# Gramática Categorial
# Segunda lista de exercícios

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## 1 "toda menina chutou uma bola"

### 1.1 Quantificador universal com escopo sobre existencial

$$\dfrac{\dfrac{\dfrac{\dfrac{\text{toda}}{(N \Uparrow S)/N_c : \lambda P_0.\lambda P_1.\forall x.((P_0\ x) \to (P_1\ x))}\,L \quad \dfrac{\text{menina}}{N_c : M'_1}\,L}{N \Uparrow S : (\lambda P_0.\lambda P_1.\forall x.((P_0\ x) \to (P_1\ x))\ M'_1) =_{red.\beta} \lambda P_1.\forall x.((M'_1\ x) \to (P_1\ x))}\,E/}{N : x_0}\,0 \quad \dfrac{\dfrac{\dfrac{\text{chutou}}{(N\backslash S)/N : C'_5}\,L \quad \dfrac{\dfrac{\text{uma}}{(N \Uparrow S)/N_c : \lambda Q_0.\lambda Q_1.\exists y.((Q_0\ y) \wedge (Q_1\ y))}\,L \quad \dfrac{\text{bola}}{N_c : B'}\,L}{N \Uparrow S : (\lambda Q_0.\lambda Q_1.\exists y.((Q_0\ y) \wedge (Q_1\ y))\ B') =_{red.\beta} \lambda Q_1.\exists y.((B'\ y) \wedge (Q_1\ y))}\,E/}{N : x_1}\,1}{N\backslash S : (C'_5\ x_1)}\,E/}{S : ((C'_5\ x_1)\ x_0)}\,E\backslash$$

$$\dfrac{S : (\lambda Q_1.\exists y.((B'\ y) \wedge (Q_1\ y))\ \lambda x_1.((C'_5\ x_1)\ x_0)) =_{red.\beta} \exists y.((B'\ y) \wedge (\lambda x_1.((C'_5\ x_1)\ x_0)\ y)) =_{red.\beta} \exists y.((B'\ y) \wedge ((C'_5\ y)\ x_0))}{S : (\lambda P_1.\forall x.((M'_1\ x) \to (P_1\ x))\ \lambda x_0.\exists y.((B'\ y) \wedge ((C'_5\ y)\ x_0))) =_{red.\beta} \forall x.((M'_1\ x) \to (\lambda x_0.\exists y.((B'\ y) \wedge ((C'_5\ y)\ x_0))\ x)) =_{red.\beta} \forall x.((M'_1\ x) \to \exists y.((B'\ y) \wedge ((C'_5\ y)\ x)))}\,E\Uparrow^0\ E\Uparrow^1$$

### 1.2 Quantificador existencial com escopo sobre universal

$$\dfrac{\dfrac{\dfrac{\dfrac{\text{toda}}{(N \Uparrow S)/N_c : \lambda P_0.\lambda P_1.\forall x.((P_0\ x) \to (P_1\ x))}\,L \quad \dfrac{\text{menina}}{N_c : M'_1}\,L}{N \Uparrow S : (\lambda P_0.\lambda P_1.\forall x.((P_0\ x) \to (P_1\ x))\ M'_1) =_{red.\beta} \lambda P_1.\forall x.((M'_1\ x) \to (P_1\ x))}\,E/}{N : x_0}\,0 \quad \dfrac{\dfrac{\dfrac{\text{chutou}}{(N\backslash S)/N : C'_5}\,L \quad \dfrac{\dfrac{\text{uma}}{(N \Uparrow S)/N_c : \lambda Q_0.\lambda Q_1.\exists y.((Q_0\ y) \wedge (Q_1\ y))}\,L \quad \dfrac{\text{bola}}{N_c : B'}\,L}{N \Uparrow S : (\lambda Q_0.\lambda Q_1.\exists y.((Q_0\ y) \wedge (Q_1\ y))\ B') =_{red.\beta} \lambda Q_1.\exists y.((B'\ y) \wedge (Q_1\ y))}\,E/}{N : x_1}\,1}{N\backslash S : (C'_5\ x_1)}\,E/}{S : ((C'_5\ x_1)\ x_0)}\,E\backslash$$

$$\dfrac{S : (\lambda P_1.\forall x.((M'_1\ x) \to (P_1\ x))\ \lambda x_0.((C'_5\ x_1)\ x_0)) =_{red.\beta} \forall x.((M'_1\ x) \to (\lambda x_0.((C'_5\ x_1)\ x_0)\ x)) =_{red.\beta} \forall x.((M'_1\ x) \to ((C'_5\ x_1)\ x))}{S : (\lambda Q_1.\exists y.((B'\ y) \wedge (Q_1\ y))\ \lambda x_1.\forall x.((M'_1\ x) \to ((C'_5\ x_1)\ x))) =_{red.\beta} \exists y.((B'\ y) \wedge (\lambda x_1.\forall x.((M'_1\ x) \to ((C'_5\ x_1)\ x))\ y)) =_{red.\beta} \exists y.((B'\ y) \wedge \forall x.((M'_1\ x) \to ((C'_5\ y)\ x)))}\,E\Uparrow^0\ E\Uparrow^1$$

