

tag	accuracy	f1 score	accuracy for unknown words	accuracy for known words	number of unknown words	number of known words
A (إسم)	78.44 %	11.95 %	77.76 %	78.39 %	16	208
B (رقم)	98.2 %	45.06 %	93.33 %	98.24 %	6	185
C (إسم معرف)	73.94 %	10.42 %	55.96 %	75.71 %	15	146
D (إضافة)	74.72 %	10.94 %	55.61 %	77.24 %	18	142
E (منعوت)	87.48 %	13.28 %	82.75 %	87.73 %	6	142
F (نعت)	86.74 %	11.71 %	54.59 %	90.07 %	16	151
G (حرف جر)	89.28 %	28.24 %	20.0 %	90.36 %	1	44
H (إسم مجرور)	75.71 %	21.29 %	57.78 %	84.53 %	12	26
I (وحدة قياس)	92.85 %	28.09 %	62.04 %	93.41 %	2	93
J (واو العطف)	88.45 %	26.72 %	NULL	88.45 %	0	33
K (فعل مبني للمجهول)	38.68 %	11.82 %	33.75 %	40.29 %	5	26
L (المفعول المطلق)	0.0 %	0.0 %	0.0 %	0.0 %	1	0
M (أداة عطف غير واو العطف)	34.81 %	13.77 %	NULL	34.81 %	0	8
.	99.97 %	89.99 %	NULL	99.97 %	0	789

Table 1: Average performances for each tag of our ingredient extractor for the first layer with  $\lambda = 4$  using a first order HMM

tag	accuracy	f1 score	accuracy for unknown words	accuracy for known words	number of unknown words	number of known words
A (إسم)	94.56 %	56.12 %	83.45 %	95.39 %	16	208
B (رقم)	99.29 %	62.09 %	100.0 %	99.27 %	6	185
C (إسم معرف)	89.76 %	48.07 %	74.83 %	91.37 %	15	146
D (إضافة)	81.83 %	66.89 %	34.87 %	87.67 %	18	142
E (منعوت)	94.48 %	68.51 %	63.17 %	96.09 %	6	142
F (نعت)	83.05 %	49.88 %	50.98 %	86.15 %	16	151
G (حرف جر)	96.28 %	59.18 %	80.0 %	96.44 %	1	44
H (إسم مجرور)	74.74 %	60.13 %	56.09 %	82.78 %	12	26
I (وحدة قياس)	98.32 %	64.6 %	88.89 %	98.42 %	2	93
J (واو العطف)	94.38 %	55.4 %	NULL	94.38 %	0	33
K (فعل مبني للمجهول)	88.74 %	37.14 %	86.39 %	89.77 %	5	26
L (المفعول المطلق)	40.48 %	35.71 %	61.11 %	25.0 %	1	0
M (أداة عطف غير واو العطف)	60.46 %	33.01 %	NULL	60.46 %	0	8
.	99.79 %	56.62 %	NULL	99.79 %	0	789

Table 2: Average performances for each tag of our ingredient extractor for the second layer with  $\lambda = 4$

	First Layer first order HMM				Second Layer second order HMM			
Tag	accuracy	f1 score	accuracy unknown words	accuracy known words	accuracy	f1 score	accuracy unknown words	accuracy known words
A (إسم)	78.44 %	11.95 %	77.76 %	78.39 %	94.56 %	56.12 %	83.45 %	95.39 %
B (رقم)	98.2 %	45.06 %	93.33 %	98.24 %	99.29 %	62.09 %	100.0 %	99.27 %
C (إسم معرف)	73.94 %	10.42 %	55.96 %	75.71 %	89.76 %	48.07 %	74.83 %	91.37 %
D (إضافة)	74.72 %	10.94 %	55.61 %	77.24 %	81.83 %	66.89 %	34.87 %	87.67 %
E (منعوت)	87.48 %	13.28 %	82.75 %	87.73 %	94.48 %	68.51 %	63.17 %	96.09 %
F (نعت)	86.74 %	11.71 %	54.59 %	90.07 %	83.05 %	49.88 %	50.98 %	86.15 %
G (حرف جر)	89.28 %	28.24 %	20.0 %	90.36 %	96.28 %	59.18 %	80.0 %	96.44 %
H (إسم مجرور)	75.71 %	21.29 %	57.78 %	84.53 %	74.74 %	60.13 %	56.09 %	82.78 %
I (وحدة قياس)	92.85 %	28.09 %	62.04 %	93.41 %	98.32 %	64.6 %	88.89 %	98.42 %
J (واو العطف)	88.45 %	26.72 %	NULL	88.45 %	94.38 %	55.4 %	NULL	94.38 %
K (فعل مبني للمجهول)	38.68 %	11.82 %	33.75 %	40.29 %	88.74 %	37.14 %	86.39 %	89.77 %
L (المفعول المطلق)	0.0 %	0.0 %	0.0 %	0.0 %	40.48 %	35.71 %	61.11 %	25.0 %
M (أداة عطف غير واو العطف)	34.81 %	13.77 %	NULL	34.81 %	60.46 %	33.01 %	NULL	60.46 %
.	99.97 %	89.99 %	NULL	99.97 %	99.79 %	56.62 %	NULL	99.79 %

Table 3: Average performances for each tag of our ingredient extractor for the first and second layer with  $\lambda = 4$

	First Layer first order HMM				Second Layer second order HMM			
Fold	accuracy	f1 score	accuracy unknown words	accuracy known words	accuracy	f1 score	accuracy unknown words	accuracy known words
0	90.33 %	70.61 %	50.55 %	92.14 %	95.43 %	66.98 %	61.54 %	96.97 %
1	87.65 %	73.73 %	52.03 %	89.76 %	93.92 %	65.93 %	70.73 %	95.28 %
2	88.97 %	75.28 %	66.99 %	90.16 %	94.44 %	66.9 %	66.02 %	95.97 %
3	87.67 %	72.16 %	66.27 %	88.6 %	94.88 %	66.9 %	63.86 %	96.22 %
4	87.21 %	73.14 %	63.11 %	88.44 %	93.61 %	66.42 %	72.82 %	94.66 %
5	91.23 %	76.51 %	62.92 %	92.47 %	94.82 %	68.17 %	69.66 %	95.92 %
6	90.53 %	73.87 %	59.3 %	91.86 %	93.81 %	65.12 %	54.65 %	95.48 %
7	88.94 %	78.32 %	61.22 %	90.31 %	93.75 %	65.09 %	55.1 %	95.66 %
8	89.28 %	77.76 %	67.86 %	90.16 %	94.97 %	67.81 %	64.29 %	96.23 %
9	89.4 %	77.29 %	65.98 %	90.53 %	94.01 %	65.01 %	60.82 %	95.62 %
Avg	89.12 %	74.87 %	61.62 %	90.44 %	94.36 %	66.43 %	63.95 %	95.8 %

Table 4: Average performances of our ingredient extractor with various accuracy on the first layer and  $\lambda = 4$  using 10 fold cross-validation