Learning Household Task Knowledge from WikiHow Descriptions

Yilun Zhou, Julie A. Shah, Steven Schockaert
Learning Household Task Knowledge from WikiHow Descriptions. Y. Zhou, J. A. Shah, S. Schockaert
Learning Household Task Knowledge from WikiHow Descriptions. Y. Zhou, J. A. Shah, S. Schockaert
Introduction

Can you bring me the bread and milk?
Introduction

Can you bring me the scissors?
Can you make a cup of coffee for me?
Related Work

- **Knowledge representation**
  - ConceptNet [Speer, Chin, and Havasi]
  - KnowRob
- **Script knowledge learning**
- **WikiHow mining**
Related Work

- **Knowledge representation**
  - ConceptNet
  - *KnowRob [Tenorth and Beetz]*

- **Script knowledge learning**

- **WikiHow mining**
Related Work

- Knowledge representation
- **Script knowledge learning**
  - [Chambers and Jurafsky]
  - [Modi and Tidov]
  - [Pichotta and Mooney]
- WikiHow mining
Related Work

- Knowledge representation
- Script knowledge learning
- WikiHow mining
  - [Chu, Tandon, and Weikum]
  - [Park and Nezhad]
Related Work

- Knowledge representation
- Script knowledge learning
- WikiHow mining
  - [Chu, Tandon, and Weikum]
  - [Park and Nezhad]
Dataset Description

Learning Household Task Knowledge from WikiHow Descriptions. Y. Zhou, J. A. Shah, S. Schockaert
Dataset Description

[Diagram showing various tasks and categories such as plan a healthy diet, find the right pixie cut, save money to travel, get rid of dry hair and dry scalp, save money to travel, get rid of dry hair and dry scalp, mend a crack in pottery, make rice milk, discuss important issues with your parents, prevent earwax buildup, harvest rosemary, how to use light umbrellas, and other categories like arts and entertainment, cars & other vehicles, computers and electronics, education and communications, family life, finance and business, food and entertaining, health, hobbies and crafts, holidays and traditions, home and garden, personal care and style, pets and animals, philosophy and religion, relationships, sports and fitness, travel, wikihow, work world, and youth.]
Dataset Description

How to Plant Ivy

1 Select a species of ivy. Nearly all species of ivy will grow well in anything from full sun to deep shade, and all will provide excellent ground cover and erosion control. The most common species is English Ivy (Hedera helix), although another popular variety is Algerian Ivy (Hedera Canariensis), which sports broad, 8 inch (20 cm) leaves. You should plant the ivy in spring.\[1\]

2 Select a spot for growing the ivy. Ivy works well in nearly any location, but it is especially useful for addressing difficult gardening spots. Steep hills, which are hard to plant with grass or other plants due to erosion concerns, are perfect for ivy. Ivy also works well in very shady areas that would otherwise need to be mulched. You can also consider planting ivy to grow up a wall or trellis.\[2\]

3 Water the soil thoroughly before planting the ivy. New ivy plants will grow best in soil that is very moist.
### Dataset Description

**Title**

<table>
<thead>
<tr>
<th>How to Plant Ivy</th>
</tr>
</thead>
</table>

**Step gist**

1. **Select a species of ivy.** Nearly all species of ivy will grow well in anything from full sun to deep shade, and all will provide excellent ground cover and erosion control. The most common species is English ivy (Hedera helix), although another popular variety is Algerian ivy (Hedera Canariensis), which sports broad, 8 inch (20 cm) leaves. You should plant the ivy in spring.[1]

2. **Select a spot for growing the ivy.** Ivy works well in nearly any location, but it is especially useful for addressing difficult gardening spots. Steep hills, which are hard to plant with grass or other plants due to erosion concerns, are perfect for ivy. Ivy also works well in very shady areas that would otherwise need to be mulched. You can also consider planting ivy to grow up a wall or trellis.[2]

3. **Water the soil thoroughly before planting the ivy.** New ivy plants will grow best in soil that is very moist.

