GROUP RECOMMENDATIONS:

AXIOMS, IMPOSSIBILITIES, AND RANDOM WALKS

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MAKING A CHOICE...

Plenty of item classes where there is a wide variation in quality, but no easy way to estimate it…

How do we make a decision?

RECOMMENDATIONS

SOURCES OF RECOMMENDATIONS

Professional reviewers (newspapers, online, etc.)

Signals (not applicable in all cases)

Friends and family opinions
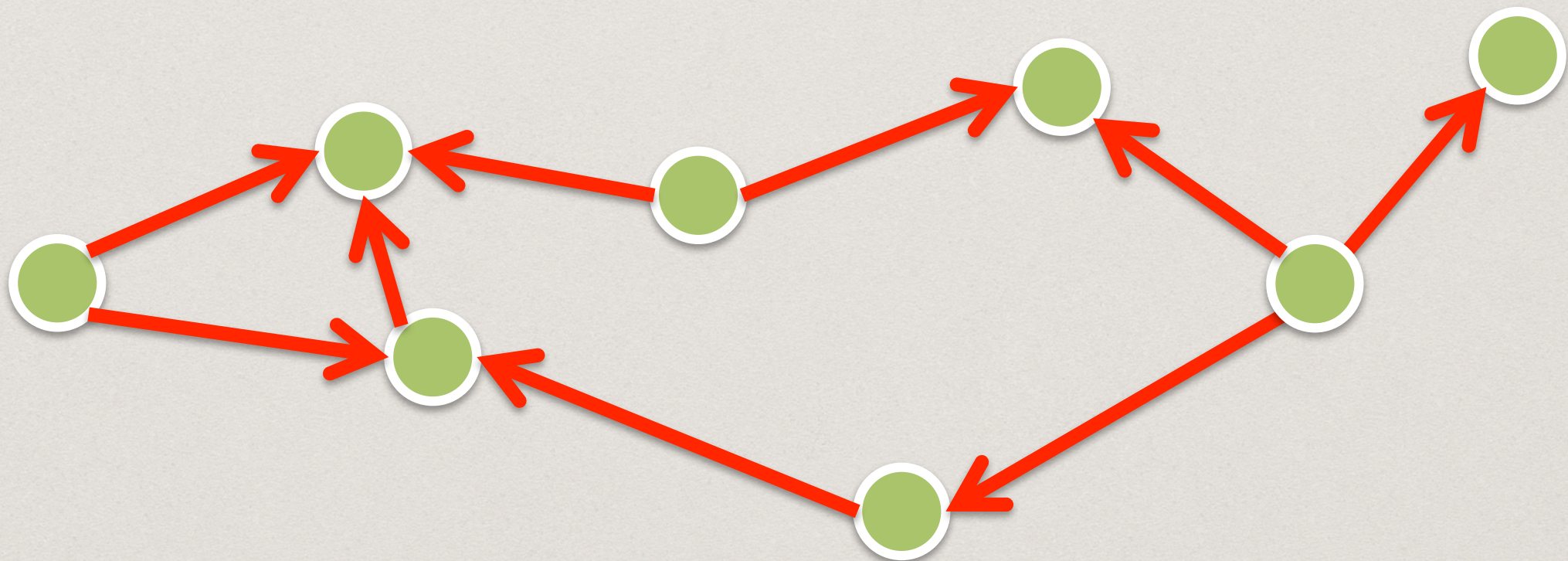
Computer recommendation systems

COLLABORATIVE FILTERING

Using the large datasets collected on users, find a user with similar tastes, and recommend according to it.
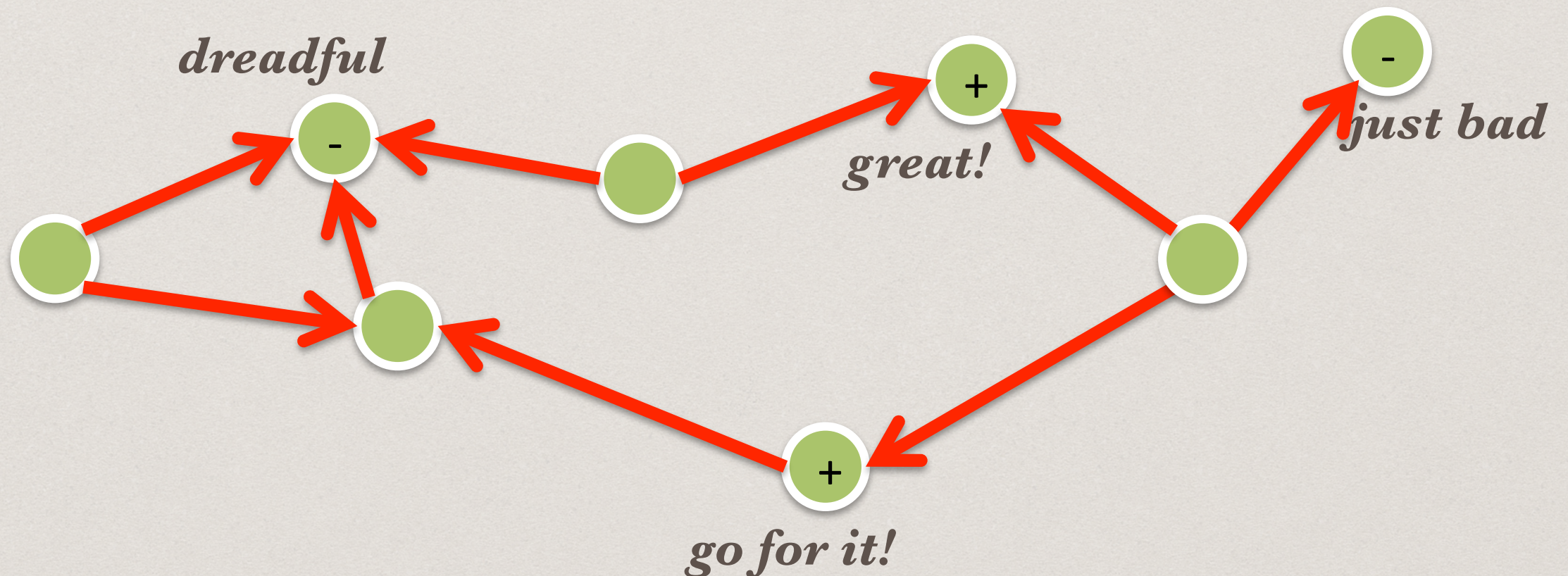
MIND THE GRAPH

In real life family and friends are prime source of opinion and influence, so the social graph should be taken into consideration when making recommendations.

