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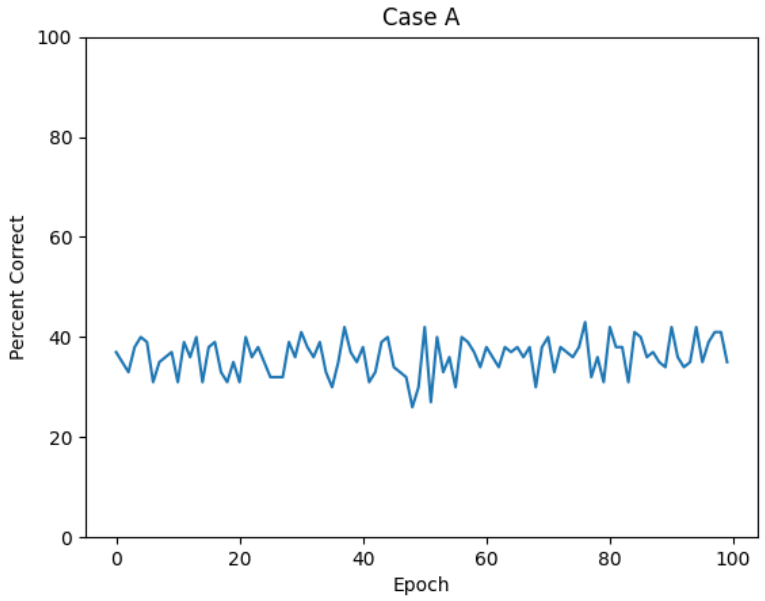
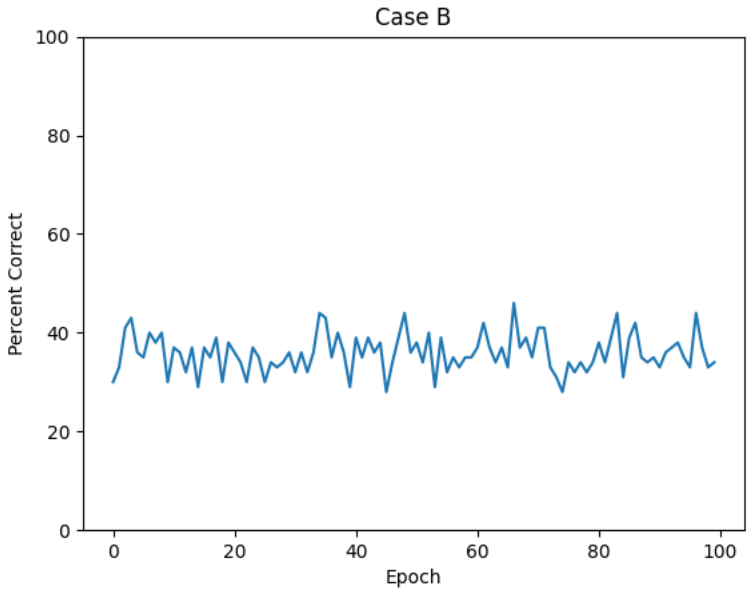
Assignment #4 – Test

1. Result Summary

Question 1

After running this simulation with 20 candidates, 5 questions, and 5 choices to choose from, both cases ended up hovering around 40% correctness. Case B, randomly picking the question to be correct, yielded a slightly higher max percent throughout the epoch at 46% as opposed to Case A, having the last question always be correct, with its max being 43%





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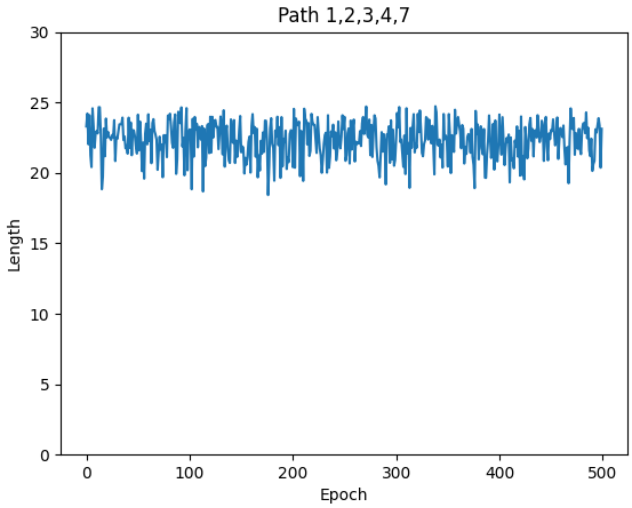
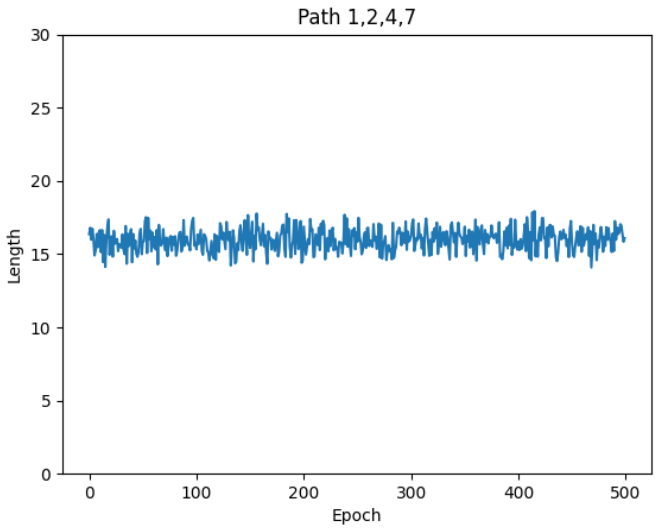
When experimenting with the number of candidates and number of questions to see the effect of the overall percentages, I found that the number of candidates didn't change the percentages too much but changing the number of questions yielded significant changes. The less questions there were, the higher the chances of the candidates getting the answers correct. Though because there were always only 5 choices, with one answer always being correct, it never dropped below 20%, no matter how many questions there were just from the laws of probability.

