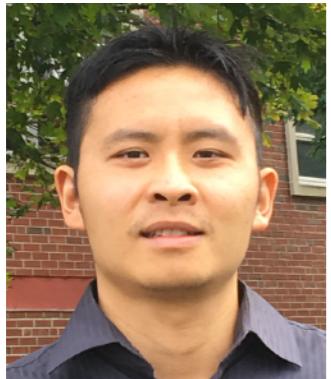


# Predicting Institution Hierarchies with Set-Based Models



Derek  
Tam



Nicholas  
Monath



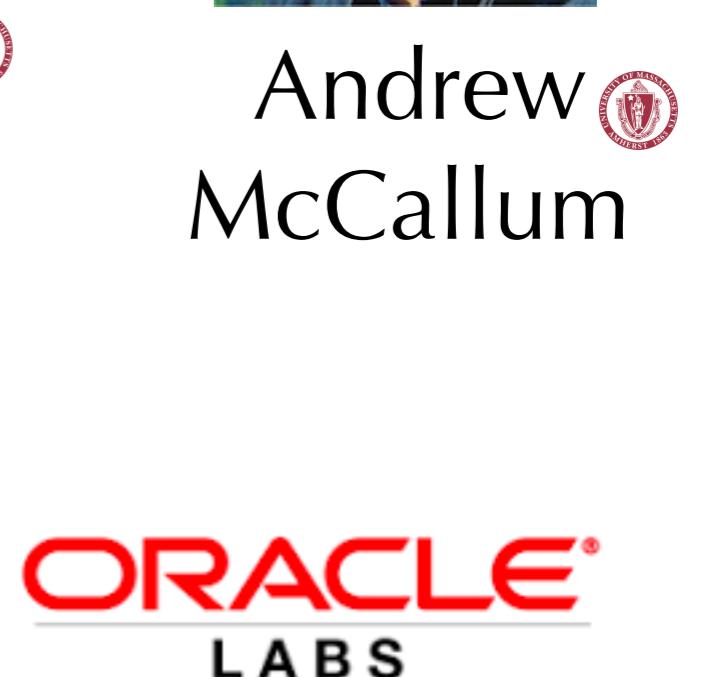
Ari  
Kobren



Andrew  
McCallum



UMassAmherst  
College of Information  
and Computer Sciences



## ABSTRACT

---

# Money for Something: The Links between Research Funding and Innovation<sup>1</sup>

Federal research funding to universities is often based on a desire to stimulate innovation – so that they spend taxpayer money for “something”. There is growing understanding of the need to change the structure of research funding in order to do so; less is known about the effectiveness of different organizational structures. Yet, as Jones has pointed out, increasing the efficiency with which we transfer knowledge from one generation to the next could have important implications for innovation and productivity growth. In this paper we use new data to examine how the main organizational structure used to train the next generation of scientists and inventors – teams funded by research grants – leads to innovative activity as measured by patents.

**JEL Classification:** O30, O31, O38

**Keywords:** UMETRICS, innovation, patents, research policy, teams

### **Britta Glennon**

*Carnegie Mellon University*

### **Julia Lane**

*New York University and IZA*

### **Ridhima Sodhi**

*New York University*

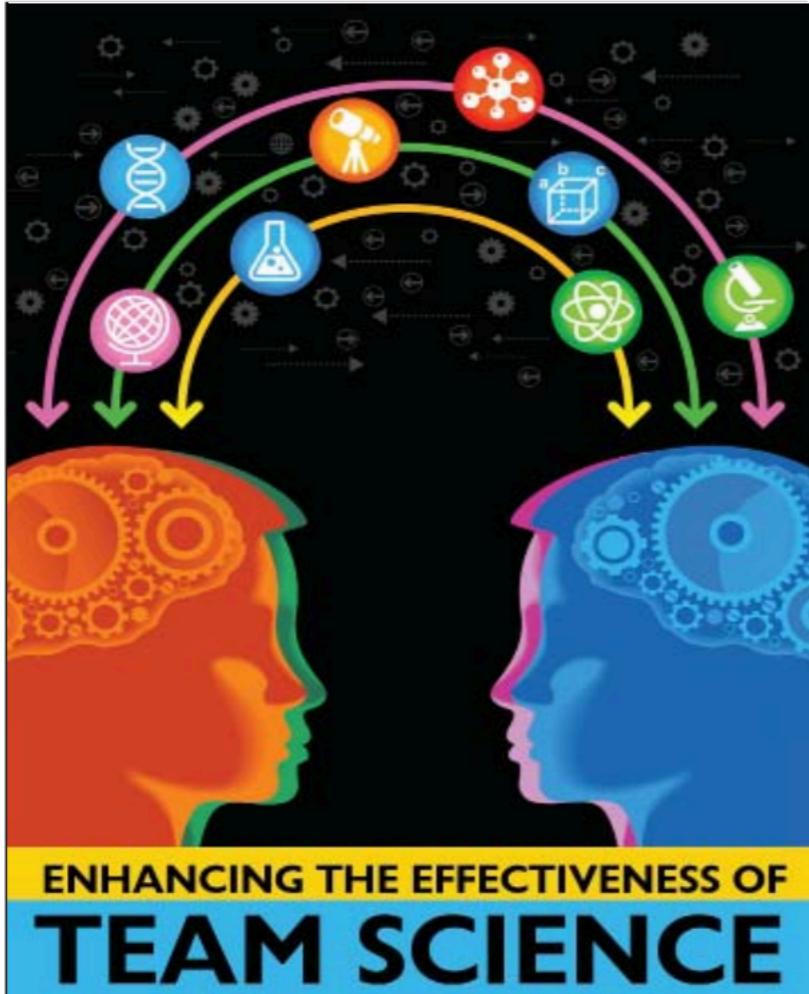
# ABSTRACT

## Money for Something: The Links between Research Funding and Innovation<sup>1</sup>

Federal research funding to universities is often based on a desire to stimulate innovation

### REPORT BRIEF

## Enhancing the Effectiveness of Team Science



Over the past six decades, as scientific and social challenges have become more complex and scientific knowledge and methods have advanced, scientists have increasingly joined with colleagues in a collaborative research approach referred to as team science. Today, over 90 percent of all publications in science and engineering are co-authored by teams of two or more. Team science has led to scientific breakthroughs that would not otherwise have been possible, such as the discovery of the transistor effect, the development of antiretroviral medications to control AIDS, and confirmation of the existence of dark matter. Emerging research shows that team science can lead to results with greater scientific impact, innovation, productivity, and reach than single-investigator approaches. When team science works, it works very well.

