Toward an Interactive Robot Docent: Estimating Museum Visitors' Comfort Level with Art

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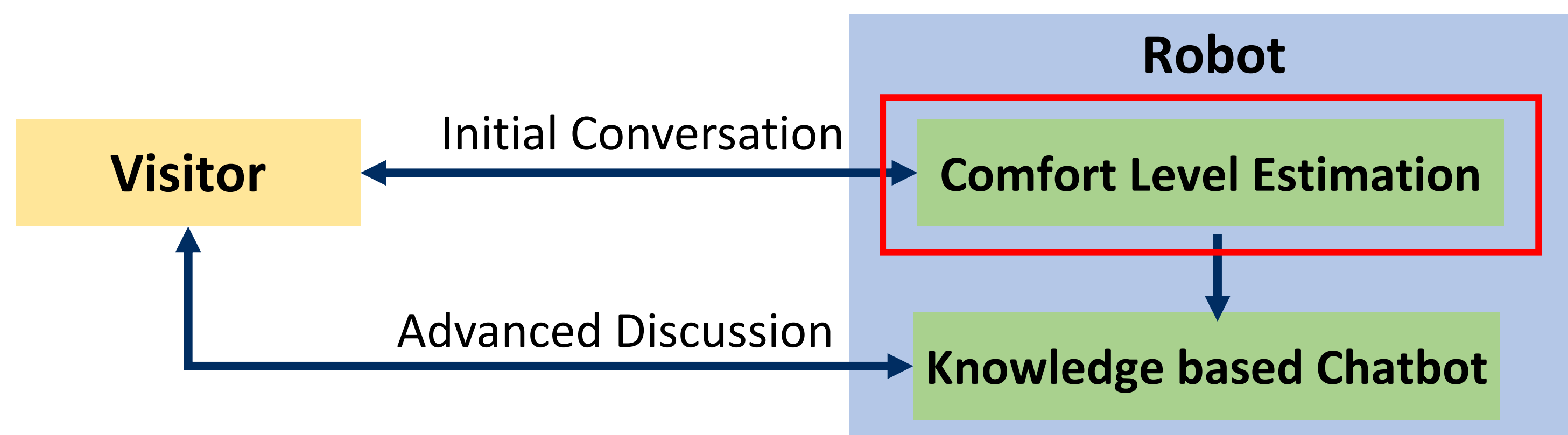University of Michigan, Ann Arbor, US

Motivation

- Use robot docent to arouse human's interest to arts.
- Deliver different materials based on the visitor's comfort level of art.
- Estimate comfort level of interacting with arts based on initial conversations.
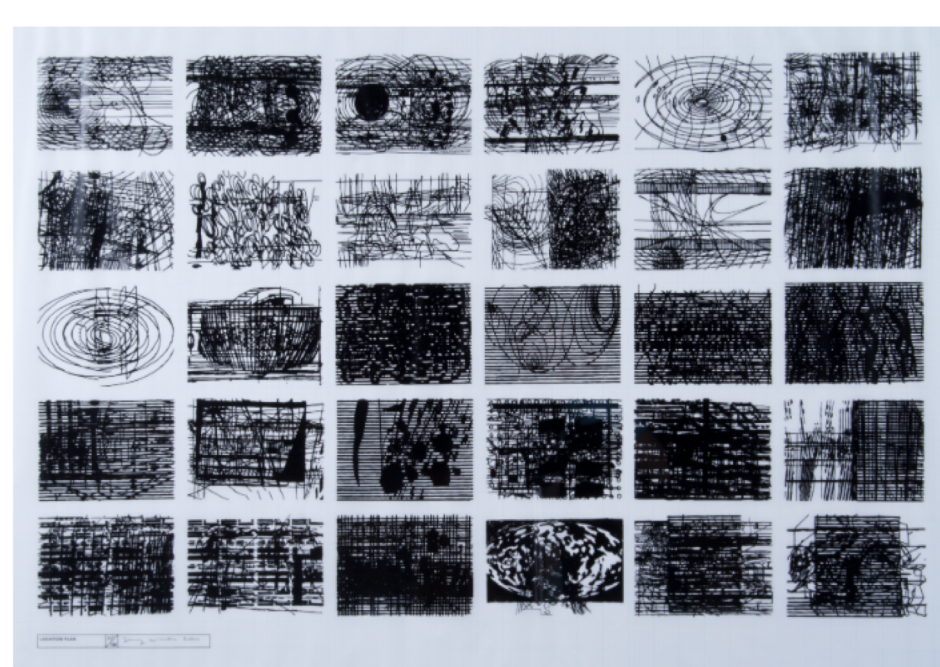

- Docent: What do think of this drawing?
  - Visitor A: I saw some messy curves.
  - Visitor B: The composition is interesting...

