

In this section we give detailed description of every notation used in table 1.

GTD2 convergence analysis results are taken from Touati et al. (2018). The learning rate required for their guarantee to work is set to $\frac{9^2 \times 2\sigma}{8\sigma^2(k+2)+9^2\zeta}$ and complexity to obtain accuracy ϵ is $\mathcal{O}(\frac{\kappa(Q)^2 \mathcal{H}d}{\lambda_{\min}(G)\epsilon})$. In this notation:

- σ is the minimum eigenvalue of matrix $A^T M^{-1} A$, where matrix

$$M = \mathbb{E}[\phi(s_k, a_k)\phi(s_k, a_k)^T]$$

and

$$A = \mathbb{E}[e_k(\gamma \mathbb{E}_\pi[\phi(s_{k+1}, \cdot)] - \phi(s_k, a_k))^T],$$

where e_k is eligibility trace vector $e_k = \lambda \gamma \kappa(s_k, a_k) e_{k-1} + \phi(s_k, a_k)$.

- k is an iteration number.
- Matrix G plays key role in their analysis, it is block matrix of the form

$$G = \begin{pmatrix} 0 & \sqrt{\beta} A^T \\ -\sqrt{\beta} A & \beta M_k \end{pmatrix}$$

and G_k is a matrix of similar form generated from quantities estimated at time point k .

- ζ is $2 \times 9^2 c(M)^2 \rho^2 + 32c(M)L_G$, where $c(M)$ is the condition number of matrix M , ρ is the maximum eigenvalue of matrix $A^T M^{-1} A$ and L_G is the $L_G = \|\mathbb{E}[G_K^T G_K | \mathcal{F}_{k-1}]\|$. \mathcal{F}_{k-1} in this analysis is sigma algebra generated but all previous history up to moment $k-1$.
- Quantity \mathcal{H} is equal to $\mathbb{E}\|G_K z^* - g_k\|$, where $z^* = (\theta^*, \frac{1}{\sqrt{\beta} w^*})$ is the optimal solution and $g_k = (0, \frac{1}{\sqrt{\beta}} b)$.
- The last quantity left undefined is $\kappa(Q)$, which is the condition number of matrix Q , obtained by diagonalization of matrix $G = Q^T \Lambda Q$.

PD SVRG and **PD SAGA** use the same quantities as **GTD2**, except that matrices A and C are defined the same way as in this paper:

$$A = \mathbb{E}[\phi(s)(\phi(s) - \gamma \phi(s'))^T]$$

and

$$C = \mathbb{E}[\phi(s)\phi^T(s)].$$

- n in this notation is the size of the dataset.
- μ_ρ is the minimum eigenvalue of matrix $A^T C^{-1} A$.

All other quantities are defined in the paper.