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Krok 1

$w_1 = [-3, 4, 1]$
$w_2 = [-3, -1, -3]$
$w_3 = [0, -1, -6]$

Vzdálenosti od w_1:

$p_1 : \sqrt{(-3-0)^2 + (4+1)^2 + (1+2)^2} = 6{,}56$
$p_2 : \sqrt{(-3+3)^2 + (4+1)^2 + (1+3)^2} = 6{,}4$
$p_3 : \sqrt{(-3-1)^2 + (4+3)^2 + (1-2)^2} = 8{,}12$
$p_4 : \sqrt{(-3+2)^2 + (4+2)^2 + (1-2)^2} = 6{,}16$
$p_5 : \sqrt{(-3-1)^2 + (4-2)^2 + (1+4)^2} = 6{,}71$
$p_6 : \sqrt{(-3-0)^2 + (4+4)^2 + (1-3)^2} = 8{,}77$
$p_7 : \sqrt{(-3-1)^2 + (4-0)^2 + (1+3)^2} = 6{,}93$
$p_8 : \sqrt{(-3+3)^2 + (4-0)^2 + (1-0)^2} = 4{,}12$
$p_9 : \sqrt{(-3+2)^2 + (4-2)^2 + (1+4)^2} = 5{,}48$
$p_{10} : \sqrt{(-3+2)^2 + (4-4)^2 + (1-3)^2} = \mathbf{2{,}24}$
$p_{11} : \sqrt{(-3-3)^2 + (4+2)^2 + (1-4)^2} = \mathbf{9}$
$p_{12} : \sqrt{(-3-2)^2 + (4+5)^2 + (1+4)^2} = 11{,}45$

Vzdálenosti od w_2:

$\sqrt{(-3-0)^2 + (-1+1)^2 + (-3+2)^2} = \mathbf{3{,}16}$
$\sqrt{(-3+3)^2 + (-1+1)^2 + (-3+3)^2} = \mathbf{0}$
$\sqrt{(-3-1)^2 + (-1+3)^2 + (-3-2)^2} = \mathbf{6{,}71}$
$\sqrt{(-3+2)^2 + (-1+2)^2 + (-3-2)^2} = \mathbf{5{,}2}$
$\sqrt{(-3-1)^2 + (-1-2)^2 + (-3+4)^2} = 5{,}1$
$\sqrt{(-3-0)^2 + (-1+4)^2 + (-3-3)^2} = \mathbf{7{,}35}$
$\sqrt{(-3-1)^2 + (-1-0)^2 + (-3+3)^2} = 4{,}12$
$\sqrt{(-3+3)^2 + (-1-0)^2 + (-3-0)^2} = \mathbf{3{,}16}$
$\sqrt{(-3+2)^2 + (-1-2)^2 + (-3+4)^2} = \mathbf{3{,}32}$
$\sqrt{(-3+2)^2 + (-1-4)^2 + (-3-3)^2} = 7{,}87$
$\sqrt{(-3-3)^2 + (-1+2)^2 + (-3-4)^2} = 9{,}27$
$\sqrt{(-3-2)^2 + (-1+5)^2 + (-3+4)^2} = 6{,}48$

Vzdálenosti od w_3:

$p_1 : \sqrt{(0-0)^2 + (-1+1)^2 + (-6+2)^2} = 4$
$p_2 : \sqrt{(0+3)^2 + (-1+1)^2 + (-6+3)^2} = 4{,}24$
$p_3 : \sqrt{(0-1)^2 + (-1+3)^2 + (-6-2)^2} = 8{,}31$
$p_4 : \sqrt{(0+2)^2 + (-1+2)^2 + (-6-2)^2} = 8{,}31$
$p_5 : \sqrt{(0-1)^2 + (-1-2)^2 + (-6+4)^2} = \mathbf{3{,}74}$
$p_6 : \sqrt{(0-0)^2 + (-1+4)^2 + (-6-3)^2} = 9{,}49$
$p_7 : \sqrt{(0-1)^2 + (-1-0)^2 + (-6+3)^2} = \mathbf{3{,}32}$
$p_8 : \sqrt{(0+3)^2 + (-1-0)^2 + (-6-0)^2} = 6{,}78$
$p_9 : \sqrt{(0+2)^2 + (-1-2)^2 + (-6+4)^2} = 4{,}12$
$p_{10} : \sqrt{(0+2)^2 + (-1-4)^2 + (-6-3)^2} = 10{,}49$
$p_{11} : \sqrt{(0-3)^2 + (-1+2)^2 + (-6-4)^2} = 10{,}49$
$p_{12} : \sqrt{(0-2)^2 + (-1+5)^2 + (-6+4)^2} = \mathbf{4{,}9}$

Počáteční zařazení bodů do clusteru:

$(2, 2, 2, 2, 3, 2, 3, 2, 2, 1, 1, 3)$

Každá složka n-tice odpovídá indexu clusteru, ve kterém leží bod na indexu této složky. Ve výpočtech výše je nejnižší hodnota označena tučným výsledkem.