"Trust-based recommendation systems: an axiomatic approach ", Andersen et al.

MIND THE GRAPH - SHOULD I READ THAT BOOK?

Opinionated members of the social graph have differing recommendations, which undecided people take into account…

dreadful

+

-

just bad

great!

go for it!

How do we decide on where to go to dinner?

GROUP RECOMMENDATIONS

GROUP RECOMMENDATIONS

A single, joint, recommendation made to a group of people, intending to do an activity together:
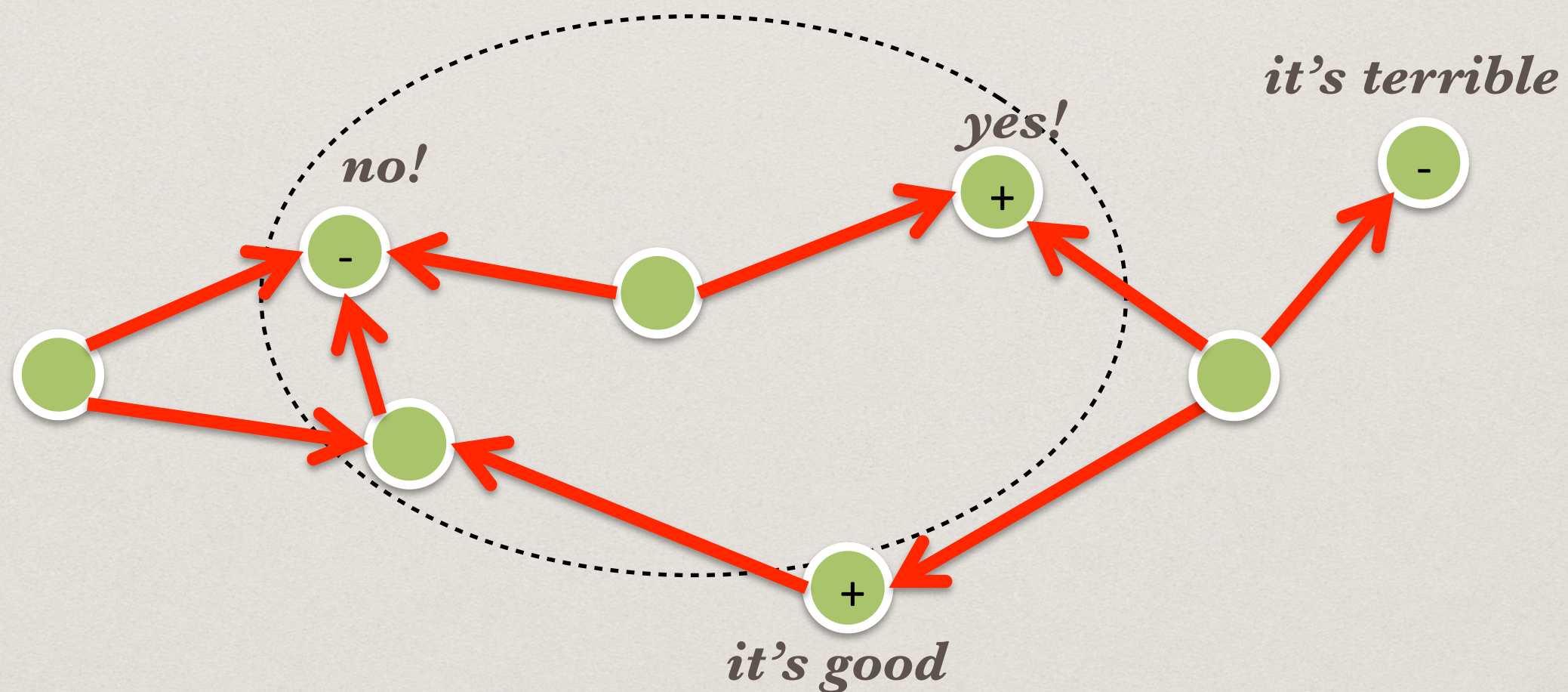
Restaurants

