Interaction Network Structure in Community Genetics

A Genes to Ecosystem Model

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Main Questions:

1. What is the structure of genotype-genotype networks?
    1. trait variation (matching)
    2. mobility
    3. space
    4. demography (death rate)
    5. ???
2. How does genotype-genotype network structure influence the evolution of species and network architecture?
    1. random
    2. nested
    3. modular
    4. centralized
    5. ???
3. How does genotype-genotype network structure influence ecological structure?
    1. species abundance curves
    2. genotype-species networks

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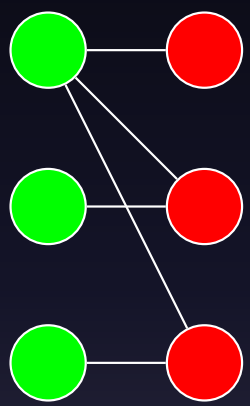
Evolution “OF” Networks



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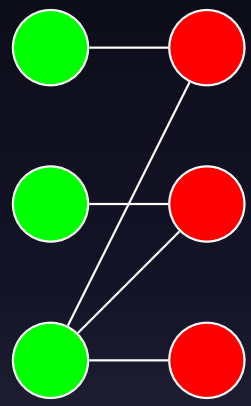

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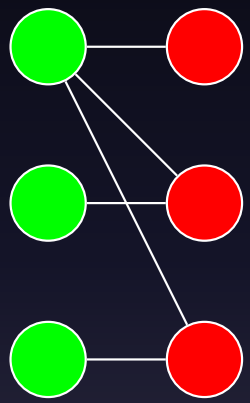
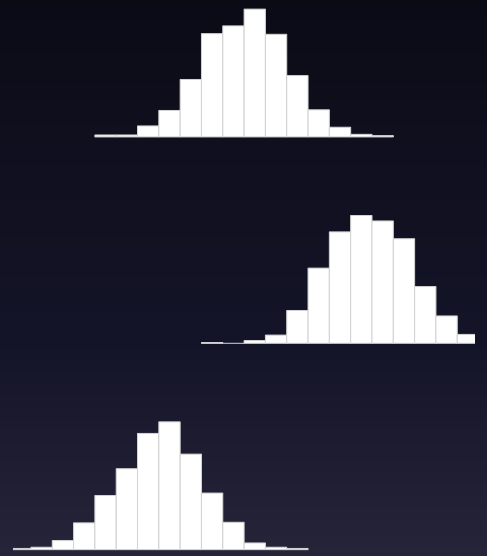
Interaction traits evolve and change network architecture.

