# Playground

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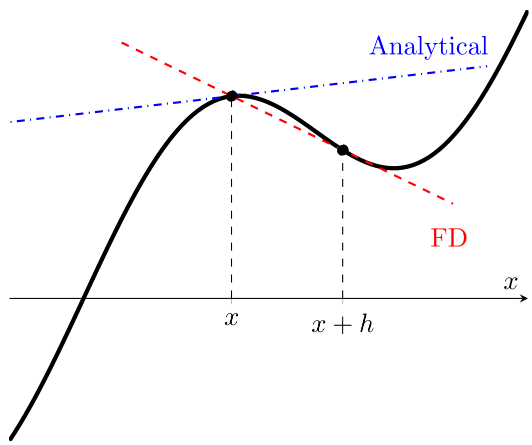


Figure 1: Forward Finite Difference

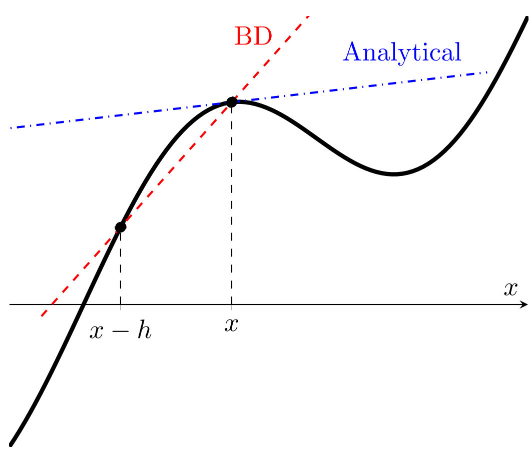


Figure 2: Backward Finite Difference

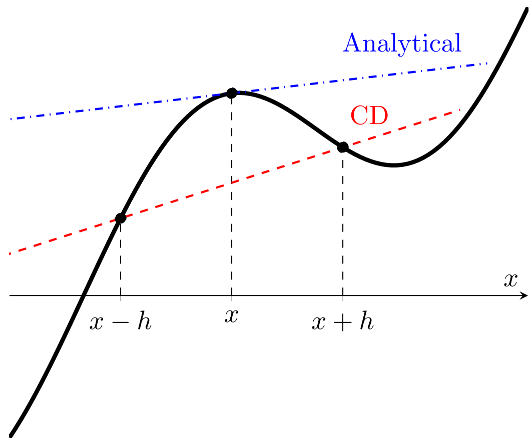


Figure 3: Central Finite Difference

| **Assumptions** | |
|---|---|
| Steady & Fully developed $\Rightarrow 1$ | $\frac{\partial}{\partial t} = 0\ ,\quad \frac{\partial}{\partial x} = 0$ |
| No-Slip Condition $\Rightarrow 2$ | $\mathbf{u}(x,0) = \mathbf{0}\ ,\quad \mathbf{u}(x,d) = \begin{bmatrix} U \\ 0 \end{bmatrix}$ |
| Constant Pressure $\Rightarrow 3$ | $\frac{\partial p}{\partial x} = 0\ ,\quad \frac{\partial p}{\partial y} = 0$ |
| Newtonian Fluid | constant viscosity ($\nu$) |
| Incompressible | constant density ($\rho$) |
| Laminar & Purely axial | $v = 0$ |

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| Constant Pressure $\Rightarrow 3$ | $\frac{\partial p}{\partial x} = -G\ ,\quad \frac{\partial p}{\partial y} = 0$ |
| Newtonian Fluid | constant viscosity ($\nu$) |
| Incompressible | constant density ($\rho$) |
| Laminar & Purely axial | $v = 0$ |

| **Assumptions** | |
|---|---|
| Steady & Fully developed $\Rightarrow 1$ | $\frac{\partial}{\partial t} = 0\ ,\quad \frac{\partial}{\partial x} = 0$ |
| No-Slip Condition $\Rightarrow 2$ | $\mathbf{u}(x,y,z) = \mathbf{0} \quad \Longleftrightarrow \quad \sqrt{y^2+z^2} = R$ |
| Constant Pressure $\Rightarrow 3$ | $\frac{\partial p}{\partial x} = -G\ ,\quad \frac{\partial p}{\partial y} = 0\ ,\quad \frac{\partial p}{\partial z} = 0$ |
| Newtonian Fluid | constant viscosity ($\nu$) |
| Incompressible | constant density ($\rho$) |
| Laminar & Purely axial | $v = 0\ ,\quad w = 0$ |