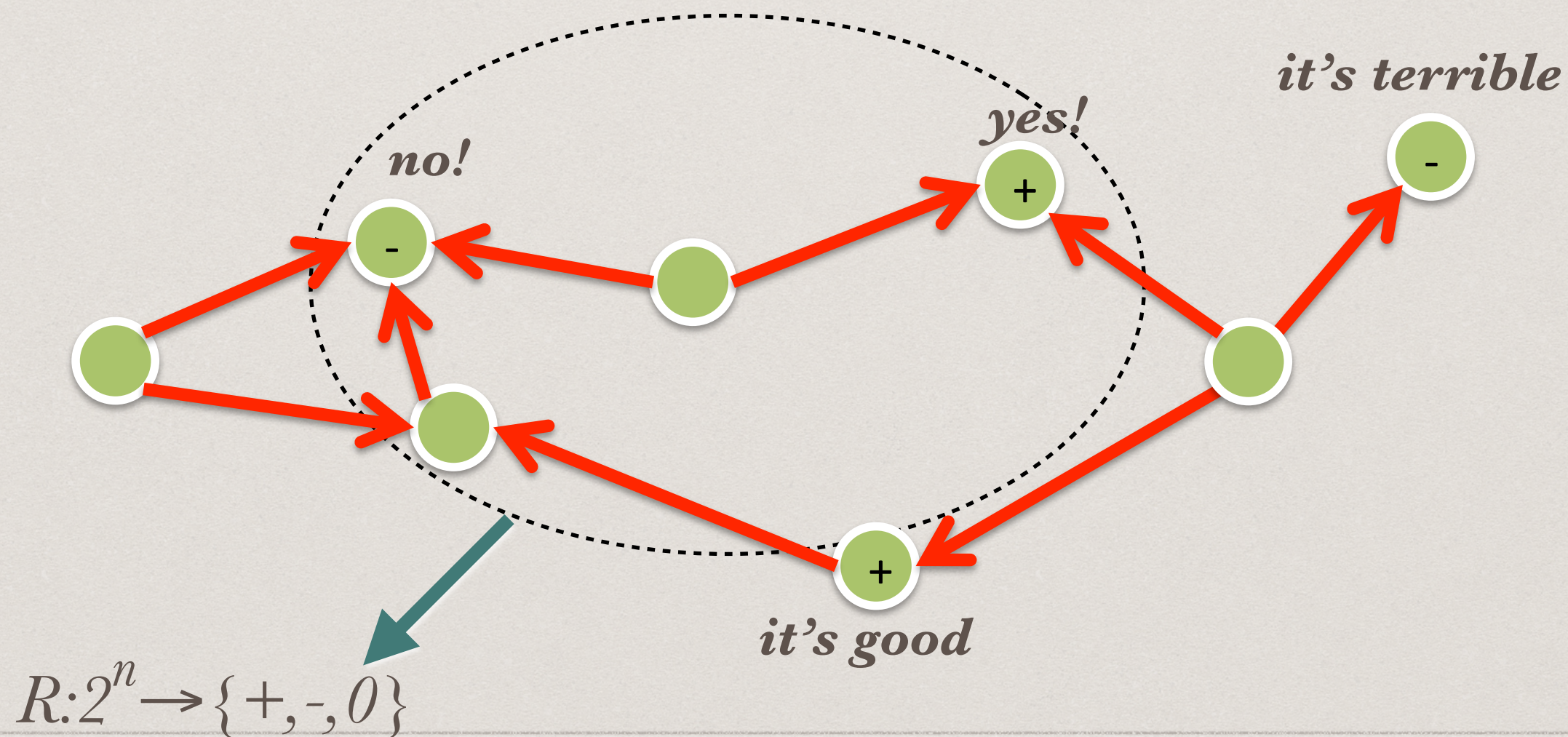Vacation destination

Movies

Book club

Computer (& Xbox) games

MIND THE GRAPH - LET'S GO TO DINNER: IS THAT RESTAURANT ANY GOOD?

Opinionated members of the social graph have differing recommendations…

MIND THE GRAPH - LET'S GO TO DINNER: IS THAT RESTAURANT ANY GOOD?

A recommendation gives the group "+", "-", or 0.
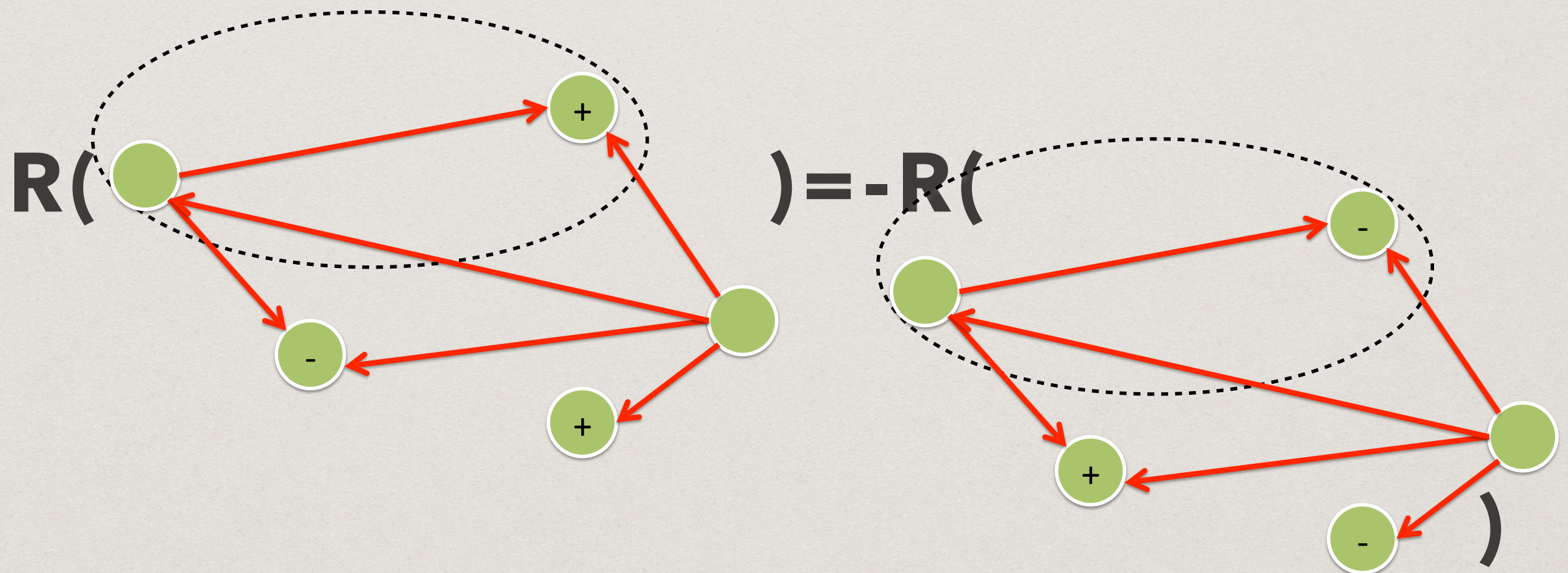

