ESSLLI 2010

University of Copenhagen

August 9th – August 20th

This booklet was edited and laid out by
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Welcome to ESSLLI!

Welcome to ESSLLI 2010 in Copenhagen.

It has been over a year since we started the preparation for the biggest summer school in logic, language and information in the world. This event would not have been possible without the kind assistance of a number of organizations and people.

We would like to thank The University of Copenhagen / Humanities Campus for being willing to host this event and FOLLI for deciding to put ESSLLI 2010 in our hands. Thanks also to the ESSLLI 2010 Program Committee, and in particular to Prof. Valentin Goranko for putting such an exquisite program together.

The core group of the ESSLLI 2010 Organizing Committee consists of Jens Ulrik Hansen, Tinna Kryger, Rasmus Rendsvig, and Sine Zambach, without whom this summer school would never have seen the light of day. This core group has put in long hours, night and day, to make ESSLLI 2010 the success we envision. We owe them much.

Finally, we would like to thank you, students, lecturers, volunteers, and invited speakers, for coming together here in Copenhagen for ESSLLI 2010.

We hope you will enjoy both the courses and the workshops chosen for this year's ESSLLI, as well as the city of Copenhagen. This year, 43 courses, 6 workshops, student sessions, social events and more are scheduled in addition to what Copenhagen itself has to offer. In this booklet, you will find information on ESSLLI, food, drinks, transportation, maps, and more.

Again, welcome to Copenhagen for ESSLLI 2010. Carpe Diem.

Vincent F. Hendricks

Professor of Formal Philosophy
University of Copenhagen and Columbia University

Chairman of ESSLLI 2010 Organizing Chair

Course schedule, week 1

Time	LaCo	LoCo
9:00 – 10:30	Resource-light Morphosyntactic Analysis of Highly Inflected Languages **FND** 27.0.09 Evolutionary Linguistics **INT** 22.0.11	Structured Operational Semantics **INT** 23.0.49 Specification and Verification of Multi-Agent Systems **ADV** 21.0.19
11:00 – 12:30	Computational models of text quality **INT** 27.0.09 Learnable representations of languages **ADV** 22.0.11	Introduction to Proof Theory **INT** 23.0.49 Ehrenfeucht-Fraïssé Games: Applications and Complexity **ADV** 21.0.19
14:00 – 15:30	Word Sense Disambiguation and Induction **INT** 27.0.09	Introduction to Category Theory, Algebras and Coalgebras **INT** 22.0.11 Implicit Computational Complexity **INT** 23.0.49 Ten problems of deontic logic and normative reasoning in computer science **FND** 21.0.19
17:00 – 18:30	Log-Linear Regression in Corpus Linguistics **INT** 27.0.09 Authorship attribution and stylometry **INT** 22.0.11	Kripke's World: an introduction to modal logics via tableau systems **FND** 23.0.49 Automatic structures **ADV** 21.0.19

LoLa	Other	Time
Sense and denotation as algorithm and value **ADV** 21.1.15 Psychological Reality of Semantic Theories **FND** 21.1.21		9:00 – 10:30
Focus **INT** 21.1.15 Conceptual spaces and semantics maps **ADV** 21.1.21	Logics in Security **WS** 21.1.47	11:00 – 12:30
Processing of Quantifiers **INT** 21.1.15 Scalar Implicatures and Grammar **INT** 21.1.21		14:00 – 15:30
Logics for natural language inference **ADV** 21.1.15 Formal Approaches to Thematic/Semantic Roles **INT** 21.1.21		17:00 – 18:30

Course schedule, week 2

Time	LaCo	LoCo
9:00 – 10:30	Computational Modeling of Human Language Acquisition **ADV** 27.0.09 Statistical Machine Translation **ADV** 22.0.11	Decidable problems for counter machines **ADV** 21.0.19 Dynamic Epistemic Logic **INT** 23.0.49
11:00 – 12:30	Painless NLP Programming with UIMA **ADV** 27.0.09 Words and their secrets **FND** 22.0.11	Proof Complexity of Non-Classical Logics **ADV** 23.0.49 Probabilistic Model Checking **ADV** 21.0.19
14:00 – 15:30	Dependency grammar for computational linguists **INT** 27.0.09 Memory-based Language Modeling **ADV** 21.1.49	The Complexity of Constraint Satisfaction **INT** 23.0.49
17:00 – 18:30	Interactive Machine Translation and Human Translation Processes **INT** 27.0.09 Empirically-based multimodal studies **INT** 22.0.11	Dependence and independence in logic **WS** 21.1.47 Answering Queries in Description Logics: Theory and Applications to Data Management **INT** 21.0.19

LoLa	Other	Time
Using Logic in Syntax and Semantics **FND** 21.1.15 Compositionality and distributional semantic models **WS** 21.1.21		9:00 – 10:30
Compositionality **INT** 21.1.15 Theories of information dynamics and interaction and their application to dialogue **WS** 21.1.21	Logic, Interaction and Collective Agency **INT** 21.1.47	11:00 – 12:30
Anaphora, Binding and Ellipsis **INT** 22.0.11 Game Theoretic Pragmatics **ADV** 21.1.21	Logic, Rationality, and Intelligent Interaction **WS** 21.1.47	14:00 – 15:30
Dynamic Semantics **ADV** 21.1.15 Objects, events, qualities: an introduction to formal ontological distinctions in DOLCE **ADV** 21.1.21	Computational Cognitive Science: Probability, Programs, and the Mind **INT** 23.0.49	17:00 – 18:30

Brief course descriptions

Below, abbreviated descriptions of all ESSLLI 2010 courses are listed in alphabetical order. The unabbreviated versions may be found at esslli2010-cph.info/?page_id=209.

Anaphora, Binding and Ellipsis (Pauline Jacobson), introductory course. Logic and language, week 2, 14:00 – 15:30. This course focuses on some of the core phenomena in the domain of anaphora (the data will be drawn entirely from English), and will elucidate the interactions of these phenomena and demonstrate two main sets of tools used to account for these. I will therefore develop the domain(s) both in terms of a fairly "standard" model of the grammar which uses variables and also makes use of a level of LF and – in parallel – in terms of a variable-free direct compositional view. The emphasis, however, is not so much on theory comparison; the reason for the double-pronged approach (aside from my belief that students should know both) is that seeing phenomena from two different points of view helps give a much more robust sense of the empirical generalizations. (I will be stressing the parallels between these two viewpoints).

