**Solve one of the following projects using TVLA/**

**Project 1**: Proving Partial Correctness of a Simple Mark and Sweep Garbage Collection

* 1. Document the predicates and the actions in the tvp files for the Mark and Sweep example. In particular, explain the instrumentation predicates and their meanings (15%).
  2. Remove the focus operations in stat\_set.tvp and study the resulting analysis (15%)
  3. What are the difficulties in extending the analysis to handle Garbage Collection Algorithms like Copy Garbage Collection in which the garbage collector can mutate the heap (10%)
  4. (Bonus) Add actions for showing that the Mark phase must eventually terminate. One way to show that is by showing that the set of nodes reachable from the pointer variable x (used in the while loop condition in mark.tvp) decreases in every loop iteration (15%)

### Project 2: Proving Partial Correctness of Sorting Algorithm

1. Document the predicates and the actions in the tvp files for the sorting example. In particular, explain the instrumentation predicates and their meanings (5%).
2. Remove the focus operations in cond.tvp and study the resulting analysis (10%)
3. Write an improved version of bubble sort in C called smart-bubble-sort which stops once the list is sorted and doesn't compare elements which are already in place (using linked lists and pointers). Then, convert it manually into tvp and run it. Study the results of the analysis (25%)
4. (Bonus) Add actions for showing that the loops in insertion sort and bubble sort must eventually terminate. One way to show that is by showing that the set of nodes reachable from the temporary variable x  decreases at every loop iteration (15%)