

Ideas of optimization: from saving a drowning child, to managing an investment portfolio



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Quotes

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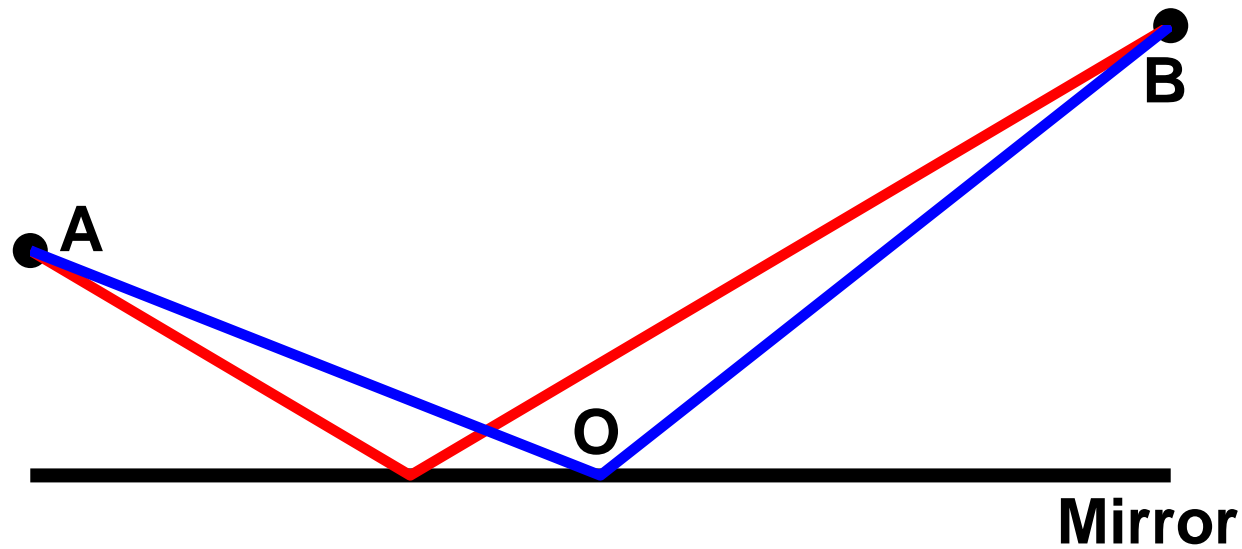
Quotes

- “Nature’s great book is written in mathematical language.” – Galileo Galilei
- “Mathematics is a game played according to certain simple rules with meaningless marks on paper.” – David Hilbert
- “Mathematicians are like Frenchmen: whatever you say to them they translate into their own language and forthwith it is something entirely different.” – Johann Wolfgang von Goethe (Maxims and Reflexions, 1829)

