LOGIC COLLOQUIUM '83

AND

EUROPEAN SUMMERMEETING OF THE ASL

Ž Mijajlović

RWTH Aachen, West-Germany

JULY 18th-23rd, 1983

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CONTENTS

OUR THANKS FOR FINANCIAL SUPPORT WHICH MADE THIS CONFERENCE POSSIBLE

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Division of Logic, Methodology and Philosophy of Science (DLMPS)
EUREGIO Maas-Rhein REGIO Aachen e.V., Aachen
FAHO Gesellschaft von Freunden der Aachener Hochschule e.V.
GEI gesytec, Aachen
Gesellschaft für Mathematik und Informatik mbH, Aachen
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Nagel und Hoffbaur, Aachen
PROCOM, Aachen
Siemens AG, München
Stadtsparkasse Aachen, Aachen
Stadt Aachen

WELCOME ADDRESS

Ladies and Gentlemen,

the local organizers welcome you to Germany, to the city of Aachen, to the Rheinisch-Westfälische Technische Hochschule and to the Logic Colloquium '83
It makes us happy that so many scholars from countries all over the world have come together here to exchange information, to renew and strengthen old connections and to form new ones.

If you have any problems please contact the information desk or anyone of us.

Barbara Heußen

Susanne Kemmerich

Walter Oberschelp

Michael M. Richter

Britta Schinzel

Wolfgang Thomas

Christiane Weinand (Secretary)

COMMITTEES

PROGRAM COMMITTEE

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N. Guilleaume (Clermont Ferrand), P. Eklof (Irvine),
H. Läuchli (Zürich), G. H. Müller (Heidelberg),
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ORGANIZING COMMITTEE

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LOCAL ORGANIZERS

B. Heußen, S. Kemmerich, W. Oberschelp, M. M. Richter,
B. Schinzel, W. Thomas, Ch. Weinand.

GENERAL INFORMATION

1. CONGRESS BUILDING

All lectures will take place in the Karman Auditorium. Lecture rooms are FO 2, FO 3, FO 4, SFo 3, SFo 4, SFo 9 and SFo 10.

2. INFORMATION DESK

The information desk is in the entrance hall of the Karman Auditorium.

OPENING HOURS 9^{00} - 13^{00} and 15^{30} - 19^{00}.

TELEPHONE NUMBER 80 - 4299

NOTICE BOARD There is a notice board beside the information desk where you can find actual information. It may also be used for notices of the congress participants to each other.

3. BOOK EXHIBITION

There is a book exhibition in front of the lecture room FO 4 which is organized by Augustinus-Buchhandlung, Pontstr. 66, Aachen.

4. MEALS AND REFRESHMENT

i) There is a snack-bar in the congress building which offers snacks, pastry, coffee, tea, soft drinks.

Opening hours:	Mo - Fr	9^{00} - 18^{00}
	Sa	10^{30} - 12^{00}.

ii) There are two cafeterias of the university one of them in the Hauptgebäude (just opposite to the Karman Auditorium)
which offers one menue, several short meals, and breakfast

in the morning.
Opening hours: 8^{00} - 11^{30} and 12^{00} - 15^{30}.

The other one you find in the Auditorium Maximum (Wüllnerstr.). It offers two menues at noon and breakfast in the morning.
Opening hours: 8^{00} - 11^{00} and 11^{45} - 15^{30}.

iii) The student mensa you find at Turmstr. 3 (two menues at 1,80 DM and 2,50 DM).

iv) There are a lot of restaurants in the vicinity of the congress building (Templergraben, Pontstraße, Annuntiatenbach, Markt), which offer good and cheap menues.
Vegetarian restaurants:
Reuterhaus, Pontstr. and Zobra the Buddha, Römerstr.

5. TRANSPORTATION

USING PUBLIC BUSES

Public buses (ASEAG) may be used from the hotels to the congress building (get off at "Technische Hochschule, Templergraben"). You will find a map with the routes at the notice board beside the information desk.

TAXI PHONE NUMBERS

55 10 00, 55 10 55, 2 10 00, 22 00 0.

6. WORKING FACILITIES

LIBRARY

The Mathematics Library is open to the participants of the Logic Colloquium. The library is situated in the second floor of the Hauptgebäude, (just opposite to the congress building).
Opening hours: 8^{30} - 12^{00} and 13^{00} - 17^{00}.

Xeroxing

There are a lot of commercial copying shops near the congress building (for instance: Annuntiatenbach, Templergraben).

7. VARIOUS FACILITIES

Banks

Deutsche Bank, Pontwall 2
Stadtsparkasse Aachen, Pontstr. 137

Public Telephones

There are public telephones on the right side of the Hauptgebäude (opposite to the congress building).

Post Office

The nearest post office is at the corner of Templergraben and Hirschgraben.

Parking

There is a big free parking place at Bendplatz.

EXCURSIONS AND SOCIAL PROGRAM

1. RECEPTION IN THE TOWN-HALL

At Monday, July 18, 19^{30} - 21^{00}, there will take place a reception in the town-hall.
A welcome address will be given by Prof.Dr.W.Kruse, Erste Bürgermeisterin of the city of Aachen.

2. EXCURSION TO MONSCHAU

Monschau is a 900 year-old pretty town in the North Eifel Nature Park on the fringe of the Hohes Venn. It has many faces composed of dignified patrician's houses, winding lanes and picturesque views.
We have planned a walking-tour in the environ of Monschau and a stroll through the little town.

Time:	Wednesday, July 2o, 15^{oo}	
Starting-point:	Hauptgebäude, Templergraben 55	
Return:	18^{3o}	or
	21^{oo}	for those of you who want to have supper in Monschau
Fare:	5 DM	
Registration:	If you want to book this excursion please enter your name in the list " Excursion to Monschau " at the information desk till Tuesday, July 19, 17^{oo} and pay the fare.	

3. GUIDED CITY TOUR

If you want to stay at Aachen on Wednesday afternoon you are invited to take part in a guided city tour walking through the old city of Aachen. You will see the historic core, the cathedral which has just been included in the UNESCO list of the most important monuments of the world, and the townhall where German kings were crowned.

Time: Wednesday, July 2o, 14^{3o}

Starting Point: Haus Löwenstein, Markt, opposite to the town-hall

Fee: 2 DM

Registration: Please enter your name in the list "City Tour" at the information desk till Tuesday, July 19, 17^{oo} and pay the fee.

4. Guided Visit of the Cathedral and the Treasury

You will see the Cathedral with its octogonal Palatinate Chapel which numbers among the culturally most important monuments of the world. The Treasury contains one of the most precious church treasures this side of the Alps - with its Shrines of Charlemagne and of Mary, the Lothar Cross and the famous Charlemagne Bust.

Time: Wednesday, July 2o, 16^{3o}

Starting Point: Westside of the Kreuzgang (cloister) of the Cathedral

Fee: 3 DM

Registration: Please enter your name in the list "Cathedral and Treasury" at the information desk till Tuesday, July 19 17^{oo} and pay the fee.

5. Organ-Recital

Thursday July 21, $2o^{oo}$ in Adalbertkirche, Kaiserplatz given by

Ulrich Peters

Baroque works:

1. Ferdinando Richardson, (18^{th} century): Variatio

2. Girolamo Frescobaldi, (1583 - 1643): Capriccio sopra il cuccho

3. Antonio Vivaldi, (1678 - 1741): Concerto in d-moll
   bearbeitet für Orgel von J.S. Bach

Big Organ:

4. Hendrik Andriessen, (born 1892): Thema met variaties

5. Johann Sebastian Bach, (1685 - 1750): Dorische Toccata und Fuge, BWV 538

6. Felix Mendelssohn-Bartholdy, (1809 - 1847): Präludium und Fuge in d-moll

7. Olivier Messiaen, (born 1908): Jesù accepte la souffrance

Admission free

OPENING SESSION

Monday, July 18, 9^{30}

Karman Auditorium, FO 4

General Welcome

Prof. Dr. M. M. Richter
Chairman of the DVMLG

Address

Prof. Dr. W. Eversheim
Prorektor of the RWTH Aachen

Address and Opening of the Colloquium

Dr. Jansen
Oberkreisdirektor and Official Representative
of the EUREGIO
which has the patronage of the Logic Colloquium

SCIENTIFIC PROGRAM

TIME SCHEDULE

TIME	MONDAY	TUESDAY	WEDNESDAY	THURSDAY	FRIDAY	SATURDAY
$9^{30}-10^{20}$	Opening FO 4 addresses	Soare FO 4	Wainer FO 4	Jockusch FO 2	Feferman FO 4	Hinman FO 4
$10^{40}-11^{30}$	Pour-El FO 4	Rödding FO 4	Woodin FO 4	Woodin FO 2 Gurevich FO 3	Woodin FO 4 Lewis FO 3	Woodin FO 4 Moerdijk FO 3
$11^{50}-12^{40}$	Cherlin FO 4	Prestel FO 4	Weispfenning FO 4	Ziegler FO 4 Hajek FO 3	Thiel FO 4	Hodges FO 4
$16^{00}-18^{30}$ or $15^{30}-18^{30}$ (with *)	Generalized SFo 3 Quantifiers and Topological Model Theory - Recursion SFo 9 Theory - Intuitio- SFo 10 nistic Logic and Constructive Mathematics	Nonstandard SFo 3 Analysis - * Non - SFo 4 classical Logic - Set Theory I SFo 9 - Peano SFo 10 Arithmetic	Excursions	Boolean SFo 3 Algebras - Proof SFo 4 Theory - General SFo 9 Model Theory - Logic SFo 10 versus Computer Science (section)	* Logic SFo 3 versus Computer Science - Set Theory II SFo 9 - Model SFo 10 Theory and Groups	
	19^{30} Reception in the town-hall	20^{00} Moschovakis		20^{00} Organ-recital	20^{00} Scott	

INVITED LECTURES

Series on Recursion Theory

R. I. SOARE
U. of Chicago

Degrees of Models of Arithmetic

Tuesday July 19, 9^{30} - 10^{20}, FO 4

S. S. WAINER
Leeds

The Π^1_2- Approach to Subrecursive Hierarchies

Wednesday July 20, 9^{30} - 10^{20}, FO 4

C. JOCKUSCH
Urbana

1-Generic Degrees and Minimal Degrees

Thursday July 21, 9^{30} - 10^{20}, FO 2

P. HINMAN
Ann Arbor

Finitely Approximable Sets

Saturday July 23, 9^{30} - 10^{20}, FO 4

Series on Computation and Logic

D. RÖDDING
Münster

Some Logical Problems (and Results) Connected with a Modular Decomposition Theory of Automata

Tuesday July 19, 10^{40} - 11^{30}, FO 4

Y. GUREVICH
Ann Arbor

Logic Tailored for Computational Complexity

Thursday July 21, 10^{40} - 11^{30}, FO 3

H. R. LEWIS — Logical Syntax and Complexity
Harvard U.

Friday July 22, 10^{40} - 11^{30}, FO 3

Series on Set Theory

W. H. WOODIN — Aspects of Determinacy (I-IV)
Harvard U.

Wednesday July 20, 10^{40} - 11^{30}, FO 4
Thursday July 21, 10^{40} - 11^{30}, FO 2
Friday July 22, 10^{40} - 11^{30}, FO 4
Saturday July 23, 10^{40} - 11^{30}, FO 4

Series on Decidability in Field Theory

G. CHERLIN — Decidable Theories of Pseudo-Algebraically Closed Fields
Rutgers

Monday July 18, 11^{50} - 12^{40}, FO 4

A. PRESTEL — Decidable Theories of Real Fields
Konstanz

Tuesday July 19, 11^{50} - 12^{40}, FO 4

V. WEISPFENNING — Decidable Theories of Valued Fields
Heidelberg

Wednesday July 20, 11^{50} - 12^{40}, FO 4

M. ZIEGLER — Undecidability of Theories of Local Fields
Bonn
Thursday July 21, 11^{50} - 12^{40}, FO 4

Other Topics in Mathematical Logic and Foundation of Mathematics

S. FEFERMAN
Stanford

Between Constructive and Classical Mathematics

Friday 22, 9^{30} - 10^{20}, FO 4

P. HAJEK
Prag

A New Kind of Partial Conservativity and a Strengthening of Gödel's Second Incompleteness Theorem

Thursday July 21, 11^{50} - 12^{40}, FO 3

W. HODGES
Bedford C. London

The Model Theory of Locally Finite Groups

Saturday July 23, 11^{50} - 12^{40}, FO 4

J. MOERDIJK
Amsterdam

Monoid Models for Choice Sequences

Saturday July 23, 10^{40} - 11^{30}, FO 3

M. B. POUR-EL
U. of Minneapolis, Minnesota

Analysis and Physics from the Viewpoint of Computability: Banach Spaces, Linear Operators, and Eigenvalue Problems

Monday July 18, 10^{40} - 11^{30}, FO 4

C. THIEL
Erlangen

The Explicit Philosophy of Mathematics Today

Friday July 22, 11^{50} - 12^{40}, FO 4

Evening Lectures

Y. N. MOSCHOVAKIS U. of California, Los Angeles	Abstract Recursion Theory and the Semantic Specification of Algorithms Tuesday July 19, 20^{00} - 20^{50}, FO 4
D. SCOTT Carnegie-Mellon U., Pittsburgh	Logic and Computing Friday July 22, 20^{00} - 21^{00}, FO 4

SPECIAL SESSIONS

Generalized Quantifiers and Topological Model Theory

organized by J. Flum

Monday July 18, 16^{00} - 18^{30}, SFo 3

Lectures start at every full and half-hour.

J. C. MARTINEZ ALONSO Madrid	$(L\omega_1\omega)_t$-Equivalence for T_3-Spaces
H. LEIß Bonn	Beth's Theorem for Syntopogenous Structures
* A. RAPP Freiburg	Some Results on Logics with Malitz Quantifiers
P. H. SCHMITT Heidelberg	Decidability of the $L(Q_\alpha)$-Theory of the Class of all Ordered Abelian Groups
* Y. KAKUDA Kobe, Japan	Some Results and Problems Concerning Set Theory with a Filter Quantifier

Nonstandard Analysis

organized by K.-H. Diener

Tuesday July 19, 16^{00} - 18^{30}, SFo 3

Lectures start at every full and half-hour.

K.-H. DIENER Köln	Which Set Theory for the Working (Nonstandard) Mathematician?

H. W. BUFF Herisau, CH	ω-Konservativität der Nelson-Mengen- lehre
Sh.-Ch. LIU Taiwan	A Proof Theoretic Approach to Non-Standard Analysis (continued)
B. BENNINGHOFEN Aachen, Iowa City	Application of Superinfinitesimals to the Generalized Riemann Integral
A. SOCHOR Prag	Models for Alternative Set Theory

BOOLEAN ALGEBRAS

organized by S. Koppelberg

Thursday July 21, 16^{00} - 18^{30}, SFo 3

H. DOBBERTIN Hannover	Boolean Algebras an Vaught Monoids
A. MARCJA Florenz	Analyzing Elementary Theories by the Boolean Algebras of Definable Subsets of their Models
R. BONNET Paris	Sur les algebres de Boole d'intervalles
P. ŠTĚPÁNEK Prag	Automorphisms and Embeddings of Boolean Algebras

Logic versus Computer Science

organized by E. Börger

Friday July 22, 15^{30} - 18^{30}, SFo 3

Lectures start at every full and half-lour.

H. G. CARSTENS Bielefeld	Criteria for Unsolvability in Recursive Graph Theory
G. GERMANO Pisa	Functional Semantics without Recursion and Calculability on the Integers
A. WASILEWSKA Easton	Programs, Automata and Gentzen Type Formalizations
P. H. SLESSENGER Leeds	On Subsets of the Skolem Class T of Exponential Polynomials
M. D. DAVIS * E. WEYUKER New York	A Formal Notion of Program-Based Test Data Adequacy
E. DAHLHAUS Berlin	Combinatorial Characterisation of Spectra

* speaker

SECTIONS

Recursion Theory

Chairman: B. Benninghofen

Monday July 18, SFo 9

16^{00} J. N. CROSSLEY*; J. B. REMMEL
Clayton Clayton

Recursive Equivalence, Undecidability and Co-Simple COTs

16^{30} K. AMBOS-SPIES
Dortmund

Contiguous Degrees and Lattice Embeddings in the R.E. Degrees

17^{00} D. SPREEN
Aachen

Effective Operators in a Topological Setting

* speaker

Intuitionistic Logic and Constructive Mathematics

Chairman: J. Moerdijk

Monday July 18, SFo 10

16^{00} P. RODENBURG
Amsterdam

Correspondence Theory for Intuitionistic Logic

16^{30} Ch. KREITZ* ; K. WEIHRAUCH
Herdecke Hagen

Theory of Representations as a Basis for Constructive Analysis

* speaker

Non-Classical Logics

Chairman:

Tuesday July 19, SFo 4

15^{30} A. VINCENZI
Savona

Some Good Properties of Modal Model Theory

16^{00} B. BORIČIĆ
Belgrad

On an Intermediate Propositional System

16^{30} M. FONT
Barcelona

Monadicity in Topological Pseudo-Boolean Algebras

17^{00} J. CZELAKOWSKI
Kedzierzyn

Some Remarks on Finitely Based Logics

17^{30} J. HAWRANEK
Wrocław

On the Degree of Matrix Complexity of Johansson's Minimal Logic

18^{00} G. K. GARGOV
Sofia

Some Properties of Probability Logics

SET THEORY I

Chairman: F. R. Drake

Tuesday July 19, SFo 9

16^{00} E. KRANAKIS*; I. C. C. PHILLIPS
Heidelberg Minnesota

Partitions and Homogeneous Sets for Admissible Ordinals

16^{30} J. K. TRUSS
Paisley

Cancellation Laws for Surjective Cardinals

17^{00} A. URSINI
Siena

Some Problems in Set Theory

17^{30} J. BAETEN
Minnesota

Filters and Ultrafilters over Definable Subsets of Admissable Ordinals

18^{00} K. CIELSIELSKI
Warschau

Extensions of Invariant Measures on Euklidean Spaces

* speaker

PEANO ARITHMETIC

Chairman: H. G. Carstens

Tuesday July 19, SFo 10

16^{00} R. MURAWSKI
Posen

A "Negative" Result on Trace Expansions

16^{30} P. LINDSTRÖM
Göteborg

On Faithful Interpretability in Theories Containing Arithmetic

17^{00} R. KURATA
Fukuoka

A Simple Proof for a Statement which is Equivalent to Harrington's Principle

17^{30} Z. MIJAJLOVIĆ
Belgrad

Definable Points in Models of Peano Arithmetic

18^{00} Z. ADAMOWICZ
Warschau

Some Results on Weak Systems of Arithmetic

PROOF THEORY

Chairman:

Thursday July 21, SFo 4

16^{00} * W. SIEG
New York

A Note on König's Lemma

16^{30} J. DILLER
Münster

On the Reduction of ID_1

17^{00} P. SCHROEDER-HEISTER
Konstanz

Natural Deduction Calculi with Rules of Higher Levels

17^{30} U. SCHMERL
München

* Diophantine Equations in a Fragment of Number Theory

18^{00} E. WETTE
Hennef

1977 Wrocław Abstract Renewed:
Control for the Exhibition of Inconsistent Numbers

General Model Theory

Chairman: V. Weispfenning

Thursday July 21, SFo 9

16^{00} * G. CHERLIN; H. VOLGER*
New Haven Tübingen

Convexity Properties and Algebraic Closure Operators

16^{30} K. L MANDERS
Pittsburgh

Model Completeness in Geometry

17^{00} W. ZADROZNY
Heidelberg

* Introducing Partial Reflection

17^{30} * Z. RATAJCZYK
Warschau

Traces of Models on Initial Segments

18^{00} D. MUNDICI
Florenz

Higher Model Theory and Inverse Systems.