Although team science promises to address

# ABSTRACT

## Money for Something Research Funding

Federal research funding to universities

– S of abo out the par the to i JEL Ke

Enhancing the

par the to i JEL Ke

Br Ca Ju Ne Ri Ne

ENHANCING THE EFFECTIVE TEAM SCIE

## Incentives and creativity: evidence from the academic life sciences

Pierre Azoulay\*

Joshua S. Graff Zivin\*\*

and

Gustavo Manso\*\*\*

*Despite its presumed role as an engine of economic growth, we know surprisingly little about the drivers of scientific creativity. We exploit key differences across funding streams within the academic life sciences to estimate the impact of incentives on the rate and direction of scientific exploration. Specifically, we study the careers of investigators of the Howard Hughes Medical Institute (HHMI), which tolerates early failure, rewards long-term success, and gives its appointees great freedom to experiment, and grantees from the National Institutes of Health (NIH), who are subject to short review cycles, predefined deliverables, and renewal policies unforgiving of failure. Using a combination of propensity-score weighting and difference-in-differences estimation strategies, we find that HHMI investigators produce high-impact articles at a much higher rate than a control group of similarly accomplished NIH-funded scientists.*

RAND Journal of Economics  
Vol. 42, No. 3, Fall 2011  
pp. 527–554

# ABSTRACT

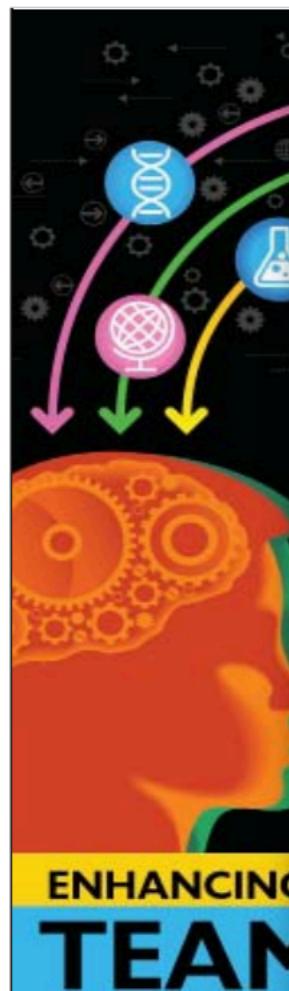
## Money for Something Research Funding

Federal research funding to universities

– S of abo out the par the to i JEL Key

Enhancing the

REPORT BRIEF



## Incentives and creativity: evidence from the academic life sciences

Pierre Azoulay\*

Joshua S. Graff Zivin\*\*

Published: 10 June 2015

## Mobility: A strategic move

Julie Gould

*Nature* 522, 245–247(2015) | [Cite this article](#)

246 Accesses | 1 Citations | 78 Altmetric | [Metrics](#)

**Short-term upheaval can yield widespread collaborations and long-term resources.**

Ecologist Roberto Salguero-Gomez has moved countries six times in the

RAND Journal of Economics  
Vol. 42, No. 3, Fall 2011  
pp. 527–554

singly little about streams within and direction of Howard Hughes success, and gives Institutes of Health renewal policies and difference-in- high-impact articles funded scientists

# Hierarchical Structure of Institutions

# Hierarchical Structure of Institutions



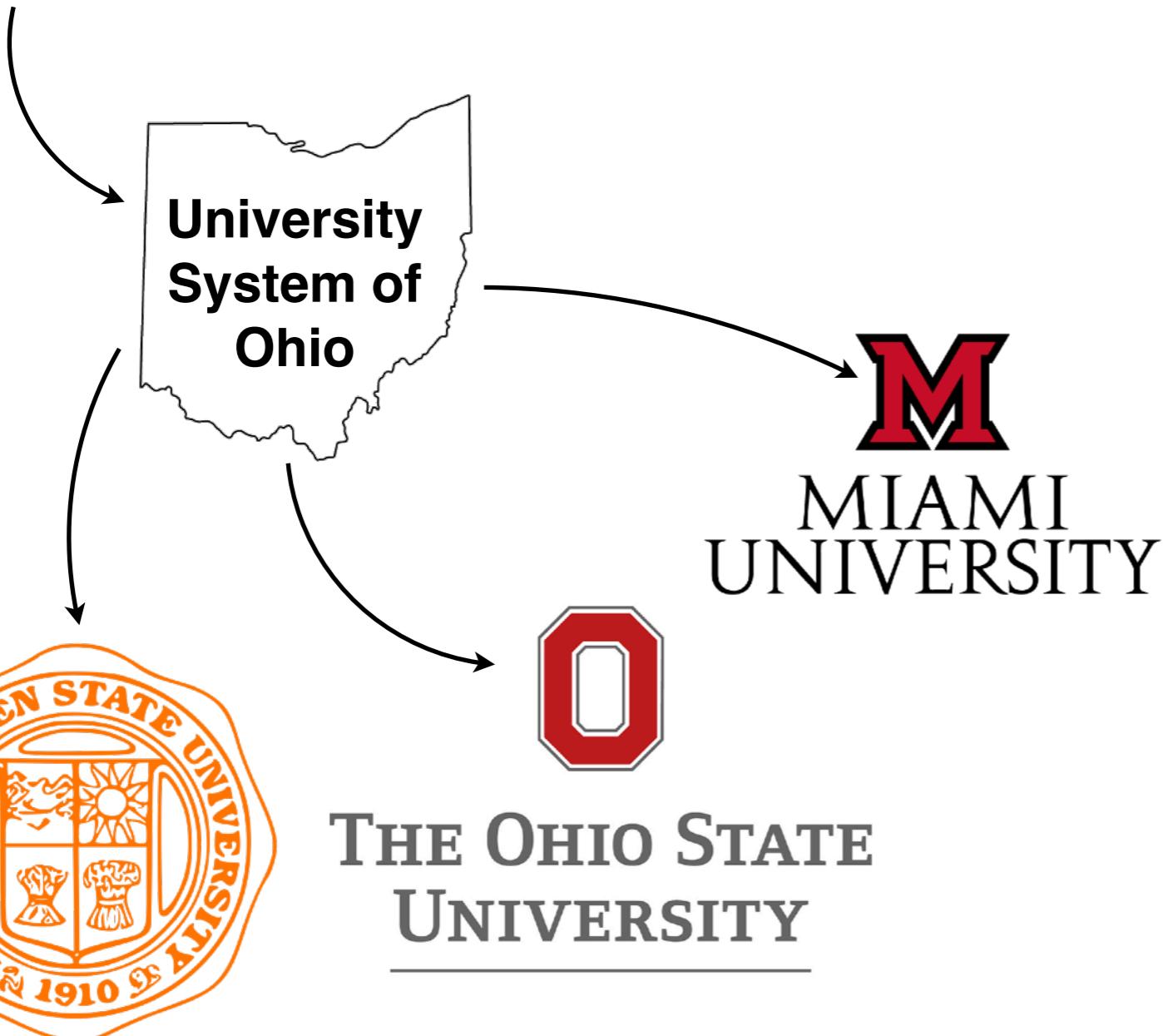
# Hierarchical Structure of Institutions