Answering Queries in Description Logics: Theory and Applications to Data Management (Diego Calvanese and Michael Zakharyaschev), introductory course. Logic and computation, week 2, 17:00 – 18:30. The course will cover the following topics: Correspondence between DLs and data modeling

formalisms, and discussion on how DLs can be adopted as conceptual layer to access data; Relationships and differences between querying in traditional databases (model checking) and querying in the presence of ontologies (reasoning), and challenges arising when accessing and querying large amounts of data through an ontology; Detailed survey of the DLs designed to provide high-level conceptual interface for querying databases and the corresponding complexity results and reasoning procedures.

Authorship attribution and stylometry (Patrick Juola), introductory course. Language and computation, week 1, 17:00 – 18:30. Stylometry — the analysis of individual variation in language — is emerging as an important field of computational linguistics, with many applications. This course covers the linguistic, statistical, and computational basis for stylometry, using the freely-available JGAAP software system (www.jgaap.com) for teaching and using Patrick Juola's freely available survey article (Juola, 2008; Foundations and Trends in Information Retrieval) as a text.

Automatic structures (Dietrich Kuske), advanced course. Logic and computation, week 1, 17:00 – 18:30. The course will cover the following topics: Definitions and examples of automatic and non-automatic structures; decidability of the first-order theory of any automatic structure, extensions to more general automata models; characterisation of some classes of automatic structures (e.g., ordinals, Boolean algebras); (computational) complexity of the first-order theory for automatic structures (in general and under degree restrictions); (recursion-theoretic) complexity

of, e.g., the isomorphism problem for some classes of automatic structures.

Compositionality (Peter Pagin and Dag Westerstahl), introductory course. Logic and language, week 2, 11:00 – 12:30. The course gives an introduction to the basic ideas of compositionality, a brief historical overview, a survey of varieties of stronger forms (including the addition of inverse compositionality), weaker forms, relations to effective computability, and extensions for handling linguistic and extra-linguistic context dependence. It also covers discussions of arguments for and against the idea that natural language is compositional, and discussions of problem cases.

Compositionality and distributional semantic models (Alessandro Lenci and Roberto Zamparelli), workshop. Logic and language, week 2, 9:00 – 10:30. In the last ten years distributional semantic models (DSMs), such as LSA, HAL, etc. have been quite successful at addressing semantic similarity, lexical ambiguity, lexical entailment, verb selectional restrictions and other word level relations. In this class of models, the meaning of a content word is represented in terms of a distributed vector recording its pattern of cooccurrences (sometimes, in specific syntactic relations) with other content words within a corpus. Different types of semantic tasks and phenomena are then modeled in terms of linear algebra operations on distributional vectors.

Computational Cognitive Science: Probability, Programs, and the Mind (Noah Goodman and Josh Tenenbaum), introductory course. Other, week 2, 17:00 – 18:30. This course will introduce the struc-

tured-Bayesian approach to cognitive science, in which learning and reasoning are understood as inference in complex probabilistic models. Using the formal framework of stochastic lambda calculus, and it's practical realization as a probabilistic programming language, we will study principles and techniques underlying probabilistic approaches to human cognitive modeling and artificial intelligence.

Computational Modeling of Human Language Acquisition (Afra Alishahi and Afsaneh Fazly), advanced course. Language and computation, week 2, 9:00 – 10:30. This course discusses the main research topics in computational modeling of language acquisition, and reviews common approaches to developing and evaluating such models. The first part of the course focuses on more general issues, such as different views on language modularity, and the major arguments on language learnability and innateness. The second part takes a closer look at some of the existing models of language learning.

Computational Models of Text Quality (Ani Nenkova), introductory course. Language and computation, week 1, 11:00 – 12:30. In this course, we will overview a wide range of text quality factors: vocabulary-related, syntactic and discourse, including form of referring expressions and word, entity and topic flow. The factors will be introduced and compared in the context of specific applications such as information ordering: deciding in what order to present a set of selected sentences, clauses or predicates; determining grade level readability: deciding if a particular text is suitable for readers known to be in a given school grade; assessing sentence fluency for

machine translation and text simplification; summarization.

Conceptual Spaces and Semantics Maps (Joost Zwarts), advanced course. Logic and language, week 1, 11:00 – 12:30. The course intends to give students a thorough introduction to the domain of a spatial or geometric representation of word meanings by a guided reading of the literature, hands-on experience with problem sets and discussion of general issues. The central goal will be to understand the similarities and differences between these different 'spatial' ways of understanding language variation and universals.

Decidable Problems for Counter Machines (Stephane Demri), advanced course. Logic and computation, week 2, 9:00 – 10:30. This course is dedicated to present decidable problems for counter machines. We develop techniques for various classes of counter machines (vector addition systems, reversal-bounded counter machines, counter automata with errors, one-counter machines, etc.) and for various problems including reachability problems, boundedness, and model-checking with temporal logics, which is a well-known approach to verifying behavioral properties of computing systems.

Dependence and Independence in Logic (Juha Kontinen and Jouko Vaananen), workshop. Logic and computation, week 2, 17:00 – 18:30. The goal of this workshop is to provide an opportunity for researchers to further explore the very notions of dependence and independence and their role in formal logic, in particular with regard to logics of imperfect information.

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Dependency Grammar for Computational Linguists (Matthias Buch-Kromann), introductory course. Language and computation, week 2, 14:00 – 15:30. In this course we will see how to turn dependency grammar into a full-fledged linguistic theory that can account for even sophisticated linguistic phenomena, such as discontinuous word orders, secondary dependencies (filler-gap constructions), elliptic coordinations (gapping coordinations), speech repairs, discourse and anaphora. We will also show how to build dependency-based generative probability models that can account for these phenomena probabilistically.

Dynamic Epistemic Logic (Hans van Ditmarsch), introductory course. Logic and computation, week 2, 9:00 – 10:30. In this course will include the basics of Dynamic Epistemic Logic, focussing on the semantics and the applications. This will include (i) epistemic logic (including group epistemic operators such as common knowledge), (ii) public announcement logic, (iii) action model logic (full expressive power, includes non-public events), (iv) recent developments (factual change, belief revision), (v) applications and puzzles (communication protocols, 100 prisoners, hangman paradox, …).

