形式化方法 实验作业2 firts-attempt model

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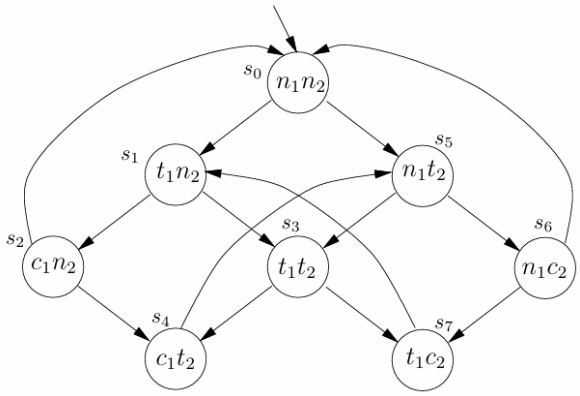
1 实验内容

使用NuSMV实现PPT中first-attempt model, 要求用CTL设计Non-blocking, No strict sequencing, 并验证所有四个性质

A first-attempt model:



processes

- 1,2

states

- n: in its *non-critical* state
- t: *trying* to enter its *critical* state
- c: in its *critical* state

state transitions

- $n_i \to t_i \to c_i \to n_i \ldots$

问题: Is the model correct?

2 代码实现

模型实现

根据模型的状态转换，描述模型如下

```
MODULE main
    VAR
        p1: {n, t, c};
        p2: {n, t, c};

    ASSIGN
        init(p1) := n;
        init(p2) := n;

        next(p1) := case
            p1 = n & p2 = n : {n, t};   -- s0
            p1 = t & p2 = n : {c, t};   -- s1
            p1 = c & p2 = n : {c, n};   -- s2
            p1 = t & p2 = t : {c, t};   -- s3
            p1 = c & p2 = t : {n};      -- s4
            p1 = n & p2 = t : {n, t};   -- s5
            p1 = n & p2 = c : {n, t};   -- s6
```

```
            p1 = t & p2 = c : {t};      -- s7
            TRUE : {p1};              -- default case
        esac;

        next(p2) := case
            (next(p1) = p1) & (p2 = n) : t;   -- s0>, s1>, s2>
            (next(p1) = p1) & (p2 = t) & (p1 != c) : c;   -- s3>, s5>
            (next(p1) = p1) & (p2 = c) : n;   -- s6>, s7>
            TRUE : {p2};              -- default case
        esac;
```

约束实现

- Safety: Only one process is in its critical section at any time.
- Liveness: Whenever any process requests to enter its critical section, it will eventually be permitted to do so.
- Non-blocking: A process can always request to enter its critical section.
- No strict sequencing: Processes need not enter their critical section in strict sequence.

```
    -- Safety
    LTLSPEC G !(p1 = c & p2 = c)
    -- Liveness
    LTLSPEC G ((p1 = t -> F p1 = c) & (p2 = t -> F p2 = c))
    -- Non-blocking
    CTLSPEC AG ((p1 = n -> EF (p1 = t)) & (p2 = n -> EF (p2 = t)))
    -- No strict sequencing
    CTLSPEC EG ((p1=c -> EF (p1=c)) & (p2=c -> EF (p2=c)))
```

3 检查结果

使用指令 `NuSMV first.model`，输出如下

```
-- specification AG ((p1 = n -> EF p1 = t) & (p2 = n -> EF p2 = t))  is true
-- specification EG ((p1 = c -> EF p1 = c) & (p2 = c -> EF p2 = c))  is true
-- specification  G !(p1 = c & p2 = c)  is true
-- specification  G ((p1 = t ->  F p1 = c) & (p2 = t ->  F p2 = c))  is false
-- as demonstrated by the following execution sequence
Trace Description: LTL Counterexample
Trace Type: Counterexample
  -> State: 1.1 <-
    p1 = n
    p2 = n
  -> State: 1.2 <-
```

```
    p2 = t
  -- Loop starts here
  -> State: 1.3 <-
    p1 = t
  -> State: 1.4 <-
    p1 = c
  -> State: 1.5 <-
    p1 = n
  -> State: 1.6 <-
    p1 = t
```

可见该模型满足`Safety` `Non blocking` `No strict sequencing`三个要求，不满足`Liveliness`