Institute for Logic, Language and Computation

corrections to the first edition of
METAMATHEMATICAL INVESTIGATION OF
INTUITIONISTIC ARITHMETIC AND ANALYSIS

A.S. Troelstra
(editor)

ILLC Prepublication Series
X-93-04

University of Amsterdam
The ILLC Prepublication Series

1990

Logic, Semantics and Philosophy of Language

LP-90-01 Jaap van der Does A Generalized Quantifier Logic for Naked Infinities
LP-90-02 Jeroen Groenendijk, Martin Stokhof Dynamic Montague Grammar
LP-90-03 Renate Bartsch Concept Formation and Concept Composition
LP-90-04 Elena Ràba Introspective Categorial Grammar
LP-90-05 Patrick Blackburn Nominal Tense Logic
LP-90-06 Gennaro Chierchia The Variability of Impersonal Subjects
LP-90-07 Gennaro Chierchia Anaphora and Dynamic Logic
LP-90-08 Herman Hendriks Flexible Montague Grammar
LP-90-09 Paul Dekker The Scope of Negation in Discourse, towards a Flexible Montague grammar
LP-90-10 Theo M.V. Jansen Models for Discourse Markers
LP-90-11 Johan van Bentheim General Dynamics
LP-90-12 Serge Lapierre A Functional Partial Semantics for Intensional Logic
LP-90-14 Jeroen Groenendijk, Martin Stokhof Two Theories of Dynamic Semantics
LP-90-15 Maarten de Rijke The Modal Logic of Inequality
LP-90-16 Yde Venema L. Wang, Karen Kwast Awareness, Negation and Logical Omniscience
LP-90-17 Paul Dekker Existential Disclosure, Implicit Arguments in Dynamic Semantics

Mathematical Logic and Foundations

ML-90-01 Harold Schelin Isomorphisms and Non-Isomorphisms of Graph Models
ML-90-02 Jaap van Oosten A Semantical Proof of De Jongh's Theorem
ML-90-03 Yde Venema Relational Games
ML-90-04 Maarten de Rijke Unary Interpretability Logic
ML-90-05 Domenico Zambella Sequences with Simple Initial Segments
ML-90-06 Jaap van Oosten Extension of Lifschitz Realizability to Higher Order Arithmetic, and a Solution to a Problem of F. Richman
ML-90-07 Maarten de Rijke A Note on the Interpretability Logic of Finitely Axiomatized Theories
ML-90-08 Harold Schelin Some Syntactical Observations on Linear Logic
ML-90-09 Dick Jongh, Duccio Pianigiani Solution of a Problem of David Guaspari
ML-90-10 Michiel van Lambalgen Randomness in Set Theory
ML-90-11 Paul C. Gilmore The Consistency of an Extended NaSet

Computation and Complexity Theory

CT-90-01 John Tromp, Peter van Emde Boas Associative Storage Modification Machines
CT-90-02 Sieger van Dennenheuvel, Gerard R. Renardel de Lavalette A Normal Form for PCSJ Expressions
CT-90-03 Ricardo Gavaldà, Leen Torenvliet, Osamu Watanabe, José L. Balcázar Generalized Kolmogorov Complexity in Relativized Separations
CT-90-04 Harry Buhrman, Edith Spaan, Leen Torenvliet Bounded Reductions
CT-90-05 Sieger van Dennenheuvel, Karen Kwast Efficient Normalization of Database and Constraint Expressions
CT-90-06 Michiel Smid, Peter van Emde Boas Dynamic Data Structures on Multiple Storage Media, a Tutorial
CT-90-07 Koos Doets Greatest Fixed Points of Logic Programs
CT-90-08 Sieger van Dennenheuvel, Ernest Rotterdam, Sieger van Dennenheuvel, Peter van Emde Boas Physiological Modelling using RL
CT-90-09 Roel A.S. Troelstra Unique Normal Forms for Combinatory Logic with Parallel
Other Prepublications

CT-90-10 Roel. A.S. Troelstra Conditional, a case study in conditional rewriting
CT-90-11 Yde Venema Remarks on Intuitionism and the Philosophy of Mathematics, Revised Version
CT-90-12 Jeroen Groenendijk Some Chapters on Interpretability Logic
CT-90-13 L.D. Beklemishev On the Complexity of Arithmetical Interpretations of Modal Formulas
CT-90-14 Yde Venema Annual Report 1989
CT-90-15 Valentin Shehtman Derived Sets in Euclidean Spaces and Modal Logic
CT-90-16 Valentin Goranko, Solomon Passy Using the Universal Modality: Gains and Questions
CT-90-17 Y. Shavrukov The Lindenbaum Fixed Point Algebra is Undecidable
CT-90-18 L.D. Beklemishev Provability Logics for Natural Turing Progressions of Arithmetical Theories
CT-90-19 V. Yu. Shavrukov On Rosser's Provability Predicate
CT-90-20 Sieger van Dennenheuvel, Peter van Emde Boas An Overview of the Ktes Language RL/1
CT-90-21 Alessandra Carbone Provably Fixed points in IΔ0+Ω1, revised version
CT-90-22 Maarten de Rijke B-Unary Interpretability Logic
CT-90-23 A. Ignatiev Onzhapardiz's Polymorphic Logic: Arithmetical Completeness, Fixed Point Property, Craig's Property
CT-90-24 L.A. Chagrova Undecidable Problems in Correspondence Theory
CT-90-25 A.S. Troelstra Lectures on Linear Logic

1991

Logic, Semantics and Philosophy of Language

LP-91-01 Wiebe van der Hoek, Maarten de Rijke Generalized Quantifiers and Modal Logic
LP-91-02 Frank Veltman Defaults in Update Semantics
LP-91-03 Willem Groeneveld Dynamic Semantics and Circular Prepositions
LP-91-04 Willem de Jong and Kees Paap The Lambek Calculus enriched with Additional Connectives
LP-91-05 Zhiheng Huang, Peter van Emde Boas The Schoenmakers Paradox: Its Solution in a Belief Dependence Framework
LP-91-06 Zhiheng Huang, Peter van Emde Boas Belief Dependence, Revision and Persistence
LP-91-07 Henk Verhey, Jaap van der Does The Semantics of Plural Noun Phrases
LP-91-08 Víctor Sánchez Valencia Categorial Grammar and Natural Reasoning
LP-91-09 Arthur Nieuwlandik Semantics and Comparative Logic
LP-91-10 Johan van Bentheim Logic and the Flow of Information

