4 Operating Systems (rmn1002)

(a) Address binding refers to the process of resolving memory references in a program to physical addresses when that program is brought into memory. Describe what is required for it to happen:

(i) At compile time

(ii) At load time

(iii) During execution

[3 marks]

(b) In a system containing three frames, consider the following string of page references:

1 2 3 2 4 3 5 1 3 2 3 4

Compute the sequence in which pages are allocated frames under the following algorithms:

(i) Optimal, OPT

(ii) Least Recently Used, LRU

(iii) First-In First-Out, FIFO

[9 marks]

(c) FIFO can exhibit Béladý’s anomaly. State Béladý’s anomaly, and explain why neither OPT nor LRU can exhibit it, but FIFO can.

[4 marks]

(d) LRU is relatively expensive to implement, so some systems approximate it cheaply, determining which page to replace by using a reference bit and a dirty bit, respectively indicating whether a page was recently referenced or written to. A focused engineer wishes to implement such an LRU approximation on a machine that does not have hardware support for either reference or dirty bits. How might they emulate reference and dirty bits using paging hardware?

[4 marks]