COMP3121 21T2 Assignment 1 Q2

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Since,

$$y_i = c_i + E \tag{1}$$

and,

$$c_i \geq 1 \tag{2}$$

Hence,

$$y_{min} - E \geq 1 \tag{3}$$

Eventually,

$$y_{min} - 1 \geq E \tag{4}$$

E is a positive integer, hence $E = [1, y_{min} - 1]$. Add up $\frac{x_i}{y_i - e}$ for every single i value from 1 to n in a while loop, with different e value in each while loop. The value of e can be determined using binary search, if the sum generated by e is smaller than S, which means current e is larger than E, then next while loop will use a e value from smaller range via binary search, and vice-versa. At the end, the value of E can be determined once the sum generated by e is equal to S. And all the correct fractions of $\frac{x_i}{c_i}$ can be obtained through $\frac{x_i}{y_i - E}$.

The overall time complexity is $O(n \log(miny_i))$ by multiplying the time $O(n)$ generated by while loop and time generated by binary search $O(\log n)$.