A Software Framework for Interactive Visualization of Optimization Algorithms

MASTER THESIS No. 1666

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Outline

Mathematical optimization problems

Optimization algorithms

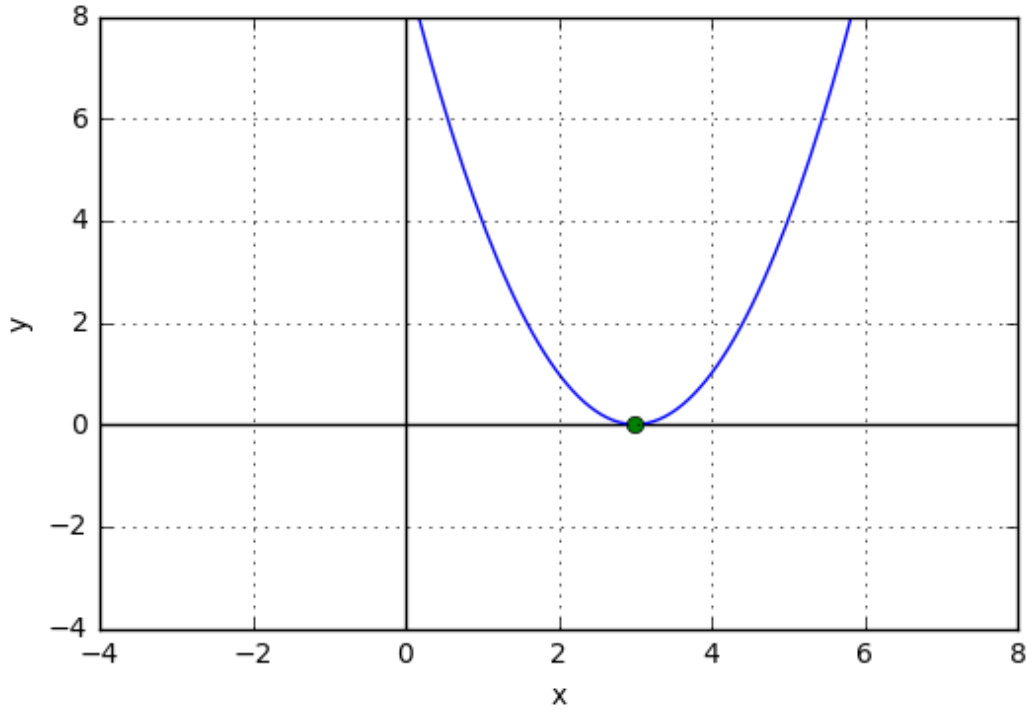
Technologies

Implementation

Using the framework

Conclusion

Mathematical optimization problems



