Numbers and functions

Lesson #1

MAT 1375 Precalculus

New York City College of Technology CUNY

Number systems

Natural numbers $\mathbb{N}$

Examples:

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Examples: $7, 2, 5, 1003$

$1, 2, 3, 4, 5, \ldots$

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fractions $\frac{a}{b}$ for integers a, b, and $b \neq 0$

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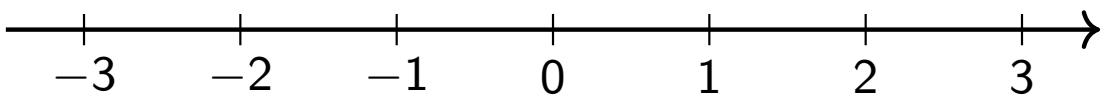

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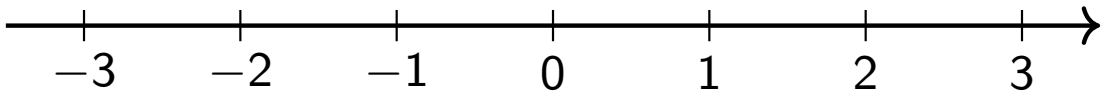

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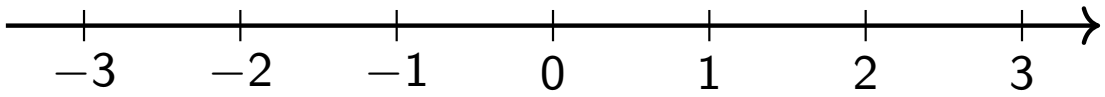

Examples: $\frac{2}{3}, 7, -3, 0, \frac{-36}{17}$
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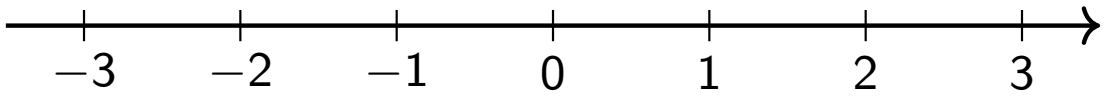

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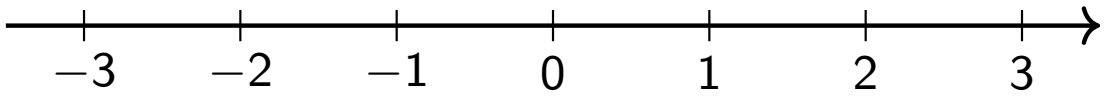

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Complex numbers $\mathbb{C}$

$a + bi$, for real numbers a, b

Examples: 2+3i, i=0+1i

Interval notation - review

3 ways to express an interval

1. On the number line:

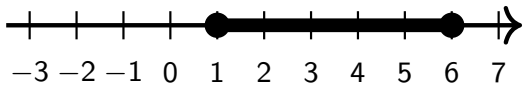
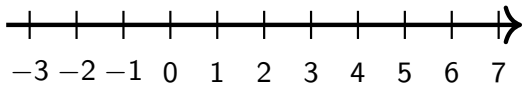
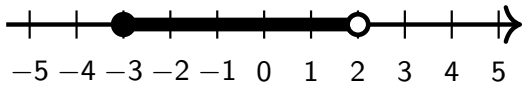
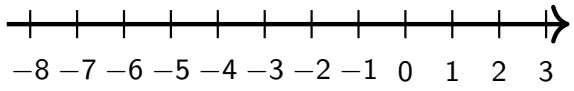
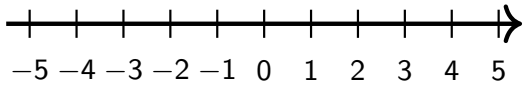
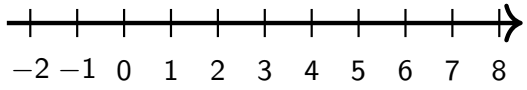
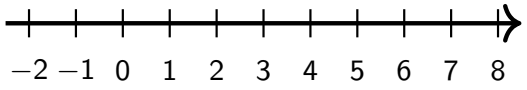
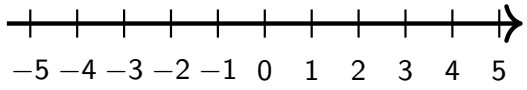
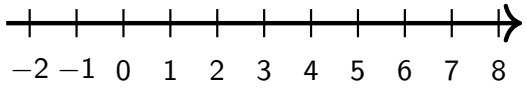
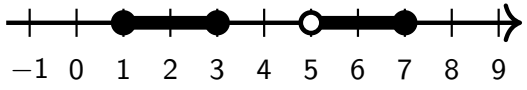
2. Inequality notation:

$$2 \leq x \leq 5$$

3. Interval notation:

$$[2, 5]$$

Interval notation - exercises

	Inequality notation	Number line	Interval notation
(a)			
(b)	$2 < x < 5$		
(c)			
(d)			$(-5, -2]$
(e)	$-1.5 \leq x < \sqrt{5}$		
(f)	$2 \leq x$		
(g)			$(-\infty, 5]$
(h)	$-\pi < x$		
(i)	$5 \leq x \leq 2$		
(j)			

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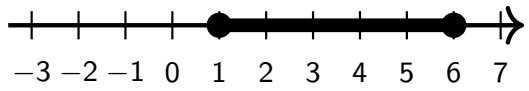
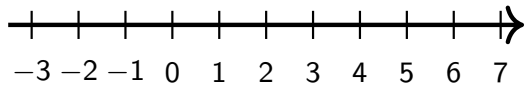
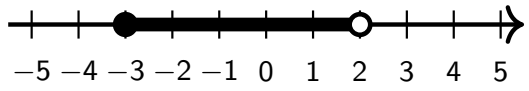
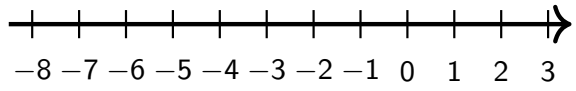
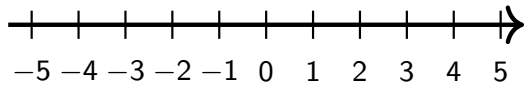
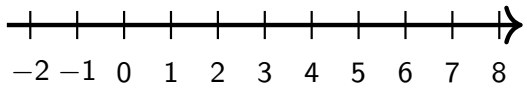
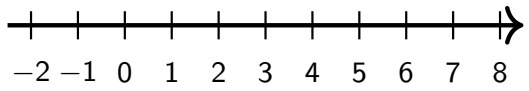
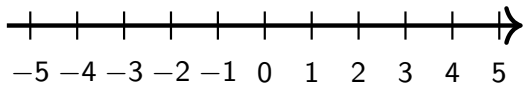
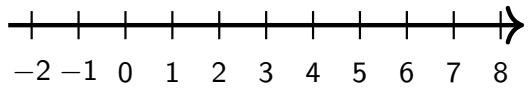
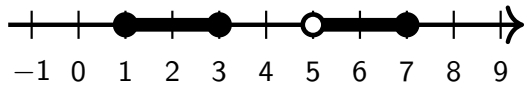
(a)	$1 \leq x \leq 6$		$[1, 6]$
(b)	$2 < x < 5$		
(c)			
(d)			$(-5, -2]$
(e)	$-1.5 \leq x < \sqrt{5}$		
(f)	$2 \leq x$		
(g)			$(-\infty, 5]$
(h)	$-\pi < x$		
(i)	$5 \leq x \leq 2$		
(j)			