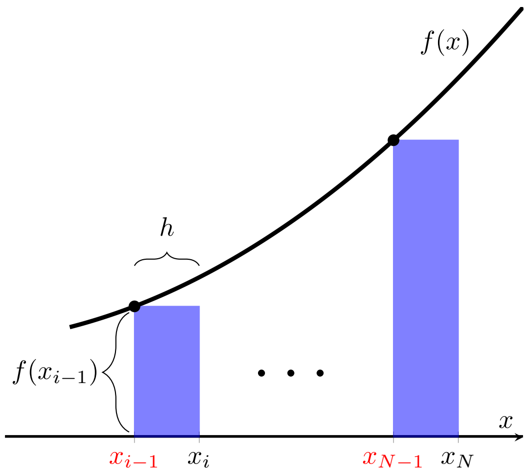


Figure 4: Rectangle Method Left Point Rule

# References

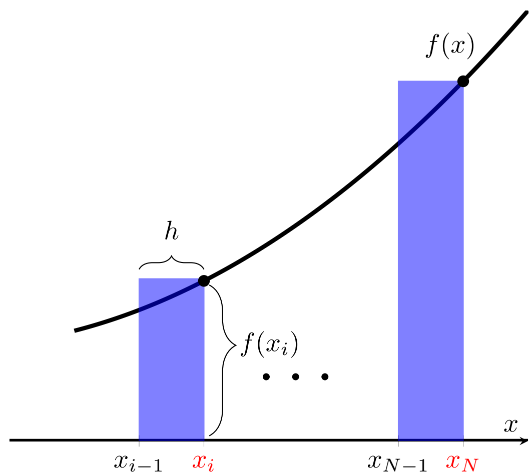


Figure 5: Rectangle Method Right Point Rule

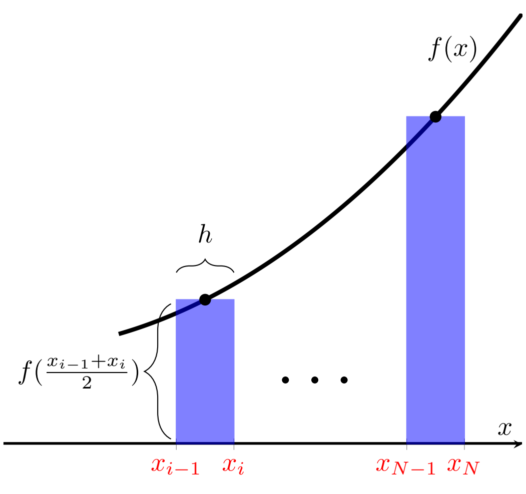


Figure 6: Rectangle Method Midpoint Rule

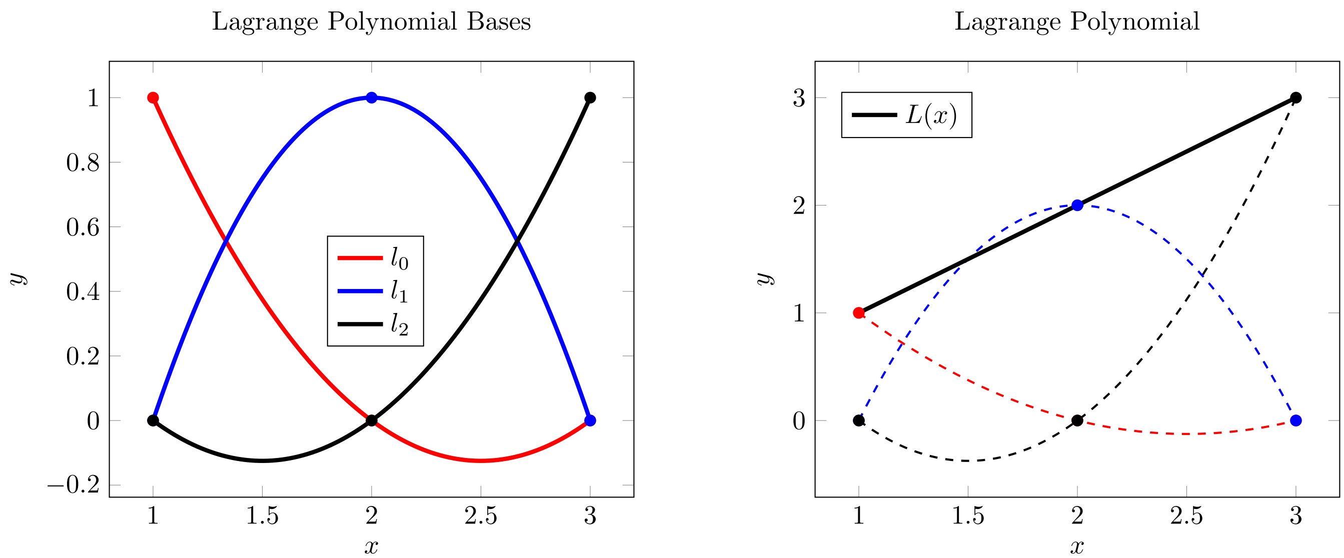


