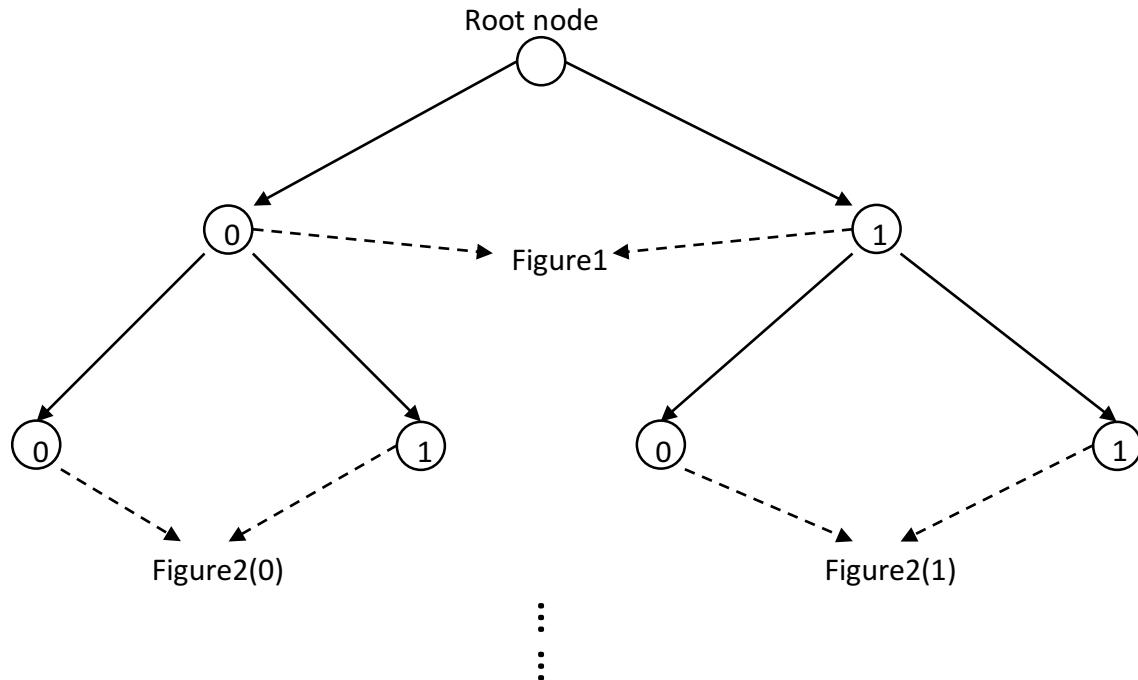


## 1. $8 \times 8$ overlapping blocks in each image

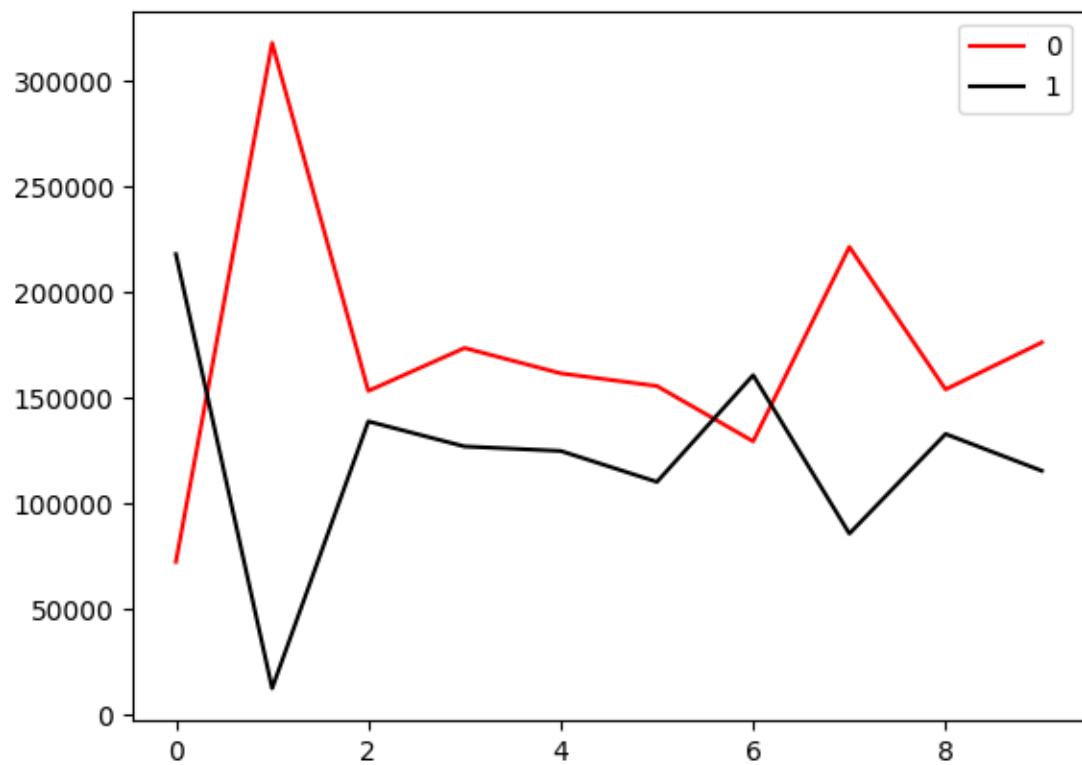
For this experiment, I utilized the hierarchy k-means algorithm to cluster all  $8 \times 8$  overlapping blocks from all images and each image has 49  $8 \times 8$  blocks. I plotted the number of the blocks from “0” to “9” images for each node, and to make it clear and easy to compare, I plotted the two children nodes from their parent node. “0” means the left child and “1” means the right child. For example, the figure named “Figure\_3(00)” means the parent node is the third layer and is the left child of the left child of the root and the figure shows the two children nodes of that parent node.

However, it seems that it is very hard to get pure nodes using this method and all nodes are mixed. I will show all the figures below.



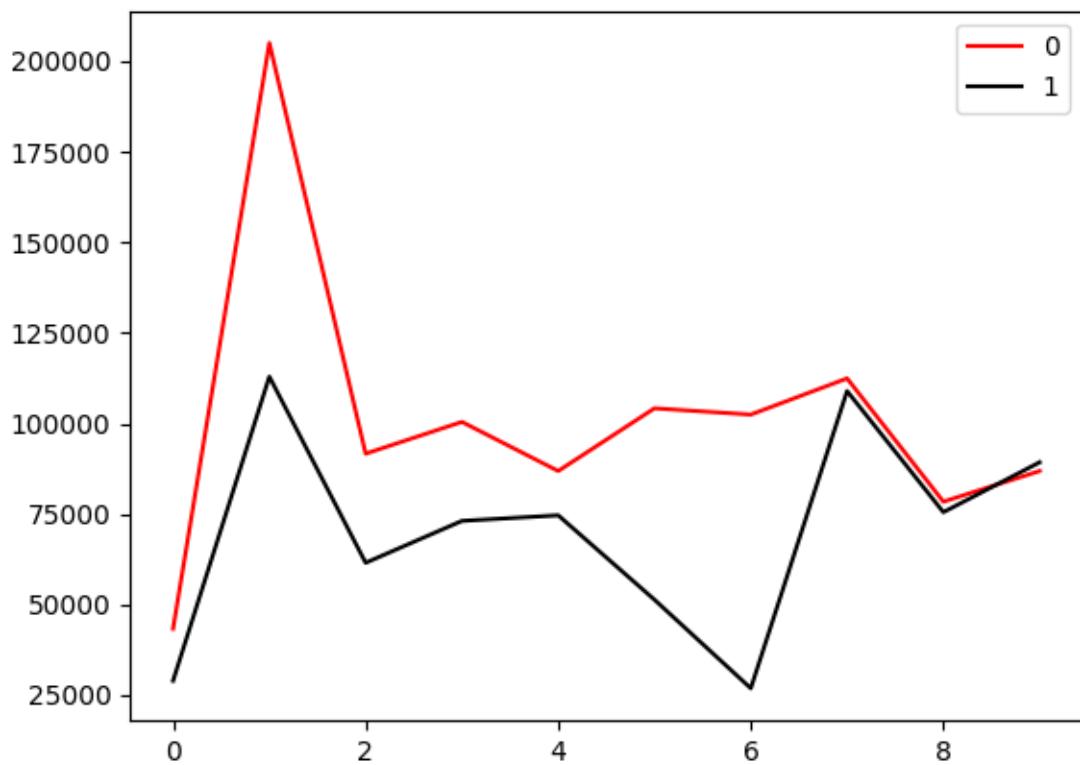
**The 1<sup>st</sup> layer:**

Figure\_1

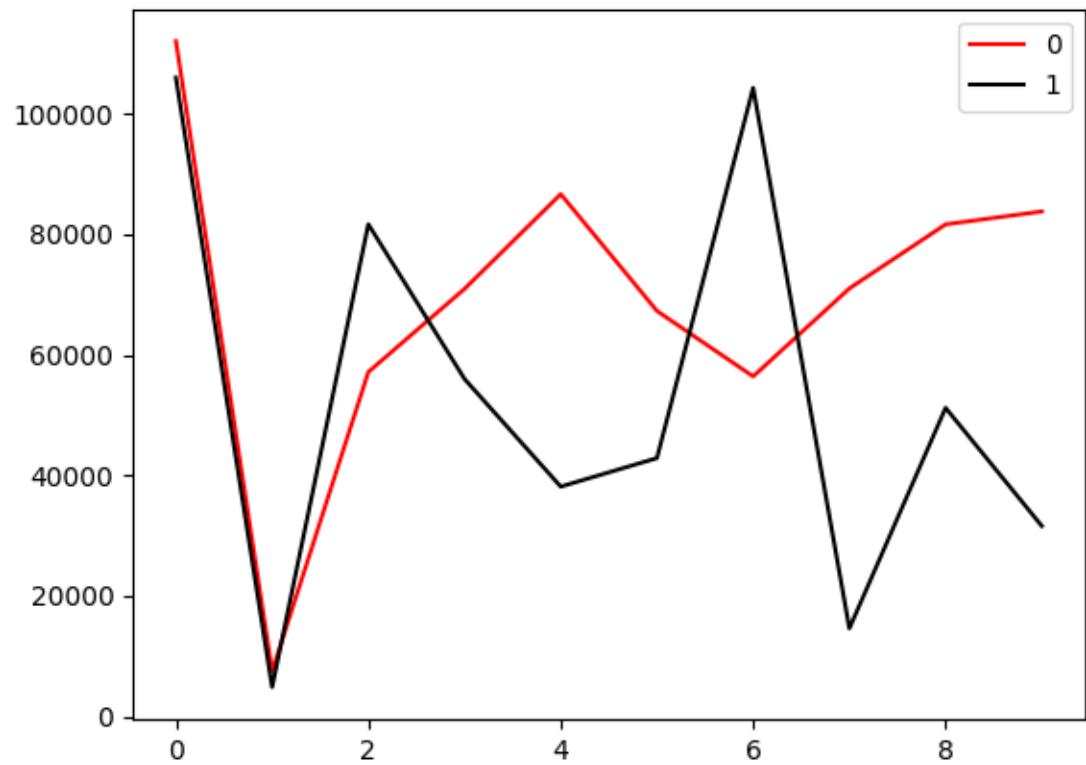


The 2<sup>nd</sup> layer:

Figure\_2(0)

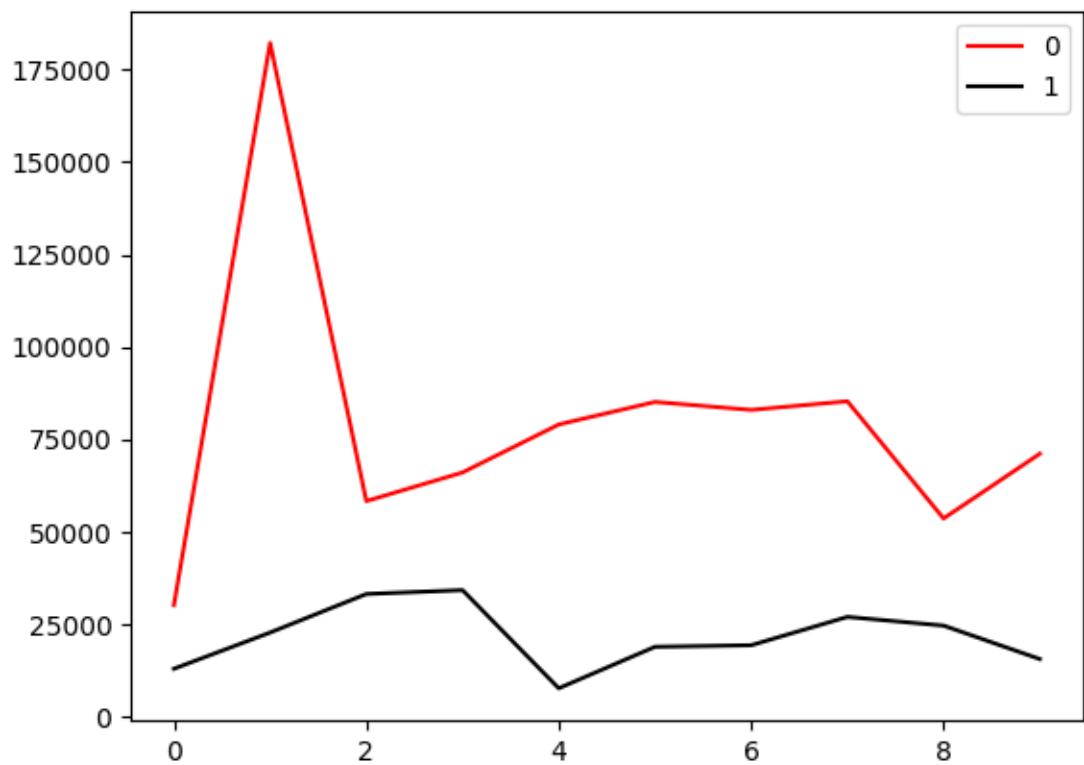


Figure\_2(1)

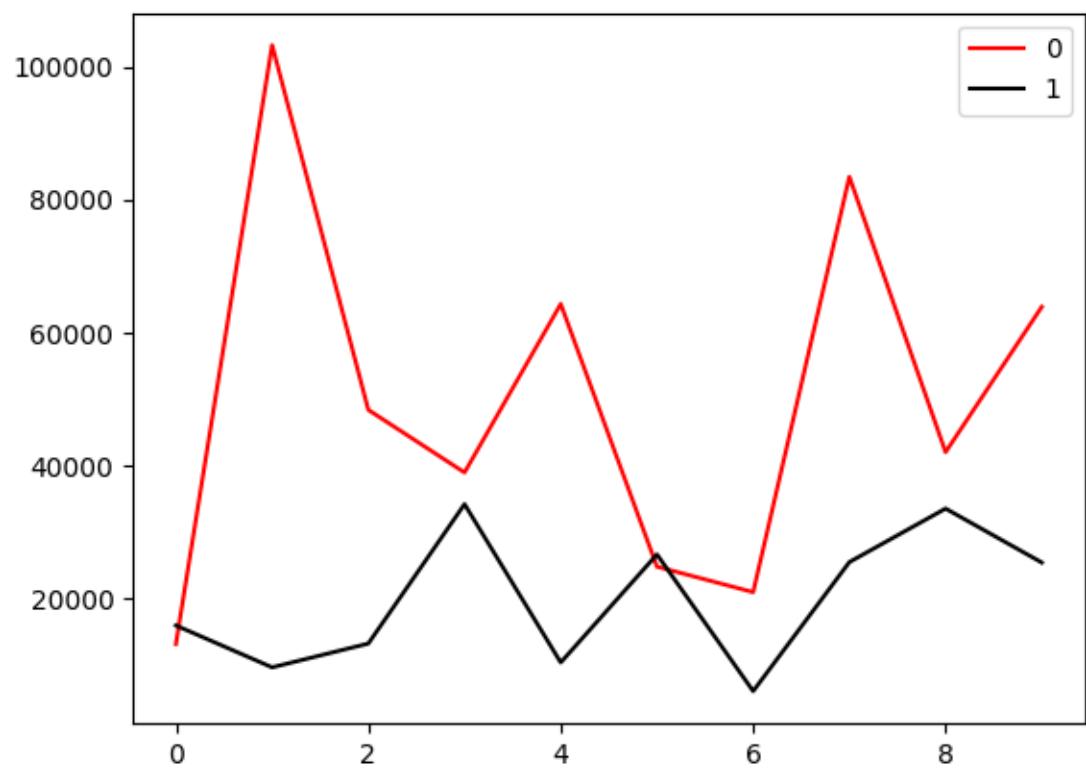


The 3<sup>rd</sup> layer:

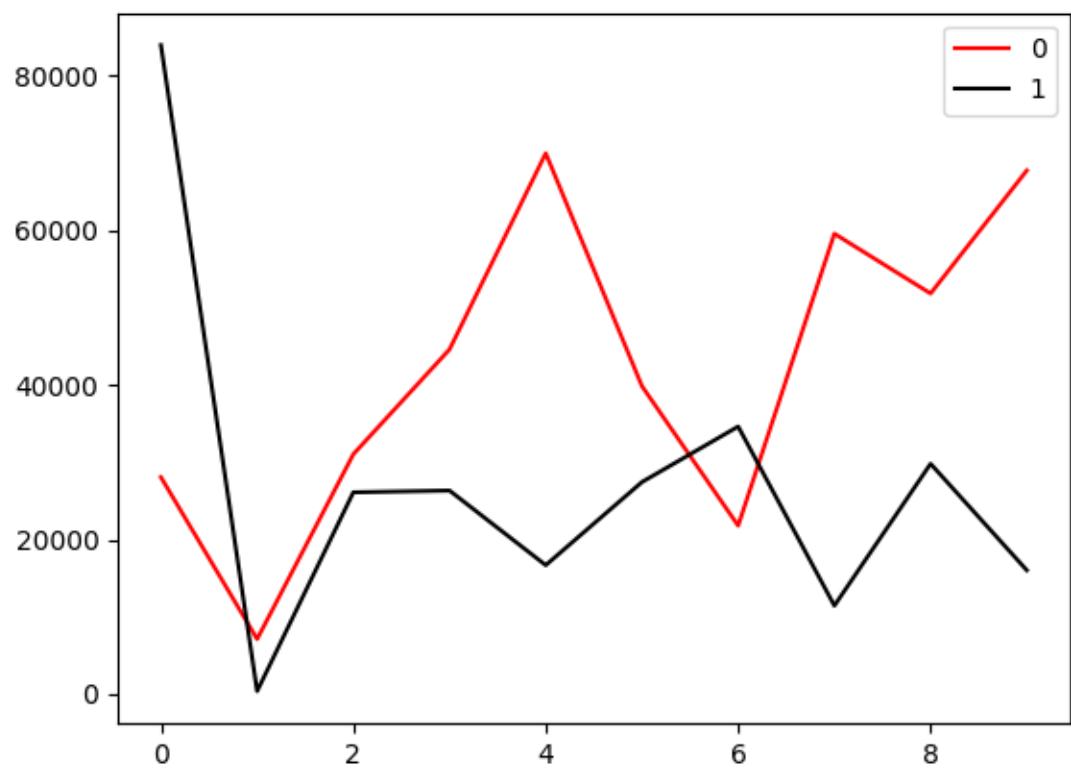
Figure\_3(00)



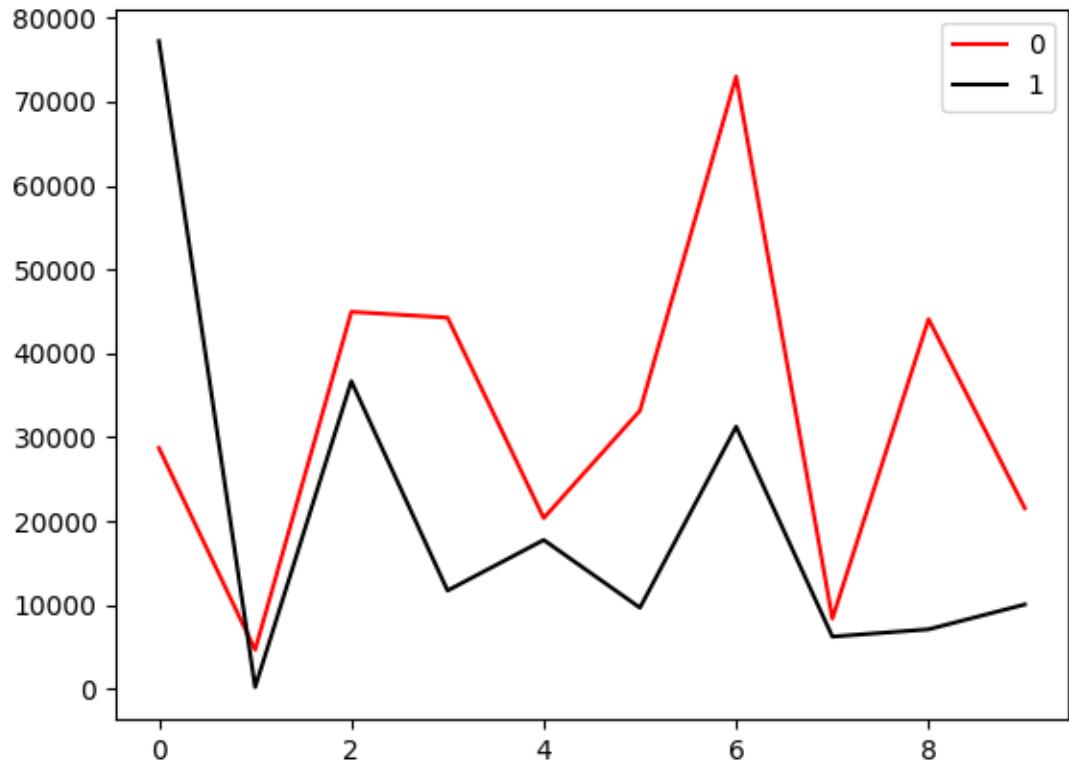
Figure\_3(01)



Figure\_3(10)

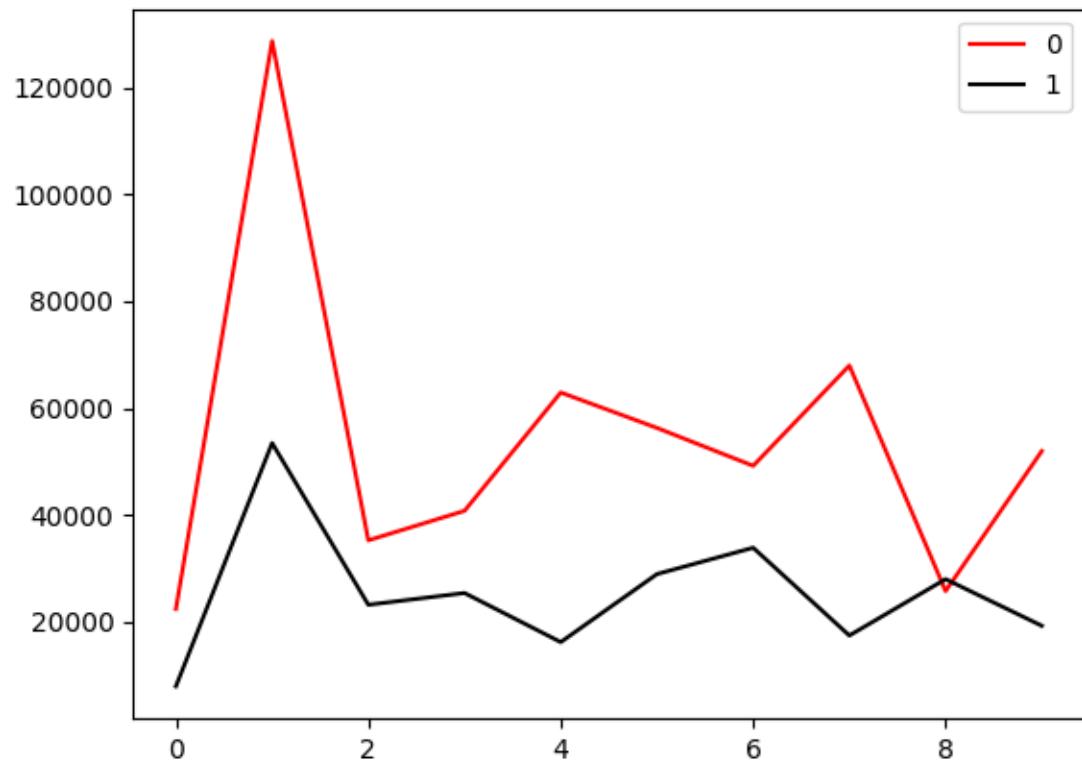


Figure\_3(11)

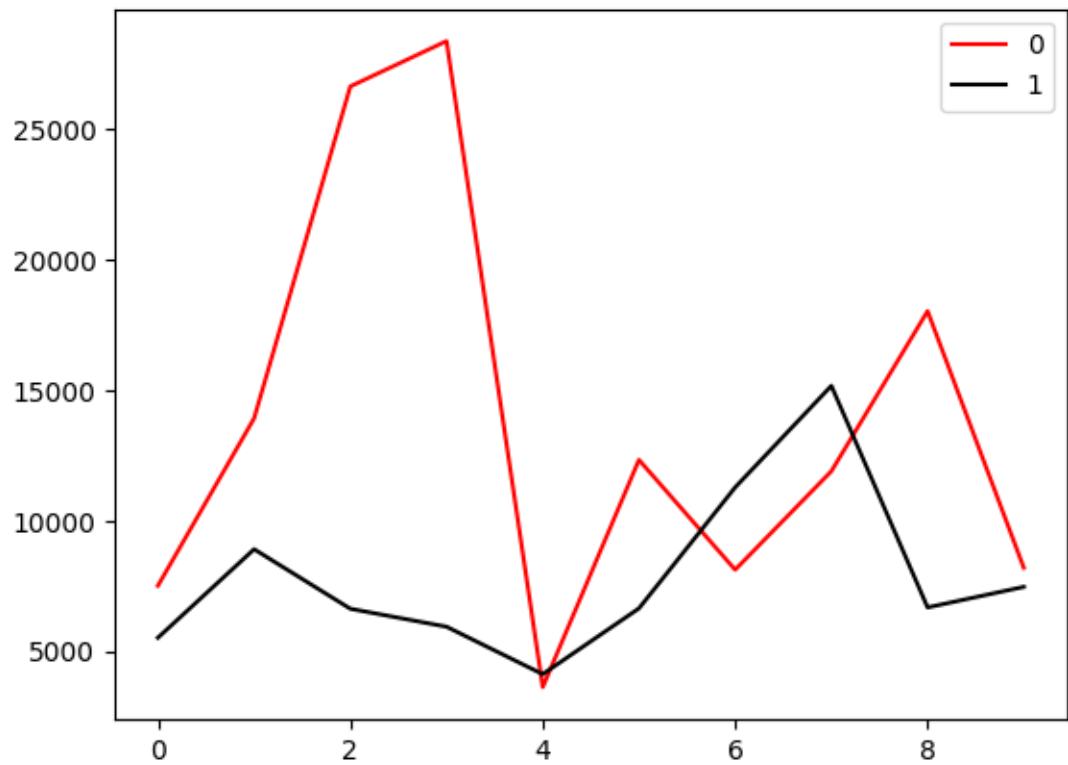


The 4<sup>th</sup> layer:

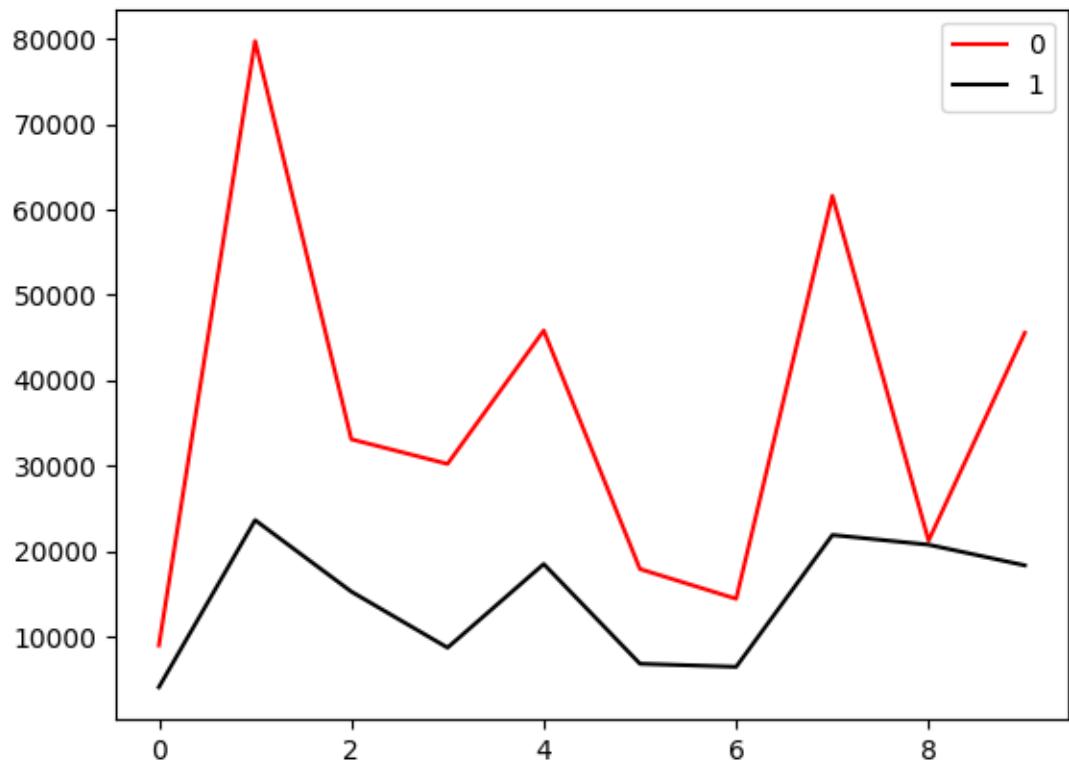
Figure\_4(000)



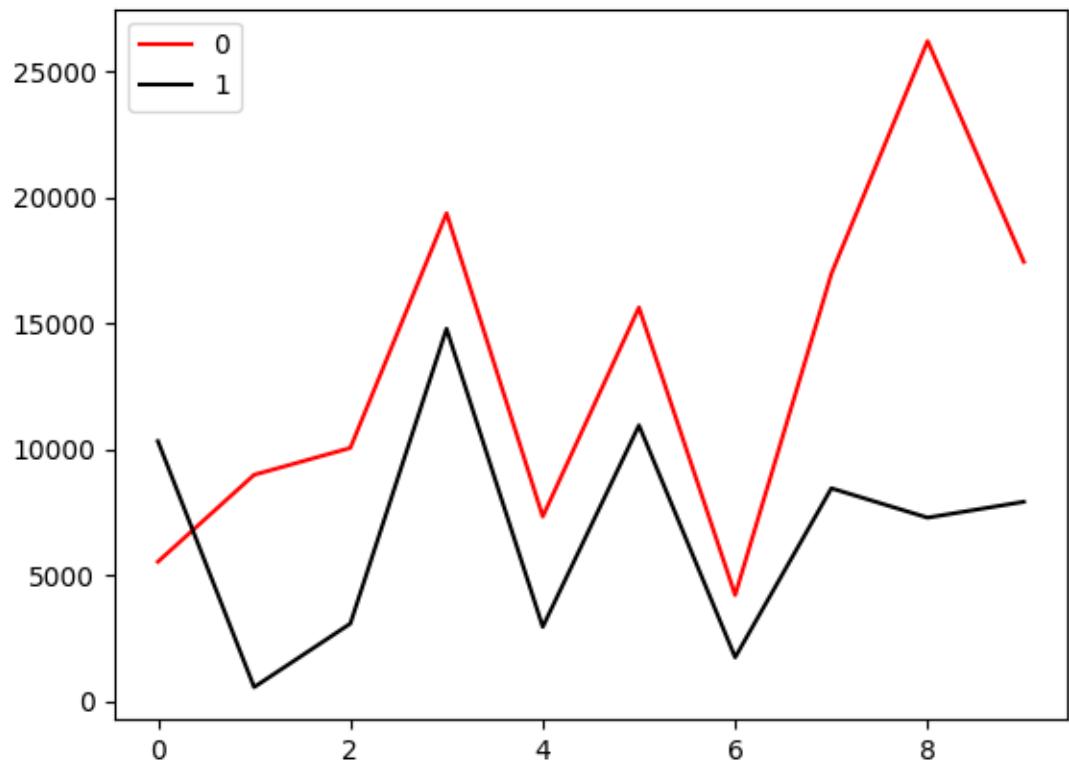
Figure\_4(001)



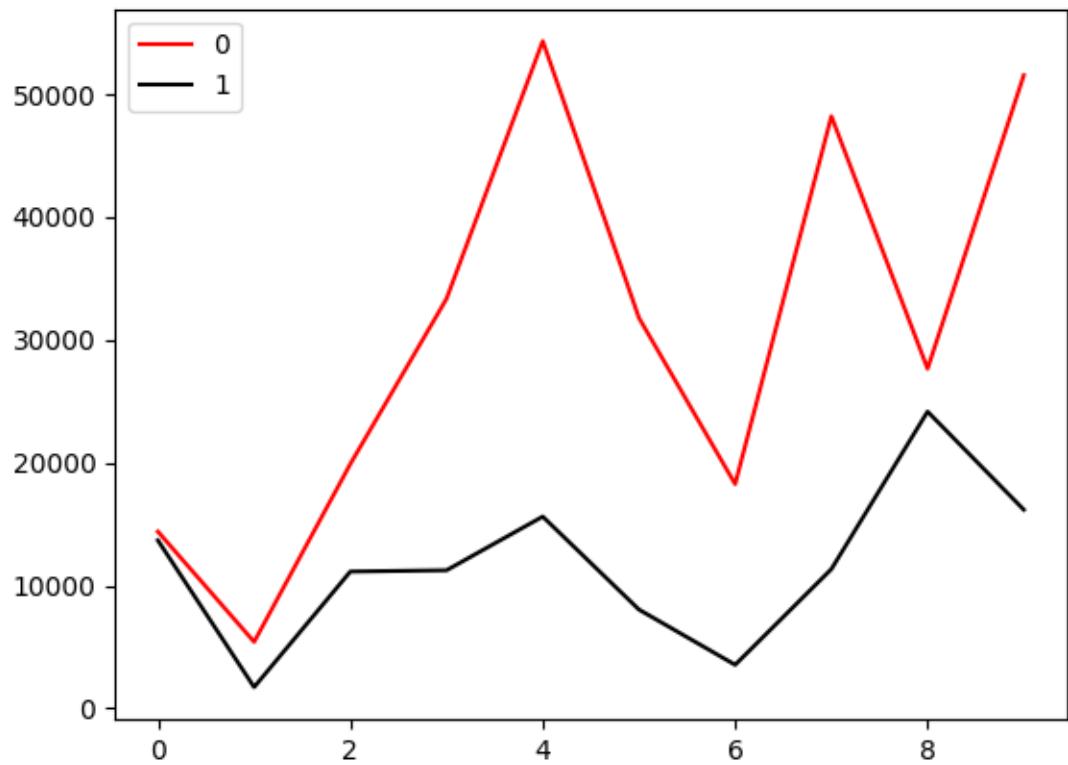
Figure\_4(010)



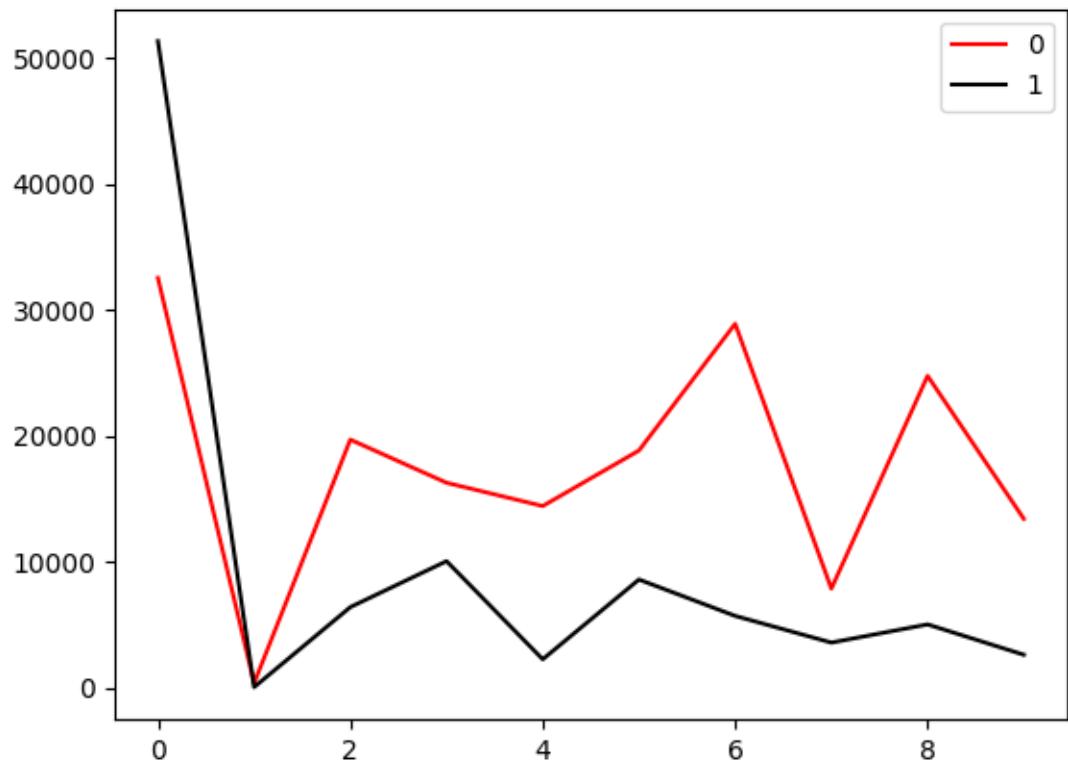
Figure\_4(011)



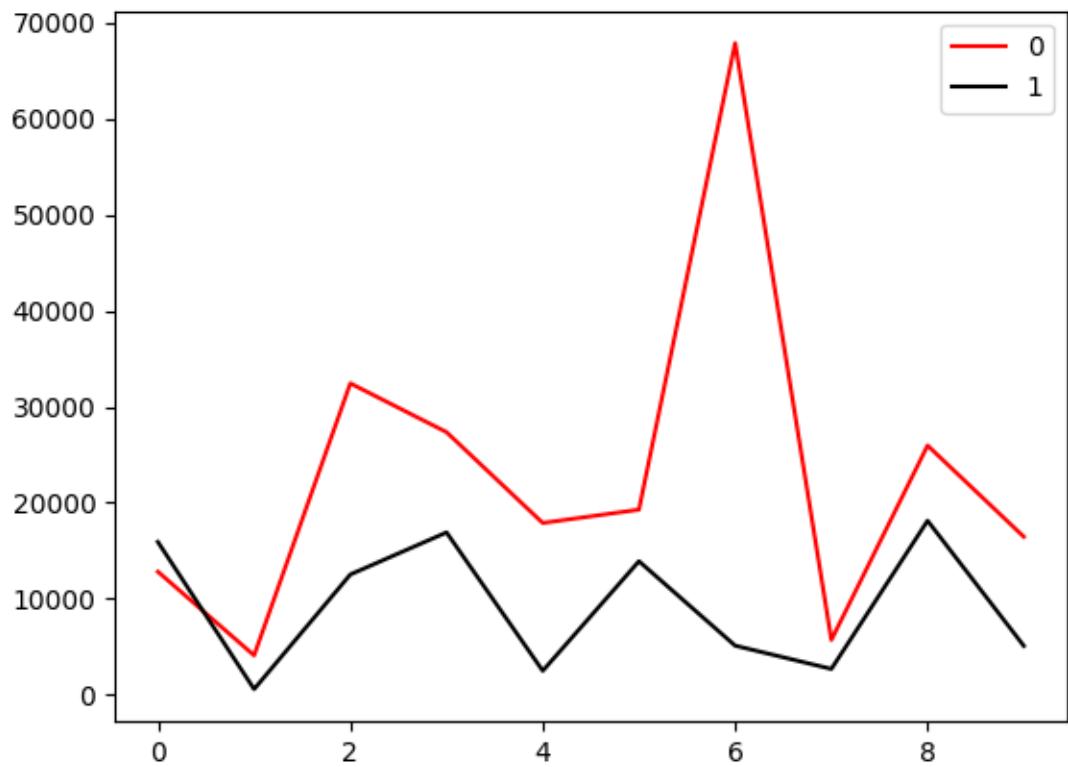
Figure\_4(100)