Data Collection

- Crowdsourcing on Amazon Mechanical Turk
- Demographic survey + 6 questions about 3 specific art objects
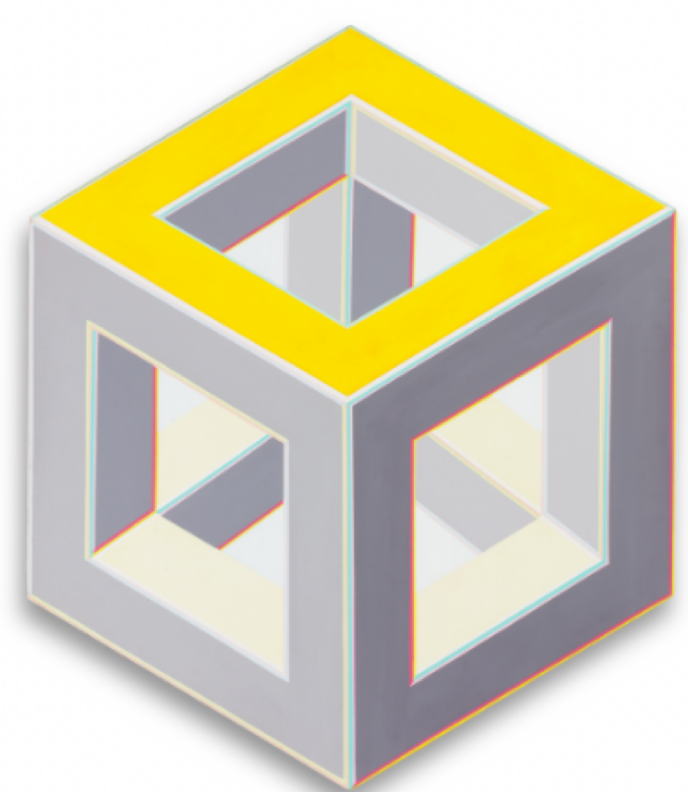- Experts reviewed answers and labeled

Selected objects and example answers

high comfort level VS low comfort level

- **How would you describe these lines?**
  - The artist has used straight horizontal lines in almost all of these little sketches, as if it were a constant in them all
  - these are modern art
- **Why might the rectangles be placed in these positions:**
  - Possibly so we look at each one equally
  - it is just a creativity

Location Plan, Terry Winters

- **What shapes do you see?**
  - I see squares, rhombuses, triangles and trapeziums
  - Cube
- **How does the artist use color in this work?**
  - The artist uses color to make each nook and cranny pop out some some, adding 3D emphasis to the image. Color is also used to emphasize the square on the top, so it doesn't seem as plain
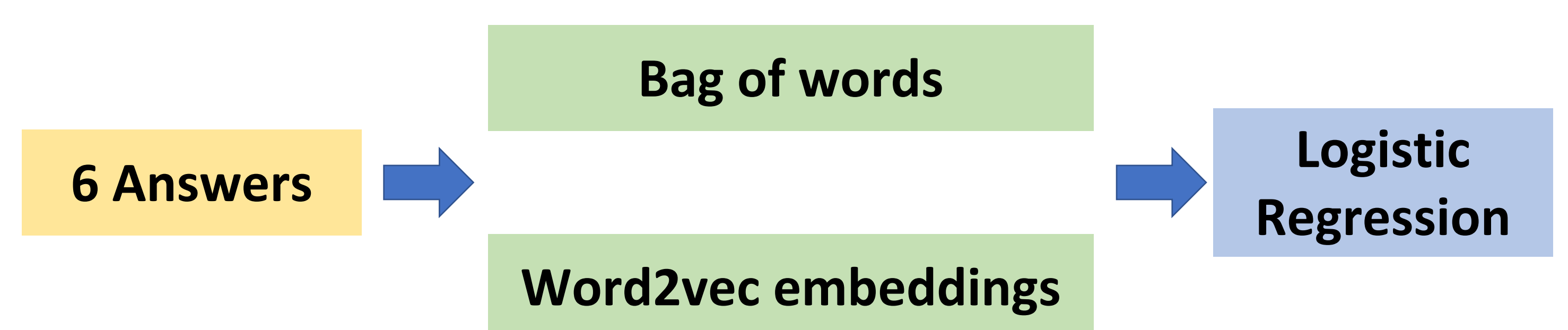 - Very nice

