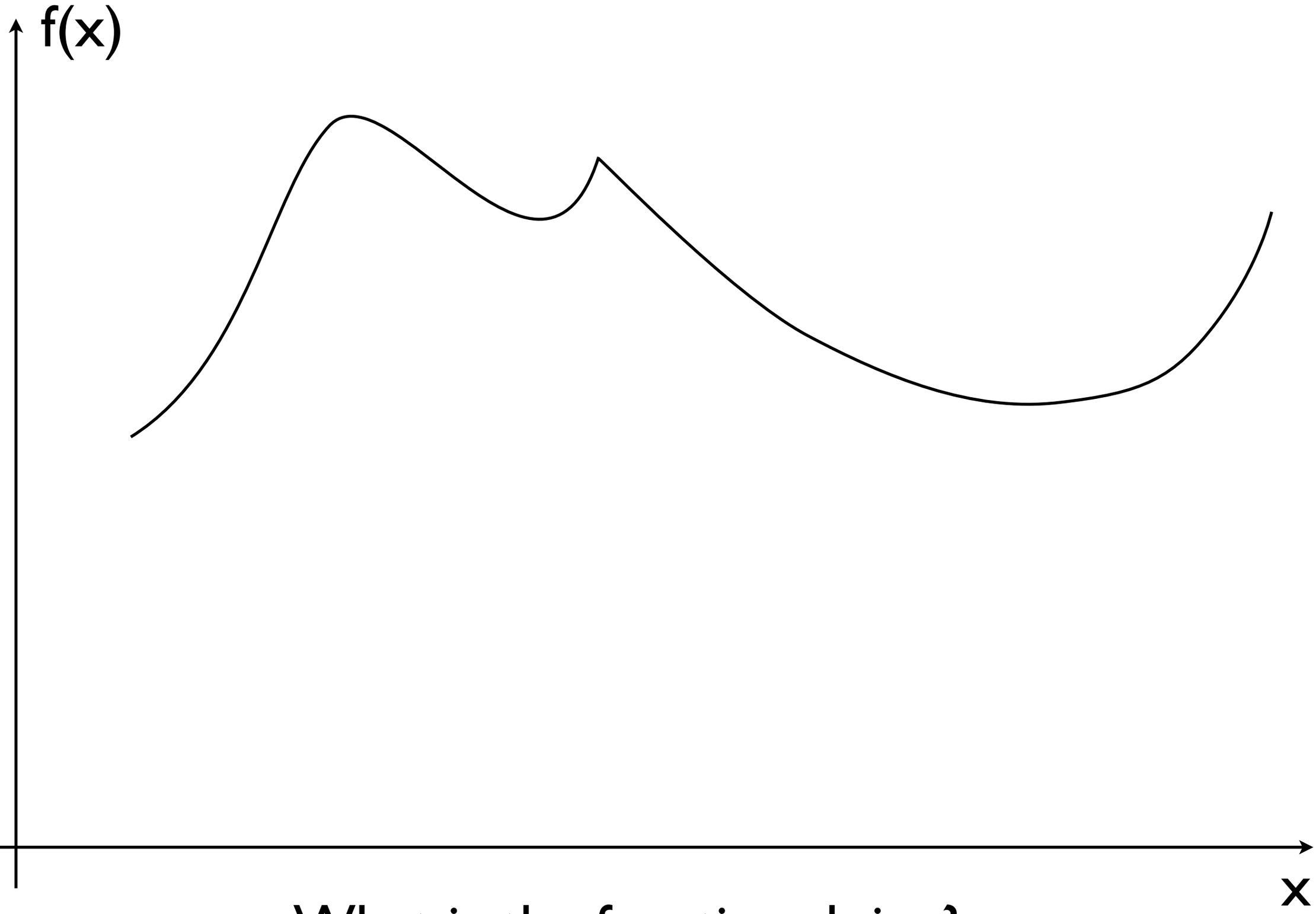
Today

- Putting it all together - using f, f′ and f″ to sketch a graph.
- Absolute extrema
- Intro to optimization

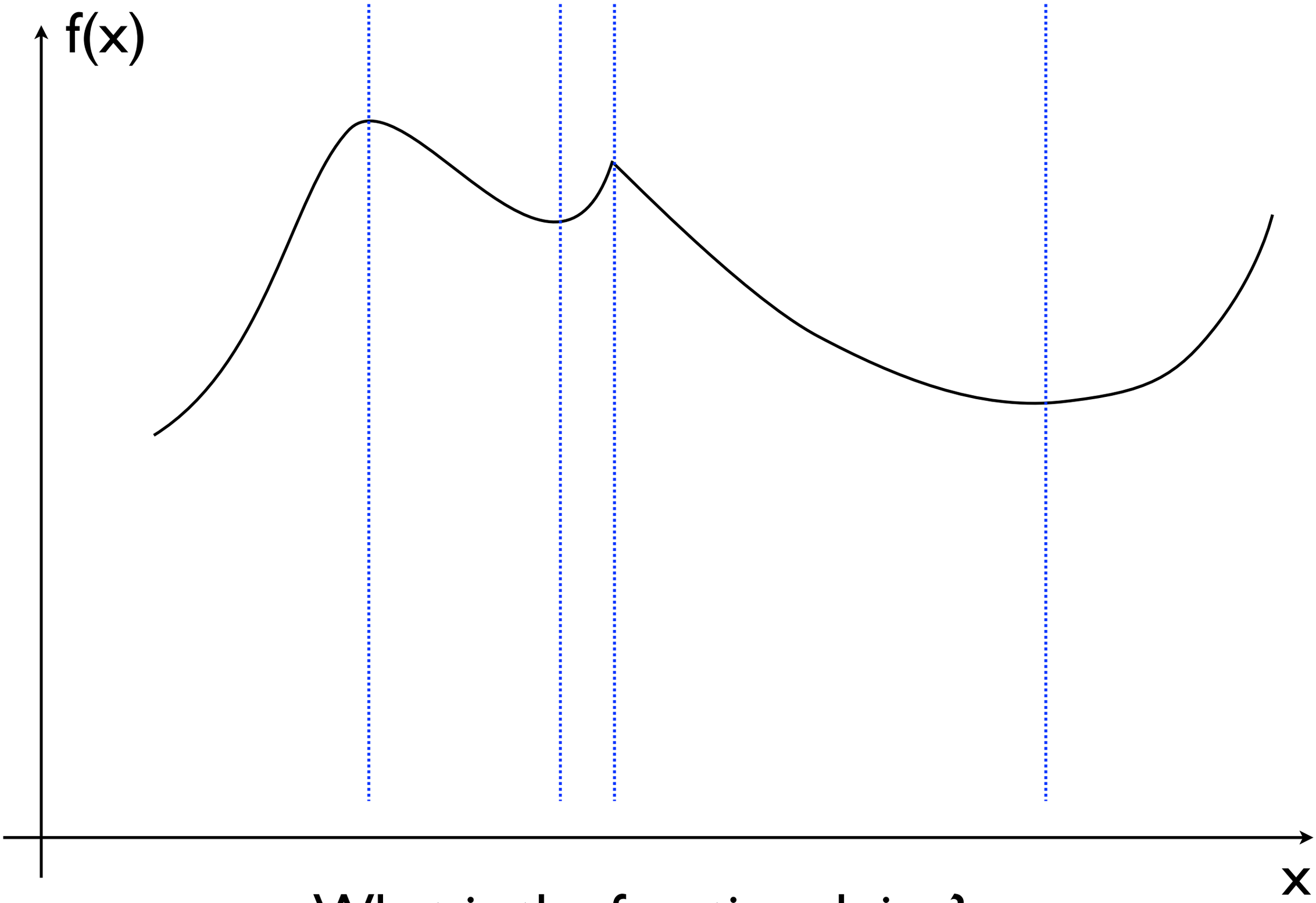
Using f, f′ and f″ to graph f

Annotating the graph of f(x) with f'(x) info



What is the function doing?

Annotating the graph of f(x) with f'(x) info



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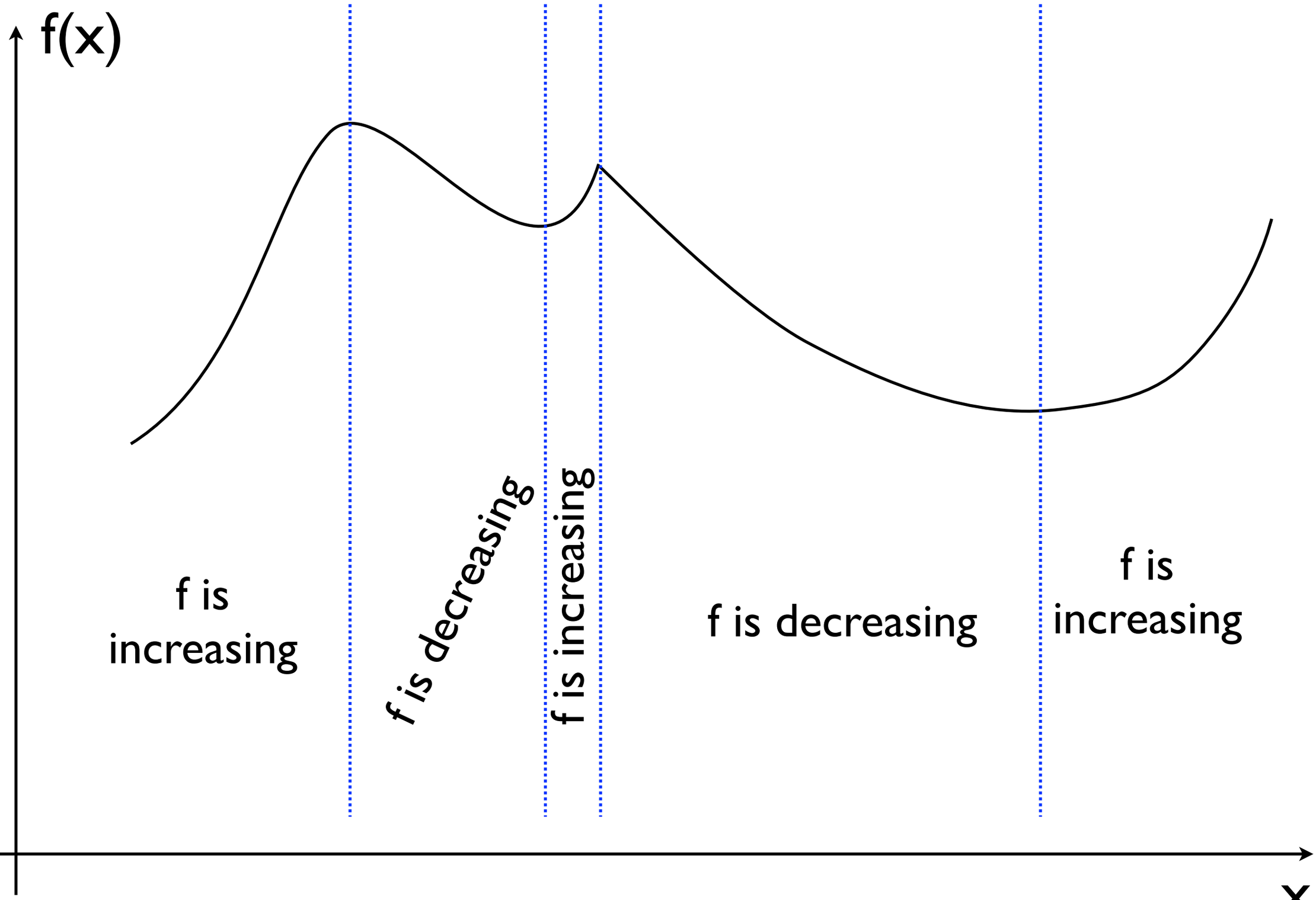
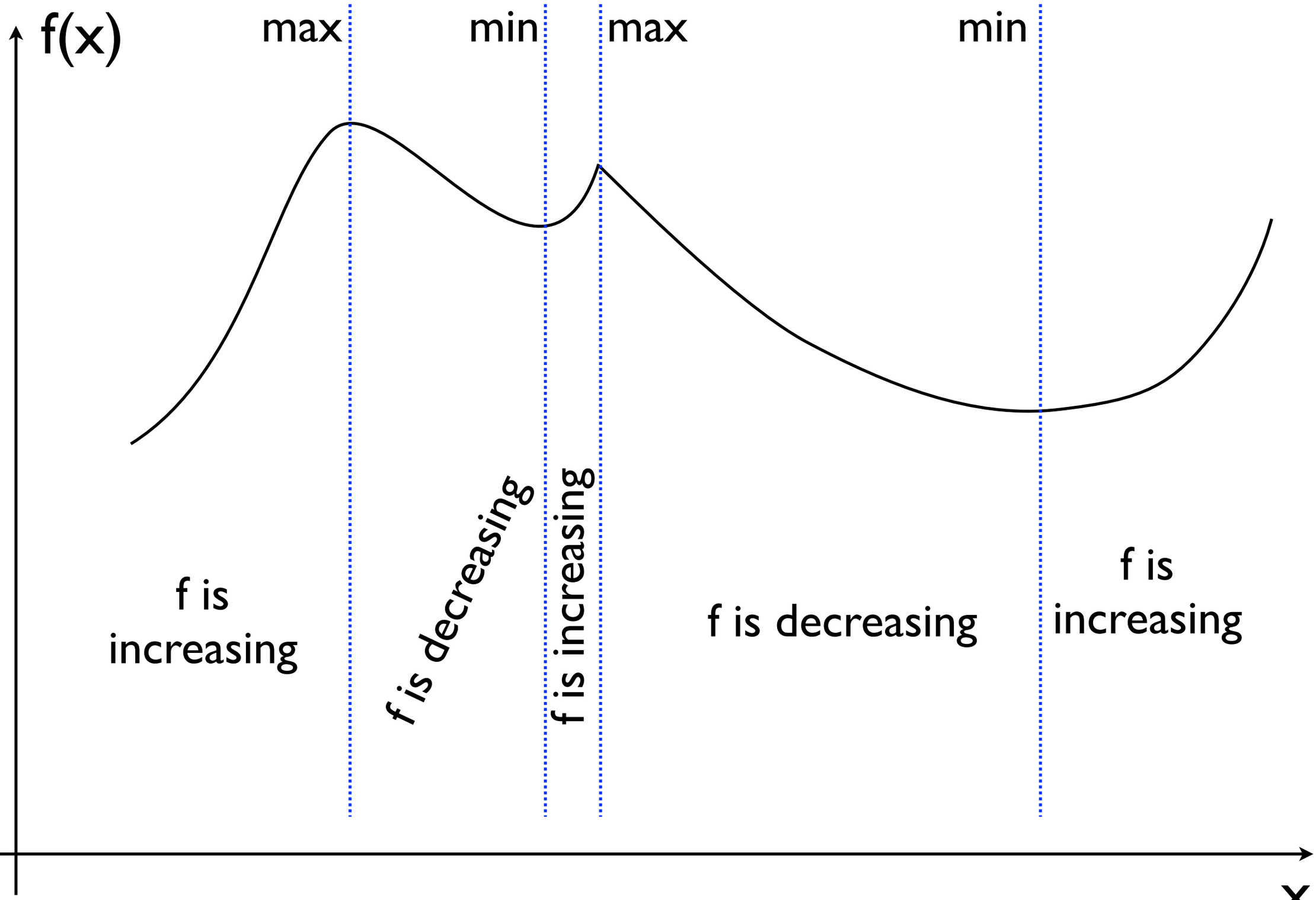


What does that mean for the first derivative?