Krok 2

$w_1 = [0{,}5; 1; 3{,}5]$
$w_2 = [-1{,}29; -1{,}29; -0{,}29]$
$w_3 = [1{,}33; -1; -3{,}67]$

Vzdálenosti od w_1:

$p_1 : \sqrt{(0{,}5-0)^2+(1+1)^2+(3{,}5+2)^2} = 5{,}87$
$p_2 : \sqrt{(0{,}5+3)^2+(1+1)^2+(3{,}5+3)^2} = 7{,}65$
$p_3 : \sqrt{(0{,}5-1)^2+(1+3)^2+(3{,}5-2)^2} = 4{,}3$
$p_4 : \sqrt{(0{,}5+2)^2+(1+2)^2+(3{,}5-2)^2} = 4{,}18$
$p_5 : \sqrt{(0{,}5-1)^2+(1-2)^2+(3{,}5+4)^2} = 7{,}58$
$p_6 : \sqrt{(0{,}5-0)^2+(1+4)^2+(3{,}5-3)^2} = 5{,}05$
$p_7 : \sqrt{(0{,}5-1)^2+(1-0)^2+(3{,}5+3)^2} = 6{,}6$
$p_8 : \sqrt{(0{,}5+3)^2+(1-0)^2+(3{,}5-0)^2} = 5{,}05$
$p_9 : \sqrt{(0{,}5+2)^2+(1-2)^2+(3{,}5+4)^2} = 7{,}97$
$p_{10} : \sqrt{(0{,}5+2)^2+(1-4)^2+(3{,}5-3)^2} = \mathbf{3{,}94}$
$p_{11} : \sqrt{(0{,}5-3)^2+(1+2)^2+(3{,}5-4)^2} = \mathbf{3{,}94}$
$p_{12} : \sqrt{(0{,}5-2)^2+(1+5)^2+(3{,}5+4)^2} = 9{,}72$

Vzdálenosti od w_2:

$\sqrt{(-1{,}29-0)^2+(-1{,}29+1)^2+(-0{,}29+2)^2} = 2{,}16$
$\sqrt{(-1{,}29+3)^2+(-1{,}29+1)^2+(-0{,}29+3)^2} = \mathbf{3{,}22}$
$\sqrt{(-1{,}29-1)^2+(-1{,}29+3)^2+(-0{,}29-2)^2} = \mathbf{3{,}66}$
$\sqrt{(-1{,}29+2)^2+(-1{,}29+2)^2+(-0{,}29-2)^2} = \mathbf{2{,}5}$
$\sqrt{(-1{,}29-1)^2+(-1{,}29-2)^2+(-0{,}29+4)^2} = 5{,}46$
$\sqrt{(-1{,}29-0)^2+(-1{,}29+4)^2+(-0{,}29-3)^2} = \mathbf{4{,}45}$
$\sqrt{(-1{,}29-1)^2+(-1{,}29-0)^2+(-0{,}29+3)^2} = 3{,}77$
$\sqrt{(-1{,}29+3)^2+(-1{,}29-0)^2+(-0{,}29-0)^2} = \mathbf{2{,}16}$
$\sqrt{(-1{,}29+2)^2+(-1{,}29-2)^2+(-0{,}29+4)^2} = 5{,}01$
$\sqrt{(-1{,}29+2)^2+(-1{,}29-4)^2+(-0{,}29-3)^2} = 6{,}26$
$\sqrt{(-1{,}29-3)^2+(-1{,}29+2)^2+(-0{,}29-4)^2} = 6{,}1$
$\sqrt{(-1{,}29-2)^2+(-1{,}29+5)^2+(-0{,}29+4)^2} = 6{,}2$

Vzdálenosti od w_3:

$p_1 : \sqrt{(1{,}33-0)^2+(-1+1)^2+(-3{,}67+2)^2} = \mathbf{2{,}13}$
$p_2 : \sqrt{(1{,}33+3)^2+(-1+1)^2+(-3{,}67+3)^2} = 4{,}38$
$p_3 : \sqrt{(1{,}33-1)^2+(-1+3)^2+(-3{,}67-2)^2} = 6{,}02$
$p_4 : \sqrt{(1{,}33+2)^2+(-1+2)^2+(-3{,}67-2)^2} = 6{,}65$
$p_5 : \sqrt{(1{,}33-1)^2+(-1-2)^2+(-3{,}67+4)^2} = \mathbf{3{,}04}$
$p_6 : \sqrt{(1{,}33-0)^2+(-1+4)^2+(-3{,}67-3)^2} = 7{,}43$
$p_7 : \sqrt{(1{,}33-1)^2+(-1-0)^2+(-3{,}67+3)^2} = \mathbf{1{,}25}$
$p_8 : \sqrt{(1{,}33+3)^2+(-1-0)^2+(-3{,}67-0)^2} = 5{,}76$
$p_9 : \sqrt{(1{,}33+2)^2+(-1-2)^2+(-3{,}67+4)^2} = \mathbf{4{,}5}$
$p_{10} : \sqrt{(1{,}33+2)^2+(-1-4)^2+(-3{,}67-3)^2} = 8{,}98$
$p_{11} : \sqrt{(1{,}33-3)^2+(-1+2)^2+(-3{,}67-4)^2} = 7{,}91$
$p_{12} : \sqrt{(1{,}33-2)^2+(-1+5)^2+(-3{,}67+4)^2} = \mathbf{4{,}07}$

Předchozí zařazení bodů do clusteru:

$(2, 2, 2, 2, 3, 2, 3, 2, 2, 1, 1, 3)$

Nové zařazení bodu do clusteru:

$(\mathbf{3}, 2, 2, 2, 3, 2, 3, 2, \mathbf{3}, 1, 1, 3)$

Krok 3

$w_1 = [0{,}5; 1; 3{,}5]$
$w_2 = [-1{,}4; -2; 0{,}8]$
$w_3 = [0{,}4; -0{,}4; -3{,}4]$

Vzdálenosti od w_1:

$p_1 : \sqrt{(0{,}5-0)^2+(1+1)^2+(3{,}5+2)^2} = 5{,}87$
$p_2 : \sqrt{(0{,}5+3)^2+(1+1)^2+(3{,}5+3)^2} = 7{,}65$
$p_3 : \sqrt{(0{,}5-1)^2+(1+3)^2+(3{,}5-2)^2} = 4{,}3$
$p_4 : \sqrt{(0{,}5+2)^2+(1+2)^2+(3{,}5-2)^2} = 4{,}18$
$p_5 : \sqrt{(0{,}5-1)^2+(1-2)^2+(3{,}5+4)^2} = 7{,}58$
$p_6 : \sqrt{(0{,}5-0)^2+(1+4)^2+(3{,}5-3)^2} = 5{,}05$
$p_7 : \sqrt{(0{,}5-1)^2+(1-0)^2+(3{,}5+3)^2} = 6{,}6$
$p_8 : \sqrt{(0{,}5+3)^2+(1-0)^2+(3{,}5-0)^2} = 5{,}05$
$p_9 : \sqrt{(0{,}5+2)^2+(1-2)^2+(3{,}5+4)^2} = 7{,}97$
$p_{10} : \sqrt{(0{,}5+2)^2+(1-4)^2+(3{,}5-3)^2} = \mathbf{3{,}94}$
$p_{11} : \sqrt{(0{,}5-3)^2+(1+2)^2+(3{,}5-4)^2} = \mathbf{3{,}94}$
$p_{12} : \sqrt{(0{,}5-2)^2+(1+5)^2+(3{,}5+4)^2} = 9{,}72$

Vzdálenosti od w_2:

$\sqrt{(-1{,}4-0)^2+(-2+1)^2+(0{,}8+2)^2} = 3{,}29$
$\sqrt{(-1{,}4+3)^2+(-2+1)^2+(0{,}8+3)^2} = 4{,}24$
$\sqrt{(-1{,}4-1)^2+(-2+3)^2+(0{,}8-2)^2} = \mathbf{2{,}86}$
$\sqrt{(-1{,}4+2)^2+(-2+2)^2+(0{,}8-2)^2} = \mathbf{1{,}34}$
$\sqrt{(-1{,}4-1)^2+(-2-2)^2+(0{,}8+4)^2} = 6{,}69$
$\sqrt{(-1{,}4-0)^2+(-2+4)^2+(0{,}8-3)^2} = \mathbf{3{,}29}$
$\sqrt{(-1{,}4-1)^2+(-2-0)^2+(0{,}8+3)^2} = 4{,}92$
$\sqrt{(-1{,}4+3)^2+(-2-0)^2+(0{,}8-0)^2} = \mathbf{2{,}68}$
$\sqrt{(-1{,}4+2)^2+(-2-2)^2+(0{,}8+4)^2} = 6{,}28$
$\sqrt{(-1{,}4+2)^2+(-2-4)^2+(0{,}8-3)^2} = 6{,}42$
$\sqrt{(-1{,}4-3)^2+(-2+2)^2+(0{,}8-4)^2} = 5{,}44$
$\sqrt{(-1{,}4-2)^2+(-2+5)^2+(0{,}8+4)^2} = 6{,}6$