# Hierarchical Structure of Institutions



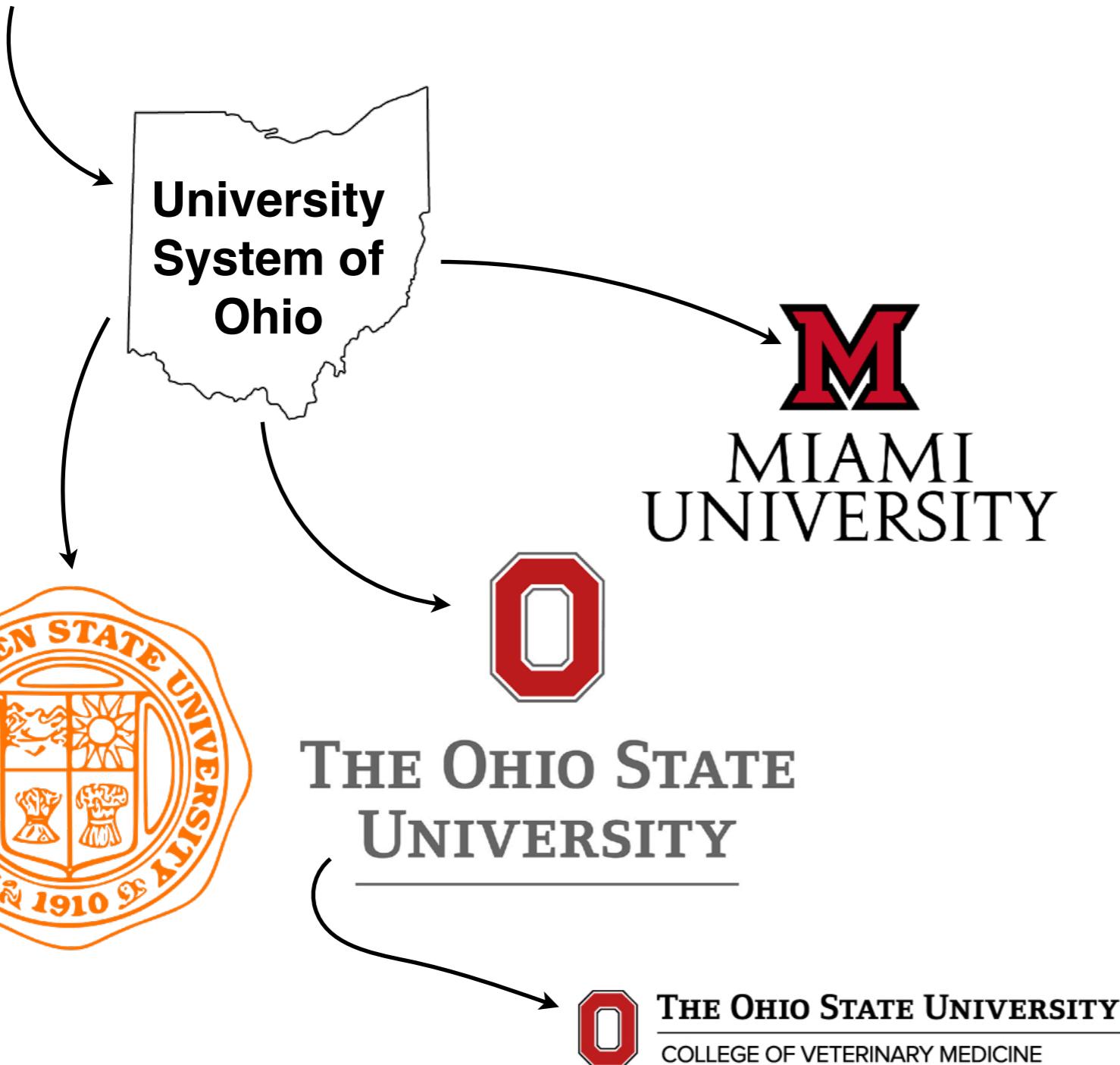
Department of Higher Education



# Hierarchical Structure of Institutions

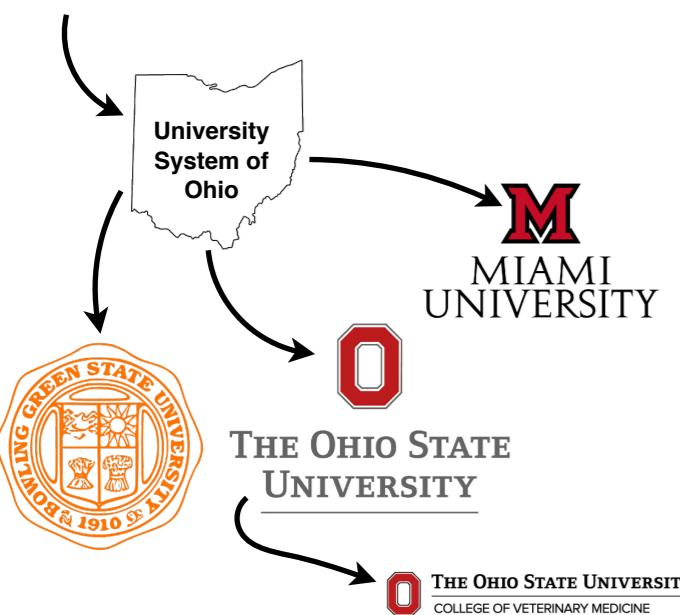


Department of Higher Education



# Hierarchical Structure of Institutions

OhioHigherEd  
Department of Higher Education



# GRID

Global Research Identifier Database

Cataloging the world's research organisations

DOWNLOAD THE FREE DATABASE

## MAKE SENSE OF YOUR INSTITUTIONAL DATA

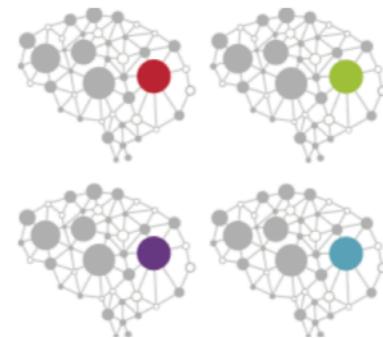
Capture data accurately



Ensure robust reporting



Disambiguate your data



# The Ohio State University

grid.261331.4

[REPORT AN ERROR](#)

## Metadata:

ID grid.261331.4

Types Education

Established 1870 CE

## External links:

Institute Links <http://www.osu.edu/>

Wikipedia [http://en.wikipedia.org/wiki/Ohio\\_State...](http://en.wikipedia.org/wiki/Ohio_State...)

 ISNI 0000 0001 2285 7943

 Crossref 100006928\*, 100005520, 100007760, 100008547, 100007759, 100005951, 100008747, 100007076, 100008788, 100007107, 100010396, 100009626, 100010640, 100006929, 100007077, 100005166

 OrgRef 22217\*, 3583247

 Q309331

 ROR [https://ror.org/00rs6vg23\\*](https://ror.org/00rs6vg23*)

\* Preferred ID

## Alternate Labels:

Aliases Ohio Agricultural and Mechanical College

Acronyms OSU

Spanish Universidad Estatal de Ohio

French Université d'État de l'ohio

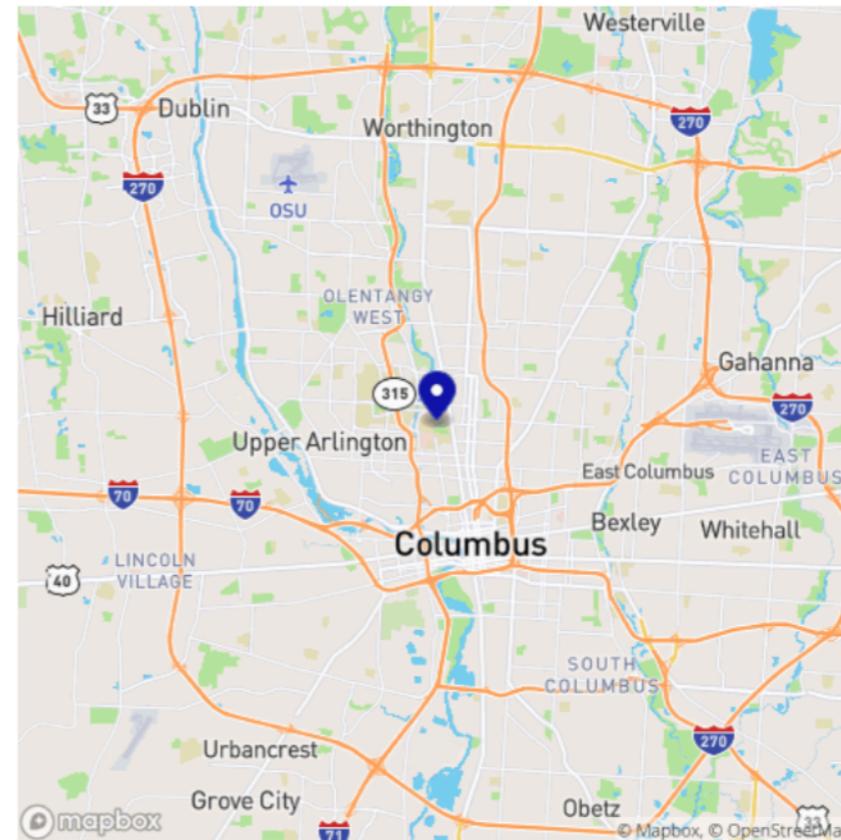
## Relationships:

Parent Institutes [University System of Ohio](#)

Child Institutes [The Ohio State University Newark](#)  
[The Ohio State University at Lima](#)  
[The Ohio State University at Mansfield](#)  
[The Ohio State University at Marion](#)

Related Institutes [James Cancer Hospital](#)  
[Nationwide Children's Hospital](#)  
[Ohio State University Hospital](#)  
[The Ohio State University Wexner Medical Center](#)

## Columbus - Ohio - United States

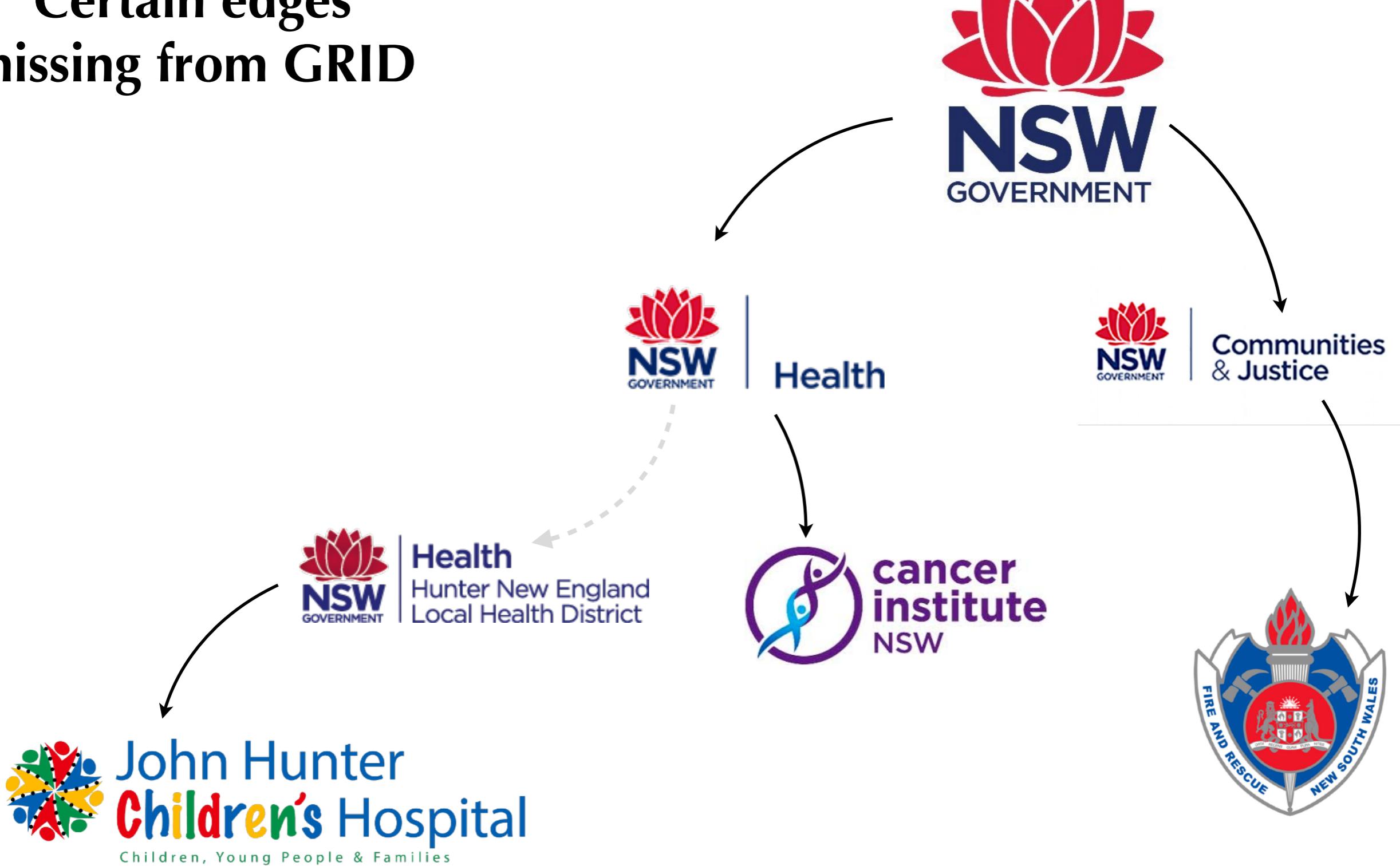


## GeoNames

Type	Name	GeoNames Code	GeoNames ID
City	Columbus		4509177
Admin 2 Region	Franklin County	US.OH.049	4512214
Admin 1 Region	Ohio	US.OH	5165418
Country/Territory	United States	US	6252001

# KB Completion: Hierarchy Prediction

Certain edges  
missing from GRID



# KB Completion: Hierarchy Prediction

Certain edges  
missing from GRID

Train model to predict  
sub/super institution  
relationships



Health



NSW  
GOVERNMENT



Communities & Justice



# Our Approach

**Prediction based on  
Institution Name Spelling, Location, Type**

**Model Sets of Overlapping / Non-  
Overlapping Tokens with Set Transformers**

[Lee et al, 2019]