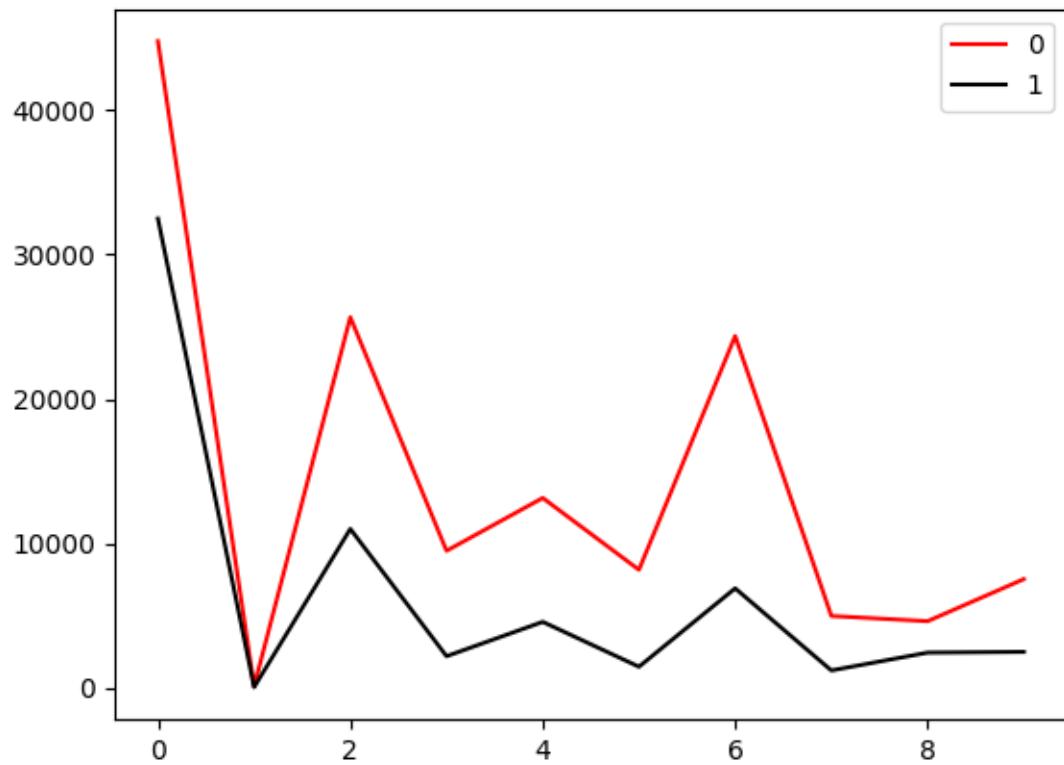
Figure\_4(101)



Figure\_4(110)

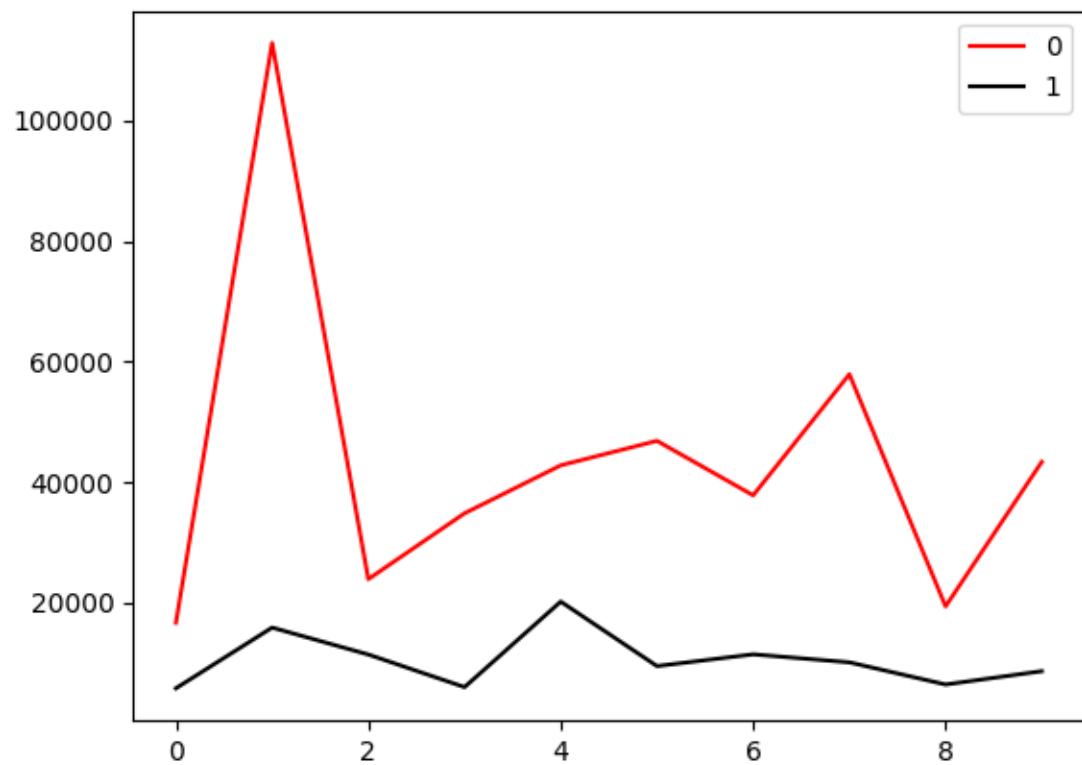


Figure\_4(111)

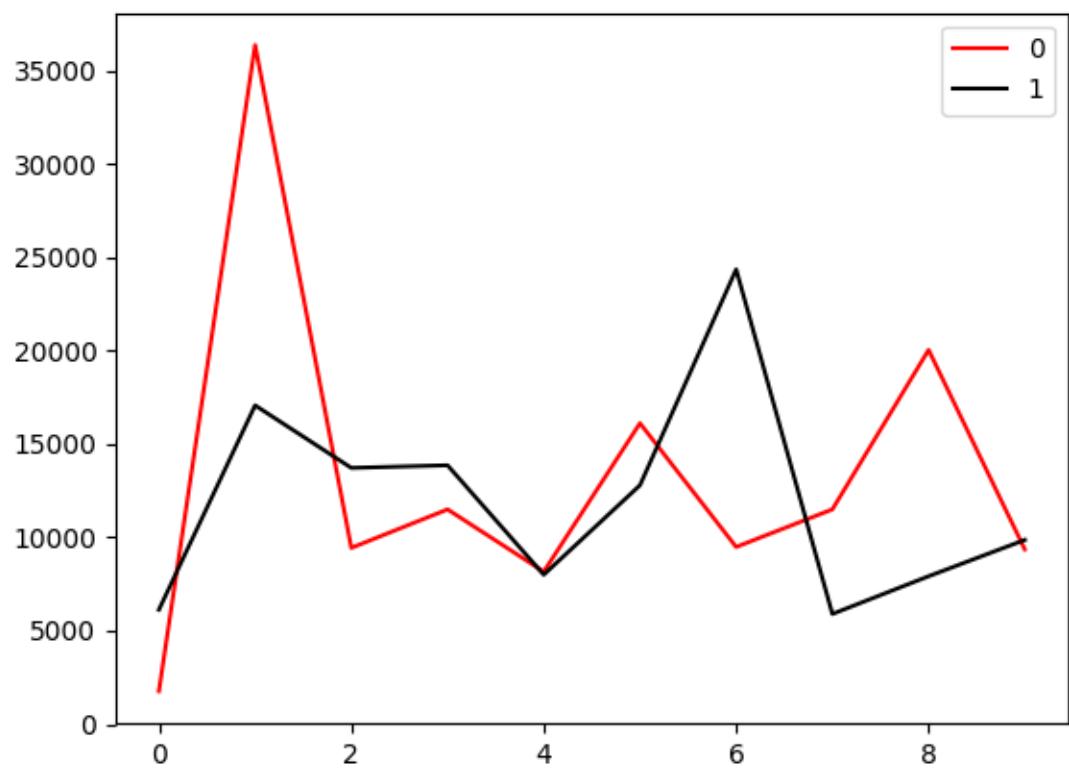


The 5<sup>th</sup> layer:

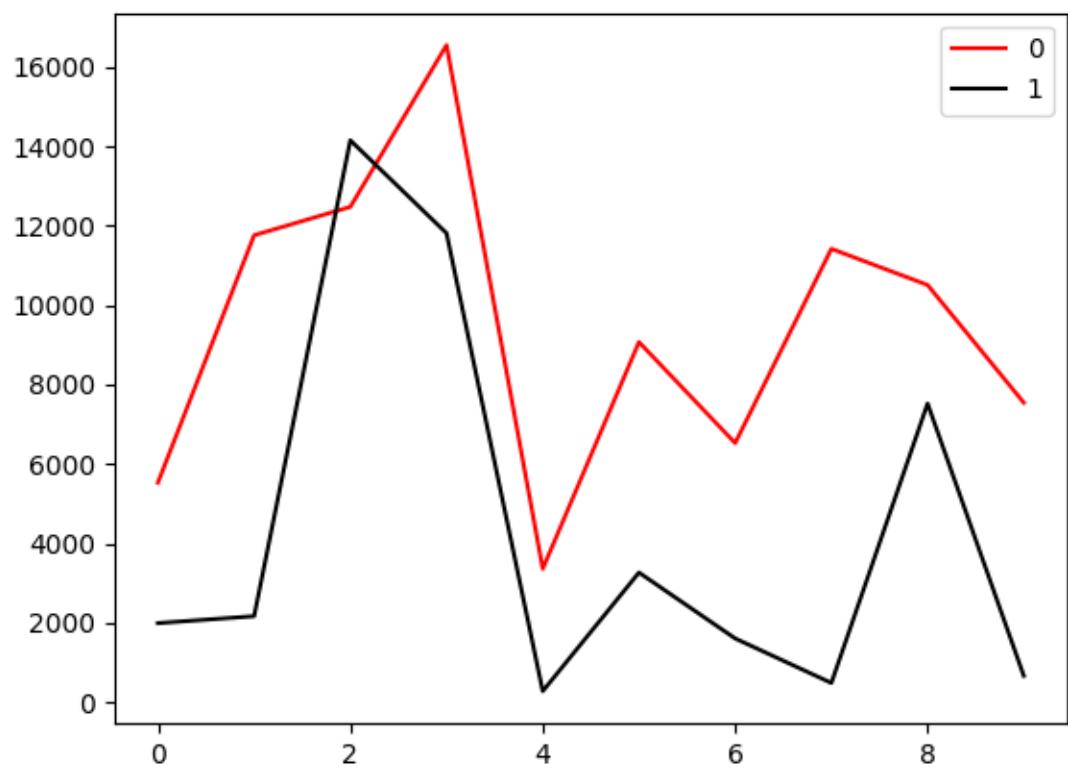
Figure\_5(0000)



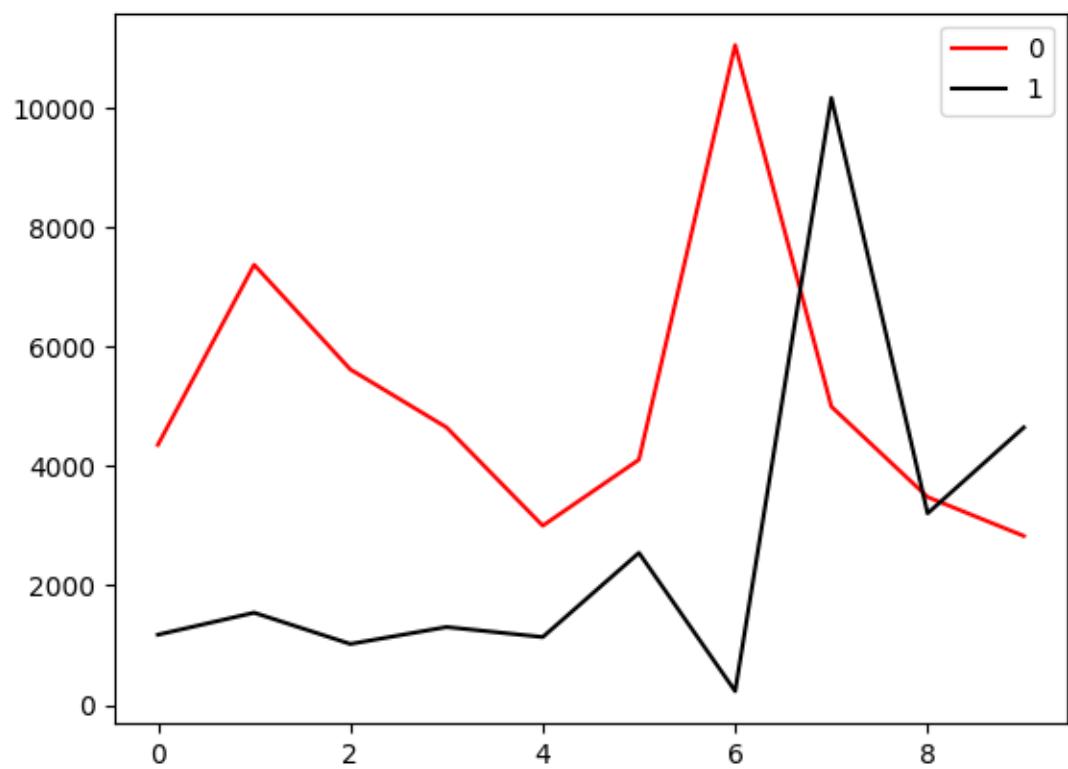
Figure\_5(0001)



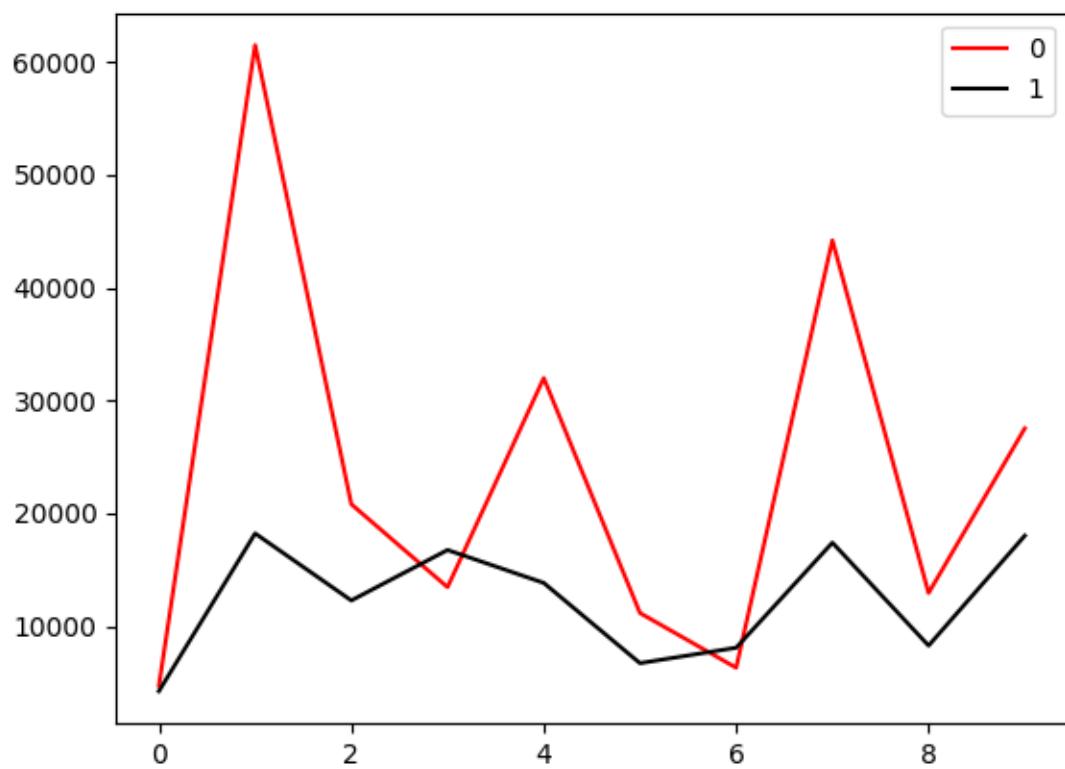
Figure\_5(0010)



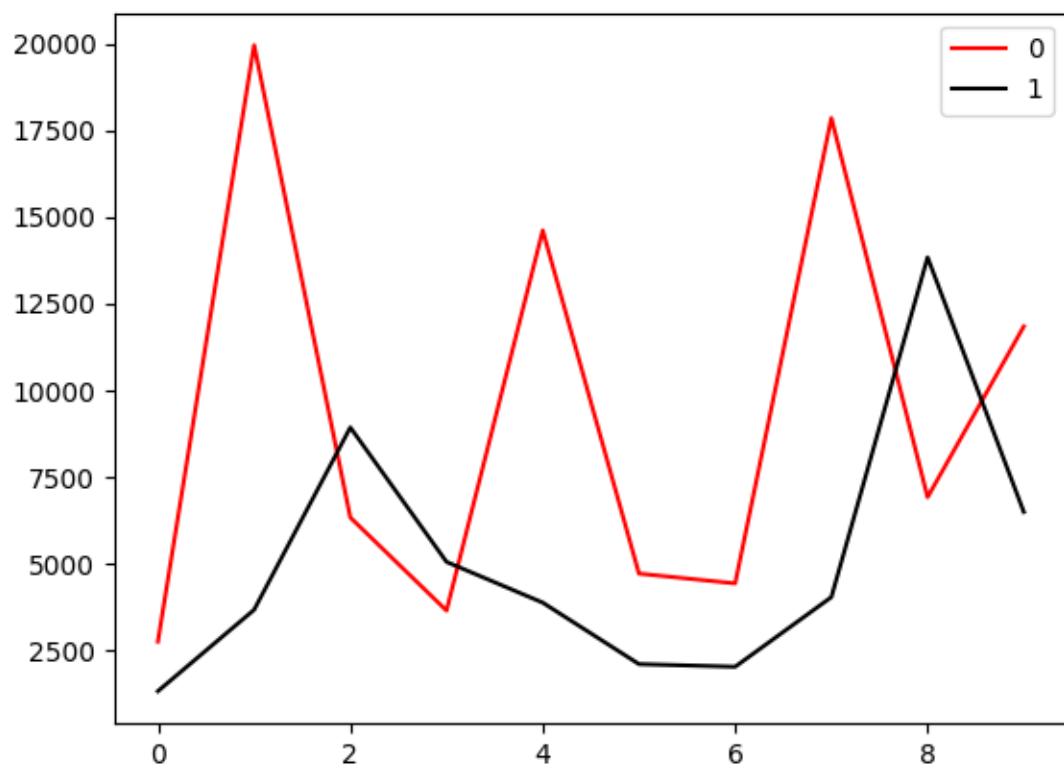
Figure\_5(0011)



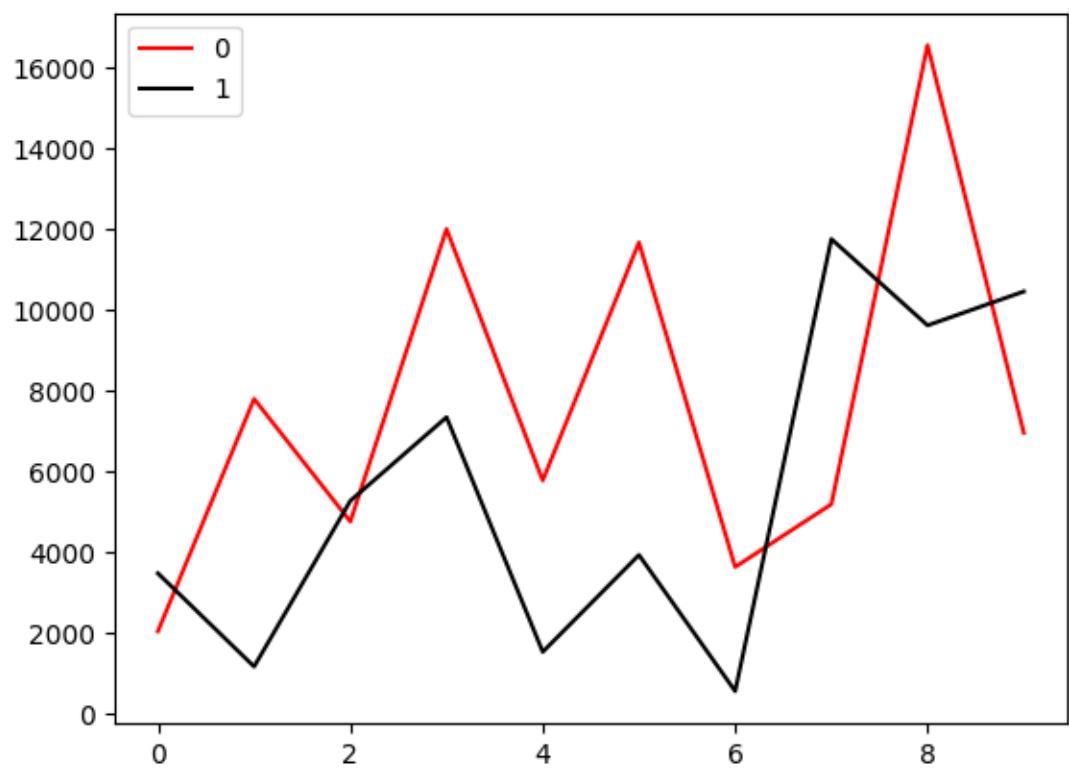
Figure\_5(0100)



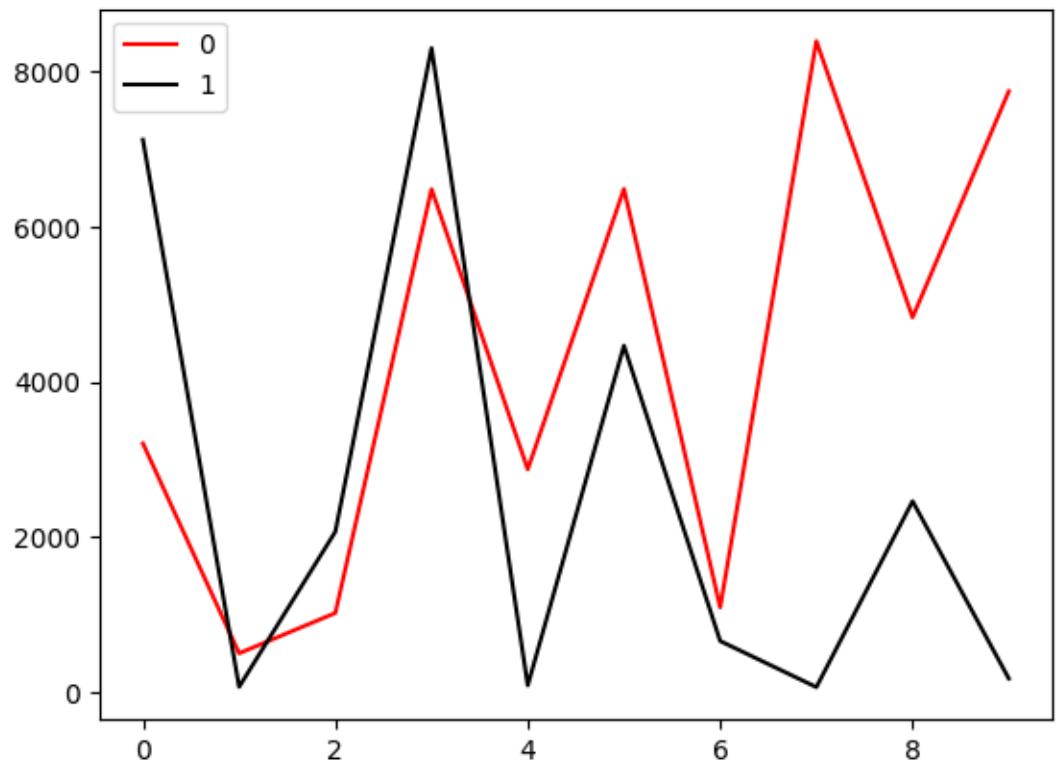
Figure\_5(0101)



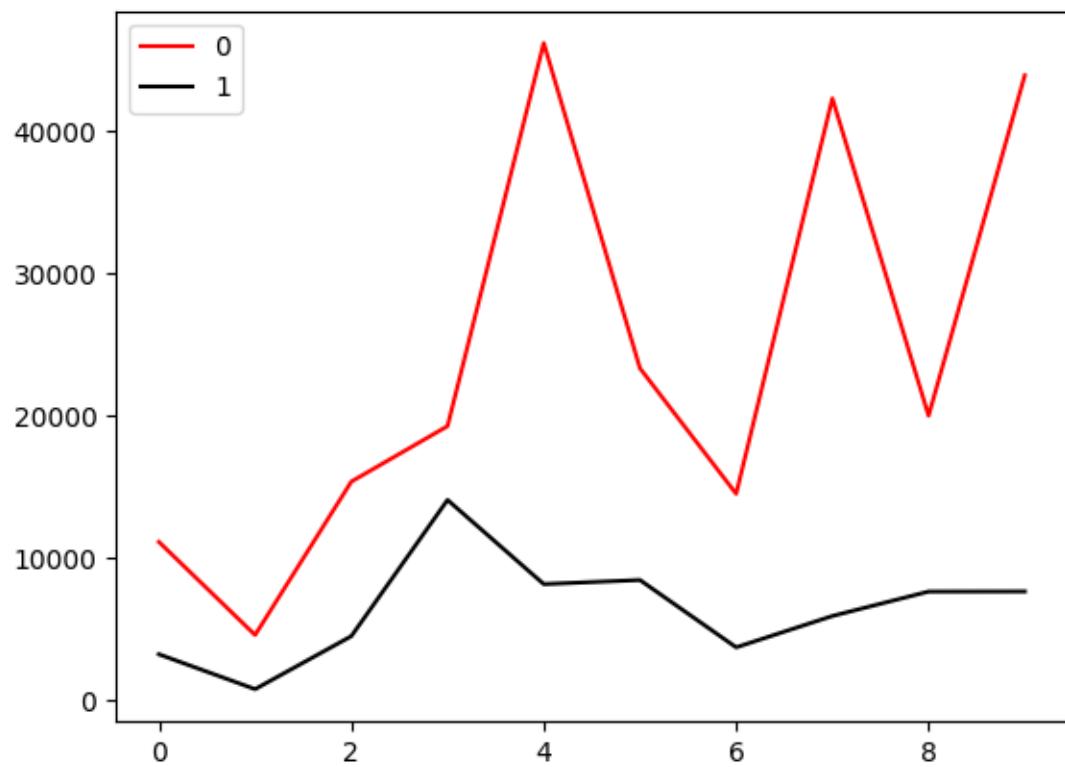
Figure\_5(0110)



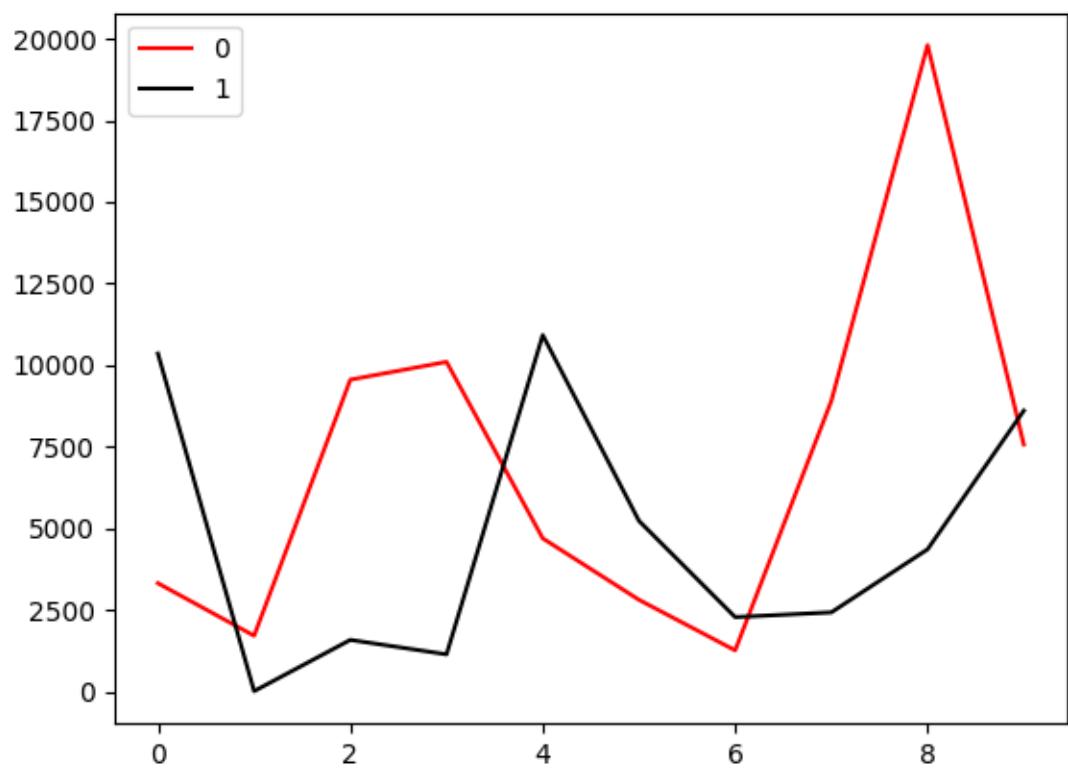
Figure\_5(0111)



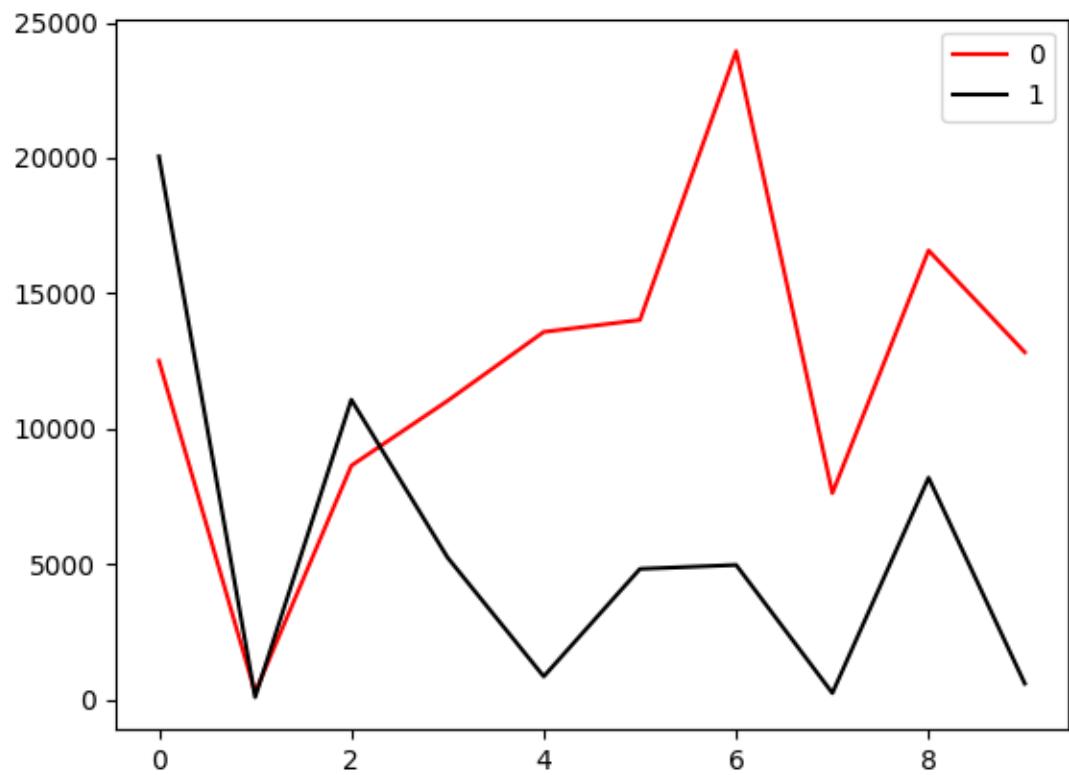
Figure\_5(1000)



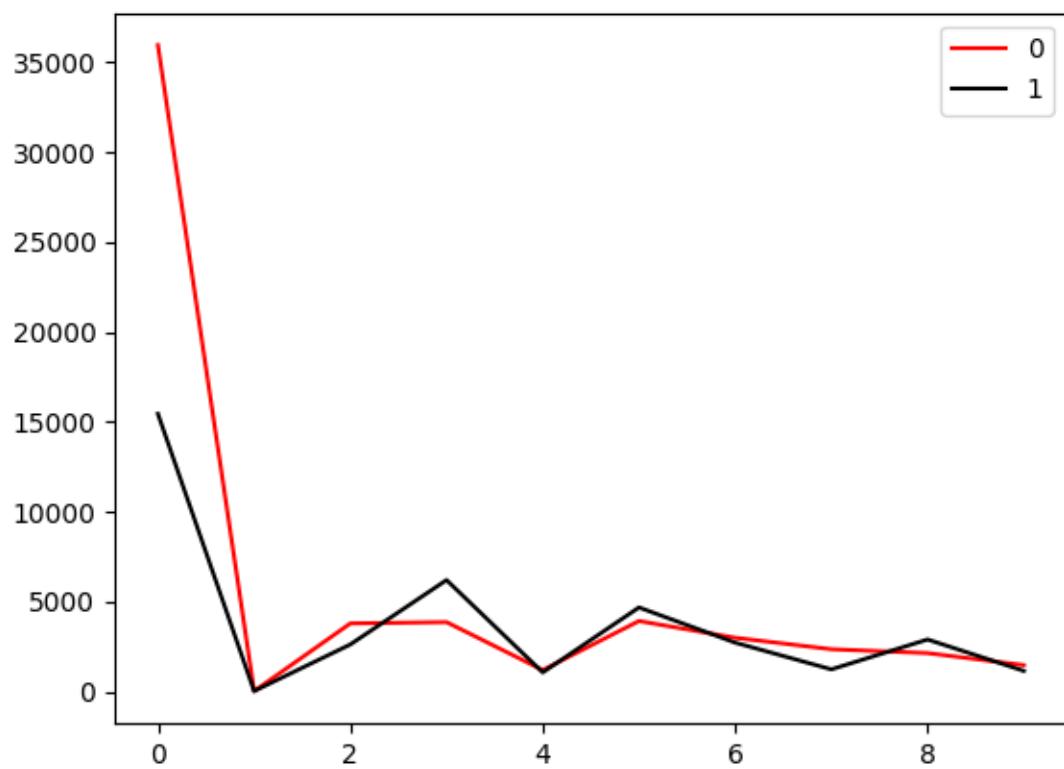
Figure\_5(1001)



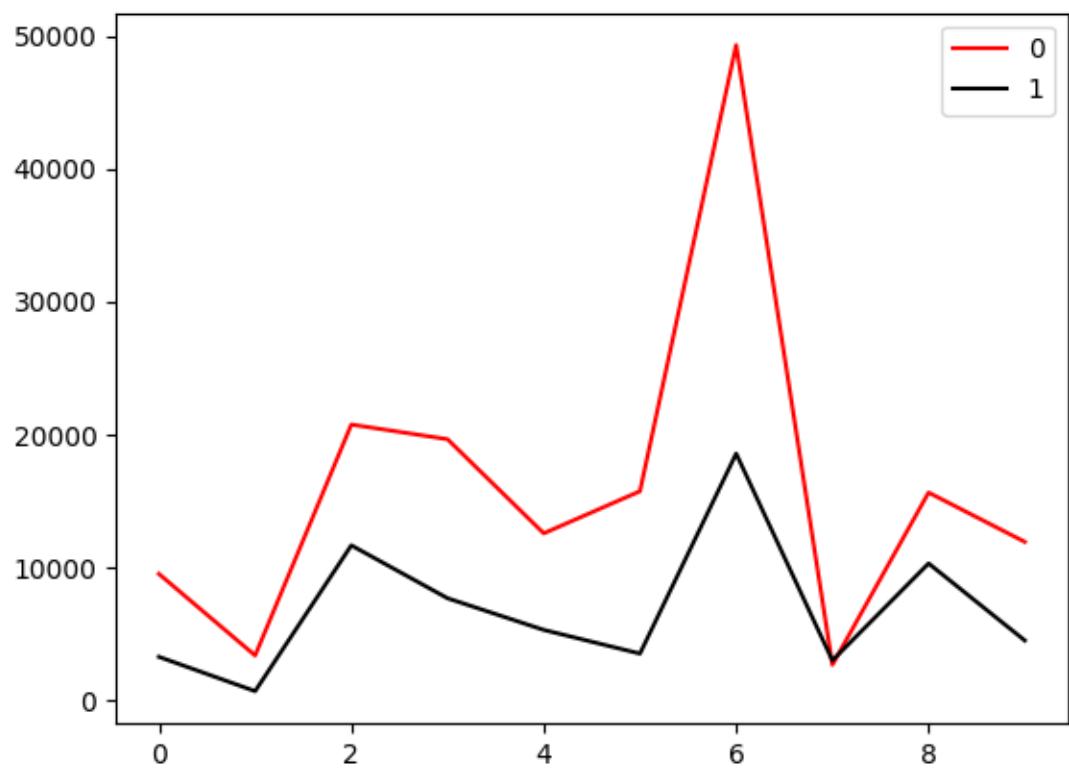
Figure\_5(1010)



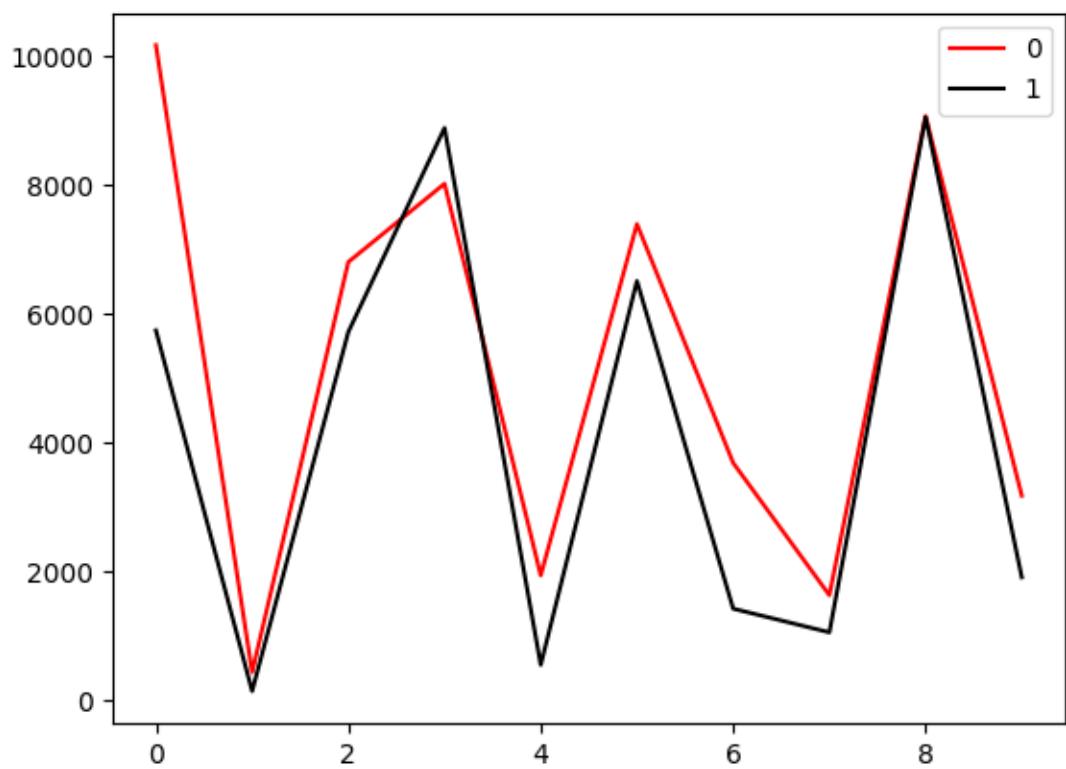
Figure\_5(1011)



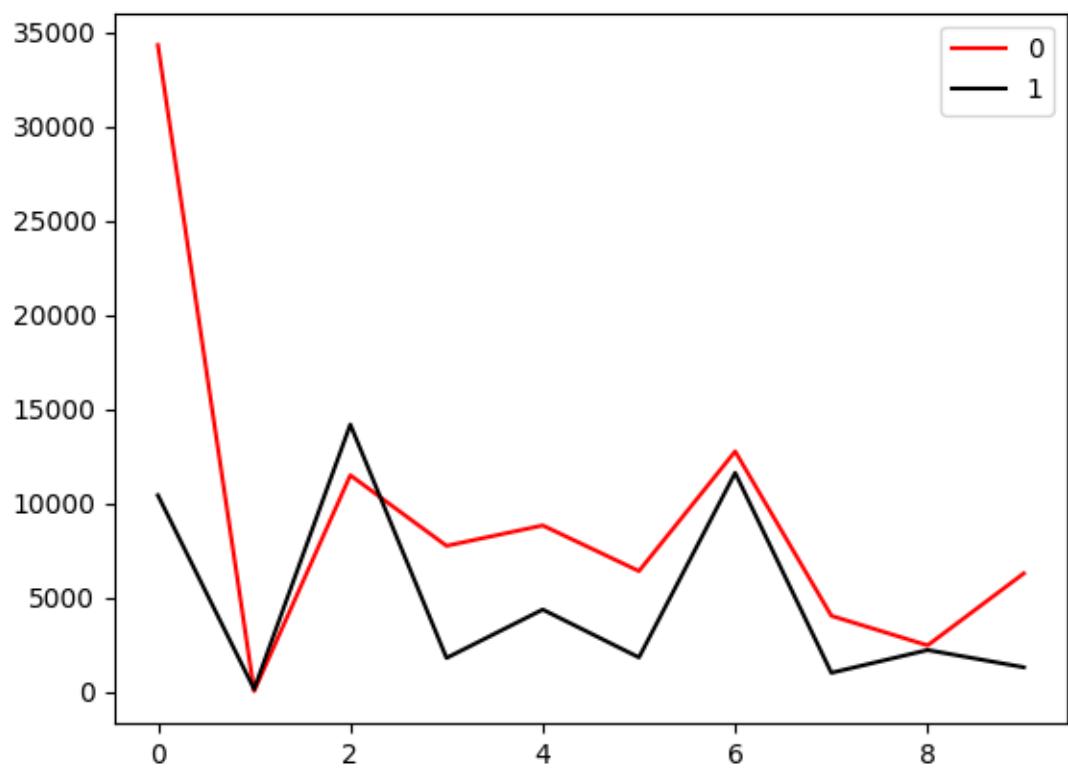
Figure\_5(1100)



