**Description of Supplementary Files**

**File Name:** [Supplementary Video 1](https://static-content.springer.com/esm/art%3A10.1038%2Fs41467-019-08987-4/MediaObjects/41467_2019_8987_MOESM3_ESM.mov)

**Description:** Video showing the visuals of the Atari Pinball game together with the heatmaps computed by LRP. The agent moves the ball into a scoring switch four times to activate a multiplier and then maneuvers the ball to score infinitely. The heatmap shows that the flippers > Seite 2/2 are completely ignored by the agent throughout the entire game. The agent has learned to control the ball by “nudging” the table.

File Name: [Supplementary Video 2](https://static-content.springer.com/esm/art%3A10.1038%2Fs41467-019-08987-4/MediaObjects/41467_2019_8987_MOESM4_ESM.mov)

Description: Video showing the visuals of the Atari Breakout game together with the heatmaps computed by Sensitivity Analysis and LRP. Sensitivity Analysis explains a local variation of the agent’s decision function. It produces a result that is noisy and hard to interpret. LRP explains not a variation, but the decision function itself. It distinctly highlights the ball, the tunnel and the paddles, all of which are indeed relevant to the agent’s decision.