Project Documentation

Lecturer: Prof. Dr.-Ing. Alfred Strey

Created by: Niklas Sauer, Malcolm Malam

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Abstract

Implement an assembly program approximating sin(x) through a Taylor series and extending the definition from $-\pi/2 \leq x \leq \pi/2$ to arbitrary positive and negative values. Additionally, provide cosine and tangent solutions. Finally, allow the user to specify an interval $[x_{min}, x_{max}]$ and tabulate the aforementioned function results for n equidistant values.

Program Flow

Upon program execution the user has to specify the following inputs:

- x_{min} = interval start
- x_{max} = interval end
- $n \in \mathbb{N}, n \geq 1$ = number of equidistant values

Outgoing from x_{min} all trigonometric function values are displayed in a table by calculating the result for $x = x_{min} + i \times [x_{max} - x_{min}]$, where i = current iteration step $\leq n$ and $x_{max} - x_{min}$ = partition size.

x	sin(x)	cos(x)	tan(x)
1	0.841470984648068021	0.540302305868030075	1.55740772435940511
4	-0.756802495285939014	-0.653643620861661945	1.15782128231939052
7	0.656986598716676085	0.753902254322743381	0.871447982745283123

Figure 1: *QtSpim Console Output*

Approximation of Sine

Sine can be approximated easily by use of a Taylor series. When examining the formula, it becomes clear, that further summands can be calculated by multiplying the previous summand with a correction term [**Fig. 2**]. This itself is an improvement to calculating a growing factorial denominator multiple times. We therefore must save both the result and most recently calculated term. In the unusual case of only one desired Taylor approximation, we simply return x.

$$\frac{x^2}{(2*i)*(2*i+1)}$$

Figure 2: *Correction Term*

It shall be noted however, that this approximation is only valid for values of $-\pi/2 \leq x \leq \pi/2$. Arbitrary values must be mapped into this interval by first determining whether $x < 0$ (set $x = -x$) and then subtracting π until $x \leq \pi/2$. For every subtraction the separately stored factor $s = 1$ must be inverted, i.e. $s = -s$.

Per definition $cos(x) = sin(\pi/2 - x)$ and $tan(x) = \frac{sin(x)}{cos(x)}$, where $cos(x) \neq 0$ can be derived.