* speaker

Logic versus Computer Science

Chairman: D. Spreen

Thursday July 21, SFo 10

	Implicit Definitions on Finite Models: with Applications to DATA BASE Theory
16^{00}	M. E. SZABO Montreal
	Star-Deterministic Parallel Programs
16^{30}	Y. LU Nanjing
	Some Applications of Boolean Form to Analyse and Manage Large Data Sets
17^{00}	B. MIKOLAJCZAK Posen
	Proving System Properties with Help of Logic Functions
17^{30}	Th. STREICHER Linz
	A Solution for the Definability Problem for "Deterministic" Domains
18^{00}	J. MAKOWSKY Haifa

Set Theory II

Chairman: E. J. Thiele

Friday July 22, SFo 9

16^{00} I. JUHASZ
Budapest

Point-pickung games and HFD's

16^{30} A. KRAWCZYK
Warschau

Note on Random Reals

17^{00} A. PELC
Warschau

Universal and Maximal Invariant Measures on Groups

17^{30} W. BUSZKOWSKI
Posen

The Axioms Essential in Ackermann's Set Theory

18^{00} Ph. WELCH
Oxford

Σ_3^1-Wellfounded Relations and the Core-Model

Model Theory and Groups

Chairman: M. Ziegler

Friday July 22, SFo 10

16^{00} P. H. SCHMITT
Heidelberg

Model- and Substructure Complete Theories of Ordered Abelian Groups

16^{30} W. LENSKI
Mosbach

Elimination of Quantifiers for the Theory of Archimedian Ordered Divisible Groups in $L(Q_0^n)$

17^{00} R. L. SAMI
Kairo

Group Actions and the Vaught Conjecture

17^{30} Z. CHATZIDAKIS
New Haven

Model Theory of Profinite Groups Having IF

18^{00} S. THOMAS
London

Large Universal Logical Finite Groups

SECTION OF LATE PAPERS

Friday July 22, 16^{00} - , SFo 4

16^{00}

K. SEITZ
Budapest

Grouptheoretical Problems in Mathematical Logic

ABSTRACTS

NAME: K. Ambos-Spies

UNIVERSITY: Dortmund

TITLE OF THE TALK: Contiguous Degrees and Lattice Embeddings in the r.e.-Degrees

SECTION: Recursion Theory

ABSTRACT:

An r.e. (Turing) degree is *contiguous* if it contains only one r.e. weak truth table (wtt) degree. Ladner and Sasso (1975) observed that contiguous degrees can be used to translate results about r.e. wtt-degrees to ones about r.e. Turing degrees.

We present some new results on the existence of contiguous degrees, from which we deduce some new facts about the algebraic structure of the r.e. Turing degrees. E.g. we obtain the following embeddability criterion for finite distributive lattices: Such a lattice L is embeddable in an initial segment $R(\leq a)$ of the r.e. degrees by a map which preserves the least element iff the maximum number of elements of L which form pairwise minimal pairs is not greater than the maximum number of degrees in $R(\leq a)$ which are pairwise minimal pairs.

NAME: Irving H. Anellis

UNIVERSITY: Hamilton, Ontario

TITLE OF THE TALK: A New Proof of the Strong Version of the Löwenheim-Skolem Theorem

SECTION: By Title

ABSTRACT:

Let Q be full quantification theory and let F_{Qn} be the axioms of Q. We present each formula of Q in a Skolem Normal Form conjunction. If F_{Qn} allows, for every finite k, a formula $F_{Qk}^{n_k}$ which is k-satisfiable and is associated to the conjuncts of F_{Qn}, then $F_{Qn}^{n_k}$ is consistent. Now to a formula F^1 of Q 1-satisfiable, we conjoin an exhaustive list of formulas $F^2,\ldots,F^{n-1},F^n$ for Q consistent, and to each conjunct assign a value of i. By Herbrand expansion, eliminate all quantifiers and assign value j to constants replacing variables in the scope of quantifiers. If no F^m is a denial of $\bar{F}^m$ in the conjunction, the conjunction is 2-satisfiable.

For Q^* a standard model for Q, we obtain $F_{Q^*_k}^{n_k}$ k-satisfiable, and associate to k some element n of $N' = \langle 0, \omega, +, \cdot \rangle$. For 1 conjuncts in $F_{Q^*_k}^{n_k}$, we obtain a value n^1, and associate $\aleph_0$ to $K(n^g)=m$, for n^g max(N) and m the value of n^g. Thus, if $F_{Q^*_k}^{n_k}$ is k-satisfiable, it is $\aleph_0$-satisfiable if to $F_{Q^*_k}^{n_k}$ we replace some term

$F^{n^1}{}_{k_j g}$ with $F^{n^1}{}_{k_j m}$ and associate m to $\aleph_0$.
$(m=\omega)$

NAME: Jos Baeten

UNIVERSITY: Minnesota

TITLE OF THE TALK: Filters and ultrafilters over definable subsets of admissible ordinals

SECTION: Set Theory I

ABSTRACT:

ne search for a (countable) recursive analogue of a measurable cardinal leads
› a study of filters and ultrafilters over certain definable subsets of a
:ountable) ordinal, using the hierarchy of constructible sets.
›nnections with admissability are explored, and we find that the existence
: a normal (ultra)filter is stronger than the existence of the same type
: (ultra)filter. We look at the analogues of certain classical filters,
ımely the co-finite filter and the normal filter of closed unbounded sets.
›ntrary to intuition, any (normal) filter of a certain type on a countable
:dinal can be extended to a (normal) ultrafilter of the same type.

NAME: B. BENNINGHOFEN

UNIVERSITY: AACHEN

TITLE OF THE TALK: APPLICATIONS OF SUPERINFINITESIMALS TO THE GENERALIZED RIEMANN INTEGRAL

SECTION: NONSTANDARD ANALYSIS

ABSTRACT:

If $\varphi = [a,b] \to \mathbb{R}$ is a standard Riemann integrath function, $a = x_0 < x_1 < \ldots < x_n = b$, $\forall i < n \quad x_{i+1} \approx x_i \wedge \zeta_i \in [x_i, x_{i+1}]$, then $\int\limits_b^a \varphi(t)\, dt \approx \sum\limits_{i=0}^{n-1} (x_{i+1}-x_i)\cdot(\zeta_i)$. In order to get an integral which integrates all derivations, we consider a restricted set of infinitesimal partitions. We require that $\zeta_i \in \{x_i, x_{i+1}\}$ and $[x_i, x_{i+1}] \subseteq {}^\pi\mu_{\mathbb{R}}(\zeta_i)$ where ${}^\pi\mu_{\mathbb{R}}$ denotes the super-monad. Using these partitions we obtain the generalized Riemann integral. Using the theory of superinfinitesimals it is very easy to see that this integral has the following properties:

(i) Φ: $[a,b] \to \mathbb{R}$ continuous $A \subseteq [a,b]$, card $A \leq \aleph_0$, Φ' exists on $[a,b] \setminus A$. Then Φ' is integrable and $\Phi(b) - \Phi(a) = \int\limits_a^b \Phi'(t)\, dt$.

(ii) The generalized Riemann integral is an extension of the Lesbesgue integral and the Perron integral.

We also define a fuction which does not have a generalized Riemann integral. The following theorem which was also proved by different methods gives us more general examples:

Theorem

If φ, $|\varphi|$ have generalized Riemann integral on $[a,b]$ then $\varphi \in \mathscr{L}^1(a,b)$.

This theorem does also hold for a generalized Riemann-Stieltjes integral.

Theorem

φ: $[a,b] \to \mathbb{R}$ has a generalized Riemann integral $\Phi(x) := \int\limits_a^x \varphi(t)\, dt$.
Then Φ is continuous and we have:
$\varphi = \Phi'$ a.e.

The above theorems also hold for the Perron integral.
But it is an open question whether the generalized Riemann integral is a proper extension of the Perron integral.

NAME: R. Bonnet

UNIVERSITY: Claude Bernard, Lyon

TITLE OF THE TALK: SUR LES ALGEBRES DE BOOLE D'INTERVALLES

SECTION: Boolean Algebra

ABSTRACT:

Rappelons qu'historiquement, les algèbres de Boole interviennent en logique (Lindenbaum - Tarski), théorie de la mesure, et plus récemment en théorie des ensembles et en topologie.

Dans cet article, on va exposer quelques aspects relatifs aux algèbres de Boole d'intervalles. On commence (§ 0) par expliciter la dualité "algèbres de Boole - espaces Booléiens" (M.Pouzet, voir aussi Ch.Charretton et M.Pouzet) ; il est à noter que l'espace est "concret" et que l'on n'utilise pas l'axiome de l'ultrafiltre et donc pas l'axiome du choix. Le § 1 sera consacré aux algèbres de Boole dénombrables (théorèmes de Mostowski-Tarski ; Mayer-Pierce, Ketonen) et un résultat (non encore publié) concernant le théorème de Tarski sur l'équivalence élémentaire, dans le cas des algèbres dénombrables. Enfin dans le § 2, on développera les algèbres rétractives (Rubin), les types d'isomorphie (en utilisant les idées de Shelah) et les algèbres rigides.

NAME: Branislav R. Boričić

UNIVERSITY: Belgrad

TITLE OF THE TALK: On an Intermediate Propositional System

SECTION: Non-classical Logics

ABSTRACT:

By giving a positive solution to the problem posed in [6] we have shown (v. [1]) that the sequence of intermediate propositional systems NLC_n $(n \geqslant 1)$ contains three different systems only: the classical propositional calculus NLC_1, Dummett's system NLC_2 (v. [3]) and the system NLC_3. We will consider the completeness, separability and decidability of the last system.

Note that NLC_3 can be axiomatized by adding the formula c_3: $((A \to B) \to D) \to (((B \to C) \to D) \to (((C \to A) \to D) \to D))$ as an axiom to the Heyting propositional calculus H. $IH+c_3$ is the positive implicational calculus (v. [2]) extended by c_3.

T h e o r e m 1. $IH+c_3$ is characterised by all Kripke frames (X,R) (i.e. partially ordered sets) with property

$(*)$ $(\forall x,y,z \in X)(xRy \vee yRz \vee zRx)$.

T h e o r e m 2. $H+c_3$ (i.e. NLC_3) is characterised by all Kripke frames with property $(*)$.

C o n s e q u e n c e. $H+c_3$ is a conservative extension of $IH+c_3$.

Having in mind that the condition $(*)$ is absolute (v. [4]), we have:

T h e o r e m 3. $H+c_3$ is characterised by the class of all finite Kripke frames with $(*)$.

In other words, $H+c_3$ has the finite model property. Hence, by result of Harrop [5], we have:

T h e o r e m 4. $H+c_3$ is decidable.

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NAME: H.W. Buff

UNIVERSITY: Herisau

TITLE OF THE TALK: ω-Konservativität der Nelsonmengenlehre

SECTION: Nonstandard Analysis

ABSTRACT:

Die Nichtstandardmengenlehre von Nelson (Edward Nelson: Internal Set Theory, a new approach to Nonstandard Analysis, Bull AMS 83(6), 1977) ist eine Erweiterung von einer "gewöhnlichen" Mengenlehre, zB von ZFC. Zusätzlich zur zweistelligen Relation $\in$ ("ist Element von") wählt Nelson ein einstelliges (undefiniertes) Prädikat st ("ist standard") und formuliert drei Axiomenschemata (T), (I) und (S).
(T) besagt, dass das Universum aller Mengen eine elementare Erweiterung des Teiluniversums der Standardmengen ist, (I) gewährleistet die Existenz von Nichtstandardmengen, welche bei Robinson für "concurrent relations" von Fall zu Fall als neue Objekte relativ widerspruchsfrei dazugenommen werden dürfen, und (S) ist ein Aussonderungsschema für Standardmengen.

Lässt man das Auswahlaxiom weg, so lässt sich (aus ZF+(T)+ +(I)+(S)) immerhin noch eine abgeschwächte Form des Auswahlaxioms, nämlich der Kompaktheitsatz, herleiten.

Die vorliegende Arbeit zeigt, dass sich das volle Auswahlaxiom nicht aus ZF+(T)+(I)+(S) herleiten lässt:

Jeder Satz der Sprache $\{\in\}$, welcher aus ZF+(T)+(I)+(S) herleitbar ist, ist in allen ω-Modellen von ZF+Kompaktheit (natürliche Zahlen vom Ordnungstyp ω) gültig.

NAME: W. Buszkowski

UNIVERSITY: Posen

TITLE OF THE TALK: The Axioms Essential in Ackermann's Set Theory

SECTION: Set Theory I

ABSTRACT:

Scott [6] proved that the theory ZF without the axiom of extensionality is interpretable in Z, hence it is considerably weaker than ZF. Here we show that after simultaneous dropping the axiom of extensionality and the axiom of heredity from Ackermann's set theory A (cf. Ackermann [1]) one still obtains a system equivalent (up to interpretation) to A. The remaining axioms of A appear to be essential.

The logic of A is first-order logic with identity; the non-logical symbols are $\in$ (membership) and S (a monadic predicate). The individual variables x, y, z (also with indices) range over the pure classes; S(x) means "x is a set".

By $\underline{A}$ (resp. $\underline{B}$) we denote any (resp. S-free) formula of A; by $\overline{x}$ any string of individual variables; by $(\forall\overline{x})_P$, $(\exists\overline{x})_P$, $\underline{A}^P$, where P is a primitive or defined monadic predicate, we denote the quantifiers restricted to P and the relativization of $\underline{A}$ to P, respectively.

We now list the axioms of A (they have no free variable):

(E) $\forall x,y(\forall z(z\in x \leftrightarrow z\in y) \rightarrow x = y)$ (extensionality),

(H) $\forall x,y(S(x) \,\&\, y\in x \rightarrow S(y))$ (heredity),

(S) $\forall x,y(S(x) \,\&\, \forall z(z\in y \rightarrow z\in x) \rightarrow S(y))$, (subset),

(CE) $\forall\overline{x}(\forall x(\underline{A} \rightarrow S(x)) \rightarrow \exists y\forall x(x\in y \leftrightarrow A))$ (class existence),

(SE) $(\forall\overline{x})_S(\forall x(\underline{B} \rightarrow S(x)) \rightarrow (\exists y)_S\forall x(x\in y \leftrightarrow \underline{B}))$ (set existence).

NAME: H.-G. Carstens - P. Päppinghaus

UNIVERSITY: Bielefeld - Hannover

TITLE OF THE TALK: Criteria for Unsolvability in Recursive Graph Theory

SECTION: Logic versus Computer Science

ABSTRACT:

We are interested in recursive aspects of the theory of countable graphs, in particular in giving counterexamples obstructing recursive solutions for graph theoretical problems. For instance we look at infinite paths matchings, colorings, or Ramsey-sets.

Most constructions of counterexamples in the literature are strikingly similar diagonalizations which work as follows. With every algorithms one associates an infinite subgraph of the graph to be defined and thinks of the e-th algorithm as working on the e-th subgraph. With different stages of the computations one associates growing finite subgraphs of these infinite subgraphs, i.e. to stage zero a "start graph" and to stage n+1 a "cable graph" extending the graph for stage n . Whenever one of the algorithms, say the e-th one, has computed sufficiently many values a "trap" is built into the e-th subgraph obstructing these values as part of a solution.

We mimic this constructions in an abstract framework, giving general theorems which reduce the work of defining a counterexample to the "finite geometry", i.e. the task of drawing a start, a cable and a trap.

By this we give "the essence of the counterexamples" and everything else is routine which we have done here once and for all.

NAME: Z. Chatzidakis

UNIVERSITY: New Haven

TITLE OF THE TALK: Model Theory and Profinite Groups Having IP

SECTION: Model Theory and Groups

ABSTRACT:

We refer to [CDM] for the basic definitions and facts about co-model theory and profinite groups having IP. By developing the analogue of stability theory for these groups, we obtain some structure theorems.

Definition: [LH]. Let H be a profinite group. A universal embedding cover (UEC) for H is a profinite group G having IP with a continuous epi θ $G \twoheadrightarrow H$ such that every diagram

$$\begin{array}{ccc} & & G \\ & & \downarrow \theta \\ J & \xrightarrow{\varphi} & H \end{array}$$

where φ is a continuous epi and J has IP can be completed by a continuous epi $G \twoheadrightarrow J$ to a commuting diagram.

Theorem 1: Let G be a profinite group having IP. Then Th(S(G)) is ω-stable.

Theorem 2: Every profinite group has a UEC, unique up to topological isomorphism.

The study of saturated models gives us the following

Theorem 3: Let $\kappa \geq \chi_0$, let G_κ be the profinite completion of the discrete free group on κ generators. Then G_κ is topologically isomorphic to the free profinite group on 2^κ generators.

Theorem 4: Let $(K_i)_{i\in I}$ be a family of fields whose absolute Galois groups are free. Then the absolute Galois group of any ultraproduct of the K_i's is also free.

We also interpret the notions of multidimensionnality and DOP. As a corollary we get:

Theorem 5: Let T be the theory of the free profinite group on χ_c generators.

1) There is a model G of T, and a diagram

$$\begin{array}{ccc} & & G \\ & & \downarrow \\ G & \longrightarrow & A \end{array}$$

where both maps are continuous epis, and A is a finite group, which cannot be completed.

2) There are 2^κ (non topologically isomorphic) models of T of cocardinality κ.

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NAME: G.L. Cherlin and H. Volger

UNIVERSITY: New Haven / Tübingen

TITLE OF THE TALK: Algebraic Closure Operators and Convexity Properties

SECTION: General Model Theory

ABSTRACT: In 1962 M.O.Rabin has given a syntactic characterization of those elementary classes which are closed under arbitrary intersections. Extending results of D.M.R. Park in 1964 we are able to give a syntactic characterization of those elementary classes which are closed under intersections of descending chains , thus solving a problem left over from the early sixties.

More generally , we consider convexity (=intersection) properties for partially ordered sets of models and embeddings for a given partial order P . Our methods are based on a new set of algebraic closure operators , which are algebraic in the following sense: A given substructure A of a structure B is being closed under the addition of finite A-definable subsets. In the case of arbitrary intersections resp. intersections of descending chains we can show that the corresponding convexity property is equivalent to heredity w.r.t. closed substructures for an appropriate closure operator. This leads to a syntactic characterization in both cases. However , the characterization in terms of the closure operator seems to be more useful. In addition , we can show that these are the only convexity properties.

More generally , we replace embeddings by embeddings w.r.t. a given set of formulas. In the general situation there can be at most ω+2 convexity properties. In the case of elementary embeddings there is exactly 1 convexity property. However, the syntactic characterization of this convexity property remains an open problem.

AMS-Classification: 03 C 40,52

Key words: Preservation theorem, Convexity (=intersection) property, Algebraic closure operator

NAME: Krzysztof Ciesielski

UNIVERSITY: Warschau

TITLE OF THE TALK: Extensions of invariant measures on Euclidean spaces

SECTION: Set Theory I

ABSTRACT:

A measure on a set X is a non-negative, extended real valued function m defined on a σ-algebra $\mathfrak{M}$ of subsets of X containing all singletons, such that: $m(\{x\}) = 0$ for any $x \in X$, $m(X) > 0$, $m(\bigcup_{n\in\omega} A_n) = \sum_{n\in\omega} m(A_n)$ for pairwise disjoint sets A_n from $\mathfrak{M}$. A measure is: σ-finite iff X is a countable union of sets of finite measure; semiregular iff every set of positive measure contains a set of positive finite measure; universal iff it is defined on $P(X)$. If G is any group of bijections of a set X, a measure m defined on a σ-algebra $\mathfrak{M}$ of subsets of X is G-invariant iff $g[A] \in \mathfrak{M}$ and $m(g[A]) = m(A)$ for any $g \in G$ and $A \in \mathfrak{M}$.

The following results were obtained by K. Ciesielski and A. Pelc. The first theorem provides a solution of a problem of Sierpiński:

Theorem 1. Let G be any group of isometries of the Euclidean space E^n, which contains all translations. Then every σ-finite G-invariant measure on E^n has a proper extension. In particular there is no maximal G-invariant extension of the Lebesgue measure on E^n.

For semiregular measures the situation is different:

Theorem 2. Let G be any group of isometries of the Euclidean space E^n. The following are equivalent:

/a/ there exists a real valued measurable cardinal κ such that $\kappa \leq 2^\omega$,

/b/ there exists a universal semiregular G-invariant measure on E^n,

/c/ there exists a maximal semiregular G-invariant measure on E^n.

NAME: J.N. Crossley and J.B. Remmel

UNIVERSITY: Clayton

TITLE OF THE TALK: Recursive Equivalence, Undecidability and CO-Simple COTs

SECTION: Recursion Theory

ABSTRACT:

We continue work published in our Recursive Equivalence and Undecidability, I (Proceedings of South-East Asian Logic Conference, Singapore 1981, ed. C.T. Chong).