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

$$\underset{x}{minimize}\ f(x) : \mathbb{R}^n \rightarrow \mathbb{R}$$

Constraints

Explicit constraints

$$\overrightarrow{x_l} \leq \overrightarrow{x} \leq \overrightarrow{x_u}$$

Implicit constraints

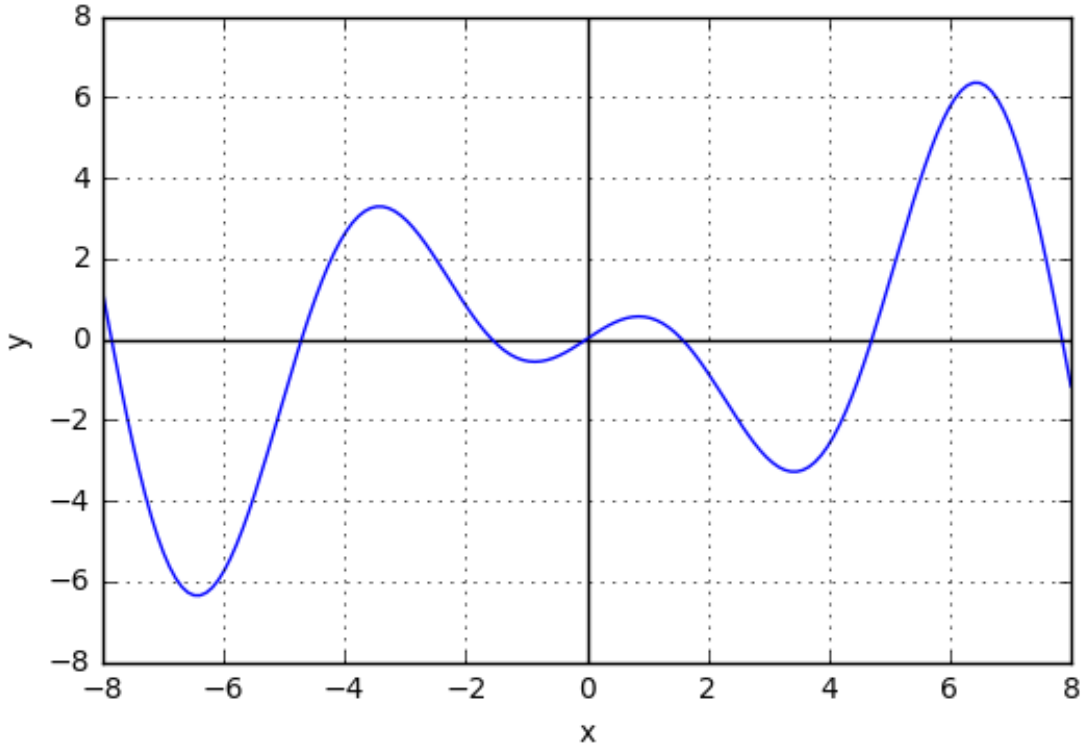
$$g_i(x) \leq 0$$

$$h_j(x) = 0$$

Constraints

Explicit constraints