$$R:2^n \rightarrow \{+,-,0\}$$

AXIOMATIC APPROACH

Defining the properties of the system we desire, and build a system using them, instead of accepting the problems and limitations of the system we have thought of.
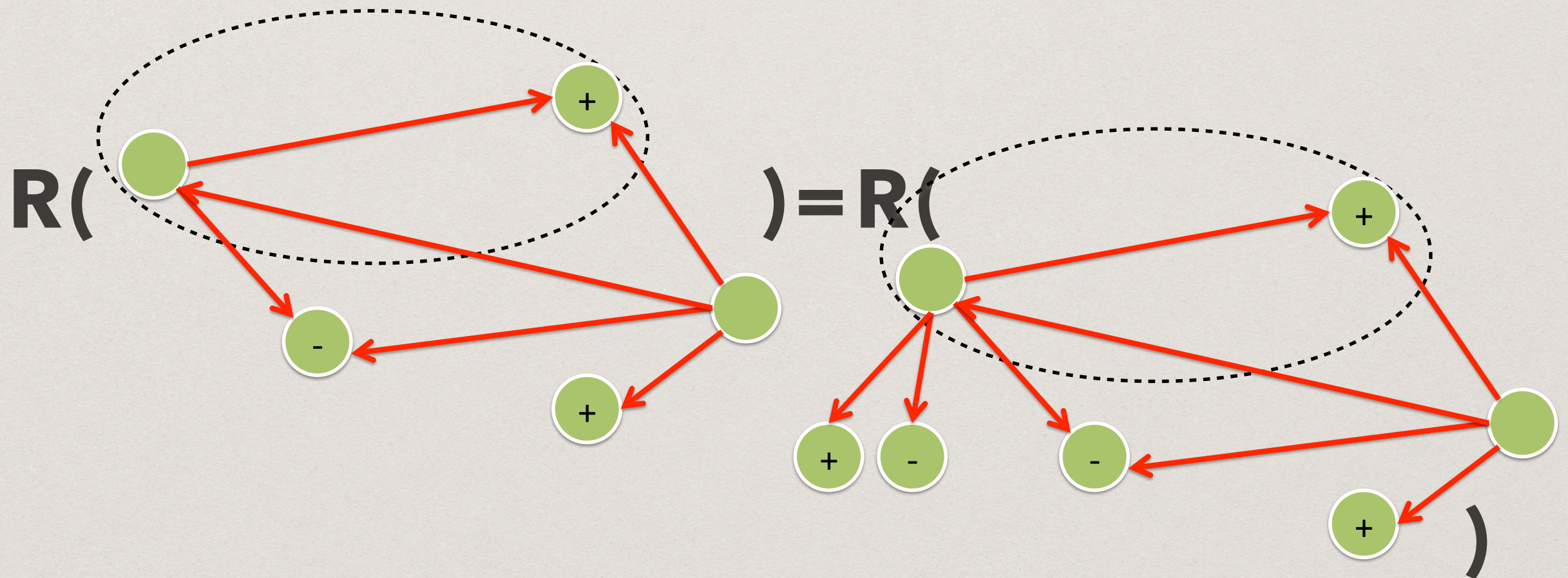
BASIC AXIOMS

AXIOM I: ANONYMITY

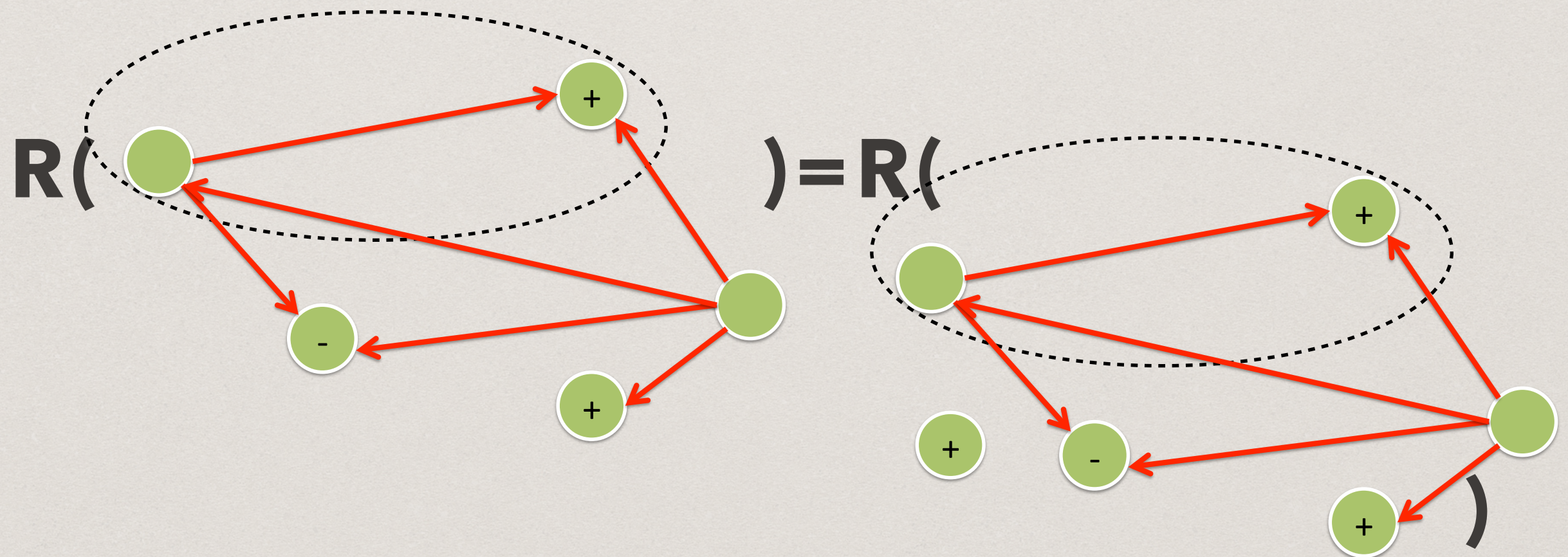Isomorphic graphs have isomorphic recommendations.

AXIOM II: POSITIVE RESPONSE

If recommended "+", adding a "+" node doesn't change the recommendation. Adding a "+" and "-" connected to the same node doesn't change recommendation.

