TÓPICOS EM CIÊNCIA DE DADOS PARA O ESPORTE

ALGORITMO TRUESKILL

DIEGO RODRIGUES DSC

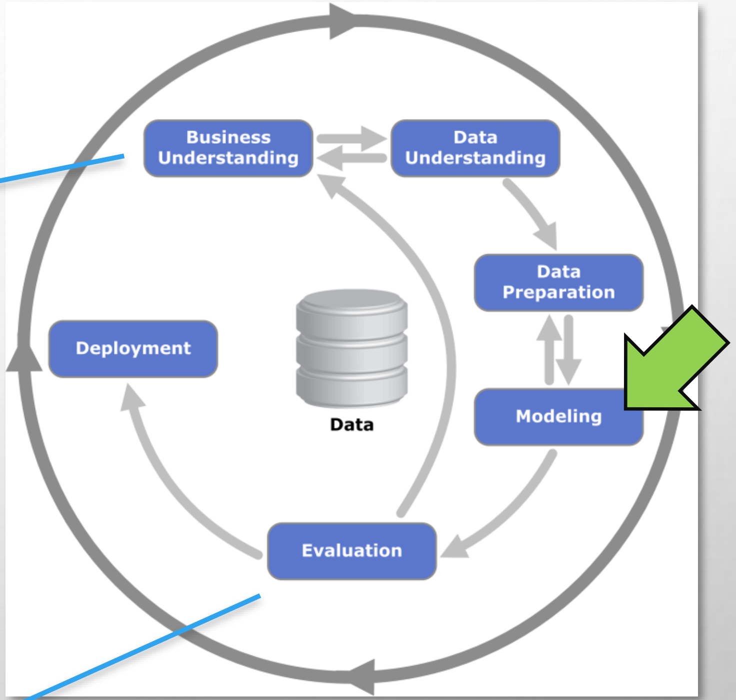
INFNET

AGENDA

- PARTE 1 : TEORIA
  - CONTEXTO
  - ALGORITMO TRUESKILL
- PARTE 2 : PRÁTICA
  - PROGRAMA PYTHON → RANQUEAMENTO ESTATÍSTICO DO BRASILEIRÃO (ELO VS TRUESKILL)

CRONOGRAMA

DIA	NÚMERO	ÁREA	AULA	TRABALHOS
10/10/2023	1	Intro	Introdução a Disciplina e Organização do Ambiente	
17/10/2023	2	Dados	Coleta de Dados e Sensoriamento	
19/10/2023	3	Estatística	Variáveis Aleatórias	Grupos
24/10/2023	4		Análise Exploratória	
26/10/2023	5		Estatísticas para Ranqueamento	
31/10/2023	6		Ranqueamento Estatístico : ELO	Base de Dados
07/11/2023	7		Ranqueamento Estatístico : Glicko	
09/11/2023	8		Ranqueamento Estatístico : TrueSkill	
14/11/2023	9		Ranqueamento Estatístico : XELO	
16/11/2023	10	ML	Modelos de Aprendizado de Máquina	Pesquisa
21/11/2023	11		Machine Learning: Classificação	
23/11/2023	12		Machine Learning: Regressão	
28/11/2023	13		Machine Learning: Agrupamento	
30/11/2023	14		Machine Learning: Visão Computacional	Modelo
5/12/2023	15	Esportes	Aplicações & Artigos: Esportes Independentes	
7/12/2023	16		Aplicações & Artigos: Esportes de Combate	
12/12/2023	17		Aplicações & Artigos: Esportes de Objeto	
14/12/2023	18		Aplicações & Artigos : Betting	
19/12/2023	19	Workshop	Workshop	
21/12/2023	20		Apresentações de Trabalhos	Apresentação