Question 2

After running the simulation 500 times, these are the graphs of results achieved for each epoch. For the first path, [1, 2, 3, 4, 7], the results varied between 18-25 due to the uniform distribution and triangular distribution.



The second path, [1, 2, 4, 7], was a tighter range, being between 14-18. This was due to the path having two links with a uniform distribution between 4-6.



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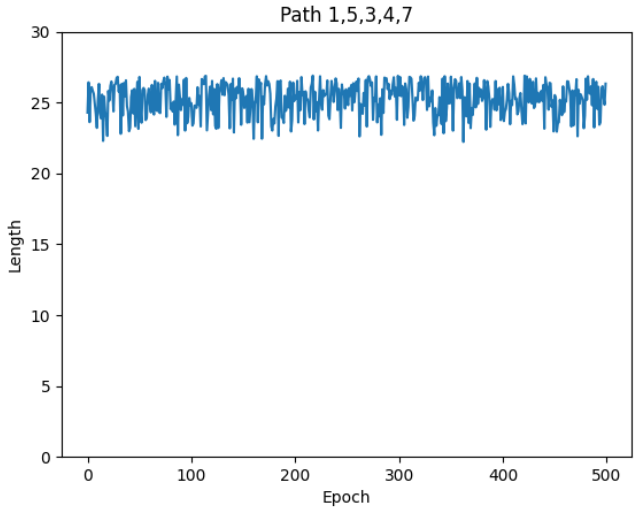
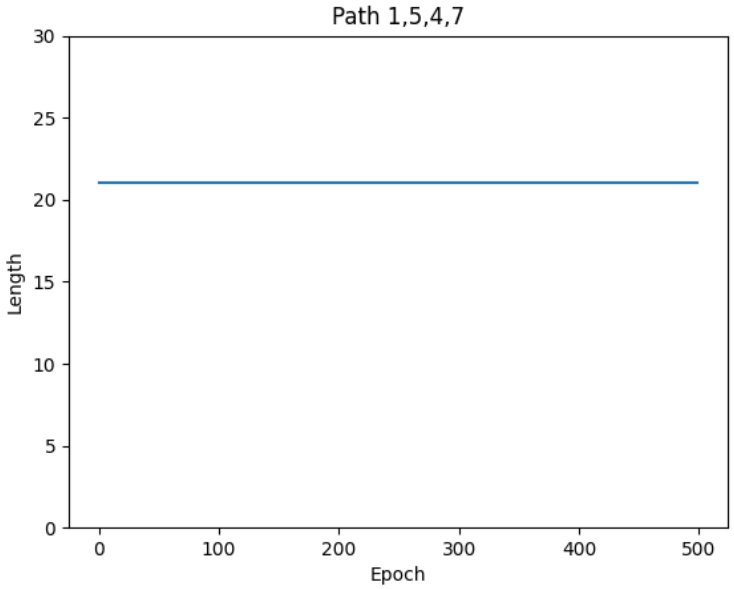
The third path, [1, 5, 3, 4, 7], is similar to the last path in range, being between 22-27. This only has one triangular distribution, but this causes the variation.



This path, [1, 5, 4, 7], as no range due to all of the connections between the nodes having constant values. There are no distributions like the others.



The last path, [1, 5, 6, 7], has little variation ranging between 23-26. There are two uniform distribution, one only ranging from 8 to 10 and one from 9 to 10. These don’t cause too much variation.

