Robustness of spatial micronetworks

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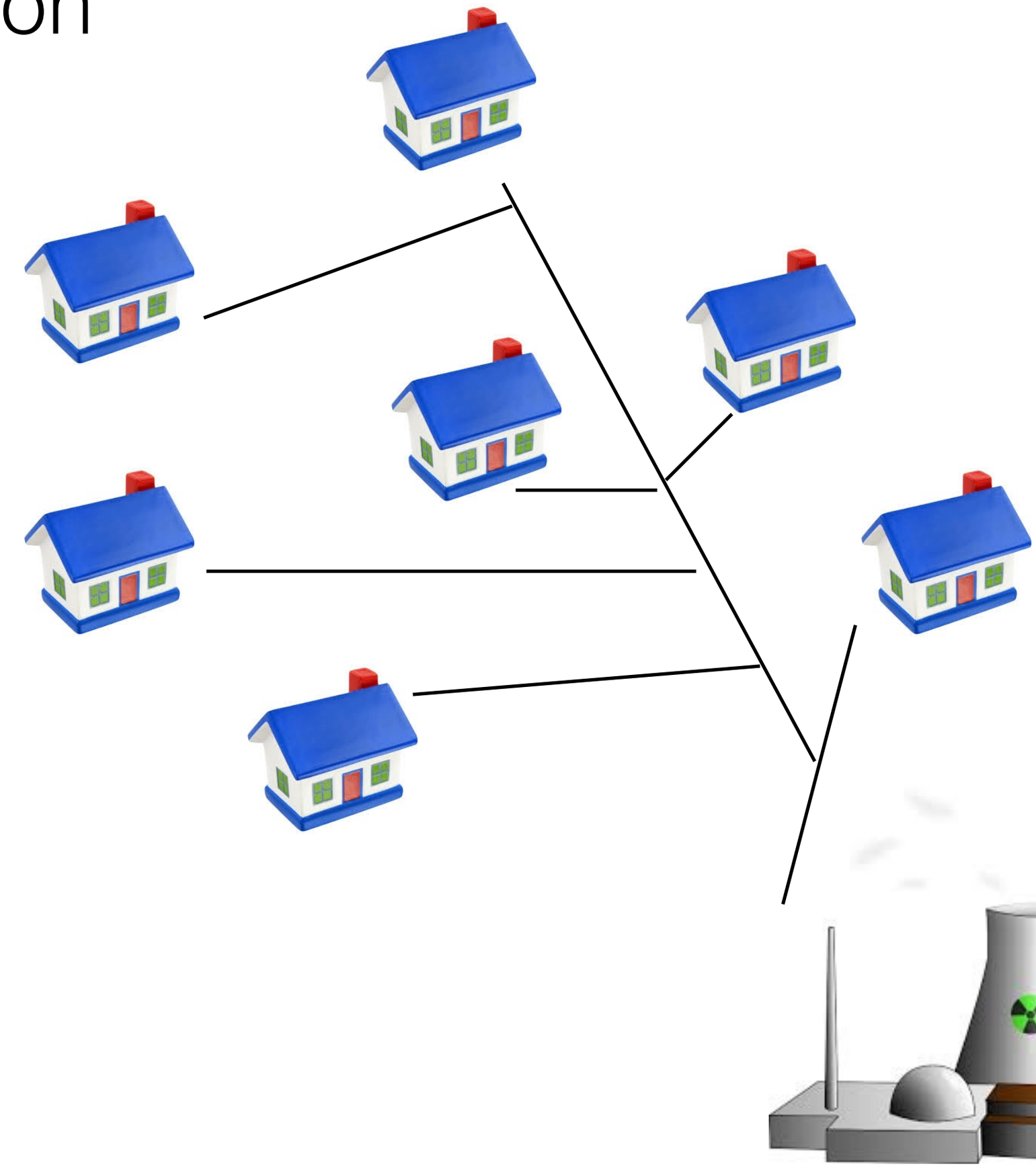
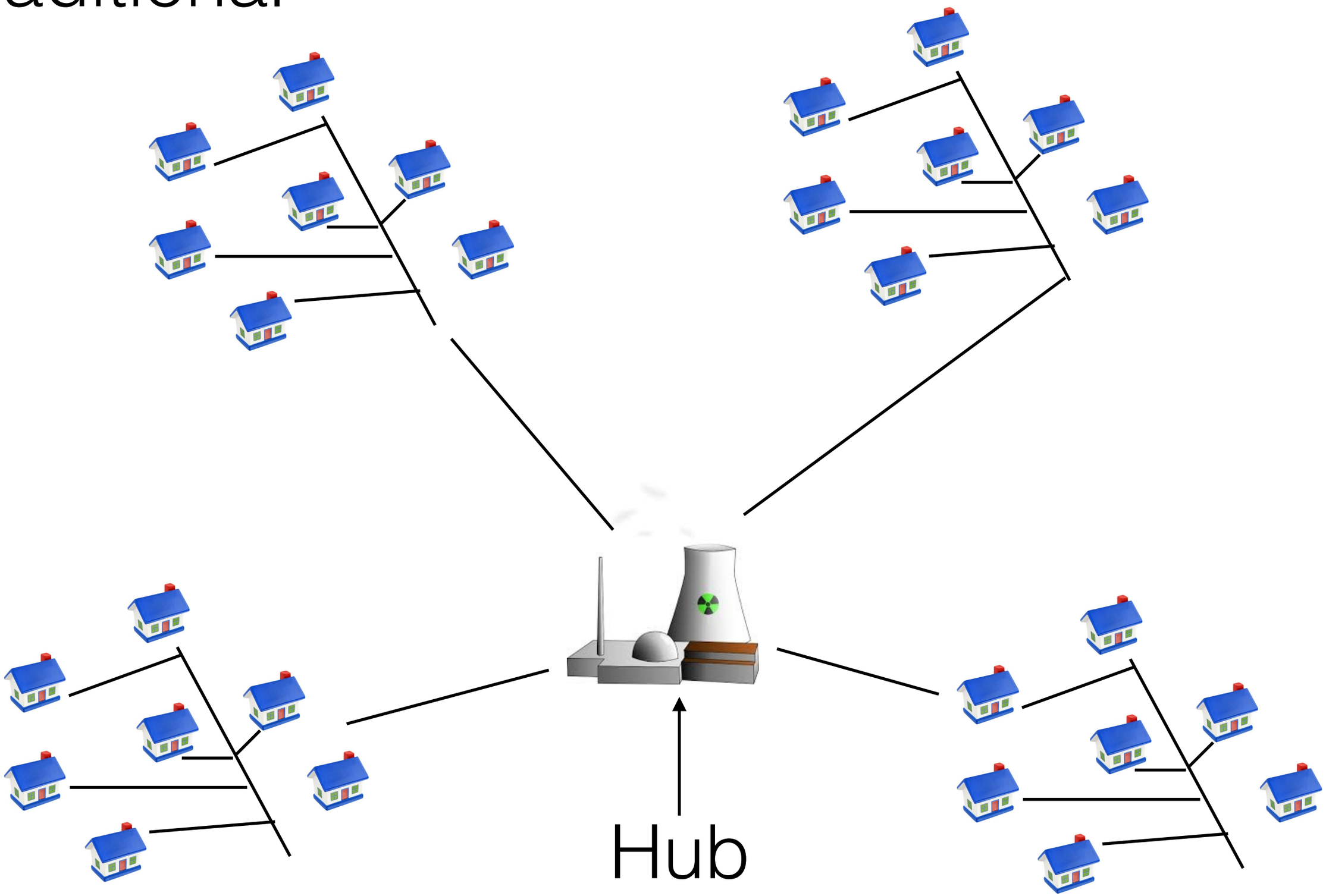
University of Vermont

