Writing a Paper & Research Career Paths

CS 197 | Stanford University | Michael Bernstein
Today’s goals

We have a bunch of things we tried, some of them worked, some of them didn’t — how do we write a paper about this?

Introducing the concept of model papers and how to use them

What happens if I keep doing research at Stanford? And after?
Writing A Paper
Entropic Loss is used to train any scene graph prediction model. Each heuristic and is estimated by maximizing the marginal probability of their individual labels; the model's output is a probabilistic graph of relationships. Figure 2 shows the relationship between objects and scenes, which a Scene Graph Prediction with Limited Labels model can use to predict relationships. We introduce the concept of a scene graph, which is a probabilistic representation of relationships between objects, and we develop methods to maximize the marginal probability of the individual labels of these relationships.

2. Related work

Technical knowledge was previously obtained via experts' specific features, which are defined as the unique spatial and contextual features of the objects involved. To analyze our data, we propose a novel approach that integrates knowledge from experts to obtain a more robust understanding of the scene graph. We focus on two main aspects: (1) the relationship between objects, and (2) the properties of the objects themselves. We assume that the relationship between objects is the primary factor in determining their properties. To represent the relationship between objects, we use a graph-based approach in which each node represents an object, and each edge represents a relationship between objects. We use this graph to model the interaction between objects and to identify patterns in the data. We then use these patterns to extract features that are useful for predicting relationships.

3. Analyzing visual relationships

Visual relationships are inferred in the context of the input image and introduce additional constraints represented by their categorical features. To analyze these relationships, we introduce a novel method that combines the powers of both deep learning and human expertise. We propose a model that leverages the strengths of both approaches to automatically generate labels for missing visual features. In the context of the Visual Genome dataset, which all have thousands of labeled instances, we evaluate the performance of our approach.

4. Approach

We aim to automatically generate missing relationship labels using a small labeled dataset and an image generation model. We use a model that generates images from the input text and then uses the generated images to learn the missing relationship labels. We evaluate the performance of our method using a held-out test dataset. We also compare our results to those obtained using a baseline method that uses only the input text and the generated images. We find that our approach outperforms the baseline method in terms of both accuracy and efficiency.

5. Discussion of image-centric features

We introduced a new approach that combines image-centric features with the ability to predict missing relationship labels. We evaluated our approach on the Visual Genome dataset and found that it outperforms the baseline methods in terms of both accuracy and efficiency. Our results demonstrate the potential of our approach for applications such as image captioning and question answering.

6. Conclusion

In conclusion, we have introduced a novel approach that combines deep learning and human expertise to automatically generate missing relationship labels. We evaluated our approach on the Visual Genome dataset and found that it outperforms the baseline methods in terms of both accuracy and efficiency. Our results demonstrate the potential of our approach for applications such as image captioning and question answering.

We hope that our work will inspire further research in the area of image-centric feature prediction and enable the development of new applications that leverage these features. Additionally, we believe that our approach can be extended to other datasets and tasks, and we encourage further exploration of this topic.
The common malpractice

Why is this malpractice? [1 min with a partner]

Research papers are complex documents, with too many degrees of freedom to “just write”. Being strategic will save time and avoid dead ends.
...so what do we do instead?
There are many genres

Even within areas, there exist many different genres of paper. Each genre is typically built around the claim you are making, and implies a structure to the sections and to the writing. For example:

**We solve a problem:** articulate the problem, explain what causes that problem and what others have done to deal with it, detail your approach, and prove that you make progress on the problem.

**We measure an outcome:** explain that nobody has bothered understanding how a phenomenon behaves, explain how to create a study that sheds light, and report the outcomes of it.

**We introduce a technique:** articulate a problem as above, but focus the narrative on the technique you’ve created, since it will generalize.
Genres imply structure

Common “We Solve A Problem” structure:

Introduction: overview and thesis
Related Work: situate your contribution relative to prior research
Approach: describe your approach and important implementation details
Evaluation: test whether your approach succeeds at its stated goals
  Method
  Results
Discussion: reflect on limitations, implications, and future work
Conclusion: summarize and restate your contribution

But, this will vary by area!
“Which genre is our project?”

You can often derive the appropriate genre in the same way that you derived the evaluation — what is the thesis and claim that you are supporting?

But this may be challenging until you’ve read a large number of papers. So instead…
Model papers

A model paper is a paper that you can use as a model or template for constructing your paper.

You should be able to structure your paper in the same way as your model paper

- Follow its general flow of argument in the introduction
- Use similar section and subsection heading organization
- Create figures, tables, and graphs that fulfill the same function as theirs
- Apply the same general proportions, e.g., number of pages per section
Selecting your model paper

Model paper != nearest neighbor paper

The model paper should be a paper that makes the same type of argument as yours. It should be in the same genre as you seek.

Often the nearest neighbor paper will make a similar form of argument, but not necessarily

Often the nearest neighbor paper will be a well-written paper, but not necessarily

Find your model paper and share it with your TA for a thumbs up before writing.
From model to paper

Start by outlining the model paper:

How does it structure its argument into sections?

What is the main expository goal of each section? What is its sub-thesis?

What role does each figure play?
From model to paper

Next, build a mapping from their outline to yours.

Translate each section and sub-section heading into what the equivalent heading is for you

Translate each sub-thesis into what the equivalent sub-thesis is for you

Translate each figure into what the equivalent figure is for you
What if it doesn’t quite fit?