Vzdálenosti od w_3:

$p_1 : \sqrt{(0{,}4-0)^2+(-0{,}4+1)^2+(-3{,}4+2)^2} = \mathbf{1{,}57}$
$p_2 : \sqrt{(0{,}4+3)^2+(-0{,}4+1)^2+(-3{,}4+3)^2} = \mathbf{3{,}48}$
$p_3 : \sqrt{(0{,}4-1)^2+(-0{,}4+3)^2+(-3{,}4-2)^2} = 6{,}02$
$p_4 : \sqrt{(0{,}4+2)^2+(-0{,}4+2)^2+(-3{,}4-2)^2} = 6{,}12$
$p_5 : \sqrt{(0{,}4-1)^2+(-0{,}4-2)^2+(-3{,}4+4)^2} = \mathbf{2{,}55}$
$p_6 : \sqrt{(0{,}4-0)^2+(-0{,}4+4)^2+(-3{,}4-3)^2} = 7{,}35$
$p_7 : \sqrt{(0{,}4-1)^2+(-0{,}4-0)^2+(-3{,}4+3)^2} = \mathbf{0{,}82}$
$p_8 : \sqrt{(0{,}4+3)^2+(-0{,}4-0)^2+(-3{,}4-0)^2} = 4{,}82$
$p_9 : \sqrt{(0{,}4+2)^2+(-0{,}4-2)^2+(-3{,}4+4)^2} = \mathbf{3{,}45}$
$p_{10} : \sqrt{(0{,}4+2)^2+(-0{,}4-4)^2+(-3{,}4-3)^2} = 8{,}13$
$p_{11} : \sqrt{(0{,}4-3)^2+(-0{,}4+2)^2+(-3{,}4-4)^2} = 8$
$p_{12} : \sqrt{(0{,}4-2)^2+(-0{,}4+5)^2+(-3{,}4+4)^2} = \mathbf{4{,}91}$

Předchozí zařazení bodu do clusteru:

$(3, 2, 2, 2, 3, 2, 3, 2, 3, 1, 1, 3)$

Nové zařazení bodu do clusteru:

$(3, \mathbf{3}, 2, 2, 3, 2, 3, 2, 3, 1, 1, 3)$

Krok 4

$w_1 = [0{,}5; 1; 3{,}5]$
$w_2 = [-1; -2{,}25; 1{,}75]$
$w_3 = [-0{,}17; -0{,}5; -3{,}33]$

Vzdálenosti od w_1:

$p_1 : \sqrt{(0{,}5-0)^2+(1+1)^2+(3{,}5+2)^2} = 5{,}87$
$p_2 : \sqrt{(0{,}5+3)^2+(1+1)^2+(3{,}5+3)^2} = 7{,}65$
$p_3 : \sqrt{(0{,}5-1)^2+(1+3)^2+(3{,}5-2)^2} = 4{,}3$
$p_4 : \sqrt{(0{,}5+2)^2+(1+2)^2+(3{,}5-2)^2} = 4{,}18$
$p_5 : \sqrt{(0{,}5-1)^2+(1-2)^2+(3{,}5+4)^2} = 7{,}58$
$p_6 : \sqrt{(0{,}5-0)^2+(1+4)^2+(3{,}5-3)^2} = 5{,}05$
$p_7 : \sqrt{(0{,}5-1)^2+(1-0)^2+(3{,}5+3)^2} = 6{,}6$
$p_8 : \sqrt{(0{,}5+3)^2+(1-0)^2+(3{,}5-0)^2} = 5{,}05$
$p_9 : \sqrt{(0{,}5+2)^2+(1-2)^2+(3{,}5+4)^2} = 7{,}97$
$p_{10} : \sqrt{(0{,}5+2)^2+(1-4)^2+(3{,}5-3)^2} = \mathbf{3{,}94}$
$p_{11} : \sqrt{(0{,}5-3)^2+(1+2)^2+(3{,}5-4)^2} = \mathbf{3{,}94}$
$p_{12} : \sqrt{(0{,}5-2)^2+(1+5)^2+(3{,}5+4)^2} = 9{,}72$

