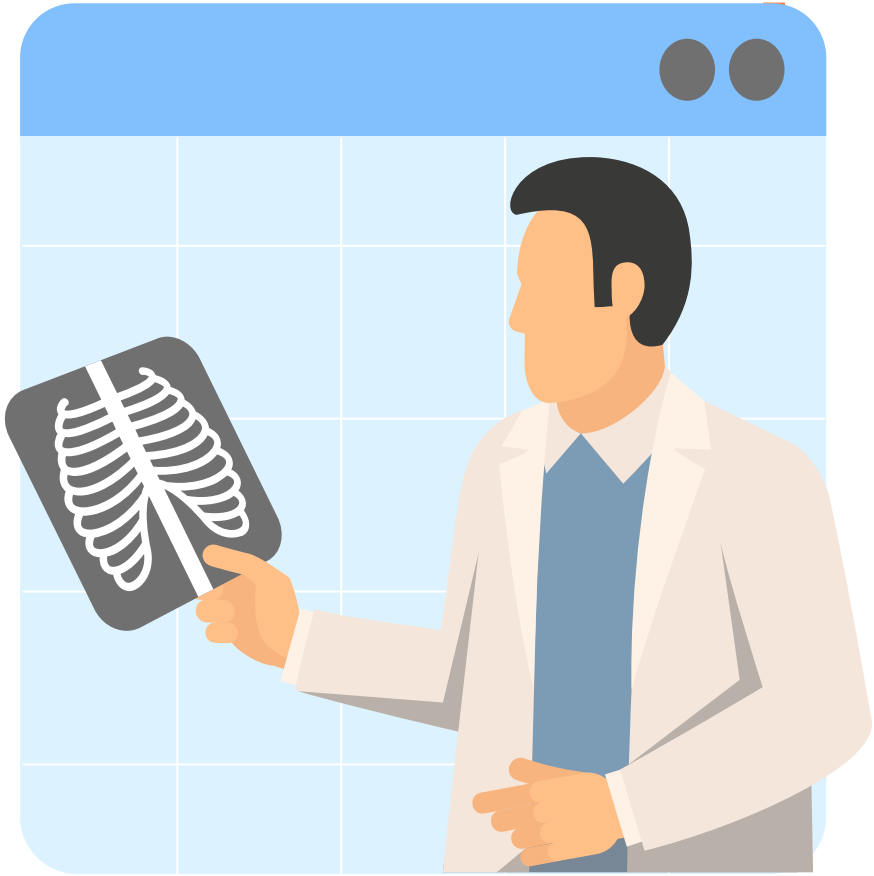
Machine Learning for Medical Image Analysis



By
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About Me

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BSc in CSE from AUST

What is Machine Learning?

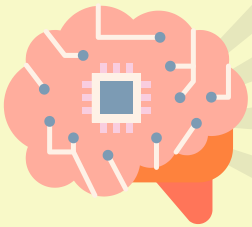
Artificial Intelligence(AI)
enables computers to mimic human behaviour

Machine learning(ML), a subset of AI, enables **systems** to learn and improve from experience **without being explicitly programmed**.

Deep learning(DL), a subset of ML, extracts patterns from data using neural networks

Machine Learning uses **data** and **algorithms** to **imitate the way that humans learn**, gradually improving its **accuracy.**

Some **Machine Learning Applications** in the **Medical Field**



Medical Image Classification

Labeling images based on their features

Drug Discovery

For decision-making in pharmaceutical data

Segmentation or Localization

Segmentation/localiza--tion of image portions

Medical Diagnosis

Diagnosing diseases based on symptoms in input data

History of **Machine Learning** in **Medical Image Analysis**

Initial Phase

Low level pixel processing & Mathematical Modelling were used

End of 1990s

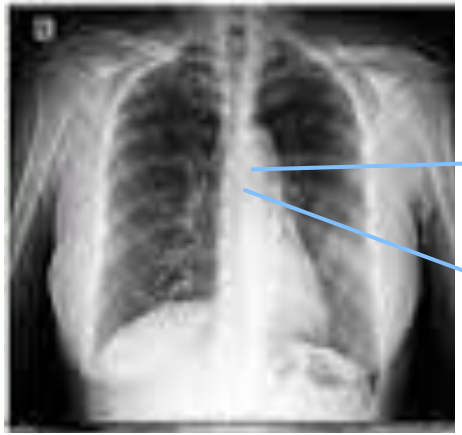
Traditional machine learning methods such as Supervised techniques were used. Features were extracted and passed to the system