### 1.3 Sugestão para reduzir trabalho duplicado

#### 1.3.1 Derivação comum às duas análises

$D_1$:

$$\dfrac{\dfrac{\dfrac{\dfrac{\text{toda}}{(N \Uparrow S)/N_c : \lambda P_0.\lambda P_1.\forall x.((P_0\ x) \to (P_1\ x))}\,L \quad \dfrac{\text{menina}}{N_c : M'_1}\,L}{N \Uparrow S : (\lambda P_0.\lambda P_1.\forall x.((P_0\ x) \to (P_1\ x))\ M'_1) =_{red.\beta} \lambda P_1.\forall x.((M'_1\ x) \to (P_1\ x))}\,E/}{N : x_0}\,0 \quad \dfrac{\dfrac{\dfrac{\text{chutou}}{(N\backslash S)/N : C'_5}\,L \quad \dfrac{\dfrac{\text{uma}}{(N \Uparrow S)/N_c : \lambda Q_0.\lambda Q_1.\exists y.((Q_0\ y) \wedge (Q_1\ y))}\,L \quad \dfrac{\text{bola}}{N_c : B'}\,L}{N \Uparrow S : (\lambda Q_0.\lambda Q_1.\exists y.((Q_0\ y) \wedge (Q_1\ y))\ B') =_{red.\beta} \lambda Q_1.\exists y.((B'\ y) \wedge (Q_1\ y))}\,E/}{N : x_1}\,1}{N\backslash S : (C'_5\ x_1)}\,E/}{S : ((C'_5\ x_1)\ x_0)}\,E\backslash$$

### 1.3.2 Quantificador universal com escopo sobre existencial

$$\dfrac{\dfrac{\dfrac{\text{toda menina chutou uma bola}}{S : ((C'_5\ x_1)\ x_0)}\,D_1}{S : (\lambda Q_1.\exists y.((B'\ y) \wedge (Q_1\ y))\ \lambda x_1.((C'_5\ x_1)\ x_0))}\,E\Uparrow^1}{\begin{array}{c} S : (\lambda P_1.\forall x.((M'_1\ x) \to (P_1\ x))\ \lambda x_0.\exists y.((B'\ y) \wedge ((C'_5\ y)\ x_0))) \\ =_{red.\beta}\ \forall x.((M'_1\ x) \to (\lambda x_0.\exists y.((B'\ y) \wedge ((C'_5\ y)\ x_0))\ x)) \\ =_{red.\beta}\ \forall x.((M'_1\ x) \to \exists y.((B'\ y) \wedge ((C'_5\ y)\ x))) \end{array}}\,E\Uparrow^0$$

### 1.3.3 Quantificador existencial com escopo sobre universal

$$\dfrac{\dfrac{\dfrac{\text{toda menina chutou uma bola}}{S : ((C'_5\ x_1)\ x_0)}\,D_1}{S : (\lambda P_1.\forall x.((M'_1\ x) \to (P_1\ x))\ \lambda x_0.((C'_5\ x_1)\ x_0))}\,E\Uparrow^0}{\begin{array}{c} S : (\lambda Q_1.\exists y.((B'\ y) \wedge (Q_1\ y))\ \lambda x_1.\forall x.((M'_1\ x) \to ((C'_5\ x_1)\ x))) \\ =_{red.\beta}\ \exists y.((B'\ y) \wedge (\lambda x_1.\forall x.((M'_1\ x) \to ((C'_5\ x_1)\ x))\ y)) \\ =_{red.\beta}\ \exists y.((B'\ y) \wedge \forall x.((M'_1\ x) \to ((C'_5\ y)\ x))) \end{array}}\,E\Uparrow^1$$

