

# Monash Collegiate Programming Contest

## Editorial

Shizhe Zhao



# Cast

- Coach: Shizhe Zhao
- Problem setters:
  - Ali Toosi, Monash
  - Jackson Goerner, Monash
  - Shizhe Zhao, Monash
- Tester:
  - Ali Khosravi, RMIT
  - Sublimation, Xidian University



# Storage Room I/II

Author: Ali Toosi

- Constraint:  $1 \leq V \leq 10^3$
- Brute-force: try all possible  $L, W, H$
- Common mistakes:
  - float-point error
  - incomplete search
  - bad pruning (3 nested loops)



# Storage Room I/II

Author: Ali Toosi

- Constraint:  $1 \leq V \leq 10^{12}$
- Observation:
  - assume  $L \leq W \leq H$
  - thus  $L \leq W \leq \sqrt{V}$
  - $L, W$  must be divisor of  $V$
  - #divisors of  $V$  in  $[1, \sqrt{V}]$ ? Not too much!<sup>1</sup>
  - Brute-force all possible  $L, W$  in divisors.

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<sup>1</sup><http://oeis.org/A066150>



# Fast and Furious I

Author: Shizhe Zhao

- Method 1: BFS - status  $x$ ,  $y$ , direction.
- Method 2: Greedy - make  $|dx - dy|$  as small as possible



# Fast and Furious II

Author: Shizhe Zhao

- Dynamic programming:  $dp(x, y, step, d)$ 
  - $dp(x, y, step, d) \rightarrow dp(x', y', step + 1, d')$
  - $step \leq 3 * (dx + dy) \approx 300$
  - memory cost:  $50 * 50 * 300 * 4 = 3 * 10^6$



# Hearty Frogger I/II

Author: Jackson Goerner

3	3	3		
	5		1	1
2			2	2
6	5			
			0	

3	3	3		
	5		1	1
2			2	2
	${}^5X^6$			
			${}^0X^0$	

- Observation: change the frame of reference so that we can assume only Alice move, and she can take all hearts in left-up diagonal line.
- Thus, for version I, we can Brute-force all start and count values on left-up diagonal line.



# Hearty Frogger I/II

Author: Jackson Goerner

⇒ 4	3	3			3
⇒ 3		1	1		5
⇒ 2	2	2	2		
⇒ 1			$^5X^6$		
⇒ 0			$^0X^0$		

3	3			3
	1	1		5
2	2	2		
	6	5		
			0	

- For better visualization, we shift the  $i$ th row to right  $b - i - 1$  position.
- For a spawn location  $(row, col, tl, tr)$ , the best answer is  $\max(\text{vert\_sum}(i) | i \in [l', r'])$ .
- This is a range query problem - assuming we already have the  $\text{vert\_sum}$  from 0 to  $row$ .





# Hearty Frogger I/II

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3	3			3
	1	1		5
2	2	2		
	6	5		
			0	

- We can maintain such array by: processing rows from top to bottom, adding trucks on each row -
- which is a range updating problem
- Both range query and range updating can be handled by segment tree.