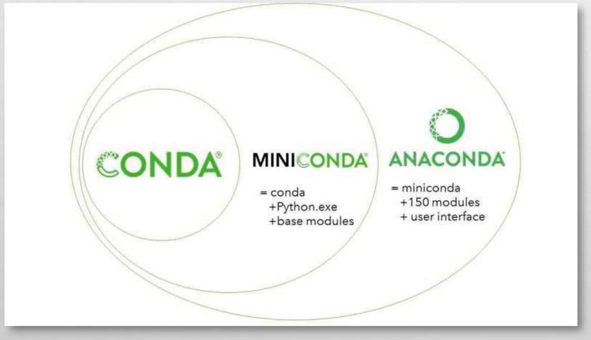
CRISP-DM

SETUP INICIAL DO AMBIENTE PYTHON

4. Variáveis Aleatórias

5. Visualização

6. Estimação e Inferência



1. Editor de Código

2. Gestor de Ambiente

3. Ambiente Python do Projeto

3. Notebook Dinâmico

CONTEXTO

FACTOR GRAPHS

Frank R. Kschischang

498 IEEE TRANSACTIONS ON INFORMATION THEORY, VOL. 47, NO. 2, FEBRUARY 2001

Factor Graphs and the Sum-Product Algorithm

Frank R. Kschischang, *Senior Member, IEEE*, Brendan J. Frey, *Member, IEEE*, and Hans-Andrea Loeliger, *Member, IEEE*

***Abstract*—Algorithms that must deal with complicated global functions of many variables often exploit the manner in which the given functions factor as a product of "local" functions, each of which depends on a subset of the variables. Such a factorization can be visualized with a bipartite graph that we call a *factor graph*. In this tutorial paper, we present a generic message-passing algorithm, the sum-product algorithm, that operates in a factor graph. Following a single, simple computational rule, the sum-product algorithm computes—either exactly or approximately—various marginal functions derived from the global function. A wide variety of algorithms developed in artificial intelligence, signal processing, and digital communications can be derived as specific instances of the sum-product algorithm, including the forward/backward algorithm, the Viterbi algorithm, the iterative "turbo" decoding algorithm, Pearl's belief propagation algorithm for Bayesian networks, the Kalman filter, and certain fast Fourier transform (FFT) algorithms.**

***Index Terms*—Belief propagation, factor graphs, fast Fourier transform, forward/backward algorithm, graphical models, iterative decoding, Kalman filtering, marginalization, sum-product algorithm, Tanner graphs, Viterbi algorithm.**

The aim of this tutorial paper is to introduce factor graphs and to describe a generic message-passing algorithm, called the *sum-product algorithm*, which operates in a factor graph and attempts to compute various marginal functions associated with the global function. The basic ideas are very simple; yet, as we will show, a surprisingly wide variety of algorithms developed in the artificial intelligence, signal processing, and digital communications communities may be derived as specific instances of the sum-product algorithm, operating in an appropriately chosen factor graph.

Genealogically, factor graphs are a straightforward generalization of the "Tanner graphs" of Wiberg *et al.* [31], [32]. Tanner [29] introduced bipartite graphs to describe families of codes which are generalizations of the low-density parity-check (LDPC) codes of Gallager [11], and also described the sum-product algorithm in this setting. In Tanner's original formulation, all variables are codeword symbols and hence "visible"; Wiberg *et al.*, introduced "hidden" (latent) state variables and also suggested applications beyond coding. Factor

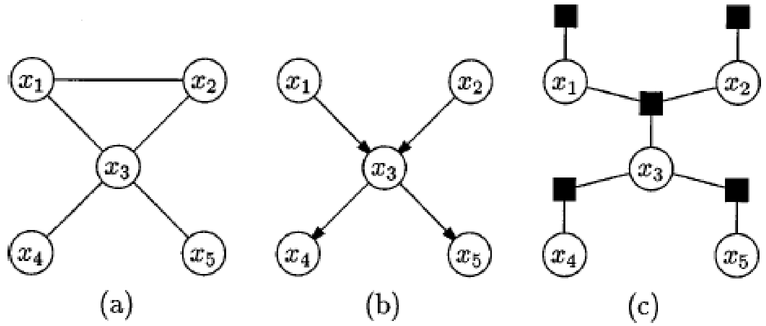


Fig. 24. Graphical probability models. (a) A Markov random field. (b) A Bayesian network. (c) A factor graph.

