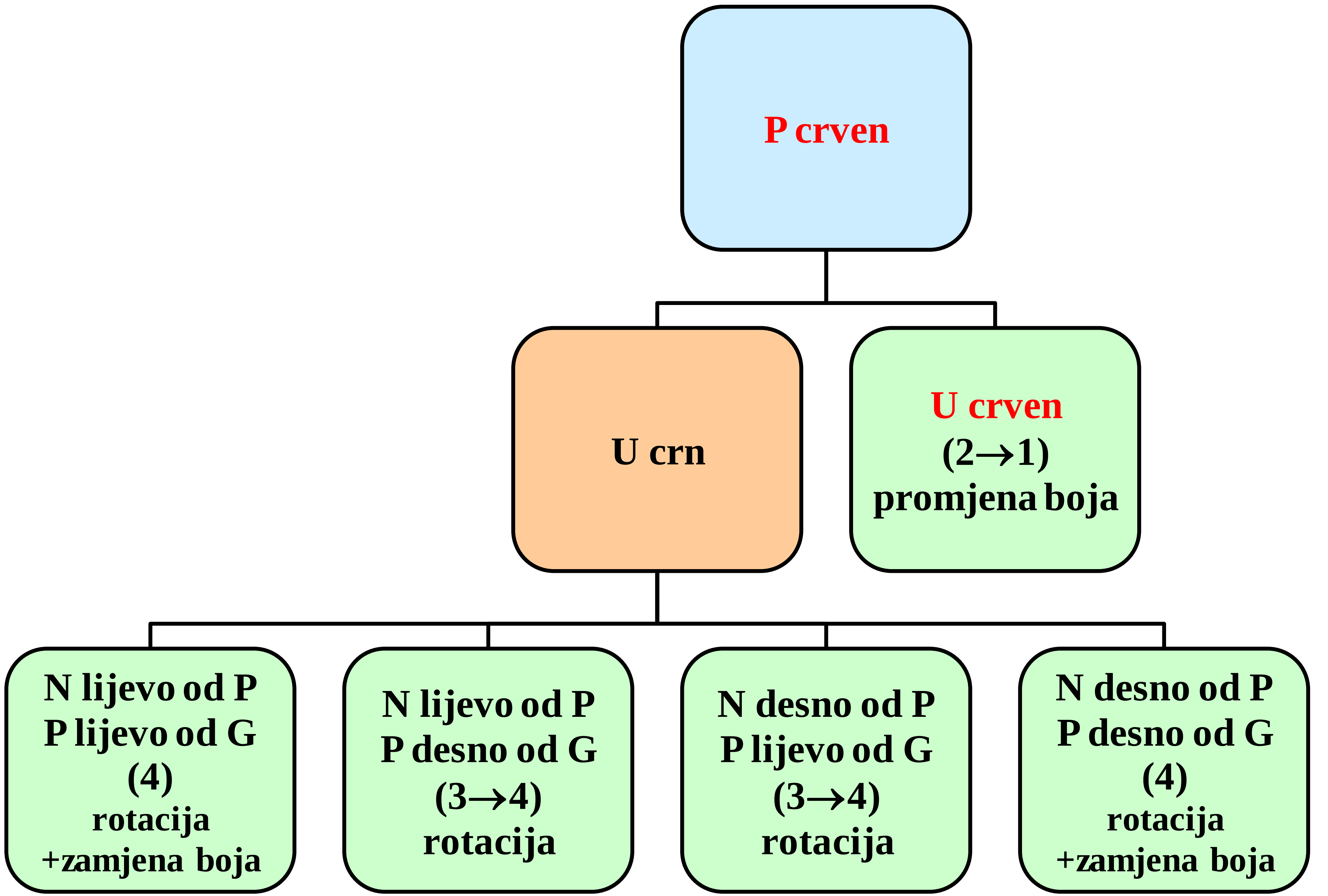
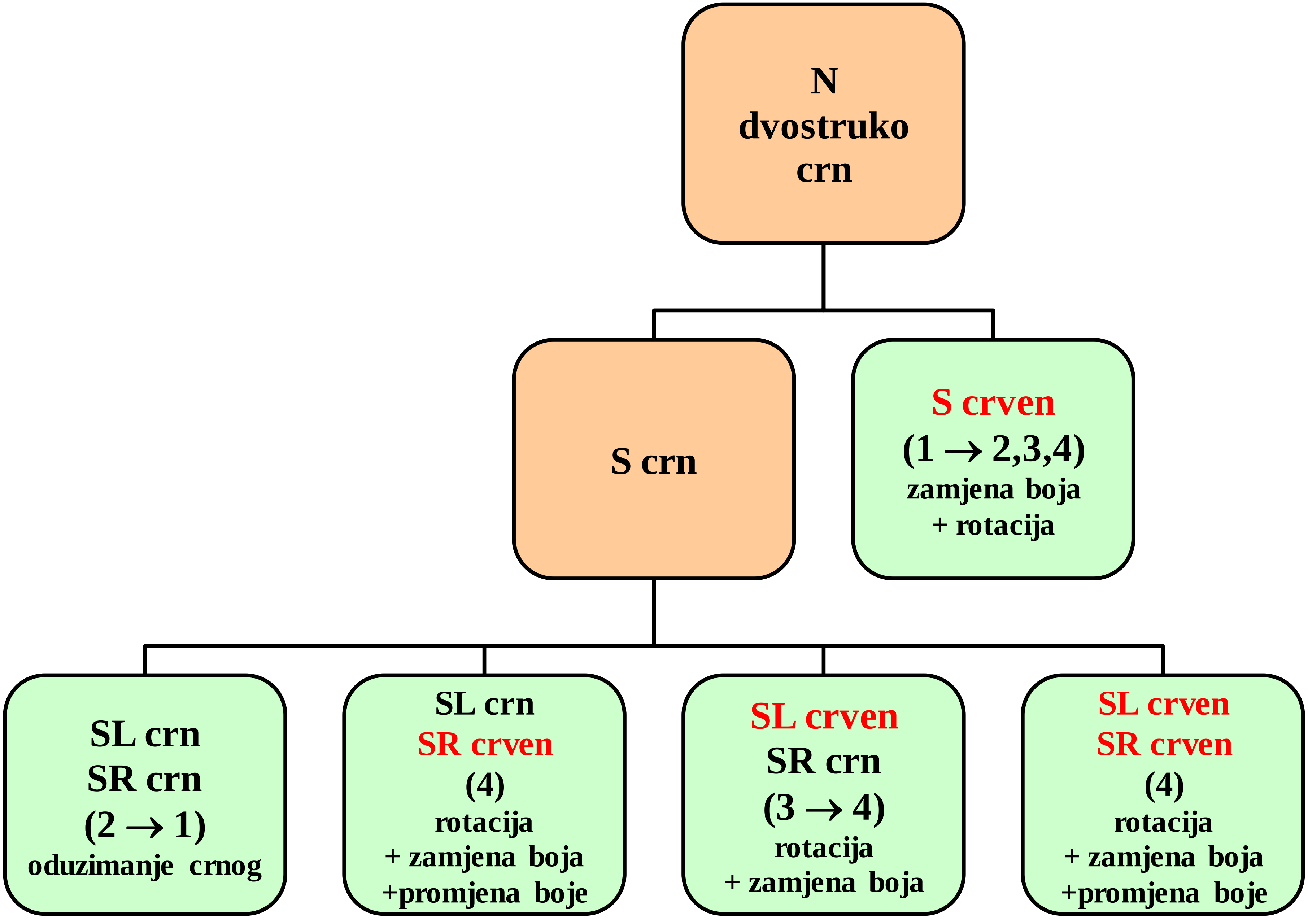