Light optimizes: Reflection

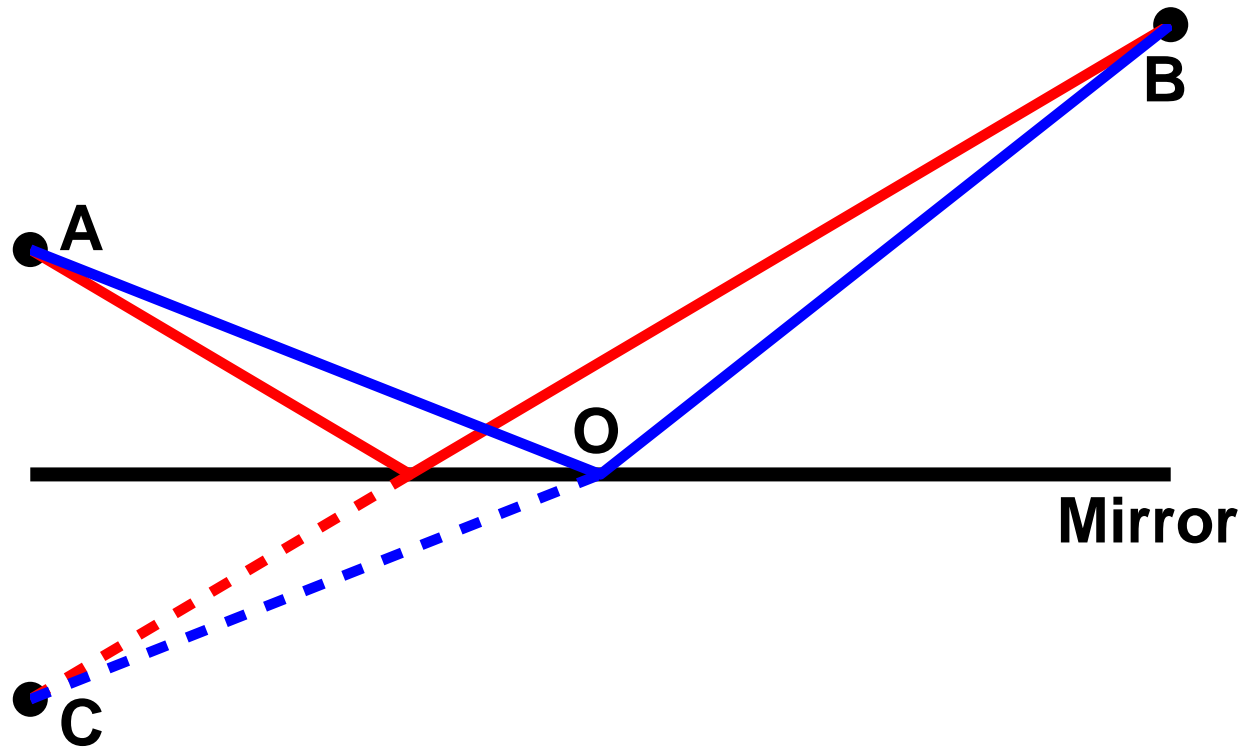


Light optimizes: Reflection



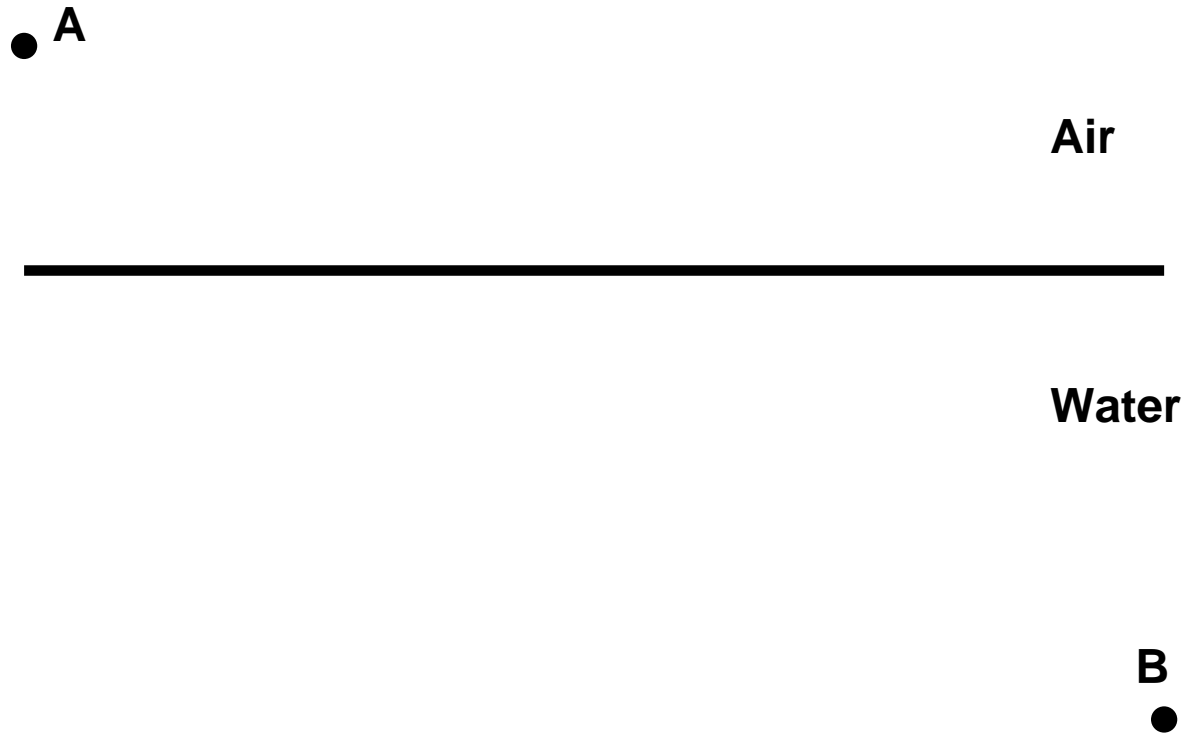
Which path? Shortest one!

