Q1 NFSA to Regular Expression:

a. a(a?b)+
b. (ab(a)?)+

Q2 Bigram Probabilities

The Fed chairman warned that the board 's decision is bad

P(sentence) = P (Fed | The) * P (chairman | Fed) * P (warned | chairman) * P (that | warned) * P (the | that) * P (board | the) * P (‘s | board) * P (decision | ’s) * P (is | decision) * P (bad | is)

No smoothing:

= 0.013157894736842105 * 0.21052631578947367 * 0 * 0.333333333333333 * 0.20233463035019456 * 0.1006993006993007 * 0.04644808743169399 * 0.025974025974025976 * 0.058823529411764705 * 0

= 0

Add One smoothing:

= 0.0005210142410559222 * 0.0008888888888888889 * 0.00016233766233766234 * 0.00035656979853806385 * 0.009039740747057821 * 0.02060830017055145 * 0.003014065639651708 * 0.0018360874645301285 * 0.00035568202027387515 * 0.00017262213015708613

= 1.6969283969765793e-30

Good Turing smoothing:

= 5.792294601790971e-05 * 0.0001464014294401328 * 0 * 1.2187097170440138e-05 * 0.003054050939264723 * 0.0 * 0.0005186124236487266 * 0.00042257308593599935 * 1.2187097170440138e-05 * 0.0

= 0

Q3

A. Transformation based POS tagging:

Best transformation rule for NN to JJ:

This transformation will cause decrease in accuracy as total score is negative. But following are the best rules received.

From	to	IF Previous	Score
NN	JJ	EX	-1
NN	JJ	MD	-1

Best transformation rule for NN to VB:

From	to	IF Previous	Score
NN	VB	MD	45

The_DT standard_?? Turbo_NN engine_NN is_VBZ hard_JJ to_TO work_??

Most common tag for standard and work both is NN and we don't have any rule in best rules list which can change this to improve accuracy so final output will be:

The_DT standard_**NN** Turbo_NN engine_NN is_VBZ hard_JJ to_TO work_**NN**

B. Naïve Bayesian:

The_DT standard_?? Turbo_NN engine_NN is_VBZ hard_JJ to_TO work_??

Most probable tag for word standard and work

P(standard) = Argmax (P (standard |JJ) * P (JJ | DT) * P(NN|JJ), P (standard |NN) * P (NN | DT) * P(NN|NN))

= (0.000774593338497289 * 0.22808970892317482 * 0.5435063258455978, 0.0006305170239596469 * 0.5094639732781931 * 0.17123040893532696)
= JJ

P (work) = Argmax (P (work |NN) * P (NN | TO), P (work |VB) * P (VB | TO))

= (0.002251846514141596 * 0.03288201160541586,
0.0035035035035035035 * 0.63571889103804
= VB