1. Let $x$ and $y$ be subjects, $z$ a subject or object, and $r$ be a read right. Write the following access control command that captures the take rule of the Take-Grant model. Assume that an access control matrix $A$ contains the rights specified in a Take-Grant graph.

command take_right($x$, $y$, $z$, $r$): $x$ takes right $r$ over $z$ from $y$, provided $x$ has take right over $y$, and $y$ has $r$ right over $z$.

Answer:

command take_right($x$, $y$, $z$, $r$)

if $t$ in $A[x, y]$ and $r$ in $A[y, z]$
    enter $r$ into $A[x, z]$

end

2.
a. For the lattice shown above give the following:

\[ \text{glb}(100, 001) = 000 \]

\[ \text{lub}(110, 010) = 110 \]

\[ \text{glb}(000, 001) = 000 \]

\[ \text{lub}(110, 101) = 111 \]

b. Write a predicate expression for the sentence:

i. “All that glitters is not gold”

\[ \exists x, \text{Glitters}(x) \rightarrow \neg \text{IsGold}(x) \]

ii. “Every file resides in some directory”

\[ \forall x, \exists y, F(x) \land D(y) \rightarrow \text{Contains}(y, x) \]

3. Mark the appropriate answer

a. Which of the following correctly models a component of the Take-Grant model?

\[ \text{[ ] } \text{link}(X, Y) = X/g \in \text{dom}(Y) \lor Y/t \in \text{dom}(X) \]

\[ \text{[X]} \text{link}(X, Y) = Y/g \in \text{dom}(X) \lor X/t \in \text{dom}(Y) \]

\[ \text{[ ] } \text{link}(X, Y) = Y/t \in \text{dom}(X) \lor X/t \in \text{dom}(Y) \]

\[ \text{[ ] } \text{link}(X, Y) = Y/g \in \text{dom}(X) \lor X/g \in \text{dom}(Y) \]

b. Which of the following statements about confidentiality models is incorrect?

\[ \text{[ ] } \text{Confidentiality models are aimed at controlling flow of information} \]

\[ \text{[ ] } \text{Confidentiality models are more applicable in military than commercial environments} \]

\[ \text{[X]} \text{Confidentiality models only address information flow that occurs because of transfer of rights} \]

\[ \text{[ ] } \text{Confidentiality models do not give primary importance to who can alter information} \]

c. Which of the following statements is not true?

\[ \text{[ ] } \text{SPM model does not allow deletion and destroy operations as HRU does} \]

\[ \text{[ ] } \text{SPM model subsumes multilevel security} \]

\[ \text{[ ] } \text{HRU model subsumes Take-grant model} \]
SPM subsumes Take-grant as well as HRU model

d. Write T for true and F for false for each of the statement below.

[F] Usurpation refers to unauthorized interruption of correct operation of a function.

[T] In some systems (like Unix), if a subject $s$ is owner of object $o$, then even if $s$ has no read or write right over $o$, $s$ may give read or write right over $o$ to another subject. This, however, does not violate the principle of attenuation of privilege.

4. Write witness to the theft of rights $a$ by $s$ in the following graph.

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