MenuOptimizer

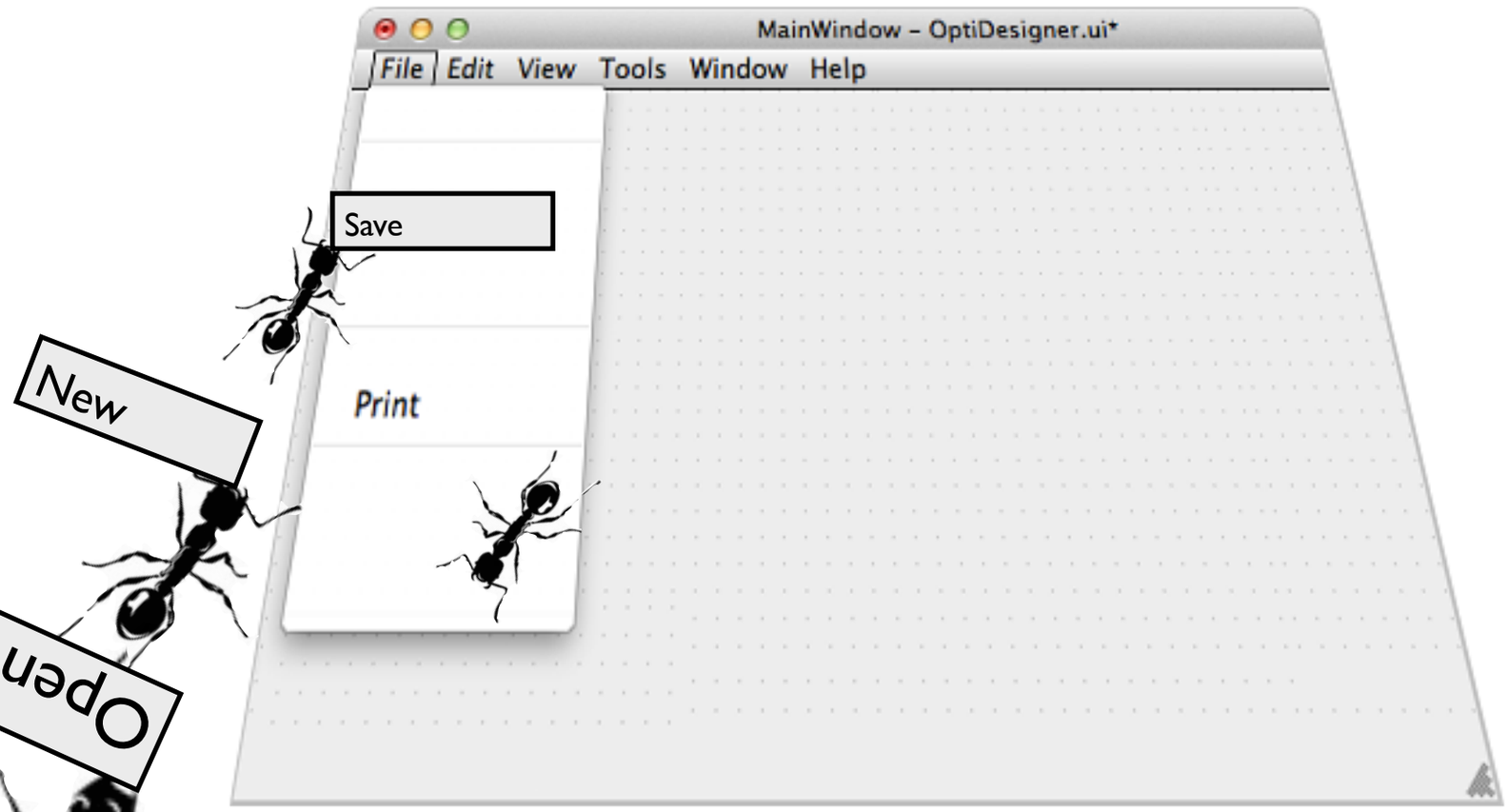
Interactive Optimization of Menu Systems

Gilles Bailly

Antti Oulasvirta

Timo Koetzing

Sabrina Hoppe



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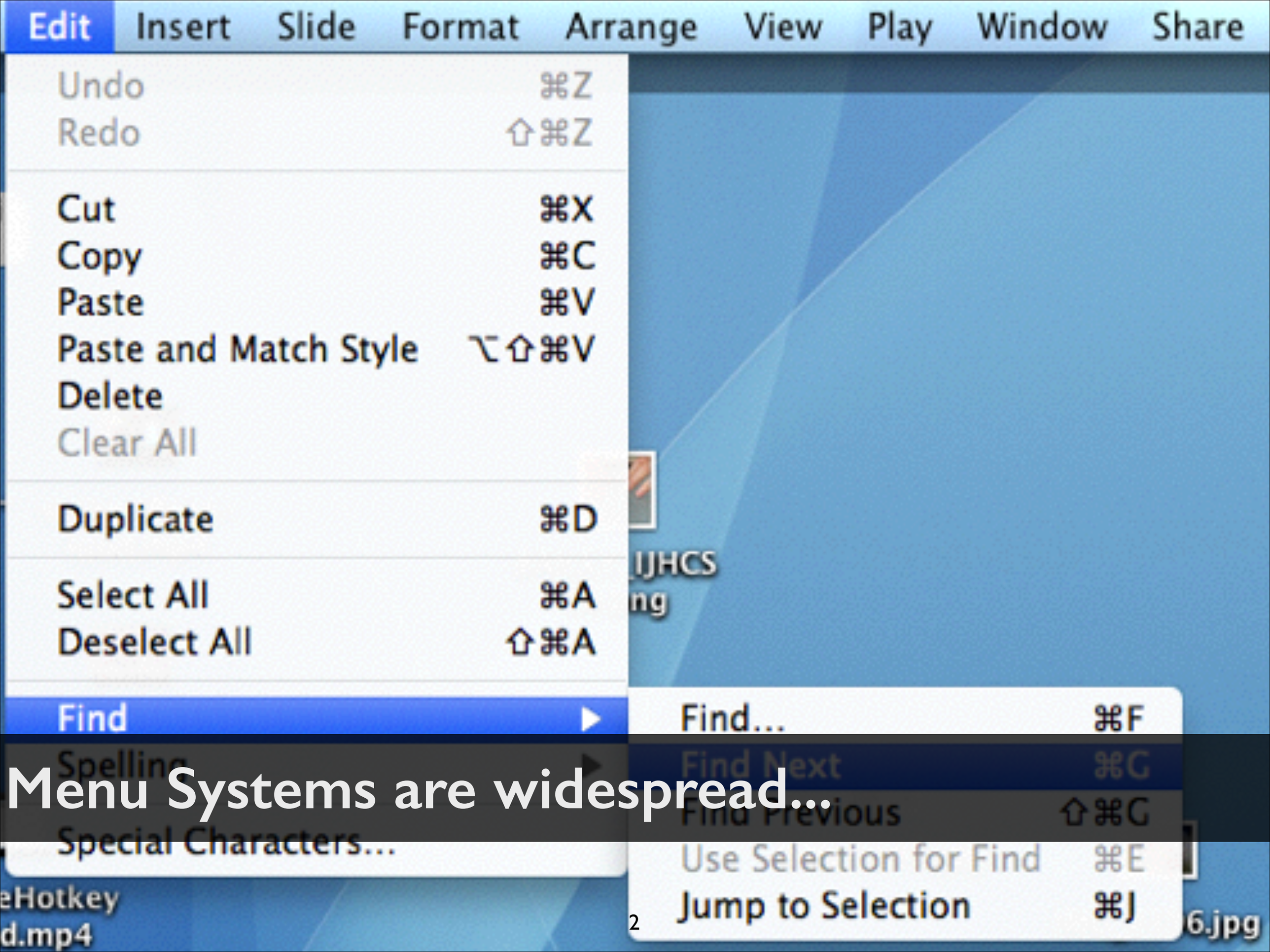
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Redo ⇧⌘Z
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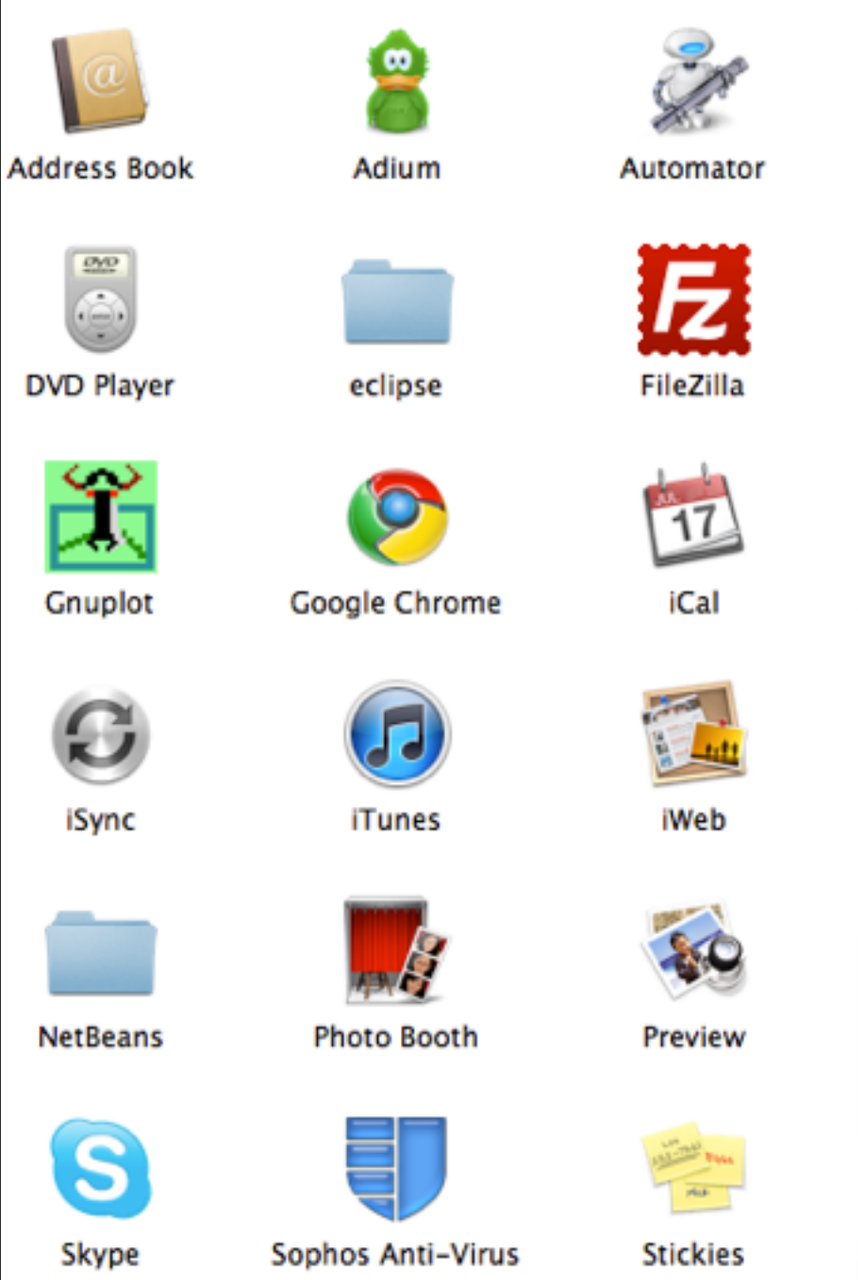
Copy ⌘C
Paste ⌘V
Paste and Match Style ⌥⇧⌘V
Delete
Clear All
Duplicate ⌘D
Select All ⌘A
Deselect All ⇧⌘A
Find
Spelling
Special Characters…
Find… ⌘F
Find Next ⌘G
Find Previous ⇧⌘G
Use Selection for Find ⌘E
Jump to Selection ⌘J
Menu Systems are widespread...

