## Learning Neural Templates for Text Generation

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#### HARVARD

School of Engineering and Applied Sciences

## Template-style Text Generation

A classical NLG template:

```
<restaurant_name> is a
<food_type> <restaurant_type>
with a <num_stars> star rating. It is
located in <neighborhood>, and its
price range is <pri>price_range>.
```

## Why Templates?

Template-based generation addresses certain deficiencies in encoder/decoder style generation.

More interpretable

More controllable

## Where We're Going

An end-to-end, encoder/decoder style model that allows for:

Induction of discrete, template-like objects from text

- Interpretable and controllable generation with these induced templates
- Good, but not quite SOTA performance on automatic metrics

#### Data-to-Text Generation

[c.f., Lebret et al., 2016]

#### Frederick Parker-Rhodes

**Born** 21 November 1914

Newington, Yorkshire

**Died** 2 March 1987 (aged 72)

Residence UK

**Nationality** British

**Known for** Contributions to

computational linguistics,

combinatorial physics, bit-

string physics, plant

pathology, and mycology

Scientific career

Fields Mycology, Plant Pathology,

Mathematics, Linguistics,

**Computer Science** 

Author abbrev. Park.-Rhodes

(botany)



"Frederick Parker-Rhodes (21 November 1914 – 2 March 1987) was an English linguist, plant pathologist, computer scientist, mathematician, mystic, and mycologist."

#### **Data-to-Text Generation**

[c.f., Novikova et al., 2017]

Name	The Eagle
Eat Type	coffee shop
Food	French
Price Range	moderate
Customer Rating	3/5
Area	riverside
Kids Friendly	yes
Near	Burger King



"The three star coffee shop, The Eagle, gives families a mid-priced dining experience featuring a variety of wines and cheeses. Find The Eagle near Burger King."

## Argument for Templates #1: Interpretability

#### **Frederick Parker-Rhodes**

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## **Argument for Templates #1: Interpretability**

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<name> (born <born>) was a
<nationality> <occupation>, who
lived in the <residence>. He was
known for contributions to <known for>.

## Argument for Templates #2: Controllability

Name	The Eagle
Eat Type	coffee shop
Food	French
Price Range	moderate
Customer Rating	3/5
Area	riverside
Kids Friendly	yes
Near	Burger King

<name> is a kid-friendly <eat\_type>
serving <food> cuisine in the <area>
area.



The <customer\_rating> star rated
<name> serves <food> food at a
<price\_range> price.

Near <near> is a <food> <eat\_type>
with a <customer\_rating> star rating.
It is family friendly, and its price range is
cprice\_range>.

## Goal: Learned Template-style Generation

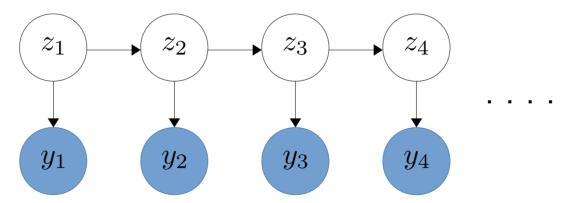
- Idea: use a Hidden Semi-Markov Model (HSMM) decoder
  - Preserve most of the encoder/decoder setup
  - Learn template-like representations jointly with learning to generate

[Gales and Young, 1993; Ostendorf et al., 1996]

- Give a joint distribution over observations  $y_{1:T}$  and discrete latents  $z_{1:S}$ 
  - Like HMMs, but observations can last multiple time-steps:

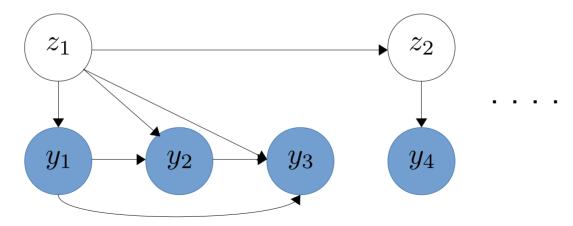
[Gales and Young, 1993; Ostendorf et al., 1996]

