**Objasnjenje:**

Ovo su susjedi celije koje koristimo:

 set es-color [pcolor] of patch-at 1 -1 ;east-south susjed

 set e-color [pcolor] of patch-at 1 0 ;east

 set en-color [pcolor] of patch-at 1 1

 set s-color [pcolor] of patch-at 0 -1

 set n-color [pcolor] of patch-at 0 1

 set ws-color [pcolor] of patch-at -1 -1

 set w-color [pcolor] of patch-at -1 0

 set wn-color [pcolor] of patch-at -1 1

 set enn-color [pcolor] of patch-at 1 2

 set ww-color [pcolor] of patch-at -2 0

 set ess-color [pcolor] of patch-at 1 -2

 set ss-color [pcolor] of patch-at 0 -2

 set een-color [pcolor] of patch-at 2 1

 set wwn-color [pcolor] of patch-at -2 1 ;west-west-north

 set nn-color [pcolor] of patch-at 0 2

 set wws-color [pcolor] of patch-at -2 -1

 set ees-color [pcolor] of patch-at 2 -1

 set wnn-color [pcolor] of patch-at -1 2

 set ee-color [pcolor] of patch-at 2 0

 set wss-color [pcolor] of patch-at -1 -2

Globalne promjenljive ;

 broj-ticksCA ;broji time steps

 stopUnutrasnjeRupe? ;zaustavlja labeling

 stopCluster? ;zaustavlja labeling cluster-a

**Dalje, max-pxcor, min-pxcor, max-pycor, min-pycor su kod mene ugradjene vrijednosti (najvece i najmanje x i y koordinate). Takodje, kod mene koordinate idu od -L/2 do L/2, gdje je N=LxL velicina grida.**

**CA A1 (postavlja boje na osnovu pozucije celije u nekim bijelim celijama)**

to oznakaDoljeDesnoPozicija ;sa to i end pocinje i zavrsava procedura

ask patches with [pcolor = white] [ ;patche je celija (nas cell)

 let corX pxcor

 let corY pycor

 let postavljenaBoja (corX + max-pxcor) \* (max-pxcor + 1) + (corY + max-pycor) + 46 ;dodajem 46 jer kod mene je 45 zuta koju koristim za backbone

ifelse(pxcor != min-pxcor and pycor != min-pycor and pxcor != max-pxcor and pycor != min-pycor)

 [ if(s-color = black and e-color = black and es-color = black) [ set pcolor postavljenaBoja ]

 ]

 [if(pxcor = min-pxcor and pycor = min-pycor) [set pcolor postavljenaBoja ]

 if(pxcor = max-pxcor and pycor = min-pycor) [set pcolor postavljenaBoja ]

 ]

 ]

tick ;time step

set broj-ticksCA broj-ticksCA + 1 ;broji time steps

end

----------------------------------------------------------------------------------------------------------------

**CA A2 (boji bijele nnn komponente)**

to unutrasnjeRupeDoKraja

%To j erekurzija - rešil sem jo z več koraki v for zanki

while[stopUnutrasnjeRupe?]

[

 unutrasnjeRupe

 tick

 set broj-ticksCA broj-ticksCA + 1]

 end

to unutrasnjeRupe ;boji bijele nnn komponente razlicitim bojama tako sto za svaku ne crnu celiju bira najvecu ne bijelu i ne crnu boju iz nnn susjedstva

 set stopUnutrasnjeRupe? false

 ask patches with [pcolor != black ]

[

 ;ako nismo na krajevima grida

 if(pxcor != min-pxcor and pycor != min-pycor and pxcor != max-pxcor and pycor != max-pycor)

 [

 let postavljeno? false

 let nestoDrugo? false ;nestoDrugo? pamti da li u okolini (ne crne celije) imamo celiju koja nije ni crna ni bijela

 set nestoDrugo? (w-color != black and w-color != white) or (n-color != black and n-color != white) or (e-color != black and e-color != white) or (s-color != black and s-color != white) or (ws-color != black and ws-color != white) or (wn-color != black and wn-color != white) or (en-color != black and en-color != white) or (es-color != black and es-color != white)

 let k -1 ;lokalna promjenljiva pamti da li je izabrana neka ne crna i ne bijela celija

 if(nestoDrugo?)