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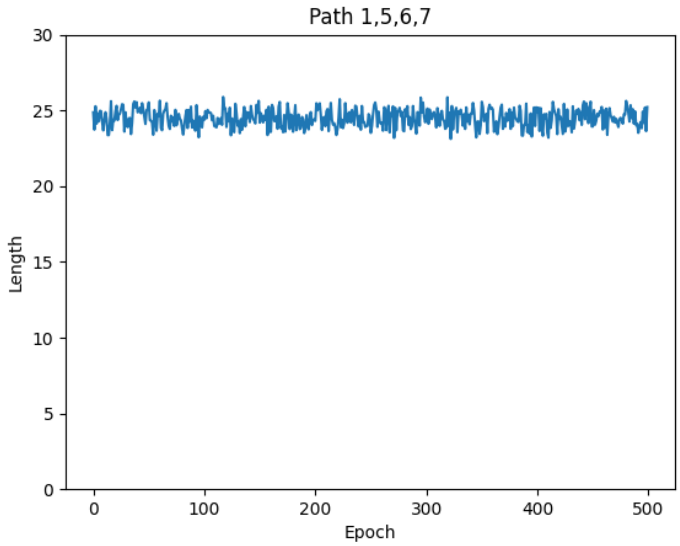

The criticality of each path should be chosen based on the length changes between the path with the distribution or the one with the constant one. For example, if there is a path that is consistent that yields 22 length every time, but there is another path that contains a distribution causing the length to range from 19-23, the second path would be a better option. While there is still a possibility of the length being longer, there is a greater possibility that it will be less than the first.

If I were to redesign this, I would try to cut down on the number of distributions to reduce inconsistency. That being said, if there are distributions, try to shorten their width. I also noticed that triangular distributions caused the most variation, causing some paths max length to be longer than the average. I would try to steer clear of those routes to avoid this.

2. Implementation Summary

Question 1

For this problem, I coded it all in python. I first defined how many epochs this would run, my choice being 100 to get a good sample size. I started each epoch by creating the HR answer key by selecting random whole numbers ranging from 1 to 5 (because there are always 5 choices to choose from) for each of the questions depending on the defined question count variable. Then I went through and created as many candidates as the candidate number variable was, randomly selecting their answers in a similar way as I got the HR answer key. For case 1, I then replaced the last question's answer in every candidate with the HR's answer to ensure it was correct. For case 2, I picked a random number indicating the question it would replace and simply assigned the item in the index of the HR's answer key to the same index of the candidate's answers. I then looped through all the candidates, checking all their answers, and tallying up the total number of correct answers throughout all

candidates. I then found the percentage correct and stored it into an array. After all epochs were done, I used the array that had all the correct percentages for each epoch and graphed it using matplotlib. You can see the last two epochs of each run here, the first being case A and the second being case B.

```
Epoch 99 performance
Correct Answers: 41/100
Percent: 41.00%

Epoch 100 performance
Correct Answers: 35/100
Percent: 35.00%

Best percent correct: 43.00%
```

```
Epoch 99 performance
Correct Answers: 33/100
Percent: 33.00%

Epoch 100 performance
Correct Answers: 34/100
Percent: 34.00%

Best percent correct:  46.00%
```

Question 2

Similar to the last problem, this was all coded in Python and the simulation ran for a certain number of epochs. For this one, I chose 500 epochs for a greater number of variants. In each epoch, each path is calculated and added to an array based on each path. Since there are only 5 possible paths, these arrays are hard coded to make it simpler. I then used matplotlib again to plot the graph. Below is the overall average as well as the average, minimum, and maximum length of each path.

```
Overall          Avg: 108.94211165799275
Path 1,2,3,4,7   Avg: 22.324837702777543     Min: 18.65862611756198      Max: 24.74552521361278
Path 1,2,4,7     Avg: 15.92332754861407      Min: 14.063067078374788     Max: 17.817818030983794
Path 1,5,3,4,7   Avg: 25.258411892619534     Min: 22.25186642487966      Max: 26.89822321897512
Path 1,5,4,7     Avg: 21.0       Min: 21     Max: 21
Path 1,5,6,7     Avg: 24.43553451398161      Min: 23.047343132773637     Max: 25.927118371914467
```

3. Critical Thinking Summary

I think the most difficult part of this problem was trying to figure out how to implement which random question would be always correct. I solved it by finding a random number and using that as an index to make the candidate's answer the correct answer. If I did this project again, I would try to implement and experiment with the possibility of having more than just one question always correct and see the variance created from it.

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I learned a lot about distributions such as the triangular distribution. I was very familiar with the uniform distribution but not as much with triangular. I liked seeing how it worked and how it caused variation. I could use this type of distribution in future projects to add more variance to my simulation.