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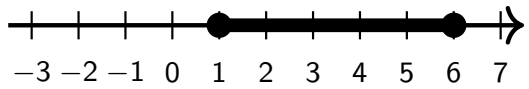
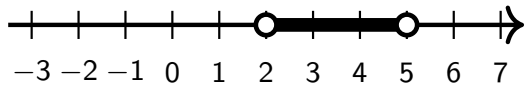
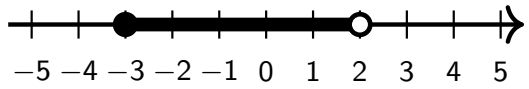
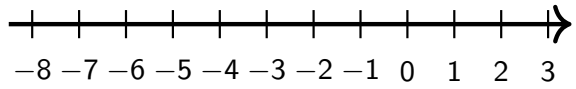
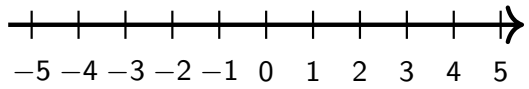
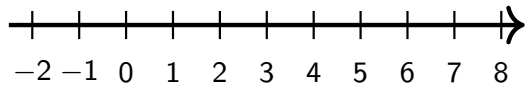
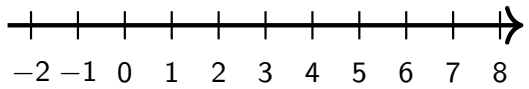
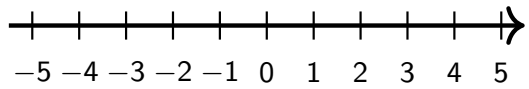
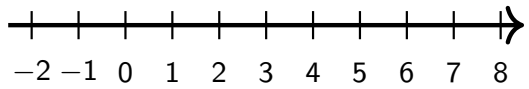
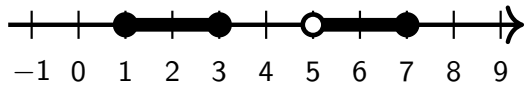
(a)	$1 \leq x \leq 6$		$[1, 6]$
(b)	$2 < x < 5$		$(2, 5)$
(c)			
(d)			$(-5, -2]$
(e)	$-1.5 \leq x < \sqrt{5}$		
(f)	$2 \leq x$		
(g)			$(-\infty, 5]$
(h)	$-\pi < x$		
(i)	$5 \leq x \leq 2$		
(j)			