MESSAGE PASSING ALGORITHM

Frank R. Kschischang

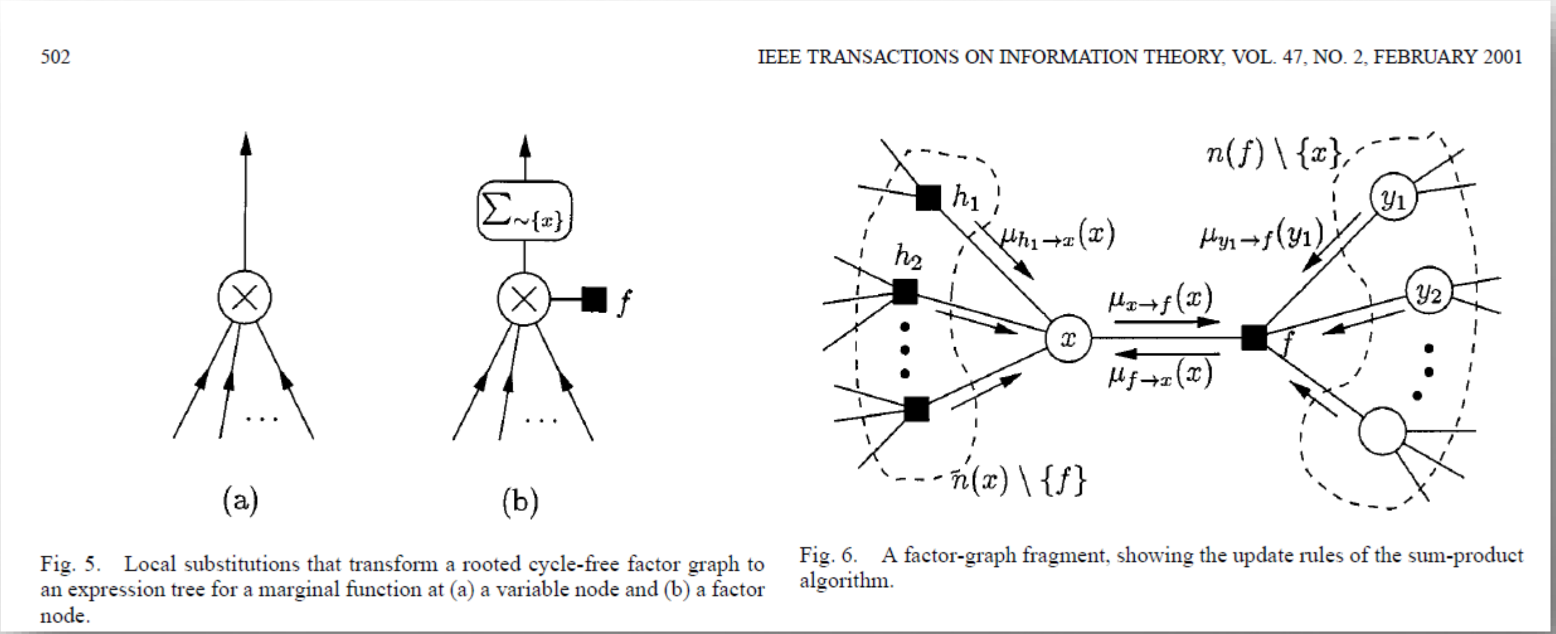


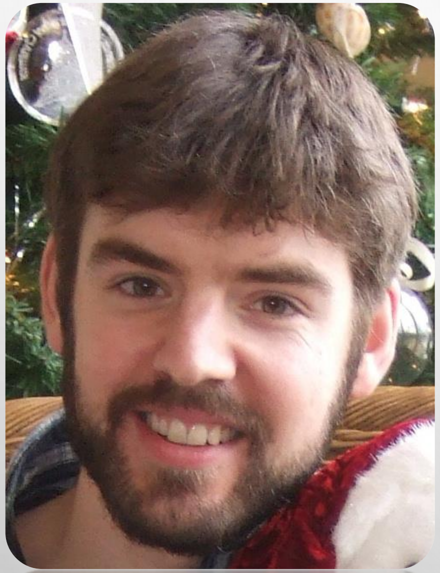
Fig. 5. Local substitutions that transform a rooted cycle-free factor graph to an expression tree for a marginal function at (a) a variable node and (b) a factor node.

