# The Cantor Set and Mathematica

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|---|---|
| CantorSet.ma | package definitions |
| Cantor0.ma | an historical preface |
| Cantor1.ma | several approaches to the Cantor set and generalizations |
| Cantor2.ma | the Cantor function and generalizations |
| Cantor3.ma | Lebesgue measure, dimension |

a:AUTHORS

Steven R. Dunbar
Department of Mathematics and Statistics
University of Nebraska-Lincoln
Lincoln, NE 68588-0323

(402)-472-7236
srd@mathcml.unl.edu (non-NeXT mail)
sdunbar@mathlab01.unl.edu (NeXT mail)

David Fowler
Department of Curriculum and Instruction
University of Nebraska-Lincoln
Lincoln, NE 68588-

(402)-472-3347
dfowler@cantor.unl.edu (NeXT mail)

b:CATEGORY for NeXT PUBLIC DOMAIN CD-ROM FOR EDUCATION:

Mathematics (NeXT Mathematica Notebooks)

c:WHAT THE APPLICATION DOES:

This series of Mathematica Notebooks provides a visual and analytic introduction to the Cantor set, the Cantor function and some generalizations. The Cantor set is a standard example in advanced undergraduate and graduate level courses in mathematical analysis and topology. The Cantor set is particularly well-suited for visualizing and experimenting with such mathematical topics as limits, alternate number bases and series, iterated-function-systems, symmetry relations, derivatives, Riemann-Stieltjes integrals, Lebesgue measure, fractal dimension, Hausdorff dimension, similarity dimension, complex numbers, connectedness, and topological groups.

The method of the Notebooks is a modified version of the famous Moore method of teaching advanced mathematics. That is, we present the basic definitions and theorems and then present some examples. The examples are usually visual and invite experimentation and alteration. The intent is to provide new

ways of thinking about concepts which are usually presented abstractly. Then we present some exercises, divided into three categories: Basic Exercises, Try for Yourself, and Have Fun With Mathematica. The Basic Exercises are just that, straight-forward applications of the definitions and concepts. The Try for Yourself exercises are more difficult and challenging. The Have Fun with Mathematica exercises are intended to extend the Notebooks by providing further visualization of the concepts.

d:HOW THE APPLICATION IS USED AT UN-L

At UN-L the series of Notebooks is used as a directed reading course for advanced undergraduates and beginning graduate students in mathematics. The students have either completed or are taking concurrently a standard course in analysis or topology, based on for example W. Rudin's Principles of Mathematical Analysis. The Notebooks are intended as a supplement to the course, providing visualization and alternate viewpoints of concepts introduced in the standard course. A grade for the reading course is mastery based, that is, a student contracts for a grade based on the number and difficulty of Basic Exercises, Try for Yourself, and Have Fun with Mathematica problems to be completed. The

problems are to be written up in the rigorous style of a typical course in analysis and graded. Incorrect or incomplete proofs are returned and rewritten until correct. The intent of the Notebooks is to stimulate thinking about the concepts which will lead to being able to write correct proofs.

The Notebooks can also be used for self-study.

e:SOFTWARE VERSIONS:

The Notebooks were developed under NeXT Release 2.1, Mathematica Kernel Version 2.0 and NeXT Front End Version 2.0

f:INSTALLATION INSTRUCTIONS:

The Notebooks all use the Mathematica package CantorSet.ma for basic definitions and functions. This package must be loaded into the notebooks with the Mathematica Get[ ] command.

Depending on the local defaults for package locations, it may be necessary to first set the directory containing CantorSet.ma with the Mathematica command SetDirectory.ma

g:OTHER COMMENTS

This series of Notebooks is still under construction and modification. Some inconsistencies in notation, function definitions, and some evidence of the construction may still be apparent. Indeed, some of the Mathematica code may have bugs in it, or even may not work! Please accept these Notebooks as a preliminary and incomplete at this stage. Beginning about August 24, 1992 this series of Notebooks will undergo initial use by a group of mathematics graduate students. We expect to learn from their experience and considerably improve the format and content of the Notebooks. In addition, at least two more Notebooks are under construction at this time: Cantor4.ma,Complex Cantor Sets; and Cantor5.ma: The Cantor Set as Topological Group.

Report any bugs, inconsistencies, errors, comments, suggestions, and ideas to the authors

above.

A detailed explanation of our motivation and philosophy for this series of Notebooks is explained in "Cinematic Thinking and Mathematica Notebooks", Steven R. Dunbar, David Fowler, Mathematica in Education, Vol. 1, Number 3, page 1.