UNITED STATES MILITARY ACADEMY
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Research Games as Network Generators

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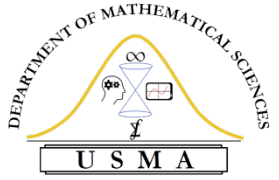


Agenda

- Network Generators
- Serious Games
- Results

Network Generators

Networks consist of sets of nodes V and edges E. Edges may be directed or undirected.

Examples of real networks include:

- Neural connections in the brain
- Infrastructure grids
- Social interaction
- The water cycle
- Data storage and retrieval
- And so much more…

Network Generators

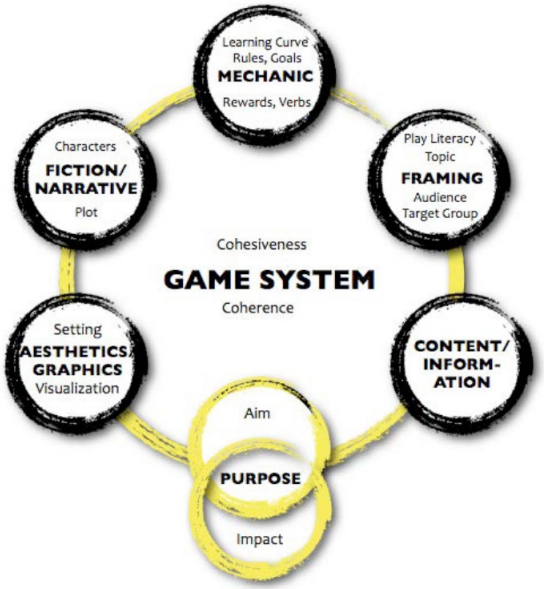
Network generators create synthetic networks by various processes.

1. Erdös-Rényi (1959)
2. Random Geometric models
3. Watts-Strogatz (1998)
4. Barabási-Albert (2002)

And more recent, temporally-focused generators using techniques such as *data infusion*, controlling the expected degree distribution, and motif presence.

Games

- *Serious games* are games played for reasons other than entertainment
- *Research games* are games used for research purposes and incorporate player feedback at the start of game design



We assess game design in various ways, including the Serious Game Design Assessment Framework.

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Games

Macro Game Design

- Synthetic networks mimic expected real communication networks
- Synchronize game mechanics with approachability

