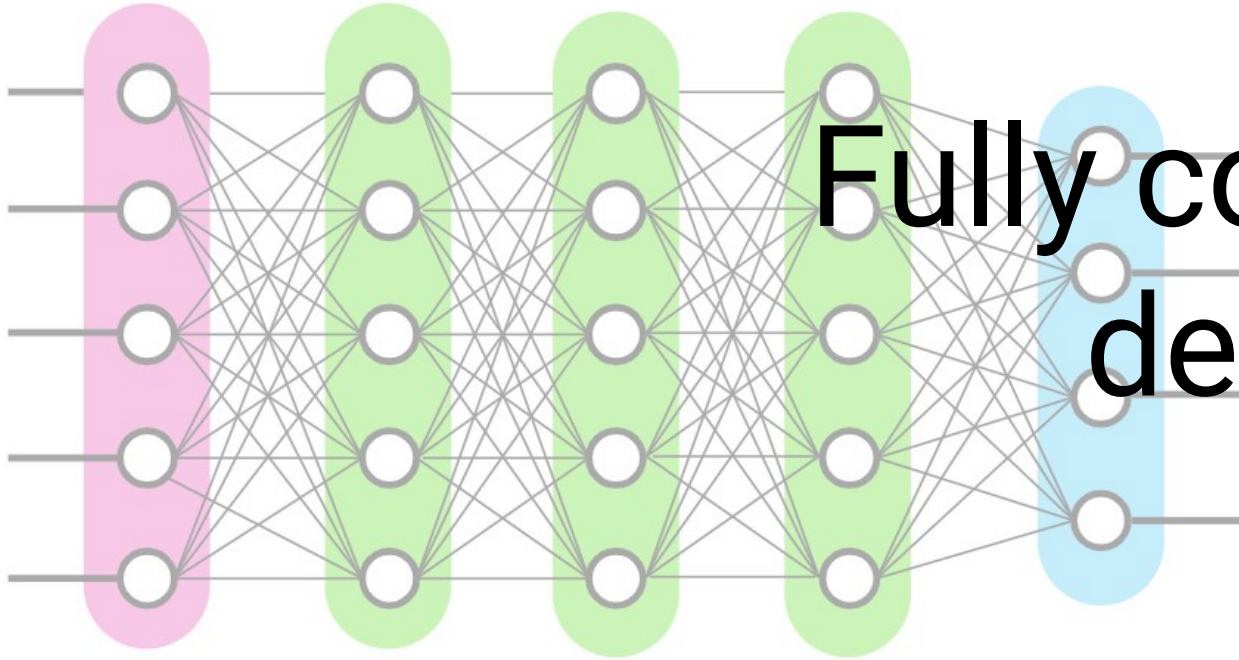


# Class core values

1. Be **respectful** to yourself and others
2. Be **confident** and believe in yourself
3. Always do your **best**
4. Be **cooperative**
5. Be **creative**
6. Have **fun**
7. Be **patient** with yourself while you learn
8. Don't be shy to **ask "stupid" questions**
9. Be **inclusive** and **accepting**

Week 3, Lecture 2

# Fully connected dense ANN



# Learning Objectives

1. Evaluate literature using ANNs for protein design
2. Apply keras to generate ANN
3. Make predictions using ANNs

# Keras: a powerful package to build DL models



Simple. Flexible. Powerful.

The website:

<https://keras.io/>

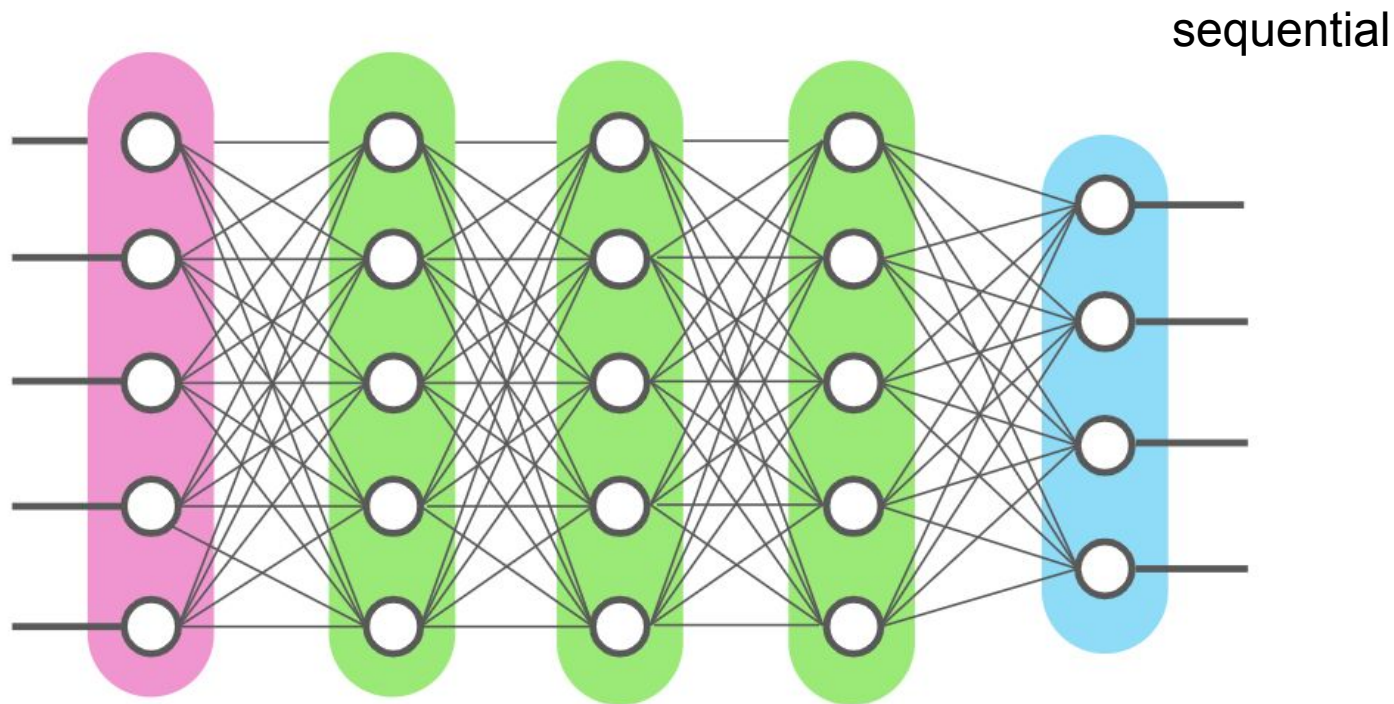
Some example/guide:

<https://github.com/keras-team/keras>

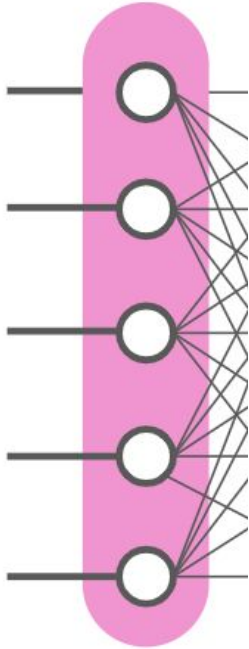
Tutorial:

<https://elitedatascience.com/keras-tutorial-deep-learning-in-python>

# First step is to build a model



# First step is to build a model



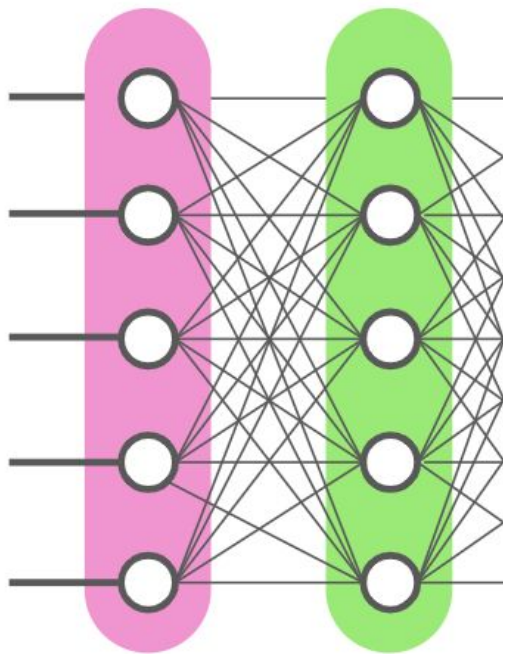
Input layer:

Dense

Dimension = # features

Activation function = 'ReLU'

# First step is to build a model

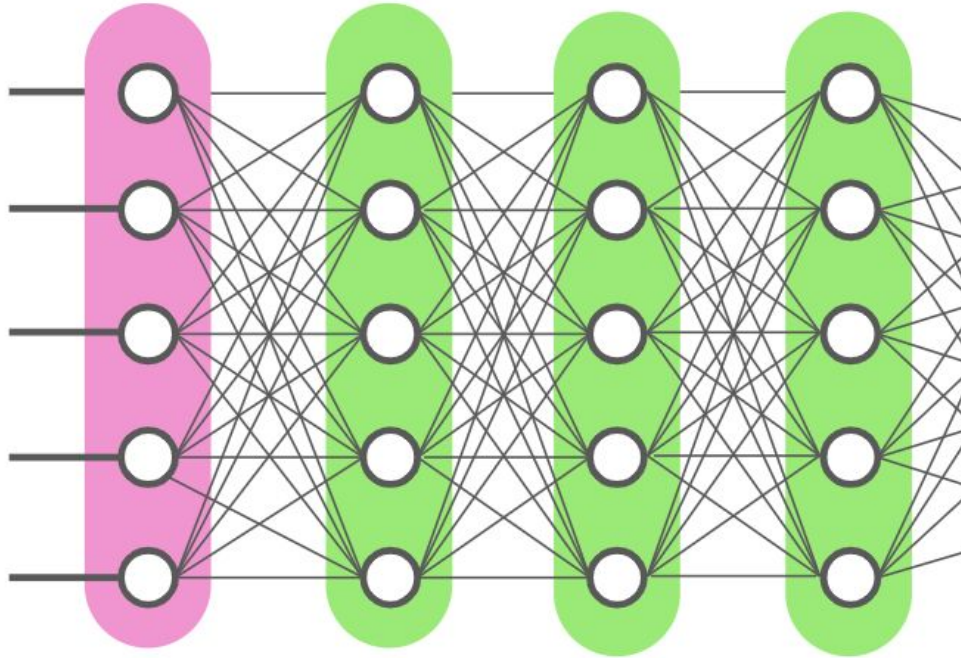


First hidden layer:

Dense

Activation function = 'ReLU'