Mathematical Logic and Foundations

ML-91-01 Yde Venema Cylindric Modal Logic
ML-91-02 Alessandro Berarducci, Rineke Verbrugge On the Metamathematics of Weak Theories
ML-91-03 Domenico Zambella On the Proofs of Arithmetical Completeness for Interpretability Logic
ML-91-04 Raymond Hohmann, Harold Schelin Isomorphisms of Graph Models by Proctors
ML-91-05 A.S. Troelstra History of Constructivism in the Twentieth Century
ML-91-06 Inge Bethke Finite Type Structures within Combinatory Algebras
ML-91-07 Yde Venema Modal Derivation Rules
ML-91-08 Inge Bethke Going Stable in Graph Models
ML-91-09 Y. Yu. Shavrukov A Note on the Diagonalizable Algebras of PA and ZF
ML-91-10 Maarten de Rijke, Yde Venema Sahlin's Theorem for Boolean Algebras with Operators
ML-91-11 Rineke Verbrugge Feasible Interpretability
ML-91-12 Johan van Bentheim Modal Frame Classes, revisited

Computation and Complexity Theory

CT-91-01 Ming Li, Paul M.B. Vitányi Kolmogorov Complexity: Arguments in Combinatorics
CT-91-02 Ming Li, John Tromp, Paul M.B. Vitányi How to Share Concurrent Wait-Free Variables
CT-91-03 Ming Li, Paul M.B. Vitányi How to Average Case Complexity under the Universal Distribution Equals Worst Case Complexity
CT-91-04 Sieger van Dennenheuvel, Karen Kwast Weak Equivalence
CT-91-05 Sieger van Dennenheuvel, Karen Kwast Weak Equivalence for Constraint Sets
CT-91-06 Edith Spaan Censor Techniques on Relativized Space Classes
CT-91-07 Karen L. Kwast The Incomplete Database
CT-91-08 Koos Doets Levantius Laws
CT-91-09 Ming Li, Paul M.B. Vitányi Combinatorial Properties of Infinite Sequences with high Kolmogorov Complexity
CT-91-10 John Tromp, Paul Vitányi A Randomized Algorithm for Two-Process Wait-Free Test-and-Set
CT-91-11 A. Hennachandra, Edith Spaan Quick-Injective Reductions
CT-91-12 Krysztof R. Apt, Dino Pedreschi Reasoning about Termination of Prolog Programs
corrections to the first edition of

METAMATHEMATICAL INVESTIGATION OF

INTUITIONISTIC ARITHMETIC AND ANALYSIS

A.S. Troelstra
(editor)
Department of Mathematics And Computer Science
University of Amsterdam

The first edition appeared in 1973 with
Springer verlag, Berlin (ISBN 3-540-06491-5)

received June 1993
Corrections to: A.S. Troelstra (editor),
Metamathematical Investigation of
Intuitionistic Arithmetic and Analysis
June 8, 1993

This report contains corrections and additions to “Metamathematical Investigation of
Intuitionistic Arithmetic and Analysis” which appeared in 1973 as number 344 in the
“Springer Lecture Notes in Mathematics” series. The book has been out of print for
several years now. Since there is still a small but steady demand for the volume, it was
decided to produce a new edition as a report in the Mathematical Logic series of the
Institute for Logic, Language and Information of the University of Amsterdam. All errata
and additions of the present list have been incorporated in this new edition; the present
report enables the owners of a copy of the original edition to make the corrections in their
volumes.

This report has been typeset in Latex. Wavy underlining in the original text is now
interpreted as boldface, underlining as italics. Double wavy underlining has been inter-
preted by a sans serif fount. However, we have retained double underlining and did not
replace it by Fraktur.

A first list of Errata appeared in 1974 as a report of the Mathematical Institute of
the University of Amsterdam; many more errata have been discovered since then. In
particular I should like to thank Marc Bezem, Susumu Hayashi, Jane Bridge Kister, Jaap
van Oosten and Jeffery Zucker.

The counting of lines includes the lines in displayed formulas; for indications, e.g. a
name or a number for a group of displayed lines, which are between lines so to speak, an
ad hoc indication will be chosen.

Underlining in the original text has been rendered as italics in these correction; double
underlining has been rendered as such, but a double wavy underlining corresponds to a
sans serif letter in these corrections.

XIII Add below the summary of §6:

§7 Applications: proof theoretic closure properties
List of rules (3.7.1) — closure under ED, DP, CR, ECR, ECR', ACR, IPRw (3.7.2–
5) — closure under CR (3.7.6) — closure under ECR1 (3.7.7–8) — extensions to
analysis (3.7.9)

6 In 1.1.7, interchange “\(\ldots\)" and “\(\ldots\)".

713 Read “\(\exists E\)" for “\(\exists I\)".

85 Read “essentially”.

8 In the first proof tree, “\(B \rightarrow \lambda\)" should be “\(B \rightarrow \lambda(2)\)" and “(2)" should be repeated
at the lowest horizontal line.

1613 Read “\(A\)" for “\(F\)".
In 1.3.3 the axiom
\[ x_i = x'_i \rightarrow \phi(x_1, \ldots, x_i, \ldots, x_n) = \phi(x_1, \ldots, x'_i, \ldots, x_n) \]
(for any n-ary function constant \( \phi \), \( 1 \leq i \leq n \)) can be replaced by the corresponding axiom for \( S \) only:
\[ x = y \rightarrow Sz = Sy, \]
since the general case can be established by induction (since all \( \phi \) except \( S \) are introduced by schemas for primitive recursive functions).

Read “Defining” for “Definining”.

Add at the bottom of the page rules expressing the functional character of the \( F_k \):
\[ \frac{F_{k_1 t_1 \ldots t_{n-1} t_n} F_{k_1 t_1 \ldots t_{n-1} t'_n}}{t_n = t'_n}. \]

Replace “\( F_{k_m} \)” by “\( F_{k_m} \)”.

Addition to second paragraph of (D) : “Canonical” essentially means that the arithmetization provably satisfies the “same” inductive closure conditions as the predicate itself.

Read “\( \tau \gamma \)” for “\( \tau \)”.

Read “that \( \tau A(x_1, \ldots, x_n) \)” stands for “…”.

Read “\( \simeq \)” for “\( = \)”.

Add at the bottom of the page a paragraph:
We follow Kleene 1952 and use \( \Delta x.t \), \( t \) a p-term, to indicate a gödelnumber for \( t \) as partial recursive function of \( x \); if \( t \) contains, besides the free variables \( x, x_1, \ldots, x_n \), \( \Delta x.t \) is a (primitive) recursive function of \( x_1, \ldots, x_n \).

Read “\( y_0 \)” for “\( y \)”.

Read “\( y_1 \)” for “\( y \)”.

Read “We put \( \tau t_1 \ldots t_n \gamma = \ldots \)”.

Read “\( t' \neq x^\sigma \)” for “\( t' \neq x^\sigma \)”.

Replace “slightly ... is” by “seemingly stronger (but in fact equivalent) variant is”.

Delete “In ... EXT-R’.”
Replace these lines by the following:

The following two propositions are due to M. Bezem (Equivalence of Bar Recursors in the Theory of Functionals of Finite Type, *Archive for Mathematical Logic* 27 (1988), 149–160).

