

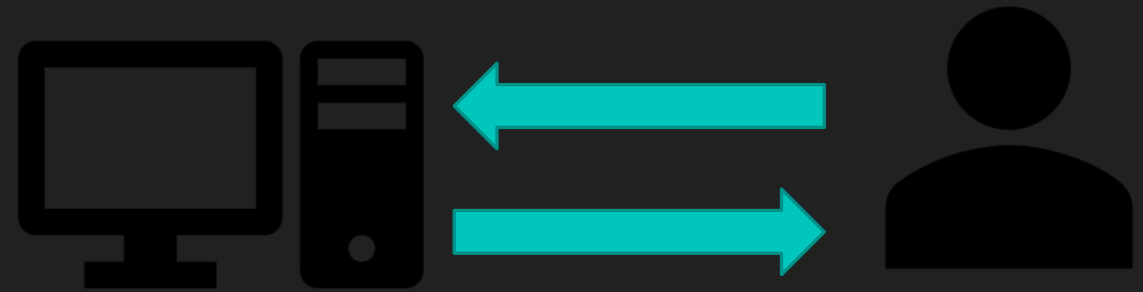
A User-Interactive Machine Learning Model for Identifying Structural Relationships of Code Features

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Introduction

Problems with tools using Machine Learning:

- User doesn't know what is happening
- Get's not say on how the system works



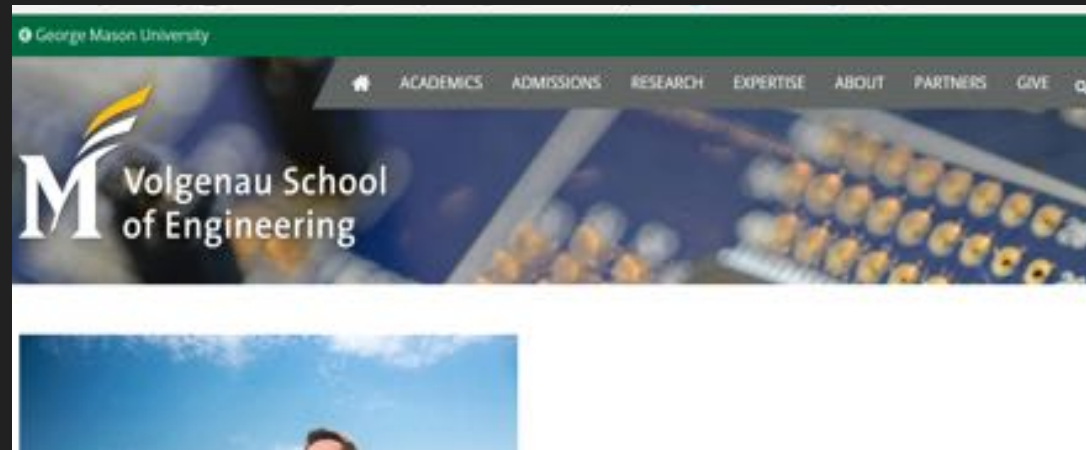
Applied in a tool that combines both Machine Learning and User Interaction:

- Applied to an HTML editor and Auto-Complete
- Includes User Interface

Introduction

HTML Structural patterns:

