

## CS4021/4521 Tutorial 1

- Q1. How many ways can the three statements of two identical processes be interleaved? How many ways can the four statements of three identical processes be interleaved? How many ways can the  $n$  statements of  $m$  identical processes be interleaved?
- Q2 Consider the following C/C++ code for the Bakery lock [[Lamport 1975](#)].

```

int choosing[MAXTHREAD]; // initially 0
int number[MAXTHREAD]; // initially 0

void bakeryLock (int pid) { // process id in range 0 .. MAXTHREAD-1

    choosing[pid] = 1;
    int max = 0;
    for (int i = 0; i < n; i++) {
        if (number[i] > max)
            max = number[i];
    }
    number[pid] = max + 1;
    choosing[pid] = 0;

    for (int j = 0; j < n; j++) {
        while (choosing[j]);
        while ((number[j] != 0) && ((number[j] < number[pid]) ||
            ((number[j] == number[pid]) && (j < pid))));
    }

    // critical section

    number[pid] = 0;
}

```

Using Promela/Spin show that the Bakery lock has the following desirable properties: safety, deadlock free, liveness and starvation free.

**As an alternative**, prove that these four properties hold for the “The Black-White Bakery Algorithm” [[Taubenfeld 2005](#)] which has the advantage of bounding the values stored in the number array.