$$\overrightarrow{x_l} \leq \overrightarrow{x} \leq \overrightarrow{x_u}$$



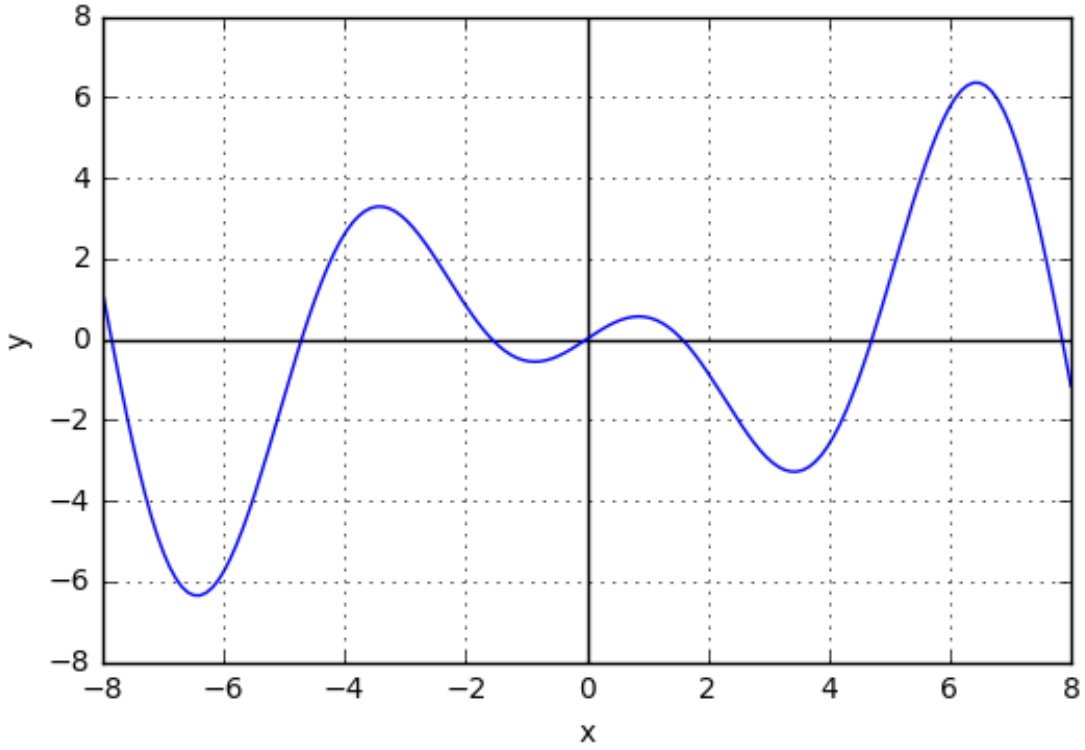
$$f(x) = x \cdot cos(x)$$

Constraints

Explicit constraints

$$\overrightarrow{x_l} \leq \overrightarrow{x} \leq \overrightarrow{x_u}$$

$$-4 \leq x \leq 4$$



$$f(x) = x \cdot cos(x)$$

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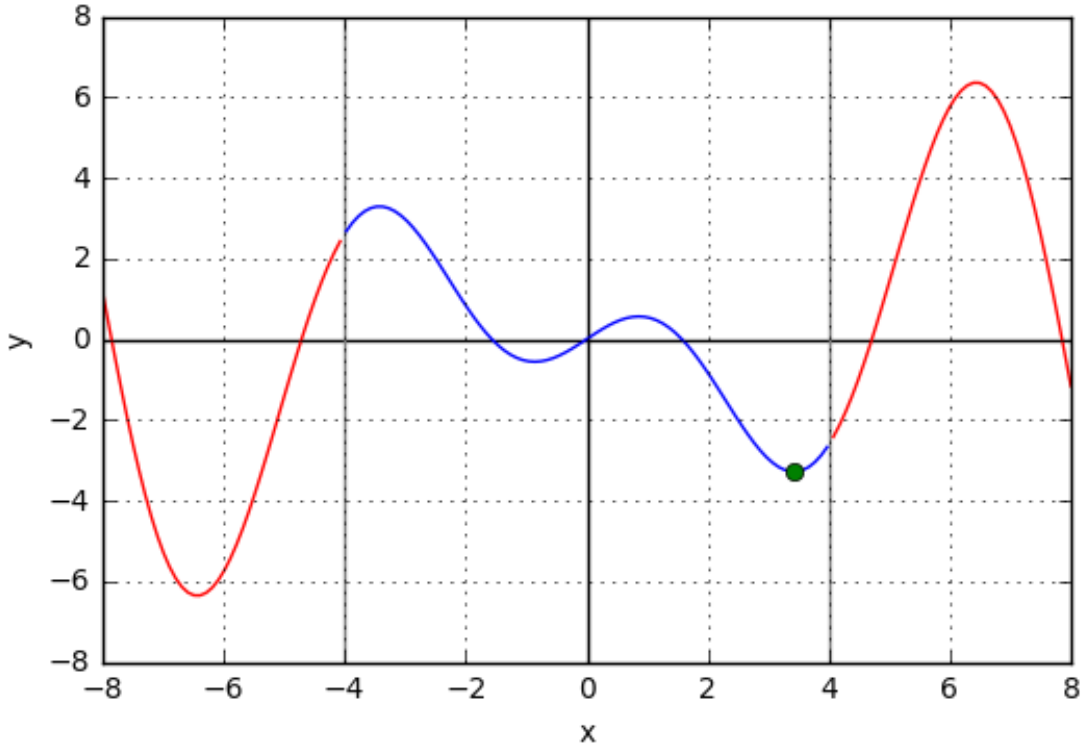


