Games as Systems

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Administrative Stuff

- Exercise today
  - Meet at Erik Stemme 13.00

Games as…

- emergent systems
- systems of uncertainty
- information theory systems
- systems of information
- cybernetic systems
- game theory systems

- Chapter 5 in the book
  - And chapters 14-19 in *Rules of Play*

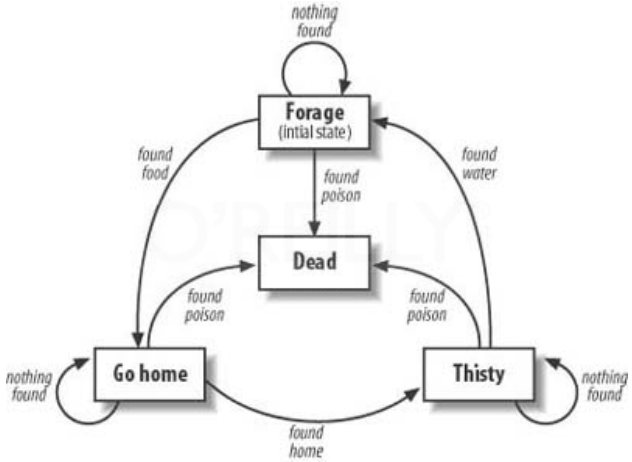
Exercise: No Thanks!

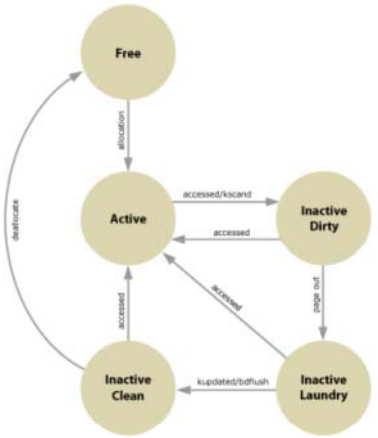
Systems: basic concepts

- *"Set of interacting or interdependent entities"*
- *Open* and *closed* systems
- System
  - Objects
  - Properties
  - Behaviors
  - Relationships
- Economies
  - Exchange of something (e.g. objects)
  - Agents of exchange
  - Methods of exchange (actions)

Systems: basic concepts

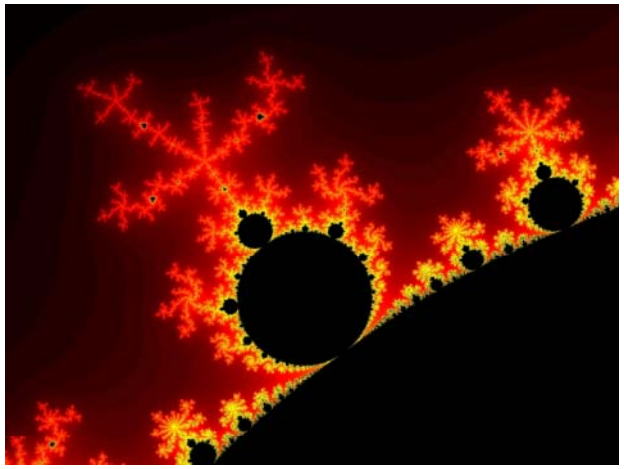
- State machine
  - State
    - Initial
    - End
    - Goal
  - Events (or rules)
    - update the state
    - can be initiated by actions from players or previous events





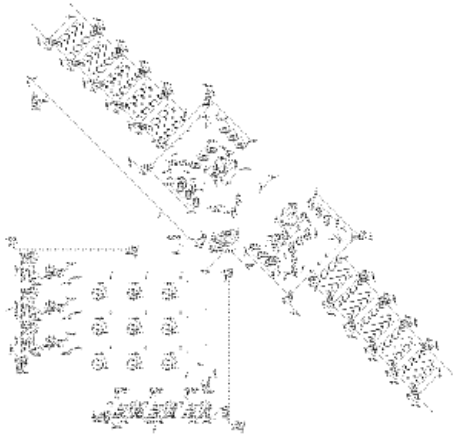
Games as emergent systems

- Types of systems
  - Fixed
  - Periodic
  - Complex
  - Chaotic
- *Emergent systems* generate unpredictable patterns of complexity
  - 1+1=3 (the sum is more than the parts)
  - Coupled and Context-dependent
  - (*Orthogonal Unit Differentiation*)
- Players can create emergence
  - Bluffing in Poker
- Second-order effect
  - as gameplay