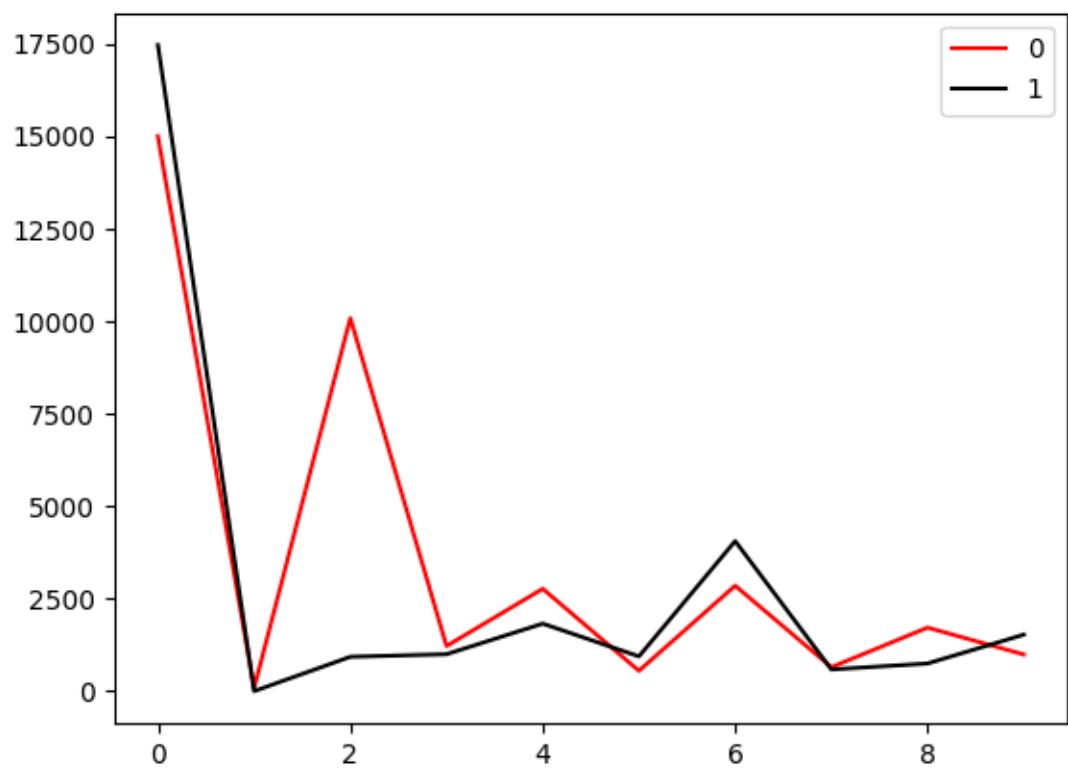
Figure\_5(1101)



Figure\_5(1110)

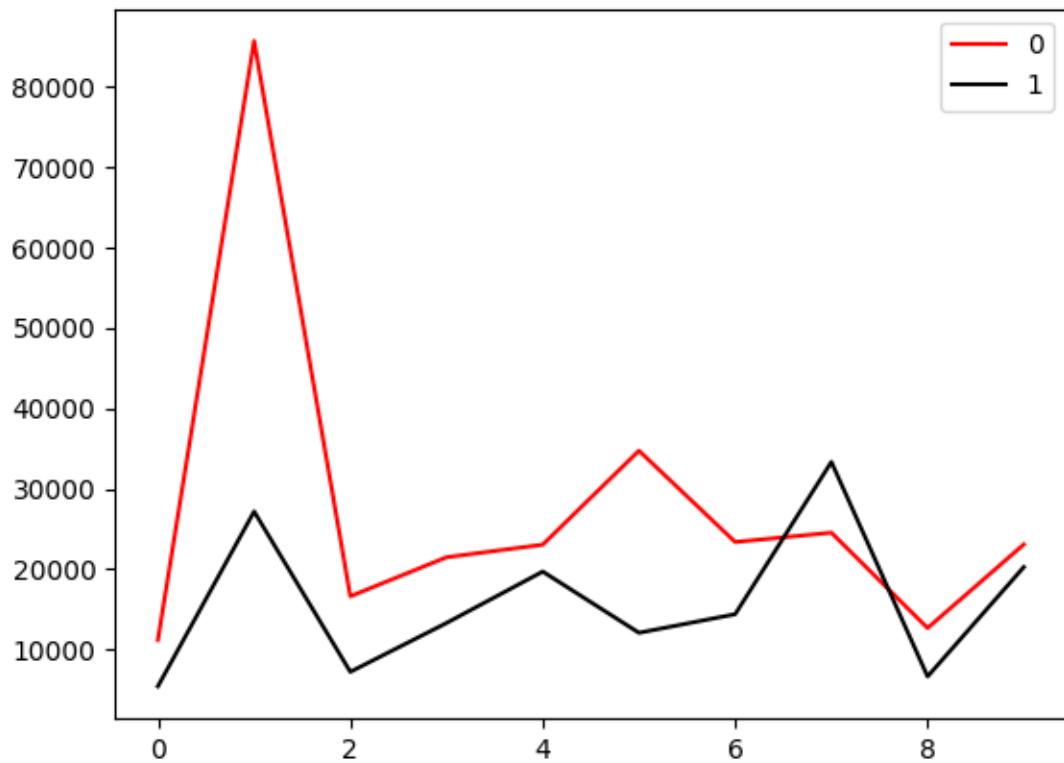


Figure\_5(1111)

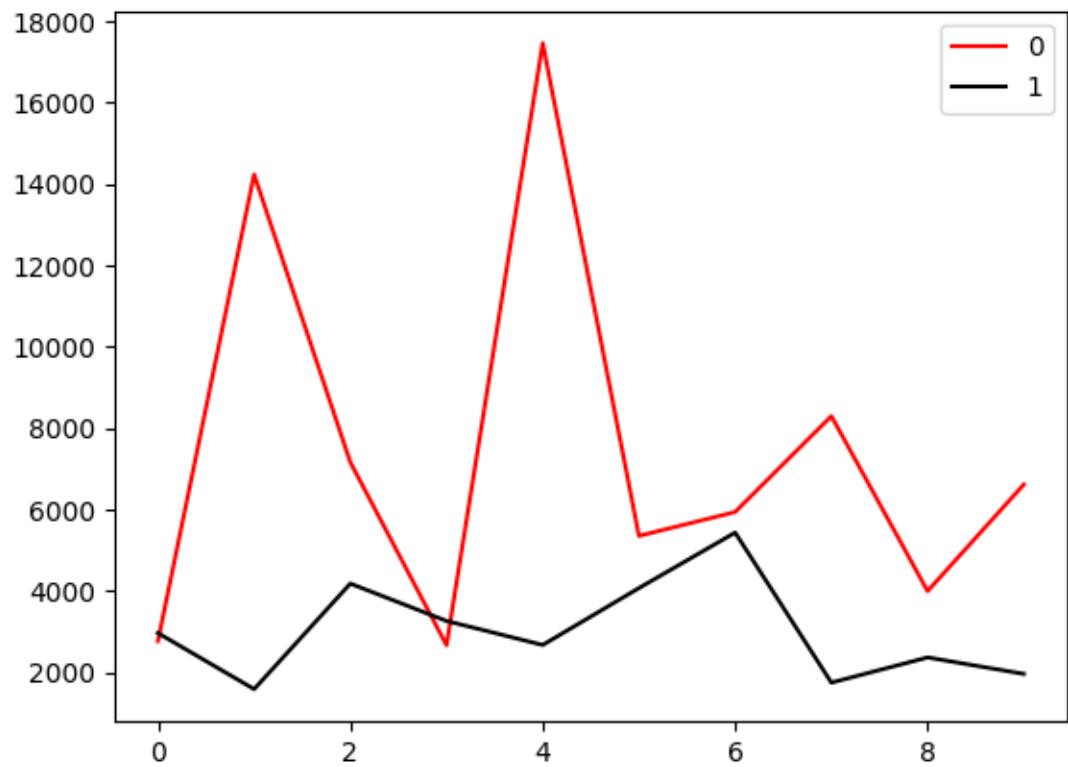


The 6<sup>th</sup> layer:

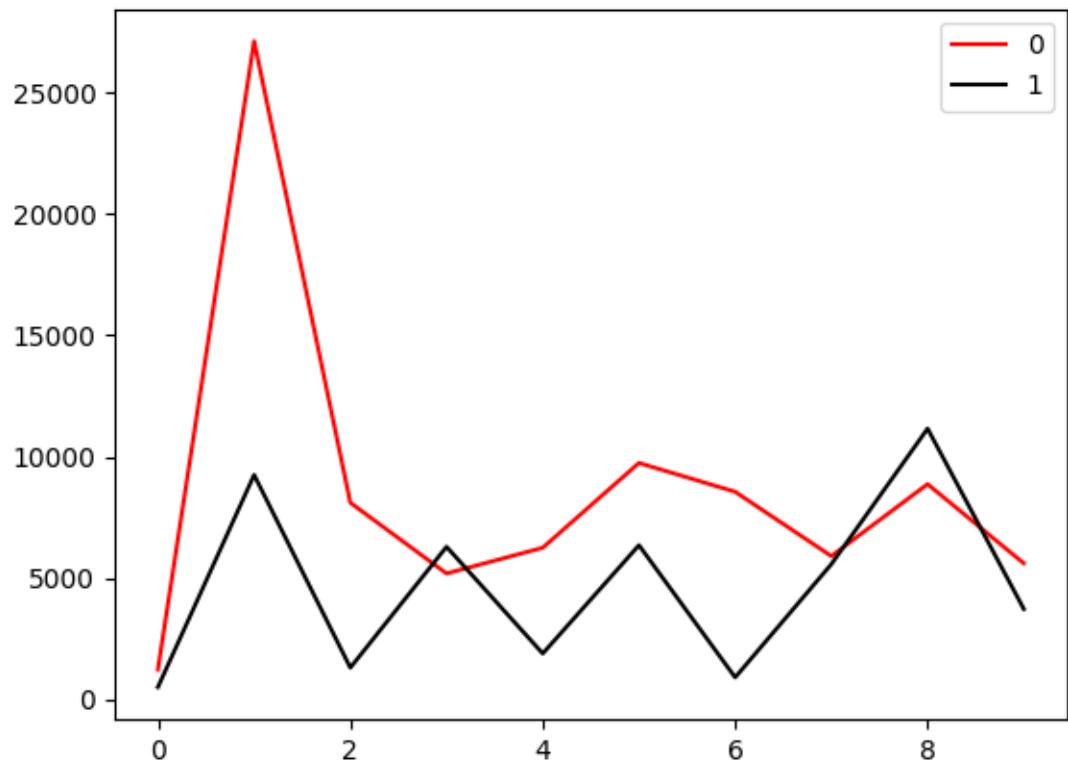
Figure\_6(00000)



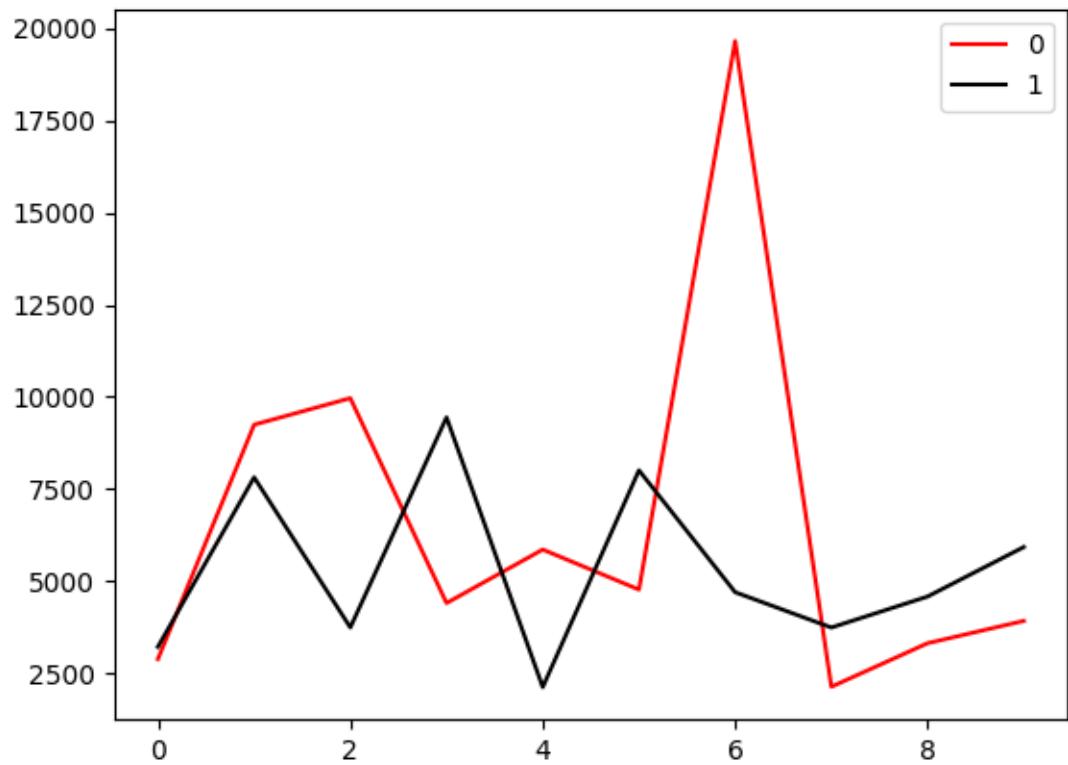
Figure\_6(00001)



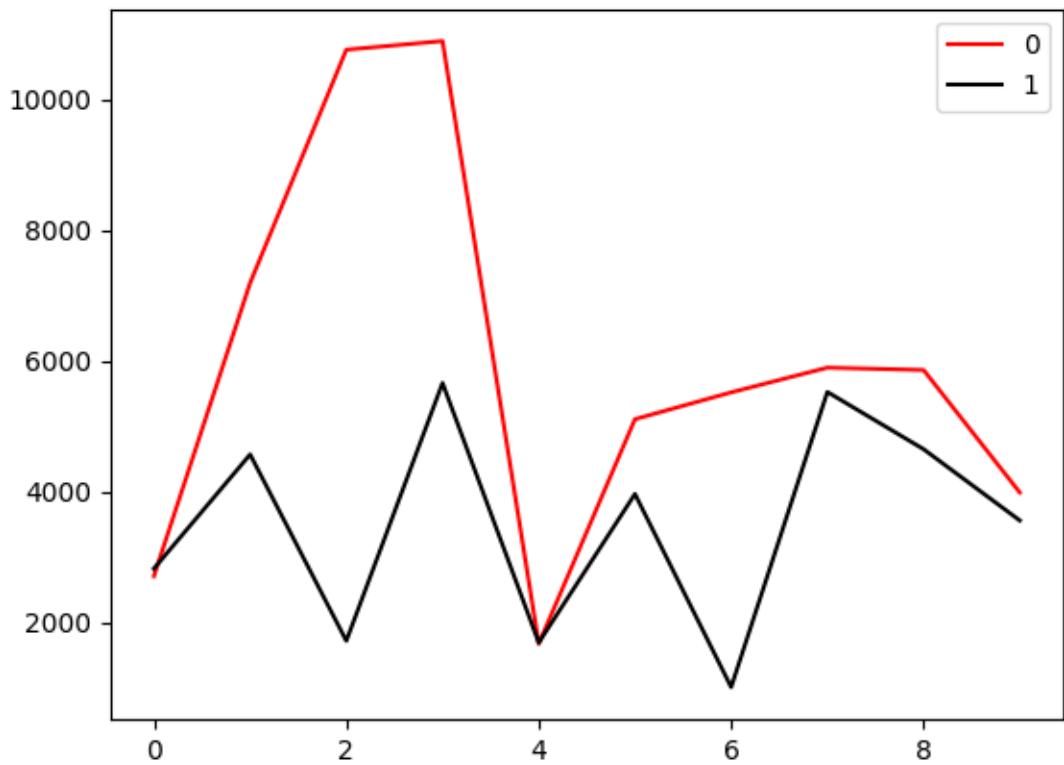
Figure\_6(00010)



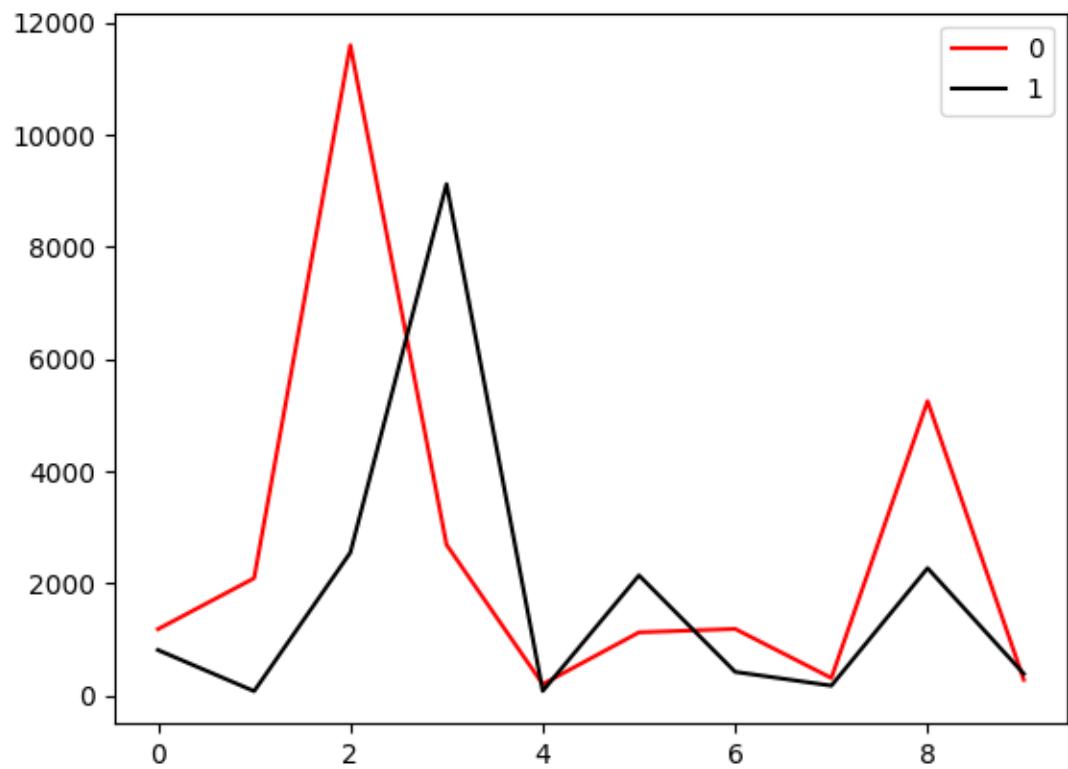
Figure\_6(00011)



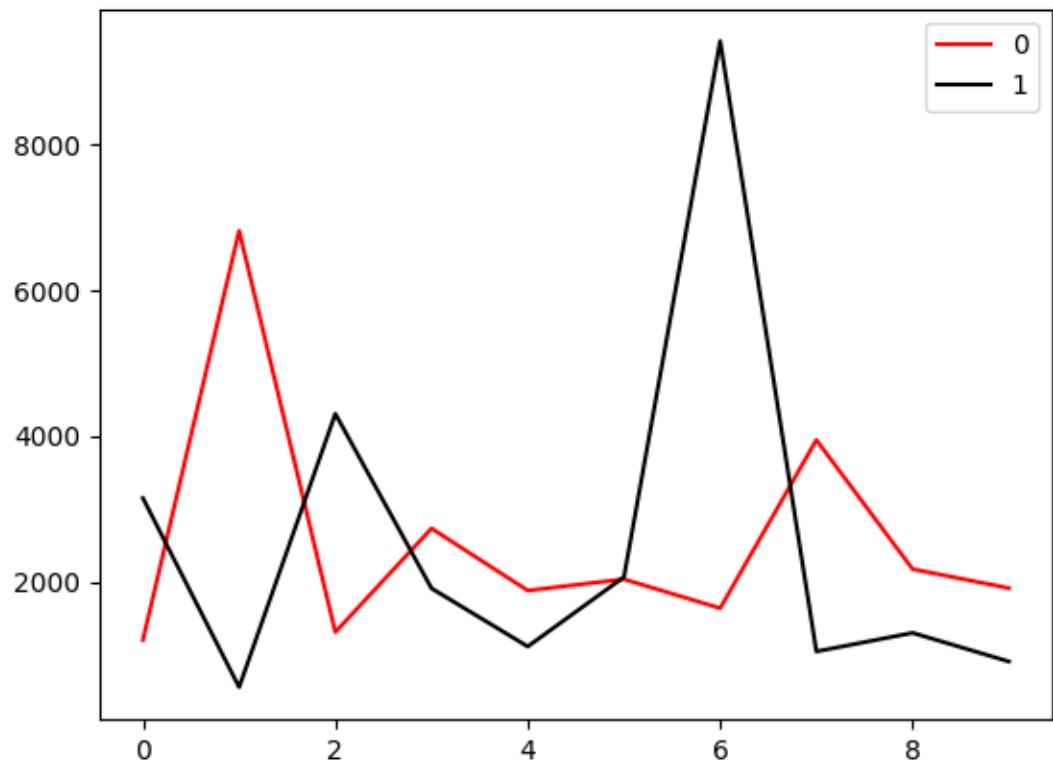
Figure\_6(00100)



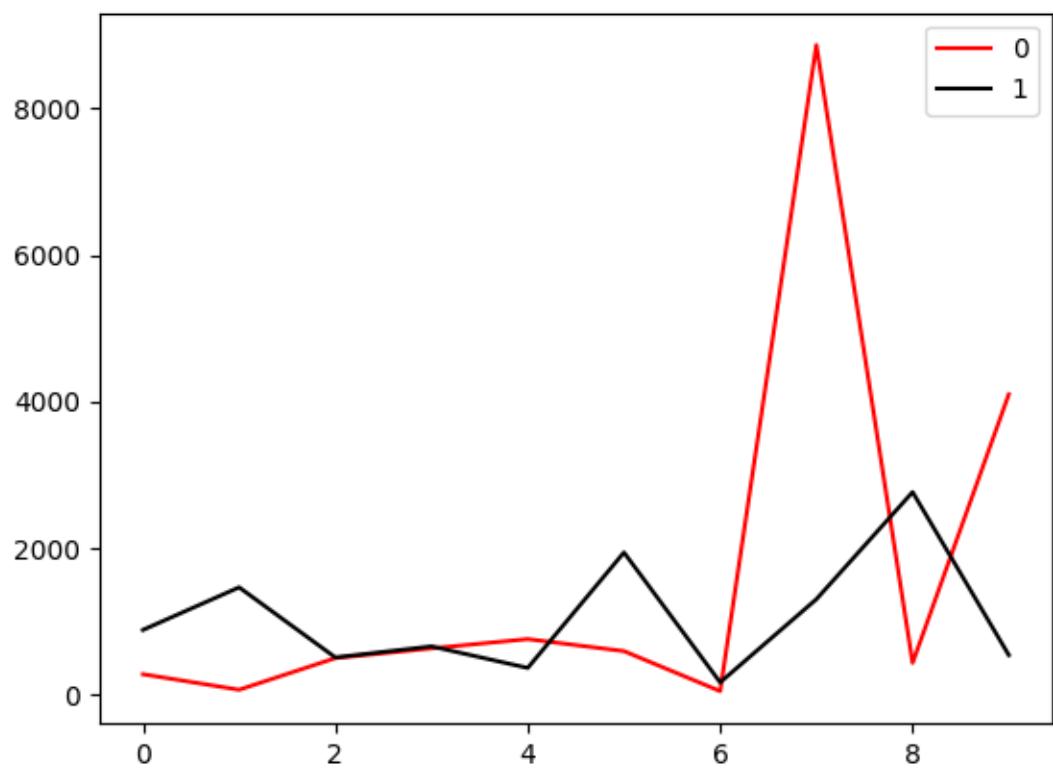
Figure\_6(00101)



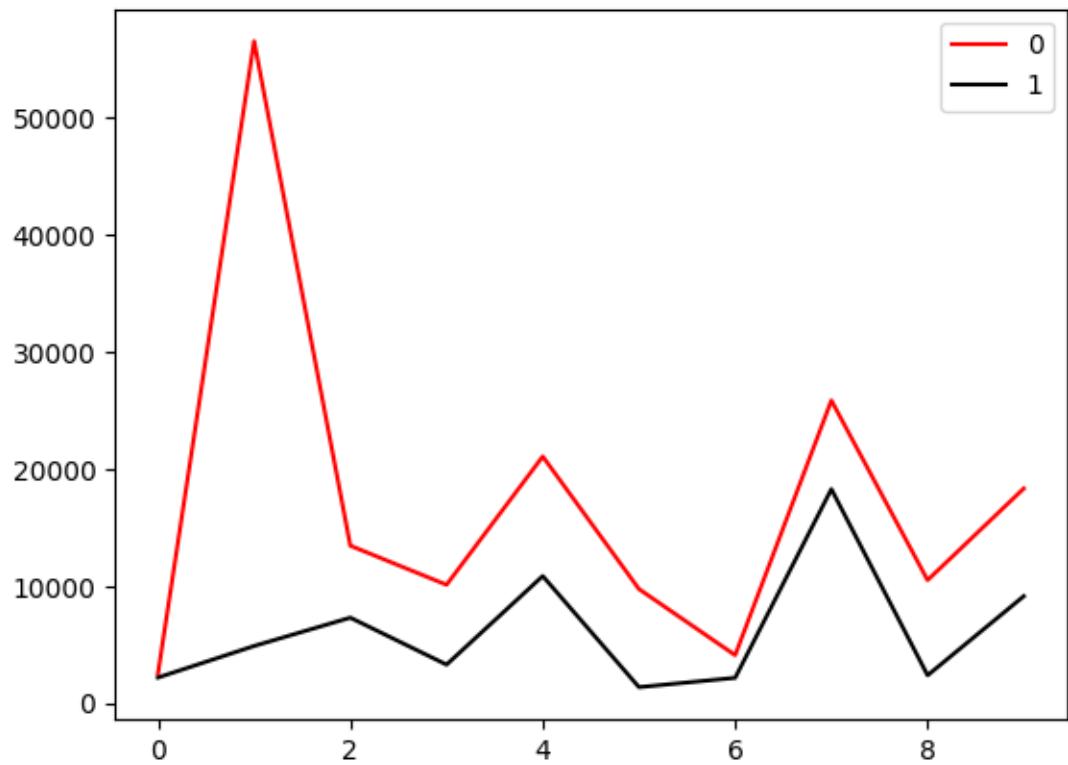
Figure\_6(00110)



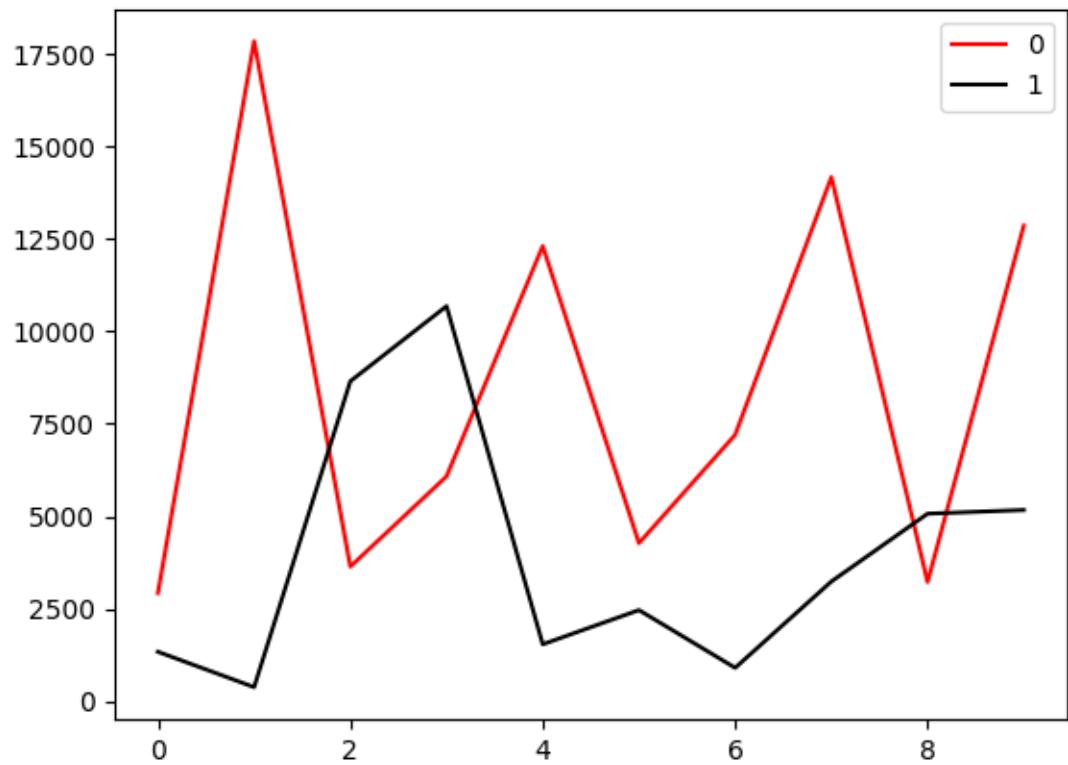
Figure\_6(00111)



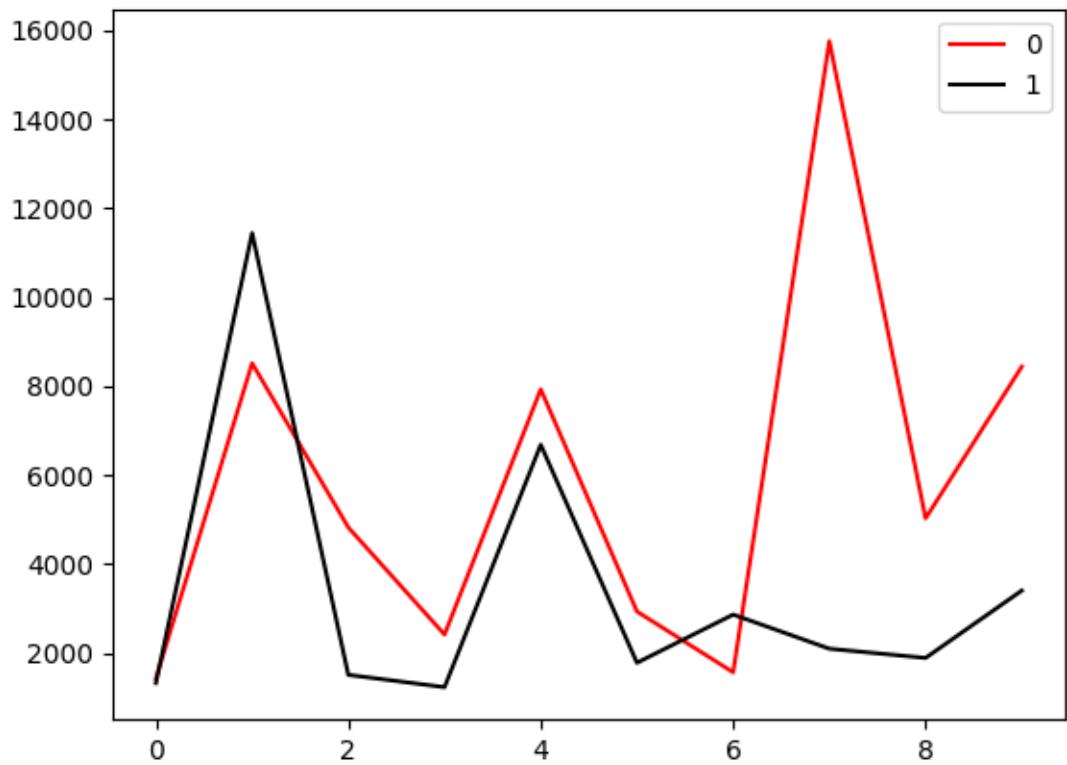
Figure\_6(01000)



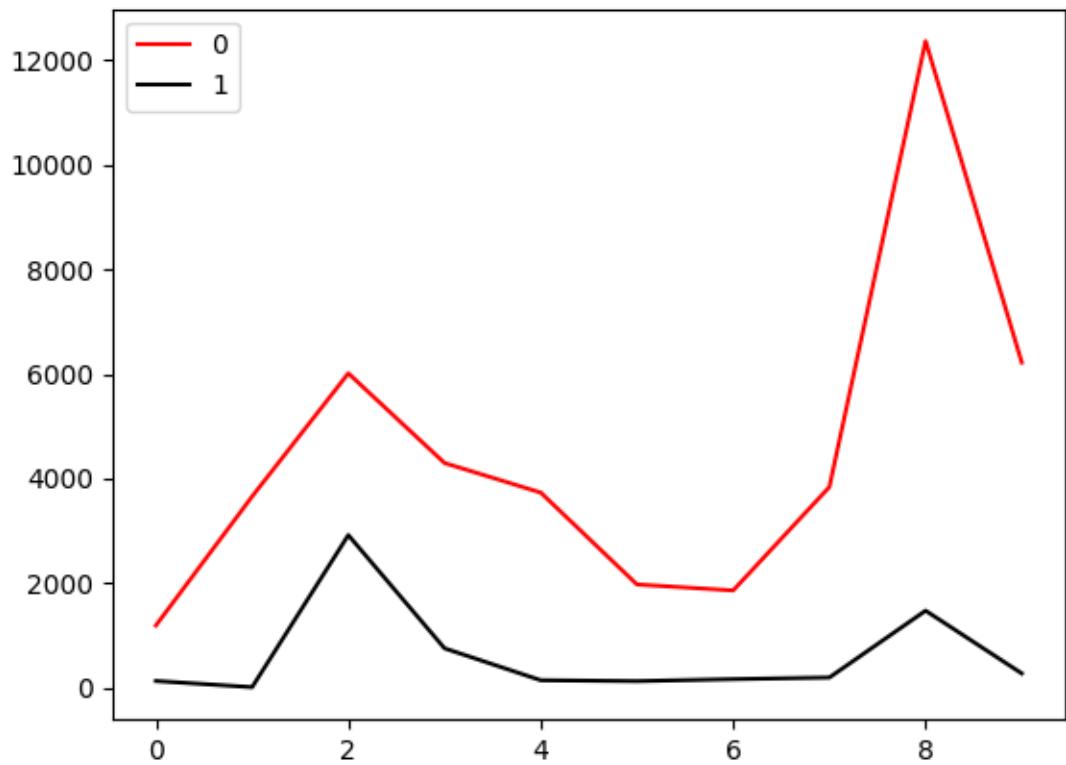
Figure\_6(01001)



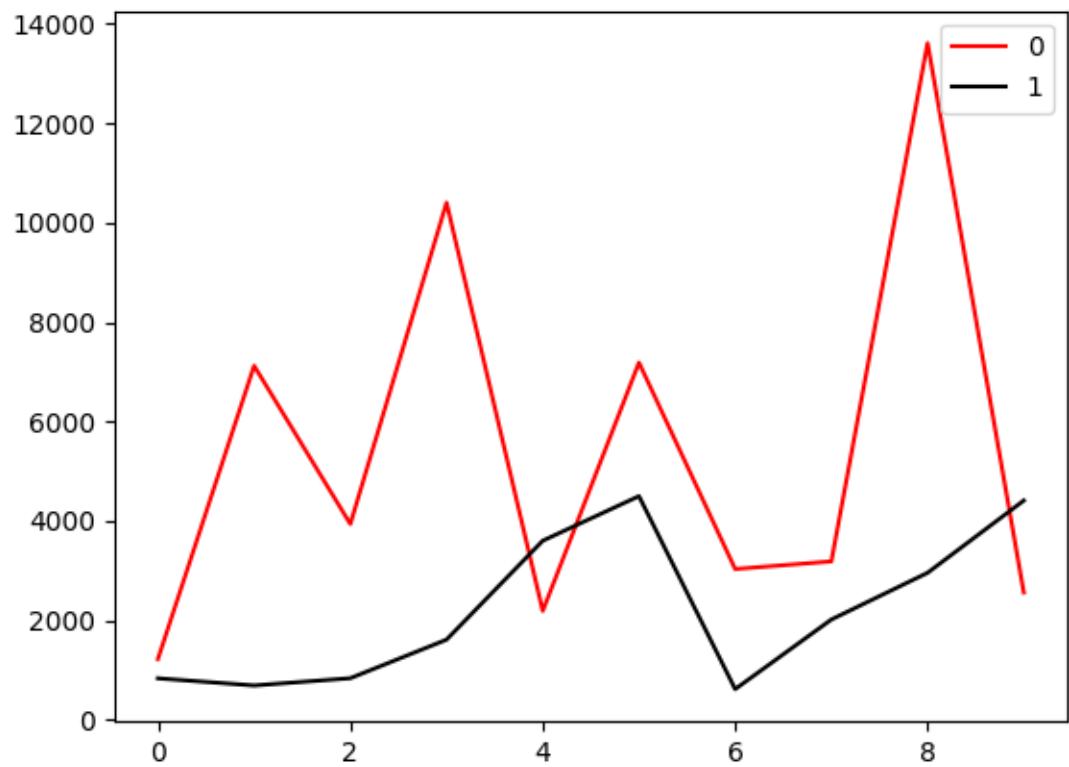
Figure\_6(01010)



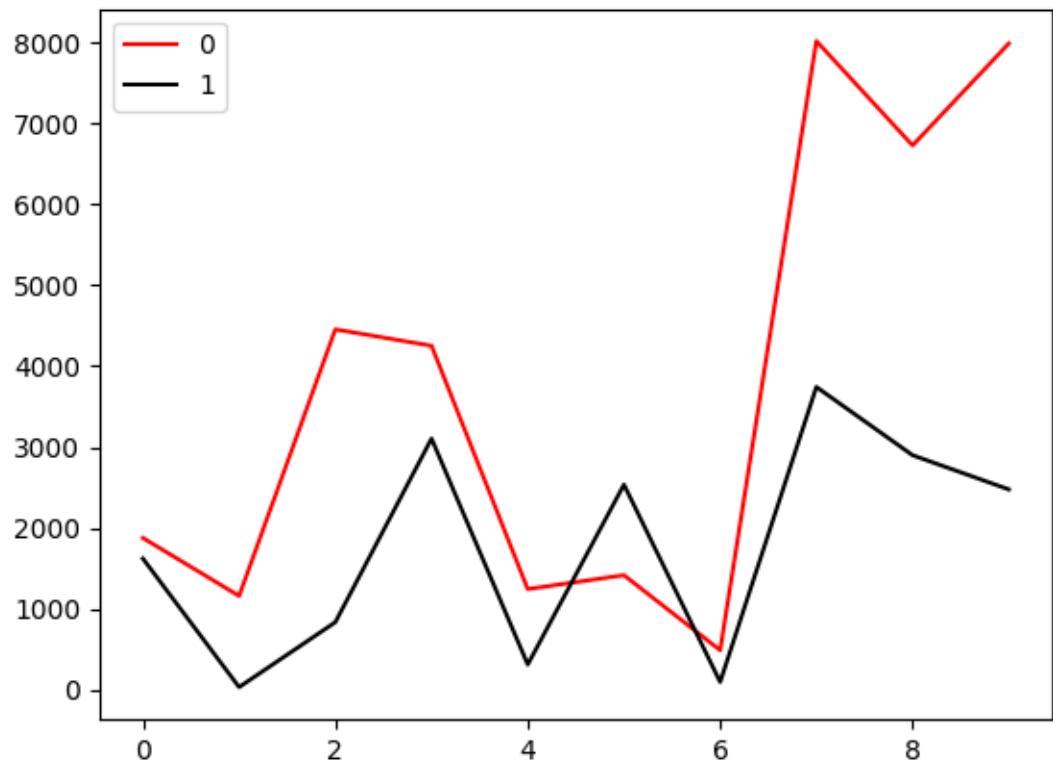
Figure\_6(01011)