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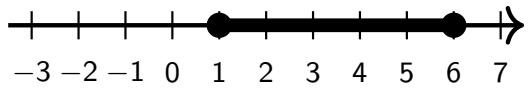
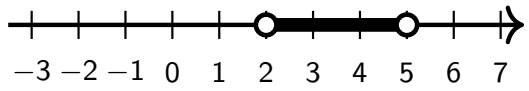
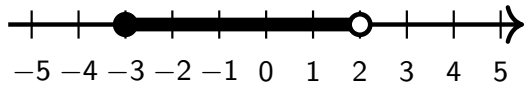
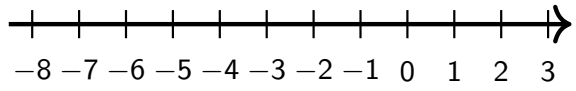
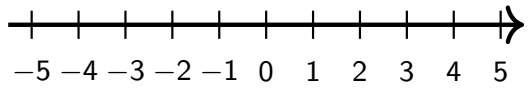
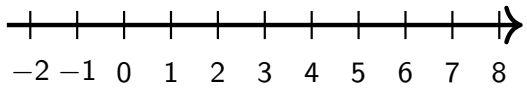
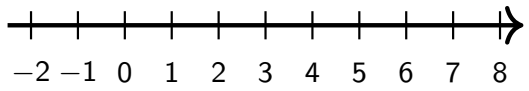
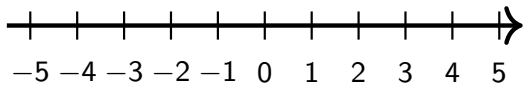
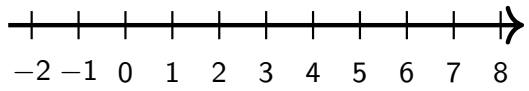
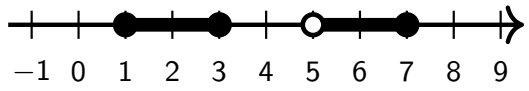
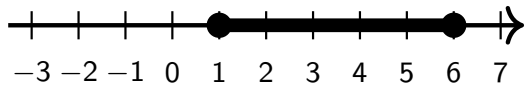
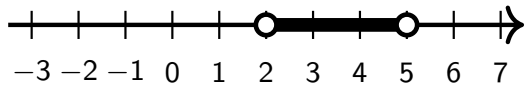
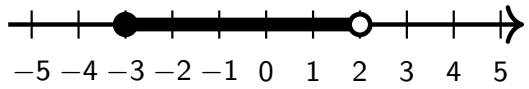
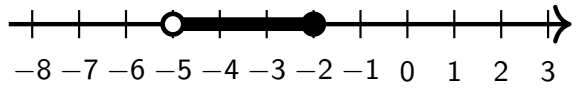
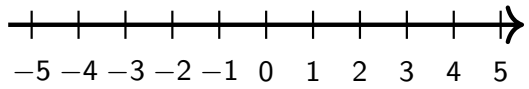
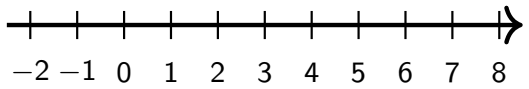
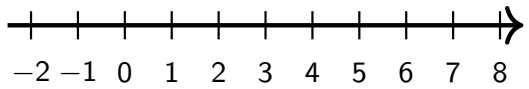
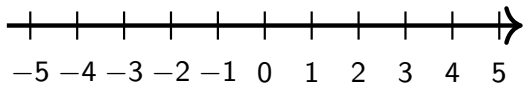
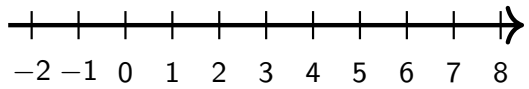
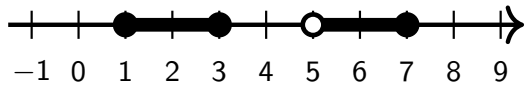
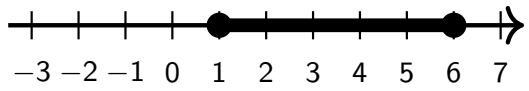
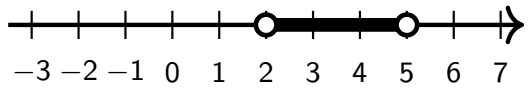
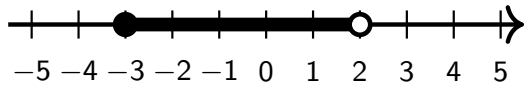
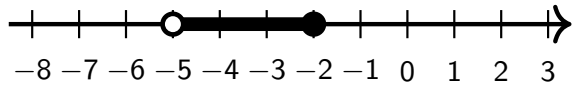
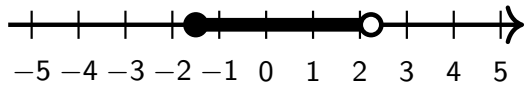
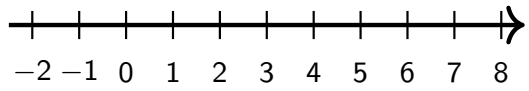
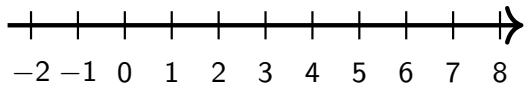
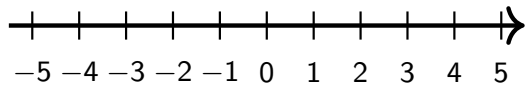
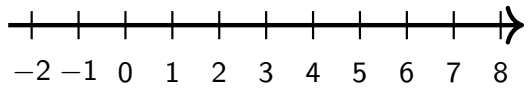
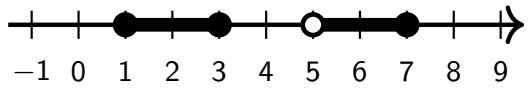
(a)	$1 \leq x \leq 6$		$[1, 6]$
(b)	$2 < x < 5$		$(2, 5)$
(c)	$-3 \leq x < 2$		$[-3, 2)$
(d)			$(-5, -2]$
(e)	$-1.5 \leq x < \sqrt{5}$		
(f)	$2 \leq x$		
(g)			$(-\infty, 5]$
(h)	$-\pi < x$		
(i)	$5 \leq x \leq 2$		
(j)			

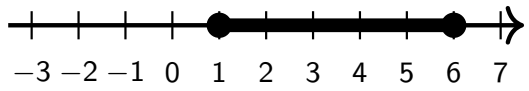
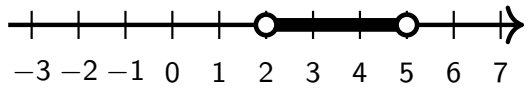
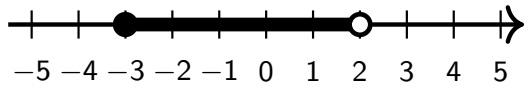
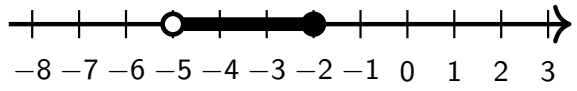
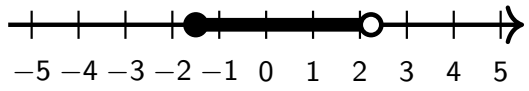
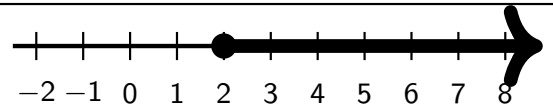
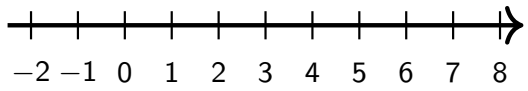
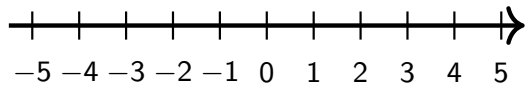
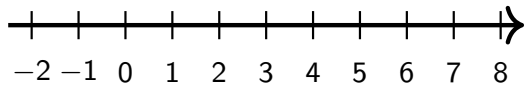
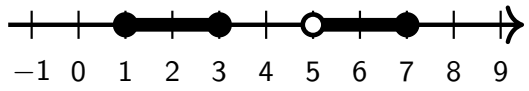
Interval notation - exercises

	Inequality notation	Number line	Interval notation
(a)	$1 \leq x \leq 6$		$[1, 6]$
(b)	$2 < x < 5$		$(2, 5)$
(c)	$-3 \leq x < 2$		$[-3, 2)$
(d)	$-5 < x \leq -2$		$(-5, -2]$
(e)	$-1.5 \leq x < \sqrt{5}$		
(f)	$2 \leq x$		
(g)			$(-\infty, 5]$
(h)	$-\pi < x$		
(i)	$5 \leq x \leq 2$		
(j)			

