Research notes

Primes (part 03): Recursion - New approach for also non-prime times tables

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Abstract

This notes gives a short overview over a new approach for also non-prime times tables and their intersection solutions.

Content

$$\bar{n}_1' = (2x_1+1)(2u_1+1) - 2\Delta_1 \cdot \Delta x_{1,2} + \alpha_1$$

$$\bar{n}_2' = \underbrace{(2x_1+1)(2x_1'+1)}_{=:(2x_2+1)}(2u_2+1) - 2\Delta_2 \Delta x_{1,2} + \alpha_2$$

$\Rightarrow \quad \bar{n}_1' = \bar{n}_2'$

$$(2x_1+1)(2u_1+1) - 2\Delta_1 \Delta x_{1,2} + \alpha_1 = (2x_1+1)(2x_1'+1)(2u_2+1) - 2\Delta_2 \Delta x_{1,2} + \alpha_2$$

$$\Leftrightarrow \quad (2x_1+1)(2u_1+1) = (2x_1+1)(2x_1'+1)(2u_2+1) - 2\Delta_2 \Delta x_{1,2} + 2\Delta_1 \Delta x_{1,2} + \alpha_2 - \alpha_1$$

$$\Leftrightarrow \quad (2u_1+1) = (2x_1+1)(2u_2+1) + 2\frac{(-\Delta_2+\Delta_1)\Delta x_{1,2}}{2x_1+1} \quad (*)$$

$$+ \frac{2(-\Delta_2+\Delta_1)\Delta x_{1,2} + \alpha_2 - \alpha_1}{2x_1+1}$$

$$\left(\begin{array}{l} \alpha_2 = \alpha_2' \cdot \Delta x_{1,2} \\ \alpha_1 = \alpha_1' \cdot \Delta x_{1,2} \\ \Rightarrow + \dfrac{2(-\Delta_2+\Delta_1)\Delta x_{1,2} + (\alpha_2' - \alpha_1') \cdot \Delta x_{1,2}}{2x_1+1} \\ = \Delta x_{1,2} \cdot \dfrac{2(-\Delta_2+\Delta_1) + (\alpha_2' - \alpha_1')}{2x_1+1} \end{array} \right)$$

I. $(2x_1+1)$

II. $(2x_2+1) = (2x_1+1)(2x_1'+1) = 2 \cdot (\underbrace{2x_1 x_1' + x_1 + x_1'}_{= x_2}) + 1$

$\underline{x_2 > x_1}$

$$\Rightarrow \Delta x_{1,2} = x_2 - x_1 = (2x_1 x_1' + x_1 + x_1') - x_1$$
$$= 2x_1 x_1' + \cancel{x_1} + x_1' - \cancel{x_1}$$
$$= 2x_1 x_1' + x_1'$$

$$\boxed{\Delta x_{1,2} = (2x_1+1)x_1'}$$

$\Rightarrow$ This is integer divisible by $(2x_1+1)$!

$$\Longrightarrow (*) = 2\frac{(-\Delta_2+\Delta_1)\Delta x_{1,2}}{2x_1+1} = 2\frac{(-\Delta_2+\Delta_1)\cancel{(2x_1+1)}x_1'}{\cancel{2x_1+1}}$$

$$= 2(-\Delta_2+\Delta_1)x_1 \Rightarrow \boxed{2u_1+1 = (2x_1+1)(2u_2+1) + 2(-\Delta_2+\Delta_1)x_1}$$

$$2k_1+1 = (2x_1+1)(2k_2+1) + 2(-\Delta_2+\Delta_1)x_1$$

Be $k_2 = (-\Delta_2+\Delta_1+1)x_1$

$$\Rightarrow \quad 2k_1+1 = (2x_1+1)\left[2(-\Delta_2+\Delta_1+1)x_1+1\right] + 2(-\Delta_2+\Delta_1)x_1$$

$$= (2x_1+1)\,2\cdot(-\Delta_2+\Delta_1+1)x_1 + (2x_1+1) + 2(-\Delta_2+\Delta_1)x_1$$

$$= (2x_1+1)\cdot 2(-\Delta_2+\Delta_1+1)x_1 + 2(-\Delta_2+\Delta_1+1)x_1 + 1$$

$$= 2\left[(2x_1+1)(-\Delta_2+\Delta_1+1)x_1 + (-\Delta_2+\Delta_1+1)x_1\right]+1$$

$$= 2\left[(-\Delta_2+\Delta_1+1)\underbrace{x_1(2x_1+1+1)}\right]+1$$

$$= x_1(2x_1+2)$$

$$= 2x_1x_1 + 2x_1$$

$$= 2x_1x_1 + x_1 + x_1 = x_2$$

$\Rightarrow$ For this case follows: $x_1 = x_1'$

General case

$$2k_1+1 = (2x_1+1)(2k_2+1) + 2(-\Delta_2+\Delta_1)x_1$$

$$\Leftrightarrow \quad 2k_1 = (2x_1+1)(2k_2+1) + 2(-\Delta_2+\Delta_1)x_1 - 1$$

$$k_1 = \frac{1}{2}\left[(2x_1+1)(2k_2+1) + 2(-\Delta_2+\Delta_1)x_1 - 1\right]$$

$$= \frac{1}{2}\left[\underbrace{(2x_1+1)(2k_2+1)}_{\hat{=}\text{ odd number}} - 1\right] + (-\Delta_2+\Delta_1)x_1$$

$\Rightarrow \frac{1}{2}\left((2x_1+1)(2k_2+1)-1\right)$ is an integer number, too.