Fig. 6. A factor-graph fragment, showing the update rules of the sum-product algorithm.

ALGORITMO TRUESKILL

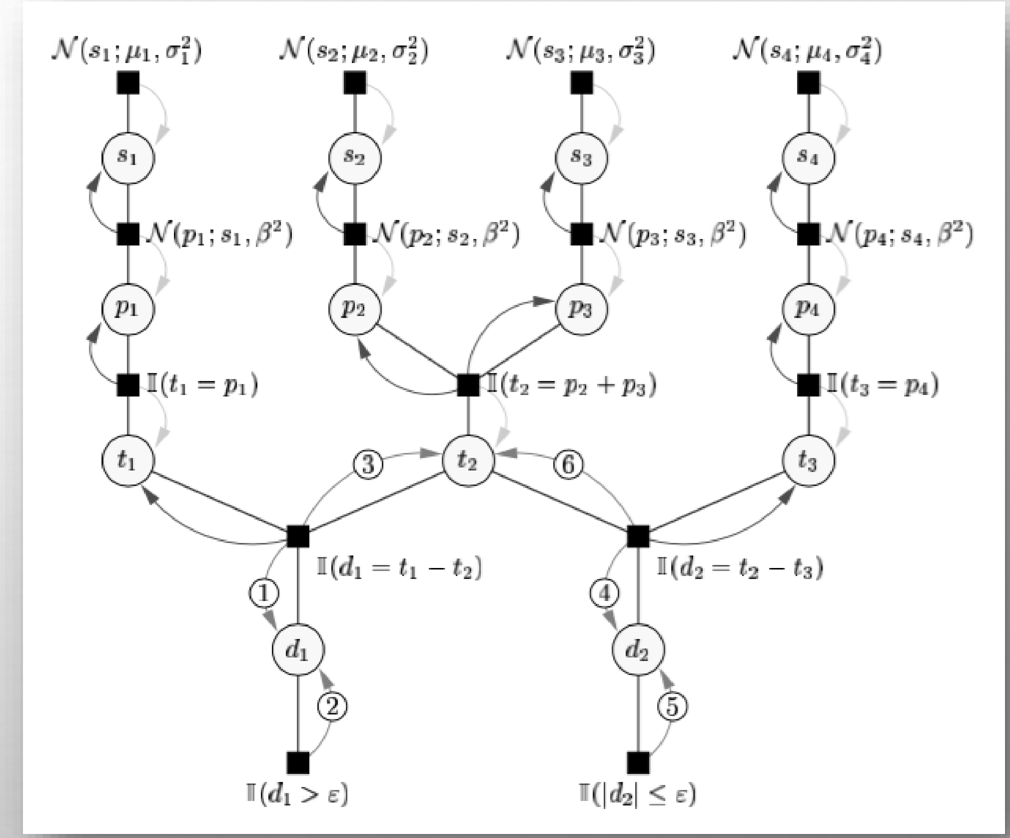
TRUESKILL

$$p(\mu|\mathbf{y}, A) = \frac{P(\mathbf{y}|\mu, A)\, p(\mu)}{P(\mathbf{y}|A)}$$

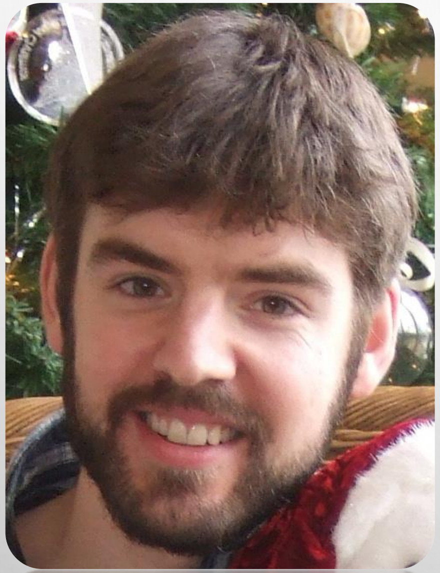


Tom Minka