Dynamic Semantics, (Chris Barker), advanced course. Logic and language, week 2, 17:00 – 18:30. Traditionally, sentences express truth conditions, and speech participants update their beliefs by reasoning about speech acts (Grice, Lewis, Stalnaker). Then, in the 1980's, Heim and also Kamp on the one hand (Discourse Representation Theory), and Groenendijk and Stokhof on the other (Dynamic Montague Gram-

mar), argued that sentences should be viewed as instructions for updating a discourse representation. More recently, reactionary elements (Dekker, Schlenker, Breheny, Moss, others) have called into question the dynamic view. Do they have a case? Just how compelling are the arguments for dynamic meaning? Or should we re-relegate all dynamic effects to a pragmatic theory of discourse processing?

Ehrenfeucht-Fraïssé Games: Applications and Complexity (Angelo Montanari and Nicola Vitacolonna), advanced course. Logic and computation, week 1, 11:00 – 12:30. We introduce the fundamental notions related to Ehrenfeucht-Fraïssé games as logical combinatorial games and describe the correspondence between formulae and games, we analyze the notions of winning strategies, the remoteness of a game and the optimal (as opposed to winning) strategies for a player. Further, we present some general sufficient conditions that can be used to prove inexpressivity results, such as Arora and Fagin's theorem and Schwentick's theorem. Finally, we focus on algorithmic questions related to EF-games and some significant variants of EF-games.

Empirically-based Multimodal Studies (Costanza Navarretta and Patrizia Paggio), introductory course. Language and computation, week 2, 17:00 – 18:30. The goal of the course is to introduce the attendees to the field of empirically based multimodal studies, where insight gained from the analysis of data concerning human communication is increasingly being used to design embodied conversational agents and multimodal systems. The course is intended as a mixture of theoretical presentations,

discussions of video examples and practical hands-on experience with annotation work.

Evolutionary Linguistics (Remi van Trijp and Martin Loetzsch), introductory course. Language and computation, week 1, 9:00 – 10:30. This course introduces the students to Evolutionary Linguistics, a field that uses a systematic methodology for investigating the evolution of linguistic phenomena. This involves the following steps: (a) Identify and reverse-engineer a specific language system; (b) Identify its function in communication; (c) Identify the language strategy that is needed for learning, expanding and aligning such a system; (d) Understand how this language strategy may have originated; (e) Show the selective advantage of the strategy. At each step, computational models and robotic experiments are carried out to ensure that a proposed theory works. The goal of this course is to provide students with a clear insight into each aspect of the methodology and what skills are required to join this exciting field.

Focus (Mats Rooth), introductory course. Logic and language, week 1, 11:00 – 12:30. The course introduces phenomena and theories of focus at the levels of phonetics, phonology, syntax, semantics and pragmatics, and the interfaces between them. Common grammatical and contextual environments that trigger focus are surveyed. We will look in detail at the most prominent accounts of the semantics of focus, namely alternative semantics and entailment semantics, and consider how they are applied in particular cases.

Formal Approaches to Thematic/Semantic Roles (Olga Borik and Maarten Janssen), introductory

course. Logic and language, week 1, 17:00 – 18:30.
The concept of thematic (semantic) roles is a fundamental concept in linguistic theory, used to reflect the most basic relations: those that the verb bears to its arguments. The goal of this course is to critically review some formal approaches to thematic roles, including model-theoretic based formalizations such as Dowty (1979, 1991), trying to determine which of the theoretical implementations is better equipped to handle the problems associated with the notion of thematic roles, such as mapping problems (Baker 1988, Levin & Rappaport-Hovav 1995), and focusing on the most prominent regularities observed in the mapping between semantic roles and grammatical relations such as subject, direct object, etc.

Game Theoretic Pragmatics (Anton Benz), advanced course. Logic and language, week 2, 14:00 – 15:30.
The goal of this course is to provide an advanced introduction into game theoretic pragmatics. It will concentrate on game theoretic models of Gricean pragmatics. In this area, there has been considerable progress over the last years, both with respect to conceptual matters as well as with respect to the range of phenomena covered by game theoretic models. Of special interest are recent development of the iterated best response models (Franke 2009, Ebert & Jäger 2009) and refinements of the optimal answer model (Benz & v. Rooij 2007). These are frameworks which concentrate on communication. This means that we will not address models of language evolution or typological investigations.

Implicit Computational Complexity (Ugo Dal Lago and Simone Martini), introductory course. Logic

and computation, week 1, 14:00 – 15:30. This course is an introduction to Implicit Computational Complexity, which aims at characterizing complexity classes by logical systems and paradigmatic programming languages. After a brief review of computability and complexity, we will describe some proposals for characterizations of the classes of functions computable in polynomial and elementary time. We will focus our attention on functional programming languages, presenting some results on imperative languages if time permits. Interesting connections with mathematical logic (recursion and proof theory) will arise along the way.

Interactive Machine Translation and Human Translation Processes (Michael Carl and Philipp Koehn), introductory course. Language and computation, week 2, 17:00 – 18:30. Machine Translation (MT) systems have become widely available and are more frequently used in the past few years but the quality of the translated texts often does not exceed the level of information gisting. Human intervention is in many cases required to reach higher quality translations. Currently research is at an initial stage as to how MT systems could be designed and how MT output should be presented so that it is better suited and acceptable for human translators. In order to advance the knowledge in this field, this course seeks to bridge the gap between research in human translation processes and interactive MT.

Introduction to Category Theory, Algebras and Coalgebras (Jiri Adamek and Stefan Milius), introductory course. Logic and computation, week 1, 14:00 – 15:30. Category Theory has become a valuable tool

for mathematicians, logicians, and computer scientists alike. In this course we will first give an introduction to the most important basic concepts of category theory, and we will then focus on initial algebras and terminal coalgebras for functors. We shall show how initial algebras give a uniform way to study inductive data type definitions and proofs over such data types. Final coalgebras yield semantic domains for systems (e.g. various types of automata and labeled transition systems), and they provide coinduction as a definition and proof principle. Finally, we shall explain how final coalgebras allow us to give a new abstract semantics of recursive specifications such as in process algebras, stream calculus and algebraic semantics.