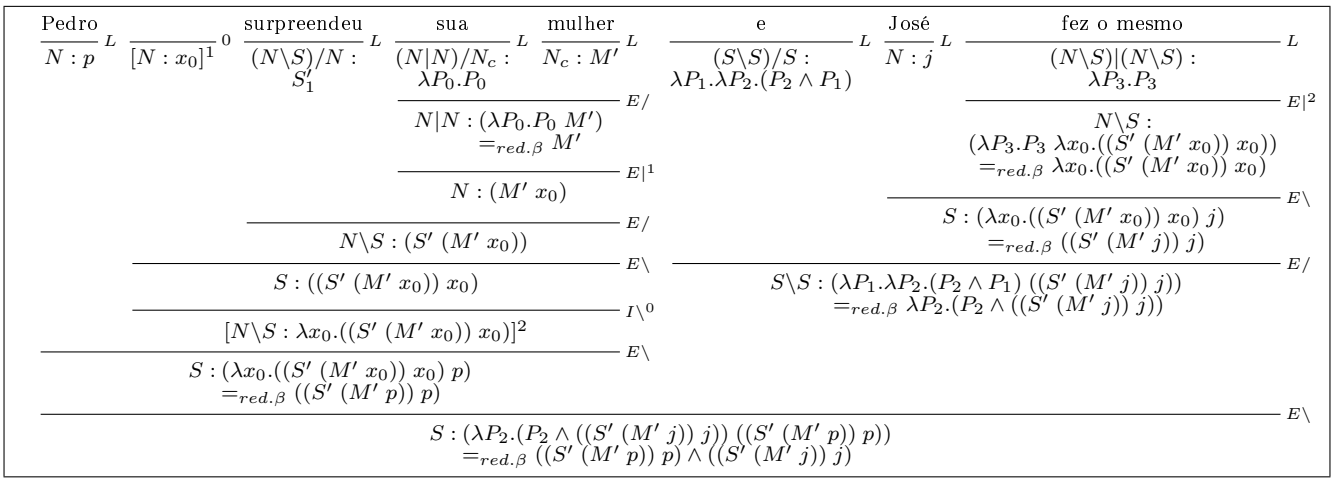
# 2 “Pedro surpreendeu sua mulher e José fez o mesmo”

Aqui, como foi comentado em aula, a interpretação de $M'$ precisaria ser como termo funcional, e não termo predicativo; conforme diferença em [1, p. 17]

## 2.1 Leitura de identidade estrita

$$\dfrac{\dfrac{\dfrac{\dfrac{\dfrac{\dfrac{\text{Pedro}}{[N : p']^0}\,L \quad \dfrac{\text{surpreendeu}}{(N\backslash S)/N : S'_1}\,L \quad \dfrac{\dfrac{\text{sua}}{(N|N)/N_c : \lambda P_0.P_0}\,L \quad \dfrac{\text{mulher}}{N_c : M'}\,L}{N|N : (\lambda P_0.P_0\ M') =_{red.\beta} M'}\,E/}{N : (M'\ p')}\,E|^0}{[N\backslash S : (S'\ (M' p'))]^1}\,E/ \quad \dfrac{\dfrac{\dfrac{\text{e}}{(S\backslash S)/S : \lambda P_1.\lambda P_2.(P_2 \wedge P_1)}\,L \quad \dfrac{\text{José}}{N : j'}\,L}{S\backslash S : (\lambda P_1.\lambda P_2.(P_2 \wedge P_1)\ ((S'\ (M'\ p'))\ j')) =_{red.\beta} \lambda P_2.(P_2 \wedge ((S'\ (M'\ p'))\ j'))}\,E/}{S : ((S'\ (M'\ p'))\ j')}\,E\backslash}{S : ((S'\ (M'\ p'))\ p')}\,E\backslash \quad \dfrac{\dfrac{\text{fez o mesmo}}{(N\backslash S)|(N\backslash S) : \lambda P_3.P_3}\,L}{N\backslash S : (\lambda P_3.P_3\ (S'\ (M'\ p'))) =_{red.\beta} (S'\ (M'\ p'))}\,E|^1}{\begin{array}{c} S : (\lambda P_2.(P_2 \wedge ((S'\ (M'\ p'))\ j'))\ ((S'\ (M'\ p'))\ p')) \\ =_{red.\beta}\ ((S'\ (M'\ p'))\ p') \wedge ((S'\ (M'\ p'))\ j') \end{array}}\,E\backslash$$

## 2.2 Leitura de identidade fajuta




# Referências

[1] Jon Barwise and John Etchemendy. *The Language of First-Order Logic*. CSLI, Stanford, CA, third edition, 1992.