DOŠEN, Kosta: *Specialties:* proof theory, categorical logic, substructural logics.

Born: 5 June 1954 in Belgrade, Serbia.

Educated: University of Oxford, St John's College, D.Phil. (Mathematical Logic) 1980, University of Belgrade B.A. (Philosophy) 1977.

Dissertation: Logical Constants: An Essay in Proof Theory; supervisor Michael Dummett.

Personal Web Page: http://www.mi.sanu.ac.yu/∼kosta

Regular Academic or Research Appointments: PROFESSOR OF LOGIC, FACULTY OF PHILOSOPHY, UNIVERSITY OF BELGRADE, 2003–; Professor, Mathematical Institute, Serbian Academy of Sciences and Arts, Belgrade, 1982–; Professor, Institut de Recherche en Informatique de Toulouse, Université de Toulouse III, 1994–1998.

Visiting Academic or Research Appointments: Part-Time Professor, Faculty of Mathematics, University of Belgrade, 2000–2001, 1991–1992, 1985–1986; Visiting Professor, Department of Mathematics, University of Athens, 2001; Visiting Professor, Wilhelm-Schickard-Institut, Universität Tübingen, 1997; Visiting Professor, Département de Mathématiques et Informatique, Université de Montpellier III, 1992–1994; Visiting Scholar, Institut de Recherche en Informatique de Toulouse, Université de Toulouse III, 1992; Visiting Scholar, Zentrum Philosophie und Wissenschaftstheorie, Universität Konstanz, 1989–1990; Visiting Professor, Institute of Mathematics, University of Montenegro, Podgorica, 1988–1989; Visiting Professor, Department of Philosophy, University of Notre Dame, 1986–1987.

Research Profile: Došen's work in proof theory belongs to what, after Dag Prawitz, is called *general proof theory*. Since the late 1990s he has concentrated on the problem of identity criteria for proofs, and used as the main tool representations of proofs as arrows in freely generated categories with structure. This area of general proof theory, called *categorial* (or categorical) *proof theory*, started with Joachim Lambek's work in the 1960s. Among the not very numerous books in the field, Došen's are three, the last two being written with Zoran Petrić. In the monograph [1] one finds a nontrivial notion of identity of proofs for classical propositional logic — something which was previously considered unattainable. This notion, which is in accordance with

Gentzen's cut-elimination procedure for plural (multiple-conclusion) sequent systems modified by adding new principles called *union* of proofs and *zero* proofs, is inspired by taking *generality* of proofs as a criterion for identity of proofs (cf. [3]), and leads to what in category theory is called *coherence*. In his previous monograph [6] Došen showed that fundamental notions of category theory, and in particular the notion of adjoint functor, can be characterized proof-theoretically by cut (i.e. composition) elimination. This book contains a systematic presentation of various alternative equational definitions of the notions of adjunction and comonad (i.e. monad, or triple). It contains also a geometrical model of adjunction, related to developments in knot theory arising from Jones' polynomial (cf. [4]). Roughly speaking, adjunction is about "straightening a sinuosity" — this notion is caught by Reidemeister moves of planar ambient isotopies. The third book [20] is a study of coherence for star-autonomous categories, which are closely tied to the proof nets of classical linear logic. The paper [7] is about isomorphism of formulae in linear logic. This categorial notion, which codifies a relation stronger than logical equivalence, is proposed as an analysis of the notion of propositional identity (see [8] and [2]).

Since his doctoral thesis (partly summarized in [19] and [15]) Došen investigated substructural logics in a unified manner. For all of them he keeps the rules for logical operations unchanged and varies only Gentzen's structural rules. Relevant logic (without distribution of additive conjunction over additive disjunction) is then simply characterized by lack of thinning. The rules for logical operations, which take the form of equivalences between premises and conclusions, are related to William Lawvere's thesis that all logical operations are tied to adjoint situations. Došen amends Lawvere's thesis by suggesting that one of the functors should be a structural functor, where "structural" is understood in the sense of Gentzen. This requires that the adjunction characterizing implication should be different from Lawvere's adjunction between functors based on product and exponentiation in cartesian closed categories. Došen proposes an adjunction underlying the *functional completeness*, in the sense of Lambek, of closed categories (see [5], [9] and [10]), from which Lawvere's adjunction is derived. In his doctoral thesis Došen proposed a criterion for the demarcation of logic (see [15]), which is tied to Lawvere's thesis in its amended form. Došen investigated linear logic *avant la lettre* (it is prefigured in his thesis). In [16] (made public in 1985) intuitionistic linear nonmodal propositional logic was called system M, after "multiset". He is not only a pioneer in the unified investigation of substruc-

tural logics: in 1990 he coined the name "substructural logics" (see the often cited collection of papers [12]; the first appearance in print of the term is in [14]). He is one of those authors who in the 1980s, before the advent of linear logic, revived interest in the Lambek calculus (using for it the name that has become standard both in logic and in theoretical linguistics; see [17]). Došen is one of the pioneers in the investigations of intuitionistic modal logic, using Kripke models with two accessibility relations, one intuitionistic and the other modal (see [18]). He applied such models to study negation understood as a modal operator. He defined for intuitionistic propositional logic most general models in the style of Kripke where the accessibility relation satisfies conditions weaker, and sometimes more complicated, than reflexivity and transitivity (see [13]). He was led to these models by embeddings of intuitionistic logic in modal systems weaker than S4, which he investigated previously.