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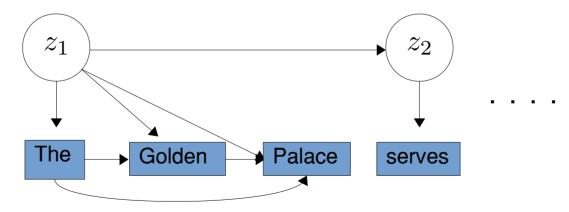
[Gales and Young, 1993; Ostendorf et al., 1996]

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- Give a joint distribution over observations  $y_{1:T}$  and discrete latents  $z_{1:S}$ 
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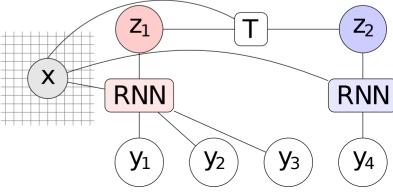


**Upshot:** HSMMs give us typed segmentations.

## A Conditional (Neural) HSMM

$$p(y, z \mid x) = \prod_{s=1}^{S} \underbrace{p(z_s \mid z_{s-1}, x)}_{\text{transition prob}} \underbrace{p(l_s \mid z_s)}_{\text{length prob}} \underbrace{p(y_{t_0(s):t_1(s)} \mid z_s, l_s, x)}_{\text{segment prob}}$$

- We parameterize probabilities with neural components:
  - Segment probabilities are given by an RNN + attention + copy attention



## Learning

- We're given a dataset of x, y pairs
- Segmentations z are unobserved at training time
- Maximize  $\ln p(y_{1:T} | x) = \ln \sum_{z} p(y_{1:T}, z | x)$ 
  - Can use a dynamic program analogous to the forward or backward algorithm used in learning HMMs [c.f., Murphy 2002]
  - Can simply backprop through the dynamic program
    - Easy with pytorch!

#### Generation

- Given an input x, we could generate by approximating  $\underset{y,z}{\arg\max}\,p(y,z\,|\,x)$
- Instead, we'll first extract "templates":
  - 1) Viterbi-segment the training data

#### Generation

- Given an input x, we could generate by approximating  $\underset{y,z}{\arg\max}\,p(y,z\,|\,x)$
- Instead, we'll first extract "templates":
  - 1) Viterbi-segment the training data

```
[The Golden Palace]_{55}[is a]_{59}[coffee shop]_{12}[providing]_{3}[Indian]_{50}[food]_{1}[in the]_{17}[£20-25]_{125}[price range]_{16}[.]_{2}[It is]_{8}[located in the]_{25}[riverside]_{40}[.]_{53}[Its customer rating is]_{19}[high]_{23}[.]_{2}
```

#### Generation

- Given an input x, we could generate by approximating  $\underset{y,z}{\arg\max}\,p(y,z\,|\,x)$
- Instead, we'll first extract "templates":
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```
[The Golden Palace]_{55}[is a]_{59}[coffee shop]_{12}[providing]_{3}[Indian]_{50}[food]_{1}[in the]_{17}[£20-25]_{125}[price range]_{16}[.]_{2}[It is]_{8}[located in the]_{25}[riverside]_{40}[.]_{53}[Its customer rating is]_{19}[high]_{23}[.]_{2}
```

Note: each segment gets a latent-state label.

- We'll call a sequence of labels  $z^{(i)}$  a "template."
- E.g.,  $z^{(i)}$  = 55, 59, 12, 3, ...

## What's Good about these "Templates"?

1) Dim. reduction: latent states correspond to functional categories.