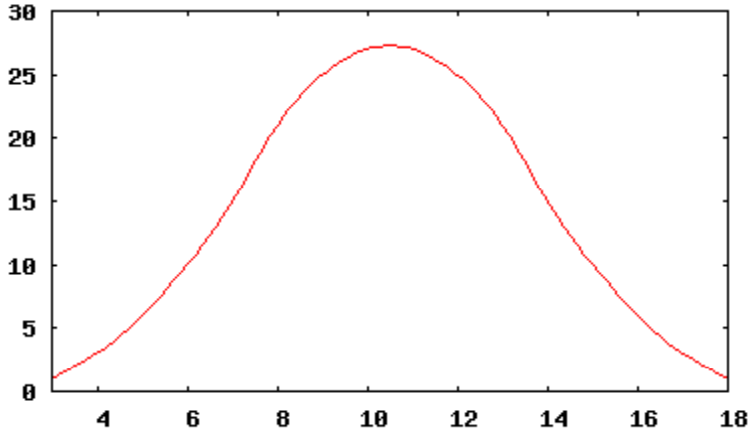
Example: Game of Life

- Rules to apply per turn
  - 'populated‘ spaces
    - Neighbors <= 1 -> remove
    - Neighbors >= 4 -> remove
  - 'empty‘ spaces
    - Neighbors = 3 -> add
- Turing equivalent



Games as systems of uncertainty

- Probability
- Risk
- Key component
  - Otherwise players' actions not interesting
- Feeling of randomness
- Determines importance of planning ahead
  - *Analysis Paralysis* and *pure chance*



Games as information theory systems

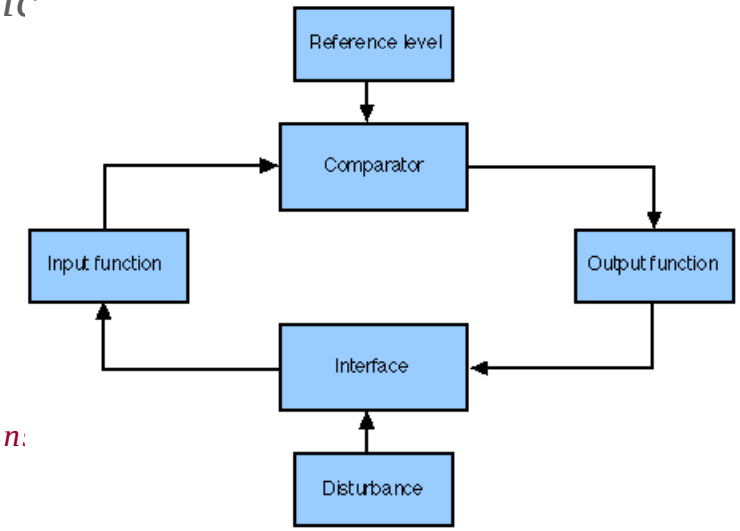
- Information theory
  - *Entropy* – (average) number of bits required for storing or transmitting
  - Source coding – storing information in a state (as *compact* as possible; assumes a *context*)
  - Channel coding - Redundancy (possibility to *extract correct information from partial sources*)
  - Information doesn't measure meaning (in this theory)
- *Exformation*
- Passing information usually means introducing noise
- Uses for games
  - Goal to state information (Mastermind)
  - Entertainment due to noise effect (Telephone game)
  - Make risk/reward choices regarding level of redundancy

Games as systems of information

- Availability
  - Known to all
    - Perfect information games
  - Known to some
    - Imperfect information games
  - Known to the system
  - Randomly generated
- Value of information depends on its relation to other units of information
- Objective information and perceived information

Games as cybernetic systems

- *"the science of communication and control theory that is concerned especially with the comparative study of automatic control systems"*
- Components
  - A *sensor*
    - which provides input to
  - A *comparator*
    - which directs a
  - An *activator*
    - that changes the environment detected by the *sen*
- *Negative feedback* loop
  - Bring the sensor value to a stable value
- *Positive feedback* loop
  - Bring sensor value to an extreme value



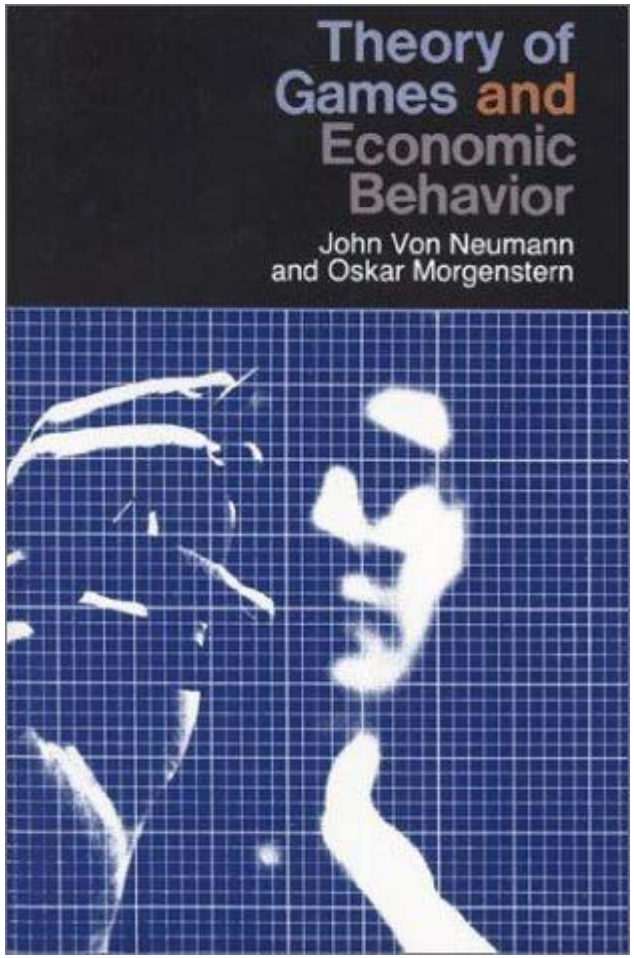
Games as cybernetic systems, cont.

