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**FACULTY  
OF INFORMATION  
TECHNOLOGY  
CTU IN PRAGUE**

Bachelor's thesis

# **Finite Automata iPad Editor**

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November 4, 2020



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## Acknowledgements

THANKS (remove entirely in case you do not wish to thank anyone)



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In Prague on November 4, 2020

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## Abstrakt

V několika větách shrňte obsah a přínos této práce v českém jazyce.

**Klíčová slova** Replace with comma-separated list of keywords in Czech.

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## Abstract

Summarize the contents and contribution of your work in a few sentences in English language.

**Keywords** Replace with comma-separated list of keywords in English.



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# Introduction

## 1.1 Motivation, Focus of Thesis

Finite automata have been first described by Warren McCulloch and Walter Pitts in 1943 and since then they have become one of the cornerstones of computer science. While finite automata research is limited nowadays, it is still something that we build upon today and every student of computer science needs to understand its concepts.

And although there is a lot of resources one can learn from, there is a lack of those that utilize modern tools. One of such modern tools is iPad (and touch devices in general). I'd like to fill in this gap and build a finite automata editor native application for iPad in this thesis.

Furthermore, I'd like to expand on the recent work done at FIT CTU concerning development of algorithms library and, more importantly for this thesis, finite automata algorithms including simulating input. This library is named Algorithms Library Toolkit and it has been open sourced.

Last but not least, in this thesis I will try out the new iOS programming declarative paradigm which has been introduced by Apple with the new SwiftUI framework with the combination of a functional architecture, called Composable Architecture.

The main motivation of this thesis is to improve how students learn finite automata and more specifically, enhance the current course BI-AAG that is taught at FIT CTU. It's also an opportunity to try out algorithms library in practice and create a concrete example of how it can be leveraged.

## 1.2 Thesis Goals

Goals of this thesis are the following:

- prepare and explore how to create interface for automata library

- find possible solutions of how to detect automata elements from shapes made by hand on the touch screen
- implement a prototype of an automata editor for iPad
- assess the usability of SwiftUI and Composable Architecture
- perform user testing of the implemented automata editor prototype

### 1.3 Thesis Structure

Let me now introduce you to the structure of the rest of the thesis:

- In **Chapter 2** I will go over the theoretical concepts to properly explain terms and concepts on which it will be built upon later.
- **Chapter 3** is concerned with analysis of already existing solutions of creating automata editor.
- **Chapter 4** is about the design of the editor itself.
- In **Chapter 5** I will write about the implementation.
- **Chapter 6** will go into the specifics of user testing and its outcomes.
- In **Chapter 7** I will assess the usability of the new SwiftUI framework alongside with a functional Composable Architecture.
- **Conclusion** is the last chapter of this thesis.

### 1.4 Literary Research

**This will not be part of the final version of the thesis**

In the literary research I will need to study the current literature for the theoretical background of finite automata. In chapter 2 I will use the literature to explain the concepts and terms that are necessary to understand the rest of the thesis.

For chapter 3 I will need to go through current implementations of automata editors, assessing what value they provide and making sure my thesis is, indeed, creating something new. This can also prove to be helpful during the implementation as I can be inspired by projects that have already been made.

chapter 4 is concerned with design of the editor - the literature will be focused on the UX and UI of interactive editors, not limited to finite automata. Besides that, I will also study available methods for discerning automata shapes drawn by hand and going through already available technology



on this topic. Last but not least, I will go over the architectural design in the form of Composable Architecture - this will encompass studying other functional and non-functional architectures. This part of research will also include research on SwiftUI and how it compares with UIKit (UI framework predecessor) and other declarative libraries such as React for web.



## CHAPTER 2

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# Theory



CHAPTER **3**

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**Analysis**



# **Automata Editor Design**





# Implementation



## User testing



# **SwiftUI and Composable Architecture Assessment**



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# Conclusion

## 8.1 Goals Assessment

One of the goals of this thesis was to assess the usability of new iOS programming paradigm of SwiftUI with the new functional architecture pattern Composable Architecture. This combination has proven to be beneficial and it is a good option for new iOS applications.

The main goal of this project was to create a prototype of automata editor for iPad while showcasing the Algorithms Library Toolkit that is being continuously developed at FIT CTU.

I have successfully implemented editing and simulating input for finite automata and Algorithms Library Toolkit to the editor if someone wants to see its capabilities.

One of the other requirements of the automata editor has been to discern automata elements from shapes drawn by hand on the device. The solution chosen during the analysis made this possible as has been described in more detail in chapter 5.

## 8.2 Thesis Contribution

The contribution of this thesis is testing Algorithms Library Toolkit in practice and can now be pointed to for users who want to see its capabilities. The editor can now also be recommended in the course of BI-AAG at FIT CTU (and other universities) - for students and teachers alike.

## 8.3 Future Work

Algorithms Library Toolkit is an extensive library and there are still capabilities that are not implemented in the editor.

## 8. CONCLUSION

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The choice of developing a native iOS application has resulted in good UX, but in the future it would be beneficial to broaden the possible audience and either develop a similar Android app or create a ubiquitous web interface.



## Acronyms

**GUI** Graphical user interface

**UX** User experience



## Contents of enclosed CD

	readme.txt .....	the file with CD contents description
	src .....	the directory of source codes
	editor .....	implementation sources
	thesis .....	the directory of L <sup>A</sup> T <sub>E</sub> X source codes of the thesis
	text .....	the thesis text directory
	thesis.pdf .....	the thesis text in PDF format
	usertesting.pdf .....	the directory of source codes
	editor .....	directory of screenshots from the editor