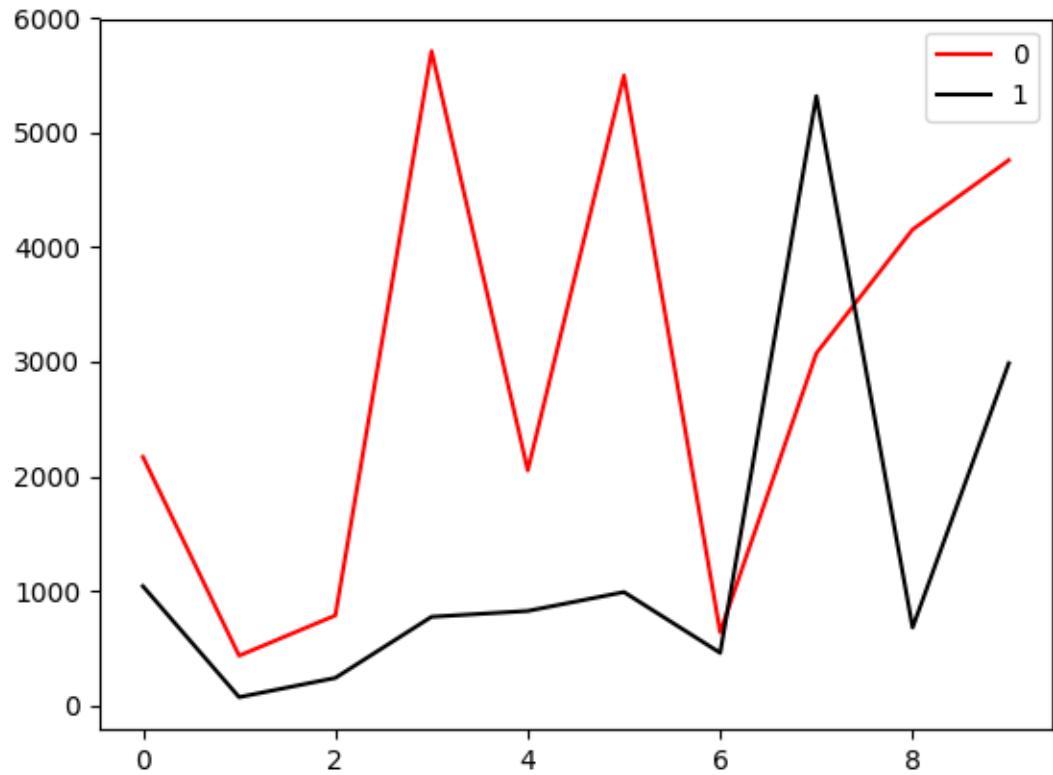
Figure\_6(01100)



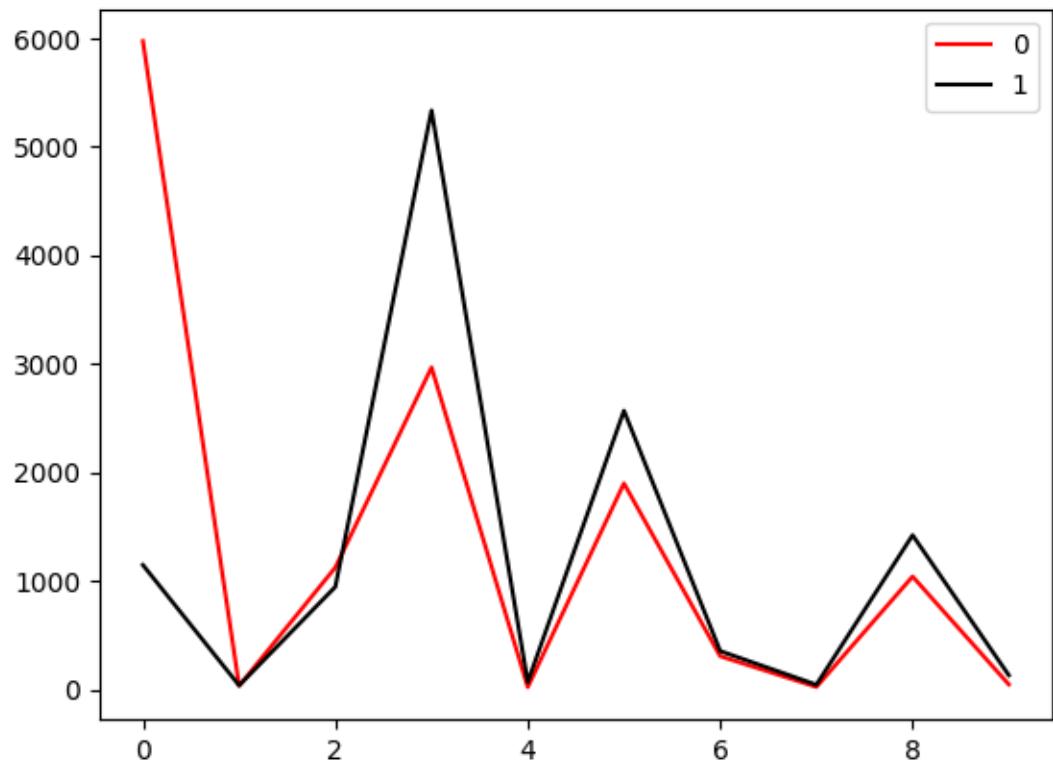
Figure\_6(01101)



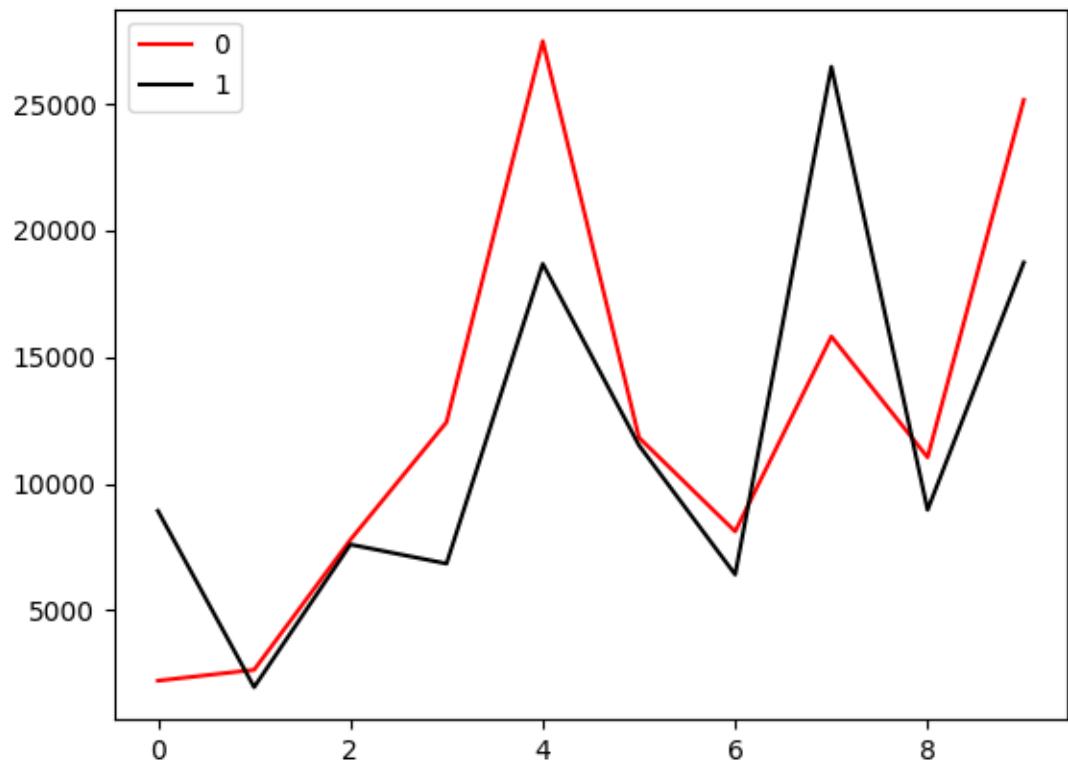
Figure\_6(01110)



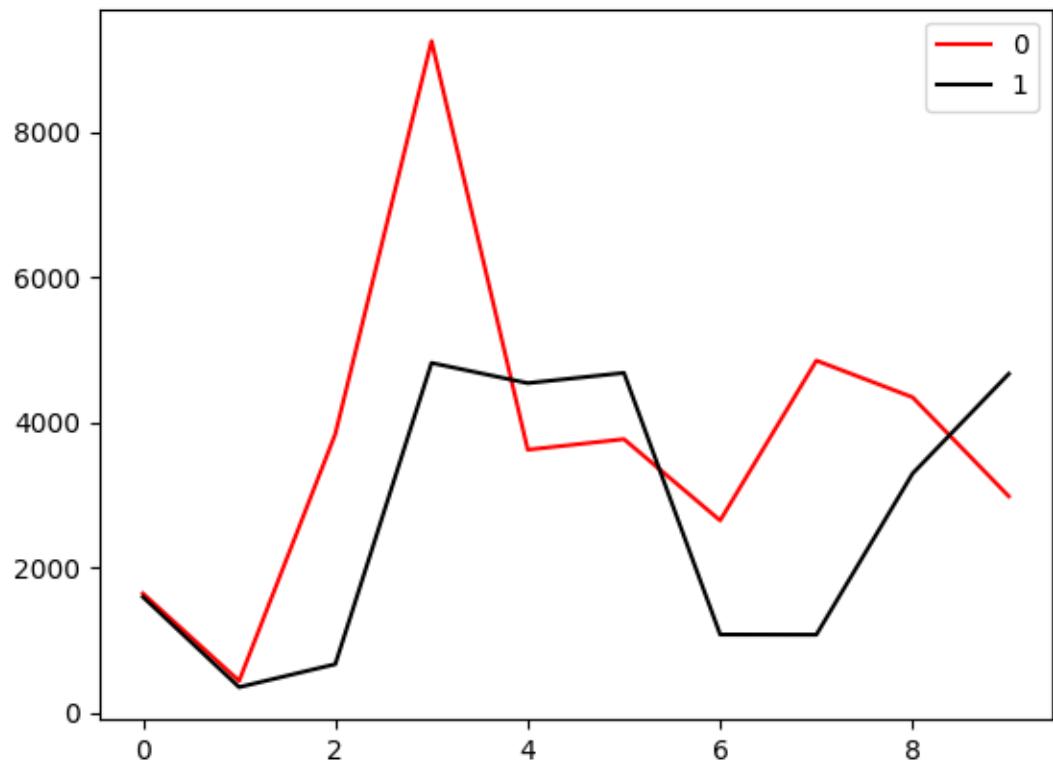
Figure\_6(01111)



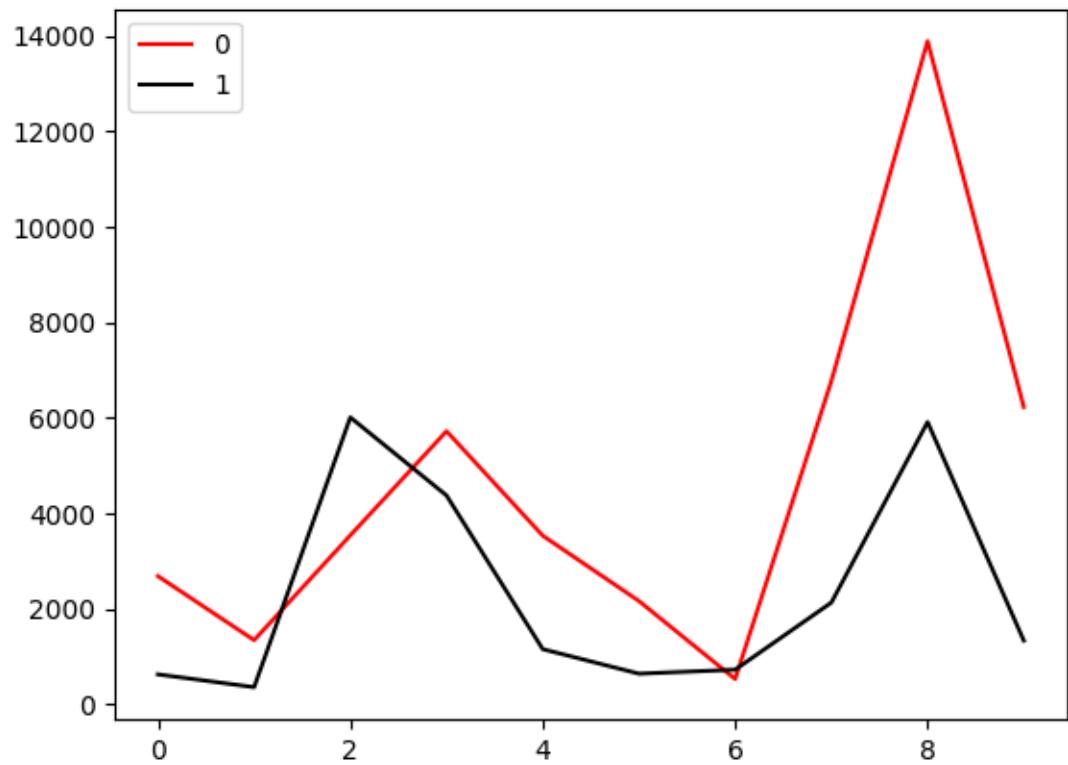
Figure\_6(10000)



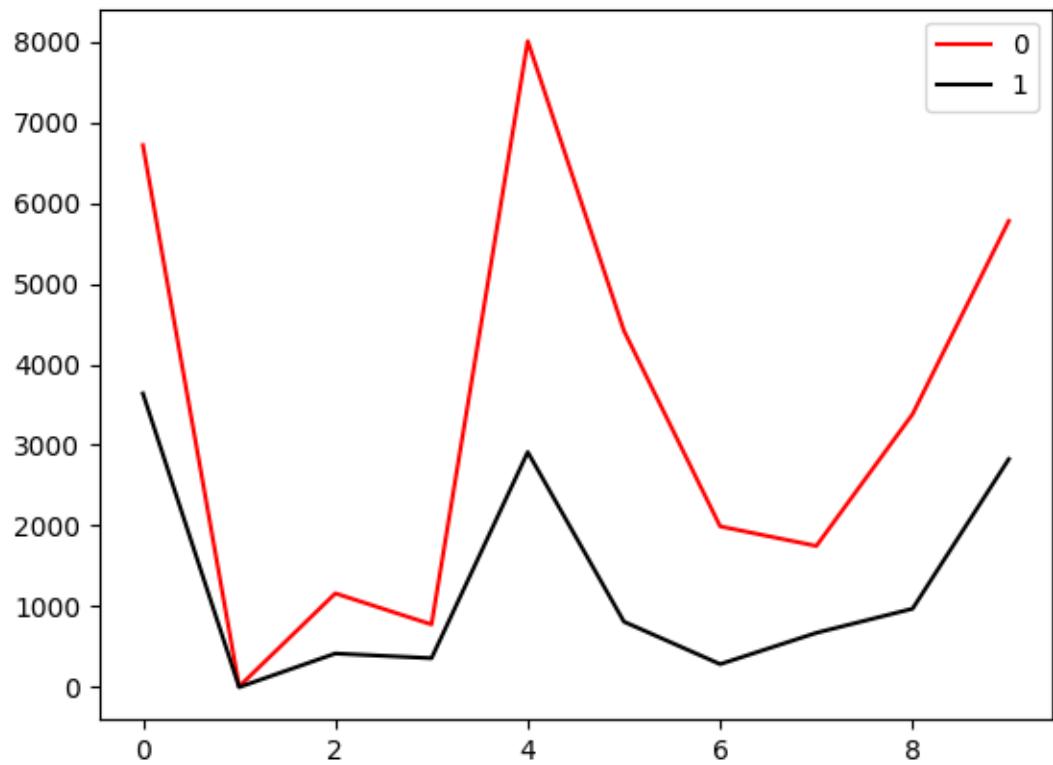
Figure\_6(10001)



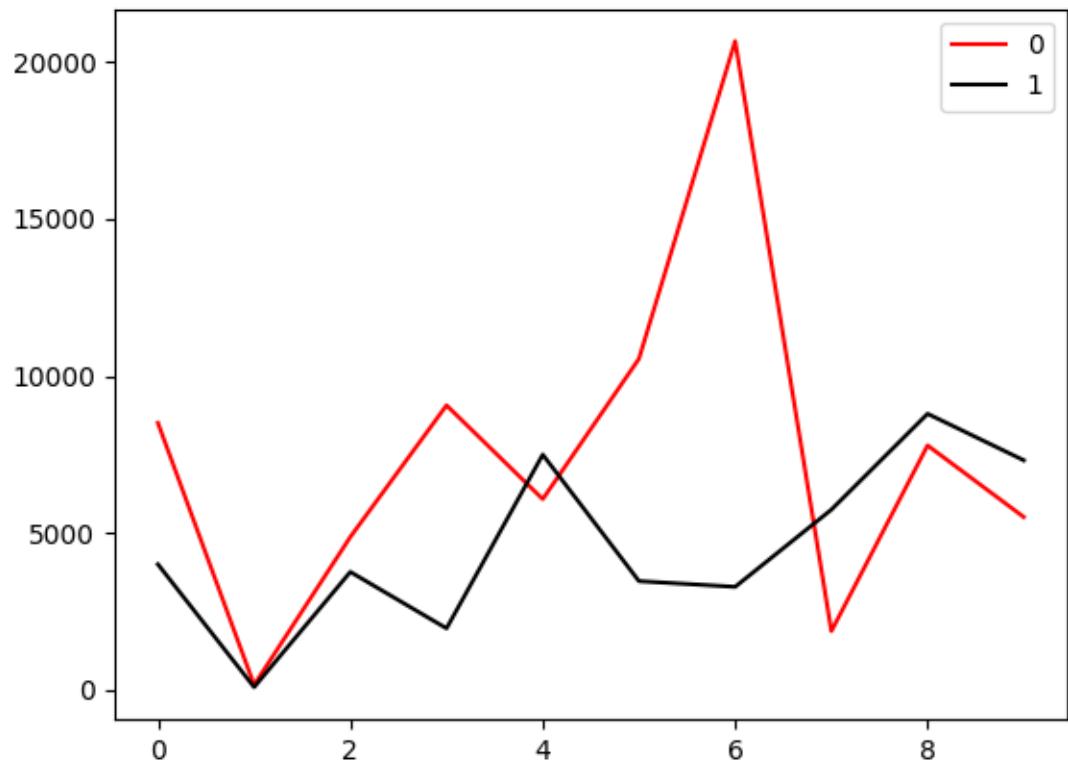
Figure\_6(10010)



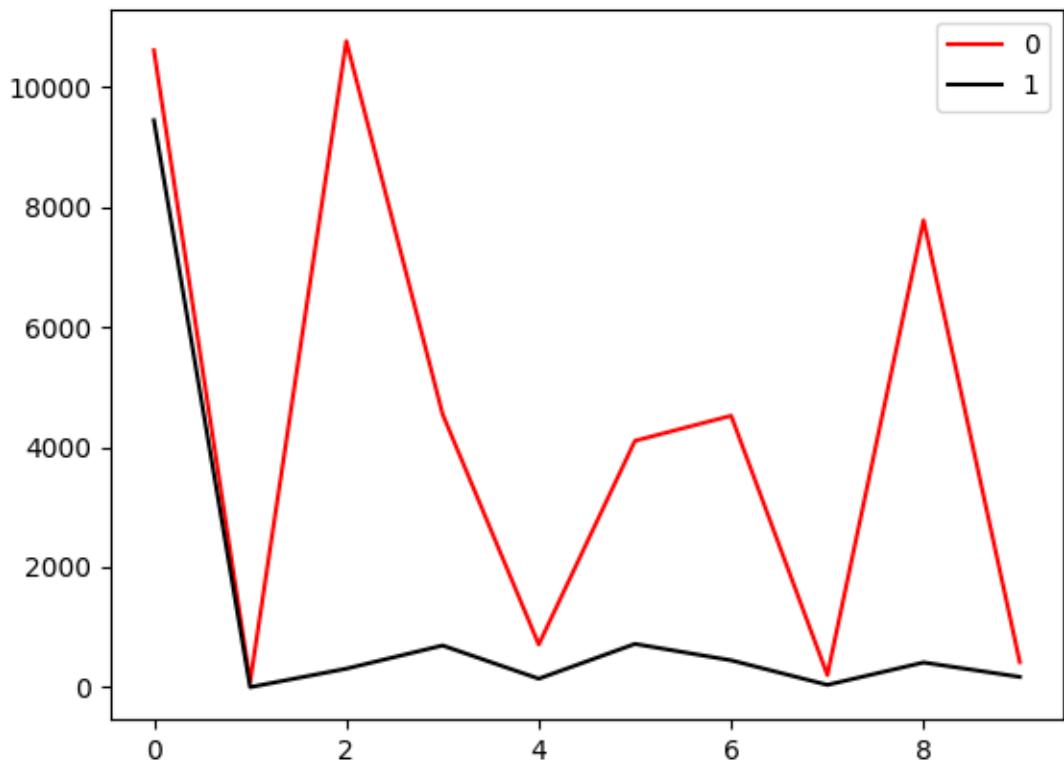
Figure\_6(10011)



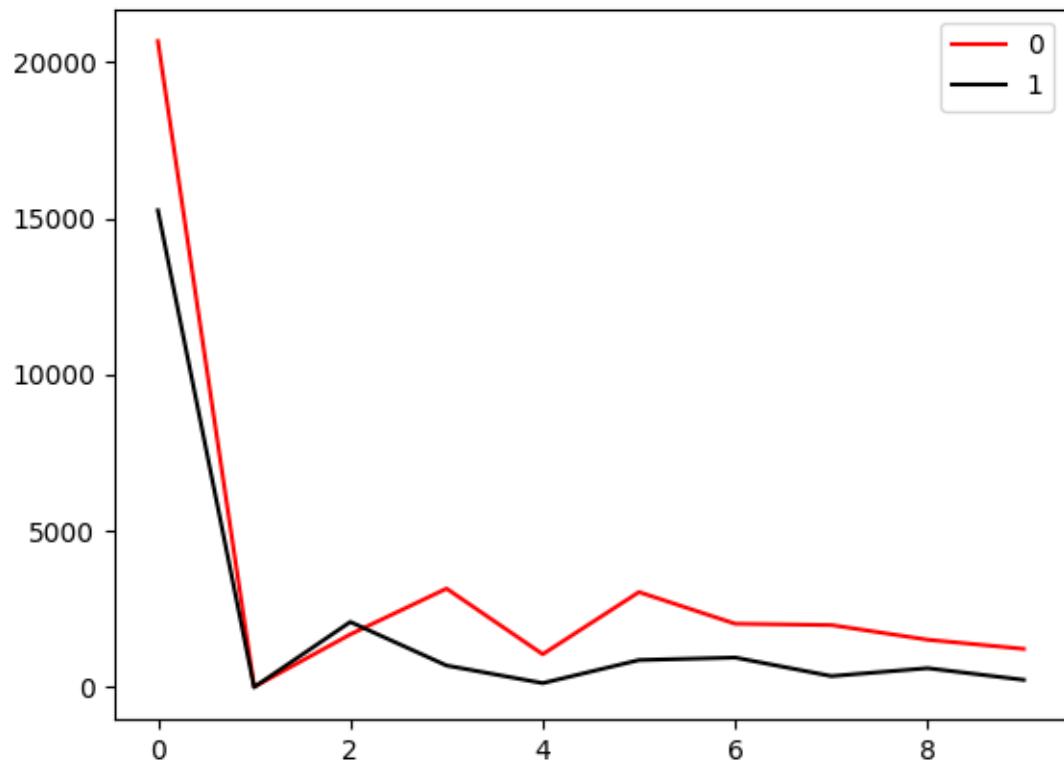
Figure\_6(10100)



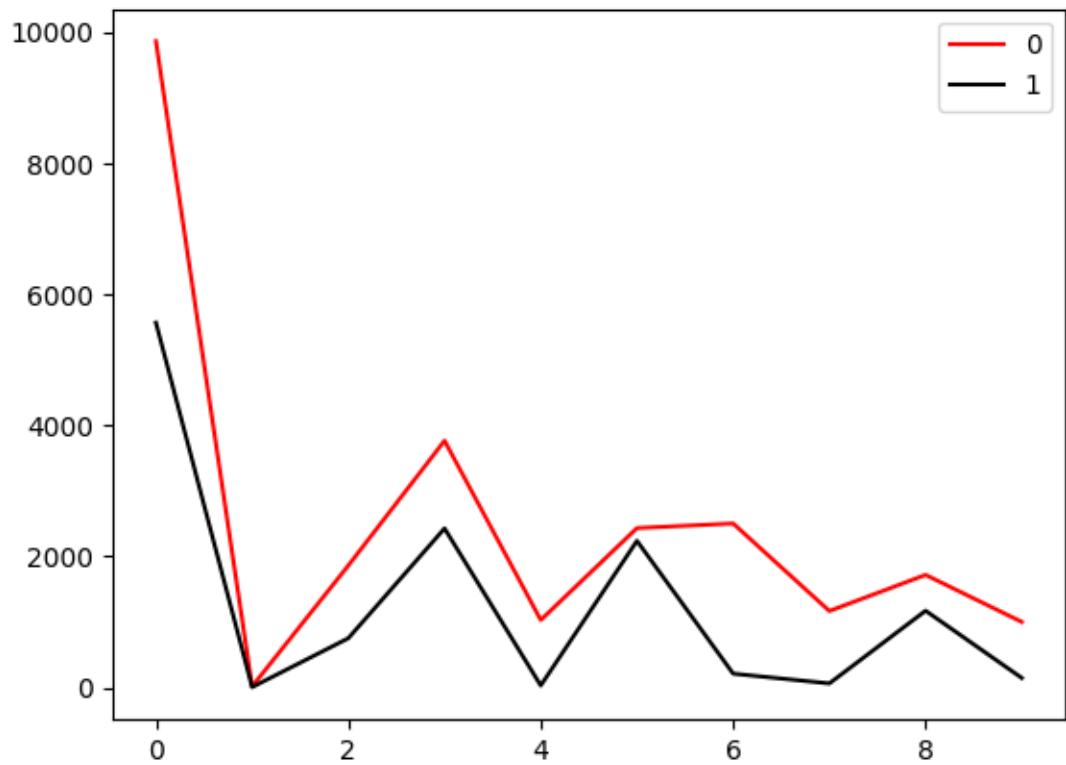
Figure\_6(10101)



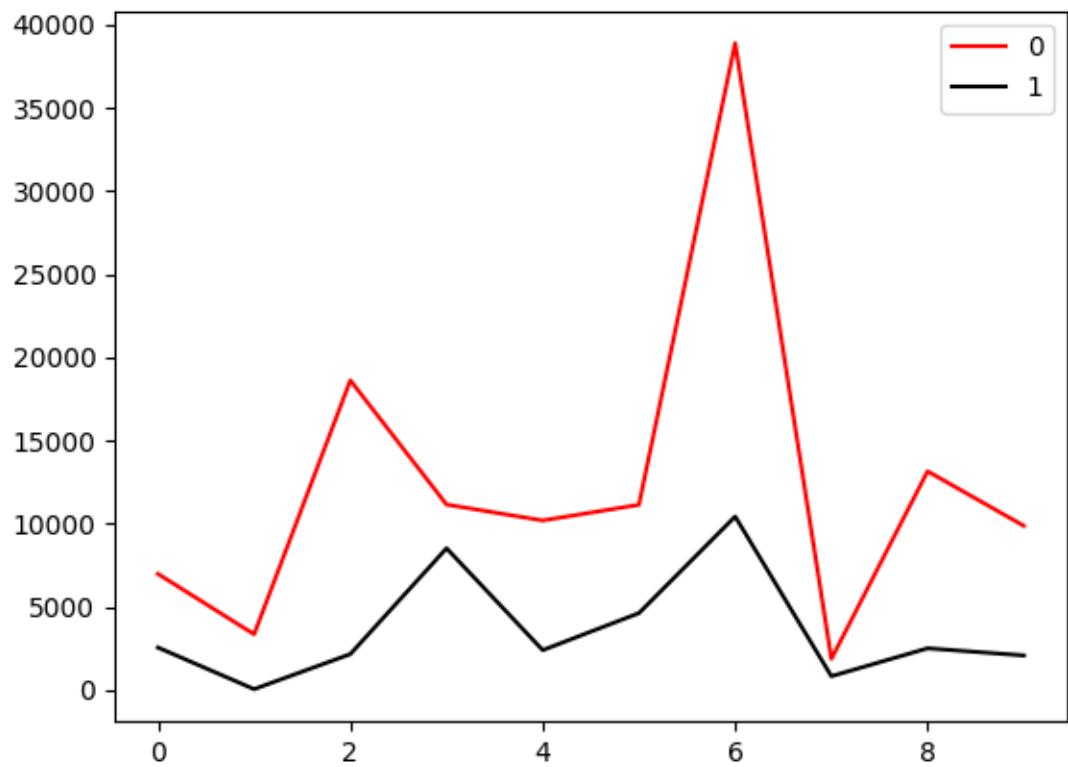
Figure\_6(10110)



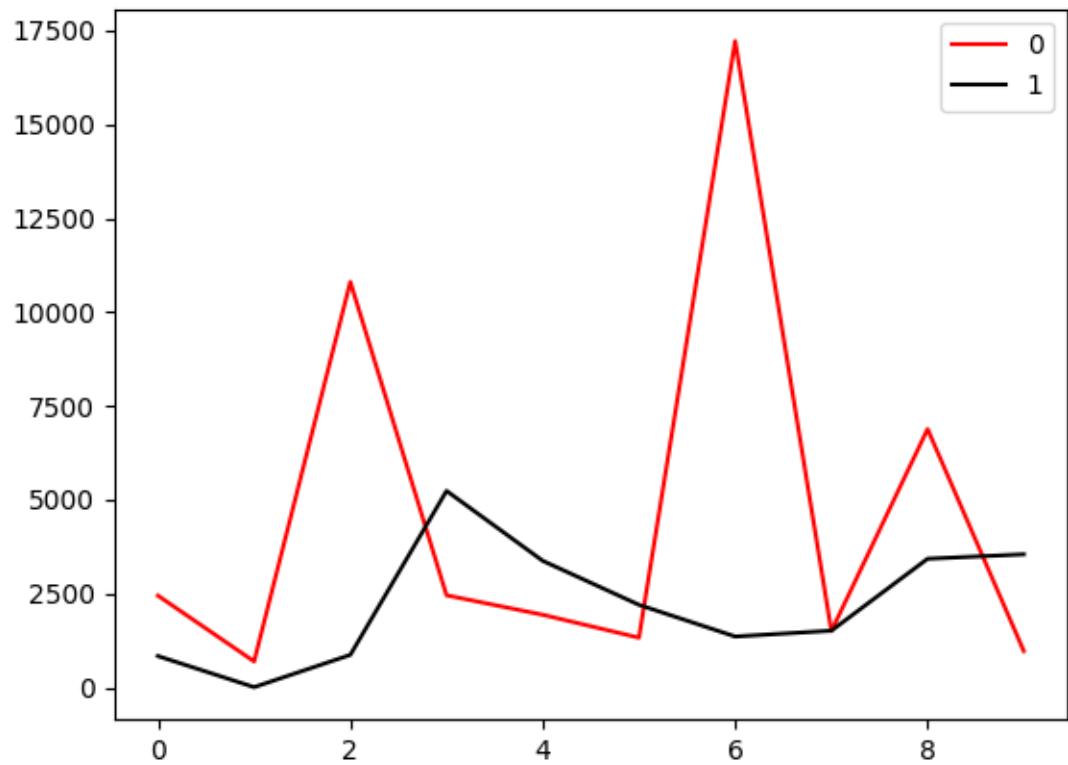
Figure\_6(10111)



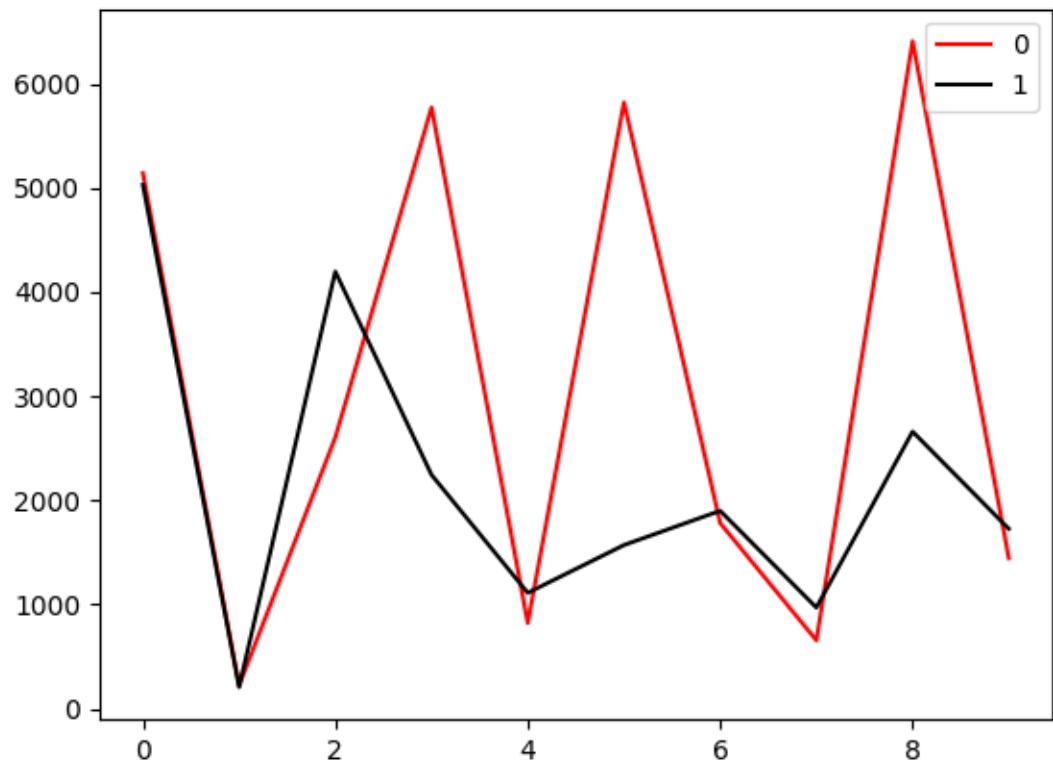
Figure\_6(11000)



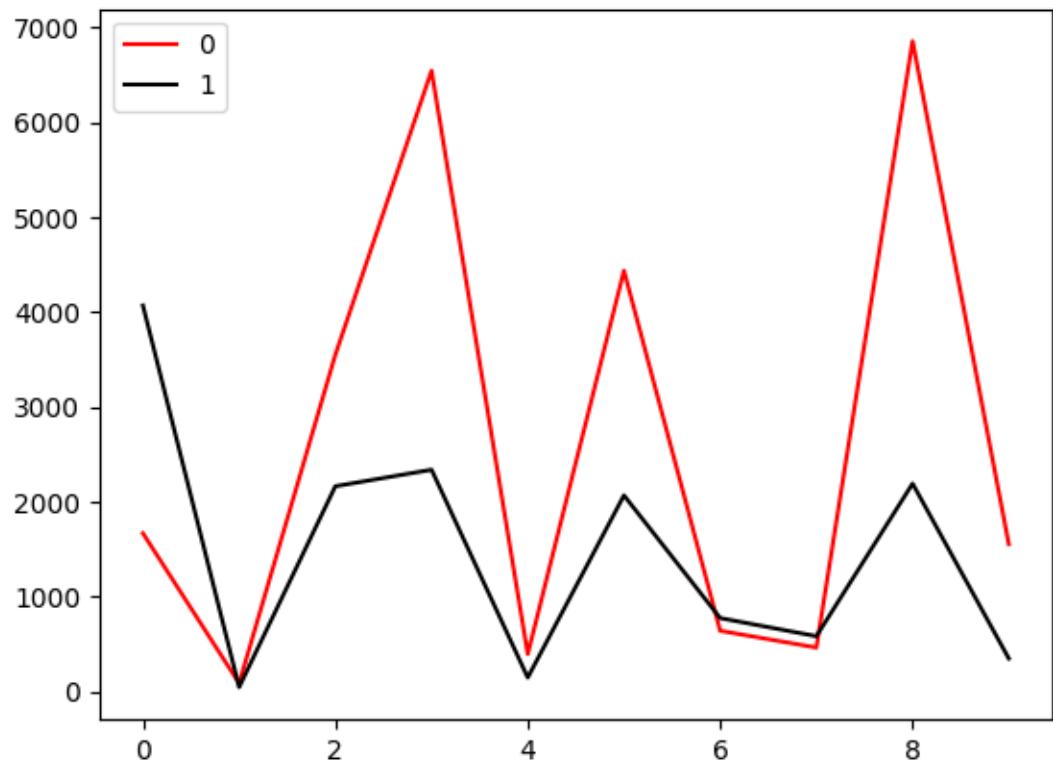
Figure\_6(11001)



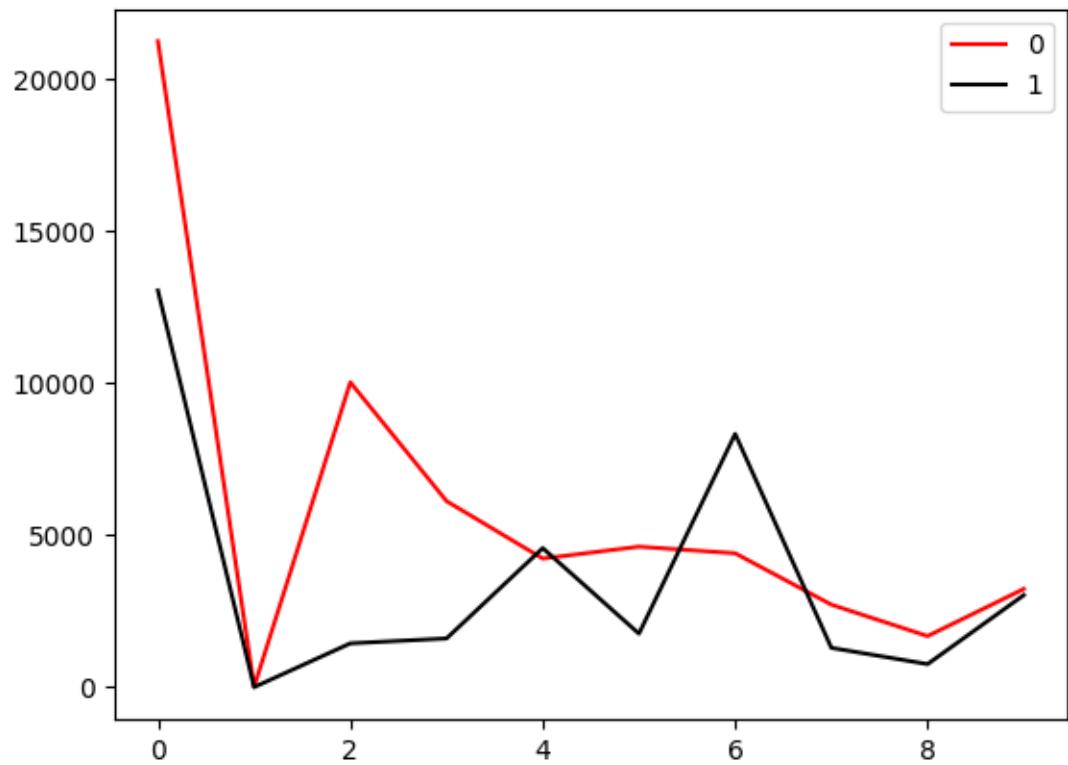
Figure\_6(11010)



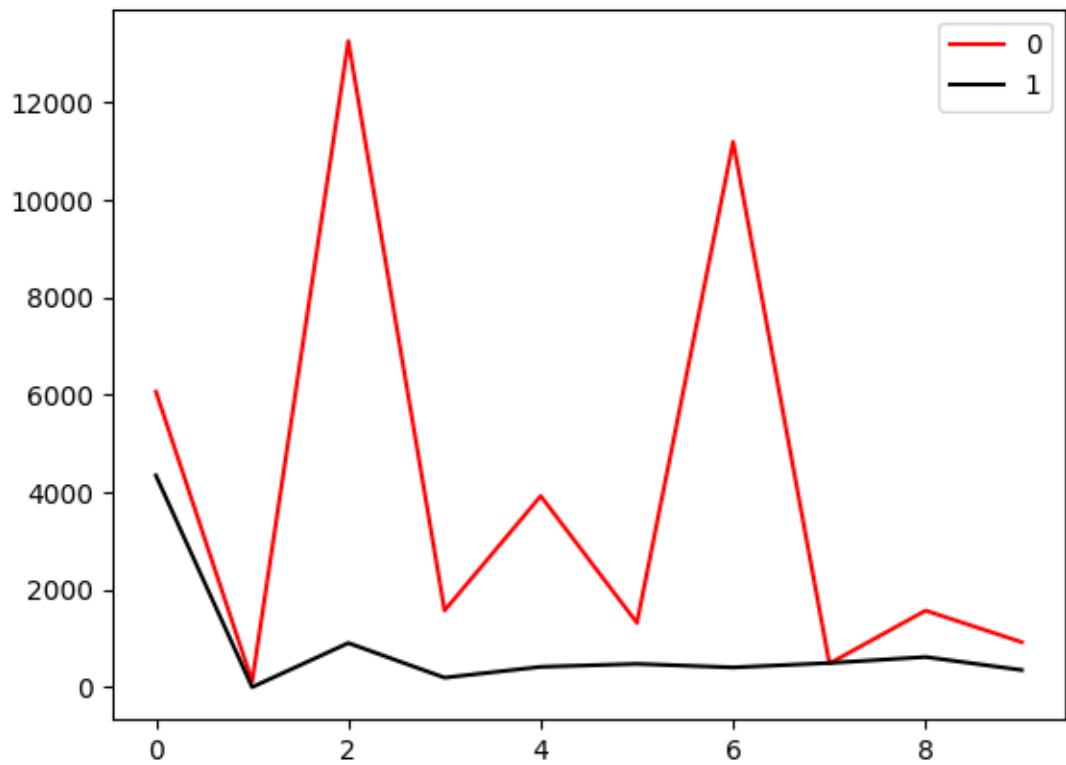
Figure\_6(11011)



