

CS345 Programming Assignment 1

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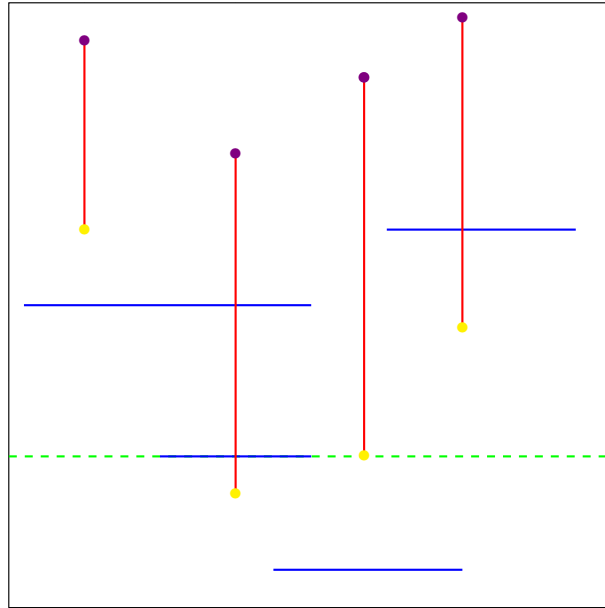
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1 Red-Blue line segments

1.1 Algorithmic Description

For the given $2 * n$ line segments (n vertical red and n horizontal blue) (inside the square defined by $(0,0)$ and $(1,1)$) our implementation does the following to find the number of intersection.

- We use a line sweep along the Y-direction.



- The green dashed line in the above figure shows our sweep line. This basically means that the horizontal blue lines are processed in increasing y co-ordinates.

- All yellow points (bottom point of red lines) that lies below or on the sweep line indicate those red lines that can potentially cause an intersection with the blue line. So, the x -coordinates of these yellow points are inserted into the BST maintained.
- All violet points (top point of red lines) that lies above the sweep line indicate those red lines that can no longer cause an intersection with the blue line. So, the x -coordinates of these violet points are deleted from the BST maintained.
- Now the number of intersections of this blue line (say is defined by $(x_1, y), (x_2, y)$) are found by finding the number of nodes in the BST having x in the range $[x_1, x_2]$.
- To optimize the above implementation, the BST was augmented by subtree size along with usual node data.
- Two implementations of the range count was done, with first one being submitted -
 - By finding count of $x > x_2$ and $x \geq x_1$ and by taking their difference for the required range.
 - by LCA method

1.2 Implementation Description

- **Language of Implementation** - C++
- **Number of lines of Code** - 190 lines (including time and random generator functions)
- **Configuration of System used for Experiment**

```
$ lscpu
Architecture:          x86_64
CPU op-mode(s):        32-bit, 64-bit
Byte Order:            Little Endian
CPU(s):                4
On-line CPU(s) list:   0-3
Thread(s) per core:    1
Core(s) per socket:    4
Socket(s):             1
NUMA node(s):          1
Vendor ID:              GenuineIntel
CPU family:             6
Model:                 23
Stepping:              10
CPU MHz:               1998.000
BogoMIPS:              5302.48
Virtualization:         VT-x
L1d cache:             32K
L1i cache:             32K
L2 cache:              2048K
NUMA node0 CPU(s):     0-3
```

- **Number of repetitions** made for a given n is $10^7/n$.
- **Range of n** is $\{1, 10, 10^2, 10^3, 10^4, 10^5, 10^6, 10^7\}$

Result Table					
n	Time(seconds)	No. of Intersec- tions	$n^2/9$	$n * \log n$	$(10^7 * Time/n * \log n)$
1	0	0.1111			
10	$4.00E - 06$	11.1052			
10^2	$7.00E - 05$	1110.92			
10^3	0.0011	111082			
10^4	0.015	$1.11E + 07$			
10^5	0.25	$1.11E + 09$			
10^6	4.8	$1.11E + 11$			
10^7	62	$1.11E + 13$			