Introduction to Proof Theory (Lutz Strassburger), introductory course. Logic and computation, week 1, 11:00 – 12:30. The course will give a basic introduction to proof theory, focussing on those aspects of the field that are most relevant to ESSLLI. In particular, the student will learn what is a deductive system and why cut elimination is important. The course will also discuss the presentation of proofs via proof nets, which are graph-like objects that allow to quotient away the syntactic bureaucracy of deductive systems. Finally, we will also see how category theory can be used to describe proofs as algebraic objects.

Kripke's World: an introduction to modal logics via tableau systems (Olivier Gasquet and Andreas Herzig), foundational course. Logic and computation, week 1, 17:00 – 18:30. The aim of the course is to provide a step-by-step introduction to modal logics, both in terms of Kripke models and in terms of semantic

tableaux. The different logics will be illustrated by means of examples. We will use the generic tableaux theorem prover Lotrec (www.irit.fr/Lotrec), which is a piece of software that allows to build models, check whether a given formula is true in a model, and check whether a given formula is valid in a given logic.

Learnable Representations of Languages (Alexander Clark), advanced course. Language and computation, week 1, 11:00 – 12:30. This course addresses the learnability of language; we will discuss the theory of grammatical inference as it relates to learnability issues in language acquisition. None of the levels of the Chomsky hierarchy are learnable for reasons of computational complexity. However, we now understand that this does not rule out the existence of representations that are learnable. We will discuss a hierarchy of models that are based on observationally defined representations.

Log-Linear Regression in Corpus Linguistics (Jong Sup Jun), introductory course. Language and computation, week 1, 17:00 – 18:30. This course aims to introduce practical techniques of using log-linear regression in corpus linguistics to graduate students and scholars that are not familiar with statistics. The purpose of log-linear regression is to find the most parsimonious model among possible mathematical models that explain the observed frequency data defined by more than three categorical variables. Log-linear regression is used to find meaningful generalizations out of a multi-way contingency table in corpus linguistics.

Logic, Interaction and Collective Agency (Eric

Pacuit and Olivier Roy), introductory course. Other, week 2, 11:00 – 12:30. Questions of collective agency are not new in philosophy, but in recent years they have increasingly been investigated using logical methods. While decision- and game-theoretical approaches build on resolutely individualistic premises, studying the logic of individual belief and preferences in interactive decision making, the aforementioned philosophical theories take a more collectivist standpoint, focusing on how decision makers engage in "group", "team" or "we-mode" of reasoning, which is often claimed to involve irreducibly collective attitudes. Little is known, however, about the relationship between these views on interaction and collective agency. This course will introduce the relevant bodies of literature in order to clarify their relationship, both from a logical and conceptual point of view.

Logic, Rationality, and Intelligent Interaction (Johan van Benthem and Eric Pacuit), workshop. Other, week 2, 14:00 – 15:30. In recent years there has been a good deal of interest in developing two perspectives in tandem: logics that analyze agent interaction, and introducing interactive viewpoints into logic itself. While this has generated much new research, many broad questions remain. This workshop will systematically cover a number of major issues that arise here: Interactive agency: the dynamic turn in logic; Interactive agency: a view from philosophy; Modeling agency: a view from computer science; Strategic interaction: a view from game theory.

Logics for Natural Language Inference (Larry Moss), advanced course. Logic and language, week

1, 17:00 – 18:30. This course will study logical systems which are relevant to semantics and also logical systems which try to use surface forms directly. It also will cover in detail how various standard logical systems work, including natural deduction systems, and others; the typed lambda calculus; and first-order logic and its decidable fragments. It will also present detailed studies of logical systems which are closer to natural language, such as extended syllogistic logics. These topics will be taught from the point of view of representing natural language inference.

Logics in Security (Dov Gabbay and Leon van der Torre), workshop. Other, week 1, 11:00 – 12:30. In the past two decades, a number of logics and formal frameworks have been proposed to model and analyse interconnected systems from the security point of view. Recently, the increasing need to cope with distributed and complex scenarios forced researchers in formal security to employ non-classical logics to reason about these systems. The aim of this workshop is to bring together logicians and formal security researchers to foster the cross-fertilization between these two areas. Logicians have a lot to benefit from specifying and reasoning about real-world scenarios as well as researchers in security can apply recent advances in non-classical logics to improve their formalisms.

Memory-based Language Modeling (Antal van den Bosch), advanced course. Language and computation, week 2, 14:00 – 15:30. The course challenges participants to reconsider textbook ideas on language modeling and their usual applications. The wider applicability of memory-based language models to

spelling correction, machine translation, and paraphrase generation should interest application-oriented researchers. At the same time, memory-based models are a direct implementation of example-driven Saussurean analogy; inspecting and analyzing its inner workings offers linguistically relevant insights on the coverage of analogical reasoning and the shape of "language space". Also, empirical findings suggest correlations of memory-based language modeling and human sentence processing, making the method of interest to psycholinguistic computational modeling.

Objects, Events, Qualities: an introduction to formal ontological distinctions in DOLCE (Nicola Guarino and Claudio Masolo), advanced course. Logic and language, week 2, 17:00 – 18:30. This course is intended to introduce the student to the formal distinctions among basic ontological categories, such as objects, events, and qualities. These categories will be characterized in an axiomatic way, using the analytic tools of so-called formal ontology, which builds on general notions such as parthood, dependence, identity, constitution. We shall discuss in particular the foundational choices behind the DOLCE ontology (www.loa-cnr.it/DOLCE.html), an axiomatic upper-level ontology being used for various purposes by a growing community of researchers, which has been designed to provide some ontological ground to commonsense natural language expressions.

Painless NLP Programming with UIMA (Jordi Atserias and Bart Mellebeek), advanced course. Language and computation, week 2, 11:00 – 12:30. UIMA

(Unstructured Information Management Architecture) is a modular and flexible framework which enables researchers to easily construct a software pipeline able to analyse large volumes of unstructured information. This course is designed as a practical and highly interactive workshop in which participants are invited to write, over the course of one week, a UIMA-based Semantic Search application (Java) under the supervision of the organisers. Participants will also be shown how to use UIMA for data mining in a real-world application (data mining from biomedical texts).