 [

 if(w-color != black and w-color != white ) [set k w-color set postavljeno? true]

 if(n-color != black and n-color != white and NOT postavljeno?) [set k n-color set postavljeno? true]

 if(e-color != black and e-color != white and NOT postavljeno?) [set k e-color set postavljeno? true]

 if(s-color != black and s-color != white and NOT postavljeno?) [set k s-color set postavljeno? true]

 if(wn-color != black and wn-color != white and NOT postavljeno?) [set k wn-color set postavljeno? true]

 if(ws-color != black and ws-color != white and NOT postavljeno?) [set k ws-color set postavljeno? true]

 if(en-color != black and en-color != white and NOT postavljeno?) [set k en-color set postavljeno? TRUE]

 if(es-color != black and es-color != white and NOT postavljeno?) [set k es-color set postavljeno? true]

 if( postavljeno?)

 [

 if( w-color > k) [set k w-color]

 if(s-color > k) [set k s-color]

 if( n-color > k) [set k n-color]

 if( e-color > k) [set k e-color]

 if( ws-color > k) [set k ws-color]

 if(wn-color > k) [set k wn-color]

 if(es-color > k) [set k es-color]

 if(en-color > k) [set k en-color]

 if(pcolor != k)[set pcolor k set stopUnutrasnjeRupe? true ]

 ]

 ]

 ]

 ;ako smo na lijevoj strani grida grida treba paziti na nepostojece susjede

 if(pxcor = min-pxcor )

[

 let postavljeno? false

 ifelse(pycor != min-pycor)[ set es-color [pcolor] of patch-at 1 -1][set es-color white]

 set e-color [pcolor] of patch-at 1 0

 ifelse(pycor != max-pycor)[set en-color [pcolor] of patch-at 1 1][set en-color white]

 ifelse(pycor != min-pycor)[set s-color [pcolor] of patch-at 0 -1][set s-color white]

 ifelse(pycor != max-pycor)[set n-color [pcolor] of patch-at 0 1][set n-color white]

 let nestoDrugo2? false

 set nestoDrugo2? (n-color != black and n-color != white) or

 (e-color != black and e-color != white) or (s-color != black and s-color != white) or

 (en-color != black and en-color != white) or (es-color != black and es-color != white)

 let k2 -1

 if(nestoDrugo2?)

 [

 if(n-color != black and n-color != white and NOT postavljeno?) [set k2 n-color set postavljeno? true]

 if(e-color != black and e-color != white and NOT postavljeno?) [set k2 e-color set postavljeno? true]

 if(s-color != black and s-color != white and NOT postavljeno?) [set k2 s-color set postavljeno? true]

 if(en-color != black and en-color != white and NOT postavljeno?) [set k2 en-color set postavljeno? TRUE]

 if(es-color != black and es-color != white and NOT postavljeno?) [set k2 es-color set postavljeno? true]

 if( postavljeno?)

 [

 if(s-color > k2) [set k2 s-color]

 if( n-color > k2) [set k2 n-color]

 if( e-color > k2) [set k2 e-color]

 if(es-color > k2) [set k2 es-color]

 if(en-color > k2) [set k2 en-color]

 if(pcolor != k2)[set pcolor k2 set stopUnutrasnjeRupe? true]

 ]

 ]

 ]

 ;ako smo na desnoj strani grida grida treba paziti na nepostojece susjede

 if(pxcor = max-pxcor )

[

 let postavljeno? false

 ifelse(pycor != min-pycor)[set s-color [pcolor] of patch-at 0 -1][set s-color white]

 ifelse(pycor != max-pycor) [set n-color [pcolor] of patch-at 0 1][set n-color white]

 ifelse(pycor != min-pycor)[set ws-color [pcolor] of patch-at -1 -1][set ws-color white]

 set w-color [pcolor] of patch-at -1 0

 ifelse(pycor != max-pycor) [set wn-color [pcolor] of patch-at -1 1][set wn-color white]

 let nestoDrugo3? false

 set nestoDrugo3? (w-color != black and w-color != white) or (n-color != black and n-color != white) or

 (s-color != black and s-color != white) or (ws-color != black and ws-color != white) or

 (wn-color != black and wn-color != white)

 let k3 -1

 if(nestoDrugo3?)

 [

 if(w-color != black and w-color != white ) [set k3 w-color set postavljeno? true]

 if(n-color != black and n-color != white and NOT postavljeno?) [set k3 n-color set postavljeno? true]

 if(s-color != black and s-color != white and NOT postavljeno?) [set k3 s-color set postavljeno? true]

 if(wn-color != black and wn-color != white and NOT postavljeno?) [set k3 wn-color set postavljeno? true]

 if(ws-color != black and ws-color != white and NOT postavljeno?) [set k3 ws-color set postavljeno? true]

 if( postavljeno?)