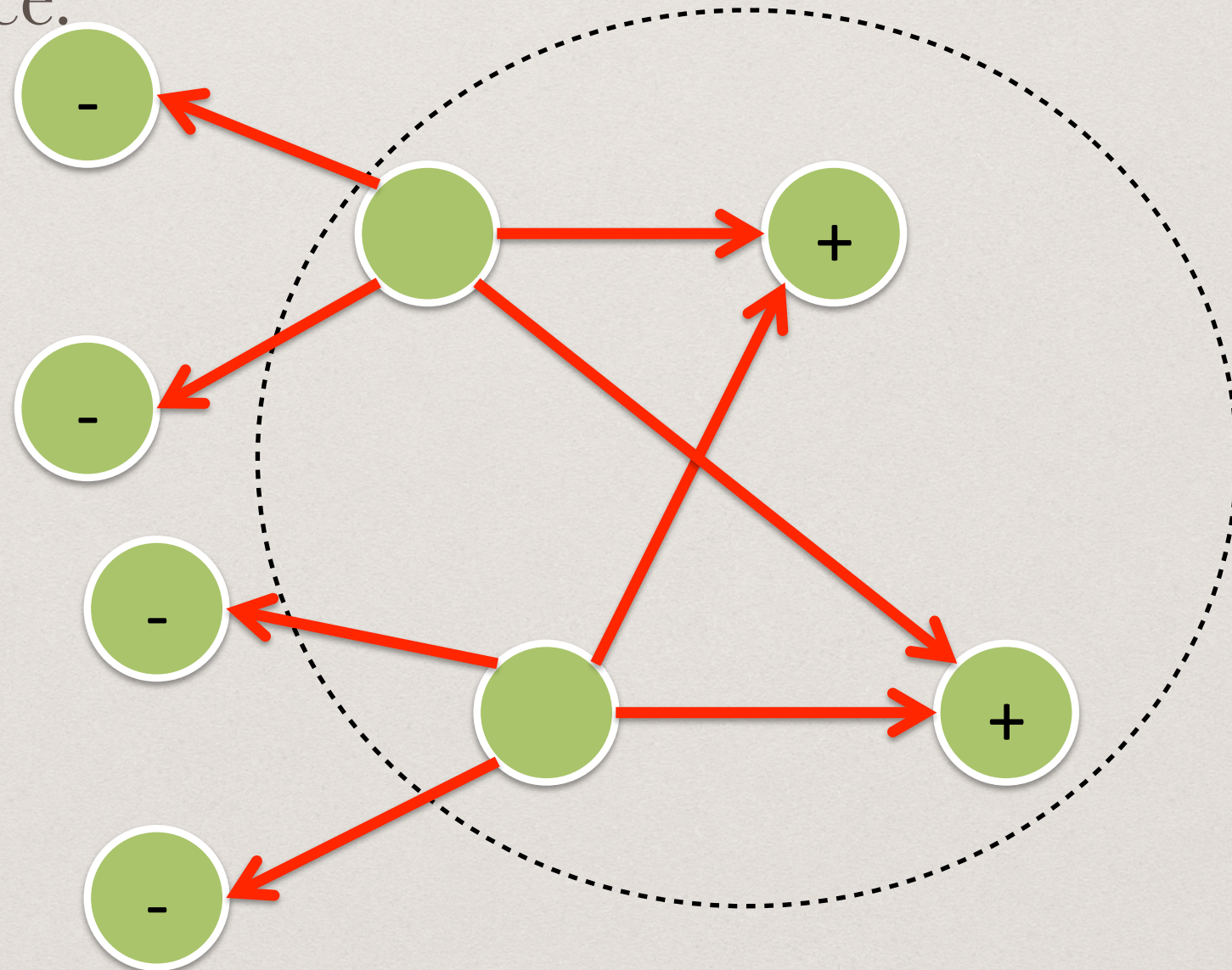# AXIOM III: IIS (INDEPENDENCE OF IRRELEVANT STUFF)

Adding unconnected nodes does not effect the recommendation.
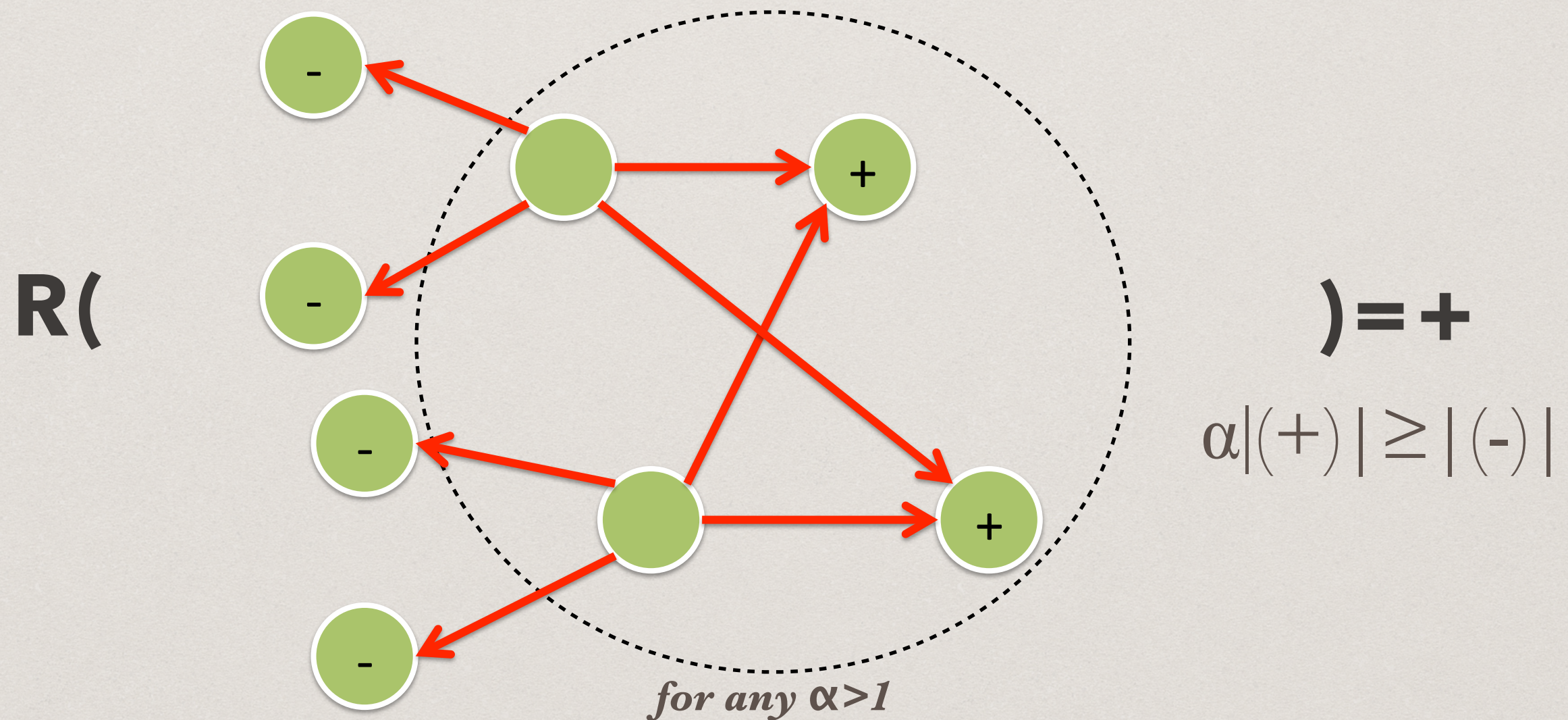
GROUP POWER AXIOMS

STAR GROUPS

Groups which are internally homogenous, with opposite outside influence.