Probabilistic Model Checking (Marta Kwiatkowska and David Parker), advanced course. Logic and computation, week 2, 11:00 – 12:30. This course will give an overview of the area of probabilistic model checking, covering both the theoretical foundations as well as the practical aspects of the topic. The lectures will include four types of probabilistic models (all variants of Markov chains), specification notations (based on probabilistic temporal logics), and techniques available for their automatic verification. The course will also introduce PRISM (www.prism modelchecker.org), a state-of-the-art probabilistic model checker, and illustrate several case studies that have been modelled and analysed in PRISM, such as the Bluetooth device discovery, Zeroconf link-local addressing, power management, probabilistic contract signing, and biological signalling pathways.

Processing of Quantifiers (Kevin Paterson), introductory course. Logic and language, week 1, 14:00 – 15:30. Quantification is a central topic in research in logic and formal linguistics that is becoming impor-

tant in cognitive psychological research on language production and comprehension. The course provides an overview of cognitive psychological research in this area and have three specific aims: (1) to provide a detailed introduction to experimental research me–thods, (2) to outline how this research advances our understanding of quantifier processing and, (3) to consider future topics of research.

Proof Complexity of Non-Classical Logics (Olaf Beyersdorff and Oliver Kutz), advanced course. Logic and computation, week 2, 11:00 – 12:30. The aim of this course is to present an up-to-date introduction to proof complexity with emphasis on non-classical logics and their applications. In particular, we will cover proof systems for modal logics, intuitionistic logics and non-monotonic reasoning. The course will introduce the relevant logics and explain in detail the proof systems associated with them. One of the main objectives in proof complexity is to obtain tight bounds on the size of proofs. In the course we will explain the method of feasible interpolation as one universal technique for proving lower bounds for the proof size.

Psychological Reality of Semantic Theories (Hans Kamp), foundational course. Logic and language, week 1, 9:00 – 10:30. What in current semantic theory reflects human semantic knowledge more closely than is testified by a correct assignment of truth conditions alone, and what of it is in accordance with human semantic processing? And how exactly should such questions be understood and formulated, and what could count as evidence for or against the answers we may want to give to them? In this

course we address these methodological issues by looking closely at three areas in which (in my view) they arise with particular urgency: (i) vagueness and its context-dependent reductions; (ii) temporal reference and aspectual structure; (iii) the role of discourse referents in dynamic approaches to semantics such as Discourse Representation Theory and Dynamic Semantics.

Resource-light Morpho-syntactic Analysis of Highly Inflected Languages (Anna Feldman and Jirka Hana), foundational course. Language and computation, week 1, 9:00 – 10:30. This course lays out the linguistic and computational foundations of morphological analysis and tagging of highly inflected languages, with an emphasis on resource-light analysis and tagging of fusional languages.

Scalar Implicatures and Grammar (Danny Fox and Benjamin Spector), introductory course. Logic and language, week 1, 14:00 – 15:30. We will present current debates about the nature of Scalar Implicatures (SIs) and provide the necessary background. We will begin with a systematic introduction to the classical view of SIs. The major observation we will focus on is that any approach to SIs must say something about alternatives and the way they are determined. This raises the possibility that the theory of SIs should be connected to a well known grammatical theory of alternatives, namely the theory of association with focus (Rooth 1992). We will formulate an alternative grammatical approach to SIs and will compare the two resulting approaches in light of various challenges that have recently been presented to both.

Sense and Denotation as Algorithm and Value

(Fritz Hamm and Yiannis Moschovakis), advanced course. Logic and language, week 1, 9:00 – 10:30. This course presents a thorough introduction to the theory of referential intensions developed by Yiannis Moschovakis, with special emphasis on its applications to linguistics.

Specification and Verification of Multi-Agent Systems (Wojtek Jamroga and Wojtek Penczek), advanced course. Logic and computation, week 1, 9:00 – 10:30. The course offers an introduction to some important developments in the area of Multi-Agent Systems. We introduce modal logics used for specification of temporal, epistemic, and strategic properties of systems; then, we present model checking algorithms based on SAT, and discuss the computational complexity of the model checking problem. We also consider symbolic (compact) representations of systems, and how the representations change the semantic and algorithmic side of model checking. Finally, we discuss some techniques that help to reduce the complexity and make verification feasible even for large systems.

Statistical Machine Translation (Adam Lopez), advanced course. Language and computation, week 2, 9:00 – 10:30. This course will provide a thorough introduction to statistical machine translation. We will describe all aspects of building a statistical machine translation system, from both formal and practical perspectives. Topics include translation modeling, rule induction and parameter learning, search algorithms, engineering techniques, and evaluation of systems. Within each of these areas we will cover a variety of alternatives, from the mainstream to the

novel, explaining current state of the art and identifying the open questions that are the topic of current research.

Structured Operational Semantics (Mohammadreza Mousavi and Michel Reniers), introductory course. Logic and computation, week 1, 9:00 – 10:30. Structured Operational Semantics (SOS) clearly lies in the intersection of Logic and Computation: it is a logical means to define the computational behavior of programs and specifications. SOS was introduced as a systematic way to define operational semantics by a set of deduction rules of a certain shape. SOS has gradually become a de facto standard in formal semantics. Its wide-spread use called for a more fundamental study of SOS and hence SOS rules became the object of study and several authors have contributed to the meta-theory of SOS. In this course, we first present the basic theoretical underpinnings of SOS and apply it to several case studies from practical programming and specification languages. We then give an overview of the most relevant results in the research field of SOS.

Ten Problems of Deontic Logic and Normative Reasoning in Computer Science (Jan Broersen and Leon van der Torre), foundational course. Logic and computation, week 1, 14:00 – 15:30. Deontic logicians often hear that people do not know or understand what deontic logic is about, and, more in particular, what problems they study. In reaction to that, the course will be problem driven. That is, we present, discuss and ask the audience to think about 10 of the most challenging and important problems of deontic logic and normative reasoning in computer science.

The Complexity of Constraint Satisfaction (Hubie Chen), introductory course. Logic and computation, week 2, 14:00 – 15:30. In this course, we aim to give a self-contained introduction to constraint satisfaction problems and the universal algebraic approach. In particular, we will use this approach to present a contemporary proof of Schaefer's Theorem (1978). This theorem classifies the complexity of all constraint languages over a two-element set, and in particular gives a uniform treatment of many well-known boolean satisfiability problems, both tractable (e.g. 2-SAT, Horn SAT, Affine SAT) and intractable (e.g. 3-SAT, 1-in-3 SAT, Not-all-equal SAT). This theorem is of broad appeal, as it provides a rich class of NP-complete satisfiability problems which often aid the development of NP-hardness proofs in general.