Final Phase

Deep Learning methods, such as convolutional neural networks are used nowadays

Traditional Machine Learning for Medical Image analysis

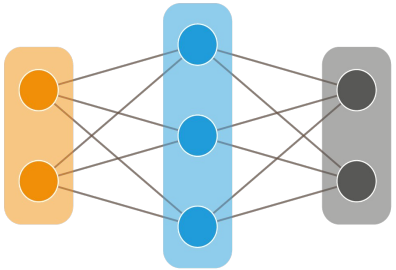
Pixel classification with features computed from the image patch



Input image

1. Reticular interstitial thickness,
2. Consolidation,
3. Pleural effusion

Feature engineering

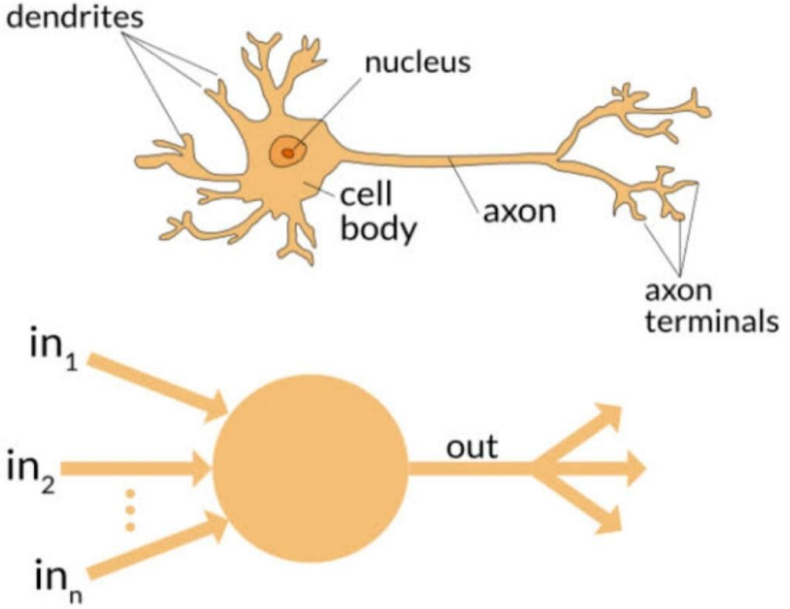


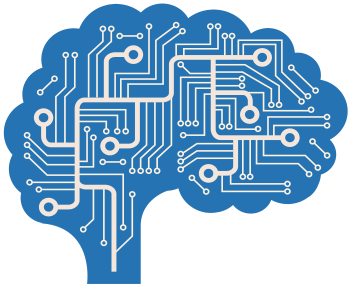
Classification

The Deep Learning Principle

What is Deep Learning(DL)?

Deep Learning(DL) is subset of machine learning(ML), which is essentially a neural network with three or more layers. These neural networks attempt to simulate the behavior of the human brain.

