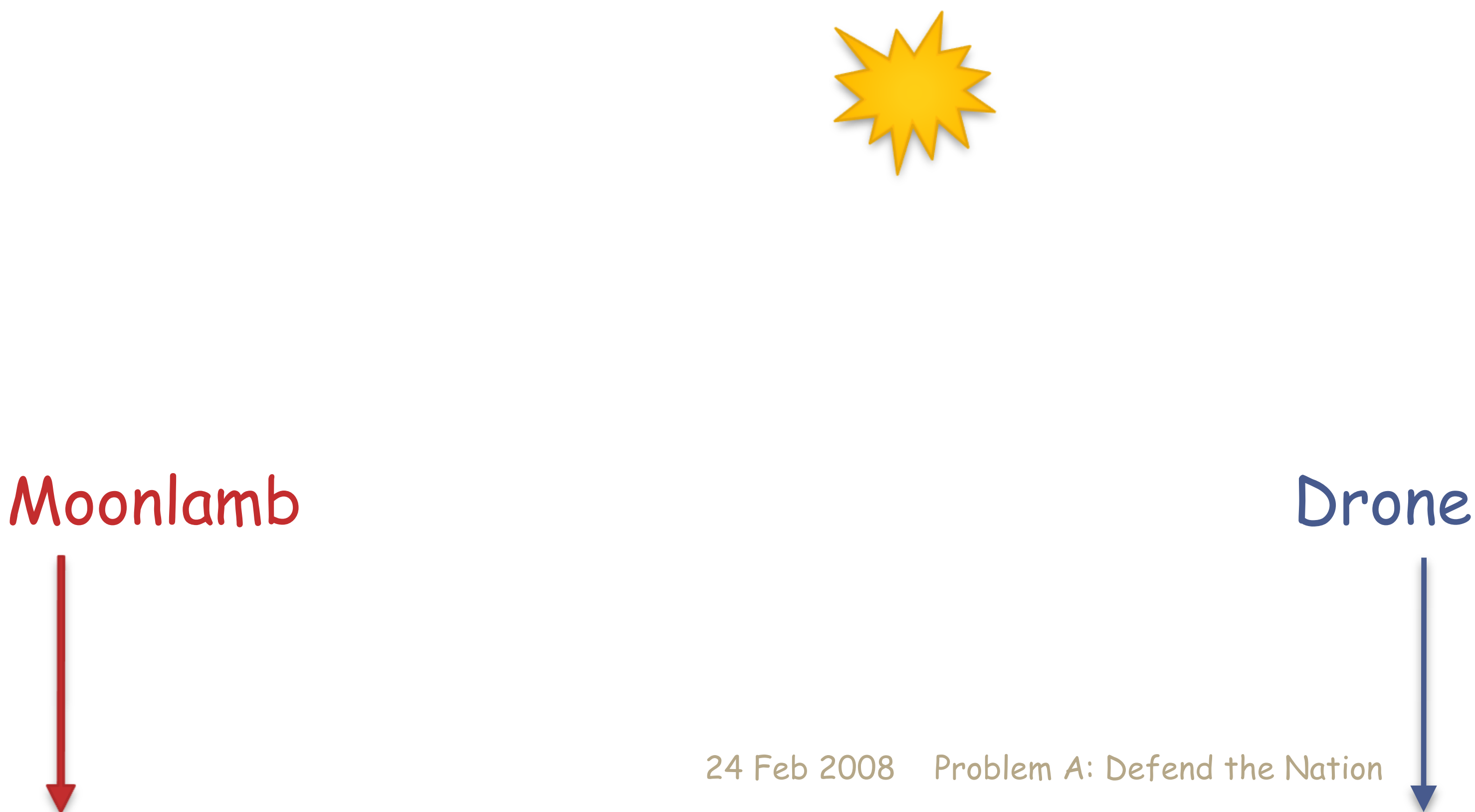
Problem A in Day 2:
Defend the Nation

Problem: Y. Izumi

Solutions: Y. Izumi and N. Araki

Slides: Y. Izumi

Problem in Brief



Summary

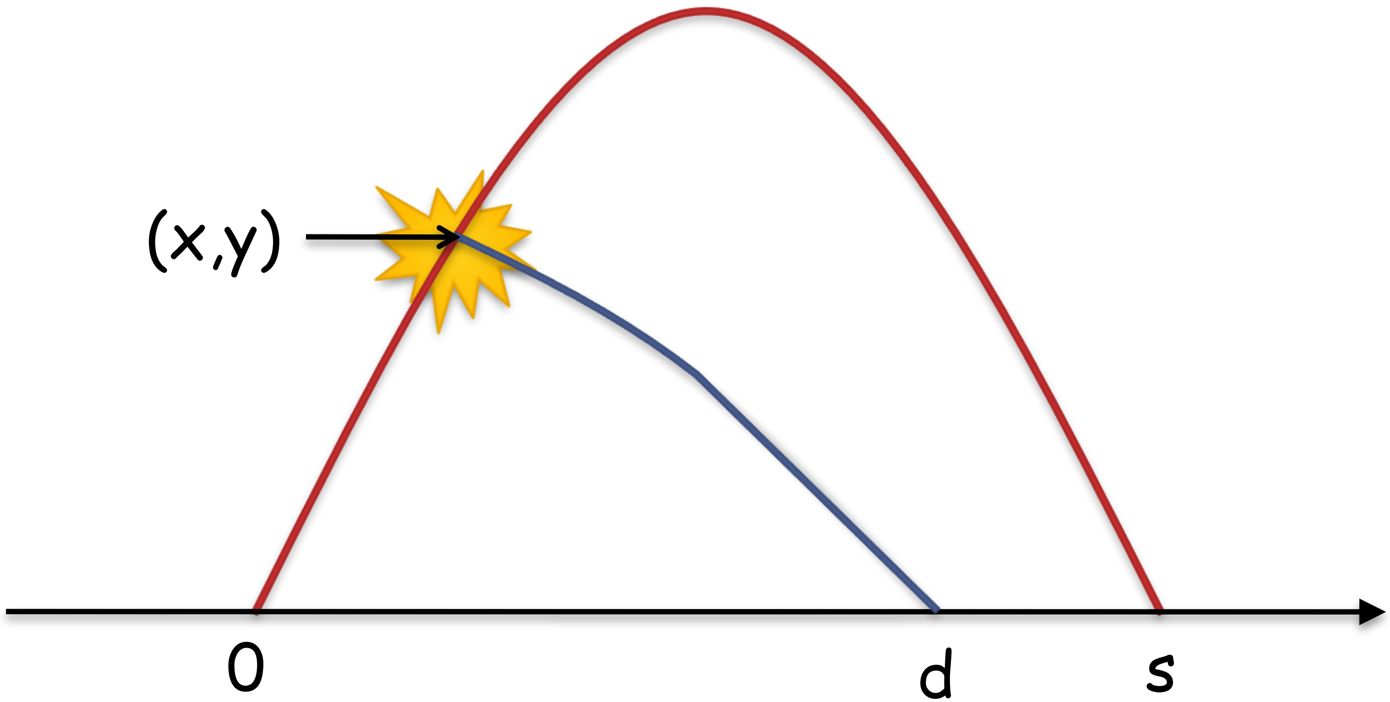
- # Submissions : 12
  - Unknown (6), MPI*3.0 (6)
- # Acceptances : 0
  - MPI*3.0 was closer to the solution.

How to Solve

- Struggle against the problem with your pencil and paper.
- Then write 200+ lines of code.
  - Pay much attention to the corner cases.
- Avoid this problem.
  - This is a problem to defend the judge from all problems being solved!

Basic Strategy

- Fix where the projectile destroyed.
  - Then everything can be solved.