Motivation



Traditional



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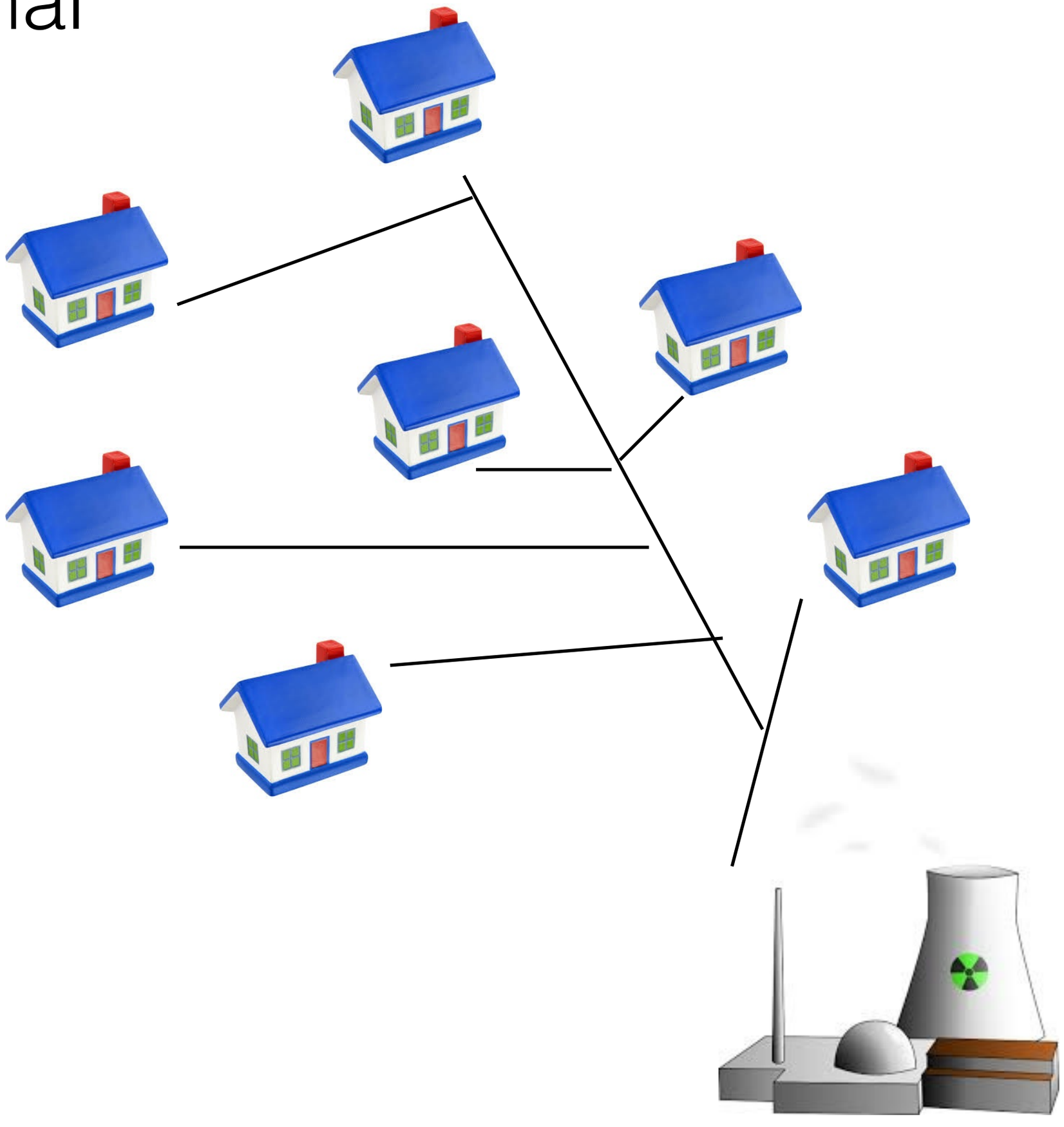

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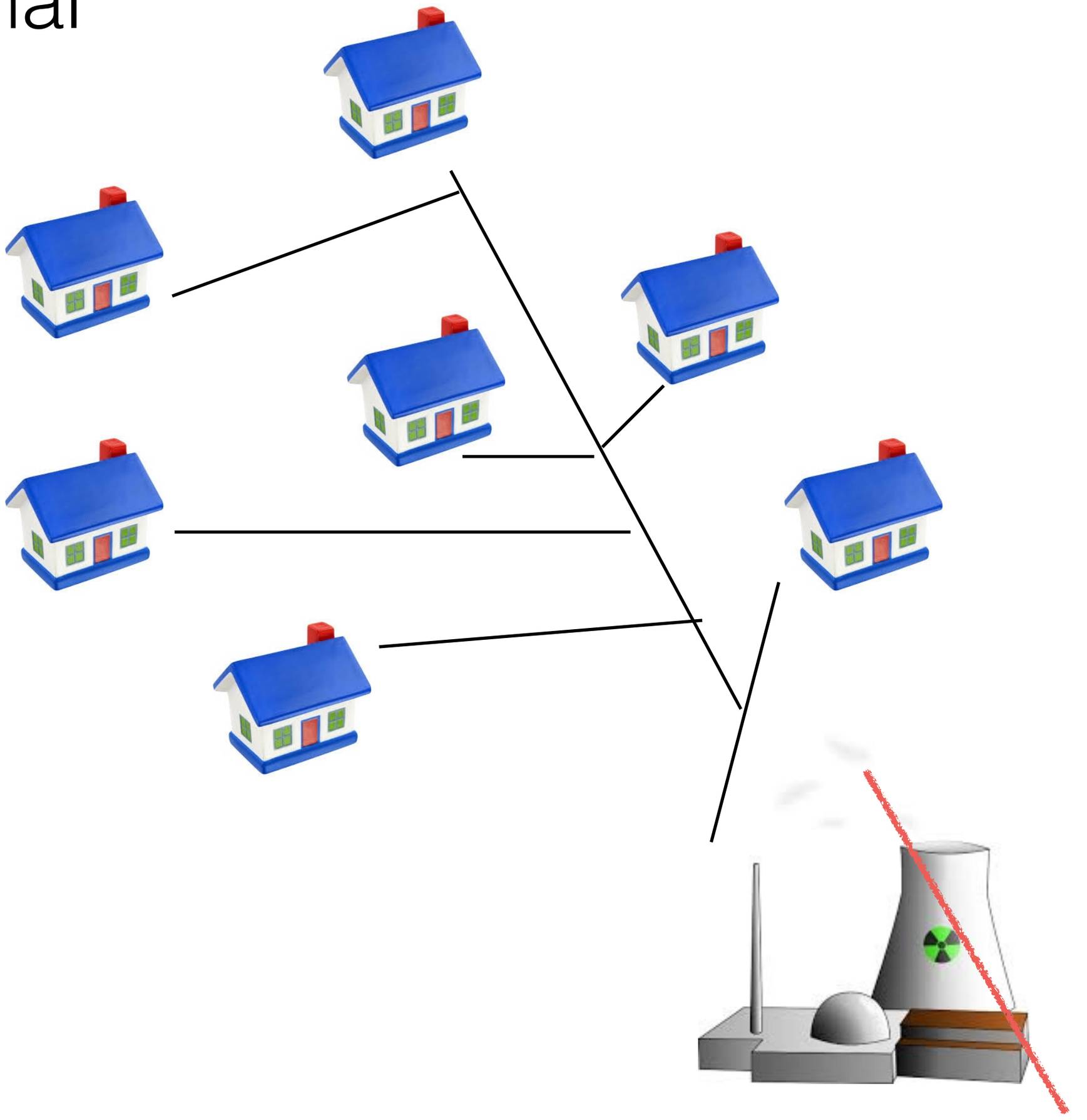
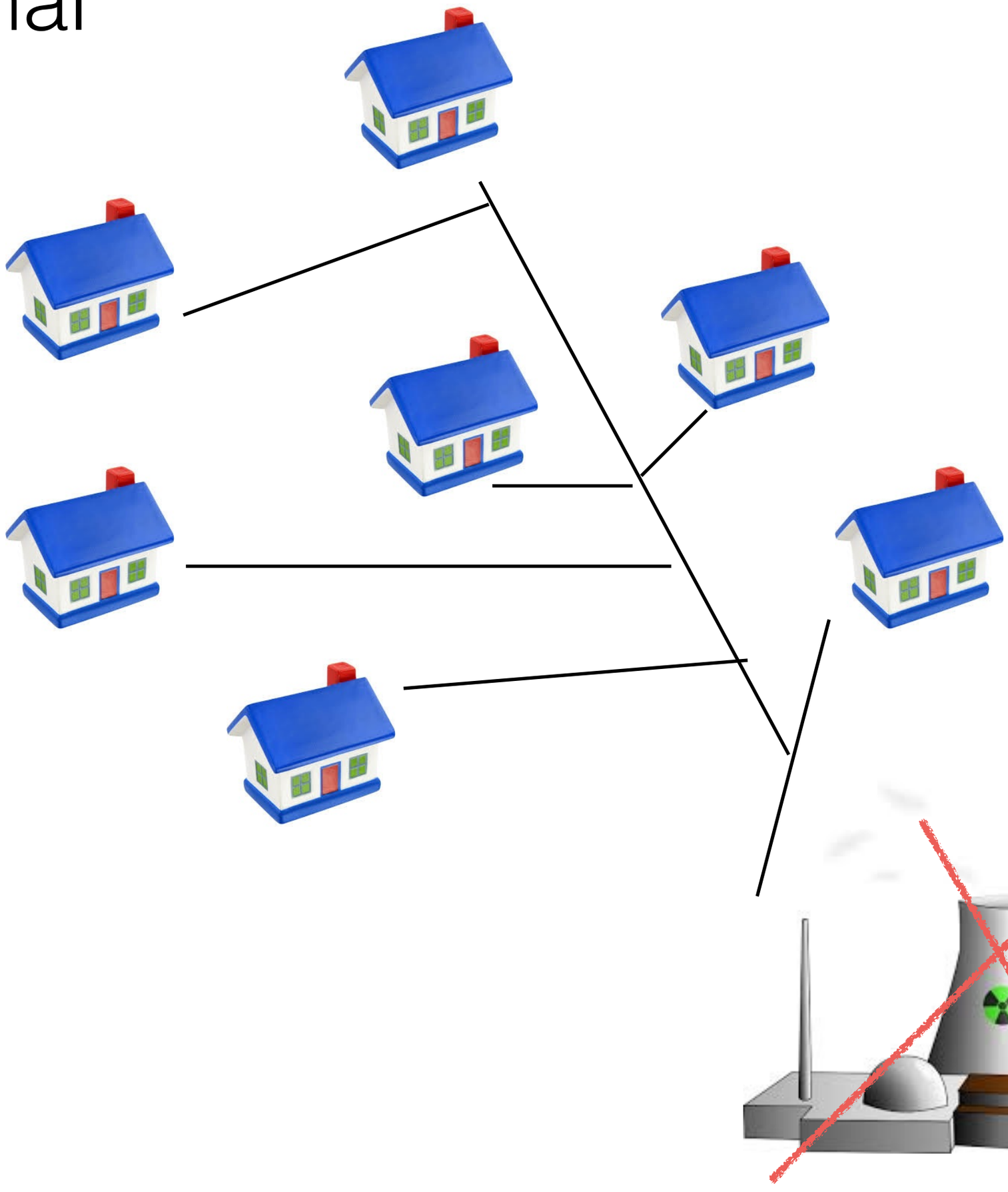


