Categorial Grammar: Logical Syntax, Semantics, and Processing, Glyn Morrill, Oxford University Press, 2010, 0191625094, 9780191625091, 256 pages. This book provides a state-of-the-art introduction to categorial grammar, a type of formal grammar which analyses expressions as functions or according to a function-argument relationship. The book's focus is on linguistic, computational, and psycholinguistic aspects of logical categorial grammar, i.e. enriched Lambek Calculus. Glyn Morrill opens with the history and notation of Lambek Calculus and its application to syntax, semantics, and processing. Successive chapters extend the grammar to a number of significant syntactic and semantic properties of natural language. The final part applies Morrill's account to several current issues in processing and parsing, considered from both a psychological and a computational perspective. The book offers a rigorous and thoughtful study of one of the main lines of research in the formal and mathematical theory of grammar, and will be suitable for students of linguistics and cognitive science from advanced undergraduate level upwards.

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The Mathematics of Language 10th and 11th Biennial Conference, MOL 10, Los Angeles, CA, USA, July 28-30, 2007 and MOL 11, Bielefeld, Germany, August 20-21, 2009, Revised Selected Papers, Christian Ebert, Gerhard Jäger, Jens Michaelis, Sep 30, 2010, Computers, 297 pages. The FoLLI LNAI subline aims to disseminate cutting-edge results in logic, language and information (LLI) research, development and education. LLI is the topical focus of FoLLI ....


Type-logical Semantics , Bob Carpenter, 1997, Language Arts & Disciplines, 575 pages. The book, which stepwise develops successively more powerful logical and grammatical systems, covers an unusually broad range of material.

Type Logical Grammar Categorial Logic of Signs, Glyn V. Morrill, 1994, Computers, 307 pages. This book sets out the foundations, methodology, and practice of a formal framework for the description of language. The approach embraces the trends of lexicalism and ....

Formal Semantics An Introduction, Ronnie Cann, Feb 26, 1993, Language Arts & Disciplines, 344 pages. This accessible introduction to formal, and especially Montague, semantics within a linguistic framework, presupposes no previous background in logic, but takes students step ....

The Logic of Categorial Grammars A Deductive Account of Natural Language Syntax and Semantics, Richard Moot, Christian Retore, Jul 2, 2012, 310 pages. This book is intended for students in computer science, formal linguistics, mathematical logic and to colleagues interested in categorial grammars and their logical foundations ....


The Oxford Handbook of Linguistic Analysis , Bernd Heine, Heiko Narrog, Dec 17, 2009, Language Arts & Disciplines, 1048 pages. This handbook compares the main analytic frameworks and methods of contemporary linguistics. It offers a unique overview of linguistic theory, revealing the common concerns of ....

Reference , Barbara Abbott, Mar 25, 2010, Language Arts & Disciplines, 328 pages. This book introduces the most important problems of reference and considers the solutions that have been proposed to explain them. Reference is at the centre of debate among ....
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I'm interested in language, logic and computation; particularly the roles of logic in grammar and language processing. Photo: me, Michael Moortgat and Raffaella Bernardi, Ottawa 2003. (For a putative categorial syntactic structure to be correct, a proof net, it has to contain a Girard "long trip").


Categorial grammar (also categorical grammar) is a term used for a family of formalisms in natural language syntax motivated by the principle of compositionality and organized according to the view that syntactic constituents should generally combine as functions or according to a function-argument relationship. Most versions of categorial grammar analyze sentence structure in terms of constituencies (as opposed to dependencies) and are therefore phrase structure grammars (as opposed to dependency grammars).

A categorial grammar consists of two parts: a lexicon, which assigns a set of types (also called categories) to each basic symbol, and some type inference rules, which determine how the type of a string of symbols follows from the types of the constituent symbols. It has the advantage that the type inference rules can be fixed once and for all, so that the specification of a particular language grammar is entirely determined by the lexicon.

A categorial grammar shares some features with the simply typed lambda calculus. Whereas the lambda calculus has only one function type, a categorial grammar typically has two function types, one type which is applied on the left, and one on the right. For example, a simple categorial grammar might have two function types and . The first, , is the type of a phrase that results in a phrase of type when followed (on the right) by a phrase of type . The second, , is the type of a phrase that results in a phrase of type when preceded (on the left) by a phrase of type .

As Joachim Lambek explains, the notation is based upon algebra. A fraction when multiplied by (i.e. concatenated with) its denominator yields its numerator. Since concatenation is not commutative, it makes a difference whether the denominator occurs to the left or right. The concatenation must be on the same side as the denominator for it to cancel out.

The first and simplest kind of categorial grammar is called a basic categorial grammar, or sometimes an AB-grammar (after Ajdukiewicz and Bar-Hillel). Given a set of primitive types , let be the set of types constructed from primitive types. In the basic case, this is the least set such that and if then . Think of these as purely formal expressions freely generated from the primitive types; any semantics will be added later. Some authors assume a fixed infinite set of primitive types used by all grammars, but by making the primitive types part of the grammar, the whole construction is kept finite.

Such a grammar for English might have three basic types , assigning count nouns the type , complete noun phrases the type , and sentences the type . Then an adjective could have the type , because if it is followed by a noun then the whole phrase is a noun. Similarly, a determiner has the type , because it forms a complete noun phrase when followed by a noun. Intransitive verbs have
the type, and transitive verbs the type. Then a string of words is a sentence if it has overall type.