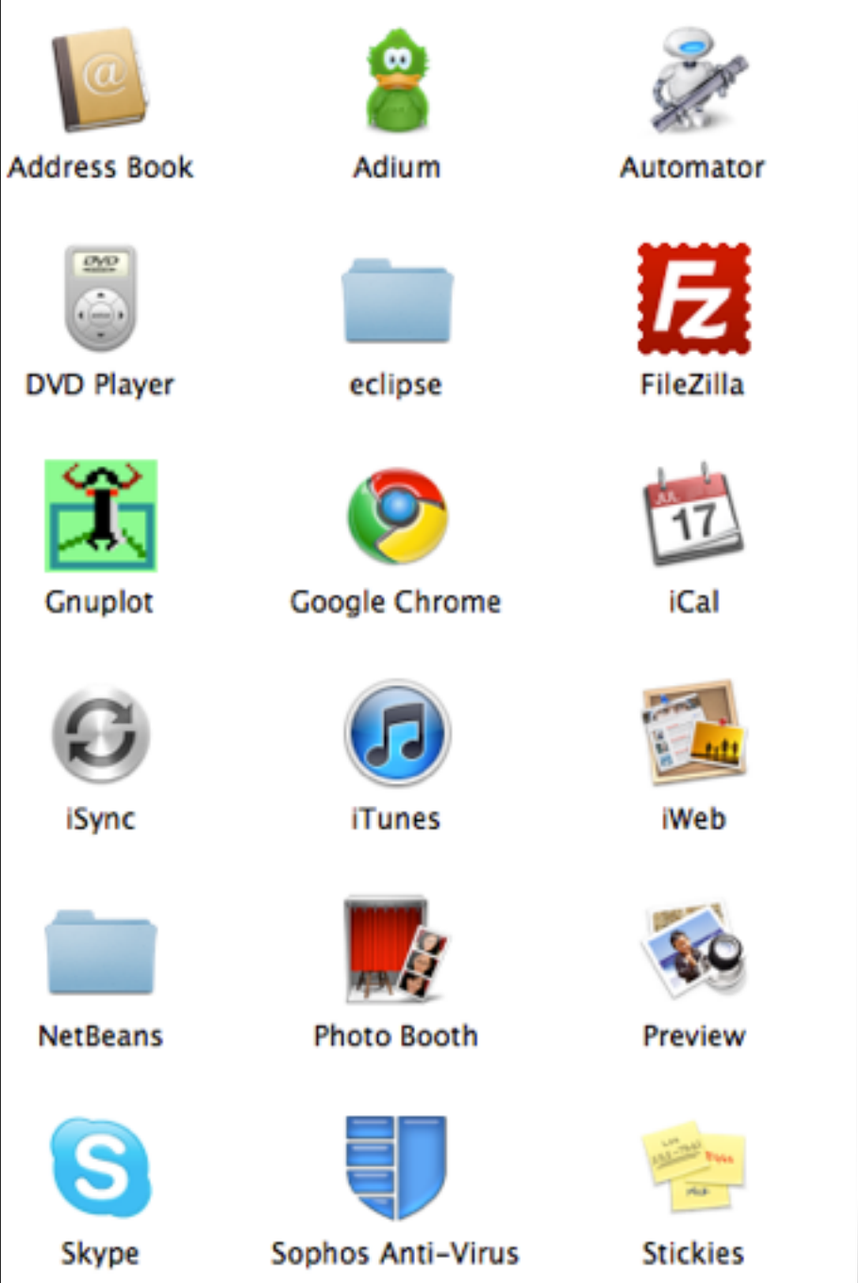


Application

Platform

User

Menu Systems are widespread...



Application

Platform

User

Menu Systems are widespread...