Traditional



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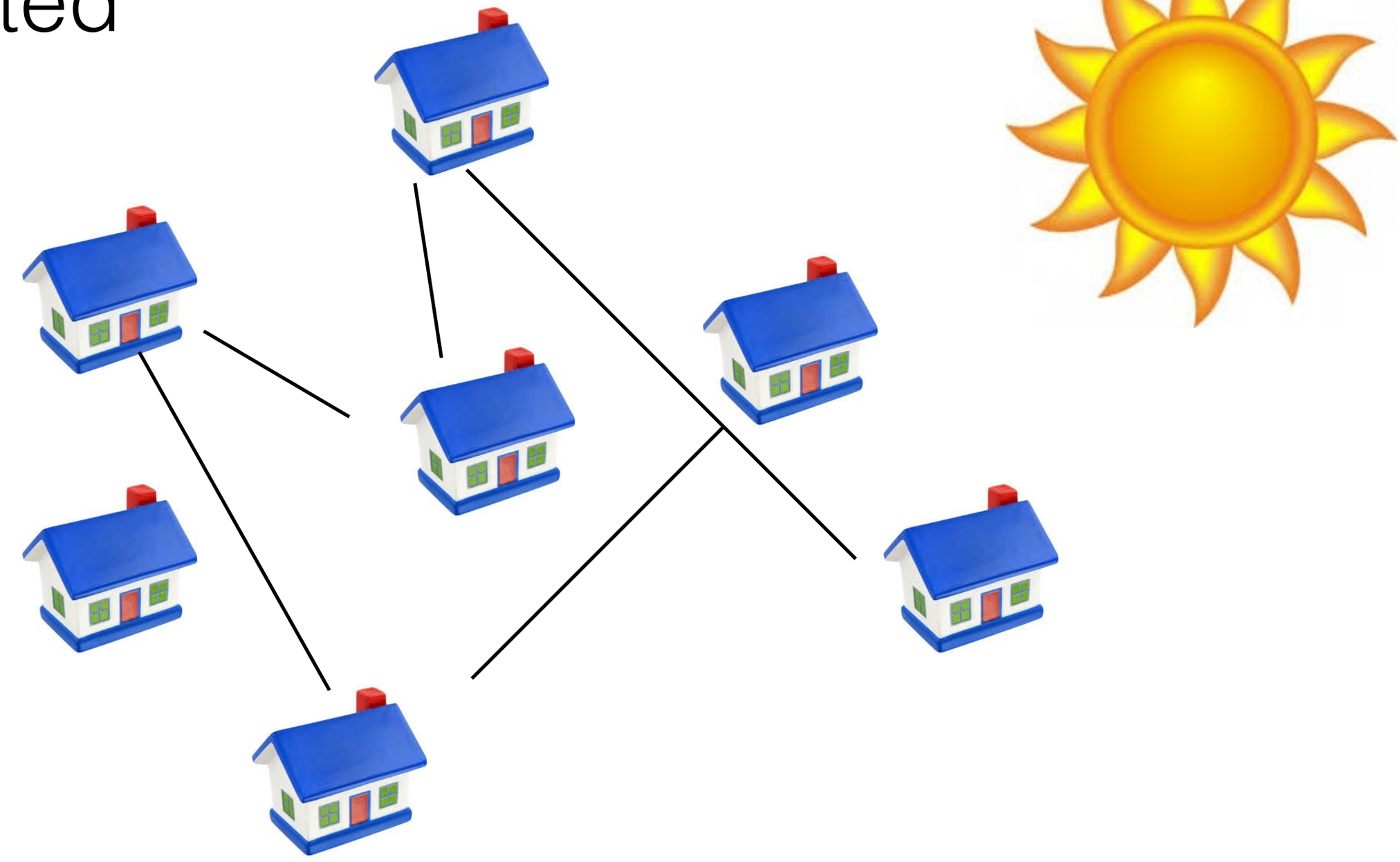

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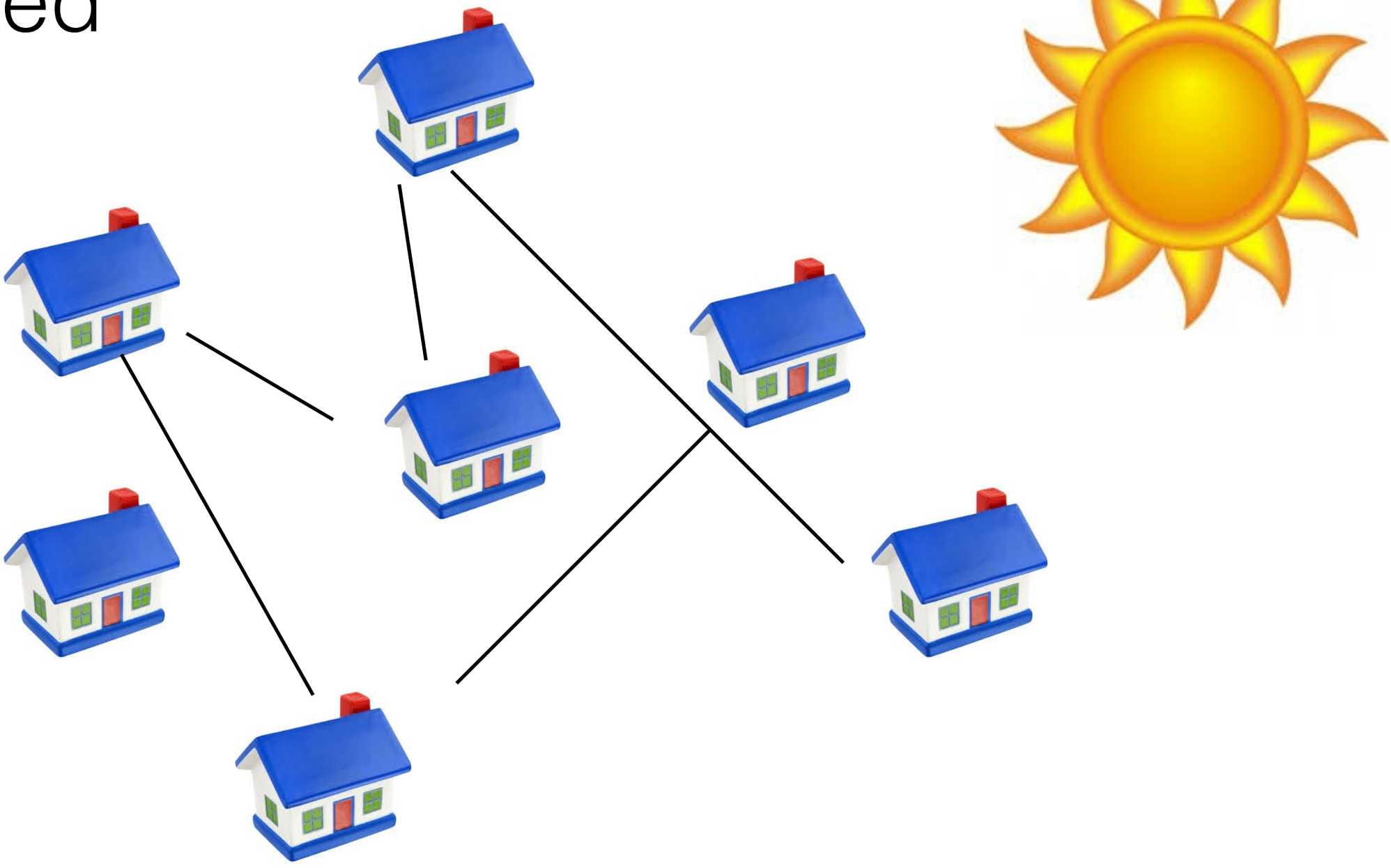
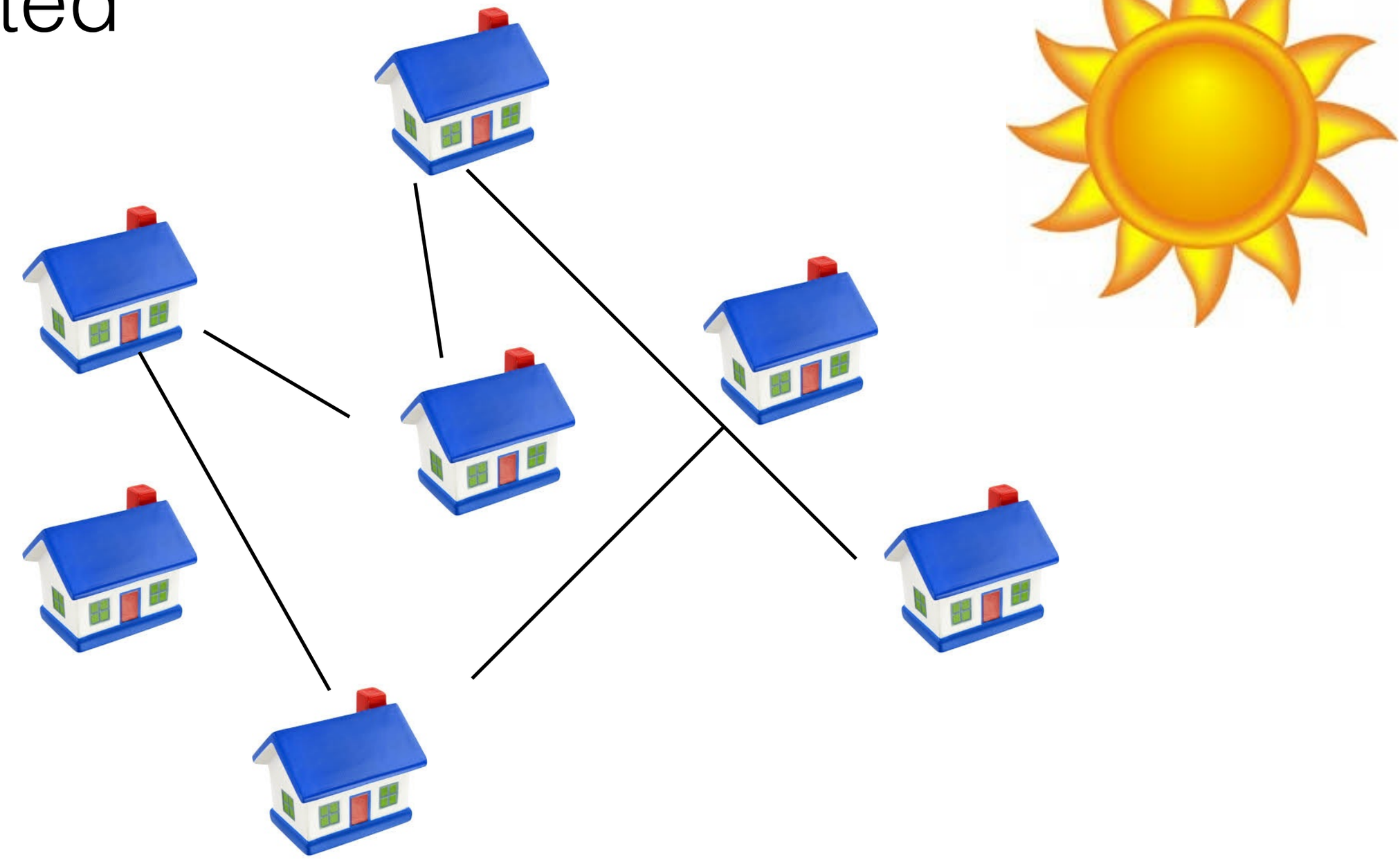