**PROPOSITION.** The rule EXT-R’ is derivable in cf-WE-HAω.

**PROOF.** Assume EXT-R, and let ⊢ P → s1 = s2, ⊢ Q[x/t1] Here s1 = s2 as usual is shorthand for an equation between terms of type 0 s1x1x2...xn = s2x1x2...xn, where x1, x2, ..., xn are variables not free in P, s1, s2. Without loss of generality we can assume P ≡ (t1 = 0), Q[x] ≡ (t[x] = 0) (x not free in P, s1, s2. Below we shall abbreviate t[x/s], for arbitrary s, as t[s]. So we have

(1) ⊢ t1 = 0 → s1 = s2, ⊢ t[s1] = 0.

Define

s′i := Rσs0(σ(0)σ), si ∈ σ.

Then, with x /∈ FV(s), i = 1, 2:

\[ ⊢ x = 0 → s′ix = si, \quad ⊢ x ≠ 0 → s′ix = 0^σ. \]

Applying EXT-R to s′0 = si; yields ⊢ t[s] = t[s′0]. By replacement (i.e. x = y → t[x] = t[y]) we obtain

\[ ⊢ t1 = 0 → t[s′0] = t[s′t1]. \]

Since also (1) holds, and t1 = 0 is decidable, ⊢ s′t1 = t′t1, so again using EXT-R

\[ ⊢ t[s′t1] = t[s′t1], \]

hence

\[ ⊢ t1 = 0 → t[s2] = t[s′0] = t[s′t1] = t[s′t1] = t[s′0] = t[s1] = 0. \]

Q.e.d.

**PROPOSITION.** The deduction theorem holds for qf-WE-HAω + EXT-R’, hence also for qf-WE-HAω.

**PROOF.** It suffices to prove the deduction theorem for the system with EXT-R’, and in this case the deduction theorem is easy.

Delete these lines.

Read “ z < x ” for “ z < z ”.

Read “ Q(x, y) ” for “ Q(0, y) ”.
56. Read "T" for "T".

58.12 Read "T" for "T".

59. Add at the bottom: "Cf. also Luckhardt 73, pp. 66–67."

63. Delete the first equation.

67. At end of line we add "assumed to be provably linear in HA".

71. Read "σ((Q_2 V_1) A) ≡ (Q_1 ν_2 Q_1 σ(A),...)."

74. In comparing section 1.9.14 with more recent literature (such as A.S. Troelstra, D. van Dalen, Constructivism in Mathematics, Amsterdam 1988), it is to be noted that definedness of a term containing functions and numbers with partial application is here supposed to be defined in the sense of Kleene 1969, that is to say a function applied to an argument is defined if we can sufficiently many values of the function to find its value at the argument; this convention does not agree with the logic of partial terms with its strictness condition.

75. Read "U(lth(u)) = y" for "U(lth(u) = y)."

75. Read "x" for "α".

80.13 Addition to 1.9.23: "Cf. also Kreisel 1967, page 249, where the role of generalized bar induction in proving the continuous functionals to be a model of bar recursion is mentioned."

83.18.13 Read "0_α" for "0_σ".

83.10 Read "B_σ y z u (c * v) c" for "B_σ y z u c (c * v) c."

91.12 Add "In Friedman B it is shown that for r.e. axiomatizable extensions of HA, DP implies ED."

94.5 Replace by: "In Luckhardt A it is shown that the principle is equivalent to M."

95. Add at the end of 1.11.6:

It has been noted by C.A. Smorynski that, for theories with decidable prime formulas, IP + M together amount to the principle of the excluded third. E.g. for HA, HA + IP + M = HA^c, which is seen as follows. Assume A ∨ ¬A to be proved already in HA + IP + M, and consider ∃x Ax. By M, ∀x(Ax ∨ ¬Ax) & ¬¬∃x Ax → ∃x Ax; by the induction hypothesis and IP, this implies ∃x Ax ∨ ¬∃x Ax. Application of propositional operators preserves decidability, and ∀x Ax ↔ ¬¬∃x Ax by the decidability of A, hence (∀x Ax ∨ ¬∀x Ax) ↔ (¬∃x ¬Ax ∨ ¬¬∃x ¬Ax) ↔ ¬∃x ¬Ax ∨ ∃x ¬Ax, hence ∀x Ax ∨ ¬∀x Ax.

95.4 Replace "ax = uz" by "αy = uz."

98.6 Read "x^{(σ)}_1 r" for "x^{(σ)} r."

111.9 Read "t_1 ≡ t'_1" for "t_1 ≡ t'."
1134 Read " $\text{IH} \vdash t = \bar{n}$."

1176 Read "and $t$ is" for "and $r$ is".

1194 Read "...representing $an$.".

1251 Read " $(\sigma)(\tau)\sigma$ " for " $(\sigma)(\tau),\sigma$ ".

12610 Read "of" for "if".

12812,13 The open problem has been solved by M. Bezem, in the sense that the two structures are isomorphic: J.S.L. 50 (1985), pp. 359–371.

129 Add between lines 6 and 7:

If we replace in the right hand side of this equivalence $A$ by a predicate letter $X$, we have the inductive condition $B(X, x, y)$ characterizing $A$.

13218,20 Replace " I-HA$^\omega$ " by " I-HA$^\omega$ + IE$_0$ ".

134 Delete " , CTM', CTNF' ".

13310,11 Replace final comma by stop in line 10 and delete " CTM', CTNF' " in line 11.

1335,4 Read " CTNF' " for " CTNF ".

14110 Read " $W^1_\sigma$ " for " $I^1_\sigma$ ".

1448 Read " (4) " for " (1) ".

1471,1481 Read " $p_q$ " for " $p_k$ ".

1481 Insert before comma "& $\{z(\{q\}) = \{z\}(y) \text{ (since } z \in E(V), y \in V^*) \}$ ".

15813 Read " $t = s$ " for " $t = s$ ".

15816 Read " CTNF " for " CTNF' ".

15811 Read " $x^2[\Sigma(\Pi x^2)\Pi]$ ".

1588 Read " , that $\Sigma(\Pi x^2)\Pi$ and ".

1588 Read " " $\Sigma(\Pi x^2)\Pi$ in the model ".

15912 Read "...which $x^1 \bar{n}_i$ contr $\bar{m}_i$ has".

15914 Read " $t' \in 2$ " for " $t' \in z$ ".

1591,2 - 1601-4 Replace these lines by:

$$i^2\bar{\alpha} = \begin{cases} 0 & \text{if } \exists i (1 \leq i \leq k \& \bar{\alpha}_1(k + 1) = \bar{\alpha}(k + 1) \\ m + 1 & \text{otherwise, where } m = \max\{\alpha_i(y) | 1 \leq i \leq k, 0 \leq y \leq k\}. \end{cases}$$

Now $Ft^2 \neq 0$; for, $(\pi_0,0)(k + 1)$, $\ldots$, $(\pi_0,0)(k + 1)$ are all distinct, hence one of them, say $(\pi_0,0)(k + 1)$, $0 \leq k_0 \leq k$, is distinct from all $\bar{\alpha}_1(k + 1)$, $\ldots$, $\bar{\alpha}_k(k + 1)$, and therefore $i^2(t(\pi_0,0)(k + 1)) = m + 1$; but then $(\lambda x^3.t^2(\pi_0,0)(x))(k + 1)$ differs from all $\bar{\alpha}_1(k + 1)$, $\ldots$, $\bar{\alpha}_k(k + 1)$, and thus $Ft^2$ takes the value $m + 1$. 

