# CS344: HW3

October 8, 2017

- Out Oct 8, Due week of Oct 23. Hand it to your TAs at the beginning of the recitation. No late homeworks please.
- Let $\mathcal{H}$ be a set of universal hash functions from $\{1, ..., U\}$ to $\{0, 1, ..., m-1\}$.

  Show the results we showed in the class for hashing with chaining for SUCCESSFUL and UNSUCCESSFUL SEARCH operations with universal hash functions (and not simple uniform hashing like we assumed in the class).
- Let $p$ be a prime number. Consider pairs $(x, y)$, where $x$ and $y$ are in $[0, p-1]$. Consider the hash function

  $$h_{a,b}(x, y) = (ax + by) \bmod p$$

  where $a, b \in [0, p-1]$.
  - Fix $a, b$. Describe a method generate $p$ distinct input pairs $(x_i, y_i)$ for which $h_{a,b}(x_i, y_i)$ has the same value (i.e, all the inputs $(x_i, y_i)$ which hash to the same slot.
  - Fix two non-identical inputs $(x, y)$ and $(x', y')$ (They may have the same $x$ or $y$ values, but not both.) For how many distinct pairs $(a, b)$ will these two inputs hash to the same slot?