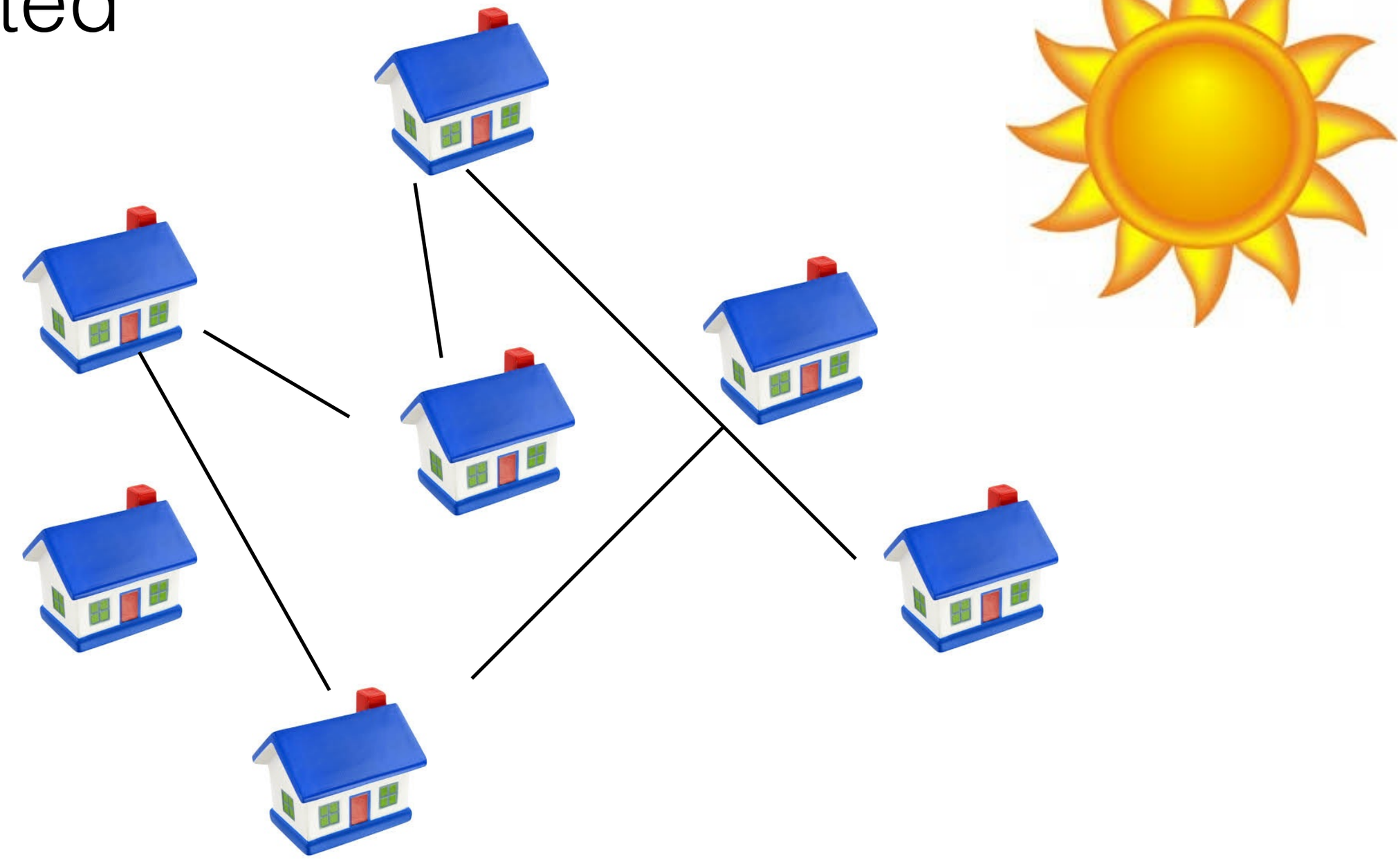
Share Electric Bill

Distributed



Share Electric Bill
Connectedness

Distributed



Share Electric Bill
Connectedness
Lower Carbon Footprint

Model - construction

$$d_{\text{eff}}(i,j) = \sqrt{N}\lambda d_{ij} + (1-\lambda)$$

0 — λ — 1

Non-Spatial — Spatial

Model - construction

$$d_{\text{eff}}(i,j) = \sqrt{N}\lambda d_{ij} + (1-\lambda)$$

0 λ 1

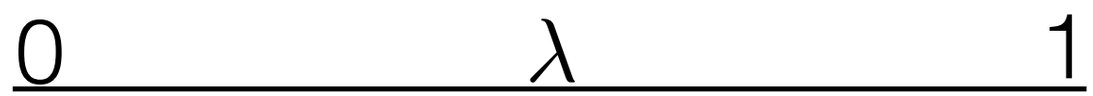