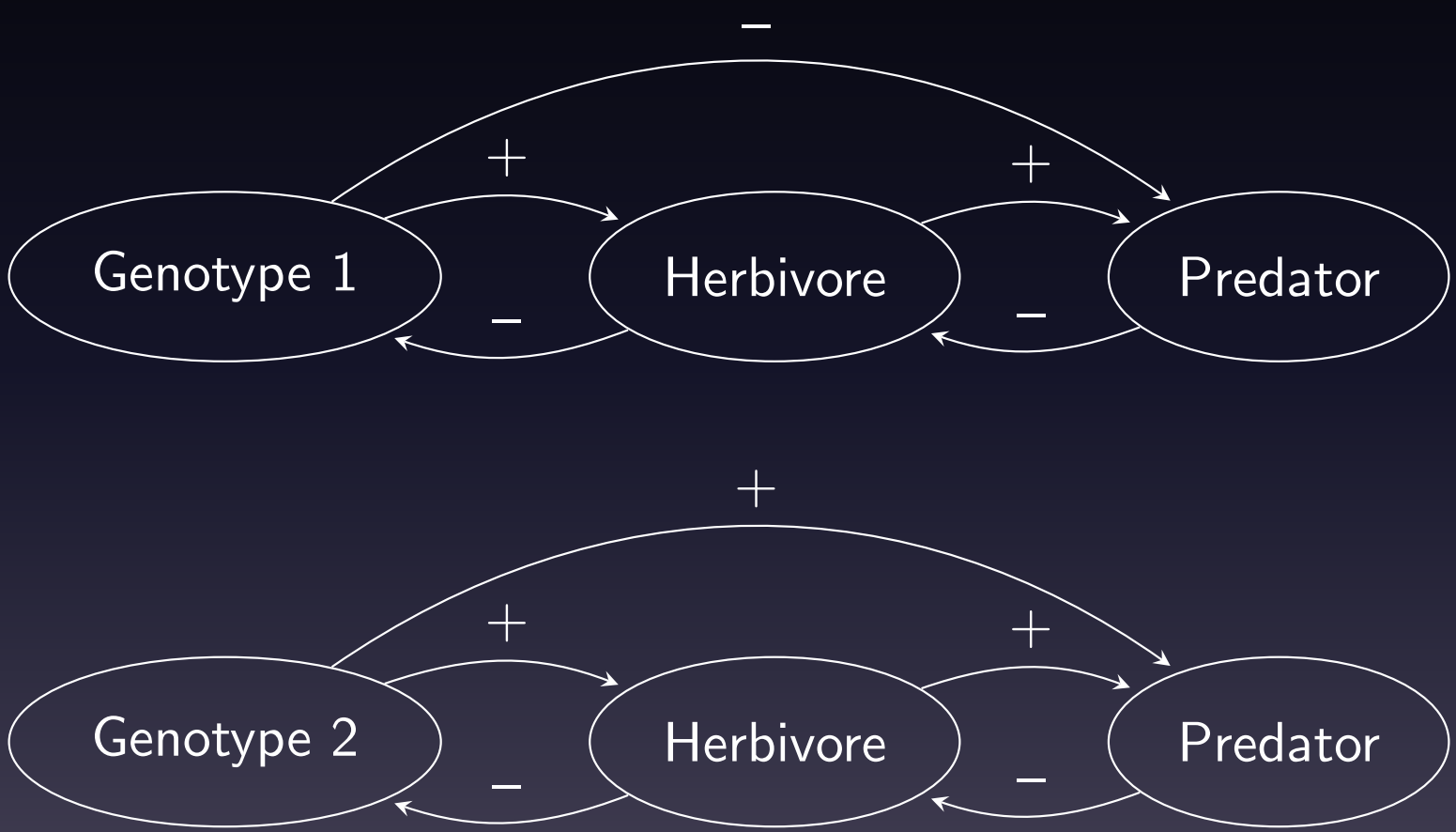
Evolution “ON” Networks





Traits (interactions or otherwise) evolve from direct and indirect selection.