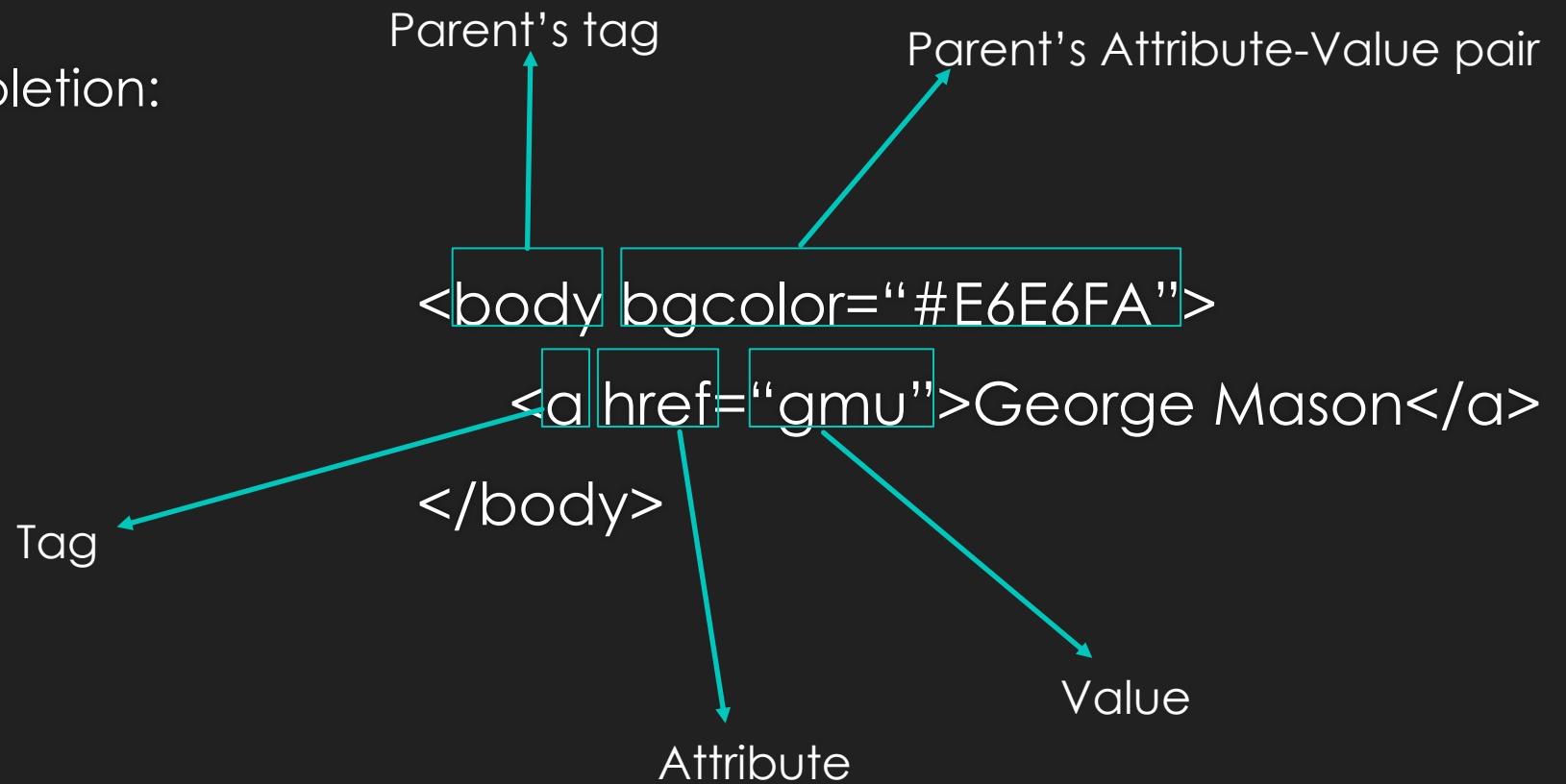
- Elements in same section
- Type of element
- Size
- Position
- Color
- Etc.



Code Completion

Types of code completion:

- Tag
- Attribute
- Value

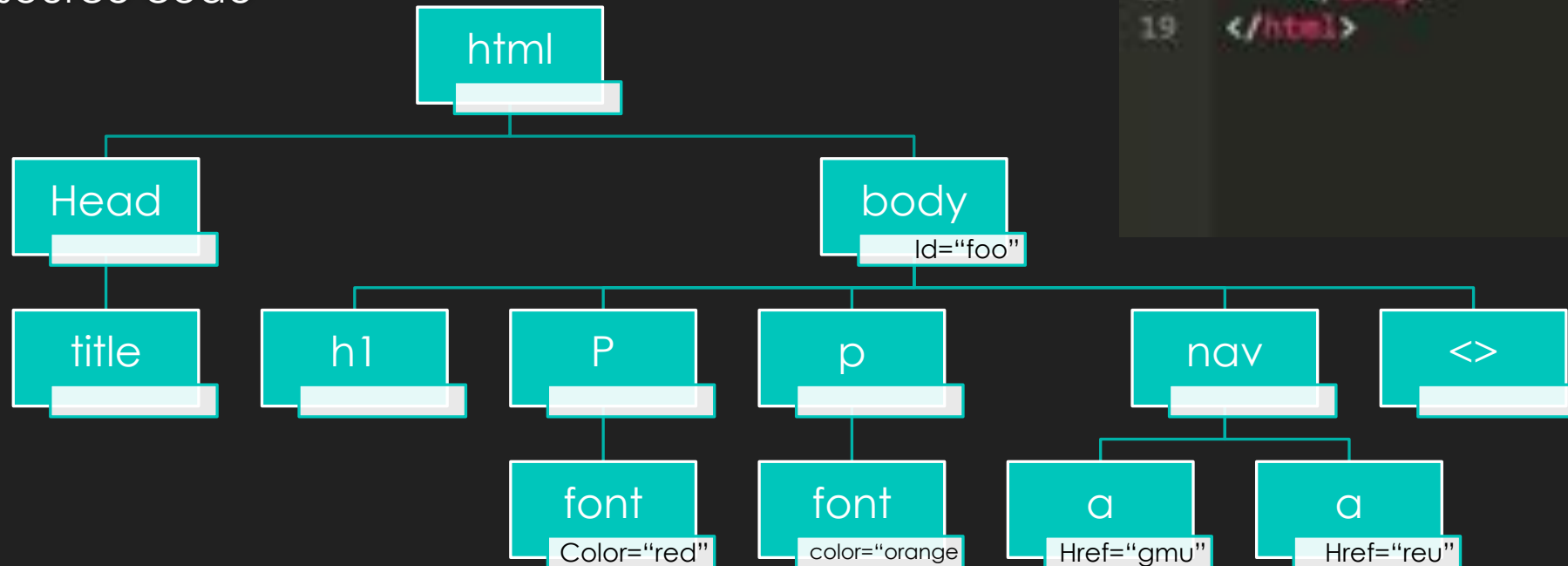


Auto Complete Process

Every time user types something:

- Determines the type of prediction
- Get Abstract Syntax Tree (AST) from source code

```
12     <p><font color="orange">Presenta
13 -   <nav>
14       <a href="gmu">George Mason</
15       <a href="reu">REU Summer 201
16     </nav>
17   <
18 </body>
19 </html>
```



Auto Complete Process

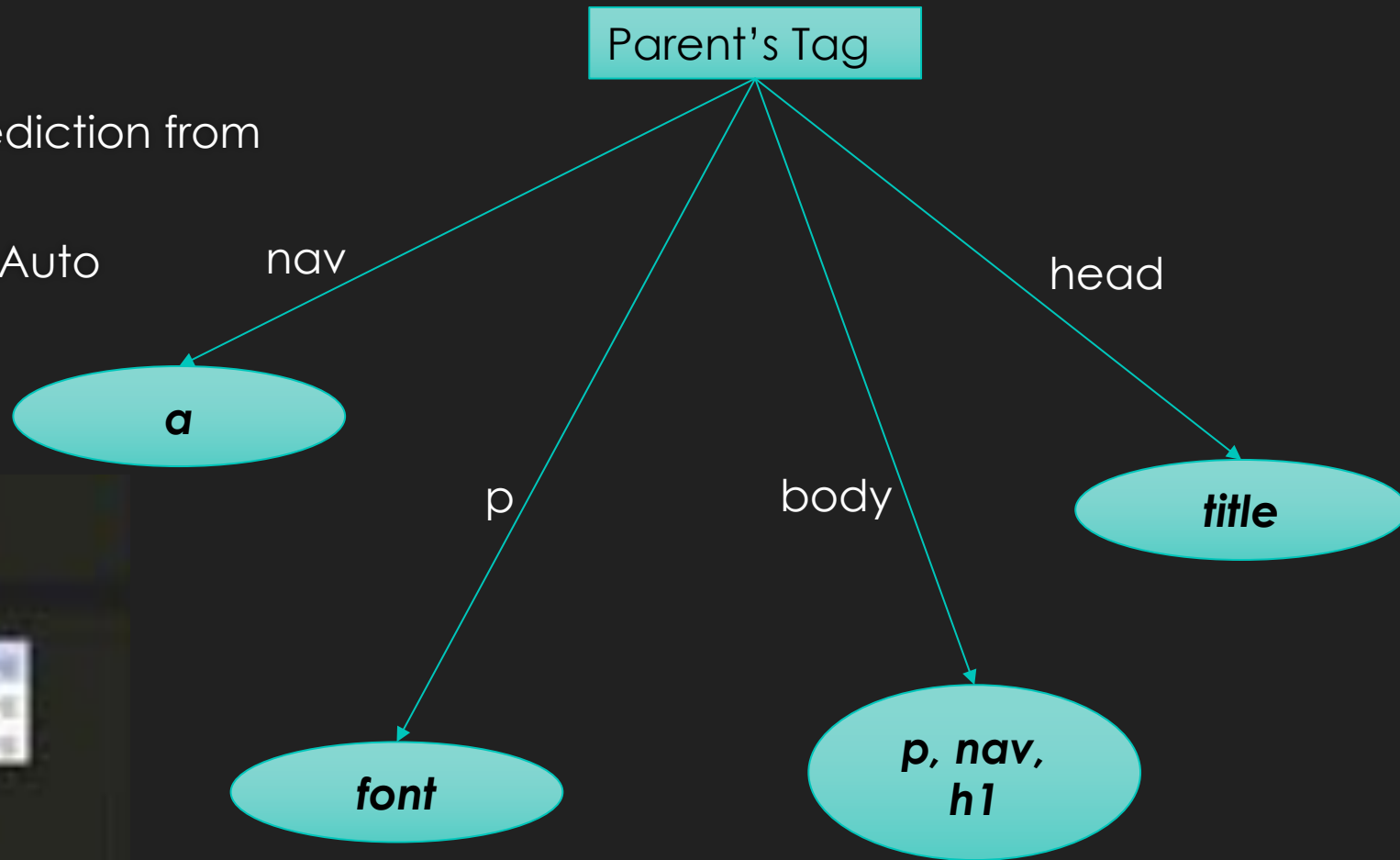
- Obtain training data, and sample features from AST.