Non-Spatial Spatial

Internet

Airport

Model - construction

$$d_{\text{eff}}(i,j) = \sqrt{N}\lambda d_{ij} + (1-\lambda)$$



Non-Spatial — Spatial

Internet — Powergrid

Airport — Roadways

Model - construction

$$d_{\text{eff}}(i,j) = \sqrt{N}\lambda d_{ij} + (1-\lambda)$$

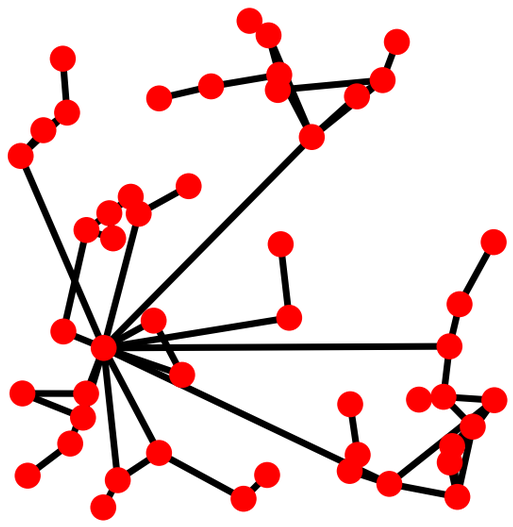
0 λ 1

Non-Spatial — Spatial

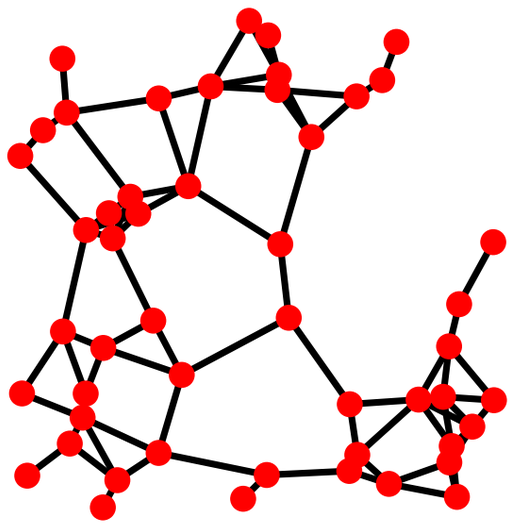
Internet — Powergrid