Vzdálenosti od w_2:

$\sqrt{(-1-0)^2+(-2{,}25+1)^2+(1{,}75+2)^2} = 4{,}08$
$\sqrt{(-1+3)^2+(-2{,}25+1)^2+(1{,}75+3)^2} = 5{,}3$
$\sqrt{(-1-1)^2+(-2{,}25+3)^2+(1{,}75-2)^2} = \mathbf{2{,}15}$
$\sqrt{(-1+2)^2+(-2{,}25+2)^2+(1{,}75-2)^2} = \mathbf{1{,}06}$
$\sqrt{(-1-1)^2+(-2{,}25-2)^2+(1{,}75+4)^2} = 7{,}42$
$\sqrt{(-1-0)^2+(-2{,}25+4)^2+(1{,}75-3)^2} = \mathbf{2{,}37}$
$\sqrt{(-1-1)^2+(-2{,}25-0)^2+(1{,}75+3)^2} = 5{,}62$
$\sqrt{(-1+3)^2+(-2{,}25-0)^2+(1{,}75-0)^2} = \mathbf{3{,}48}$
$\sqrt{(-1+2)^2+(-2{,}25-2)^2+(1{,}75+4)^2} = 7{,}22$
$\sqrt{(-1+2)^2+(-2{,}25-4)^2+(1{,}75-3)^2} = 6{,}45$
$\sqrt{(-1-3)^2+(-2{,}25+2)^2+(1{,}75-4)^2} = 4{,}6$
$\sqrt{(-1-2)^2+(-2{,}25+5)^2+(1{,}75+4)^2} = 7{,}04$

Vzdálenosti od w_3:

$p_1 : \sqrt{(-0{,}17-0)^2+(-0{,}5+1)^2+(-3{,}33+2)^2} = \mathbf{1{,}43}$
$p_2 : \sqrt{(-0{,}17+3)^2+(-0{,}5+1)^2+(-3{,}33+3)^2} = \mathbf{2{,}9}$
$p_3 : \sqrt{(-0{,}17-1)^2+(-0{,}5+3)^2+(-3{,}33-2)^2} = 6$
$p_4 : \sqrt{(-0{,}17+2)^2+(-0{,}5+2)^2+(-3{,}33-2)^2} = 5{,}84$
$p_5 : \sqrt{(-0{,}17-1)^2+(-0{,}5-2)^2+(-3{,}33+4)^2} = \mathbf{2{,}84}$
$p_6 : \sqrt{(-0{,}17-0)^2+(-0{,}5+4)^2+(-3{,}33-3)^2} = 7{,}24$
$p_7 : \sqrt{(-0{,}17-1)^2+(-0{,}5-0)^2+(-3{,}33+3)^2} = \mathbf{1{,}31}$
$p_8 : \sqrt{(-0{,}17+3)^2+(-0{,}5-0)^2+(-3{,}33-0)^2} = 4{,}4$
$p_9 : \sqrt{(-0{,}17+2)^2+(-0{,}5-2)^2+(-3{,}33+4)^2} = \mathbf{3{,}17}$
$p_{10} : \sqrt{(-0{,}17+2)^2+(-0{,}5-4)^2+(-3{,}33-3)^2} = 7{,}98$
$p_{11} : \sqrt{(-0{,}17-3)^2+(-0{,}5+2)^2+(-3{,}33-4)^2} = 8{,}13$
$p_{12} : \sqrt{(-0{,}17-2)^2+(-0{,}5+5)^2+(-3{,}33+4)^2} = \mathbf{5{,}04}$

Předchozí zařazení bodu do clusteru:

$(3, 3, 2, 2, 3, 2, 3, 2, 3, 1, 1, 3)$

Nové zařazení bodu do clusteru:

$(3, 3, 2, 2, 3, 2, 3, 2, 3, 1, 1, 3)$

Zařazení do clusterů se nezměnilo, algoritmus tedy skončil a byly nalezeny shluky.

Výsledky

Algoritmus skončil s následujícími středy shluků:

$w_1 = [0{,}5; 1; 3{,}5]$
$w_2 = [-1; -2{,}25; 1{,}75]$
$w_3 = [-0{,}17; -0{,}5; -3{,}33]$

Shlukům odpovídají následující množiny bodů:

$w_1 : \{p_{10}, p_{11}\}$
$w_2 : \{p_3, p_4, p_6, p_8\}$
$w_3 : \{p_1, p_2, p_5, p_7, p_9, p_{12}\}$