

Cockrell School of Engineering

Verifying Distributed Algorithms in Promela

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Outline

Introducing Promela

Dining Philosophers

Token Ring

Lamport's

Szymanski's

Questions

Cockrell School Beamer Presentation Template

- ▶ Conforms to **Cockrell School Visual Style Guide**
 - Exact color palette
 - Opensans fonts
- ▶ Easily change department names in title bar
 - Full citation with active hyperlinks to DOI upon first citation.
 - See next slide for repeated citation behavior

Dining Philosophers

An equation block

$$\vec{F} = m\vec{a}$$

- ▶ Second instance of citations use short citation hyperlinked to original.

Token Ring Algorithm

- ▶ Simple and easily scalable
 - Pass token around ring of processes
 - Only processes with token can enter CS
 - No Starvation

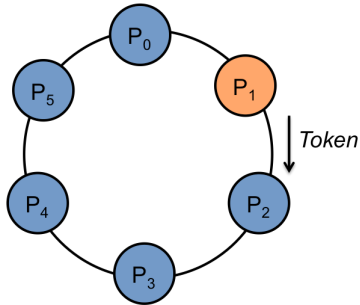


Figure: Token Ring Algorithm

Token Ring Implementation

```
#ifndef N
#define N 10
#endif

#ifndef size
#define size 10
#endif

byte state[N];
bit _Permission[N];
bit _Executing[N];

byte in_cs;
byte token;

init {
    atomic {
        byte i = 0;
        token = 0;
    }

    do
        :: i < N → run P(i); i++;
        :: else → break;
    od;
}

proctype P(byte id) {
    NonCritical:
        _Permission[id] = true;
        printf("Token value: %d", token);
    Wait:
        _Executing[id] = true;
        if
            :: id != token → _Permission[id] = false; goto Wait;
            :: id == token
        fi;
        Critical:
            atomic { in_cs--; }
            printf("Process %d has entered critical section");
            _Permission[id] = false;
            _Executing[id] = false;
            if
                :: token < N → token = ((token + 1) % N);
                :: atomic{token > (N-1) → token = 0; }
            fi;
            goto NonCritical;
}
```

Lamport's

An equation block

$$\vec{F} = m\vec{a}$$

- ▶ Second instance of citations use short citation hyperlinked to original.

Szymanski's Algorithm

- ▶ Extension of Lamport's
 - satisfies linear wait
 - three booleans per process
- ▶ Extension of Lamport's

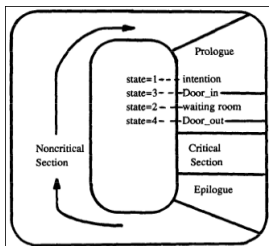


Figure: Szymanski's Algorithm

Coding of the flag values			
flag	intent	door_in	door_out
0	0	0	0
1	1	0	0
2	0	1	0
3	1	1	0
4	1	1	1

Figure: State-tracking booleans

Szymanski's Implementation

```
start:
    /* 1. SEKCJA LOKALNA */
    local_section();

    /* 2. PROLOG */
    intent[i] = true;

started_protocol:
    skip;

    /* 3. Others are trying to
       * enter waiting room? */
    (count(1,1,0) +
     count(1,1,1) == 0);

    /* 4. Enter waiting room */
    door_in[i] = true;

anteroom_check:
    if
        :: (count(1,0,0) +
            count(1,0,1) > 0) →
    {
        /* State 2 */
        intent[i] = false;

    in_anteroom:
        ((count(0,0,1) +
          count(0,1,1) +
          count(1,0,1) +
          count(1,1,1) > 0)
        );

        /* State 3 */
        intent[i] = true;
    }
    :: else
fi;

/* . Proceed into CS when
 * it is your turn */
door_out[i] = true;

wait_forall(k, i + 1, N,
            (!door_in[k] || door_out[k]));

wait_forall(k, 0, i,
            (!door_in[k]));

critical_section:
    /* . SEKCJA KRYTYCZNA */
    critical_section();

    /* . EPILOG */
    door_out[i] = false;
    door_in[i] = false;
    intent[i] = false;
```

Szymanski's Analysis

Questions

- ▶ English mothafucka, do you speak it?