# Selected Exercise Solutions for The Art Of Computer Programming

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## 1   Basic Concepts

### 1.1   Algorithms

5. The procedure fails to be a genuine algorithm for the following three points:

   - *Finiteness.* After one finishes all the 12 chapters, the procedure suggests starting from Chapter 1.
   - *Output.* The procedure does not have outputs.
   - *Effectiveness.* It is unclear whether each step can be completed in a finite amount of time. For instance, there are open problems in the exercises which no one knows the solution.

   The procedure has the following differences in format between it and Algorithm E:

   - The procedure does not include a paragraph specifying the inputs and the purpose (outputs) of the procedure.
   - Each step of the procedure does not have a phrase that briefly summarizes the principal content of the step.

7. Let $n \in \mathbb{N}$. If $n > m$, then after E1, $r = m \neq 0$. Therefore, in E3, $m$ and $n$ are essentially exchanged. This reduces to the definition of $T_m$. Since $T_m$ is well-defined, then so is $U_m$, and $U_m = T_m + 1$.

9. We say that "$C_2$ is a representation of $C_1$" or "$C_2$ simulates $C_1$" if

   - there exists $\delta : Q_1 \to 2^{Q_2}$ such that for all $q_1, q_2 \in Q_1$ with $q_1 \neq q_2$, $\delta(q_1) \cap \delta(q_2) = \emptyset$;
   - for all $q \in Q_1$ and $q' \in \delta(q)$, there exist $n \in \mathbb{N}$ and $q'_1, \ldots, q'_n \in Q_2$ such that

   $$
   \begin{aligned}
   q'_1 &= f_2\left(q'\right), \\
   q'_{i+1} &= f_2\left(q'_i\right), \qquad\qquad \forall i = 1, \ldots, n-1, \\
   q'_n &\in \delta\left(f_1(q)\right).
   \end{aligned}
   $$