

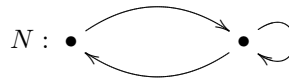
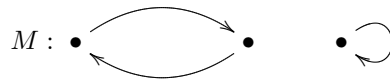


Amsterdam University College

Logic, Information flow and Argumentation

**Homework exercises, Week 8, part a (due Friday 30 March).**

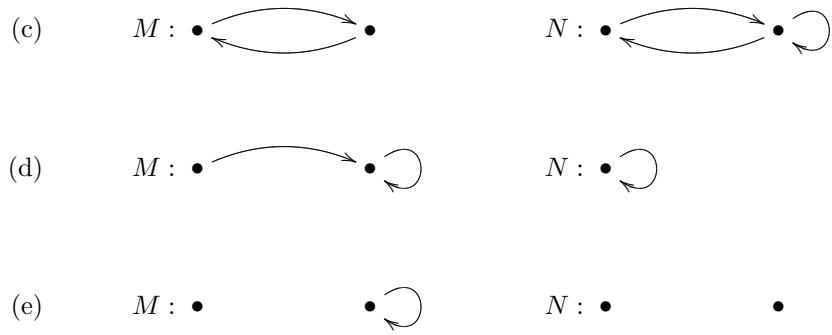
1. Consider the following two models  $M$  and  $N$ , with the arrow representing an abstract relation  $R$ :



For each model, decide whether the following sentences are true:

- (a)  $\forall x Rxx$
  - (b)  $\exists x \forall y \neg Rxy$
  - (c)  $\exists x \exists y \exists z (Rxy \wedge Rxz \wedge \neg(y = z))$
  - (d)  $\forall x \forall y \forall z ((Rxy \wedge Rxz) \rightarrow y = z)$
  - (e)  $\forall x \forall y (Rxy \rightarrow Ryx)$
2. For each of the following pairs of models  $M$  and  $N$ , find a formula  $\phi$  that is true in one model but false in the other.





3. For each of the following sentences, construct one model (in the same style as above) that make the sentence true, and another that makes it false.

- (a)  $\forall x Rxx$
- (b)  $\forall x \forall y (Rxy \rightarrow Ryx)$
- (c)  $\exists y \forall x \neg Rxy$
- (d)  $\exists x \exists y (x = y \wedge Rxy)$
- (e)  $\exists x \exists y (\neg(x = y) \wedge \forall z (z = x \vee z = y))$
- (f)  $\exists x \exists y (\neg(x = y) \wedge \forall z (z = x \vee z = y) \wedge \neg Rxx \wedge Rxy \wedge \neg Ryx \wedge Ryy)$