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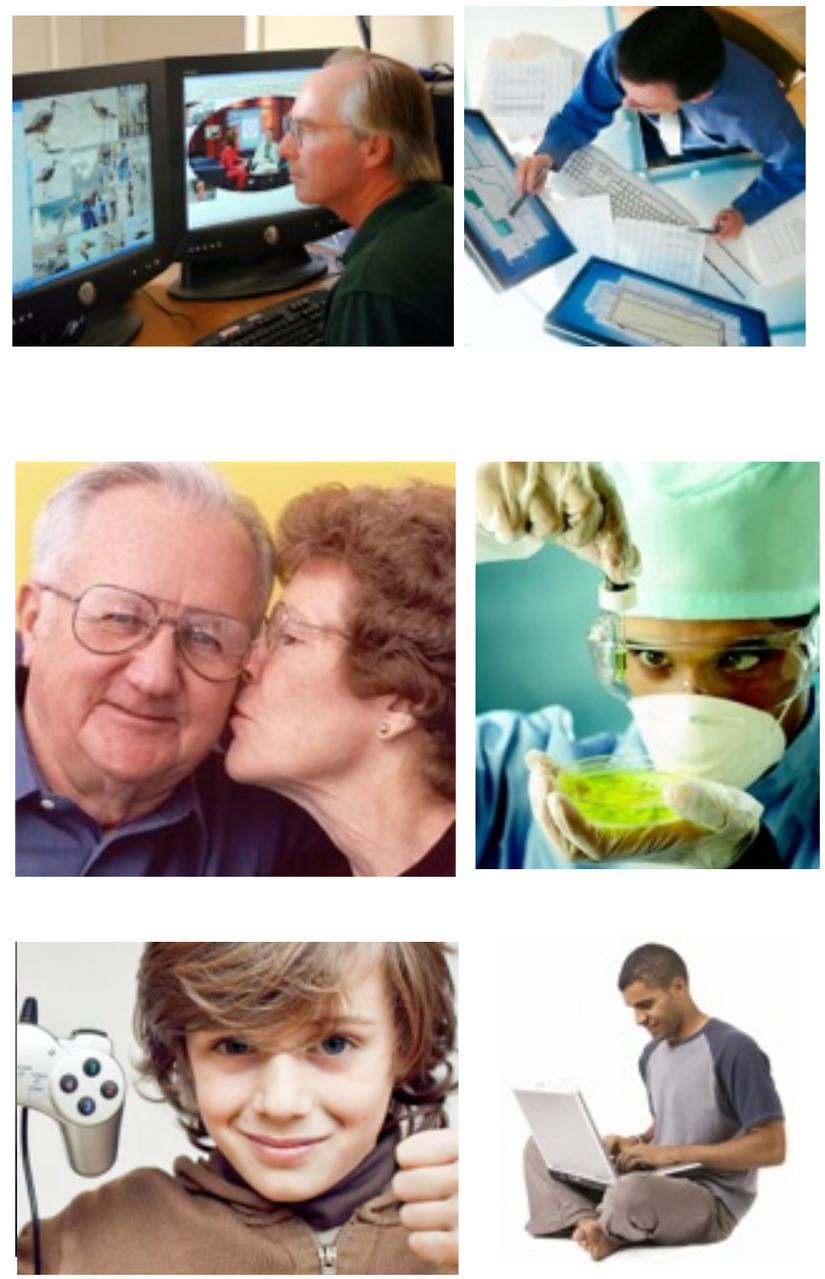
Platform



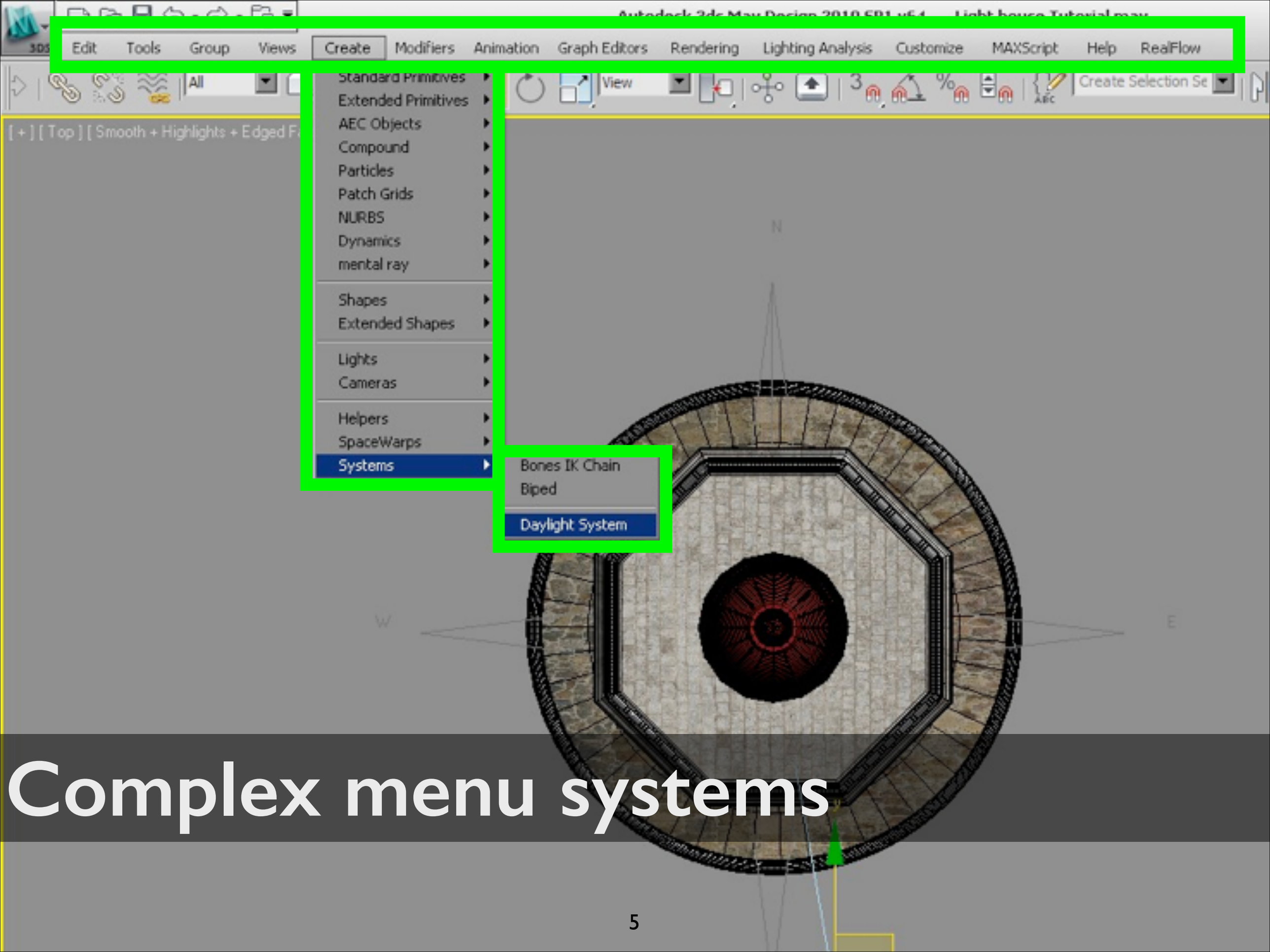
User

Menu Systems are widespread...

Designing menu systems is **easy**

Designing menu systems is **easy**

Designing **usable** menu systems is **difficult**



Complex menu systems

- Interview of 6 experienced menu designers
  - 1-3 complex menu systems per year (~ 1000 commands)

- Findings

1. Designing menus is difficult
2. Designing menus is an interactive process
3. Designers focus too much on novice users
   "*Satisfy the **immediate expectations** of their clients*"

   Designers do not focus enough on expert users and long-term efficiency.

Interviews

How to help **designers**

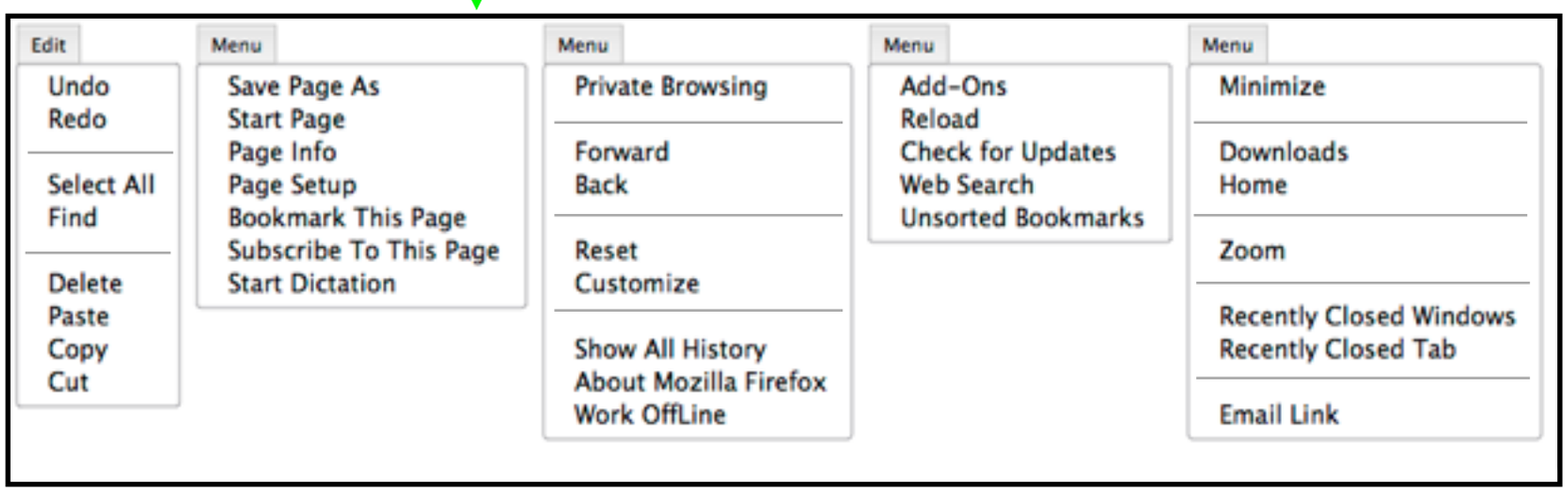
to design **usable** **menu** Systems?