Airport — Roadways

$\lambda = 0$



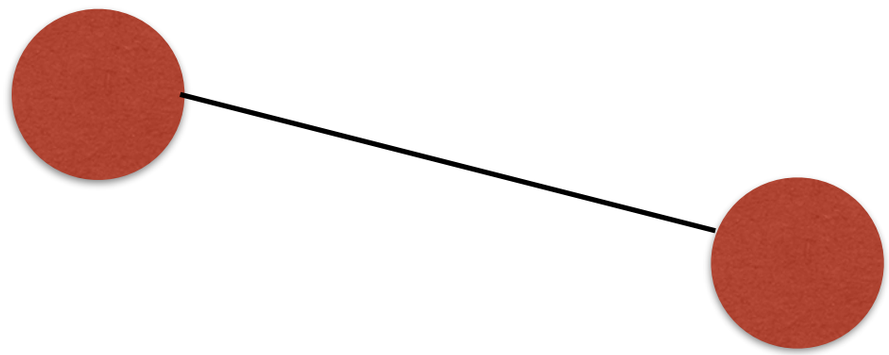
$\lambda = 1$



Model -destruction

Model -destruction

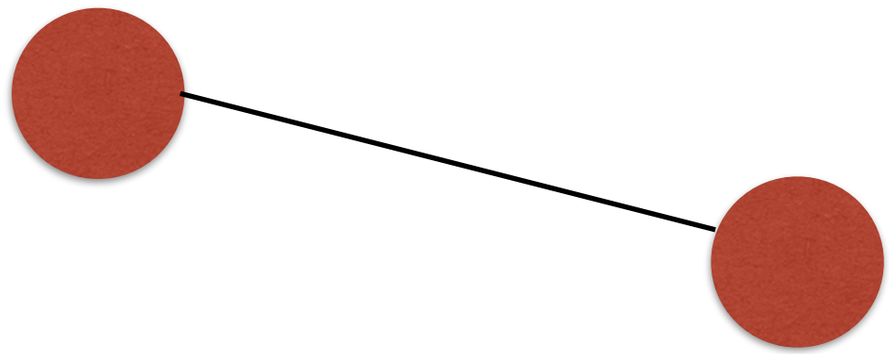
Look at each link



Model -destruction

Flip a Coin

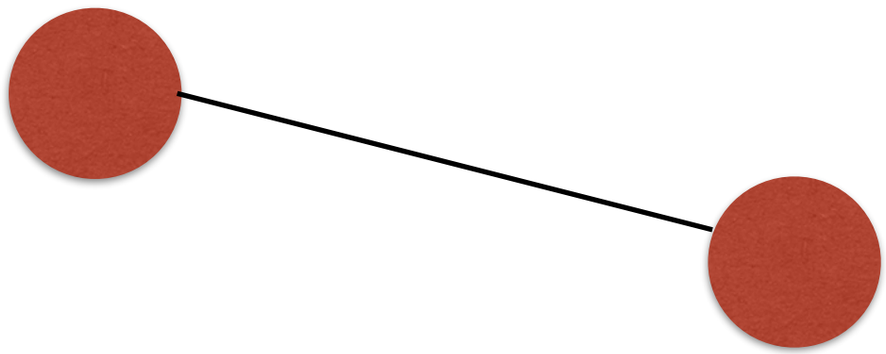
Look at each link



Model -destruction

Flip a Coin

Look at each link

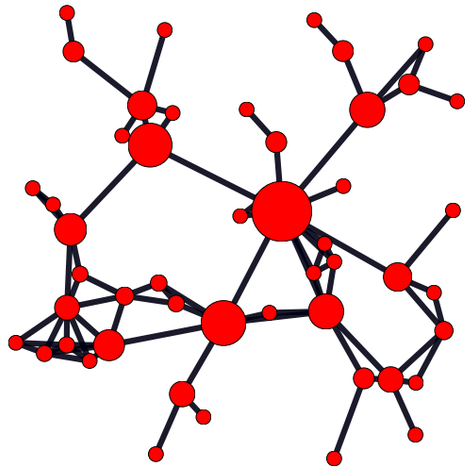


Longer edges are **more likely** to fail

