CIS*4720 Image Processing and Vision

Assignment 1

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I have read and understood the Academic Misconduct section in the course outline. I assert this work is my own.

1a)

- For any image f, we need to find two total functions $s \wedge t \in 0..L-1 \rightarrow 0..L-1 \mid f = s\ o\ f \wedge f = t\ o\ g$
- To do this, we will use the identity function i. The identity function is a total function where it returns the value that was used as its argument without being changed. (ex. $f(x) = x$)
- Let's say $s = t = i$ where $s(x) = x \wedge t(x) = x$, $\forall x \in 0..L-1$
- From this, we have
  $(f = s\ o\ f = i\ o\ f = f) \wedge$
  $(f = t\ o\ f = i\ o\ f = f)$
- $\therefore$ we have shown $f\ R\ f$ meaning it is reflexive

1b)

- For any image $f \wedge g$, we need to find two total functions $s \wedge t \in 0..L-1 \rightarrow 0..L-1 \mid g = s\ o\ f \wedge f = t\ o\ g$, then $\exists$ two total functions $u \wedge v \in 0..L-1 \rightarrow 0..L-1 \mid f = u\ o\ g \wedge g = v\ o\ f$
- Now let's define $u = t \wedge v = s$, then we have
  $f = u\ o\ g = t\ o\ g \wedge$
  $g = v\ o\ f = s\ o\ f$
- $\therefore$ We have shown $f\ R\ g$ then $g\ R\ f$ meaning it is symmetric

1c)

- Let's assume that $fRg \wedge gRh$. $\exists$ total functions $s \wedge t \in 0..L-1 \rightarrow 0..L-1 \mid g = s\ o\ f \wedge f = t\ o\ g$
- Let's also assume that $\exists$ total functions $u \wedge v \in 0..L-1 \rightarrow 0..L-1 \mid g = u\ o\ h \wedge h = v\ o\ g$
- Then we want to show that that $\exists$ two total functions $m \wedge n \mid f = m\ o\ h \wedge h = n\ o\ f$
- To do this let's define $m \wedge n$ as the following:
  $m = u\ o\ s$
  $n = t\ o\ v$
- We can compose these two functions and use the associative property to show that
  $f = m\ o\ h = (u\ o\ s)\ o\ h = u\ o\ (s\ o\ h) \wedge$
  $h = n\ o\ f = (t\ o\ v)\ o\ f = t\ o\ (v\ o\ f)$
- $\therefore$ we have shown $f\ R\ g \wedge g\ R\ h$, then $f\ R\ h$

2. There are $3^6 = 729$ total images since for each value of $M \times N$, we have 3 possible values of L to choose from $\therefore L^{MN}$

2a)

base image

0	1	2
2	1	0

1	0	2
2	0	1

2	1	0
0	1	2

0	2	1
1	2	0

1	2	0
0	2	1

2	0	1
1	0	2

2b)

base image

1	1	1
1	1	1

0	0	0
0	0	0

2	2	2
2	2	2