Complex System Modeling

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by

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Complex System Modeling

- ICPSR Summer Program in Quantitative Methods of Social Research
  - Complex System Modeling (Scott E. Page, Ken Kollman)
- NetLogo is a cross-platform multi-agent programmable modeling environment
- NetLogo was authored by Uri Wilensky in 1999 and is under continuous development at Northwestern University

- NetLogo
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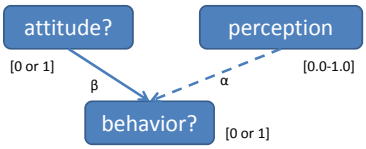
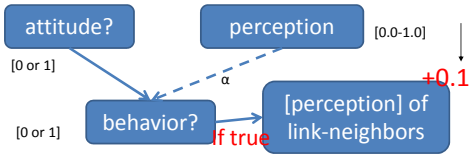
Fundamental model



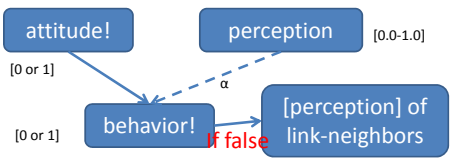

```
ask one-of turtles with [ attitude? = true ]
 [ifelse β + α * perception >= random-float 1[
 [set behavior? True]

α : contribution ratio of perception
β  contribution ratio of attitude?
α+β<=1.0
```

behavior!?→ link-neighbors




```
ask one-of turtles with [ attitude? = true ]
 [ifelse beta + alpha * perception >= random-float 1[
 [set behavior? True
  ask link-neighbors
    [ifelse perception < 0.9
      [set perception perception + 0.1]
      [set perception 1.0]
    ]
 ]
```

behavior? → link-neighbors

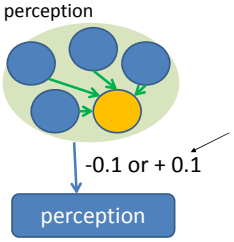



```
[
    set behavior? False
    ask link-neighbors
    [
     ifelse perception > 0.1
      [set perception perception - 0.1]
      [set perception 0]
    ]
  ]
```

Network effect to perception

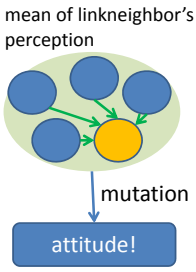
```
ask one-of turtles with [ attitude? = false ]
[
 set link-perception-list [perception] of link-neighbors
 if mean link-perception-list > 0.8
 [
  set attitude? True
 ifelse perception > 0.9
  [set perception 1.0]
  [set perception perception + 0.1]
 ]
]
ask one-of turtles with [ attitude? = true ]
[
 set link-perception-list [perception] of link-neighbors
 if mean link-perception-list < 0.2
 [
  set attitude? false
  false-beta-false-atti
  ifelse perception < 0.1
  [set perception 0]
  [set perception perception - 0.1]
 ]
]
```

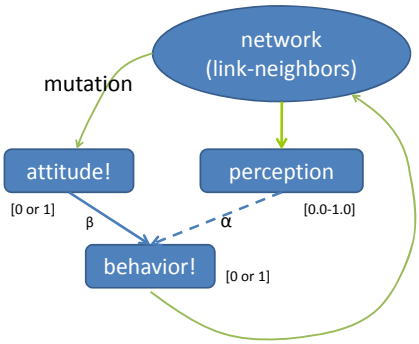
mean of linkneighbor's perception



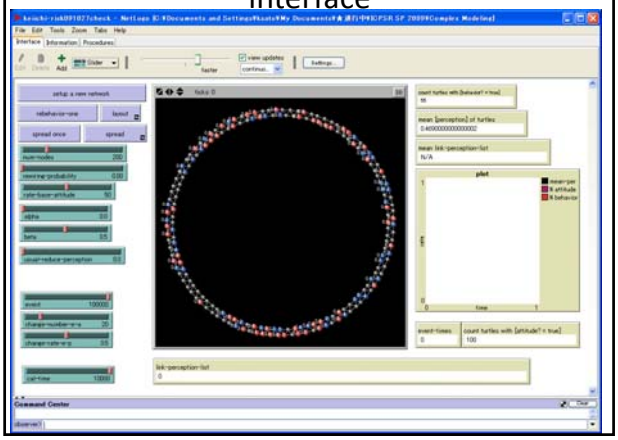
mutation of attitude?

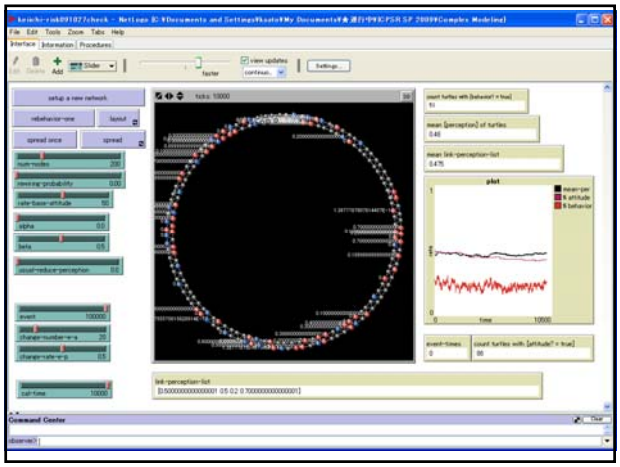
```
ask one-of turtles with [ attitude? = false ]
 [
  set link-perception-list [perception] of link-neighbors
   if mean link-perception-list > 0.8
   [
    set attitude? true
   ]
 ]

 ask one-of turtles with [ attitude? = true ]
 [
  set link-perception-list [perception] of link-neighbors
   if mean link-perception-list < 0.2
   [
    set attitude? false
    false-beta-false-atti
   ]
 ]
```