Learning Household Task Knowledge from WikiHow Descriptions. Y. Zhou, J. A. Shah, S. Schockaert
### Dataset Description

#### How to Start a Garden

<table>
<thead>
<tr>
<th>Part</th>
<th>Section</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Planning the Garden</td>
</tr>
<tr>
<td>2</td>
<td>Getting Ready to Plant</td>
</tr>
<tr>
<td>3</td>
<td>Growing the Garden</td>
</tr>
</tbody>
</table>

#### 1. Decide what type of garden to grow.
What purpose do you want your garden to serve? Some gardens are functional, and produce fruit and vegetables you can use to feed your family or give away to neighbors. Others are more ornamental in purpose, serving to beautify your property and provide a pleasing sight to people passing by.[32] If you’re not sure what type of garden you want, consider the following options:

- Vegetable gardens can include peppers, tomatoes, cabbages and lettuces, potatoes, squash, carrots, and many other vegetables. If a vegetable is able to grow in your region, you can find a way to grow it in your yard.
- In flower gardens, different types of flowers may be strategically planted so that something is in bloom almost all year long. Some flower gardens are structured, with flowers planted in neat rows and patterns; others are wilder in appearance. Your personal style and yard type will determine what type of flower garden you might plant.
- Herb gardens often complement both flower and vegetable gardens, since they tend to flower beautifully and also serve the functional purpose of adding flavor to your food. Herb gardens might include rosemary, thyme, dill, cilantro and a variety of other herbs you may want to use to make dried spices and teas.
- In general, vegetable gardens have the highest soil and maintenance requirements. Flowers and herbs can withstand more neglect than vegetable plants.

#### 2. Decide what specific plants to include in your garden.
Find out what grows well in your region garden zone by using this zone finder to determine what zone you are in, then research which plants do well in your area. As you find out more about your options,

#### 3. Choose a spot for your garden.
Take a look around your yard to assess the where you want the garden to be located. The location you choose should both help the

#### 4. Make a garden design.
Draw an outline of your garden or yard space. Map out different options where you want to plant various items in the location you chose.
## Dataset Description

### How to Start a Garden

<table>
<thead>
<tr>
<th>Part</th>
<th>Section</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Planning the Garden</td>
</tr>
<tr>
<td>2</td>
<td>Getting Ready to Plant</td>
</tr>
<tr>
<td>3</td>
<td>Growing the Garden</td>
</tr>
</tbody>
</table>

### Decide what type of garden to grow

What purpose do you want your garden to serve? Some gardens are functional, and produce fruit and vegetables you can use to feed your family or give away to neighbors. Others are more ornamental in purpose, serving to beautify your property and provide a pleasing sight to people passing by. If you’re not sure what type of garden you want, consider the following options:

- **Vegetable gardens** can include peppers, tomatoes, cabbages and lettuces, potatoes, squash, carrots, and many other vegetables. If a vegetable is able to grow in your region, you can find a way to grow it in your yard.
- In **flower gardens**, different types of flowers may be strategically planted so that something is in bloom almost all year long. Some flower gardens are structured, with flowers planted in neat rows and patterns; others are wilder in appearance. Your personal style and yard type will determine what type of flower garden you might plant.
- **Herb gardens** often complement both flower and vegetable gardens, since they tend to flower beautifully and also serve the functional purpose of adding flavor to your food. Herb gardens might include rosemary, thyme, dill, cilantro and a variety of other herbs you may want to use to make dried spices and teas.
- In general, **vegetable gardens** have the highest soil and maintenance requirements. Flowers and herbs can withstand more neglect than vegetable plants.