Untitled Cube, Alvin D. Loving

- **What do you think is happening in this sculpture?**
  - A woman is scared and running from a situation. Because here eyes are closed I would guess that she is either blind or trying to not look at what is behind her.
  - working hard
- **This sculpture is made of marble - why do you think the artist used this material?**
  - There is a timelessness to marble that shows that the artist intends for their work to endure. Also Marble has a classical tradition that the artist may wish to tap into
  - It is strong
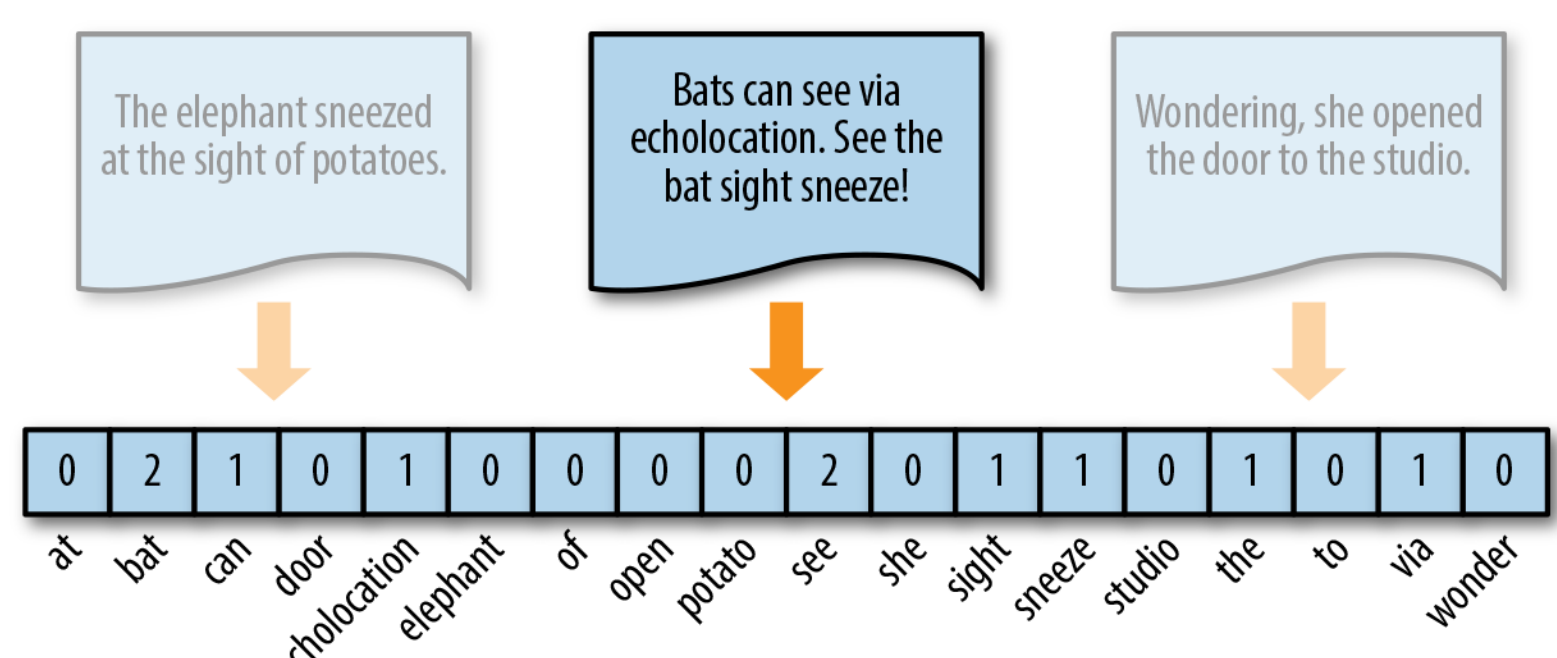
Nydia, Randolph Rogers

Data Processing

- Museum education experts labeled data with comfort level
- Agreement between experts measured using Fleiss' Kappa
- Final scores calculated through voting
- 215/250 participants, 112 low level + 103 high level

Fleiss' Kappa Score	High Comfort (participants)	Medium Comfort (participants)	Low Comfort (participants)
0.5754	35	74	103
0.6957	**112**	**Merged with High**	**103**