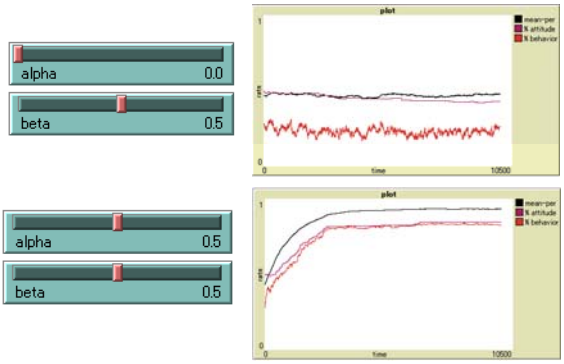


interface





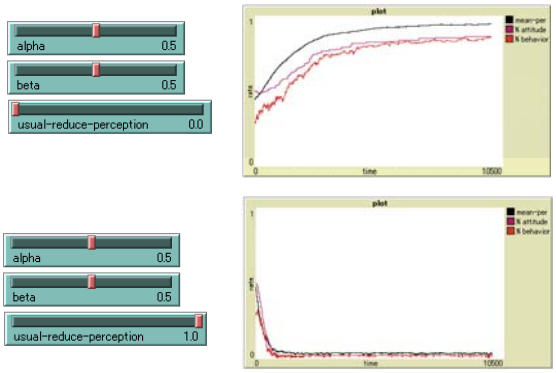
alpha, network effect



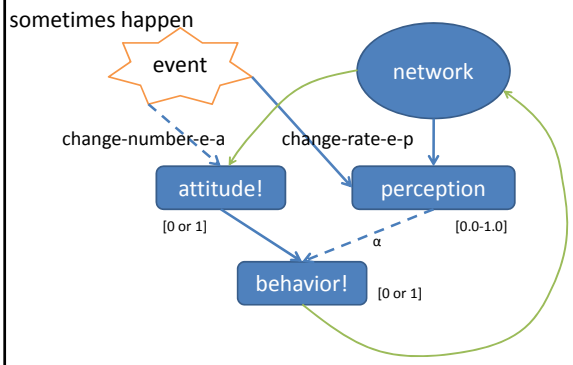
Risk perception reduces with time

```
ask one-of turtles
 [
  set r1 random-float usual-reduce-perception
  ifelse perception < r1
  [set perception 0]
  [set perception perception - r1]
 ]
```

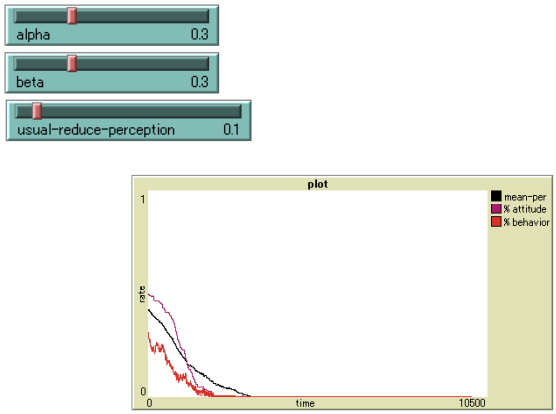
Risk perception reduces with time



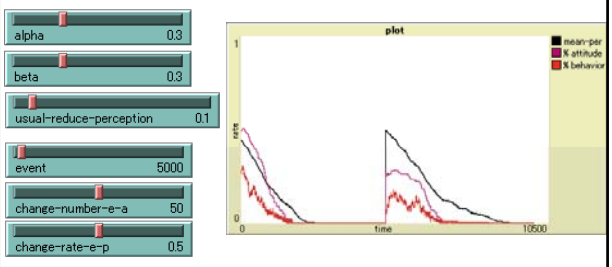
Risk event




```
; when a event occurs, some turtle's attitude? becomes
   true
 if random event = 1 [
      ask n-of (change-number-e-a) turtles[
      set attitude? true
   ]
; when a event occurs, some turtle's perception increases
     ask n-of (num-nodes * change-rate-e-p) turtles[
     set r2 random-float change-rate-e-p
     ifelse r2 > (1 - perception)
     [set perception perception + r2 ]
     [set perception 1.0]
   ]
 ]
```



A risk event occurs



It depends on base structure of the model

Forgetting risk like real society

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- – rewiring probability
-
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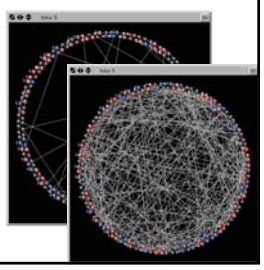
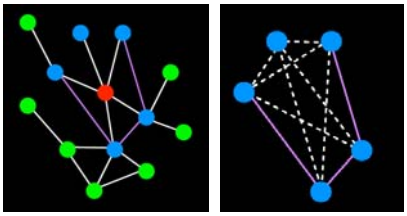


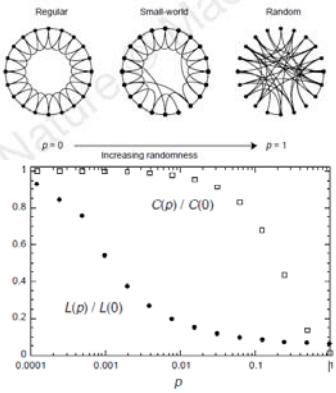
Network

- Average Path Length
  - 2
- Clustering Coefficient
  -
    - neighbors neighbors
  -



clustering coefficient for red node is 3/10=.3.

Network



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Regular
Small-world

Duncan J. Watts & Steven H. Strogatz(1998) “Collective dynamics of 'small-world' networks” Nature

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  - Small-world
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