
Algorithm *Preconditioned Conjugate Gradient*

- 1: $\mathbf{r}_0 = \mathbf{b} - \mathbf{A}\mathbf{x}_0$
 - 2: $\tilde{\mathbf{r}}_0 = \mathbf{L}^{-T}\mathbf{L}^{-1}\mathbf{r}_0$
 - 3: $\mathbf{p}_0 = \tilde{\mathbf{r}}_0$
 - 4: **for** $i = 0, 1, \dots$ until convergence **do**
 - 5: $\alpha = \frac{\overbrace{(\mathbf{r}_i, \tilde{\mathbf{r}}_i)}^{\delta_i}}{\underbrace{(\mathbf{A}\mathbf{p}_i, \mathbf{p}_i)}_t}$
 - 6: $\mathbf{x}_{i+1} = \mathbf{x}_i + \alpha\mathbf{p}_i$
 - 7: $\mathbf{r}_{i+1} = \mathbf{r}_i - \alpha \underbrace{\mathbf{A}\mathbf{p}_i}_t$
 - 8: check the convergence of \mathbf{r}_{i+1} . If converge, **return**
 - 9: $\tilde{\mathbf{r}}_{i+1} = \mathbf{M}^{-1}\mathbf{r}_{i+1} = \mathbf{L}^{-T}\mathbf{L}^{-1}\mathbf{r}_{i+1}$
 - 10: $\beta = \frac{\overbrace{(\mathbf{r}_{i+1}, \tilde{\mathbf{r}}_{i+1})}^{\delta_{i+1}}}{\underbrace{(\mathbf{r}_i, \tilde{\mathbf{r}}_i)}_{\delta_i}}$
 - 11: $\mathbf{p}_{i+1} = \tilde{\mathbf{r}}_{i+1} + \beta\mathbf{p}_i$
 - 12: **end for**
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