Coffee: A coffee store in town is celebrating 1th anniversary of its opening. On the day of the celebration, store is going to reward one customer with yearlong supply of coffee. At the door, each customer is given a ticket with a randomly assigned number between 1 and 100 and writes his/her info and order on the ticket. The first customer whose number is the same as an earlier customer wins the reward. Suppose you can get in line wherever you want and you really want to win. What position would you take to maximize your chance?

- Please **Submit** your solution to
  - *Dr. Erol Akbas,* eakbas@gsu.edu or
  - *Dr. Tirtha Timsina,* ttimsina@gsu.edu

  before the deadline: **Friday, March 30th, 7:00PM.**
- The WINNER will be awarded with a $25 gift certificate and will be announced in the NEXT issue.

Problem of the last month:

Water: Two cups of equal size are placed one on the top of the other. The one on the top is filled with pure water. The one on the bottom is filled with pure alcohol. Through a small hole, water drips into the alcohol cup at constant rate and mixture drips at the same rate through a hole in the bottom cup. Assume that water and alcohol mix completely and instantly. What is the alcohol percentage in the bottom cup when the water cup is completely empty?

Solution: Let $W_{(t)}$ = Volume of the alcohol in the bottom cup t seconds after water and alcohol start dripping. Let the size of the alcohol cup be $V \Rightarrow W_{(0)} = V$. Let water drip at the rate of r unit volume per second. Suppose that Δt represents infinitesimal time length.

$$W_{(t+\Delta t)} = W_{(t)} - \frac{W_{(t)}}{V} \cdot r \cdot \Delta t \quad \Rightarrow \quad W_{(t+\Delta t)} - W_{(t)} = -\frac{W_{(t)}}{V} \cdot r \cdot \Delta t \Rightarrow \frac{W_{(t+\Delta t)} - W_{(t)}}{\Delta t} = -\frac{W_{(t)}}{V} \cdot r$$

$\Rightarrow \dfrac{dW_{(t)}}{dt} = -\dfrac{r}{V} \cdot W_{(t)} \Rightarrow W_{(t)} = C \cdot e^{-\frac{r}{V} \cdot t}$ for some C. Notice that C is the initial value of $W_{(t)}$. So $C = V \Rightarrow W(t) = V \cdot e^{-\frac{r}{V} \cdot t}$. It takes $\dfrac{V}{r}$ seconds all the water in the top cup to drip. When the water cup is empty, volume of the alcohol in the bottom cup is $W_{\left(\frac{V}{r}\right)} = V \cdot e^{-1} \Rightarrow$ When the water cup is completely empty, alcohol percentage in the bottom cup is $e^{-1} \cdot 100 \approx 36.8\%$.

Winner: **Joseph Moravitz**