- ESTENDE O GLICKO PARA O CASO DE TIMES COM TAMANHO DESBALANCEADO. A HABILIDADE DO TIME É A SOMA DAS HABILIDADES INDIVIDUAIS DOS JOGADORES.
- ATUALIZA AS HABILIDADES UTILIZANDO UM ALGORITMO DE PROPAGAÇÃO DE EXPECTATIVA, UTILIZANDO UM GRÁFICO DE FATORES.



PARÂMETROS DO MODELO



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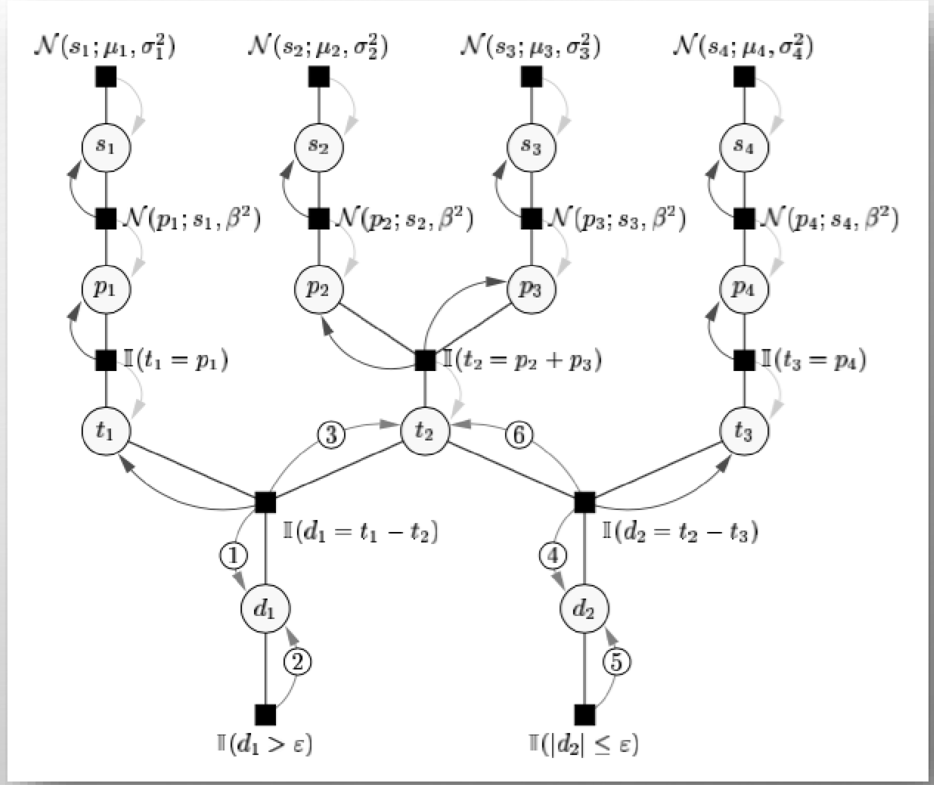
M= M INICIAL