Model papers should be templates, not straightjackets. You will probably need to adapt your mapping slightly from what your model paper does.

- e.g., you require a slightly different evaluation structure or visualization than them
- e.g., you’re drawing on a different literature than them, and need to explain something that they didn’t

You can play with the genre — just don’t discard the genre. Check with your TA for any substantial changes that you want to make.
Research career paths
“OK, so I took CS 197, now what?”

What can you do after Stanford?
What can you do at Stanford?
Pathways for research

Research is interesting

(we'll unpack this part in a moment)

Professor

Research scientist in industry

Entrepreneur

Engineer / Engineering Lead
Professor

Work on research that you and the field find interesting.
Recruit the best rising talent in the world and mentor them.
Teach in your area of expertise.
Typical goals:

- Do research and have impact (e.g., publications, software adoption)
- Graduate amazing students
- Inspire students to learn about your area
- Room for personalization: entrepreneurship, speaking, consulting, &etc.
Research scientist

Join a company’s research division and work on research from within the company. Examples: Microsoft Research, FAIR, nVidia Research, Google Brain

Typical goals:

Do research and have impact (but more focus on translation to the company’s products and less on publication)

Create innovations that transform the company you’re working for (e.g., Kinect, BERT, TPUs)
Entrepreneur

Start your own company, often based on the research you’re doing, and grow it.

Typical goals:

Scale your ideas and make them available to millions of people

Start a new industry: your start-up is not a “me too” startup. Typically, it’s pitching a dramatically new angle.

Little focus on doing research in the short term
Engineer / Engineering Lead

Join a company and apply your skills toward the development of product

Typical goals:

Be the company’s expert in an area, and potentially grow a team to drive product in that space

Typically, these jobs are for types of levels of expertise and experience that cannot be acquired through a BS or MS

Little focus on doing research in the short term
What’s the distribution?

I looked into this! I scraped names of all Ph.D. graduates in Computer Science from Stanford, MIT, and UC Berkeley.

I then mapped the names onto LinkedIn pages (yes, LinkedIn availability adds bias, but we found about 75% of people)

Tag their jobs on their LinkedIn:

- Faculty: job titles including words such as "faculty" or "professor"
- Entrepreneurship: triggered by titles such as "founder" or "partner"
- Research scientist: titles such as "researcher" or "scientist" (natch)
- Engineer: titles such as "programmer" or "architect"
No statistically significant difference

Percentages add up to more than 100% because people can hold more than one position. Entrepreneurs and research scientists are a common mix. Faculty, likewise, can sometimes jump into industry research or start a company.
Pathways for research

Research is interesting

(we'll unpack this part in a moment)

Professor

Research scientist in industry

Entrepreneur

Engineer / Engineering Lead
Pathways for research

Research is interesting

Academic year research

Summer CURIS internship

BS with honors

Professor
Research scientist in industry
Entrepreneur
Engineer / Engineering Lead
Academic year research

Get units for doing research with a faculty member

Generally, start with CS 195, which fulfills the CS Senior Project requirement, then go on to CS 199

How to get started? Talk to your TA about possible faculty to approach, and we can help facilitate an introduction.

Typically, you’ll get involved in a project ongoing in the lab
Summer CURIS research

Apply your full effort toward a fun research project for the summer

- Get mentored by a faculty member and PhD student
- Get paid
- No need to balance the project against classes
- Live on campus

Typically, you join a project that's ongoing in the faculty member's lab

Apply early in winter quarter at curis.stanford.edu
BS with honors

Receive a special designation on your diploma ("BS with honors")

Engage in a yearlong research project your senior year

  Takes the place of the senior project

  Typically, you do this with faculty who you’ve already been working with

Apply in the spring of your junior year
Pathways for research

Research is interesting → Academic year research → Summer CURIS internship → BS with honors → Professor, Research scientist in industry, Entrepreneur, Engineer / Engineering Lead
Pathways for research

Research is interesting → Academic year research → Summer CURIS internship → BS with honors → Ph.D. → Professor

Research scientist in industry
Entrepreneur
Engineer / Engineering Lead
All of you can succeed at a PhD!

A Ph.D. is a grown-up version of the research you do as an undergraduate or master’s student. You get much more control over the projects you are working on, and become first author on the resulting publication.

It’s challenging because we doubt ourselves constantly. But you also earn the ability to tackle any complex problem.

Cool side benefit: become Dr. [Lastname]
How do I get in to a Ph.D.?

The most important criteria for getting into a Ph.D. program is demonstrated interest and ability to do research.

“How do I demonstrate interest and ability?” Do research!
How do I get in to a Ph.D.?

In your statement, talk about research you did and the impact you had on the project. (You can include your CS 197 class project in it!)

You will want three recommendation letters from people with Ph.D.s to support your case.

Typically, one is the faculty you worked most closely with on research. The other two can be supporting letters, or other research mentors available.
What questions do you have?
Assignment 8: draft paper

Work together with your team to write a draft paper. This should be a complete draft in the template format of your research, and include reviewable drafts of every section.

“Can we include text we already wrote?” Absolutely! + tweaks

“Do we need the results of our evaluation?” Yes, but you can continue to update your results through the final presentations.

“What if our project doesn’t work out?” Still write up the report. Negative results can be valuable. Unpack in Discussion what it was about your idea or assumptions that wasn’t borne out.

Next week, we’ll be doing mock peer review of your draft papers!
Writing a Paper & Research Career Paths

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