HKOI 2015/16 Solution
Senior Q1 (Military Training)

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23/1/2016

Task Description

- Given a N*N grid
- A robot starts on (r_0, c_0)
- It moves according to a sequence of commands
  - Each command is up (U), down (D), left (L), right (R)

- Ends until the robot moves out of grid

Task Description

- Command length is K, repeats infinitely
  - e.g. "**U**LLD" → Robot moves up → "**L**LDU" → Robot moves left → "**L**DUL" …
- Robot won't be back to (r_0, c_0) after K steps

- Task: find maximal number of times a square is visited

50% Solution

- Pure simulation ☺

- declare f[2002][2002]; set f[i][j] to 0
- set r = r_0, c = c_0
- while robot is not out of grid
- 	move (r, c)
- 	add 1 to f[r][c]
- output max(f[i][j])

Example (N = 4, (r_0, c_0) = (1, 1), move = “RDL”)

(1,1)	(1,2)	(2,2)	(2,1)
	(2,2)	(3,2)	(3,1)
	(3,2)	(4,2)	(4,1)
	(4,2)	(5,2) → END	

Observation 1

- There exists a most frequently visited cell on the first row

(1,1)	(1,2)	(2,2)	(2,1)
	(2,2)	(3,2)	(3,1)
	(3,2)	(4,2)	(4,1)
	(4,2)	(5,2) → END	

Observation 2

- No need to consider the robot's movement beyond row (K+1)

(1,1)	(1,2)	(2,2)	(2,1)
	(2,2)	(3,2)	(3,1)
	(3,2)	(4,2)	(4,1)
	(4,2)	(5,2) → END	

Idea

- (1) There exists a most frequently visited cell on the first row
  - Only need to declare an array to count the cells “around” (r_0, c_0)
  - +/- 2000 (K_{max}) is enough

- (2) No need to consider robot’s movement beyond row (K+1)
  - Only need to simulate the first K^2 moves

Full solution

- declare f[4002][4002]; set f[i][j] = 0
- set sx = 2000, sy = 2000
- set r = r_0, c = c_0
- for i from 1 to K^2
  - move (r, c) and (sx, sy)
  - if (r, c) is out of grid
    - break
  - if 0 <= sx <= 4000 and 0 <= sy <= 4000
    - add 1 to f[sx][sy]
- output max(f[i][j])

Thank you

- Any questions?