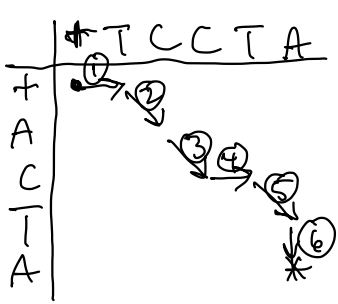
Needleman-Wunsch Algorithm

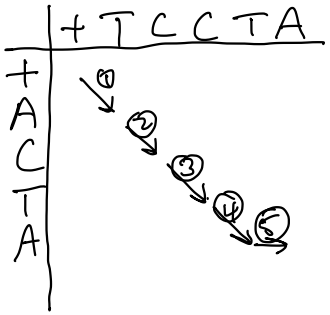
Alignment Matrix

- 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

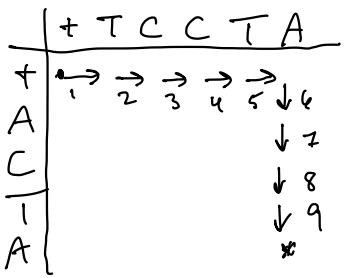
T C C T A
A C T A



1 2 3 4 5 6
+ T C C T A –
+ – A C – T A



① ② ③ ④ ⑤
+ T C C T A
+ A C T A –



① ② ③ ④ ⑤ ⑥ ⑦ ⑧ ⑨
+ 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

Example 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 =

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

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