Parent's Tag	Parent's Attr-Val Pair	Tag
body	Id="foo"	(prediction)

Parent's Tag	Parent's Attr-Val Pair	Tag
head	""	Title
body	Id="foo"	h1
body	Id="foo"	p
p	""	font
body	Id="foo"	p
p	""	font
body	Id="foo"	nav
nav	""	a
nav	""	a

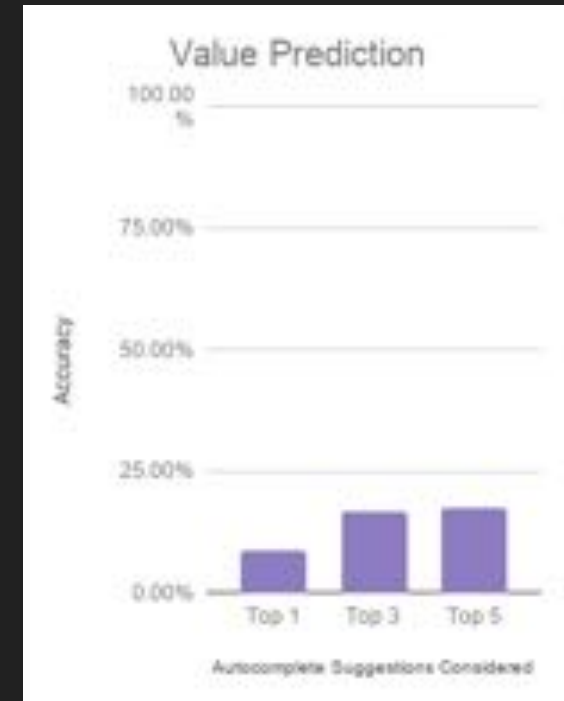
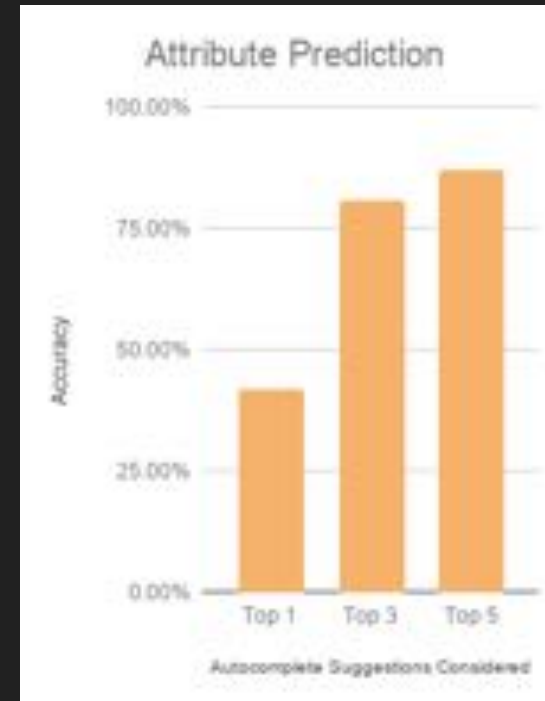
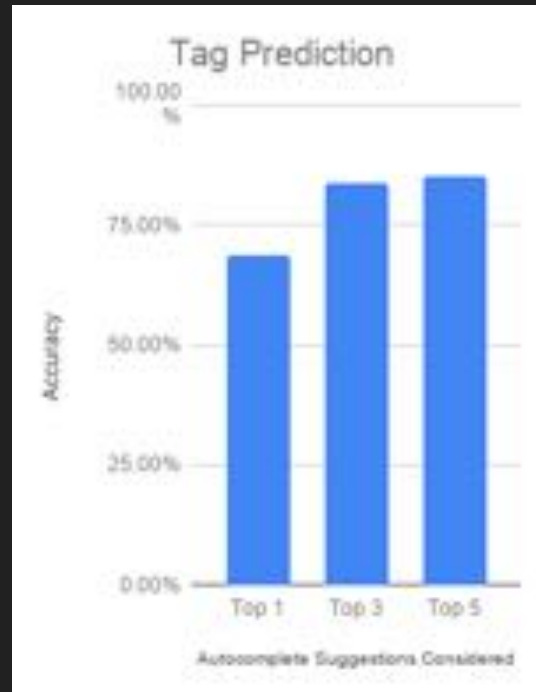
Auto Complete Process