$<_w$ and $<_w^*$ are the orderings on constructive order types (COTs) given by $\underline{A} <_w \underline{B}$ ($\underline{A} <_w^* \underline{B}$) if there exist representatives $\underline{\underline{A}} \in \underline{A}$ and $\underline{\underline{B}} \in \underline{B}$ and a one-one, partial recursive order preserving map of $\underline{\underline{A}}$ onto an initial (final) (not necessarily r.e. separable) segment of $\underline{\underline{B}}$.

THEOREM 1. (i) The theory of constructive order types with $<$ and $<^*$ as its only non-logical constants is undecidable and recursively isomorphic to second order arithmetic.

(ii) As for (i) with $<_w$ and $<_w^*$ replacing $<$ and $<^*$.

THEOREM 2. (i) Each of the following theories with $<$ and $<^*$ as the only non-logical constants is undecidable and recursively isomorphic to second order arithmetic: (a) co-ordinals, (b) quords, (c) quasi-finite COTs, (d) losols.

(ii) As for (i) with $<_w$ and $<_w^*$ replacing $<$ and $<_w^*$.

A COT $\underline{A}$ is said to be co-simple if there exists $\underline{\underline{A}} \in \underline{A}$ where $\underline{\underline{A}}$ as a set (of natural numbers) is immune and its complement is r.e.

THEOREM 3. The theory of co-simple COTs (a) with $+$ and (b) with $<$ and $<^*$ as its only non-logical constants is undecidable.

NAME: Janusz Czelakowski

UNIVERSITY: Kedzierzyn

TITLE OF THE TALK: Some remarks on finitely based Logics

SECTION: Non-classical Logics

ABSTRACT:

There are many nonequivalent definitions of sentential logics. Some logicians prefer to call a logic any invariant (i.e. closed under substitutions) set of formulas that is additionally closed under some explicitly given rules of inference. Thus the term 'logic' is understood here as 'logical theory', i.e. as a set of sentences that tell us what is logically true much the same as say laws of physics tell us "truth" about physical phenomena. This attitude is shared by people working in modal and intermediate logics. But logic is also viewed as a tool that serves us to draw valid conclusions from valid premises. According to this standpoint, logic is a set of valid inferences, not just valid formulas. The difference is essential: the notion of a valid formula can be defined in terms of valid inferences but, in general, not vice versa. Thus we face two different methodological perspectives. The one that dominates in Polish writings is inferential. The inferential approach was originated by Alfred Tarski in the thirties with his works on deductive systems and consequence operation, and then continued by Łoś, Suszko, Rasiowa, Wójcicki, to mention only a few names. We shall follow this line.

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NAME: Elias Dahlhaus

UNIVERSITY: Berlin

TITLE OF THE TALK: Combinatorial Characterisation of Spectra

SECTION: Logic versus Computer Science

ABSTRACT:

Scholz(5) defined spectra as sets of the finite cardinalities of the models of a fixed first-order theory. Asser(1) published the complement closure of spectra as an open problem, and Fagin(3) and Jones and Selman(4) described connections between spectra and NP. Motivated by the NP-completeness of CLIQUE, I will give following characterisation of spectra:

$(G_n : n \in \mathbb{N}) = ((V_n, E_n) : n \in \mathbb{N})$ is called a system of equality graphs: iff

i) there exists a natural number ν, s.t. for each natural number n:
$V_n := (n)^\nu := \{(x_0..x_{\nu-1}) : x_0...x_{\nu-1} < n$ and for $i \neq j : x_i \neq x_j\}$

and

ii) there are $T_0...T_m \subseteq \{0...\nu-1\}^2$ (equality colours), s.t. for each $T_j : (i,k),(i',k') \in T_j$ implies ($i \neq i'$ and $k \neq k'$) or ($i=i'$ and $k=k'$) (partial bijection property), and for each natural number n:
$\{(x_0...x_{\nu-1}),(y_0..y_{\nu-1})\} \in E_n$ iff there is an equality colour T_j, s.t. for each $i,k < \nu$: $x_i = y_k$ iff $(i,k) \in T_j$ or for each $i,k < \nu$: $y_i = x_k$ iff $(i,k) \in T_j$

THEOREM: $S \subseteq \mathbb{N}$ is a spectrum iff there is a system of equality graphs $(G_n : n \in \mathbb{N})$ and a polynom P and a natural number k, s.t for allmost all $n \in \mathbb{N}$:
$n \in S$ iff G_{n+k} has a clique of cardinality P(n) (see also Dahlhaus(2))

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2) Dahlhaus: Doctoral Dissertation, FB 20, TU(D83), 1982.

3) Fagin: Generalized First Order Spectra and Polynomial Time Recognizable Sets, SIAM-AMS Proceedings, Vol.7, 1974

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5) Scholz: Ein ungelöstes Problem der symbolischen Logik, JSL 17(1952), p.160.

NAME: M.D. Davis und E. Weyuker

UNIVERSITY: New York, Courant Institut

TITLE OF THE TALK: A Formal Notion of Program-Based Test Data Adequacy

SECTION: Logic versus Computer Science

ABSTRACT:

Computer programs are generally certified for use after they have performed successfully on a particular set of inputs called the test data. Implicit in this procedure is the idea that it makes sense to speak of a particular set of test data as being adequate for a particular program. We propose and study a formal notion intended to explicate this idea. Our first attempt is to regard a finite set T as adequate for a program P if P is extensionally equivalent to all programs "shorter" than P that produce the same outputs as P on inputs from T. But a diagonal construction shows that most programs will fail to have a test set adequate in this sense. This result calls attention once again to the pervasiveness of diagonal constructions made possible by self-reference. This is not the first time that these theoretical considerations have had their effect on efforts to guarantee the quality of software. We avoid the diagonal construction by modifying our definition of adequacy by eliminating from the class of "shorter" programs with which P is being compared, all programs that (in a sense which we make precise) have parts extensionally equivalent to P. We show that with this modification, our notion of adequacy subsumes several adequacy notions used in practice, that lower and upper bounds are obtainable on the size of the test data needed for adequacy, and that our notion leads to a suggestive notion of critical elements which must be present in every adequate set of test data.

NAME: K.-H. Diener

UNIVERSITY: Köln

TITLE OF THE TALK: Which Set Theory for the (Nonstandard) Mathematician?

SECTION: Nonstandard Analysis

ABSTRACT:

The classical approach to Nonstandard Analysis is based on higher-order structures and their enlargements. This involves the use of a type-theoretic language and the "construction" of specific enlargements in every particular case. To avoid these disadvantages, E. NELSON (Bull.Am.Math.Soc. 83 (1977), 1165-1198) and K. HRABACEK (Fund.Math. 98 (1978), 1-19) suggested various extensions of first order ZF set theory, providing a unifying framework for nonstandard mathematics with "built-in" nonstandard elements for every infinite set.

In this talk we compare NELSON's and HRABACEK's set theories and discuss their advantages and disadvantages. Furthermore, we will formulate and investigate a version of a NELSON type set theory avoiding some of the difficulties of NELSON's original system.

NAME: Justus Diller

UNIVERSITY: Münster

TITLE OF THE TALK: On the reduction of ID_1

SECTION: Proof Theory

ABSTRACT:

In the standard reduction of ID_1 to $ID_1(W)$, the theory of well-founded recursive trees, there remains a gap concerning arithmetic comprehension (with second order parameters) which is used to reduce ID_1 but cannot be imbedded into $ID_1(W)$ by relativization to Rec(W). We close this gap as follows.

For $\mathbb{F}$ a class of formulae, let $\mathbb{F}$-$\forall E$ be the schema $\forall X F(X) \rightarrow F(G)$ for $F(X) \in \mathbb{F}$ and arbitrary G. $\mathbb{F}^-$-$\forall E$ is the corresponding schema with no second order parameters in F(X) besides X. It is well known that $(\Pi^{0-}_\infty\text{-}\forall E) \supseteq ID_1$ and $(BI_{pr})^- \vdash \Sigma^{0-}_1\text{-}\forall E$ for functions, which is $\forall \alpha \exists R(\overline{\alpha}x) \rightarrow \forall x \exists! y G(x,y) \rightarrow \exists x R(\overline{G}(x))$ for primitive-rekursive R(s) without second order parameters and arbitrary G. However, the following seems to have escaped notice.

Proposition. $(BI_{pr})^- = (\Sigma^{0-}_1\text{-}\forall E$ for functions$) = (\Pi^{1-}_1\text{-}\forall E)$ (and the same without the superscript $^-$).

The essential step $(\Sigma^{0-}_1\text{-}\forall E$ for functions$) \vdash \Pi^{1-}_1\text{-}\forall E$ is due to H.D. Wunderlich from Münster and makes use of first order identities only. This yields

$$ID_1 \subseteq (\Pi^{1-}_1\text{-}\forall E) = (BI_{pr})^- \subseteq ID_1(W) .$$

NAME: Hans Dobbertin

UNIVERSITY: Hannover

TITLE OF THE TALK: Boolean Algebras and Vaught Monoids

SECTION: Boolean Algebras

ABSTRACT:

Let BA_κ (κ infinite cardinal) denote the monoid, under direct sums, of all isomorphism types of Boolean algebras with cardinality $\leq \kappa$. In [1] it has been shown that for each κ there exists a greatest Vaught monoid V_κ of sum rank κ, unique up to isomorphism.

THEOREM 1. ([1]) $BA_\omega = V_\omega$.

$\overline{BA}_\kappa$, denoting BA_κ factorized by its greatest Vaught relation, is a Vaught monoid for $\kappa > \omega$.

THEOREM 2. $\overline{BA}_{\omega_1} = V_{\omega_1}$.

PROBLEM. Is $\overline{BA}_\kappa = V_\kappa$ true for $\kappa > \omega_1$?

I conjecture an affirmative answer, at least under suitable set-theoretical assumptions.

Reference

[1] H. Dobbertin, On Vaught's criterion for isomorphisms of countable Boolean algebras, Algebra Univ. 15 (1983), 95 - 114.

NAME: J.M. Font

UNIVERSITY: Barcelona

TITLE OF THE TALK: Monadicity in Topological Pseudo-Boolean Algebras

SECTION: Non-classical Logics

ABSTRACT:

The problem of selecting an intuitionistic analogue of modal system S5 (and the one of finding good criteria for this) has been deeply studied by G. Fischer-Servi, after an initial setting of R.A. Bull, in the case where L and M are both primitive operators and neither of the equations $L = \neg M \neg$ and $M = \neg L \neg$ hold.

We investigate the algebraic consequences of applying the Gödelian proposal (take L primitive and define M as $\neg L \neg$) to an intuitionistic base. Topological pseudo-Boolean algebras are the algebraic models of the intuitionistic analogue of S4. In our work we examine several (algebraic or logical) conditions classically used to reach S5 from S4, that is, monadic Boolean algebras from topological ones. So we are approaching the concept of monadicity in pseudo-Boolean algebras.

We find six "equivalence classes" of conditions :

A { $M\neg Mp \leftrightarrow \neg Mp$ (von Wright 1951) ; $M(p \wedge Mq) \leftrightarrow Mp \wedge Mq$ (Halmos 1955) ; $\neg(p \wedge Mq)$ implies $\neg(Mp \wedge Mq)$ (Davis 1954) }

B { $L\neg Lp \leftrightarrow \neg Lp$ (Wajsberg 1933, Monteiro 1971, and credited to Gödel 1933 by Prior, possibly erroneously) ; $LMp \leftrightarrow Mp$ (Lewis and Langford 1932) ; $p \to LMp$ (Becker 1930) ; $Mp \to q$ implies $p \to Lq$ }

C { $L(Lp \to q) \leftrightarrow (Lp \to Lq)$ (Beth and Nieland 1965) }

D { Semisimplicity (Halmos, Monteiro) ; $MLp \leftrightarrow Lp$; $MLp \to p$; $L\neg Lp \vee Lp$ (Bull 1965) }

E { $L(p \vee Lq) \leftrightarrow (Lp \vee Lq)$ (Monteiro) }

F { The closed elements form a subalgebra (Halmos, Davis) }

and the following implications between them : $D \to C$, $D \to F$, $D \to E$, $C \to B$, $F \to A$, $B \to A$

We also prove several algebraic properties of the subclasses of topological pseudo-Boolean algebras that naturally arise. Most of these properties have a strong intuitionistic character, for instance those concerning dense elements and regular elements; others gradually approach classical properties such as duality between open and closed elements via negation or the structure of filters.

NAME: G. Germano

UNIVERSITY: Pisa

TITLE OF THE TALK: Funtional Semantics without Recursion and Calculability on the Integers

SECTION: Logic versus Computer Science

ABSTRACT:

Functional semantics of programs and calculability. Semantics of while independently from recursion and fix-point theory. Iterative calculability on natural numbers revisited. Iterative calculability on integers and computational induction. Extending the Church-Thesis to functions on integers.

NAME: Petr Hajek

UNIVERSITY: Prag

TITLE OF THE TALK: A new kind of partial convervativity

SECTION: Invited lecture

ABSTRACT: PA is Peano arithmetic, $PA_c = PA + \{c > \bar{n},\ n \text{ natural}\}$ (PA with a constant for a non-standard element). A Δ-formula $\Phi(x)$ is $(2^c,c)$-conservative if, for each Δ-formula $\Psi(x)$, $PA_c \vdash \Phi(2^c) \rightarrow \Psi(c)$ implies $PA_c \vdash \Psi(c)$. Similarly for $(2^{2^c},c)$-conservativity etc.

Theorem 1. There is a Φ such that both Φ and $\neg\Phi$ is $(2^{2^c},c)$-conservative.

Theorem 2. The set of all $(2^{2^c},c)$-conservative formulas is Π^0_2-complete.

Theorem 3. There is a Φ such that $PA_c \nvdash \Phi(2^c)$ and Φ is $(2^c,c)$-conservative.

Theorem 4. The formula $\neg Con(x)$ saying (roughly) "beneath x, there is a proof of contradiction in PA" is $(2^{2^{2^{2\cdot c}}},c)$-conservative.

Fact. Φ is $(2^c,c)$-conservative iff for each non-standard $M \models PA$ and each $b \in M - N$ there is a $M' \models PA$ containing b, identical with M beneath b and such that $M' \models \Phi(2^b)$. Similarly for 2^{2^c}, etc.

Corollary. For each $M \models PA$ and each $b \in M - N$ there is a $M' \models PA$ containing b, identical with M beneath b and such that in M' there is a $d < 2^{2^{2^{2\cdot b}}}$ which is a proof on contradiction in PA.

Remark. The work of Paris and Dimitracopoulos was the main inspiration for obtaining these results.

NAME: Martha Harrell

UNIVERSITY: St. John's, New York

TITLE OF THE TALK: Solved and Unsolved Problems in Axiomatic Geometry

SECTION: By Title

ABSTRACT:

Euclid's Elements, the most influential primer of all times and famous, inter alia, for its axiomatic method, had its image tarnished among mathematicians by new developments in geometry and logic beginning in the 18th C. with forerunners of Non-Euclidean geometry. The security of fundamental principles of geometry as well as of axioms and rules of inference thereof, however, may well be questioned in the context of such developments as Non-Euclidean geometries, local and global differential geometry together with applications in theories of relativity, the discovery of and responses to paradoxes of set theory and Gödel's incompleteness results.

I will discuss two solved problems, briefly, and two related unsolved problems, in the remaining allotted time. The solved problems are: (i) the status of Euclid's Parallel Postulate and (ii) the status of extended function calculi and certain associated higher-order logic(s); emphasis here is upon implications for the security of geometry and contribution to the two unsolved problems I will consider next. The unsolved problems to be discussed are: (i) that regarding theory of order in geometry and (ii) the question whether geometry is in some way an extension of arithmetic, especially where arithmetic, and thus such parts dependent upon it as algebra and analysis, holds priority and superior strength.

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NAME: Jacek Hawranek

UNIVERSITY: Wroclaw

TITLE OF THE TALK: On the degrees of matrix complexity of Johansson's minimal logic

SECTION: Non-classical logic

ABSTRACT:

This paper is a contribution to the subject of matrix semantics, as originally presented by Łoś and Suszko [2] and developed by Wójcicki [3],[4]. By <u>sentential logics</u> we shall understand any pair (L,C), where C is a consequence operation on a sentential language L and : 1. L is an absolutely free algebra of formulas generated by a denumerable set of sentential variables, 2. C is <u>structural</u>, that is $eC(X)\subseteq C(eX)$ for all $X\subseteq L$ and $e\in End(L)$.

A pair $M=(A,D)$ is called a <u>matrix</u> for L provided that A is an algebra similar to L and the set D of designated elements is a subset of A. Every such M determines a structural consequence operation Cn_M given by the following formula: $\alpha\in Cn_M(X)$ iff for each valuation $h\in Hom(L,M)$, if $hX\subseteq D$ then $h\alpha\in D$. If $\mathbb{K}$ is a class of matrices for L we define $Cn_{\mathbb{K}}$ as follows:

$$Cn_{\mathbb{K}}(X)=\bigcap\{Cn_M(X):\ M\in\mathbb{K}\},\ \text{for all } X\subseteq L,$$

i.e.,

$$Cn_{\mathbb{K}}=\inf\{Cn_M:\ M\in\mathbb{K}\}.$$

A class $\mathbb{K}$ is strongly adequate for C if $C=Cn_{\mathbb{K}}$. When $\mathbb{K}$ is countable and each member of $\mathbb{K}$ is countable, then C is said to have a <u>countable semantics</u>.

One of the main methodological questions in matrix semantics is the adequacy problem: Given a logic (L,C) under what conditions on C, logical or syntactical in nature, does there exist a matrix /or a class of matrices/ strongly adequate for C ?

The class $\mathbb{K}=\{(L,C(X)):\ X\subseteq L\}$ is called the Lindenbaum boundle for C.

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NAME: W. Hodges

UNIVERSITY: Bedford College

TITLE OF THE TALK: THE MODEL THEORY OF LOCALLY FINITE GROUPS

SECTION: Invited Lecture

ABSTRACT:

A survey, leading up to Simon Thomas' characterisation of the ω_1-categorical locally finite simple groups as the Chevalley groups over algebraically closed locally finite fields.

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NAME: Carl Jockusch

UNIVERSITY: Urbana

TITLE OF THE TALK: 1-Generic Degrees and Minimal Degrees

SECTION: Invited Lecture

ABSTRACT:

The following theorem (joined with C.T. Chong) will be discussed:

No 1-generic degree below $\underset{\sim}{0}'$ bounds a minimal degree.

Also a new notion of genericity for r.e. sets will be introduced. Degrees of sets generic in this sense are not involved in nontrivial infs of r.e. degrees, i.e. are nonbranching and strongly noncappable.

NAME: I. Juhasz

UNIVERSITY: Budapest

TITLE OF THE TALK: Point-picking Games and HFD's

SECTION: Set Theory II

ABSTRACT:

Let X be a topological space, P a property of subsets of X and α an ordinal number. We denote by $G^P_\alpha(X)$ the following two-person game (played by players I and II): A round of a play consists of I choosing an open (non-empty) set $O \subset X$ and then II choosing a point $x \in O$. A round is played for each ordinal less than α. Player I wins if the set of points chosen by II has property P. In this talk, the results of which were obtained jointly with A. Berner, we are mainly interested in the properties:

$P = D$ (dense), $P = SD$ (somewhere dense),

$P = ND$ (non-discrete).

A sample of results:

Theorem 1. If κ is a cardinal satisfying $\kappa^\omega = \kappa$ and X is a T_3 space then I wins $G^D_\kappa(X)$ if and only if $\pi(X) \le \kappa$ (i.e. X has a π-base of size $\le\kappa$).

Theorem 2. If X is T_3 then I wins $G^{SD}_\omega(X)$ if and only if $\pi_0(X) \le \omega$, where

$$\pi_0(X) = \min\{\pi(G) : \emptyset \ne G \subset X \text{ open}\} .$$

Theorem 3. If X is an HFD then I wins $G^D_{\omega^2}(X)$. (Note that $\pi(X) > \omega$ for an HFD!)

Theorem 4. (CH) There is an HFD space X such that II wins $G_{\omega}^{ND}(X)$ and $G_{\alpha}^{SD}(X)$ for each $\alpha<\omega^2$.

Theorem 5. ($\diamond$) There is an HFD space X for which neither I nor II wins $G_{\omega}^{D}(X)$ or $G_{\omega}^{SD}(X)$.

HFD's are special types of hereditarily separable spaces introduced in [HJ] to construct S spaces. CH implies that HFD's exist but they do not exist e.g. under MA_{ω_1} . Thus the question arises whether T_3 spaces X satisfying the conclusions of theorems 3-5 exist in ZFC.

