10 **Exercise 1:**
Here is a classical planning problem that involves moving blocks around on a table.

$$s_0 = \{on(c1, table), on(c3, c2), clear(c3), on(c2, table), clear(c1)\}$$
$$g = \{on(c1, c2), on(c2, c3)\}$$

$pickup(x)$
precond: $on(x, table), clear(x)$
effects: $\neg on(x, table), \neg clear(x), holding(x)$

$putdown(x)$
precond: $holding(x)$
effects: $on(x, table), clear(x), \neg holding(x)$

$unstack(x, y)$
precond: $on(x, y), clear(x)$
effects: $\neg on(x, y), \neg clear(x), holding(x), clear(y)$

$stack(x, y)$
precond: $holding(x), clear(y)$
effects: $clear(x), on(x, y), \neg clear(y), \neg holding(x)$

4 1. Rewrite the problem as a set-theoretic planning problem.
Hint: You do not need to specify all actions, if you give at least 3 examples,
plus a description of how all actions can be generated and how many actions will result.

1 2. Why are there separate operators for putdown and stack, rather than a single operator for both?

1 3. In the DWR domain, why do we not need two operators analogous to putdown and stack for placing containers onto a pile with a crane?

4 4. Rewrite the problem as a state-variable planning problem.