Theories of Information Dynamics and Interaction and their Application to Dialogue (Emiliano Lorini and Laure Vieu), workshop. Logic and language, week 2, 11:00 – 12:30. This workshop aims at discussing formal theories and logics of information dynamics and interaction and their applications to dialogue and communication modeling. It is intended to bring together logicians, linguists and computer scientists in order to provide a better understanding of the potentialities and limitations of formal methods for the analysis of dialogue and communication. Its scope includes not only the technical aspects of logics, but also multidisciplinary aspects from linguistics, philosophy of language, philosophy of social reality, social sciences (social psychology, economics).

Using Logic in Syntax and Semantics (Reinhard Muskens), foundational course. Logic and lan-

guage, week 2, 9:00 – 10:30. This course introduces some of the basic techniques used in ESSLLI's Logic and Language section. It will be quick-paced, but almost completely self-contained. We will study the use of classical logic for linguistic purposes. A multi-modal logic will be introduced as a fragment of predicate logic and its uses in semantics and in syntactic description will be discussed. The typed lambda calculus will be defined and will be shown to be very close to language. This makes it a good basis for semantic theory and I will show how this logic can be used to provide syntactic trees with meaning.

Word Sense Disambiguation and Induction (Roberto Navigli and Simone Paolo Ponzetto), introductory course. Language and computation, week 1, 14:00 – 15:30. Word Sense Disambiguation (WSD), the ability to identify the intended meanings of words (senses) in context, is a key problem in Natural Language Processing (NLP), potentially enabling deeper representations of text. WSD is performed with respect to an existing inventory of word senses. If such inventory is not available, or within application-driven scenarios, a sense inventory can be automatically acquired from text corpora, a task known as Word Sense Induction (WSI). This course will provide an introduction to Word Sense Disambiguation and Induction. The aim of the course is two-fold: first, we introduce the audience to a wide range of techniques for the two tasks; in addition, we provide tools for the development of systems able to participate in past and current evaluation exercises for WSD and WSI (Semeval-2007 and 2010).

Words and Their Secrets (Maria José Bocorny Finat-

to and Diana Santos), foundational course. Language and computation, week 2, 11:00 – 12:30. What is a word? Which lexical measures have been used and why? What is a keyword? What is type/token ratio? And, more importantly: why does it matter? This foundational course discusses the notion of word, or lexical item, in both a practical and a theoretical vein, aiming to present several approaches ranging from lexicology, terminology, corpus linguistics and information retrieval. The lecturers will emphasize several different ways to look at words, several different conceptions of what a word is, and the huge number of approaches to "wordness" and to lexicon organization that have been put forward. Also, translation, evaluation, and resources such as wordnets will be discussed.

Evening lectures

In addition to the week-long courses, ESSLLI offers four evening lectures. The topics and speakers are:

- **August 10th: Integrating Logic Reasoning and Network Reasoning**, Dov Gabbay (Kings College London, University of Luxembourg, and Bar Ilan University, Israel).

- **August 12th: The Richness of the Stimulus: Confessions of a Nascent Empiricist**, Shalom Lappin (King's College London).

- **August 17th: Properties of a program's runtime state space, Neil Jones (University of Copenhagen)**

- **August 19th: Logical Dynamics of Rational Agency** by Johan van Benthem (University of Amsterdam and Stanford University)

All evening lectures take place between 19:00 and 21:00 in auditorium 23.0.50. Further information may be found at esslli2010cph.info/?page_id=516.

Student session schedule

This year, ESSLLI includes an extensive student session with papers and poster on a variety of topics.

Each day, three papers or posters are presented between 15:40 and 16:50. The posters will be exhibited throughout the summer school on the ground floor of building 23.

The schedule for the presentations is:

Monday, August 9th (LaCo)

15:40 – 16:10   Marcin Wlodarczak – Ranked multi-dimensional dialogue act annotation.

16:10 – 16:40 Gwendoline Fox and Juliette Thuilier – Predicting the Position of Attributive Adjectives in the French NP.

16:40 – 16:45 (poster) Leon Derczynski and Robert Gaizauskas – Using Signals to Improve Automatic Classification of Temporal Relations.

16:45 – 16:50 (poster) Bartosz Zaborowski – Tagger for Polish based on binary classifier.

Tuesday, August 10th (LoLa)

15:40 – 16:10   Arno Bastenhof – Tableaux for the Lambek-Grishin calculus.

16:10 – 16:40 Mike Solomon – Donkey Readings and Delayed Quantification.

16:40 – 16:45 (poster) Svetlozara Leseva – Frame-Evoking and Lexical Prefixes in Bulgarian.

Wednesday, August 11th (LoCo)

15:40 – 16:10   Wesley Holliday – A Logic of Relevant Alternatives.

16:10 – 16:40 Antonius Weinzierl – Comparing Inconsistency Resolutions in Multi-Context Systems.

16:40 – 16:45   (poster) Shasha Feng – Computing Query Difference for DL_Lite_{bool}.

16:45 – 16:50 (poster) Yining Wu – A Labelling-Based Justification Status of Arguments.

Thursday, August 12th (LaCo)

15:40 – 16:10 Johann-mattis List- Phonetic Alignment Based on Sound Classes. A New Method for Sequence Comparison in Historical Linguistics.

16:10 – 16:40 Simon Pauw and Michael Spranger – Embodied determiners.

16:40 – 16:45   (poster) Iria Bello – An Initial Analysis of Nominalizations in Scientific Texts (1700-1900).

16:45 – 16:50 (poster) Kim Allan Hansen, Sine Zambach and Christian Theil Have – Ontology-based retrieval of bio-medical information based on microarray text corpora.

Friday, August 13th (LoLa)

15:40 – 16:10   Hanna de Vries – The syntax and semantics of evaluative degree modification.

16:10 – 16:40 Daniel Lassiter – Epistemic Modals are (Almost Certainly) Probability Operators.

16:40 – 16:45 (poster) Fiora Salis – Fictional Names.

Monday, August 16th (LoCo)

15:40 – 16:10 Rasmus K. Rendsvig – Epistemic Term-Modal Logic.

16:10 – 16:40 Anderson de Araujo – Universal Turing machines without using codification

16:40 – 16:45 (poster) Ronald de Haan – Reasoning about Belief in Social Software using Modal Logic.