Another question we could not answer is whether a T_3 space X could exist such that I wins $G_{\alpha}^{D}(X)$ but II wins $G_{\beta}^{D}(X)$ for each $\beta<\alpha$, where α is a countable ordinal different from ω^2 .

References

[BJ] A. Berner and I. Juhász, Point-picking games and HFD's (in preparation).

[HJ] On hereditarily α -Lindelöf and α -separable spaces, II, Fund. Math. 81 (1974), 148-158.

NAME: E. Kranakis _ I.C.C. Phillips

UNIVERSITY: Heidelberg , Minneapolis

TITLE OF THE TALK: Partitions and Homogeneous Sets for Admissible Ordinals

SECTION: Set Theory I

ABSTRACT:

Several reflection and partition properties of admissible ordinals are studied. Let $\kappa = \omega\kappa > 0$ and $n > 0$; cf^n_κ denotes the $\Sigma_n(L_\kappa)$ cofinality of κ; the partition symbol $\kappa \xrightarrow{\Sigma_n} (\kappa - \Sigma_s)^m$ means that every $\Sigma_n(L_\kappa)$ partition of $[\kappa]^m$ into two pieces has a homogeneous set I (i.e. $[I]^m$ is included in exactly one of the two pieces) which is $\Sigma_s(L_\kappa)$ definable. Below follow some of the results obtained.

Theorem 1 If κ is Σ_{n+1} admissible and L_κ satisfies the power set axiom then $\kappa \xrightarrow{\Sigma_n} (\kappa - \Sigma_{n+1})^2$.

Theorem 2 If is Σ_{n+1} admissible and L satisfies the power set axiom and $cf^{n+j}_\kappa = \omega$ $(j > 1)$ then $\kappa \xrightarrow{\Sigma_n} (\kappa - \Sigma_{n+j})^2$.

An examble can also be given which shows that the cofinality hypothesis of theorem 2 can not be omitted.

The symbol $\leq\kappa \xrightarrow{\Pi_n} (\kappa - X)^1_{<\kappa}$ means that for any $\alpha < \kappa$ and any partition of a $\Pi_n(L_\kappa)$ subset of κ into α pieces there is a homogeneous set of type κ which is a subset of X.

Theorem 3 The following statements are equivelant (i) κ is Σ_{n+2} admissible (ii) $\leq\kappa \xrightarrow{\Pi_n} (\kappa)^1_{<\kappa}$ (iii) $\leq\kappa \xrightarrow{\Sigma_1} (\kappa - S^n_\kappa)^1_{<\kappa}$, where $S^n_\kappa = \{\alpha < \kappa : L_\alpha <_n L_\kappa\}$

Theorem 4 If $\kappa \xrightarrow{\Sigma_1} (\kappa - S^n_\kappa)^1_{<\kappa}$ and L_κ satisfies the power set axiom then κ is Π_{n+3} reflecting.

NAME: Christoph Kreitz und Klaus Weihrauch

UNIVERSITY: Herdecke (Hagen)

TITLE OF THE TALK: Theory of Representations as a Basis for Constructive Analysis

SECTION: Intuitionistic Logic and Constructive Mathematics

ABSTRACT:

Many mathematicians familiar with the constructivistic objections (Brouwer [1]) to classical mathematics concede their validity but remain unconvinced that there is any satisfactory alternative. Even Bishop's famous approach [2] is not really accepted mainly because of problems with its foundation.

The basic idea of our approach is that real world computers as well as mathematicians can only operate on names and not on "abstract" elements of a set M. We choose $\mathbb{F} := \mathbb{N}^{\mathbb{N}}$ as the (standard) set of possible names, and the naming or representation is a (partial, onto) function $\delta: \mathbb{F} \dashrightarrow M$. On $\mathbb{F}$ a very nice theory of continuity and computability can be developed. These concepts are transferred by δ to M. Thus, our approach generalizes the recursive analysis of the Polish school (Grzegorczyk [3]), where only computability is studied. Using appropriate representations of $\mathbb{R}$, of open, closed, bounded, or compact subsets of $\mathbb{R}$, different "effective" versions of theorems of classical and also of constructive analysis can be proved. Concepts like those of "located sets" or "complemented sets" from Brouwer's approach find their natural counterparts in our theory. A function which is constructive in Brouwer's sense generally is easily computable, if appropriate representations are used, if it is not constructive or not computable in recursive analysis it is not even continuous in most cases. Thus in most cases discontinuity is the deeper reason for noncomputability or nonconstructivity.

Obviously the choice of the representation δ of a set M is crucial. Natural representations δ of a set M are usually defined by considering a canonical construction of M (e.g. Cauchy completion). A good representation of a topological space M should have several natural topological properties. The decimal representation δ_D of $\mathbb{R}$ is topologically bad, which implies that addition is not even continuous (relative to δ_D). However, for any separable T_0-space M, there is an open and continuous representation δ which is maximal in the class of all continuous representations of M. In addition a good representation should satisfy some computability properties. Standard representations of $2^{\mathbb{N}}$, $\mathbb{R}$ (Grzegorczyk

[3]), effective cpo's (Weihrauch and Schäfer [4]) and effective metric spaces (Weihrauch [5]) are of this kind. For example, the computable L^P-functions (Pour El and Richards [6]) are the computable elements w.r.t. a standard representation of the (separable metric) space L^P. The approach also is appropriate to study computational complexity (Ker-I Ko [7]).
In summary, the approach studies continuity and computability w.r.t. representations using classical logic. The philosophical part of the theory is reduced to the selection and justification of the "reasonable" representations and the interpretation of the results.

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NAME: Reijiro Kurata

UNIVERSITY: Fukuoka

TITLE OF THE TALK: A Simple Proof for a Statement which is Eqivalent to Harrington's Principle

SECTION: Peano Arithmetic

ABSTRACT:

§1. Introduction.

Throughout this abstract, we shall let T denote the theory defined in 2.1 of [PH]. Harrington Principle (H) means that, for any k, n and r in ω, there exists an M such that $M \to (k)^n_r$ (1.1 in [PH]).

Paris and Harrington proved in [PH] that

$(H) \leftrightarrow \mathrm{ConT} \leftrightarrow \mathrm{RFN}_{\Sigma_1}$ is provable in PA,

where RFN_{Σ_1} is the reflection principle on PA for Σ_1-formulas.

In the following, we shall show that ConT can be easily verified from some property of limited formulas, and we can also obtain $\mathrm{PA} + \mathrm{RFN}_{\Sigma_1} \vdash \mathrm{ConT}$ by formalizing this proof.

§2. Determined Partition.

DEFINITION. A partion $P:[\omega]^n \to 2$ is said to be determined iff

(i) there exist function sequence $\beta_1, \beta_2(x_1), \ldots, \beta_n(x_1, \ldots, x_{n-1})$ such that $P(a_1, \ldots, a_n)$ = constant for all $a_1 < a_2 \ldots < a_n$, $\beta_1 < a_1$, $\beta_2(a_1) < a_2 \ldots$ $\ldots \beta_n(a_1, \ldots, a_{n-1}) < a_n$.

(ii) For any i $(1 \leq i \leq n)$ and fixed $c_1, \ldots, c_{i-1}$ in ω, the partition $\lambda a_i \ldots \lambda a_n P(c_1 \ldots c_{i-1} a_i \ldots a_n):[\omega]^{n-i+1} \to 2$ has property (i).

(Note that the value of constant in (ii) depends on $c_1, \ldots, c_{i-1}$.)

We write $|\psi|:[\omega]^n \to 2$ for the partition associated a formula ψ of T with n-free variables.

LEMMA 1. For any limited formula $\psi(a_1 \ldots a_n)$, partition $|\psi|$ is determined and β_j $1 \leq j \leq n$ can be taken primitive recursive functions.

§3. Consitency of T

LEMMA 2. Suppose that finite number of partitions $P_1, \ldots, P_\ell : [\omega]^n \to 2$ are all determined, then for all cardinal $k \leq \aleph_0$, there exist a homogeneous set H_k with cardinality k for all $P_1, \ldots, P_\ell$ simultaneously.

THEOREM. Let S be a arbitrary finite subset of T, and k be the maximum index i of c_i occuring in S. Then, there exist $c_0, \ldots, c_k$ in ω such that $\langle \omega, +, \cdot, c_0 \ldots c_k \rangle$ is a model of S. Moreover, by formalizing this proof, we also obtain

$\mathrm{PA} \vdash \mathrm{ConPA} \to \mathrm{Con}(S)$ and,

$\mathrm{PA} + \mathrm{RFN}_{\Sigma_1} \vdash \mathrm{ConT}$.

Reference

[PH] J.Paris and L.Harrington, A Mathematical Incompleteness in Peano Arithmetic, Handbook of Mathematical Logic, 1977.

NAME: H. Leiß

UNIVERSITY: Bonn

TITLE OF THE TALK: Beth's Theorem for Syntopogenous Structures

SECTION: Generalized Quantifiers and Topological Model Theory

ABSTRACT:

A.Császár introduced the notion of a "syntopogenous system" $(A,\Sigma^<)$ to give a unified treatment of topological, uniform and proximity spaces. Here Σ is a non-empty directed family of binary relations on P(A) - "topogenous orderrelations" - satisfying certain quasi first-order conditions. Σ is a basis for the system

$$\Sigma^< := \{\sigma \mid \sigma \subseteq \overset{<}{\tau} \text{ for some } \tau\in\Sigma\}\ , \text{ where for } \tau \subseteq P(A)^2$$
$$\overset{<}{\tau} := \{(B,C) \mid B \subseteq D,\ E \subseteq C \subseteq A \text{ for some } (D,E)\in\tau\}\ .$$

A first-order language L is extended to talk about structures $(\mathfrak{A},\Sigma)$ with arbitrary $\Sigma \subseteq P(P(A)^2)$. The extended language L_Σ has new atomic formulas $t\in X$ and allows restricted higher-order quantification as in $\exists\tau\in\Sigma\ \phi(\tau^+,..)$ or $\exists(X,Y)\in\tau\ \psi(X^+,Y^-,...)$ (i.e. τ must not occur negatively in ϕ ..). L_Σ-formulas express the basis-invariant properties of $\Sigma^<$.

Theorem:
Let T be a theory in L_Σ such that $\Sigma^<$ is a directed system and contains a non-empty element in every $(\mathfrak{A},\Sigma)\models T$. Then
T defines the system $\Sigma^<$ implicitly if and only if
T defines (a basis of) the system $\Sigma^<$ explicitly.

It is not clear if the theorem can be generalized by dropping the assumption that $\Sigma^<$ is a directed system in every $(\mathfrak{A},\Sigma)\models T$. Difficulties and some positive results in this direction are indicated.

NAME: Wolfgang Lenski

UNIVERSITY: Mosbach

TITLE OF THE TALK: Elimination of Quantifiers for the Theory of Archimedian Ordered Divisable Groups in $L(Q_0^n)$

SECTION: Model Theory and Groups

ABSTRACT:

For $n>1$ let Q_0^n be the Ramsey quantifier in the $\aleph_0$-interpretation. Let $L(Q_0^n)$, $n>1$, be the logic obtained from first order logic by adding the following formation rule: If φ is a formula and $x_1,\dots,x_n$ are distinct variables, then $Q_0^n x_1,\dots,x_n \varphi$ is a formula. The Ramsey quantifier is defined in a structure $\mathfrak{A}$ as usual: $\mathfrak{A} \models Q_0^n x_1,\dots,x_n \varphi$ iff there is a subset M of $|\mathfrak{A}|$ with card(M) $\geq \aleph_0$, such that for all distinct $a_1,\dots,a_n \in M$: $\mathfrak{A} \models \varphi[a_1,\dots,a_n]$.

Let now be DOG the theory of divisible, ordered abelian groups in the language $L_G = \{+,-,0,<\}$. In $L(Q_0^n)$, $n>1$, we can distinguish by means of the Ramsey quantifier the case of an archimedian ordering from the one of an non-archimedian ordering: There exists a sentence ψ of $L(Q_0^n)$, $n>1$, which is valid in a model $\mathfrak{A}$ of DOG iff $\mathfrak{A}$ is archimedian ordered.

Define ADOG:=DOG $\cup \{\psi\}$, that is ADOG is the theory of archimedian ordered divisible abelian groups.

It is shown that ADOG admits elimination of quantifiers in $L(Q_0^n)$ for $n>1$:

Theorem: ADOG admits elimination of quantifiers in $L(Q_0^n)$ for $n>1$.

From the decidability of DOG we get

Corollary: ADOG is decidable in $L(Q_0^n)$ for $n>1$.

Further let $T_Z=Th(Z,\emptyset)$ be the first order theory of Z-groups in the language $L_Z=\{+,-,0,1, \equiv_n (n>1), <\}$. By T_{AZ} we denote the theory of archimedian ordered Z-groups. With the same method as used for ADOG an analogous result can be proved:

Theorem: T_{AZ} admits elimination of quantifiers in $L(Q_0^n)$ for $n>1$.

Just as for ADOG it follows from the decidability of T_Z

Corollary: T_{AZ} is decidable in $L(Q_0^n)$ for $n>1$.

NAME: Harry R. Lewis

UNIVERSITY: Harvard

TITLE OF THE TALK: LOGICAL SYNTAX AND COMPLEXITY

SECTION: Invited Lecture

ABSTRACT:

What is the effect of syntactic form on the strength of logical language? We examine predicate logic and strive to distinguish the impact of quantificational structure from that of truth-functional form. Alternating automata are used to establish lower bounds on the complexity of the satisfiability problem for several classes of Krom (CNF-2) and Horn Formulas. Applications of the methods to complexity theory and to logic programming are mentioned.

NAME: Per Lindström

UNIVERSITY: Göteborg

TITLE OF THE TALK: On Faithful Interpretability in Theories Containing Arithmetic

SECTION: Peano Arithmetic

ABSTRACT:

S is (X-)faithfully interpretable in T, $S \trianglelefteq T$ ($S \trianglelefteq_X T$), if there is an interpretation f of S in T s.t. for every φ, if $T \vdash f\varphi$ (and $\varphi \in X$), then $S \vdash \varphi$. (All theories considered are r.e.) Let

$$T^{\{S\}} = \{\varphi : \exists m T \vdash Pr_{S \restriction m}(\overline{\varphi}) \Rightarrow S \vdash \varphi\}.$$

Generalizing a result of Feferman, Kreisel, and Orey (1-consistency and faithful interpretations, Archiv f. math. Logik u. Grundlf. 6 (1960), 52 - 63) we prove the following

THEOREM. If T is an extension of P(eano arithmetic), $\sigma(x)$ numerates S in T, and $T \vdash Con_\sigma$, then $S \trianglelefteq_{T^{\{S\}}} T$.

Two of the more interesting corollaries of this result are the following. Let A, B be essentially reflexive extensions of P.

COROLLARY 1. $S \trianglelefteq_X A$ iff S is interpretable in A and $X \subseteq A^{\{S\}}$.

COROLLARY 2. $A \trianglelefteq B$ iff $A \vdash \pi \Rightarrow B \vdash \pi$ for every $\pi \in \Pi^0_1$ and $B \vdash \sigma \Rightarrow A \vdash \sigma$ for every $\sigma \in \Sigma^0_1$.

Corollary 1 can be applied to study the set of interpretations in A in terms of the pre-ordering $\leq_A$ defined by:

$$f \leq_A g \text{ iff } \{\varphi : A \vdash f\varphi\} \subseteq \{\varphi : A \vdash g\varphi\}.$$

Corollary 2 can be used to develop a theory of degrees of faithful interpretability analogous to the theory of degrees of interpretability (V. Švejdar, Degrees of interpretability, Comment. Math. Univ. Carolinae 19 (1978), 789 - 813. P. Lindström, Some results on interpretability, Proc. of the 5th Scand. Logic Symp., Aalborg 1979, 329 - 361 and On certain lattices of degrees of interpretability, to appear.).

NAME: Shibi-Chao Liu

UNIVERSITY: Taiwan

TITLE OF THE TALK: A Proof Theoretic Approach to Non-Standard Analysis (continued)

SECTION: Nonstandard Analysis

ABSTRACT:

This talk is based upon my previous paper "A proof-theoretic appraoch to non-standard analysis with emphasis on distinguishing between constructive and non-constructive results" in [The kleene Symposium, 1980]. I first give a sketch of the main points of that paper but in a newly reorganized form with some new materials which were not contained in my previous paper, and then add more remarks and reflections on this subject. I think that such a proof-theoretic appraoch to non-standard analysis is worth to be further developed either theoretically or in its applications.

We start with the assumption that the axiomatic set theory ZF is consistent. For each intuitive natural number i, let $\ulcorner i \urcorner$ to denote the set definable in ZF according to the following recursion : $\ulcorner 0 \urcorner = 0$; $\ulcorner i+1 \urcorner = \ulcorner i \urcorner \cup \{\ulcorner i \urcorner\}$. By Goedel's technique and the fact that the law of excluded middle holds in ZF we can show that there exists a set definable in ZF, which we denote by ∞, such that (i) ZF $\vdash \infty \in \omega$, and (ii) $\infty \leq \ulcorner i \urcorner$ is unprovable in ZF for i = 0,1,... . Hence ZF can be extended to a consistent theory ZF* by adding as new axioms the sentences $\ulcorner 0 \urcorner < \infty, \ulcorner 1 \urcorner < \infty, \ulcorner 2 \urcorner < \infty, \ldots$. Since the real field R, the rational field Q, the set of integers C, the set of natural numbers ω and the following relation and operations $x < y$, $x + y$, $x.y$, $|x|$, $-x$, $1/x$ are all definable in ZF, they are also definable in the extension ZF* by the same formulas as in ZF. We further introduce the notation δ by $\delta = 1/\infty$. By non-standard analysis I mean the discipline of metamathematics about ZF* especially when the notion of convergence defined in terms of ∞ or δ for real functions (namely functions from R to R) is involved.

NAME: Yizhong Lu

UNIVERSITY: Nanjing

TITLE OF THE TALK: Some Applications of Boolean Form to Analyse and Manage Large Data Sets

SECTION: Logic versus Computer Science

ABSTRACT:

In [1] and [2] the authors give some algorithms to calculate some complex Boolean functions and analyse some large data sets. The paper discuss some exceptional cases and some new results which can be analysed and managed effectively by recusion theory and Boolean form. The main results in the paper are

1. A effective algorithm to calculate the exceptional cases of the algorithm in [1] and [2] was found.

2. The representing function of decision predicate of tree-structure consistency is a weak elementary function [3].

3. A tree-structure is consistent iff B = 0.

4. The calculation of B is very quick and minimizes the space necessary for calculating B.

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3. J. P. Tremblγ and R. P. Manohar
4. Robert R. Korfhage

NAME: Kenneth L. Manders

UNIVERSITY: Pittsburgh / Utrecht

TITLE OF THE TALK: Model Completeness in Geometry

SECTION: General Model Theory

ABSTRACT:

It follows directly from an examination of the quantifier structure of the classical interpretations-coordinatisation resp. coordinate based geometry - between geometries and fields that

(i) $\mathrm{Th}\{\mathbb{P}^2(k): k \models T\}$ is model complete iff T is:

(ii) $\mathrm{Th}\{\mathbb{A}^2(k): k \models T\}$ is model complete iff T is,

where $\mathbb{P}^2(k)$ is projective n-space over k formalised as point set with collinearity relation, and $\mathbb{A}^2(k)$ is affine n-space over k, but formalised as point set with quaternary parallelism relation $ab \parallel cd$. If we formalise affine spaces with collinearity relation and restrict to fields of characteristic zero, as assumed henceforth, the relation $ab \parallel cd$ is never existentially definable, and model completeness fails. (Embed $\mathbb{A}^2(k)$ in $\mathbb{P}^2(k)$; any finite subset of $\mathbb{P}^2(k)$ can again be embedded in $\mathbb{A}^2(k)$.)

We characterise all embeddings among affine collinearity spaces, and show (writing $\mathbb{P}^2(T)$ for $\mathrm{Th}\{\mathbb{P}^2(k): k \models T\}$ and similarly $\mathbb{A}^2(T)$):

(iii) $\mathbb{A}^2(T)$ has the amalgamation property iff T has;

(iv) $\mathbb{P}^2(T^*)$ is the model completion of $\mathbb{A}^2(T)$ iff T^* is the model completion of T.

Analogous results hold for the language of ordered fields and the corresponding geometric languages and higher dimensions.

