Faculty of Science

Towards Automatic Program Specification Using SME Models

Communicating Process Architectures 2018 – Technische Universität Dresden

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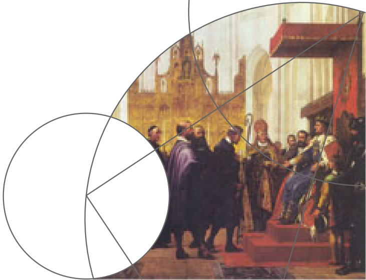

21 August 2018

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Ariane-5

4th June 1996

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Overflow caused the self-destruct mechanism in both primary and backup computer

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No people where harmed

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Inaccurate results == missile misses target

What have we done?

A transpiler which transpiles SMEIL code to CSP_M in order to verify SME models with FDR4

SME

The SME model builds on the CSP algebra what more to add?

SMEIL

You have just been introduced to SMEIL in the previous presentation

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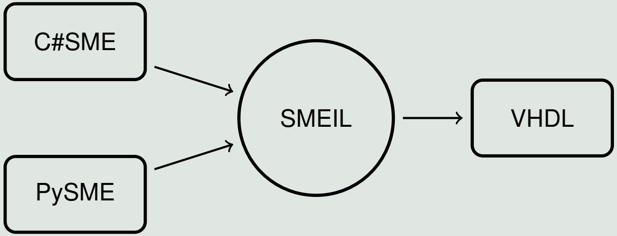


Figure. SMEIL transpiler structure.

Seven segment display clock

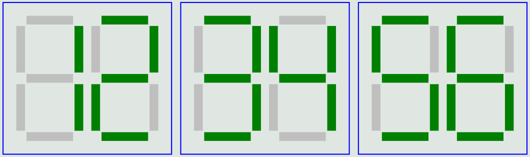
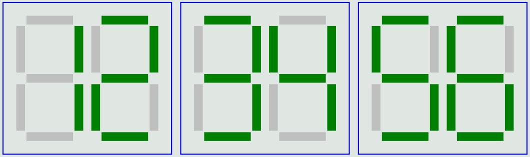


Figure. Digital clock with six seven segment displays, displaying 12:34:56.

Seven segment display clock



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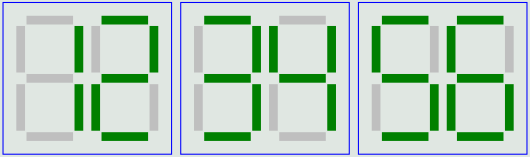

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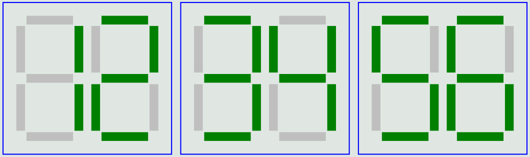
Arithmetics calculate hours, seconds and minutes respectively

Seven segment display clock



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Seconds since midnight

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Two seven segment displays pr. `time` process

Simple example

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In this case we can restrict the assertions further.
Hours will never be more than 24, etc.

Simple example

Seven Segments SMEIL Structure

SMEIL code:

```
proc seconds (in seconds_in)
    bus seconds_out {first_digit: u3 range 0 to 5;
                     second_digit: u4 range 0 to 9;};
    var seconds: u6 range 1 to 59;
    var seconds_first_temp: u3 range 0 to 5;
    var seconds_second_temp: u4 range 0 to 9;
{
    seconds = seconds_in.val % 60;
    seconds_first_temp = seconds / 10;
    seconds_second_temp = seconds % 10;
    seconds_out.first_digit = seconds_first_temp;
    seconds_out.second_digit = seconds_second_temp;
}
```

Simple example

Seven Segments SMEIL Structure

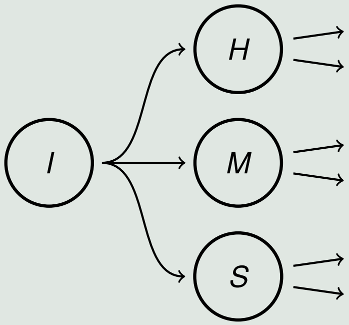

Figure. SMEIL network for a seven segment display clock. Each SMEIL process is represented by a cicle with a letter corresponding to the processes Input, Hours, Minutes and Seconds respectively.

SMEIL bus to CSP$_M$ channel

SMEIL code:

```
channel seconds_out_first_digit : {0..7}
channel seconds_out_second_digit : {0..15}

    ⋮

Seconds(seconds_in) =
let
    seconds = seconds_in % 60
    seconds_first_temp = seconds / 10
    seconds_second_temp = seconds % 10
within
    seconds_out_first_digit ! seconds_first_temp ->
    seconds_out_second_digit ! seconds_second_temp ->
    SKIP
```

CSP$_M$ process structure

Code example

Monitor process

SMEIL code:

```
Seconds_out_first_digit_monitor(c) =
    c ? x -> if 0 <= x and x <= 5 then SKIP else STOP
Seconds_out_second_digit_monitor(c) =
    c ? x -> if 0 <= x and x <= 9 then SKIP else STOP
```

Example continued

CSP_M code

CSP_M code? Do we even need this?

Results - time to verify in FDR4?

The seven segment example have been run on a Intel(R) Xeon(R) CPU E5-2698 v4 @ 2.20GHz.

The example were run x times and the average was measured. (If I have time)

Conclusion

With this system we can transpile hardware models to CSP$_M$

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and verify values on the CSP_M channels

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With this system we can transpile hardware models to CSP$_M$

and verify values on the CSP$_M$ channels

and thereby verify the original hardware model

Future work

Rest of SMEIL grammar?

+ more?

Questions?

Thank you!

Thank you so much for your time.
Feel free to ask anything.