Greedy Algorithms: Activity Selection

Algorithms for Optimizing Activity Selection

Note: In this algorithm we assume that all activities in the input array are stored in ascending order of the activity’s end time. If this is not the case, the algorithms can be modified in one of two ways:

- sort all activities in ascending order of the activity’s end time, then call the algorithm.
- call, on each step, a function that finds, among the remaining activities the one that ends at the earliest time.

Iterative Algorithm

```
ALGORITHM ActivitySelection(N, A[1..N][1..2])
begin
    S[0..N]; //initialize output array
    currentEndTime ← 1; //initialize current end time counter
    i ← 1;
    while i ≤ N do
        //check to see if current activity can be scheduled
        if A[i][1] ≥ currentEndTime then
            S[i] ← 1; //select it
            S[0] ← S[0] + 1; //update scheduled activity count
            currentEndTime ← A[i][2]; //update current end time marker
        endif
        i ← i + 1;
    endwhile
    return S[0..N];
end
```
Recursive Algorithm

Note: The ActivitySelectionRecursive() algorithm adds a pair of input parameters. One, \(K\), is the current index in the array \(A[i]\) of activities. The other, \(\text{StartTime}\) is the earliest possible start time for the activities at the current moment. The initial call to this algorithm will set \(k = 1\) and \(\text{StartTime} = 0\).

Note: Again, this algorithm works only for arrays \(A\) that are sorted in ascending order by their second component.

\begin{algorithm}
\textbf{Algorithm} ActivitySelectionRecursive(N, A[K..N][1..2], K, \text{StartTime})
// K is the "current" index in the array of activities.
//\text{StartTime} is the earliest allowed start time
\begin{algorithmic}
\State \textbf{begin}
\If {A[K][1] ≥ \text{StartTime}}
\State \text{decision} ← 1;\hspace{1em} // A[K] will be selected
\State \text{StartTime} ← A[K][2];\hspace{1em} // establish new start time
\ElsIf {}\text{decision} ← 0;\hspace{1em} // A[K] will NOT be selected
\EndIf
\If {\(K = N\)}
\State S[0..N];
\State S[0] = \text{decision};\hspace{1em} // set number of selected activities
\State S[N] = \text{decision};\hspace{1em} // set activity selection flag
\State \textbf{return} S[0..N];
\Else \hspace{1em} // recursion step
\State S[0..N];
\State S[0..N] ← ActivitySelectionRecursive(N, A[K+1..N][1..2], K+1, \text{StartTime});
\State S[K] = \text{decision};\hspace{1em} // set activity selection flag
\State S[0] = S[0] + \text{decision};\hspace{1em} // update number of selected activities
\State \textbf{return} S[0..N];
\EndIf
\end{algorithmic}
\end{algorithm}