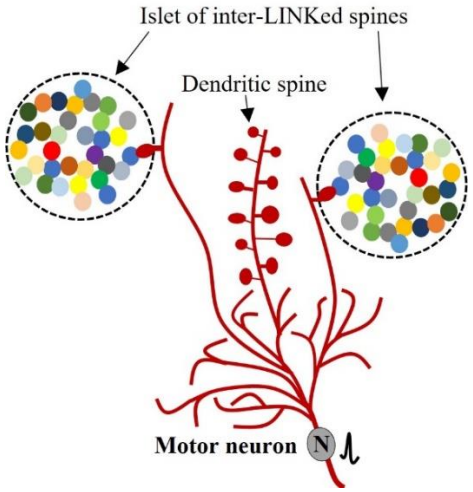
Dear student, Hope you will be able to imagine some things. Let us figure it out.

Imagine that you are walking through a forest of mango trees, each tree producing a particular-colored mango on them. Tree branches are full of mangoes. The distance between mangoes is more than the size of a mango. Usually, there is one mango on one stalk (pedicel). Also imagine a huge forest of mango trees hanging up in the air whose root tips are coming and touching on the mangoes that you are seeing while walking through the forest. The tip of each rootlet from the trees above you (in the air) touches only one mango from one tree in the forest. Wha! What a wonderful scenario! Neurons in the brain are like these mango trees. But there is a major difference. To get sunlight, the branches of mango trees on Earth usually do not touch each other. But in the brain, branches of neuronal trees go in between the branches of other neuronal trees. So, there is a huge overlap between mango tree branches. Hope you are with me.

Now, we were thinking that memories are stored at the junction where the rootlet of the trees in the air meet with the mangoes on the trees on Earth. But I found a problem. To explain all the features of the brain, this type of connection alone is not sufficient. In addition to the above connection, there should be another connection. The branches of many mango trees overlap and so mangoes of different colors (from different trees) touch each other. When we learn something, there must be some changes occurring at the location where the skins of mangoes of different colors (that belong to different trees) touch each other. We can see groups of many different colored mangoes touching each other. At these locations, many related memories can be stored.

In neuroscience, we see mango-like structures (dendritic spines) from different tree-like structures called neurons touching each other when we do electron microscopy. But we have not yet proven that there will be some changes occurring between the skins of these mango-like structures when we learn. When artificial intelligence (AI) scientists tried to use this concept of mango-like structures interacting with each other in mathematical terms (using linear algebra), they got good AI. By keeping more mangoes in groups, and by training them more, they are getting better AI. Now that we are getting AI when we make the mangoes (dendritic spines) of different colors from different trees (neurons) interact, we can assume that the brain must also be working in the same manner. Now we must study interactions between dendritic spines of different neurons in the brain. Bottomline: Sometimes, science takes a long route to find solutions to some problems!

Now look at the figure below to see a mango tree with red mangoes in the middle branch. One left and right branches have only one mango each on them; but their outer skins are touching with mangoes of different colors from different trees. This form two large groups of interacting mangoes shown inside two large circles drawn using dotted lines.



Now see the mathematics – linear algebra – matrix stuff. It is a little bit difficult for you to understand. But see 4 groups of mangoes of different colors (drawn in 4 circles) correspond to 4 different entries (which are shaded) in a 4x4 matrix. I hope you can see the similarities.