```
The Eagle
                            provides
                                        Indian
                                                                                     price range
                                                                                                         It is
                                                                                                                       near
                                                   food
                                                             in the
                                                                          high
                                                                       moderate | customer rating |
       The Golden Curry | providing | Chinese |
                                                  cuisine |
                                                             with a
                                                                                                       They are
                                                                                                                  located in the
                                        English
                                                   Food
                                                           and has a
                                                                        average
                                                                                        rating
              Zizzi
                              serves
                                                                                                                   located near
                             Its customer rating is 1 out of 5
              riverside
             city centre
                                    It has a
                                                      average
             Cafe Sicilia
                              The price range is
        Located near
                        The Portland Arms
                                                     is an
                                                                    Italian
                                                                                                   The Waterman
                                                                               restaurant called
       Located in the
                             riverside
                                             is a family friendly
                                                                   fast food
                                                                                  place called
                                                                                                       Cocum
            Near
                                                   there is a
                                                                    French
                                                                               restaurant named
                                                                                                     Loch Fyne
                             city centre
                            Italian
                                                            The Waterman
                                      restaurant
                                                      is
                                          pub
                                                    called \bot
                          fast food 1
                                                                Cocum
3.
                            French
                                      coffee shop
       A family friendly
                                                   _{\mathrm{named}}
                                                               Loch Fyne
                        The Portland Arms
        Located near
                                                    The Eagle
                                                                             is a
                                                                                               cheap
                                                                                                             Italian
                                                                                                                        restaurant
       Located in the
                             riverside
                                                The Golden Curry | is a family friendly | family-friendly
                                                                                                            fast food
                                                                                                                           pub
                            city centre
                                                                            is an
                                                                                          family friendly
                                                                                                             French
                                                                                                                       coffee shop
                            Italian
                                      restaurant
                                                        near
                                                                     riverside
                                                                                           The Waterman
                                                                                    is
                                                   located in the | city centre
                           fast food
                                          pub
                                                                                  _{\mathrm{called}}
                                                                                               Cocum
                                                    located near
       A family friendly
                                      coffee shop
                                                                    Cafe Sicilia
                                                                                  named |
                                                                                             Loch Fyne
                            French
```

## What's Good about these "Templates"?

1) Dim. reduction: latent states correspond to functional categories.

