Root Finding

ME EN 275
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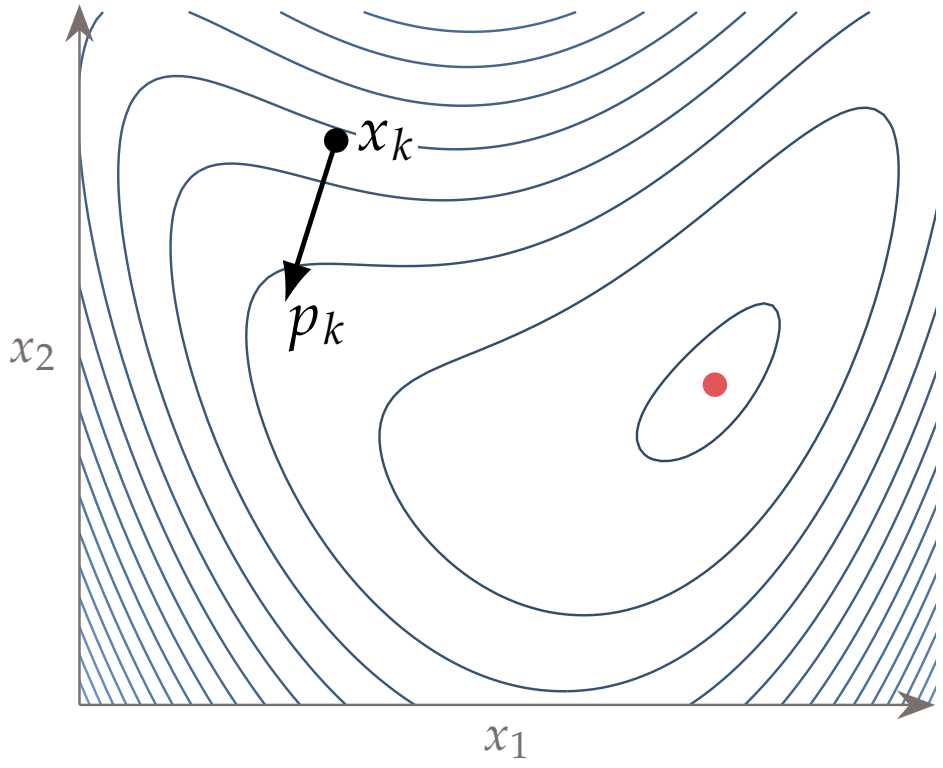
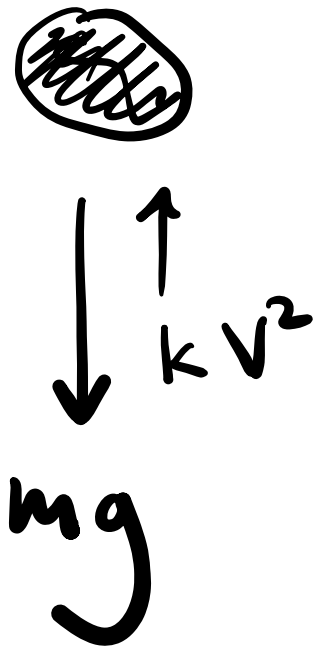


Motivation



$$V = \sqrt{\frac{mg}{k}} \tanh\left(\sqrt{\frac{kg}{m}}\, t\right)$$

Implicit Equation

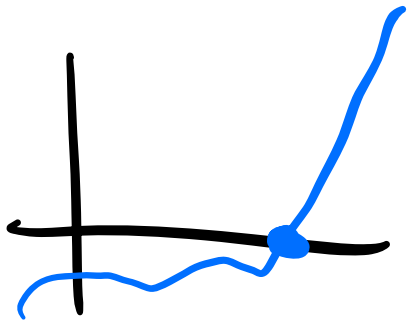
$m = \ldots$ (explicit)

$f(m) = 0$ (implicit)

