Operations on Patterns, Part 4: Repetition

Repetition is a common way to extend a small pattern to make a larger one. Repetition is a special case of concatenation [1].

Like concatenation, repetition can be horizontal or vertical. We'll use the notation $P \vdash i$ to denote the repetition of P horizontally i times. Similarly, the notation $P \top i$ denotes the repetition of P vertically i times.

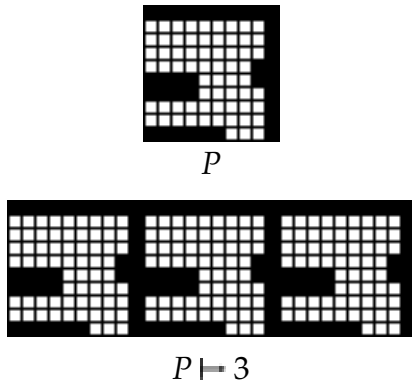Figures 1 and 2 illustrate examples of these operations.

P

$P \vdash 3$

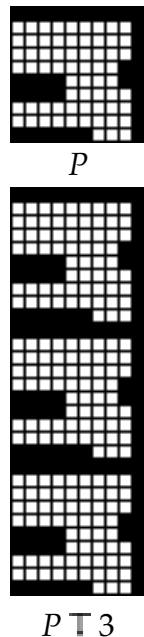**Figure 1. Horizontal Repetition**

P

$P \top 3$

Figure 2. Vertical Repetition

Duplicate Edges

As in concatenation, duplicate edges at boundaries are discarded by the repetition operations. Figure 3 shows an example.
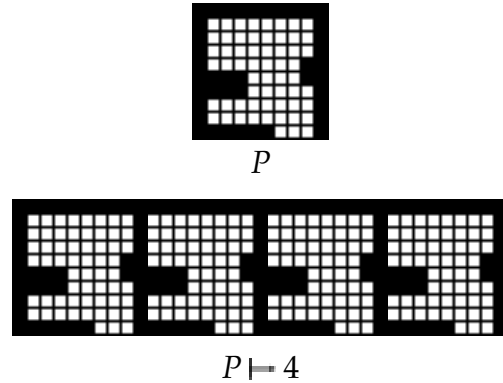

P

$P \vdash 4$

Figure 3. Repetition with Duplicate Removal

Duplicate removal is automatic in the repetition of patterns. If duplicate removal is not desired, the operations $\vdash_+$ and $\top_+$ can be used.

Figure 4 shows an example of horizontal repetition without duplicate removal.
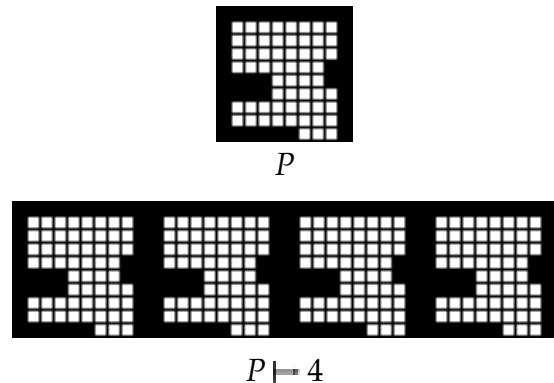

P

$P \vdash 4$

Figure 4. Concatenation without Duplicate Removal

Note: Duplicate edges are removed only at adjoining boundaries. Any other duplicate rows or columns are not affected.

Extension

Sometimes it is useful to extend a pattern by repetition to a width or height that is not an even multiple of that dimension of the pattern. The operations $P \Rightarrow i$ and $P \Downarrow i$ extend P by repetition to a total of i columns and i rows, respectively.

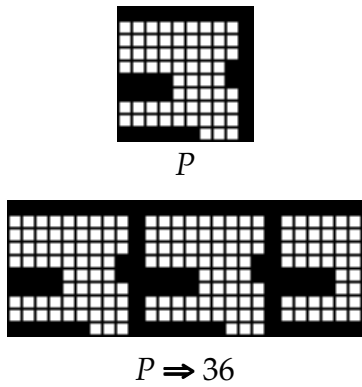Figures 4 and 5 show examples of extension.

P

$P \Rightarrow 36$

Figure 4. Horizontal Extension
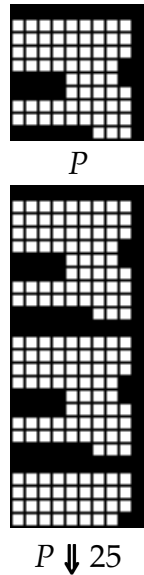

P

$P \Downarrow 25$

Figure 5. Vertical Extension

Note: If *i* is less that the dimension of the pattern in the given direction, the pattern is truncated at the right or bottom, accordingly.

As with repetition, duplicate edges at the boundaries of patterns are removed. The operations $P \Rightarrow_+ i$ and $P \Downarrow_+ i$ do not remove duplicate edges.

Summary

$\vdash i$	horizontal repetition
$\top i$	vertical repetition
$\Rightarrow i$	horizontal extension
$\Downarrow i$	vertical extension
$\vdash_+ i$	horizontal repetition without duplicate removal
$\top_+ i$	vertical repetition without duplicate removal
$\Rightarrow_+ i$	horizontal extension without duplicate removal
$\Downarrow_+ i$	vertical extension without duplicate removal

Reference

1. Ralph E. Griswold, "Operations on Patterns, Part 3: Concatenation", 2004: http://www.cs.arizona.edu/patterns/weaving/webdocs/gre_pop3.pdf

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