These facts are of interest because of the suggestion that model completion may be a metamathematical correlate of the conceptual and geometrical unification and simplification obtained from the embedding of affine in projective space.

NAME: A. Marcja

UNIVERSITY: Florenz

TITLE OF THE TALK: Analyzing Elemantary Theories by the Boolean Algebras of definable Subsets and their Models

SECTION: Boolean Algebras

ABSTRACT:

Let T be a countable complete first order theory; for every $M \models T$ let $\mathcal{B}(M)$ be the Boolean algebra of M-definable subsets of M.

General Problem: classify elementary theories by isomorphism types of $\mathcal{B}(M)$ with M countable (or of fixed power).

Definition 1
T is pseudo $\aleph_0$-categorical if and only if there is only one isomorphism type.

Theorem 1
1. If T is $\aleph_1$-categorical then T is pseudo $\aleph_0$-categorical.
2. Every countable atomic Boolean algebra is isomorphic to $\mathcal{B}(M)$, with M countable model of a countable superstable pseudo $\aleph_0$-categorical theory.

Definition 2
For T as above and ω-stable we call Cantor-Bendixson spectrum of T (CB-Spec T) the set, ordered lexicographica-lly, of the Cantor-Bendixson types $(\alpha_{B(M)}, d_{B(M)})$ for $M \models T$ $|M| = \aleph_0$.

Reduced Problem. Find what subsets of $\omega_1 - \{0\} \times \omega - \{0\}$ are CB-spectra of a countable complete ω-stable theory.

Theorem 2 (Toffalori)
Let $X \subset \omega_1 - \{0\} \times \omega - \{0\}$ such that

- min $X \neq (3,1)$
- there exists max $X = (\lambda, 1)$, λ a limit ordinal
- $\{\alpha+2 : \exists d (\alpha+2, d) \in X\}$ is cofinal in λ,

then X is a CB-spectrum.

Theorem 3
Let T be an ω-stable theory such that : $(1,1) \in$ CB-Spec T (W.l.o.g. the prime model M_0 of T is the only one of CB type $(1,1)$) and $M_1 = M_0[a]$ $(a \notin M_0)$ has CB-type $(\alpha, d) > (1,1)$.

1. If there exists a maximal CB-rank β of definable subsets of M_1 disjoint from M_0, then there exists a 0-definable equivalence relation E on the models of T, having in M_0 infinitely many classes of finite unbounded size.

2. If $d > 1$ then
   i) $\beta = \alpha$
   ii) $a/E = M_1 - M_0$
   iii) $\{(1,1)\} \cup \{(\alpha, nd) : n \in \omega - \{0\}\} \cup \{(\alpha+1, 1)\} \subset$ CB-Spec T.

3. If $d = 1$ and $\beta = \alpha$ then again
   i) $a/E = M_1 - M_0$
   ii) $\{(1,1)\} \cup \{(\alpha, nd) : n \in \omega - \{0\}\} \cup \{(\alpha+1, 1)\} \subset$ CB-Spec T

4. If $d = 1$, α successor, $\beta + 1 = \alpha$ then E admits in $M_1 - M_0$ infinitely many classes of CB-rank β.

5. Id $d = 1$ and α is limit there is a counterexample to 1.

NAME: J.C. Martinez Alonso

UNIVERSITY: Madrid

TITLE OF THE TALK: $(L\omega_1\omega)_t$ -eqivalence for T_3 Spaces

SECTION: Generalized Quantifiers and Topological Model Theory

ABSTRACT:

In [1] the L_t-theory of a T_3 topological space is characterized by using the topological notion of the type of a point.Looking at the behavior of convergence we refine the notion of type and in this way we are able to prove a characterization of the $(L\omega_1\omega)_t$-theory of a wide class of spaces.

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NAME: Ž. Mijajlović

UNIVERSITY: Belgrad

TITLE OF THE TALK: Definable Points in Models of Peano Arithmetic

SECTION: Peano Arithmetic

ABSTRACT:

In the paper it is applied the Friedman analyzis of embeddings of models of Peano arithmetic and their standard systems. The intersections of all Σ_k^0-elementary submodels, and the intersection of initial segments of countable nonstandard models of elmentary arithmetic are described in terms of definable points in these models (Mc Aloon's minimal Π_k^0 points). As a consequence, Σ_k^0-elementary extensions of the standard number system $\underline{\omega}$ are characterized.

If M is a model of Peano arithmetic let Δ_k^M denote the set of all Δ_k^0-definable elements in M, and let Π_k^M denote the set of all Π_k^0-definable points in M. If $X \subseteq M$ let J(X) denote the initial segment of M generated by X. Further, let Q_k^M be the intersection of all initial segments I of M which are Σ_k^0-embedded into M, and $I \cong M$.

Theorem $J(\Delta_{k+1}^M) = J(\Pi_k^M) = Q_k^M$.

Corollary 1. For every $k \in \omega$ there is an initial segment $J \subseteq_{\Sigma_k^0} M$ such that $J \cong M$ and $J \neq M$.

Corollary 2. For any countable model of Peano arithmetic the following are equivalent:

(1) $\underline{\omega} \prec_{\Sigma_{k+1}^0} M$, (2) $\Delta_{k+1}^M = \omega$, (3) $Q_k^M = \omega$.

NAME: B. Mikolajczak

UNIVERSITY: Posen

TITLE OF THE TALK: Proving System Properties with Help of Logic Functions

SECTION: Logic versus Computer Science

ABSTRACT:

This paper is a comparative study of results achieved during last years in the area of application of logic functions to proving different properties of systems; especially with respect to discrete systems used in computer science. The special emphasis is posed onto the problem of proving computational complexity results for discrete systems by reducing them to respective problems for logic functions. As models of discrete systems we use: deterministic and undeterministic automaton, alternating automaton, Turing machine, Petri net and directed acyclic graph.

We have analysed the investigation with help of logic functions such system properties like: controllability, intractability, deadlock, and different graph properties. Especially it has been shown:

i) proving the existing of cliques in a graph representing discrete system,

ii) proving coloracillity properties of a graph describing discrete system,

iii) representing some classes of logic functions by deterministic and undeterministic automata,

iv) representing arbitrary logic functions by Turing machine,

v) representing of some classes of logic functions by acyclic directed graphs with special application for proving time-spece tradeoff results for the system,

vI) proving the reducibility of liveness problem for Petri nets to the problem of satisfiability of logic functions.

NAME: Moerdijk, I.

UNIVERSITY: Universiteit van Amsterdam

TITLE OF THE TALK: Monoid models for choice sequences

SECTION: Invited lecture

ABSTRACT:

The theory of choice sequences that seems to have received most of the attention so far is the theory CS of Kreisel and Troelstra, which includes axioms like

analytic data $\quad A\alpha \to \exists F\ (\alpha \in im(F)\ \&\ \forall \beta \in im(F)\ A\beta)$

continuous choice $\quad \forall \alpha \exists \beta A(\alpha, \beta) \to \exists F \forall \alpha A(\alpha, F\alpha)$

(where α, β range over choice sequences, and F over lawlike continuous operations on choice sequences).

We will discuss a model for the theory CS obtained using a notion of forcing over a monoid of continuous functions from Baire space to itself.
Using a similar model, we show that an axiom of continuous choice as above is consistent with the principle of spreaddata

$$A\alpha \to \exists \text{ spread } S\ (\alpha \in S\ \&\ \forall \beta \in S\ A\beta),$$

(roughly, a spread is a closed subspace of the space of choice sequences), which seems closer to the original theory of Brouwer than the axiom of analytic data.

NAME: Roman Murawski

UNIVERSITY: Posen

TITLE OF THE TALK: A "Negative" Result on Trace Expansions

SECTION: Peano Arithmetic

ABSTRACT:

Let PA denote Peano arithmetic and A_2^- the second order arithmetic. Gödel has shown that PA is incomplete. Hence it is natural to investigate its extensions. In particular we may consider the following "second order generated" extension

$$(PA)^{A_2^-} = \{ \varphi \in L(PA) : A_2^- \vdash \varphi \} .$$

It can be shown that N is a model of $(PA)^{A_2^-}$ iff there exists a model M such that $M \equiv N$ and M is A_2^--expandable, i.e. there is a family $\mathcal{X}_M \subseteq \mathcal{P}(M)$ such that $(\mathcal{X}_M, M, \in) \models A_2^-$. This fact justifies the study of A_2^--expandability of models of PA (for more details on A_2^--expandability cf. our survey paper [3]).

In recent years much attention was payed to the study of possible A_2^--expansions of expandable models of PA. In particular expansions of initial segments of a given model of PA were studied - cf. e.g. [1] and [4]. In the last paper we have considered so called trace expansions, i.e. given a model $M \models PA$ and its A_2^--expansion $(\mathcal{X}_M, M, \in)$ consider initial segments $I \subseteq_e M$ such that $(\mathcal{X}_M \cap I, I, \in) \models A_2^-$. Using indicators we have proved several facts about such segments and its expansions. But the situation is not so nice as these results could suggest. Namely we have the following "negative" result which generalizes a result of Mostowski [2].

THEOREM. Let M be a countable nonstandard model of PA which is expandable to a model of $A_2^* = A_2^- +$ CONSTR having a full substitutable satisfaction class S such that $S(A_2^*)$. Then there exist an extension M_1 of M and an A_2^--expansion $\mathfrak{Z} = (\mathcal{X}_{M_1}, M_1, \in)$ of M_1 such that

$$\mathfrak{M}_1 \equiv M,$$
$$(\mathcal{X}_{M_1} \cap M, M, \in) \text{ non} \models A_2^-.$$

Models M_1 and $\mathfrak{Z}$ are constructed using nonstandard Skolem ultrapowers. Taking a particular ultrfilter we get that traces on M of sets of $\mathfrak{Z}$ do not form an expansion of M. By construction we get $M \subseteq M_1$ but M is not an initial segment of M_1. The assumption that the satisfaction class S is substitutable can be weakened to the following conditions: 1° S is substitutable to the axiom scheme of induction and 2° the comprehension scheme for atomic formulas containing the predicate S holds.

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NAME: Andrzej Pelc

UNIVERSITY: Warschau

TITLE OF THE TALK: Universal and maximal invariant measures on gloups

SECTION: Proof Theory II

ABSTRACT:

A measure on X is a countably additive σ-finite non-negative extended real-valued function defined on a σ-algebra of subsets of X and vanishing on singletons. A measure on X is universal iff it is defined on P(X). If H is a subgroup of a group G then a measure m on G is H-invariant iff $m(hA) = m(A)$ for any m-measurable set A and any $h \in H$.

Thm 1. /Harazišvili, Erdös, Mauldin, Ryll-Nardzewski, Telgarsky/
If H is an uncountable subgroup of a group G then there is no universal H-invariant measure on G.

Thm 2.
If H is a countable subgroup of a group G then a universal H-invariant measure exists on G iff $|G| \geq$ a real-valued measurable cardinal.

Thm 3.
If H is an uncountable abelian subgroup of a group G then every H-invariant measure on G has a proper H-invariant extension.

Thm 4.
Let H be a countable subgroup of a group G.

a/ If H is a direct sum of finite groups or groups isomorphic to (Z,+) then every non-universal H-invariant measure on G has a proper H-invariant extension.

b/ If G has measurable cardinality and H does not have proper subgroups of finite index then there exists a non-universal H-invariant measure on G without proper H-invariant extensions.

NAME: A. Prestel

UNIVERSITY: Konstanz

TITLE OF THE TALK: Decidable theories of real fields

SECTION: Invited Lecture

ABSTRACT:

Summary: A field F which admits at least one ordering is called *real*. The set X_F of all orderings can be naturally endowed with a Boolean topology. The notion of a real closed field can be generalized in such a way that every Boolean space occurs as order space X_F of such a field. The decidability of subclasses of such generalized real closed fields then reduces to the decidability of the corresponding classes of Boolean spaces. We will mainly concentrate on decidable classes of real fields arising in this way. Other decidable classes will be mentioned.

NAME: Andreas Rapp

UNIVERSITY: Freiburg

TITLE OF THE TALK: Some Results on Logics with Malitz Quantifiers

SECTION: Generalized Quantifiers and Topological Model Theory

ABSTRACT:

In [1] Magidor and Malitz introduced the quantifiers Q_α^n $(n \geq 1, \alpha \geq 0)$ and, more generally, Q_α^s for s a finite sequence of positive integers. They posed the problem of determining the hierarchy of expressive power of the logics $L(Q_\alpha^s)$. This problem is solved by the following

Theorem 1. For all ordinals α and all sequences s and t:

$L(Q_\alpha^s) \preceq L(Q_\alpha^t)$ if and only if $s \leq t$.

Here $\leq$ is a suitably defined partial ordering: for $s = \langle n_1, \ldots, n_k \rangle$, $t = \langle m_1, \ldots, m_l \rangle$, where $n_i, m_j \geq 1$, put $s \leq t$ iff there is a 1-1 function $f: \{1, \ldots, k\} \to \{1, \ldots, l\}$ such that $n_i \leq m_{f(i)}$ for all $i \leq k$. Theorem 1 generalizes a result of Garavaglia and Shelah that, for all α and n, $L(Q_\alpha^{n+1})$ is strictly more expressive than $L(Q_\alpha^n)$. The proof uses tecniques similar to those employed by Garavaglia in [2]. Along the same lines a question raised by Malitz in [3] can be answered:

Theorem 2. For each $\alpha \geq 1$ and each n there is a structure $\mathfrak{A}_{n,\alpha}$ such that the $L(Q_\alpha^n)$-theory of $\mathfrak{A}_{n,\alpha}$ is decidable whereas its $L(Q_\alpha^{n+1})$-theory is not.

Some further results concerning eliminability of the quantifiers Q_α^n are discussed.

NAME: Z. Ratajczyk

UNIVERSITY: Warschau

TITLE OF THE TALK: Traces of Models on Initial Segments

SECTION: General Model Theory

ABSTRACT:

Let $I \subset_e M$ denotes that I is a proper initial segment of $M \models I\Delta_0$ closed under addition and multiplication. Let $\Delta_0(M)$ denotes the family of all Δ_0-definable subsets of M. Let $R_M I = \{ X \cap I : X \in \Delta_0(M) \}$. The second order structure $(R_M I, I, \in, +, \times)$ is called a trace of M on I and is denoted shortly by $(R_M I, I)$.

<u>Definition 1.</u> Let S be the theory in second order language of aritmetic consisting of the following axioms: $B\underset{\sim}{\Sigma}_1$ i.e. collection schema for Σ_1-formulas with class parameters; $\underset{\sim}{\Delta}_1^c$-CA i.e. comprehension schema for Δ_1-formulas with class parameters, KL* i.e. König lemma for binary trees.

<u>Proposition 2.</u> If T is a theory and $M \models I\Delta_0 + T$ then for every $I \subset_e M$, $(R_M I, I) \models \Pi_1 \cap T + S$, where Π_1 is the first level of Kleene-Mostowski hierarchy.

<u>Theorem 3.</u> If $(\mathfrak{F}, M_1) \models \Pi_1 \cap T + S + exp$, $(\mathfrak{F}, M_1)$ is countable, M_1 satisfies Π_1-overspill and T is r.e. then there exists a model M_2 such that $M_1 \subset_e M_2$ and $(R_{M_2} M_1, M_1) = (\mathfrak{F}, M_1)$.

<u>Corollary 4.</u> If T is r.e. $T \supseteq I\Delta_0$, then $Th(\{(R_M I, I) : I \subset_e M, M \models T, I$ is closed under exponentiation$\}) = \Pi_1 \cap T + S + exp$.

<u>Theorem 5.</u> If $M_1 \models I\Sigma_1$, M_1 is countable, then there exists a family $\mathfrak{F} \subseteq P(M_1)$ such that $(\mathfrak{F}, M_1) \models I\underset{\sim}{\Sigma}_1 + \underset{\sim}{\Delta}_1$-CA + KL*.

<u>Corollary 6.</u> If M_1 is a countable model for $I\Sigma_1$ then there exists a model M_2, such that $M_2 \models I\Sigma_1$ and M_1 is a semiregular initial segment of M_2.

NAME: Pieter Rodenburg

UNIVERSITY: Amsterdam

TITLE OF THE TALK: Correspondence Theory for Intuitionistic Logic

SECTION: Intuitionistic Logic and Constructive Mathematics

ABSTRACT:

The main reason why Kripke semantics has been a usefool tool for the study and classification of intermediate logics, lies in the correspondence it establishes between such logics and properties of partially ordered sets. We can, so to speak, " visualize what a formula says about the way knowledge grows". For example, $(p \to q) \vee (q \to p)$ expresses that the different stages through which our knowledge may develop are linearly ordered; $\neg p \vee \neg\neg p$ that there is a last stage.

Now of course, via the semantics, every formula says something about p.o. sets. The interest of the above examples lies in the simplicity of the properties defined. In particular, they are first order, and the question arises whether all formulas of intuitionistic (propositional) logic define first order properties. The answer is negative. Some examples will be given, and their nature discussed in the light of various restrictions on both p.o. sets and formulas.

NAME: D. Rödding

UNIVERSITY: Münster

TITLE OF THE TALK: Some Logical Problems Connected with a Modular Decomposition Theory of Automata

SECTION: Invited Lecture

ABSTRACT:

In the context of a theory concerning networks of automata which has been developed to a certain amount of interesting results we shall present some logical problems arising in a natural way from this context. The fundamental "basis-problem" is unsolved up to now, but there are some partial results. Concerning "normed network constructions", we consider two different approaches which make it possible to study decision problems for first order languages handling these normed constructions. Next, it is possible to use network constructions for the representation of some recursive functionals: this can be extended to the characterization of a class of functionals of arbitrary finite type. Finally, the "loop-problem" for networks can be considered in the context of the P-NP-problem: a new result is presented in comparison with an older result which can be formulated entirely in terms of network constructions.

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NAME: Ramez L. Sami

UNIVERSITY: Kairo

TITLE OF THE TALK: Group Actions and the Vaught Conjecture

SECTION: Model Theory and Groups

ABSTRACT:

Vaught's conjecture (that a sentence of $L_{\omega_1\omega}$ has countably many or $2^{\aleph_0}$ isomorphism types of countable models) is known to follow from the following conjecture in descriptive set theory:

(*) If G is a Polish topological group and J: $G \times S \to S$ is a continuous action of G on a Polish space S, then there are either countably or perfectly many orbits (that is: there is a perfect $P \subseteq S$, no two distinct members of which share the same orbit.)

This is known to be true for locally compact or abelian polish groups.

Assume below that J is a Δ^1_1 group action, where both G and S are recursively presented. For x in S, let $[x]$ denote the orbit of x.

Proposition 1: For any $x \in S$, $[x]$ is $\underset{\sim}{\Pi}^0_{\omega_1^x+2}$.

Theorem 2: Let $U \subseteq S$ be $\underset{\sim}{\Sigma}^1_1$ invariant. If for all $x \in U$, $[x]$ is $\underset{\sim}{\Pi}^0_{\omega_1^x}$, then U has countably or perfectly many orbits.

In the model theory case, $\underset{\sim}{\Sigma}^1_1$ invariant subsets are none other than $PC_{\omega_1\omega}$ classes of countable models; one can improve Thm. 2 for this case:

Theorem 3: Let U be a $PC_{\omega_1\omega}$ class of models (with universe ω) If for all $x \in U$, $[x]$ is $\underset{\sim}{\Sigma}^0_{\omega_1^x+2}$, then U has countably many or perfectly many orbits

Remarks: 1) Prop. 1 generalizes a known fact in model theory (See [5]). The proof here however is less elaborate than the special case (which uses Scott sentences).

2) Theorem 2 was proved by Steel [5] under the hypothesis: $\forall x (x^\# \text{ exists})$. Makkai [1] gives a proof of a weaker statement (in effect strengthening the hypothesis to: $[x]$ is $\underset{\sim}{\Pi}^0_{\omega_1^x}$, for all $x \in U$.) Our proof builds upon [3].

NAME: Ulf. R. Schmerl

UNIVERSITY: München

TITLE OF THE TALK: Diophantine Equations in a Fragment of Number Theory

SECTION: Proof Theory

ABSTRACT:

We study the following problem: Given a diophantine equation, is it possible to find out whether or not this equation can be proved impossible in the fragment Z_o of classical first order arithmetic in 0, S, +, ·, and open induction.
Using proof-theoretic methods we prove the following: Let $r(x_1,..,x_n)=s(x_1,..,x_n)$ be a diophantine equation in the variables $x_1,..,x_n$. Then

$\forall x_1..x_n[r(x_1..x_n)\neq s(x_1..x_n)]$ is provable in Z_o iff

$\exists c\in\mathbb{N}\ \forall(\hat{x}_1..\hat{x}_n)\in I^c_{x_1..x_n}\ \ r(\hat{x}_1..\hat{x}_n)-s(\hat{x}_1..\hat{x}_n)\mid 1+\mathbb{N}[x_1..x_n]$.