AXIOM IV: α-CENTRIPETAL

Opinionated nodes in the recommended group have a larger influence on the recommendation than those outside it.

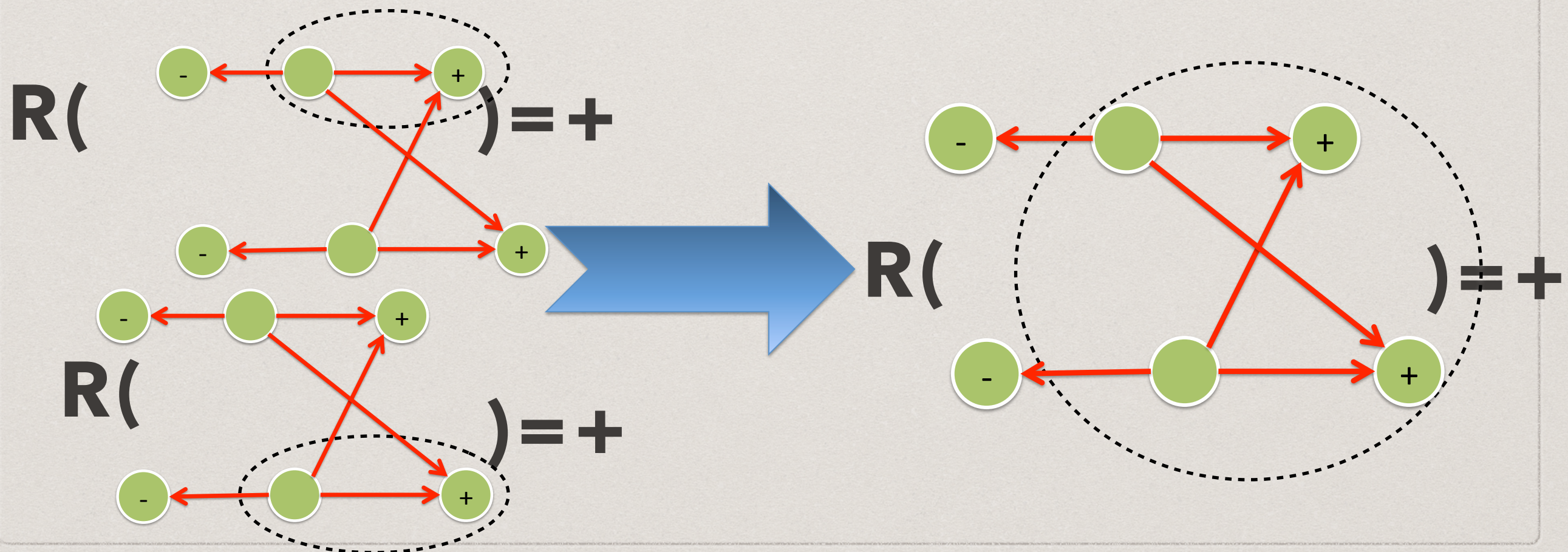**R(** **)=+**

$$\alpha|(+)| \geq |(-)|$$

for any α>1

AXIOM V: (β,r)-CENTRIFUGAL

The opinionated nodes in the recommended group do not always determine the recommendation, depending on the ratio of undecided to decided voters (r).

$$R(\quad)=-$$

$$\beta|(+)| \leq |(-)|$$

for r>1 and β<1.5
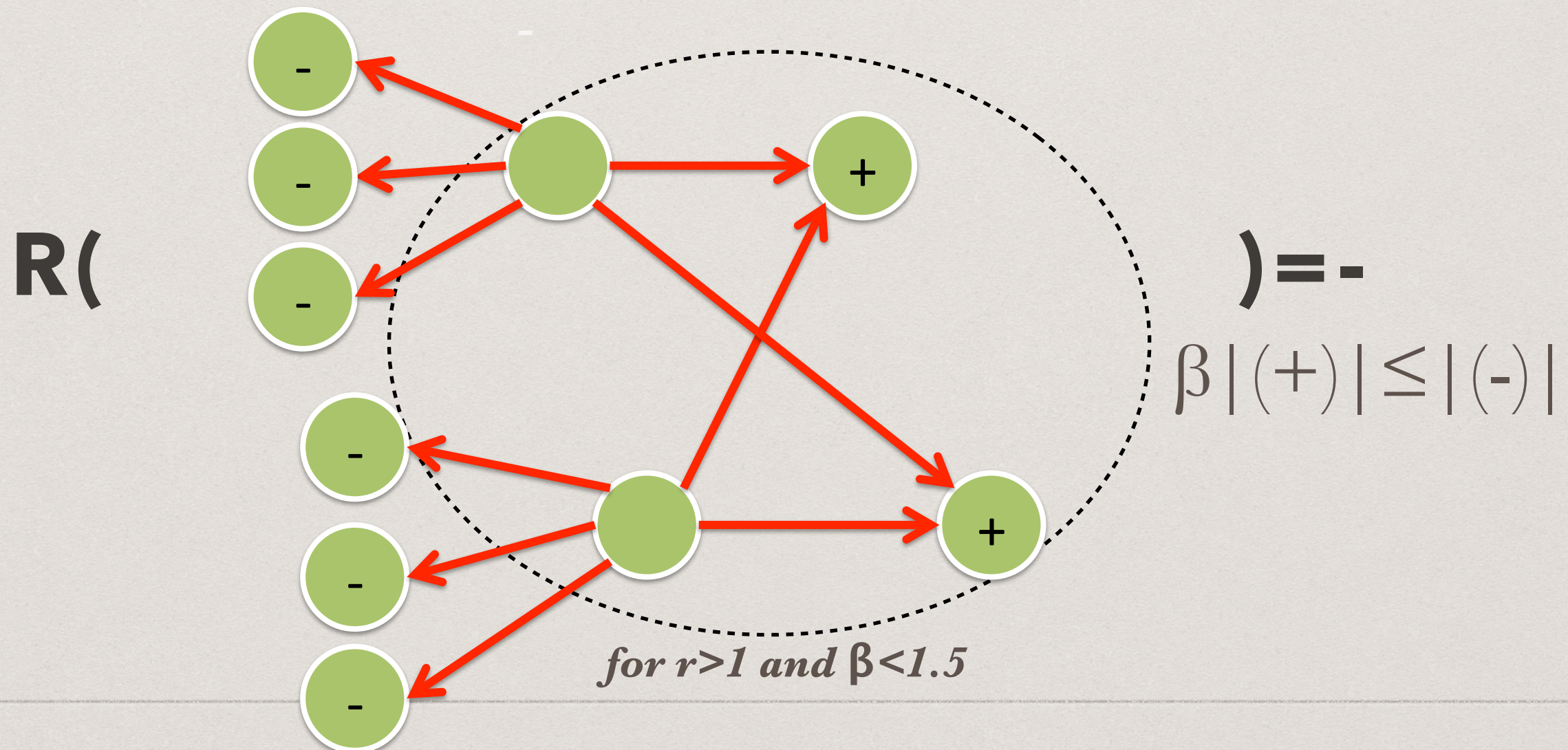
AXIOM VI: INTERNAL CONSISTENCY

If all unanimous disjoint divisions of a group have the same (none 0) recommendation - that should be the group's recommendation.

