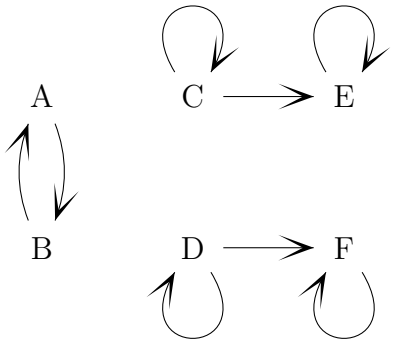
CS 173, Fall 17 Examlet 4, Part B

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) Let $\sim$ be the relation defined on set of pairs $(x, y) \in \mathbb{R}^2$ such that $(x, y) \sim (p, q)$ if and only if $x^2 + y^2 = p^2 + q^2$. Find three elements in the equivalence class $[(0, 1)]$

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

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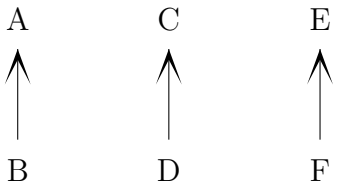

Reflexive: ☐ Irreflexive: ☐

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 T is the relation on the set of integers such that aTb if and only if $\gcd(a, b) = 3$. Is T transitive? Informally explain why it is, or give a concrete counter-example showing that it is not.

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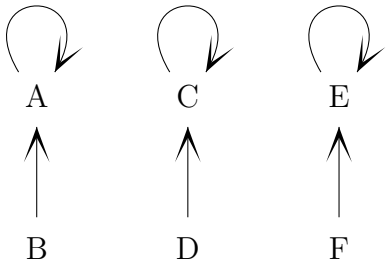

Reflexive: ☐ Irreflexive: ☐

Symmetric: ☐ Antisymmetric: ☐

Transitive: ☐

2. (5 points) 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) Suppose that R is the relation on $\mathbb{Z}^4$ such that $(a, b, c, d)R(w, x, y, z)$ if and only if $c = w$, $d = x$, $a = y$, and $b = z$. Is R symmetric? Informally explain why it's true or give a concrete counter-example.

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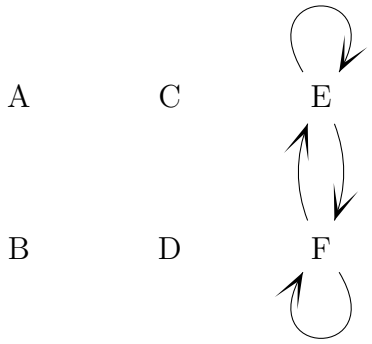

Reflexive: ☐ Irreflexive: ☐

Symmetric: ☐ Antisymmetric: ☐

Transitive: ☐

2. (5 points) Let R be the relation on the integers such that aRb if and only if $2a \equiv -3b \pmod 5$. Find three elements in the equivalence class $[7]$.

3. (5 points) Suppose that R is the relation on $\mathbb{Z}^3$ such that $(a, b, c)R(x, y, z)$ if and only if $c = x$, $a = y$, and $b = z$. Is R transitive? Informally explain why it's true or give a concrete counter-example.

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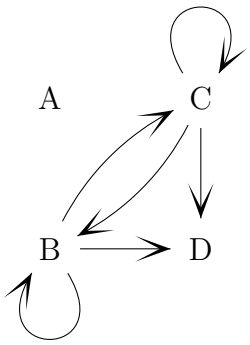

Reflexive: ☐ Irreflexive: ☐

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 are the same length. For example, `01011` $\sim$ `00010`. List three members of [`1111`].

3. (5 points) Let T be the relation on $\mathbb{R}^2$ such that $(x, y)T(p, q)$ if and only if $(x, y) = \alpha(p, q)$ for some real number α. Is T symmetric? Informally explain why it is, or give a concrete counter-example showing that it is not.

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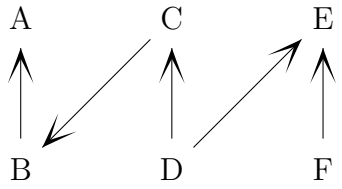

Reflexive: ☐ Irreflexive: ☐

Symmetric: ☐ Antisymmetric: ☐

Transitive: ☐

2. (5 points) Can a relation with at least one related pair (i.e. at least one arrow in a diagram) 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 $\succeq$ 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.