1a

stack	buffer	new dependency	transition
[ROOT]	[Nadia, rode, the, old, donkey, with, stripes]		Initial Config
[ROOT, Nadia]	[rode, the, old, donkey, with, stripes]		SHIFT
[ROOT, Nadia, rode]	[the, old, donkey, with, stripes]		SHIFT
[ROOT, rode]	[the, old, donkey, with, stripes]	rode $\xrightarrow{\text{nsubj}}$ Nadia	LEFT-ARC
[ROOT, rode, the]	[old, donkey, with, stripes]		SHIFT
[ROOT, rode, the, old]	[donkey, with, stripes]		SHIFT
[ROOT, rode, the, old, donkey]	[with, stripes]		SHIFT
[ROOT, rode, the, old, donkey, with]	[stripes]		SHIFT
[ROOT, rode, the, old, donkey, with, stripes]	[]		SHIFT
[ROOT, rode, the, old, donkey, with]	[]	with $\xrightarrow{\text{pobj}}$ stripes	RIGHT-ARC
[ROOT, rode, the, old, donkey]	[]	donkey $\xrightarrow{\text{prep}}$ with	RIGHT-ARC
[ROOT, rode, the, donkey]	[]	donkey $\xrightarrow{\text{amod}}$ old	LEFT-ARC
[ROOT, rode, donkey]	[]	donkey $\xrightarrow{\text{det}}$ the	LEFT-ARC
[ROOT, rode]	[]	rode $\xrightarrow{\text{dobj}}$ donkey	RIGHT-ARC
[ROOT]	[]	ROOT $\xrightarrow{\text{head}}$ rode	RIGHT-ARC

1b A sentence containing n words will be parsed in 2n+1 steps. For any sentence, the first step is always going to be initial config with the stack to be just [ROOT], and the buffer is all the words in the sentence, and no new dependency (1 step). For each word, it will take one step for it to be shifted from the buffer to the stack, and one step to mark the word to remove from stack, so for each word there's 2 steps in total. So for n words it is 2n (move to stack remove from stack for each word) + 1 (initialize). Therefore total is 2n+1 steps.

1c

The gap degree is 1.

I know this because:

For "John", "yesterday", "which", "a Yorkshire Terrier" are all trivial and have gap degree 0. Therefore for all of the above, k = 0.

For "was", it has 2 dependencies "was → which", and "was → a Yorkshire Terrier", which both are single contiguous substring, therefore gap degree = 1 - 1 = 0. Therefore k = 0.

For "a dog", the only dependency is "a dog → was". Since "was" has one contiguous substring, and "a dog", "was" are not contiguous, so "a dog →

was" has 2 contiguous substring $\implies$ The gap degree is 2 - 1 = 1. Therefore k = 1

For "saw", there's 3 dependencies:

"saw $\rightarrow$ John" is a single contiguous substring, so gap degree is 1 - 1 = 0.

"saw $\rightarrow$ a dog" is a single contiguous substring but for "a dog" there are 2 contiguous substrings so the gap degree is = gap degree of "a dog" = 1

"saw $\rightarrow$ yesterday" is a single contiguous substring, so gap degree is 1 - 1 = 0

the least k such that there's k+1 contiguous substrings is 0. Therefore k = 0.

The maximum k for all the words is k = 1, so therefore the gap degree of the tree is 1.

3a

For U(a, b), the formula of mean is:

μ = 1/2 * (a + b)

$\implies 0 = 1/2 * (a + b)$ [$\mu = 0$ given in question]

$\implies 0 = (a + b)$ [simplify]

$\implies a = -b$ [simplify] $(\star)$

For U(a, b), the formula of variance is:

$\sigma^2 = 1/12 * (b - a)^2$

$\implies 2/m = 1/12 * (b - a)^2$ [$\sigma^2 = 2/m$ given in question]

$\implies 24/m = (b - a)^2$ [simplify]

$\implies 24/m = (b - (-b))^2$ [by $(\star)$]

$\implies 24/m = (b + b)^2$ [simplify]

$\implies 24/m = (2b)^2$ [simplify]

$\implies 24/m = 4b^2$ [simplify]

$\implies 6/m = b^2$ [simplify]

$\implies b = \pm\sqrt{6/m}$ [simplify]

But since a < b and a = -b, then b = $\sqrt{6/m}$, and a = -$\sqrt{6/m}$

Therefore the values of a and b that yield a uniform distribution U (a,b) with the mean and variance given above is a = -$\sqrt{6/m}$, b = $\sqrt{6/m}$

3b

Best record for test:

LAS: 0.880

UAS: 0.896

Best record for validation:

LAS: 0.879

UAS: 0.896

I did not do any optional hyperparameter tweaking nor ran into trouble anywhere.

CSC 485, Summer 2020: Assignment 1

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I declare that this assignment, both my paper and electronic submissions, is my own work, and is in accordance with the University of Toronto Code of Behaviour on Academic Matters and the Code of Student Conduct.

Signature: Heng Liu