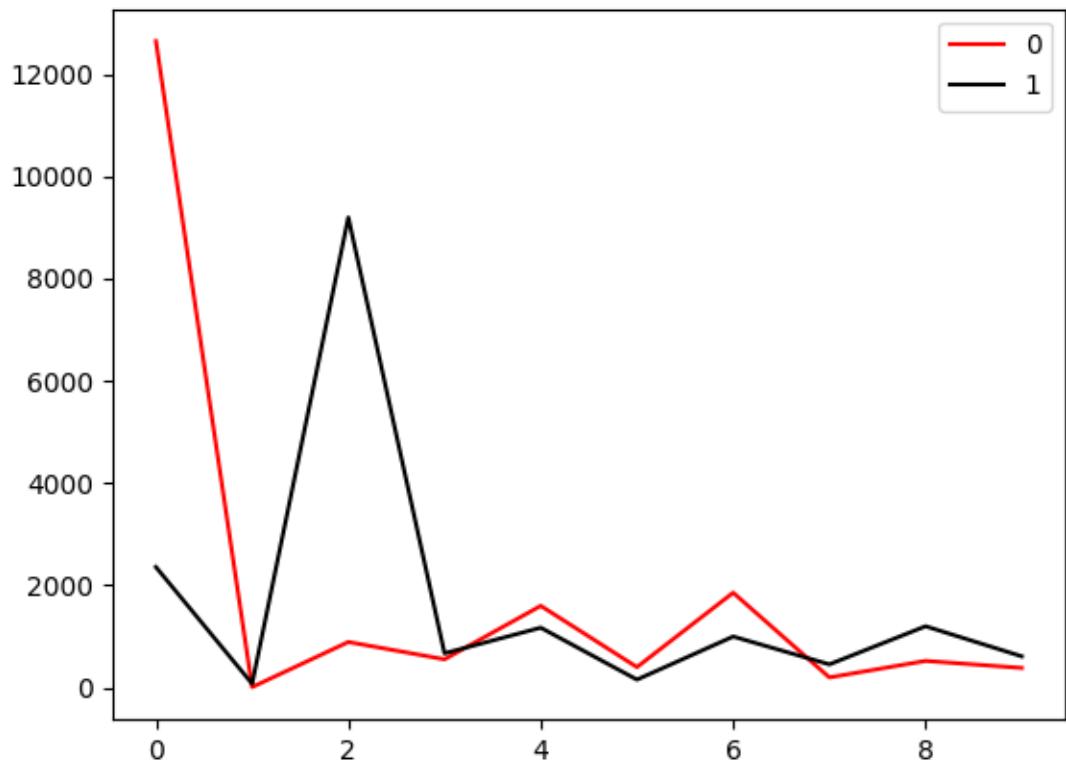
Figure\_6(11100)



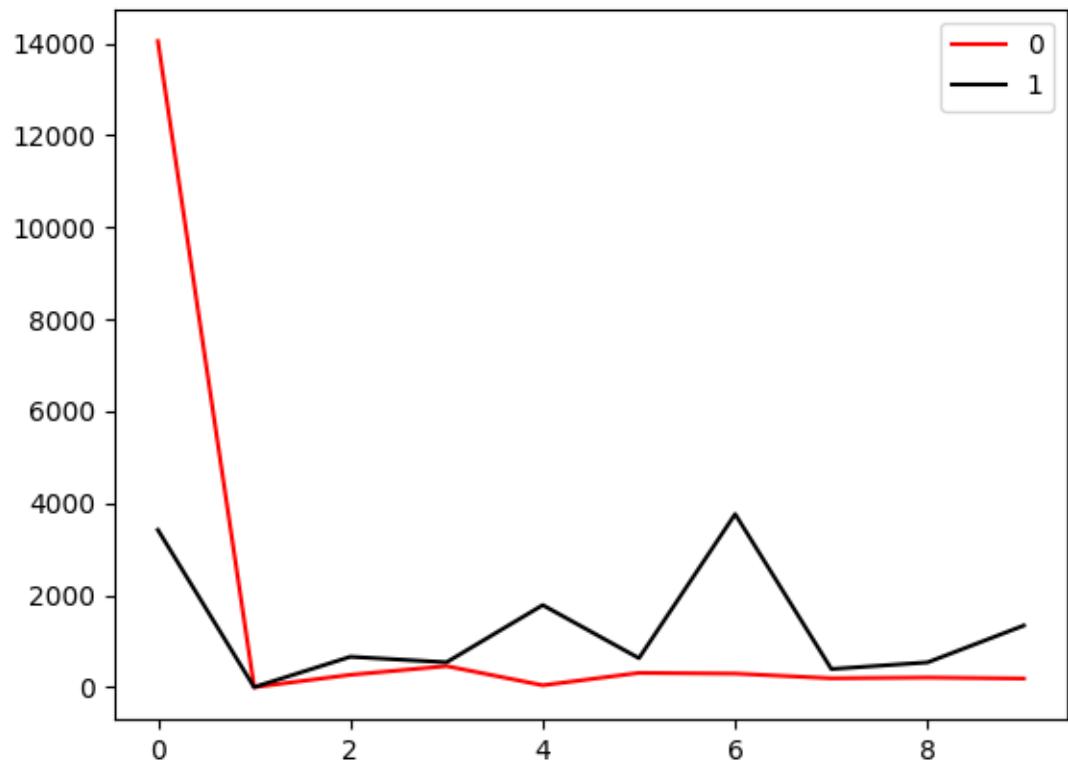
Figure\_6(11101)



Figure\_6(11110)



Figure\_6(11111)



## **2. Average pooling to 8×8 for each image**

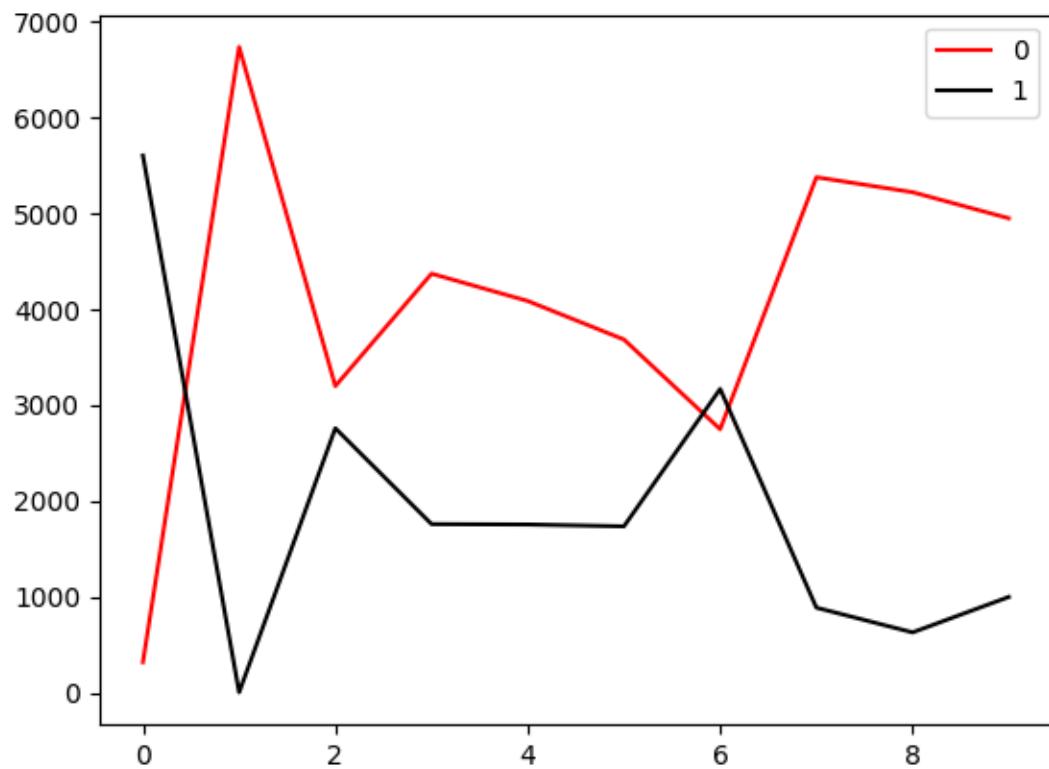
For this experiment, First I did average pooling to change 32×32 images to 16×16 images, and then did the process again to 8×8 images. After that, I did the hierarchy k-means to all 8×8 images. The names of the figures have the same regularity as above.

Even though the number of some classes in the figures are close to 0, but they are not zero.

Although the figures are better than the results above, we still cannot get pure nodes for each class.

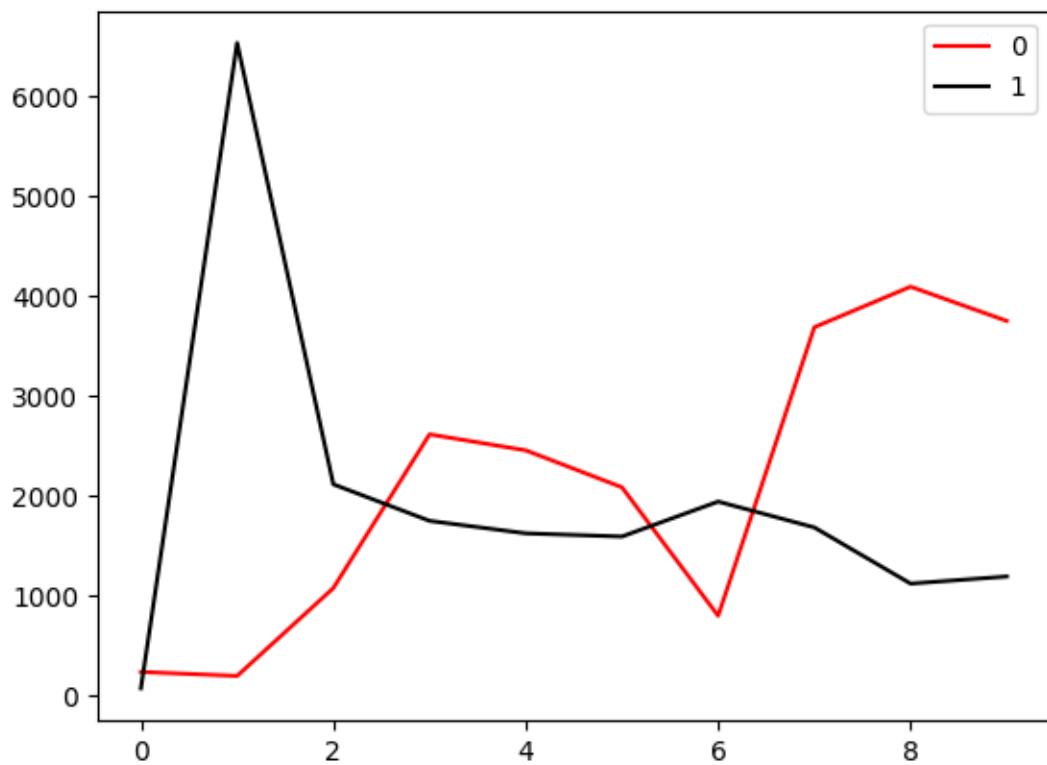
**The 1<sup>st</sup> layer:**

Figure\_1

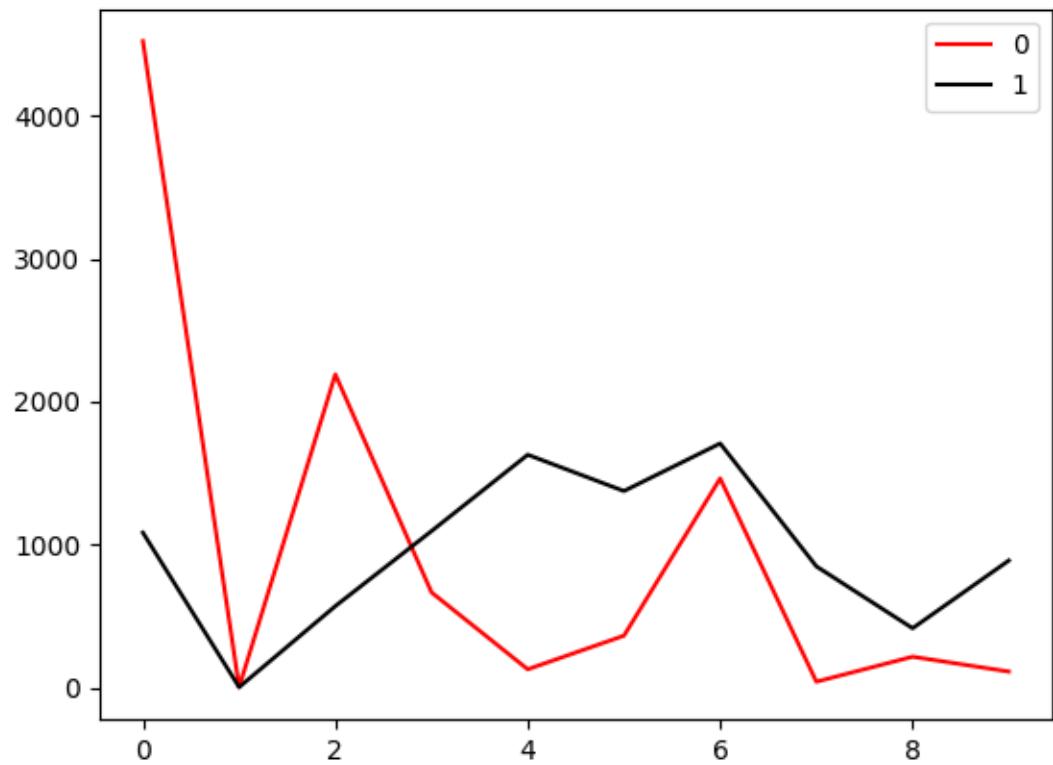


The 2<sup>nd</sup> layer:

Figure\_2(0)

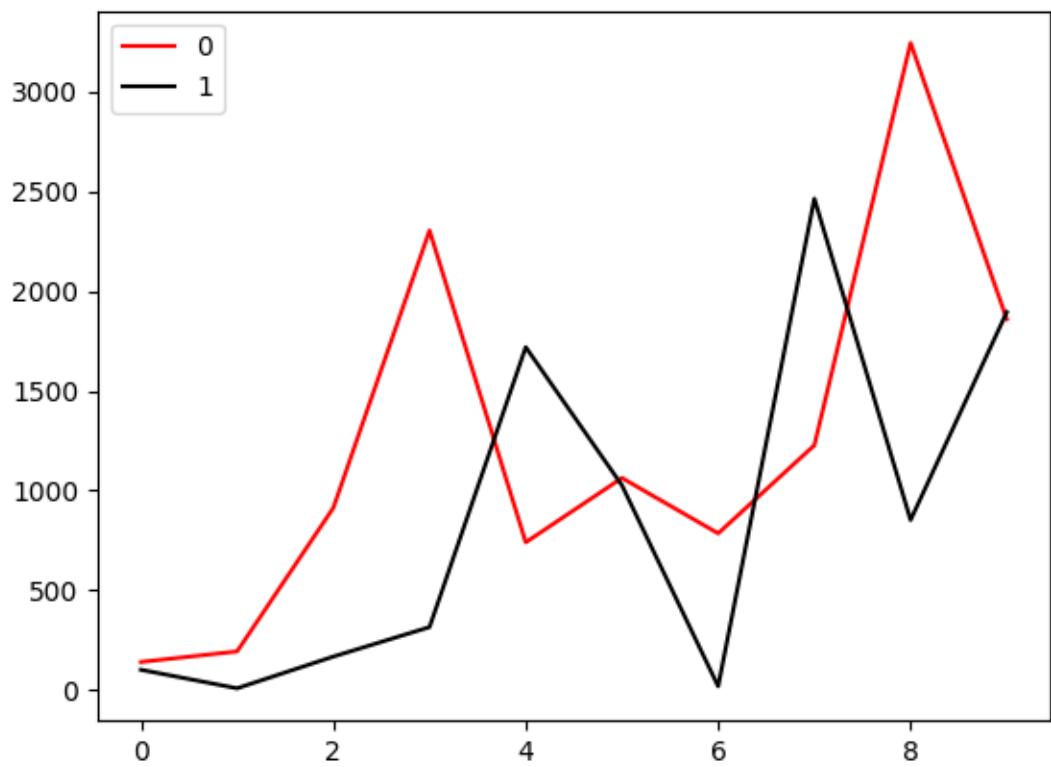


Figure\_2(1)

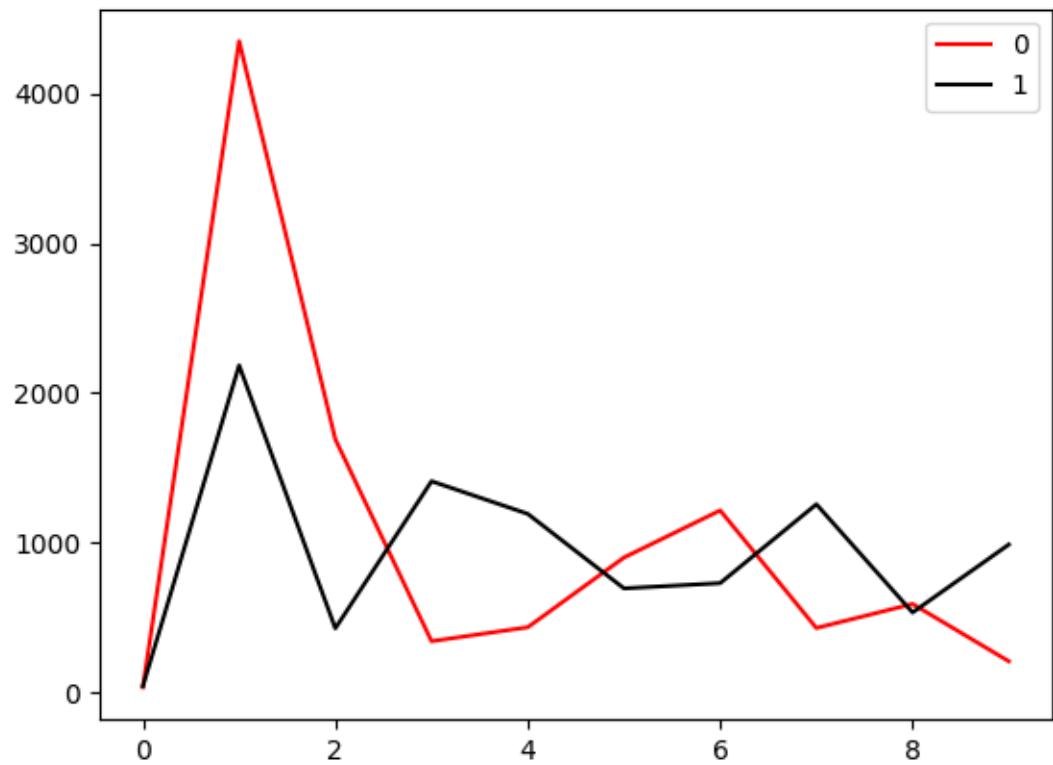


**The 3<sup>rd</sup> layer:**

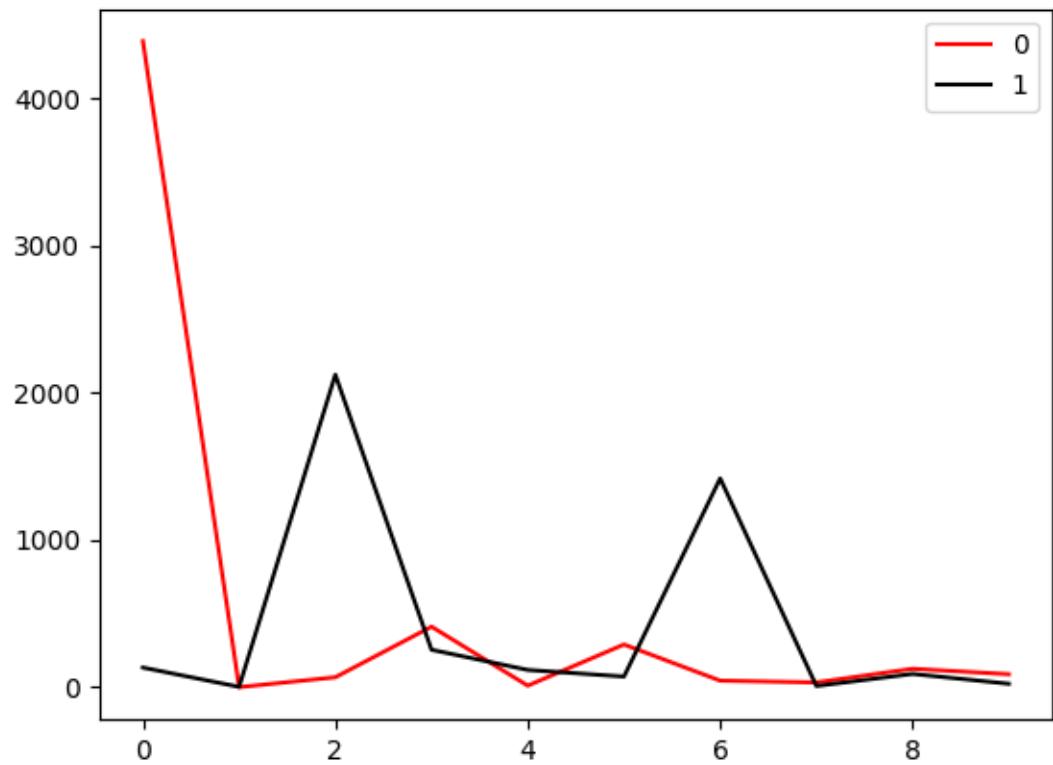
Figure\_3(00)



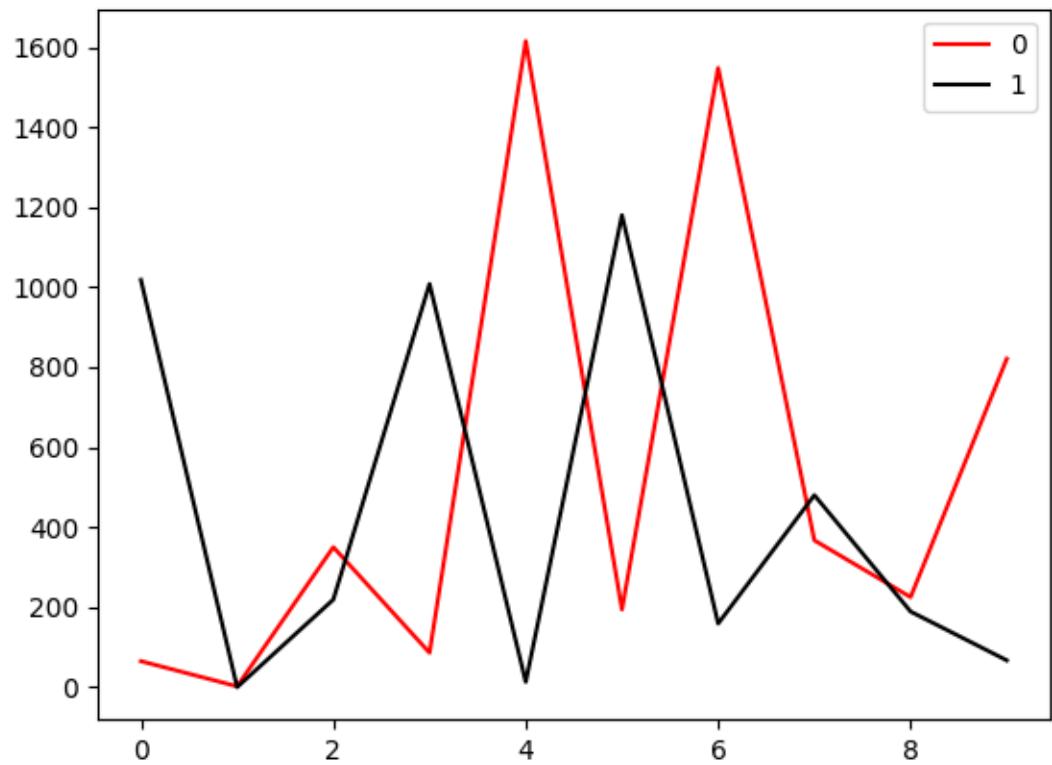
Figure\_3(01)



Figure\_3(10)

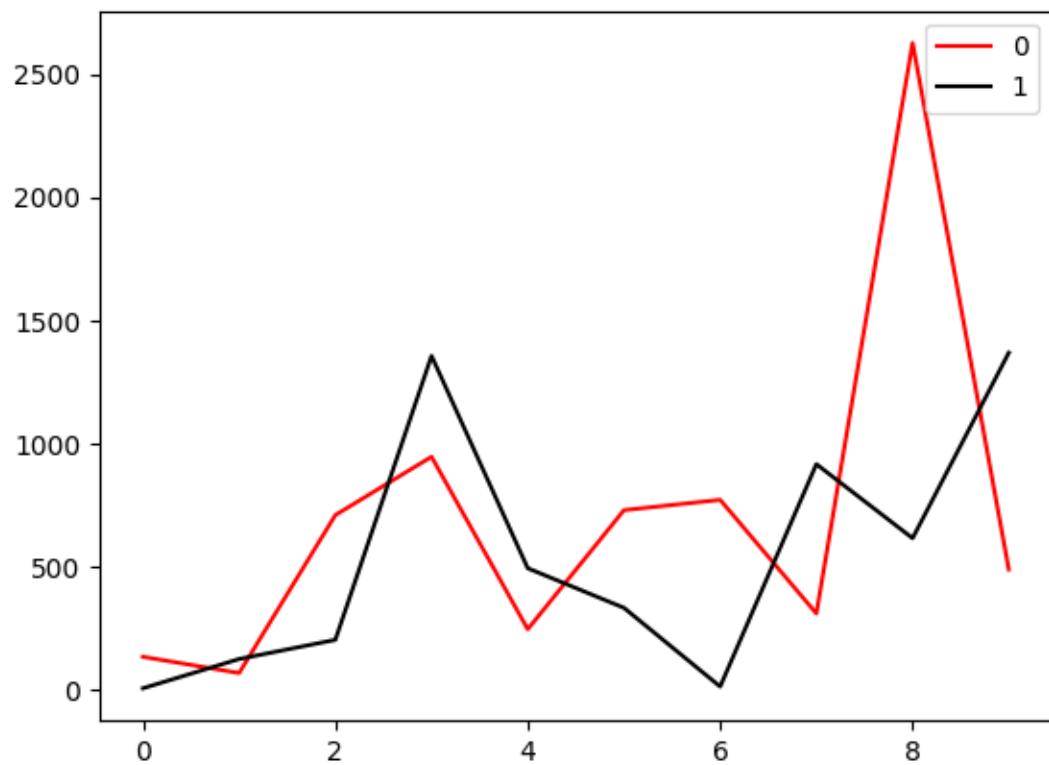


Figure\_3(11)

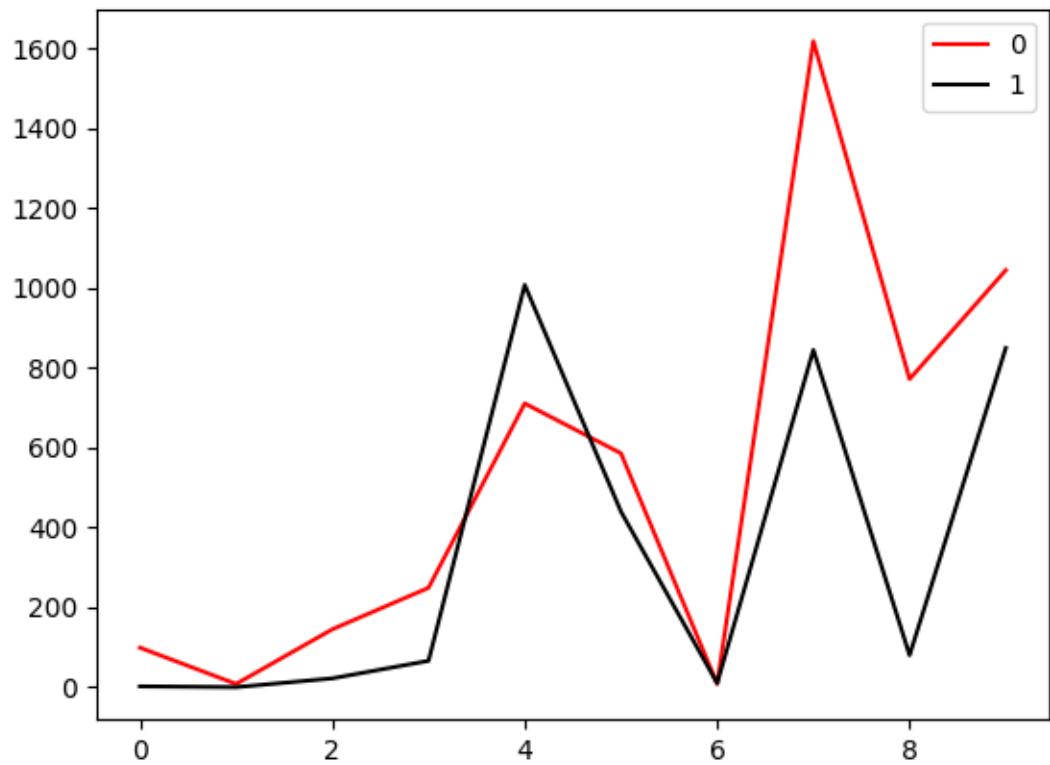


The 4<sup>th</sup> layer:

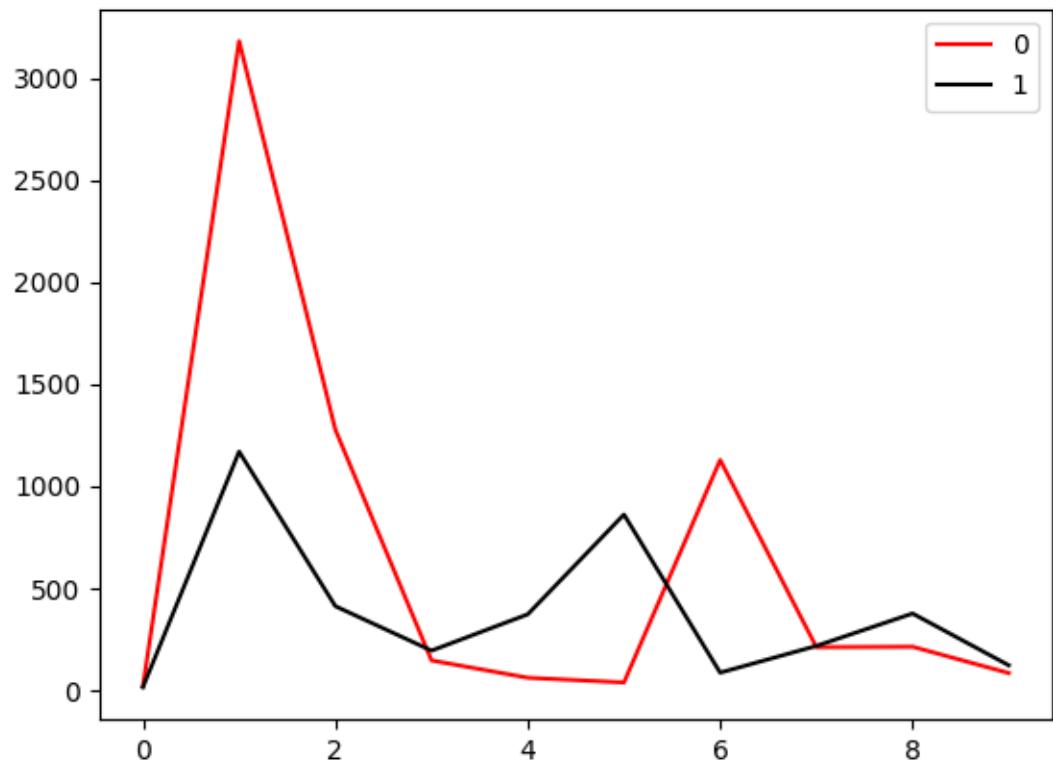
Figure\_4(000)



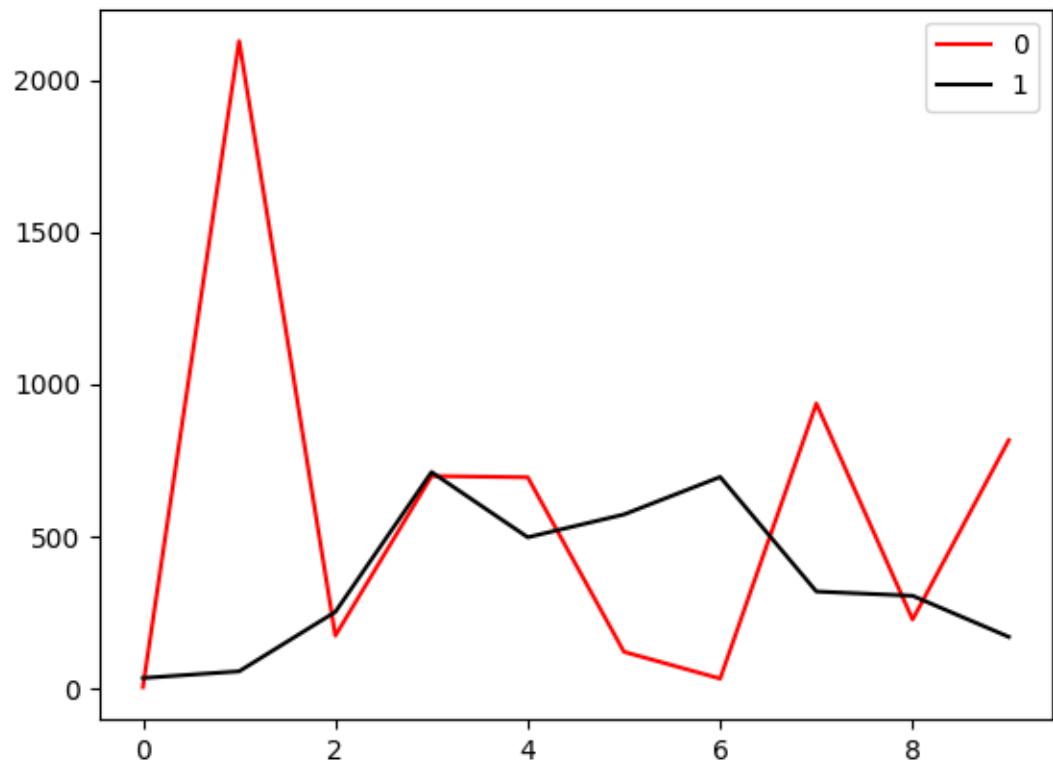
Figure\_4(001)



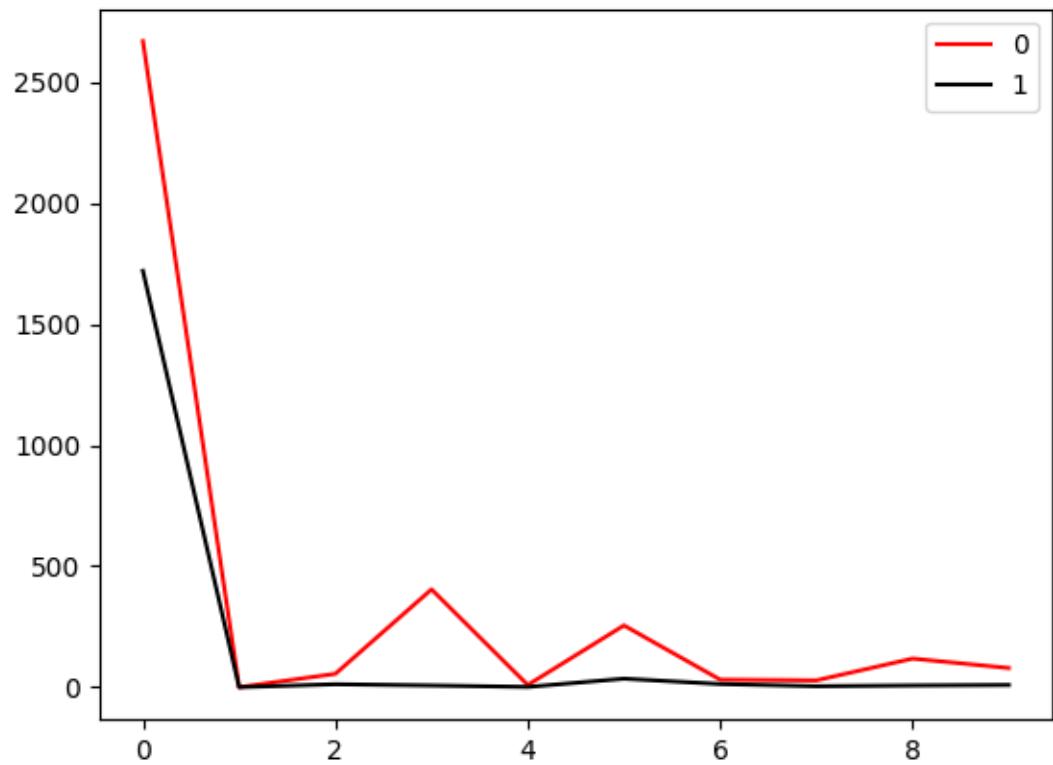
Figure\_4(010)



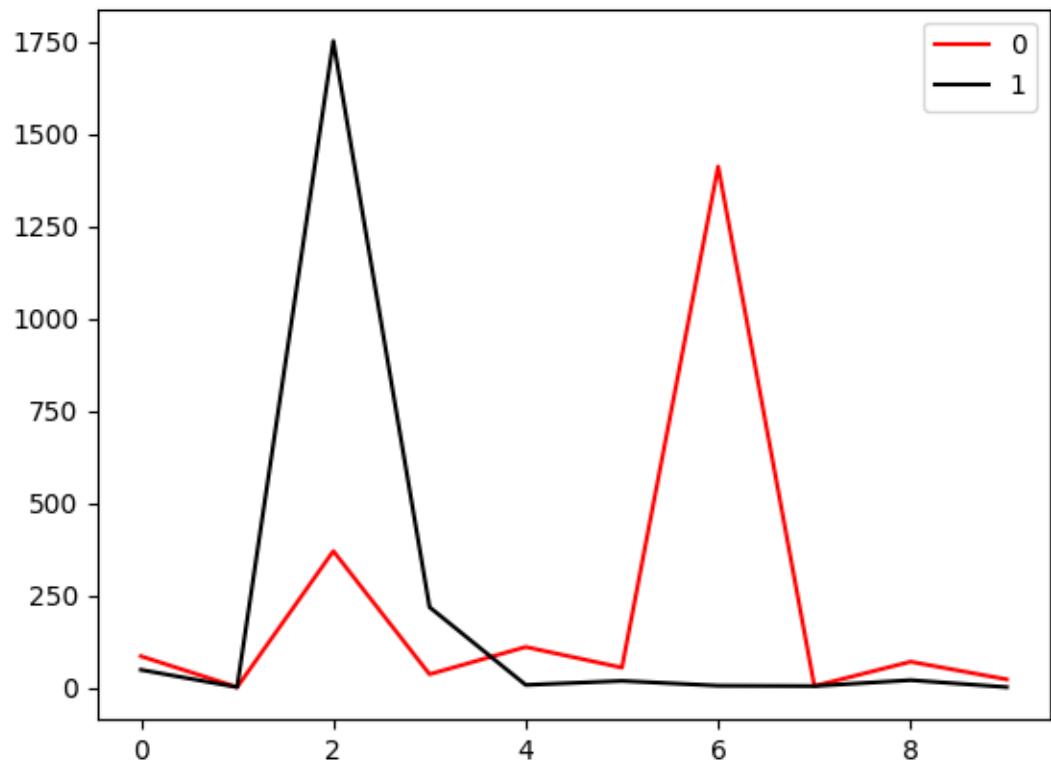
Figure\_4(011)



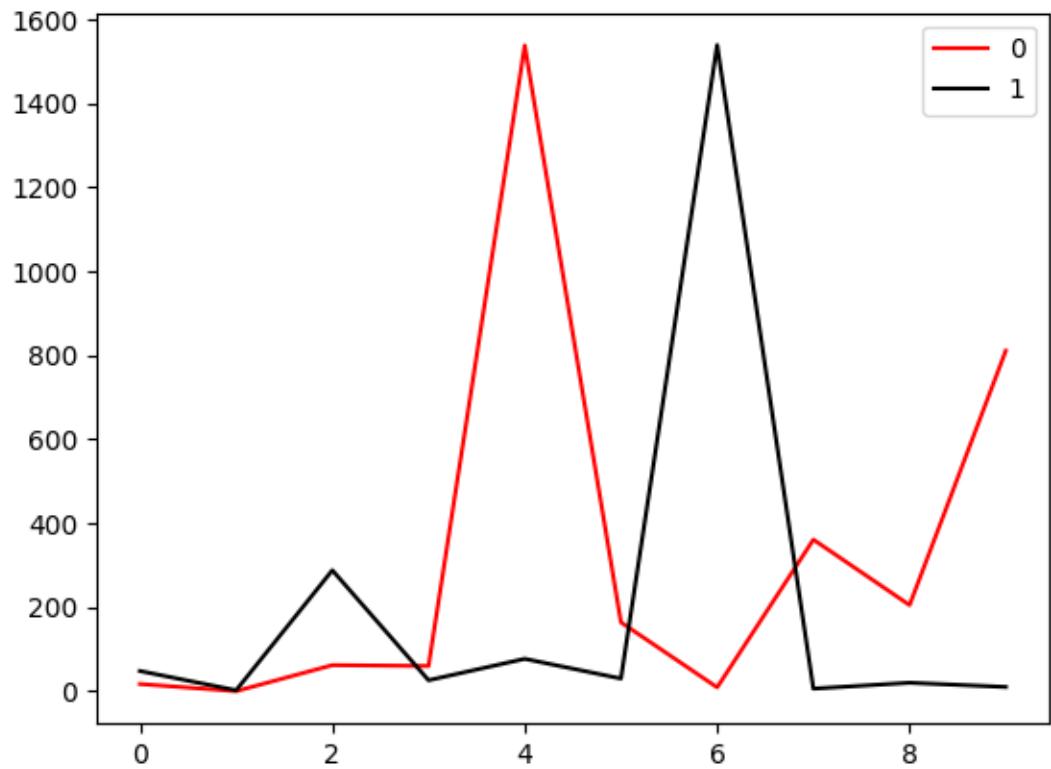
Figure\_4(100)