Research question

MenuOptimizer

Designer

Edit

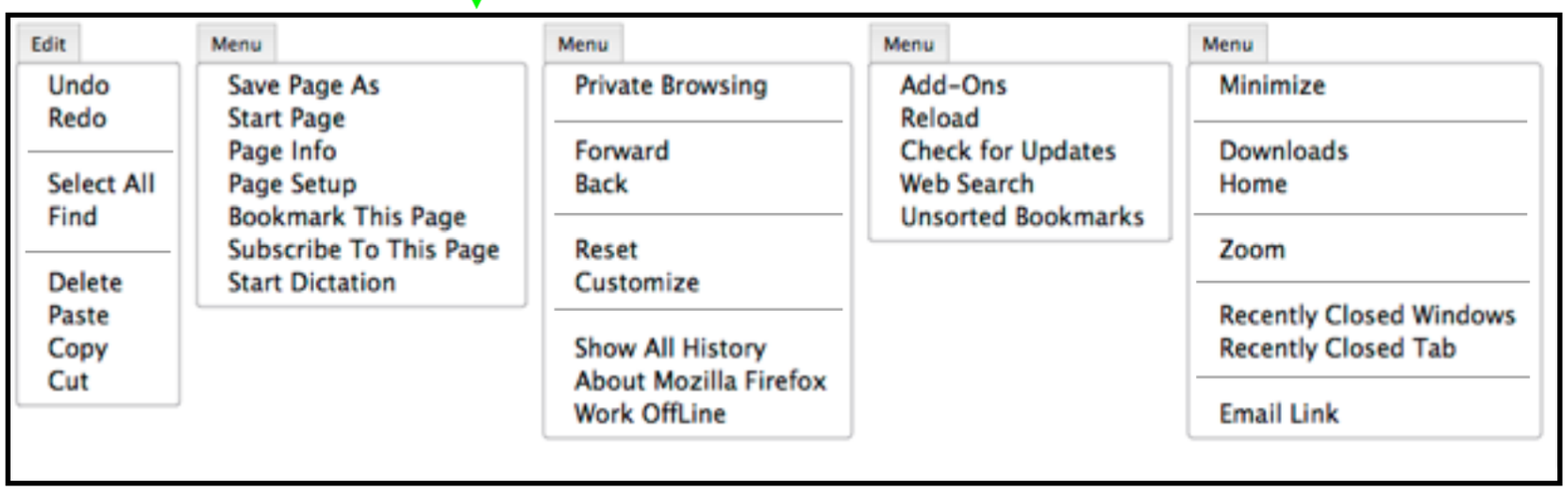


MenuOptimizer

Designer

Optimizer

Edit



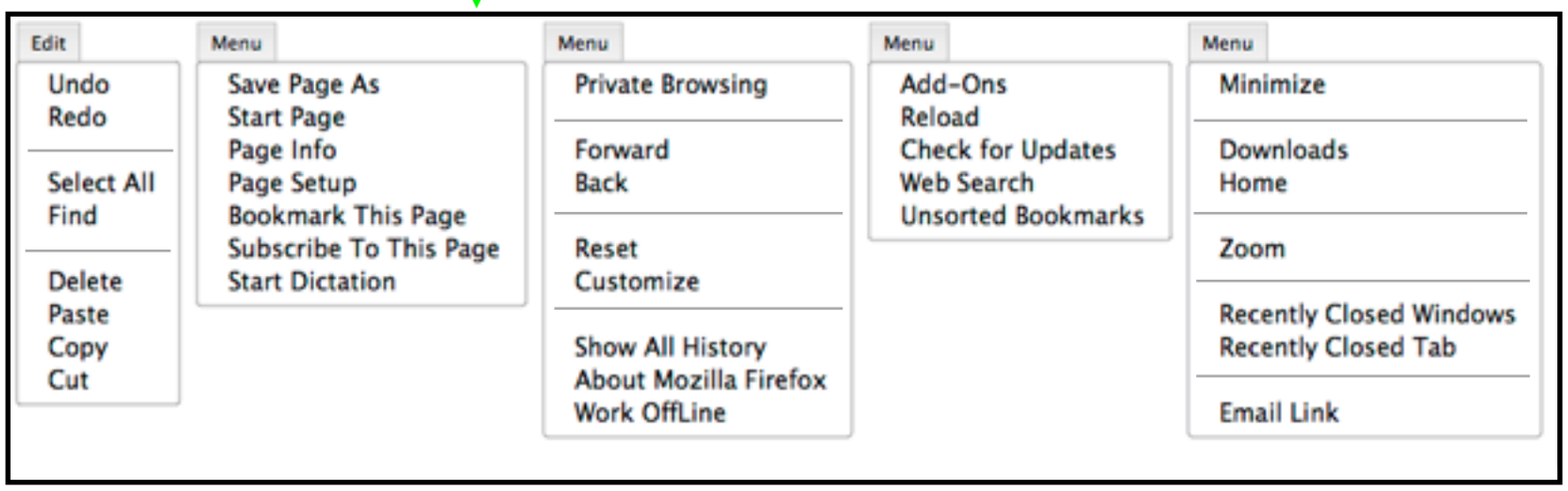
MenuOptimizer

Designer

Edit goals
and assumptions

Optimizer

Edit



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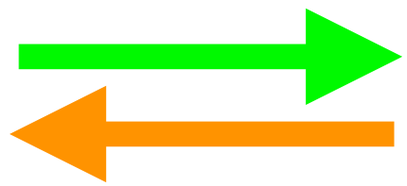
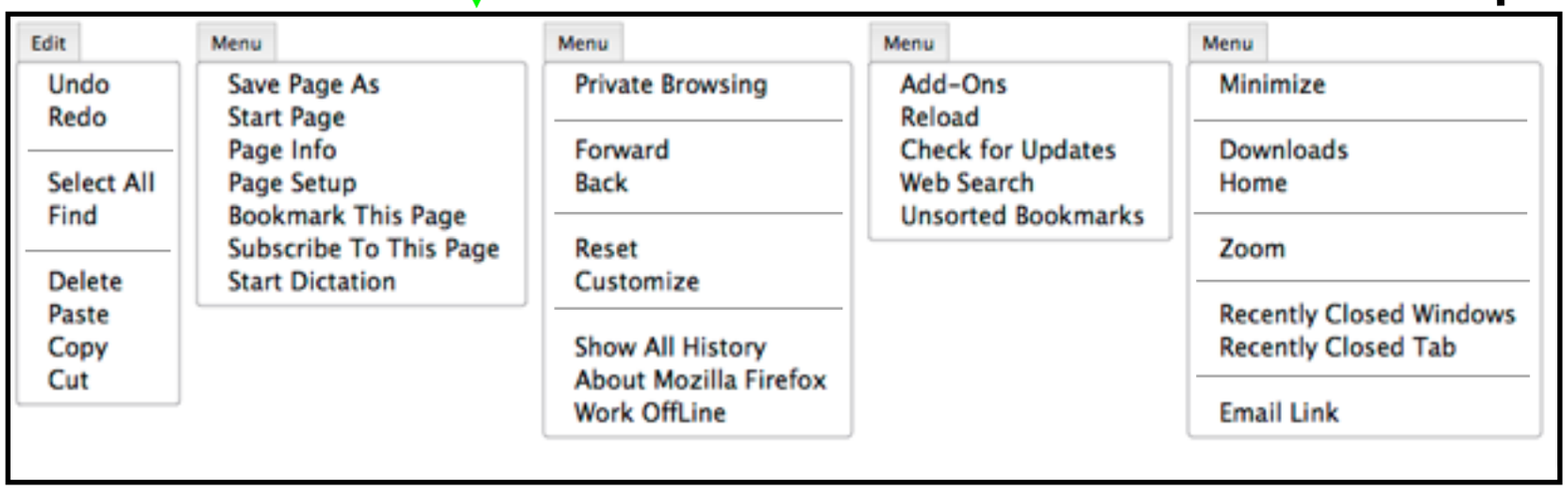