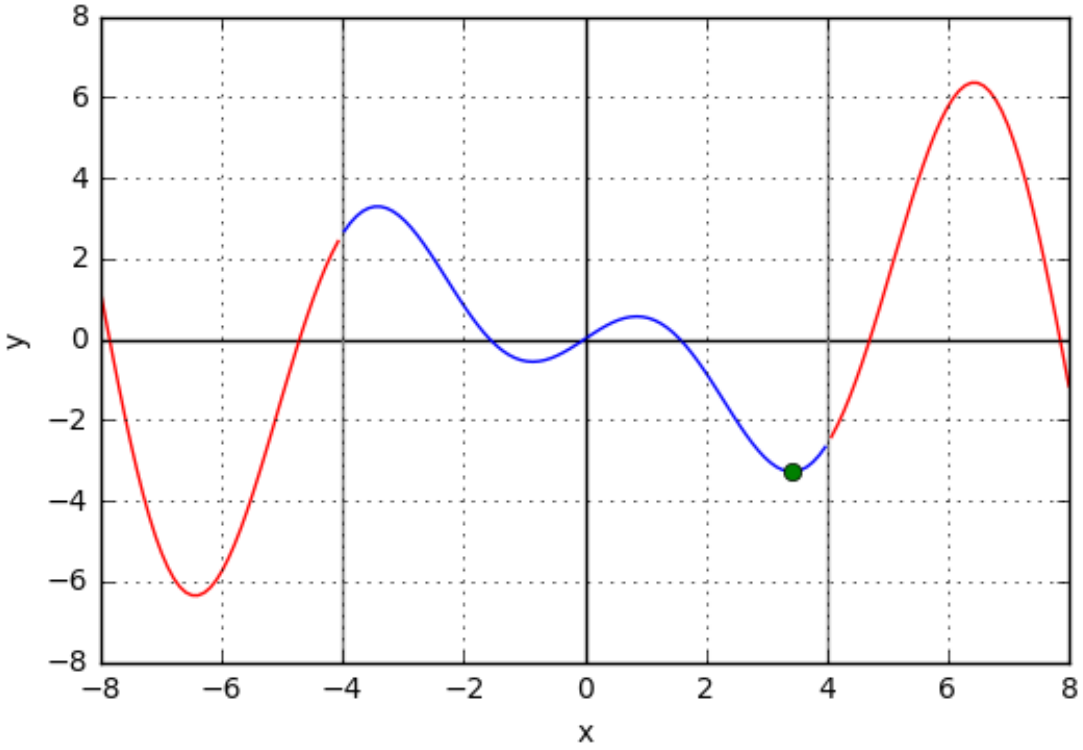
$$f(x) = x \cdot cos(x)$$

Constraints

Implicit constraints

$g_i(x) \leq 0$ - inequality

$h_j(x) = 0$ - equality



$$f(x) = x \cdot cos(x)$$

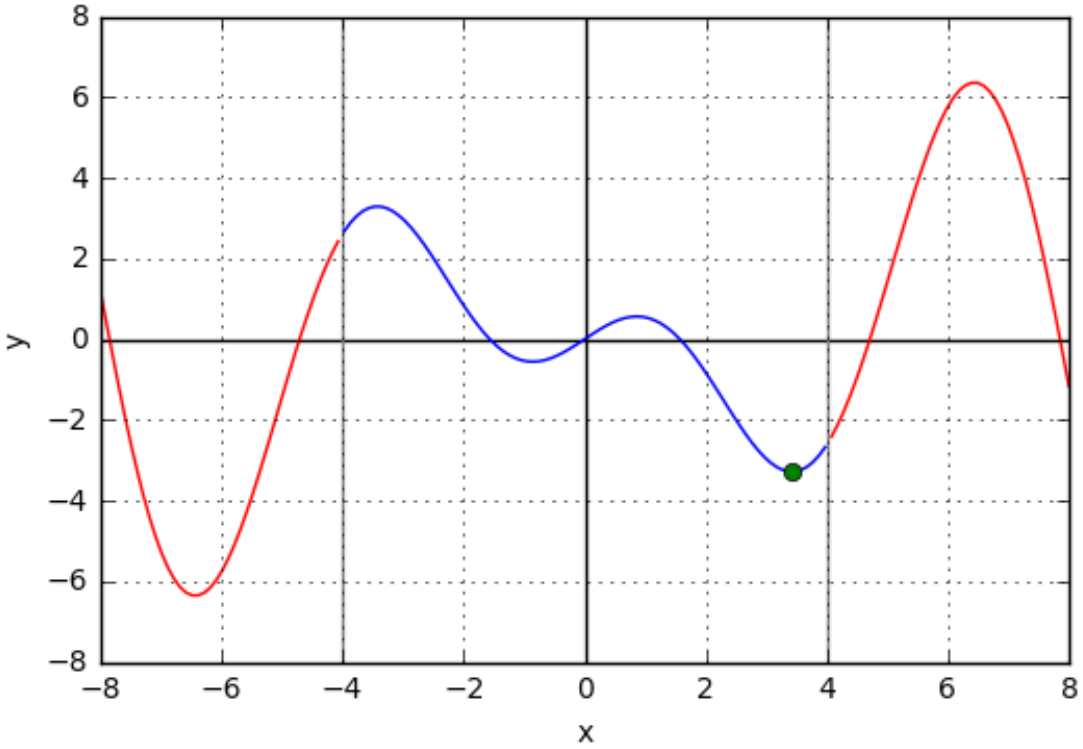
Constraints