# **Proposed Model**

**The Ohio State University**

*c*

**University System of Ohio**

*p*

The  
Ohio  
State  
University

**The Ohio State University**

*C*

University  
System  
Of  
Ohio

**University System of Ohio**

*p*

The  
Ohio  
State  
University

*c*

University  
System  
Of  
Ohio

*p*

The  
Ohio  
State  
University

**The Ohio State University**

*c*

University  
System  
Of  
Ohio

**University System of Ohio**

*p*

The  
Ohio  
State  
University

*c*

Ohio  
University

*c ∩ p*

University  
System  
Of  
Ohio

*p*

The  
Ohio  
State  
University

**The Ohio State University**

*c*

University  
System  
Of  
Ohio

**University System of Ohio**

*p*

The  
Ohio  
State  
University

$c$

Ohio  
University

$c \cap p$

System  
Of

$p \setminus c$

University  
System  
Of  
Ohio

$p$

The  
Ohio  
State  
University

**The Ohio State University**

$c$

University  
System  
Of  
Ohio

**University System of Ohio**

$p$

University  
System  
Of  
Ohio

$p$

Ohio  
University

$c \cap p$

The  
Ohio  
State  
University

$c$

Ohio  
University

$c \cap p$

System  
Of

$p \setminus c$

University  
System  
Of  
Ohio

$p$

The  
Ohio  
State  
University

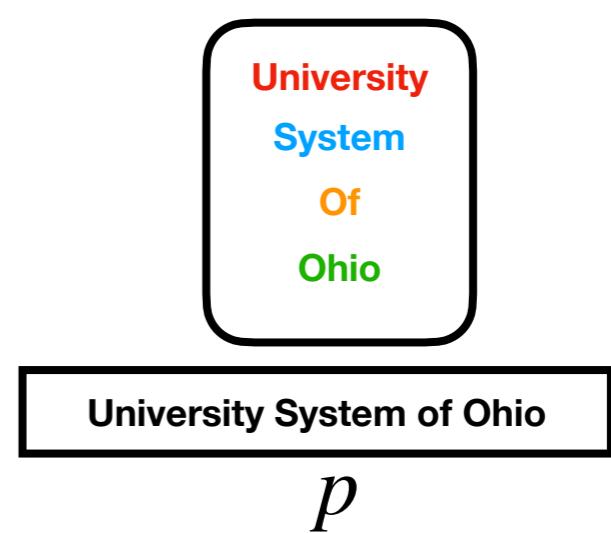
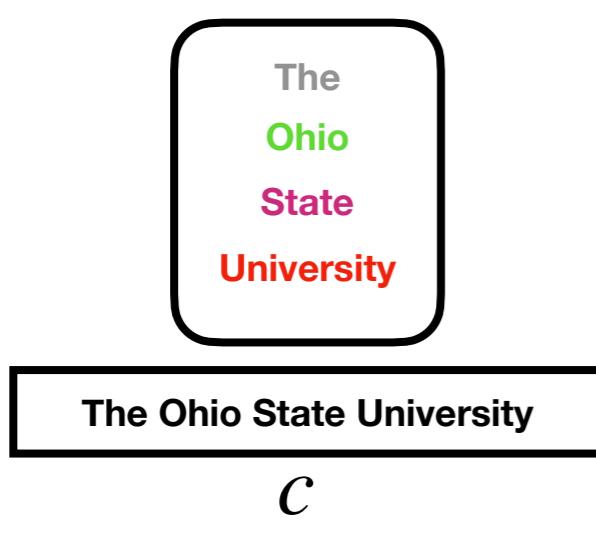
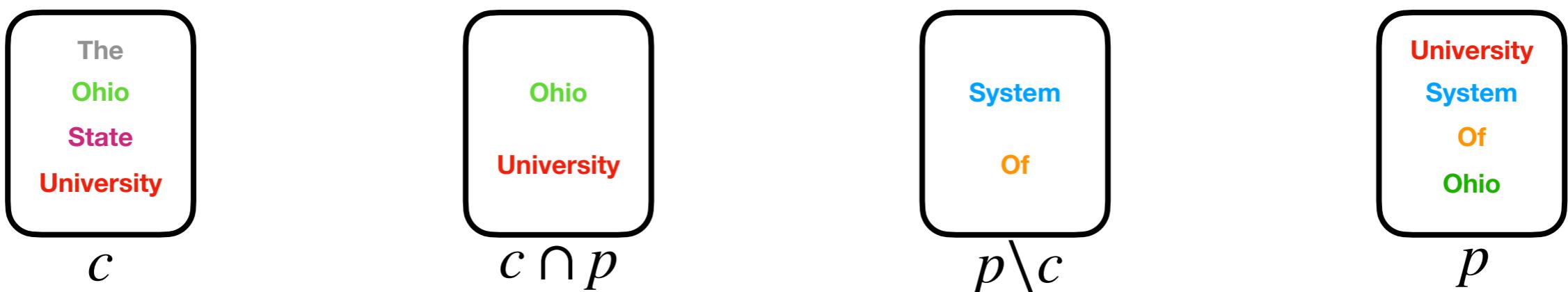
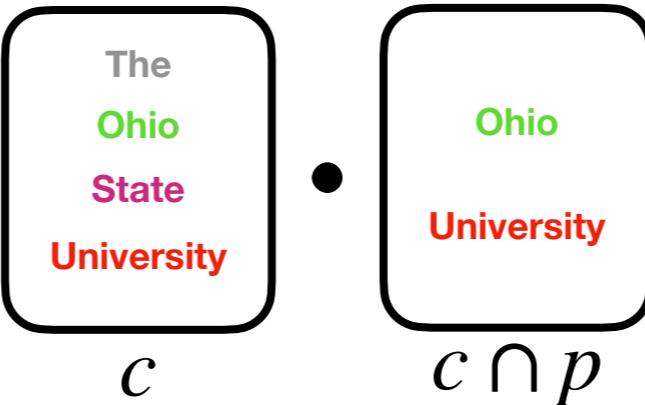
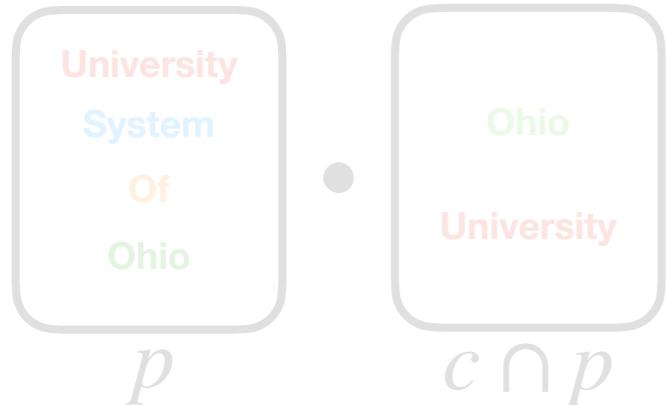
The Ohio State University

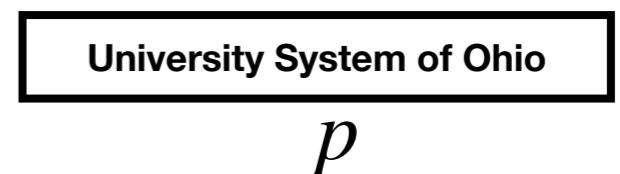
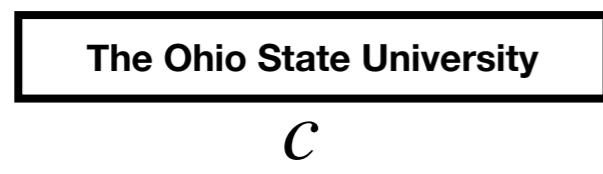
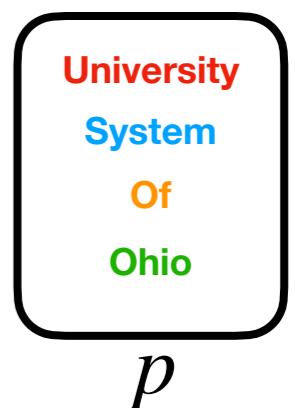
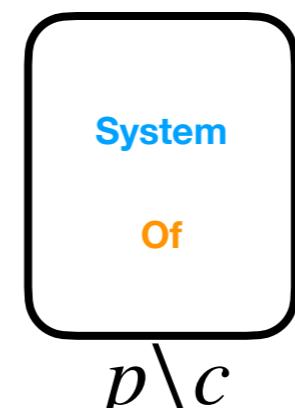
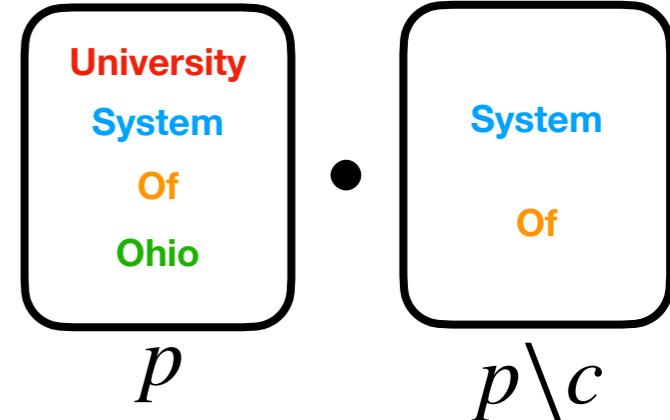
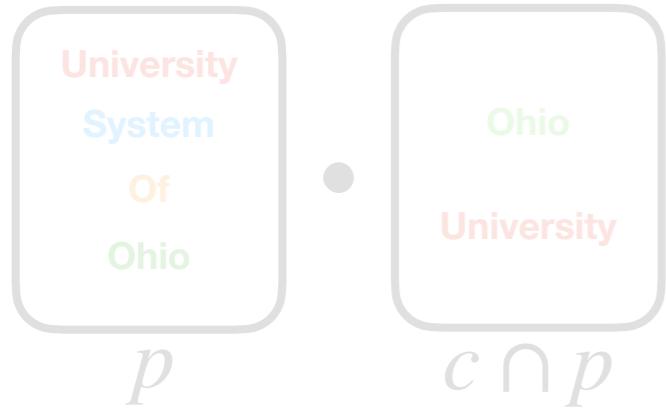
$c$