Annotating the graph of f(x) with f'(x) info



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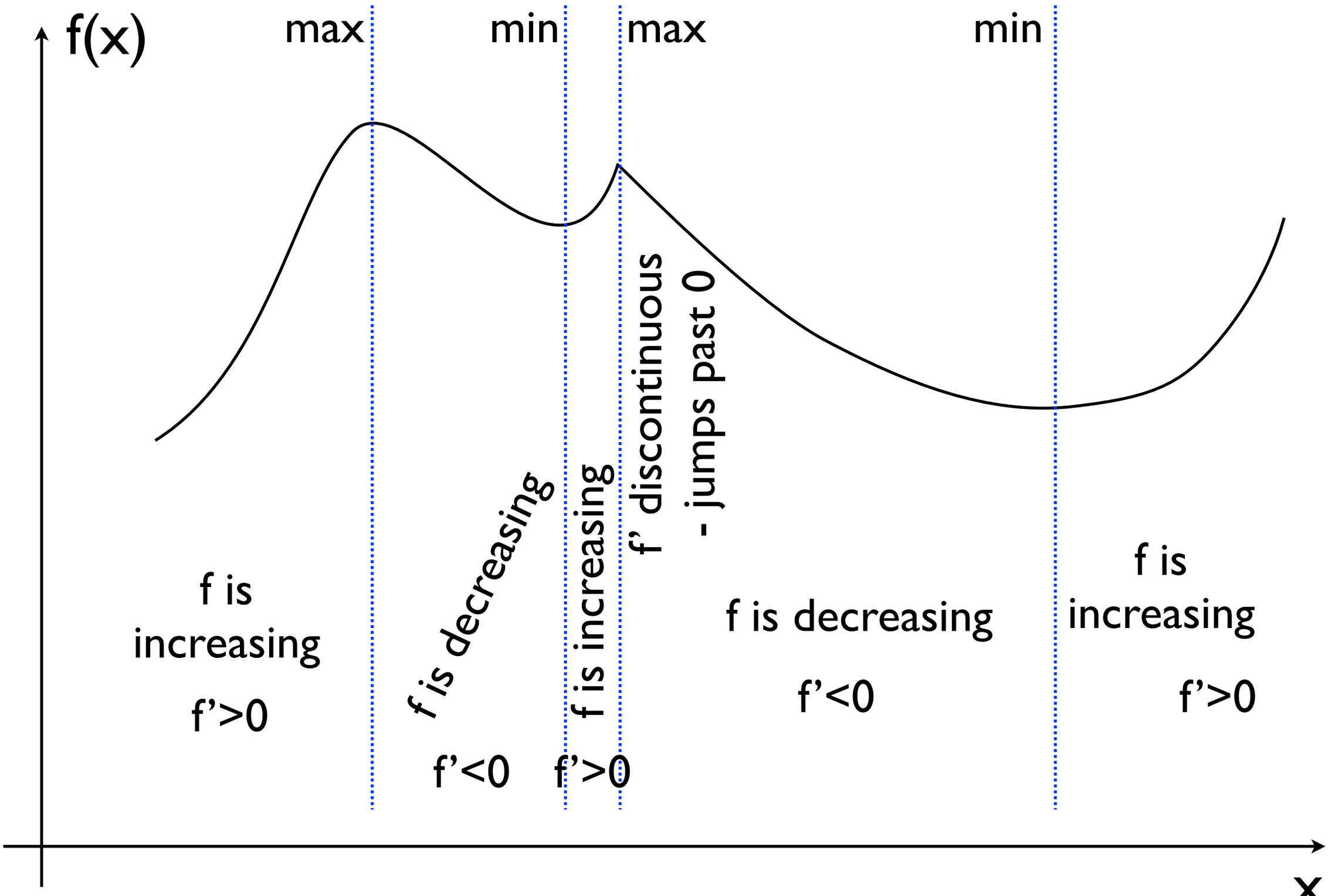

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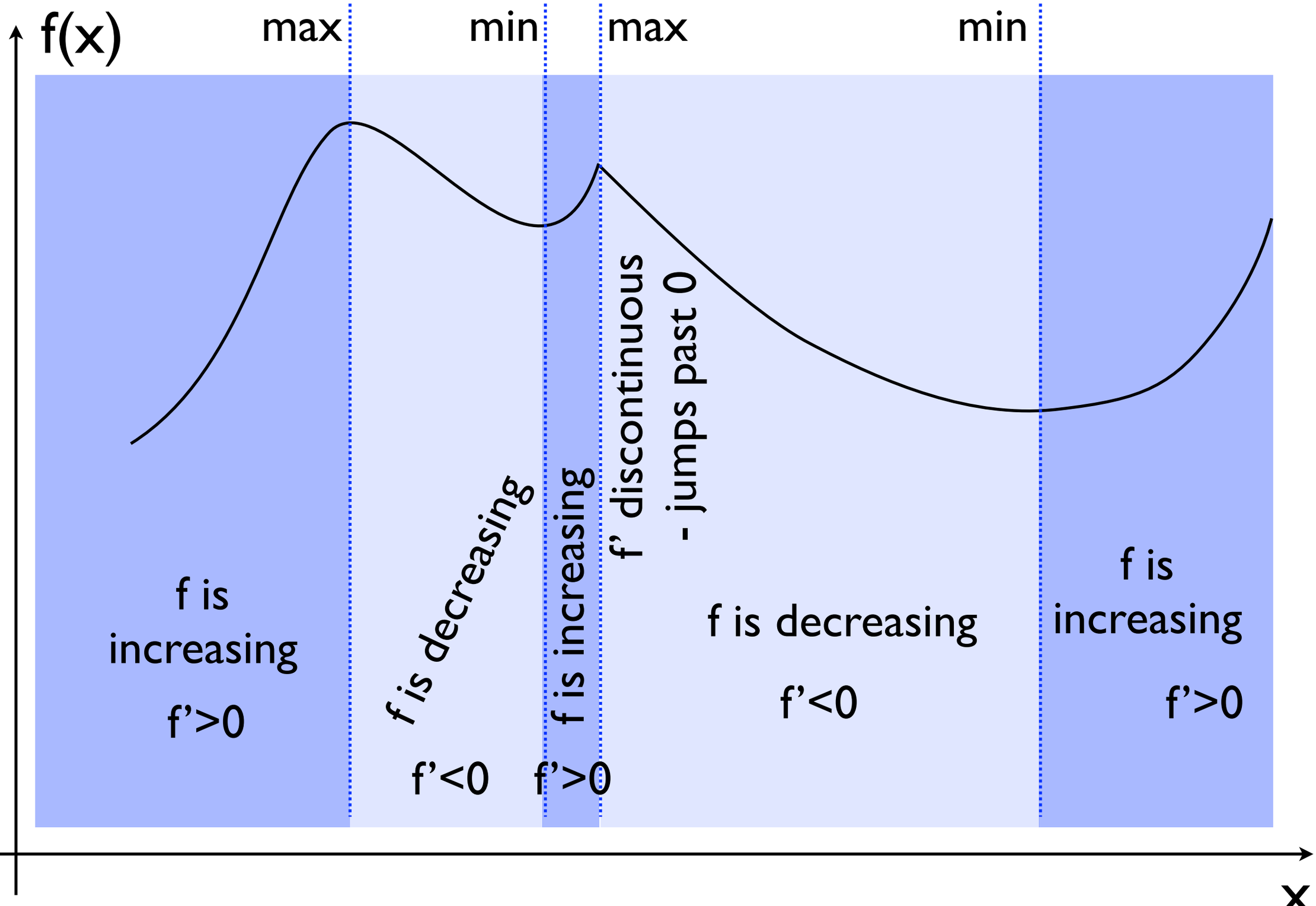
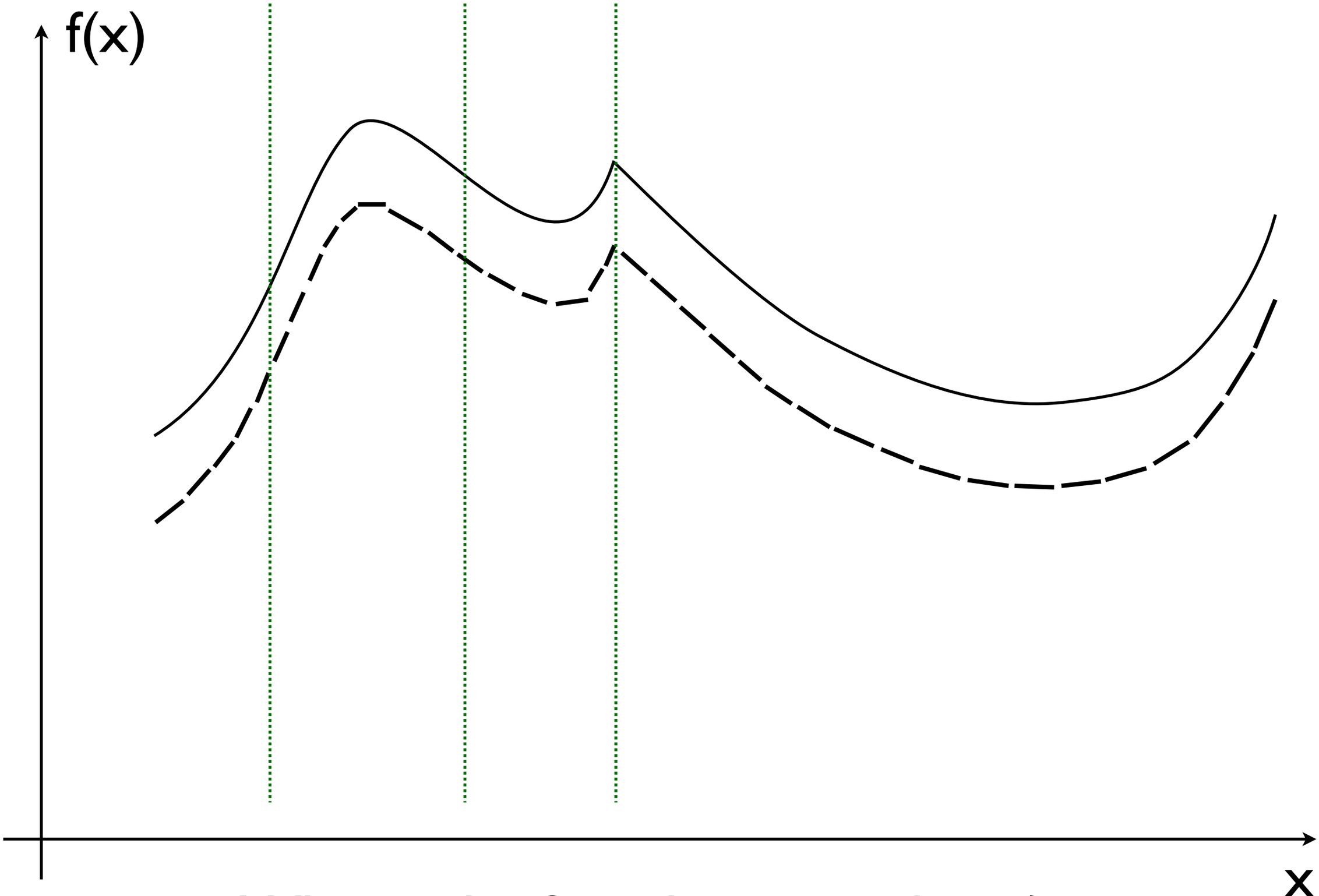


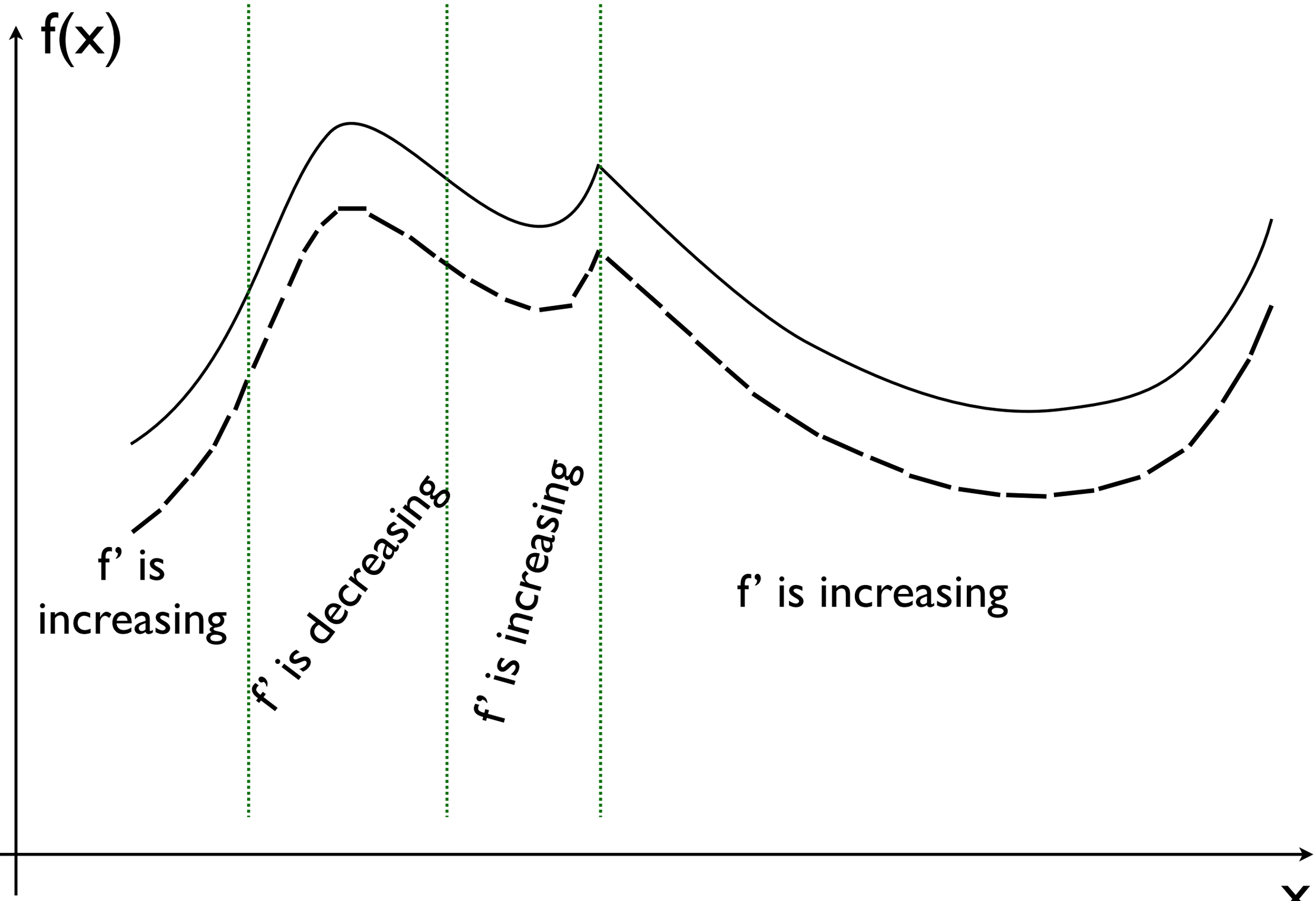
What does that mean for the first derivative?

Annotating the graph of f(x) with f”(x) info



What is the first derivative doing?