Light optimizes: Reflection: a proof by Hero

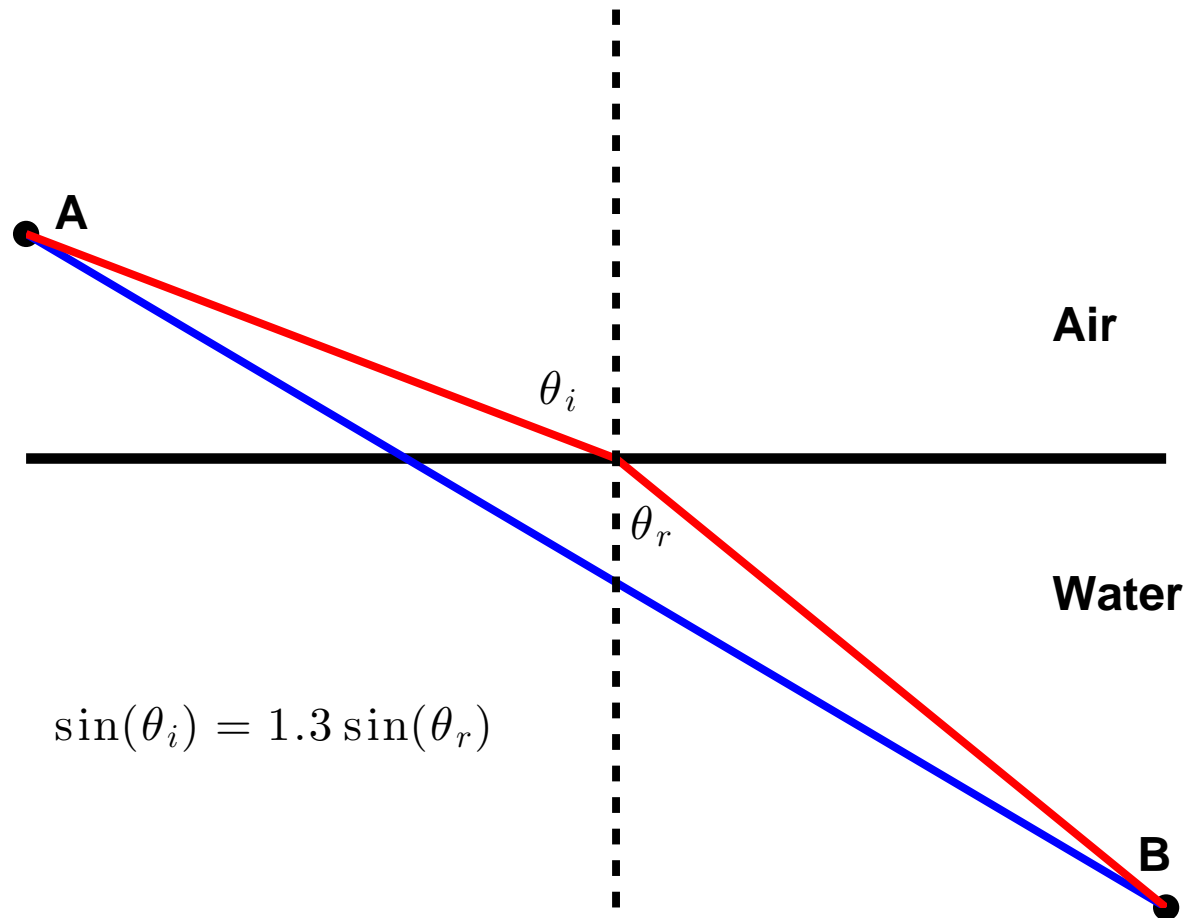


Which path? Shortest one!

