



Silesian  
University  
of Technology

## FINAL PROJECT

Desktop application supporting learning of stereometry

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## **Thesis title**

Desktop application supporting learning of stereometry

## **Abstract**

The aim of the work is to design and implement a desktop application that supports children in learning geometry. The user of the application will have several types of tasks to choose from, in which it will be necessary to calculate the areas and volumes of three-dimensional geometric figures. There will also be an educational component where it will be possible to visualize the changes in the areas and volumes of the figures as the parameters describing the figure are altered.

## **Key words**

application, education, geometry, stereometry

## **Tytuł pracy**

Aplikacja na komputer stacjonarny wspomagająca naukę stereometrii

## **Streszczenie**

Celem pracy jest zaprojektowanie i wdrożenie aplikacji desktopowej wspomagającej dzieci w nauce geometrii. Użytkownik aplikacji będzie miał do wyboru kilka typów zadań, w których będzie musiał obliczyć pola i objętości trójwymiarowych figur geometrycznych. Aplikacja będzie również zawierać część edukacyjną, umożliwiającą wizualizację zmian pól i objętości figur wraz ze zmianą parametrów opisujących figurę.

## **Słowa kluczowe**

aplikacja, edukacja, geometria, stereometria



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# **Chapter 1**

## **Introduction**

### **1.1 Introduction into the problem domain**

With the development of technology, education changes from classical approaches to ones using tools and methods previously unavailable. As computers become more accessible and widespread, schools introduce more digital ways of teaching students. One of the goals of educational applications is to aid teachers in conveying knowledge more effectively than using classical methods. A well-designed educational application should be able to provide all the tools necessary to teach students a certain subject. It may also be installed on the student's personal computer, allowing them to study and practice efficiently even outside of school.

The problem domain of the thesis are applications which allow the user to gain and improve their skills in the field of stereometry. Stereometry (or solid geometry) is geometry in three-dimensional space. Stereometry is concerned with the measurement of surface areas and volumes of solid figures, such as polyhedrons, spheres, cylinders and cones.

### **1.2 Objective of the thesis**

The objective of the thesis is to design and implement a desktop application which allows the user to solve solid geometry tasks, consequently expanding their skills and knowledge in this field. After solving a task incorrectly, the user will receive a tip, to help them solve the task successfully. A database containing all mathematical formulas, as well as tips related to the tasks will be accessible. The user will have the possibility to change the task data and see the surface area and volume change dynamically. An important part of the application is its customizability - the user should be able to tweak the settings of the application as well as each task such that they get the best experience tailored to their needs.

### **1.3 Scope of the thesis**

### **1.4 Short description of chapters**

- The second chapter analyses the problem and presents already existing solutions.
- The third chapter states the functional and nonfunctional requirements, describes the use cases and presents the tools used in the project's development.
- The fourth chapter serves as the user manual. It specifies the system requirements and provides instructions on how to run and use the application.
- The fifth chapter is focused on the implementation of the project. It explains the architecture of the application.
- The sixth chapter **TODO**.
- The seventh chapter concludes the thesis. It compares the achieved results to the objectives of the thesis and explores prospects of the project's further development.

### **1.5 Clear description of contribution of the thesis's author**

# Chapter 2

## [Problem analysis]

- problem analysis
- state of the art, problem statement
- literature research (all sources in the thesis have to be referenced [2, 1, 3, 4])
- description of existing solutions (also scientific ones, if the problem is scientifically researched), algorithms, location of the thesis in the scientific domain

Mathematical formulae

$$y = \frac{\partial x}{\partial t} \tag{2.1}$$

and single math symbols  $x$  and  $y$  are typeset in the mathematical mode.

body of the definitions



# **Chapter 3**

## **Requirements and tools**

- functional and nonfunctional requirements
- use cases (UML diagrams)
- description of tools
- methodology of design and implementation



# Chapter 4

## External specification

- hardware and software requirements
- installation procedure
- activation procedure
- types of users
- user manual
- system administration
- security issues
- example of usage
- working scenarios (with screenshots or output files)

