

T-106.420 Concurrent programming

Homework assignment 2 (Oct. 13, 2003)

The deadline for this exercise is Sunday, Oct. 26, 2003

- Express each of the following as a formula of first order predicate logic, using suitable quantifications where necessary:
 - The average of the array $x[0 \dots N - 1]$, $N \geq 1$, is m .
 - The segment of the array x that is between indices p and $q - 1$ inclusive contains only zeroes.
 - The index of the minimum value of the array $x[0 \dots N]$, $N \geq 0$, is i .
 - The value of each element in array $x[0 \dots N]$, $N \geq 1$, is unique (within the array).
- Suppose your machine has the following atomic instruction:

```
flip(lock) : {lock = (lock + 1) % 2; # flip the lock
              return(lock);}
```

Someone suggests the following solution to the critical section problem for *two* processes:

```
int lock = 0;

process CS[i = 1 to 2] {
  while (true) {
    while (flip(lock) != 1)
      while (lock != 0) skip;
    critSection();
    lock = 0;
    nonCritSection();
  }
}
```

- Does this solution work? If not, give an execution order that results in both processes being in their critical sections at the same time.
- How does the situation change if the number of processes remains the same, but the flip instruction has the form:

```
flip(lock) : {lock = (lock + 1) % 3; # flip the lock
              return(lock);}
```