Radomir S. Stanković and Jaakko Astola

From Boolean Logic to Switching Circuits and Automata

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Towards Modern Information Technology

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Preface

This book contains travelers logs and records of milestones on the road we have traveled to understand the development of *Switching Theory*.

Besides being a reminder of an exciting journey, we believe it can be useful for other travelers to the same spiritual territory or perhaps some other destinations by making different choices at various cross-roads. If so, we would be glad, and will have an excuse to presenting it to public notice.

<div align="right">

Voyagers,

Radomir Stanković, Jaakko Astola

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Niš, Serbia, Tampere, Finland,

How to Use This Book

Dear Traveler Companion,

This journey to the *History of Switching Theory* has few sections. A traveler may choose one of them and go along by exploring presented details and contemplating them. Then, he may decide to take another part and continue. Please, pay attention to selected pages and read text on them as one reads inscriptions on famous monuments. These pages are really milestones and monuments in the imaginary Word that we are traveling through. Look into distribution of other details and their placement, some discrete colours and lines, as on traffic lights and road signals. Then, when the journey is completed, you may want to read the Postscript to compare you impressions and conclusions with those we got along the same trip.

Someone who carefully plans ones journeys may want to first read the Postscript as a guide book, carefully select places to visit, and then invest time and efforts in exploring them.

Whatever is the way you would chose, we wish you a nice trip.

Срећан пут
Hyvä matka

Intentions

Studying the historical development of theoretical foundations and tracing the train of thought that led to their formulations and to related practical discoveries are very suitable ways of learning and getting insight into how to determine the roads for future research and investigations in similar areas.

This booklet presents some historical remarks about the development of the switching theory and recalls and highlights some not widely known details about the contributions to this area of scholars from different parts of the world. In particular, we discuss the origins of the application of Boolean algebra in circuit design and related topics.

This booklet contains many reprints of pages selected from important publications by several authors. We did not want to rephrase or rewrite their original statements, since we believe that the way they were presented originally by authors, has a particular value for the reader. The manner of writing and the way of presenting some important concepts often reflects not just the fashion of the times, but also the authors attitude to the subject being discussed and to the other circumstances at the time when the notions were introduced and theories formulated.

Therefore, we did not dare disturb and destroy the initial composition of the contents and their formulation, as done by the authors, by rewording the statements in present terminology. Thus, we restricted the contribution on our part to the selection of what we consider most interesting to present to the readers notice. We kindly ask for these reprints not to be considered simply as graphic illustrations from previous publications, but to be read as a part of the presentations.

We have also kept the hand written remarks which we wrote for ourselves when recording a particular page for selection, since they explain in brief the motivation for each page selection.

About the Way of Writing

Advanced technologies for transmitting and storing information drastically change also the way of presenting it to potential users. Especially the Internet, as a relatively new medium for presenting and reaching information has a very strong impact to the way of anticipating facts and getting knowledge, as well as the manner of learning in general.

Very often, combinations of pictures, diagrams and drawings with text, expressed in short segments that the screen space allows, make this way of transferring knowledge much more appealing for customers, formerly readers, than whatever smart and deep considerations when presented in the form of a condense typed text in classical book formats.

Dynamic way of leaving and professional work usually shortly narrow towards specialized areas, often do not allow time for learning aside topics although as individuals we may be highly interesting in that.

In such circumstances, due to the lack of time for a longer continuous study of a particular subject, many readers prefer to get some facts in an obvious as possible manner, simply to anticipate, quick to learn, and easy to remember. This way of instant learning is quite accepted, and allows an individual to increase knowledge although the information is presented fragmentary, but allows him to fill the gaps by himself, learning piecewise, whenever possible. Sometimes, we find the linking information unexpectedly when looking for various, quite unrelated information by using advanced technology, just due to the imperfection of it. It means, interesting links and web pages can appear due to imperfection of tagging and similar reasons although we were not looking for them at the particular moment. Then, the way of thinking may go in different directions than previously planned resulting in widening the horizons.

Short web articles written and posted by many enthusiastic individuals, as well as various free encyclopedia, get their popularity, among other reasons, due to fitting well into this trend of learning and self-education noticeable nowadays.

As eager users of new technologies, but still funs of classical books, and all their strong features, we believe a compromise can be made by slightly changing the way of writing books to make them more appealing for potential readers, when the subjects considered allows to do that.

We believe that, when possible, books should be short. It is advisable that the presentation is split into reasonably small but self-contained bibliographic items that might be later assembled into larger and more complete volumes.

This may bring a potential reader easier to the conclusion as, Well I may find time to go it through, instead just putting the book aside after some possibly highly interesting look over it, waiting for some more free time, that hardly ever comes.

Furthermore, the presentation should be more likely as that the users of other media are customized. This is especially important for the youngster generation of potential readers, that first start with electronic media and spend much more time in joining with them than that devoted to classical books.

The presentation should be open in the sense that the reader should feel welcomed to participate into further development of the book by introducing by himself missing parts between carefully selected basic elements as fundamental building blocks of the presented knowledge. It is assumed that some necessary remarks and guide lines, that we call mile stones in the Preface, are provided for a proper navigation of the reader. These remarks should be short and highly informative, and in this respect can be compared to the traffic signs along a road.

However, selected references for further reading should be provided as a guidance to those that may want to explore the subject further and invest more time in study of it.