5
160 Read " = " for " ≡ ".
161 Delete "not".
164 Remark to be added at the end of 2.8.5: J.M.E. Hyland showed in his thesis that Scarpellini's model coincides with the model ECF.
167 Read "establishing" for "establish".

173 Remark to be added in 2.9.10:
If a coding by functions is given for the elements of σ−, such that there are continuous Φ, Φ with Φ ≡ Φ(ξ) the length of the sequence coded by ξ, Φ(η, ξ) the n-th component extracted from ξ, then one can construct a bijection between two codings of this kind.

179 Read "HA + G1.
180 Read "|F holds" for "| holds".
182 Read "P" for "D".
183 Read "PCA, " for "PA, "
184 Add after "terms": "satisfying (t ∈ V and t = t' ⇒ t' ∈ V)".
188 Read "mathematical".
189 Read " & P(B(j1x))" for " & P(A(j1x))"
190 Delete "and, P(F1), \ldots, P(Fn)"
190 Delete "Also ∀xP(Bx)"
194 Delete "It follows that \ldots hence P(C),", and replace "Also" by "Then".
192 Add after "hence": " !t \& t \rho A is an abbreviation for (∃x(t \equiv x \& x \rho A))."

192. The argument given in the first edition is not correct. The result is a consequence of the unprovability in HA of the DP, which has been proved by J. Myhill (A note on indicator functions, Proc. Amer. math. Soc. 29 (1973), 181–183) and by Friedman in a stronger form (On the derivability of instantiation properties, J.S.L. 42 (1977), 506–514).

194 Insert "HA ⊢ " between "(ii)" and "A(a) \rightarrow !\psi(a) & \ldots".

194 Replace this line by
Proof. The "only if" part is established as follows. Assume ⊢ Aa ↔ Ba, B almost negative. Then there is a recursive φ such that ⊢ ∀u(u \rho Aa \rightarrow ![j1φa](u) \& \{j1φa\}(u) \rho Ba), and ⊢ ∀u(u \rho Ba \rightarrow ![j2φa](u) \& \{j2φa\}(u) \rho Aa), which together with 3.2.11 for B readily yields the desired conclusion.

194 Read "U \rho A a" for "\nu \rho A a".
Add after 3.2.22:

**Remark.** In the writings of the Russian constructivist school (cf. e.g. Dragalin 1969) one finds the following extension of CT₀:

\[ \forall x(\neg Ax \to \exists yBxy) \to \exists u \forall x(\neg Ax \to \exists v(Tuxv \& B(x, u))]. \]

However, in the presence of M this is equivalent to ECT₀, i.e.

\[ \text{HA} + \text{ECT}_0 + M = \text{HA} + \text{CT}' + M. \]

To see this, let us first assume CT', M, and let Ax be almost negative. Then by M Ax \iff A'x, A' negative, and hence \( \neg \neg A'x \iff Ax \) (1.10.8); thus an instance of ECT₀ can be interpreted as an instance of CT'.

Conversely, if ECT₀ and M are assumed, and we let \( \forall x(\neg Ax \to \exists yBxy) \), then by ECT₀, 3.2.8 \( \neg Ax \iff \exists z(zr \neg Ax) \iff \forall z(zr \neg Ax) \iff 0r \neg Ax ; 0 r \neg Ax \) is almost negative. Replacing \( \neg Ax \) by \( 0 r \neg Ax \) we have \( \forall x(\exists 0 r \neg Ax \to \exists yBxy) \) to which we can apply ECT₀ etc.

200–201 The claim of 3.2.26 has not been established: it is not known whether the schema

\[ \forall x[A \vee \neg A] \& [\forall xA \to \exists yB] \to \exists y[\forall xA \to B] \]

is HA-c-r-realizable.

203 Add after 3.2.29: “Friedman has shown (Friedman B) how to extend q-realizability by a similar trick.”.

2034 Read “Cellucci”.

2145 Replace “negative” by “ \( \exists \)-free (i.e. not containing \( \lor, \exists \) ”.

2145,3 Delete “on the convention ... omitted,”.

2151 Replace “negative” by “ \( \exists \)-free”.

2159 Add “ N-HA \( \omega \)” after “ HA \( \omega \) ”.

21511 Read “...sequence \( \xi \) of ...”.

21515 Replace “negative” by “ \( \exists \)-free”.

21620 Read “ \( \frac{y}{s}mrPA \)” for “ \( ymrPA \)”.

2171,2,17 Read “\( Tm \)” for “\( T \)” (4 times).

21713 Replace this line by:

\[ \text{IP}^- \quad (A \to \exists y^\sigma B) \to \exists y^\sigma (\neg A \to B) \]

(\( y^\sigma \) not free in \( A, A \ \exists \)-free, i.e. not containing \( \lor, \exists \)
217_{16,15} \text{ Delete ", taking for \ldots into account". Add after 3.4.7:}

\textit{Remark. (E.R. Alward). By induction on the complexity of } A \text{, one readily shows that in any of the systems } \mathbf{H} \text{, to each } A \text{ there exists an } \exists\text{-free } B \text{ such that}

\[
\mathbf{H} \vdash \neg A \leftrightarrow B.
\]

Hence \(\text{IP}^-\) implies

\[
\text{IP}^- \quad (\neg A \to \exists y^\sigma B) \to \exists y^\sigma (\neg A \to B) \quad (y^\sigma \text{ not free in } B).
\]

Since in systems with decidable prime formulae negative and \(\exists\)-free formulas coincide, and for negative \(A \equiv \neg A \leftrightarrow A\), we have in such cases also that \(\text{IP}^-\) implies \(\text{IP}^-\).

217_{10,8,4,2,1} \text{ Replace "IP" by " IP".}

217_{10} \text{ Read " } \mathbf{H} + " \text{ for " } \mathbf{H} \vdash ".

217_{8} \text{ Add after line: "For } \mathbf{H} = \mathbf{HA}^\omega, \mathbf{I-HA}^\omega, \mathbf{HRO}^-, \mathbf{E-HA}^\omega, \text{ IP}^- \text{ may be replaced by IP}^-\".".

217_{5} \text{ Read "} \exists\text{-free" for "negative".}

221_{7} \text{ Read " } \text{MP}_\mathbf{PR} " \text{ for " } \text{MP}_\mathbf{PR} ".

