

G51APS, Algorithmic Problem Solving

Coursework 5, 2012/2013

Induction

School of Computer Science
University of Nottingham

September 28, 2012

Abstract

This document details the last of 5 courseworks for the module G51APS in the academic year 2012/2013. The coursework does not count towards the final assessment but, if submitted by the deadline, will be marked and returned for feedback purposes. A substantial proportion of the (unseen 90 minute) examination will be based on the five courseworks. Marks shown are indicative of the marks that would be awarded in a written examination. A record will be taken of submitted work; non-submission may result in your being assumed to have withdrawn from the course.

Answer ALL questions.

(a) Construct the state-transition diagram for the Tower of Hanoi problem for the case that there are 2 disks. Using A, B and C to name the poles, label each state with the positions of the disks on the poles. (5)

(b) Suppose $T.n$ is the number of state transitions in the state-transition diagram for the Tower of Hanoi problem in the case that there are n disks.

What are the values of $T.0$, $T.1$ and $T.2$? (3)

Express $T.(n+1)$ as a function of $T.n$. Prove inductively that

$$\left[T.n = \frac{3}{2} \times (3^n - 1) \right] . \quad (7)$$

(c) A *simple* path in a graph is a path that has no loops (so no node is visited twice). Consider solutions to the Tower of Hanoi problem that correspond to the longest simple path in the state-transition diagram for the problem. Construct solutions to the Tower of Hanoi problem that correspond to the longest simple path in the state-transition diagram for the case that the number of disks is 0, 1 and 2. (In the case that the number of disks is 2, mark a path on your solution to (a).) (5)

(d) Formulate an inductive solution to the problem of determining a solution to the Tower of Hanoi problem that corresponds to finding a longest simple path in the state-transition diagram. Solutions expressed informally will be accepted. (10)

What to Submit and When

Your solutions should be submitted to the School Office by **3.00pm on Friday, 7th December**. Feedback on this coursework is planned for the week beginning Monday, 10th December.