Feedback

Optimizer

Edit



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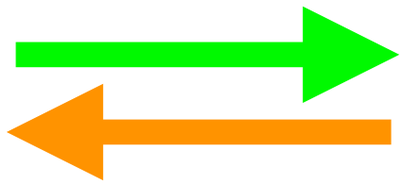
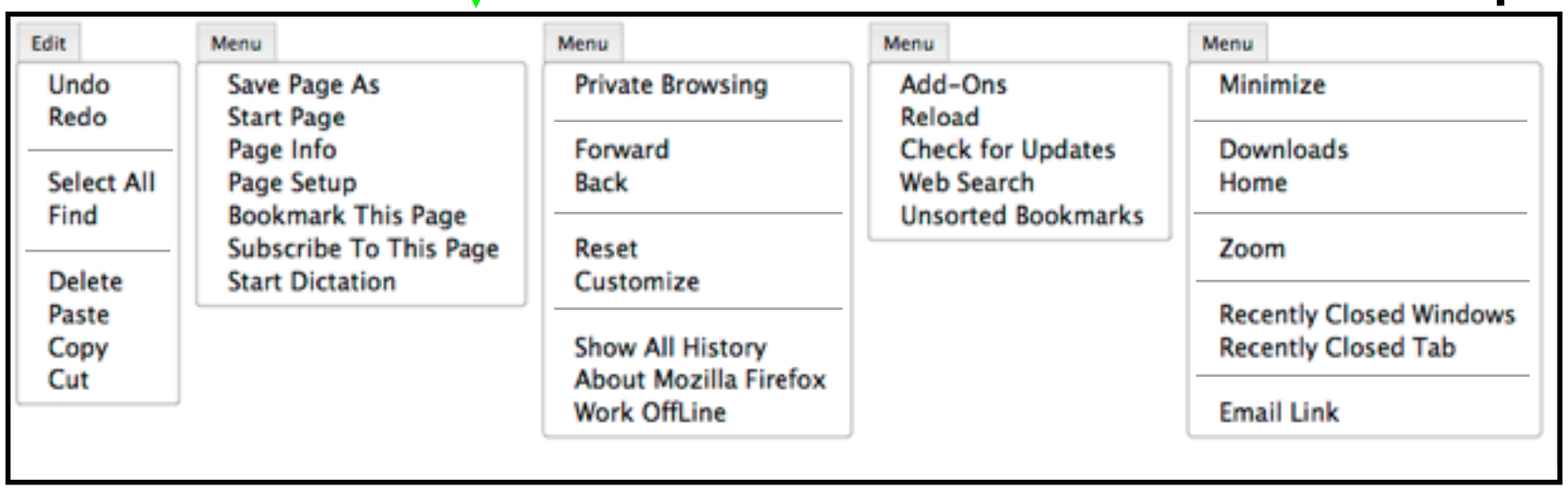


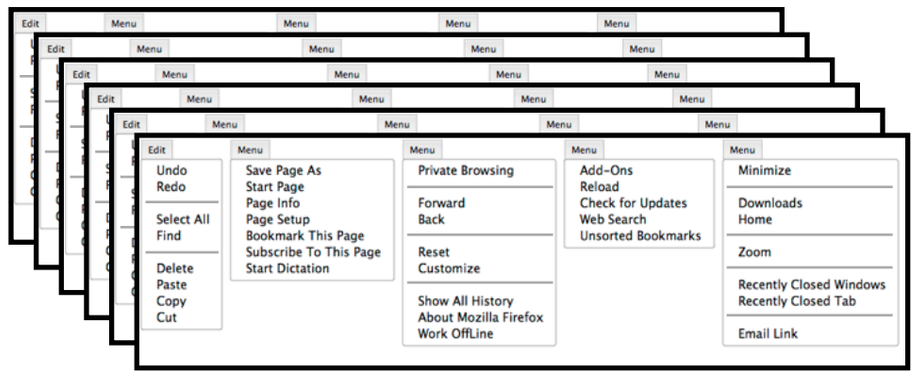
Feedback

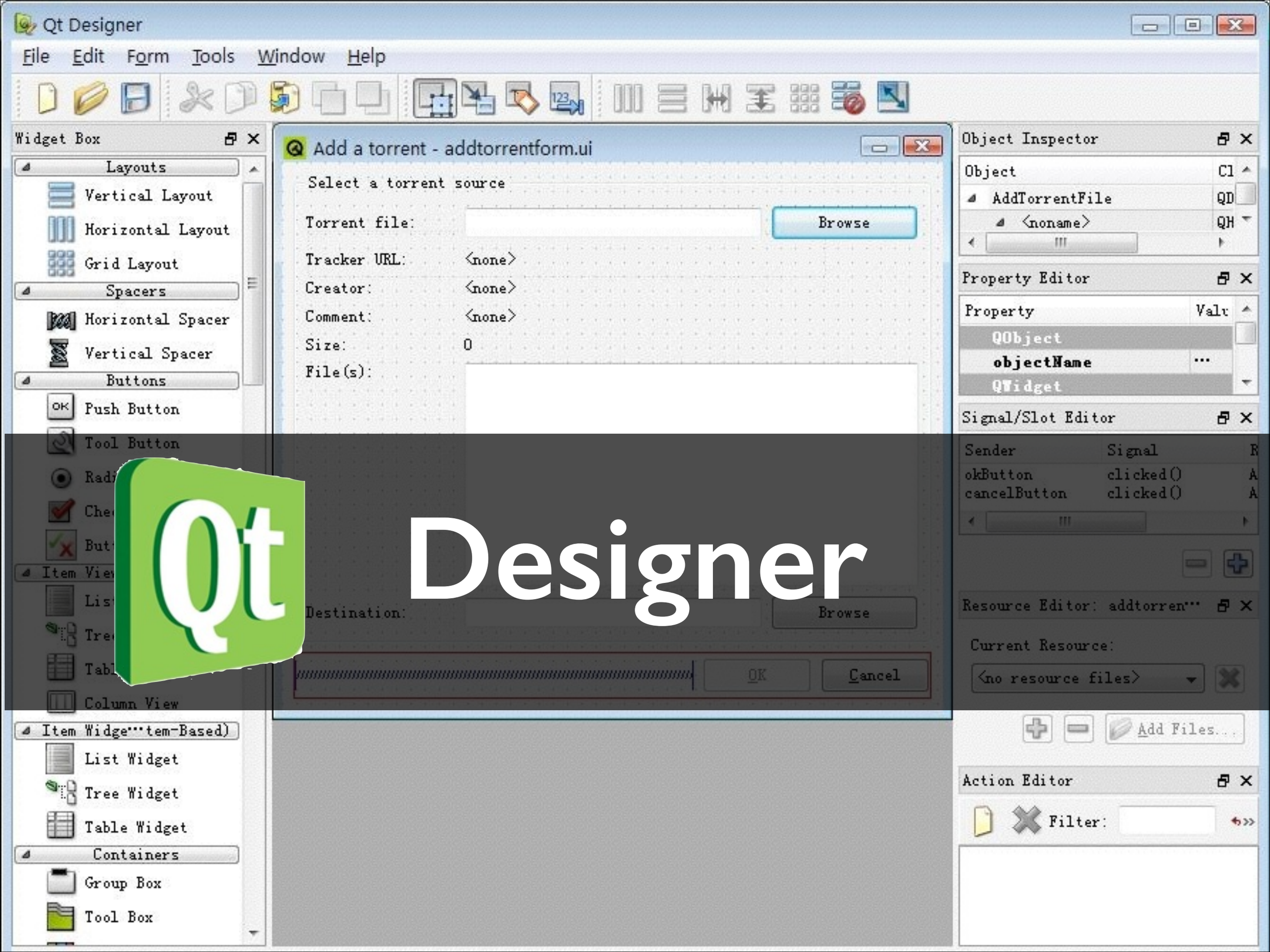
Optimizer

Edit

suggestions



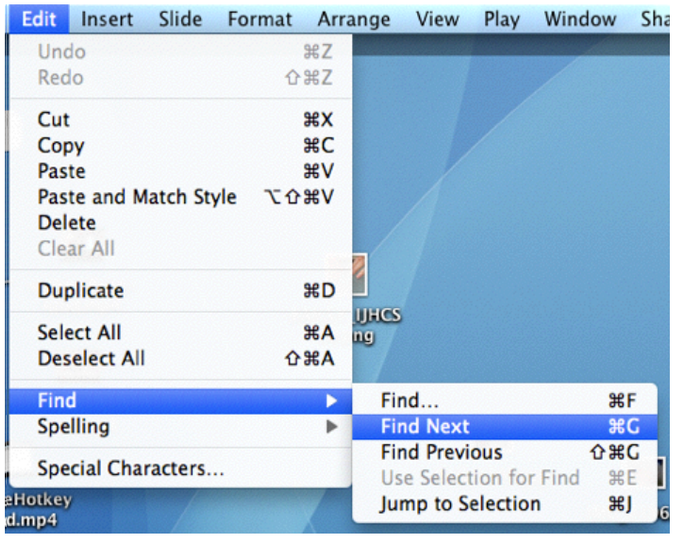



Qt Designer
File Edit Form Tools Window Help
Widget Box
Layouts
Vertical Layout
Horizontal Layout
Grid Layout
Spacers
Horizontal Spacer
Vertical Spacer
Buttons
Push Button
Tool Button
Column View
Item Widge···tem-Based)
List Widget
Tree Widget
Table Widget
Containers
Group Box
Tool Box
Add a torrent - addtorrentform.ui
Select a torrent source
Torrent file:
Browse
Tracker URL:
<none>
Creator:
<none>
Comment:
<none>
Size:
0
File(s):
Destination:
Browse
OK
Cancel
Object Inspector
Object
AddTorrentFile
<noname>
Property Editor
Property
QObject
objectName
QWidget
Signal/Slot Editor
Sender
Signal
okButton
clicked()
cancelButton
clicked()
Resource Editor: addtorren···
Current Resource:
<no resource files>
Add Files...
Action Editor
Filter:
Qt
Designer

