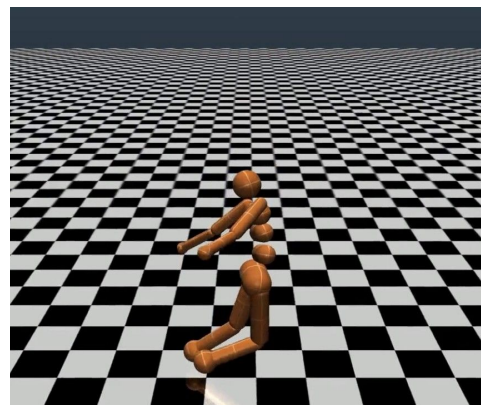
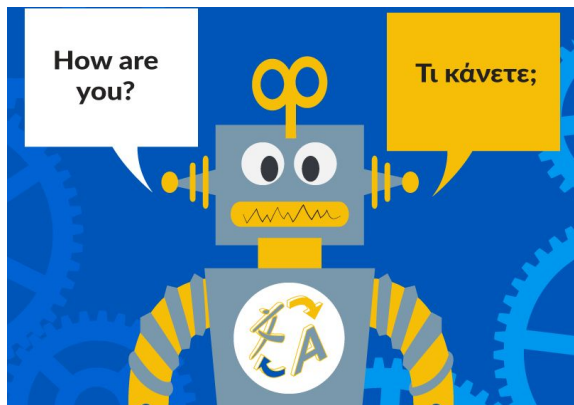
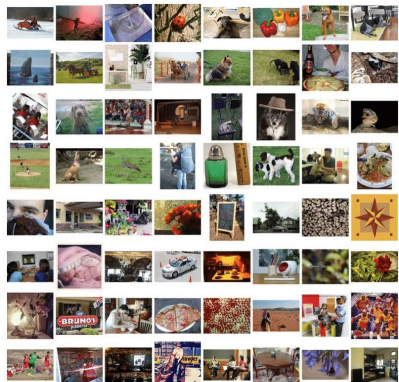