Implicit constraints

$g_i(x) \leq 0$ - inequality

$h_j(x) = 0$ - equality

$x^2 - 4 \leq 0$



$f(x) = x \cdot cos(x)$

Constraints

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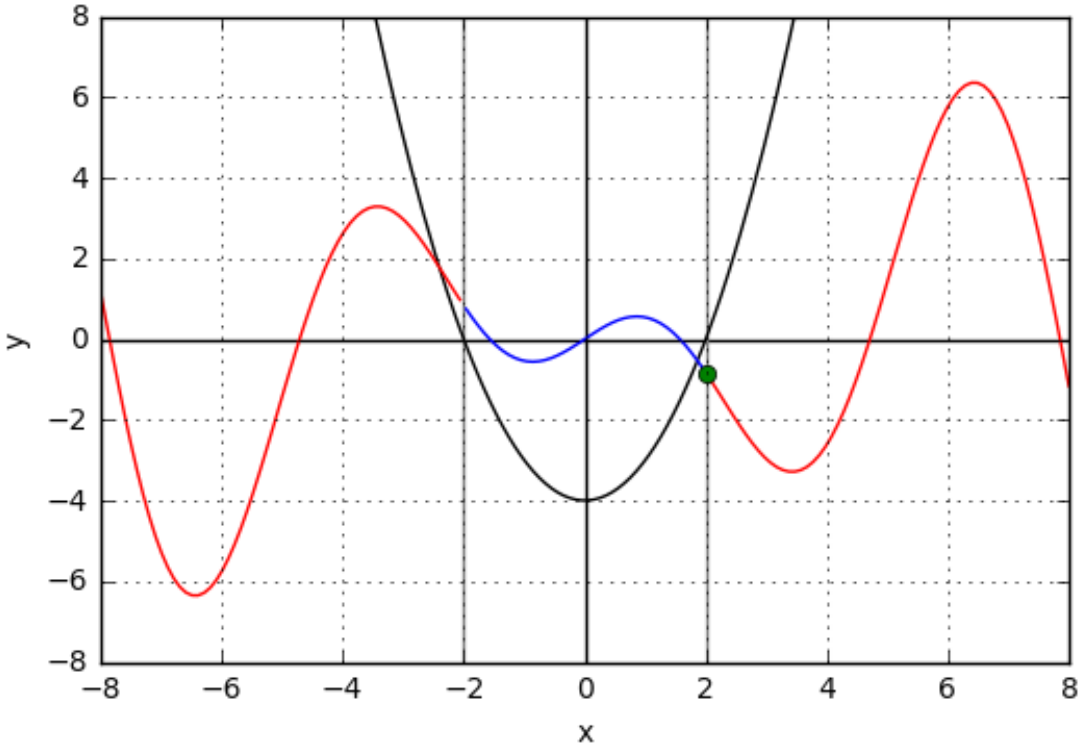
$x^2 - 4 \leq 0$



