Assignment 5

Due: July 21st, 2024

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Use pseudo-code in questions that need you to present your algorithms, but your pseudo-code can be "English-like" if the operation is obvious. Make sure that each line in your pseudo-code is numbered, and the indentation is correct.

1. In Lecture 13, we solved the Fractional Knapsack problem (Example 2) using a greedy algorithm ("iteratively choosing the item with largest unit value") and we proved it can yield an optimal solution. Describe this greedy algorithm formally in pseudo-code.

2. Bob loves foreign languages and plans to take one language course each semester. He wants to plan his course schedule to take the following 10 language courses. Find a sequence of courses that allows Bob to satisfy all the prerequisites and show how you find this sequence.

Course	**Prerequisites**
$LA15$	None
$LA16$	$LA15, LA17$
$LA17$	$LA15$
$LA22$	None
$LA31$	$LA15$
$LA32$	$LA16, LA31$
$LA126$	$LA22, LA32, LA127$
$LA127$	$LA16$
$LA141$	$LA22, LA169$
$LA169$	$LA32$

3. Given a simple undirected graph $G = (V, E)$, present an algorithm that determines whether G contains a cycle in $O(|V|)$ time. Analyze the time complexity of your algorithm to show why it finishes in the required running time.

4. Given a simple undirected graph $G = (V, E)$, present an algorithm that determines whether G is bipartite in $O(|V| + |E|)$ time. A graph $G = (V, E)$ is bipartite, by its definition (on page 1172 in the 3^{rd} edition of CLRS), if and only if V can be decomposed into L and R, where $|L| + |R| = |V|$ and $L \cap R = \emptyset$, such that for each edge $e \in E$, one endpoint is in L and the other is in R. In other words, $G = (V, E)$ is bipartite if and only if G contains no cycles of odd length.