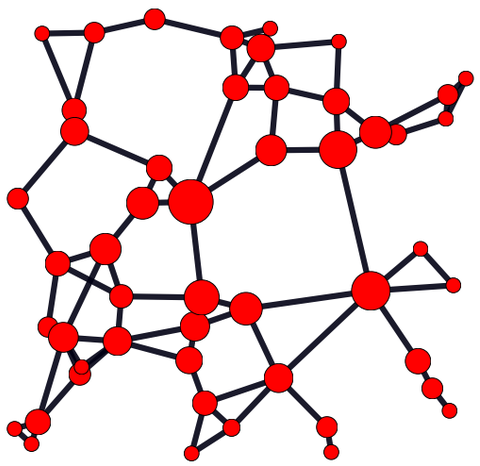
Size of Node = Importance

$\alpha = 0.0$

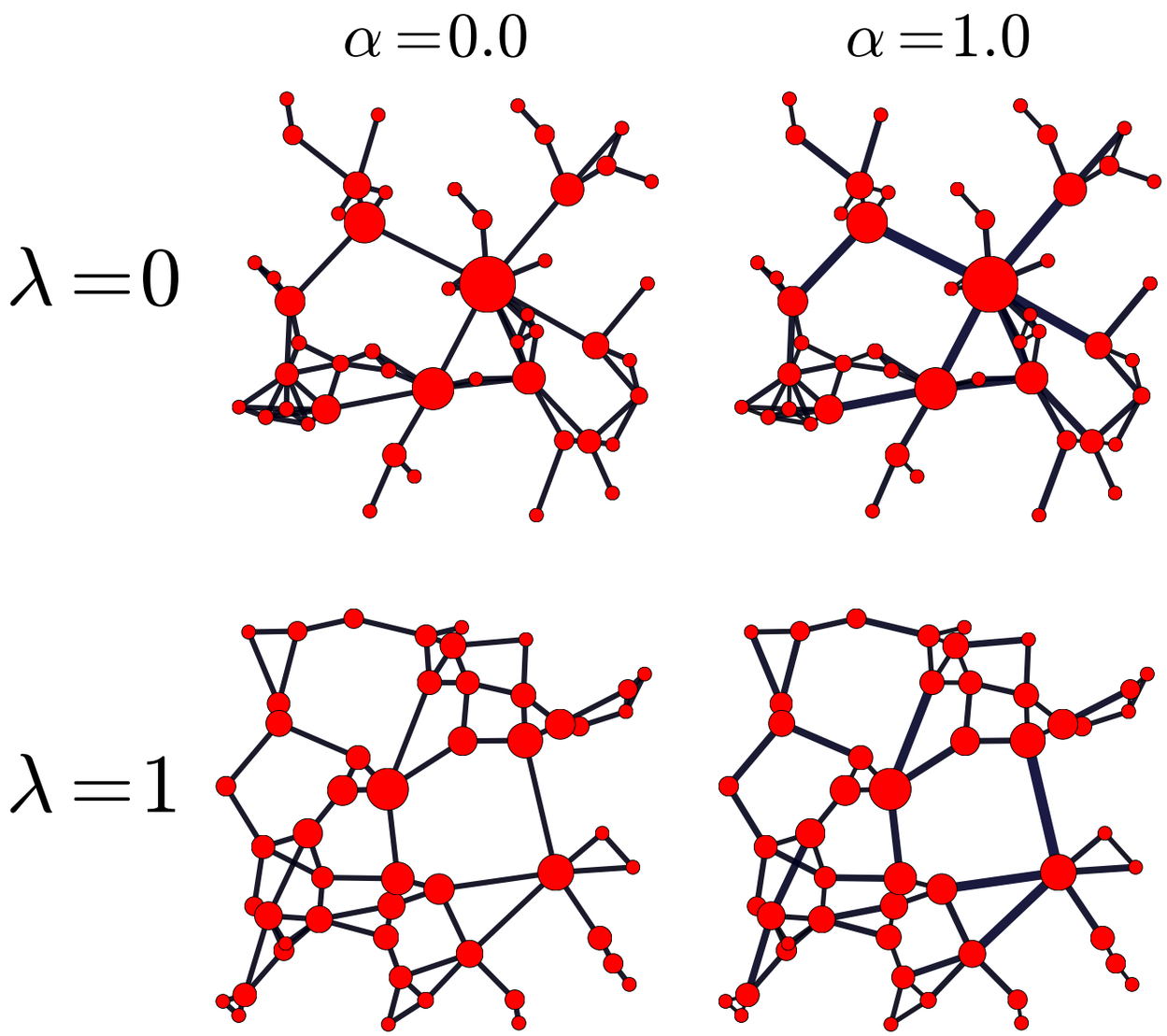
$\lambda = 0$



$\lambda = 1$

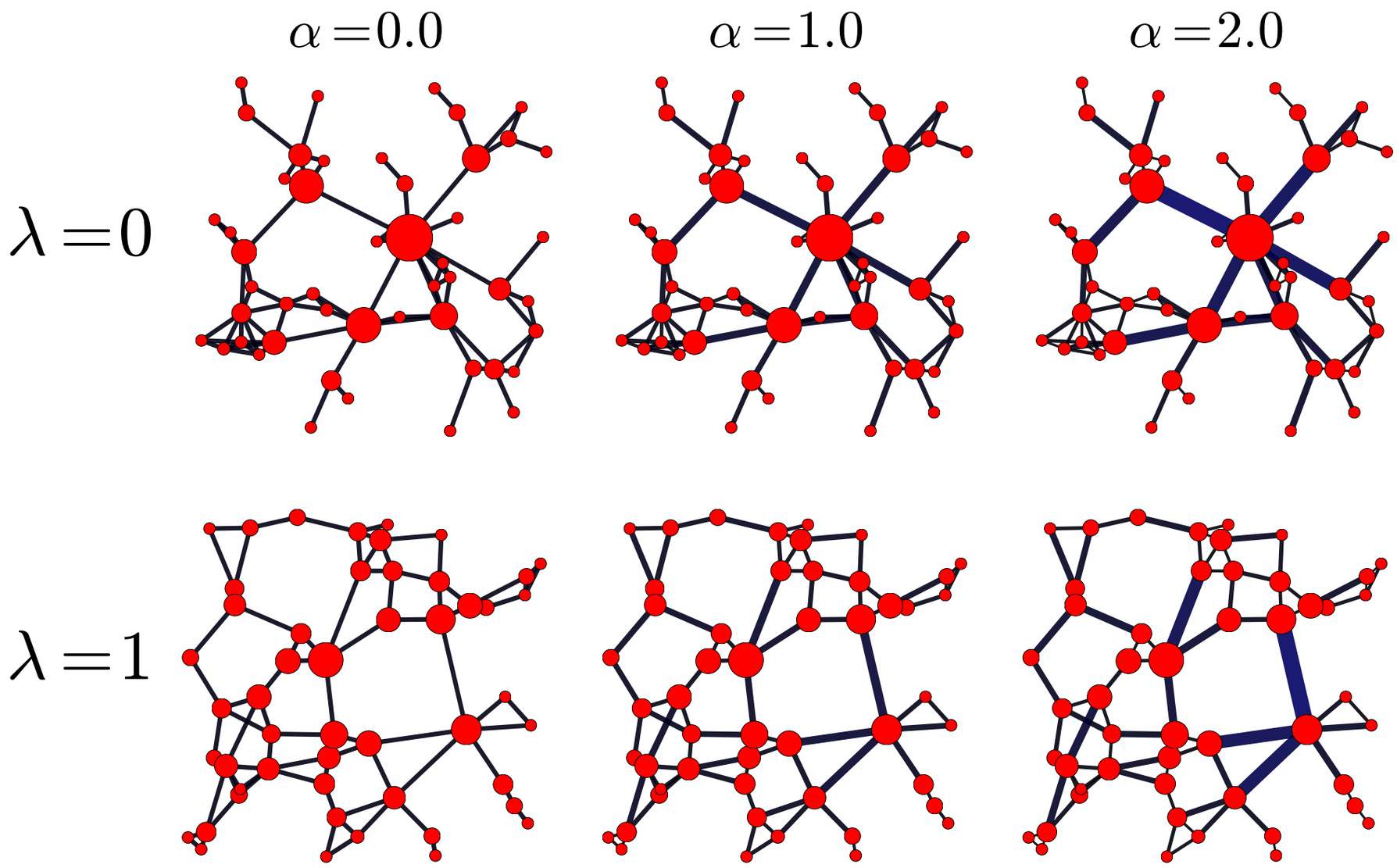


Size of Node = Importance



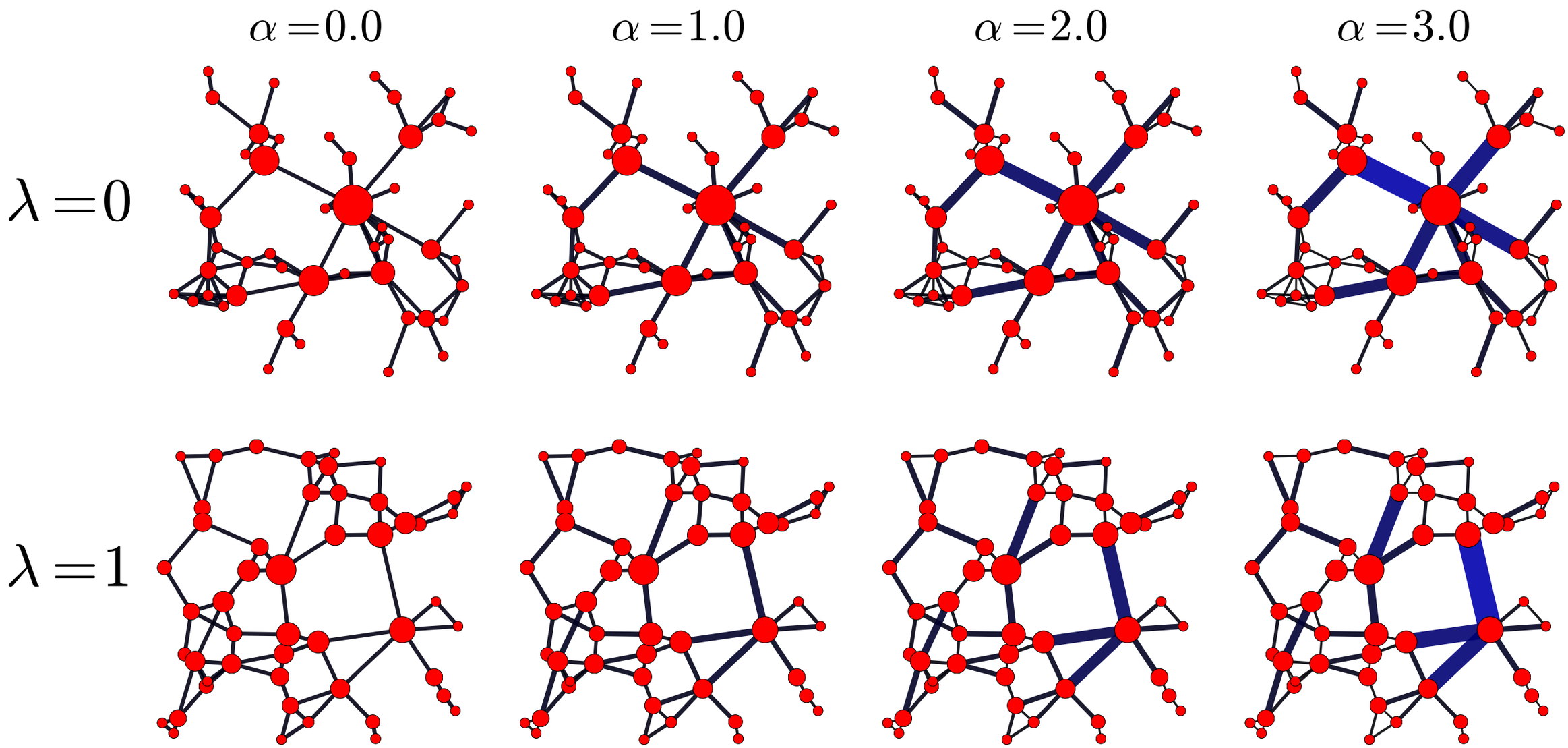
Link thickness = number of times failed

Size of Node = Importance



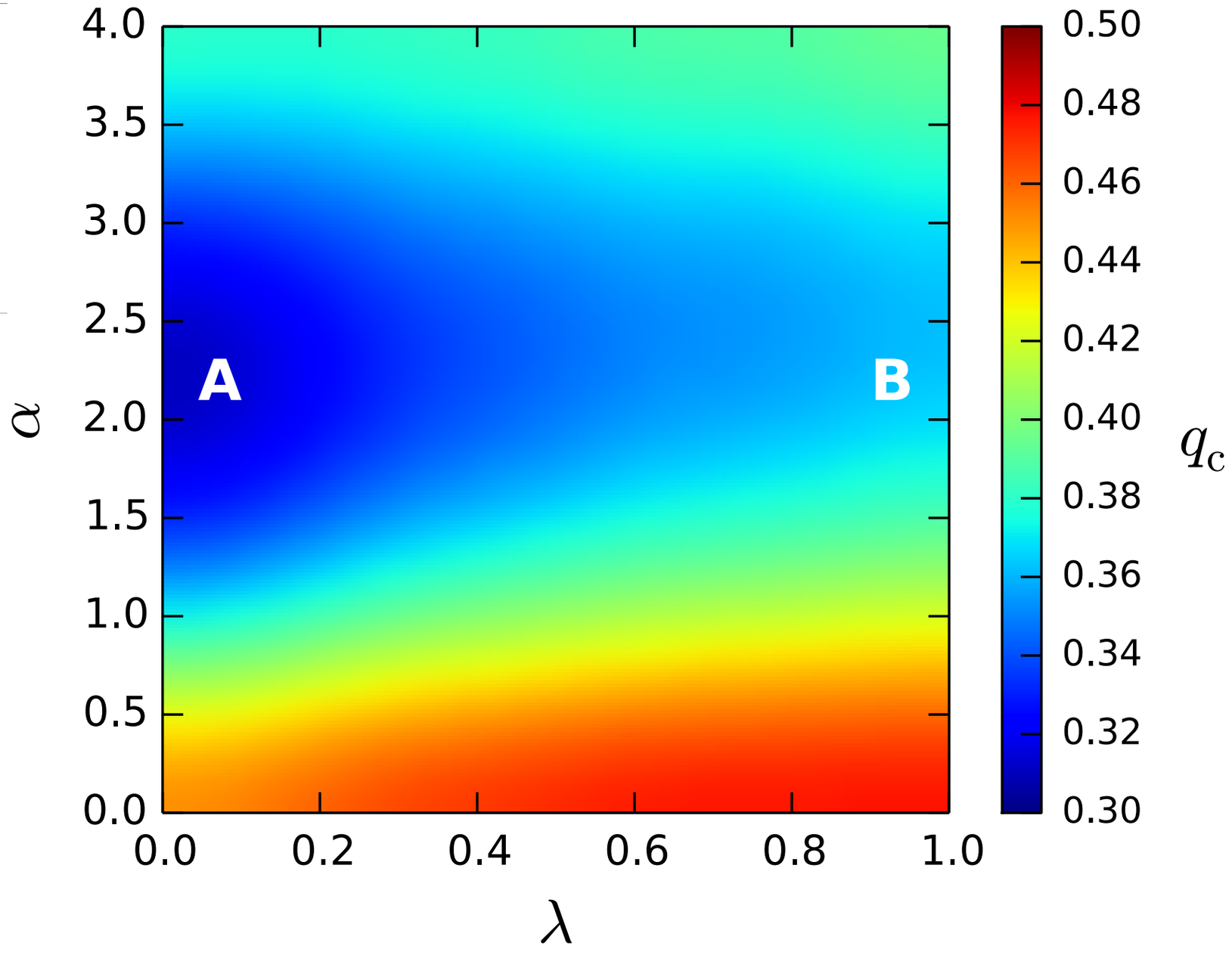
Link thickness = number of times failed

