INDIVIDUAL PROJECT
FGC: FUNCTION'S GRAPHICAL CALCULATOR

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Business Analysis

Abstract

The aim of this project is to design and implement graphical calculator of one variable functions. It will perform complex mathematical calculations. In the business analysis we will limit ourselves to the modelling of dynamic behavior. We will make use of user stories to present main functionalities and priorities of the project. In the supplementary specification we will describe how the application should work. In the last section we will describe GUI design.

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History of changes			
Version	**Date**	**Who**	**Description**
01	3.03.2014	Karol Muszyński	Main goals of the project
02	6.03.2014	Karol Muszyński	Detailed description of functionalities
03	10.03.2014	Karol Muszyński	Version 02 corrected
04	15.03.2014	Karol Muszyński	Correcting main functionalities
05	16.03.2014	Karol Muszyński	Correcting list of functional requirements
06	17.03.2014	Karol Muszyński	Adding summary management and conclusions

1. Summary for management

In this document we will focus on describing the goals of the project. Program aims at providing a user with especially designed tools to solve complex mathematical equations of one variable functions and to plot graphs of that functions.

We will describe main functionalities and requirements of the application in the supplementary specification. We will also propose a GUI design for the application.

2. User stories

Functionalities
As a user I want to perform algebraic calculations (+, - , *, /, ^, floor, ceiling, truncate, round, min, max) by clicking a proper button so that I can obtain complex desired mathematical result
As a user I want to be able to use relational operators (<, <=, >=, >, ==, !=) by clicking a proper button so that I can compose equations
As a user I want to calculate polynomials, logarithms, trigonometric and hyperbolic functions so that I can obtain complex desired mathematical result
As a user I want to be able to assemble functions by choosing them from a list of provided elements so that I can compose equations
As a user I want to be able to choose constant values (such as Pi) by pressing a proper button so that I can compose equations
As a user I want to define domain and codomain by clicking on them so that I have more control over the calculation procedure (by default it will be automatically computed)
As a user I want to control colors and width of functions by clicking on graphs so that I can have more control over the output
As a user I want to control description of axes by clicking on them so that I can change their name
As a user I want to be able to plot graphs so that I can visualize the result
As a user I want to be able to save output graphs to an image file

3. Supplementary specification

3.1.Requirements

List of functional requirements

Function	Description
Calculating procedures	Provide facilities for calculating functions of one variable
Composing functions	Provide tools for assembling functions
Inputting data	Provide facilities for entering input by the user
Plotting graphs	Provide facilities for plotting the result as 2D graphs
Saving graphs	Provide facilities for saving graphs as image file
Showing message boxes	Provide facilities for informing the user about the procedures with message boxes
Validating input	Provide warnings about input data by the user
Personalizing interface	Provide facilities for changing user interface

3.2.GUI for functions' graphical calculator

It will enable entering input by user from the console which will be situated at the bottom of the screen. The console will be simple and very straightforward to use, however it will preserve all important functionalities. It will consist of a set of buttons and a list of trigonometric and hyperbolic functions to choose from. Buttons will have constant values. Pressing them will print proper value in the screen. If input data is incorrect suitable warning and message box will appear in the screen. In the center of the screen there will be a place to show plotted graphs. User will be enabled to change its color. It will be also possible to save graphs as an image file with a proper png or jpg format. There will be a possibility to personalize user interface by changing its colors, size and some descriptions.

4. Conclusions

The program is designed to be a simple and straightforward to use application. It will provide a user with a set of tools to solve equations of one variable functions. It will also enable a user to plot graphs and to save it to an image file. The application should be easy to learn and use by users.

Technical Analysis

PRODUCTION MODEL

All development will use Waterfall model and MVC which is a sequential design model going through phases of:

- Requirements
- Design
- Implementation
- Verification and Maintenance

TECHNOLOGY PLATFORM

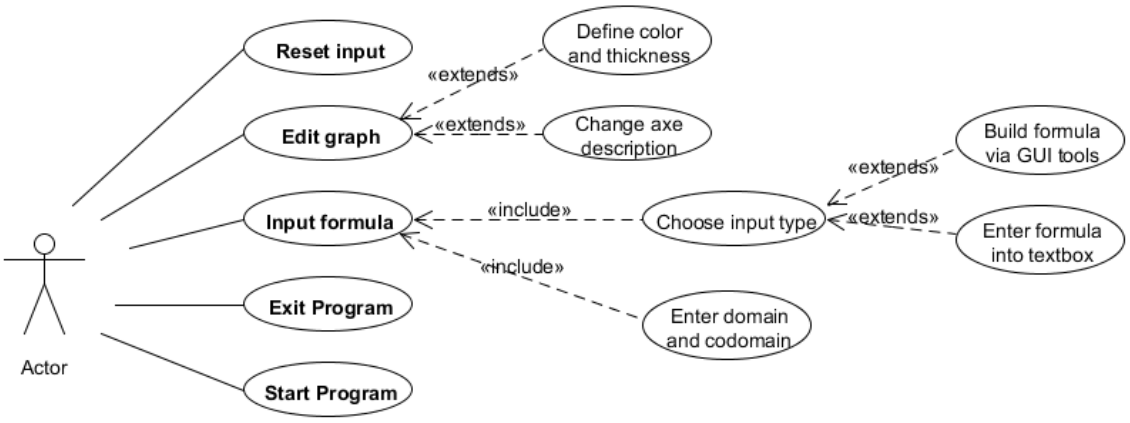
- Application will be written in Java languages.
- IntelliJ IDEA will be used for development process.
- JavaFX Scene Builder and javaFX language will be used in order to provide the final product meeting the requirements for GUI.
- Application will run on any PC with Windows, Linux of Mac OS systems providing that Java SDK is installed.
- External library “exp4j“ will be used.
    - exp4j is capable of evaluating expressions and functions in the real domain. It's a small (40KB) library without any external dependencies that implements Dijkstra's Shunting Yard Algorithm. It comes with a standard set of built-in functions and operators, in addition users are able to create custom operations and functions for use in their mathematical expressions.
    - In computer science, the **shunting-yard algorithm** is a method for parsing mathematical expressions specified in infix notation.
- Development model – Waterfall.
- Waterfall model is a sequential design process in which progress is seen as flowing steadily downwards (like a waterfall) through the phases of Conception, Initiation, Analysis, Design, Construction, Testing, Production/Implementation, and Maintenance.