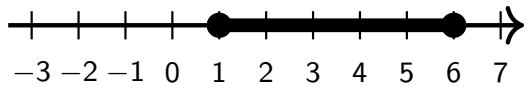
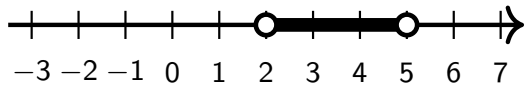
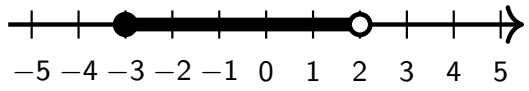
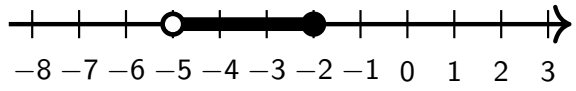
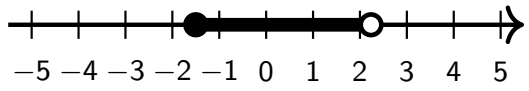
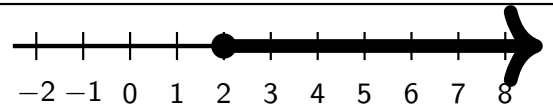
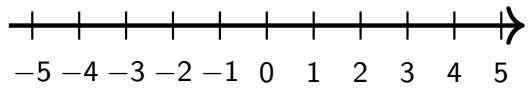
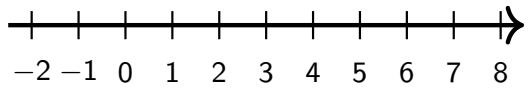
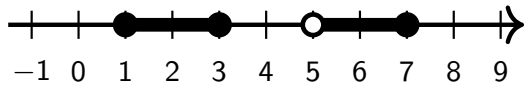
Interval notation - exercises

	Inequality notation	Number line	Interval notation
(a)	$1 \leq x \leq 6$		$[1, 6]$
(b)	$2 < x < 5$		$(2, 5)$
(c)	$-3 \leq x < 2$		$[-3, 2)$
(d)	$-5 < x \leq -2$		$(-5, -2]$
(e)	$-1.5 \leq x < \sqrt{5}$		$[-1.5, \sqrt{5})$
(f)	$2 \leq x$		
(g)			$(-\infty, 5]$
(h)	$-\pi < x$		
(i)	$5 \leq x \leq 2$		
(j)			

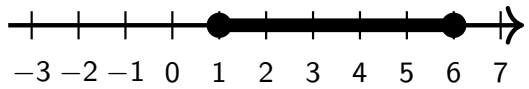
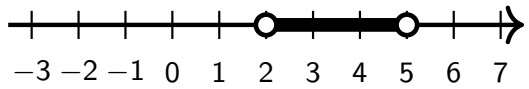
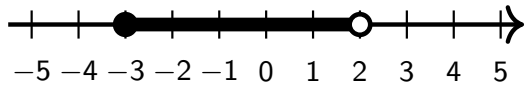
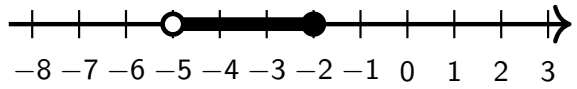
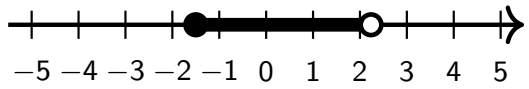
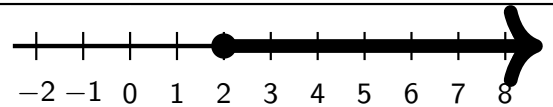
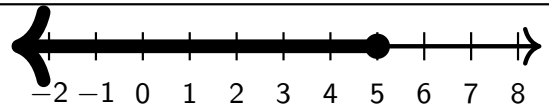
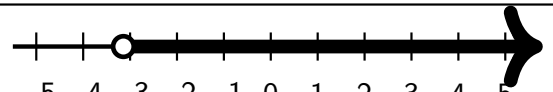
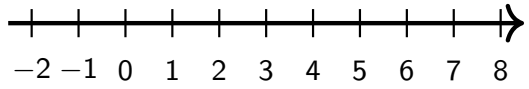
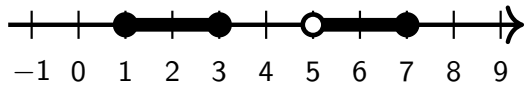
Interval notation - exercises

	Inequality notation	Number line	Interval notation
(a)	$1 \leq x \leq 6$		$[1, 6]$
(b)	$2 < x < 5$		$(2, 5)$
(c)	$-3 \leq x < 2$		$[-3, 2)$
(d)	$-5 < x \leq -2$		$(-5, -2]$
(e)	$-1.5 \leq x < \sqrt{5}$		$[-1.5, \sqrt{5})$
(f)	$2 \leq x$		$[2, \infty)$
(g)			$(-\infty, 5]$
(h)	$-\pi < x$		
(i)	$5 \leq x \leq 2$		
(j)			

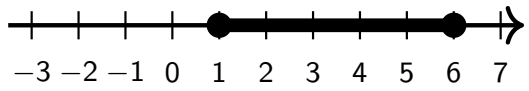
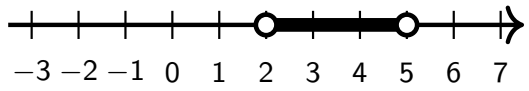
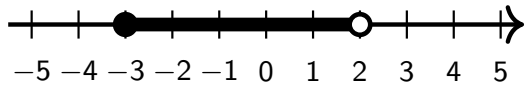
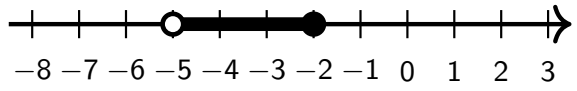
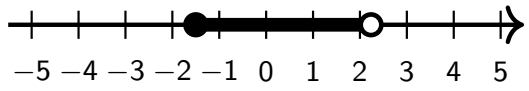
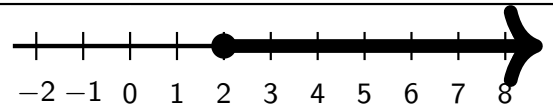
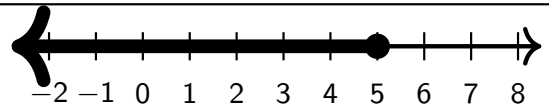
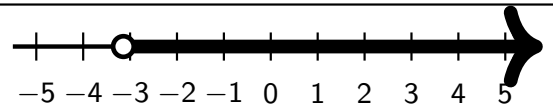
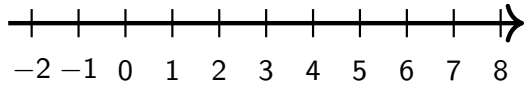
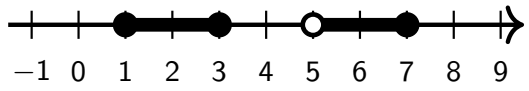
Interval notation - exercises