 [

 if( w-color > k3) [set k3 w-color]

 if(s-color > k3) [set k3 s-color]

 if( n-color > k3) [set k3 n-color]

 ;if( e-color > k) [set k e-color]

 if( ws-color > k3) [set k3 ws-color]

 if(wn-color > k3) [set k3 wn-color]

 ;if(es-color > k) [set k es-color]

 ;if(en-color > k) [set k en-color]

 if(pcolor != k3)[set pcolor k3 set stopUnutrasnjeRupe? true]

 ]

 ]

]

]

end

---------------------------------------------------------------------------------------------

**CA A3 (boji artikulacione cvorove. Oni koji mogu biti dio backbone-a boji u bijelo, a u drugom koraku taguje odgovarajuce susjede koristeci jednu od 12 boja)**

to kicma4

 ask patches with [pcolor = black and pxcor != min-pxcor and pycor != min-pycor and pxcor != max-pxcor and pycor != max-pycor]

[

 ;12 boja koje koristimo za tagovanje

 let tagBoja 3

 let tagBoja1 4

 let tagBoja2 5

 let tagBoja3 6

 let tagBoja4 7

 let tagBoja5 8

 let tagBoja6 9

 let tagBoja7 16

 let tagBoja8 17

 let tagBoja9 18

 let tagBoja10 19

 let tagBoja11 20

;U prvom pozivu mijenjamo stanja celijama za koje smo sigurni da su artikulacioni cvorovi, a za one koji jesu artikulacioni cvorovi ali mozda pripadaju backbone-u oznacimo u bijelo

 ifelse(e-color != white and n-color != white and s-color != white and w-color != white)

[

 if(e-color = w-color and e-color != pcolor and e-color != white) [set pcolor e-color]

 if(s-color = n-color and s-color != pcolor and s-color != white ) [set pcolor s-color]

 ;dva crna susjeda

 if(n-color = black and e-color = black and w-color = en-color and w-color = s-color and w-color != black) [set pcolor w-color]

 if (n-color = black and w-color = black and e-color = wn-color and e-color = s-color and e-color != black) [set pcolor e-color]

 if(s-color = black and w-color = black and e-color = ws-color and e-color = n-color and e-color != black) [set pcolor e-color]

 if(s-color = black and e-color = black and w-color = es-color and w-color = n-color and w-color != black) [set pcolor w-color]

 ;tri crna susjeda

 if(n-color = black and e-color = black and s-color = black and w-color = en-color and w-color = es-color and w-color != black) [set pcolor w-color ]

 if(n-color = black and e-color = black and s-color = black and w-color = en-color and w-color != black and es-color != w-color ) [set pcolor white]

 if(n-color = black and e-color = black and s-color = black and w-color = es-color and w-color != black and en-color != w-color ) [set pcolor white]

 if(w-color = black and e-color = black and n-color = black and s-color = wn-color and s-color = en-color and s-color != black) [set pcolor s-color ]

 if(w-color = black and e-color = black and n-color = black and s-color = en-color and s-color != black and wn-color != s-color ) [set pcolor white ]

 if(w-color = black and e-color = black and n-color = black and s-color = wn-color and s-color != black and en-color != s-color ) [set pcolor white ]

 if(n-color = black and s-color = black and w-color = black and e-color = wn-color and e-color = ws-color and e-color != black ) [set pcolor e-color ]

 if(n-color = black and s-color = black and w-color = black and e-color = wn-color and e-color != black and ws-color != e-color ) [set pcolor white]

 if(n-color = black and s-color = black and w-color = black and e-color = ws-color and e-color != black and wn-color != e-color ) [set pcolor white ]

 if(e-color = black and w-color = black and s-color = black and n-color = ws-color and n-color = es-color and n-color != black) [set pcolor n-color ]

 if(e-color = black and w-color = black and s-color = black and n-color = es-color and n-color != black and ws-color != n-color ) [set pcolor white ]

 if(e-color = black and w-color = black and s-color = black and n-color = ws-color and n-color != black and es-color != n-color ) [set pcolor white ]

 ;;4 crna susjeda

 if(n-color = black and e-color = black and s-color = black and w-color = black and wn-color = es-color and ws-color != wn-color and en-color != wn-color ) [set pcolor white ]

 if(n-color = black and e-color = black and s-color = black and w-color = black and en-color = ws-color and wn-color != en-color and es-color != en-color ) [set pcolor white]

