Question 1:

(a) The lower / upper bounds and average diagram length at a depot constraints.

(b) (i) Greedy heuristic is to pre-processed the input before it going to the select phase. And the dataset can be large, because it build all possible shifts. So greedy heuristic can help to reduce the size of candidate shifts. Some of the work pieces are less important. Greedy heuristic find the optimal solutions for each aspects, then it comes up to the global optimal solutions.

(ii) Minimise the number of candidate shifts covering work piece. And try to increase the set of work pieces covered by one shift. And re-compute until the pot size meets the size target.

(iii) Reduce number of relief opportunities. These work pieces that are highly covered are less important should be deleted.

(c) (i) Stage 1: solve the relaxed LP by using the Revised Simplex Method.

Relaxed LP. Ignores the integer constraints. And the solution is not final, except the continuous solution are all-integer. Or using relaxed LP solver. Solve the LP using only a small pot of candidate shifts, which computationally very fast.

Stage 2: derive an all-integer solution. Employs the commonly used Branch-and-Bound technique. Progressively adds extra constraints to the LP and solving it.

(ii) Using specific characteristics can divide the pot of candidate shifts. And add extra constraints to the LP and soving it. Adding constraints to a branch is implemented by a banning status variable on each candidate shift, instead of mathematically add. For example, we may add a relief opportunity R that one station has dinning hall. Then one branch bans all shifts using R. Another branch using R. It can divide the search space more efficiently. Disable stations for changing coupling formations. And full utilisation of arc flow potentials.

Question 2:

1. As for long term planning (LTP), it advance pre-planning for a new public timetable usually lasting 6 months. Also to set such LTP, it much more harder and takes more time to implement when it compares to the short one. The advantages for LTP is that, it can minimise total crew cost, like the number of shifts and total hours paid, all work covered, it’s conflict free with the vehicle schedule. For public transport, bus and train scheduling can be different. Bus scheduling can be feasible. Train scheduling must cover all the trips in a fixed timetable.
2. (i) By seeing if the timetable have conflicts, like if two course take place in the same room at the same time. And whether the rooms are suitable for each class’s requirement, including room capcaticy, etc.

(ii) Define LLH1 as swap individually in rows, LLH2 as swap in columns. LLH3 as swap both rows and columns. Exceute each LLH repeatly until this LLH doesn’t improve any performance, then switch to the next LLH. If the solution is good enough then stop.

1. Single Hubble Space Telescope,

The job is predictable, clairvoyant and pre-emption needed, minimize weighted job unit pentalty.