Main Publications:

1. *Proof-Theoretical Coherence* (with Zoran Petrić), *Studies in Logic 1*, King's College Publications, London, 2004, xiv+369 pp.

2. "Identity of proofs based on normalization and generality", *The Bulletin of Symbolic Logic* **9** (2003), pp. 477–503.

3. "Generality of proofs and its Brauerian representation" (with Zoran Petrić), *The Journal of Symbolic Logic* **68** (2003), pp. 740–750.

4. "Self-adjunctions and matrices" (with Zoran Petrić), *Journal of Pure and Applied Algebra* **184** (2003), pp. 7–39.

5. "Abstraction and application in adjunction", in Z. Kadelburg (ed.), *Proceedings of the Tenth Congress of Yugoslav Mathematicians*, Faculty of Mathematics, University of Belgrade, 2001, pp. 33–46 (http:// arXiv. org/ math. CT/ 0111061).

6. *Cut Elimination in Categories*, *Trends in Logic 6*, Kluwer, Dordrecht, 1999, xii+229 pp.

7. "Isomorphic objects in symmetric monoidal closed categories" (with Zoran Petrić), *Mathematical Structures in Computer Science* **7** (1997), pp. 639–662.

8. "Logical consequence: A turn in style", in M.L. Dalla Chiara et al. (eds.), *Logic and Scientific Methods, Volume One of the Tenth International Congress of Logic, Methodology and Philosophy of Science*, Florence, August 1995, Kluwer, Dordrecht, 1997, pp. 289–311.

9. "Deductive completeness", *The Bulletin of Symbolic Logic* **2** (1996), pp. 243–283, p. 523.

10. "Modal functional completeness" (with Zoran Petrić), in H. Wansing (ed.), *Proof Theory of Modal Logic*, Kluwer, Dordrecht, 1996, pp. 167–211.

11. "Equality in substructural logics, Substructural predicates", in W. Hodges et al. (eds.), *Logic, from Foundations to Applications: European Logic Colloquium*, Oxford University Press, Oxford, 1996, pp. 71–101.

12. *Substructural Logics* (ed., with Peter Schroeder-Heister), Oxford University Press, Oxford, 1993.

13. "Rudimentary Kripke models for the intuitionistic propositional calculus", *Annals of Pure and Applied Logic* **62** (1993), pp. 21–49.

14. "Modal translations in substructural logics", *Journal of Philosophical Logic* **21** (1992), pp. 283–336.

15. "Logical constants as punctuation marks", *Notre Dame Journal of Formal Logic* **30** (1989), pp. 362–381; reprinted in a slightly amended version in D.M. Gabbay (ed.), *What is a Logical System?*, Oxford University Press, Oxford, 1994, pp. 273–296.

16. "Sequent-systems and groupoid models", *Studia Logica* **47** (1988), pp. 353–385, **48** (1989), pp. 41–65, **49** (1990), p. 614.

17. "A completeness theorem for the Lambek calculus of syntactic categories", *Zeitschrift für mathematische Logik und Grundlagen der Mathematik* **31** (1985), pp. 235–241. (Cf. A brief survey of frames for the Lambek calculus, *ibid.* **38** (1992), pp. 179–187.)

18. "Models for normal intuitionistic modal logics" (with Milan Božić), *Studia Logica* **43** (1984), pp. 217–245, **44** (1985), pp. 39–70.

19. "Sequent-systems for modal logic", *The Journal of Symbolic Logic* **50** (1985), pp. 149–168.

20. *Proof-Net Categories* (with Zoran Petrić), Polimetrica, Monza, 2007, viii+147 pp.

Service to the Profession: Editor, *Notre Dame Journal of Formal Logic* 1991–; Editor, *Studia Logica* 1993–1997; Reviewer, *Mathematical Reviews* 1985–1997; Chairman of the Logic Seminar, Mathematical Institute, Belgrade, 1985–1989, 2001–; Leader of the Study Group for Quantum Groups, Belgrade, 1999–2000.

Teaching: There is in Belgrade a school of categorial proof theory, of which Došen is the founder. His student and closest collaborator in the last ten years is Zoran Petrić, who wrote an award-winning doctoral thesis in 1997 (partly published in papers of Petrić in the *Annals of Pure and Applied Logic* and *Studia Logica*). Došen worked together for some time with Djordje Čubrić, who also made significant contributions to the field. Došen's other students are Silvia Ghilezan, Mirjana Borisavljević and Branislav Boričić, who made contributions to the typed lambda calculus and general proof theory. He teaches an undergraduate course in mathematical logic, and has taught at various places advanced courses in proof theory, categorial logic, the lambda calculus, intuitionistic logic, modal logic and formal grammars.

Vision Statement: If in the order of explanation deducing precedes asserting, as asserting precedes naming, the theory of proofs should have precedence over the rest of logic. The difference between this theory and the rest of logic is that in it one studies a consequence *graph* rather than a consequence *relation*.

Honours and Awards: Alexander von Humboldt Fellow, 1989–1990.