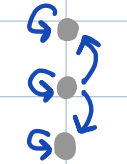


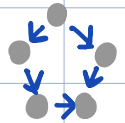
Velkommen!

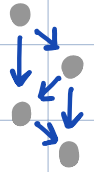
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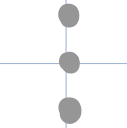
Relasjoner og funksjoner









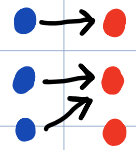


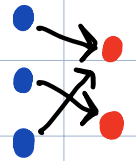


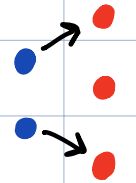
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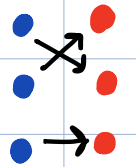
arthuk@uio.no

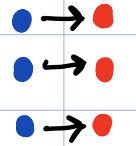


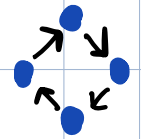


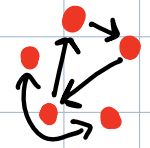








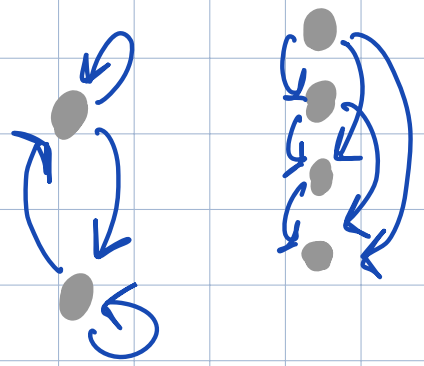




Relasjoner

Binær relasjon på en mengde M:

En mengde med 2-tupler av elementer i M



Eksempel: $M = \{1, 2, 3\}$

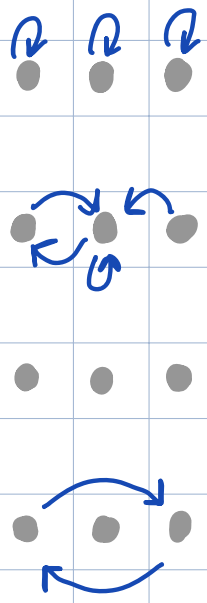
Relasjoner på M:

$\{\langle 1,1\rangle, \langle 2,2\rangle, \langle 3,3\rangle\}$

$\{\langle 1,2\rangle, \langle 2,1\rangle, \langle 2,2\rangle, \langle 3,2\rangle\}$

$\{\}$

$\{\langle 1,3\rangle, \langle 3,1\rangle\}$



binære

Ikke relasjoner på M:

$\{\langle 1,2,3\rangle\}$

$\langle 1,2\rangle$

$\{\langle 1\rangle, \langle 2\rangle\}$

$\{\langle 1,2\rangle, \langle 3\rangle\}$

Egenskaper ved relasjoner

R er en binær relasjon på mengden M

Refleksiv

For alle $x \in M$, finnes $\langle x, x \rangle$ i R



Irrefleksiv

Det finnes ingen $\langle x, x \rangle$



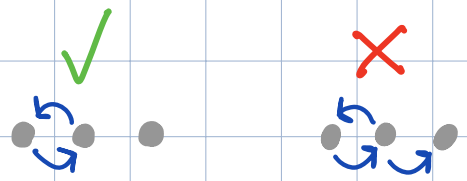
Ekvivalensrelasjon

- Refleksiv
- Symmetrisk
- Transitiv



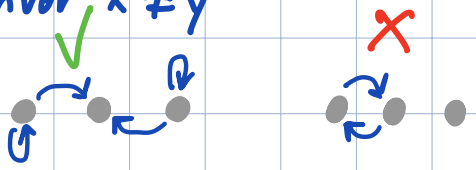
Symmetrisk

Hvis $\langle x, y \rangle \in R$, så er $\langle y, x \rangle \in R$



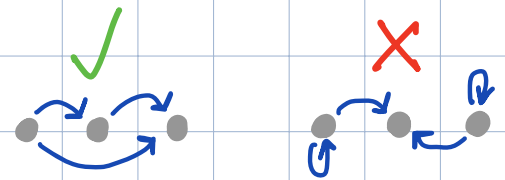
Anti-symmetrisk

Det finnes ingen $\langle x, y \rangle$ og $\langle y, x \rangle \in R$ hvor $x \neq y$