221_{2} \text{ Read "3.4.14" for "3.4.4".}

222 \text{ Add after 3.4.14:}

\textit{Remark. V.A. Lifschitz has shown (Proceedings of the American Mathematical Society 73 (1979), 101–106) that also } \mathbf{HA} + \text{CT}_0 \not\vdash \text{CT}_0, \text{ where}

\[
\text{CT}_0! \quad \forall x \exists y A(x,y) \to \exists u \forall x \exists v (Tu xv \wedge A(x,Uv)).
\]

222_{2} \text{ Read " } \forall \alpha \neg \exists x " \text{ for " } \forall \alpha \neg \exists z .

223_{1} \text{ Read "...was suggested by results contained in".}

224_{1,225_{1}} \text{ Read " } \text{IP}^- " \text{ for " } \text{IP}^- \".

226_{16} \text{ Replace " for " by " . For "}.

226_{8} \text{ Insert after "...numbers" "(provably linear in } \mathbf{HA} \text{)".}

227 \text{ Add "(\langle provably linear in } \mathbf{HA} \rangle".}

228_{16} \text{ Read " } U_{j(n,i)}^1 x " \text{ for " } U_{j(n,i)}^1 x ".

228_{7,6} \text{ These lines must read respectively "... } \equiv \forall X \forall D_X(x \text{ mr } A(X)) \text{ " and "... } \equiv \exists X \exists D_X(x \text{ mr } A(X)) \text{ "}.

229_{11} \text{ Read " of } s^1 \text{ in HRO".}
Read “eliminating” for elementary.

Read “ $\Pi_2^0$ ” for “ $\Pi_2^0$ ”.

Delete “ $J^D$ ”.

Read “ $(x, y, Zv)$ ” for “ $(x, y, Z, y)$ ”.

Read “ $\overline{y}$ ” for “ $\overline{y}$ ”.

Read “ $\vdash F^D$ ” for “ $\vdash F^D$ ”.

Read “now” for “not”.

Replace these lines by:

If we take everywhere $X$ to be identically 1, we obtain the Dialectica interpretation.

“Shoenfield” should be underlined.

Delete “ $\mathbf{N-HA}^{\omega}$ ”, and add “; $\mathbf{(N-HA}^{\omega} + \mathbf{IP}^- + \mathbf{AC}) \cap \Gamma_1 = \mathbf{N-HA}^{\omega} \cap \Gamma_1$ ” (cf. the corrections to page 217).

Read “ $\ldots \& A^*y$ ] ”.

Read “ $\mathbf{HA}$ ” for “ $\mathbf{HA}$ ”.

Read “ $\rightarrow \exists x^p A$ ” for “ $\rightarrow \exists x^p A$ ”.

Read “ $(z \neq 0 \rightarrow \neg A)$ ” for “ $(z \neq 0 \rightarrow A)$ ”.

Read “ $\exists y(y \in p$ ” for “ $\exists(y \in p$ ”.

Read “ 3.9.13 ” for “ 3.9.11 ”.

Read “ 3.9.14 ” for “ 3.9.12 ”.

Read “ 3.9.15 ” for “ 3.9.13 ”.

Delete “ ( ”.

Second proof tree under 4), read “ $\Pi$ ” for the lowest “ $\Pi_i$ ”.

Replace in the first four proof trees exhibited the occurrences of “ $A$ ” (but not the $A$ in “ $A_1$ ”, “ $A_2$ ”, “ $A_3$ ” or “ $\exists x A^p$ ”) by “ $B$ ” (7 occurrences).

Replace under “ 13) ” “ $A0$ ” by “ $Aa$ ”.

Read “ $\Pi' \gg_1 \Pi''$ ”, (without “$\ldots$ ”).

Add “ of $A_1$ ” at the end.
282 In the display at the bottom of the page, the first two lines should be

\[
\begin{align*}
\Pi & \quad \Pi \\
A \quad 0 & = 0 \\
A \quad sa & = sa
\end{align*}
\]

283 In the displayed prooftree read " &₁E " for " &E ".

284¹ read "form (Prawitz)" for " (from Prawitz) ".

285 Immediately above the paragraph starting with "This makes it . . . " read

\[
\begin{align*}
\Pi' & \quad \Pi \\
[A] & \quad [A] \\
\Pi & \quad \Pi \\
B & \quad B
\end{align*}
\]

286 Replace last paragraph of 4.1.7. by:

For applications, we need only a normalization theorem (not a strong normalization theorem) relative to \( \mathcal{R}_{\lambda} \); so if the reader wishes, he may use the preceding remark and delete everything in the proof below referring to \( \lambda \)-contractions.

287¹⁶ Read " Prd₁(Π), Prd₂(Π), . . . ".

287₅ Read " SV(Sub(\( \lambda \),Π,Prd(Π),Ass(Π))) ".

287₂ Read " Π " for " Π₁ ".

288⁹ Insert " Ass(Π) " after " Prd₂(Π) ".

288 Directly above footnote, read

\[
\begin{align*}
\frac{\Pi'}{A} & \quad \text{for} \quad \frac{\Pi}{A}.
\end{align*}
\]

290¹⁷ Read " Π' \in PRD(Π) ".

290 In the first displayed prooftree, replace " At " by " At' ".

291 The second displayed prooftree should read:

\[
\begin{align*}
\Pi'_1 \ldots \Pi'_n \\
A
\end{align*}
\]

292¹ Read "condition IV " for " condition Π ".

293 Second line of paragraph starting with "Condition IV for Π' . . . ", read "for Π " instead of "for Π ".

294 Replace in the second display " Π₃ " by " Π₄ ", and in the line under this display, replace "Π₄" by "Π₅".

10
Replace in the third display "\( \Pi_3 \)" by "\( \Pi_4 \)". In the line under the third display, insert after "reduces to": "the left subdeduction of".

Read " \( \Pi_6 \) " for " \( \Pi_3 \) ".

In the third display, place in the second proof tree " \( \Pi_6 \) " above " \( \exists x Bx \) ".

Insert between "condition" and "\( \Gamma \)": "IV, and hence".

In the line below the third display, insert before "is SV":

"and also \( \Pi_4 \)"

\[ B_1 t' \]
\[ \Pi'_1 (t') \]
\[ D \]
\[ \Pi_1 (t) \]
\[ A \]

Read " 2.2.25 " for " 2.2.31 ".

Add " (major) " at the end.

Add after the comma "which may be empty,".

Replace "preceding" by "succeeding".

Read "were" for "would be".

Add before " ( )": " ; also, \( A_i \) cannot be discharged by IND, since no application of IND lies below \( A_1 \) ".

Read " 4.2.8 " for " 2.8 ".

Read "normal" for "formal".

Add " \( \sigma \) " at the end.

Insert "(by 4.2.7)" before " ; ".

Read "were" for "would be".

Read "or IND-application occurring" for "occurring".

Replace " IND-application " by " begin with a conclusion of an IND-application ".

Read "Let \( \Phi \) denote the ".

