**Worksheet 3 Report Analysis**  
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**Task 1: Explorers Searching for Rare Flowers**

**Objective:** The first task for one explorer is to find a very rare flower that is hidden in one of 10 forest zones. At each run, the explorer had no background on the location of that flower; it was assumed that each zone had equal probability. The idea is to show just how an explorer will go about exploring the forest effectively in 1000 runs or turns.

* How the search works:
  + The explorer chooses a region to search in, based on current belief. (Initially, all regions are believed equally likely.
  + For the others, it updates the probability when it cannot find the flower in an area it has already searched and sends that zone to zero.
  + In every finding of the flower, the search is reset, and explorer starts anew, having no memory of the past.
* Code explanation
  + **Explorer class:** this will be initialized with the probability distribution of the flower being at anyone of 10 zones, all equally likely.
  + The method **choose\_zone()** does choose the most likely zone - randomness between several equally likely zones.
  + **Belief Update:** If such a zone is searched and flower is not found, then its probability is assigned a value of 0 and the remaining probability values are redistributed among other zones not yet tested.
  + **Simulation:** It runs 1000 times: At each run, explorer moves into one of the zones to make the search, update beliefs based on the result, and start the iteration anew when the flower has been found.
  + **Observer Class:** The frequency of visits to each zone will be noted along with the frequency of finding the flower, all without interference in the explorer's behavior.
* Results:
  + In this task, an independent search strategy was adopted without learning from other agents. In 1000 turns, an explorer found the flower in 95 of these.
  + The distribution across the various zones was uniform, and no zone was visited more often than necessary once it had been eliminated. Since the explorer does not get to learn from the other explorers, the search is much more time-consuming with many more zone visits.

**Task 2: Cooperative Explorers Searching for Rare Flowers**

**Objective**: Whereas in the first model, there was only one agent searching for the flower in the forest, now we have 10 such explorers independently trying to find the flower in the same forest. Now, however, they can indirectly cooperate by observing each other’s searches and updating their beliefs using Bayesian updates on what others have looked at. We will then compare this Bayesian search strategy with independent search.

* How the search works:
  + As before, the prior distribution for each explorer is uniform over all the zones.
  + However, here, a searcher updates his belief not only after searching in a zone but also by observing what other searchers are doing and updating the beliefs based on this observation. In this way, he will avoid the zones for which others have searched and will make the search efficient.
  + If the flower was found, all group members start the process again by searching.
* Code explanation:
  + **Many Explorers:** This time there are 10 adventurers. Again each of them have a different prior distribution over each zone.
  + **Bayesian Updates:** Explorers take turns in the search for zones. Consecutively, after each has taken a search, all the explorers update their belief based on what they perceive others are doing. As this Bayesian update does, the probability of the seen zone will slowly get damped down, whereas the rest will be distributed over the remaining, unseen zones.
  + **Simulation:** Run the simulation for 1000 turns, updating the belief of each explorer and taking a turn for each explorer to search. Share the result from each search in the group to enable cooperative learning, hence searching more effectively.
  + **Comparisons:** In order to compare the Bayesian search with the independent one, observe in the graph the number of flower finds against the number of visits in each zone. Notice that the Bayesian strategy is using shared information with the purpose of avoiding any redundant searches.
* Results and Comparison:
  + It thus follows that in 1000 turns Bayesian Search yielded 132 flower finds versus 95 flower finds by Independent Search.
  + Bayesian Search performed better because the explorers learned from other explorers' actions so that there were no more redundant searches and their flowers found more.
  + The Bayesian approach yielded less total visitations. This was because the explorers avoided regions that others had already explored and found nothing.
* Conclusion:
  + Independent Search is not effective because the foragers are only trusting their own searches. Visits to the zone are generally higher while flower finds are minimal.
  + While, on the other hand, as opposed to Bayesian Search, explorers might be indirectly collaborating, flowers will be found within fewer turns because sharing information and updating beliefs of the other searches can only focus the search more effectively on likely zones.
  + These 132 flower finds for Bayesian contrast with 95 flower finds for Independent reveal the clear advantage of a cooperative, learning-based strategy.