Annotating the graph of f(x) with f”(x) info



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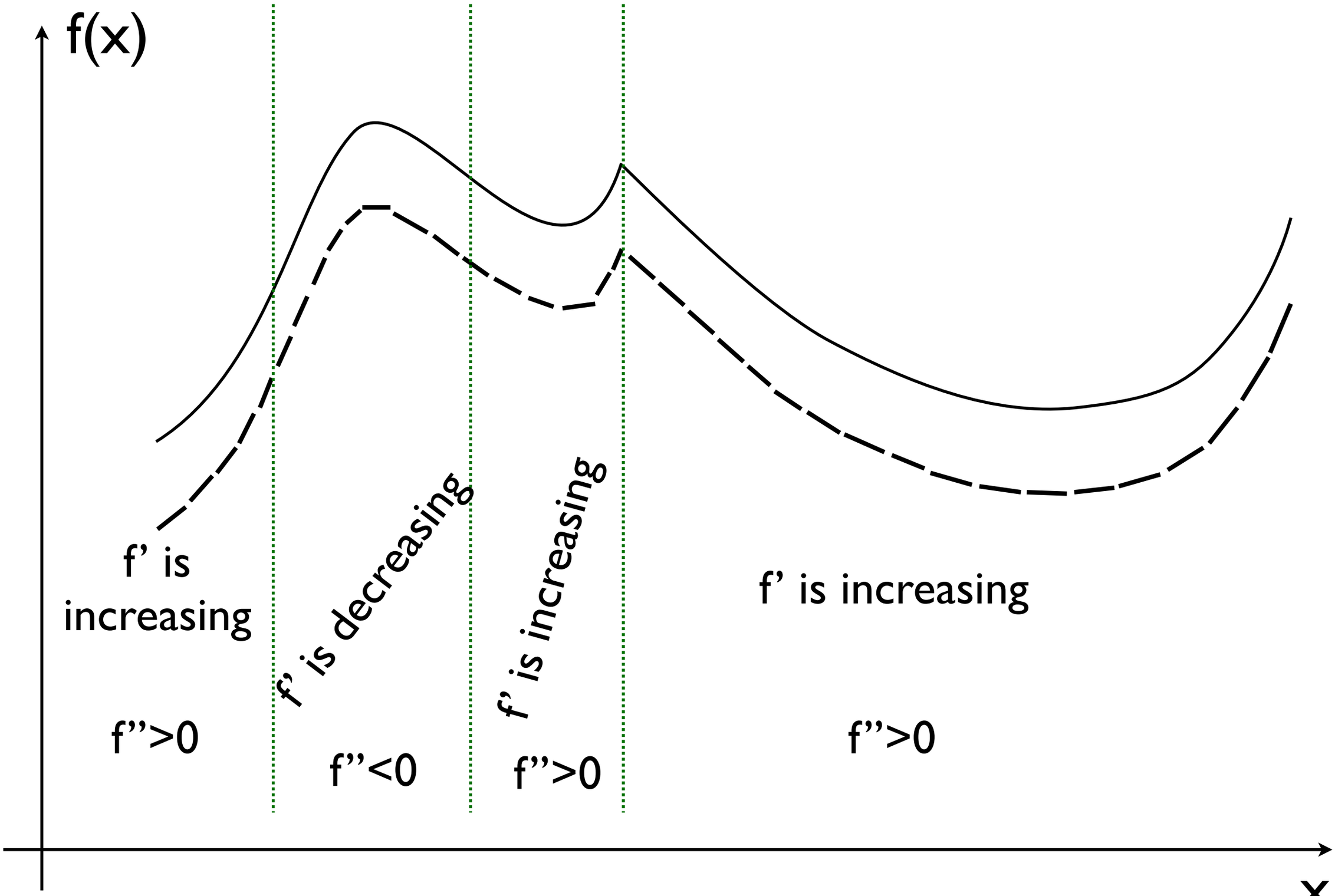

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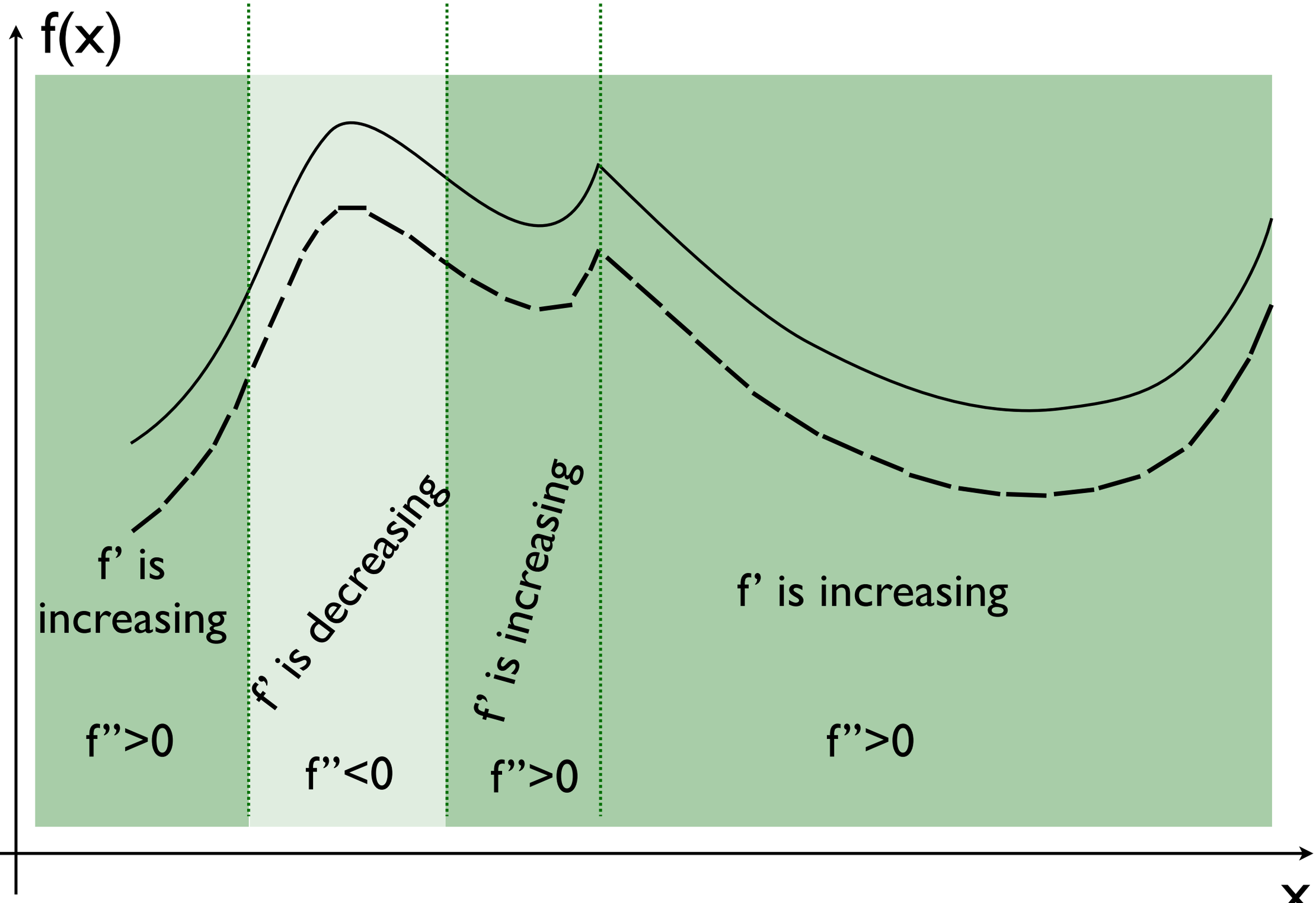
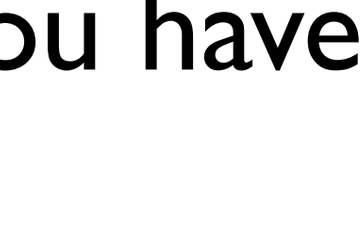


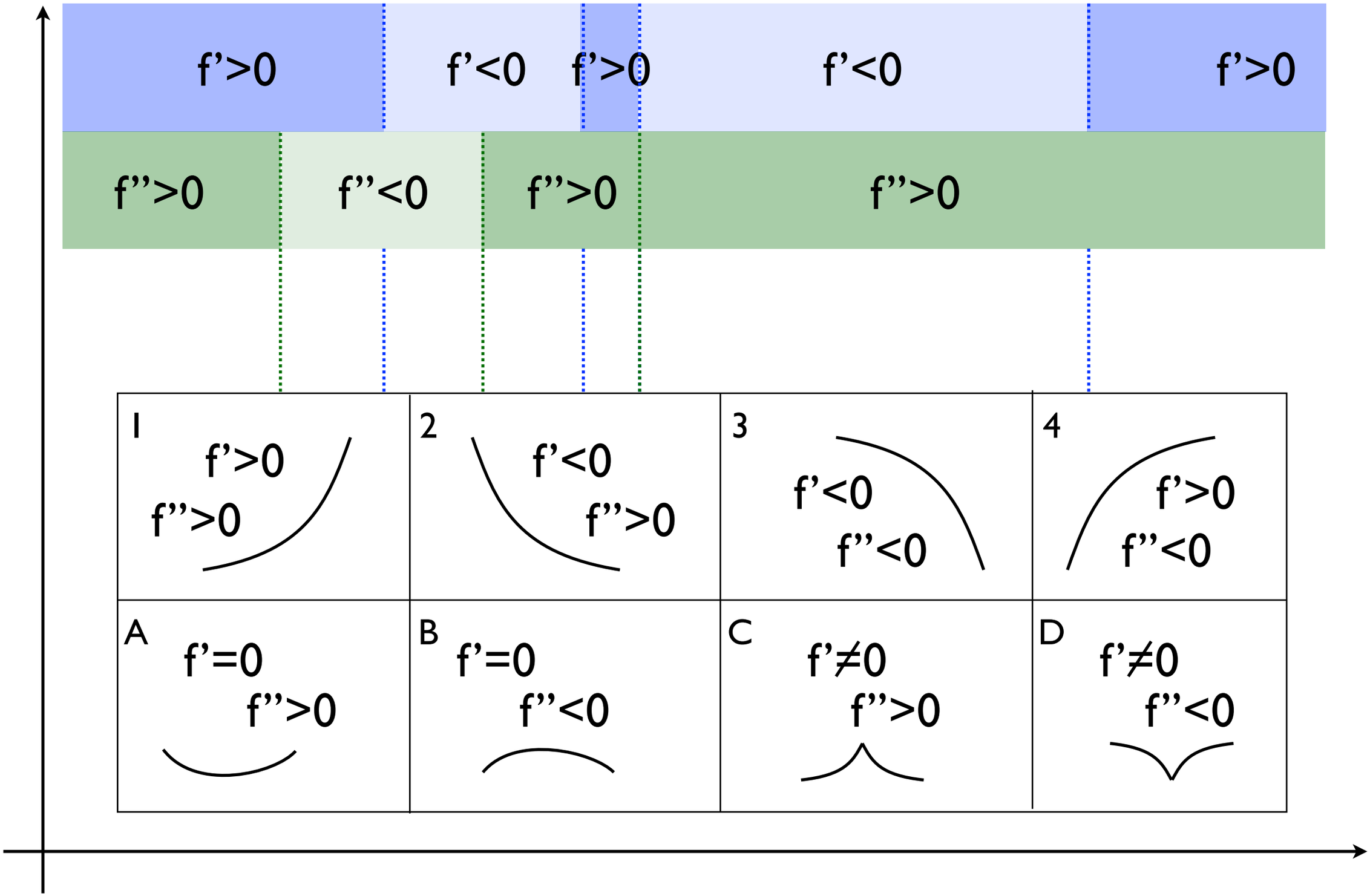
What does that mean for the second derivative?

What you have to do to graph it.

The parts list:

1 	2 	3 	4 
A 	B 	C 	D 

What you have to do to graph it.



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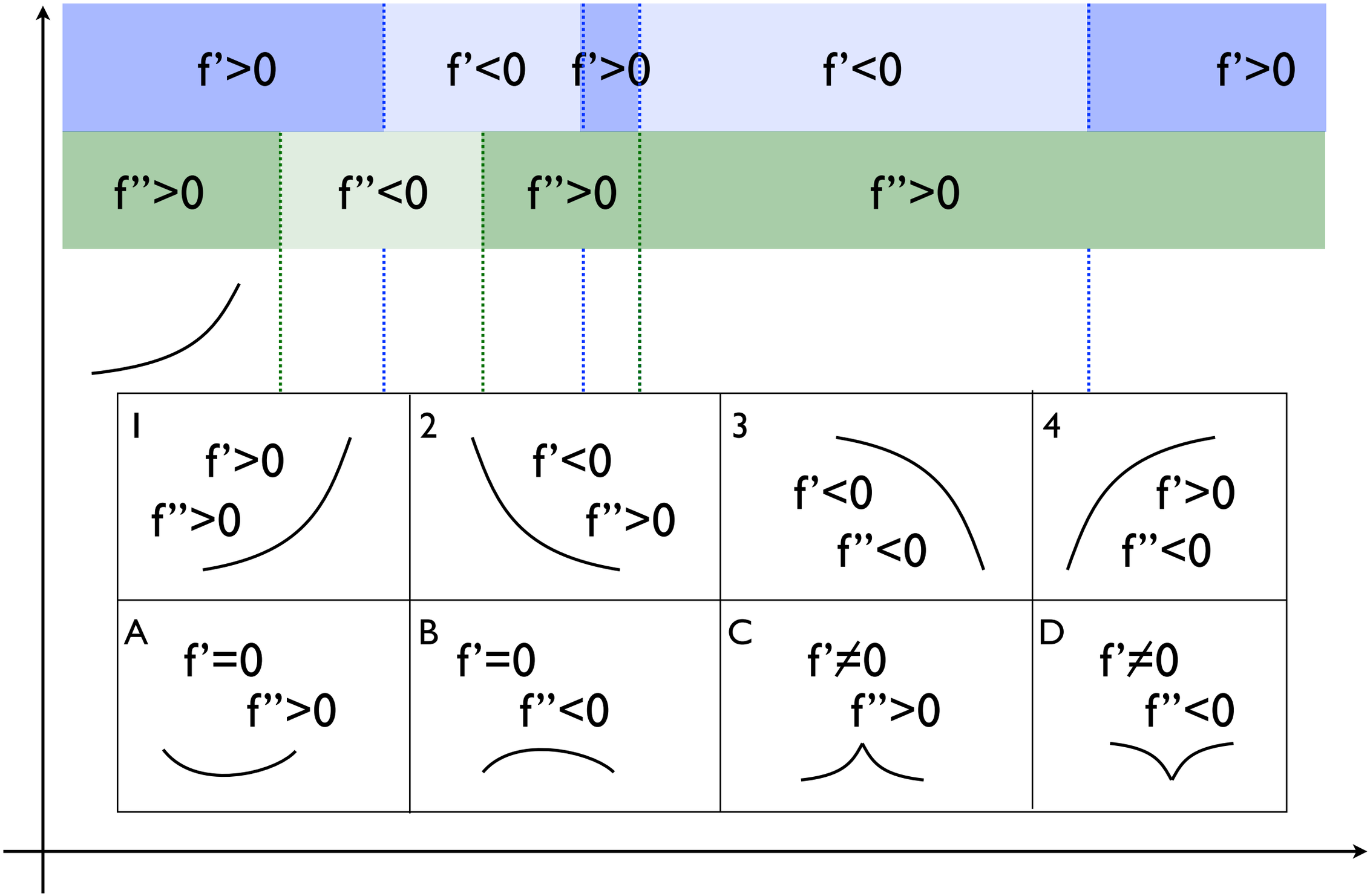