What recommendation system supports all these axioms?

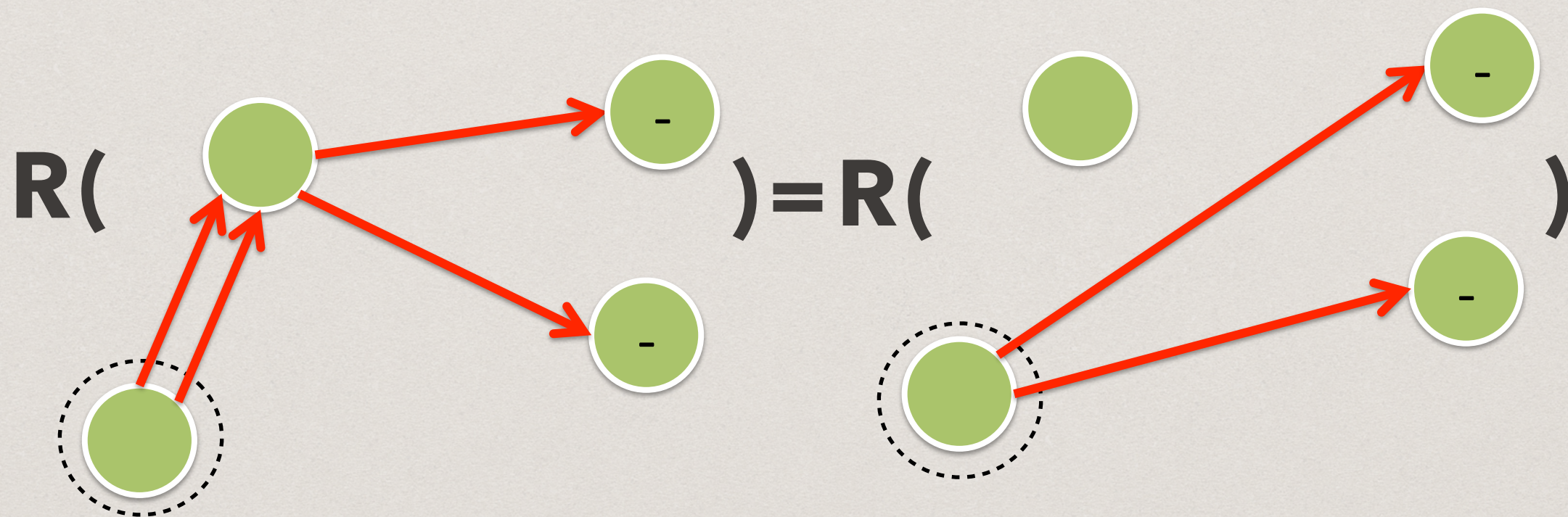**NONE!**

IMPOSSIBILITY THEOREM

Axioms 1-6 are not compatible: No recommendation system can ensure all 6.
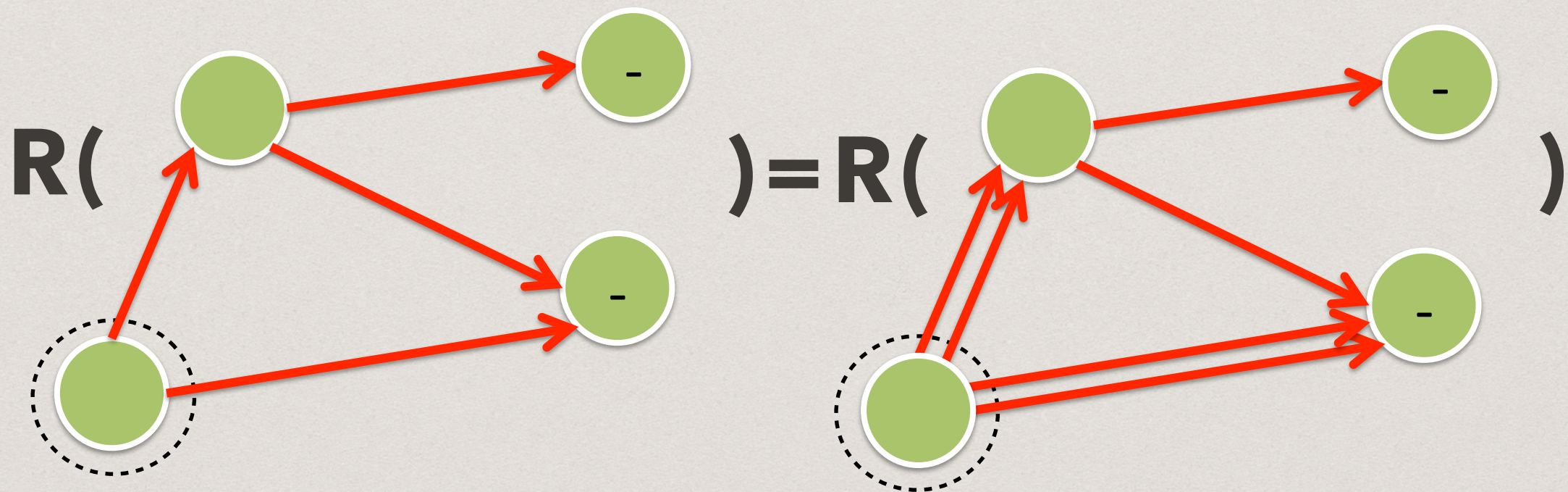
INFLUENCE STRUCTURE AXIOMS

AXIOM VII: TRUST PROPAGATION

Trusting an undecided node outside the recommended group is like trusting the nodes it trusts.

