1. **[3 marks]** Consider the transition system shown below.
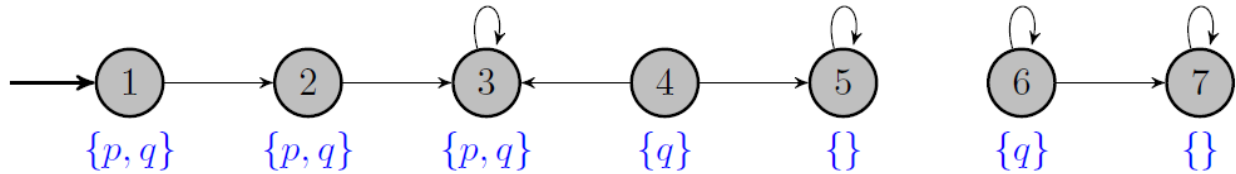

We would like to model this using CBMC and prove that q is a 2-inductive invariant (recall that this works when you add the constraint that all states on any counterexample to the step case are pairwise different). Your task is to submit two files, that can be used to prove the base case and the step case of the 2-induction. You must also submit a `readme` file that contains instructions on how your code should be run, and how should the output be interpreted.

2. **[3 marks]** For the transition system in the question above, show how the IC3 algorithm will work step-by-step to prove that the bad states are unreachable. Note that for q to be an invariant, states 5 and 7 are bad. Do not generalize the CTIs in your proof.

3. **[2 marks]** Consider the program, P, shown below.

```
k = 0; j = 1;

while(k != n) {
    k = k + 1;
    j = 2 + j;
}
```

Prove the validity of the following:
$\{n > 0\} \quad P \quad \{j = 1 + 2.n\}$