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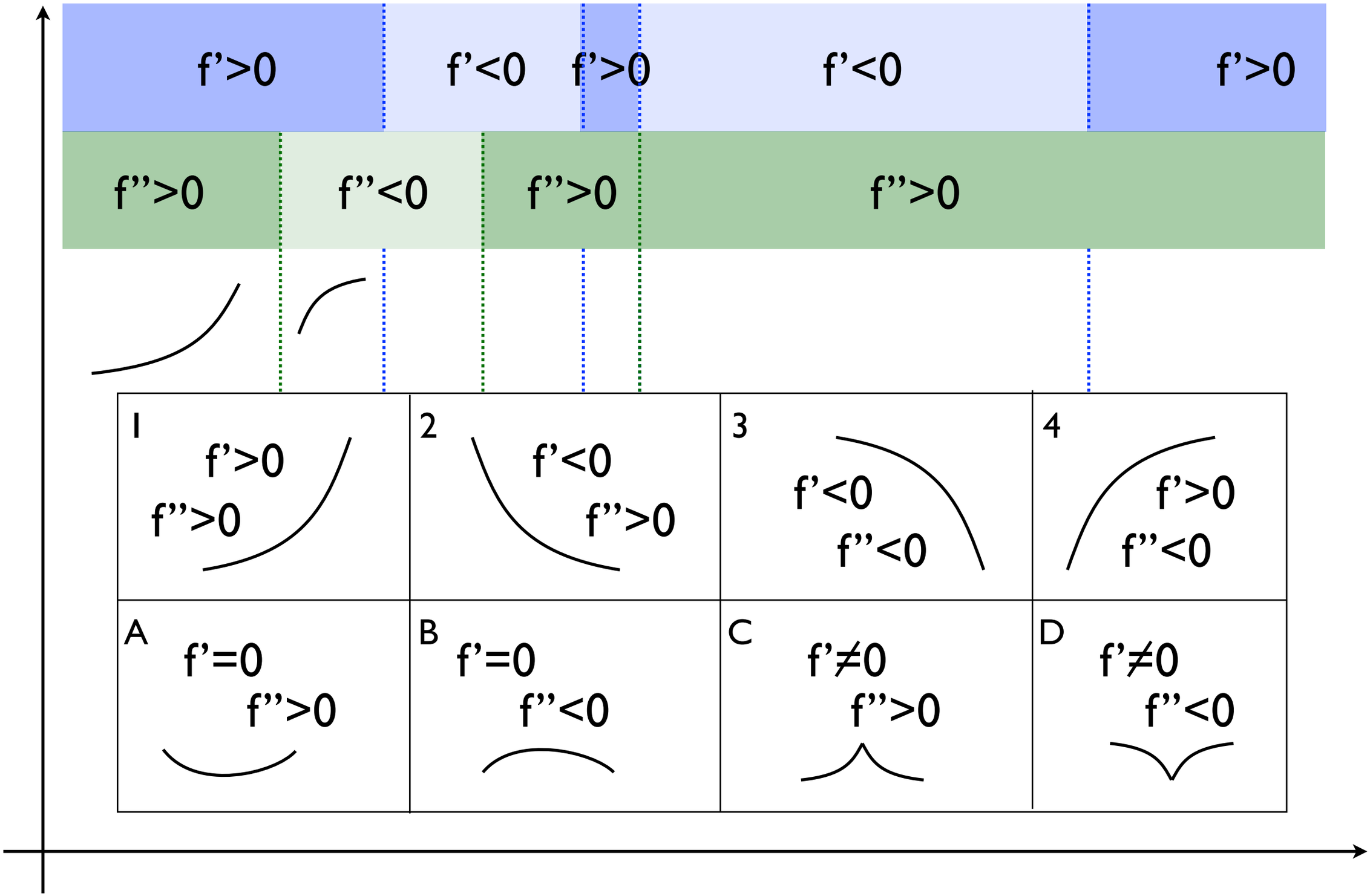

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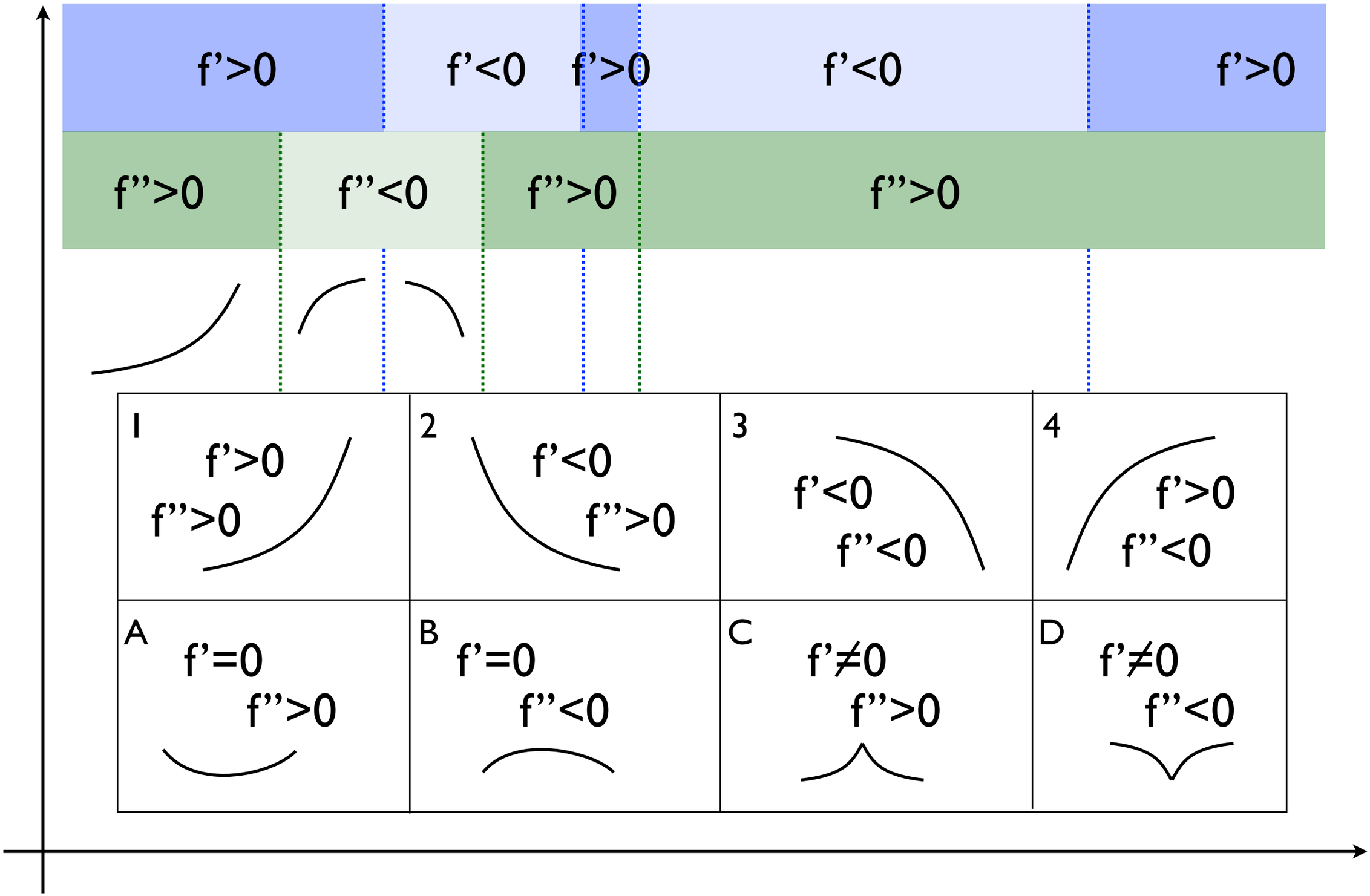

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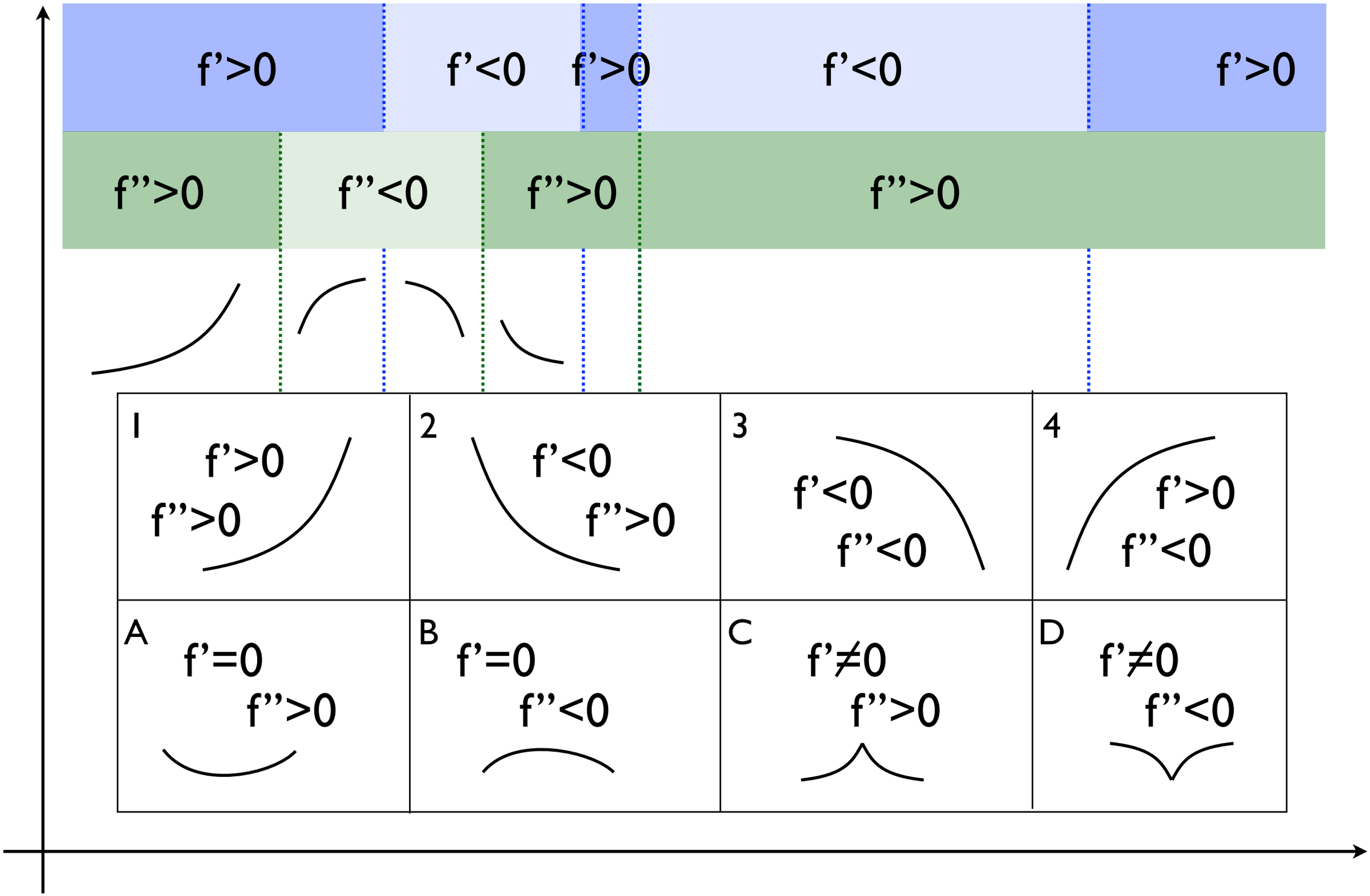

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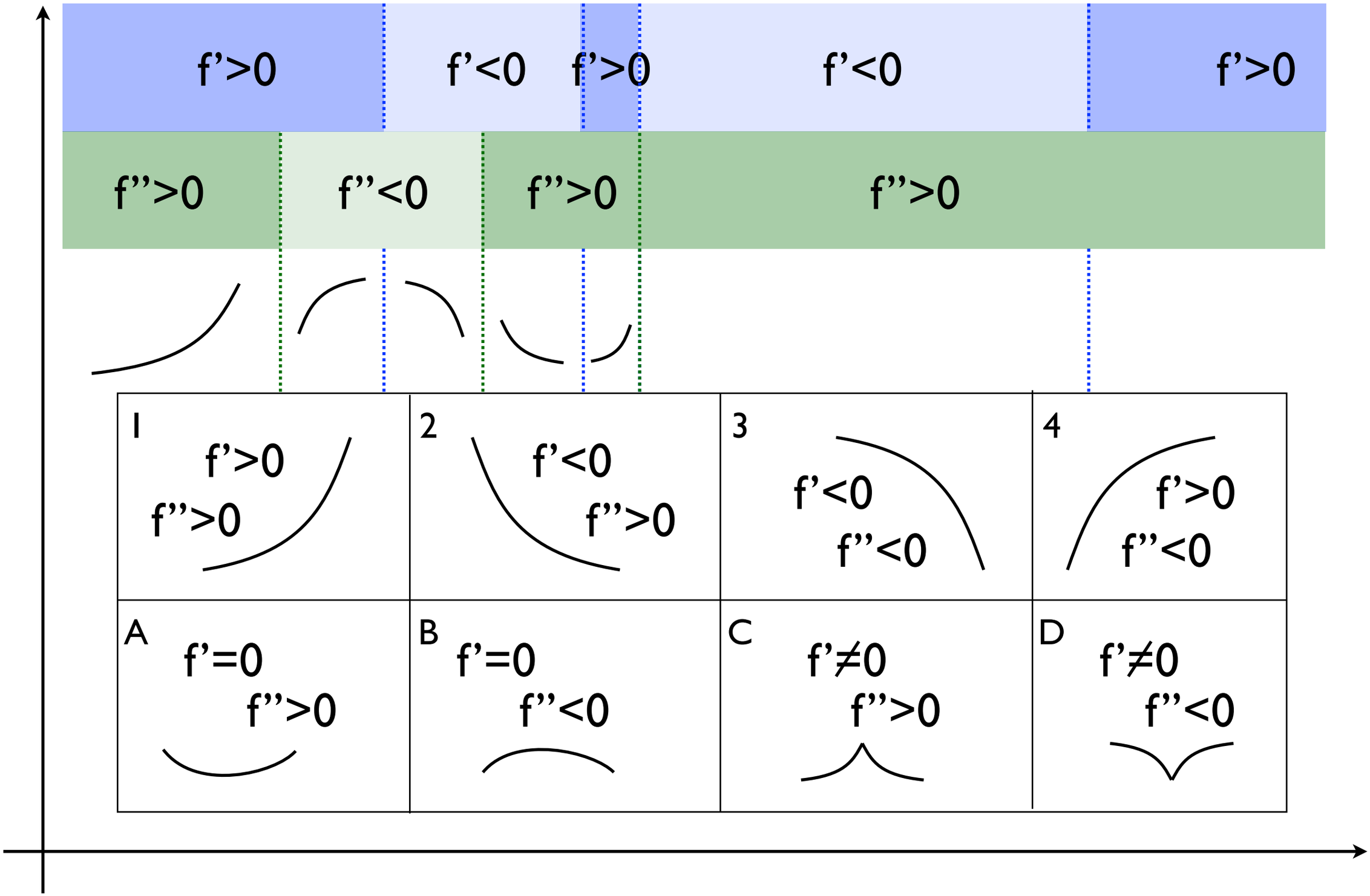