AXIOM VIII: SCALE INVARIANCE

Multiplying all edges from a node does not influence the recommendation.

AXIOM IX: PROPORTIONAL INCLUSIVENESS

An opinionated node outside the recommended group, connected to an undecided node inside it, has an influence with relation to its significance on the undecided, and the nonvoter's in the group.
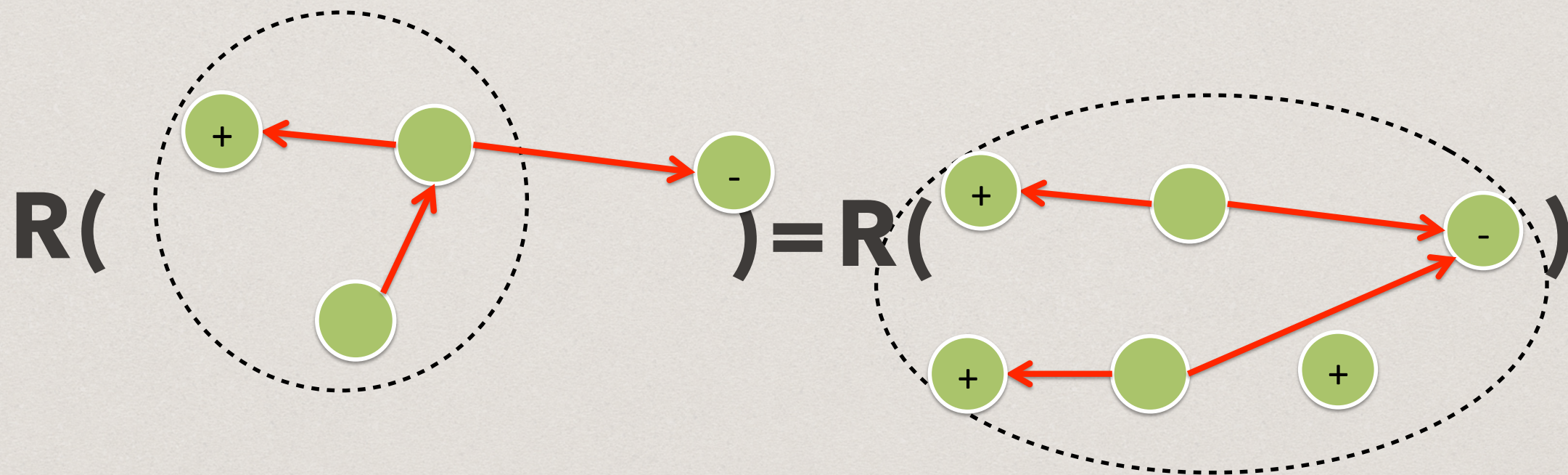
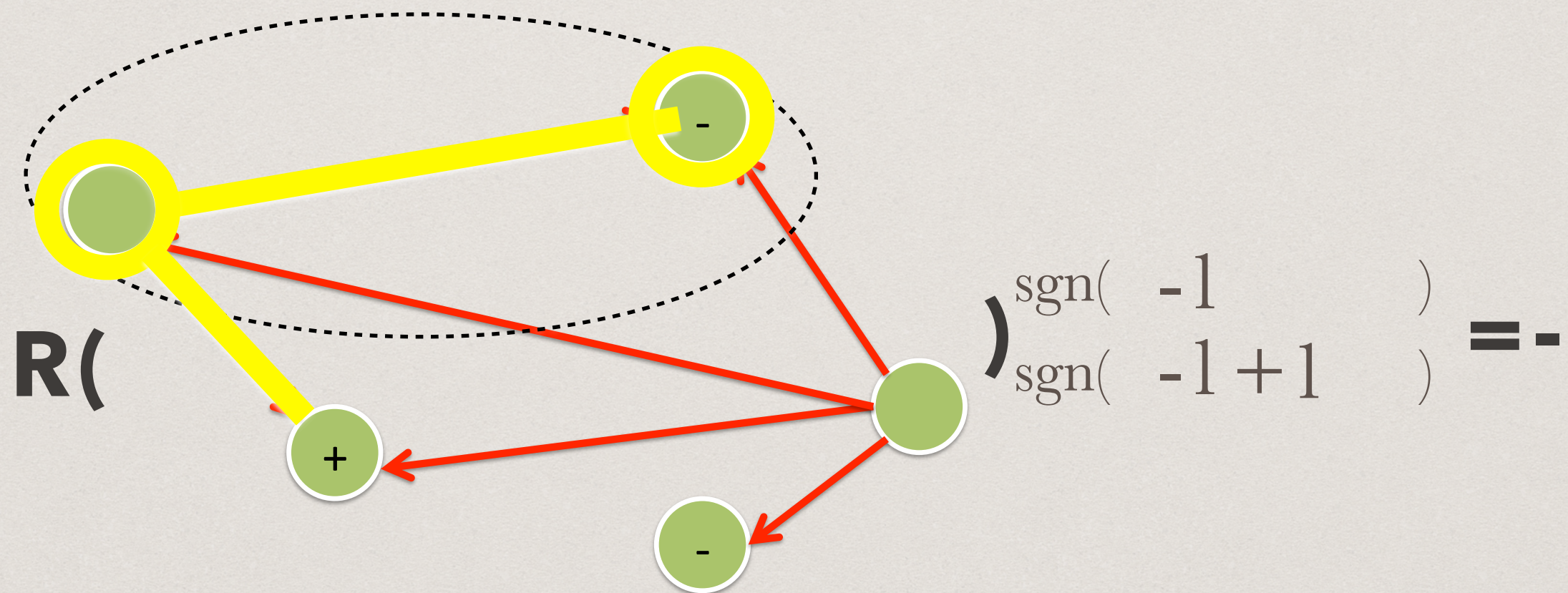*What recommendation system supports these axioms?*

RANDOM WALK

Well, a group variant of it…

THEOREM II

Axioms 1-3 and 7-9 are satisfied by a single recommendation system — group random walk.

GROUP RANDOM WALK

FUTURE WORK

Expand the use of the social graph in group recommendation settings.

Axiomatizing other recommendation systems.

Finding further desirable features of group recommendation systems

The End

Some recommendations don't work out very well…

Thanks for listening