,3), padding='same', activation=tf.nn.relu),
    tf.keras.layers.Conv2D(64, (3,3), padding='same', activation=tf.nn.relu),
    tf.keras.layers.Conv2D(64, (3,3), padding='same', activation=tf.nn.relu),
    tf.keras.layers.Conv2D(64, (3,3), padding='same', activation=tf.nn.relu),
    tf.keras.layers.Conv2D(3, (3,3), padding='same')
])

restored_output = model_core(noisy_input) + noisy_input
model = tf.keras.models.Model(inputs=tensor_input, outputs=restored_output)

model.compile(
    optimizer = tf.keras.optimizers.Adam(lr=learning_rate),
    loss = tf.keras.losses.MeanSquaredError(),
    metrics = [tf.keras.metrics.Accuracy()]
)

model.summary()
```

- Build model

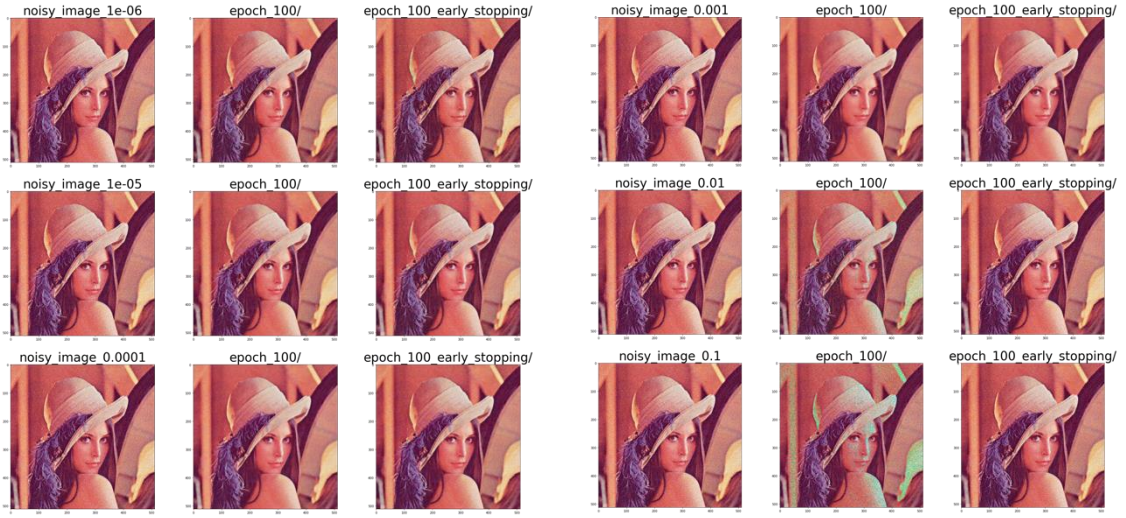
In [14]:

```
model_core = tf.keras.models.Sequential([
    tf.keras.layers.Conv2D(64, (3,3), input_shape=(32,32,3), padding='same'),
    tf.keras.layers.BatchNormalization(),
    tf.keras.layers.Activation('relu'),
    tf.keras.layers.Conv2D(64, (3,3), padding='same'),
    tf.keras.layers.BatchNormalization(),
    tf.keras.layers.Activation('relu'),
    tf.keras.layers.Conv2D(64, (3,3), padding='same'),
    tf.keras.layers.BatchNormalization(),
    tf.keras.layers.Activation('relu'),
    tf.keras.layers.Conv2D(64, (3,3), padding='same'),
    tf.keras.layers.BatchNormalization(),
    tf.keras.layers.Activation('relu'),
    tf.keras.layers.Conv2D(3, (3,3), padding='same')
])

restored_output = model_core(noisy_input) + noisy_input
model = tf.keras.models.Model(inputs=tensor_input, outputs=restored_output)

model.compile(
    optimizer = tf.keras.optimizers.Adam(lr=learning_rate),
    loss = tf.keras.losses.MeanSquaredError(),
    metrics = [tf.keras.metrics.Accuracy()]
)