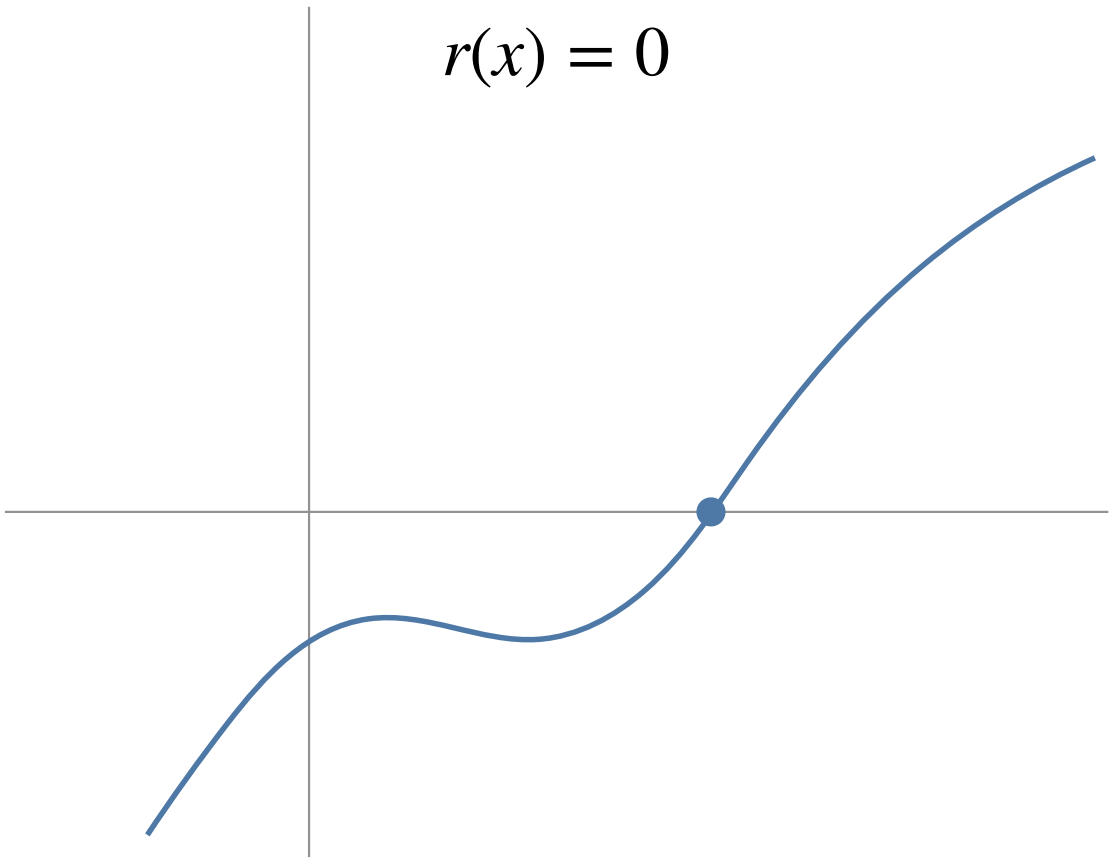
Implicit Equation

$$V = \sqrt{\frac{mg}{k}} \tanh\left(\sqrt{\frac{kg}{m}} t\right)$$

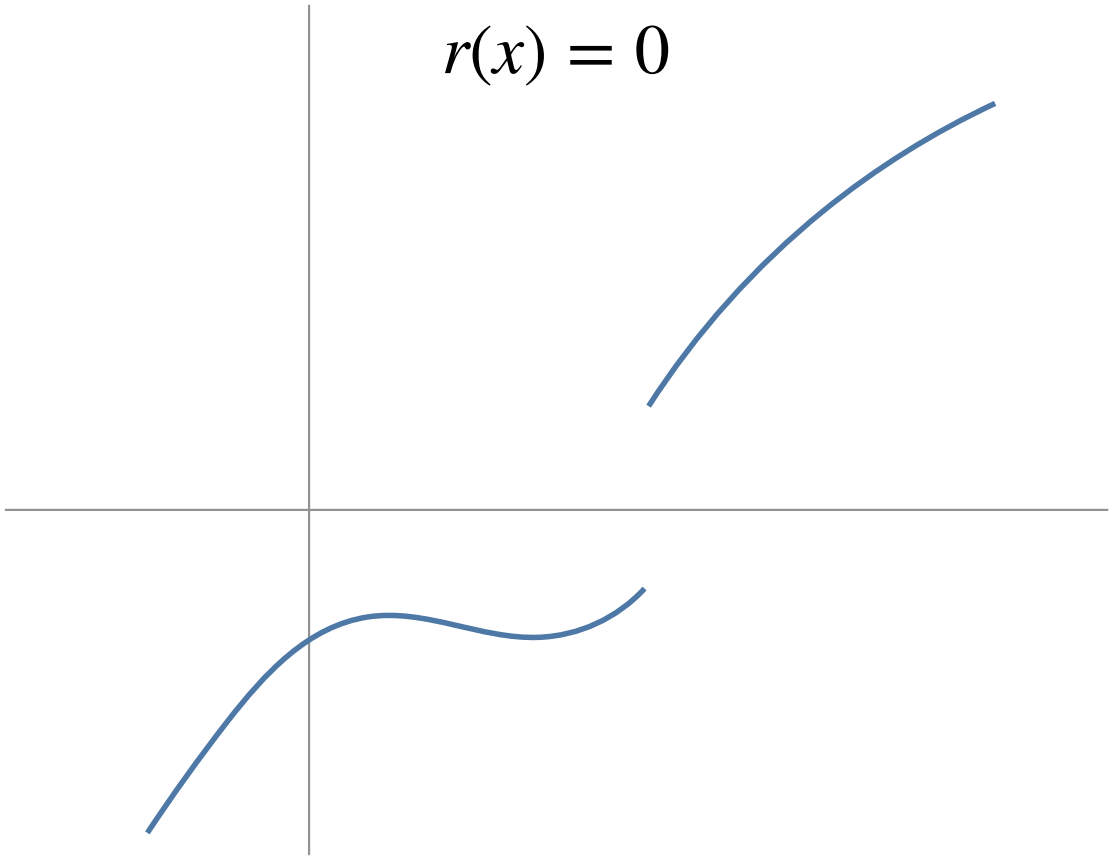
$$\underbrace{\sqrt{\frac{mg}{k}} \tanh\left(\sqrt{\frac{kg}{m}} t\right) - V}_{f(m)} = 0$$



