TEMP 101: A Template for Everything
My Template

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Problem 1

How is life without LaTeX?

Solution

Life without LaTeX is $\emptyset$

Problem 2

Prove LaTeX is good.

Solution

Proof. Assume LaTeX is not good.
Now life is bad.
Since life should not be bad.
Then LaTeX is good. □

Problem 5

Solve

$$I = \int_0^\infty \frac{x}{(x^2+1)^2}\, dx$$

Solution

When $x = 0$, $\theta = 0$ and
$x \to \infty$, $\theta \to \frac{\pi}{2}$

$$
\begin{aligned}
I &= \int_0^\infty \frac{x}{(x^2+1)^2} dx \\
&= \int_0^{\frac{\pi}{2}} \frac{\tan\theta}{(\tan^2\theta+1)^2} \cdot \sec^2\theta\, d\theta \\
&= \int_0^{\frac{\pi}{2}} \frac{\tan\theta}{\sec^4\theta} \cdot \sec^2\theta\, d\theta \\
&= \int_0^{\frac{\pi}{2}} \tan\theta \cdot \frac{1}{\sec^2\theta}\, d\theta \\
&= \int_0^{\frac{\pi}{2}} \frac{\sin\theta}{\cos\theta} \cdot \cos^2\theta\, d\theta \\
&= \int_0^{\frac{\pi}{2}} \sin\theta \cos\theta\, d\theta \\
&= \frac{1}{2}\int_0^{\frac{\pi}{2}} \sin(2\theta)\, d\theta
\end{aligned}
$$

Which can be solved by:

$$\frac{1}{2} \left[-\frac{1}{2} \cos(2\theta) \right]_0^{\frac{\pi}{2}}$$

$$= \frac{1}{2} \cdot \left(-\frac{1}{2} [\cos \pi - \cos 0] \right)$$

$$= \frac{1}{2} \cdot \left(-\frac{1}{2} [-1 - 1] \right)$$

$$= \frac{1}{2} \cdot 1 = \frac{1}{2}$$

Therefore,

$$\boxed{\int_0^\infty \frac{x}{(x^2 + 1)^2} \, dx = \frac{1}{2}}$$

`REMARK` `Integrals are great!`

Problem 4

Let $T : V \to W$ be a linear transformation, and,

- $Tv_1 = w_1 + 2w_2$

- $Tv_2 = 2w_1 - w_2$

What is $M(T)$?

`NOTE` v `and` w `are basis.`

Solution to Problem 4

The Matrix of T is:

$$T = \begin{bmatrix} 1 & 2 \\ 2 & -1 \end{bmatrix}$$

Problem

Write an algorithm (please)

Solution

Here is a nice algorithm:

Algorithm 1 Example of a placeholder algorithm

1: **function** DOTHIS(a, b)
2:     **if** $start \geq b$ **then**
3:         **return**
4:     **end if**
5:     $a + b = 0$
6: **end function**

`Important thing to notice, this is not a real algorithm.`