The proof in subsection 4.2.16 in the first edition contains a gap. Much simpler is the following argument:

**Proof.** Note that \( \Psi \) is equivalent to a set of Harrop formulas: if \( \exists x Px \in \Psi \), then we may replace this formula by \( P\bar{n} \) for some \( \bar{n} \) such that \( \text{HA} \vdash P\bar{n} \). Then we can apply 4.2.12.
Delete "", or $A_1$ is a basic axiom ".

Read " $A_1 \in \Psi$, i.e. $B$ is prime ".

Remark at 4.2.17: instead of referring to 3.6.7(ii), it suffices to note that only true closed $\Sigma^0_1$-formulae are provable in $\text{HA}$ and $\text{HA}^c$.

Proof of 4.2.18. This proof is incorrect as it stands, since the conclusion of an IND-application is not necessarily atomic, only quantifier-free. The proof is correct if we replace in the statement of the theorem $\text{H}$, qf-$\text{HA}$ by the corresponding systems with induction for atomic formulas only.

To establish the theorem as stated, we can e.g. proceed as follows: define a path of order 0 to be a path $A_1, \ldots, A_n$ with $A_n$ conclusion of the deduction, and define a path of order $m + 1$ to be a path $A_1, \ldots, A_n$ such that either $A_n$ is minor premiss of an $\rightarrow E$-application the major premiss of which belongs to a path of order $m$, or premiss of an IND-application the conclusion of which belongs to a path of order $m$.

In a strictly normal derivation, every formula occurrence belongs to some path of order $m$, for suitable $m$ (since redundant applications of $\forall E$, $\exists E$ have been removed). Then one readily proves, by induction on $m$, that for a strictly normal derivation of a quantifier-free formula in $\text{H}$ all formula occurrences on a path of order $m$ are quantifier-free. (Note that here normalization also w.r.t. permutative reductions is necessary, in contrast to other applications. This could have been avoided by reduction of qf-$\text{HA}$ to a logic-free calculus, which is not a very elegant solution, however.)

Read " 2.5.7 " for " 2.5.6 ".

Line 2 below second display. Read " $\mathcal{R}_c$ " for " $\mathcal{R}_c$ ".

Read " 4.1.16 " for " 4.1.15 ".

Last line of first display, replace in proof tree $\Pi^\prime \leftarrow A \rightarrow Bx$ by " $\rightarrow A \rightarrow \exists x Bx$ ".

Replace second sentence of the statement of 4.3.5 by:

Then a spine of $\Pi$ not ending with an introduction does not contain IP-applications, and ends with an application of a basic rule or an atomic instance of $\lambda_1$.

Delete the third sentence.

The proof of 4.3.5. should be reformulated as follows:

Let $A_1, \ldots, A_n$ be a spine of $\Pi$ not ending with an introduction. Then, by 4.3.4(iii) there are two cases:

1. $A_1$ is a basic axiom. So the spine coincides with its minimum part, hence $A_n$ is atomic.

2. $A_1$ is of the form $\neg B$, to be discharged by $\rightarrow I$, followed by IP. this case is excluded, for the sort of inference following $A_1$ can be (not IP, or $\rightarrow I + IP$, but) $\rightarrow E$ only, leaving us with $A_2 \equiv \lambda$, and a minimum part $A_2, \ldots, A_n$.

Read "any one".
311\textsuperscript{17} Read "Red\textsubscript{1}" for "Red".
311\textsuperscript{19} Read "of" for "from".
311\textsuperscript{12} Read " \forall I \textsubscript{r} " for " \forall I \textsubscript{r} ".
311\textsuperscript{11} Read " \forall I \textsubscript{r} " for " \forall I \textsubscript{r} ".
311\textsuperscript{7} Read " SV\textsubscript{d-1}(Subst(\text{Param}(\Pi), x, Prd\textsubscript{1}(\Pi))) \) ".
313\textsuperscript{1} Read " (ii) " for " (iii) ".
313\textsuperscript{12} Read " 4.4.3 " for " 4.4.2 ".
313\textsuperscript{10} Insert "(1.5.6)" before " . ".
314\textsuperscript{4} Read " Proof\textsubscript{n} " for " Proof ".
314\textsuperscript{5} Read " 4.4.3 " for " 4.4.2 ".
314\textsuperscript{3} Read " HA \vdash \forall x \exists y z(\text{Proof}\textsubscript{n}(y, \gamma A(x, z) \gamma \& A(x, z)) \) ".

321 As observed by S.Hayashi, (On derived rules of intuitionistic second order arithmetic, Commentarii Mathematici Universitatis Sancti Pauli 26 (1977), 77–103), the proof of 4.5.8 indicated in the text of the first edition establishes a result which is too weak, e.g.

\[
\forall n \forall A \in \text{Fm}\textsuperscript{(n)}(\vdash \text{Sat}\textsuperscript{(n)}(X, \gamma \forall x Ax \gamma) \iff \forall x \text{Sat}\textsuperscript{(n)}(X, \gamma A(x) \gamma))
\]

instead of

\[
\forall n(\vdash \forall A \in \text{Fm}\textsuperscript{(n)}(\text{Sat}\textsuperscript{(n)}(X, \gamma \forall x Ax \gamma) \iff \forall x \text{Sat}\textsuperscript{(n)}(X, \gamma A(x) \gamma))).
\]

Following Hayashi, the desired stronger conclusion can be established as follows.

We first define the notion of a formation sequence of a formula A in \text{Fm}\textsuperscript{(n)}.

**DEFINITION.** A formation sequence (fs) of \emph{A} \in \text{Fm}\textsuperscript{(n)} is a finite sequence of quadruples \( \langle a_0, b_0, c_0, t_0 \rangle, \ldots, \langle a_m, b_m, c_m, t_m \rangle \) such that

1. \emph{t}_m = \gamma A \gamma; \emph{t}_0, and \emph{c}_i for \( 1 \leq i \leq m \) are codes of formulas of complexity \( \leq n \).
2. \emph{a}_i \in \mathbb{N} for \( 0 \leq i \leq m \), \emph{a}_{i+1} \leq i \) for \( 0 \leq i < m \).
3. \emph{b}_i, \emph{c}_i \in \mathbb{N} for \( 0 \leq i \leq m \); \emph{t}_{i+1} is the code of the term which is the result of substituting the term with code \emph{t}_{a_{i+1}} for the second-order variable \( V^p_{t_{i+1}} \) in the formula (with index) \emph{c}_{i+1} and logical complexity \( \leq n \), where \emph{p} is the number of free variables in \emph{t}_{a_{i+1}} (end of definition).