model.summary()
```

Results

Results of model #1

Results of model #2



Results of model #3

Best parameters and options

- **Early-stopping option : DO NOT USE IT**

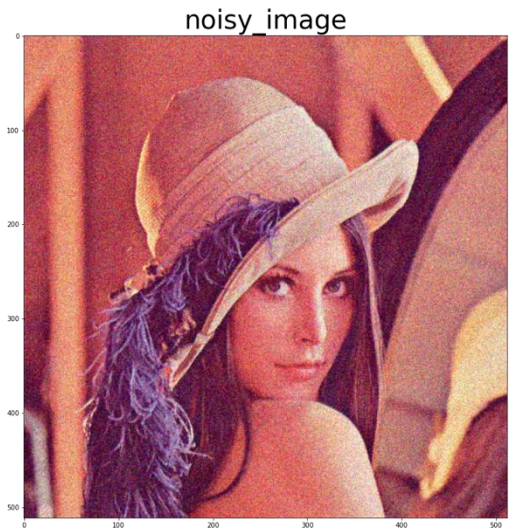
  Initially, I expected that the performance of photo recovery would be better if the early-stopping option was added. Because early-stopping option prevents model from being trained excessively only about training data, and reduces the differences(error) between restored image and original image.

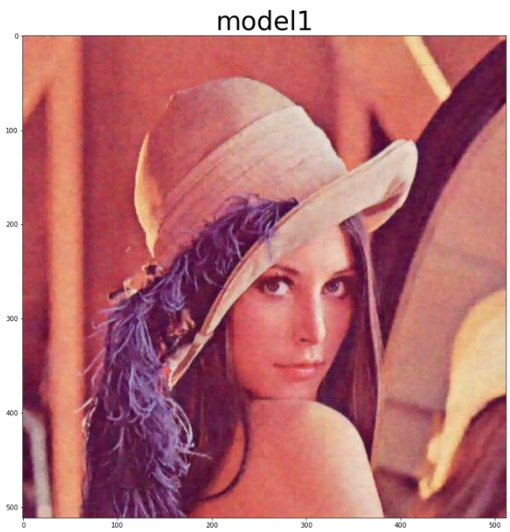
  But unlike my thoughts, early-stopping does not matter for reducing noisy of image. Trained model with early-stopping option often show worse performance compared to other trained model with no early-stopping option

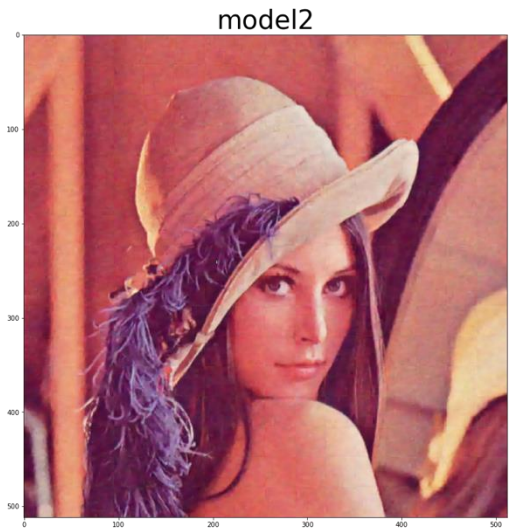
- **Learning Rate : 1e-4**

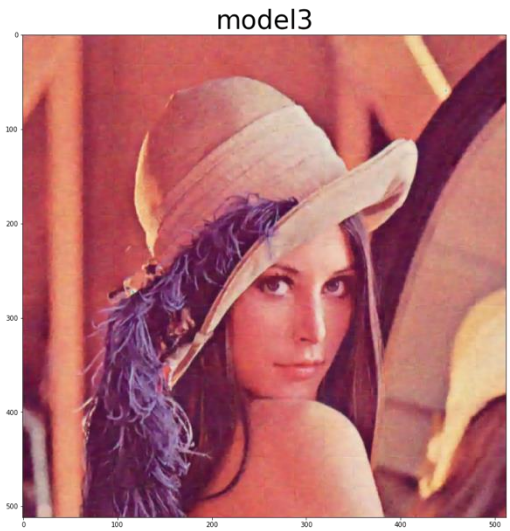
  model1, model2 and model 3 showed the best performance in restoring noisy image when the learning rate value was 1e-4

- **Results of learning_rate, 1e-4**









trial to reduce the grid

- Model 1

- Model 2

- Model 3

I tried to remove grid by using bilinear interpolation. But it just reduce the size of each grid.