	Inequality notation	Number line	Interval notation
(a)	$1 \leq x \leq 6$		$[1, 6]$
(b)	$2 < x < 5$		$(2, 5)$
(c)	$-3 \leq x < 2$		$[-3, 2)$
(d)	$-5 < x \leq -2$		$(-5, -2]$
(e)	$-1.5 \leq x < \sqrt{5}$		$[-1.5, \sqrt{5})$
(f)	$2 \leq x$		$[2, \infty)$
(g)	$x \leq 5$		$(-\infty, 5]$
(h)	$-\pi < x$		
(i)	$5 \leq x \leq 2$		
(j)			

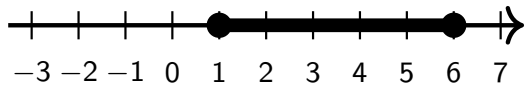
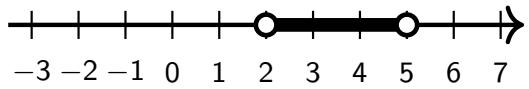
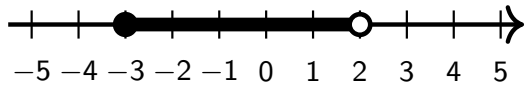
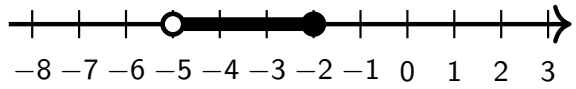
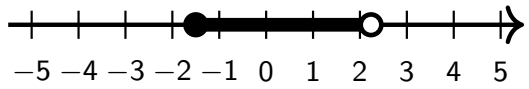
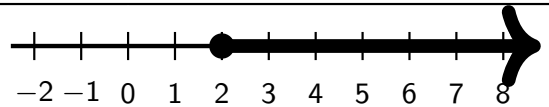
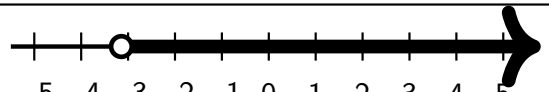
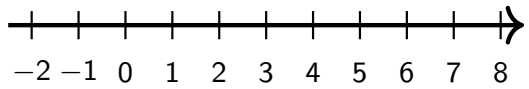
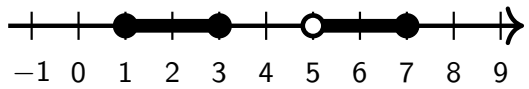
Interval notation - exercises

	Inequality notation	Number line	Interval notation
(a)	$1 \leq x \leq 6$		$[1, 6]$
(b)	$2 < x < 5$		$(2, 5)$
(c)	$-3 \leq x < 2$		$[-3, 2)$
(d)	$-5 < x \leq -2$		$(-5, -2]$
(e)	$-1.5 \leq x < \sqrt{5}$		$[-1.5, \sqrt{5})$
(f)	$2 \leq x$		$[2, \infty)$
(g)	$x \leq 5$		$(-\infty, 5]$
(h)	$-\pi < x$		$(-\pi, \infty)$
(i)	$5 \leq x \leq 2$		
(j)			

Interval notation - exercises

	Inequality notation	Number line	Interval notation
(a)	$1 \leq x \leq 6$		$[1, 6]$
(b)	$2 < x < 5$		$(2, 5)$
(c)	$-3 \leq x < 2$		$[-3, 2)$
(d)	$-5 < x \leq -2$		$(-5, -2]$
(e)	$-1.5 \leq x < \sqrt{5}$		$[-1.5, \sqrt{5})$
(f)	$2 \leq x$		$[2, \infty)$
(g)	$x \leq 5$		$(-\infty, 5]$
(h)	$-\pi < x$		$(-\pi, \infty)$
(i)	$5 \leq x \leq 2$		no such number
(j)			

Interval notation - exercises

	Inequality notation	Number line	Interval notation
(a)	$1 \leq x \leq 6$		$[1, 6]$
(b)	$2 < x < 5$		$(2, 5)$
(c)	$-3 \leq x < 2$		$[-3, 2)$
(d)	$-5 < x \leq -2$		$(-5, -2]$
(e)	$-1.5 \leq x < \sqrt{5}$		$[-1.5, \sqrt{5})$
(f)	$2 \leq x$		$[2, \infty)$
(g)	$x \leq 5$		$(-\infty, 5]$
(h)	$-\pi < x$		$(-\pi, \infty)$
(i)	$5 \leq x \leq 2$		no such number
(j)	$1 \leq x \leq 3$ or $5 < x \leq 7$		$[1, 3] \cup (5, 7]$

Functions - definition

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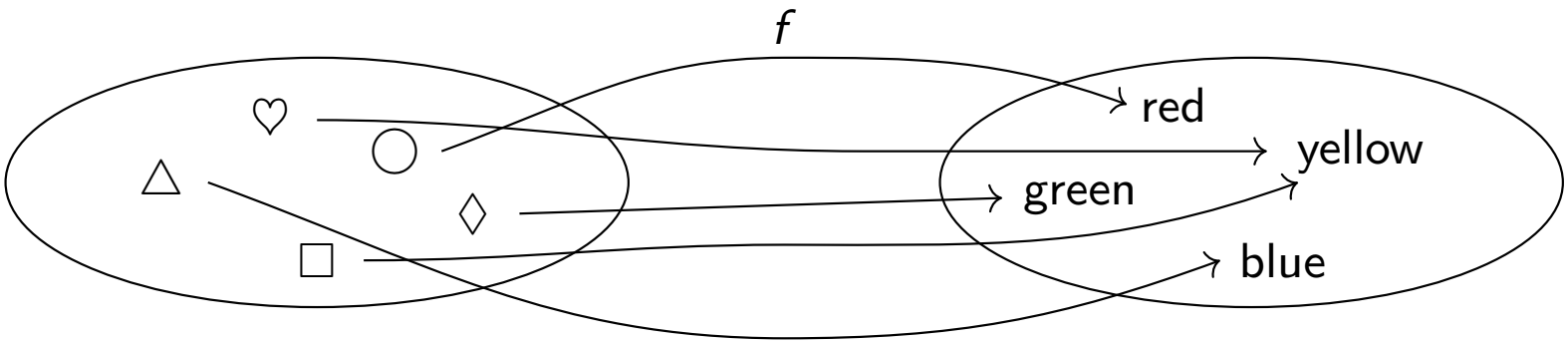
1. 

