Explicit Modelling of Model Debugging Environments

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Motivation
Motivation

Engineer

Experiments

Simulator

Model
Debugging
Simulation
Example: CBD
Example: CBD

**Algorithm 1** The CBD simulator’s “main loop”.

1. $time \leftarrow 0$
2. **while** not end_condition **do**
3. \hspace{1em} $schedule \leftarrow LOOPDETECT(DEPGRAPH(cbd))$
4. \hspace{1em} **for** gbblock **in** schedule **do**
5. \hspace{2em} $COMPUTE(gblock)$
6. \hspace{1em} **end for**
7. $time \leftarrow time + \delta_t$
8. **end while**
Time

Simulated Time (ST) vs. Wallclock Time (WCT)

- Analytical time (as fast as possible)
- (Scaled) real-time: $ST = s \times WCT$
- Scales: $s > 1$, $s = 1$, $s < 1$

Events:
- Pause event
- Resume event
- Scale factor change
- Stop event
De-Reconstruction
Adding Debugging

MERGE INSTRUMENT
Example: CBD

Algorithm 1 The CBD simulator’s “main loop”.

1: \( \text{time} \leftarrow 0 \)
2: \textbf{while} not end\_condition \textbf{do}
3: \hspace{1em} \text{schedule} \leftarrow \text{LOOPDETECT} \left( \text{DEPGRAPH}(\text{cbd}) \right) \)
4: \hspace{1em} \textbf{for} gb\text{block} \textbf{in} schedule \textbf{do}
5: \hspace{2em} \text{COMPUTE}(gb\text{block})
6: \hspace{1em} \textbf{end for}
7: \hspace{1em} \text{time} \leftarrow \text{time} + \delta_t
8: \hspace{1em} \textbf{end while}
Example: CBD

Algorithm 2 The CBD simulator’s “main loop”.

1: \( \text{time} \leftarrow 0 \)

2: while not end\_condition do

3: \( \text{schedule} \leftarrow \text{LOOPDETECT}(\text{DEPGRAPH}(\text{cbd})) \)

4: for \( \text{gblock} \) in \( \text{schedule} \) do

5: \( \text{COMPUTE}(\text{gblock}) \)

6: end for

7: \( \text{time} \leftarrow \text{time} + \delta_t \)

8: end while
Algorithm 3 The CBD simulator’s “main loop”.

1: \( \text{time} \leftarrow 0 \)
2: \textbf{while} not end\_condition \textbf{do}
3: \quad \text{schedule} \leftarrow \text{LOOPDETECT(\text{DEPGRAPH(cbd)})}
4: \quad \textbf{for} \text{ gbblock in schedule} \textbf{do}
5: \quad \quad \text{\texttt{COMPUTE(gblock)}}
6: \quad \textbf{end for}
7: \quad \text{time} \leftarrow \text{time} + \delta_t
8: \textbf{end while}
Example: CBD
Example: CBD

```
[DELTA_T(Count) = 1.0]
)`b1(Adder) = 1.0]
)`b5(Product) = 0.0, `cb4(Adder) = 0.0]
)`bp(Breakpoint) = 0]
End of iteration 0 out of 9 at time stamp (in sec): 0.500000

Current simulation iteration = 1
)`b6(Count) = 3.0]
)`b2(Delay) = 1.0]
)`negBP(Negator) = -1.0]
)`constBP(Count) = 4.0]
)`addBP(Adder) = 5.0]
)`DELTA_T(Count) = 1.0]
)`b1(Adder) = 2.0]
)`b5(Product) = -1.5, `cb4(Adder) = -0.5]
)`cb3(Count) = 0.0]
)`bp(Breakpoint) = 0]
End of iteration 1 out of 9 at time stamp (in sec): 1.000000

Current simulation iteration = 2
)`b6(Count) = 3.0]
)`b2(Delay) = 2.0]
)`negBP(Negator) = -2.0]
)`constBP(Count) = 4.0]
)`addBP(Adder) = 2.0]
)`DELTA_T(Count) = 1.0]
)`b1(Adder) = 3.0]
)`b5(Product) = -3.0, `cb4(Adder) = -1.0]
)`cb3(Count) = 0.0]
)`bp(Breakpoint) = 0]
End of iteration 2 out of 9 at time stamp (in sec): 1.500000

Current simulation iteration = 3
)`b6(Count) = 3.0]
)`b2(Delay) = 3.0]
)`negBP(Negator) = -3.0]
)`constBP(Count) = 4.0]
)`addBP(Adder) = 1.0]
)`DELTA_T(Count) = 1.0]
)`b1(Adder) = 4.0]
)`b5(Product) = -4.5, `cb4(Adder) = -1.5]
)`cb3(Count) = 0.0]
)`bp(Breakpoint) = 1]
Model execution paused because of breakpoint, bp at time stamp (in sec): 2.000000

End of iteration 3 out of 9 at time stamp (in sec): 2.000000
```
Conclusion

• Complexity of simulation experimentation environments
• Reactive and autonomous, so model explicitly, using Statecharts
• Successfully applied to CBDs and Parallel DEVS (and Statecharts before)
Future Work