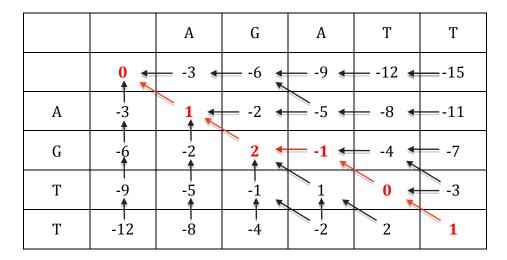
Problem 2. Global alignment (10 points)



x: A G A T T y: A G - T T

Problem 3. Local alignment (10 points)

		G	A	A	G	A	G
	0	0	0	0	0	0	0
A	0	0	1	1	0	1	0
A	0	0	1	2	0	1	0
G	0	1	0	0	3	0	2
С	0	0	0	0	0	2	0

x: AAG y: AAG

## Problem 4. Concepts in probability (9 points)

(a) 
$$P(S=chips) = 3/9$$
,  $P(S=cereal) = 6/9$ 

- (d) S is independent of D since for all s and d, P(S=s,D=d) = P(S=s)\*P(D=d).
- (e) S is not independent of D given T=morning, since  $P(S=s,D=d \mid T=morning) \text{ is not } P(S=s \mid T=morning)*P(D=d \mid T=morning).$   $P(S=cereal \mid T=morning) = 4/5$   $P(D=coffee \mid T=morning) = 4/5$   $P(S=cereal \mid T=morning) * P(D=coffee \mid T=morning) = 4/5 *4/5 = 15/25$   $P(S=cereal, D=coffee \mid T=morning) = 3/5$
- (f) S is independent of D given T=noon, since for all s and d, P(S=s,D=d | T=noon) = P(S=s | T=noon)\*P(D=d | T=noon).

## Problem 5. Applying concepts of probability to sequence alignment (6 points)

(a) Related model (p<sub>xy</sub>):

	A	Т	G	С
A	10/145	20/145	10/145	5/145
Т		30/145	20/145	10/145
G			15/145	10/145
С				15/145

Unrelated model (qa):

$q_A$	55/290
$q_T$	110/290
$\mathbf{q}_{\mathrm{G}}$	70/290
qc	55/290

(b) 
$$S(x,y) = \sum_{i=1}^{n} log\left(\frac{p_{x_iy_i}}{q_{x_i}q_{y_i}}\right)$$
 
$$S(ATA,GTC) = log\left(\frac{p_{AG}}{q_Aq_G}\right) + log\left(\frac{p_{TT}}{q_Tq_T}\right) + log\left(\frac{p_{AC}}{q_Aq_C}\right) = 0.3174 > 0$$

Since the log odd is positive, the alignment was more likely to be generated by the related model.