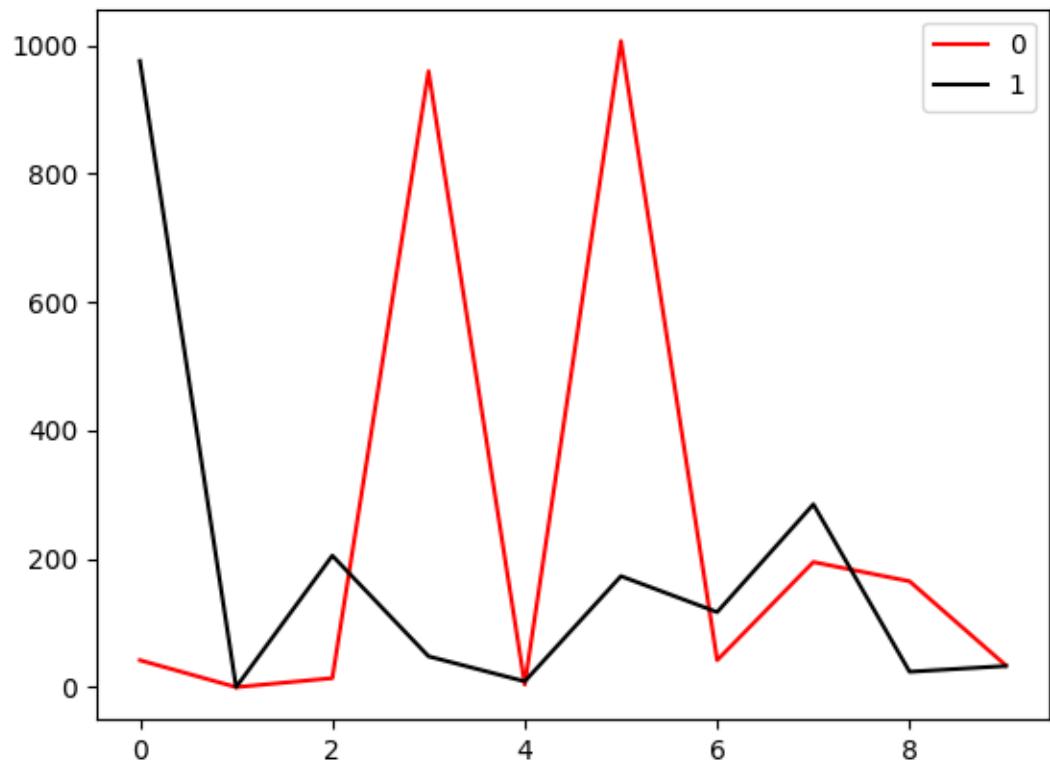
Figure\_4(101)



Figure\_4(110)

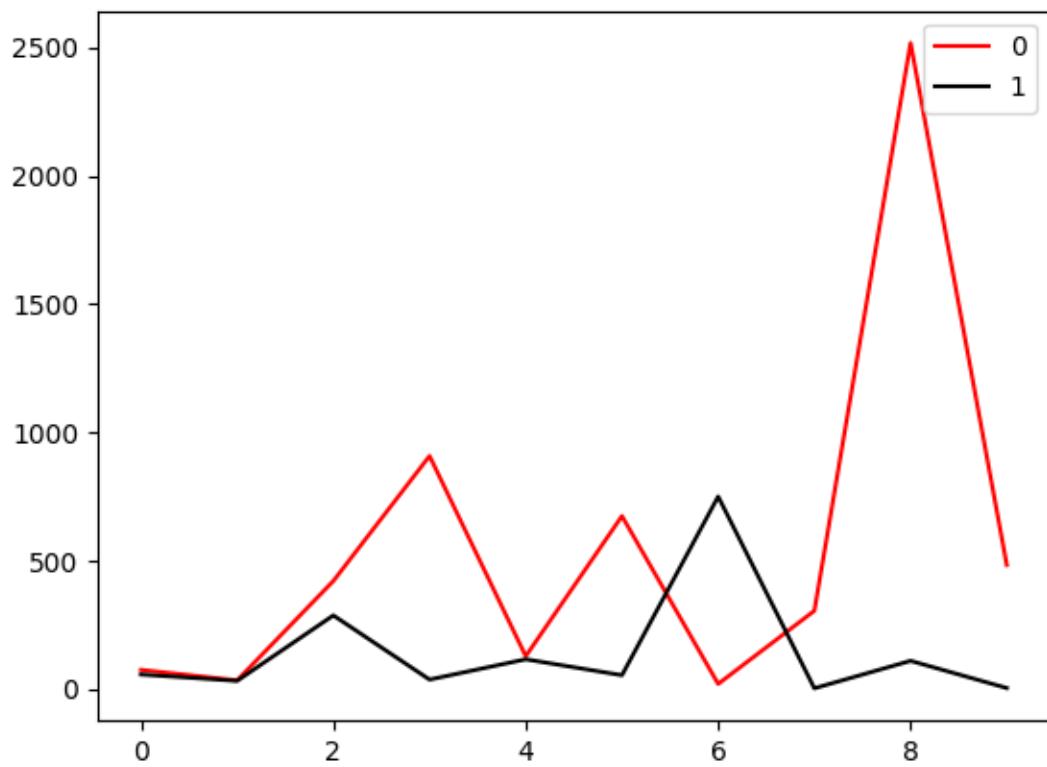


Figure\_4(111)

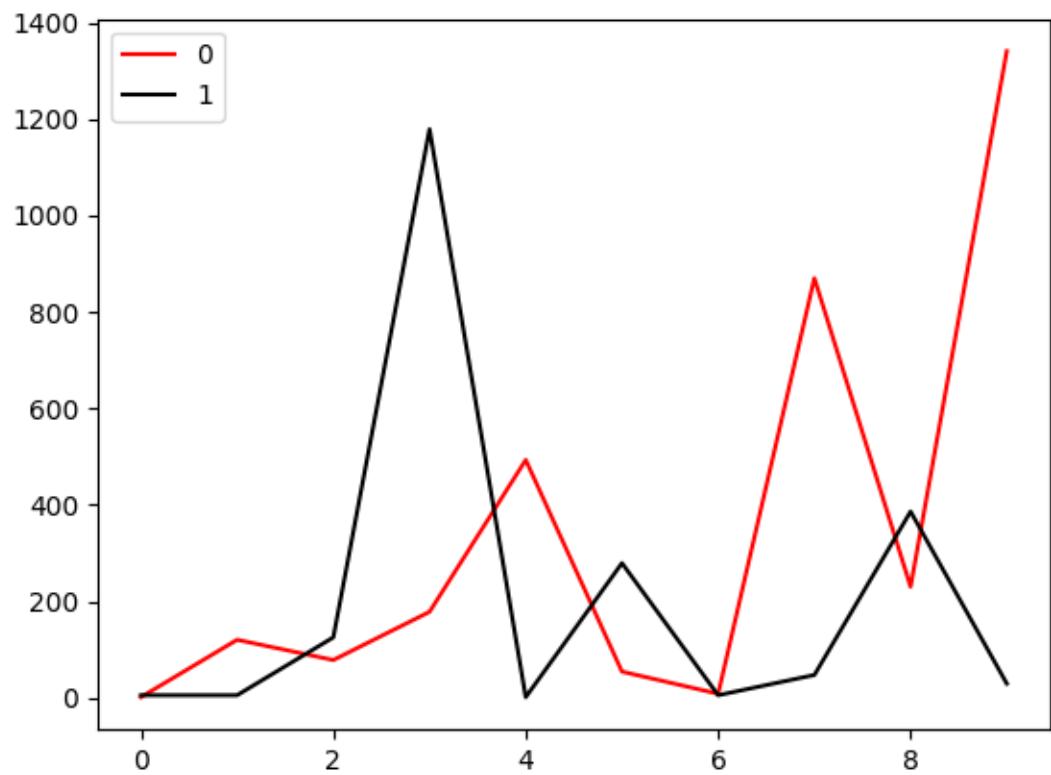


The 5<sup>th</sup> layer:

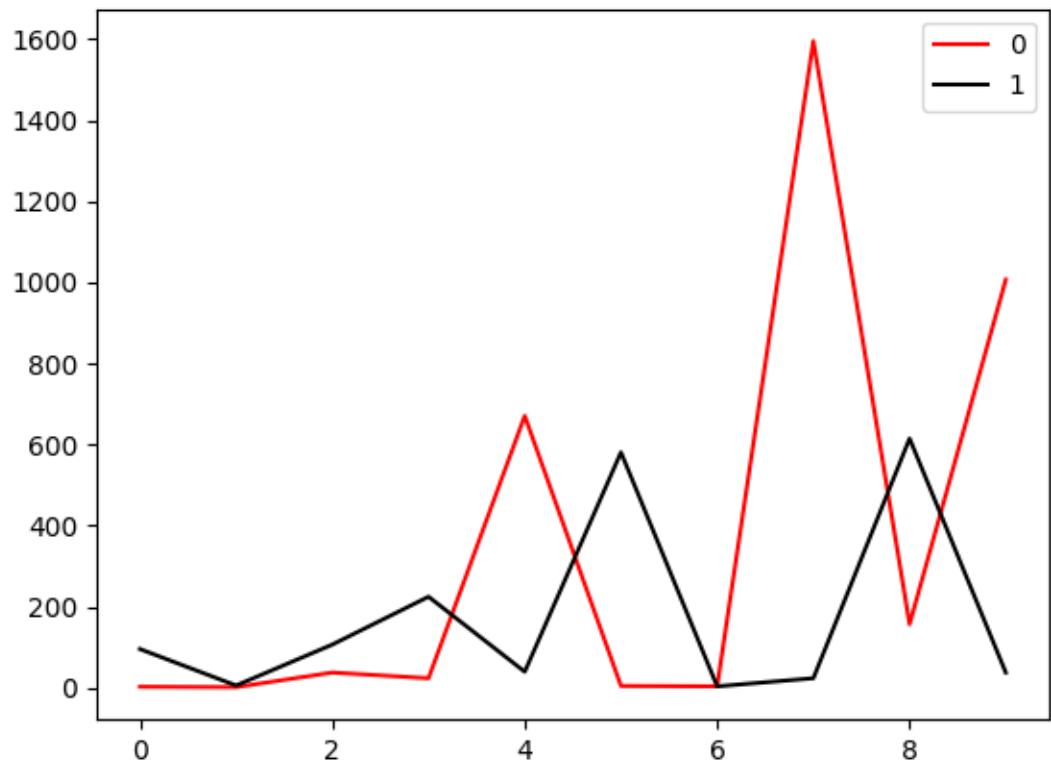
Figure\_5(0000)



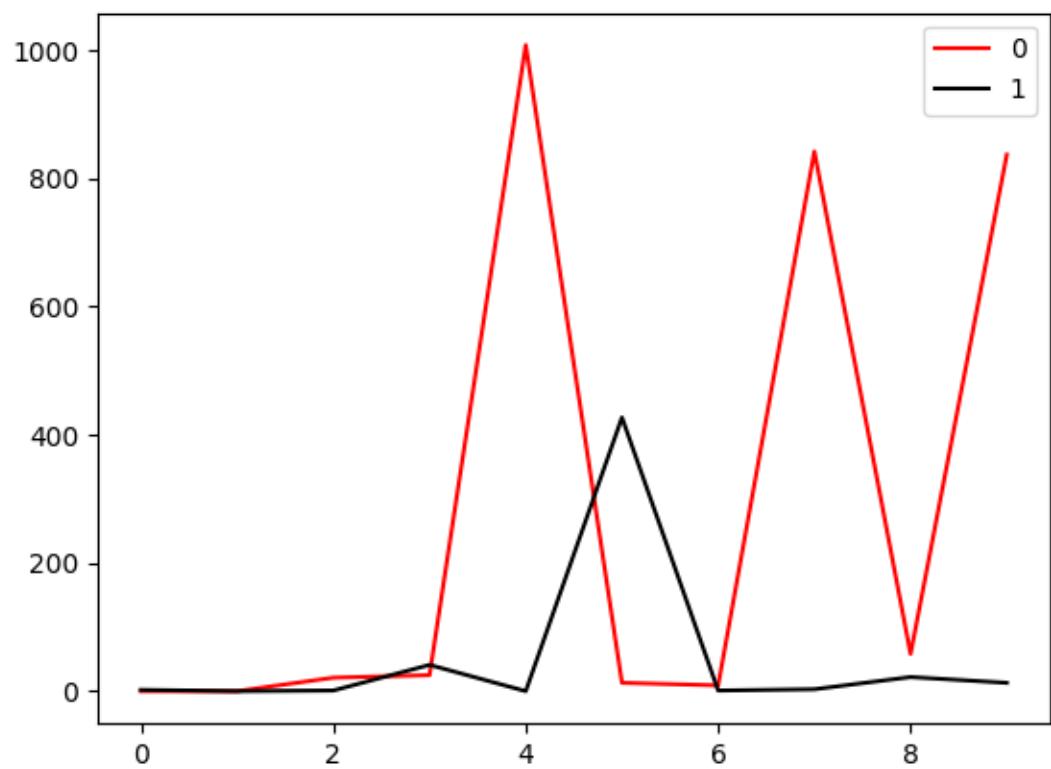
Figure\_5(0001)



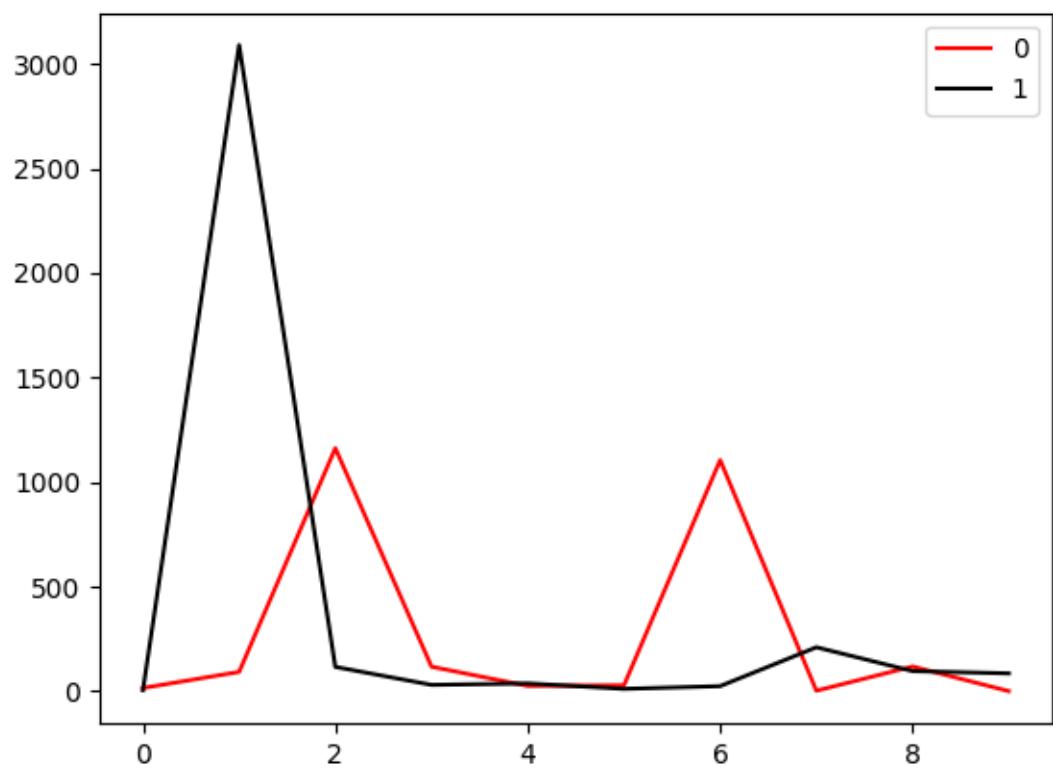
Figure\_5(0010)



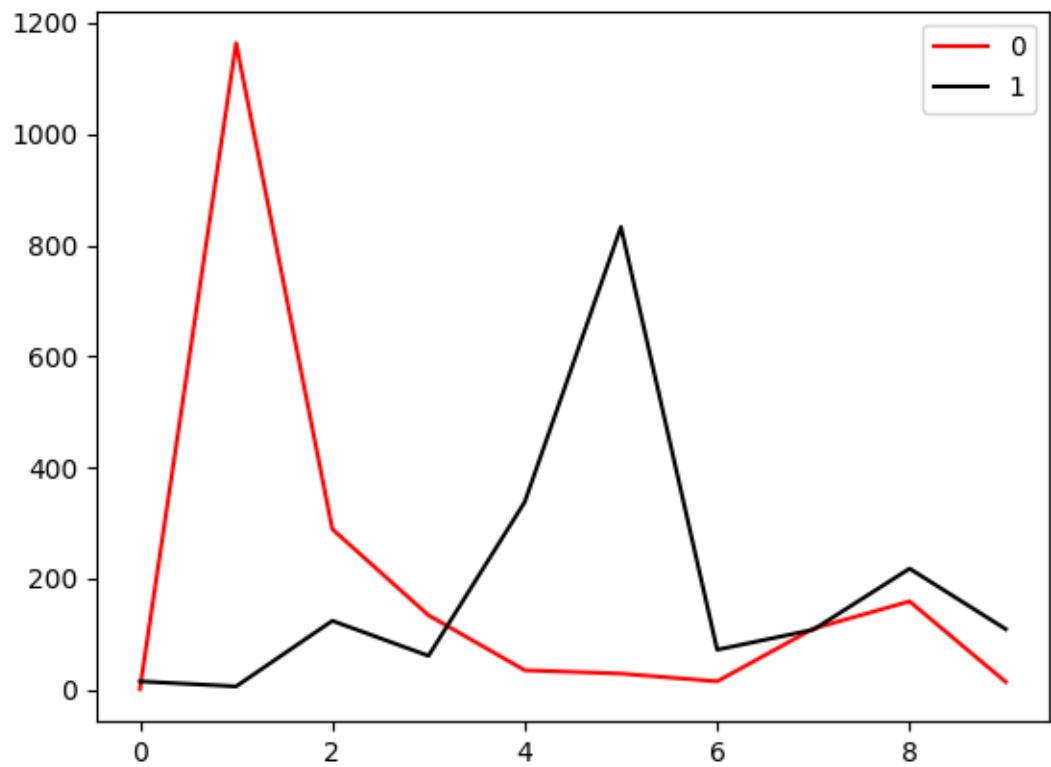
Figure\_5(0011)



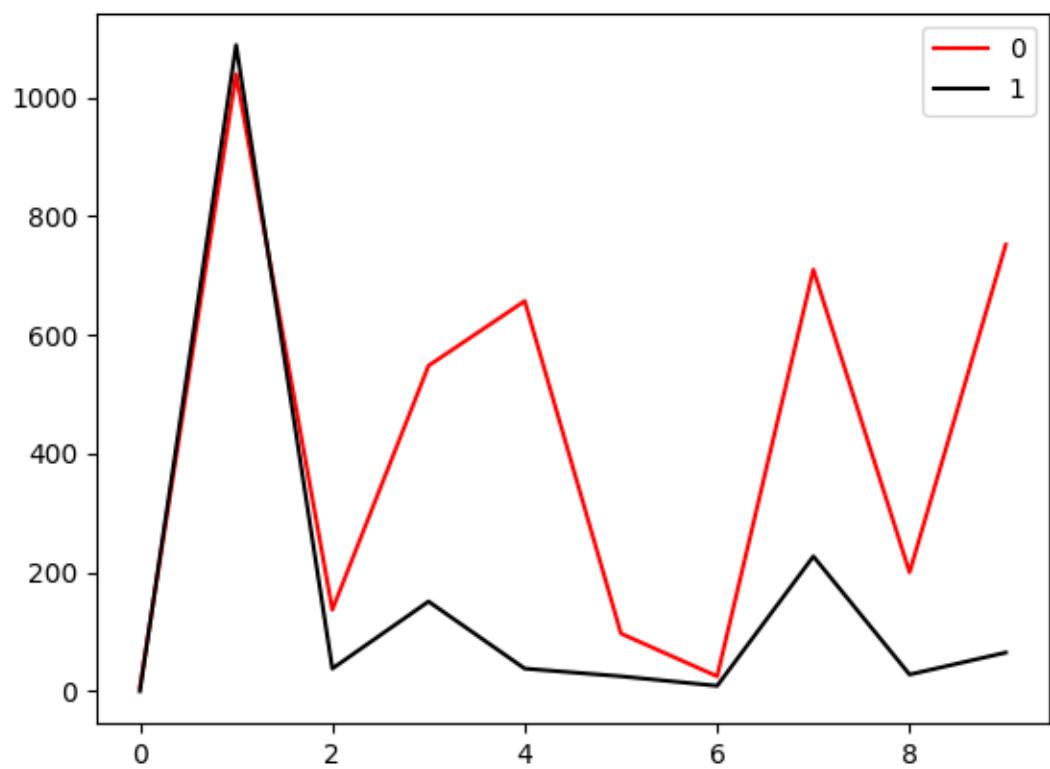
Figure\_5(0100)



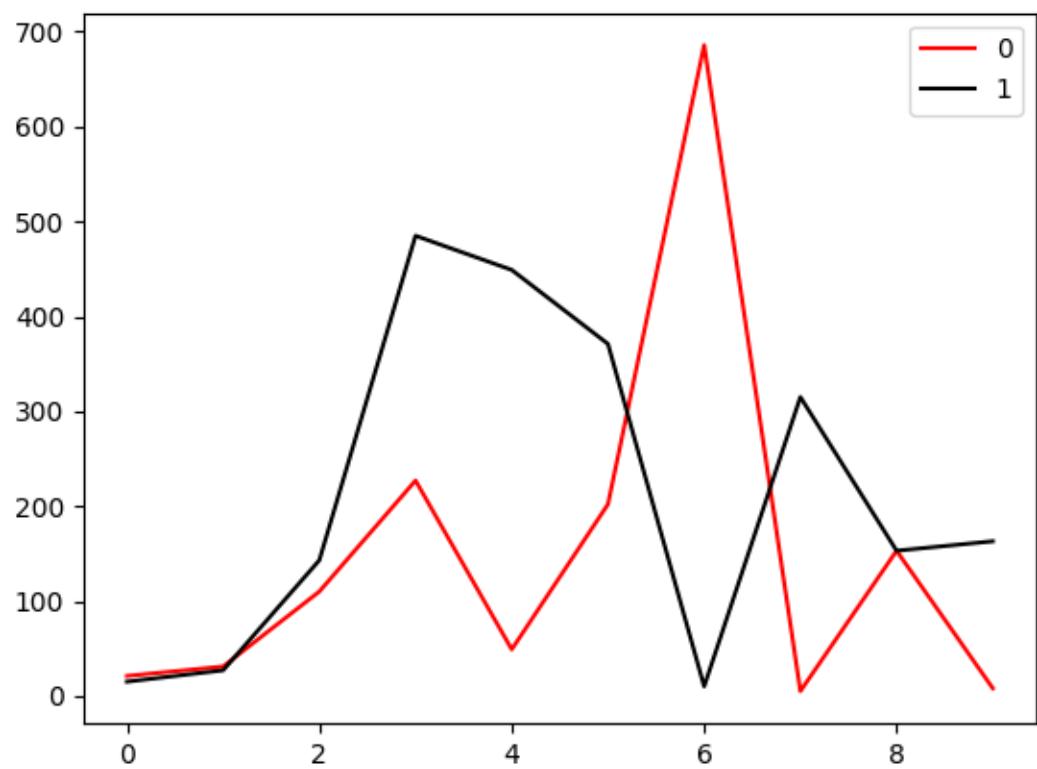
Figure\_5(0101)



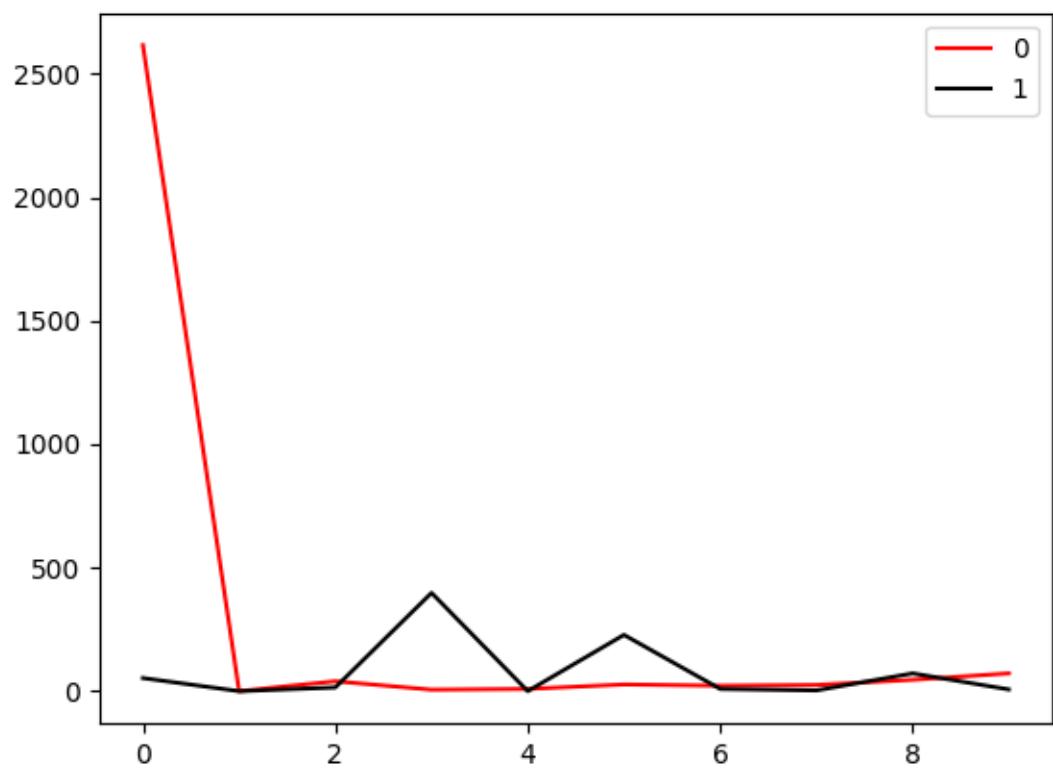
Figure\_5(0110)



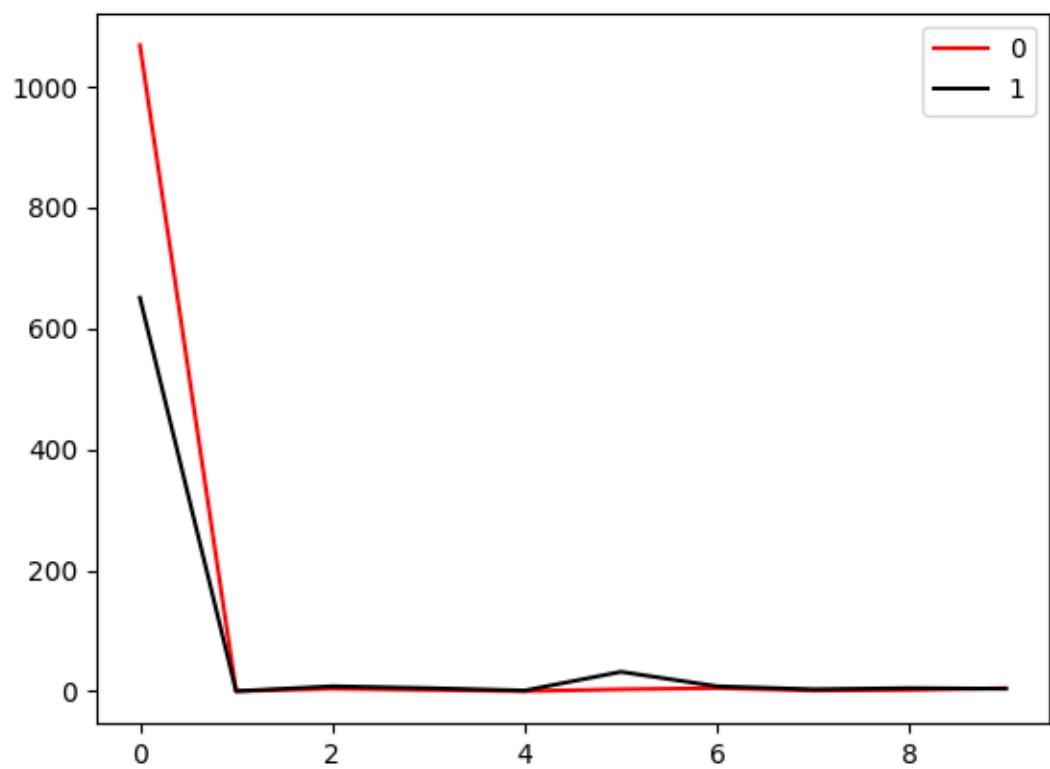
Figure\_5(0111)



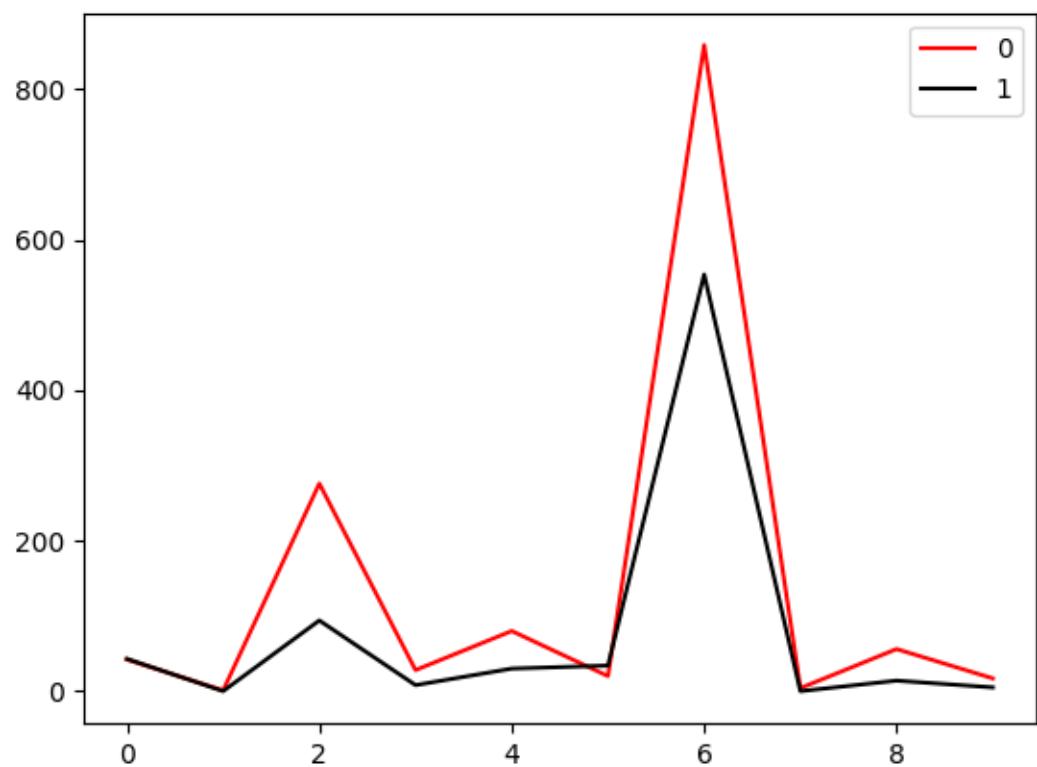
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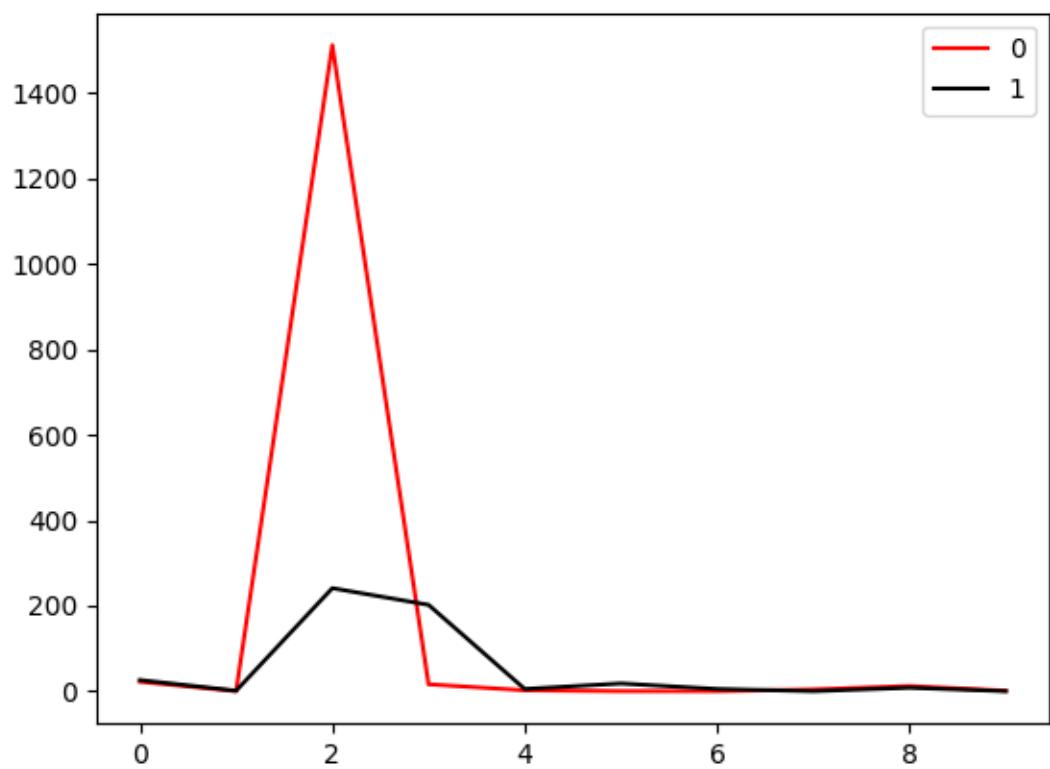
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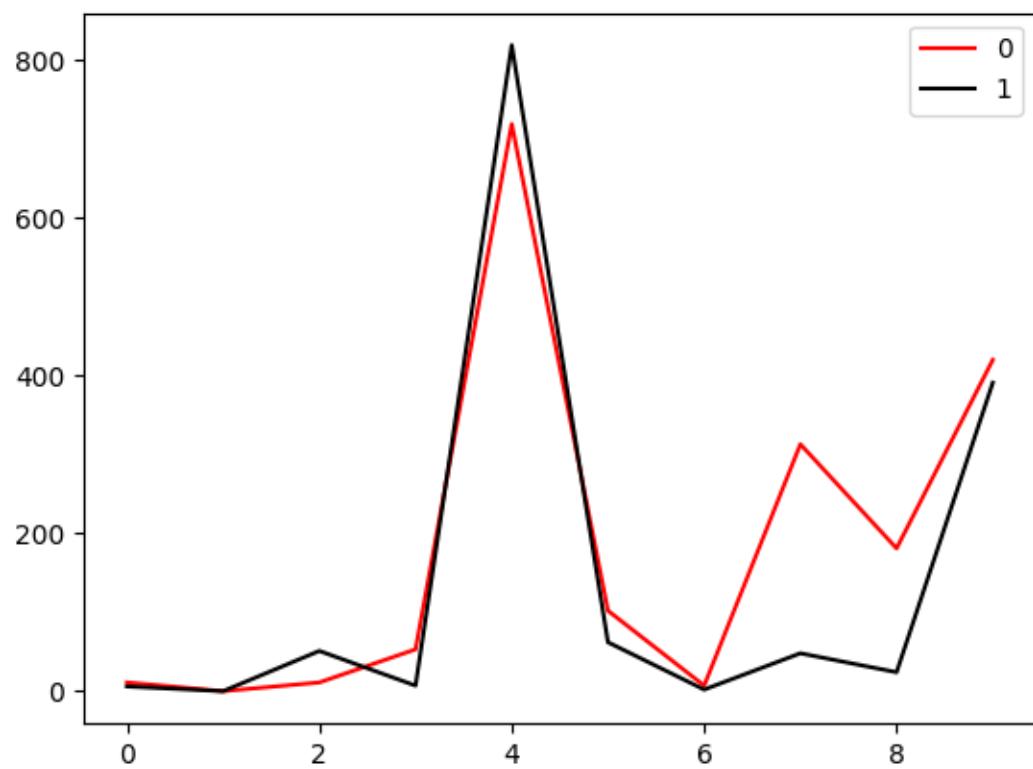
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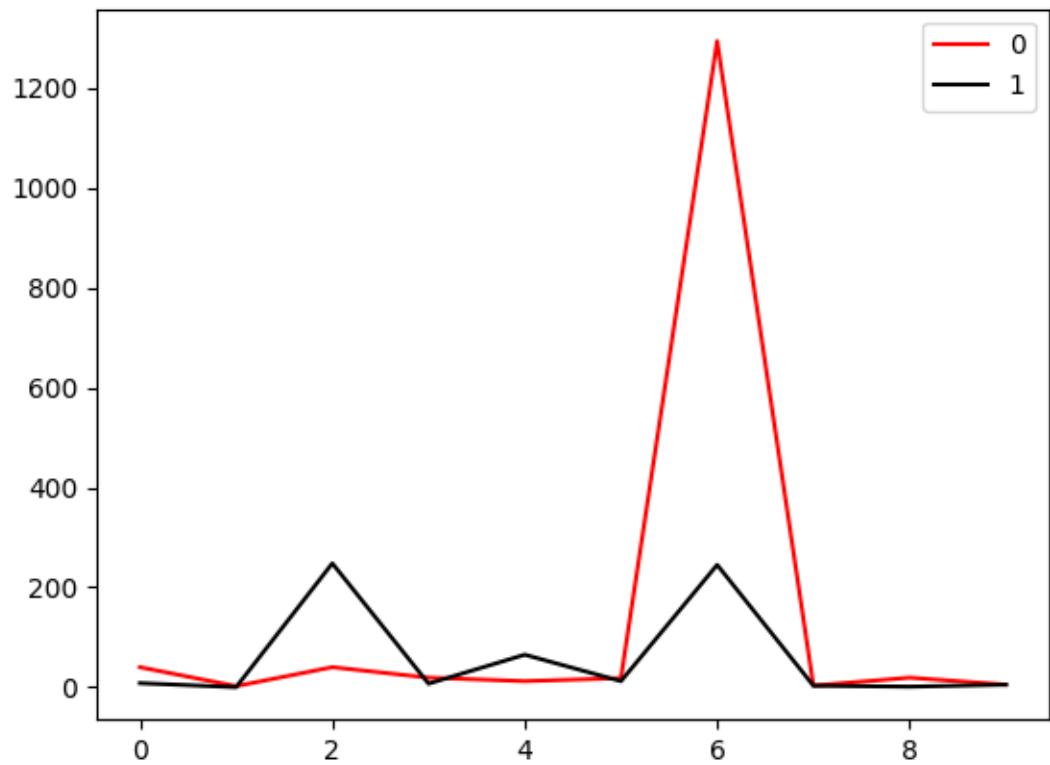
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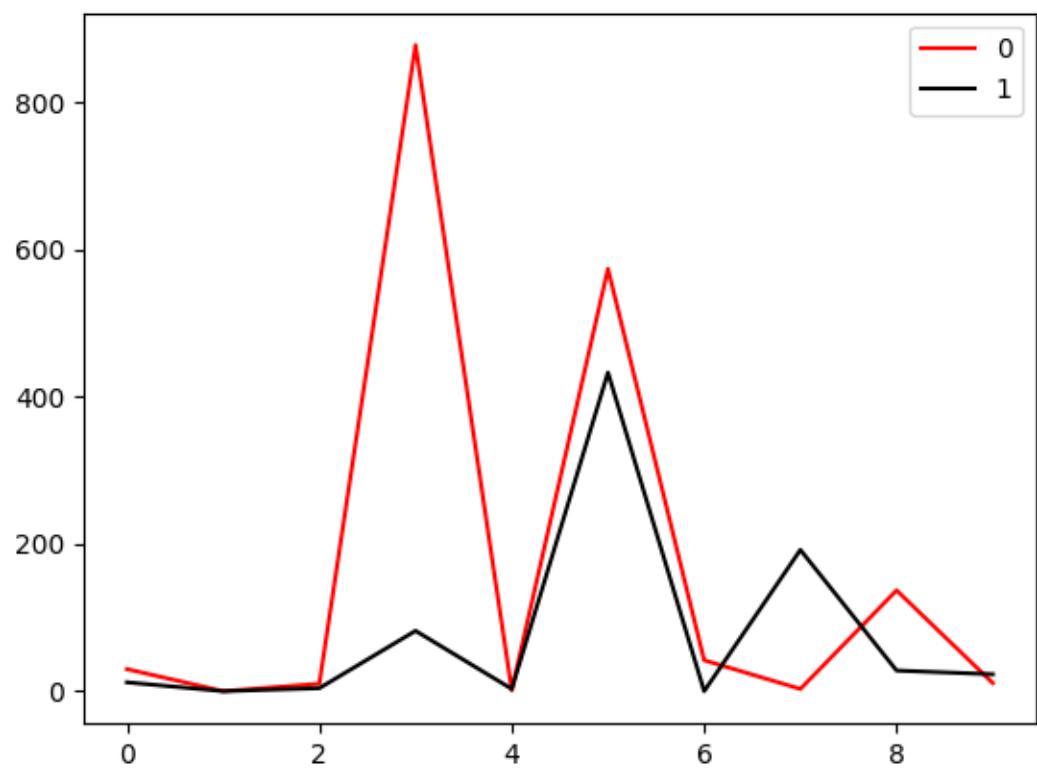
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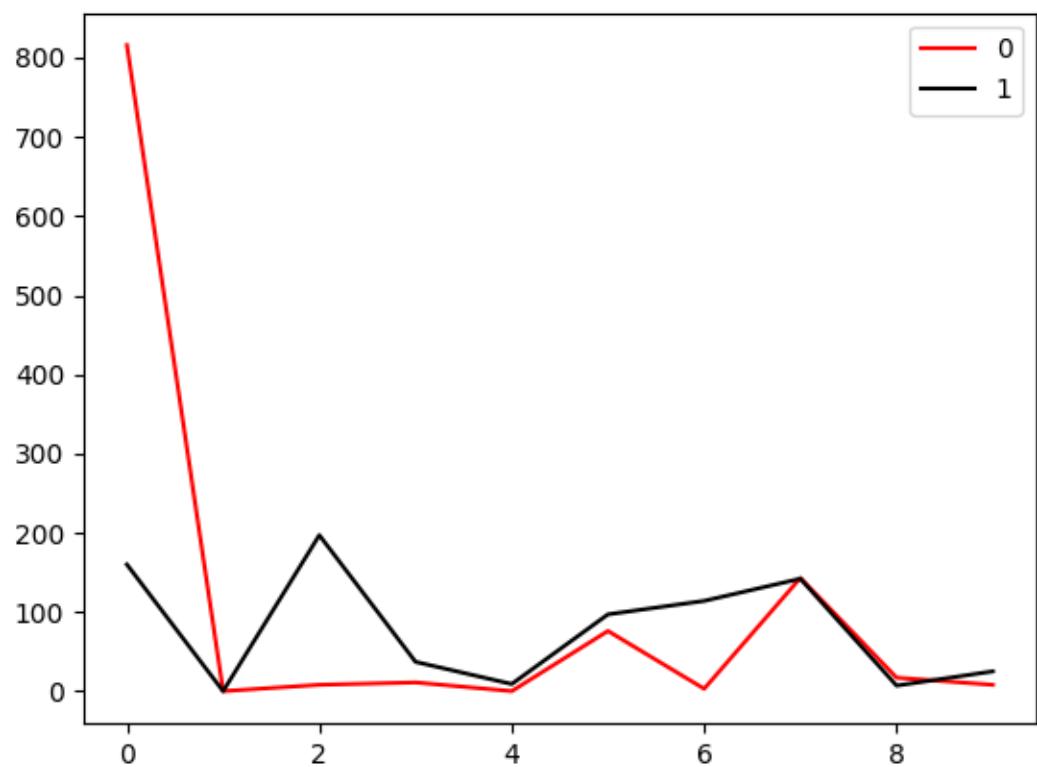
Figure\_5(1101)