Here $I^c_{x_1..x_n}=\{0,1,..,c-1,x_1+c\}\times..\times\{0,1,..,c-1,x_n+c\}$, $1+\mathbb{N}[x_1..x_n]$ is the set of polynomials in $x_1..x_n$ with coefficients from $\mathbb{N}$ and absolute coefficient $\neq 0$, and $r(\hat{x}_1..\hat{x}_n)-s(\hat{x}_1..\hat{x}_n)\mid 1+\mathbb{N}[..]$ means that $r(\hat{x}_1..\hat{x}_n)-s(\hat{x}_1..\hat{x}_n)$ - understood as a polynomial from $Z[x_1..x_n]$ - devides some polynomial in $1+\mathbb{N}[x_1..x_n]$.

This characterization still holds when the functions P (predecessor), sg, and $\overline{sg}$ (sign and cosign) are added to Z_o.

NAME: P.H. Schmitt

UNIVERSITY: Heidelberg

TITLE OF THE TALK: Decidability of the $L(Q_\alpha)$-theory of the Class of all ordered Abelian Groups

SECTION: Model Theory and Groups

ABSTRACT:

The language $L(Q_\alpha)$ arises from ordinary first-order logic by adding the quantifier $Q_\alpha x$ with the interpretation that $Q_\alpha x \varphi$ is true in a structure M if the set of elements $a \in M$ satisfying $M \models \varphi(a)$ has at least cardinality $\aleph_\alpha$.

Theorem 1 : The $L(Q_\alpha)$-theory of the class of all ordered Abelian groups is decidable for $\alpha = 0$ and $\alpha = 1$.

In the course of proof for this theorem we need as an auxiliary result:

Theorem 2 : The $L(Q_\alpha)$-theory of the class of all complete linear orderings is decidable for $\alpha = 0$ and $\alpha = 1$.

NAME: P.H. Schmitt

UNIVERSITY: Heidelberg

TITLE OF THE TALK: Model- and Substructure complete Theories of ordered Abelian Groups

SECTION: Model Theory and Groups

ABSTRACT:

In his pioneering paper [1] Yuri Gurevich associated with every ordered Abelian group G for every $n \geq 2$ a coloured chain (i.e. a linear order with additional unary predicates) $Sp_n(G)$, called the n-spine of G and proved:

$$G \equiv H \quad \text{if and only if} \quad \text{for all } n \geq 2 \quad Sp_n(G) \equiv Sp_n(H)$$

Thus for every elementary class $\mathcal{M}$ of ordered abelian groups there are theories T_n in the language of n-spines , such that

$$G \in \mathcal{M} \quad \text{if and only if} \quad \text{for all } n \geq 2 \quad Sp_n(G) \models T_n$$

Main Theorem: If for all $n \geq 2$ T_n is model complete (substructure complete) then $\mathcal{M}$ is model complete (resp. substructure complete) in a certain definitional extension of the language of ordered groups.

NAME: P. Schroeder-Heister

UNIVERSITY: Konstanz

TITLE OF THE TALK: Natural Deduction Calculi with Rules of Higher Levels

SECTION: Proof Theory

ABSTRACT:

Natural deduction calculi, as introduced by S. Jaśkowski and G. Gentzen, differ from Hilbert-type calculi as well as from sequent calculi in that assumptions may be discharged with the application of inference rules. An inference rule in such calculi can be stated as

$$\frac{\begin{matrix}\Gamma_1 & & \Gamma_\ell \\ A_1 & \ldots & A_\ell\end{matrix}}{A}$$

where the Γ's are (possibly empty) sequences of formulas indicating the assumptions which may be discharged. This concept of a calculus can be generalized in the following way: In the first step one allows not only formulas but also rules as assumptions. If a rule R which does not belong to the basic inference rules of the calculus considered, is used in a derivation of a formula A, then A is said to depend on R. In the second step one defines inference rules which allow one to discharge assumptions which are themselves rules. This leads to the concept of rules of arbitrary (finite) levels: A level-0-rule is a formula, a level-1-rule is a rule not allowing one to discharge any assumption (like rules in Hilbert-type systems), a level-(m+2)-rule is a rule allowing one to discharge assumptions which are level-m-rules. An example of a level-3-rule is

$$\frac{\begin{matrix} & A \Rightarrow B \\ A \to B & C\end{matrix}}{C}$$

where '→' is the implication sign and A⇒B is a linear notation for the level-1-rule $\frac{A}{B}$. This level-3-rule is equivalent to modus ponens. With the help of level-m-rules for arbitrary (finite) m, a general schema for introduction and elimination rules for n-place sentential connectives and quantifiers is definable, thus yielding a natural deduction system for logical operators in a generalized sense. Derivations in this system are normalizable. Furthermore, the (functional) completeness of the standard intuitionistic operators '∧', '∨', '→', '⊥', '∀' and '∃' can be proved. The system is not suitable for the interpretation of modal calculi without modifications. So the meaning of level-m-rules is somewhat different from the meaning of sequents of higher levels used by K. Došen ('Logical Constants', Ph.D. thesis, Oxford 1980) for the interpretation of various logical systems including modal and relevant logics.

NAME: W. Sieg

UNIVERSITY: Columbia

TITLE OF THE TALK: A Note on König's Lemma

SECTION: Proof Theory

ABSTRACT:

Every finitely branching, but infinite tree has an infinite branch. That is König's lemma KL, a most useful tool for mathematical and metamathematical investigations. The Heine/Borel covering theorem and Gödel's completeness theorem, to mention just two examples, can be proved using KL (over a very weak theory, see below). KL can be formulated as an "abstract principle" [2] in the language of second order arithmetic:

KL $(\forall f)[\mathcal{T}(f) \& (\forall x)(\exists y)(lh(y)=x \& f(y)=0 \rightarrow (\exists g)(\forall x)\ f(\bar{g}(x))=0]$

where $\mathcal{T}(f)$ abbreviates that $\{x \mid f(x)=0\}$ forms a finitely branching tree; i.e. $(\forall x)(\forall y)(f(x*y)=0 \rightarrow f(x)=0)\ \&\ (\forall x)(\exists z)(\forall y)(f(x*\langle y\rangle)=0 \rightarrow y \leq z)$. Over BT -- the second order version of PRA together with the comprehension principle for quantifier-free formulas -- plus Σ^0_1-AC_0, KL is equivalent to the full arithmetical choice principle Π^0_∞-AC_0 ([1]). Thus the theory $(BT+\Sigma^0_1\text{-}AC_0+KL)$ $[(BT+\Sigma^0_1\text{-}AC_0+\Pi^1_\infty\text{-}IA+KL)]$ is equivalent to $(\Pi^0_\infty\text{-}AC_0)\restriction$ $[(\Pi^0_\infty\text{-}AC_0)]$ and, consequently [NOT] conservative over elementary number theory Z.

In the presence of Σ^0_2-AC_0, i.e. in effect Π^0_∞-AC_0, KL is equivalent over BT to a version in which a bound for the size of the immediate descendants of a node is given by a function.

KL_b $(\forall f)(\forall g)\{\mathcal{T}(f,g)\ \&\ (\forall x)(\exists y)(lh(y)=x \& f(y)=0) \rightarrow (\exists h)(\forall x)\ f(\bar{h}(x))=0]$

where $\mathcal{T}(f,g)$ abbreviates now $(\forall x)(\forall y)(f(x*y)=0 \rightarrow f(x)=0)\ \&$ $(\forall x)(\forall y)(f(x*\langle y\rangle)=0 \rightarrow y \leq g(x))$. KL_b is by itself, however, weaker than KL: if (K) is $(BT+\Sigma^0_1\text{-}AC_0 + \Pi^1_\infty\text{-}IA + KL_b)$, then (K) is conservative over Z. This is a slight generalization of a result of Kreisel's [2]. For the refined development of analysis and metamathematics (see [4]) other results are more significant.

THEOREM 1. (F):= $(BT+\Sigma_1^0\text{-}AC_0+\Sigma_1^0\text{-}IA+KL_b)$ is conservative over PRA for Π_2^0-sentences.

Friedman's theory WKL_0 is essentially $(BT+\Delta_1^0\text{-}CA+\Sigma_1^0\text{-}IA+WKL)$, where WKL is König's lemma for trees of sequences of 0's and 1's, and it is contained in (F). So we have as a corollary a result of Friedman's ([4]): WKL_0 is conservative over PRA for Π_2^0-sentences. Note that the examples mentioned above can be proved in WKL_0; indeed, they are equivalent to WKL ([4]).

Minc [3] formulated a theory S^+ which is $(BT+\Gamma_1^0\text{-}CA^- + \Pi_2^0\text{-}IR^-)$; the schemata extending BT are available only for formulas without function parameters. (IR is the induction rule.) WKL for primitive recursive trees can be proved in S+ and (using it) Gödel's completeness theorem. Minc showed that S^+ is a conservative extension of PRA for Π_2^0-sentences. This fact is an immediate consequence of the following stronger result.

THEOREM 2. (M):= $(BT+\Sigma_2^0\text{-}AC_0^-+\Pi_2^0\text{-}IR^-+KL_b)$ is conservative over PRA for Π_2^0-sentences.

The arguments for theorems 1 and 2 are purely proof theoretic.

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[2] KREISEL, MINC, SIMPSON, The use of abstract language in elementary metamathematics: Some pedagogic examples; in: Logic Colloquium (R. Parikh, ed.), Lecture Notes in Mathematics 453, 1975, 38-131.
[3] MINC, What can be done in PRA; Zap. Nau. Sem. LONI AN SSSR, vol. 60 (1976), 93-100. [4] SIMPSON, Which set existence axioms are needed to prove the Cauchy/Peano theorem for ordinary differential equations?; Research report, Department of Mathematics, Pennsylvania State University, 1982.

NAME: P.H. Slessenger

UNIVERSITY: Leeds

TITLE OF THE TALK: On Subsets of the Skolem Class T of Exponential Polynomials

SECTION: Logic versus Computer Science

ABSTRACT:

The Skolem class T is defined to be the least class of functions from N to N, which contains the constant function 0 and the identity function x , and containing f(x) and g(x) must contain f(x)+g(x) , f(x).g(x) and $f(x)^{g(x)}$.

The class is well ordered by eventual domination. ($f(x) \prec g(x)$ iff $\exists n \in N \ \forall x > n \ f(x) < g(x)$.) The order type is as yet unknown, but is known to be $\leq \chi_0$.

Proper subsets of T defined by Th. Skolem, H. Levitz, R. McBeth and the author have been shown to have order type ϵ_0.

Definition: $H: T \to N$ called the height function is defined so, $H(n)=0 \ \forall n \in N$, $H(f(x)+g(x)) = H(f(x).g(x)) = \max\{H(f(x)), H(g(x))\}$, and if g(x) is not constant $H(f(x)^{g(x)}) = \max\{H(f(x), H(g(x)+1\}$

Theorem: $H(f(x)) < H(g(x))$ implies $f(x) \prec g(x)$.

Definition: $H \subset T$, $x \in H$ and if $f(x), g(x) \in H$ and $H(f(x))=H(g(x))$ then f(x).g(x) and $f(x)^{g(x)} \in H$.

Theorem: The order type of H under $\prec$ is ϵ_0 .

The proof is by means of defining a standard form for each element of H. Indeed all the results calculating order types of subsets of T seem to rely heavily on some unique way of expressing each element of that subset, with a subsequent definition of a necessary and sufficient condition for one function to dominate another.

Following a result of Levitz we have,

Theorem: $f(x), g(x) \in H$ then $f(x) \prec g(x)$ iff $f(f(2)+g(2)) < g(f(2)+g(2))$.

Definition (Levitz): The subset R of regular functions of T

$R = \{f(x) \in T : g(x) \prec f(x) \text{ implies } g(x)^x \prec f(x)\}$.

Definitions: $A = \{f(x) \in T : g(x) \prec f(x) \text{ implies } g(x)+g(x) \prec f(x)\}$.

$W = \{f(x) \in T : g(x) \prec f(x) \text{ implies } g(x).g(x) \prec f(x)\}$.

A is the set of functioms defining initial segments of T closed under + , and W, those closed under $\cdot$ (multiplication).
Theorem: $f(x) \epsilon A$ iff $2^{f(x)}$, $x^{f(x)}$ ϵ W , $g(x) \epsilon W$ implies $2^{g(x)}$ ϵ R.

We also have $R \subset W \subset A$ so thier order types are the same.

NAME: Robert I. Soare

UNIVERSITY: Chicago / Leeds

TITLE OF THE TALK: DEGREES OF MODELS OF ARITHMETIC

SECTION: Invited Lecture

ABSTRACT:

We begin with a review of Turing degrees of nonstandard models of Peano arithmetic by Scott, Shoenfield, Jockusch and Soare, and others. We then raise the analogous questions for models of true arithmetic where 'recursive' is replaced by 'arithmetic', 'degree $(\emptyset^1)$' by 'degree $(0^{(\omega)})$', and ' recursively low' by 'arithmetically low'. Initial results were obtained by Feferman, J. Knight, and D. Marker. The exact analogy is carried out by results of Knight, Lackler and Soare. Later results by Marker and Macintyre and Solovay, are also mentioned.

09

NAME: Dieter Spreen

UNIVERSITY: RWTH Aachen

TITLE OF THE TALK: Effective Operators in a Topological Setting

SECTION: Recursions Theory

ABSTRACT:

It is the aim of this paper to present a uniform generalization of both the Myhill/Shepherdson and the Kreisel/Lacombe/Shoenfield theorem on effective operators. To this end we consider effective operators on countable topological T_0-spaces with a countable basis. Let (S_1,τ_1) and (S_2,τ_2) be such spaces, and let $\{B_i^{(2)}\}_{i\in\omega}$ be the set of basic open sets of topology τ_2. Moreover, for k=1,2 let $\{x_i^{(k)}\}_{i\in I_k}$ $(I_k\subseteq\omega)$ be a (partial) indexing of S_k such that

(a) $\{i \mid x_i^{(2)}\in B_j^{(2)}\}$ is r.e. in I_k and this enumeration is uniform with respect to j

(b) if $\{x^{(1)}_{\varphi_m(i)}\}_{i\in\omega}$ is a sequence in S_1 that approximates some element $x\in S_1$ then an index of x can be computed from m.

Finally, let $F\colon S_1\to S_2$ be an operator which is effective with respect to these indexings. We show that F is effectively sequence continuous. From this we deduce the above mentioned theorems.

Observe that in general in T_0-spaces the set of limit points of some sequence may contain more than one element. But in these spaces a partial order can be introduced. And in condition (b), when we say that some sequence approximates a certain point x then this means that x is the maximal limit point of the sequence under this ordering.

ACKNOWLEDGEMENT

The impetus to do this work is due to Prof. Paul Young.

NAME: Petr Štěpánek

UNIVERSITY: Prag

TITLE OF THE TALK: Automorphisms and Embeddings of Boolean Algebras

SECTION: Boolean Algebras

ABSTRACT:

Several classes of Boolean algebras e.g. rigid, homogeneous or Boolean algebras with no rigid or homogeneous factors are defined by properties of automorphisms. For each of the above classes, there is a general embedding theorem stating that every Boolean algebra B can be completely embedded in a complete Boolean algebra C which is countably generated and homogeneous [1], rigid [2], or which has no rigid or homogeneous factors [3]. It is clear that if C is rigid then no non-trivial automorphism of B extends to an automorphism of C. On the other hand, in the classical embedding theorem due to Kripke, every automorphism of B extends to an automorphism of C. We shall deal with the problem whether every boolean algebra B can be completely embedded in a complete homogeneous Boolean algebra H such that no non-trivial automorphism of B extends to an automorphism of H.

References

[1] S. Kripke, An extension of a theorem of Gaifman-Hales-Solovay, Fund. Math. 61 (1967), 29-32

[2] P. Štěpánek, B. Balcar, Embedding theorems for Boolean algebras and consistency results on ordinal definable sets, J. Symbolic Logic 42 (1977), pp 64 - 75

[3] P. Štěpánek, Boolean algebras with no rigid or homogeneous factors, Trans. AMS 270 (1982), 131 - 147

NAME: Thomas Streicher

UNIVERSITY: Linz

TITLE OF THE TALK: A SOLUTION FOR THE DEFINABILITY PROBLEM FOR "DETERMINISTIC" DOMAINS

SECTION: Logic versus Computer Science

ABSTRACT:

We define a metalanguage (a typed λ-calculus with recursion, if-then-else and some basic operations), s.t. any computable object in a "deterministic" domain (a special effectively given domain) is the denotation of an appropriate term of the metalanguage). The class of deterministic domains contains all basic domains such as the one-point domain ①, the domain of truth-values $Bool_\perp$ and the domain of natural numbers $N_\perp$ and is closed under the functors ×, &, +, →, $()_\perp$ and definition by recursive domain equations.
Any deterministic domain can be embedded into $(N_\perp \to Bool_\perp)$ by a retract definable in the metalanguage. But $(N_\perp \to Bool_\perp)$ is a universal domain for the category of coherently complete ω-algebraic domains [3] and the computable objects in this domain can be denoted by the metalanguage as follows from [2].
Thus we have defined a metalanguage for defining the denotational semantics of arbitrary deterministic, sequential programming languages.
The class of all domains needed for the denotational semantics of nondeterministic or parallel programs is the Smyth powerdomain of $(N_\perp \to Bool_\perp)$ and computable retracts of it. If one could find an extension of the metalanguage to handle nondeterminism one would have obtained a metalanguage which is complete for all domains definable by recursive domain equations even involving the powerdomain functor.
However, this problem has not yet been solved such as the problem whether the Plotkin powerdomain of $(N_\perp \to Bool_\perp)$ is universal for the category SFP.

NAME: M.E.Szabo / F.E. Farkas

UNIVERSITY: Montreal

TITLE OF THE TALK: Star-Deterministic Parallel Programs

SECTION: Logic versus Computer Science

ABSTRACT:

In this paper we introduce the concept of a hyperfinite automaton and prove that every asynchronous parallel program is equivalent to a *-deterministic sequential program on some hyperfinte automaton. We use this theorem to give nonstandard characterizations of a variety of properties of parallel programs.

00

NAME: Chr. Thiel

UNIVERSITY: Erlangen

TITLE OF THE TALK: The "Explicit" Philosophy of Mathematics Today.

SECTION: Invited Lecture

ABSTRACT:

Recent critics have charged that contemporary philosophy of mathematics is stagnant and outdated. While neglecting new directions in contemporary mathematics, they say, it continues to follow out the old talk about "foundations" within the classical triad of logicism, formalism, and intuitionism, which is as obsolete today as the epistemological triad of Platonism, empiricism, and nominalism (including conventionalism). In fact, while admitting the valuable contributions by philosophers to the field before the 20th century, they question the relevance of the philosophy of mathematics in general.

The paper, without pretending to be an apologia, will meet this grave critique by surveying the aims and topics (the objects, concepts, methods, and foundations of mathematics) treated in some recent studies within this branch of philosophy. It will attempt to set off a proper area, which includes most of the "classical" problems but is not subject to the above charges, and also to argue for its necessary independence from the style and methods of mathematics at every stage of its historical development.

NAME: J.K. Truss

UNIVERSITY: Paisley

TITLE OF THE TALK: CANCELLATION LAWS for SURJECTIVE CARDINALS

SECTION: Set Theory I

ABSTRACT:

Tarski proved without the axiom of choice that $kx \leqslant ky \rightarrow x \leqslant y$ for cardinal numbers x and y and positive integers k. His proof is "effective" in the sense that a function F is given such that whenever X, Y are sets, k a positive integer, and f is a 1 - 1 function from $k \times X$ into $k \times Y$, then F(X, Y, k, f) is a 1 - 1 function from X into Y.

We seek analogous results for $\leqslant^*$ - inequalities, i.e. for surjective maps in place of 1 - 1 ones. Let $|X|$ denote the cardinality of the set X. Then $x \leqslant^* y$ means that whenever $|X| = x$ and $|Y| = y$ there is a map from a subset of Y onto X.

