SOEN 6011: SOFTWARE ENGINEERING PROCESSES
(Function F1 : ArcCos(x))

Overview

► Java application to obtain an angle(in degrees & radians) for the inverse of cosine.

► ArcCos $\theta = \dfrac{hypotenuse}{adjacent}$

Domain & Range of ArcCos(x)

► The domain of $y = arccos(x)$ is the range of $f(x) = cos(x)$ for $0 \leq x \leq \pi$ and given by the interval **[-1,1]**. The range of arccos(x) is the domain of f which is given by the interval $[0,\pi]$.

Critical Decisions

To ensure accuracy of output, the following decisions were critical:

► Use of **Taylor series expansion formula** instead of the Chebyshev-Pade quotient approximation:
$arccos(x) = \frac{\pi}{2} - \sum_{n=0}^{\infty} \frac{2n!}{2^{2n}(n!)^2} \frac{x^{2n+1}}{2n+1}$ which converges for $-1 \leq x \leq 1$.

  ● This decision was taken to avoid any static constants and to use a combination of iterative and recursive loops.
  ● Avoid declaration of multiple static constants(Chebyshev-Pade quotient approximation) thereby increasing complexity.
  ● Distribution of various critical functions into separate methods to adhere to Object Oriented Principles of Java.
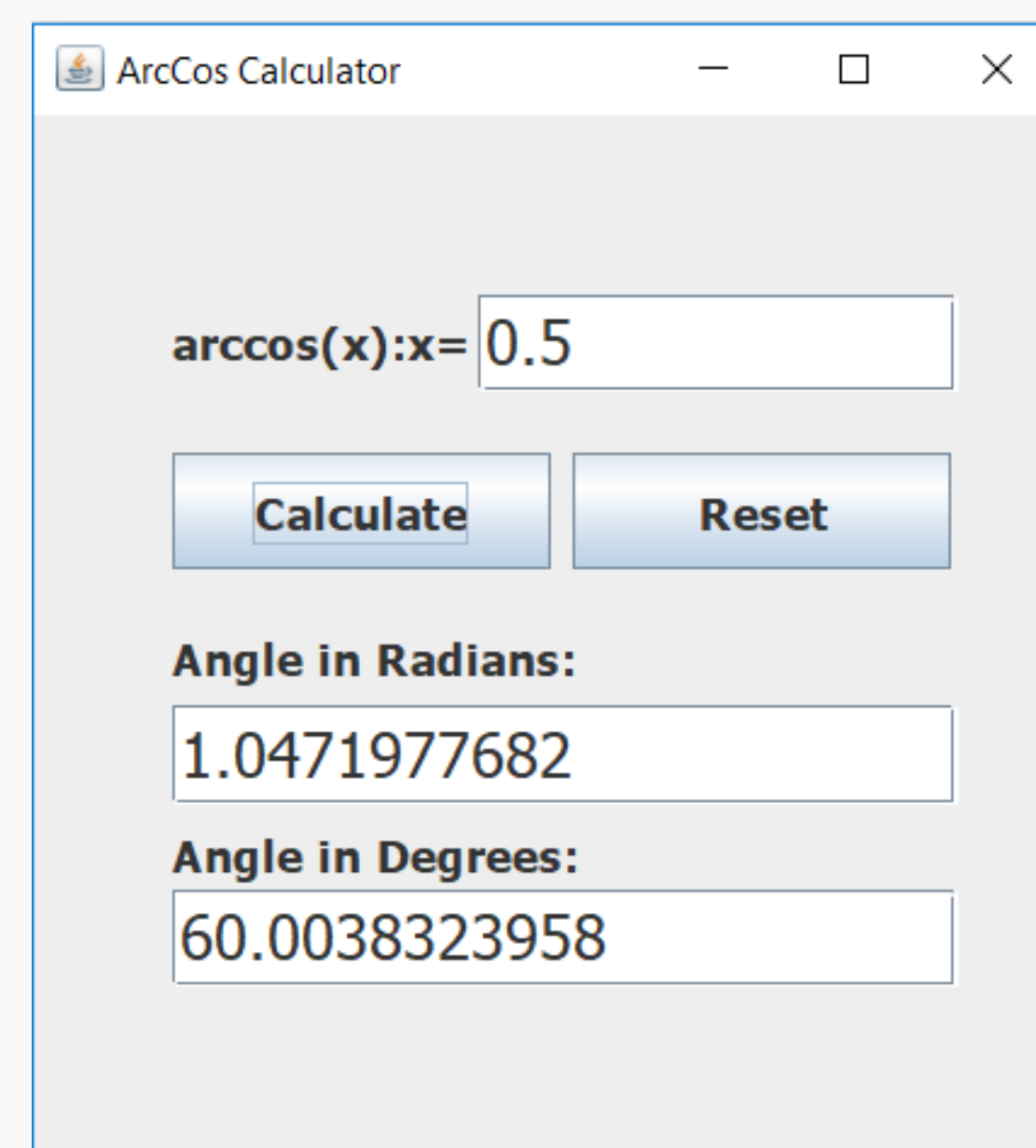
Arccos Table - Some of the commonly known values

x	arccos(x) (Rad)	arccos(x) (°)
-1	3.1413926536	180°
$-\sqrt{3}/2$	2.6178432893	150°
$-\sqrt{2}/2$	2.3560849003	135°
-1/2	2.0942951024	120°
0	1.5706963268	90°
1/2	1.0471977682	60°
$\sqrt{2}/2$	0.7854077535	45°
$\sqrt{3}/2$	0.5236495809	30°
1	0.0	0°

