
A Hierarchy of Turing Degrees

*A Transfinite Hierarchy of Lowness Notions in the
Computationally Enumerable Degrees, Unifying Classes,
and Natural Definability*

Rod Downey

Noam Greenberg

PRINCETON UNIVERSITY PRESS

PRINCETON AND OXFORD

2020

Contents

Acknowledgments	ix
1 Introduction	1
1.1 Historical context	1
1.2 Background: unifying constructions and natural definability	3
1.3 Toward the hierarchy of totally α -c.a. degrees	8
1.4 The contents of this monograph	14
1.5 An application to admissible computability	16
1.6 Notation and general definitions	17
2 α-c.a. functions	23
2.1 \mathcal{R} -c.a. functions	23
2.2 Canonical well-orderings and strong notations	29
2.3 Weak truth-table jumps and ω^α -c.a. sets and functions	37
3 The hierarchy of totally α-c.a. degrees	55
3.1 Totally \mathcal{R} -c.a. degrees	55
3.2 The first hierarchy theorem: totally ω^α -c.a. degrees	58
3.3 A refinement of the hierarchy: uniformly totally ω^α -c.a. degrees	68
3.4 Another refinement of the hierarchy: totally $< \omega^\alpha$ -c.a. degrees	74
3.5 Domination properties	80
4 Maximal totally α-c.a. degrees	84
4.1 Existence of maximal totally ω^α -c.a. degrees	84
4.2 Limits on further maximality	94
5 Presentations of left-c.e. reals	106
5.1 Background	106
5.2 Presentations of c.e. reals and non-total ω -c.a. permitting	110
5.3 Total ω -c.a. anti-permitting	123

6	<i>m</i>-topped degrees	134
6.1	Totally ω -c.a. degrees are not <i>m</i> -topped	135
6.2	Totally ω^2 -c.a. degrees are not <i>m</i> -topped	140
6.3	Totally $< \omega^\omega$ -c.a. degrees are not <i>m</i> -topped	145
7	Embeddings of the 1-3-1 lattice	149
7.1	Embedding the 1-3-1 lattice	150
7.2	Non-embedding critical triples	167
7.3	Defeating two gates	176
7.4	The general construction	184
8	Prompt permissions	188
8.1	Prompt classes	188
8.2	Minimal pairs of separating classes	202
8.3	Prompt permission and other constructions	212
	Bibliography	215