```
aftab ahmed
                                                        is an american
                                           1951
                                                                             actor
       anderson da silva
                                 born on
                                           1970
                                                       was an american
                                                                            actress
                                           1974
                                                                           cricketer |.
           david jones
                                 born 1
                                                         is an english
          aftab ahmed
                                         world war i
                                                           member of the
                                                                                               house of representatives
                              was a
                                                                                  austrian
                           is a former
       anderson da silva |
                                            liberal
                                                       party member of the | pennsylvania
                                                                                                      legislature
           david jones
                                           baseball
                                                          recipient of the
                                                                                 montana
                                                                                                        senate
        adjutant
                       aftab ahmed
                                                      world war i
                                                                       member of the
                                           was a
                                                                                                  knesset
                    anderson da silva
                                       _{\perp} is a former _{\perp}
                                                        liberal
                                                                   | party member of the | scottish parliament|
        lieutenant
3.
                                                                       recipient of the
                                                                                          fc lokomotiv liski
         captain
                       david jones
                                                        baseball
          william
                       " billy " watson
                                               1913
                                                                  1917
                                                                                                        football player
                                                                                    was an american
       john william
                            \operatorname{smith}
                                             c. 1900
                                                       in | surrey, england
                                                                                 | was an australian |
                                                                                                        rules footballer
                                                            british columbia | ) |
          iames "
                        iim " edward
                                               1913
                                                                                     is an american
                                                                                                          defenceman
                  who plays for
                                       collingwood
                                                                 victorial football league
                                                       in the
             who currently plays for
                                         \operatorname{st} kilda
                                                       of the | national football league
                who played with
                                          carlton
                                                                australian football league
                                                      and the
          aftab ahmed
                               is a
                                            member of the
                                                                       knesset
       anderson da silva | is a former | party member of the | scottish parliament
5.
                                            recipient of the
                                                                 fc lokomotiv liski
           david iones
                           is a female
```

## What's Good about these "Templates"?

- 2) We can use them to control generation:
- Select a template  $z^{(i)}=z_1^{(i)},\ldots,z_S^{(i)}$
- Generate by computing  $\underset{y}{\arg\max} p(y, z = z^{(i)} \mid x)$
- Gives a different generation for each  $z^{(i)}$ 
  - (Examples in a few slides...)

## **Generation Recap**

1) Viterbi-segment the training data

- 2) Collect frequent "templates"  $z^{(i)}=z_1^{(i)},\ldots,z_S^{(i)}$
- 3) Given a new input x , generate by finding  $\underset{y}{\arg\max}\,p(y,z^{(i)}\,|\,x)$  for a chosen template  $z^{(i)}$

### Methods

1) Condition RNNs on latent state by concatenating state-embedding to RNN input

2) Helpful to train with hard constraints: disallow splitting up segments appearing in tables

3) Segment RNNs can condition on all preceding tokens

#### **E2E Validation Results**

(Val)	BLEU	NIST	ROUGE	CIDEr	METEOR
D&J (2017)	69.25	8.48	72.57	2.40	47.03
Substitution BL					
Neural Template					

- D&J (2017) is an enc/dec + reranker system used in the E2E Challenge
- Substitution BL finds maximally similar training table and performs substitution in corresponding description
- K=60; 1x300 LSTM as segment models
- Used 100 most common z<sup>(i)</sup> and selected highest overall scorer

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(Val)	BLEU	NIST	ROUGE	CIDEr	METEOR
D&J (2017)	69.25	8.48	72.57	2.40	47.03
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Neural Template					

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Neural Template	67.07	7.98	69.50	2.29	43.07

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#### **E2E Test Results**

(Val)	BLEU	NIST	ROUGE	CIDEr	METEOR
D&J (2017)	65.93	8.59	68.50	2.23	44.83
Substitution BL	43.78	6.88	54.64	1.39	37.35
Neural Template	59.80	7.56	65.01	1.95	38.75