Application User Interface

Application User Interface - Error Handling
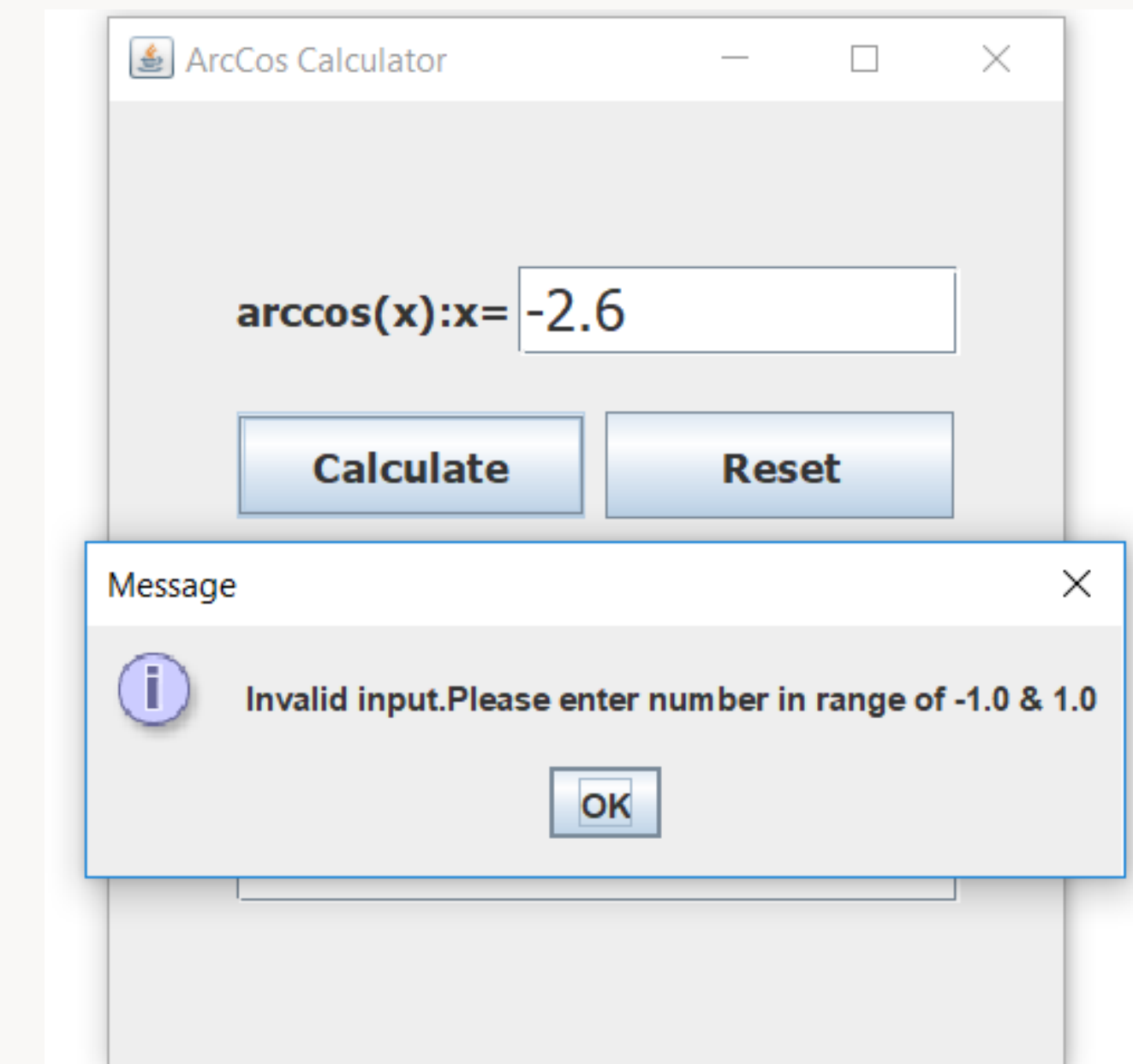
Conclusion

► The Java program/application contains all the key quality attributes such as: *Correctness, Efficiency, Maintainability, Robustness and Usability*.

► Due to the selection of the *Taylor series expansion formula* for implementation of the $arccos(x)$ function, the accuracy of output is better with error coefficient $\approx$ 0.001 to 0.003 off the actual value.

References

► https://www.mathportal.org/formulas/pdf/taylor-series-formulas.pdf
► https://en.wikipedia.org/wiki/Inverse trigonometric functions

Shashank Rao - 40104247
https://github.com/ShashankRao17/SOEN6011-Software-Engineering-Processes
Concordia University - DEPARTMENT OF COMPUTER SCIENCE AND SOFTWARE ENGINEERING

UNIVERSITÉ Concordia UNIVERSITY