$f(x) = x \cdot cos(x)$

Constraints

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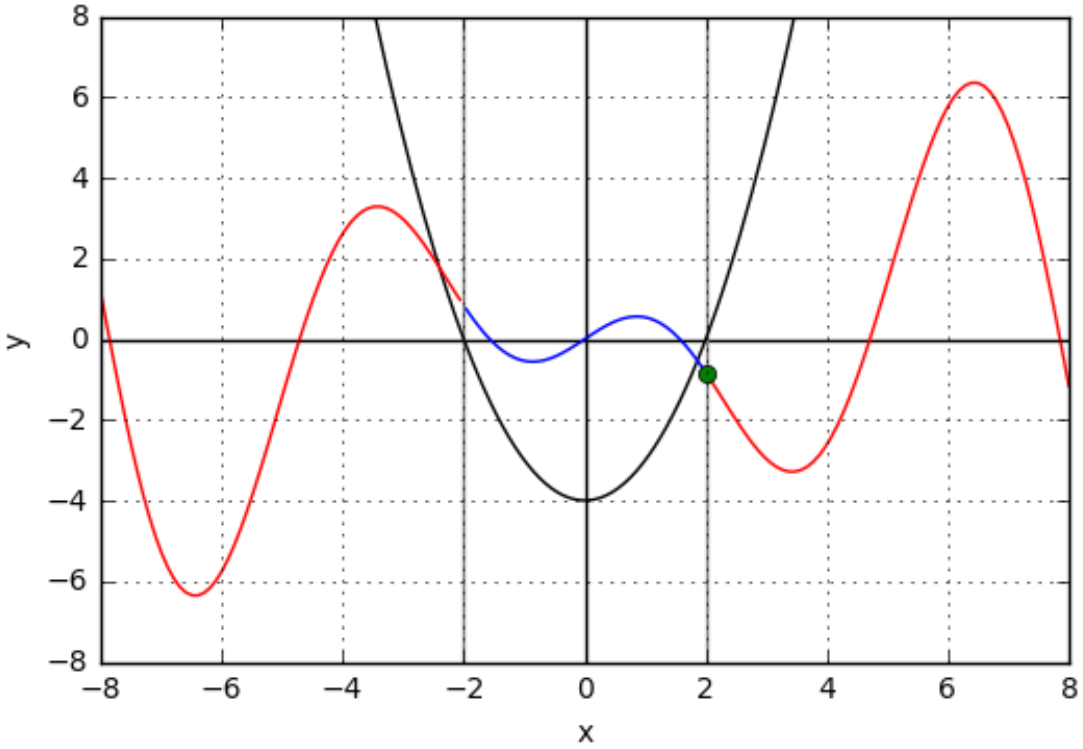
$$x^2 - \frac{\pi^2}{4} = 0$$



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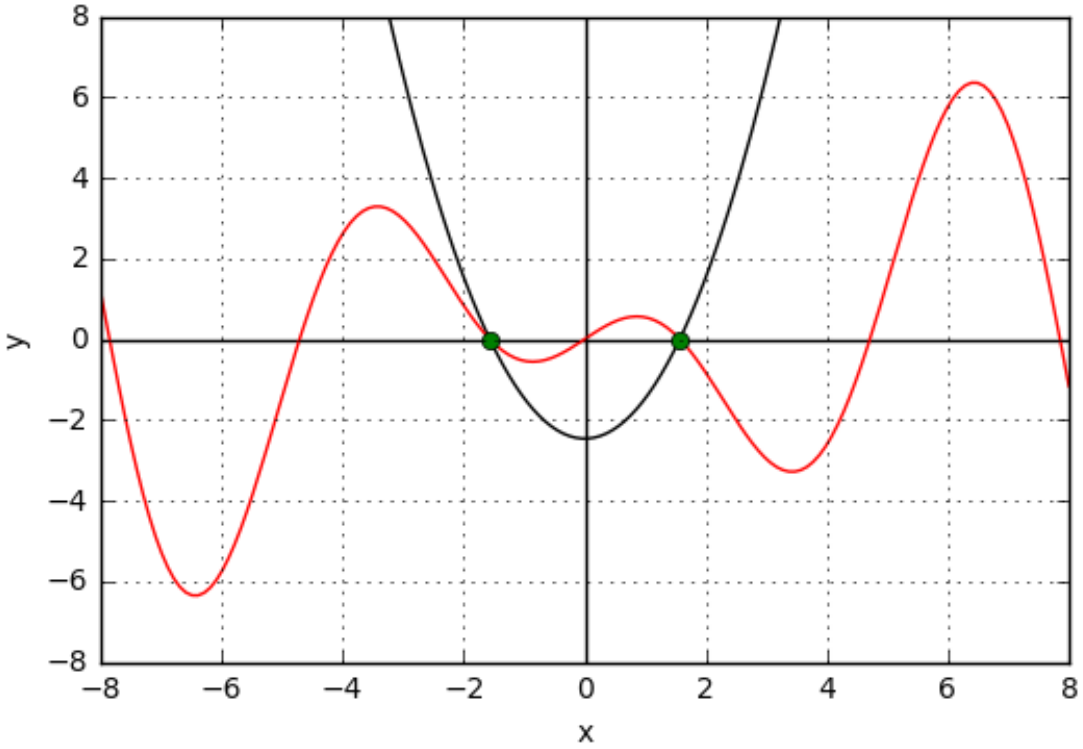


