Embedded Systems FS 2015

Exercise 2: Aperiodic Scheduling - RT Systems

Discussion Date: 18.03.2015 / 25.03.2015

Aufgabe 1: EDD

Check whether the Earliest Deadline Due (EDD) algorithm produces a feasible schedule for the following task set, given that all tasks are synchronous and arrive at time $t = 0$.

\begin{center}
\begin{tabular}{l|cccc}
 & $J_1$ & $J_2$ & $J_3$ & $J_4$ \\
\hline
$C_i$ & 3 & 6 & 2 & 4 \\
$D_i$ & 8 & 15 & 3 & 11 \\
\end{tabular}
\end{center}

Aufgabe 2: LDF

Given the precedence graph in Figure 1 and the following table of task execution times and deadlines, determine the Latest Deadline First (LDF) schedule. Is the schedule feasible?

\begin{center}
\begin{tabular}{l|cccccccc}
 & $J_1$ & $J_2$ & $J_3$ & $J_4$ & $J_5$ & $J_6$ & $J_7$ & $J_8$ \\
\hline
$C_i$ & 3 & 4 & 2 & 3 & 3 & 2 & 2 & 1 \\
$D_i$ & 5 & 8 & 11 & 15 & 12 & 18 & 19 & 20 \\
\end{tabular}
\end{center}

Aufgabe 3: EDF

Given are five tasks with arrival times, execution times and deadlines according to the following table.

(1) Determine the Earliest Deadline First (EDF) schedule. Is the schedule feasible?

\begin{center}
\begin{tabular}{l|cccc}
 & $J_1$ & $J_2$ & $J_3$ & $J_4$ \\
\hline
$a_i$ & 0 & 2 & 0 & 8 \\
$C_i$ & 3 & 1 & 6 & 2 \\
$d_i$ & 16 & 7 & 8 & 11 \\
\end{tabular}
\end{center}

(2) At time $t = 3$, a new task $J_x$ arrives with execution time $C_x = 2$ and deadline $d_x = 10$. Can you guarantee the schedulability of the task set with this new task or do you have to reject it?
Aufgabe 4: EDF*

Given are seven tasks \( A, B, C, D, E, F, G \) with following precedence constraints:

\[
A \rightarrow C, \quad B \rightarrow C, \quad C \rightarrow E, \quad D \rightarrow F, \quad B \rightarrow D, \quad C \rightarrow F, \quad D \rightarrow G
\]

All tasks arrive at time \( t_0 = 0 \), have a common deadline \( d = 20 \) and the following execution times:

<table>
<thead>
<tr>
<th></th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
<th>E</th>
<th>F</th>
<th>G</th>
</tr>
</thead>
<tbody>
<tr>
<td>( C_i )</td>
<td>3</td>
<td>2</td>
<td>4</td>
<td>3</td>
<td>2</td>
<td>5</td>
<td>1</td>
</tr>
</tbody>
</table>

(1) Construct the precedence graph for this task set. Then, modify the release times and deadlines so that EDF* can be used for its scheduling.

(2) Draw the resulting EDF* schedule and compute the average response time of the tasks.

(3) Assume the additional precedence constraint \( E \rightarrow A \). Is there still a feasible schedule for the above task set? Justify your answer.

Aufgabe 5: EDF with Precedence Constraints

Given is a set of 6 aperiodic tasks named \( A, B, C, D, E \) and \( F \) with the following precedence relations:

\[
A \rightarrow B, \quad A \rightarrow C, \quad B \rightarrow D, \quad B \rightarrow E, \quad C \rightarrow F
\]

The execution times \( C \), arrival times \( r \) and absolute deadlines \( d \) are as follows:

<table>
<thead>
<tr>
<th></th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
<th>E</th>
<th>F</th>
</tr>
</thead>
<tbody>
<tr>
<td>( C )</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>( d )</td>
<td>4</td>
<td>10</td>
<td>8</td>
<td>6</td>
<td>10</td>
<td>12</td>
</tr>
<tr>
<td>( r )</td>
<td>0</td>
<td>1</td>
<td>1</td>
<td>3</td>
<td>7</td>
<td>9</td>
</tr>
</tbody>
</table>

(1) Draw the schedule for the case when the EDF policy ignores any precedence constraints.

(2) Draw the schedule for the case when the EDF policy releases a task after all its predecessors (defined by the precedence constraints above) have finished execution.

(3) Determine the modified release times and deadlines for the EDF* policy and draw the corresponding schedule.

Which of the previous schedules would you accept?