### Decide what specific plants to include in your garden

Find out what grows well in your region garden zone by using this [zone finder](#) to determine what zone you are in, then research which plants do well in your area. As you find out more about your options,

### Choose a spot for your garden

Take a look around your yard to assess the where you want the garden to be located. The location you choose should both help the

### Make a garden design

Draw an outline of your garden or yard space. Map out different options where you want to plant various items in the location you chose.
Dataset Description

<table>
<thead>
<tr>
<th>Remove Staples with Your Bare Hands</th>
<th>Shake your clothes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Buy a Shipping Container</td>
<td>Move the bowl</td>
</tr>
<tr>
<td>Pick Up Broken Glass Splinters</td>
<td>Dig a hole about 2 ft deep</td>
</tr>
<tr>
<td>Clean Fireplace Glass</td>
<td>Take out the trash</td>
</tr>
<tr>
<td>Clean an Espresso Machine</td>
<td>Steam clean older carpets</td>
</tr>
</tbody>
</table>

Table 1: A random sample of task titles

Table 2: A random sample of task steps
Architecture

Prediction task 1

Embedding A

Text A

Prediction task 2

Embedding B

Text B
Architecture

Prediction task 1

Embedding A

Text A

Prediction task 2

Embedding B

Text B

Text Embedding

LSTM Network

Word Embedding Layer

Fill The Bucket With Clean Water
Learning Household Task Knowledge from WikiHow Descriptions. Y. Zhou, J. A. Shah, S. Schockaert
Architecture

Prediction task 1

Embedding A

Text A

Prediction task 2

Embedding B

Text B

Order Prediction

Hidden Layer

Step 2 Explanation  Step 2 Gist  Step 1 Explanation  Step 1 Gist  Task Title
Results

<table>
<thead>
<tr>
<th></th>
<th>Step relevance</th>
<th>Step ranking</th>
</tr>
</thead>
<tbody>
<tr>
<td>LSTM step explanation</td>
<td>0.911</td>
<td>0.752</td>
</tr>
<tr>
<td>bag step explanation</td>
<td>0.902</td>
<td>0.664</td>
</tr>
<tr>
<td>no step explanation</td>
<td>0.844</td>
<td>0.657</td>
</tr>
</tbody>
</table>

Table 3: Model performance on two prediction problems
Ambiguous Ordering

How to Prevent a Robbery

1. Try using a working alarm system is always a good measure. Getting one isn't very hard and usually not expensive. These alarms can be a great deterrent for burglars. Make sure, however, that it is professionally installed. Ensure that the alarm works by checking it regularly.[1]
   - If you are unable to buy an alarm system, placing stickers or signs that announce the presence of an alarm is a smart move. They are available for free or at low prices from many security companies.

2. Locking doors and windows are a good measure. Unlocked doors and windows make it easy for someone to rob your house. If a lock doesn't work, get it fixed immediately. It is recommended that you buy a deadbolt lock, preferably one that is high quality. They are available for purchase at most hardware stores. Also, consider getting a hardwood or reinforced door if you live in a high crime area.[2]

3. Destroy boxes. As strange as it may seem, people may want to rob you for what is on a box at the end of your driveway. If you have a box that shows a plasma screen TV or something else very expensive, you want to get rid of it.[3]
Integer Programming for Ordering

- \( x_{ij} = 1 \) represents that step \( i \) occurs strictly before step \( j \)
- \( w_{ij} = \log \Pr(i \text{ before } j) \)

\[
\begin{align*}
\text{maximize } & \sum_{i,j} w_{ij} x_{ij}, \\
\text{subject to } & x_{ij} \in \{0, 1\} \quad \forall i, j, \\
& x_{ij} + x_{ji} \leq 1 \quad \forall i, j, \\
& x_{ij} + x_{jk} - x_{ik} \leq 1 \quad \forall i, j, k, \\
& \sum_{i,j} x_{ij} \geq D. 
\end{align*}
\]
Integer Programming for Ordering
Embedding Visualization
Embedding Visualization
Conclusion and Future work

- Learn embedding representation from unstructured natural language
- Integer programming for order inference
Conclusion and Future work

- Learn embedding representation from unstructured natural language
- Integer programming for order inference
- Consider more problems to learn jointly
  - Predict if a certain tool is needed for a certain task
  - Predict if two steps are from two tasks are equivalent
- Text grounding
  - Map from steps/tasks to images/videos
  - Generate 3D trajectories for step execution