Selection on Networks



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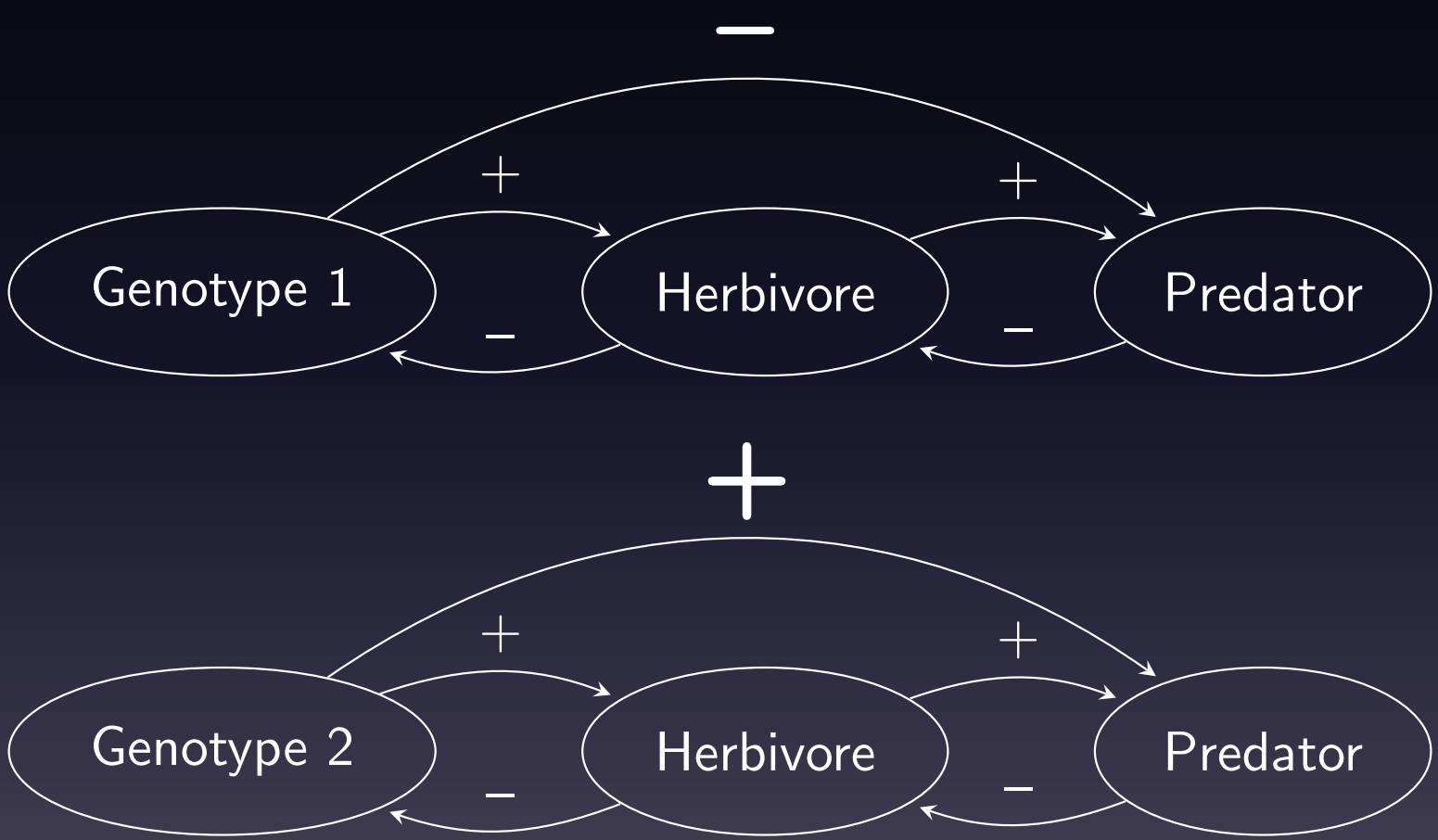