 ]

%Tu damo res dva koraka ne pa tako kot je tu z rekurzijo

 ;U drugom koraku tagujemo susjede bijelih celija (ovo je drugi korak jer tek nakon prvog imamo bijelih celija na gridu

 [

if(n-color = white and e-color != wn-color and (en-color = black or en-color = tagBoja) and wn-color != black and enn-color = wn-color and e-color != black)[set pcolor tagBoja ]

 if(w-color = white and n-color != s-color and (ws-color = black or ws-color = tagBoja) and n-color != black and ww-color = n-color and s-color != black)[set pcolor tagBoja ]

 if(s-color = white and ws-color != e-color and (es-color = black or es-color = tagBoja) and ws-color != black and ess-color = ws-color and e-color != black)[set pcolor tagBoja5 ]

 if(w-color = white and n-color != s-color and (wn-color = black or wn-color = tagBoja) and s-color != black and ww-color = s-color and n-color != black) [set pcolor tagBoja5 ]

 if(s-color = white and w-color != e-color and (ws-color = black or ws-color = tagBoja) and e-color != black and e-color = ss-color and w-color != black)[set pcolor tagBoja6 ]

 if(e-color = white and n-color != es-color and (en-color = black or en-color = tagBoja) and es-color != black and een-color = es-color and n-color != black)[set pcolor tagBoja6 ]

 if(w-color = white and n-color != ws-color and (wn-color = black or wn-color = tagBoja) and ws-color != black and wwn-color = ws-color and n-color != black)[set pcolor tagBoja7 ]

 if(s-color = white and w-color != e-color and (es-color = black or es-color = tagBoja) and w-color != black and w-color = ss-color and e-color != black)[set pcolor tagBoja7 ]

 if(n-color = white and w-color != en-color and (wn-color = black or wn-color = tagBoja) and en-color != black and en-color = wnn-color and w-color != black)[set pcolor tagBoja8 ]

 if(e-color = white and n-color != s-color and (es-color = black or es-color = tagBoja) and n-color != black and n-color = ee-color and s-color != black)[set pcolor tagBoja8 ]

 if(s-color = white and w-color != es-color and (ws-color = black or ws-color = tagBoja) and es-color != black and es-color = wss-color and w-color != black)[set pcolor tagBoja9 ]

 if(e-color = white and n-color != s-color and (en-color = black or en-color = tagBoja) and s-color != black and s-color = ee-color and n-color != black)[set pcolor tagBoja9 ]

 if(n-color = white and w-color != e-color and (en-color = black or en-color = tagBoja) and w-color != black and w-color = nn-color and e-color != black)[set pcolor tagBoja10 ]

 if(w-color = white and wn-color != s-color and (ws-color = black or ws-color = tagBoja) and wn-color != black and wn-color = wws-color and s-color != black)[set pcolor tagBoja10 ]

 if (e-color = white and s-color != en-color and (es-color = black or es-color = tagBoja) and en-color != black and en-color = ees-color and s-color != black)[set pcolor tagBoja ]

 if(n-color = white and w-color != e-color and (wn-color = black or wn-color = tagBoja) and e-color != black and e-color = nn-color and w-color != black)[set pcolor tagBoja ]

 ;;za 4 susjeda

 if((n-color = white and w-color != e-color and en-color = black and wn-color = black and nn-color = black and e-color != black and e-color = wnn-color )or

 (e-color = white and n-color != s-color and en-color = black and es-color = black and ee-color = black and n-color != black and n-color = eess-color))[set pcolor tagBoja1 ]

 if((w-color = white and s-color != n-color and wn-color = black and ws-color = black and ww-color = black and s-color != black and s-color = wwn-color)or

 (s-color = white and e-color != w-color and es-color = black and ws-color = black and ss-color = black and w-color != black and w-color = ess-color))[set pcolor tagBoja2 ]

 if((n-color = white and w-color != e-color and en-color = black and wn-color = black and nn-color = black and w-color != black and w-color = enn-color )or

 (e-color = white and n-color != s-color and en-color = black and es-color = black and ee-color = black and s-color != black and s-color = een-color))[set pcolor tagBoja3 ]

 if ((w-color = white and s-color != n-color and wn-color = black and ws-color = black and ww-color = black and n-color != black and n-color = wws-color)or