$\rightarrow$ k_2 is an arbitrary number $\in \mathbb{N}$

$$\bar{n}_1' = (2x_1+1)(2u_1+1) - 2\Delta_1\Delta x_{1/2}$$

$$\bar{n}_2' = (2x_2+1)(2u_2+1) - 2\Delta_2\Delta x_{1/2}$$

!

$$\Rightarrow u_1 = u_2 + \frac{\Delta x_{1/2}(2u_2+1)+\Delta x_{1/2}(-\Delta_2+\Delta_1)}{2x_1+1}$$

$$= u_2 + \Delta x_{1/2}\,\frac{(2u_2+1)+(-\Delta_2+\Delta_1)}{2x_1+1}$$

NR:

$$= u_2 + \Delta x_{1/2}\,\frac{(-\Delta_2+\Delta_1)\cdot(2x_1+1)(2x_1'+1)+(2x_1+1)}{2x_1+1}$$

$$u_1 = u_2 + \Delta x_{1/2}\cdot\left[(-\Delta_2+\Delta_1)\cdot(2x_1'+1)+1\right]$$

$$\frac{(-\Delta_2+\Delta_1)(2x_1+1)(2x_1'+1)+(2x_1+1)}{2x_1+1} \overset{!}{=} \frac{(2u_2+1)+(-\Delta_2+\Delta_1)}{2x_1+1}$$

$$\Leftrightarrow (-\Delta_2+\Delta_1)(2x_1+1)(2x_1'+1)+(2x_1+1) = (2u_2+1)+(-\Delta_2+\Delta_1)$$

$$\Leftrightarrow (-\Delta_2+\Delta_1)(2x_1+1)(2x_1'+1)+(2x_1+1)-(-\Delta_2+\Delta_1) = 2u_2+1$$

$$\Leftrightarrow (-\Delta_2+\Delta_1)\left[(2x_1+1)(2x_1'+1) - 1\right] + (2x_1+\cancel{1}) = 2u_2+\cancel{1}$$

$$\Leftrightarrow (-\Delta_2+\Delta_1)\left[\underbrace{(2x_1+1)(2x_1'+1) - 1}_{2(2x_1x_1'+x_1+x_1')+1-1}\right]\cdot\frac{1}{2} + x_1 = u_2$$

$$\Leftrightarrow (-\Delta_2+\Delta_1)\left[2(2x_1x_1'+x_1'+x_1)\right]\cdot\frac{1}{2} + x_1 = u_2$$

$$\Leftrightarrow (-\Delta_2+\Delta_1)(2x_1x_1'+x_1'+x_1) + x_1 = u_2$$

$$\Leftrightarrow (-\Delta_2+\Delta_1)\left[(2x_1+1)x_1' + x_1\right] + x_1 = u_2$$

$$\Leftrightarrow \underbrace{(-\Delta_2+\Delta_1)(2x_1+1)x_1'} + x_1(-\Delta_2+\Delta_1+1) = u_2$$

$$= (-\Delta_2+\Delta_1)2x_1x_1' + (-\Delta_2+\Delta_1)x_1'$$

$$= x_1'\left[(-\Delta_2+\Delta_1)2x_1 + (-\Delta_2+\Delta_1)\right]$$

$$\Leftrightarrow \cancel{(-\Delta_2+\Delta_1)(2x_1x_1'} + (-\Delta_2+\Delta_1)x_1' + x_1(\cancel{-\Delta_2}+\Delta_1)\cancel{)} + x_1 = u_2$$

$$\Leftrightarrow (-\Delta_2+\Delta_1)(\underbrace{2x_1x_1'+x_1'+x_1}_{x_2}) + x_1 = u_2$$

$$\boxed{u_2 = (-\Delta_2 + \Delta_1) x_2 + x_1}$$

Test

$$2x_1 x_1' + x_1 + x_1' = (2x_1+1)x_1' + x_1$$

$$= \Delta x_{1,2} \; \frac{2(-\Delta_2+\Delta_1)\overset{\downarrow}{x_2} + 2x_1 + 1 + (-\Delta_2+\Delta_1)}{2x_1+1}$$

$$= \Delta x_{1,2} \; \frac{2(-\Delta_2+\Delta_1)\cancel{(2x_1+1)}x_1' + 2(-\Delta_2+\Delta_1)x_1 + 2x_1 + 1 + (-\Delta_2+\Delta_1)}{\cancel{2x_1+1}}$$

$$= \Delta x_{1,2} \left(2(-\Delta_2+\Delta_1)x_1' + (-\Delta_2+\Delta_1) \underbrace{\frac{2x_1 + 1 + 2x_1 + 1}{2x_1+1}}_{=2} \right)$$

$$\Rightarrow u_1 = \overset{x_2 - x_1}{\overset{\downarrow}{\Delta x_{1,2}}} \left(2(-\Delta_2+\Delta_1)x_1' + (-\Delta_2+\Delta_1)\cdot 2 \right)$$

$$+ (-\Delta_2+\Delta_1)x_2 + x_1$$

$$= (x_2 - x_1)\left((-\Delta_2+\Delta_1)(2x_1'+2)\right) + (-\Delta_2+\Delta_1)x_2 + x_1$$

$$u_1 = x_2(-\Delta_2+\Delta_1)(2x_1'+2) - x_1(-\Delta_2+\Delta_1)(2x_1'+2)$$

$$+ (-\Delta_2+\Delta_1)x_2 + x_1$$

$$u_1 = (-\Delta_2+\Delta_1)\left[\underbrace{x_2(2x_1'+2) - x_1(2x_1'+2) + x_2}\right] + x_1$$

$$= 2x_1'x_2 + 2x_2 - 2x_1'x_1 - 2x_1 + x_2$$

$$= 2x_1'x_2 + 3x_2 - 2x_1'x_1 - 2x_1$$