Designing menu systems is

a combinatorial problem

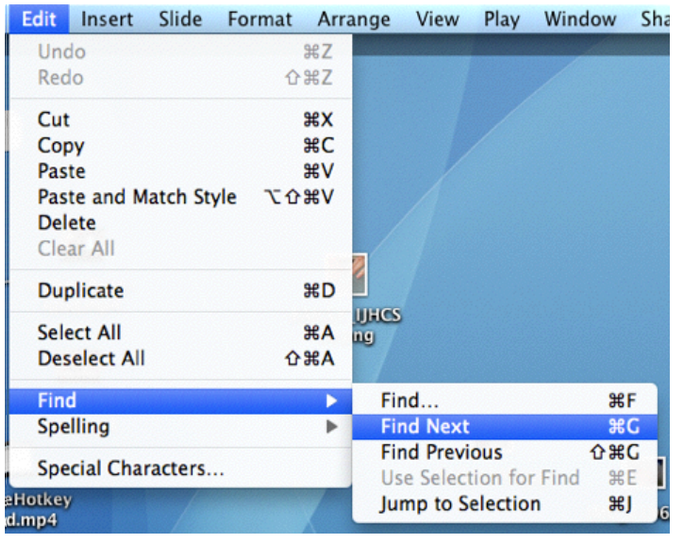
Combinatorial Problem



50 items :
~10^{158} designs

Huge
Design Space

Combinatorial Problem



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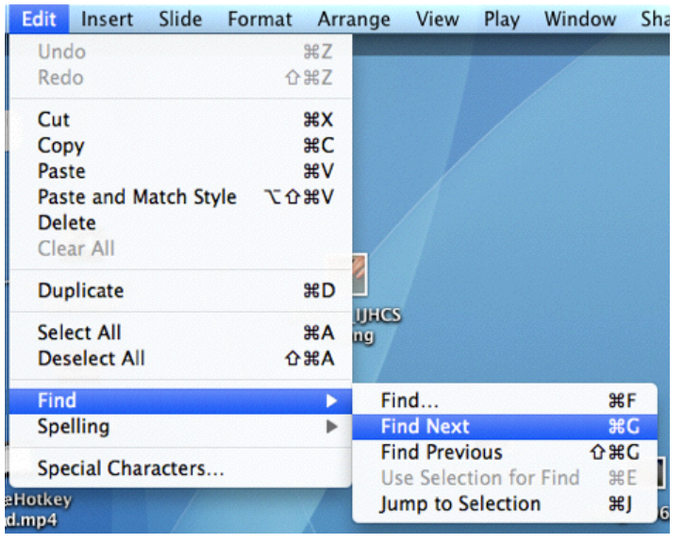
Speed, Accuracy
Aesthetics, etc.

Huge
Design Space

Multiple
Objectives

Combinatorial Problem



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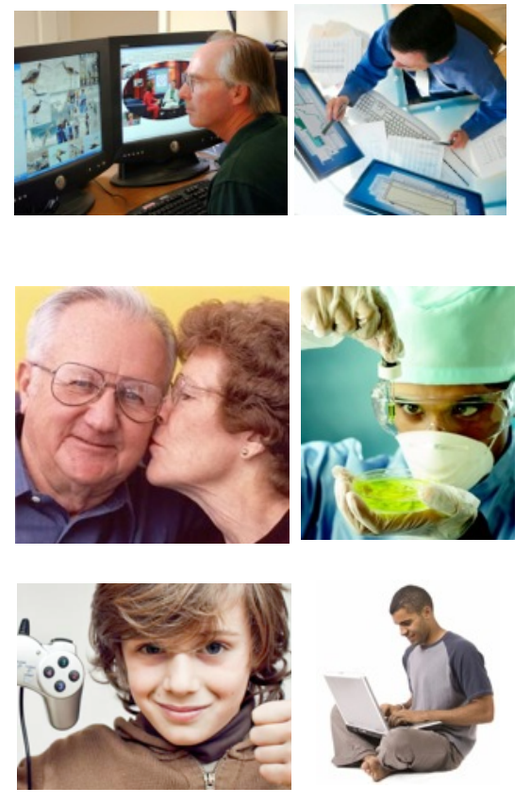

Diversity of
User Population

Design Process

Define problems
Define constraints
Cope with uncertainty
Recognize good solutions

Designer

Off-line
Optimization

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Define constraints
Cope with uncertainty
Recognize good solutions

Combinatorial problem

- Huge Design space
- Multiple objectives
- Diversity of user Population

Designer

Off-line
Optimization

Design Process

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Define constraints
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Designer

Combinatorial problem

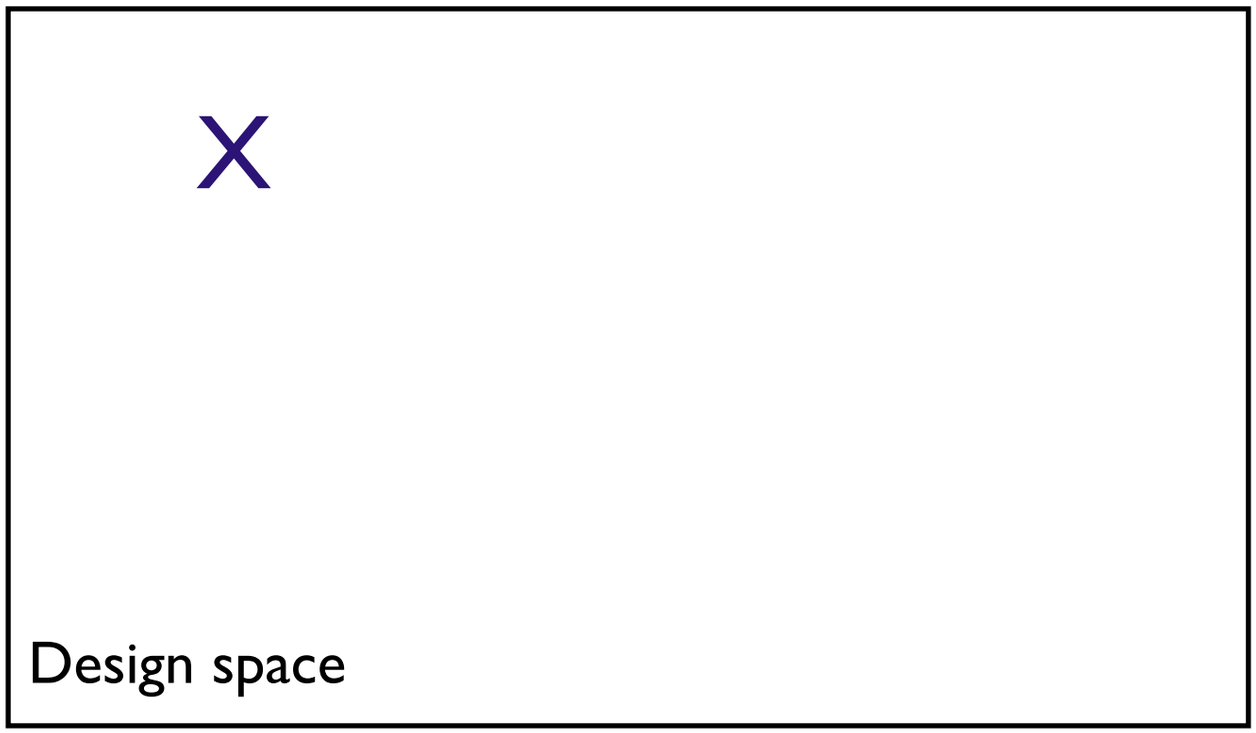
- Huge Design space
- Multiple objectives
- Diversity of user Population

