Homework Assignment 3

1. Essay question concerning switching fixed-size packets (called cells) using the iSLIP algorithm. As shown in Figure 1 (on the next page), the switch is the same as shown in Figure 13.9 (in the textbook, p318) in the textbook. However, the inputs and the starting values of accept/grant pointers are different. You have the option to show intermediate steps (like Figures 13.9 and 13.10 in the textbook) for partial credits just in case.

- (a) Please draw cell transmission timing chart like shown in Fig. 13.11.
- (b) Please write down the values of grant and accept pointers **after** the transmission of all these cells.

Figure 1: Switching using iSLIP

2. Please design an augmented data structure that, given as input a long list of memory addresses accessed (by a program), allows a companion algorithm to compute, for each memory access, its reuse distance in $O(\log N)$ time, where N is the number of distinct addresses in the list. Please describe the data structure and the companion algorithm in texts, pseudocode, and/or figures as you see fit.

3. The Z-transform of a random variable X that takes only nonnegative integer values, denoted as $\mathcal{X}(z)$, is defined as $\mathcal{X}(z) := \sum_{i=0}^{\infty} a_i z^i$ where $a_i = Pr[X = i]$ for $i = 0, 1, 2, \cdots$. Let Y be a Poisson random variable such that $Pr[Y = i] = e^{-\lambda}\frac{\lambda^i}{i!}$, for $i = 0, 1, 2, \cdots$. Prove that

$$\mathcal{Y}(z) = e^{\lambda(z-1)}$$

4. Prove that for any constant $0 < \gamma < 1$, we have

$$\lim_{z \to 1} Q'(z) = \frac{\gamma^2}{2(1-\gamma)}$$

where

$$Q(z) = \frac{(1-\gamma)(1-z)}{e^{\gamma(z-1)} - z}$$

(Hint: Apply L'Hopital's rule repeatedly.)