Learning Household Task Knowledge from WikiHow Descriptions

Yilun Zhou, Julie A. Shah, Steven Schockaert

Introduction



Introduction



Introduction



Introduction

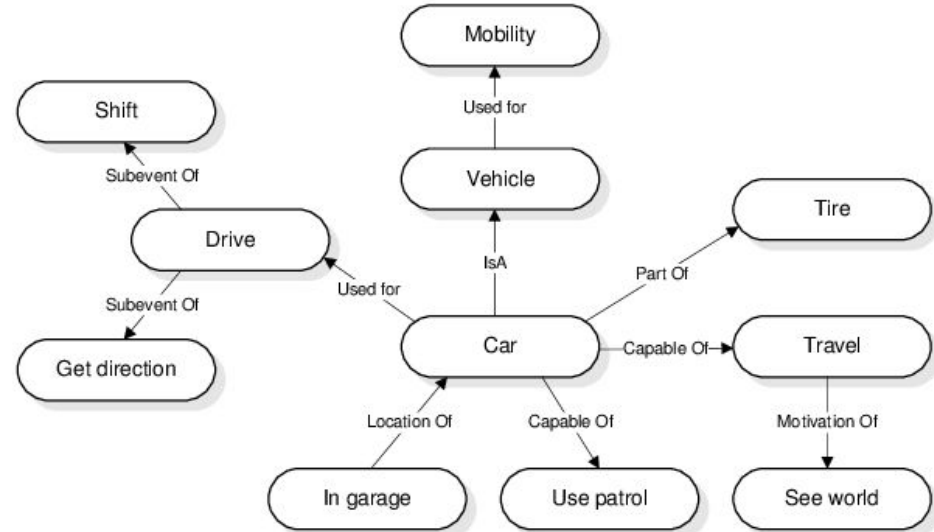


Introduction



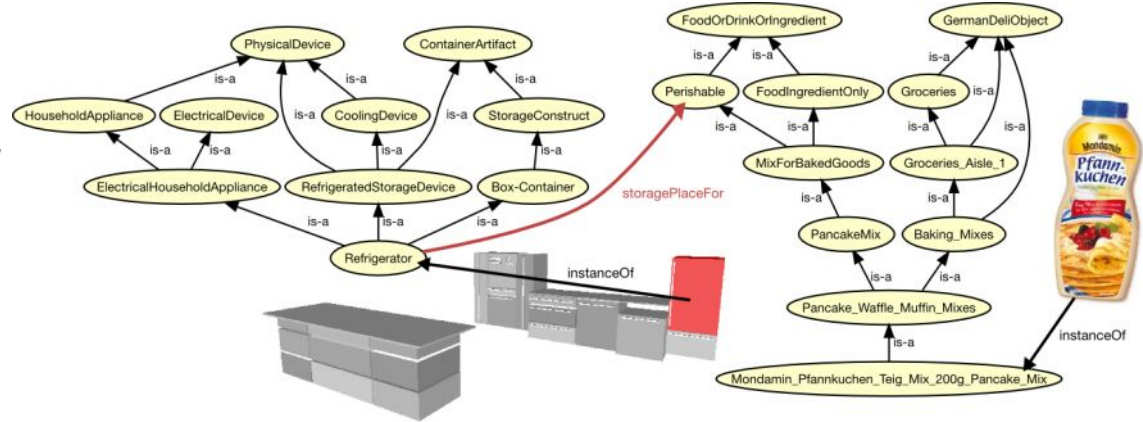
Related Work

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



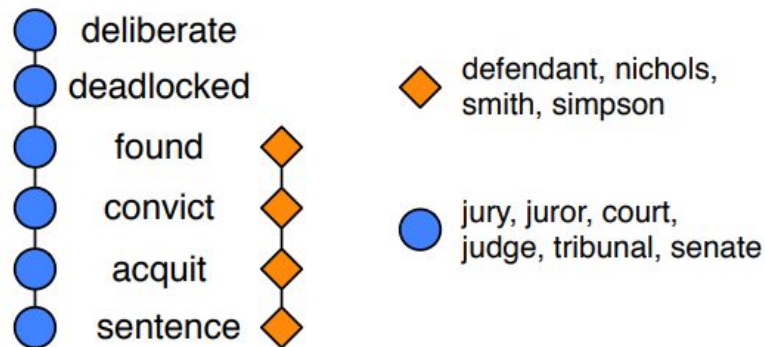
Related Work

- **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

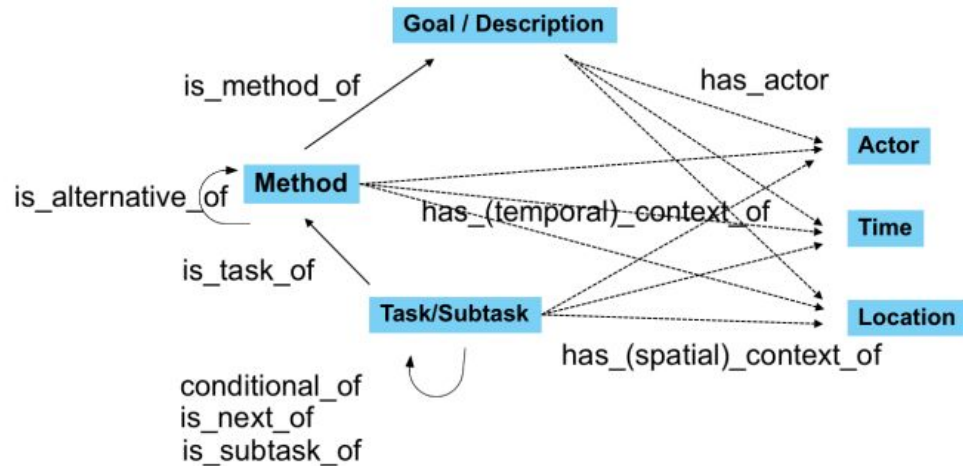
- Knowledge representation
- Script knowledge learning
- **WikiHow mining**
 - [Chu, Tandon, and Weikum]
 - [Park and Nezhad]