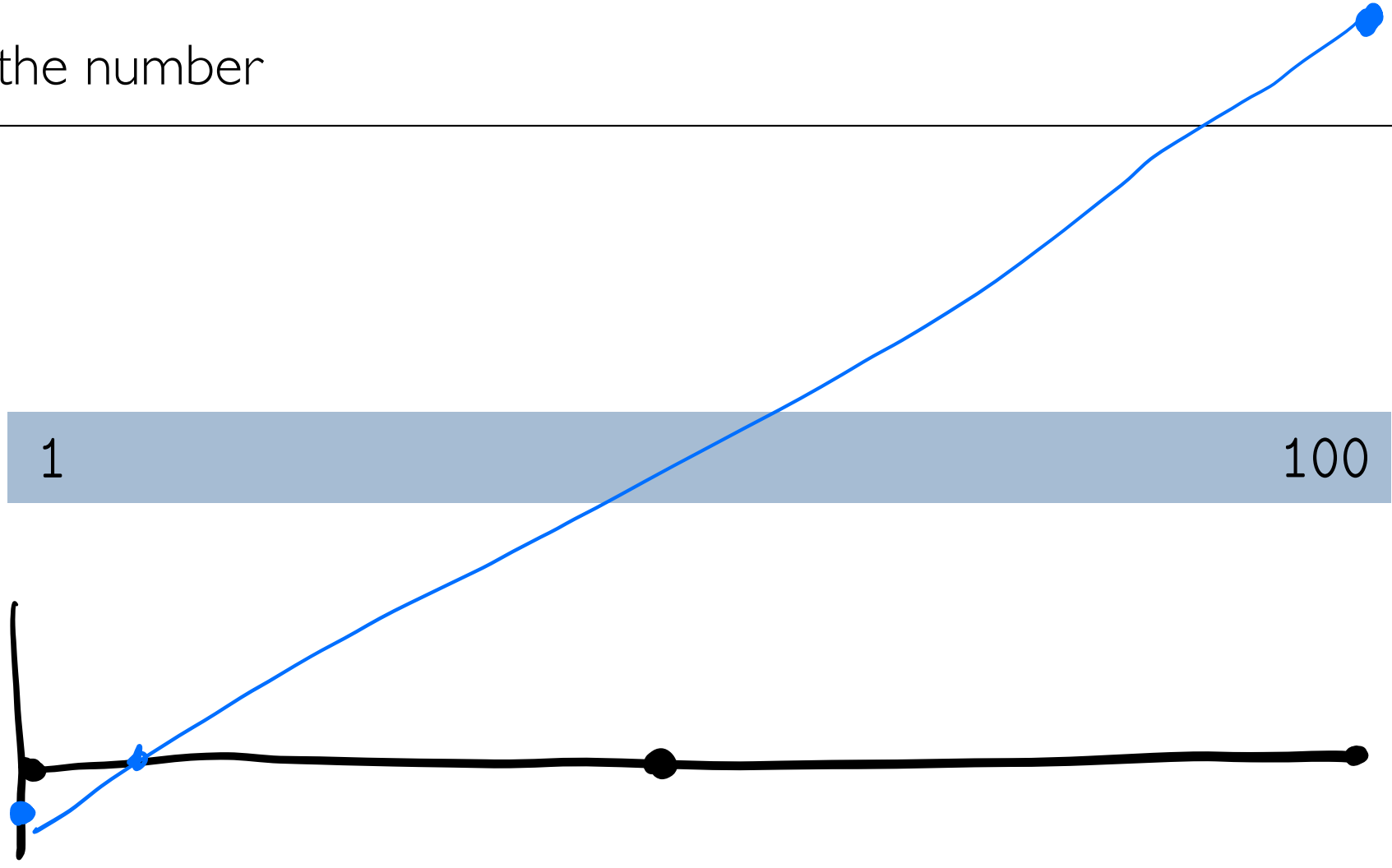
Root Finding



Root Finding

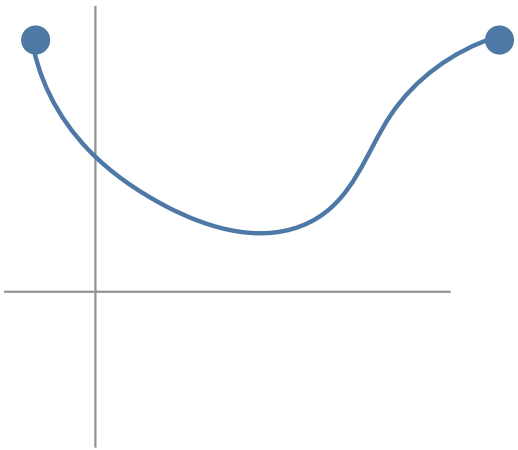


Find the number

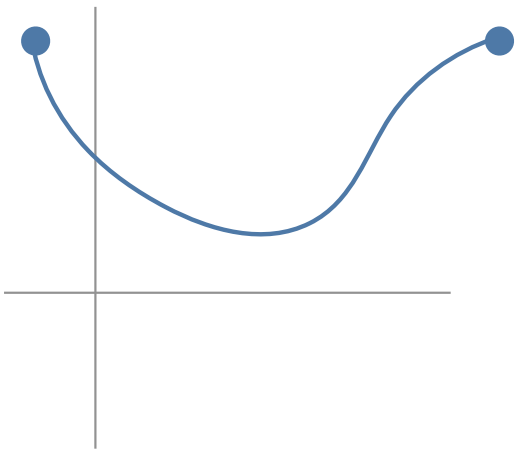


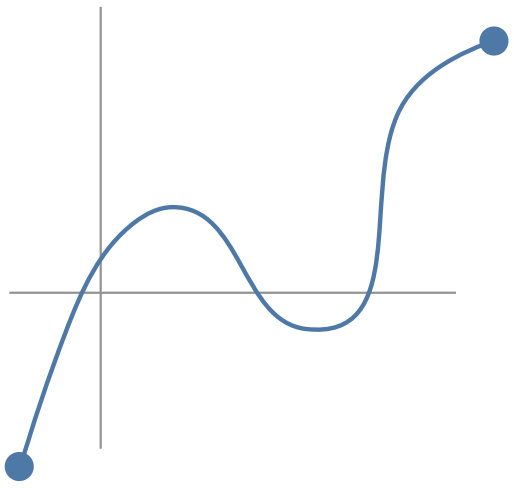
Bracketing methods

Bracket challenges

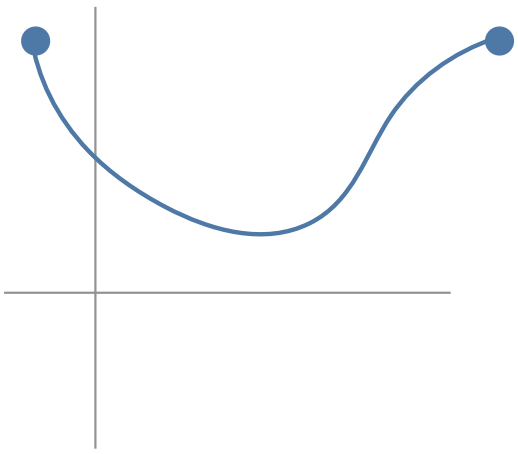