Function values: $f(\square) =$ $f(\Diamond) =$ $f(\heartsuit) =$

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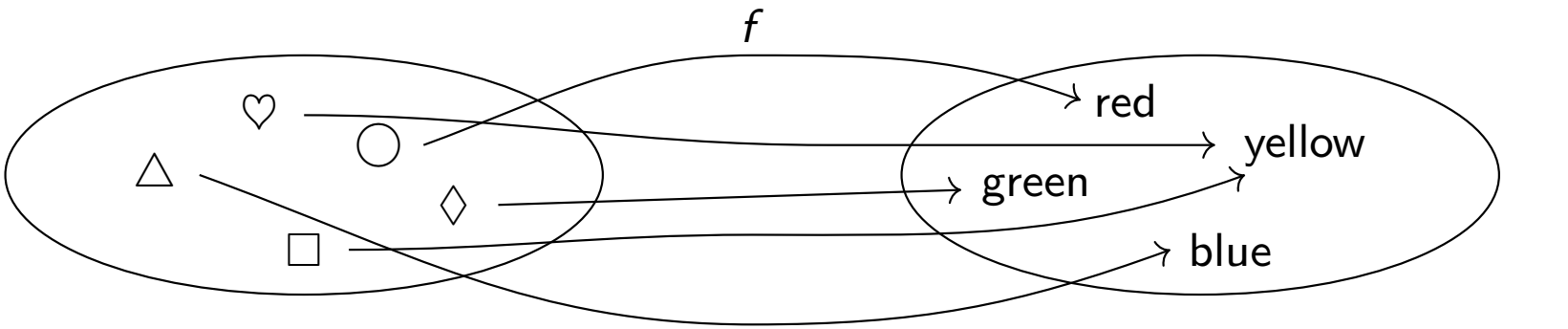
1. 

Function values: $f(\square) = yellow$ $f(\Diamond) = green$ $f(\heartsuit) = yellow$ ...

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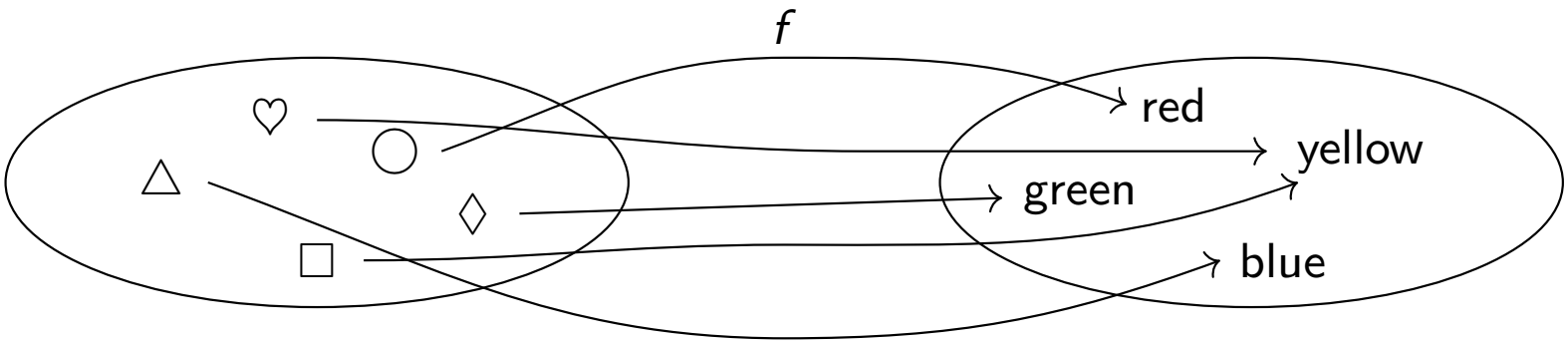
1. 

Function values: $f(\square) =$*yellow* $f(\Diamond) =$*green* $f(\heartsuit) =$*yellow* ...

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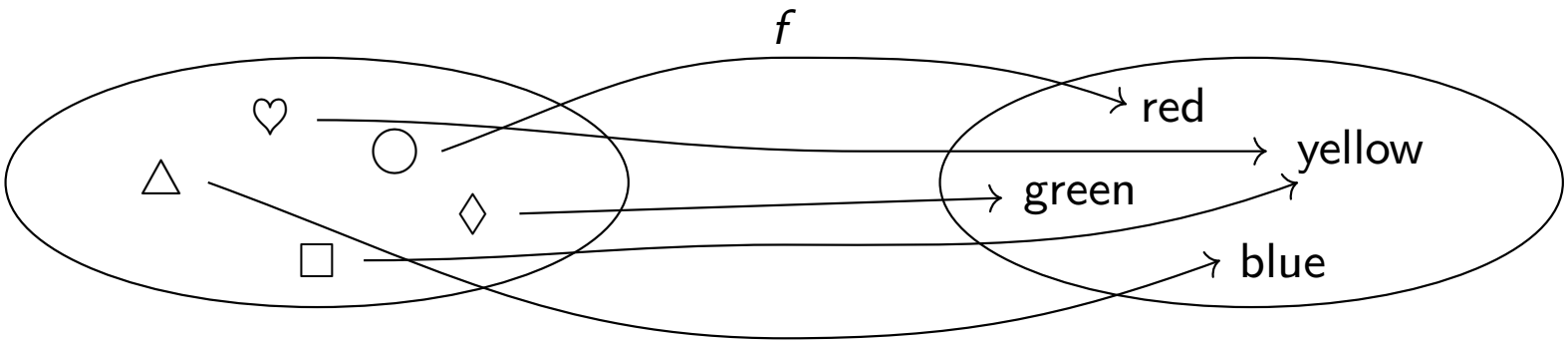
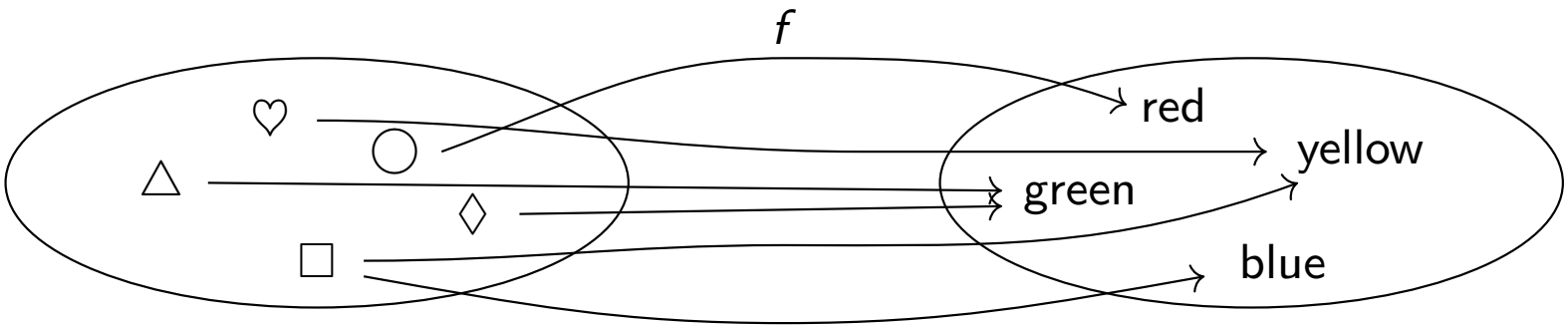
1. 