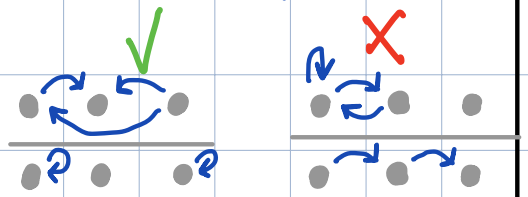
Asymmetrisk

Hvis $\langle x, y \rangle \in R$, så $\langle y, x \rangle \notin R$



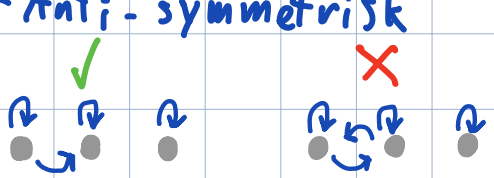
Transitiv

Hvis $\langle x, y \rangle, \langle y, z \rangle \in R$, så er $\langle x, z \rangle \in R$



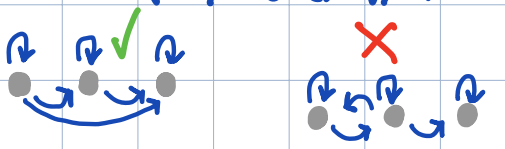
Partiell ordning

- Refleksiv
- Transitiv
- Anti-symmetrisk



Total ordning

- Partiell ordning
- For alle $x, y \in M$, enten $\langle x, y \rangle$ eller $\langle y, x \rangle \in R$

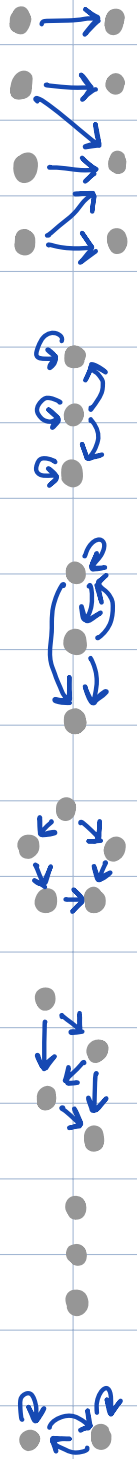
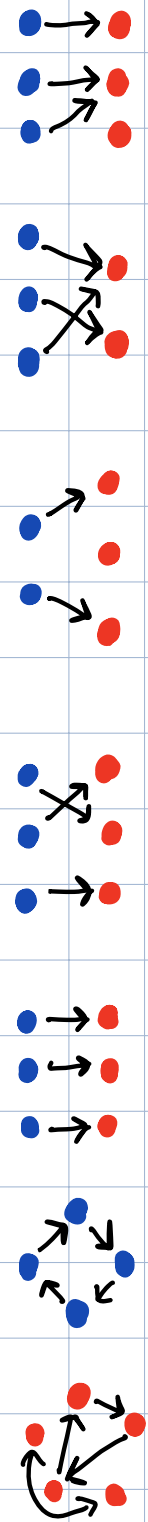


Den tomme relasjonen: {}

	$M \neq \{\}$	$M = \{\}$
Refleksiv	✗	✓
Symmetrisk	✓	✓
Transitiv	✓	✓
Anti-symmetrisk	✓	✓
Irrefleksiv	✓	✓
Asymmetrisk	✓	✓
Ekvivalensrelasjon	✗	✓
Partiell ordning	✓	✓
Total ordning	✗	✓