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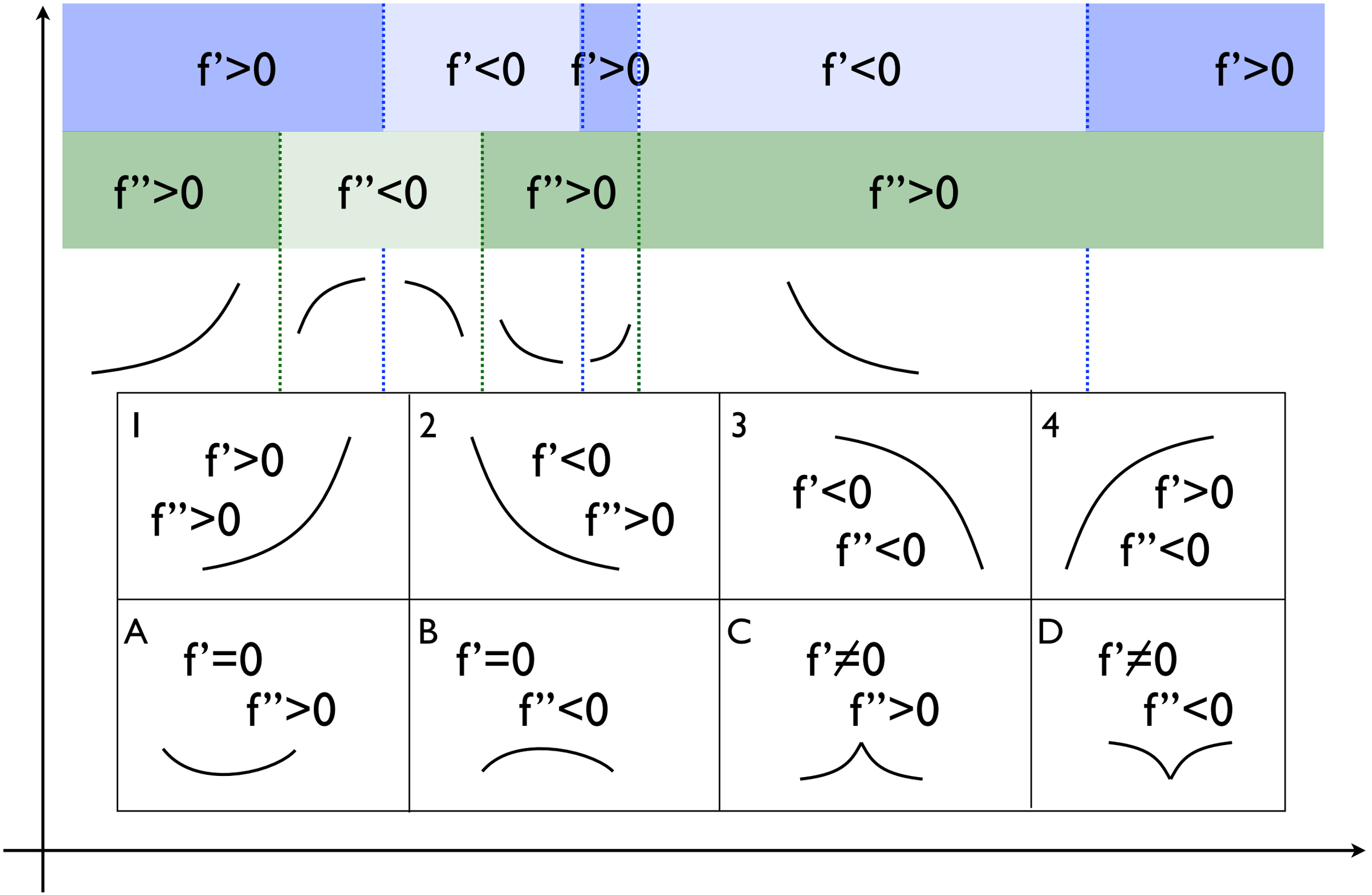

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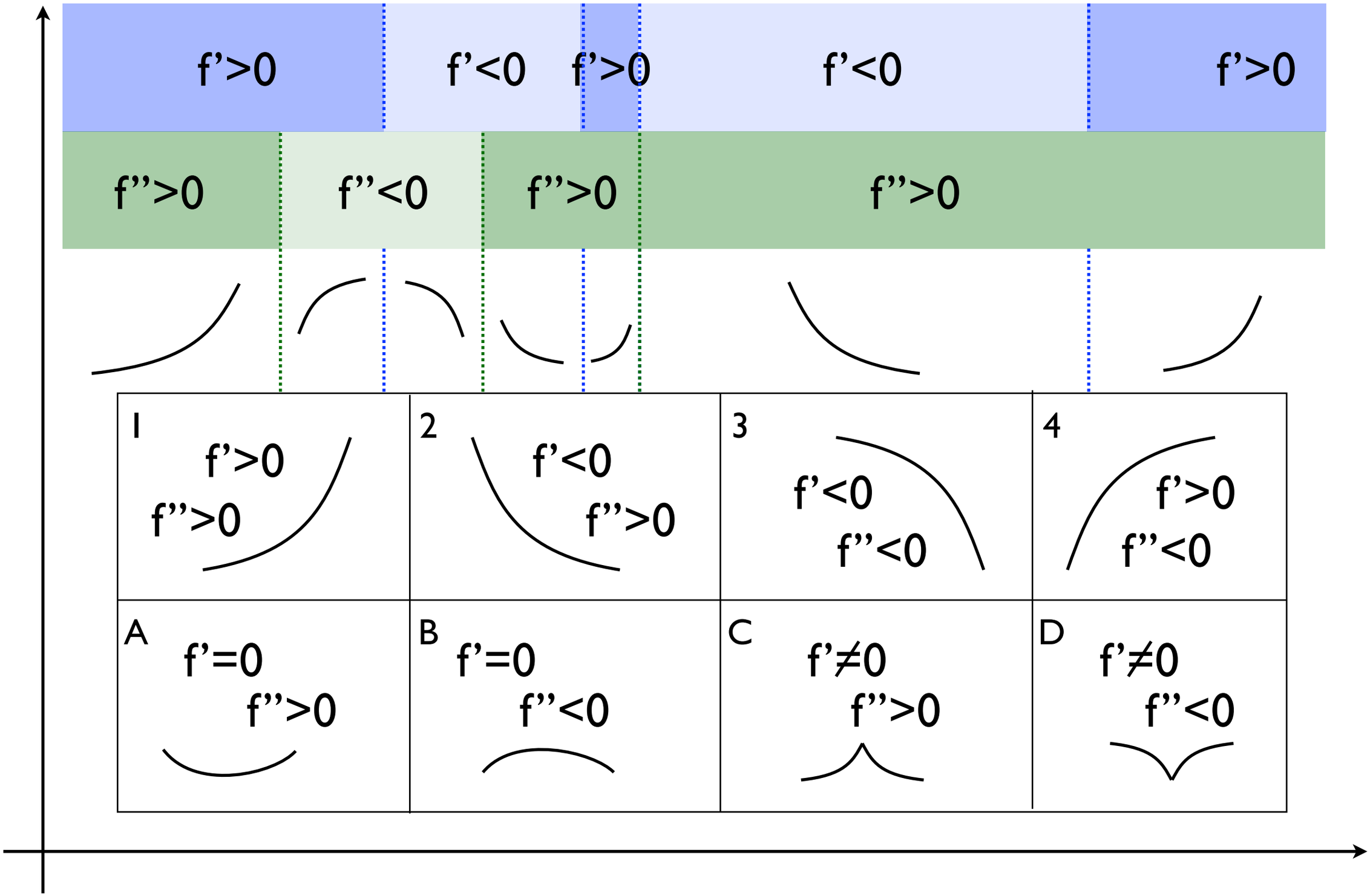

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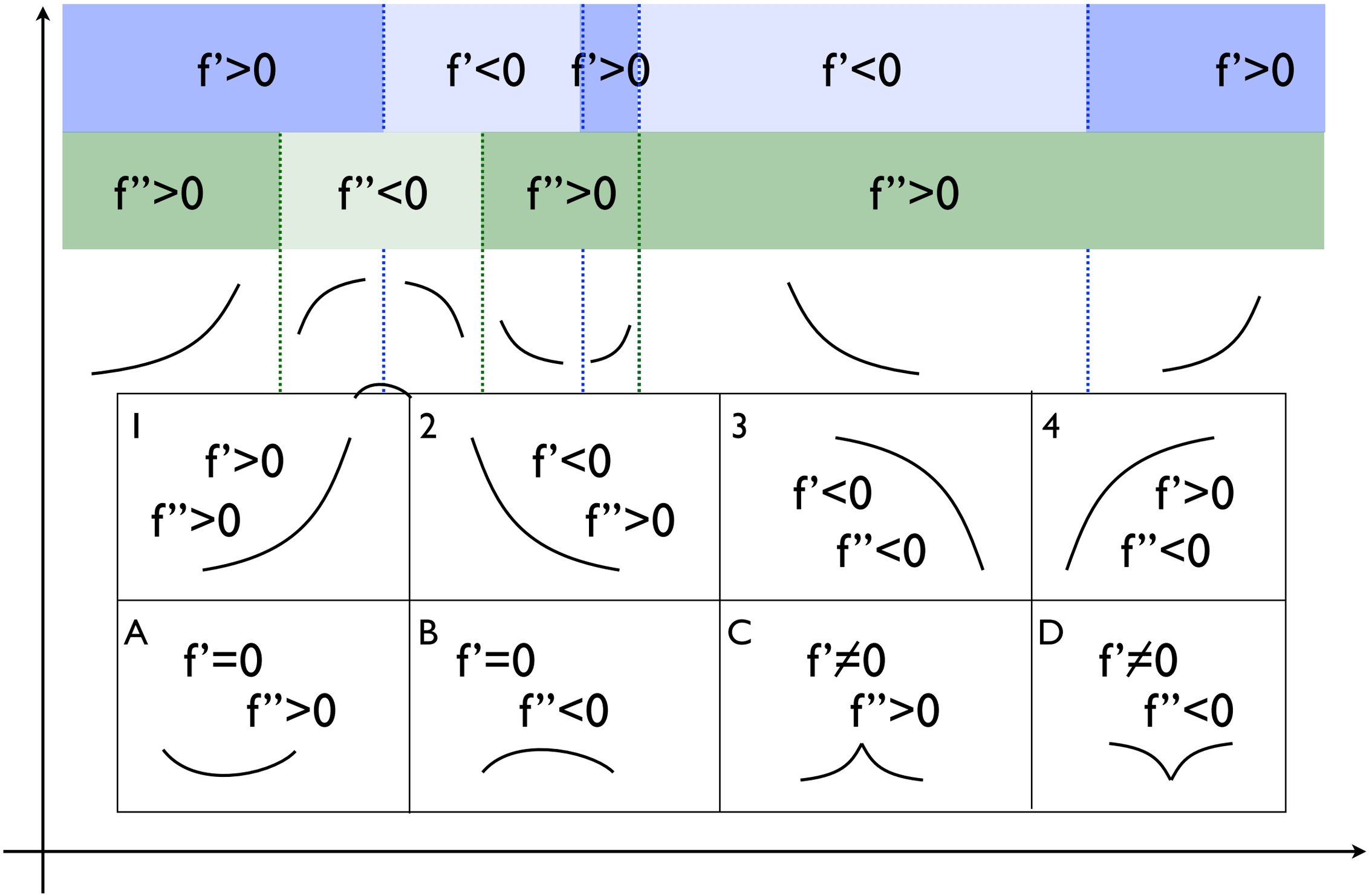

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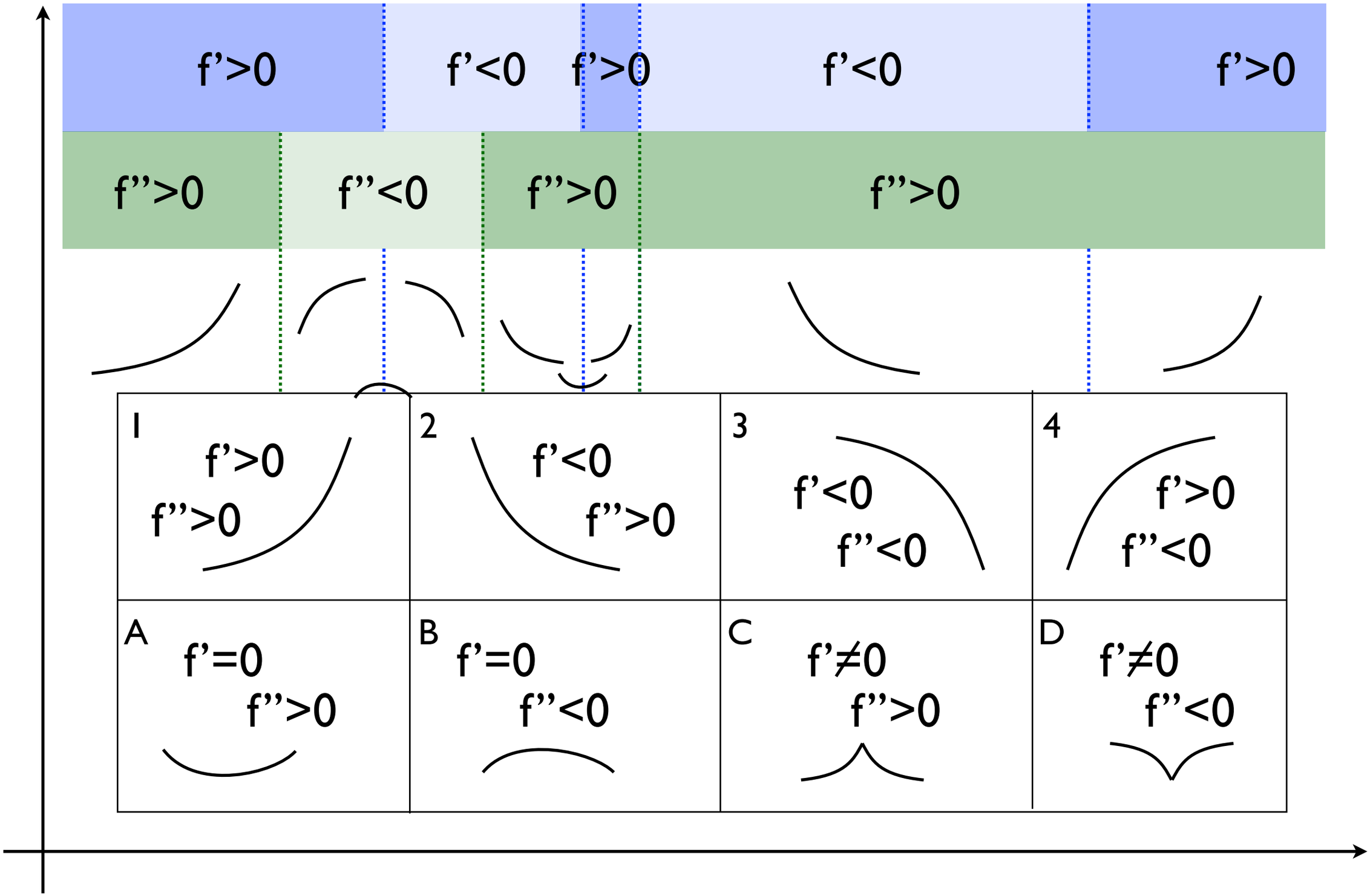

