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7. Comparison to the quadratic formula

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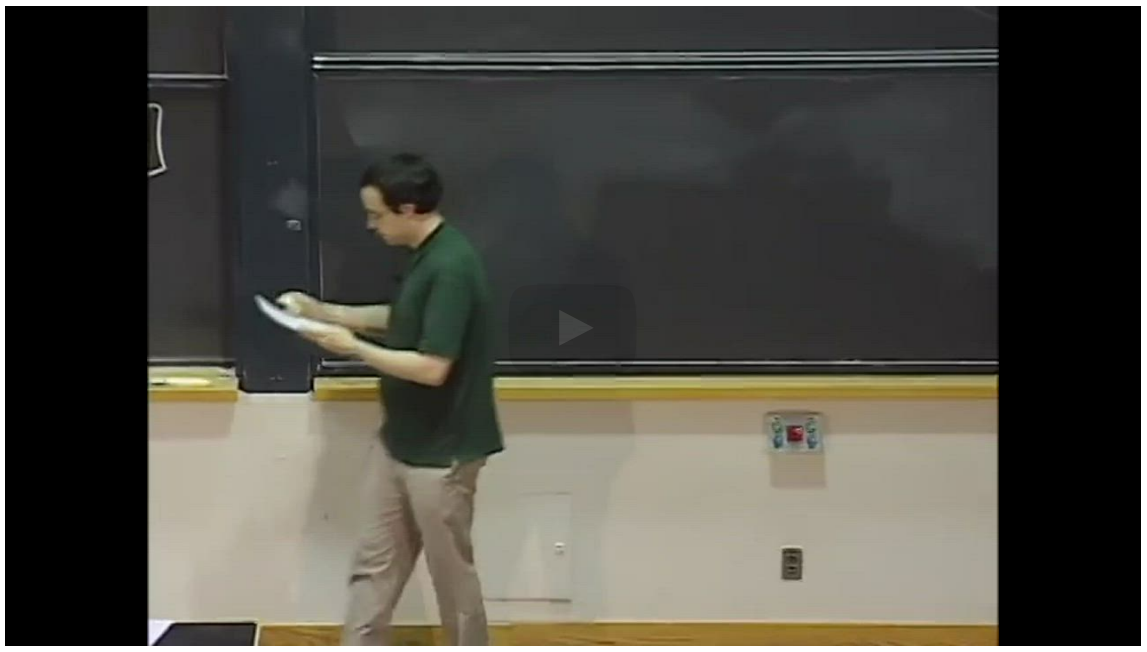

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PROFESSOR: OK so let's continue.

Oh, before we continue--

Let's see, I wanted to point out one small thing.

So here we have this magic quantity 4ac minus b squared.

You've probably seen that before in your life.

Yeah, it looks like the quadratic

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You may recognize the expression $4ac - b^2$ or rather $b^2 - 4ac$ as something that arises in the quadratic formula. This connection exists and can be made explicit if we rewrite our function $w(x, y)$ in another way.

$$w(x,y) = ax^2 + bxy + cy^2 \tag{4.64}$$

$$= \underbrace{y^2}_{\geq 0} \underbrace{\left[a\left(\frac{x}{y}\right)^2 + b\left(\frac{x}{y}\right) + c \right]}_{(*)} \tag{4.65}$$

We can try to understand the behavior of this function by exploring the expression $(*)$ above.

- If $b^2 - 4ac > 0$, this is the case that this expression has two roots. In this case, that means that this equation $(*)$ takes both positive and negative values. Thus $w(x, y)$ also takes both positive and negative values, which means that the critical point must be a saddle point.

- If $b^2 - 4ac < 0$, this equation $(*)$ has no roots, which means the equation $(*)$ is everywhere nonpositive, or everywhere nonnegative. Thus $w(x, y) \geq 0$ or $w(x, y) \leq 0$ (with equality occurring at the critical point $w(0, 0) = 0$). If $w(x, y) \geq 0$, then the critical point is a minimum. If $w(x, y) \leq 0$, then the critical point is a maximum.

7. Comparison to the quadratic formula

Topic: Unit 3: Optimization / 7. Comparison to the quadratic formula

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Degenerate function
Could anyone tell me degenerate case in detail? What actually the term degenerate means here?

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☑	Why?	7
☑	What if a=0? If we are to stick to this framework, what if b^2-4ac<0 **AND a=0**, then the parabola turns into a straight line of slope b, with one x/...	3
💬	Third degenerate case?	2
💬	[STAFF] Typ in Eq (4.65)	2

‹ Previous Next ›

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