Notes (12/5/98):
Categorial Grammars
Atomic categories; For example, N, S
Complex categories: If X and Y are categories then X/Y and X\Y are also categories.
Examples:
(S\NP)/NP: for transitive verbs
S\NP: for intransitive verbs
(S\NP)/NP(directobject)/NP(indirectobject): for ditransitive verbs
(S\NP)\(S\NP): for adverbs
N/N: for adjectives
NP/N: for determiners
Reductions:
Forward function application: X/Y Y → X
Backward function application: Y X\Y → X
Function composition: X/Y Y/Z → X/Z
(Similarly for the backslash)
Mixed composition: X/Y Y\Z → X\Z
Type raising X → Y/(Y\X)
Some derivations:

John likes apples

NP (S\NP)/NP NP

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(S\NP)

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S

John left abruptly

NP (S\NP) (S\NP)/(S\NP)

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S\NP

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S

John likes apples
I think John left

Continue this derivation:

Hint—type raise 'I' combine 'I' and 'think' and then with 'left' etc.

Categorial grammars with function application only are (weakly) equivalent to Context-free grammars. This follows from the fact for any CFG we can construct an equivalent CFG in the Greibach Normal Form, i.e., a grammar whose rules are of the form

\[
A \rightarrow aB_1B_2B_3...B_n \\
A \rightarrow a
\]

These rules correspond to catgorial assignments as follows:

\[
a : A/B_n/B_n - 1/.../B_2/B_1 \\
a : A
\]

Catgorial grammars with more complex compositions can be shown to be more powerful than CFGs.

Coordination:
One major advantage of a categorial grammar is that it can allow flexible constituency. For example, as we have seen before we obtain two analyses for John likes apples, one in which likes apples is a constituent and in the other case John apples is a constituent. This permits both

John likes apples and hates pears
John likes and Bill hates pears

A problem: Show that both John and Harry thinks Mary can have the same type. Hint: Type raise John, type-raise Harry and Mary and then combine Harry and thinks and then with Mary. What is the problem? What is a possible solution?