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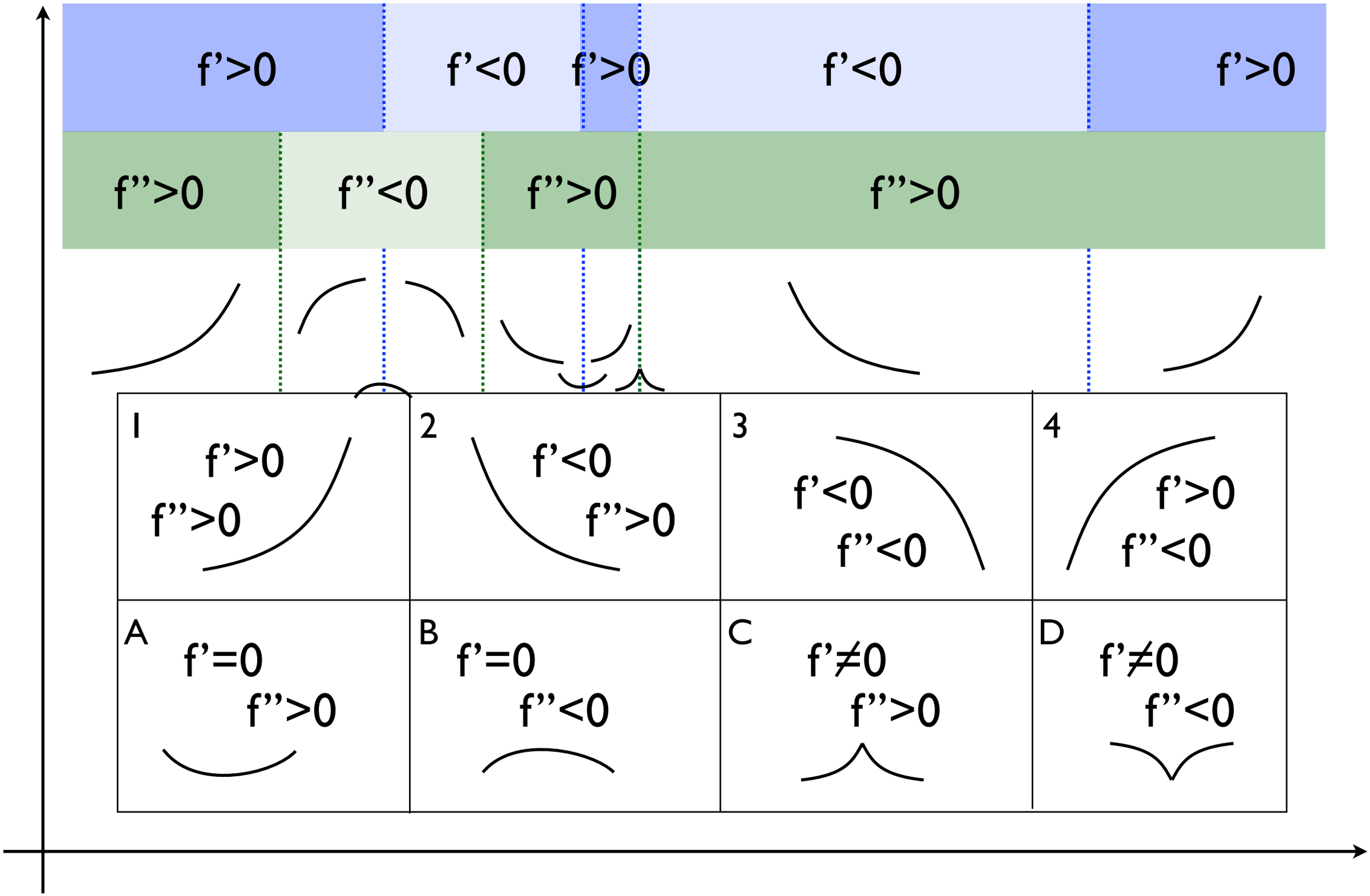

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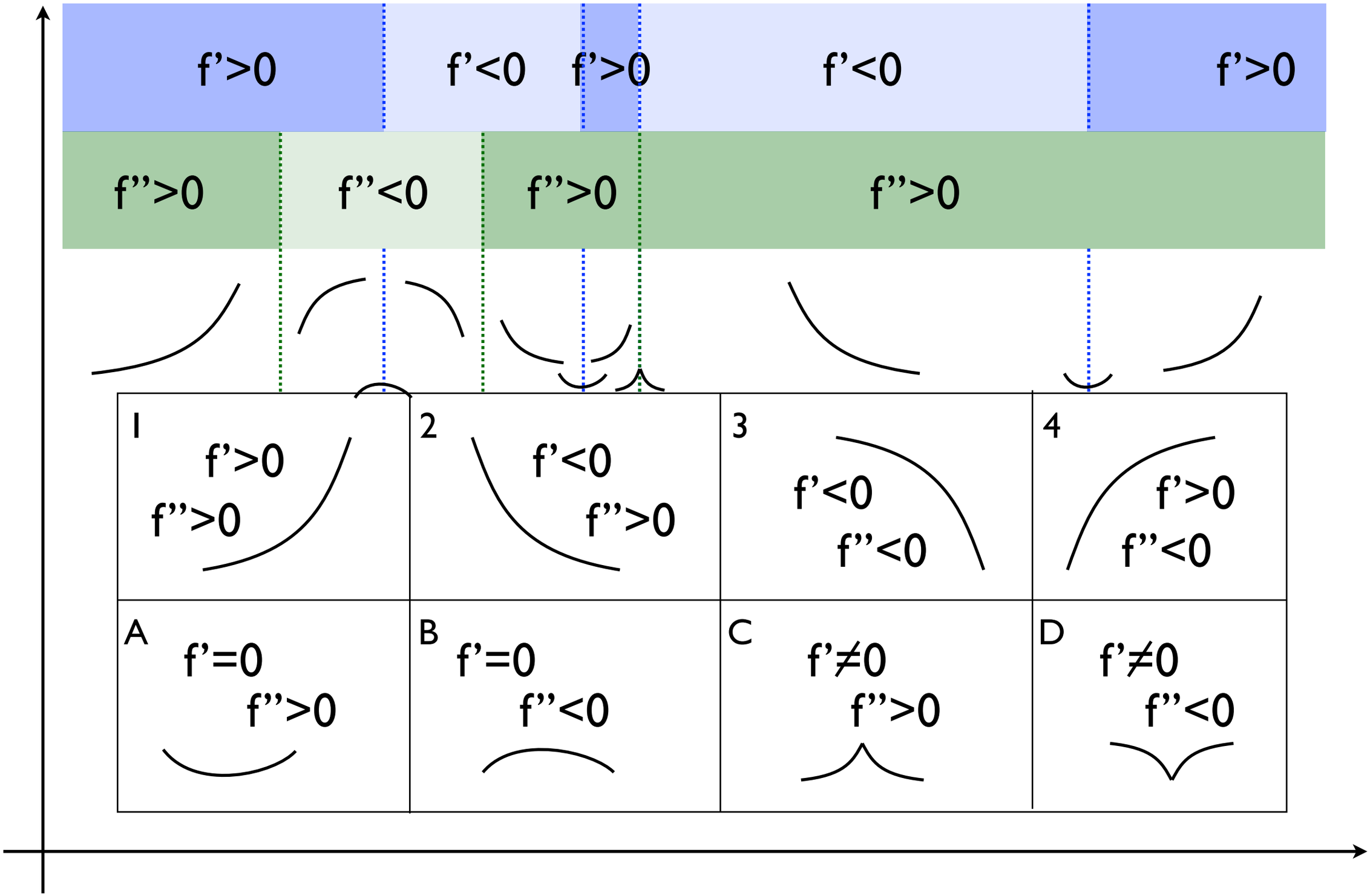

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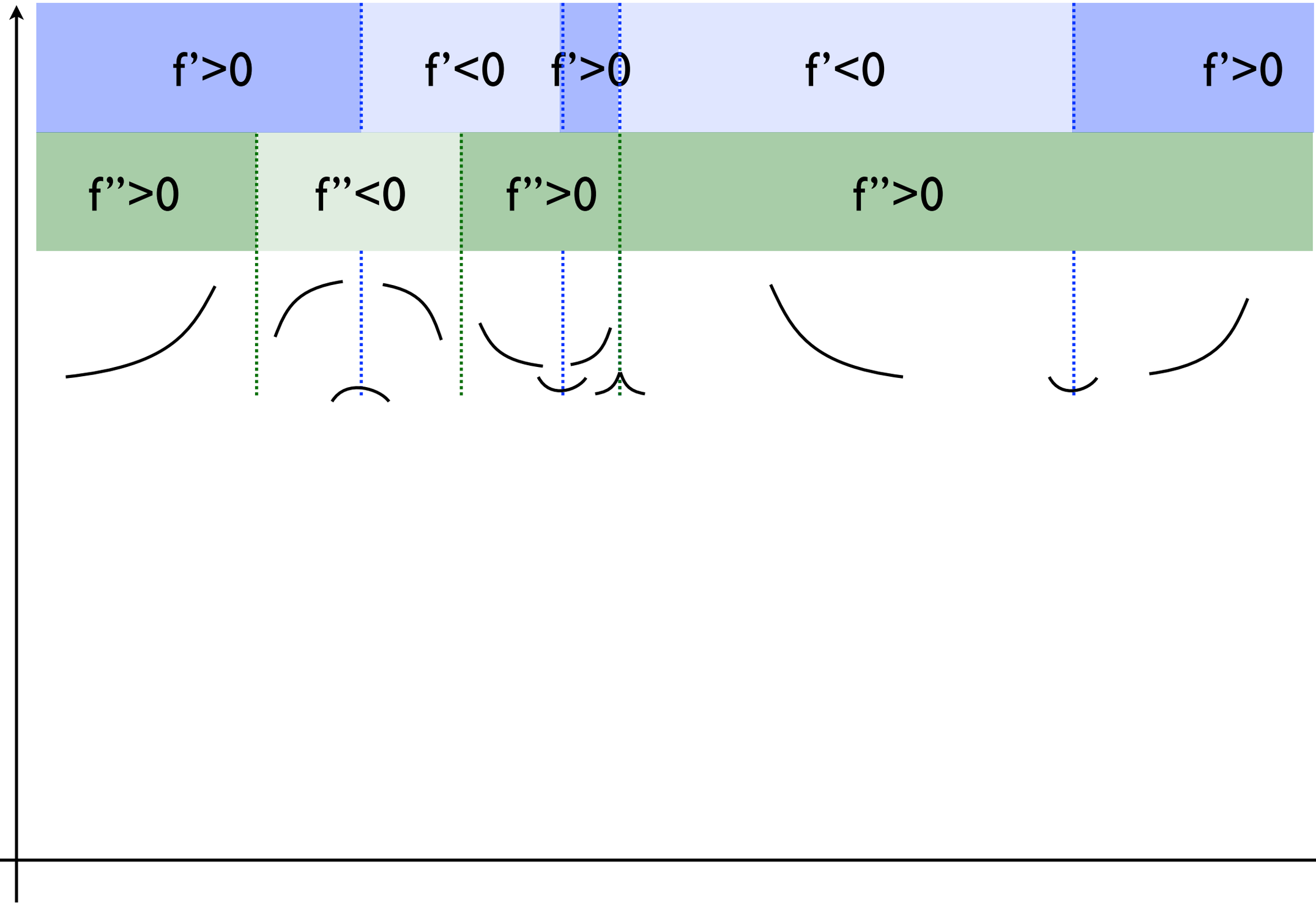

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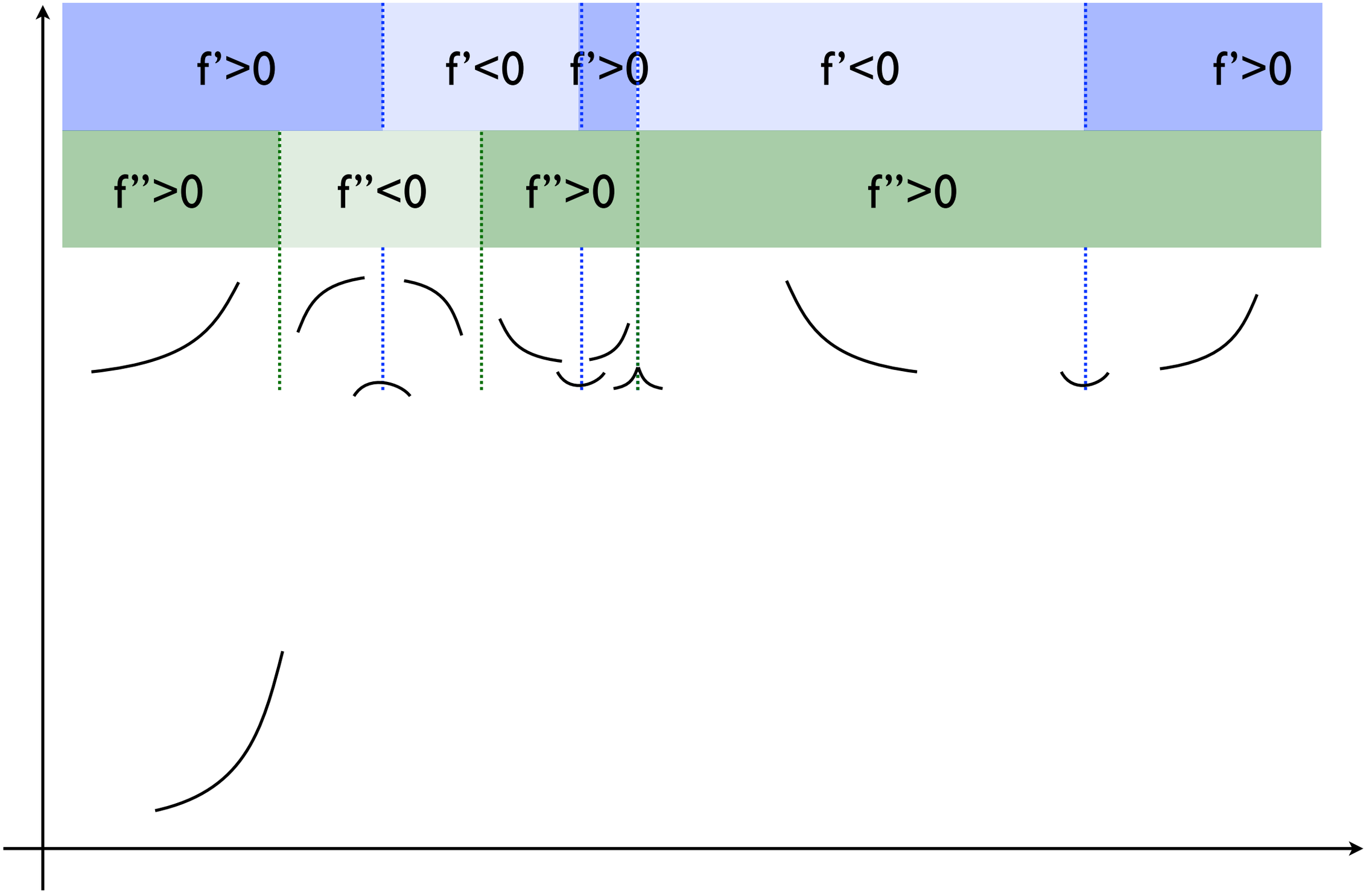