Theorem 1 : If $kx \leqslant^* ky$ & $ky \leqslant^* kx$ then $x \leqslant^* y$ & $y \leqslant^* x$.
This is proved "effectively" in the same sense as above. An adaption is used of Tarski's proof of cancellation laws in a cardinal algebra. It is not known whether "surjective cardinals" (equivalence classes under $=^*$ where $x =^* y \iff x \leqslant^* y$ & $y \leqslant^* x$) form a cardinal algebra. However we can show the following:

Theorem 2 : (a) Refinement. If $x + y =^* z + t$ there are cardinals a, b, c, d such that $x =^* a + b$, $y =^* c + d$, $z =^* a + c$, $t =^* b + d$.

(b) Approximate Cancellation. If $x + y =^* x + z$ there are cardinals p, q, r such that $x =^* x + p + q$, $y = p + r$, $z =^* q + r$.

On the negative side we find that $\leqslant^*$ behaves differently from $\leqslant$.

Theorem 3 : $(\exists x,y)(2x \leqslant^* 2y \;\&\; \neg x \leqslant^* y)$ is relatively consistent with ZF.

NAME: A. Ursini

UNIVERSITY: Siena

TITLE OF THE TALK: Some Problems in Set Theory

SECTION: Set Theory I

ABSTRACT:

A. Consider an infinite set A^o. Dedekind would teach us that there is a proper subset A^1 of A^o, equipotent with A^o. Then we go on and get $A^2, A^3, \ldots\ldots$ We can arrange things in such a way that $A^\omega = \bigcap_{i\in\omega} A^i$ is empty.

In how many ways can we find such denumerably infinite annihilating sequences?

Sometimes we can proceed further on the ordinals, so that A^ω is equipotent with A^o, then get $A^{\omega+1}$,.....

What are the ordinal which may appear in these processes, such that A^α is empty?

Consider now all possible ways of traveling down through the power set of A^o, in the manner described, to reach $\emptyset$: at each non limit stage the set is equipotent with A^o.

What natural structure is the set of all these possible threads endowed with?

Can we get thereafter a sound notion of the <u>size</u> of Card(A^o)?

B. Let L be a linear order, unbound , dense and satisfying the c.c.c.; let L^2 be $L\times L$ with the product order topology. $(SH)^2$ is the statement: "For any L as above, L^2 is homeomorphic with R^2" where R be the real line. Trivially SH implies $(SH)^2$, and truly $(SH)^n$ for any n . Does $(SH)^2$ imply SH ? Is $(SH)^2$ independent from ZFC? The same questions for $(SH)^n$ and $(SH)^\omega$.

W

NAME: Antonio Vincenzi

UNIVERSITY: Savona

TITLE OF THE TALK: SOME GOOD PROPERTIES OF MODAL MODEL THEORY

SECTION: Non-classical Logics

ABSTRACT:

Modal Model Theory L(C) has been introduced by Chang (see [**Ch**]) as a semantic refinement of Montague's *Pragmatics* (see [**Mo**]). The *syntax* of L(C) has an operator C such that if φ is a formula and t is a term, then $Ct\varphi$ is a formula, namely an *individualized* formula. The free variables of t are also free in $Ct\varphi$. The *semantics* of L(C) requires enriched structures of the form $\langle \mathfrak{A}, C^{\mathfrak{A}} \rangle$ where $\mathfrak{A}$ is an ordinary structure (with universe A) and $C^{\mathfrak{A}}$ is an arbitrary function from A into $P(P(A))$, and defines

$$\langle \mathfrak{A}, C^{\mathfrak{A}} \rangle \models_C Ct\varphi \quad \text{iff} \quad \{a \in A \mid \langle \mathfrak{A}, C^{\mathfrak{A}} \rangle \models_C \varphi[a]\} \in C^{\mathfrak{A}}(t^{\mathfrak{A}}).$$

Here we present some model theoretic properties of L(C) obtained by using the generalized abstract model theoretic techniques developed in [**Mu**].

Result 1. L(C) *is a generalized logic with relativization.*

Result 2. L(C) *can be reduced to propositional logic by assigning a truth value to every prime or individualized formula.*

Thus *Compacteness* and *Löwenheim-Skolem property* for L(C) can be obtained in the usual way (compare with [**Ch**], where the above properties are consequences of Łos theorem).

Result 3. L(C) *has the Fraissé-Ehrenfeucht property.*

From Result 3 one gets that L(C) has the *preservation property* for products but not for substructures. Notice that this is a partial solution of [**Ch**,Problem 2].

Result 4. L(C) *has the Robinson Consistency property.*

Since L(C) is a compact logic, Result 4 implies that *Craig Interpolation, Beth Definibility* and *Δ-closure theorems* hold in L(C), and solves [**Ch**,Problem 3].

[**Ch**] Chang,C.C.: *Modal Model Theory*. LNM 337, Springer 1971.

[**Mo**] Montague,R.: *Pragmatics*. In: *Contemporary Philosophy, a survey*. (Klibansky R. ed.). La Nuova Italia 1968.

[**Mu**] Mundici,D.: *Lectures on Abstract Model Theory. I,II,III*. Quaderni dell'Istituto Matematico "U.Dini" di Firenze 6,7,14 (1981/82).

NAME: S.S. Wainer

UNIVERSITY: Leeds

TITLE OF THE TALK: The Π^1_2-Approach to Subrecursive Hierarchies

SECTION: Invited Lecture

ABSTRACT:

The aim of recursion-theoretic hierarchies is to assign ordinal notations to functions in such a way as to reflect, as closely as possible, their computational complexity. A new approach to this general problem is presented here - motivated by ideas and results of Girard's "Π^1_2-Logic", but developed within a rather different framework.

The framework is induced by the "slow-growing" hierarchy G under which Kleene computations over the integers N appear as the natural collapse of identical computations defined over a maximal inductively generated set Ω of abstract ordinal notations. The naturalness of $G(\alpha)$ as a functional representation of ordinal $|\alpha|$ is illustrated by the fact that for "standard" ordinal notations $\alpha \in \Omega$, $|\alpha| = \varinjlim G(\alpha)$, the direct limit of the increasing function $G(\alpha)$.

In particular, the transfinite Grzegorczyk Hierarchy $\{F(\beta)\}$ over N appears as the collapse under G of the Bachmann Hierarchy over Ω so that, for example $|ID_{n+1}| = \varinjlim F(|ID_n|)$. Thus, $|ID_{<\omega}|$ is the limit to which we could autonomously generate the usual subrecursive hierarchies, regulated by the condition that we only proceed to level $|\alpha|$ if $G(\alpha)$ has been previously computed.

NAME: Anita Wasilewska

UNIVERSITY: Easton / Warsaw

TITLE OF THE TALK: PROGRAMS, AUTOMATA AND GENTZEN TYPE FORMALIZATIONS

SECTION: Logic versus Computer Science

ABSTRACT:

We show (Th 1,2) that the difference between Gentzen type formalizations (G.t.f.) for any propositional and predicate calculi based on enumerable languages is of the same kind as that between programs without or with recursive prodecures. To prove it we use the algebraic theory of programs as in Blikle [1] where FC and PD algorithms are introduced as models for procedure free and non-free programs, respectively and the general theory of G.t.f as in Wasilewska [2].

We introduce the notion of monadic second order (m.s.o) definability (based on ideas of Büchi [3]) and use theorem 1 to get the common characterization of G.t.f for propositional calculi, finite automata and procedure-free programs (ths 3, 4, 5). The similar problem for G.t.f. for predicate calculi in open.

[1] A. B. Blikle, "An analysis of programs by algebraic means." Banach Center Publications, Volume 2, Warsaw. (1977)

[2] A. Wasilewska, "On the Gentzen type formalizations." Zeitschr. f. Math. Logik Bd 25S. (1980)

[3] Buchi T.R. (1962) "On a decision method in restricted second order arithmatic", in Proc. 1960 Int. Cong. for Logic. Stanford, California.

NAME: Volker Weispfenning

UNIVERSITY: Heidelberg

TITLE OF THE TALK: DECIDABLE THEORIES OF VALUED FIELDS

SECTION: Invited lecture

ABSTRACT:

Fields with an additive valuation are counterparts to fields with an absolute value such as $\mathbb{Q}$, $\mathbb{R}$, $\mathbb{C}$. They arise naturally - from a geometric viewpoint- in many algebraic situations, e.g. fields of power series or nonarchimedean ordered fields. The concept of a valued field grew out of an axiomatic treatment of the fields $\mathbb{Q}_p$ of p-adic numbers. These numbers were invented by Hensel in order to treat number theoretic problems (e.g. systems of congruences) by means of ideas from complex function theory.

We give a survey on decidable theories of valued fields and their elementary invariants. The proofs employ an explicit quantifier elimination procedure originating from P. Cohen. The lecture will cover the following topics:

(1) Basic algebraic concepts ;
(2) Linear problems in valued fields (v.d.Dries) ;
(3) Algebraically closed valued fields (A. Robinson) ;
(4) Hensel fields of equal characteristic zero (Ax-Kochen, Ersov) ;
(5) Hensel fields of mixed characteristic and arbitrary ramification (Ax-Kochen, Ersov, Ziegler, Baserab, v.d.Dries);
(6) Quantifier elimination without cross-section and applications to real-closed rings (Macintyre, Cherlin-Dickman) .

NAME: Ph. Welch

UNIVERSITY: Oxford

TITLE OF THE TALK: Σ^1_3 - Wellfounded Relations and the Core Model

SECTION: Set Theory II

ABSTRACT:

Martin proved the following results on $\underset{\sim}{\Sigma}^1_3$ sets of reals (identified with $\omega_\omega = N$) (in ZF + DC + $\forall a \in N(a^{\#}$ exists): the cardinals in brackets refer to the result assuming full AC)

1) Every $\underset{\sim}{\Sigma}^1_3$ wellfounded relation $\subseteq N^2$ has length $< \aleph_{\omega+1}$ $(\aleph_3)$

(and hence $\underset{\sim}{\delta}^1_3$ = sup(lengths of $\underset{\sim}{\Delta}^1_3$ prewellorderings of N) $\leq \aleph_{\omega+1}$ $(\aleph_3)$

2) Every $\underset{\sim}{\Sigma}^1_3$ set is the union of $\aleph_{\omega+1}$ sets in $\underset{\sim}{B}_{\aleph_{\omega+1}}$

($\underset{\sim}{B}_{\kappa}$ = smallest Boolean algebra containing the closed sets and closed under unions of lengths $< \kappa$)

(AC) Every $\underset{\sim}{\Sigma}^1_3$ set is the union of $\aleph_2$ Borel sets.

If one assumes in addition $\neg 0^{\dagger}$ (or indeed $\exists b \in N(\neg b^{\dagger})$ we obtain (without AC)

1') the lengths above are $< \aleph_2$: $\underset{\sim}{\delta}^1_3 \leq \aleph_2$.

2') Every $\underset{\sim}{\Sigma}^1_3$ set is the union of $\aleph_1$ sets each of which is the union of $\aleph_1$ Borel sets. And so

(AC) Every $\underset{\sim}{\Sigma}^1_3$ set is the union of $\aleph_1$ Borel sets.

These figures depend completely on the computation of u_ω the ω'th uniform indiscernible, where

$$C = \langle u_i \mid i \in On \rangle = \bigcap_{a \in N} I^a$$

(I^a = class of Silver indiscernibles for $L(a)$)

since Martin (TS) showed that if $\forall a$ ($a^\#$ exists) then every Σ^1_3 set admits an $(u_\omega)^\omega$-scale. The bounds in 1)-2') are all obtained by computing u_ω.

Assuming all reals have sharps and O we may use Jensen's Σ^1_3 - Absoluteness Theorem for K, the Core Model (see(CM)). Using a Paris "Patterns of Indiscernibles" type result for mice we can compute that $u_\omega < \tau^*$ where τ^* = the height of the first admissible set that contains K_τ (where $\tau = \aleph_1^V$). Thus

$$\tau^* < (\tau^+)^K \leq \aleph_2.$$

Indeed defining $C^\tau = \langle u_i^\tau \mid i \in On \rangle = \bigcap_{a \in \mathcal{P}_{<\tau}(\tau)} I^a$

inside K, we obtain

$$\forall i \in On \quad u_i = u_i^\tau.$$

<u>Thus</u> (if all reals have sharps) complicated Σ^1_3 sets imply inner models with measures.

(CM) "The Core Model" Tony Dodd. LMS Lecture Note Series No.61 C.U.P.

(TS) "Notes on the Theory of Scales" A.Kechris and Y.Moschovakis, in "Cabal Seminar 76-77" SLN No.689

NAME: Eduard W. Wette

UNIVERSITY: Hennef

TITLE OF THE TALK: Control for the Exhibition of Inconsistent Numbers

SECTION: Proof Theory

ABSTRACT:

For the complete title cf. XLIV, p. 476, [12]. The abstract was written on April 30, 1977 (= C.F. Gauss* + 200 a); it summarized my ICS/acm i. a. typescript (16 pp., 1976 IX 15). The renòvation of § 1 can now refer to my 1983 Salzburg contribution (7 ICLMPS, Section 1), entitled The consistency-critical primitive recursive function and the inconsistent variable-free elementary term within formalized Peano arithmetic. Cf. also Dümmlerbuch 4711, Bonn 1982.

§ 1. Formal end of mathematics, logic: power-iteration discomputed.

The practice of primitive recursive definition with < 300 subfunctions or of binary computation with < 2300 variable-free polynomial terms annuls all the "semantic" claims of proof theory and, moreover, the truth of "proven" decision procedures. Gödel's comment on my talk (January 24, 1975): "Ende der Wissenschaft", no other words from Princeton to Washington D.C. ! His main question "was machen wir jetzt mit den Permutationen ? die sind für Chemie noch wichtig", when he telephoned me before, had been answered from my geometro-static approach to the totality of 'motion' by "the" seamless 'warp & woof' on a maximal surface.

Counter-corollaries. The intrafinite Boolean operations . × ., . + 1 mod 2, $\prod_{m<W} \delta_m$, where $\delta_m \in \{1, 0\}$, are inconsistent, if $W \geqslant \psi_3(5, 10^6)$; cf. Herbrand Symposium. The use of a language and of a free property in space & time confines us to $({}_2\log a_\wedge)^{1/4} \approx 56$ consistent steps for each dimension. ERGO: keep silence and save more degrees of freedom; re-educate your mind after a "refuting" walk.

Elementary paradoxes apply < 0.1//10 megabit of information within (i) the non-elementary function $\Omega(n) < \psi_3(n, 19^3) < \psi(4, 2n \dot{-} 1)$, and its induction-property $\mathrm{rs}(\Omega; a) \leftrightarrows \mathrm{ri}(\Omega(a)) \wedge [\Omega(a)]_3 = [a]_3 \wedge \mathrm{gl}(\Omega(a)) \leqslant \mathrm{gl}(a) - \mathrm{id}(a) - 2 \cdot \mathrm{md}(a)$, a polynomial predicate in Ω (4 depth-concepts restored minimal stilts !), (ii) the inconsistent number $a_\wedge$ (with $a_\wedge^2 < {}^2 1000000$) whose main part encodes $\vdash_{\mathfrak{Z}} R_{13.}(\xi) \rightarrow \mathrm{rs}(\Omega; \xi)$. The < 2300 key-terms which compute $a_\wedge$ from ⌜predicate⌝ & ⌜proof⌝-units, and the direct access to ⌜subwords⌝ guarantee a rapid control of the induction-free specialization $\mathrm{rs}(\Omega; a_\wedge)$ and of its consequence $49838 = [\Omega(a_\wedge)]_3 \neq 49838$. A few minutes of data processing can verify such logic-free paradoxes; explicit computation of ⌜Ω⌝ or $a_\wedge$ is a practicable problem, but the outputs (in few hours) cannot be controlled with the same certitude as a storage of 2300 key-addresses.

Note that W absorbs, e.g., a 'propositional' description for the number of the derivative solution to m^2-computation with $\simeq m^5/3$ symbols, etc., if $m \leq m_0 = {}^3 1000000$, as within my former inconsistency-computation; $W^2 \approx W$, whereas m_0^2 contains one more bit of bit of information than m_0; $\prod_{m<W} \delta_m$ eliminates ν-computed m-selections $\prod_{m;\, \nu(m) \leq m_0} \delta_{\nu(m)}$ (vs. XLII, p. 477, § 1). Logical reflection is untrue.

"Neo-Sandrechnung" stated, 2189 years after Archimedes, that reckoning is consistent, IFF one observes (A) numbers are restricted to their numerical meaning, i.e. no language, no meta-code, & (B) all intermediate results have an explicit decimal value, i.e. no implicit term without concretely accessible evaluation.

REFERENCES. [1] FRIEDMAN, König's Lemma is weak; mimeographed, Stanford 1969(?).
[2] KREISEL, MINC, SIMPSON, The use of abstract language in elementary metamathematics: Some pedagogic examples; in: Logic Colloquium (R. Parikh, ed.), Lecture Notes in Mathematics 453, 1975, 38-131.
[3] MINC, What can be done in PRA; Zap. Nau. Sem. LONI AN SSSR, vol. 60 (1976), 93-100. [4] SIMPSON, Which set existence axioms are needed to prove the Cauchy/Peano theorem for ordinary differential equations?; Research report, Department of Mathematics, Pennsylvania State University, 1982.

NAME: W. Zadrozny

UNIVERSITY: Heidelberg

TITLE OF THE TALK: Partial Reflection

SECTION: General Model Theory

ABSTRACT:

We consider the following problem: A device M is scanning some process A and produces information about A : A(0),A(1),... However some pieces of information in each A(i) can be false. One wants to extract the "truth" about A . If T is a tehory and A_i a sequence of strucures then T is partially reflected if for some T* s.t. Cn(T*) contains T , every sentence of T* is true in infinitely many A_i's . We prove that the theory of integer addition is p.reflected by Z_n's ("+" modulo n) , this theory is a unique one which admits some random testing w.r.t. Z_n's , and so can be viewed as being the "truth" given by Z_n's. We show that the theory of any ultrapower of Z_n's does not have this properties. It follows that sometimes we can extract a correct information in a constructive way, even if we are given mutually contradictory facts.

NAME: M. Ziegler

UNIVERSITY: Bonn

TITLE OF THE TALK: Finite Subtheories of Theories of Local Fields

SECTION: Invited Lecture

ABSTRACT:

I present the content of my article "Einige unentscheidbare Körpertheorien" L'enseignement mathématique vol.28 (1982)269-28o: Any finite subtheory of the theory of $\mathbb{C}$ (or any algebraically closed field) , the theory of $\mathbb{R}$ or the theory of $\mathbb{Q}_p$ is hereditarily undecidable. In fact any countable structure can be interpreted in a suitable model of such a theory. The model is constructed by a series of algebraic extensions starting with a rational function field.During the construction we control the set of q-th powers for some prime q.
As a corollary we have e.g. that the theory of euclidean fields is hereditarily undecidable.
In fact a stronger result is shown, which yields for example that the theory of formal real fields where every polynomial of odd degree has a zero is hereditarily undecidable.

LIST OF PARTICIPANTS

ADAMOWICZ, Z.

00-950 Warszawa
ul Sniadeckich 8
IM PAN Poland

AMBOS-SPIES, K.

Lehrstuhl Informatik II
Uni Dortmund, Postfach 500500
D 4600 Dortmund 50

ANDRETTA, A.

V. Fabro 12
Torino-101 22
Italy

BAETEN, J.

127 Vincent Hall
Dept. of Math, Univ. of Minn.
Minneapolis MN 55455 USA

BALDWIN, J.

University of Illinois at
Chicago Circle

Chicago, Il. 60680
USA

BARKER, F.

Dept. Pure Maths
University of Leeds
Leeds LS2 9JT
England

BENNINGHOFEN, B.

Lehrstuhl für angewandte Mathematik
insbes. Informatik der RWTH
Templergraben 64
D 5100 Aachen

BERLINE, Ch.

Université Paris 7
UER de Math. et Informatique
Couloir 45-55, 5e étage
2 Place Jussieu
F 75251 Paris Cedex 05

BERNARDI, C.

Dipartimento di Matematica
Via del Capitano 15
I 53100 Siena
Italy

BETHKE, I.

Dept. Mathematics
University of Amsterdam
Roeterstraat 15
1018WB Amsterdam
Netherlands

BÖRGER, E.

