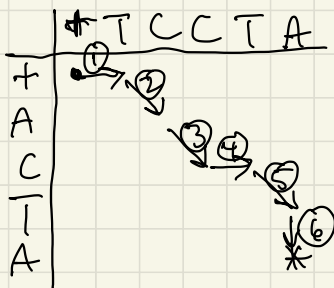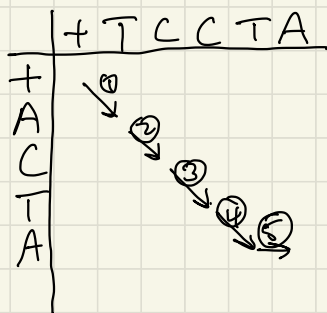# Needleman-Wunsch Algorithm

Alignment Matrix

- Representation of possible alignments

- Path in the alignment matrix from the upper left corner to the lower right corner represents a possible alignment

- Path rules:
  - Made up of a series of steps
  - Step can be:
    1) down
    2) right
    3) diagonally down + right

- Every step in a path corresponds to adding another symbol to the alignment

```
TCCTA
ACTA
```
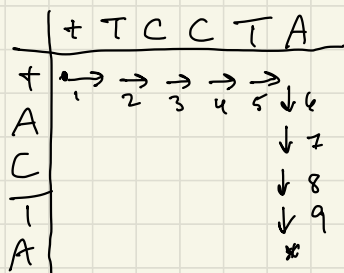
+ T C C T A
+ A C T A

Fill in alignment matrix w/ prefix alignment
  costs

- every step on an alignment has a cost,
  for every cell in the alignment matrix
  record the _minimum_ cost of alignment
  up to that cell

- cost will be determined by the cost fxn

$$w(a_i, b_i) = \begin{cases} 0 & \text{if } a_i = b_i \\ 1 & \text{otherwise} \end{cases}$$

	+	T	C	C	T	A
+	0	1	2	3	4	5
A	1	1	2	3	4	4
C	2	2	1	2	3	4
T	3	2	2	2	2	3
A	4	3	3	3	3	2

① Cost start @ 0

② Cost @ position i, j =

$$\min \begin{cases} \text{cost@ } i, j-1 + \text{gapcost} \\ \text{cost@ } i-1, j + \text{gapcost} \\ \text{cost@ } i-1, j-1 + \text{match/} \\ \qquad\qquad\qquad \text{mismatch cost} \end{cases}$$

③ Cost in lower right corner
   will be the minimum
   alignment cost of a and b

```
+ T C C T A
+ ~ A C T A
```

```
+ T C C T A
+ A C — T A
```

```
+ T C C T A
+ A — C T A
```