

For this assignment, you'll be making toy models to fit the given requirements. For each problem, draw a picture including several shapes with arrows between some of the shapes. The shapes you include will define your universe, and the arrows you draw will indicate which pairs of numbers satisfy the model's interpretation relation  $R$ . (In other words,  $R(x, y)$  means that there is an arrow pointing from  $x$  to  $y$ . Create a separate toy model for each problem. If you think that it is impossible to create a toy model fitting the requirements, you must explain why.

1. Give a toy model that satisfies  $\forall x \exists y \neg R(x, y)$  and  $\forall x \exists y R(x, y)$ .
2. Give a toy model that satisfies  $\exists x \forall y \neg R(x, y)$  and  $\exists x \forall y R(x, y)$ .
3. Give a toy model that satisfies  $\forall x \forall y \neg R(x, y)$ .
4. Give a toy model that satisfies  $\neg \forall x \exists y R(x, y)$  and  $\exists x \forall y R(x, y)$ .
5. Give a toy model that satisfies  $\neg \exists x \forall y R(x, y)$  and  $\forall x \exists y R(x, y)$ .