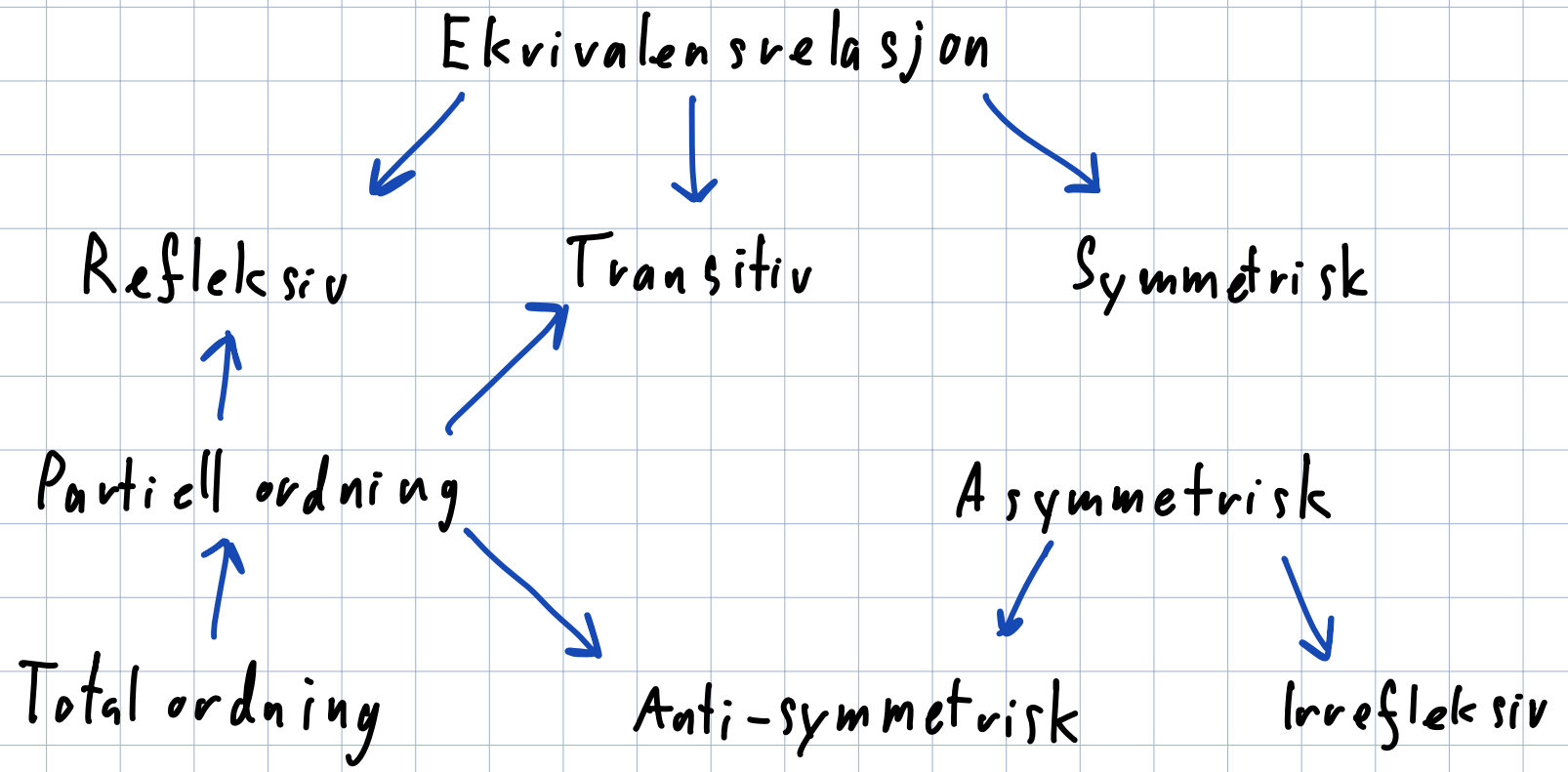
← Relasjonen {} på mengden {1} er ikke refleksiv, fordi den mangler $\langle 1, 1 \rangle$

Men! Relasjonen {} på mengden {} er refleksiv, fordi "alle" de 0 elementene er relaterf til seg selv

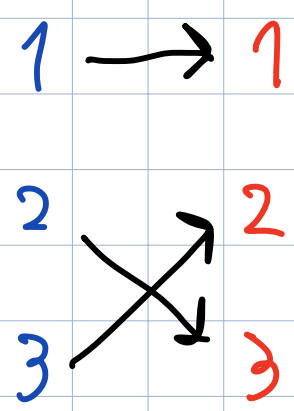
Sammenheng mellom egenskaper av relasjoner

$X \to Y$ betyr at alle relasjoner som er X også er Y



Funksjoner

- Relasjoner med et ekstra krav: Alle elementer må være relatert til ("peke på") nøyaktig ett element