Size of Node = Importance

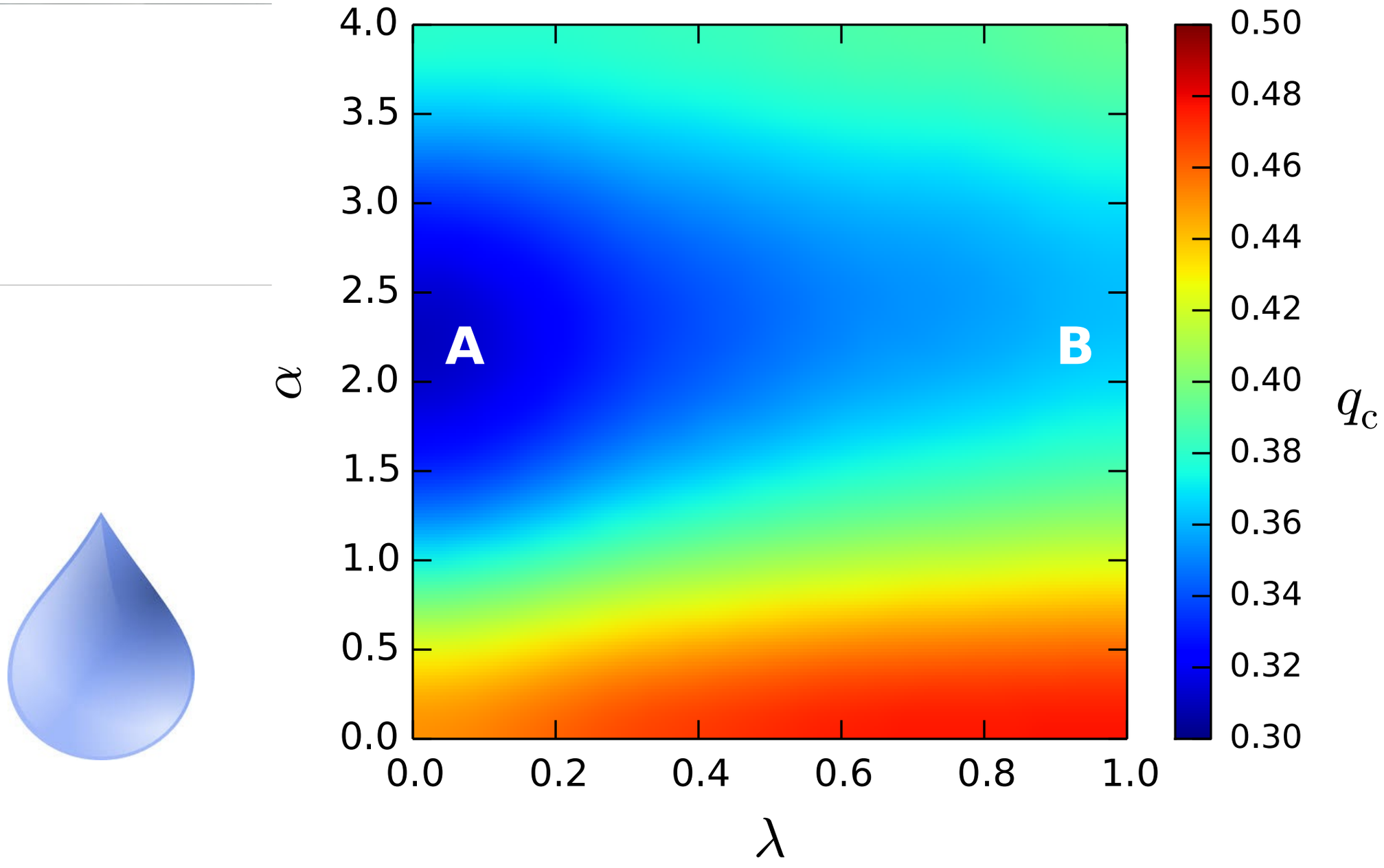


Link thickness = number of times failed

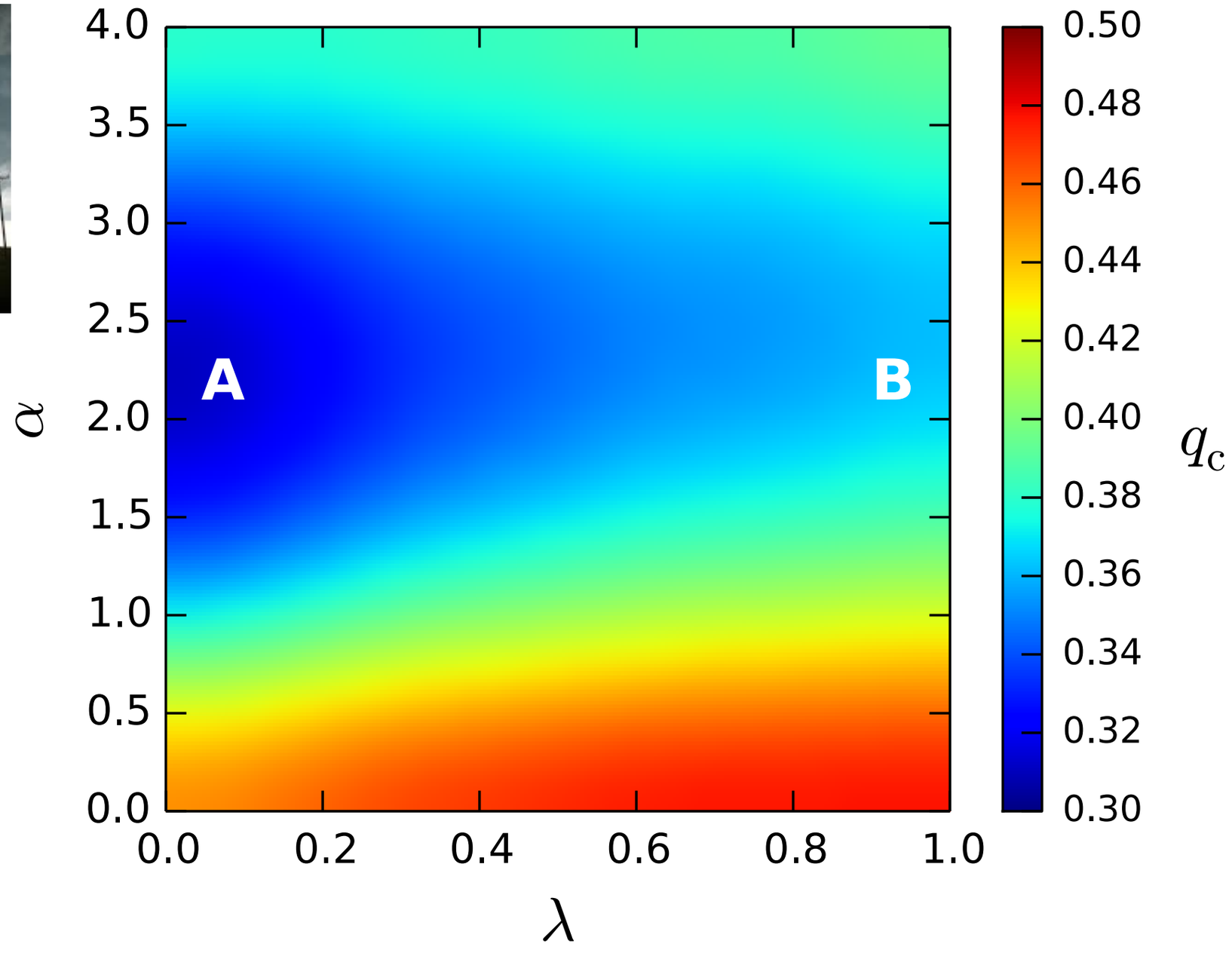
Vulnerability



Vulnerability



Vulnerability



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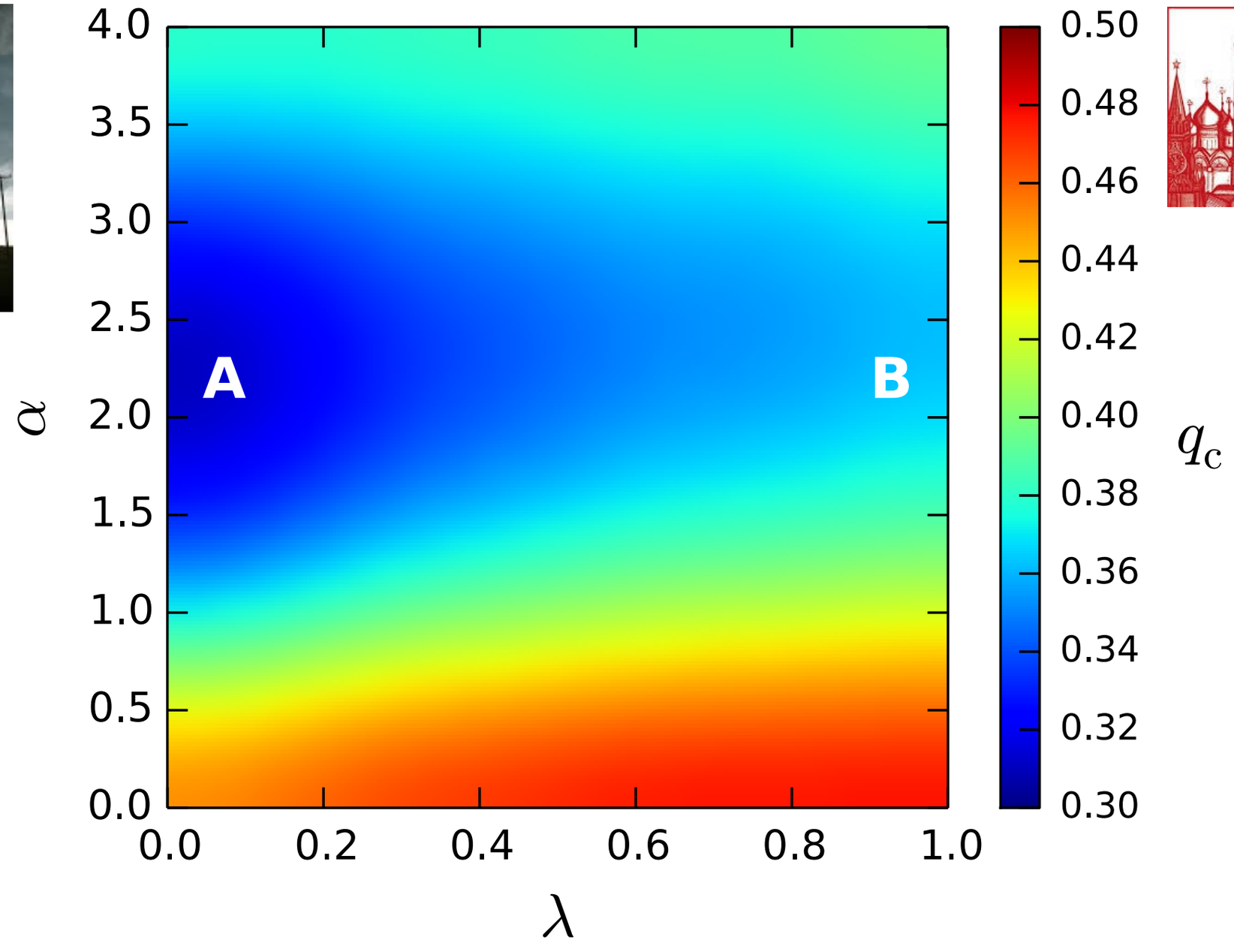
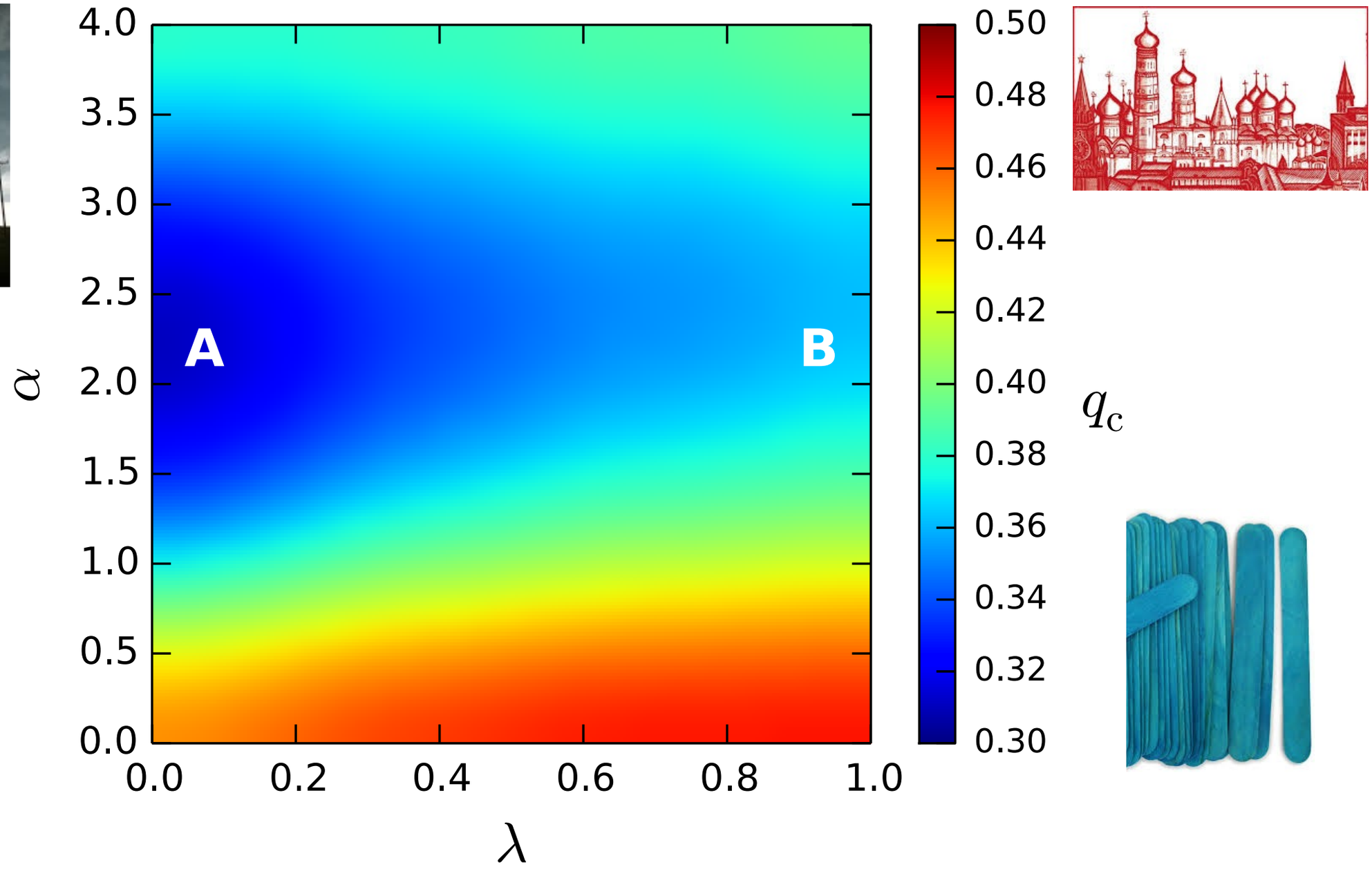


Vulnerability



Thank you

Collaborators:

Chris Danforth
James Bagrow