P crven
U crn
U crven
(2→1)
promjena boja
N lijevo od P
P lijevo od G
(4)
rotacija
+zamjena boja
N lijevo od P
P desno od G
(3→4)
rotacija
N desno od P
P lijevo od G
(3→4)
rotacija
N desno od P
P desno od G
(4)
rotacija
+zamjena boja


N
dvostruko
crn
S crn
S crven
(1 → 2,3,4)
zamjena boja
+ rotacija
SL crn
SR crn
(2 → 1)
oduzimanje crnog
SL crn
SR crven
(4)
rotacija
+ zamjena boja
+promjena boje
SL crven
SR crn
(3 → 4)
rotacija
+ zamjena boja
SL crven
SR crven
(4)
rotacija
+ zamjena boja
+promjena boje

Rješavanje sustava $\mathbf{Ax} = \mathbf{b}, \quad \mathbf{A} \in \mathrm{R}^{m \times n}$

desni pseudoinverz $= \mathbf{A}^{\mathrm{T}}\left(\mathbf{A}\mathbf{A}^{\mathrm{T}}\right)^{-1} \quad ; \quad m < n$

lijevi pseudoinverz $= \left(\mathbf{A}^{\mathrm{T}}\mathbf{A}\right)^{-1}\mathbf{A}^{\mathrm{T}} \quad ; \quad m \geq n$

