Problem Set 1

Assigned: Sept. 8
Due: Sept. 22

Problem 1

Consider the following scheduling problem. There are N tasks and K processors. Each task T has a length T.length. Each processor P has a speed P.speed. If T is assigned to P, it will take time T.length/P.speed to complete. There is an overall deadline D. A processor can only work on one task at a time, and a task cannot be split between processors. The problem is to find an assignment of tasks to processors in which the all the tasks complete before time D.

For example, suppose that $N = 4$, $K = 2$, $D = 33$ and you have the following parameters

Task	T1	T2	T3	T4
Length	12	42	48	54

Processor	P1	P2
Speed	2	3

Then one correct strategy is to assign T1 and T3 to P1, where they will take a total of 30 time units, and T2 and T4 to P2, where they will take a total of 32 time units.

A. Characterize this as a tree-structured state space search problem. In particular:

- What are the states?
- What are the operators?
- What is the branching factor?
- Is the depth of the goal node known initially?

B. Show the portion of the state space generated in solving the example in Problem 1 using depth-first search.

C. Show the portion of the state space generated in solving the example using breadth-first search.

Problem 2

Suppose we modify problem 1 as follows. Assume that each task has a value which is equal to its length; and assume that the problem specifies a *target total value* S. The problem then is to find an assignment of tasks to processors such that the tasks all complete within time D and have a value of at least S. (Problem 1 is just the special case where S is the total value of all the tasks.)

For example, using the same set of tasks as in problem 1, if the target value $S = 110$ and the deadline $D = 25$, then the solution is to assign T3 to P1, taking time 24, and T1 and T4 to P2, taking time 22, for a total value of 114.

A. Characterize this as a tree-structured search space problem, answering the same questions as in problem 1.

B. Show the portion of the state space generated in solving the example in Problem 1 using depth-first search.

C. Show the portion of the state space generated in solving the example using breadth-first search.