

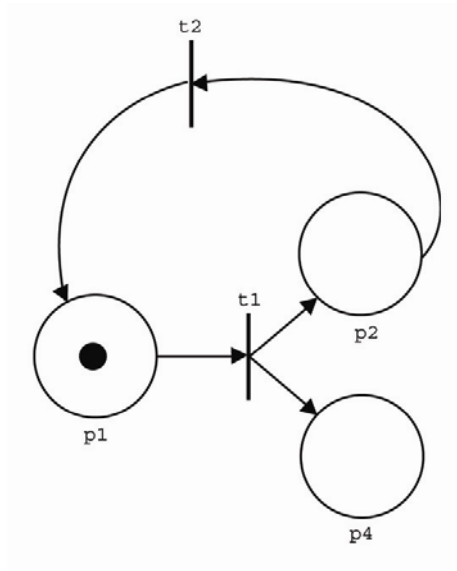
CAP 4800 and CAP 5805
FINAL EXAM, Computer Simulation, closed book & notes
DATE: December 18, 2002

The exam lasts for **2 Hours** minutes and is **100** points total. **Answer all questions.**

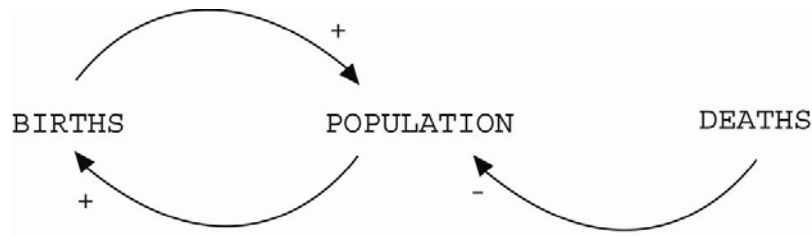
1. (15) Show and label a (chemical) kinetics graph that corresponds to the following set of equations. Assume that a bidirectional arrow between any two nodes involves a separate rate for each direction:

(a) $\frac{dA}{dt} = k_2 * B - k_1 * A$
(b) $\frac{dB}{dt} = k_1 * A + k_7 * F - k_2 * B - k_3 * B$
(c) $\frac{dC}{dt} = k_3 * B - k_4 * C - k_8 * C$
(d) $\frac{dD}{dt} = k_4 * C - k_5 * D$
(e) $\frac{dE}{dt} = k_5 * D - k_6 * E$
(f) $\frac{dF}{dt} = k_8 * C + k_6 * E - k_7 * F$

2. (20) (a) For the following Petri net, specify the state of the net over time for times 0,1,2,3, and 4. (b) For the same Petri net, make it a timed Petri net by making the delta Time for $t_1=1$ and the delta Time for $t_2=2$. Now specify the state of the net over the same times.



3. (20) For the following System Dynamics causal graph, specify (a) a flow graph, and (b) the set of equations resulting from part (a). Make sure to label everything as necessary.



4. (15) For the following interval, and for each temporal logic expression, answer whether the expression is true or false, and explain why by explicitly referring to parts of the interval for each answer. The states

Time	X	Y
σ_0	2.3	1.9
σ_1	2.5	2.3
σ_2	2.1	2.9
σ_3	7.8	8.9
σ_4	5.4	4.0

- (a) $\square (X < 9) \wedge \square (Y \geq 2)$
- (b) $\bigcirc \bigcirc \bigcirc (Y = 1.9)$
- (c) $\diamond (X < 2.5 \wedge Y > 2.0)$
- (d) $\square (X < 3.0) ; \square (Y \geq 4.0)$

5. (15) Write down a set of first-order (canonical) differential equations for each equation listed:

(a) $x' - 5x^2 = 0$

(b) $y'' + 2y - 3 = 0$

(c) $3x'' + 2y - x' + y' = 0$

6. (15) Show the evolution of the following cellular automaton using Conway's game of life rules. Start with the automaton as shown for generation 0, and show what it looks like for generations 1,2,3,4, and 5. What happens to it as time progresses?