Off-line Optimization

Optimization Method

Design space

Optimization Method



Generate

Optimization Method

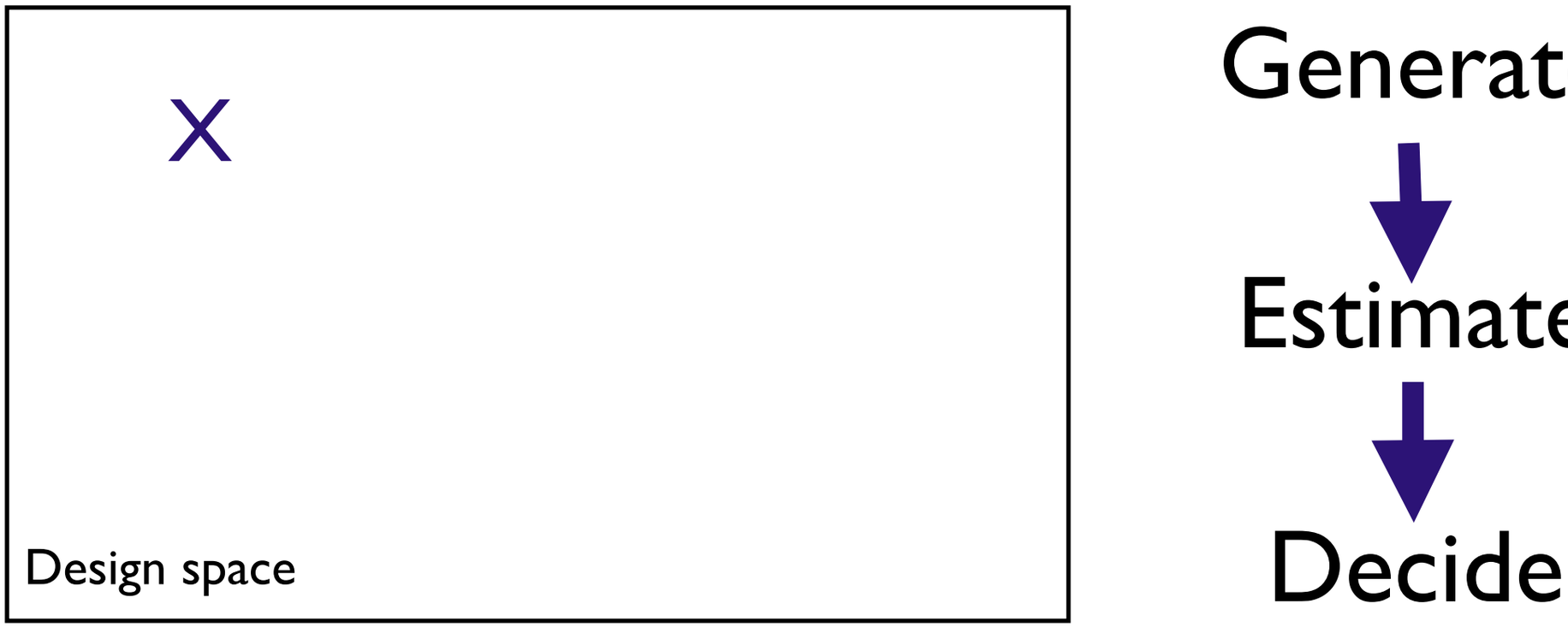
f(X) = ?

Design space

Generate

Estimate

Optimization Method

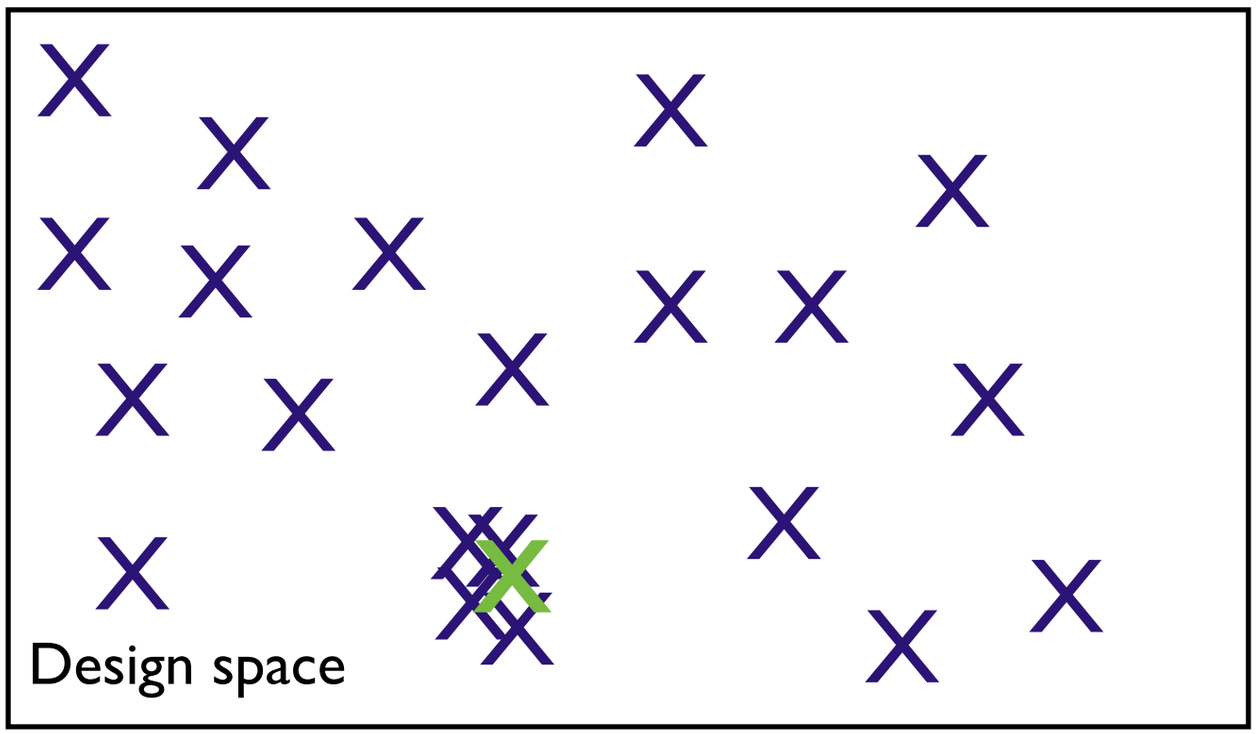


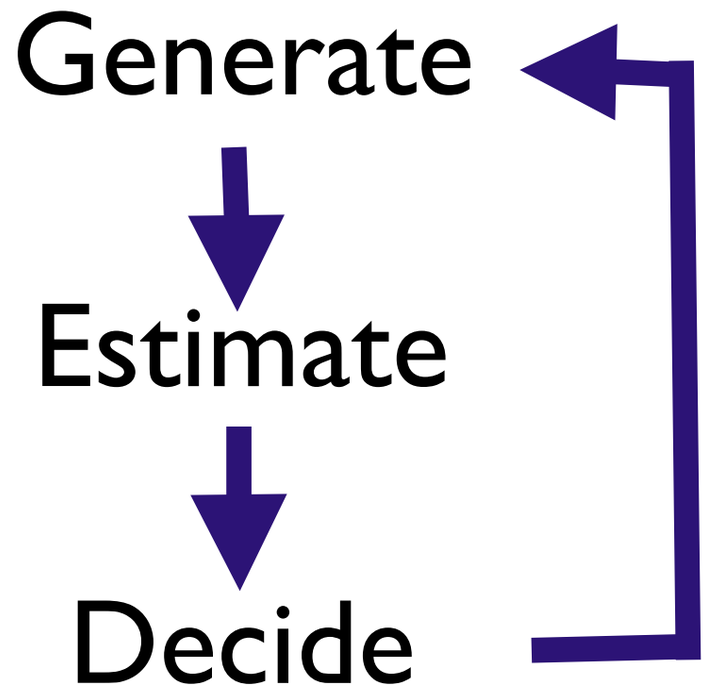
Generate

Estimate

Decide

Optimization Method





Optimization Methods

- Text entry [Light 93; Zhai 00; Oulasvirta 13; Eggers 03]
- Menus [Matsui 08; Goubko 10]
- Accessability [Gajos 04; Gajos 07]
- Dialog layout [Fogarty 03]

Optimization Methods

- Limitations

Open
Save
Save As
Close
...