- D&J (2017) is an enc/dec + reranker system used in the E2E Challenge
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### WikiBio Results

	BLEU	NIST	ROUGE-4
Template KN	19.8	5.19	10.7
NNLM (field)	33.4	7.52	23.9
NNLM (field & word)	34.7	7.98	25.8
Neural Template	34.8	7.59	38.6

- Encoder/decoder and template-style baselines from Lebret et al. (2016)
- K=45; 1x300 LSTMs as segment/history models
- Used 100 most common z<sup>(i)</sup> and selected highest overall scorer

### WikiBio Results

	BLEU	NIST	ROUGE-4
Template KN	19.8	5.19	10.7
NNLM (field)	33.4	7.52	23.9
NNLM (field & word)	34.7	7.98	25.8
Neural Template	34.8	7.59	38.6
Liu et al. (2018)	43.7	-	40.3

- Encoder/decoder and template-style baselines from Lebret et al. (2016)
- K=45; 1x300 LSTMs as segment/history models
- Used 100 most common z<sup>(i)</sup> and selected highest overall scorer

z = 55, 59, 43, 11, 25, 50, 53

Name	Travellers Rest Beefeater
Customer Rating	3 out of 5
Area	riverside
Near	Raja Indian Cuisine

Travellers Rest Beefeater<sub>55</sub> is  $a_{59}$  3 star<sub>43</sub> restaurant<sub>11</sub> located near<sub>25</sub> Raja Indian Cuisine<sub>40</sub>·<sub>53</sub>

z = 31, 29, 44, 55, 3, 50, 1, 2

Name	Travellers Rest Beefeater
Customer Rating	3 out of 5
Area	riverside
Near	Raja Indian Cuisine

Travellers Rest Beefeater<sub>55</sub> is  $a_{59}$  3 star<sub>43</sub> restaurant<sub>11</sub> located near<sub>25</sub> Raja Indian Cuisine<sub>40</sub>.<sub>53</sub>

Near<sub>31</sub> riverside<sub>29</sub>,<sub>44</sub> Travellers Rest Beefeater<sub>55</sub> serves<sub>3</sub> 3 star<sub>50</sub> food<sub>1</sub>.<sub>2</sub>

z = 55, 59, 12, 3, 50, 1, 17, 26, 16, 2, 8, 25, 40, 53

Name	Travellers Rest Beefeater
Customer Rating	3 out of 5
Area	riverside
Near	Raja Indian Cuisine

Travellers Rest Beefeater<sub>55</sub> is  $a_{59}$  3 star<sub>43</sub> restaurant<sub>11</sub> located near<sub>25</sub> Raja Indian Cuisine<sub>40</sub>.<sub>53</sub>

Near<sub>31</sub> riverside<sub>29</sub>,<sub>44</sub> Travellers Rest Beefeater<sub>55</sub> serves<sub>3</sub> 3 star<sub>50</sub> food<sub>1</sub>.<sub>2</sub>

Travellers Rest Beefeater<sub>55</sub> is  $a_{59}$  restaurant<sub>12</sub> providing<sub>3</sub> riverside<sub>50</sub> food<sub>1</sub> and has  $a_{17}$  3 out of  $5_{26}$  customer rating<sub>16</sub>·<sub>2</sub> It is<sub>8</sub> near<sub>25</sub> Raja Indian Cuisine<sub>40</sub>·<sub>53</sub>

Name	Travellers Rest Beefeater
Customer Rating	3 out of 5
Area	riverside
Near	Raja Indian Cuisine

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Travellers Rest Beefeater $_{55}$  is  $a_{59}$  restaurant $_{12}$  providing $_3$  riverside $_{50}$  food $_1$  and has  $a_{17}$  3 out of  $5_{26}$  customer rating $_{16}$ . $_2$  It is $_8$  near $_{25}$  Raja Indian Cuisine $_{40}$ . $_{53}$ 

Travellers Rest Beefeater<sub>55</sub> is a<sub>59</sub> place to eat<sub>12</sub> located near<sub>25</sub> Raja Indian Cuisine<sub>40</sub>.<sub>53</sub>

Travellers Rest Beefeater<sub>55</sub> is  $a_{59}$  3 out of  $5_5$  rated<sub>32</sub> riverside<sub>43</sub> restaurant<sub>11</sub> near<sub>25</sub> Raja Indian Cuisine<sub>40</sub>· $_{53}$ 

## Interpretability Example (WikiBio)

#### **Jimmy Deacon**

Personal information				
Full name	James Deacon			
Date of birth	23 January 1906			
Place of birth	Glasgow, Scotland			
Date of death	1976 (aged 69–70)			
Height	5 ft 7 in (1.70 m)			
Playing position Forward				
Senior career*				
Years	Team	Apps	(Gls)	
	Darlington	2	(-)	
1929–1934	Wolverhampton Wanderers	149	(52)	
1934–1939	Southend United	100	(3)	
1939–1940	Hartlepool	-	(-)	
* Senior club appearances and goals counted for the domestic league only				

james  $deacon_{42}$  ( $_{30}$  born $_{44}$  23 january 1906 $_{11}$ ) $_{22}$  was  $a_{14}$  scottish $_8$  football $_{19}$  forward $_{24}$  . $_{43}$ 

Yang Sung-chul Born 20 November 1939 (age 78) Gokseong County, Jeollanam-Citizenship South Korea Alma mater Seoul National University University of Hawaii at Manoa University of Kentucky Occupation Political scientist Graduate School of **Employer** International Studies, Korea University Known for Member of the National Assembly Ambassador to the United States **National Congress for New** Political party **Politics** Children Two

yang sung-chul<sub>42</sub> ( $_{30}$  november 20, 1939 $_{11}$  in $_{21}$  gokseong county, jeollanam-do $_{39}$ ) $_{22}$  is a $_{14}$  south korean $_{8}$  political scientist $_{24}$ . $_{43}$ 

### Conclusion

An encoder/decoder style approach to generation that:

- Allows for the induction of discrete template-like objects
- Allows for generation in a more interpretable way
- Allows for generation in a more controllable way

Thanks!

Code at github.com/harvardnlp/neural-template-gen

#### **Backward Recurrence**

$$\beta_t(j) = p(y_{t+1:T} \mid z_t = j, f_t = 1, x)$$

$$= \sum_{k=1}^K \beta_t^*(k) p(z_{t+1} = k \mid z_t = j)$$

$$\beta_t^*(k) = p(y_{t+1:T} \mid z_{t+1} = k, f_t = 1, x)$$

$$= \sum_{l=1}^{L} \left[ \beta_{t+l}(k) \, p(l_{t+1} = l \mid z_{t+1} = k) p(y_{t+1:t+l} \mid z_{t+1} = k, l_{t+1} = l) \right]$$

#### An Aside about Latent Variables

There has been much recent work on learning real-valued latent variable models for text (c.f., Bowman et al. (2016)).

- However, not especially clear what these variables are supposed to represent.
- Templates offer a discrete alternative, which are more interpretable, allow for controllable generation, and are tractable to learn!

## Another WikiBio Example

#### kenny warren

name: kenny warren, birth date: 1 april 1946, birth name: kenneth warren deutscher, birth place: brooklyn, new york, occupation: ventriloquist, comedian, author, notable work: book - the revival of ventriloquism in america

- 1. [kenneth warren deutscher]<sub>132</sub> [ ( ]<sub>75</sub> [born]<sub>89</sub> [april 1, 1946]<sub>101</sub> [ ) ]<sub>67</sub> [is an american]<sub>82</sub> [author]<sub>20</sub> [and]<sub>1</sub> [ventriloquist and comedian]<sub>69</sub> [.]<sub>88</sub>
- 2. [kenneth warren deutscher]<sub>132</sub> [ ( ]<sub>75</sub> [born]<sub>89</sub> [april 1, 1946]<sub>101</sub> [ ) ]<sub>67</sub> [is an american]<sub>82</sub> [author]<sub>20</sub> [best known for his]<sub>95</sub> [the revival of ventriloquism]<sub>96</sub> [.]<sub>88</sub>
- 3. [kenneth warren]<sub>16</sub> ["kenny" warren]<sub>117</sub> [ ( ]<sub>75</sub> [born]<sub>89</sub> [april 1, 1946]<sub>101</sub> [ ) ]<sub>67</sub> [is an american]<sub>127</sub> [ventriloquist, comedian]<sub>28</sub> [.]<sub>133</sub>
- 4. [kenneth warren]  $_{16}$  ["kenny" warren]  $_{117}$  [ ( ]  $_{75}$  [born]  $_{89}$  [april 1, 1946]  $_{101}$  [ ) ]  $_{67}$  [is a]  $_{104}$  [new york]  $_{98}$  [author]  $_{20}$  [.]  $_{133}$
- 5. [kenneth warren deutscher] $_{42}$  [is an american] $_{82}$  [ventriloquist, comedian] $_{118}$  [based in] $_{15}$  [brooklyn, new york] $_{84}$  [.] $_{88}$

### E2E Learned Template Visualization

