Tim Hung
CS455 Assignment 4
Part A

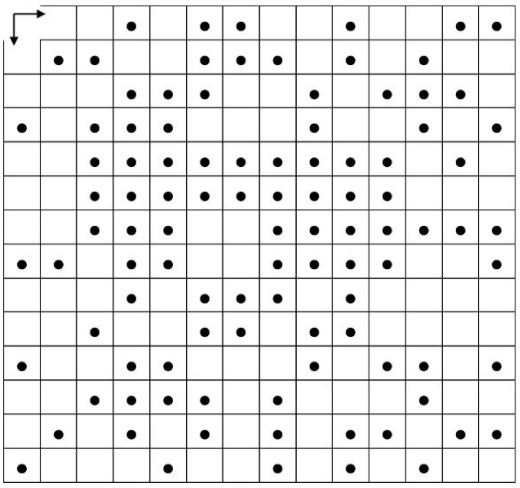
(1) (12%) Use the definition of Dilation to prove "$A \oplus B = B \oplus A$"

$A \oplus B$ = the set of all displacements which satisfies that A and $\hat{B}$ overlap at least once. It is clear that $B \oplus A$ is equivalent, the attribute of overlapping is still retained.

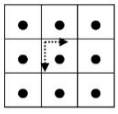
$\therefore \oplus$ is commutative.

(2) (12%) Binary image A and structuring element B are defined below. Show the result of opening operation (A ° B).

A



B



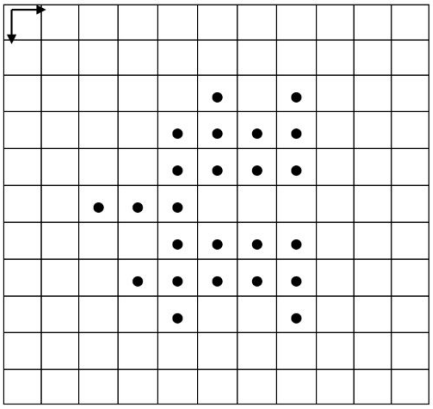
```
0 0 0 1 0 1 1 0 0 1 0 0 1 1
0 1 1 0 0 1 1 1 0 1 0 1 0 0
0 0 0 1 1 1 0 0 1 0 1 1 1 0
1 0 1 1 1 0 0 0 1 0 0 1 0 1
0 0 1 1 1 1 1 1 1 1 1 0 1 0
0 0 1 1 1 1 1 1 1 1 1 0 0 0
0 0 1 1 1 0 0 1 1 1 1 1 1 1
1 1 0 1 1 0 0 1 1 1 1 0 0 1
0 0 0 1 0 1 1 1 0 1 0 0 0 0
0 0 1 0 0 1 1 0 1 1 0 0 0 0
1 0 0 1 1 0 0 0 1 0 1 1 0 1
0 0 1 1 1 1 0 1 0 0 0 1 0 0
0 1 0 1 0 1 0 1 0 1 1 0 1 1
1 0 0 0 1 0 0 1 0 1 0 1 0 0
```

open

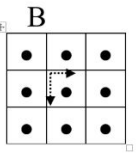
```
0 0 0 0 0 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0 0 0 0 0 0
0 0 1 1 1 0 0 0 0 0 0 0 0 0
0 0 1 1 1 0 0 1 1 1 1 0 0 0
0 0 1 1 1 0 0 1 1 1 1 0 0 0
0 0 1 1 1 0 0 1 1 1 1 0 0 0
0 0 0 0 0 0 0 1 1 1 1 0 0 0
0 0 0 0 0 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0 0 0 0 0 0
```

(2) (12%) Binary image C and structuring element B are defined below. Show the result of closing operation (C • B).

C



B

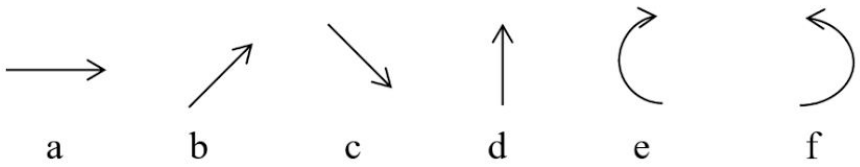


```
0 0 0 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0 0 0 0
0 0 0 0 0 1 0 1 0 0 0 0
0 0 0 0 1 1 1 1 0 0 0 0
0 0 0 0 1 1 1 1 0 0 0 0
0 0 1 1 1 0 0 0 0 0 0 0
0 0 0 0 1 1 1 1 0 0 0 0
0 0 0 1 1 1 1 1 0 0 0 0
0 0 0 0 1 0 0 1 0 0 0 0
0 0 0 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0 0 0 0
```

close

```
0 0 0 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0 0 0 0
0 0 0 0 0 1 1 1 0 0 0 0
0 0 0 0 1 1 1 1 0 0 0 0
0 0 0 0 1 1 1 1 0 0 0 0
0 0 1 1 1 1 1 1 0 0 0 0
0 0 0 1 1 1 1 1 0 0 0 0
0 0 0 1 1 1 1 1 0 0 0 0
0 0 0 0 1 1 1 1 0 0 0 0
0 0 0 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0 0 0 0
```

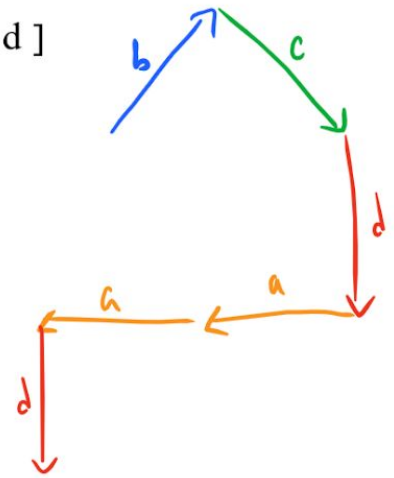
(3) (14%) Use the following primitives:



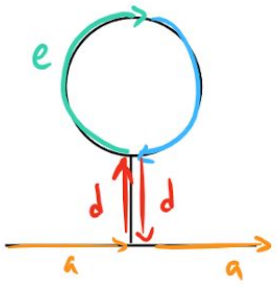
and use the structure relations given in class (+, –, ×, *, ~)

(a) (7%) Sketch the structure whose PDL (program description language) structural description is:

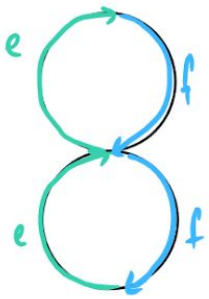
[[b – (~c)] + (~d)] – [[a – (~a)] + d]



(b) (7%) Give PDL structural description of the following two structures:



a + d + e - f - d + a



e + e - [f + f]