$$f(x) = x \cdot cos(x)$$

Optimization algorithms

Methods for solving optimization problems

Different kinds and behaviour → can be difficult to understand

Iterative → visualization helps

Technologies

Python

Jupyter Notebook

ipywidgets

Technologies

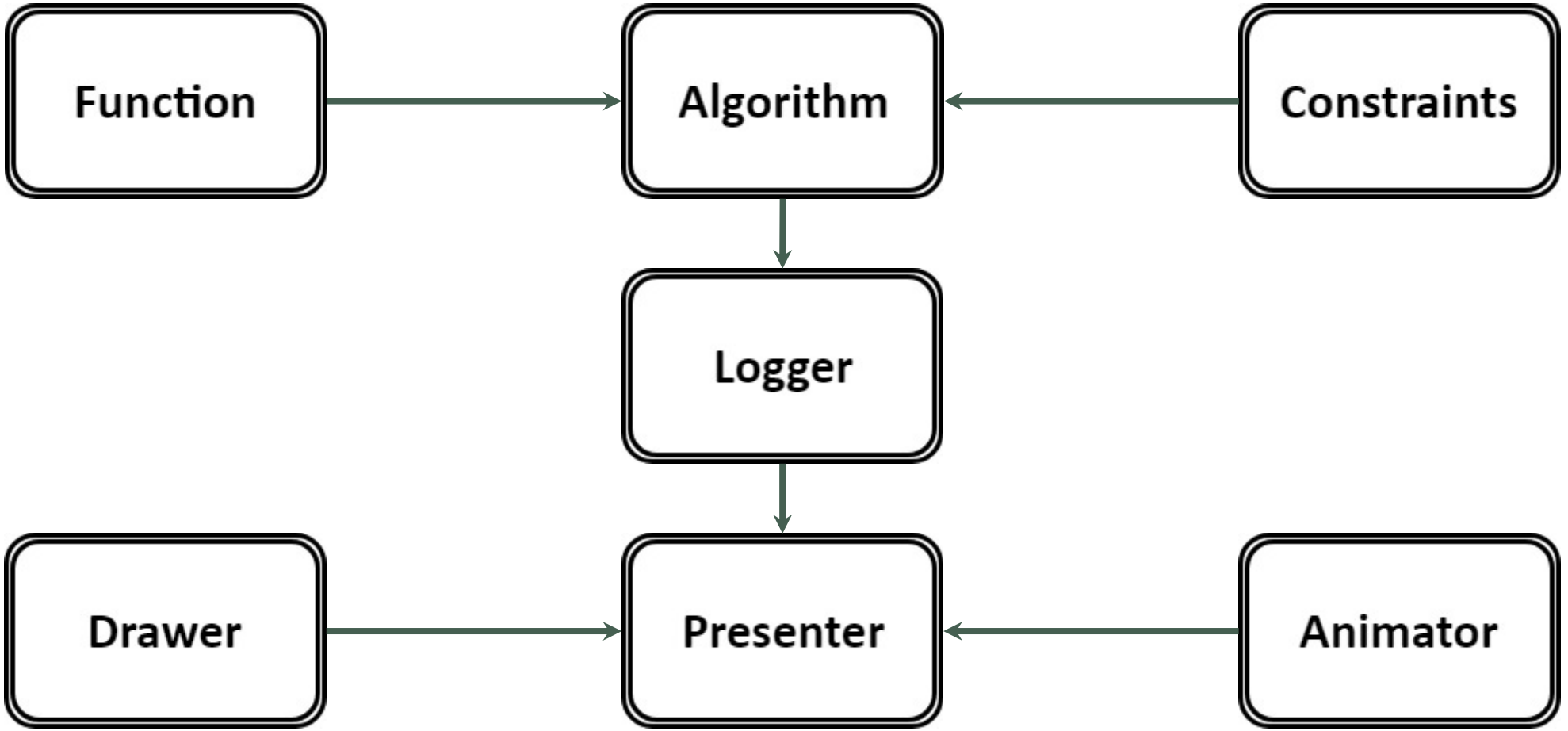
Python

Jupyter Notebook

ipywidgets

[demonstration]

Implementation



Using the framework

[demonstration]

Conclusion

Interactive visualization

Modularity - easily extended and upgraded

Ease of use; suitable for demonstration purposes

Thank you!