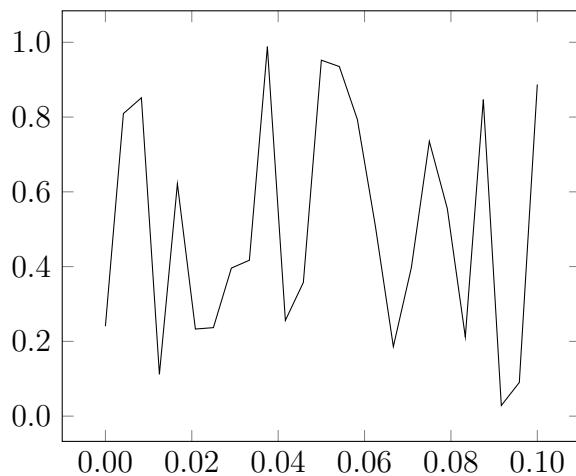


Figure 4.1: Figure caption (below the figure).



# Chapter 5

## Internal specification

- concept of the system
- system architecture
- description of data structures (and data bases)
- components, modules, libraries, resume of important classes (if used)
- resume of important algorithms (if used)
- details of implementation of selected parts
- applied design patterns
- UML diagrams

Use special environments for inline code, eg `int a;` (package `listings`). Longer parts of code put in the figure environment, eg. code in Fig. 5.1. Very long listings—move to an appendix.

---

```
1 class test : public basic
2 {
3     public:
4         test (int a);
5         friend std::ostream operator<<(std::ostream & s,
6                                         const test & t);
7     protected:
8         int _a;
9
10 };
```

---

Figure 5.1: Pseudocode in listings.

# Chapter 6

## Verification and validation

- testing paradigm (eg V model)
- test cases, testing scope (full / partial)
- detected and fixed bugs
- results of experiments (optional)

Table 6.1: A caption of a table is **above** it.

$\zeta$	method							
	alg. 1	alg. 2	alg. 3			alg. 4, $\gamma = 2$		
			$\alpha = 1.5$	$\alpha = 2$	$\alpha = 3$	$\beta = 0.1$	$\beta = -0.1$	
0	8.3250	1.45305	7.5791	14.8517	20.0028	1.16396	1.1365	
5	0.6111	2.27126	6.9952	13.8560	18.6064	1.18659	1.1630	
10	11.6126	2.69218	6.2520	12.5202	16.8278	1.23180	1.2045	
15	0.5665	2.95046	5.7753	11.4588	15.4837	1.25131	1.2614	
20	15.8728	3.07225	5.3071	10.3935	13.8738	1.25307	1.2217	
25	0.9791	3.19034	5.4575	9.9533	13.0721	1.27104	1.2640	
30	2.0228	3.27474	5.7461	9.7164	12.2637	1.33404	1.3209	
35	13.4210	3.36086	6.6735	10.0442	12.0270	1.35385	1.3059	
40	13.2226	3.36420	7.7248	10.4495	12.0379	1.34919	1.2768	
45	12.8445	3.47436	8.5539	10.8552	12.2773	1.42303	1.4362	
50	12.9245	3.58228	9.2702	11.2183	12.3990	1.40922	1.3724	

# **Chapter 7**

## **Conclusions**

- achieved results with regard to objectives of the thesis and requirements
- path of further development (eg functional extension . . . )
- encountered difficulties and problems



# Bibliography

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- [4] Name Surname, Name Surname and N. Surname. *Title of a web page*. 2021. URL: <http://somewhere/on/the/internet.html> (visited on 30/09/2021).



# **Appendices**



# Index of abbreviations and symbols

DNA deoxyribonucleic acid

MVC model–view–controller

$N$  cardinality of data set

$\mu$  membership function of a fuzzy set

$\mathbb{E}$  set of edges of a graph

$\mathcal{L}$  Laplace transformation



# Listings

(Put long listings here.)

---

```
1 if (_nClusters < 1)
2   throw std::string ("unknown number of clusters");
3 if (_nIterations < 1 and _epsilon < 0)
4   throw std::string ("You should set a maximal number of
      iteration or minimal difference --- epsilon .");
5 if (_nIterations > 0 and _epsilon > 0)
6   throw std::string ("Both number of iterations and minimal
      epsilon set --- you should set either number of iterations
      or minimal epsilon .");
```

---



# **List of additional files in electronic submission (if applicable)**

Additional files uploaded to the system include:

- source code of the application,
- test data,
- a video file showing how software or hardware developed for thesis is used,
- etc.



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