Lehrstuhl Informatik II
Uni Dortmund, Postfach 500500
D 4600 Dortmund

BOFFA, M.

49 Rue Dupré
1090 Bruxelles
Belgique

BONNET, R.

Dept. of Math.
Université Claude Bernard
69622 Villeurbanne Cedex
France

BORICIC, B.R.

J. Gagarina 107/44
11070 Beograd
Yugoslavia

BUFF, H.W.

Höhenweg 12
CH 9100 Herisan

BURWICK, H.

GMI
Theaterplatz 9
D 5100 Aachen

BUSZKOWSKI, W.

Institute of Mathematics
Adam Mickiewicz University
Matejki 48/49
6o-769 Poznan
Poland

CARSTENS, H.G.

Fakultät für Mathematik
Universität Bielefeld
Universitätsstr. 1
D 4800 Bielefeld 1

CHATZIDAKIS, Z.

Dept. of Mathematics
Yale University
PO Box 2155 Yale Station
New Haven CT 06520
USA

CHERLIN, G.

Dept. of Mathematics
Yale University
PO Box 2155 Yale Station
New Haven CT 06520
USA

CIESIELSKI, K.

Instijtut Matematyki
PKIN
oo-9o1 Warszawa
Poland

CRABBÉ, M.

Rue Chèvequeue 12
5865 Walhain
Belgium

CROSSLEY, J.N.

Monash University
Dept. of Mathematics
Clayton Victoria
Australia 3168

CZELAKOWSKI, J.

ul. Lompy 3a/5
47-22o Kedzierzyn-Koźle
Poland

CZERMAK, J.

Wäschergasse 24
A-5o2o Salzburg
Austria

DAHLHAUS, E.

Claudiusstr. 12
D-1ooo Berlin 21
Germany

DALEN VAN, D.

Mathematisch Instituut
Budapestlaan 6
Postbus 8o.o1o
35o8 TA Utrecht
Netherlands

DAVIS, M.

Courant Inst.
251 Mercer St.
New York
NY 1oo52
USA

DELON, F.

Université Paris
UER de Math. et Informatique
Couloir 45-55
2 Place Jussieu
75251 Paris Cedex o5
France

DIENER, K.-H.

Math. Institut der Univ. Köln
Weyertal 86-9o
D-5ooo Köln 41
Germany

DILLER, J.

Inst. für Mathemat. Logik
Einsteinstr. 64
D-44oo Münster
Germany

DIX, J.

Landwehrstr. 16
D-62oo Wiesbaden-Delkenheim
Germany

DOBBERTIN,H.

Inst. für Mathematik
Universität Hannover
Welfengarten 1
D-3ooo Hannover
Germany

DRABBE, J.

University of Brussels
CP 211 Campus Plaine
Bvd du Triomphe
B-1o5o Brussels
Belgium

DRAKE, F.R.

Dept. Pure Maths.
The University
Leeds LS2 9JT
England

EBBINGHAUS, H. D.

Inst. für Math. Logik
Universität Freiburg
Albertstr. 23b
D-78oo Freiburg
Germany

EKLOF, P.

Depart. of Mathematics
University of California
Irvine
California 92717
USA

FEFERMAN, S.

Dept. of Mathematics
Stanford University
Stanford
CA 943o5
USA

FLUM, J.

Mathemat. Institut
Universität Freiburg
Albertstr. 23b
D-78oo Freiburg
Germany

FONT, J.M.

Dept. of Algebra and Foundations
Faculty of Mathematics
University of Barcelona
Gran Via 585
Barcelona 7
Spain

FRANKIEWICH, R.

Institute of Mathematics
Polish Academy of Sciences
Sniadekich 8
oo-95o Warszawa
Poland

FUCHINA, S.

c/o Dr. Becker
Teutonenstr. 25a
D-1ooo Berlin
Germany

GARGOV, G.K.

Sect. Math. Logic
Inst. of Mathematics
1o9o Sofia
P.O. Box 373
Bulgaria

GARRO, I.

Nayal
Amiri St 39
Aleppo
Syria

GERMANO, G.

Dipartimento di Informatica
Università di Pisa
Corso Italia 4o
I-561oo Pisa
Italy

GROSSBERG, R.

Inst. of Math. and Computer Science
The Hebrew University of Jerusalem
Givat Ram
919o4 Jerusalem
Israel

GUREVICH, Y.

Computer and Communication
Science Department
221 Angell Hall
University of Michigan
Ann Arbor, MI 481o9
USA

HAJEK, P.

Math. Inst.
ČSAV
Žitná 25
115 67 Prag
Czechoslovakia

HAWRANEK, J.

ul. Australijska
54-4o4 Wrocław 25
Poland

HAYASHI, S.

The Metropolitan College of
Technology
6-6 Asahigaoka Hino
Tokyo
Japan

HEUSSEN, B.

Lehrstuhl f. Angewandte Math.
insbes. Informatik der RWTH
D-51oo Aachen
Germany

HINMAN, P.

Dept. of Math.
University of Michigan
Ann Arbor
MI 481o4
USA

HODGES, W.

Bedford College
Regent's Park
London NWI 4NS
Great Britain

JAMBU, M.

Dept. de Mathématiques
Université de Lyon I
43 bvd du 11 novembre 1918
F-69621 Villeurbanne
France

JOCKUSCH, C.

Dept. of Mathematics
University of Illinois
Urbana
Ill. 618o1
USA

JUHASZ,J.

Math. Institute of the
Hungarian Academy of Sciences
Budapest 1376
PO BOX 428
Hungary

KAKUDA, Y.

Dept. of Mathematics
College of Liberal Arts
Kobe University
Tsurukabuto, Nada
Kobe
Japan

KEMMERICH, S.

Lehrstuhl für Angewandte Math.
insbes. Informatik der RWTH
D-51oo Aachen
Germany

KOPPELBERG, S.

II. Math. Inst.
Königin-Luise-Str. 24-26
D-1ooo Berlin 33
Germany

KRANAKIS, E.

Math. Inst. der Universität
Im Neuenheimer Feld 288
D-69oo Heidelberg
Germany

KRAWCZYK,A.
Instytut Matematyki
Uniwersytet Warszawski
PKIN, IX p
00.901 Warszawa
Polen

KREITZ, CHR.
Neue Str. 36
D-58o4 Herdecke
Germany

KURATA, R.
Dept. of Applied Science
Faculty of Engineering
Kyushu University
Hakozaki, Fukuoka 812
Japan

LAEUCHLI, H.
Math. Inst.
des ETH-Zentrums
Rämistr. 101
CH-8006 Zürich

LASLANDES, B.
176 Grande Rue
F-9231o Sèvres
France

LEISS, H.
Seminar für Logik und
Grundlagenforschung
Beringstr. 6
D-53oo Bonn
Germany

LENSKI, W.
Fr.-Hölderlin-Str. 32
D-695o Mosbach
Germany

LEVINSKI, J.P.
Königin-Luise-Str. 24-26
D-1ooo Berlin 33
Germany

LEVY, A.
Department of Mathematics
Hebrew University of Jerusalem
Jerusalem
Israel

LEWIS, H.R.
Aiken Computation Lab.
Harvard University
Cambridge
MA o2138
USA

LINDSTRÖM, P.
Nordostpassagen 15
413 11 Göteborg
Sweden

LIPPARINI, P.
Via Zucchini 8
I-4o126 Bologna
Italy

LIU, S.-C.
Inst. of Mathematics
Academica Sinica
Nankang
Taipei
Taiwan RoC

LOLLI, G.
Ist. Sci. Inform.
Cso M. Dazeglio 42
I-1o125 Torino
Italy

LOVEYS, J.
Math. Dept.
Simon Fraser University
Burnaby
British Columbia
Canada

LÜ, Y.
Facòltà di Science
I-38o5o Povo
Trento
Italy

MAKOWSKY, J.A.

Dept. of Computer Science
Technion
Haifa 32ooo
Israel

MANDERS, K.

Math. Instituut
Budapestlaan 6
35o8 TA Utrecht
Netherlands

MANNILA, H.

Dept. of Computer Sciences
University of Helsinki
Tukholmankatu 2
SF-oo25o Helsinki 25
Finland

MANSOUL, G.

517 Grand' Route
B-411o Flemalle
Belgium

MARCJA, A.

Libera Università degli
Studi di Trento
Dipartimento di Matematica
I-38o5o Povo
Italy

MARTINEZ, J.C.

Departamento de Ecuaciones Funcionales
Facultad de Matemáticas
Universidad Complutense
Madrid 3
Spain

MEKLER,A.

Department of Mathematics
Simon Fraser University
Burnaby V5A 1S6
Canada

MICHAUX, Ch.

Brigade Piron 29o
B-6o8o Charleroi
Belgium

MIJAJLOVICZ, Z.

University of Belgrade
Faculty of Science
Institute of Mathematics
Studentski trg 16
11ooo Belgrade
Yugoslavia

MICOLAJCZAK, B.

Instytut Automatyki
Politechnika Poznańska
6o-965 Poznań
Poland

MIKULSKA, M.

1oo7 S. Busey
Urbana
IL 618o1
USA

MIROLLI, M.

Dipartimento di Matematica
Via del Capitano 15
I-531oo Siena
Italy

MOERDIJK, J.

Dept. Mathematics
University of Amsterdam
Roeterstraat 15
1o18 WB Amsterdam
Netherlands

MOSCHOVAKIS, Y.N.

Dept. of Mathematics
University of California
Los Angeles
Calif. 9oo24
USA

MUELLER , G.H.
Math. Institut der Universität
Im Neuenheimer Feld 9
D-69oo Heidelberg
Germany

MULDER, H.
Van Lieflandlaan 82
Utrecht
Netherlands

MUNDICI, D.
National Research Council
Loc. Romola N. 76
I-5oo6o Donnini (Florenz)
Italy

MURAWSKI, R.
Instijtut Matematijki VAM
ul. Matejki 48/49
6o-769 Poznan
Poland

OBERSCHELP, W.
Lehrstuhl f. Angewandte Math.
insbes. Informatik der RWTH
D-51oo Aachen
Germany

PARIGOT, M.
Université Paris
UER Mathématiques 45-55
2 Place Jussieu
F-75251 Paris Cedex o5
France

PELC, A.
Instytut Matematyki
Uniwersitet Warszawski
PKIN IX p.
oo-9o1 Warszawa
Poland

PELZ, E.
Université Bordeaux I
1. Bd. Garibaldi
F-9213o Issy-Les-Moulineaux
France

PHILLIPS, I.C.C.
School of Mathematics
University of Minnesota
127 Vincent Hall
2o6 Church Street S.E.
Minneapolis
Minnesota 55455
USA

PORTE, J.
1 Villa Ornano
75o18 Paris
France

POUR-EL, M.B.
School of Mathematics
University of Minnesota
Vincent Hall
Minneapolis
Minnesota 55455
USA

PRESTEL, A.
Fachbereich Mathematik
Universität Konstanz
Postfach 556o
D-775o Konstanz

PRIESE, L.
Fb 17
Universität-GH Paderborn
D-4790 Paderborn
Germany

RAAY VAN, R.
Prof. Dieperinklaan 15
3571 WJ Utrecht
Netherlands

RADBRUCH, K.
Fachbereich Mathematik der
Universität Kaiserslautern
Postfach 3o49
D-675o Kaiserslautern
Germany

RAPP, A.
Math. Inst. der Albert-Ludwigs-
Universität
Albertstr. 23b
D-78oo Freiburg
Germany

RATAYCYK, Z.
Institute of Math. U.W.
PKIN IX p.
oo9o1 Warszaw
Poland

RICHTER, M.M.
Lehrstuhl für Angewandte Math.
insbes. Informatik der RWTH
D-51oo Aachen
Germany

RICHTER, W.
School of Mathematics
127 Vincent Hall
2o6 Church Street S.E.
Minneapolis
Mi 55455
USA

RODENBURG, P.
Realengracht 19
1o13 KW Amsterdam
Netherlands

RÖDDING, D.
Inst. für Math. Logik und
Grundlagenforschung
Westfälische Wilhelms-Universität
D-44oo Münster
Germany

RÖDDING, W.
Wilhelm-Raabe-Straße 6
D-44oo Münster-Roxel
Germany

ROTHACKER, E.
Sprachwissenschaftliches Inst.
Ruhr-Universität Bochum
D-463o Bochum
Germany

SAFFE, J.
Inst. für Mathematik
Universität Hannover
Welfengarten 1
D-3ooo Hannover
Germany

SAMI, R.L.
Dept. of Mathematics
Faculty of Sciences
Cairo University
Cairo
Egypt

SCHÄFER, G.
Lehrstuhl für Informatik I
Büchel 29-31
D-51oo Aachen
Germany

SCHINZEL, B.
Lehrstuhl für Informatik I
Büchel 29-31
D-51oo Aachen
Germany

SCHMERL, U.R.
Math. Inst. der Universität
Theresienstr. 39
D-8ooo München
Germany

SCHMITT, P. H.

Mathematisches Institut
Im Neuenheimer Feld 294
D-69oo Heidelberg
Germany

SCHRÖDER-HEISTER, P.

Philosophische Fakultät
Fachgruppe Philosophie
Universität Konstanz
Postfach 556o
D-775o Konstanz
Germany

SCOTT, D.

Carnegie-Mellon University
Dept. of Computer Science
Schenley Park
Pittsburgh
Pennsylvania 15213
USA

SEITZ, K.

Technical University of Budapest
Transport Engineering Faculty
Dept. of Mathematics
1111 Budapest
XI Müegyetem rakpart 9H.cp.5em5
Hungary

SHARPE, R.K.

Dept. of Mathematics
The University
Manchester M13 9PL
Great Britain

SIEG, W.

Dept. of Philosophy
Columbia University
New York
NY 1oo27
USA

SLESSENGER, P. H.

Mathematics Dept.
Leeds University
Leeds LS2 9JT
Great Britain

SOARE, R.I.

School of Mathematics
The University of Leeds
Leeds LS2 9JT
Great Britain

SOCHOR, A.

Nad Petruskou 10
120 00 Praha
CSSR

SPREEN, D.

Lehrstuhl für Informatik I
Büchel 29-31
D-51oo Aachen
Germany

STEINHORN, CH.

Dept. of Mathematics
Mc Gill University
8o5 Sherbrooke Street West
Montreal PQ
Canada H3A 2K6

ŠTĚPÁNEK, P.

Dept. of Cybernetics, Informatics
and Operations Research
Charles University
Malostranské nám. 25
118 oo Praha
Czechoslovakia

STEPÁNKOVÁ, O.

Institute of Comp. Techniques
CVUT Horská 3
12o oo Praha 2
Czechoslovakia

STOMP, F.

Violenstraat 12
3551 Bc Utrecht
Netherlands

STREICHER, TH.
Institut für Mathematik
Johannes Kepler Universität
A-4o2o Linz
Austria

SUTER, D.
Robert-Blum-Str. 24
D-68oo Mannheim 23
Germany

SWART, H.C.H.
Reest 4
5o32 EP Tilburg
Netherlands

SZABO, M.E.
Dept. of Mathematics
Concordia University
7141 Sherbrooke Street West
Montreal, Quebec
H4B 1R6 Canada

THIEL, CHR.
Institut für Philosophie
Universität Erlangen-Nürnberg
Bismarckstr. 1
D-852o Erlangen
Germany

THIELE, E.J.
Breisgauer Str. 3o
D-1ooo Berlin 38
Germany

THOMAS, S.R.
Maths. Dept.
Bedford College
Regents Park
London NW1
Great Britain

THOMAS, W.
Lehrstuhl für Informatik II
Büchel 29-31
D-51oo Aachen
Germany

TOFFALORI, C.
Instituto Matematico 'U.Dini'
Viale Morgagni 67/A
I-5o134 Firenze
Italy

TRUSS, J.K.
Dept. of Mathematics
Paisley College of Technology
High Street
Paisley, Renfrewshire
Scotland

TSUKADA, H.
2-3-7 Tsubakimori
Chiba-Shi
26o Japan

TUGUE, T.
C-12 Meidai Tosei-cho Showa-ku
Nagoya 466
Japan

UESU, T.
Dept. of Mathematics
Kyushu University 33
Fukuoka
Postal No. 812
Japan

VELLEMAN, D.
Math. Department
University of Texas
Austin
TX 78712
USA

VINCENZI, A.
Via Belvedere 17/1
I17o12 Albissola Mare
Savona
Italy

VOLGER, H.
Math. Institut
Universität Tübingen
Auf der Morgenstelle 1o
D-74oo Tübingen
Germany

VRANCKEN-MAWET, L.
Rue de Heuseux 86
B-4632 Cerexhe Heuseux
Belgium

WAINER, S.S.
School of Mathematics
The University
Leeds LS29JT
Great Britain

WASILEWSKA, A.
Dept. of Mathematics
Lafayette College
Easton PA 18o42
Pennsylvania
USA

WEISSPFENNIG, V.
Mathematisches Inst. der Universität
Im Neuenheimer Feld 288
D-69oo Heidelberg
Germany

WELCH, PH.
Inst. of Mathematics
24. St. Giles
Oxford
Great Britain

WETTE, E.
Uckerath
P.O. Box 4115
D-52o2 Hennef 41
Germany

WETTE, E.W.
Uckerath
P.O. Box 4115
D-52o2 Hennef 41
Germany

WILKIE, A. J.
Université Paris VII
UER de Mathematiques
2 Place Jussieux Tour 45-55
Paris Cedex o5
France

WOODIN, W.H.
Dept. of Mathematics
Caltech
Pasadena CA 91125
USA

ZADROZNY, W.
Rombachweg 6o
D-69oo Heidelberg
Germany

ZBIERSKY, D.
Wydzial Matematyki i Mechaniki
Uniwersytet Warszawski
Warszawa
Poland

ZEEVAT, H.W.
PT-15
Erasmus Universiteit Rotterdam
Postbus 1738
3ooo DR Rotterdam
Netherlands

ZIEGLER, M.
Math. Institut
Universität Bonn
Beringstr. 6
D-53oo Bonn
Germany


KERNBEREICH
① Karman Forum
② Hauptgebäude
③ Rathaus
④ Post
⑤ Auditorium Maximum
⑥ Mensa
⑦ Bendplatz
FH
FACHHOCHSCHULE
SEILGRABEN
HIRSCHGRABEN
BÜCHEL
DOM
MARKT
AUGUSTINERBACH
ANNUNTIATENBACH
JOHANNITERSTR
KARLSGRABEN
MAUERSTR
TEMPLERGRABEN
PONTSTR
PONTTOR
PONTWALL
WÜLLNER STR
SCHINKELSTR
BARENSTR
JUNKERSTR
LANGER TURM
TURMSTR
MAASTRICHTER STR
MELATENER STR
HAINBUCHENSTR
KRUPPSTR
CLASSENSTR
GESCHW.-SCHOLL-STR
BUNSENSTR
WESTBAHNHOF
SEFFENTER WEG
PROF.-PIRLET-STR
SÜSTERFELDSTR
BENDPLATZ
P

LOGIC COLLOQUIUM

MANCHESTER 1984

Preliminary Announcement

We plan to hold a meeting of the British Logic Colloquium at the University of Manchester in July 1984, provisional dates being from 15th July until 24th July. This has now been recognised as the usual annual European summer meeting of the Association for Symbolic Logic.

It is intended to make Models of Arithmetic and Applications of Logic to Algebra the central topics of the conference. There will be expository lectures on these two topics by A. Macintyre, K. McAloon, L. van den Dries and A. Wilkie. Nevertheless, it is hoped that there will be a number of lectures on other subjects of current interest, in particular in areas such as General Model Theory, Set Theory and Computational Complexity which automatically interact with the central topics.

Most lectures will take place in the Mathematics Building and accomodation will be provided in a nearby Hall of Residence. The organisers on campus will be : P.H.G. Aczel, J.B. Paris, A. Wilkie, G. Wilmers and C.E.M. Yates (chairman). Additional members of the program committee so far include G. Cherlin, U. Felgner, W. Hodges, [redacted] A.H. Lachlan and M. Richter.

Financial support will be sought from the usual purely academic organisations, such as the IUHPS, Royal Society, British Academy and London Mathematical Society.

Further information can be obtained from:-

Professor C.E.M. Yates,
Department of Mathematics,
The University,
Oxford Road,
Manchester M13 9PL,
ENGLAND.

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FOTODRUCK J. MAINZ – Telefon: (02 41) 2 73 05
Neupforte 13, Nähe Markt, 5100 Aachen