Case 1

TASK	use keyboard
CATEGORY	Windows, Android, iPhone, Phones and Gadgets
PARTO	keyboard, song, iphone any generation, itunes, windows pc/ mac computer, android, usb cable compatible with iphone, microphone, songs you want to wake up to already installed, mac
PARENT	record phone conversation
SUB_TASK	plug in microphone, record call , click on the options tab, resize window , hold ctrl key, use in-ear microphone, wear microphone, click on the sound option in the set alarm screen, be list in the main screen, induce emoticon,
PREV	use inline recording device , enable keyboard
NEXT	use software , create own emoji keyboard , hold ctrl key
URL	Resize-Windows-Using-the-Keyboard , Zoom-Out-on-a-PC , Record-a-Phone-Conversation ,
RATING	0
VIEW	691387
SIMILAR_TASK	use song , use in-ear microphone

Related Work

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



Dataset Description

Task Cards:

- How to Plan a Healthy Diet
- How to Find the Right Pixie Cut
- How to Save Money to Travel
- How to Get Rid of Dry Hair and Dry Scalp
- How to Use Light Umbrellas
- How to Mend a Crack in Pottery
- How to Make Rice Milk
- How to Discuss Important Issues with Your Parents
- How to Prevent Earwax Buildup
- How to Harvest Rosemary

Browse Categories:

- 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
- Youth

Dataset Description

S M T W T F S
 How to Plan a Healthy Diet
 How to Find the Right Pixie Cut
 How to Save Money to Travel
 How to Get Rid of Dry Hair and Dry Scalp
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 Pets and Animals
 Philosophy and Religion
 Relationships
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 Travel
 WH WikiHow
 Work World
 Youth

Apartment Living

Apartment Cleaning ·
 Apartment Gardening ·
 Apartment Living with Children ·
 Apartment Rentals ·
 Buying Apartments ·
 Campus Apartments ·
 Decorating Apartments ·
 Moving Apartments ·
 Pets in Apartments

Disaster Preparedness

Animals in Emergencies ·
 Earthquakes and Tsunamis ·
 Fire Emergencies · Floods ·
 Hazard Survival Equipment ·
 Home Security ·
 Radiological Disasters and Threats ·
 Safe Drinking Water · Storms

DIY

Brickwork and Stone Masonry ·
 Caulking · Concrete · House Painting ·
 Metalworking · Plastic · Plumbing ·
 Tiles and Tiling

Furniture

Baby Furniture · Bedroom Furniture ·
 Building Furniture · Buying Furniture ·
 Cabinets and Cupboards ·
 Chairs and Seating ·
 Countertops and Kitchen Benches ·
 Desks · Dining Room Furniture ·
 Furniture Arrangement ·
 Furniture Care · Furniture Finishes ·
 Furniture Fixes ·
 Furniture for Children ·

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

How to Plant Ivy

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.

Step explanation

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]

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

Dataset Description

How to Start a Garden

Part 1
Planning the Garden

Part 2
Getting Ready to Plant

Part 3
Growing the Garden

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.^[1] 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

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Part
1

Planning the Garden

Part
2

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Part
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Dataset Description