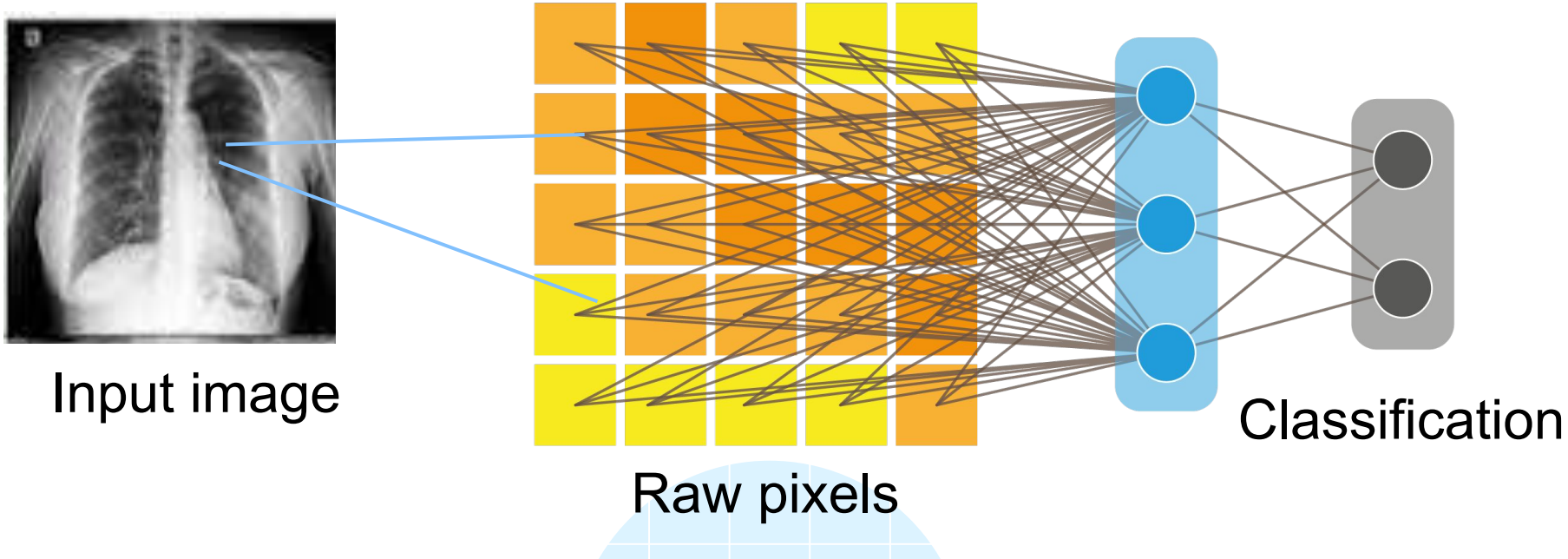




Neural networks are layers of nodes, just like how the Human brain is made up of neurons.

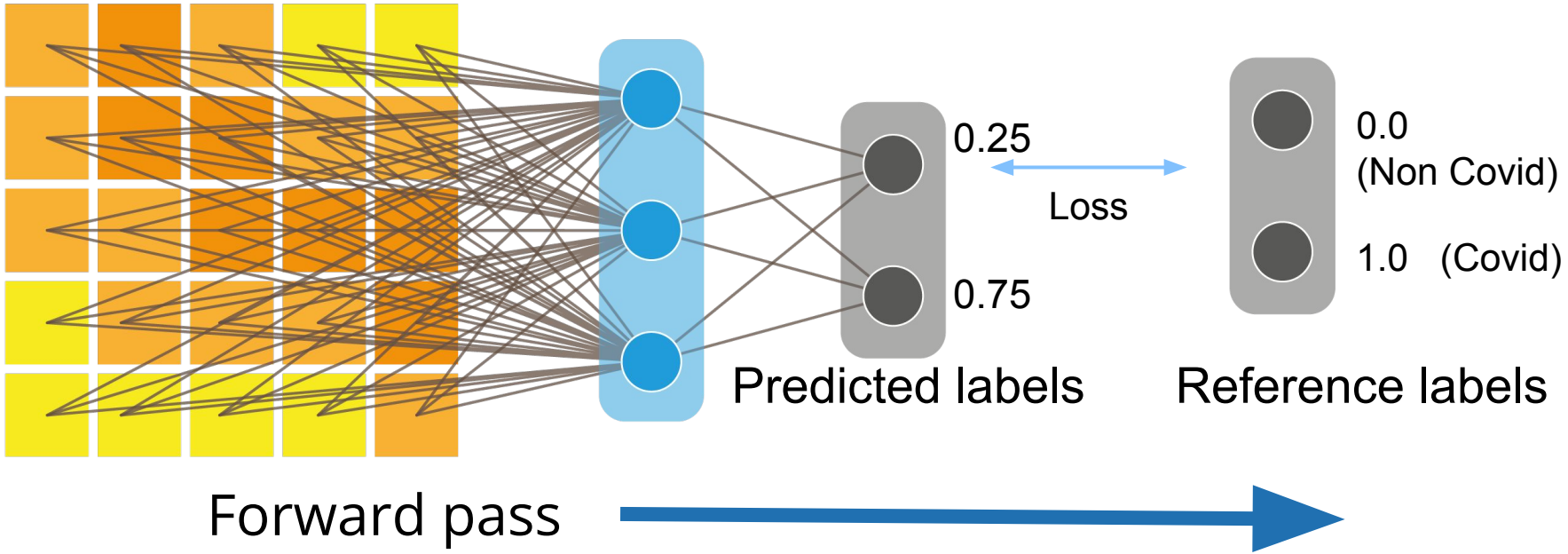
The **Deep Learning** Principle

Classifier itself learns meaningful representations from the **raw pixel values of input data**



