

| tag | accuracy | f1 score | accuracy for unknown words | accuracy for known words | number of unknown words | number of known words |
|----------------------------------|----------|----------|----------------------------------|--------------------------------|-------------------------------|-----------------------------|
| A (إسم) | 79.34 % | 11.06 % | 54.55 % | 80.69 % | 11 | 202 |
| B (رقم) | 100.0 % | 100.0 % | 100.0 % | 100.0 % | 9 | 178 |
| C (إسم معرف) | 76.71 % | 8.68 % | 33.33 % | 79.56 % | 9 | 137 |
| D (إضافة) | 78.42 % | 9.77 % | 57.14 % | 80.8 % | 14 | 125 |
| E (منعوت) | 84.57 % | 13.09 % | 83.33 % | 84.62 % | 6 | 156 |
| F (نعت) | 85.0 % | 10.21 % | 28.57 % | 89.76 % | 14 | 166 |
| G (حرف جر) | 84.09 % | 18.27 % | 0.0 % | 86.05 % | 1 | 43 |
| H (إسم مجرور) | 58.97 % | 12.37 % | 36.84 % | 80.0 % | 19 | 20 |
| I (وحدة قياس) | 97.92 % | 49.47 % | 100.0 % | 97.87 % | 2 | 94 |
| J (واو العطف) | 96.15 % | 49.02 % | NULL | 96.15 % | 0 | 26 |
| K (فعل مبني للمجهول) | 55.56 % | 17.86 % | 66.67 % | 53.33 % | 3 | 15 |
| L (المفعول المطلق) | 0.0 % | 0.0 % | 0.0 % | NULL | 2 | 0 |
| M (أداة عطف غير واو العطف) | 0.0 % | 0.0 % | NULL | 0.0 % | 0 | 1 |
| . | 100.0 % | 100.0 % | NULL | 100.0 % | 0 | 784 |

Table 1: Performances for each tag of our ingredient extractor for fold 0 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) | 93.9 % | 46.44 % | 72.73 % | 95.05 % | 11 | 202 |
| B (رقم) | 100.0 % | 100.0 % | 100.0 % | 100.0 % | 9 | 178 |
| C (إسم معرف) | 96.58 % | 48.59 % | 88.89 % | 97.08 % | 9 | 137 |
| D (إضافة) | 83.45 % | 62.41 % | 21.43 % | 90.4 % | 14 | 125 |
| E (منعوت) | 95.06 % | 62.95 % | 50.0 % | 96.79 % | 6 | 156 |
| F (نعت) | 85.56 % | 41.54 % | 50.0 % | 88.55 % | 14 | 166 |
| G (حرف جر) | 93.18 % | 48.24 % | 0.0 % | 95.35 % | 1 | 43 |
| H (إسم مجرور) | 74.36 % | 38.62 % | 63.16 % | 85.0 % | 19 | 20 |
| I (وحدة قياس) | 97.92 % | 49.47 % | 100.0 % | 97.87 % | 2 | 94 |
| J (واو العطف) | 100.0 % | 100.0 % | NULL | 100.0 % | 0 | 26 |
| K (فعل مبني للمجهول) | 94.44 % | 48.57 % | 100.0 % | 93.33 % | 3 | 15 |
| L (المفعول المطلق) | 50.0 % | 33.33 % | 50.0 % | NULL | 2 | 0 |
| M (أداة عطف غير واو العطف) | 0.0 % | 0.0 % | NULL | 0.0 % | 0 | 1 |
| . | 100.0 % | 100.0 % | NULL | 100.0 % | 0 | 784 |

Table 2: Performances for each tag of our ingredient extractor for fold 0 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) | 79.34 % | 11.06 % | 54.55 % | 80.69 % | 93.9 % | 46.44 % | 72.73 % | 95.05 % |
| B (رقم) | 100.0 % | 100.0 % | 100.0 % | 100.0 % | 100.0 % | 100.0 % | 100.0 % | 100.0 % |
| C (إسم معرف) | 76.71 % | 8.68 % | 33.33 % | 79.56 % | 96.58 % | 48.59 % | 88.89 % | 97.08 % |
| D (إضافة) | 78.42 % | 9.77 % | 57.14 % | 80.8 % | 83.45 % | 62.41 % | 21.43 % | 90.4 % |
| E (منعوت) | 84.57 % | 13.09 % | 83.33 % | 84.62 % | 95.06 % | 62.95 % | 50.0 % | 96.79 % |
| F (نعت) | 85.0 % | 10.21 % | 28.57 % | 89.76 % | 85.56 % | 41.54 % | 50.0 % | 88.55 % |
| G (حرف جر) | 84.09 % | 18.27 % | 0.0 % | 86.05 % | 93.18 % | 48.24 % | 0.0 % | 95.35 % |
| H (إسم مجرور) | 58.97 % | 12.37 % | 36.84 % | 80.0 % | 74.36 % | 38.62 % | 63.16 % | 85.0 % |
| I (وحدة قياس) | 97.92 % | 49.47 % | 100.0 % | 97.87 % | 97.92 % | 49.47 % | 100.0 % | 97.87 % |
| J (واو العطف) | 96.15 % | 49.02 % | NULL | 96.15 % | 100.0 % | 100.0 % | NULL | 100.0 % |
| K (فعل مبني للمجهول) | 55.56 % | 17.86 % | 66.67 % | 53.33 % | 94.44 % | 48.57 % | 100.0 % | 93.33 % |
| L (المفعول المطلق) | 0.0 % | 0.0 % | 0.0 % | NULL | 50.0 % | 33.33 % | 50.0 % | NULL |
| M (أداة عطف غير واو العطف) | 0.0 % | 0.0 % | NULL | 0.0 % | 0.0 % | 0.0 % | NULL | 0.0 % |
| . | 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 0 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 | - | - | - | - | - | - | - | - |
| 2 | - | - | - | - | - | - | - | - |
| 3 | - | - | - | - | - | - | - | - |
| 4 | - | - | - | - | - | - | - | - |
| 5 | - | - | - | - | - | - | - | - |
| 6 | - | - | - | - | - | - | - | - |
| 7 | - | - | - | - | - | - | - | - |
| 8 | - | - | - | - | - | - | - | - |
| 9 | - | - | - | - | - | - | - | - |
| Avg | - | - | - | - | - | - | - | - |

Table 4: Performances of our ingredient extractor in predicting ingredients states for fold 0 with $\lambda = 4$