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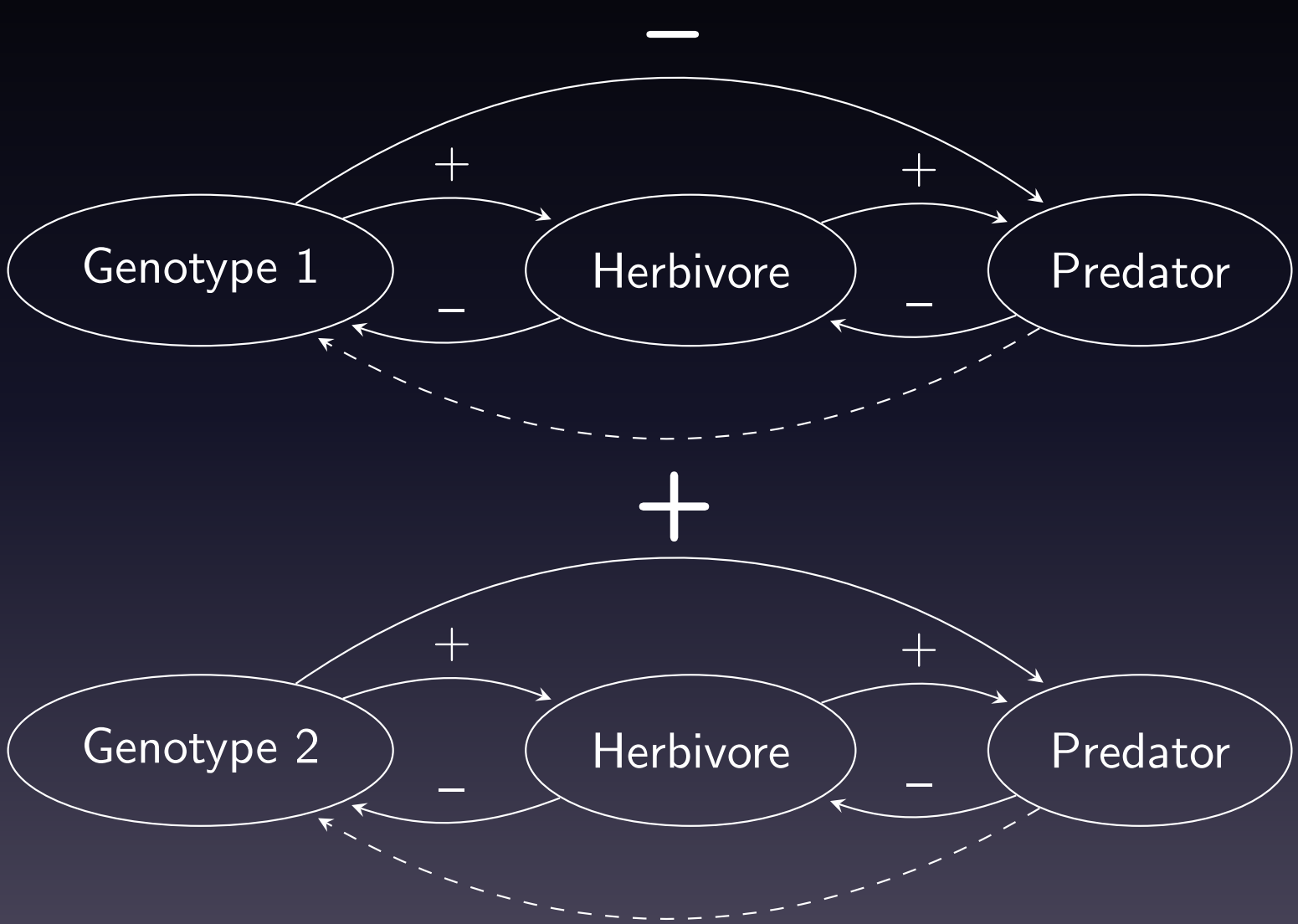