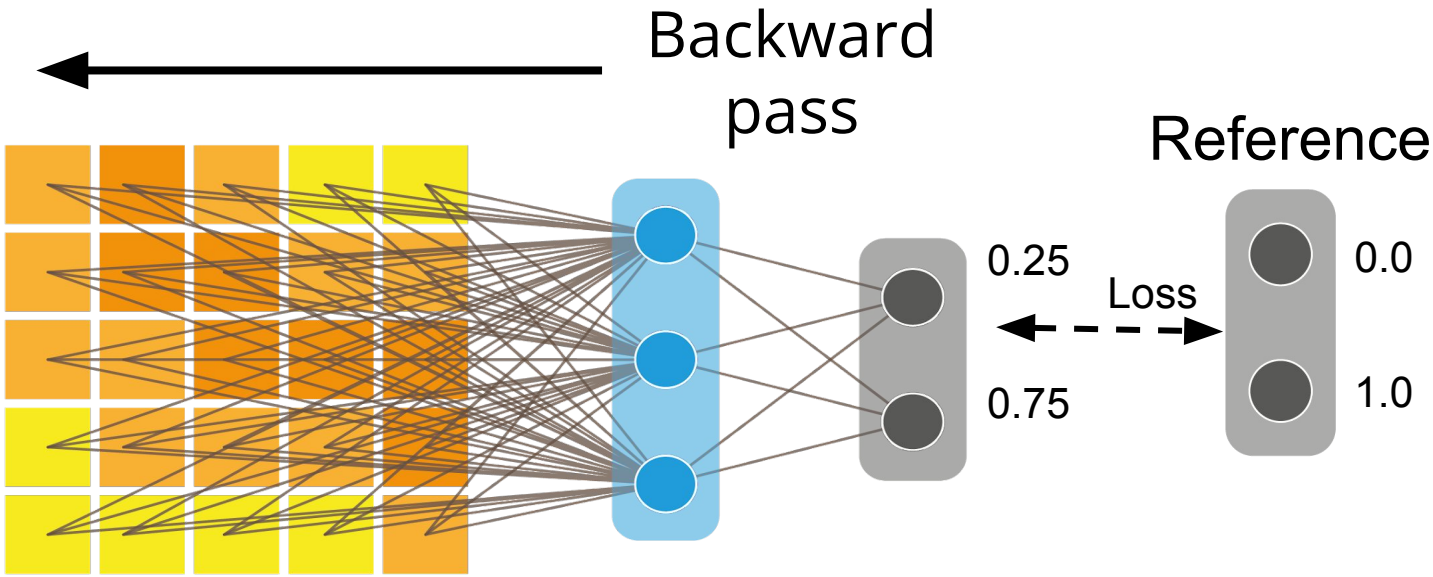
How does the network predict?

It predicts using the loss/error **between the predicted labels and reference labels(outputs)** and by calculation using its **parameters and input values** from each layer



How does the network learn?

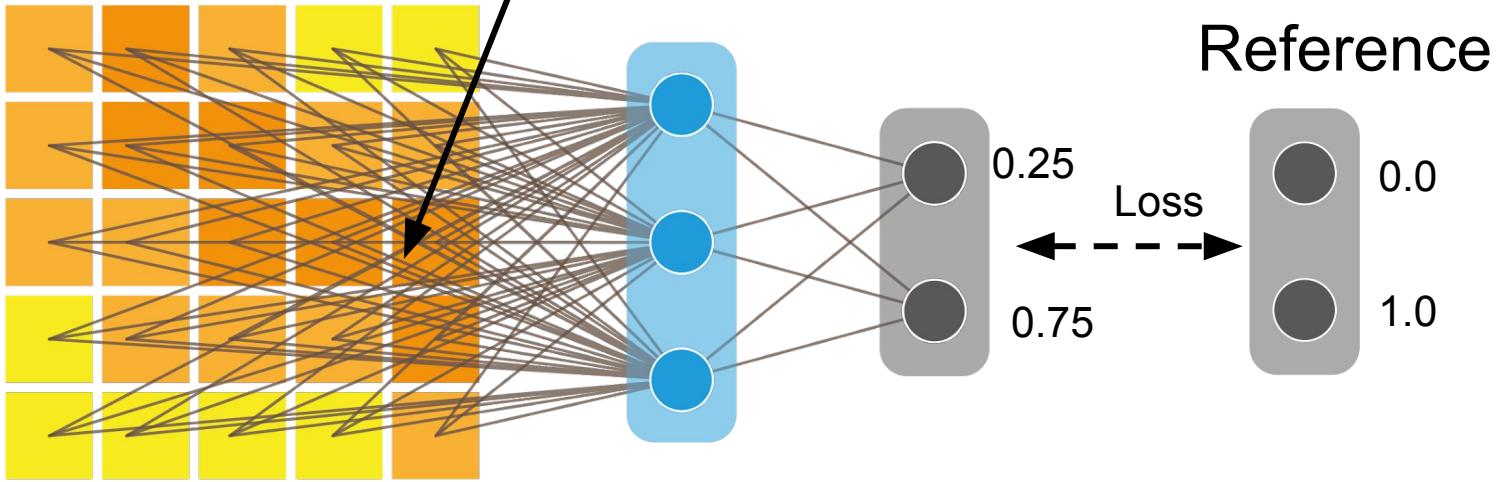
It learns by updating its parameters, after getting the value of the deviation of output value to true value