Figure 7: Lagrange Polynomial and its Bases

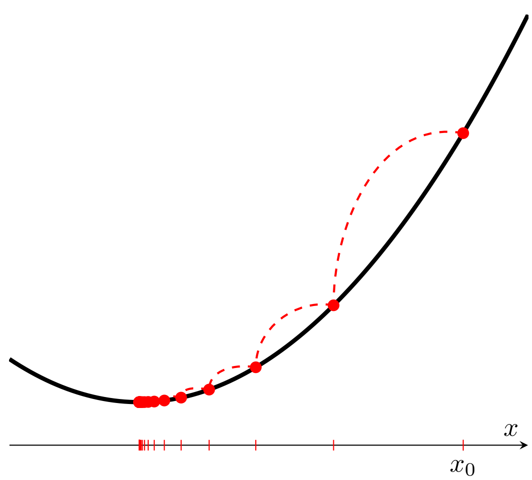


Figure 8: Gradient Decent Steps

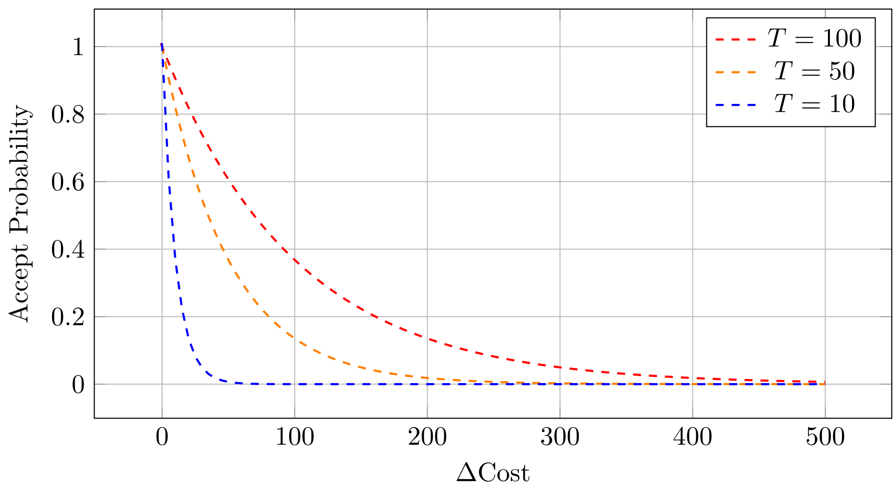


Figure 9: Simulated Annealing Temperature

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**Algorithm 1:** Simulated Annealing Algorithm