Tuesday, August 17th (LaCo)

15:40 – 16:10 Nynke H. van der Vliet – Syntax-based Discourse Segmentation of Dutch Text.

16:10 – 16:40 Zoe Bogart – Learning Positional Probabilities: An Automatic System for Ordering Adjectives.

16:40 – 16:45 (poster) Fabio Celli – Qualia and Property extraction from Italian Prepositional Phrases.

Wednesday, August 18th (LoLa)

15:40 – 16:10 Casper Storm Hansen – A Kripkean Solution to Paradoxes of Denotation.

16:10 – 16:40 Martin Aher – Inquisitive Semantics and Legal Discourse.

16:40 – 16:45 (poster) Mathias Winther Madsen-Linguistic Exchange and Consensus Bargaining.

16:45 – 16:50 (poster) Walter Pedersen – Implicit
Arguments in Minimalist Grammars.

Thursday, August 19th

15:40 – 16:40   Yury Savateev – Algorithmic Com-
plexity of Fragments of the Lambek Calculus
(winner of the 2010 E. W. Beth Dissertation Prize)

Friday, August 20th

15:40 – 16:40   Clossing Session – Presentation of
Springer awards for best paper and poster.

Social activities

A number of social activities have been planned for ESSLLI 2010:

• **Welcome reception** with a word of welcome from Organizing Committee chair Vincent F. Hendricks, Monday 9th 13:30 – 13:50 on the ground floor of building 23 on Søndre Campus.

• **Official reception**, Friday the 13th 19:00 – 21:30 in the University of Copenhagen main building, Frue Plads. During the reception, the winner of the Beth award will also be announced.

• **Canal cruise through Copenhagen**, Saturday 14th at 12:00 and Sunday August 15th at 14:00, with departure from Islands Brygge. Tickets can be bought at the ESSLLI information desk for 50 DKK.

• **Soccer match: lecturers vs. students**, Saturday 14th at 14:00, in Kløvermarken, approximately two kilometers northeast of the Søndre Campus.

• **ESSLLI 2010 party**, Saturday 14th 20:00 – 02:00 in the Mødestedet bar, by staircase 17 in the building across the canal from the ESSLLI site.

Practical information

ESSLLI 2010 takes place at the University of Copenhagen **Humanities Campus**. The campus is located on the island of Amager and is referred to as the Søndre Campus ("Southern Campus"). It is accessible by busses 12, 33, and 34, and the M1 metro line. Bus 5A also stops on the nearby Amager Boulevard.

Registration is handled at the **ESSLLI information desk**, which is located on the ground floor of building 23 of the Søndre Campus. The information desk is open on weekdays from 8:45 to 17:00. However, on Monday, August 9th, it opens on 7:00, and on Tuesday, August 10th, at 8:00.
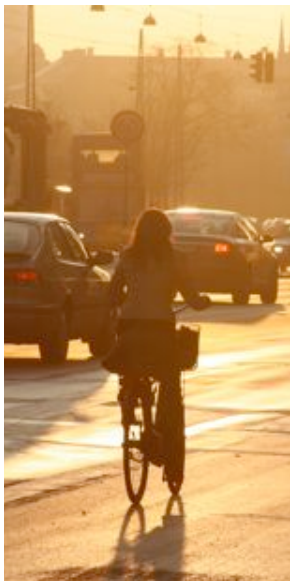
In this area, relevant **books** will also be put on display and sold daily between 12:30 and 14:00. Payments can only be made in cash with local currency.

The **local currency** is the Danish krone (DKK/kr). 100 DKK is approximately 13.50 euros, or 17.50 US dollars. There are several banks and currency exchange stores in and around the Central Station.

The **public transportation** system in Copenhagen includes busses, the metro, and the so-called S-trains. Maps and further information can be found at www.moviatrafik.dk/dinrejse/Tourist, intl.m.dk, and byenspuls.dsb.dk.

Cycling is in many cases the easiest way to get around Copenhagen, and bikes can be rented in several places, including the Danhostel. So-called **city bikes** are also available on more than 100 sites around central Copenhagen. The bikes can be borrowed for a deposit of 20 DKK, but cannot be locked. More information can be found at www.bycyklen.dk.

The **emergency phone number** in Denmark is 112. The police can be reached by dialing 114.

The fairly inexpensive **campus canteen** is located on the gound floor of building 23. It is open on weekdays from 7:45 to 18:00, except on Monday, August 13th, when it closes at 13:00.

A cheaper alternative is the Fakta **supermarket** halfway down Njalsgade towards Islands Brygge. The supermarket is open daily from 9:00 to 20:00.

Free **wireless internet** is available on the ground floor of all buildings of the University of Copenhagen. The network is called SC_Guest and requires no password.

Tips on Copenhagen

During the two busy weeks of logic, language, and information, an occasional need for sustenance, sunshine, or diversion might arise. Fortunately, Copenhagen is quite capable of delivering that as well.

On Islands Brygge, close by the Søndre Campus, Copenhageners cool off in an open air **harbor pool** free of charge. The pool is open daily from 7:00 to 19:00 and 11:00 to 19:00 on weekends.

There are also a number of parks within a reasonable distance of the Søndre Campus. These include **Kongens Have**, which lies within walking distance from Nyhavn; the smaller **Enghaveparken** at the

end of Istedgade; the **Botanical Garden**, located right across the street from the National Gallery of Art by Nørreport station; **Assistens Kirkegården**, the cemetery where Niels Bohr and Søren Kierkegaard are buried, but which is also widely used as a park; and **Ørstedsparken**, a beautiful park in the English style best known for its after-hours use as a gay meeting point.

In addition to these parks, the **Frederiksberg Campus** of the University of Copenhagen has its own garden, with a small café in the middle of the flower beds (see www.cafe.life.ku.dk). Less picturesque is the **Nørre Campus** ("Nothern Campus"), which is home to the sciences and located next to the large **Fælledparken**. The oldest part of the university is scattered around the center of the city in what is now referred to as the **City Campus**.

This part of the university is conviently located next to the **Latin Quarter**, better known as Pisserenden ("The piss trench"). A walk through this part of the old city can take you from a gourmet coffee shop to a tattoo joint in a basement, or from an SM-themed night club to the law school.

