※ 考生請注意：本試題不可使用計算機。 請於答案卷(卡)作答，於本試題紙上作答者，不予計分。

1. Briefly describe the following terms.

   (a) MapReduce. (10%)

   (b) Von Neumann Machine. (10%)

   (c) Data Hazards. (10%)

2. Let m processes $P_1, P_2, \ldots, P_m$ with the length of the CPU burst time $b_1, b_2, \ldots, b_m$ arrive at time $t_1, t_2, \ldots, t_m$, respectively. Suppose that $t_i < t_{i+1} < t_i + b_i$, $i = 1, \ldots, m$. Compute the average waiting time (over all processes) for the first-come first-served scheduling algorithm. (10%)

3. (a) What are the necessary conditions of the deadlock? (10%)
   (b) What is "deadlock prevention"? Explain it in details. (10%)
   (c) Draw a diagram to show the relation among safe states, unsafe states, and deadlock. (10%)

4. Is the resource-allocation graph shown below (Figure 1) in a deadlock state? Briefly explain why. (10%)

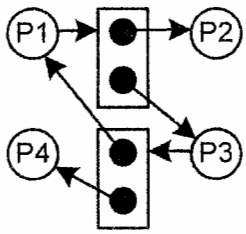

Figure 1: A resource-allocation graph.

5. Figure 2 shows the control of the multicycle MIPS precessor. There are a number of typos in the plot. Identify and correct the typos. (20%)

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考試科目：計算機組織與系統

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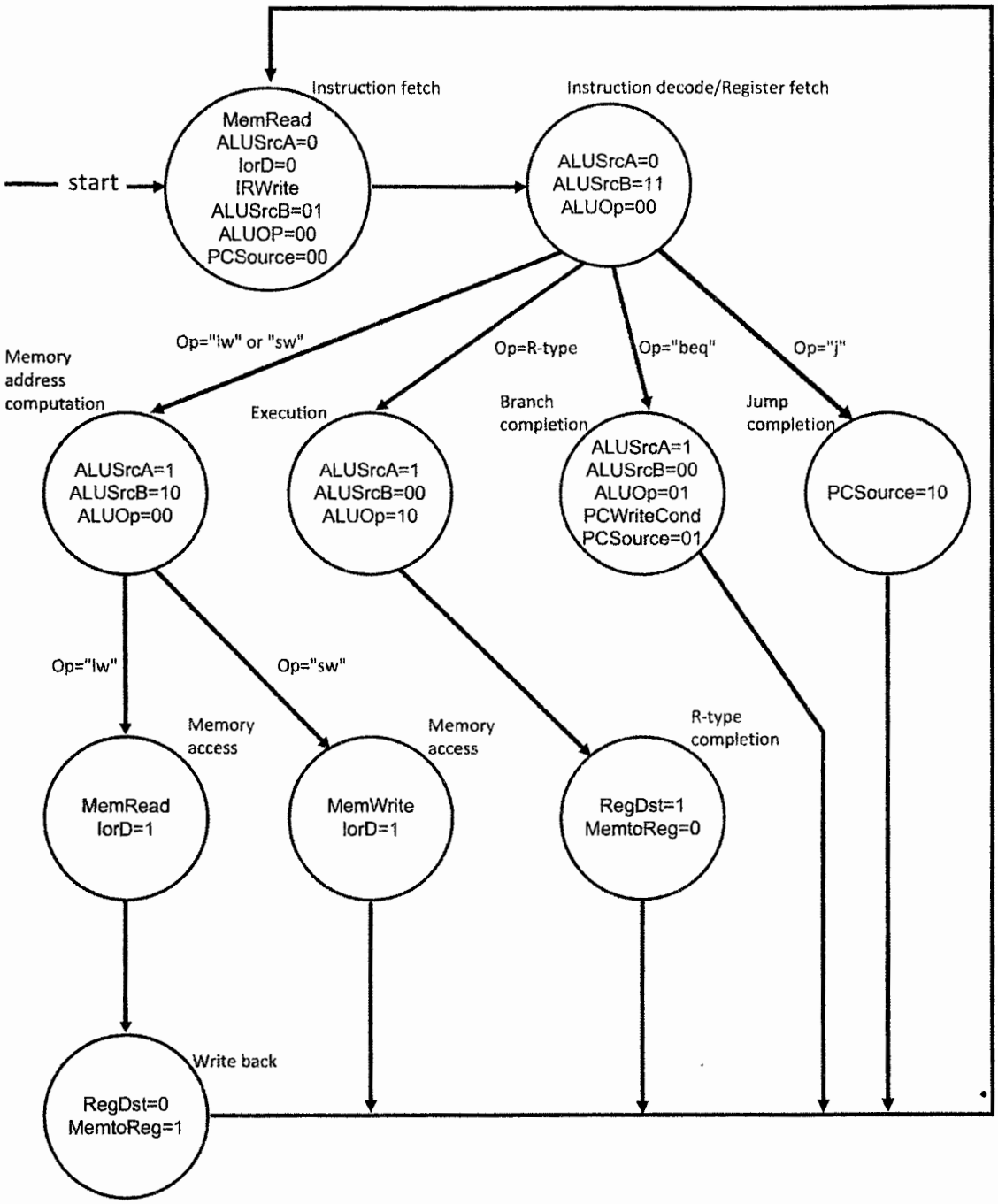

Figure 2: The control of the multicycle processor