- Build Decision Tree.
- Use sample features and get a prediction from Decision Tree
- Show the predictions as options in Auto Complete



Results for Auto Complete

- Without any user feedback
- Leave-one-out Validation
- Using 13 websites



User Interface

Information given to the user:

- Pattern rule for current top prediction
- Option to see other pattern rules

Interactive Rules Interface

The parent tag is BODY. The parent attribute-value pair is NONE.

Top Tag Prediction: P

Edit current prediction rule

View/edit prediction rules for:

Add new prediction rule for:

Interactive Rules Interface

Type predictor:

Rules prioritized by interactions:

Patterns learned automatically:

1	tag: font	parentTag: p	parentAttr/Val:	attr: color	<input type="button" value="Examples"/>	<input type="button" value="Do Not Use"/>
2	tag: font	parentTag: p	parentAttr/Val:	attr: size	<input type="button" value="Examples"/>	<input type="button" value="Do Not Use"/>
3	tag: a	parentTag: nav	parentAttr/Val:	attr: href	<input type="button" value="Examples"/>	<input type="button" value="Do Not Use"/>

User Interface

Changes made by the user:

- Prioritize or blacklist current prediction
- Change current prediction
- Add a new pattern rule



Interactive Rules Interface

The parent tag is BODY. The parent attribute-value pair is ID=FOO.

Top Tag Prediction: P

[Prioritize this rule](#)

[Don't use this rule for future predictions](#)

Change the prediction for this rule to: [Update](#)

[Main Menu](#)



Interactive Rules Interface

Enter new prediction rule

Parent Tag:

Parent Attribute-Value Pair:

Tag:

[Add](#)

Pilot Study

2 tasks for users:

- Start a document from scratch
- Complete an existing document

Features added to User Interface

- Highlight examples
- Option to unprioritized pattern rules

Interactive Rules Interface

The parent tag is BODY. The parent attribute-value pair is ID=FOO

Top Tag Prediction: P

Delete from Prioritized List

Change the prediction for this rule to: Update

Main Menu

```
1 <!DOCTYPE html>
2 <html>
3   <head>
4     <title>Web page example</title>
5   </head>
6   <body id="foo">
7     <h1>Hello World</h1>
8     <h2 value="red" class="10">Computer Science</h2>
9     <h2 value="orange">Presentation</h2>
10    <hr>
11    <hr ref="geo">George Mason</hr>
12    <hr ref="res">RES Summer 2018</hr>
13  </body>
14 </html>
15
16
17 </html>
```


Future Work

Auto Complete:

- Improve value prediction

User Interface:

- Change the way the rules are shown to the user
- Based on future pilot studies

Testing:

- 2nd Pilot study, formal user study
- More validation tests

Thank you!