Function values: $f(\square) = yellow$ $f(\Diamond) = green$ $f(\heartsuit) = yellow$ ...

Domain $D = \{\triangle, \Diamond, \bigcirc, \square, \heartsuit\}$ Range $R = \{red, green, blue, yellow\}$

Functions - examples

2.



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Functions - examples

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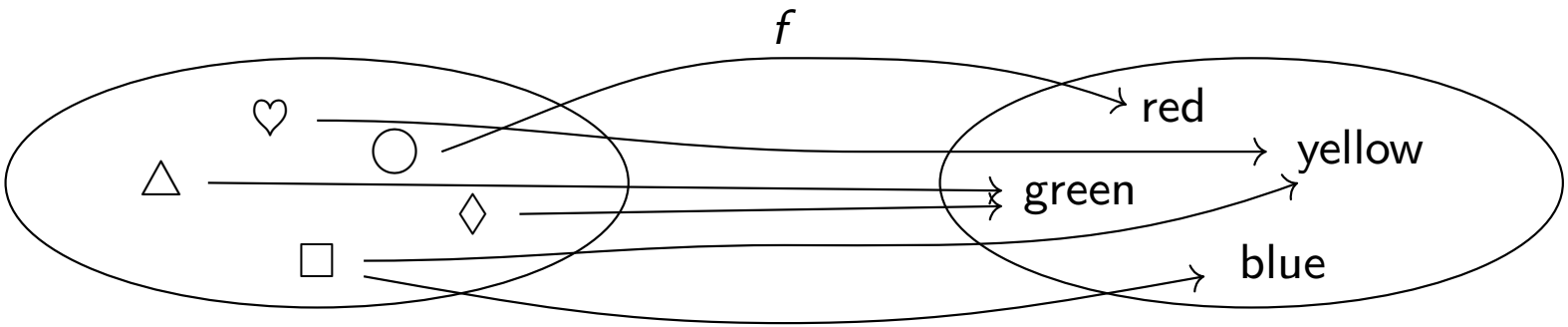

Function values: $f(\triangle) = green$ $f(\square) =$??? blue or yellow ???

$\Longrightarrow$ f is not a function ✗, since $\square$ has more than one output! (f is a *relation*.)

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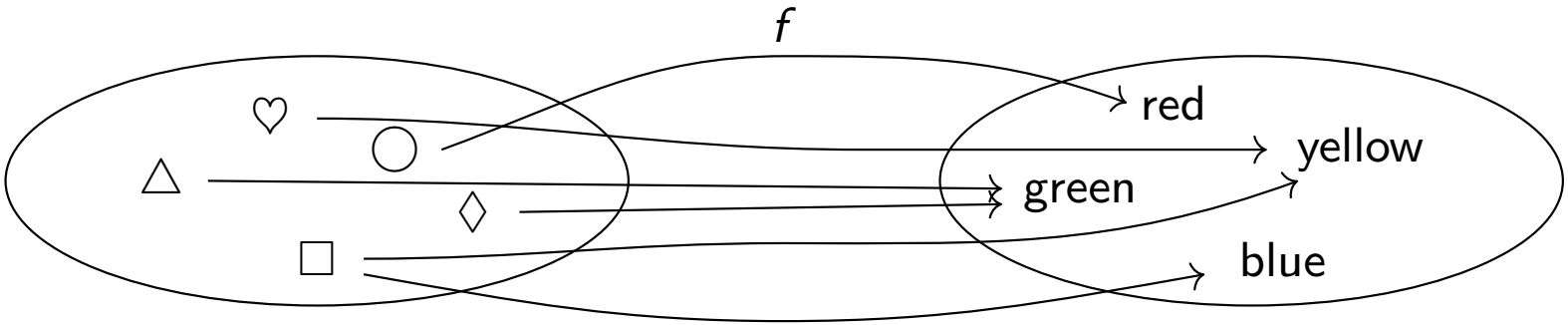

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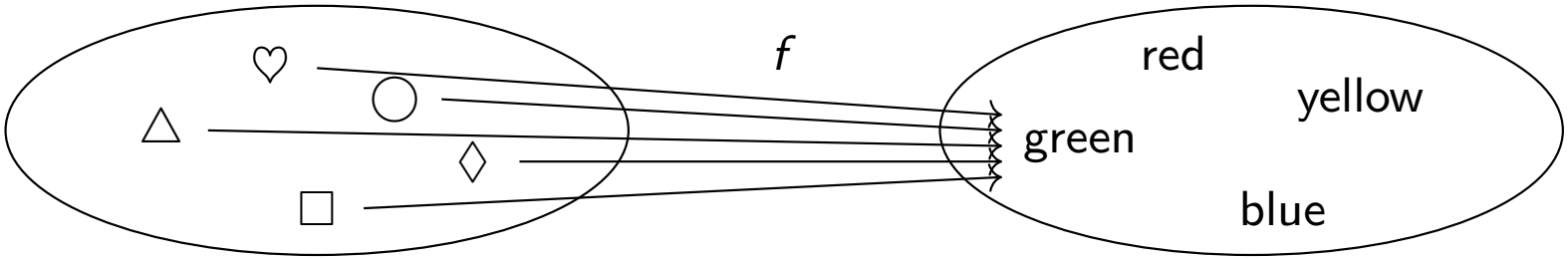

Is f a function?