 (s-color = white and e-color != w-color and es-color = black and ws-color = black and ss-color = black and e-color != black and e-color = wss-color))[set pcolor tagBoja4 ]

 ]

]

tick

set broj-ticksCA broj-ticksCA + 1

end

---------------------------------------------------------------------------------

CA A4 (boji dio backbone-a u zuto (ne boji jedino bijele celije))

to clusterDoKraja

 while[stopCluster?][

 cluster

 tick

 set broj-ticksCA broj-ticksCA + 1]

end

to cluster

 set stopCluster? false

ask patches with [pcolor = black or pcolor < 21]

[

 ifelse( pycor = max-pycor ) [set pcolor yellow set stopCluster? true]

 [

ifelse( pycor = min-pycor ) [set pcolor yellow set stopCluster? true]

 [

 ifelse(pcolor = black)

[

 if((w-color = yellow or s-color = yellow or n-color = yellow or e-color = yellow ) and (pxcor != min-pxcor and pxcor != max-pxcor))

 [set pcolor yellow set stopCluster? true]

 ]

 [if(pcolor != white)[

 if(n-color = white and s-color = white and ((wn-color = yellow and ws-color = yellow ) or (en-color = yellow and es-color = yellow ) or (wn-color = yellow and es-color = yellow ) or (en-color = yellow and es-color = yellow ))) [set pcolor yellow set stopCluster? true ]

 if(e-color = white and w-color = white and ((wn-color = yellow and ws-color = yellow ) or (en-color = yellow and es-color = yellow ) or (wn-color = yellow and es-color = yellow ) or (en-color = yellow and es-color = yellow )))

 [set pcolor yellow set stopCluster? true ]

 if((w-color = yellow or s-color = yellow or n-color = yellow or e-color = yellow) and (pxcor != min-pxcor and pxcor != max-pxcor))

 [set pcolor yellow set stopCluster? true ]

 if(n-color = white and ((wn-color = yellow and en-color != pcolor) or (wn-color != pcolor and en-color = yellow))) [set pcolor yellow set stopCluster? true ]

 if(w-color = white and ((wn-color = yellow and ws-color != pcolor) or (ws-color != pcolor and wn-color = yellow))) [set pcolor yellow set stopCluster? true ]

 if(s-color = white and ((ws-color = yellow and es-color != pcolor) or (ws-color != pcolor and es-color = yellow)));s-color = yellow or n-color = yellow or e-color = yellow) and (pxcor != min-pxcor and pxcor != max-pxcor))

 [set pcolor yellow set stopCluster? true ]

 if(e-color = white and ((en-color = yellow and es-color != pcolor) or (en-color != pcolor and es-color = yellow))) [set pcolor yellow set stopCluster? true ]

 ]

]

 ] ]]

end

------------------------------------------------------------------------------------------------

**CA A5 (artkulacioni koji jesu dio backbone-a ozncavamo u zuto)**

to bijeliUZuto2

 ask patches with [pcolor = white and pxcor != min-pxcor and pycor != min-pycor and pxcor != max-pxcor and pycor != max-pycor]

[

;ako bijela celija ima dva zuta susjeda mjenja stanje u zuto (zuto je boja backbone-a)

 ifelse((e-color = yellow and w-color = yellow) or (e-color = yellow and n-color = yellow) or (e-color = yellow and s-color = yellow) or

 (w-color = yellow and n-color = yellow) or (w-color = yellow and s-color = yellow) or (n-color = yellow and s-color = yellow))

 [set pcolor yellow]

 [ ;ako bijela celija ima jednog zutog susjeda ali ima i jednog bijelog susjeda koji ima zutog susjeda mjenja stanje u zuto (zuto je boja backbone-a)

 if(

 (e-color = yellow and ((w-color = white and ww-color = yellow) or (n-color = white and nn-color = yellow) or (s-color = white and ss-color = yellow))) or

 (w-color = yellow and ((e-color = white and ee-color = yellow) or (n-color = white and nn-color = yellow) or (s-color = white or ss-color = yellow))) or

 (s-color = yellow and ((e-color = white and ee-color = yellow) or (n-color = white and nn-color = yellow) or (w-color = white or ww-color = yellow))) or

 (n-color = yellow and ((e-color = white and ee-color = yellow) or (s-color = white and ss-color = yellow) or (s-color = white or ss-color = yellow))))

 [set pcolor yellow]

 ]

 ]

tick

set broj-ticksCA broj-ticksCA + 1

end