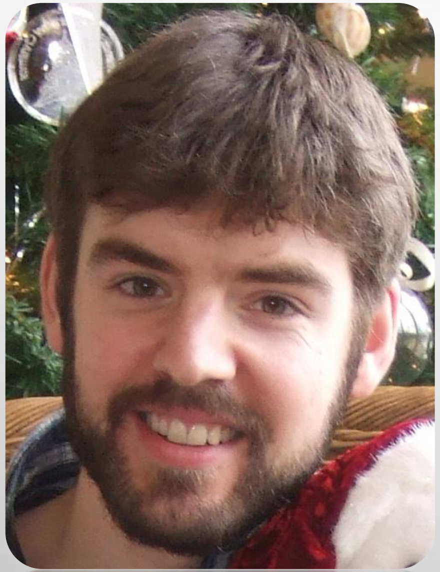
Σ= M/3

BETA= Σ/2

TAU= Σ/100



ATUALIZAÇÃO DOS PARÂMETROS



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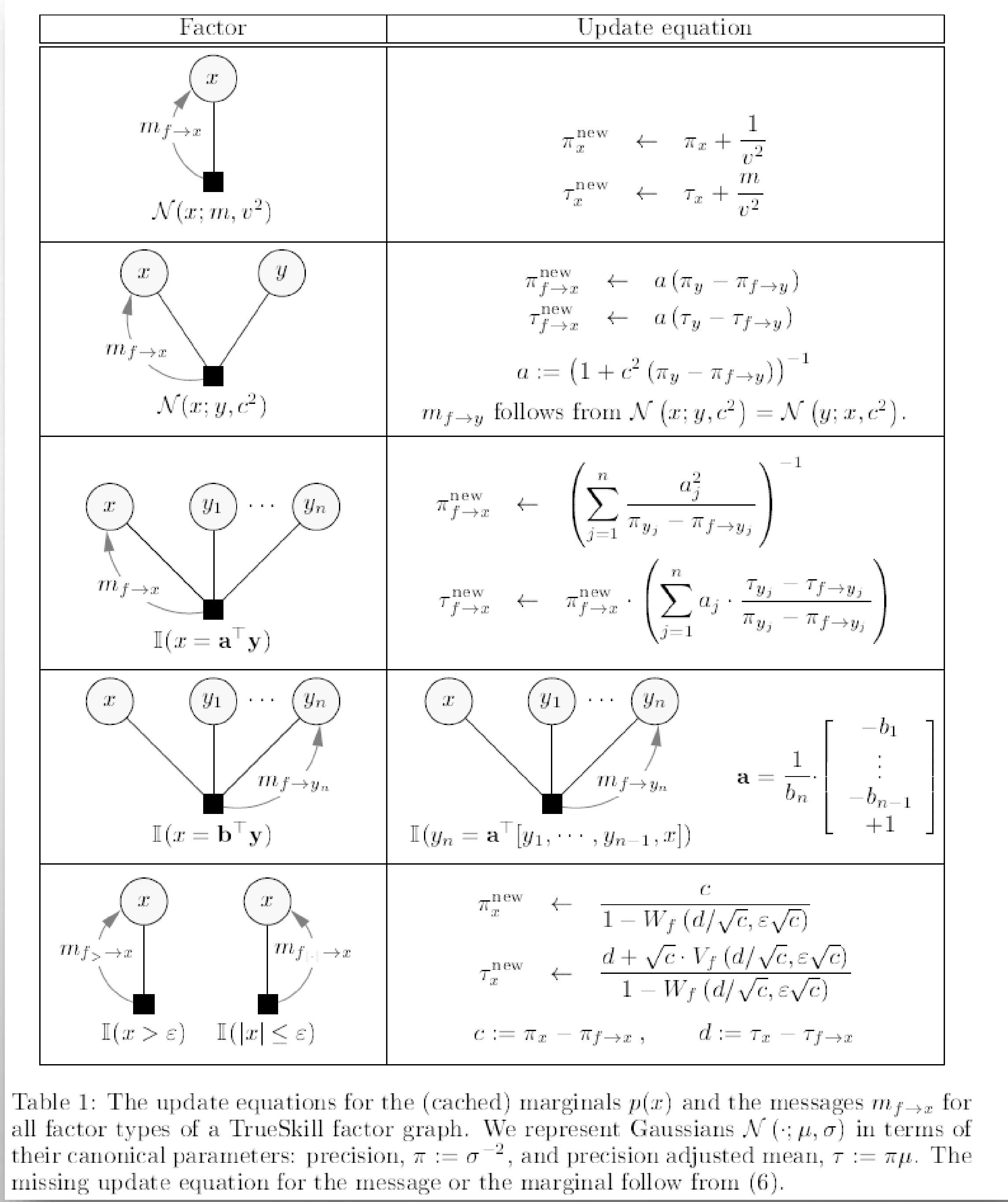