- Uses in games
  - Negative feedback
    - Stabilized the game
    - Prolongs the game
    - Magnifies late successes
  - Positive feedback
    - Destabilizes the game
    - Shortens the game
    - Magnifies early successes
- *Feedback loops can be emergent features*
- Feedback system take control away from players
- Dynamic Difficulty Adjustment

Games as game theory systems

”Theory of rational behavior for interactive decision problems. In a *game*, several agents strive to maximize their (expected) utility index by choosing particular courses of action, and each agent's final utility payoffs depend on the profile of courses of action chosen by *all* agents. The interactive situation, specified by the set of participants, the possible courses of action of each agent, and the set of all possible utility payoffs, is called a *game*; the agents 'playing' a game are called the *players*.”

From: Von Neumann, J. & Morgenstern, O. *Theory of Games and Economic Behavior*



Games as game theory systems

- Branch of economics that studies rational decision making
  - Game-like situations
  - Concerned with modeling and/or predicting agent behavior
- Decision trees
  - Game takes place in turns
  - Finite decisions with knowable outcomes
  - Finite game
- *Bounded rationality*
- Outcomes in games measured in by a *utility* function
- Zero-sum games
- Saddle points
  - Consistent best solution for (all|both|one) players
  - Degenerate strategies

	Confess A	Stay quiet A
Confess B	6 / 6	10 / 0
Stay quiet B	0 / 10	2 / 2

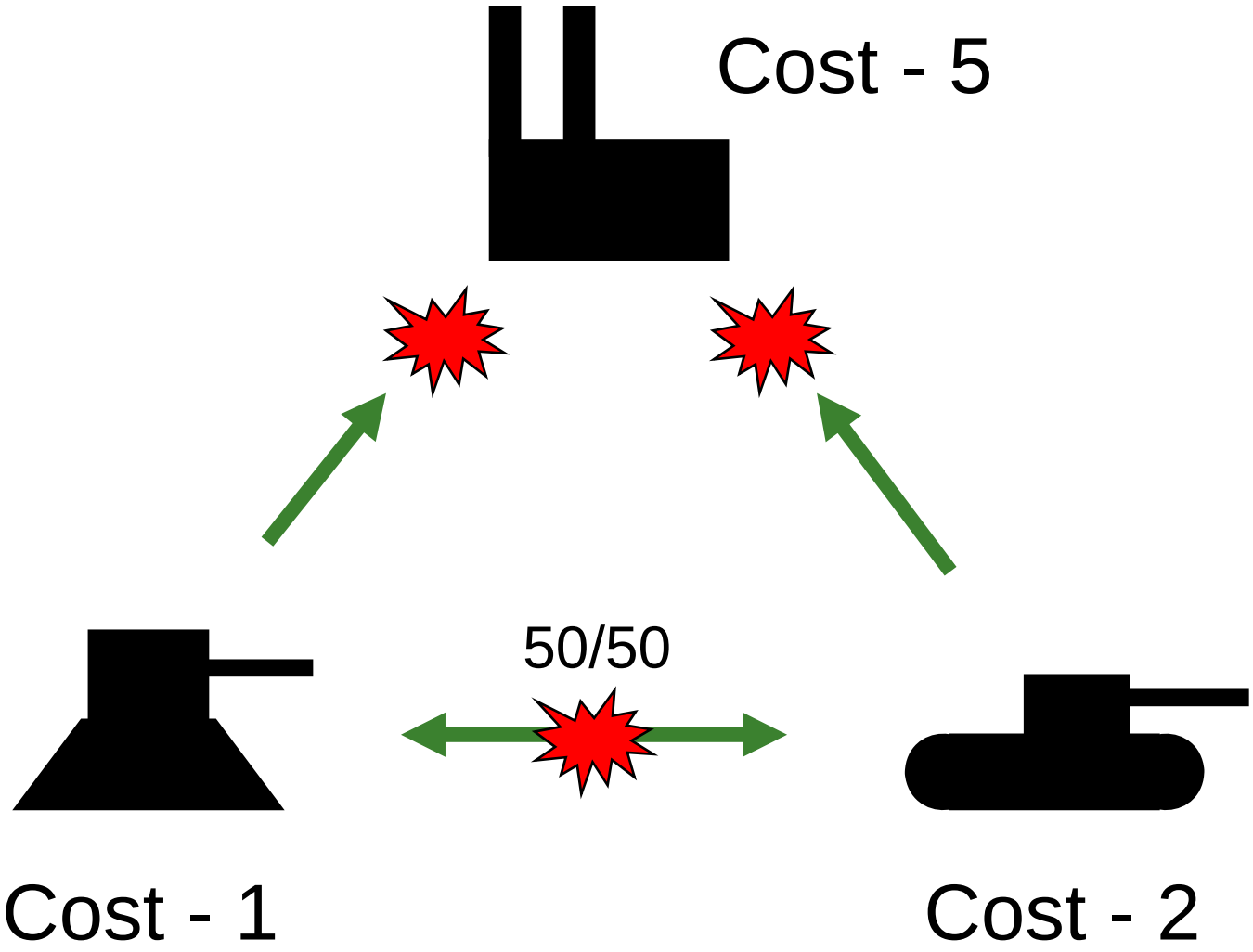
Example: SimWars

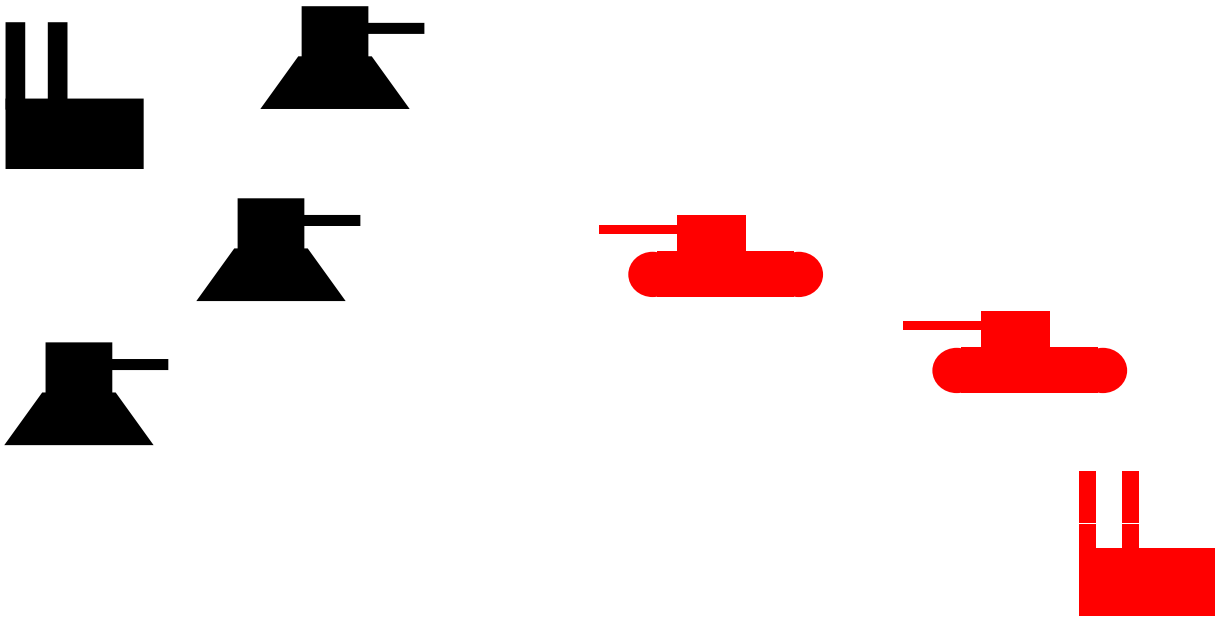
SimWar

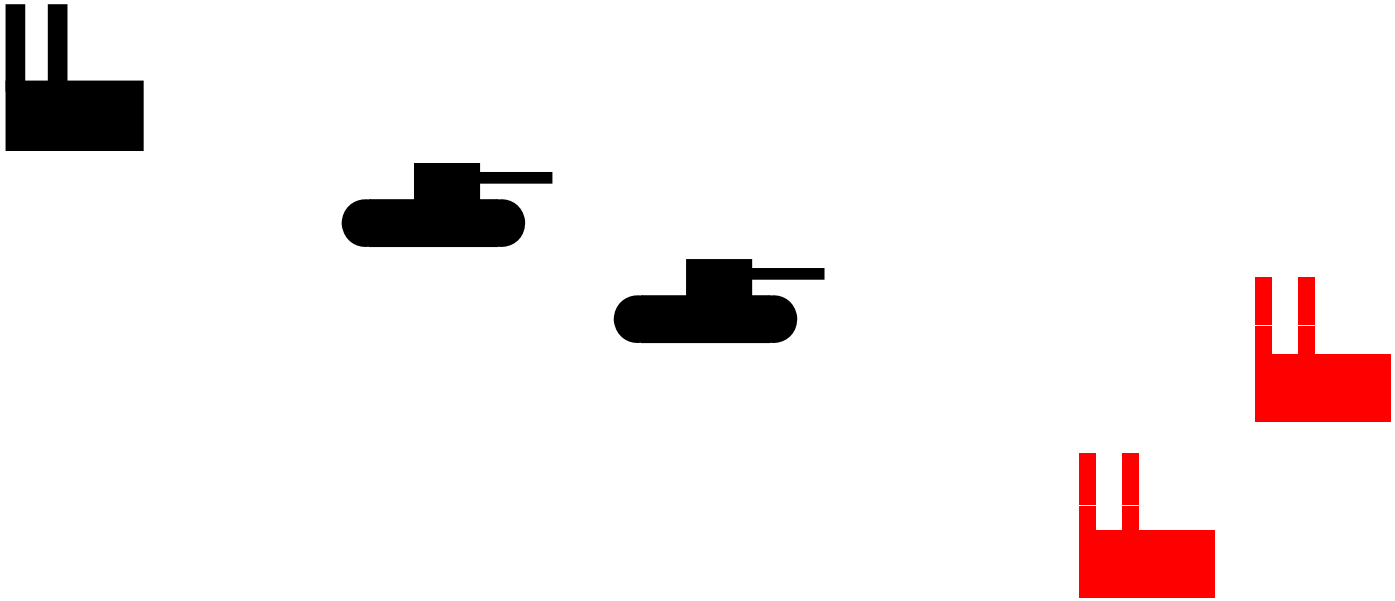
-Production

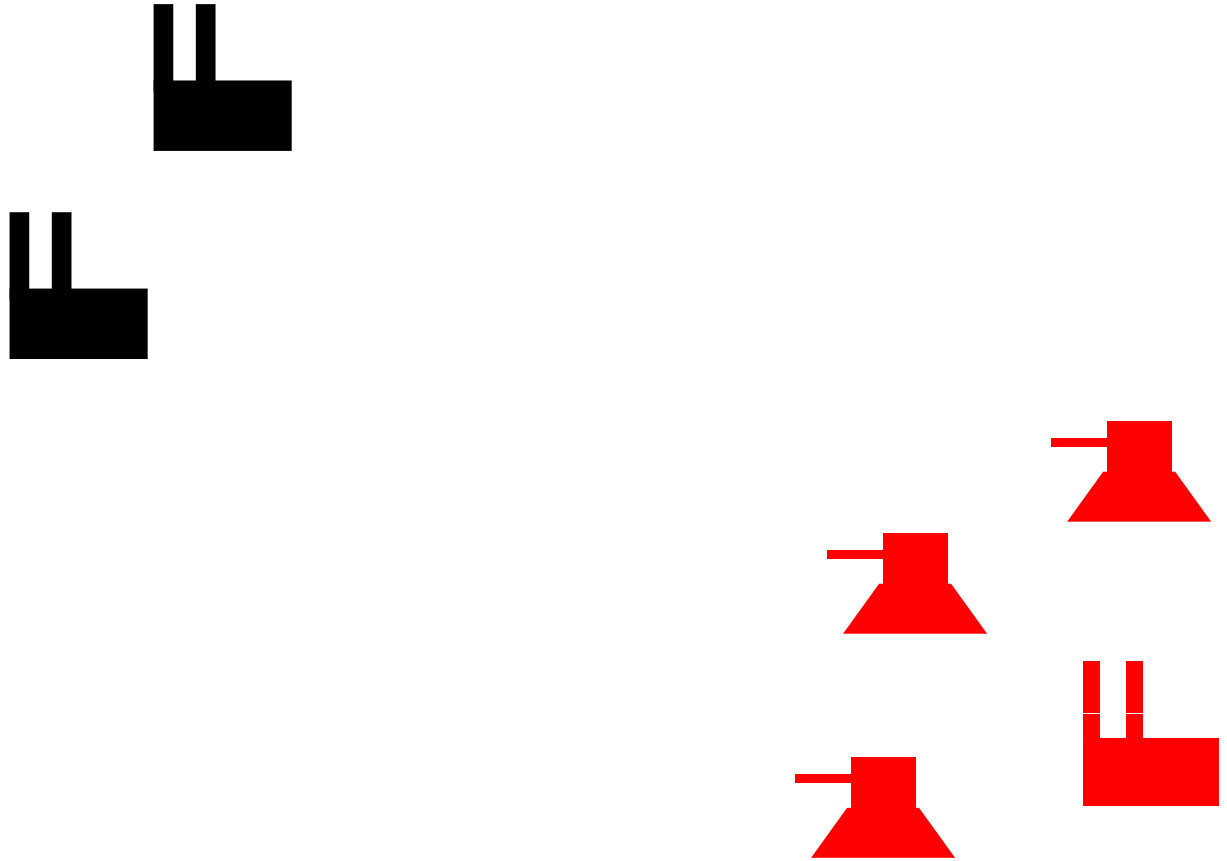
-Offense

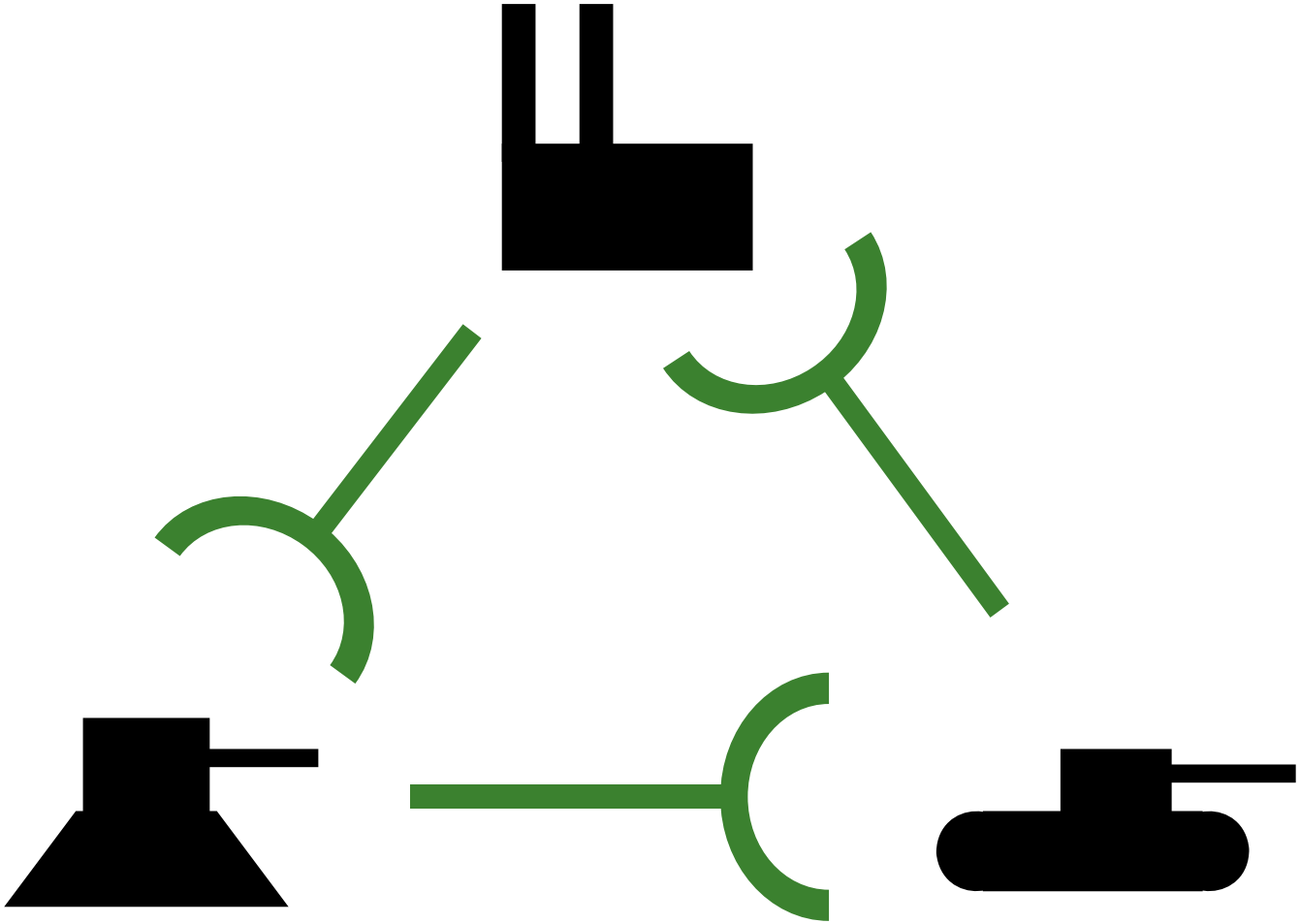
-Defense


Cost - 5
50/50
Cost - 1