Figure\_5(1110)

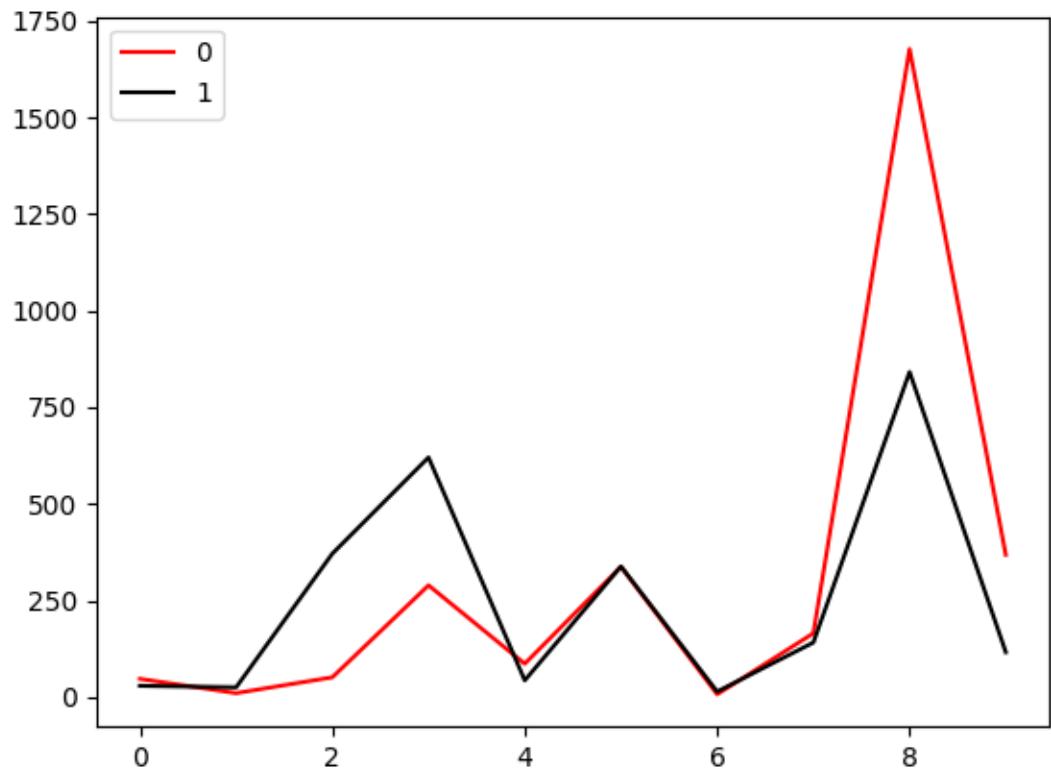


Figure\_5(1111)

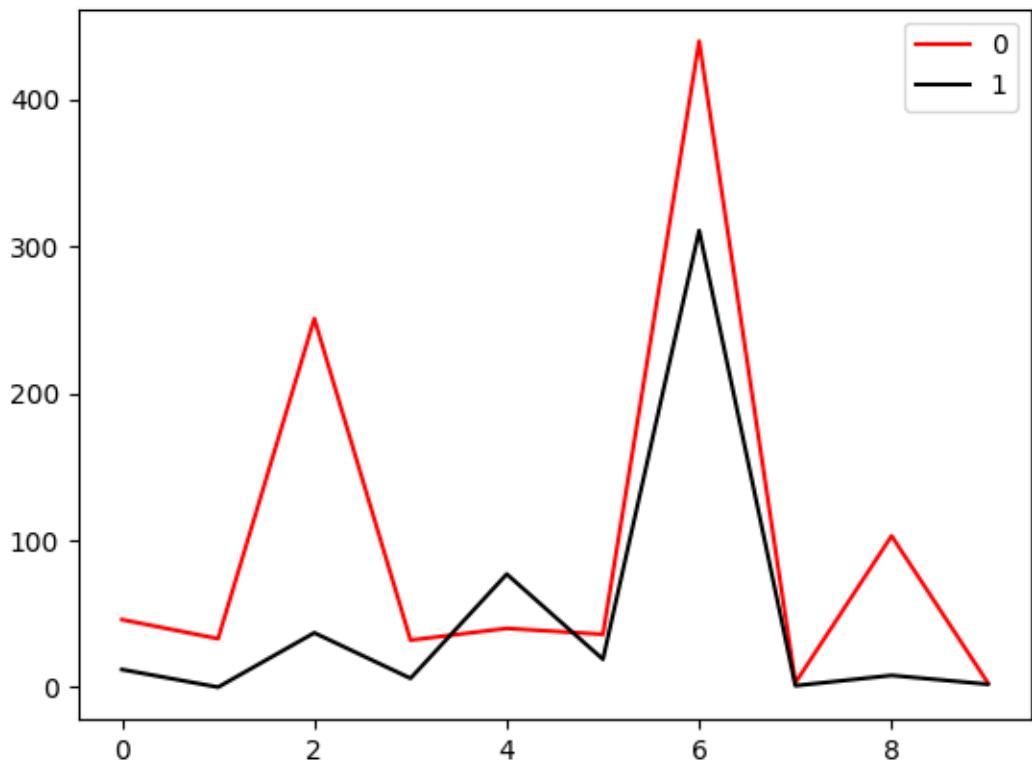


The 6<sup>th</sup> layer:

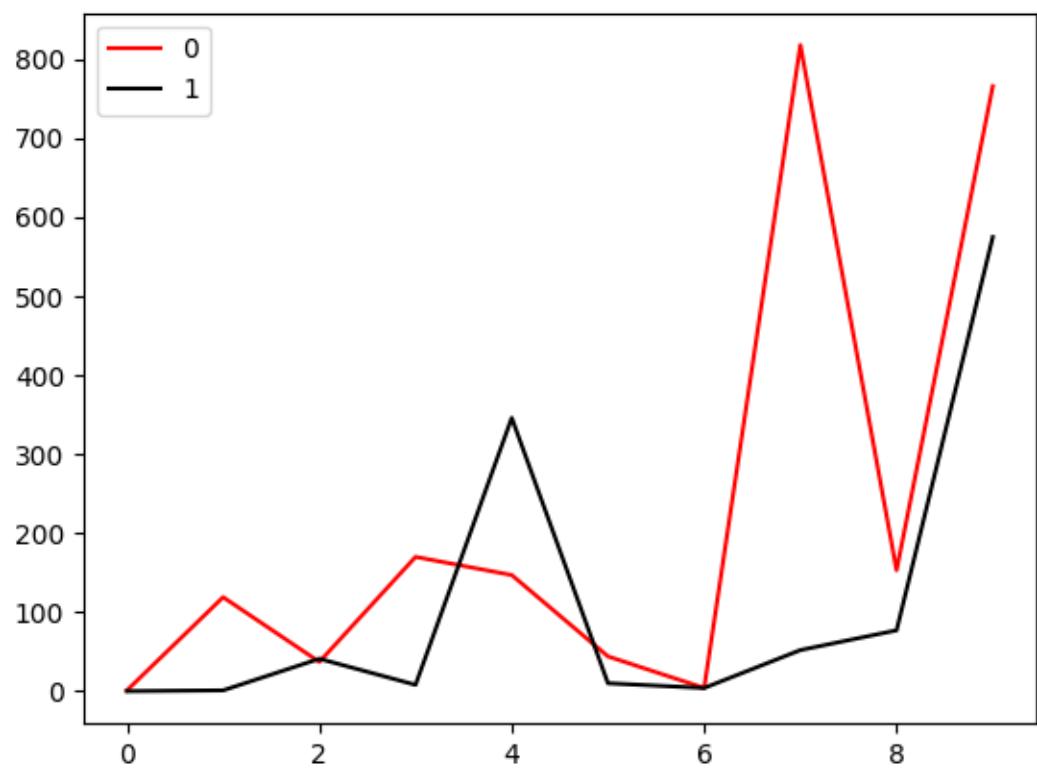
Figure\_6(00000)



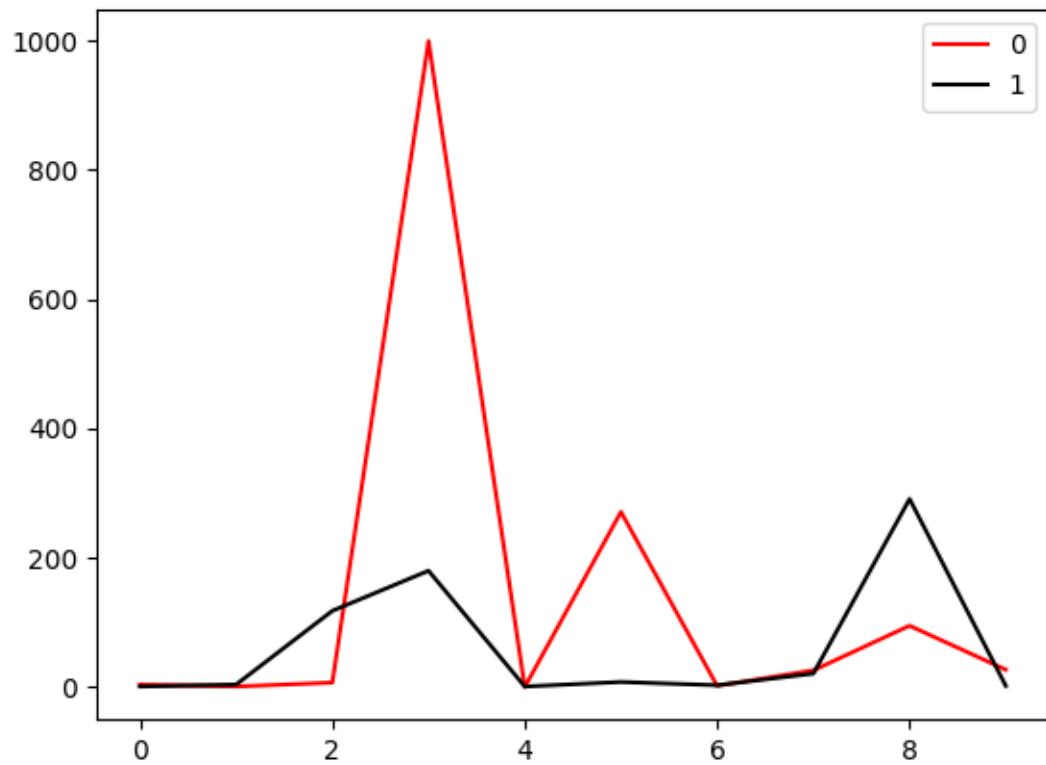
Figure\_6(00001)



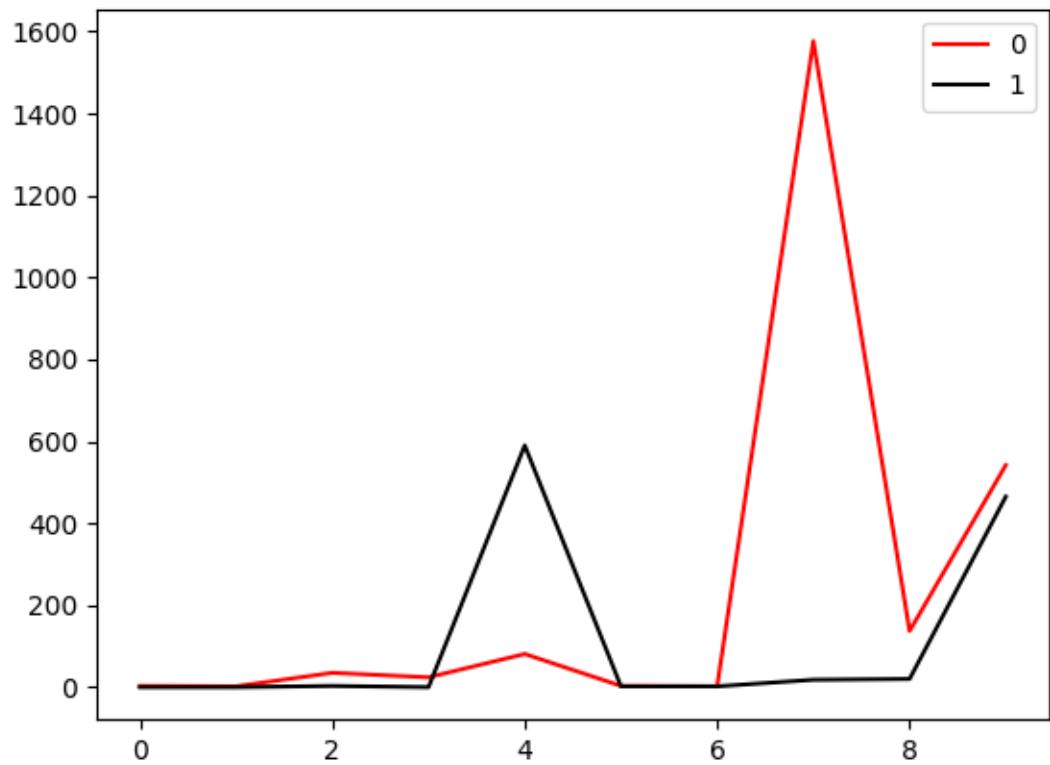
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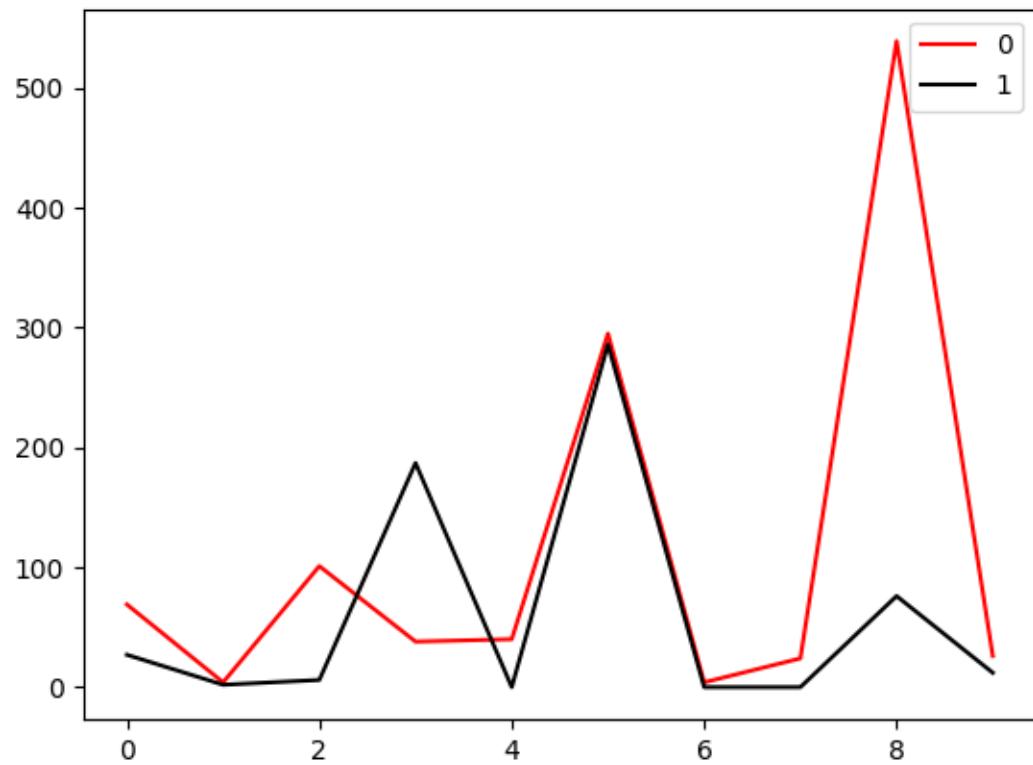
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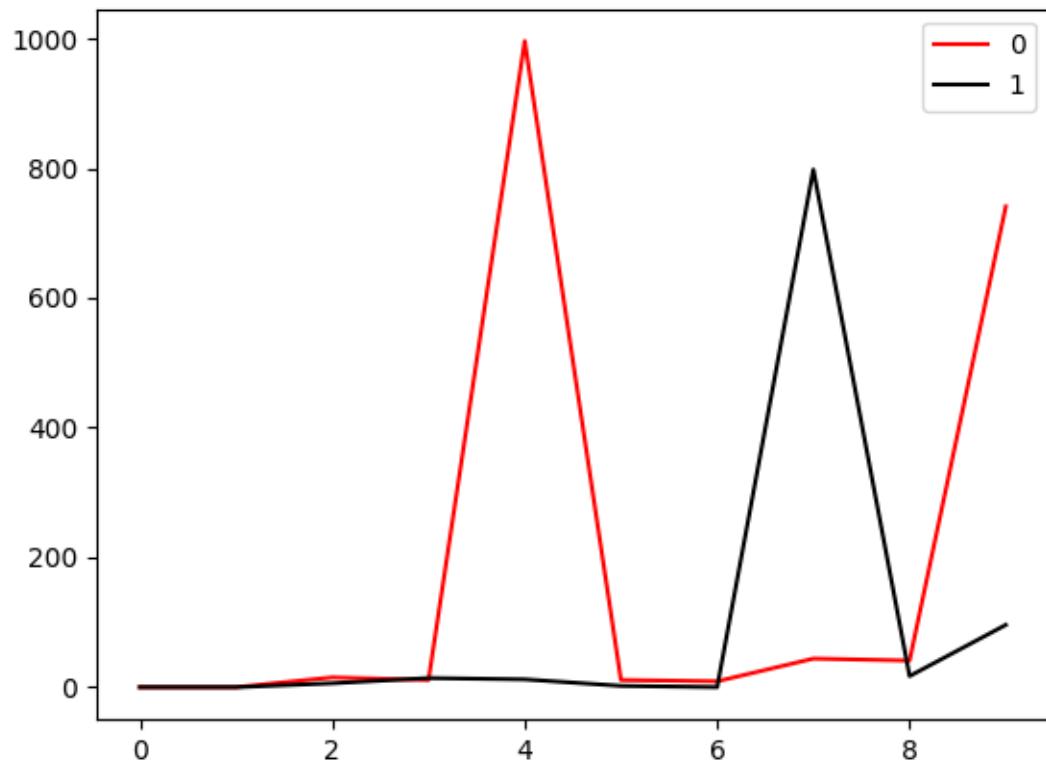
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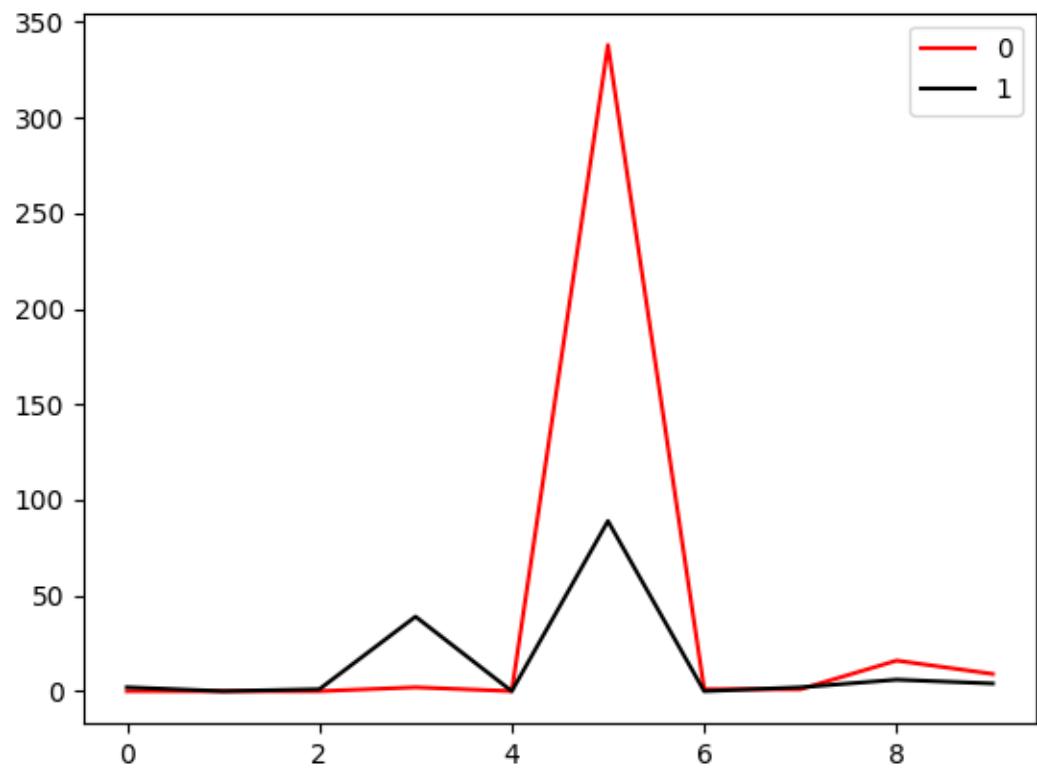
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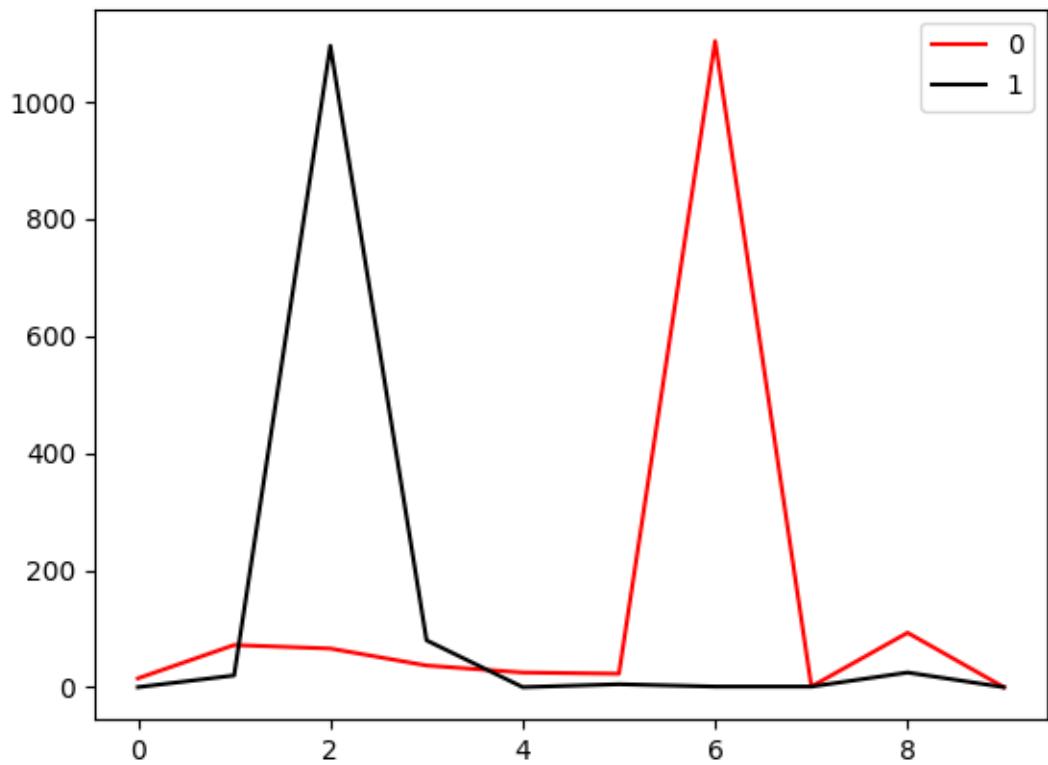
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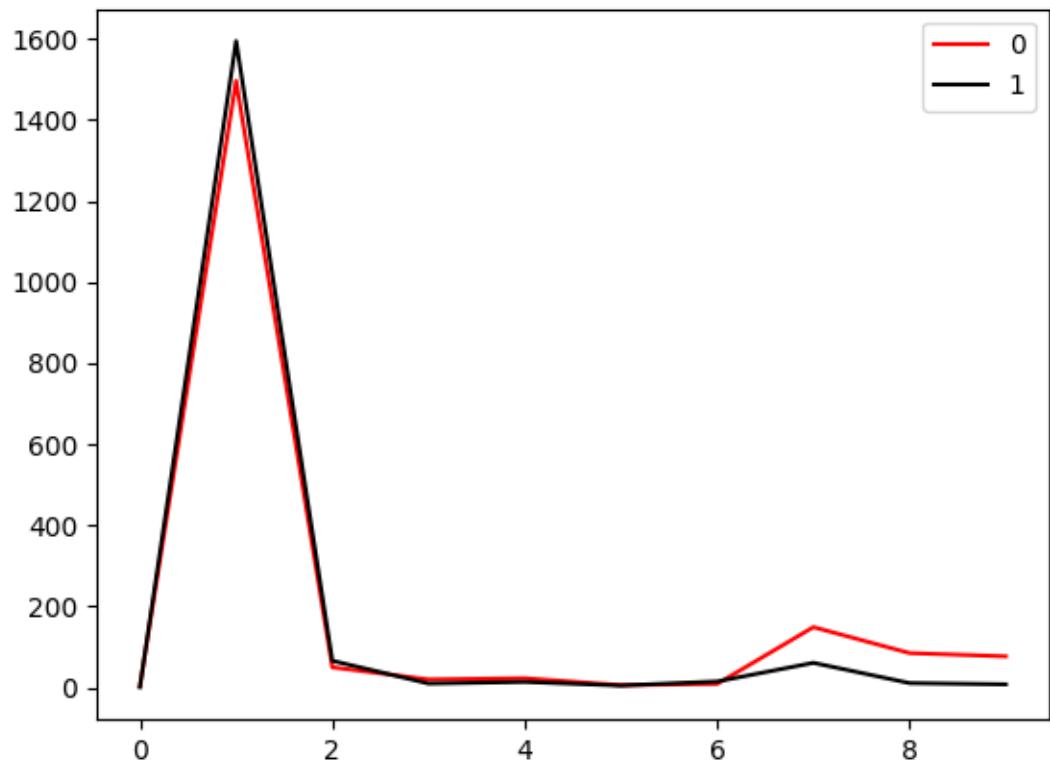
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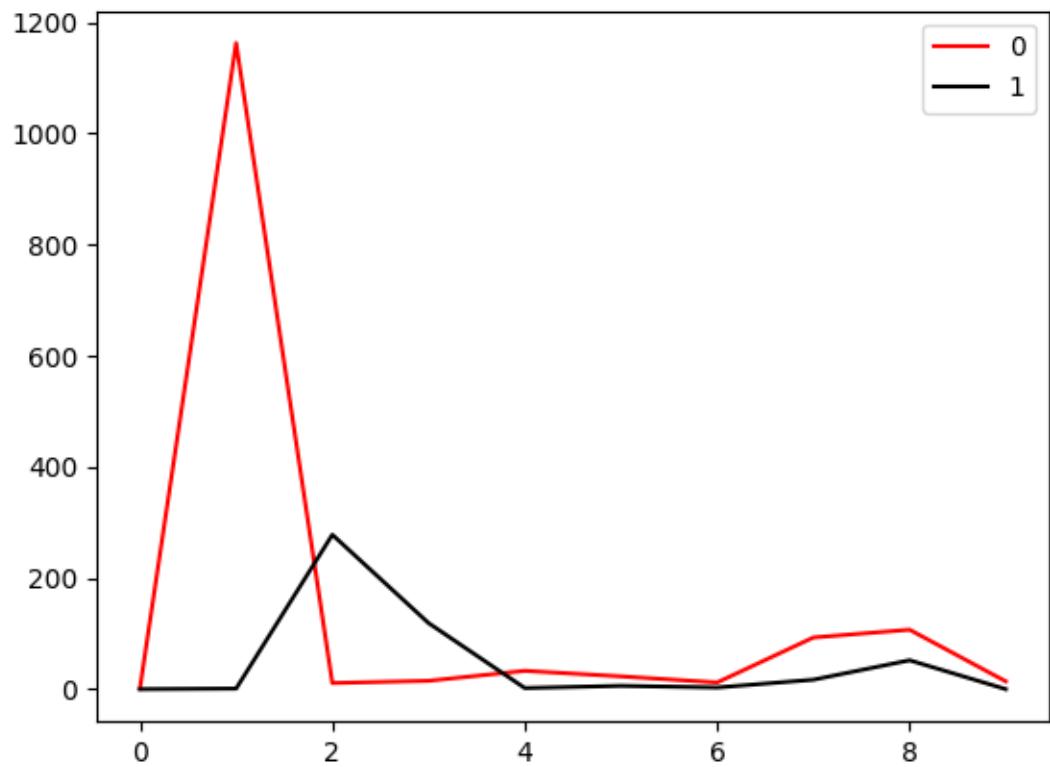
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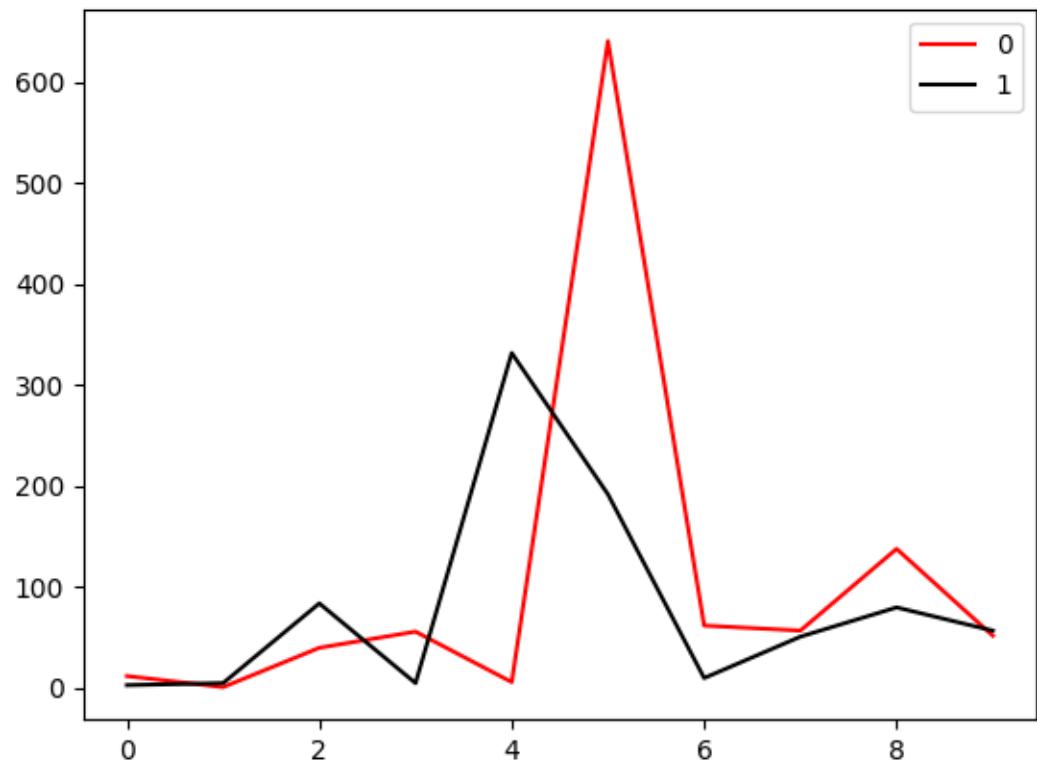
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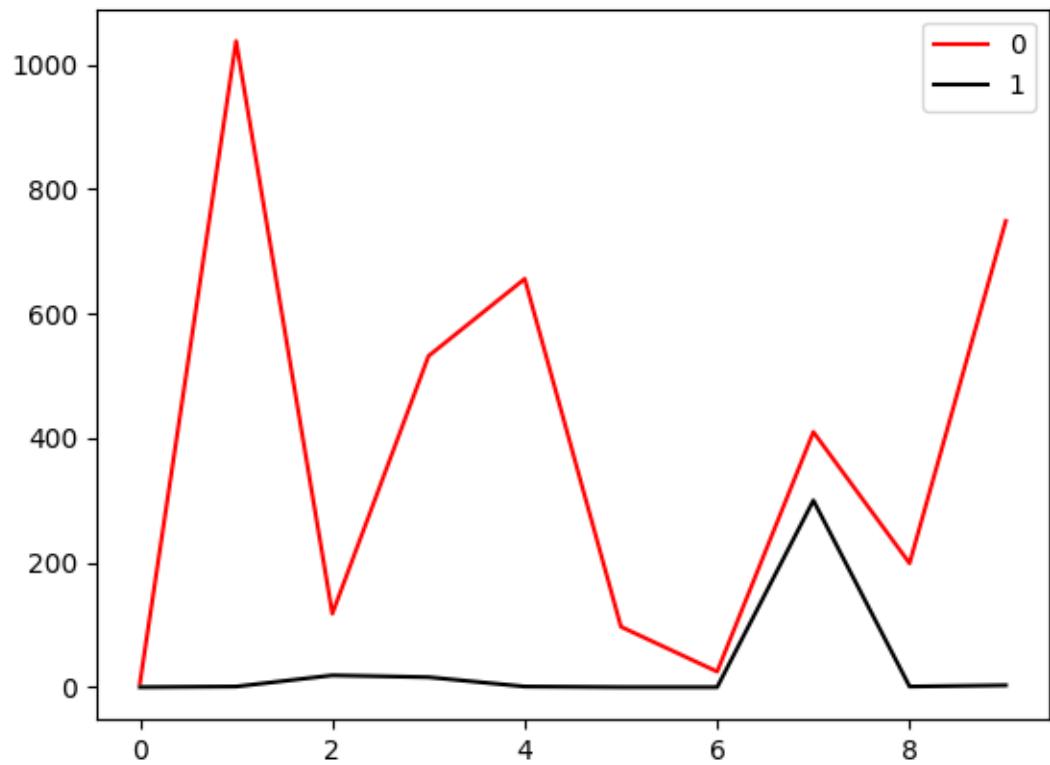
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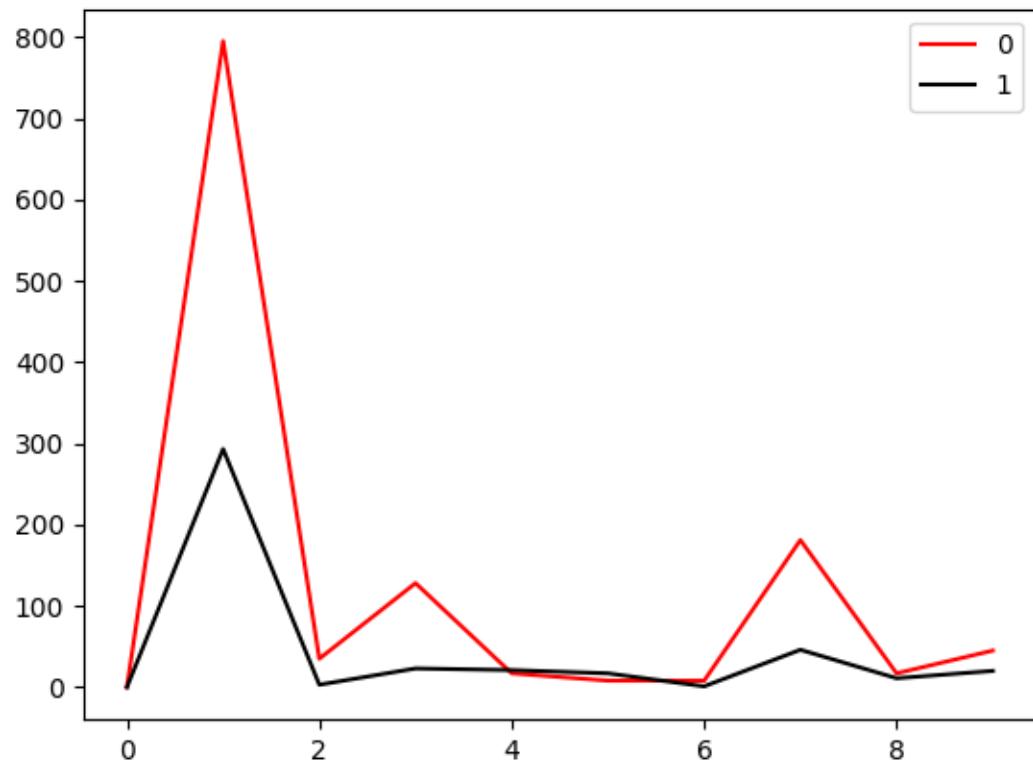
Figure\_6(01011)



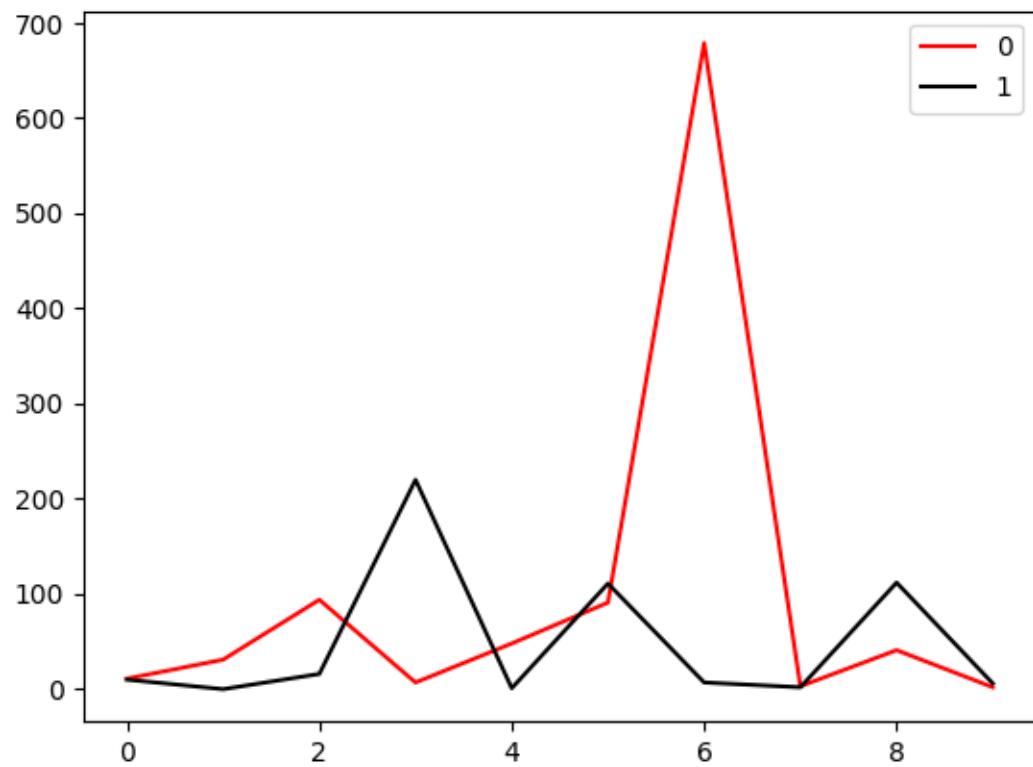
Figure\_6(01100)