How does the network **learn?**

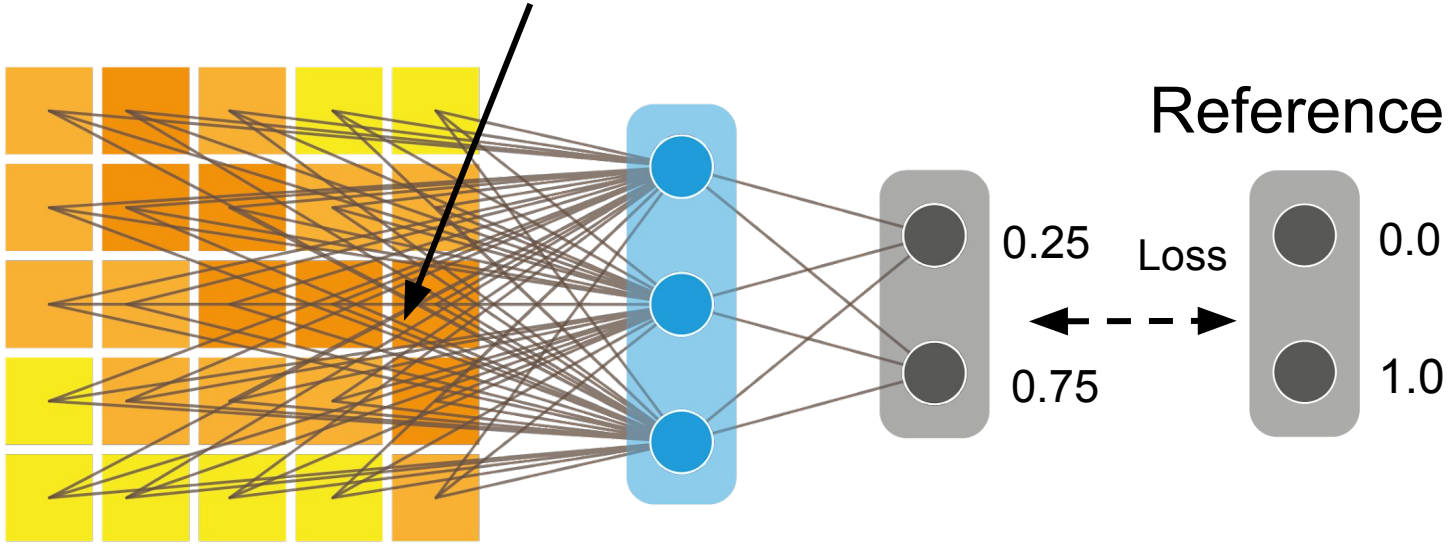
$$\frac{\delta \text{ loss}}{\delta w} =$$

