How to Choose a Research Topic

Hao Tang

What this session is not

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- Togelius and Yannakakis, Choose your weapon: Survival strategies for depressed AI academics, 2023

- Ignat et al., A PhD student's perspective on research in NLP in the era of very large language models, 2023

- Saphra et al., First tragedy, then parse: History repeats itself in the new era of large language models, 2023

- Li et al., Defining a new NLP playgroud, 2023

What is research?

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Building models

What is a model?

A **model** is an imaginary artifact that describes the inner working of something.

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- imaginary

What is a model?

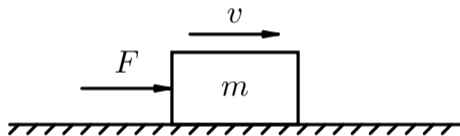A **model** is an imaginary artifact that describes the inner working of something.

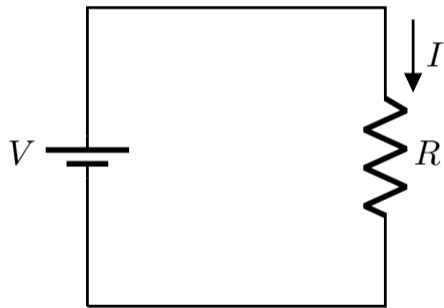- imaginary

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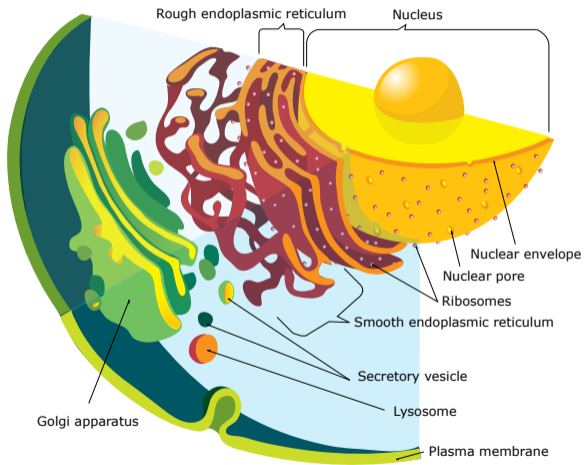- describes inner working

- of something

Examples

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The hypothesis class $\mathcal{H}$ is PAC learnable if for any distribution $\mathcal{D}$, $\epsilon > 0$, and $0 < \delta < 1$, there is a sample size m such that for every $h \in \mathcal{H}$,

$$\mathbb{P}_{S^m \sim \mathcal{D}^m}\left[|L_{\mathcal{D}}(h) - L_{S^m}(h)| > \epsilon\right] < \delta. \tag{1}$$

Examples

- phoneme

- morpheme

- generative grammar

- mentalese

Examples

- perceptron

- multi-layer perceptron

- long short-term memory network

- Transformer

Examples

Examples

Transformers Learn Shortcuts to Automata

Bingbin Liu[1*]   Jordan T. Ash[2]   Surbhi Goel[3†]   Akshay Krishnamurthy[2]   Cyril Zhang[2]

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Examples

Thinking Like Transformers

Gail Weiss [1] Yoav Goldberg [2] [3] Eran Yahav [1]

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Tighter Bounds on the Expressivity of Transformer Encoders

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Examples

Transformers as Recognizers of Formal Languages:
A Survey on Expressivity

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- A **problem** is something that bothers people.

How to choose a research topic?

- Intrinsic motivation

- Extrinsic motivation

- Constraints

Intrinsic motivation

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- That sounds fun!

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- I really want to learn that thing!

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Intrinsic motivation

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- I really want to learn that thing!

- I hope someday I can be like them!

- I cannot stand this anymore!

Intrinsic motivation

Extrinsic motivation

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- My supervisor works on this thing.

- Everybody is bothered by that same problem.

- I have a tool and I'd better use it somewhere.

- There is a low-hanging fruit.

What research is about

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Constraints

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- Where you are now

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- What you have worked on

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- Where you are now

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- Whether you have an approach to a problem

- Whether you have the resources

- Whether people care

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- "Knowledge and productivity are like compound interest." – Hendrik Bode

Should I work on this topic?

- Am I interested? Is there something I can learn from?

- Is that something people care about?

- Do I have an attack?

- Is somebody else working on it?

Further reading

- Hamming, You and your research, 1986

- Lazebnik, Can a biologist fix a radio?—or, what I learned while studying apoptosis, 2002

- Jonas and Kording, Could a neuroscientist understand a microprocessor?, 2017

- Shmueli, To explain or to predict, 2010

- Breiman, Statistical modeling: The two cultures, 2010

- Mullaney and Rea, Where research begins, 2022

- Booth et al., The craft of research, 2016

Summary

- Fuel your interests with success.

- Engage with the moving collective experience.

- Compound your knowledge and productivity.

- How likely is your work going to be rediscovered?