

**Definition** (Properties of a relation). Let  $R \subseteq \mathbf{A} \times \mathbf{B}$  be a relation.  $R$  is:

1. *Surjective* if for all  $y \in \mathbf{B}$  there exists an  $x \in \mathbf{A}$ :  $\langle x, y \rangle \in R$ ;
2. *Injective* if for all  $\langle x_1, y_1 \rangle, \langle x_2, y_2 \rangle \in R$ :  $y_1 = y_2 \Rightarrow x_1 = x_2$ ;
3. *Everywhere-defined* if for all  $x \in \mathbf{A}$  there exists an  $y \in \mathbf{B}$ :  $\langle x, y \rangle \in R$ ;
4. *Single-valued* if for all  $\langle x_1, y_1 \rangle, \langle x_2, y_2 \rangle \in R$ :  $x_1 = x_2 \Rightarrow y_1 = y_2$ .