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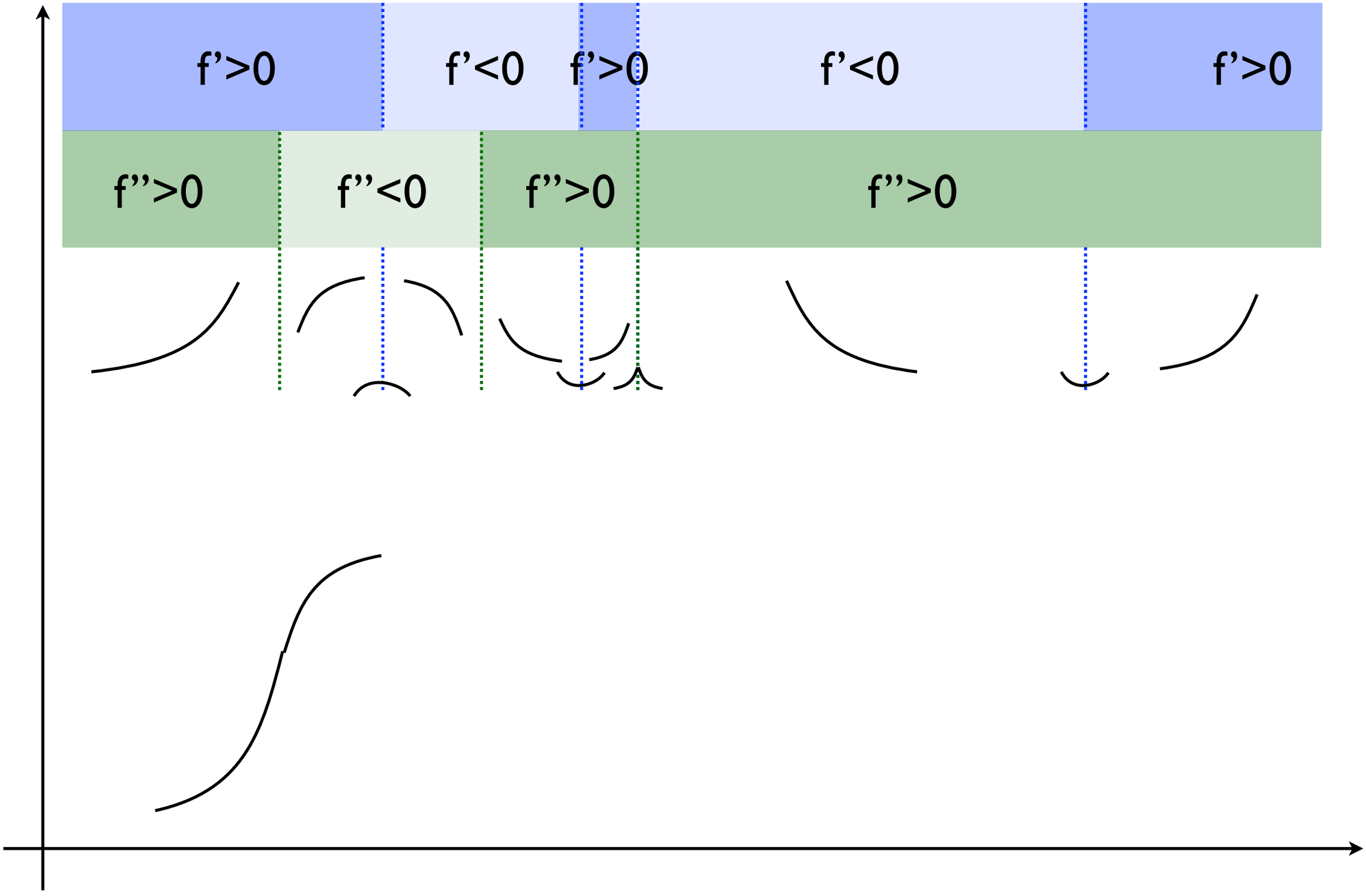

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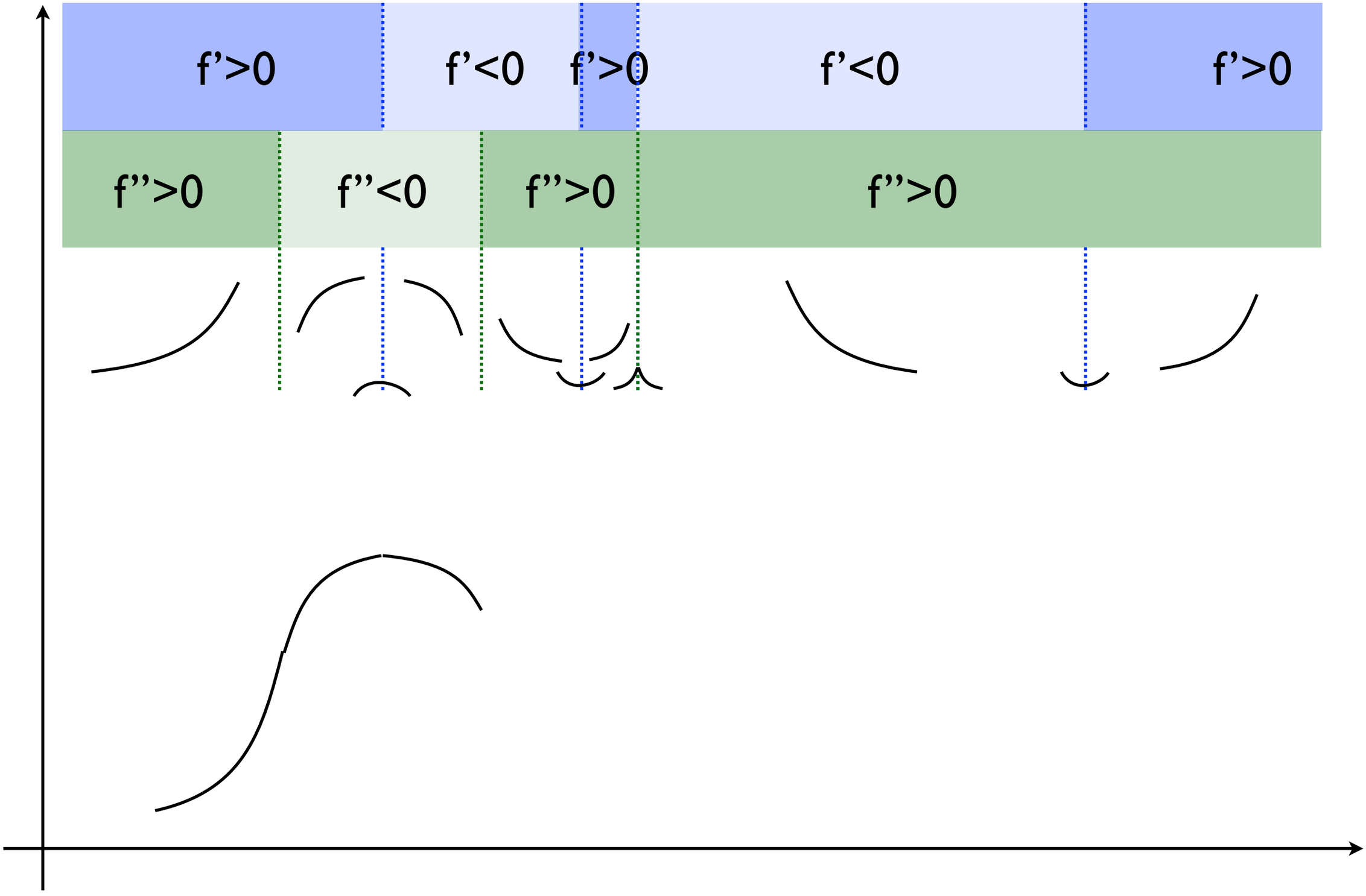

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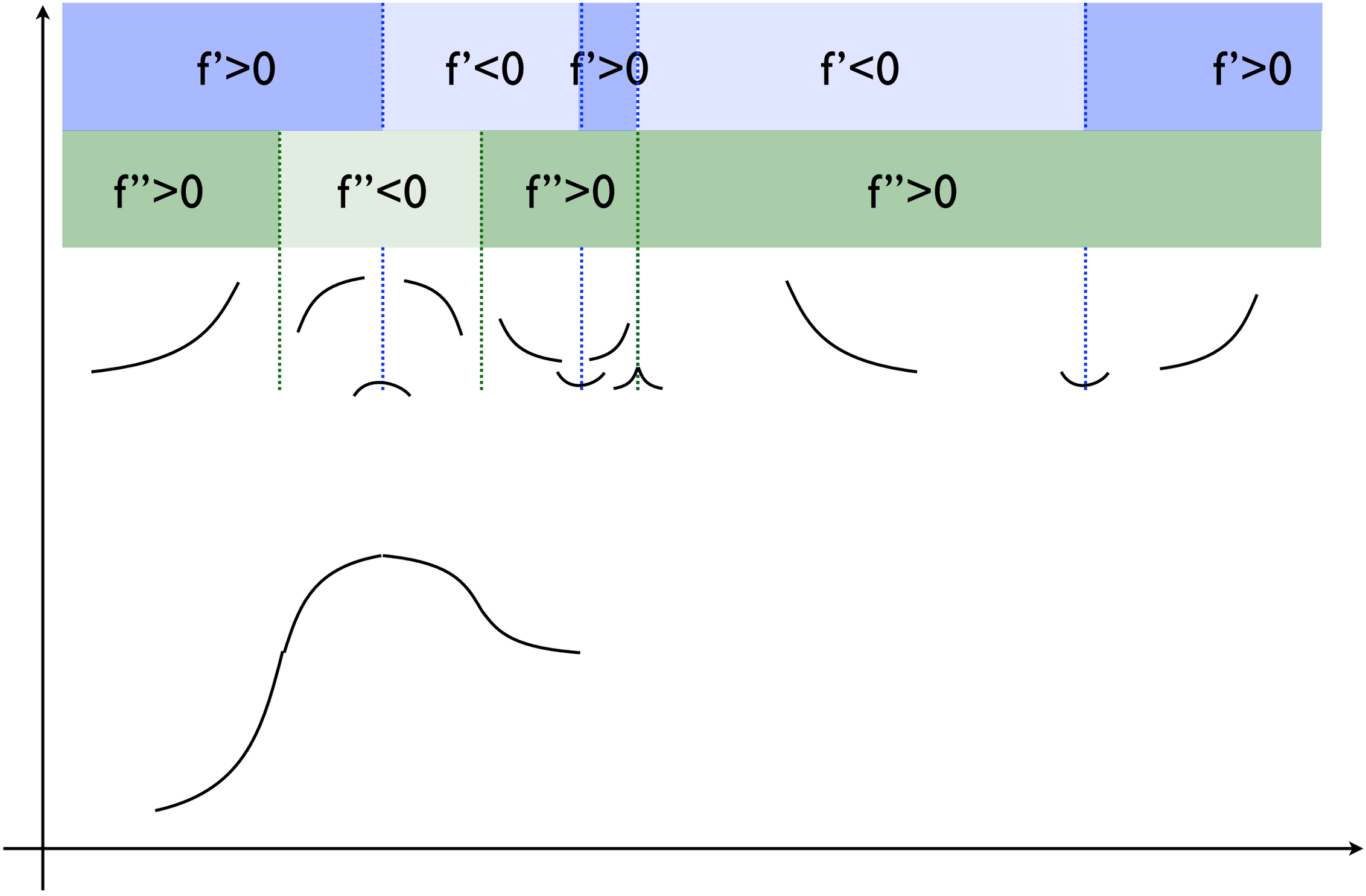

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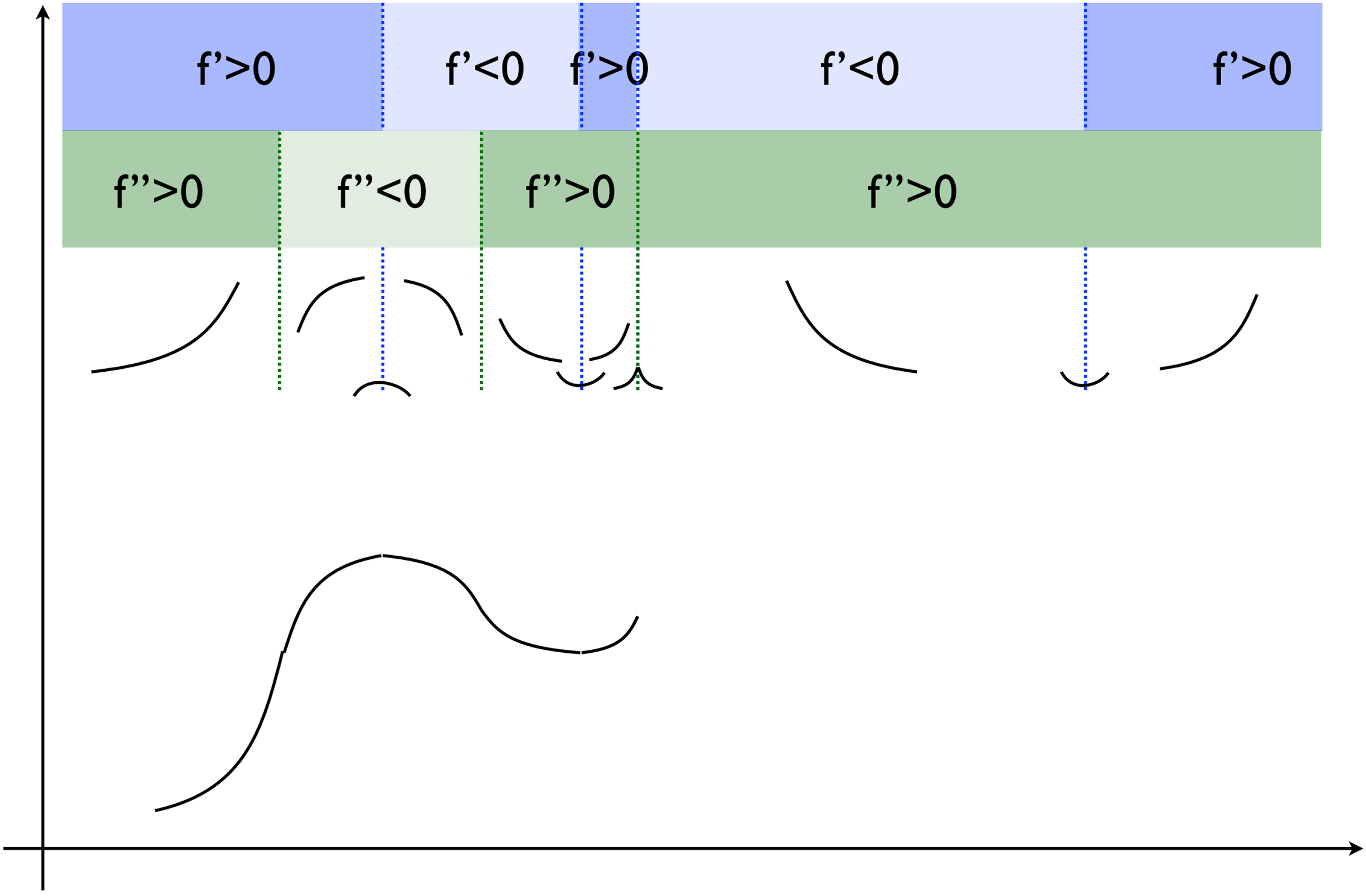

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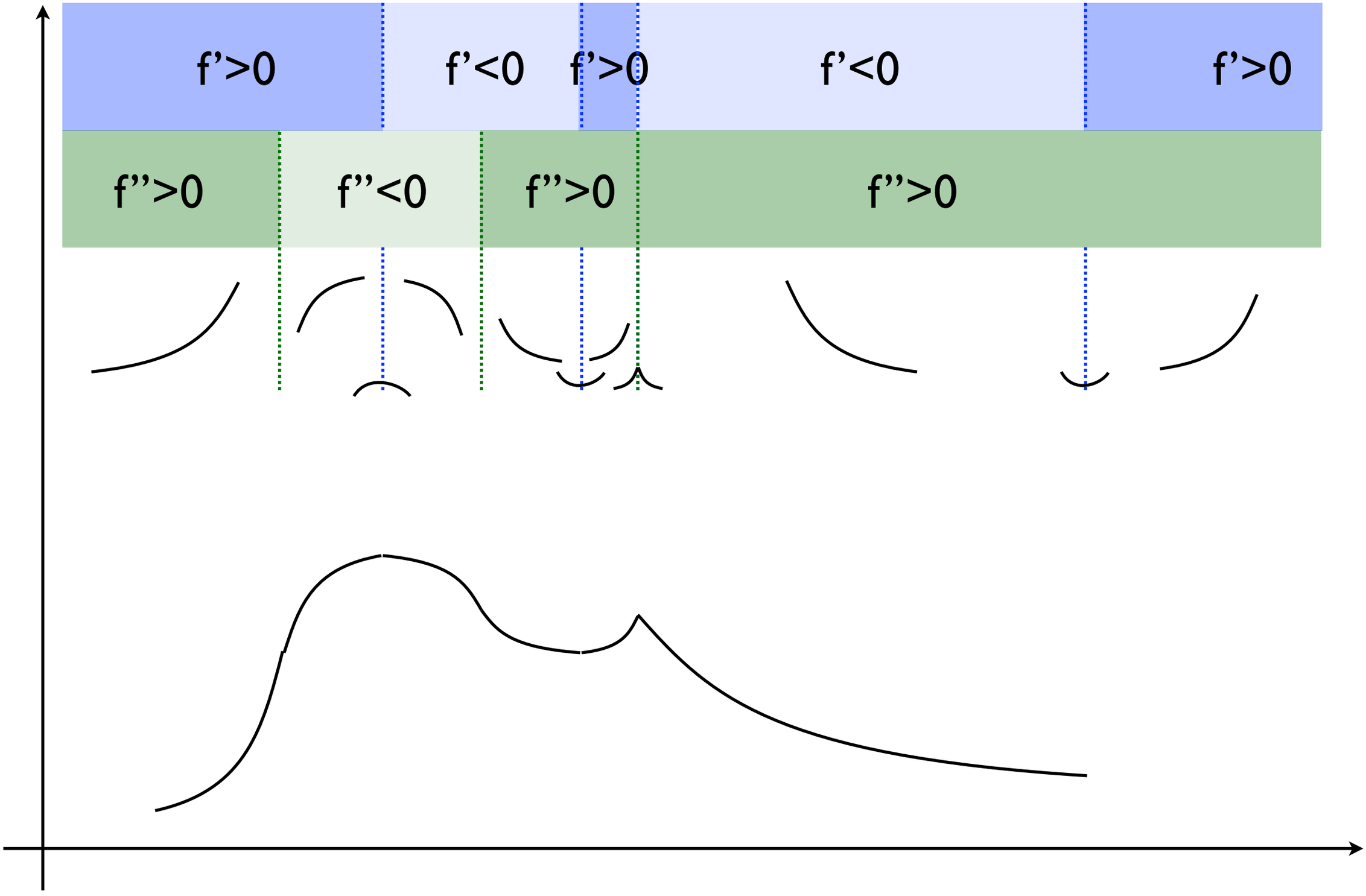