Remove Staples with Your Bare Hands

Buy a Shipping Container

Pick Up Broken Glass Splinters

Clean Fireplace Glass

Clean an Espresso Machine

Table 1: A random sample of task titles

Shake your clothes

Move the bowl

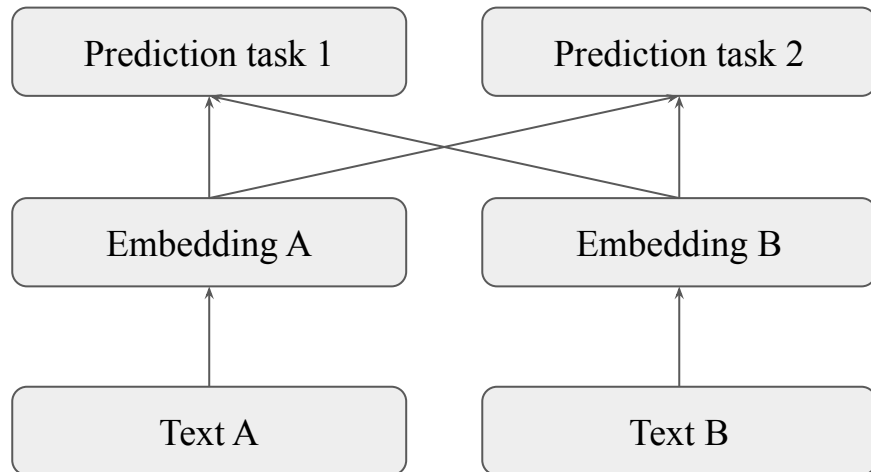
Dig a hole about 2 ft deep

Take out the trash

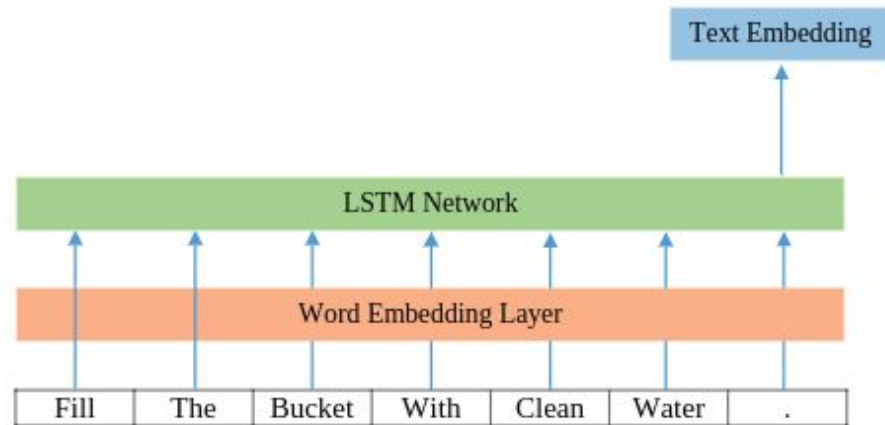
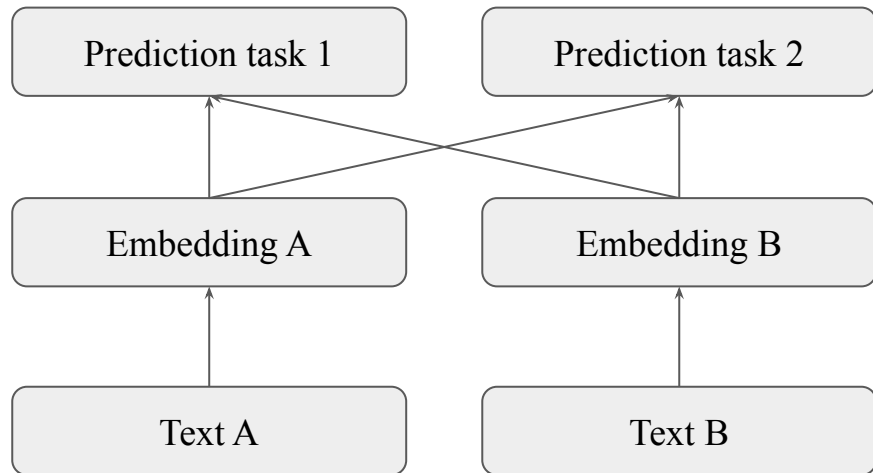
Steam clean older carpets