Categorial grammars of this form (having only function application rules) are equivalent in generative capacity to context-free grammars and are thus often considered inadequate for theories of natural language syntax. Unlike CFGs, categorial grammars are lexicalized, meaning that only a small number of (mostly language-independent) rules are employed, and all other syntactic phenomena derive from the lexical entries of specific words.

Another appealing aspect of categorial grammars is that it is often easy to assign them a compositional semantics, by first assigning interpretation types to all the basic categories, and then associating all the derived categories with appropriate function types. The interpretation of any constituent is then simply the value of a function at an argument. With some modifications to handle intensionality and quantification, this approach can be used to cover a wide variety of semantic phenomena.

The Lambek calculus consists of several deduction rules which specify how type inclusion assertions can be derived. In the following rules, upper case roman letters stand for types, upper case Greek letters stand for sequences of types. A sequent of the form can be read: a string is of type Failed to parse (Cannot store math image on filesystem.): X of strings of each of the types in Failed to parse (Cannot store math image on filesystem.): \Gamma . If a type is interpreted as a set of strings, then the may be interpreted as , that is, "includes as a subset". A horizontal line means that the inclusion above the line implies the one below the line.

The other rules come in pairs, one pair for each type construction operator, each pair consisting of one rule for the operator in the target, one in the source, of the arrow. The name of a rule consists of the operator and an arrow, with the operator on the side of the arrow on which it occurs in the conclusion.

Specifically, given a context-free grammar as above, define a categorial grammar where , and . Let there be an axiom for every symbol , an axiom for every production rule , a lexicon entry for every terminal symbol , and Cut for the only rule. This categorial grammar generates the same language as the given CFG.

Now given a CFG in Greibach normal form, define a basic categorial grammar with a primitive type for each non-terminal variable , and with an entry in the lexicon , for each production rule . It is fairly easy to see that this basic categorial grammar generates the same language as the original CFG. Note that the lexicon of this grammar will generally assign multiple types to each symbol.

The basic idea is, given a Lambek grammar, construct a context-free grammar with the same set of terminal symbols, the same start symbol, with variables some (not all) types , and with a production rule for each entry in the lexicon, and production rules for certain sequents which are derivable in the Lambek calculus.

The notation in this field is not standardized. The notations used in formal language theory, logic, category theory, and linguistics, conflict with each other. In logic, arrows point to the more general from the more particular, that is, to the conclusion from the hypotheses. In this article, this convention is followed, i.e. the target of the arrow is the more general (inclusive) type.

In logic, arrows usually point left to right. In this article this convention is reversed for consistency with the notation of context-free grammars, where the single non-terminal symbol is always on the left. We use the symbol in a production rule as in Backus-Naur form. Some authors use an arrow, which unfortunately may point in either direction, depending on whether the grammar is thought of as generating or recognizing the language.

The basic ideas of categorial grammar date from work by Kazimierz Ajdukiewicz (in 1935) and
Yehoshua Bar-Hillel (in 1953). In 1958, Joachim Lambek introduced a syntactic calculus that formalized the function type constructors along with various rules for the combination of functions. This calculus is a forerunner of linear logic in that it is a substructural logic. Montague grammar uses an ad hoc syntactic system for English that is based on the principles of categorial grammar. Although Montague's work is sometimes regarded as syntactically uninteresting, it helped to bolster interest in categorial grammar by associating it with a highly successful formal treatment of natural language semantics. More recent work in categorial grammar has focused on the improvement of syntactic coverage. One formalism which has received considerable attention in recent years is Steedman and Szabolcsi's combinatory categorial grammar which builds on combinatory logic invented by Moses Schönfinkel and Haskell Curry.

Most systems of categorial grammar subdivide categories. The most common way to do this is by tagging them with features, such as person, gender, number, and tense. Sometimes only atomic categories are tagged in this way. In Montague grammar, it is traditional to subdivide function categories using a multiple slash convention, so A/B and A//B would be two distinct categories of left-applying functions, that took the same arguments but could be distinguished between by other functions taking them as arguments.

Rules of function composition are included in many categorial grammars. An example of such a rule would be one that allowed the concatenation of a constituent of type A/B with one of type B/C to produce a new constituent of type A/C. The semantics of such a rule would simply involve the composition of the functions involved. Function composition is important in categorial accounts of conjunction and extraction, especially as they relate to phenomena like right node raising. The introduction of function composition into a categorial grammar leads to many kinds of derivational ambiguity that are vacuous in the sense that they do not correspond to semantic ambiguities.

We offer a novel synthesis of both Lambek-based and linear-implication analytic traditions in Type Logical Categorial Grammar, based not on formal proof-theoretic desiderata but rather on the severe empirical challenges posed by noncanonical coordinations in natural language, such as Dependent Cluster Coordination, Right Node Raising, and Gapping. The full range of complex syntax/semantic interactions in these coordinations pose serious problems for both major strands of CG research, a fact which is not widely appreciated in the literature. In this framework, Hybrid Type Logical Categorial Grammar (Hybrid TLCG), both directional and nondirectional modes of implication are utilized and, crucially, interact with each other in the course of proofs. This architecture makes possible simple and straightforward analyses of complex interactions between coordination, in particular apparent nonconstituent coordinations, with scopal phenomena involving not only generalized quantifiers, but auxiliaries, negation, and symmetrical predicates such as same and different.

Day 1: Survey of coordination phenomena: Non-constituent coordination (argument cluster coordination and right-node raising), Gapping; scopal interactions between NCC and quantifiers, symmetrical and related predicates, Gapping and auxiliaries, negative quantifiers. Treatments of these problems in phrase structure-based approaches and their problems.