RAM Maths Circle

March 16, 2025

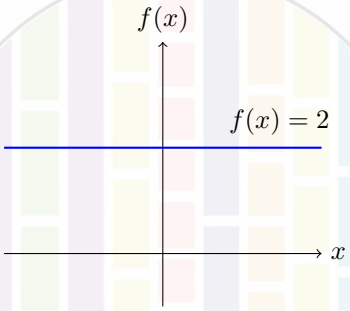
Nagpur

Introduction to Functions

A **function** is a rule that assigns each input exactly one output. Some basic types of functions are:

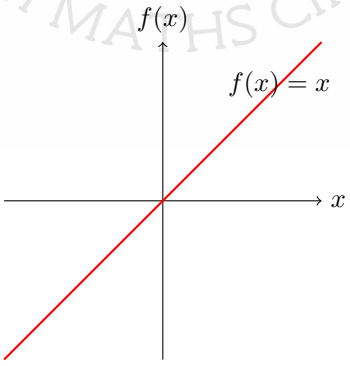
1. Constant Function: $f(x) = c$

This function always gives the same value regardless of x. Example: $f(x) = 2$



2. Identity Function: $f(x) = x$

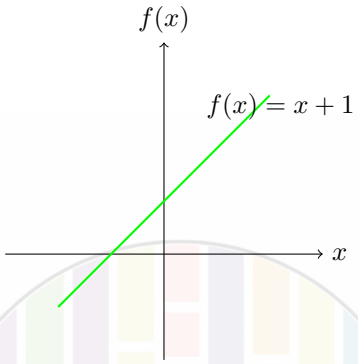
Each input is mapped to itself. Example: $f(x) = x$



3. Linear Functions: $f(x) = mx + b$

These are straight lines.

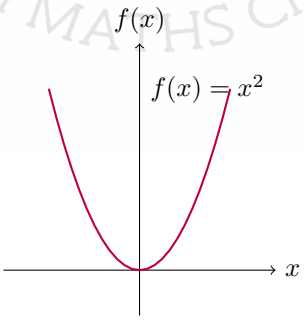
- $f(x) = x + 1$: shifts the line up by 1
- $f(x) = x + 2$: shifts the line up by 2
- $f(x) = x - 1$: shifts the line down by 1
- $f(x) = x - 2$: shifts the line down by 2



4. Quadratic Functions: $f(x) = x^2 + c$

These form U-shaped curves (parabolas).

- $f(x) = x^2$: basic parabola
- $f(x) = x^2 + 1$: shifted up
- $f(x) = x^2 - 1$: shifted down
- $f(x) = x^2 - 2$: shifted more down



Problem 2: How many times can an A4 paper be folded?

It is often said that a piece of paper cannot be folded more than 7 times. This claim holds for standard-sized paper and hand-folding due to physical limitations.

Why is folding hard after a few times?

Every time you fold the paper, its thickness doubles, and the area to work with becomes smaller. Eventually, it becomes too thick and too small to fold again.

Mathematical Model

Let the paper's original thickness be t. After n folds, the thickness becomes:

$$\text{Final thickness} = t \times 2^n$$

This shows exponential growth, making the paper extremely thick after a few folds.

Practical Limit

For an A4 sheet (approx. 0.1 mm thick, 297 mm long), the typical hand-fold limit is:

$$\boxed{\text{6 to 7 times}}$$

Historical Example

In 2002, Britney Gallivan folded a long roll of toilet paper **12 times** and derived a formula to calculate the minimum length L required for n folds This shows that folding limits are not just physical but also mathematical—depending on the length, thickness, and number of folds.

Conclusion

Even simple actions like folding paper hide interesting mathematical patterns involving exponential growth, geometry, and real-world constraints.