$\{\langle 1,1\rangle, \langle 2,3\rangle, \langle 3,2\rangle\}$

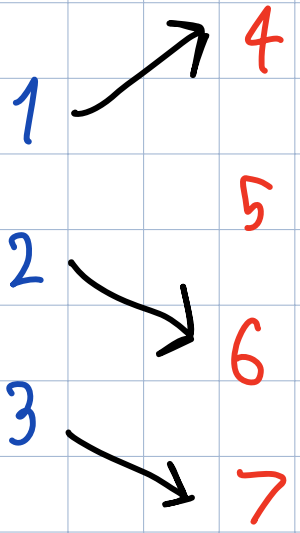
$f(1) = 1$

$f(2) = 3$

$f(3) = 2$

Bildemengde

$f : A \to B$ $\quad A = \{1, 2, 3\}$ $\quad B = \{4, 5, 6, 7\}$



Bildemengden av f: $f[A] = \{4, 6, 7\}$

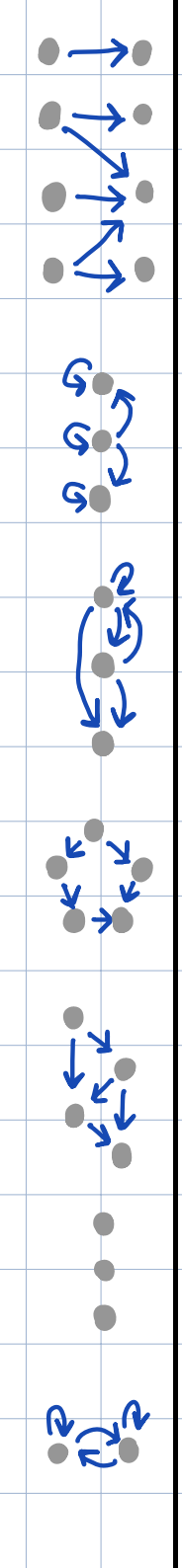
$f[\{2, 3\}] = \{6, 7\}$

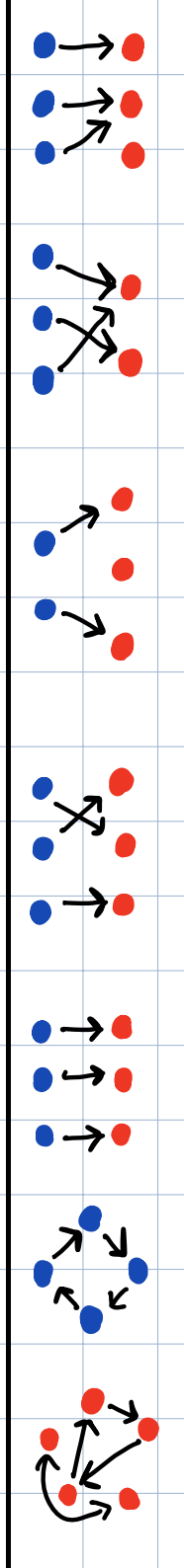
$f[\emptyset] = \{\} = \emptyset$

Oppgaveregning

Gjennomgang etterpå av: 6.4 og 7.5

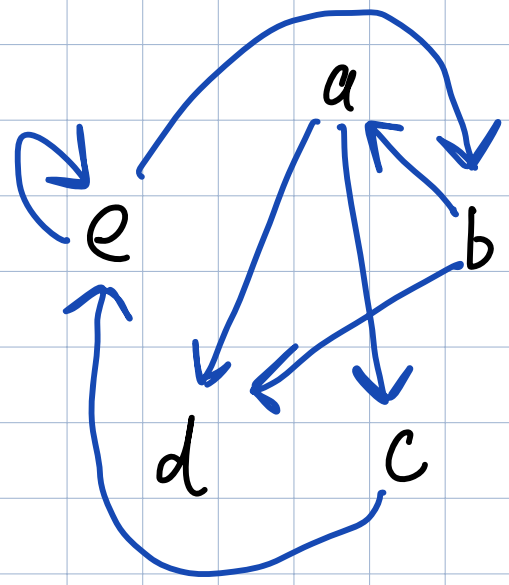
logiskemetoder.no/nettkurs/quiz





6. 4 $A = \{a, b, c, d, e\}$

$R = \{(a,c), (a,d), (b,a), (b,d), (c,e), (e,b), (e,e)\}$



Refleksiv? ✗

Irrefleksiv? ✗

Symmetrisk? ✗

Transitiv? ✗

Antisymmetrisk ✓

Asymmetrisk? ✗

7.5

$f: \mathbb{N} \to \mathbb{N}$

$f(x) = 2x + 1$

$O = \text{oddetall} \subseteq \mathbb{N} = 1, 3, 5 \ldots$

$P = \text{partall} \subseteq \mathbb{N}$

(a) Bildemengden til $f = \{1, 3, 5 \ldots\}$

(b) $f[P] = \{1, 5, 9, 13, \ldots\}$

$f(0) = 1$

$f(1) = 3$

$f(2) = 5$

$\vdots$