Contribution of weight *w* to loss

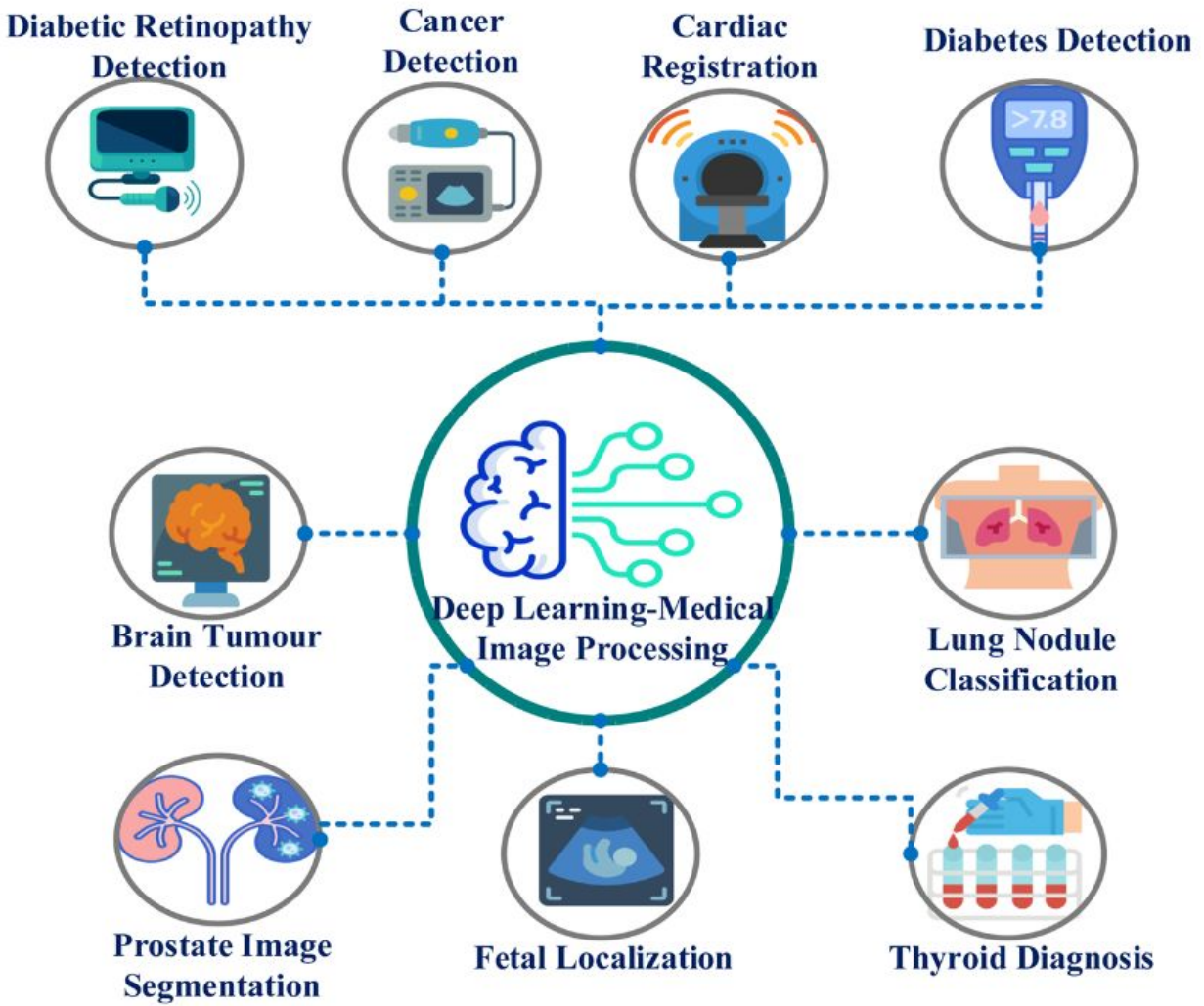


How does the network **learn?**

Update rule: $w_{\text{new}} = w_{\text{old}} - \text{LR} \cdot \frac{\delta \, \text{loss}}{\delta \, w_{\text{old}}}$



Applications of **Deep Learning** in **Medical Image analysis**



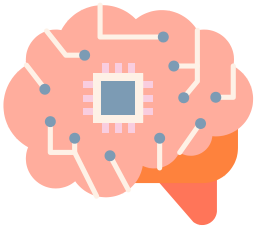
Advantage and Disadvantage of **Deep Learning**

Pros:

- **High learning** capacity of patterns or trends
- Adapts **to various input types**
- **Huge scopes** in other fields

Cons:

- Prone to **overfitting**
- Needs **huge amount of data**
- **Invariance** must be learned



Thank you

Any questions?