```
The Eagle
                           provides
                                     Indian
                                                 food
                                                           in the
                                                                       high
                                                                                  price range
                                                                                                     It is
                                                                                                                   near
                                                                     moderate | customer rating
                                                                                                              located in the
       The Golden Curry | providing | Chinese |
                                                                                                   They are 1
                                                cuisine |
                                                          with a
                                                                                    rating
              Zizzi
                            serves
                                      English
                                                 Food | and has a
                                                                     average
                                                                                                      It's
                                                                                                               located near
                                       . . .
                                                                        . . .
             riverside
                            Its customer rating is 1 out of 5
                            It has a
            city centre
                                                    average
            Cafe Sicilia
                             The price range is
        Located near
                       The Portland Arms
                                                   is an
                                                                 Italian
                                                                            restaurant called
                                                                                               The Waterman
                                       is a family friendly | fast food
       Located in the
                         riverside
                                                                            place called
                                                                                                   Cocum
2.
                                                 there is a
                                                                                                 Loch Eyne
            Near
                           city centre
                                                            French
                                                                            restaurant named
                          Italian
                                     restaurant
                                                          The Waterman
                                                    is
                          fast food
                                        pub
                                                  _{\mathrm{called}}
                                                              Cocum
       A family friendly | French
                                    coffee shop
                                                            Loch Fyne
                                                 _{\mathrm{named}}
                                                  The Eagle
        Located near
                       The Portland Arms
                                                                       is a
                                                                                           cheap
                                                                                                         Italian
                                                                                                                   restaurant
       Located in the
                           riverside
                                              The Golden Curry | is a family friendly | family-friendly
                                                                                                        fast food
                                                                                                                      pub
                                                                                       family friendly
                                                                                                                  coffee shop
                           city centre
                                                     Zizzi
                                                                         is an
                                                                                                         French
                                                                                           . . .
                                                                                                                       . . .
                                                                                                           . . .
                                                                                       The Waterman
                           Italian
                                     restaurant
                                                      near
                                                                  riverside
                                                                                is
                                                | located in the | city centre |
                                        pub
                          fast food
                                                                               called
                                                                                           Cocum
5.
                                    coffee shop | located near | Cafe Sicilia | named
       A family friendly | French
                                                                                         Loch Fyne
```

## WB Learned Template Visualization

