UNIVERSITY of GUELPH

CIS*4720 Image Processing and Vision

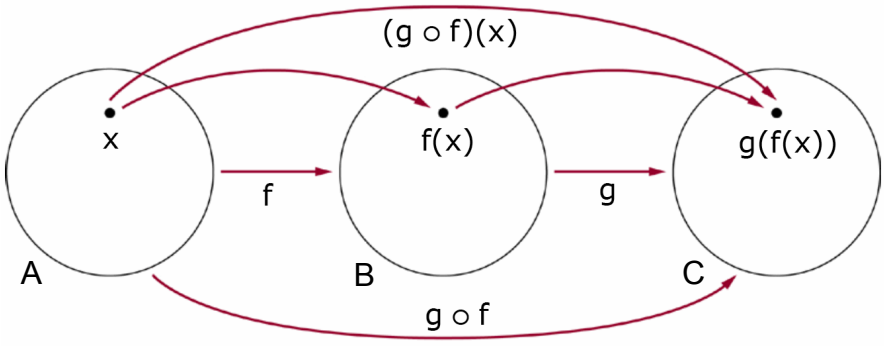
Winter 2023, Assignment 1 Part 1/2

Your submission must include the statement below, followed by your signature:
"I have read and understood the Academic Misconduct section in the course outline. I assert this work is my own."

All answers must be justified in a clear, concise and complete manner. If two answers require the same or very similar explanations, you may justify your first answer only, and refer the reader to that justification for the second answer.

NOTE

Consider three total functions $f \mid A \rightarrow B$, $g \mid B \rightarrow C$ and $h \mid C \rightarrow D$. Remember that the composite function g o f (read "g compose f ") is the total function from A to C defined by: $\forall x \in A$, $(g \circ f)(x) = g(f(x))$. Note that o is associative, i.e., $h \circ (g \circ f) = (h \circ g) \circ f$.



In this assignment, M, N and L denote three positive integers,
and an ***image*** is a total function from $0..M-1 \times 0..N-1$ to $0..L-1$.

Consider two images f and g. We say that f is ***related*** to g,
and we write $f \mathfrak{R} g$, if and only if there exist two total functions
s and t from $0..L-1$ to $0..L-1$ such that $g = s \circ f$ and $f = t \circ g$.

1/ **a.** Show that for any image f, we have: $f \mathfrak{R} f$
b. Show that for any images f and g, we have: if $f \mathfrak{R} g$ then $g \mathfrak{R} f$
c. Show that for any images f, g and h, we have: if $f \mathfrak{R} g$ and $g \mathfrak{R} h$ then $f \mathfrak{R} h$

NOTE
We say that $\mathfrak{R}$ is a ***binary relation*** on the set of all images. This relation is ***reflexive*** (according to 1/a), ***symmetric*** (according to 1/b) and ***transitive*** (according to 1/c). It is, therefore, an ***equivalence relation***.

2/ Here, M=2 and N=L=3. How many images are there?

a. The figure below represents an image f.
How many images are related to f ? Draw the corresponding figures.

0	1	2
2	1	0

b. Give an example of an image g such that exactly three images are related to g.
Draw the corresponding figures.