COMPUTER SCIENCE TRIPOS Part IB – 2012 – Paper 3

2 Algorithms II (FMS)

(a) Briefly explain the concurrency keywords "spawn", "sync" and "parallel for".
[3 marks]

(b) Define what a "determinacy race" is and list the precise circumstances under
which one may occur. [3 marks]

(c) In less than 10 lines of pseudocode, give a clear example of a determinacy race
(but *not* the same example as in the textbook or the course handout) and briefly
explain why it is one. [3 marks]

(d) Do any of the two following pseudocode functions contain determinacy races?
Justify and explain your answer for each of the two pieces of code.

```
def fibonacci(n):
    if n <= 1:
        return n
    else:
        x = spawn fibonacci(n - 1)
        y = fibonacci(n - 2)
        sync
        return x + y


def matrixMultiply(A, B):
    # PRECONDITION: A and B are square matrices of the same size
    n = A.rows
    let C be a new n x n matrix
    parallel for i = 1 to n:
        parallel for j = 1 to n:
            C[i,j] = 0
            for k = 1 to n:
                C[i,j] = C[i,j] + A[i,k] * B[k,j]
    return C
```

[8 marks]

(e) Give an example of a circumstance in which a multithreaded algorithm
containing a determinacy race might still be correct. For each of the races
you found and discussed in (d), if any, state whether this circumstance applies.
[3 marks]

1