CS135 Section 9.1

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a) $(x,y) \in R$ iff $x \neq y$

- not reflexive because $(x,x) \notin R$
- symmetric, because $(x,y) \in R$ and $(y,x) \in R$ because $x \neq y$
- not antisymmetric, because (x,y) and $(y,x) \in R$ but $x \neq y$
- not transitive, because given (x,y) and (y,x) we don't have (x,x)

e) $(x,y) \in R$ iff x is a multiple of y

- reflexive because x is a multiple of x, i.e. $(x,x) \in R$
- not symmetric, because 4 is a multiple of 2, but not vice versa
- not antisymmetric, because if $(x,y) \in R$ then $(y,x) \notin R$ (see explanation for "not symmetric" above)
  exception: 3 is a multiple of -3, but -3 is a multiple of 3
- transitive, because if $(x,y) \in R$ and $(y,z) \in R$ then it means that $x = ky$, $k \in \mathbb{Z}$, and $y = mz$, $m \in \mathbb{Z}$, so $x = kmz$, i.e. $(x,z) \in R$.

  with numbers: if 8 is a multiple of 4, and 4 is a multiple of 2, then 8 is a multiple of 2.

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f) $(x,y) \in R$ iff x and y are both negative or both non-negative.

- reflexive, because $(x,x) \in R$
- symmetric, because if $(x,y) \in R$, then $(y,x) \in R$ (signs do not change)
- not antisymmetric, because if $(x,y) \in R$ and $(y,x) \in R$ it does not guarantee that $x = y$
  example: $(2,3) \in R$ and $(3,2) \in R$, but $2 \neq 3$
- transitive, because if $(x,y) \in R$ and $(y,z) \in R$ it means that x, y and z have the same sign, i.e. $(x,z) \in R$ as well.