The selection of facts to be presented, and the way of linking them or putting together each other, should provide a vehicle to escape of being superficial in a study and to avoid presenting just a grasp of facts collected without deep thinking of relationships among them.

This booklet is an attempt in this direction and we are aware that it can be criticized in many aspects as well as the general idea behind witting, better to say drawing, or simply preparing it. Any criticism towards improving it, as well as concrete suggestions how to do that, are very welcome.

Differences in the Way of Writing

We will use the page 4 of the present book as an example illustrating what the authors of this book mean under the new way of writing, which also necessarily implies the new way of reading books, and that are both motivated by the advent of new electronic media.

Classical Way of Writing

In the classical way of writing the contents of the page can be presented as follows.

Although methods of logic and were obviously present in many cultures, which all used some intricate systems of reasoning, it is commonly accepted that explicit analysis of the principles of reasoning were developed independently in China, India, and Greece. The later being the most influential to the systems of logic in the West. In particular, the Aristotelian logic was widely accepted in the western science and mathematics. Many scholars contributed to the development, which has been continued by Islamic and medieval European scholars. The mid-fourteenth century is considered to be the period of the most respectable achievements. The period that followed including the first three or four decades of nineteenth century is viewed as a barren or even period of declination and degradation of logic.

There has been apparent a revival of study in Logic in Great Britanin at the beginning of 19th century. The most recognized scholars at that period of the time in this area were Richard Whately, John F.W. Herschel, William Whewell, and John Stuart Mill. They published considerable contributions in 1826, 1830, 1837 and 1840, and 1843, respectively. Their work leaded to the establishment of the scientific area that is nowadays called the *intuitive logic*. This revival of the interest in study of logic set a good background and provided a suitable milieu for the later work by Augustus De Morgan and George J. Boole, whose independent publications in 1847 set foundations of the scientific area called the *symbolic logic*.

Suggested Way of Writing

We first put the title and it clearly suggests that there has been a revival in study in logic in Great Britain to focus the attention of the reader to this fact.

Then, we put the block briefly describing the situation in logic before that, since it is supposed that this is already known by the reader.

Then, we write names four important scholars and posted them at the page together within a small spatial distance, and we add years to each of them.

The goal is twofold. Writing the names together immediately suggests that their work is related. These years associated indicate the period of the revival of the interest, and the reader is able to make a right conclusion about that. At the same time, the reader will wonder what these years more concretely mean, why exactly these years are pointed out, and will continue searching an answer to that. This motivates him for further reading.

Then, we put a vertical line to connect the names, and added the words intuitive logic. It is supposed that the reader will easily conclude that this is

the result of the work of the scholars connected by the line and it is called the intuitive logic.

The names of two other scholars are grouped separately and separated form the previous group by a white space. This indicates that they do not belong to the same group, but since the their names are rather closely located at the same page, the conclusion should be that there are some links between. Since, the same year is repeated twice, the conclusion is that the work by these scholars has been given independently, otherwise the grouping of names will be different, in the same row, and the year will not be repeated. The explanations of these guessing are given at pages that follow. This should be more intriguing for further reading than simple writing down all of that.

Another example of the manner of writing adopted for this book is the following. We selected a page in a very important publication by George J. Boole, where he for the first time had used the equation $x \cdot x = x$, that is a basic building block in the beautiful construction of Boolean logic. We reprinted this page (at the page 62) and put a remark for the reader explaining why this particular page is selected. This remark has the role of a traffic sign pointing to an important turnover on the road towards the mathematical logic. We kindly suppose that the reader will stop and read the entire text on the selected page and get both the information on the subject as well as some insight into the way of presenting scientific work at the time, which has it own value.

We do the similar with pages where references to the previous and related work were given by the respective authors. Pointing these references, we offer to the reader a necessary information about the links to the background work as viewed by the authors of the corresponding publications, as well as how they estimated relationships of their own work to that of predecessors or contemporarily active scholars.

This manner of presenting important publications in the area will be used in this book whenever appropriate.

Why a New Way of Writing

There can be expressed several rationales why the new way of writing, if it is the new at all or just a bit different, might be worth of suggesting. Few of them we may want to point are the following.

1. *To give the reader a more active role.*

Instead of being a passive subject of tutoring, exposed to all the conclusions explicitly presented in the way as the author formulated them, the reader is put into position to draw conclusion by himself.

2. *The learning procedure should be faster.*

In classical writing, the reader first read and then contemplate. In this approach, he is in a way forced (in a kind and respectful manner) to contemplate while reading.

3. *With graphical means, as lines, colours, spatial distribution of fact, we may help readers to easier memorize the subject.*

For instance, when we have four names of scholars, and to a name we associate the graphic of original signature, it will be easier to memorize, that there were two scholars, a scholar with round letters and another with sharp letters in their signatures. This is the example we used with the names of John Stuart Mill and Willian Herschel at the corresponding pages. If these two are memorized in this way, it is supposed that it would be easier to memorize the other two.

4. *The readers will be easily differentiated to those that just want to memorize the matter without investing much time, and others that have an intention to learn deeper while reading, and each of these categories will have equal chances to meet its interests by selecting the way of reading as we expressed in the section How to use this book.*

The active participation in anticipation of implicit presented information, which is required by readers, will support this differentiation and force a deeper understanding, thus faster and deeper learning.