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**Data:** $T_i$, $x_i$
**Result:** $x_n \leftarrow$ last solution candidate

$T_0 \leftarrow$ initial temperature of cooling schedule;
$x_0 \leftarrow$ starting solution candidate;

**for** $i \in \{0, \ldots, n\}$ **do**
    $x_{\text{neighbor}} \leftarrow$ randomly sample a neighbor from $x_i$ neighborhood;
    $\Delta\, cost \leftarrow$ compute cost difference between $x_{\text{neighbor}}$ and $x_i$;
    **if** cost($x_{\text{neighbor}}$) is better than cost($x_i$) **then**
        **Accept** $x_{i+1} \leftarrow x_i$;
    **else if** cost($x_{\text{neighbor}}$) is worse than cost($x_i$) **then**
        **if** probability $e^{-\Delta cost\, /\, T_i}$ **then**
            **Accept** $x_{i+1} \leftarrow x_i$;
        **else**
            **Reject** Do nothing;
        **end**
**end**

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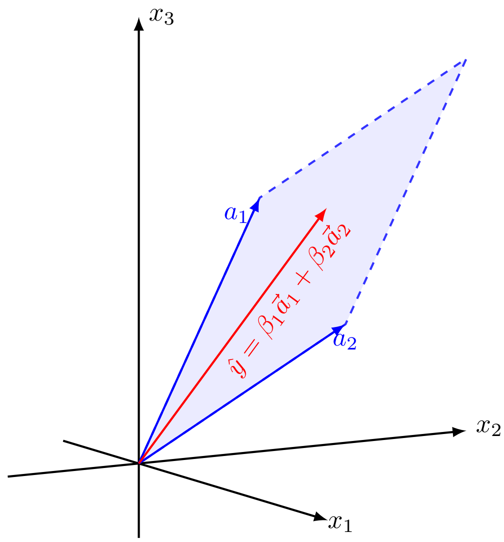

Figure 10: Least Square Problem - Linear combination of column vectors

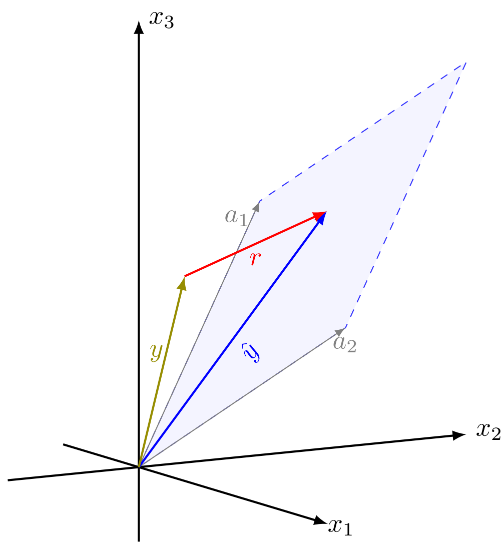

Figure 11: Least Square Problem

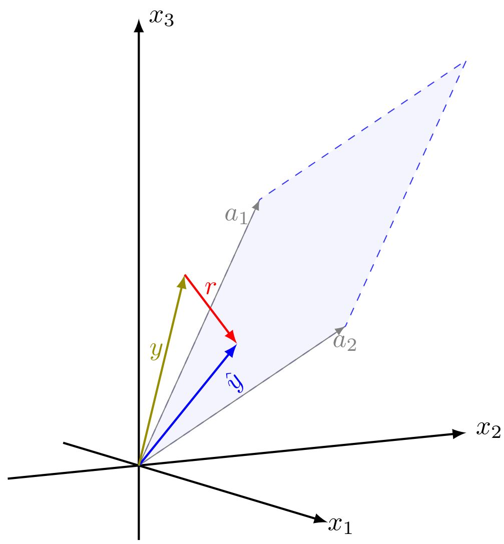


Figure 12: Least Square Problem