```
aftab ahmed
                                                        is an american
                                                                            actor
       anderson da silva
                                born on
                                                       was an american |
                                                                           actress
          david iones
                                                                          cricketer | ·
                                                         is an english
               . . .
          aftab ahmed
                              was a
                                         world war i
                                                          member of the
                                                                                 austrian
                                                                                              house of representatives
       anderson da silva
                           is a former
                                           liberal
                                                       party member of the | pennsylvania |
                                                                                                     legislature
2.
          david iones
                                           baseball
                                                          recipient of the
                                                                                montana
                                                                                                       senate
               . . .
                                           . . .
                                                                                                         . . .
                                                                       member of the
        adiutant
                       aftab ahmed
                                           was a
                                                      world war i
                                                                                                 knesset
                    anderson da silva | is a former |
                                                                   | party member of the | scottish parliament|
                                                        liberal
       lieutenant
3.
                                                                                        fc lokomotiv liski
                       david iones
                                                       baseball
                                                                  recipient of the
         captain
                            . . .
                       " billy " watson
                                                                  1917
                                                                                                       football player
          william
                                              1913
                                                                                   was an american
                                                      in | surrey, england | \ | was an australian | rules footballer
       iohn william
                            smith
                                             c. 1900
4.
                                                       - | british columbia | / | is an american
          iames "
                        jim " edward
                                              1913
                                                                                                         defenceman
                                                                victorial football league
                  who plays for
                                       collingwood
                                                      in the
                                                                                                vfl
             who currently plays for
                                                                national football league
                                         st kilda
                                                      of the \perp
                who played with
                                                     and the | australian football league
                                         carlton
          aftab ahmed
                               is a
                                            member of the
                                                                      knesset
       anderson da silva | is a former | party member of the | scottish parliament |
5.
                                                                fc lokomotiv liski
                          ^{\parallel} is a female ^{\parallel}
                                         recipient of the
           david iones
```

# **State Purity**

	NTemp	NTemp+AR
E2E	89.2 (17.4)	85.4 (18.6)
WikiBio	43.2 (19.7)	39.9 (17.9)