Now \text{Sat}\textsubscript{n}(X, \gamma A \gamma) is constructed as before. Let \emph{f}, \emph{g}, \emph{h} range over formation sequences. We then define, similar to \text{Sat}\textsuperscript{(n)}(X, \gamma A \gamma) of the text, and with help of \text{Sat}\textsubscript{n}, the formula \text{Sat}\textsubscript{f}\textsuperscript{(n)}(X, \gamma A \gamma), where \emph{f} is an \emph{fs} for \emph{A} with \emph{t}_m = \gamma A \gamma, and \text{Sat}\textsubscript{f}\textsuperscript{(n)} is constructed parallel to the substitutions of \emph{f}. Then one proves

**LEMMA.** In **HAS**
(i) \( \forall f \forall A, B \in \text{Fm}^{(n)} \exists g, h \forall \langle \text{Sat}\_f^{(n)}(X, \gamma A \circ \beta) \rangle \rightarrow \text{Sat}_g^{(n)}(X, \gamma A) \circ \text{Sat}_h^{(n)}(X, \gamma B) \rangle \)
for \( \circ \in \{ \rightarrow, \& , \lor, \lor \} \).

(ii) \( \forall f \forall A \in \text{Fm}^{(n)} \exists g \forall \langle \text{Sat}\_f^{(n)}(X, \gamma Qv_i A(v_i) \rangle \rightarrow (Qv_i)\text{Sat}_g^{(n)}(X, \gamma A(v_i) \rangle) \)
for \( Q \in \{ \forall, \exists \} \).

(iii) \( \forall f \forall A \in \text{Fm}^{(n)} \exists g \forall \langle \text{Sat}\_f^{(n)}(X, \gamma QV^P A(V^P) \rangle \rightarrow (QV^P)\forall \langle Y_{y_1, y_2, j(y_1, y_2) \neq j(p, i) \rightarrow Z^1_{(y_1, y_2)} = Y \rightarrow \text{Sat}_g^{(n)}(Z, \gamma A(V^P) \rangle \)
for \( Q \in \{ \forall, \exists \} \).

(iv) \( \forall X, f, g, n(\text{FS}(f, n) \land \text{FS}(g, n) \rightarrow \text{Sat}\_f^{(n)}(X, n) \leftrightarrow \text{Sat}_g^{(n)}(X, n)) \), where \( \text{FS}(f, n) \)
expresses “\( f \) is a formation sequence of a formula \( A \) with \( \gamma A^\gamma = n \).”

**Proof.** The proof of (i)–(iii) by induction on the length of \( f \); the proof of (iv) uses (i)–(iii) and induction on \( n \).

We may then put

\( \text{Sat}\_f^{(n)}(X, \gamma A) \leftrightarrow \exists f \text{Sat}_f^{(n)}(X, \gamma A) \)

and can then establish a stronger version of 4.5.8, namely

\( \forall n(\text{HAS} \vdash \forall A \in \text{Fm}^{(n)}(\text{Sat}\_f^{(n)}(X, \gamma Ax) \leftrightarrow \forall x \text{Sat}\_f^{(n)}(X, \gamma Ax) \rangle) \)

etc. etc.

322\textsuperscript{13} read “choice” for “choice”.

375\textsubscript{17} Read “\( \alpha > \alpha_0 \& \)” for “\( \alpha > \alpha_0 \)”.


391\textsubscript{13} read “(\( ax \neq 0 \))” for “(\( ax \neq 0 \))”.

391\textsubscript{11} Add after “\( \)” “in the presence of continuity axioms”.

398\textsubscript{12} Read “\( L[x] \)” for “\( L \)”.

414\textsubscript{11} Read “\( S_2 f \in Y \)” for “\( S_1 f \in Y \)”.

422\textsubscript{10} Read “\( \text{ID}_n \)” for “\( \text{ID}_n \)”.

433\textsubscript{10} Read “\( \text{ID}_n \)” for “\( \text{ID}_n \)”.

435\textsubscript{5} Read “\( P_t(Xn, n) \)” for “\( P_t(Xn, n) \)”.

439\textsubscript{16} Read “type-0-valued”.

14
Read "Max_1(\alpha, 0) = \alpha" for "Max_1(\alpha, 0)".

The equality in (7) of 6.9.1 was proved for all recursive \nu by 1977, independently by Buchholz, Pohlers and Sieg, using various sophisticated proof-theoretic techniques (see W. Buchholz, S. Feferman, W. Pohlers, and W. Sieg, Iterated Inductive Definitions and Subsystems of Analysis: Recent Proof-Theoretical Studies. Springer Verlag, Berlin 1977). Hence the equalities

|ID_2| = |ID_2| = |T_2|

hold (end of 6.8.9). Hence also the equalities (5) and (6) of 6.9.1 are true.

See the remark to page 448.

Read "(\lambda n. X_1 \ldots X_k)" for "(\lambda X_1 \ldots X_k)".

Insert before the second line "Corrections in the bibliography consist sometimes in replacements, sometimes in added information between square brackets."


Read "Cambridge Summer School in Mathematical Logic"


Add at the end "1973."

Delete.


Replace by: "Theoretical Computer Science 3 (1977), 225–242."

Add "[J.S.L. 41 (1976), 328–336]."

Add "[J.S.L. 40 (1975), 321–346]."

Add "[J.S.L. 41 (1976), 18–24]."

Read "Cellucci".

Read "Cambr. Proc. 1–94."

Add "[Did not appear]"

Read "Archiv für mathematische Logik 16 (1974), 49–66."

Add “, 232–252”.


Add “[Did not appear]”

Add “[Did not appear]”

Read “J.S.L. 41 (1976), 574–582.”

Read “Section VI” for “Section IV”.


Add: “[Never published]”


Read “Philosophica”.

Read “in” for “in:”.

Read “Zentralblatt”.

Read “IPT” for Oslo Proc.”

Read “Π₁” for “Π”.

Read “1” for “Γ”.


Read: “Compositio Mathematica 26 (1973), 261–275.”

Insert before stop: “, 225–250”.


Add “[Unpublished]”.

Read “1970” for “170”.

The ILLC Prepublication Series

Computational Linguistics
CL-91-01 J.C. Scholtes
CL-91-02 H.P. van Lambalgen

Other Prepublications
X-91-01 Alexander Chagrov, Michael Zachariaschew The Disjunction Property of Intermediate Propositional Logics
X-91-02 Alexander Chagrov, Michael Zachariaschew On the Undecidability of the Disjunction Property of Intermediate Propositional Logics
X-91-03 V. Yu. Shavrukov Subalgebras of Diagonalizable Algebras of Theories containing Arithmetic
X-91-04 K. Ignatiev Partial Conservativity and Modal Logics
X-91-05 Johan van Benthem Temporal Logic
X-91-06 Annual Report 1990
X-91-07 A.S. Troelstra Lectures on Linear Logic, Eratta and Supplement
X-91-08 G. Dzhaparidze Logic of Tolerance
X-91-09 L.D. Beklemishev On Bimodal Provability Logics for Π1-axiomatized Extensions of Arithmetical Theories
X-91-10 Michiel van Lambalgen Independence, Randomness and the Axiom of Choice
X-91-11 Michael Zachariaschew Canonical Formulas for K4, Part I: Basic Results
X-91-12 Herman Hendriks Flexibele Categoriale Syntax en Semantiek: de proefschriften van Frans Zwarts en Michael Mooijt
X-91-13 Max I. Kanovich The Multiplicative Fragment of Linear Logic is NP-Complete
X-91-14 Max I. Kanovich The Horn Fragment of Linear Logic is NP-Complete
X-91-15 V. Yu. Shavrukov Subalgebras of Diagonalizable Algebras of Theories containing Arithmetic, revised version
X-91-16 V.G. Kanovei Undecidable Hypotheses in Edward Nelson's Internal Set Theory
X-91-17 Michiel van Lambalgen Independence, Randomness and the Axiom of Choice, Revised Version
X-91-18 Giovanna Cappelletti New Semantics for Predicate Modal Logic: an Analysis from a standard point of view

