Problem Set 9

Assigned: July 20
Due: July 27

Problem 1

Consider the following scheduling problem. Each task I has a length $L[I]$ and a deadline $D[I]$. There is a single processor that handles one task at a time. Let $E[I]$ be the ending time of I under a given schedule. You get paid an amount $D[I] - E[I]$ if you finish task I early and you get fined an amount $E[I] - D[I]$ if you finish task I late.

There is a very simple greedy algorithm that maximizes your total reward. Find it.

Problem 2

In problem 5 of the scheduling notes, give an linear-time algorithm to compute the quantities $W[I]$.

Problem 3

Consider the following scheduling algorithm. All tasks have length 1. There is a single processor. Tasks have a partial ordering represented as a DAG. Each task I has a value $V[I]$. There is an overall deadline D. The objective is to find the schedule with the maximum possible total value.

The obvious greedy algorithm is just to always carry out next the most valuable task that is ready:

```
for (I=0 to D-1) {
   Q = the ready task with the largest value of V[I];
   schedule Q for time I;
}
```

A. Construct an example where this does not find the optimal solution.

B. Propose an alternative greedy algorithm that works on some examples where (A) does not.

C. Construct an example where the greedy algorithm in (B) does not work.

Problem 4

Modify problem 4 of the notes for the case where each task has its own deadline $D[I]$. That is: Each task I has length $L[I]$ value $V[I]$, and deadline $D[I]$. There is a single processor that executes one task at a time. You get paid $V[I]$ if you finish the execution of I before $D[I]$ and 0 if you do not.

A. Propose a greedy strategy for solving this problem.

B. Do an exhaustive search for the optimal solution for the problem below: Use your greedy solution in (A) to begin with a fairly good solution. Use branch and bound to eliminate branches that are worse than the best solution you have already found. Show a trace of the execution of your algorithm.

Task	A	B	C	D	E	F
Length	10	7	5	4	6	5
Value	10	14	9	7	6	5
Deadline	20	8	6	9	15	15