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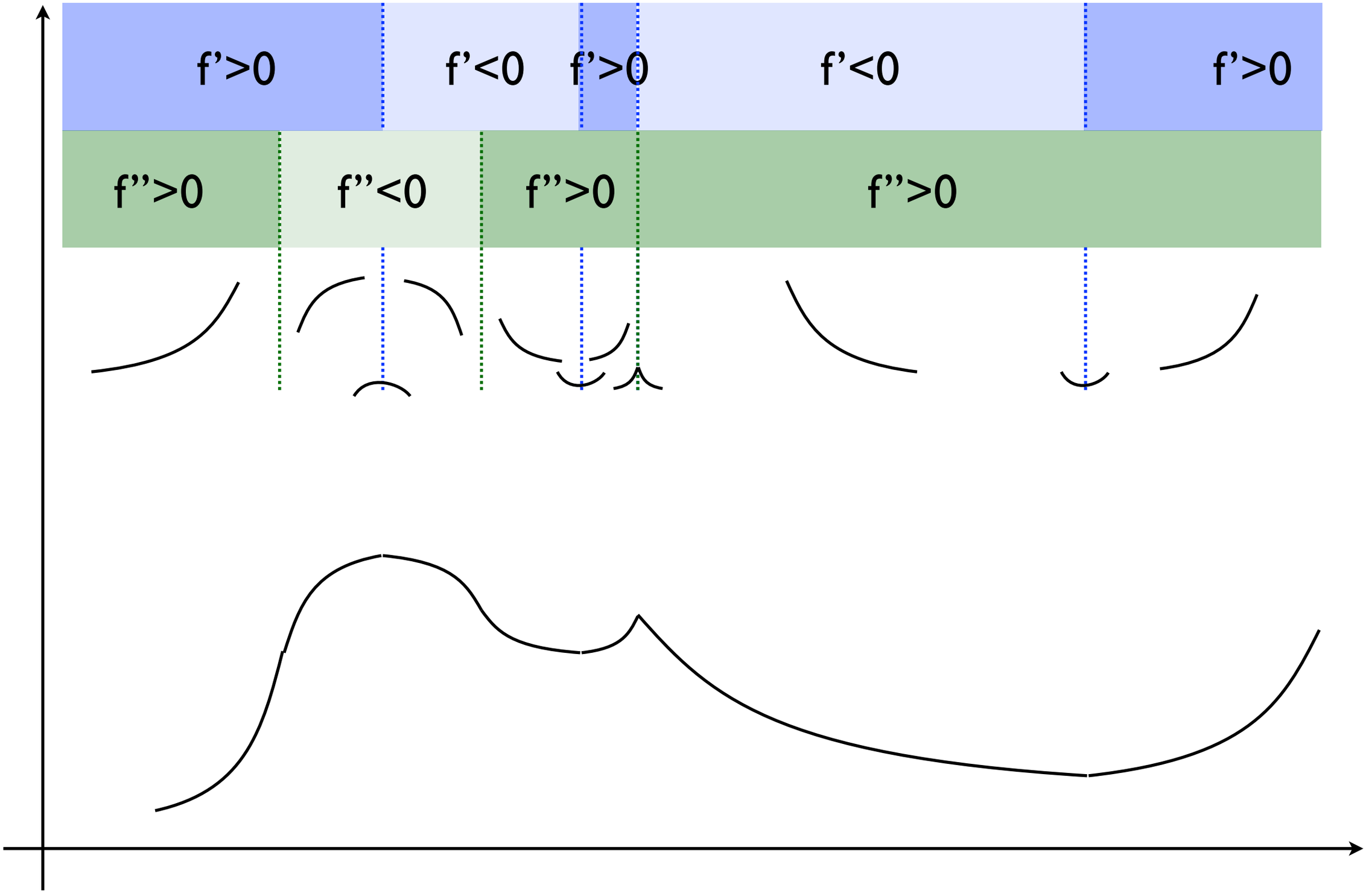

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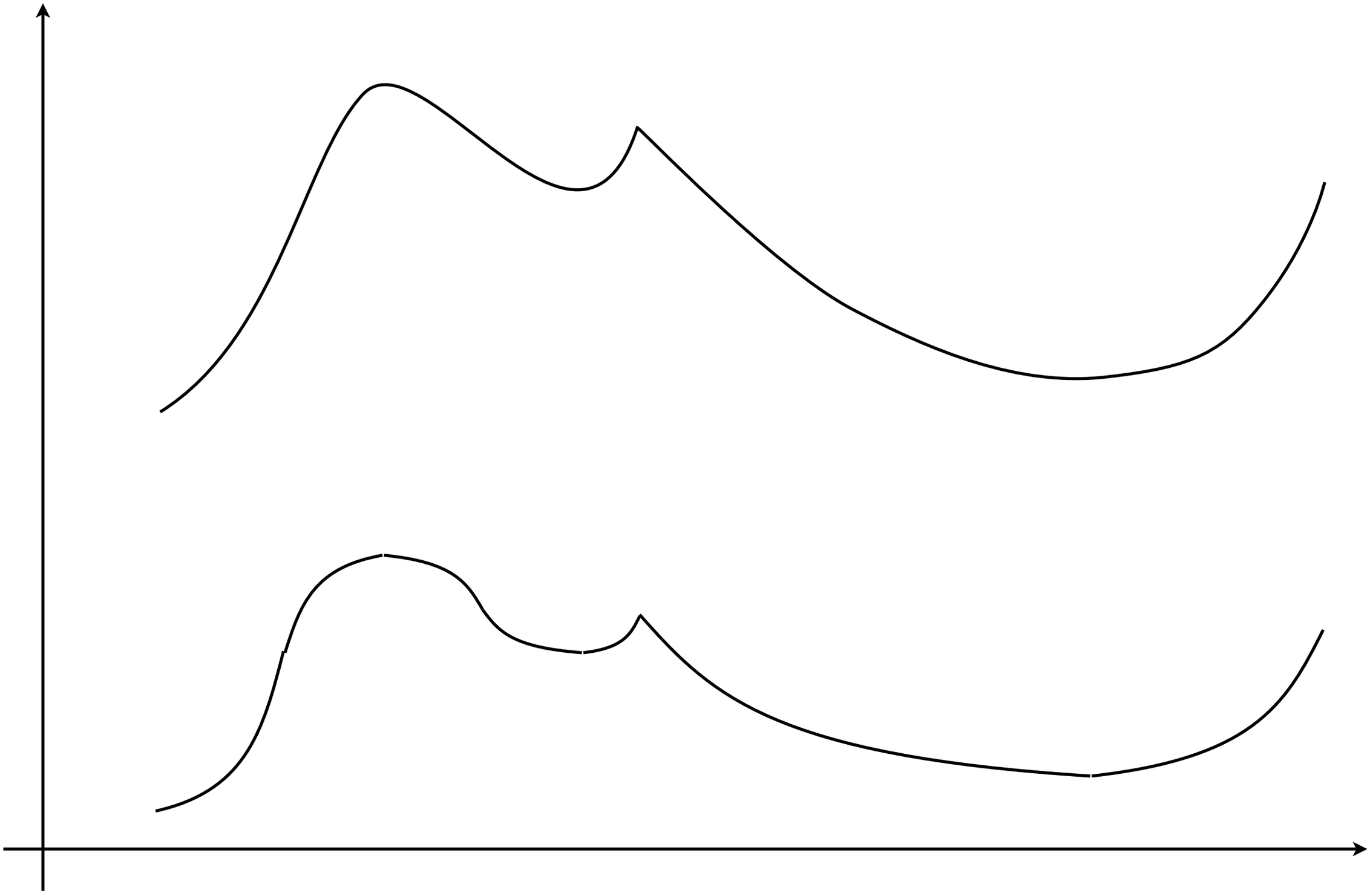

Sketch the graph of

$f(x) = 3x^4 - 4x^3$

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x					
f(x)					

Sketch the graph of $f(x) = 3x^4 - 4x^3$

x		0		4/3	
f(x)		0		0	

Sketch the graph of $f(x) = 3x^4 - 4x^3$

x	$(-\infty,0)$	0	$(0,4/3)$	$4/3$	$(4/3,\infty)$
f(x)		0		0	

Sketch the graph of $f(x) = 3x^4 - 4x^3$

x	$(-\infty,0)$	0	$(0,4/3)$	$4/3$	$(4/3,\infty)$
f(x)	+	0	-	0	+

Sketch the graph of

$$f'(x) = 12(x^3 - x^2)$$

x	$(-\infty,0)$	0	$(0,4/3)$	4/3	$(4/3,\infty)$
f(x)	+	0	-	0	+

x					
f'(x)					

Sketch the graph of $f(x) = 3x^4 - 4x^3$

$$f'(x) = 12(x^3 - x^2)$$

x	$(-\infty,0)$	0	$(0,4/3)$	4/3	$(4/3,\infty)$
f(x)	+	0	-	0	+

x		0		1	
f'(x)		0		0	

Sketch the graph of $f(x) = 3x^4 - 4x^3$

$$f'(x) = 12(x^3 - x^2)$$

x	$(-\infty,0)$	0	$(0,4/3)$	4/3	$(4/3,\infty)$
f(x)	+	0	-	0	+

x	$(-\infty,0)$	0	$(0,1)$	1	$(1,\infty)$
f'(x)		0		0	

Sketch the graph of $f(x) = 3x^4 - 4x^3$

$$f'(x) = 12(x^3 - x^2)$$

x	$(-\infty,0)$	0	$(0,4/3)$	4/3	$(4/3,\infty)$
f(x)	+	0	-	0	+

x	$(-\infty,0)$	0	$(0,1)$	1	$(1,\infty)$
f'(x)	-	0	-	0	+

Sketch the graph of

$$f''(x) = 12(3x^2-2x)$$

x	$(-\infty,0)$	0	$(0,4/3)$	4/3	$(4/3,\infty)$
f(x)	+	0	-	0	+

x	$(-\infty,0)$	0	$(0,1)$	1	$(1,\infty)$
$f'(x)$	-	0	-	0	+

x					
$f''(x)$					

Sketch the graph of

$$f''(x) = 12(3x^2-2x)$$

x	$(-\infty,0)$	0	$(0,4/3)$	4/3	$(4/3,\infty)$
f(x)	+	0	-	0	+

x	$(-\infty,0)$	0	$(0,1)$	1	$(1,\infty)$
$f'(x)$	-	0	-	0	+

x		0		2/3	
$f''(x)$		0		0	

Sketch the graph of

$$f''(x) = 12(3x^2-2x)$$

x	$(-\infty,0)$	0	$(0,4/3)$	4/3	$(4/3,\infty)$
f(x)	+	0	-	0	+

x	$(-\infty,0)$	0	$(0,1)$	1	$(1,\infty)$
$f'(x)$	-	0	-	0	+

x	$(-\infty,0)$	0	$(0,2/3)$	2/3	$(2/3,\infty)$
$f''(x)$		0		0	

Sketch the graph of

$$f''(x) = 12(3x^2-2x)$$

x	$(-\infty,0)$	0	$(0,4/3)$	4/3	$(4/3,\infty)$
f(x)	+	0	-	0	+

x	$(-\infty,0)$	0	$(0,1)$	1	$(1,\infty)$
$f'(x)$	-	0	-	0	+

x	$(-\infty,0)$	0	$(0,2/3)$	2/3	$(2/3,\infty)$
$f''(x)$	+	0	-	0	+

The whole table

x	$(-\infty,0)$	0	$(0,2/3)$	2/3	$(2/3,1)$	1	$(1,4/3)$	4/3	$(4/3,\infty)$
f(x)	+	0	−	−	−	−	−	0	+
f′(x)	−	0	−	−	−	0	+	+	+
f″(x)	+	0	−	0	+	+	+	+	+

$$f(x) = 3x^4 - 4x^3$$

The whole table

x	$(-\infty,0)$	0	$(0,2/3)$	2/3	$(2/3,1)$	1	$(1,4/3)$	4/3	$(4/3,\infty)$
f(x)	+	0	−	−	−	−	−	0	+
f′(x)	−	0	−	−	−	0	+	+	+
f″(x)	+	0	−	0	+	+	+	+	+

Not a min/max

$$f(x) = 3x^4 - 4x^3$$

The whole table

x	$(-\infty,0)$	0	$(0,2/3)$	2/3	$(2/3,1)$	1	$(1,4/3)$	4/3	$(4/3,\infty)$
f(x)	+	0	−	−	−	−	−	0	+
f′(x)	−	0	−	−	−	0	+	+	+
f″(x)	+	0	−	0	+	+	+	+	+

Not a min/max minimum

$$f(x) = 3x^4 - 4x^3$$

The whole table

x	$(-\infty,0)$	0	$(0,2/3)$	2/3	$(2/3,1)$	1	$(1,4/3)$	4/3	$(4/3,\infty)$
f(x)	+	0	−	−	−	−	−	0	+
f′(x)	−	0	−	−	−	0	+	+	+
f″(x)	+	0	−	0	+	+	+	+	+

inflection point

$= 3x^4-4x^3$

The whole table

x	$(-\infty,0)$	0	$(0,2/3)$	2/3	$(2/3,1)$	1	$(1,4/3)$	4/3	$(4/3,\infty)$
f(x)	+	0	−	−	−	−	−	0	+
f′(x)	−	0	−	−	−	0	+	+	+
f″(x)	+	0	−	0	+	+	+	+	+

$f(x) = 3 - 4x^3$

inflection point

The whole table

x	$(-\infty,0)$	0	$(0,2/3)$	2/3	$(2/3,1)$	1	$(1,4/3)$	4/3	$(4/3,\infty)$
f(x)	+	0	−	−	−	−	−	0	+
f′(x)	−	0	−	−	−	0	+	+	+
f″(x)	+	0	−	0	+	+	+	+	+

$$f(x) = 3x^4 - 4x^3$$