Light optimizes: Refraction



Light optimizes: Refraction



Fermat: Light does NOT take the shortest path, but the fastest path

We people optimize



We people optimize



We people optimize



We people optimize



We people optimize

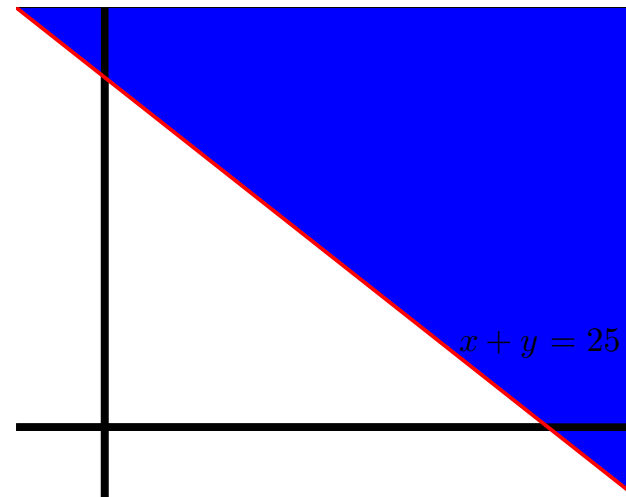


Linear Programming: Investment Portfolio Management

- A bank has to set aside \$25 million for loans to home builders.
- Allocate at least \$10 million for luxury condos.
- Required by government: at least one third of its total loans should be allocated to low-income housing.
- Returns on condos is 12% and returns on low-income housing is 10%.

Maximize $p = 0.12x + 0.10y$

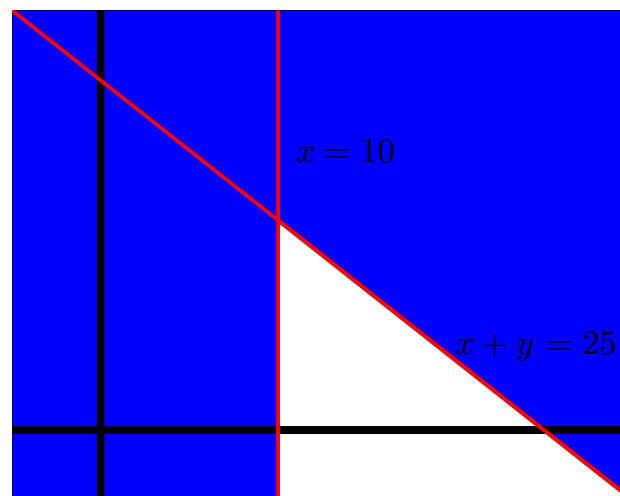
Subject to $x + y \leq 25$



Maximize $p = 0.12x + 0.10y$

Subject to $x + y \leq 25$

$x \geq 10$

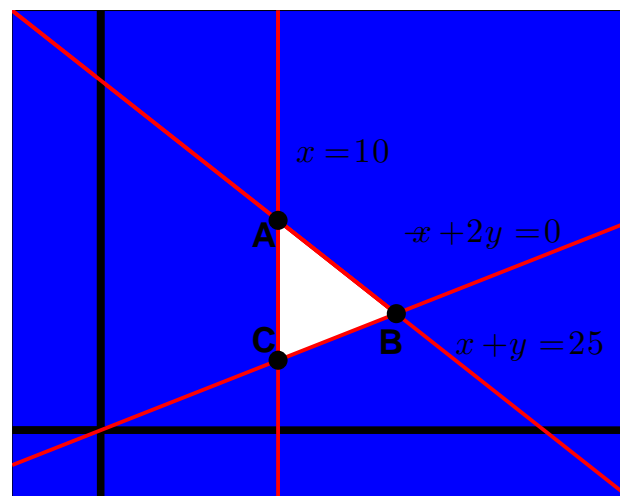


Maximize $p = 0.12x + 0.10y$

Subject to $x + y \leq 25$

$x \geq 10$


$-x + 2y \geq 0$



Points	Lines through points	Coordinates	$p = 0.12x + 0.10y$
A	$x + y = 25$ $x = 10$	$(10, 15)$	2.7
B	$x + y = 25$ $-x + 2y = 0$	$(50/3, 25/3)$	2.833
C	$x = 10$ $-x + 2y = 0$	$(10, 5)$	1.7

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