On Optimal Study Time Planning for CCIE Candidates

Introduction

Almost anyone studying for CCIE Lab has limited time resources. And practically everyone thinks about optimum study time management. For example, take IEWB-RS VOL1, which has tremendous amount of material to work on. However, the workbook is structured in sections of different sizes. Let's assume that you need to spend $T_1, T_2 \ldots T_N$ (N – number of sections) hours on section 1, 2, 3 … N but you only have T hours available for study, so that $\sum_j^N T_j > T$. Of course, if $\sum_j^N T_j \le T$, you're a lucky person and don't have to bother with optimizations :). But what should you do if the amount of time required is more than the amount of time you can allocate? How would you split the available time between the sections, is there an optimal approach?

Naive Approach

At first, it may seem logical to split the time available in portions directly proportional to the time required for every section. In essence, all you need to do is find α so that

$$\alpha \sum_j^N T_j = T$$

and spend αT_1 on first section, αT_2 on second section and so on. However, if you think of it, you may change your mind. The first thing you may want to consider is the *utility* of knowledge. Utility is the concept in mathematical economy, which defines usefulness of any quantifiable resource, such as money.

Utility Function

Generally, utility is a concave function, which reflects the law of diminishing marginal returns: the more resource you have, the less useful is every next portion of it. The classic example if that 10$ are very useful to a broke man (0$ on hands) but bear no interest for a rich guy (10000$ on hand). The same concept might be applied to accruing knowledge (with some limitations of course). For example, if you spend 100 hours studying OSPF, you may better spend next 10 hours studying BGP (provided that you didn't study it before) than continue working on OSPF. There are many types and examples of utility function, with *log* utility being one of the classic and simples one. You may find an example of good use of log utility in resolving St. Petersburg Paradox or applying the Kelly criterion for gambling. Logarithmic utility grows to infinity with the speed (derivative) decreasing to almost zero quickly. This reflects the fact that having more of "resource" will decrease the value of every next portion of resource obtained.

Optimization Task

In this post we are going to show how the logarithmic utility could be applied to the task of optimum time planning outlined above. Let's define our goal. Start by assuming that we already spent $S_1, S_2 \ldots S_N$ hours on every of N homogenous sections (homogenous means a section represents information from the same area or knowledge). The times *required* to study every section are $T_1, T_2 \ldots T_N$ and the goal is finding the variables $x_1, x_2 \ldots x_N$ so that

$$\sum_{j}^{N} x_j (T_j - S_j) = T \qquad (1)$$

$$\sum_{j=1}^{N} (T_j - S_j) > T \qquad (1')$$

and

$$\frac{1}{N} \sum_{j=1}^{N} \alpha_j [\log(S_j + x_j (T_j - S_j)) - \log(S_j)] = \max \qquad (2)$$

Here coefficients α_j represent the relative preference of one section over another, meaning that sections with larger coefficients are more "useful" (e.g. core topic section are more useful than non-core and will contribute more to the resulting utility). This is a non-linear, conditional optimization task, maximizing the summary marginal utility of time spent on every section. This task could be solved in closed form using the *Lagrange multipliers* method. The result is (we omit the derivation procedure, which is pretty straightforward):

$$x_i = \frac{\dfrac{\alpha_i}{\sum_{j=1}^{N} \alpha_j} [T + \sum_{j=1}^{N} S_j] - S_i}{T_i - S_i} \qquad (3)$$

You may substitute this in (1) to verify the formula. In case when all α_j are equal (there are not preferred sections) the result is:

$$x_i = \frac{\dfrac{1}{N} [T + \sum_{j=1}^{N} S_j] - S_i}{T_i - S_i} \qquad (3')$$

Basically, you may always scale all α_j by an arbitrary value without affecting the final result. Thus, only the relative preference is important.

Interpreting the Results

Let's explore some asymptotic cases. Assume the most simple situation, where all alpha's are equal and $S_i = 0$. This results in $x_i = \frac{T}{NT_i}$ which means you should spend *equal* amounts time T/N on every section! For example, if you have 100 hours and 15 sections of VOL1, you should spend about 6,6 hours on every section, be it QoS or OSPF. This might be quite surprising, provided that sections may vary in length significantly, and indeed is somewhat counterintuitive. However, if you think about this from the utility standpoint, it makes sense investing your time in all sections equally, provided that there are no preferences.

Now, what if we take our "weights" in consideration, still keeping $S_i = 0$? Then, we have:

$$x_i = \frac{\dfrac{\alpha_i}{\sum_{j=1}^{N} \alpha_j} T}{T_i} \qquad (4)$$

Effectively, the time spend on every section will be weighted portion of the total time, directly proportional to the section's weight but inversely proportional to the sum of all weights. Notice that the section's "recommended time" is not taken in consideration again – only the total amount of time you have and the relative weight is important. For example, if you have two large sections – Core and Non-Core, with Core being twice as important, spend 2/(1+2) of total time on Core (approx 66%) and 1/(1+2) of time on non-Core topics (approx 34%).

For all other cases of non-zero S_i, you may want to use the full formula (3) for more precise computations. This formula allows you accounting your existing efforts and (hopefully!) spending your time more effectively.

Conclusions

What we found is that application of the utility function may greatly change our intuitive planning methodology. Even though this approach could be viewed as too simplistic, it still gives an interesting perspective on study time management. We are planning to use this approach and develop a set of recommendations for our students as well as create a simple application for time management. Eventually, this is going to be a part of INE's training framework, aiming at fast learning and maximum knowledge retention for every person enrolled.

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