Annual Report 1991

Logic, Semantics and Philosophy of Language
LF-92-01 Víctor Sánchez Valencia Lambek Grammar: an Information-based Categorial Grammar
LF-92-02 Patrick Blackburn Modal Logic and Attribute Value Structures
LF-92-03 Szabolcs Mikulás The Completeness of the Lambek Calculus with respect to Relational Semantics
LF-92-04 Paul Dekker An Update Semantics for Dynamic Predicate Logic
LF-92-05 David I. Beaver The Kinematics of Presupposition
LF-92-06 Patrick Blackburn, Edith Spaan A Modal Perspective on the Computational Complexity of Attribute Value Grammar
LF-92-07 Jeroen Groenendijk, Martin Stokhof A Note on Interrogatives and Adverbs of Quantification
LF-92-08 Mark de Rijke A System of Dynamic Modal Logic
LF-92-09 Johan van Benthem Quantifiers in the World of Typeς
LF-92-10 Maarten de Rijke Meeting Some Neighbours (a dynamic modal logic meets theories of change and knowledge representation)
LF-92-11 Johan van Benthem A note on Dynamic Arrow Logic
LF-92-12 Heinrich Wansing Sequent Calculi for Normal Modal Propositional Logics
LF-92-13 Dag Westerståhl Iterated Quantifiers
LF-92-14 Jeroen Groenendijk, Martin Stokhof Intermittent and Adverbs of Quantification

Mathematical Logic and Foundations
ML-92-01 A.S. Troelstra Comparing the theory of Representations and Constructive Mathematics
ML-92-02 Dmitrij P. Skvorostov, Valentin B. Shehtman Maximal Kripke-type Semantics for Modal and Superintuitionistic Predicate Logics
ML-92-03 Zoran Marković On the Structure of Kripke Models of Heyting Arithmetic
ML-92-04 Dimitar Vakarelov A Modal Theory of Arrows, Arrow Logics I
ML-92-05 Domenico Zambella Shavrukov's Theorem on the Subalgebras of Diagonalizable Algebras for Theories containing LA + EXP
ML-92-06 D.M. Gabbay, Valentin B. Shehtman Undecidability of Modal and Intermediate First-Order Logics with Two Individual Variables
ML-92-07 Harold Schellinx How to broaden your Horizon
ML-92-08 Raymond Hoofman Information Systems as Coalgebras
ML-92-09 A.S. Troelstra Realizability
ML-92-10 V.V. Shavrukov A Smart Peano's

Computation and Complexity Theory
CT-92-01 Erik de Haas, Peter van Emde Boas Object Oriented Application Flow Graphs and their Semantics
CT-92-02 Karen L. Kwaat, Sieger van Denneheuvel Weak Equivalence: Theory and Applications
CT-92-03 Krzysztof R. Apt, Kees Doets A new Definition of SDLNF-resolution
X-92-01 Heinrich Wansing The Logic of Information Structures
X-92-02 Konstantin N. Ignatiev The Closed Fragment of Dzhaparidze's Polymodal Logic and the Logic of $\Sigma_2$ conservativity
X-92-03 Willem Groenendijk Dynamic Semantics and Circular Propositions, revised version
X-92-04 Johan van Benthem Modeling the Kinematics of Meaning
X-92-05 Erik de Haas, Peter van Emde Boas Object Oriented Application Flow Graphs and their Semantics, revised version

Logic, Semantics and Philosophy of Language
LP-93-01 Martin Spann Parallel Quantification
LP-93-02 Makoto Kanazawa Dynamic Graphs, Equivalents and Monotonicity
LP-93-03 Nikolai Pankrat'ev Completeness of the Lambek Calculus with respect to Relativized Relational Semantics
LP-93-04 Jacques van Leeuwen Identity, Quarring with an Unproblematic Notion
LP-93-05 Jaap van der Does Sums and Quantifiers
LP-93-06 Paul Decker Updates in Dynamic Semantics

Mathematical Logic and Foundations
ML-93-01 Maciej Kandulski Commutative Lambek Categorial Grammars
ML-93-02 Johan van Benthem, Nathana Alechina Modal Quantification over Structured Domains
ML-93-03 Muti Puntus The Conjunctivity Relation in Lambek Calculus and Linear Logic
ML-93-04 Andrej Prijatelj Bounded Contraction and Many-Valued Semantics
ML-93-05 Raymond Hoofman, Harold Schellinx Models of the Untyped A-calculus in Semi Cartesian Closed Categories
ML-93-06 1. Zambell Categorial Generalization of Algebraic Recursion Theory
ML-93-07 A.G. Chagrov, L.A. Chagrova Algorithmic Problems Concerning First-Order Definability of Modal Formulas on the Class of All Finite Frames
ML-93-08 Raymond Hoofman, Ieke Moerdijk Remarks on the Theory of Semi-Funcors
ML-93-09 A.S. Troelstra Natural Deduction for Intuitionistic Linear Logic
ML-93-10 Vincent Danos, Jean-Baptiste Joinet, Harold Schellinx The Structure of Exponentials: Uncovering the Dynamics of Linear LogicProofs

Computation and Complexity Theory
CT-93-01 Marianne Kalsbeek The Vanilla Meta-Interpreter for Definite Logic Programs and Ambivalent Syntax
CT-93-02 Sophie Fischer A Note on the Complexity of Local Search Problems
CT-93-03 Johan van Benthem, Jan Berghoef Logic of Transition Systems
CT-93-04 Karen L. Kwaat, Sieger van Denneheuvel The Meaning of Duplicates in the Relational Database Model
CT-93-05 Erik Aarts Proving Theorems of the Lambek Calculus of Order 2 in Polynomial Time
X-93-01 Paul Dekker Existential Disclosure, revised version
Other Prepublications
X-93-02 Maarten de Rijke
X-93-03 Michiel Leenzenberg
X-93-04 A.S. Troelstra (editor) Metamathematical Investigation of Intuitionistic Arithmetic and Analysis, Corrections to the First Edition
X-93-05 A.S. Troelstra (editor) Metamathematical Investigation of Intuitionistic Arithmetic and Analysis, Second, corrected Edition