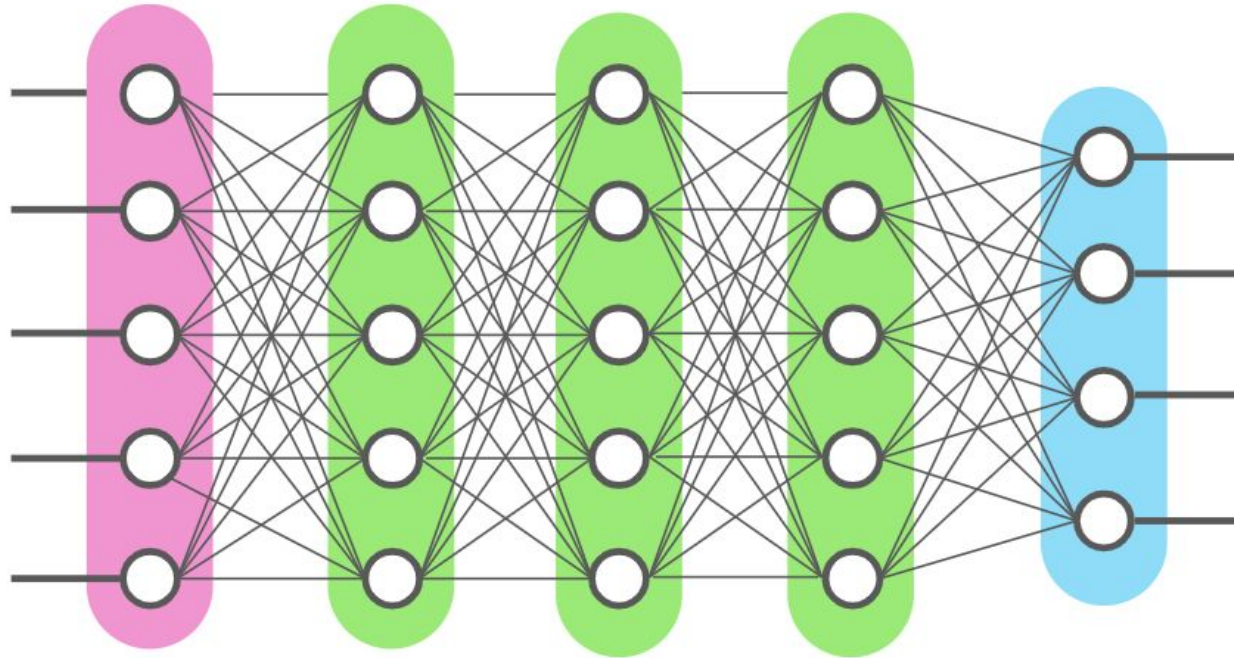
# First step is to build a model



2, 3 hidden layer:  
Dense  
'ReLU'



# First step is to build a model



Output layer  
Dense  
'sigmoid'

# The second step is to compile your model

Define some general parameters here:

- Loss function

- Optimizer

- Metrics to output

# The second step is to compile your model

Define some general parameters here:

Loss function → `binary_crossentropy`

Optimizer → `adam`

Metrics to output → `accuracy`

# The third step is to fit your model

Fitting on training dataset:

- Input data
- Labels (supervised learning)

# The third step is to fit your model

Fitting on training dataset:

- Input data
- Labels (supervised learning)

Epoch

Batch

# The third step is to fit your model

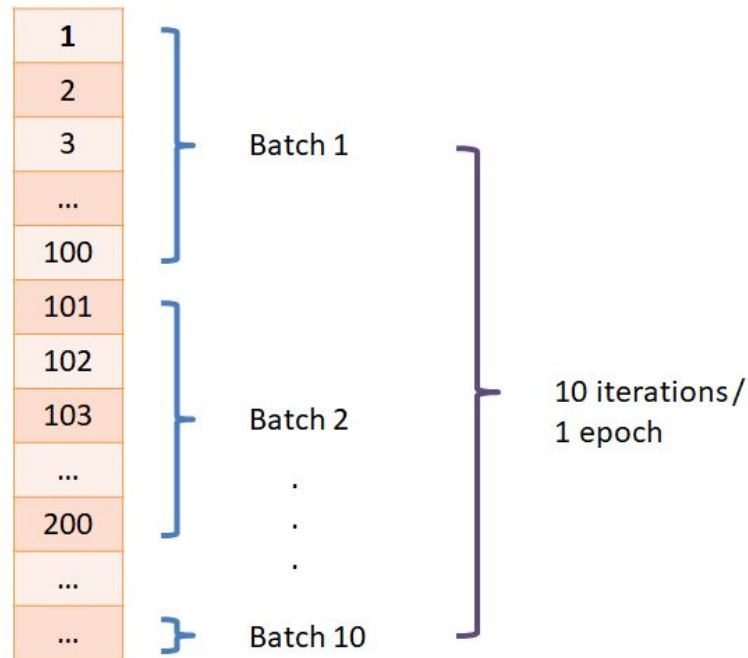
Fitting on training dataset:

- Input data
- Labels (supervised learning)

Epoch

Batch

All training samples



# The final step is to evaluate its performance on test set

$$\text{F1 score} = \frac{2 \times \text{precision} \times \text{recall}}{\text{precision} + \text{recall}}$$

$$\text{Accuracy} = \frac{\text{TP} + \text{TN}}{\text{TP} + \text{TN} + \text{FP} + \text{FN}}$$

	Positive	Negative
Positive	<b>TP (6)</b>	<b>FP (2)</b>
Negative	<b>FN (3)</b>	<b>TN (4)</b>

Next lecture:

*From 1D to 2D and the power of convolution*