Kaczmarzov algoritam: $$\mathbf{w}^{(k+1)} = \mathbf{w}^{(k)} - \mu \frac{e^{(k)}\mathbf{x}_{\mathrm{d},R(k)+1}}{\left\|\mathbf{x}_{\mathrm{d},R(k)+1}\right\|^2} \quad ,$$

gdje su: $\mathbf{w}^{(0)} = \mathbf{0}\,, \qquad 0 < \mu < 2$

$$e^{(k)} = \mathbf{x}_{\mathrm{d},R(k)+1}^{\mathrm{T}}\mathbf{w}^{(k)} - y_{\mathrm{d},R(k)+1}$$

ili $$e^{(k)} = f\left(\mathbf{x}_{\mathrm{d},R(k)+1}^{\mathrm{T}}\mathbf{w}^{(k)}\right) - y_{\mathrm{d},R(k)+1} \quad .$$

Gradijentna metoda optimizacije

$$f(\mathbf{x}) \quad , \qquad f : \mathrm{R}^n \to \mathrm{R}$$

$$\mathbf{x}^{(k+1)} = \mathbf{x}^{(k)} - \alpha_k \cdot \nabla f\left(\mathbf{x}^{(k)}\right)$$

Ciljna funkcija za *Adaline*: $$f(\mathbf{w}) = \frac{1}{2}\left\|\mathbf{X}_\mathrm{d}^\mathrm{T}\mathbf{w} - \mathbf{y}_\mathrm{d}\right\|^2$$

Gradijent ciljne funkcije: $$\nabla f(\mathbf{w}) = \mathbf{X}_\mathrm{d}\,(\mathbf{X}_\mathrm{d}^\mathrm{T}\cdot\mathbf{w} - \mathbf{y}_\mathrm{d})$$

$$\Downarrow$$

Iteracija: $$\mathbf{w}^{(k+1)} = \mathbf{w}^{(k)} - \alpha_k\cdot\mathbf{X}_\mathrm{d}\cdot\mathrm{e}^{(k)} \quad ,$$

gdje je $$\mathrm{e}^{(k)} = \mathbf{X}_\mathrm{d}^\mathrm{T}\cdot\mathbf{w}^{(k)} - \mathbf{y}_\mathrm{d} \quad .$$

Prolazak prema naprijed matrično

$$\mathbf{v} = \mathbf{W}^{\mathrm{h}} \cdot \mathbf{x} - \boldsymbol{\theta}^{\mathrm{h}} \qquad \mathbf{z} = sigmoid(\mathbf{v})$$

$$\mathbf{u} = \mathbf{W}^{\mathrm{o}} \cdot \mathbf{z} - \boldsymbol{\theta}^{\mathrm{o}} \qquad \mathbf{y} = sigmoid(\mathbf{u})$$

Rasprostiranje unatrag matrično

.* = množenje po parovima, a ne matrično!

$$\mathbf{EA}^{\mathrm{o}} = \mathbf{y} - \mathbf{y}_{\mathrm{d}}$$

$$\mathbf{EI}^{\mathrm{o}} = \mathbf{EA}^{\mathrm{o}} .* \mathbf{y} .* (\mathbf{1} - \mathbf{y})$$

$$\boldsymbol{\delta}^{\mathrm{o}} = \mathbf{EI}^{\mathrm{o}}$$

$$\mathbf{EW}^{\mathrm{o}} = \boldsymbol{\delta}^{\mathrm{o}} \cdot \mathbf{z}^{\mathrm{T}} = \mathbf{EI}^{\mathrm{o}} \cdot \mathbf{z}^{\mathrm{T}}$$

$$\mathbf{EA}^{\mathrm{h}} = (\mathbf{w}^{\mathrm{o}})^{\mathrm{T}} \cdot \mathbf{EI}^{\mathrm{o}}$$

.* = množenje po parovima, a ne matrično!

$$\mathbf{EI}^{\mathrm{h}} = \mathbf{EA}^{\mathrm{h}} .* \mathbf{z} .* (\mathbf{1} - \mathbf{z})$$

$$\boldsymbol{\delta}^{\mathrm{h}} = \mathbf{EI}^{\mathrm{h}}$$

$$\mathbf{EW}^{\mathrm{h}} = \boldsymbol{\delta}^{\mathrm{h}} \cdot \mathbf{x}^{\mathrm{T}} = \mathbf{EI}^{\mathrm{h}} \cdot \mathbf{x}^{\mathrm{T}}$$

$$\mathbf{E\Theta}^{\mathrm{o}} = -\mathbf{EI}^{\mathrm{o}} \qquad \mathbf{E\Theta}^{\mathrm{h}} = -\mathbf{EI}^{\mathrm{h}}$$

Stožerni razvoj oko (p,q)

$$y_{ij}^{'} = y_{ij} - \frac{y_{iq}}{y_{pq}} y_{pj} \qquad ; \quad i \neq p$$

$$y_{pj}^{'} = \frac{y_{pj}}{y_{pq}}$$