Cost - 2

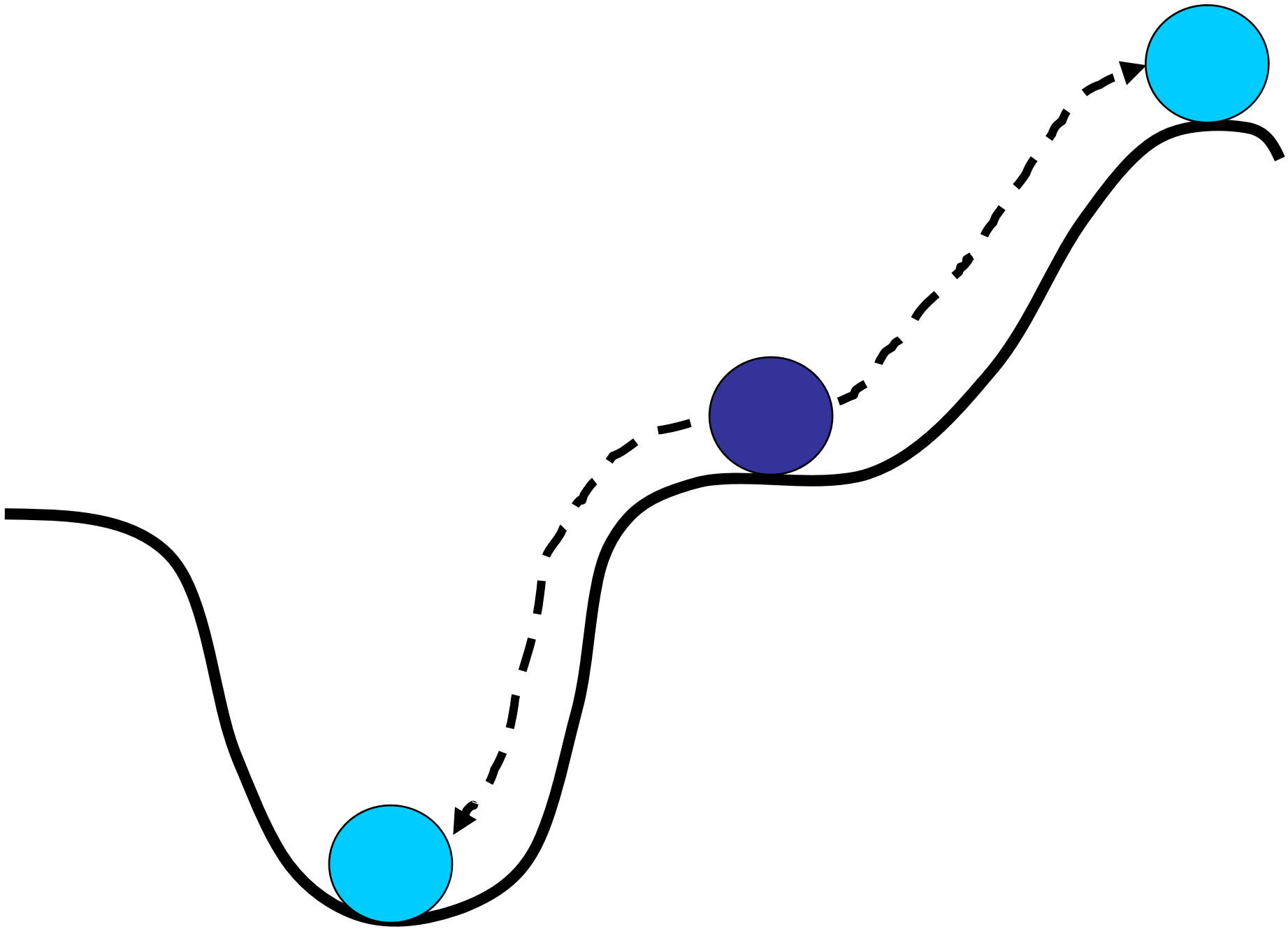


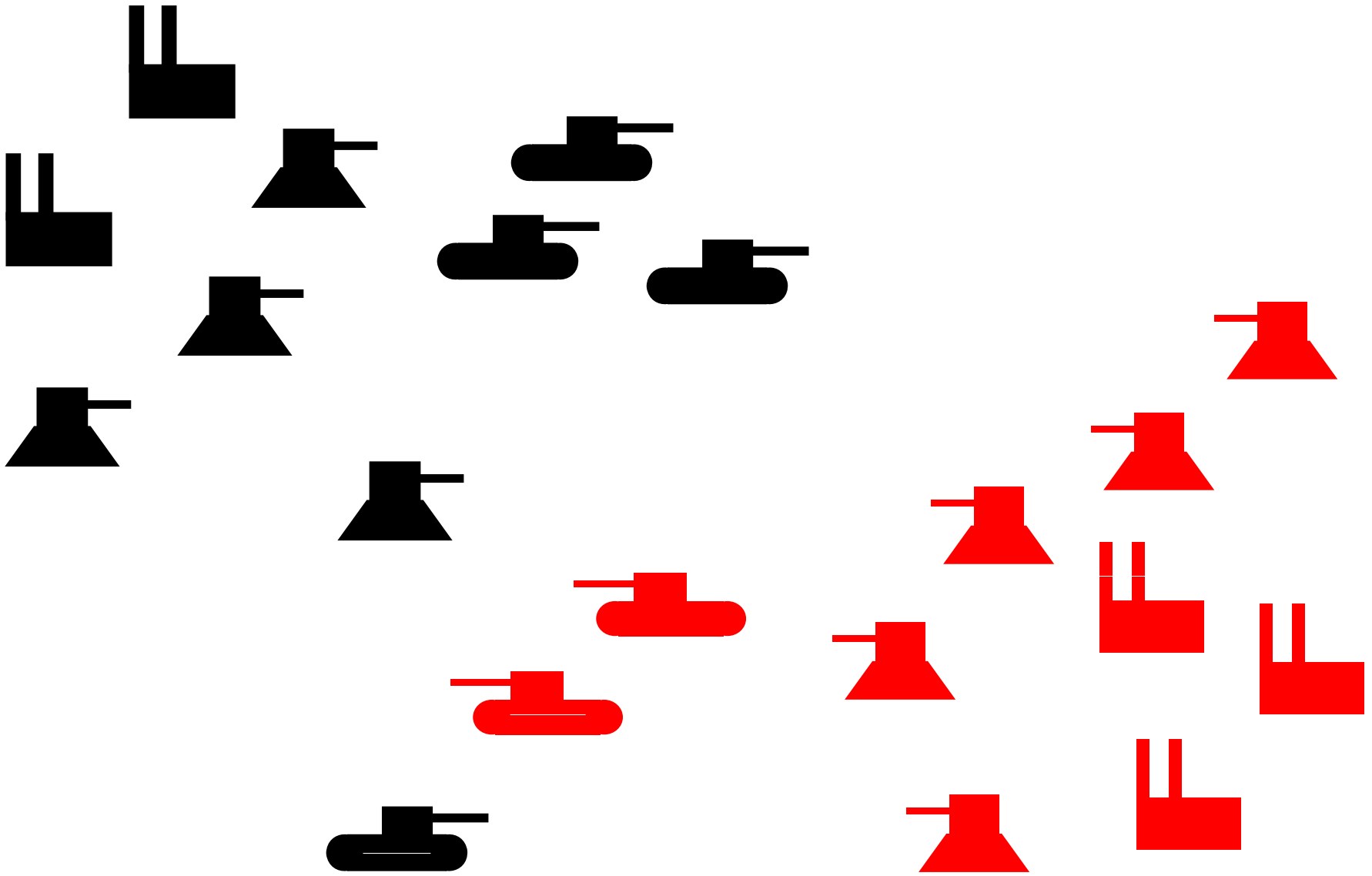




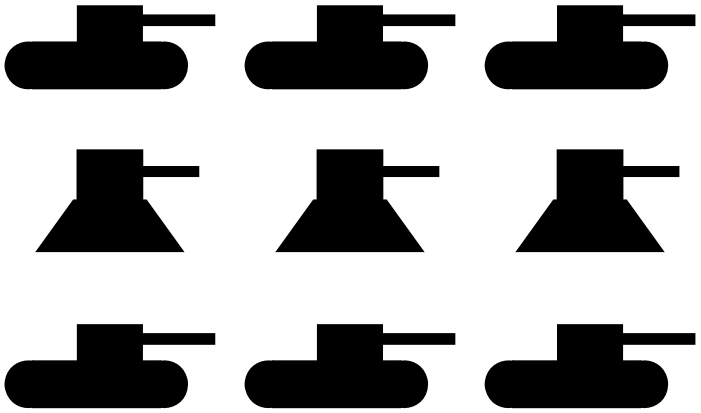


avoid strategic convergence

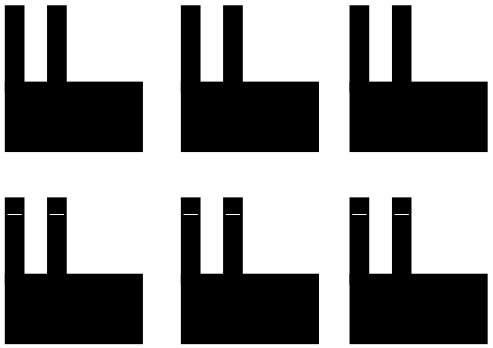




Short term

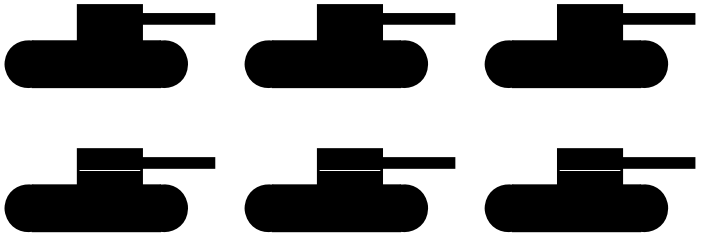


Long term

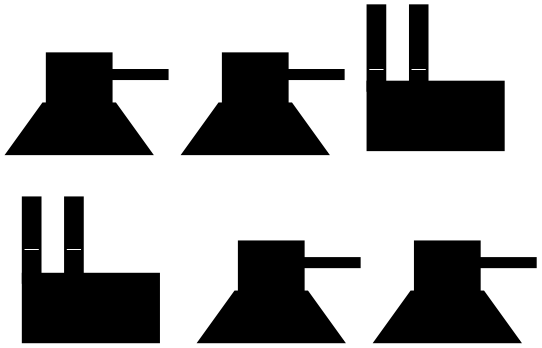


Risk - Reward

High



Low



Thank you!