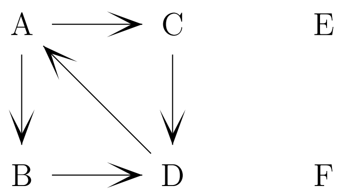
CS 173, Spring 19 **Examlet 4, white**

Name:____

NetID:________________________ **Lecture:** **A** **B**

Discussion: **Thursday** **Friday** **9** **10** **11** **12** **1** **2** **3** **4** **5** **6**

1. (5 points) Check all boxes that correctly characterize this relation on the set $\{A, B, C, D, E, F\}$.



Reflexive: ☐ Irreflexive: ☐

Symmetric: ☐ Antisymmetric: ☐

Transitive: ☐

2. (5 points) Suppose that S is the set of all binary strings (i.e. finite sequences of 1's and 0's). Suppose that $\sim$ is the relation on S where $a \sim b$ if and only if a and b contain the same number of 1's. For example, `0101` $\sim$ `1000001`. List three members of [`111`].

3. (5 points) Let T be the relation defined on set of pairs $(x, y) \in \mathbb{R}^2$ such that $(x, y)T(p, q)$ if and only if $x \leq p$ or $y \leq q$. Is T antisymmetric? Informally explain why it is, or give a concrete counter-example showing that it is not.

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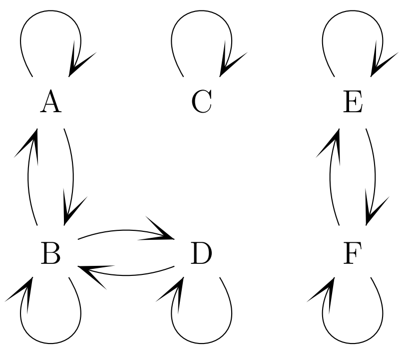

Reflexive: ☐ Irreflexive: ☐

Symmetric: ☐ Antisymmetric: ☐

Transitive: ☐

2. (5 points) A relation is a partial order if it has which three properties? (Naming the properties is sufficient. You don't have to define them.)

3. (5 points) Suppose that R is a relation on the integers such that xRy for all integers x and y. Is R an equivalence relation?

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1. (5 points) Check all boxes that correctly characterize this relation on the set $\{A, B, C, D, E, F\}$.

$$\begin{tikzcd} \mathrm{A} \arrow[r] & \mathrm{C} & \mathrm{E} \arrow[l] \\ \mathrm{B} \arrow[r] & \mathrm{D} & \mathrm{F} \arrow[l] \end{tikzcd}$$

Reflexive: ☐ Irreflexive: ☐

Symmetric: ☐ Antisymmetric: ☐

Transitive: ☐

2. (5 points) Let's define the ~~equivalence~~ relation $\sim$ on $\mathbb{N}^3$ such that $(x, y, z) \sim (p, q, r)$ if and only $(x, y, z) = \alpha(p, q, r)$ for some integer α. ~~List three members of $[(1, 2, 3)]$~~ List three elements that are related to $(1, 2, 3)$ in either direction.

3. (5 points) Suppose that R is the relation on the set of integers such that aRb if and only if $|a - b| \leq 13$ Is R transitive? Informally explain why it is, or give a concrete counter-example showing that it is not.

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Discussion: Thursday Friday 9 10 11 12 1 2 3 4 5 6

1. (5 points) Check all boxes that correctly characterize this relation on the set $\{A, B, C, D, E, F\}$.

$$\begin{tikzcd}
A \arrow[r] \arrow[d] \arrow[dr] & C \arrow[d] & E \arrow[d] \\
B \arrow[r] & D & F
\end{tikzcd}$$

Reflexive: ☐ Irreflexive: ☐

Symmetric: ☐ Antisymmetric: ☐

Transitive: ☐

2. (5 points) Let R be the relation on the integers such that xRy if and only if $\lfloor x/4 \rfloor = \lfloor y/4 \rfloor$. List the values in $[8]$.

