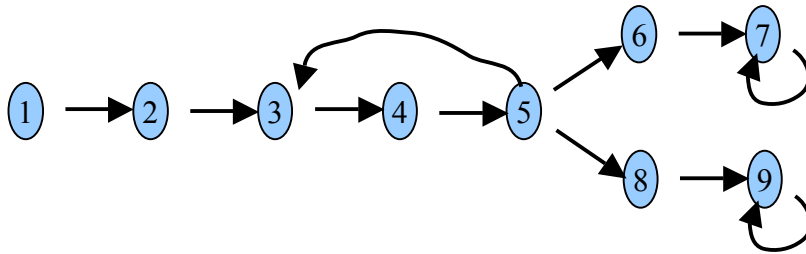


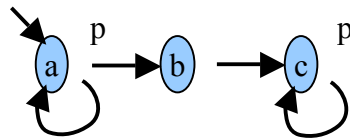
Exercise 4

Model Checking with Fairness Constraints

- 1) For the structure below, compute the set of fair states assuming that the two fairness constraints are as follows: $c_1 = \{7\}$ and $c_2 = \{4, 9\}$.



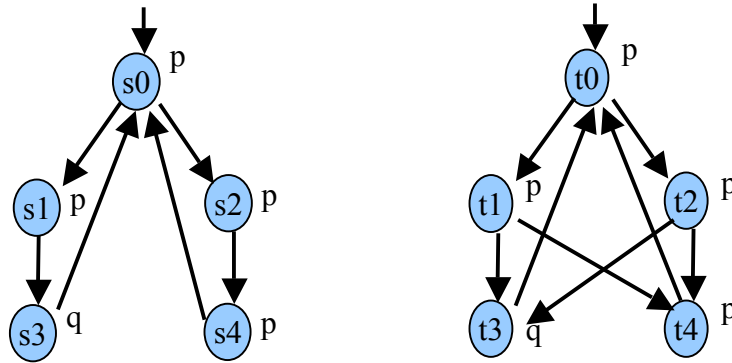
- 2) For the Kripke structure depicted below, assume that the fairness condition $\neg a$ is given. Check whether, with this addition, $K, a \models AFAG p$ holds.



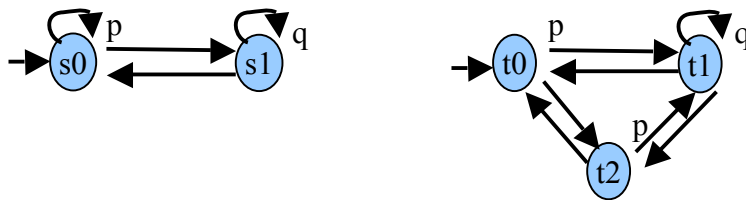
- 3) Use VIS with the two models of the dining philosophers introduced in the lecture and check for
- Mutual exclusion
 - Progress/deadlock
 - Starvation
- without fairness. Construct meaningful fairness conditions and show that the second version satisfies all properties under fairness.

Bisimulation, Simulation, and Linear Temporal Logic

4) Check if the following two structures are (i) bisimilar or/and (ii) simulation equivalent.



5) Check if the following two structures are (i) bisimilar or/and (ii) simulation equivalent.



6) Consider the dining philosophers from the last lecture. Write LTL properties for

1. Mutual exclusion
2. Progress/deadlock
3. Starvation

Use VIS with the two models introduced in the last lecture (Slide 9 and 11) and check if the models satisfy your properties. The LTL model checker of VIS is called with

```
ltl_model_check filename
```

Don't forget to read-in the verilog file first and build the transition graph:

```
read_verilog filename
init_verify
```

Write an LTL property that is true for all paths on which none of the philosophers is eating forever. Use this property and our previous properties to show that the model v2 is starvation free under the assumption that none of the philosophers is eating forever.