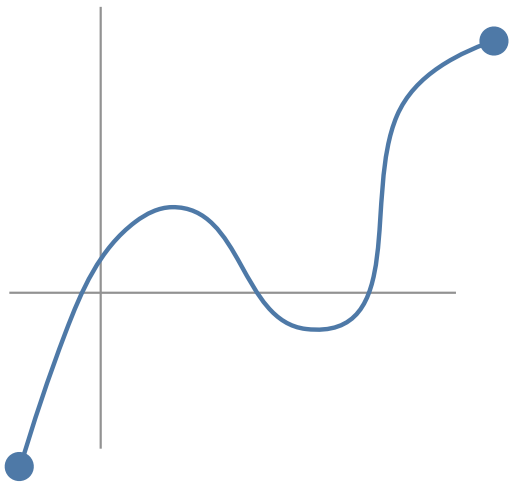
Bracket challenges

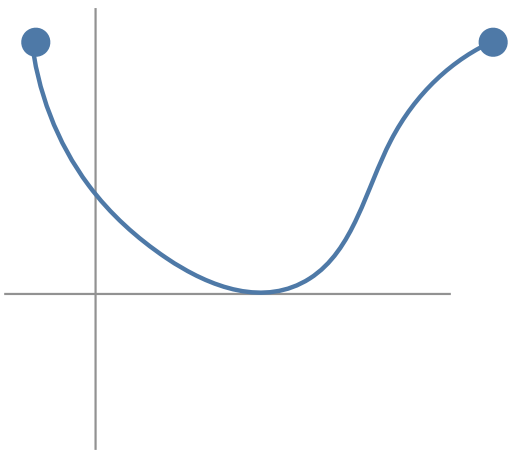




Bracket challenges







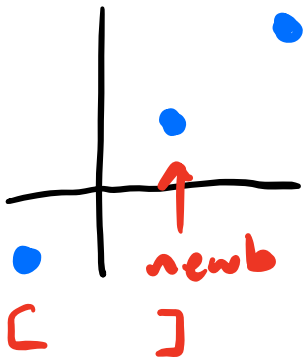
Bisection

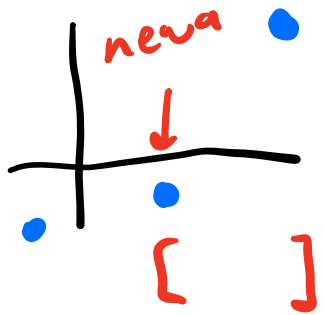
Given bracket : $[a, b]$

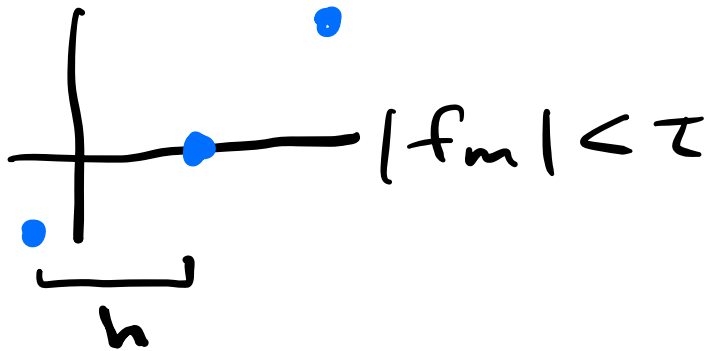
0) if $f(a) \cdot f(b) > 0$ → return.

1) $f\left(\frac{a+b}{2}\right) = f_m$

2)







update $h \leq \tau$ ← user chosen tolerance.

Scipy Demo

```python
from scipy.optimize import root_scalar

def func(x):
    return x**3 - 1

sol = root_scalar(func, bracket=[-3, 8], method="bisect")

print(sol.converged)
print(sol.root)
```