Nathan Bickel
MATH 575: Section H01
Professor: Dr. Fu
September 11, 2023

MATH 575 Homework 1

Problem 1 Write down the values for the variables `u`, `v`, `bot`, `top`, `side` after each iteration.

We will follow the procedure.

1. Since `x` $= 137641$, the groups are $(13)(76)(41)$.
2. We first have $\texttt{u} = 0, \texttt{v} = 0, \texttt{bot} = 0, \texttt{top} = 0, \texttt{side} = 0$.
3. We will iterate over each group.
   (a) The first group is 13.
   - `bot` $= (\texttt{bot} - \texttt{u})\hat{}$(the current group from `x`) $= (0-0)\hat{}13 = 013$.
   - `side` $= 2 * \texttt{top} = 2 * 0 = 0$.
   - `v` $=$ the largest single digit such that $\texttt{v} * (\texttt{side}\hat{}\texttt{v}) <= \texttt{bot} = 3$.
   - `u` $= \texttt{v} * (\texttt{side}\hat{}\texttt{v}) = 3 * (0\hat{}3) = 3 * 03 = 09$.
   - `top` $= \texttt{top}\hat{}\texttt{v} = 0\hat{}3 = 03$.

   (b) The second group is 76.
   - `bot` $= (\texttt{bot} - \texttt{u})\hat{}$(the current group from `x`) $= (013 - 09)\hat{}76 = 0476$.
   - `side` $= 2 * \texttt{top} = 2 * 03 = 06$.
   - `v` $=$ the largest single digit such that $\texttt{v} * (\texttt{side}\hat{}\texttt{v}) <= \texttt{bot} = 7$.
   - `u` $= \texttt{v} * (\texttt{side}\hat{}\texttt{v}) = 7 * (06\hat{}7) = 7 * 067 = 0469$.
   - `top` $= \texttt{top}\hat{}\texttt{v} = 03\hat{}7 = 037$.

   (c) The third group is 41.
   - `bot` $= (\texttt{bot} - \texttt{u})\hat{}$(the current group from `x`) $= (0476 - 0469)\hat{}41 = 07\hat{}41 = 0741$.
   - `side` $= 2 * \texttt{top} = 2 * 037 = 074$.
   - `v` $=$ the largest single digit such that $\texttt{v} * (\texttt{side}\hat{}\texttt{v}) <= \texttt{bot} = 1$.
   - `u` $= \texttt{v} * (\texttt{side}\hat{}\texttt{v}) = 1 * (074\hat{}1) = 1 * (074\hat{}1) = 1 * 0741 = 0741$.
   - `top` $= \texttt{top}\hat{}\texttt{v} = 037\hat{}1 = 0371$.
4. The final value of `top` is 0371.

Problem 2 What is the relationship between the final value `top` and the input 137641?

A notable relationship is that $371^2 = 137641$.

Problem 3 What is your guess for what the procedure `PROCX` is doing?

My guess is that for a given input $n \in \mathbb{N}$, `PROCX` is finding $\lfloor \sqrt{n} \rfloor$.