Factor	Update equation
$\mathcal{N}(x; m, v^2)$	$\pi_x^{\text{new}} \leftarrow \pi_x + \frac{1}{v^2}$ $\tau_x^{\text{new}} \leftarrow \tau_x + \frac{m}{v^2}$
$\mathcal{N}(x; y, c^2)$	$\pi_{f\to x}^{\text{new}} \leftarrow a\left(\pi_y - \pi_{f\to y}\right)$ $\tau_{f\to x}^{\text{new}} \leftarrow a\left(\tau_y - \tau_{f\to y}\right)$ $a := \left(1 + c^2\left(\pi_y - \pi_{f\to y}\right)\right)^{-1}$ $m_{f\to y}$ follows from $\mathcal{N}\left(x; y, c^2\right) = \mathcal{N}\left(y; x, c^2\right)$.
$\mathbb{I}(x = \mathbf{a}^\top \mathbf{y})$	$\pi_{f\to x}^{\text{new}} \leftarrow \left(\sum_{j=1}^{n} \frac{a_j^2}{\pi_{y_j} - \pi_{f\to y_j}}\right)^{-1}$ $\tau_{f\to x}^{\text{new}} \leftarrow \pi_{f\to x}^{\text{new}} \cdot \left(\sum_{j=1}^{n} a_j \cdot \frac{\tau_{y_j} - \tau_{f\to y_j}}{\pi_{y_j} - \pi_{f\to y_j}}\right)$
$\mathbb{I}(x = \mathbf{b}^\top \mathbf{y})$	$\mathbb{I}(y_n = \mathbf{a}^\top[y_1, \cdots, y_{n-1}, x])$ $\mathbf{a} = \frac{1}{b_n} \cdot \begin{bmatrix} -b_1 \\ \vdots \\ -b_{n-1} \\ +1 \end{bmatrix}$
$\mathbb{I}(x > \varepsilon)$ $\mathbb{I}(\|x\| \leq \varepsilon)$	$\pi_x^{\text{new}} \leftarrow \frac{c}{1 - W_f\left(d/\sqrt{c}, \varepsilon\sqrt{c}\right)}$ $\tau_x^{\text{new}} \leftarrow \frac{d + \sqrt{c} \cdot V_f\left(d/\sqrt{c}, \varepsilon\sqrt{c}\right)}{1 - W_f\left(d/\sqrt{c}, \varepsilon\sqrt{c}\right)}$ $c := \pi_x - \pi_{f\to x}, \quad d := \tau_x - \tau_{f\to x}$

Table 1: The update equations for the (cached) marginals $p(x)$ and the messages $m_{f\to x}$ for all factor types of a TrueSkill factor graph. We represent Gaussians $\mathcal{N}(\cdot; \mu, \sigma)$ in terms of their canonical parameters: precision, $\pi := \sigma^{-2}$, and precision adjusted mean, $\tau := \pi\mu$. The missing update equation for the message or the marginal follow from (6).

PAPER

CALCULANDO O RATING PARA UM DRILL DE FUTEBOL AMERICANO DESBALANCEADO

ESTIMATIVA DO VENCEDOR

$$P(\text{ataque}) = \Phi\left(\frac{\mu_{\text{qb}} + \mu_{\text{wr}} - \mu_{\text{db}}}{\sqrt{3\beta^2 + \sigma_{\text{qb}}^2 + \sigma_{\text{wr}}^2 + \sigma_{\text{db}}^2}}\right)$$

RATING: LIMITE INFERIOR DO INTERVALO DE CONFIANÇA PARA M.

$$h_i = \mu_i - 3\sigma_i$$

$$\hat{h}_i = \frac{h_i}{h^*}$$

RATING AGREGADO – MÉDIA PONDERADA DOS RATINGS, POR REPETIÇÃO.

$$r_i = \frac{\sum_j n_{ij}\hat{h}_{ij}}{\sum_j n_{ij}}$$

DESAFIO: RODAR O BOOTELO NA MÁQUINA III

PRÓXIMA AULA
LEITURA: INTRODUÇÃO A MACHINE LEARNING