Basic Formulae

$$\begin{cases} v_2 t_2 \cos\theta_2 = X \\ v_2 t_2 \sin\theta_2 = Y + (1/2)\cdot g t_2{}^2 \end{cases}$$

minus is enough

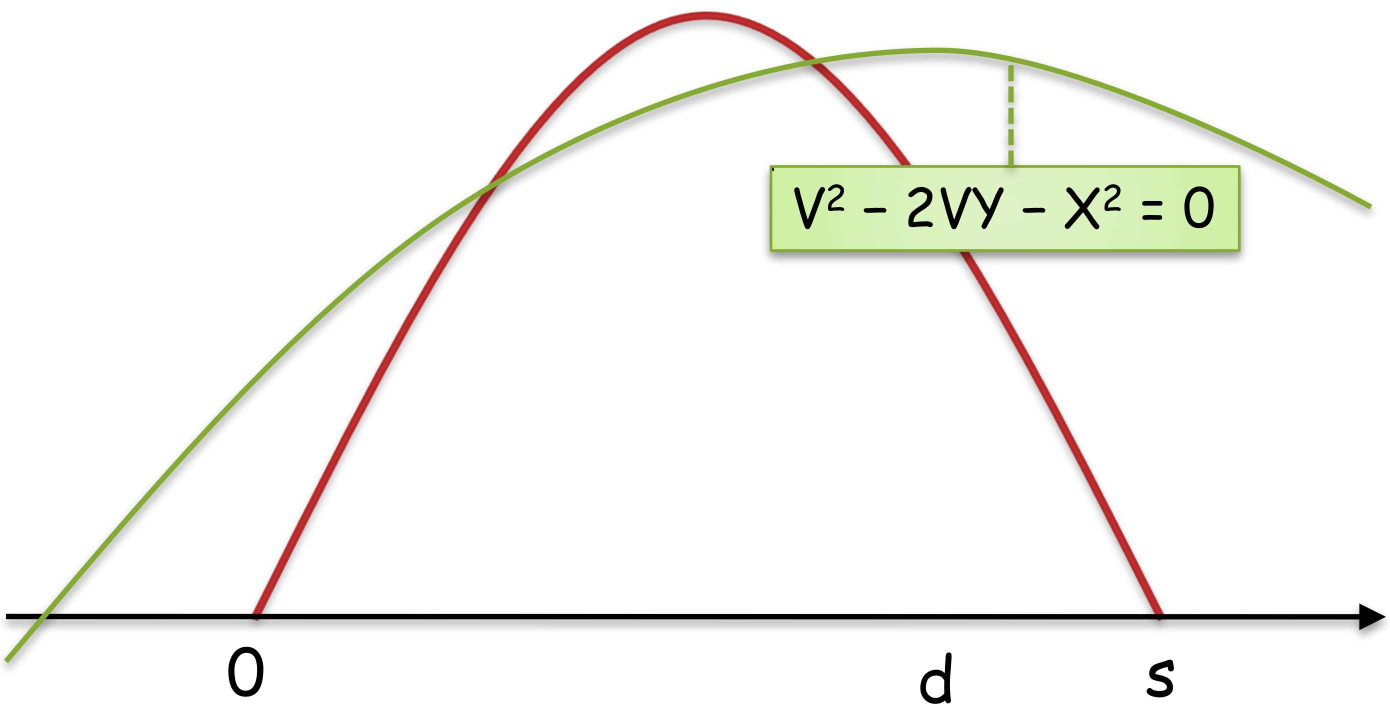
$$\Rightarrow \quad t_2{}^2 = \frac{2}{g}\left\{(V - Y) \pm \sqrt{V^2 - 2VY - X^2}\right\}$$

$$\tan\theta_2 = \frac{V \pm \sqrt{V^2 - 2VY - X^2}}{X}$$

where $\begin{cases} X = d - x \\ Y = y = \kappa \cdot x(s_1 - x) \\ V = v_2{}^2/g \end{cases}$

Feasibility

- (x,y) must be below the green line.
  - The contents of sqrt() must be positive.



Straight-forward Method

$$\Delta(x) = \frac{x}{v_1 \cos\theta_1} - t_2 \geq \tau$$

- This can be transformed into a quadradic inequation.
- Just solve it.

Advanced Method (?)

- The solution is one of the following:
  - the roots of the equation $\Delta(x) = \tau$
  - the lower boundaries of the feasible sub-ranges
- The roots of $\Delta(x) = \tau$:
  - the positions where the projectile can be destroyed when the interceptor is fired at the time τ.

By the Way

- Moonlamb ← Bonmalmo
- Drone ← Endor