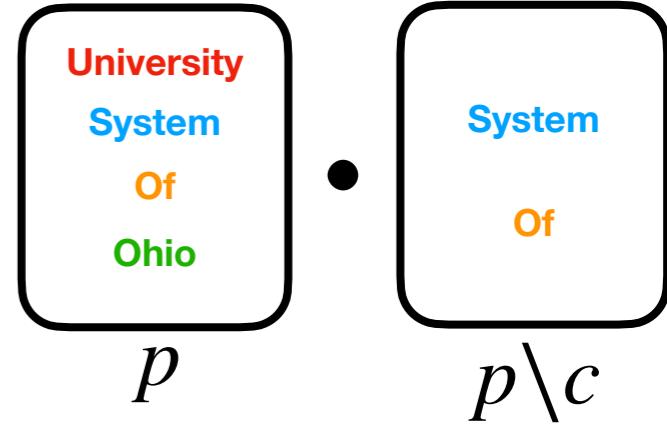
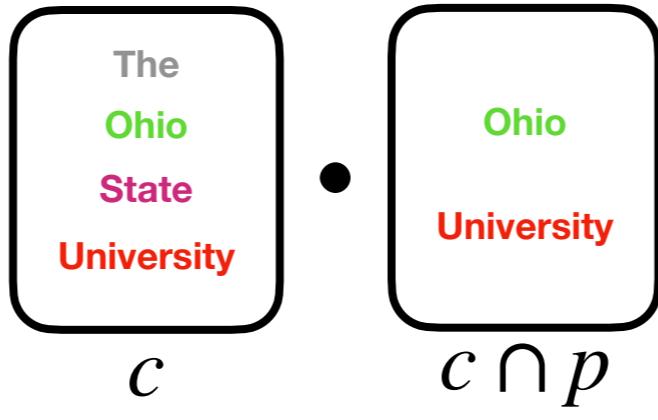
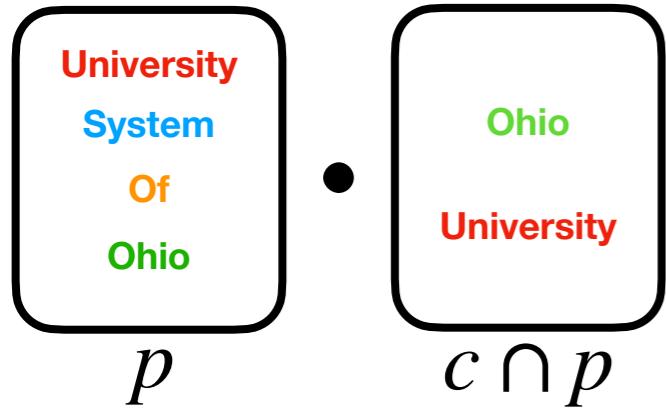
University  
System  
Of  
Ohio

