



Figure 1: Two net systems

- [Ex. 1] (i) Explain the difference between the terms “principal” and “contractor” in the context of Business Process Management.  
 (ii) Explain the difference between “point-to-point” and “hub-and-spoke” integration architectures in the context of Enterprise Application Integration

[Ex. 2] Consider a net system  $(P, T, F, M_0)$ .

Give a formal account of each of the following sentences:

- (i) “there is a reachable marking  $M$  such that  $(P, T, F, M)$  is live”;  
 (ii) “the place  $p$  will always contain at most two tokens”;  
 (iii) “the place  $p$  is not live”.

[Ex. 3] Consider the net system in Figure 1(a).

- (i) Is it a T-system (explain)?  
 (ii) Is it bounded (explain)?  
 (iii) Can you find a positive T-invariant (explain)?  
 (iv) Is it live (explain)?

[Ex. 4] Consider the net system in Figure 1(a).

- (i) Exploit the Marking Equation Lemma to find the marking reached after firing the sequence  $\sigma = t_1 t_2 t_3 t_4 t_1 t_4 t_3 t_1 t_3 t_4 t_4 t_1 t_2$ .  
 (ii) Exploit the Fundamental Property of S-invariants to justify the fact that the marking  $M = 2p_1 + 2p_2 + p_3$  is not reachable.

[Ex. 5] Consider the weakly connected net system in Figure 1(b).

- (i) Is it free-choice (explain)?  
 (ii) Is it a workflow net (explain)?  
 (iii) Is it strongly connected (explain)?  
 (iv) Find a positive S-invariant.  
 (v) Is it live (explain)?  
 (Note: do not attempt to build the reachability graph: it has 371 nodes)

[Ex. 6, Optional] Describe the three different kinds of abstraction for modelling business processes: “Horizontal”, “Aggregation” and “Vertical”.