Table 2: A random sample of task steps

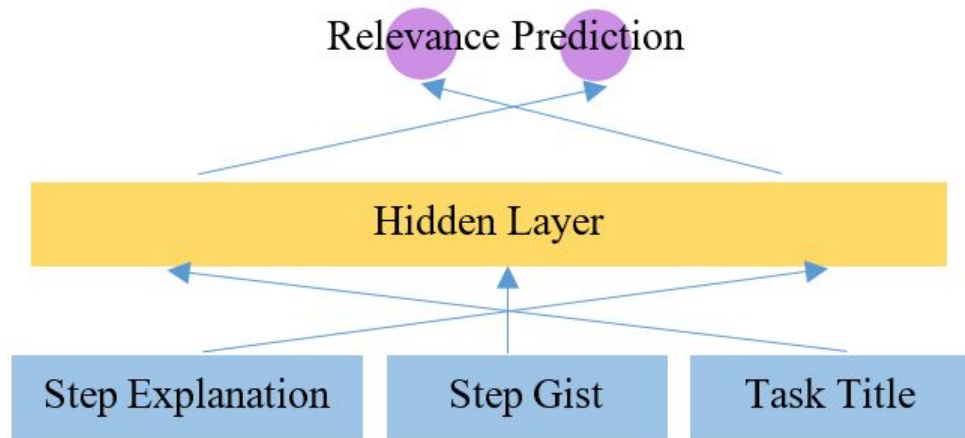
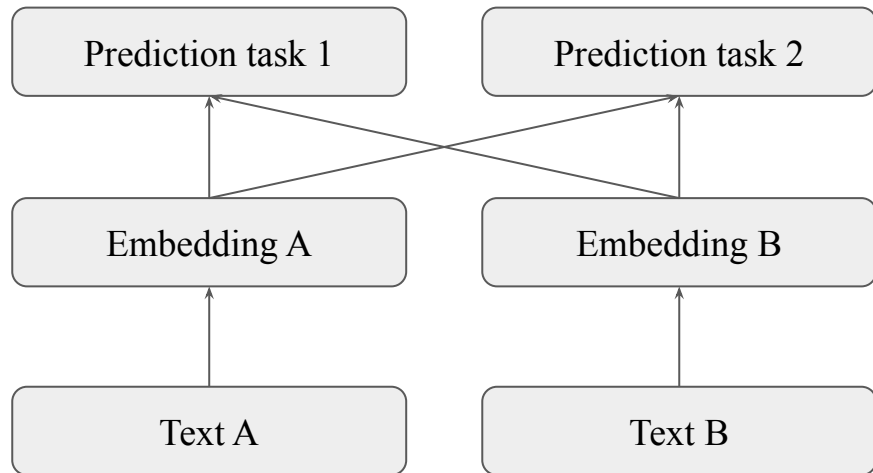
Architecture