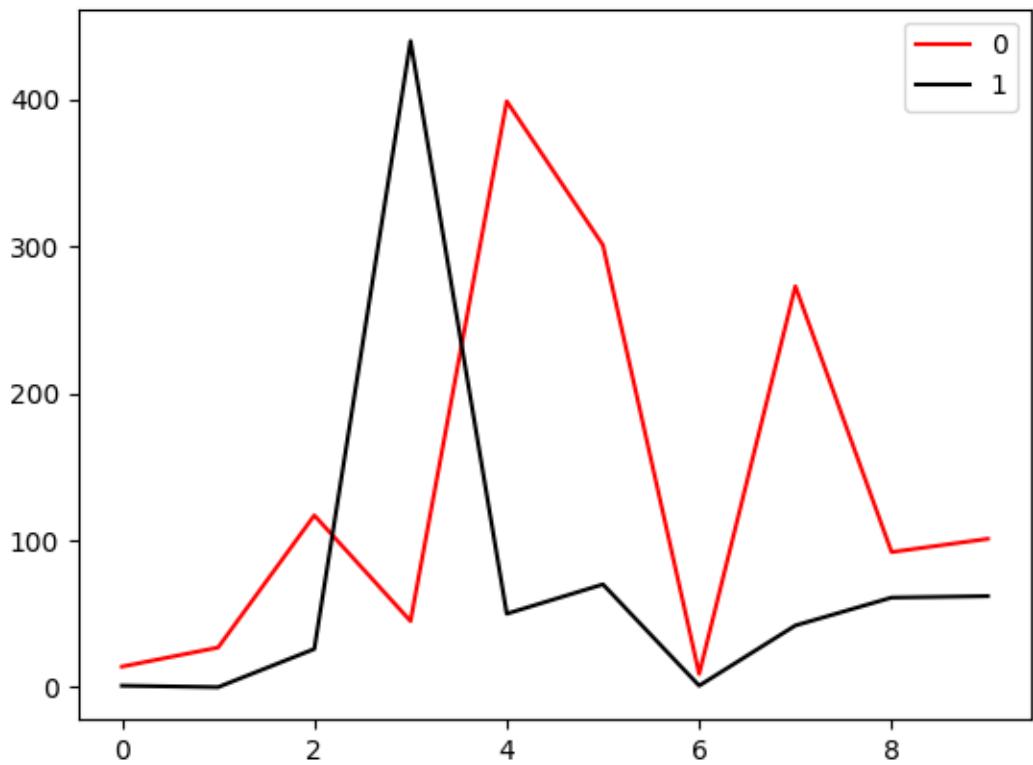
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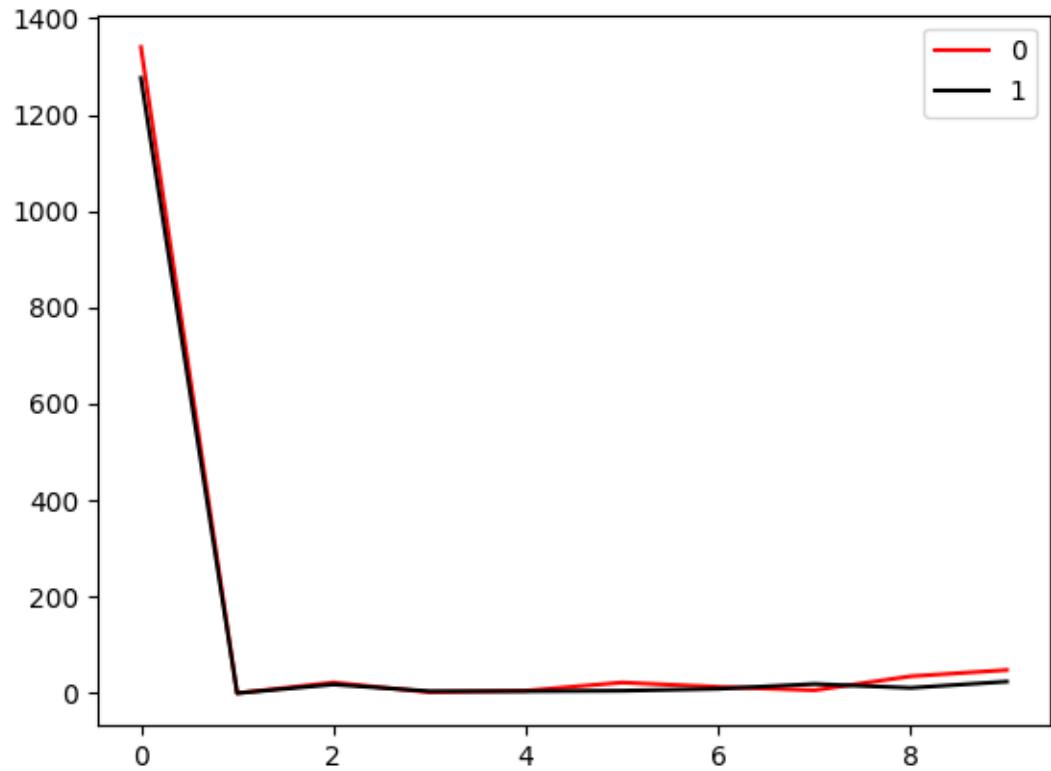
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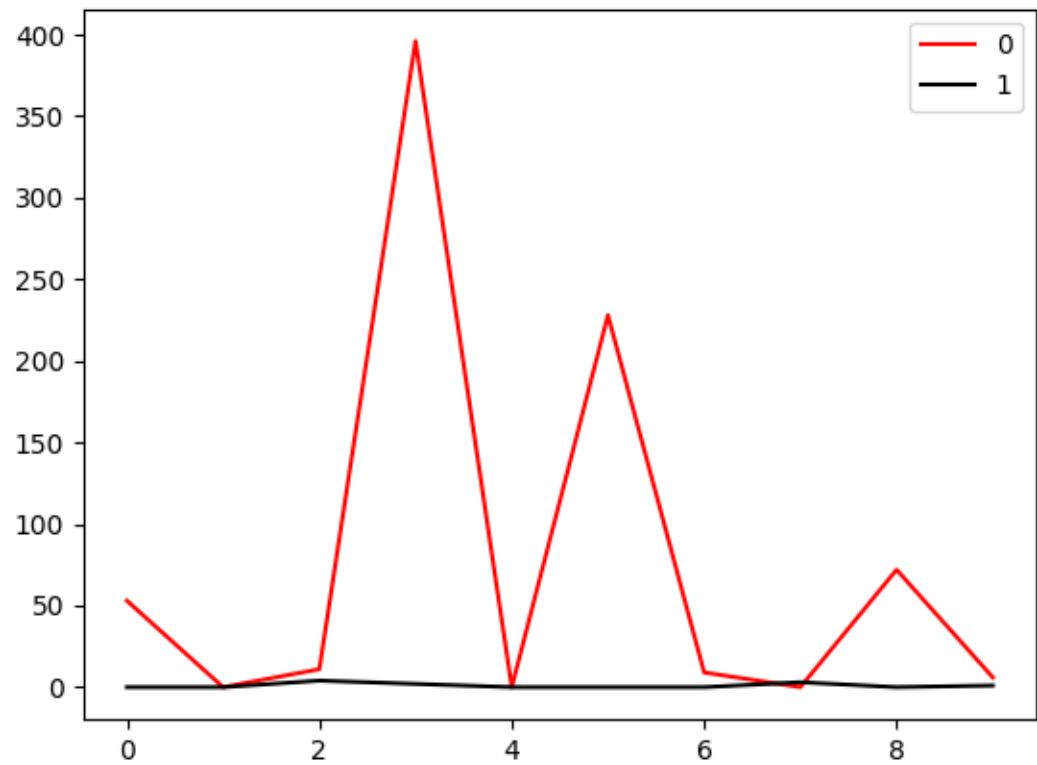
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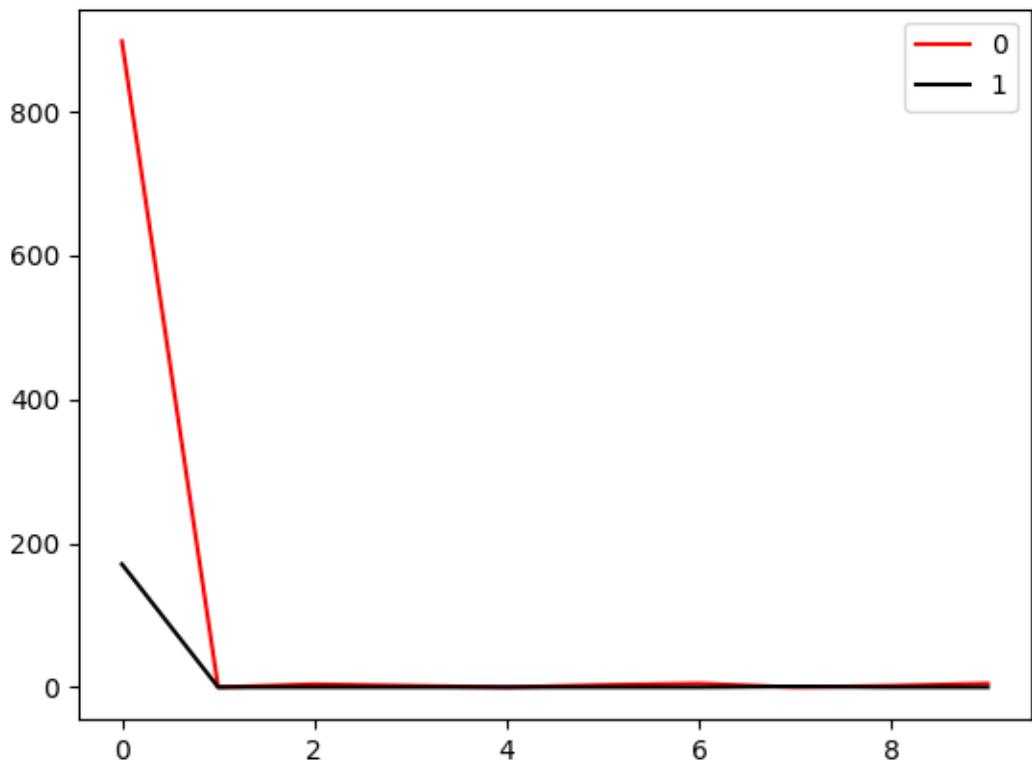
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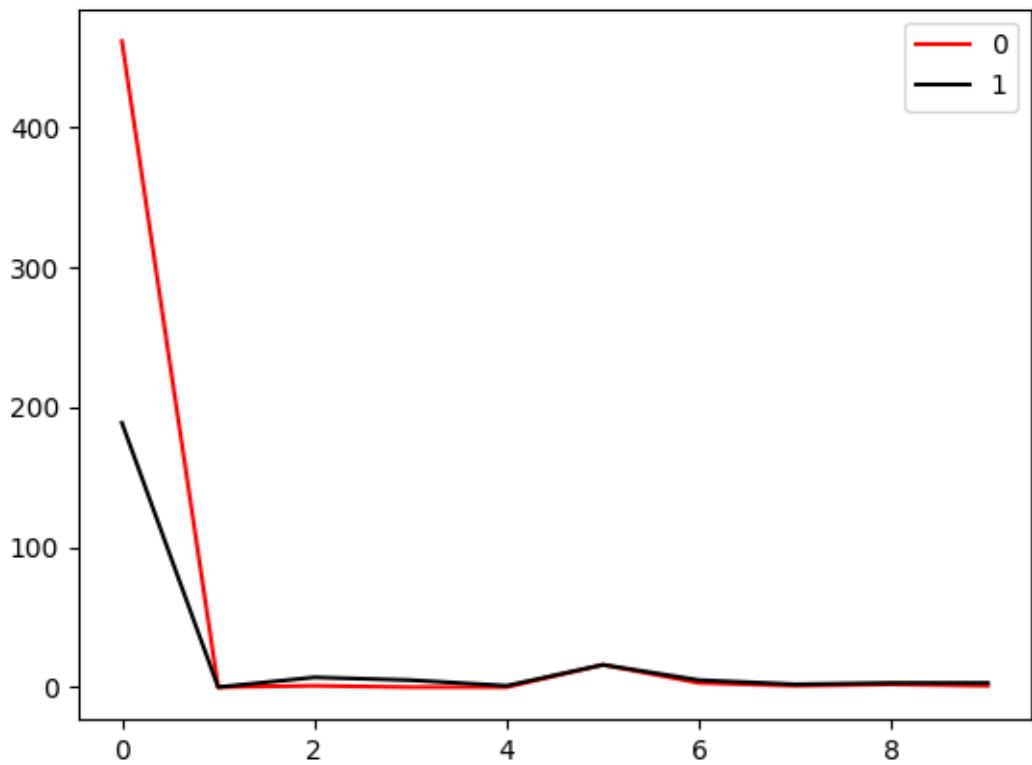
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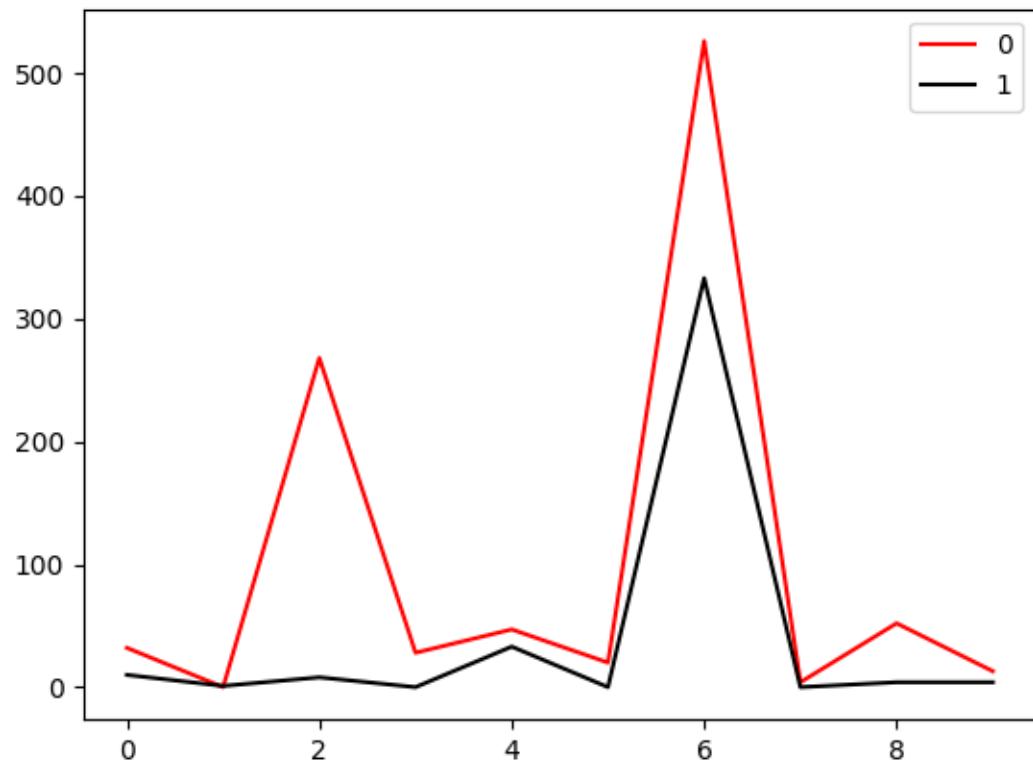
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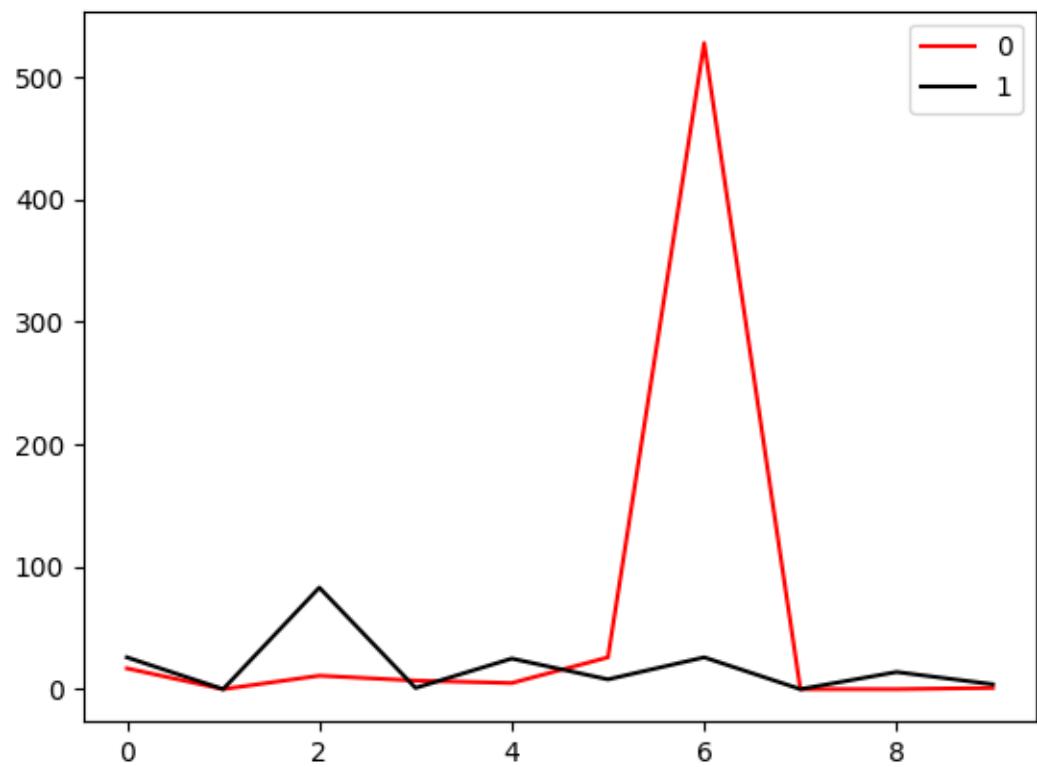
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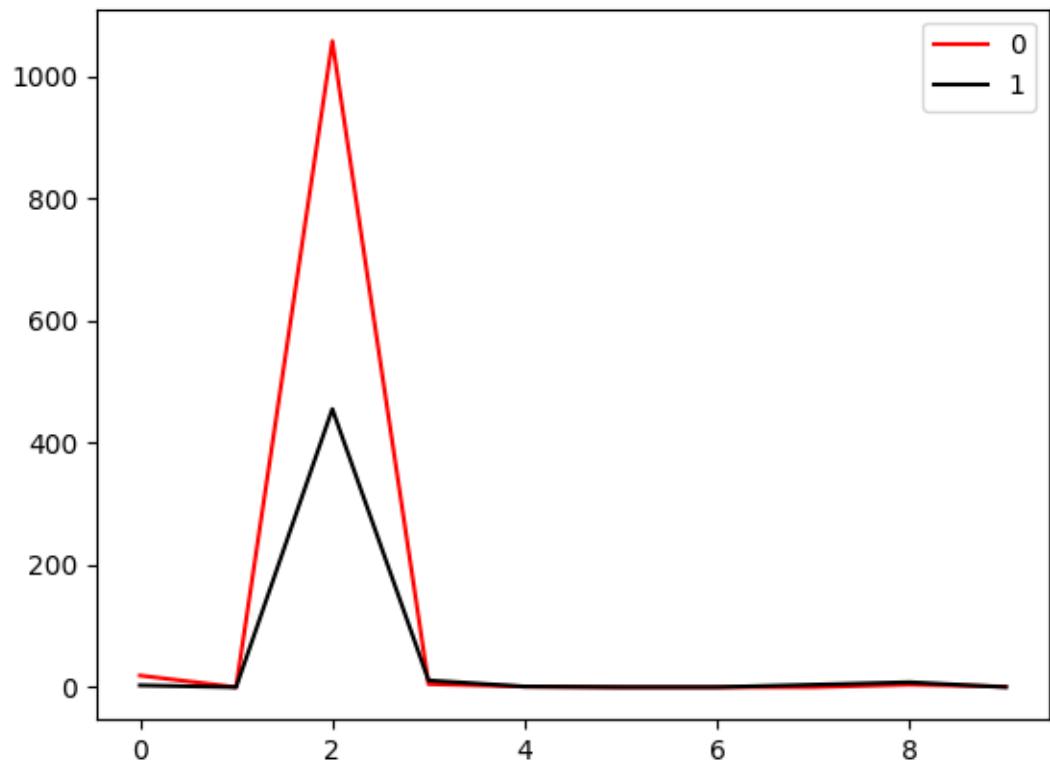
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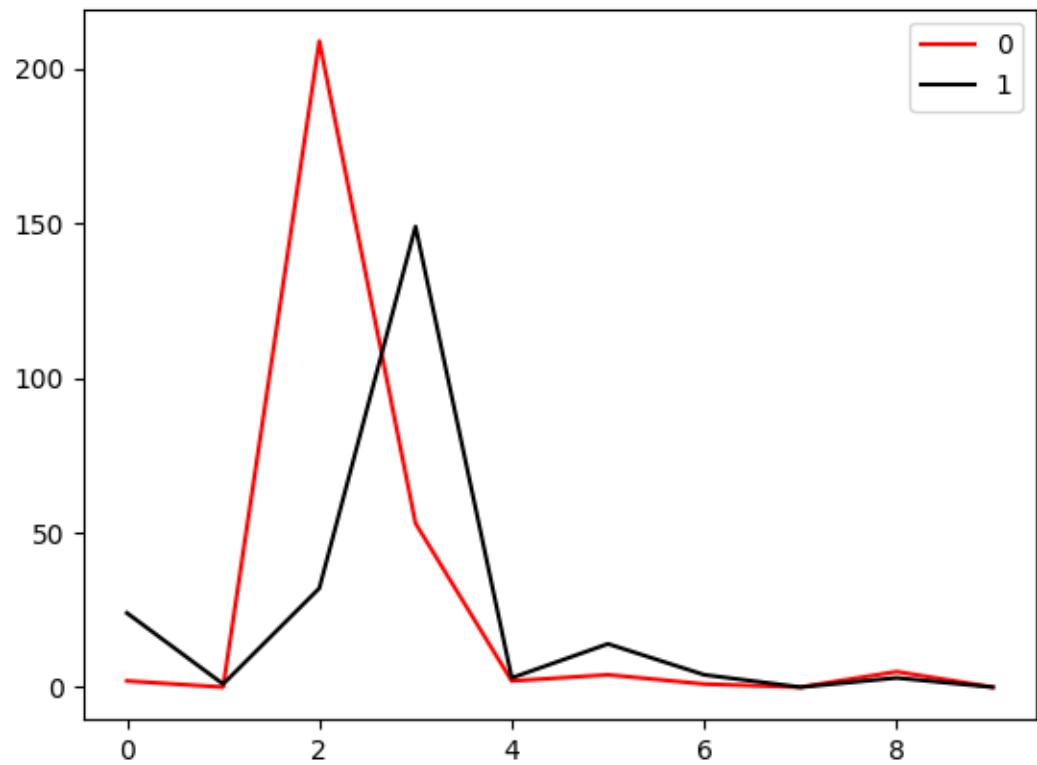
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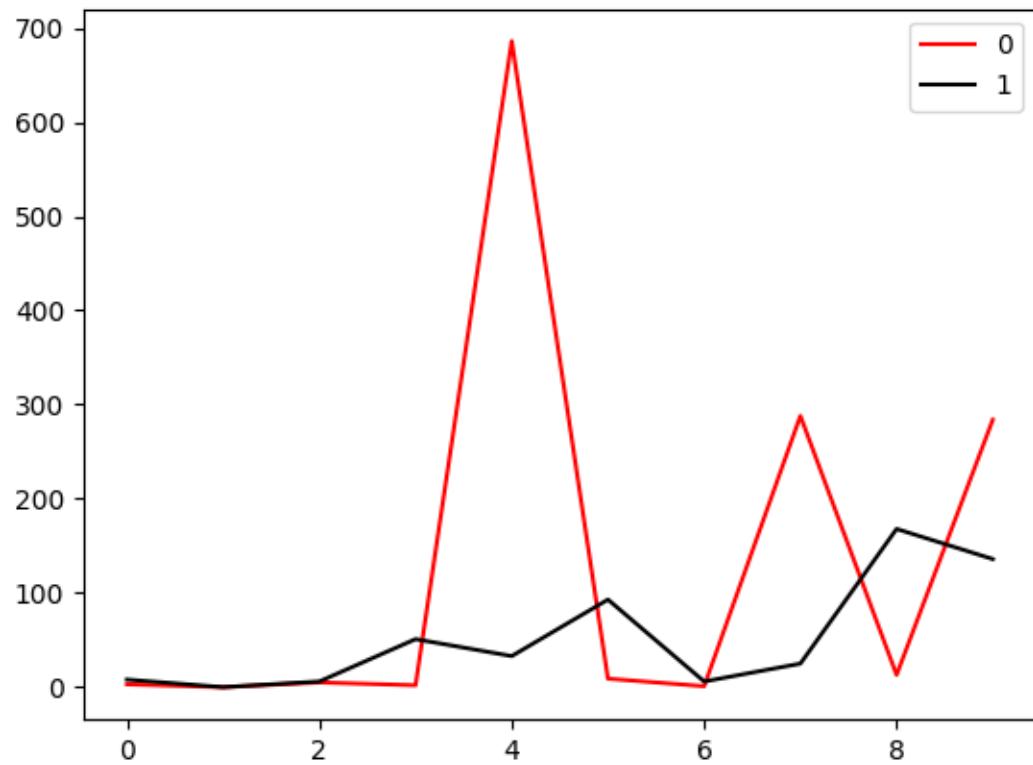
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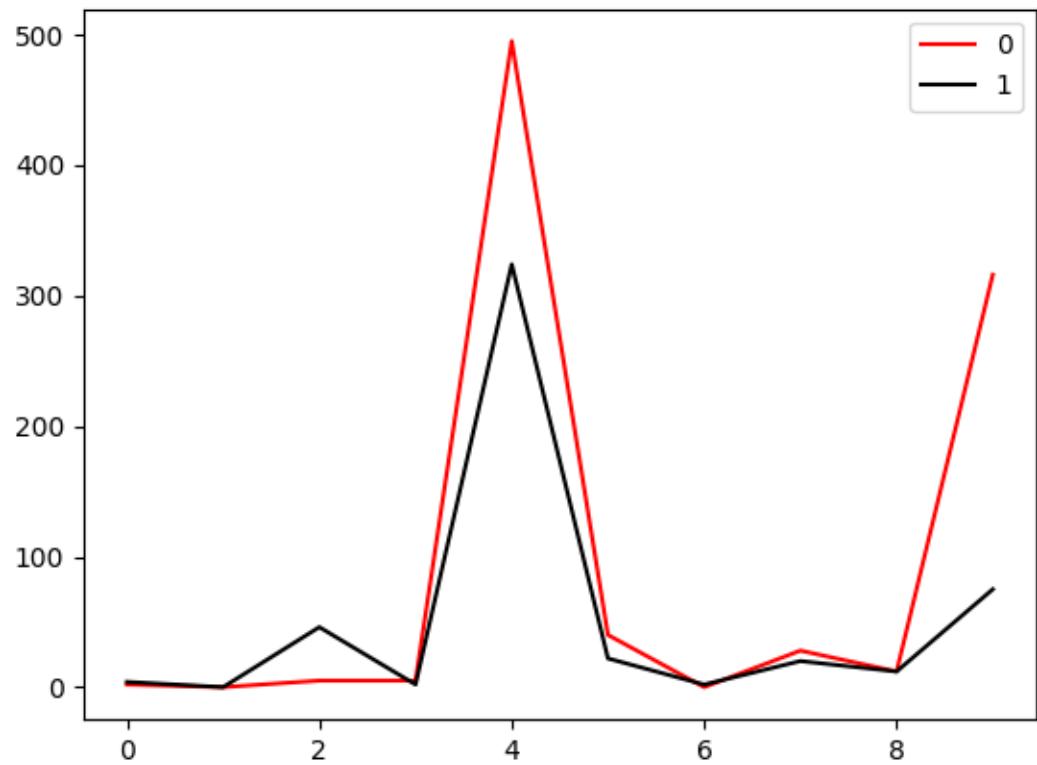
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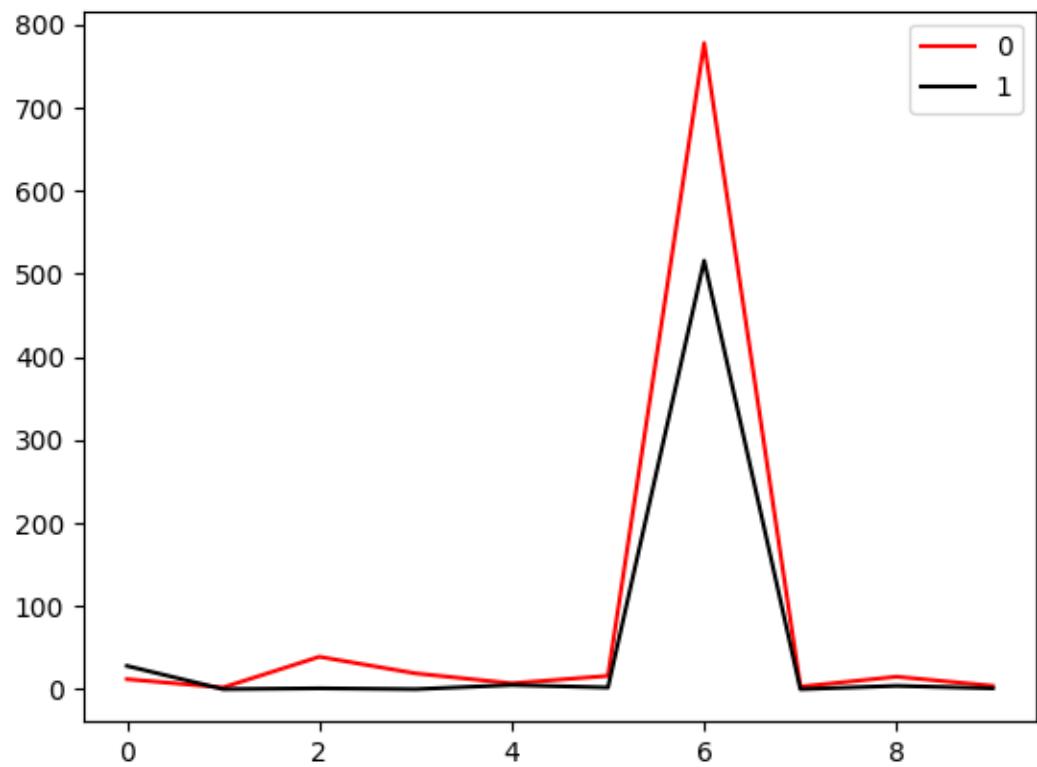
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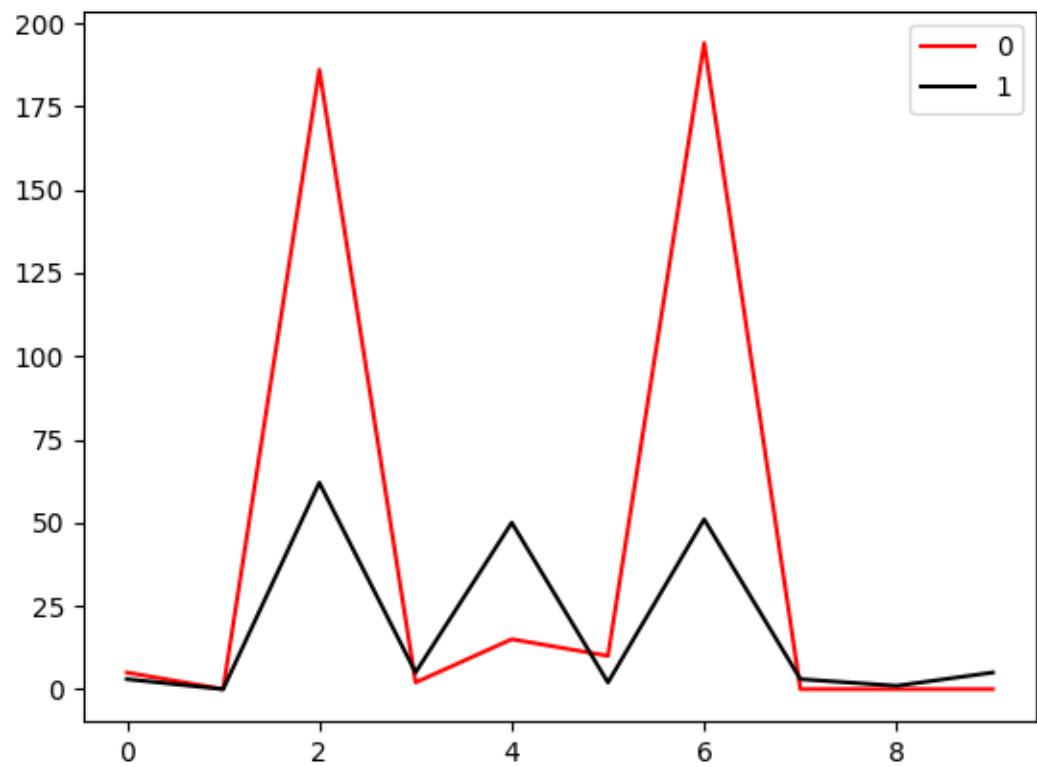
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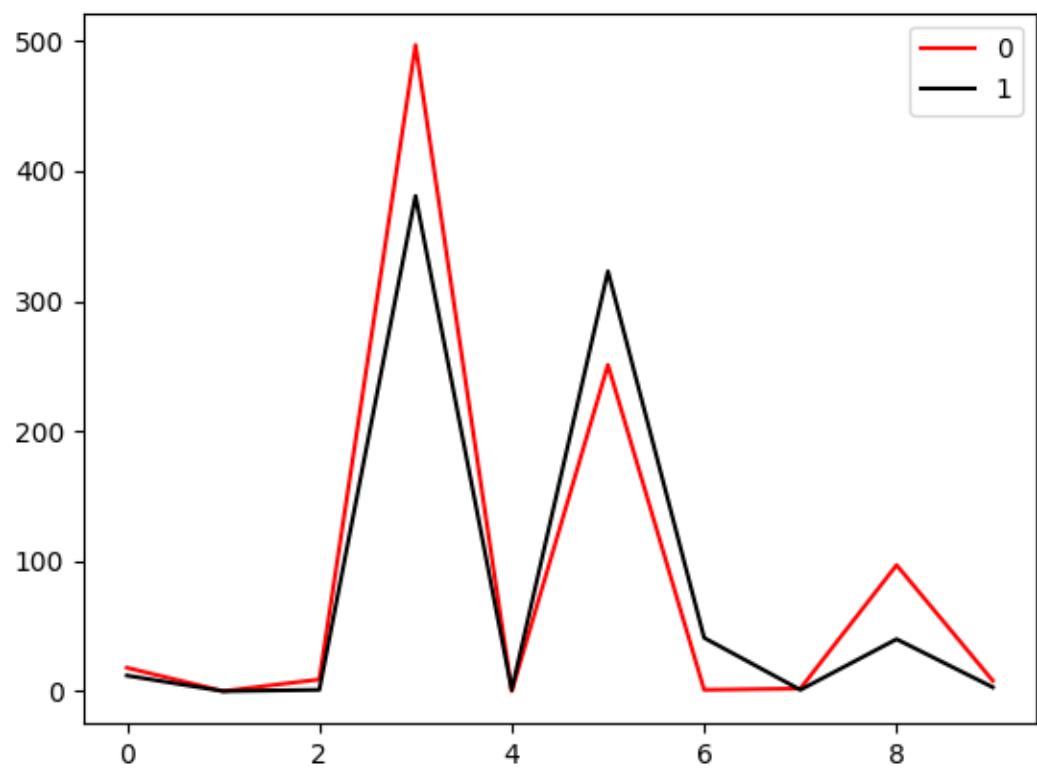
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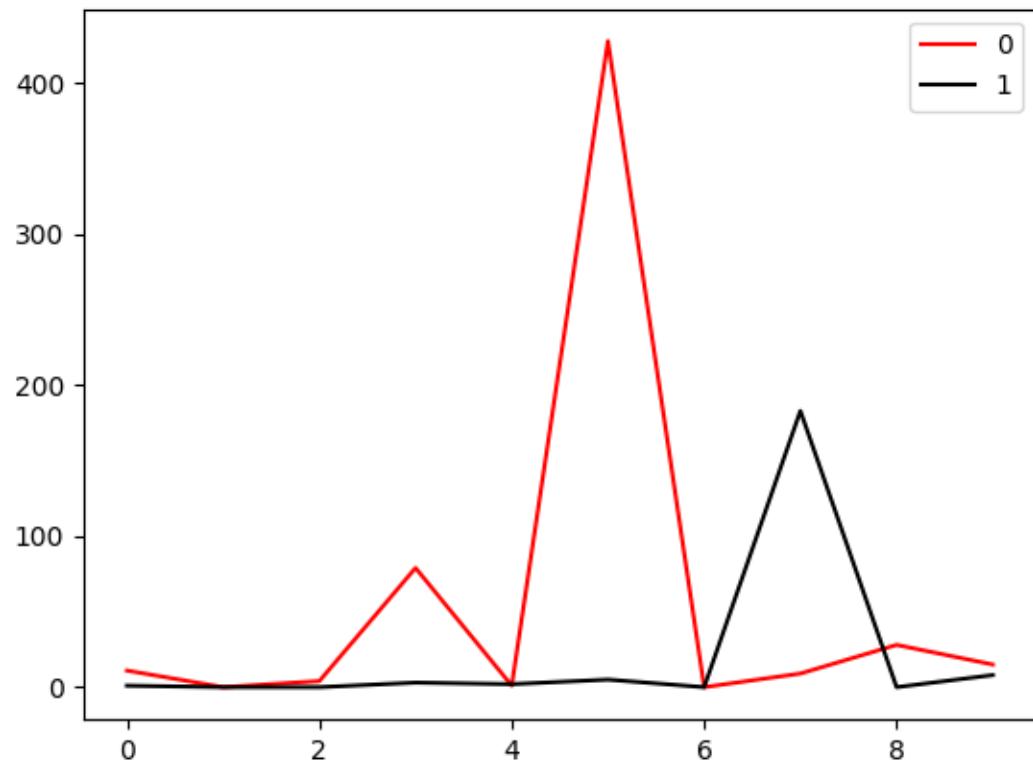
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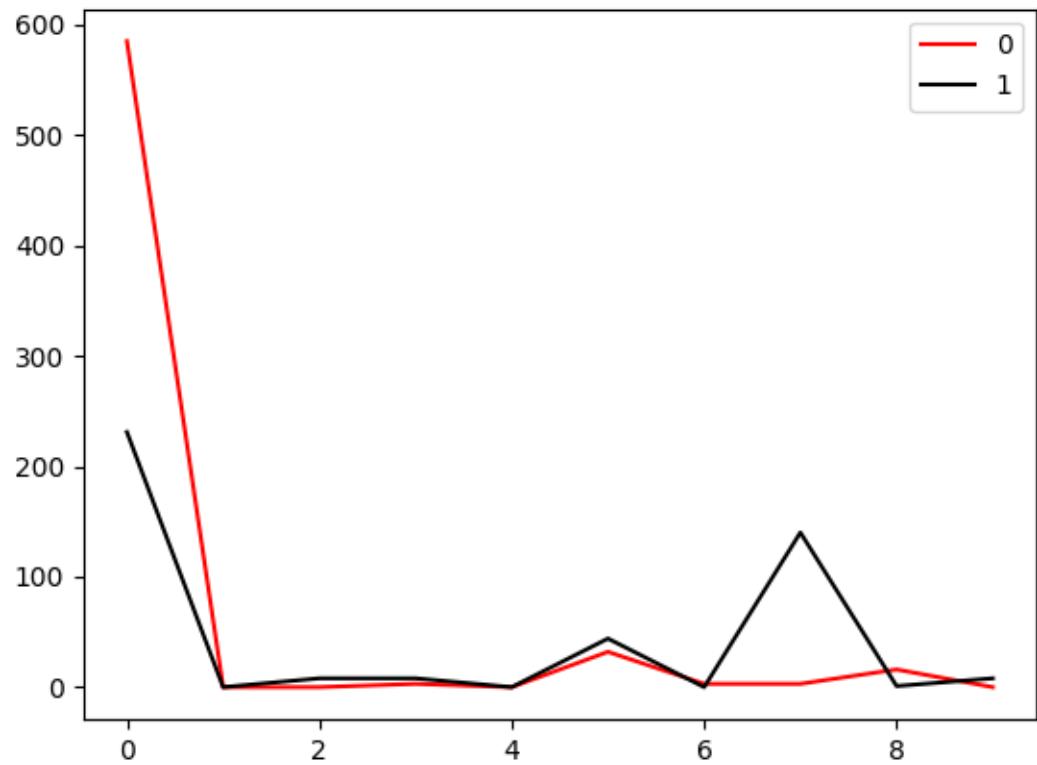
Figure\_6(11100)



Figure\_6(11101)



Figure\_6(11110)



Figure\_6(11111)