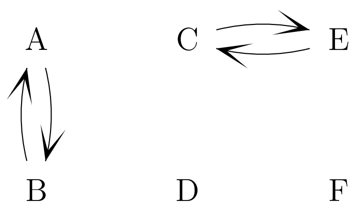
3. (5 points) Let T be a reflexive relation defined on the integers. Let S be the relation on the integers such that aSb if and only if there is an integer k such that aTk and kTb. Is S reflexive? (I.e. is S reflexive for any reflexive relation T?) Informally explain why it is, or give a concrete counter-example showing that it is not.

Name:____

NetID:________________________ **Lecture: A B**

Discussion: Thursday Friday 9 10 11 12 1 2 3 4 5 6

1. (5 points) Check all boxes that correctly characterize this relation on the set $\{A, B, C, D, E, F\}$.



Reflexive: ☐ Irreflexive: ☐

Symmetric: ☐ Antisymmetric: ☐

Transitive: ☐

2. (5 points) Can a relation be irreflexive, symmetric, and also transitive? Either give such a relation or briefly explain why it's not possible to construct one.

3. (5 points) Suppose that R is a relation on the integers such xRy if and only if $x = y$. Is R a partial order?

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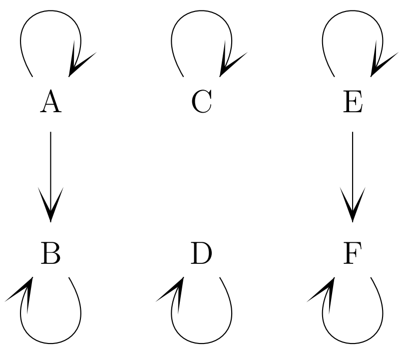
1. (5 points) Check all boxes that correctly characterize this relation on the set $\{A, B, C, D, E, F\}$.



Reflexive: ☐ Irreflexive: ☐

Symmetric: ☐ Antisymmetric: ☐

Transitive: ☐

2. (5 points) Suppose that R is a relation on a set A. Using precise mathematical words and notation, define what it means for R to be symmetric.

3. (5 points) Let T be the relation defined on $\mathbb{N}$ such that aTb if and only if $a = b + 2k$ for some natural number k. Is T antisymmetric? Informally explain why it is, or give a concrete counter-example showing that it is not.

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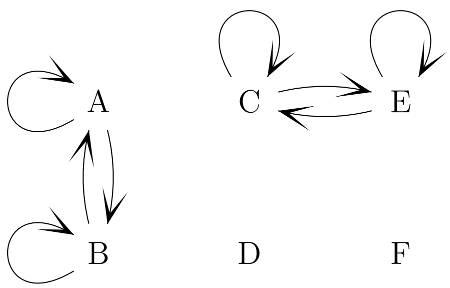
1. (5 points) Check all boxes that correctly characterize this relation on the set $\{A, B, C, D, E, F\}$.



Reflexive: ☐ Irreflexive: ☐

Symmetric: ☐ Antisymmetric: ☐

Transitive: ☐

2. (5 points) Let's define the equivalence relation $\sim$ on $\mathbb{N}^3$ such that $(x, y, z) \sim (p, q, r)$ if and only $x + y + z = p + q + r$. List three members of $[(1, 2, 3)]$.

3. (5 points) Suppose that R is a relation on the integers such xRy if and only if $xy = 1$ for all integers x and y. Is R a partial order?

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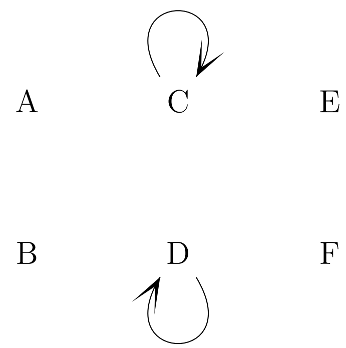

Reflexive: ☐ Irreflexive: ☐

Symmetric: ☐ Antisymmetric: ☐

Transitive: ☐

2. (5 points) A relation is an equivalence relation if it has which three properties? (Naming the properties is sufficient. You don't have to define them.)

3. (5 points) Suppose that $\succeq$ is the relation between subsets of the integers such that $A \succeq B$ if and only if $A - B \neq \emptyset$. (A and B are sets of integers, so $A - B$ is a set difference.) Is $\succeq$ transitive? Informally explain why it's true or give a concrete counter-example.