Equally mixed is **Istedgade**, on the other side of the Central Station. As Copenhageners know, local hipsters frequent the bars and night clubs west of the instersection of Istedgade and Gasværksvej, while the number of prostitues and heroine addicts jumps as you go east of Gasværksvej.

In the Nørrebro neighborhood, a large number of nice bars and cafés have clustered around the short pedestrian street **Blågårdsgade**. Cheap food is available in the area too, with café N serving a 25 DKK vegetarian meal every Friday and Støberiet offering vegetarian meals for 30 DKK on Wednesdays. Just around the corner, 20 DKK will buy you a plate of vegan food at Kafax on Korsgade on Tuesdays at 19:00, and at Folkets hus on Stengade on Mondays at 19:00.

At any time on any given day, the zillions of kebab joints on **Nørrebrogade** offer 15 kr. falafels. Nørrebrogade is also home to a number of bars with student-friendly beer prices, a casual atmosphere, and late opening hours.

On the opposite site of the lake, **Nansensgade** provides somewhat more luxury at somewhat higher prices. Along with a couple of good bars,
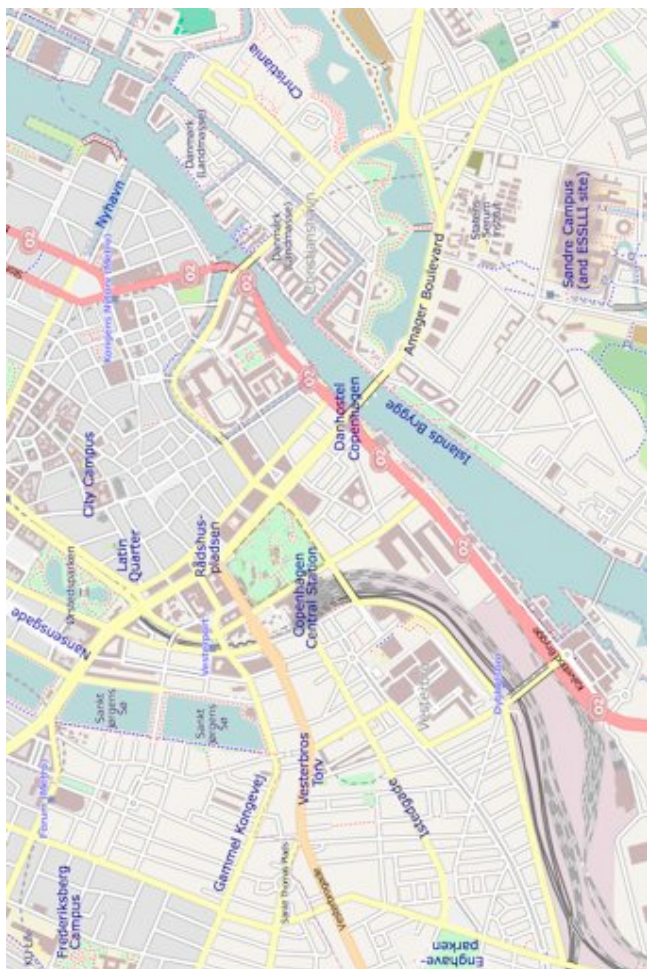
the street supplies the hungry with sushi, Thai food, tapas, and pizzas served with a genuine Italian accent.

During ESSLLI, a number of films are shown free of charge in open air cinemas in Copenhagen. The art house cinema **Husets Biograf** thus screens a number of oddball sci-fi films in their yard in Rådhusstræde 13. The TV station TV2 Zulu screens a more conventional selection on Islands Brygge and by Øksnehallen, close by the Central Station. Full programs are available on www.husetsbio.dk and zulu.tv2.dk/sommerbio.
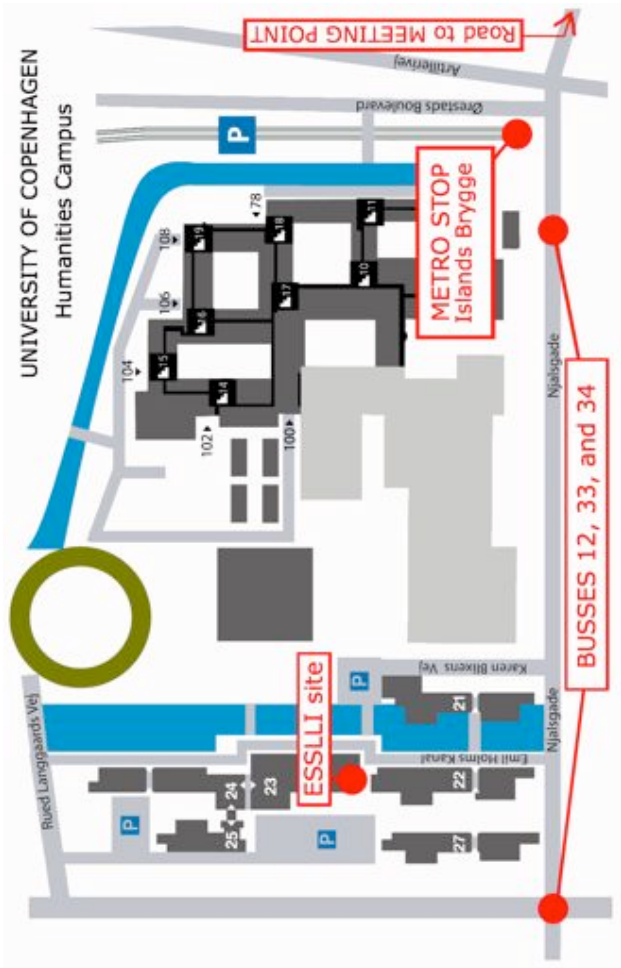
For the extremely film-hungry, **the two other art cinemas** in Copenhagen, Gloria and Vester Vov Vov, are located next to the city hall and near the Museum of Copenhagen on Vesterbros Torv, respectively. Showtimes and addresses can be found at www.gloria.dk and www.vestervovvov.dk.

Harbor bath

Danhostel

Islands Brygge (Metro)

ESLLI site

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UNIVERSITY OF COPENHAGEN
Humanities Campus

Road to MEETING POINT

Artillerivej

Ørestads Boulevard

METRO STOP
Islands Brygge

BUSSES 12, 33, and 34

ESSLLI site

Rued Langgaards Vej

Karen Blixens Vej

Emil Holms Kanal

Njalsgade

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