Functions - examples

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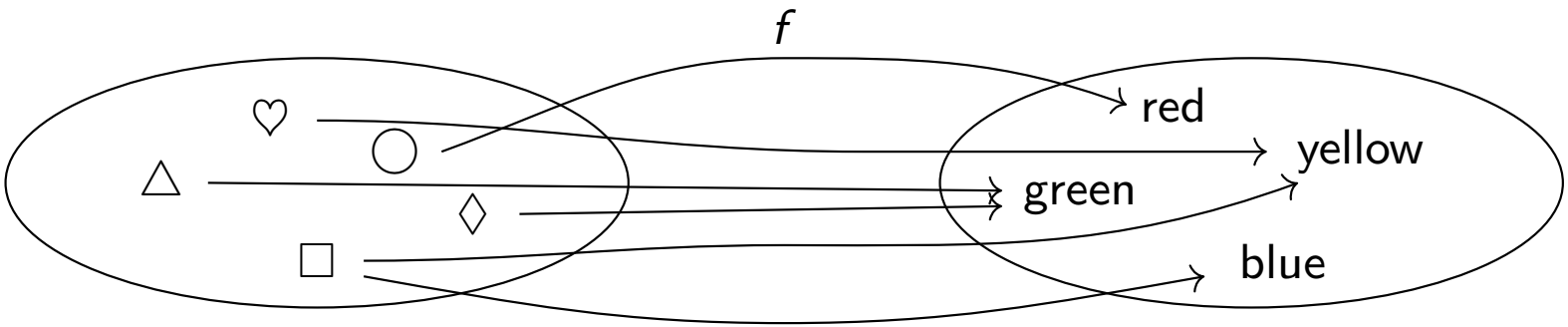

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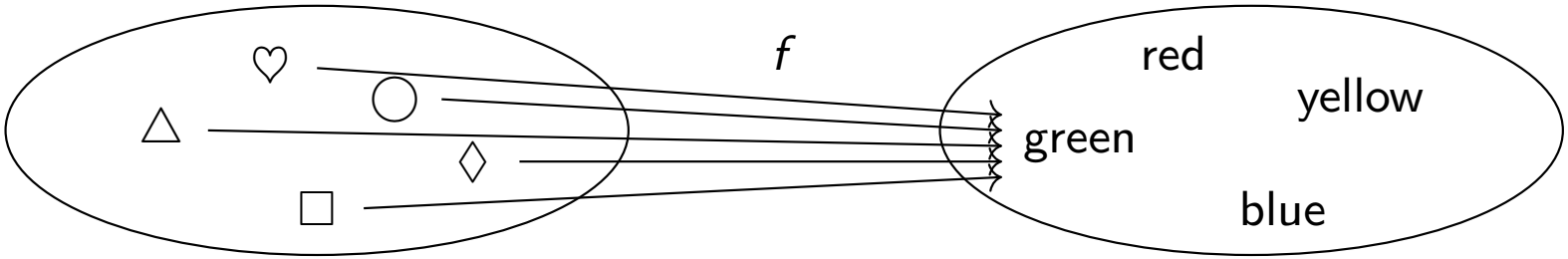

Is f a function? Yes, f is a function! ✓

Domain $D =$ $\qquad$ Range $R =$

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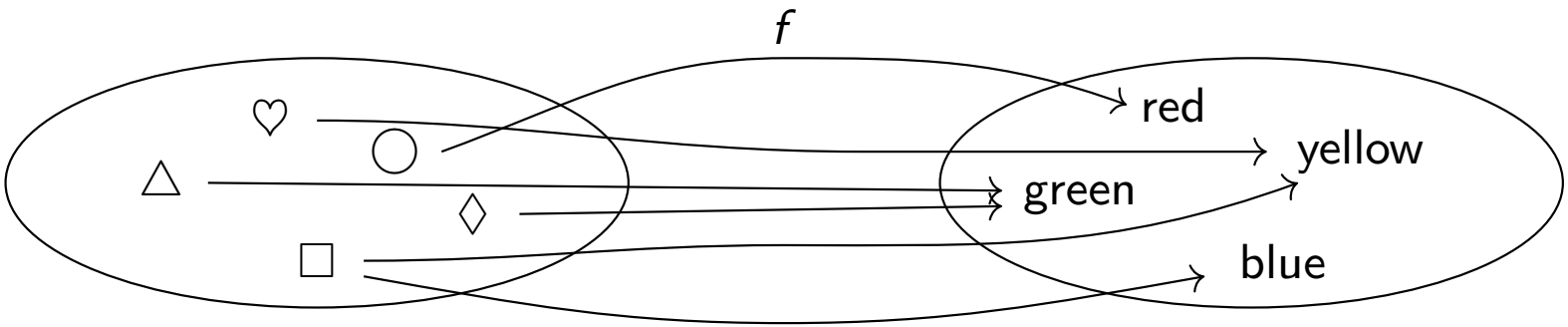

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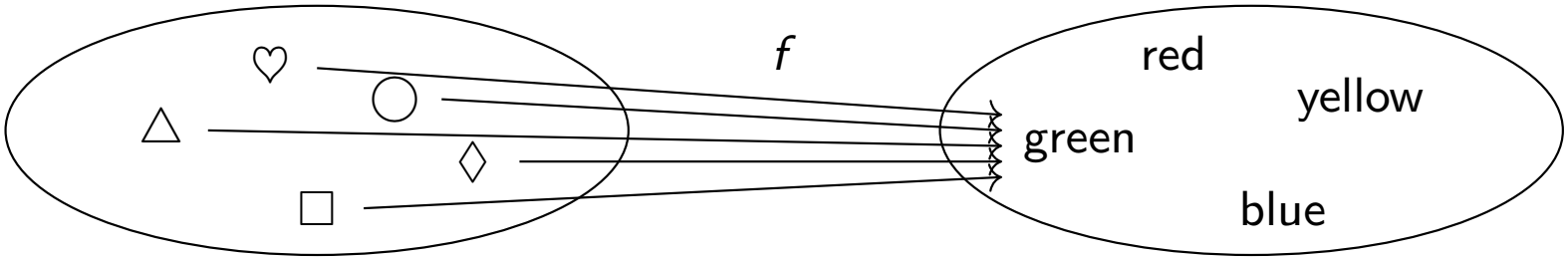

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Domain $D = \{\triangle, \Diamond, \bigcirc, \square, \heartsuit\}$ Range $R = \{green\}$

Codomain $C = \{green, yellow, red, blue\}$

- Notation: we write $f : D \to C$

Function values: $f(\square) = green$ $f(\Diamond) = green$ $f(\heartsuit) = green$ ...

Functions - word problems

1. Consider the assignment which associates to each student the chair on which the student sits.
   - **Question:** What is the domain?
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     Answer: After buying 8 cups of coffee, there is \$14 left on the card.
   - **Question:** Interpret the meaning of $f(x) > 0$.
     Answer: $f(x) > 0$ means that after purchasing x cups of coffee there is still some money left on the card.