4.2.1d  Ex. 4.9, with \( k = 3 \) and \( i = 2 \): show the steps linking
\[
(q_1, \text{BaaBBabBbbaBaba}) \vdash^* (q_1, \text{BaaBaBabBbbaBab})
\]
Recall that we start with \((s, \text{BaaBabBbbaBabaB})\) and apply \(T^{k-i+2}R^{k-i+3} = T^3R^4\): move 3 groups of non-blanks to the right one place (the place left uncovered holds a blank), to reach \((q, \text{BaaBBabBbbaBabaB})\); find the fourth blank to the right \((q??, \text{BaaBBabBbbaBabaB})\); when you find it, copy it and move left \((q_1, \text{BaaBBabBbbaBaba})\).

The next series of steps moves the underlined \(a\) to the place between the two \(B\)s, moving everyone else to the right one place.
\[
(q_1, \text{BaaBBabBbbaBaba}) \vdash (q_2, \text{BaaBBabBbbaBabB}) \vdash (q_3, \text{BaaBBabBbbaBabB}) \vdash R^4
\]
\[
(q_4, \text{BaaBBabBbbaBabB}) \vdash^T (q_5, \text{BaaBBabBbbaBabB}) \vdash (q_5, \text{BaaBBabBbbaBabB}) \vdash T^4
\]
\[
(q_6, \text{BaaBabBbbaBbbaB}) \vdash (q_1, \text{BaaBabBbbaBbbaB})
\]

4.2.3c.  Start from \((s, \text{Baaaaaa...aaBbba...BbBbccc...ccB})\). You need to set the machine up so that

1. For each \(c\), it replaces a \(c\), a \(b\) and an \(a\) with a \(B\). It also must move everybody to the right of these new blanks one (or two) place(s) to the left. If it fails in this removal (finds a blank when expecting a \(b\) or an \(a\)), it must fail.

2. When done with removing \(b\)s and \(a\)s that match \(c\)s, it must remove \(b\)s and the \(a\)s that match \(b\)s. Same failure condition.

4.2.4c.  I would suggest combining the ideas from the projection \((\pi)\) function presented in class (which tries to deal with specifying the projection coordinate as a parameter), while modifying Ex. 4.9 and Fig. 4.9.

4.2.5.  Basically, the idea here is to take a configuration \((h, BxayB)\) into a configuration \((h', BB)\). If \(xay\) were always to contain no \(B\)s, this is trivial. If intermediate \(B\)s are possible, this requires some work.

Since you are accepting strings, the initial configuration on the tape will look like \(BzB\) with \(z \in \Sigma^*\). We need to resolve the problem that would arise from introducing blanks between non-blanks during the computation. You may want to replace the \(B\) on the left with, say \(\$\), and the blank on the right with, say, \(\sigma\). so your initial configuration will now look like \((s_1, \$z\sigma)\), with \(B\)s to the right of \(\sigma\). You now need to change the transition function to deal with both \(\$\) and \(\sigma\). The general idea would be that \((h, BxayB)\) is replaced by \((h, \$xay\sigma)\). From this point it should be trivial to add the steps to get to the desired final configuration.

Ex.4.9  Start by constructing Turing machines for \(R^{k-i+2}, R^{k-i+3}, T^{k-i+3}\) and \(T\). Then glue them in the places indicated. Some of the discussion in class for the projection may be relevant.