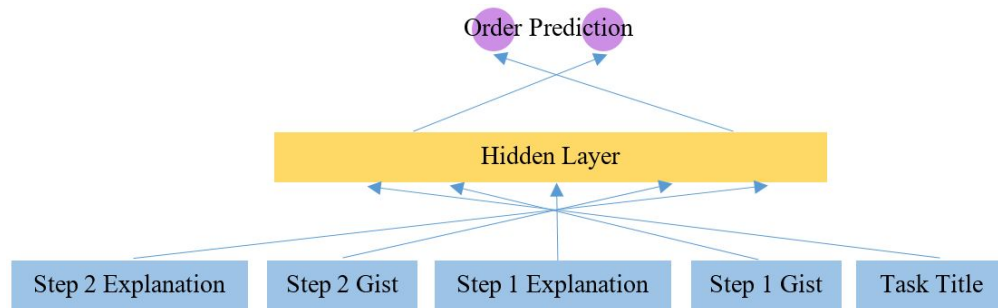
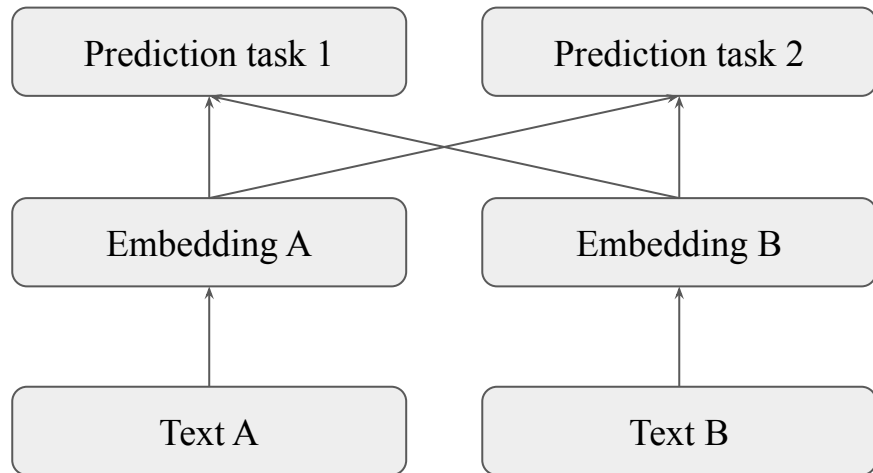
Architecture



Architecture



Architecture



Results

	Step relevance	Step ranking
LSTM step explanation	0.911	0.752
bag step explanation	0.902	0.664
no step explanation	0.844	0.657

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
- $w_{ij} = \log \Pr(i \text{ before } j)$

$$\text{maximize } \sum_{i,j} w_{ij} x_{ij},$$

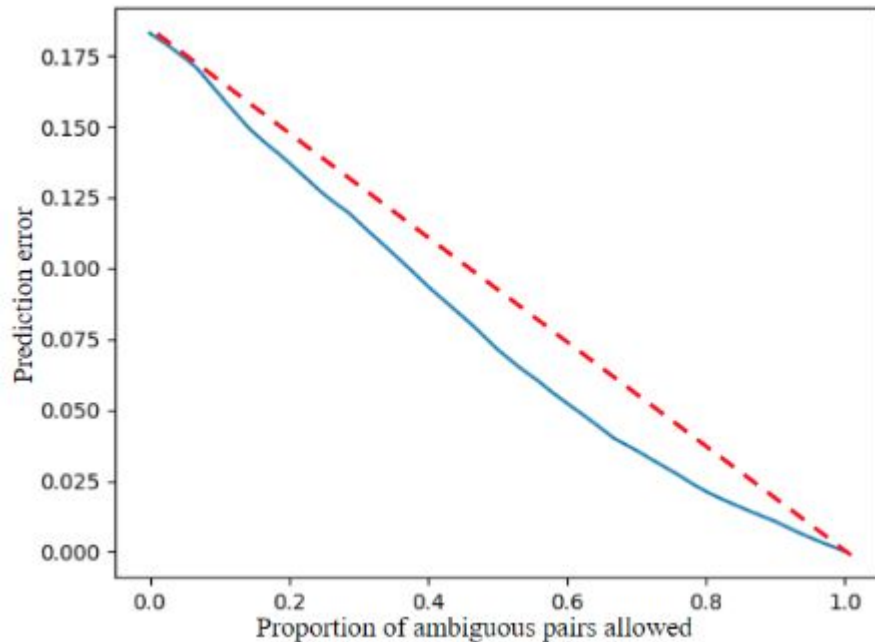
$$\text{subject to } x_{ij} \in \{0, 1\} \quad \forall i, j,$$

$$x_{ij} + x_{ji} \leq 1 \quad \forall i, j,$$

$$x_{ij} + x_{jk} - x_{ik} \leq 1 \quad \forall i, j, k,$$

$$\sum_{i,j} x_{ij} \geq D.$$

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