ALGORITHMS

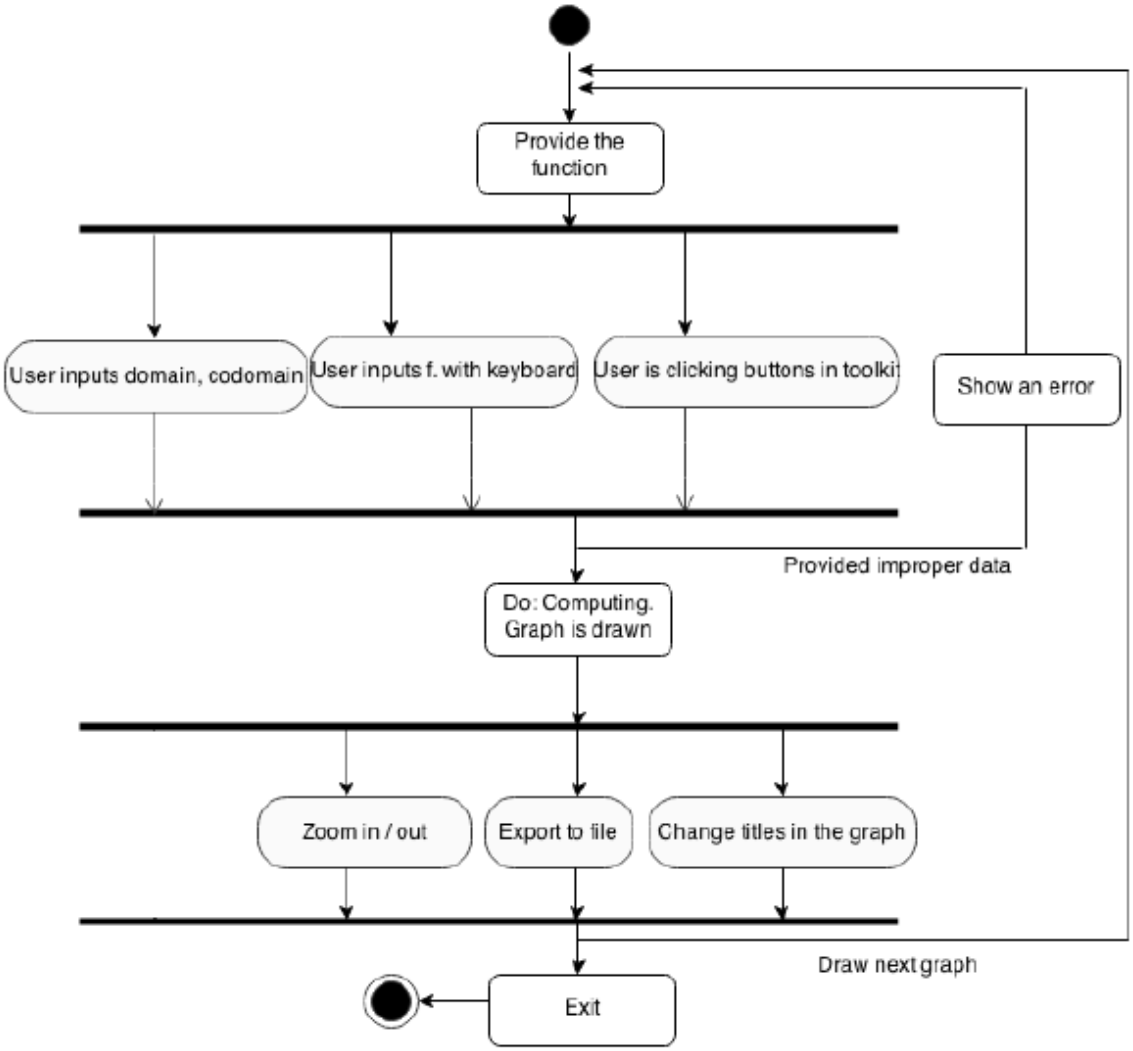
Description of an algorithm for converting text formula to a graph:

- Parse formula specify by the user using external library to the function F.
- Create vector X which will cover all pixels from the domain.
- For each pixel from the vector X compute value for function F and story it in the vector Y.
- Using vectors X and Y, which contains coordinates of every pixels, draw a graph.

USECASE DIAGRAM



STATE DIAGRAM


Provide the function
User inputs domain, codomain
User inputs f. with keyboard
User is clicking buttons in toolkit
Show an error
Provided improper data
Do: Computing. Graph is drawn
Zoom in / out
Export to file
Change titles in the graph
Draw next graph
Exit