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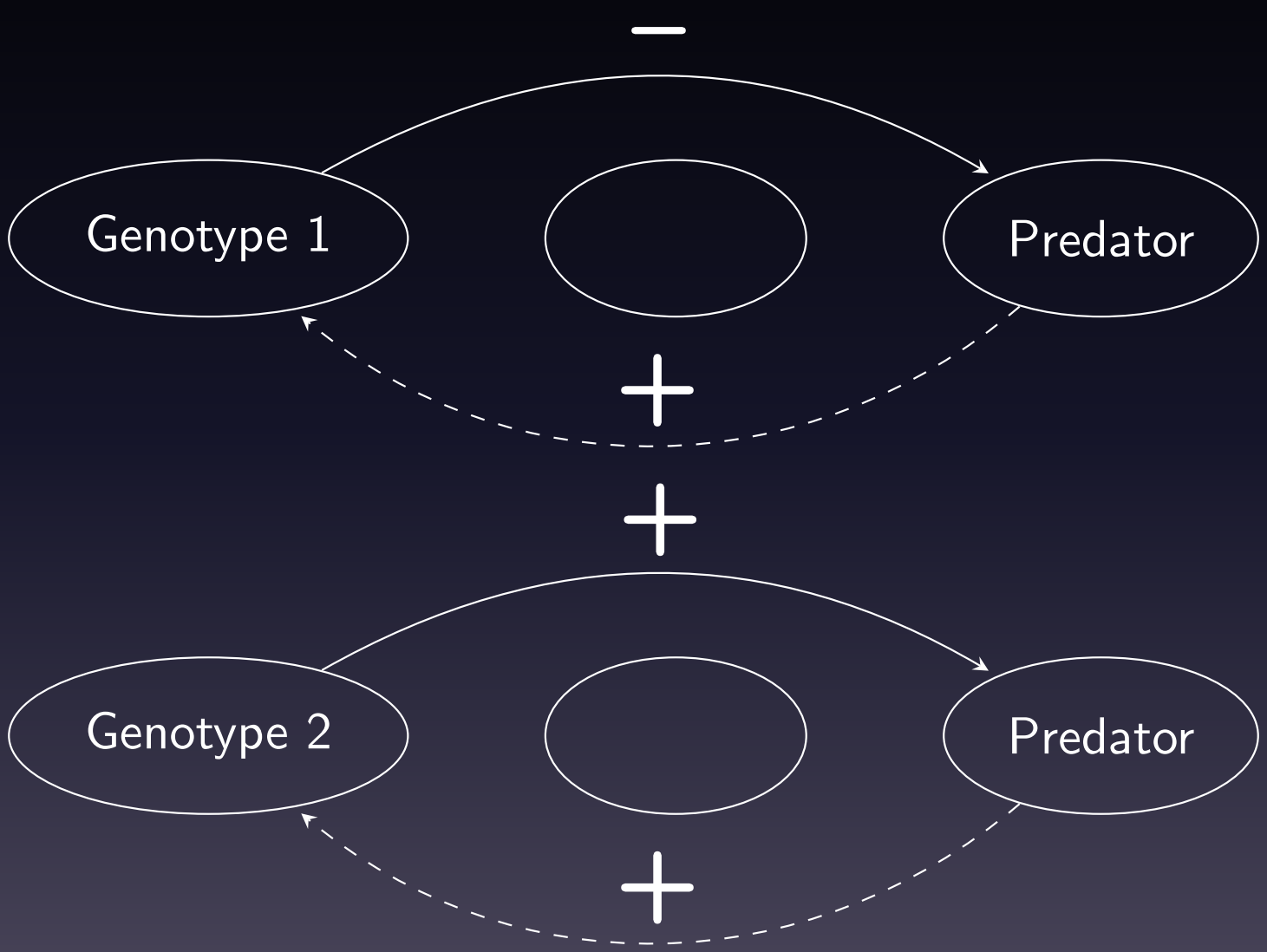

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  - Dixon's paper
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  - Shuster et al. 2006
  - Lonsdorf (unpublished)
- Papers from other community genetics groups:

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- Papers from other community genetics groups:
  - Agrawal
  - Mooney (ant-aphid-plant)
  - Genung (Genetic variation and community change âĂŞ selection, evolution, and feedbacks)
- Papers on network evolution:
  - ?????

Why model?

- General principals

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- Generate hypotheses

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- General principals
- Generate hypotheses
- Quantitative predictions

Framework

- G = genotype
- P = phenotype
- E = ecology
- F = fitness
- R = reproduction

Implementation

- Differential Equations (Mass Action)
- Individual Based Models (IBM)

Implementation: What is an IBM?

- Specify the core system processes
- Emergent properties
- Computationally intensive (tracking individuals)

Implementation: Genotype

- Binary sequence
- Ploidy

Implementation: Phenotype

- Initiate from random population means
- Dominance
- Epistasis

Implementation: Ecology

- Networks
  - Centrality
  - Nestedness
  - Modularity
- Relative abundance
- Resource limitation
- Abiotic
- Space?

Implementation: Fitness

- Trait Matching (resource)
- Resistance (trophic)

Implementation: Reproduction

- Demographics (death + birth - ?carrying capacity?)
- Recombination (based on relative fitness distribution)
- Mutation
- Hybridization

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- **S = selection**

Implementation: Selection

- Add a species (preferential attachment)
- Remove individuals
- Shift resource availability
- Evolve resistance

Implementation: Computation

- Bioinformatics Server?
- Other suggestions?

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