Methodology

- Bag of words

- Word2vec

$$v = \frac{1}{N}\sum_{i=1}^{N}\text{word2vec}(w_i)$$

Where w_i is the i th word in the answers.
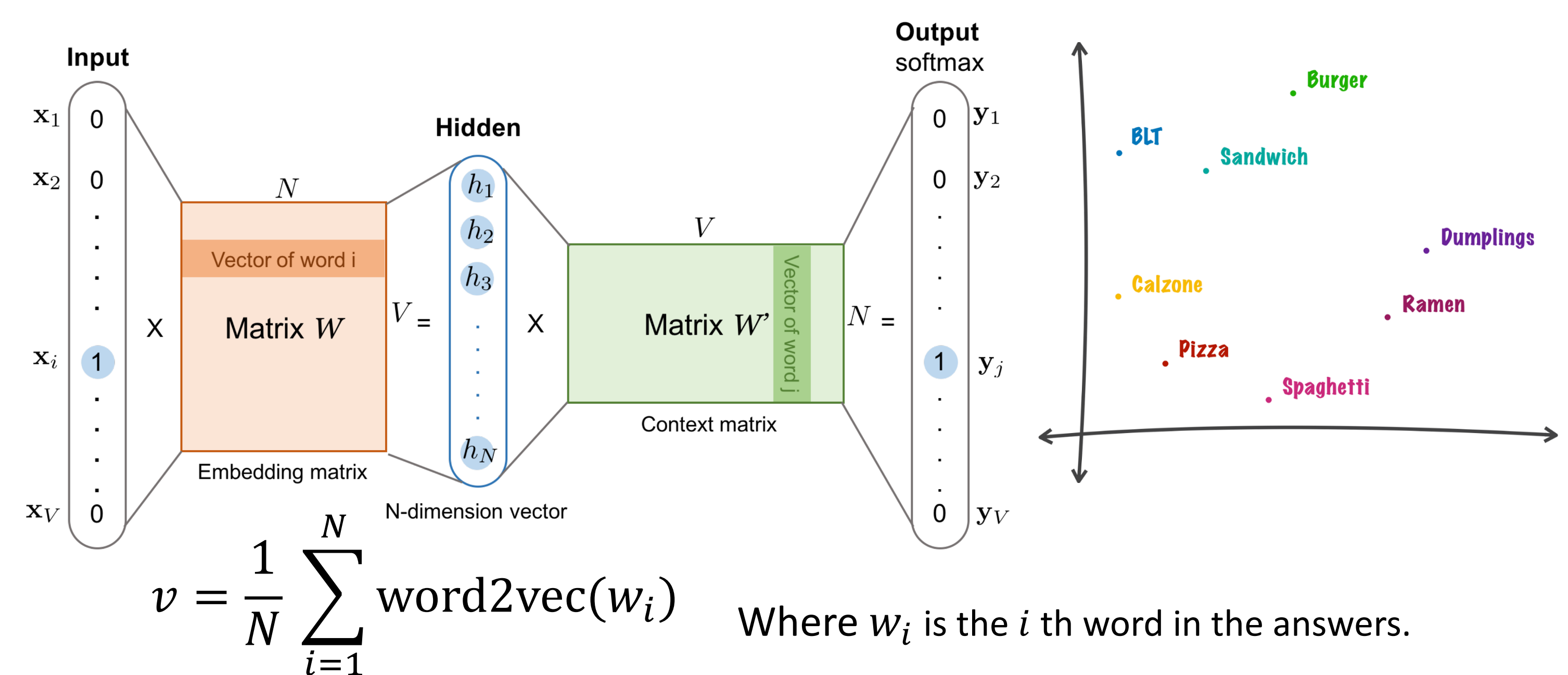
Result

- 100 holdouts
- Feature dimension 50, 100, 200 and 300
- Pretrained word embeddings on Wikipedia 2014+Word2vec[1]

Dimension	Feature		Precision	Recall	F1
300	one	**Bag of words**	**0.771±0.003**	**0.769±0.003**	**0.763±0.004**
		Word2vec	0.728±0.004	0.706±0.004	0.699±0.004
	concat.	Bag of words	0.766±0.003	0.764±0.004	0.758±0.004
		Word2vec	0.744±0.004	0.722±0.004	0.716±0.004

Note: "one": Treat all the 6 answers as one answer. "concatenate": Treat the 6 answers separately, compute a vector for each answer and concatenate them together.

Future Work

- Testing with real robot
- Collecting further data on museum visitors
- Expanding annotation categories of comfort
  - Novice, Adept, Master
  - Novice, Apprentice, Adept, Expert, Master

[1] Pennington, Jeffrey, Richard Socher, and Christopher Manning. "Glove: Global vectors for word representation." *Proceedings of the 2014 conference on empirical methods in natural language processing (EMNLP)*. 2014.