Numerical Methods I:
Lecture XI: Solving Monopoly with Linear Algebra

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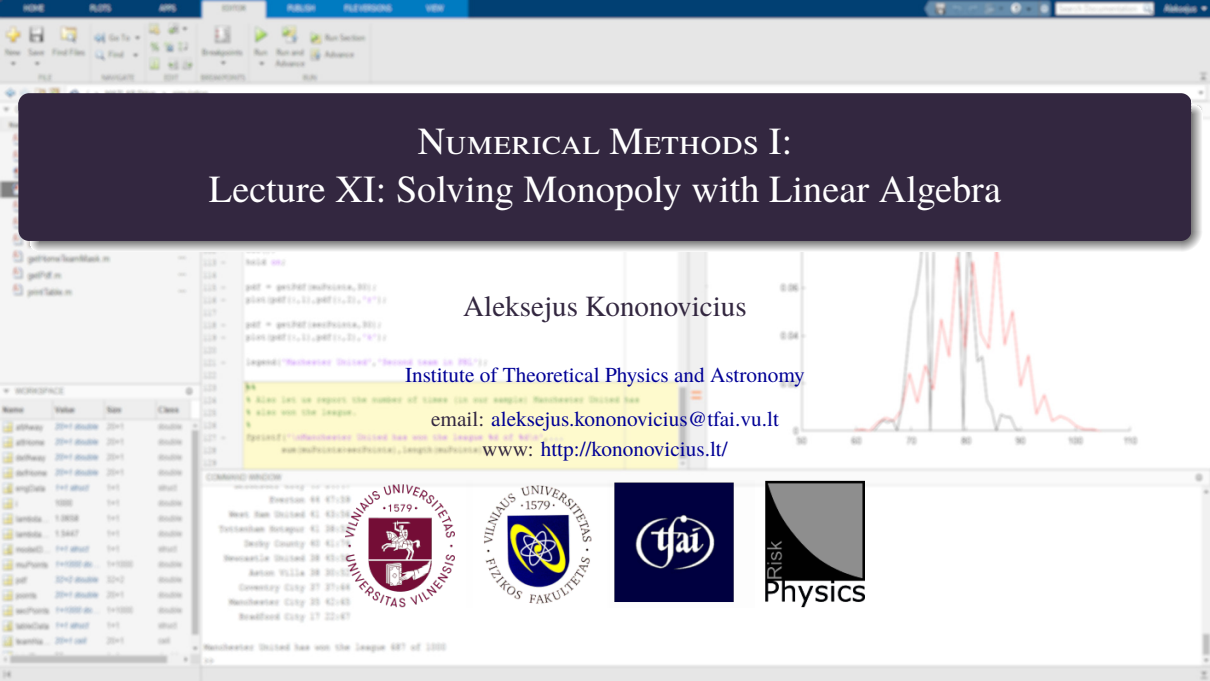
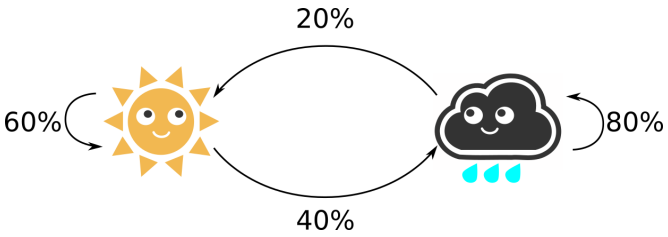


Last time: Markovian weather model



Transition matrix:

$$\mathbf{T} = \begin{bmatrix} 0.6 & 0.2 \\ 0.4 & 0.8 \end{bmatrix}.$$

State updating:

$$\vec{s}_{t+1} = \mathbf{T}\vec{s}_t.$$

What is our weekly forecast? Given that today is sunny, $\vec{s}_1 = \begin{bmatrix} 1 \\ 0 \end{bmatrix}$:

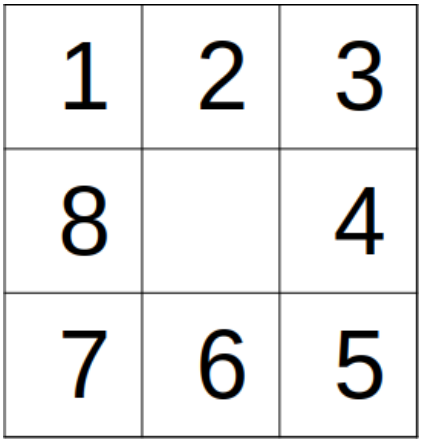
$$\vec{s}_i = \mathbf{T}\vec{s}_{i-1} = \mathbf{T}^2\vec{s}_{i-2} = \ldots = \mathbf{T}^{i-1}\vec{s}_1.$$

Images (modified): @Flaticon, Yug@Wikimedia

“Solving” linear game

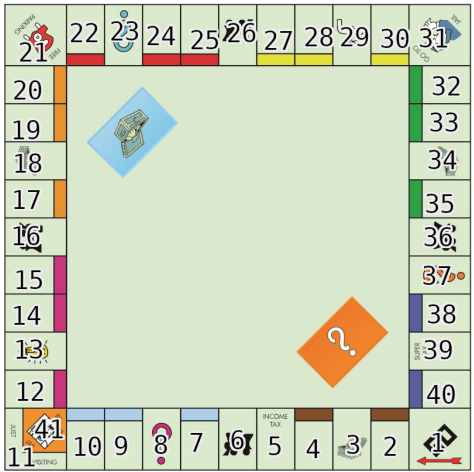
- We have linear game track.
- We roll a single standard six-sided die.
- When the game will end?

“Solving” looping game



- We have looping game track.
- We roll a single standard six-sided die.
- How likely we are to see a player visiting 8th square on 1st turn? 3rd? 100th? After infinite number of turns?

Monopoly is a bit more complicated game



- Two standard six-sided dice are rolled. Roll again if doubles.
- Looped track with 40 squares + special “In Jail” square.
- “Chance” (?) and “Community chest” (chest) cards.
- Complicated jail mechanics.
- Game ends as players go bankrupt.

Here “complicated” is not the same “complicated” as in games like Twilight Imperium.

“Chance” and “Community chest” cards

“Chance” cards (squares: 8, 23 or 37):

- 16 in total.
- “Go to’s” (10 cards):
  - Go (1)
  - Reading Railroad (6)
  - St. Charles Place (12)
  - Illinois Avenue (22)
  - Boardwalk (40)
  - Jail (41)
  - Nearest utility (13 or 29)
  - Nearest railroad (6, 16, 26 or 36)
  - Nearest railroad (6, 16, 26 or 36)
  - Back 3 spaces (5, 20 or 34)

“Community chest” cards (3, 18, 34):

- 16 in total.
- “Go to’s” (2 cards):
  - Go (1)
  - Jail (41)

Next time interpolation and extrapolation!