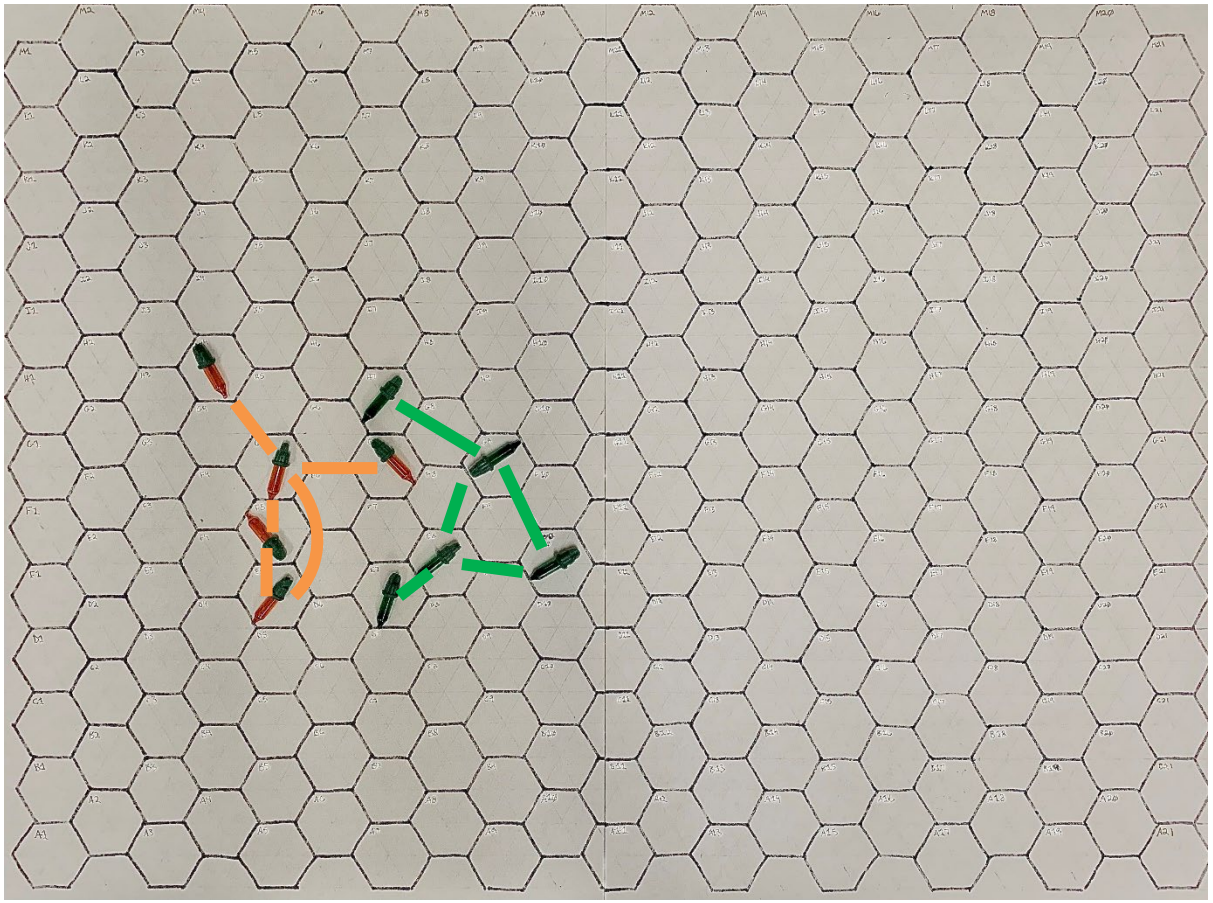
Micro Game Design

- Hexagonal board with alphanumeric encoding
- Primary goal: Defeat the opponent
- Data generation incentivized through attack boost mechanic

Key Design Refinements

- Adjust micro parameters related to movement, attack/defense strength, and attack distance
- Video-based rules explanation

Results



Results

Using the Data

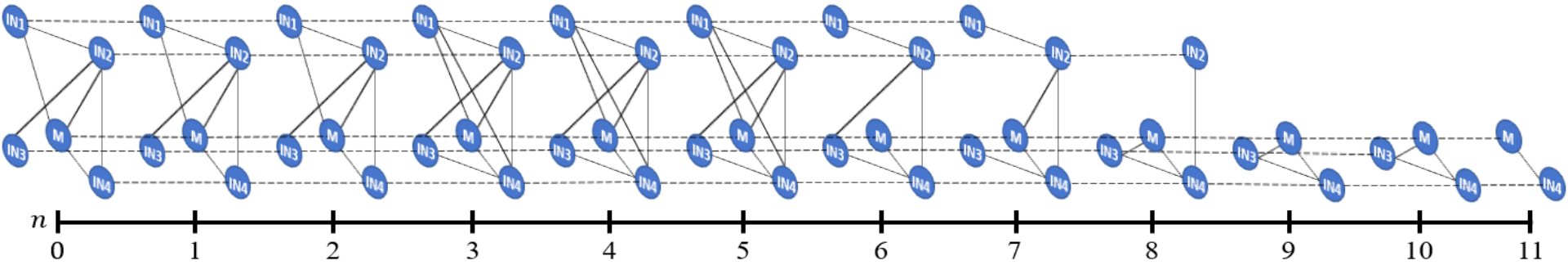
- Moves verbalized and logged in ledger
- Distances measured to create snapshots

$$d_{i,j} = |\Delta x| + |\Delta \mathrm{y}|$$

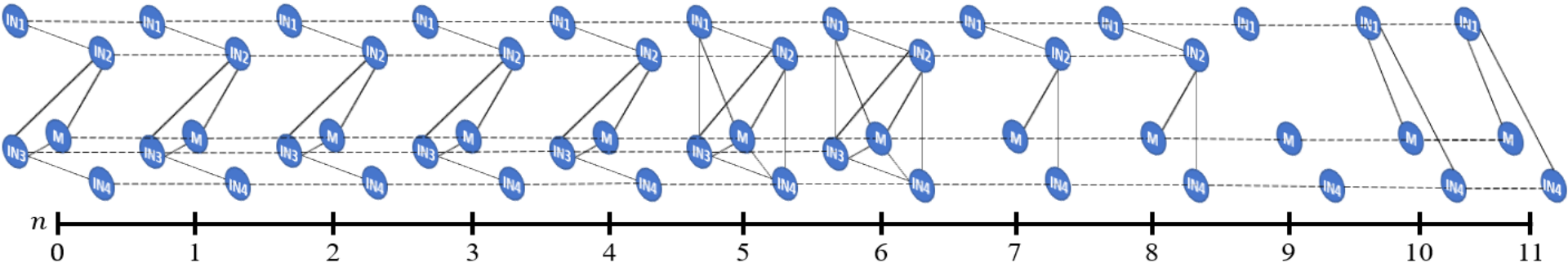
- Intralayer edges added; nodes deleted
- Centrality measurements

$$\overline{b_i} = \frac{\sum_n b_i}{|N|} \qquad \mathcal{D}_i = \overline{deg_i}$$

Results



	IN1	IN2	IN3	***IN4***	M
$\overline{b_i}$	0.00	0.27	0.00	***0.22***	0.04
$\mathcal{D}_i$	1.42	2.58	1.67	***2.75***	2.33



	IN1	IN2	***IN3***	IN4	M
$\overline{b_i}$	0.17	0.38	***0.22***	0.00	0.01
$\mathcal{D}_i$	1.31	2.67	***1.92***	1.25	1.83

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Conclusion

Summary

Serious game design enabled the creation of a prototype network generator.

Future Work

- Increase scale
- Transition to digital platform
- Introduce game mechanics which yield multilayer networks
- Imperfect information

Conclusion

Questions