

| tag | accuracy | f1 score | accuracy for unknown words | accuracy for known words | number of unknown words | number of known words |
|----------------------------------|----------|----------|----------------------------------|--------------------------------|-------------------------------|-----------------------------|
| A (إسم) | 76.09 % | 10.8 % | 93.33 % | 74.88 % | 15 | 215 |
| B (رقم) | 98.94 % | 49.73 % | 100.0 % | 98.92 % | 2 | 186 |
| C (إسم معرف) | 80.37 % | 9.9 % | 61.11 % | 82.76 % | 18 | 145 |
| D (إضافة) | 80.0 % | 12.7 % | 47.37 % | 84.25 % | 19 | 146 |
| E (منعوت) | 93.85 % | 13.83 % | 100.0 % | 93.55 % | 6 | 124 |
| F (نعت) | 93.43 % | 13.8 % | 53.85 % | 97.58 % | 13 | 124 |
| G (حرف جر) | 98.31 % | 49.57 % | NULL | 98.31 % | 0 | 59 |
| H (إسم مجرور) | 91.67 % | 23.91 % | 85.71 % | 94.12 % | 14 | 34 |
| I (وحدة قياس) | 91.49 % | 23.89 % | 50.0 % | 92.39 % | 2 | 92 |
| J (واو العطف) | 80.0 % | 14.81 % | NULL | 80.0 % | 0 | 40 |
| K (فعل مبني للمجهول) | 8.62 % | 3.97 % | 25.0 % | 6.0 % | 8 | 50 |
| L (المفعول المطلق) | NULL | NULL | NULL | NULL | 0 | 0 |
| M (أداة عطف غير واو العطف) | 16.67 % | 4.08 % | NULL | 16.67 % | 0 | 12 |
| . | 100.0 % | 100.0 % | NULL | 100.0 % | 0 | 780 |

Table 1: Performances for each tag of our ingredient extractor for fold 9 and 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) | 96.96 % | 48.27 % | 93.33 % | 97.21 % | 15 | 215 |
| B (رقم) | 99.47 % | 49.87 % | 100.0 % | 99.46 % | 2 | 186 |
| C (إسم معرف) | 83.44 % | 42.23 % | 66.67 % | 85.52 % | 18 | 145 |
| D (إضافة) | 76.36 % | 57.53 % | 15.79 % | 84.25 % | 19 | 146 |
| E (منعوت) | 97.69 % | 97.57 % | 83.33 % | 98.39 % | 6 | 124 |
| F (نعت) | 81.02 % | 53.31 % | 46.15 % | 84.68 % | 13 | 124 |
| G (حرف جر) | 100.0 % | 100.0 % | NULL | 100.0 % | 0 | 59 |
| H (إسم مجرور) | 77.08 % | 75.81 % | 50.0 % | 88.24 % | 14 | 34 |
| I (وحدة قياس) | 96.81 % | 49.19 % | 100.0 % | 96.74 % | 2 | 92 |
| J (واو العطف) | 95.0 % | 48.72 % | NULL | 95.0 % | 0 | 40 |
| K (فعل مبني للمجهول) | 93.1 % | 32.14 % | 100.0 % | 92.0 % | 8 | 50 |
| L (المفعول المطلق) | NULL | NULL | NULL | NULL | 0 | 0 |
| M (أداة عطف غير واو العطف) | 66.67 % | 40.0 % | NULL | 66.67 % | 0 | 12 |
| . | 100.0 % | 100.0 % | NULL | 100.0 % | 0 | 780 |

Table 2: Performances for each tag of our ingredient extractor for fold 9 and 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) | 76.09 % | 10.8 % | 93.33 % | 74.88 % | 96.96 % | 48.27 % | 93.33 % | 97.21 % |
| B (رقم) | 98.94 % | 49.73 % | 100.0 % | 98.92 % | 99.47 % | 49.87 % | 100.0 % | 99.46 % |
| C (إسم معرف) | 80.37 % | 9.9 % | 61.11 % | 82.76 % | 83.44 % | 42.23 % | 66.67 % | 85.52 % |
| D (إضافة) | 80.0 % | 12.7 % | 47.37 % | 84.25 % | 76.36 % | 57.53 % | 15.79 % | 84.25 % |
| E (منعوت) | 93.85 % | 13.83 % | 100.0 % | 93.55 % | 97.69 % | 97.57 % | 83.33 % | 98.39 % |
| F (نعت) | 93.43 % | 13.8 % | 53.85 % | 97.58 % | 81.02 % | 53.31 % | 46.15 % | 84.68 % |
| G (حرف جر) | 98.31 % | 49.57 % | NULL | 98.31 % | 100.0 % | 100.0 % | NULL | 100.0 % |
| H (إسم مجرور) | 91.67 % | 23.91 % | 85.71 % | 94.12 % | 77.08 % | 75.81 % | 50.0 % | 88.24 % |
| I (وحدة قياس) | 91.49 % | 23.89 % | 50.0 % | 92.39 % | 96.81 % | 49.19 % | 100.0 % | 96.74 % |
| J (واو العطف) | 80.0 % | 14.81 % | NULL | 80.0 % | 95.0 % | 48.72 % | NULL | 95.0 % |
| K (فعل مبني للمجهول) | 8.62 % | 3.97 % | 25.0 % | 6.0 % | 93.1 % | 32.14 % | 100.0 % | 92.0 % |
| L (المفعول المطلق) | NULL | NULL | NULL | NULL | NULL | NULL | NULL | NULL |
| M (أداة عطف غير واو العطف) | 16.67 % | 4.08 % | NULL | 16.67 % | 66.67 % | 40.0 % | NULL | 66.67 % |
| . | 100.0 % | 100.0 % | NULL | 100.0 % | 100.0 % | 100.0 % | NULL | 100.0 % |

Table 3: Performances for each tag of our ingredient extractor for fold 9 and 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 | 87.7 % | 73.71 % | 52.03 % | 89.81 % | 93.96 % | 65.96 % | 70.73 % | 95.32 % |
| 2 | 89.07 % | 75.34 % | 66.99 % | 90.26 % | 94.54 % | 66.97 % | 66.02 % | 96.07 % |
| 3 | 87.87 % | 72.36 % | 67.47 % | 88.75 % | 94.93 % | 66.93 % | 63.86 % | 96.27 % |
| 4 | 87.31 % | 73.21 % | 63.11 % | 88.54 % | 93.65 % | 66.46 % | 72.82 % | 94.71 % |
| 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 % | 93.86 % | 65.16 % | 54.65 % | 95.53 % |
| 7 | 89.13 % | 78.5 % | 61.22 % | 90.51 % | 93.8 % | 65.12 % | 55.1 % | 95.71 % |
| 8 | 89.28 % | 77.76 % | 67.86 % | 90.16 % | 95.01 % | 67.84 % | 64.29 % | 96.28 % |
| 9 | 89.4 % | 77.29 % | 65.98 % | 90.53 % | 93.96 % | 64.98 % | 60.82 % | 95.57 % |
| Avg | - | - | - | - | - | - | - | - |

Table 4: Performances of our ingredient extractor in predicting ingredients states for fold 9 with $\lambda = 4$