University System of Ohio

$p$







**University**  
**System**  
**Of**  
**Ohio**

*p*

**Ohio**  
**University**

*c ∩ p*

The  
**Ohio**  
**State**  
**University**

*c*

**Ohio**  
**University**

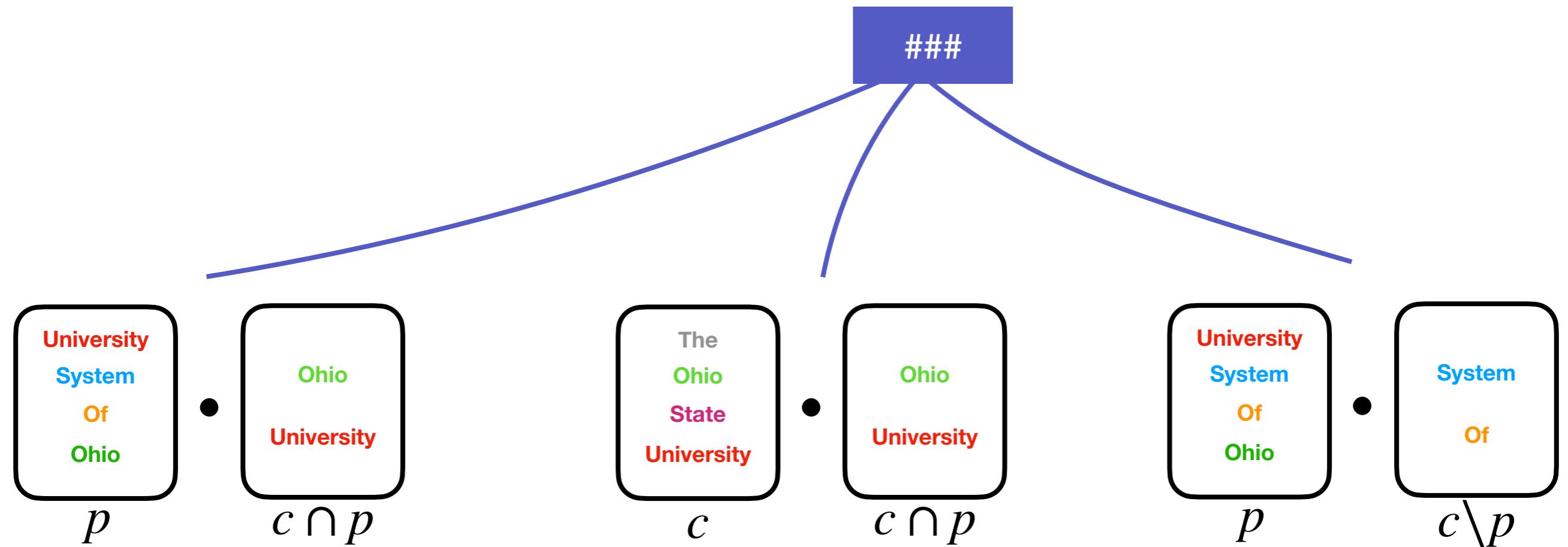
*c ∩ p*

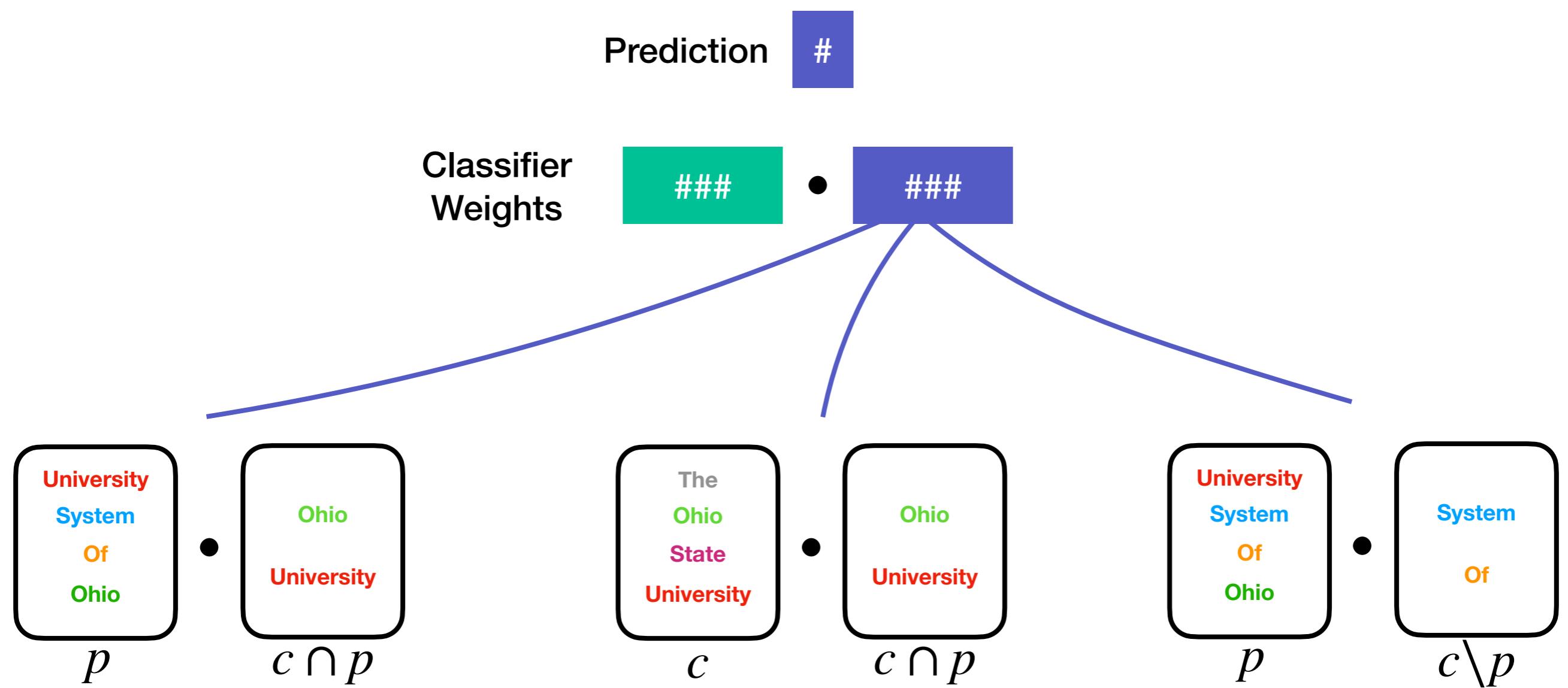
**University**  
**System**  
**Of**  
**Ohio**

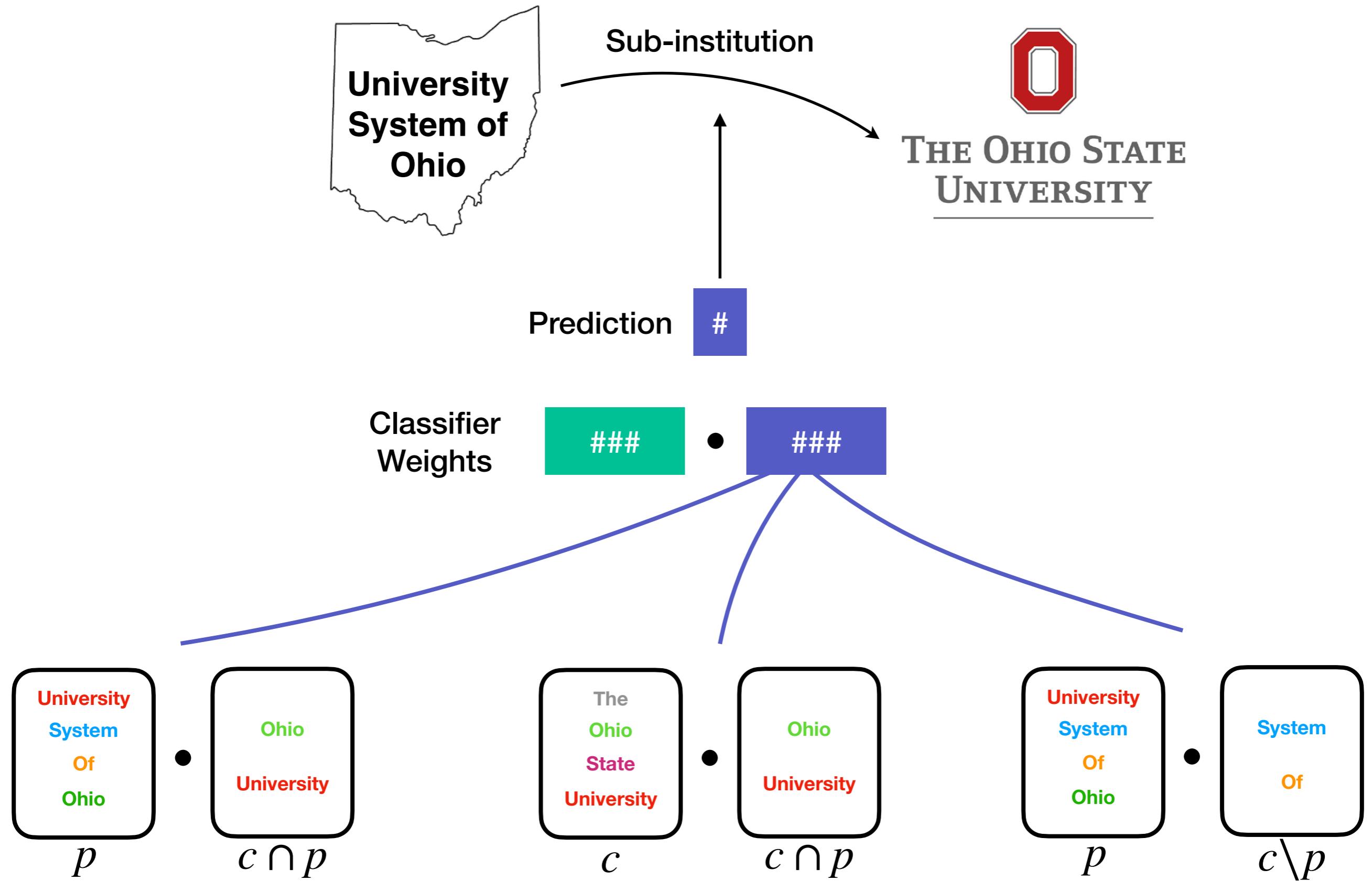
*p*

**System**  
**Of**

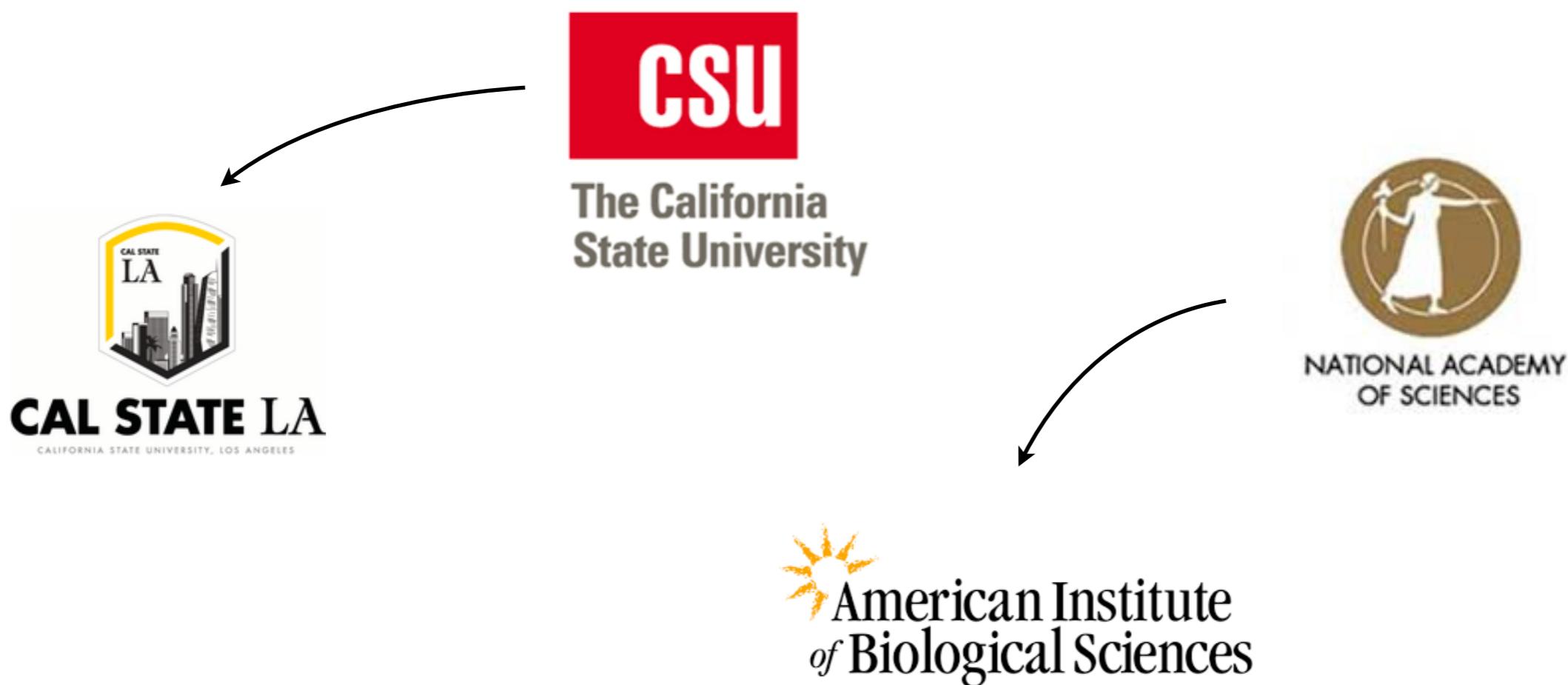
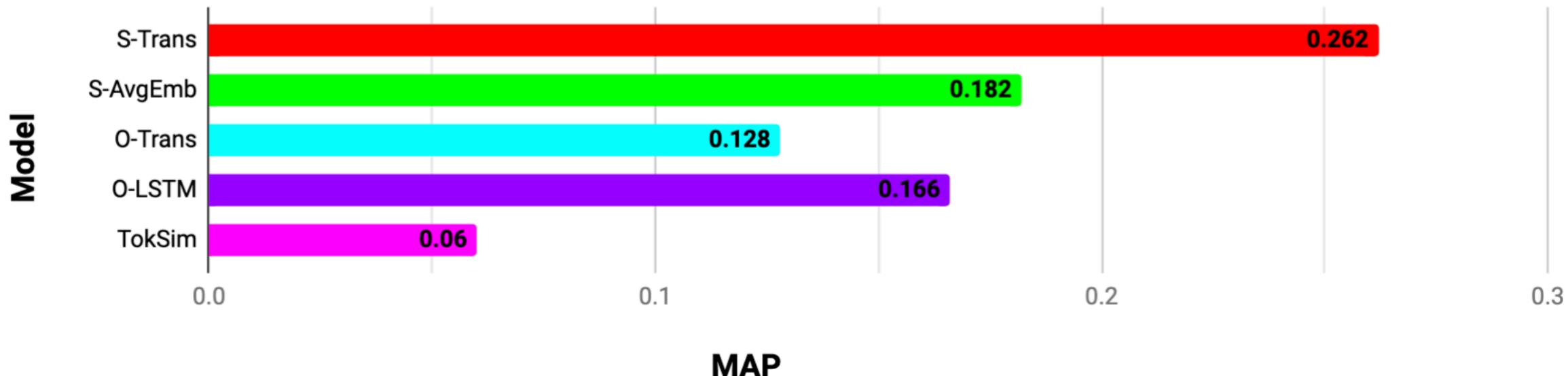
*p \ c*



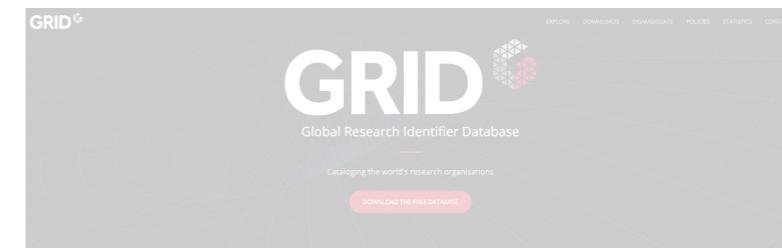
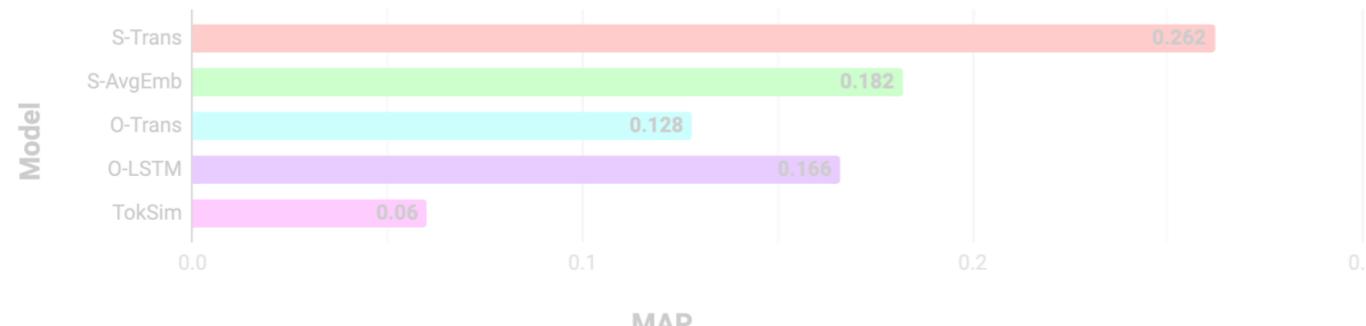




# Predicting Super Institution Performance



# Summary



Code: [https://github.com/iesl/institution\\_hierarchies](https://github.com/iesl/institution_hierarchies)