1
Problem definition

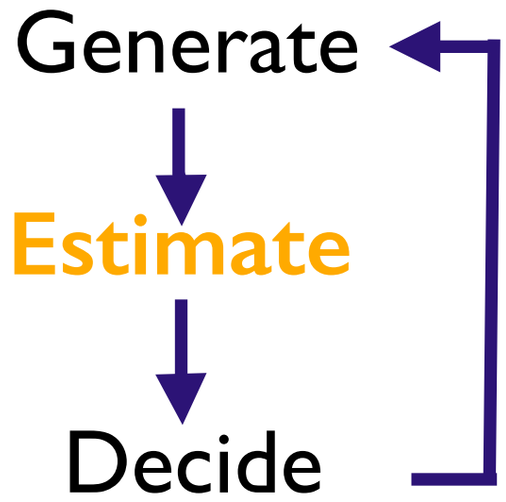
2
Predictive model

3
Time constraint

Optimization Methods

- Limitations

Open
Save
Save As
Close
...



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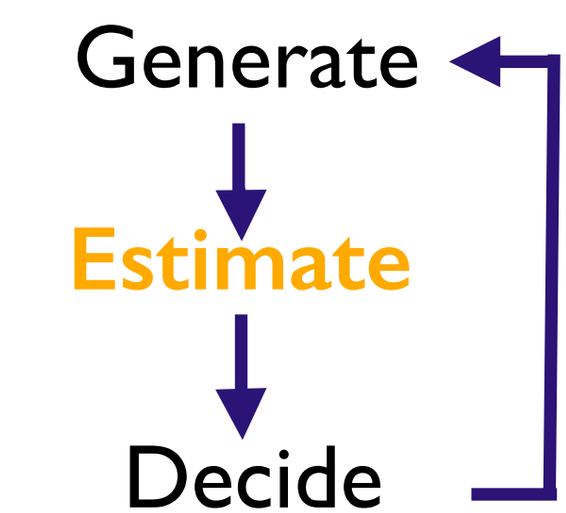


1
Problem definition

2
Predictive model

3
Time constraint

Design Process

Designer

Off-line
Optimization

Design Process

Designer

Human-Aided Optimization

Off-line Optimization

[Anderson 00;
Quiroz 07;
Scott 02]

Design Process

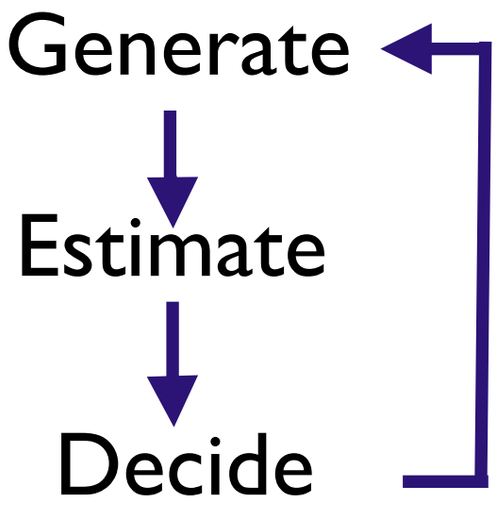
Designer

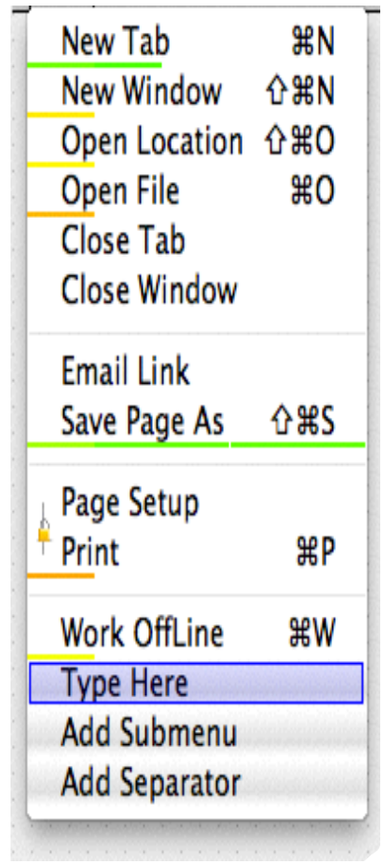
Interactive Optimization

Human-Aided Optimization

Off-line Optimization

[Anderson 00; Quiroz 07; Scott 02]





Optimizer

1

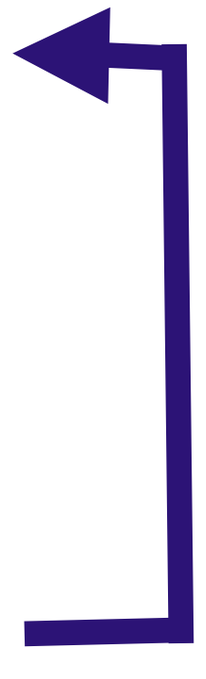
Interactions

2

Challenges

Optimizer

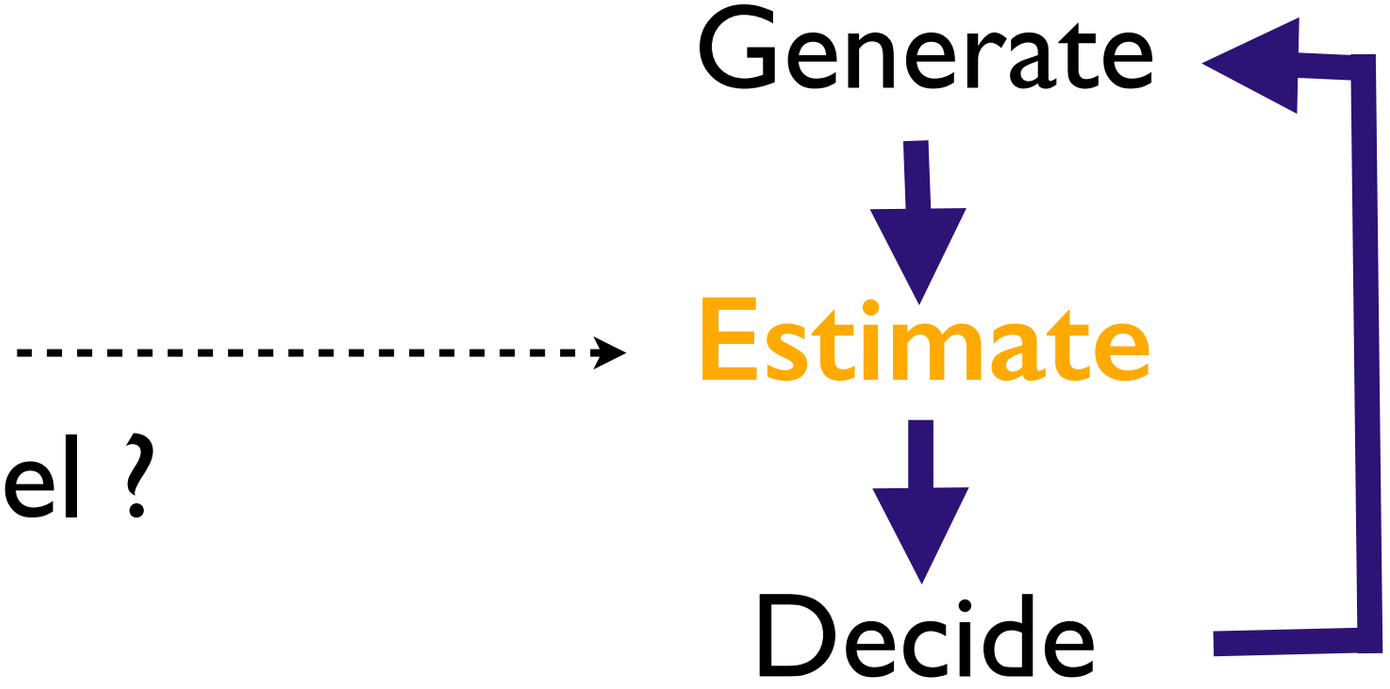
Ant Colony Optimization



More details in the paper

Optimizer

Which Predictive Model ?



Search - Decision - Pointing Model (SDP)

[Cockburn 07]

$$T = f(L, T, H, P)$$

The model is based on Fitt's law and Hick-Hyman law

Search - Decision - Pointing Model (SDP)

[Cockburn 07]

$$T = f(L, T, H, P)$$

Selection time

The model is based on Fitt's law and Hick-Hyman law

Search - Decision - Pointing Model (SDP)

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$$T = f(L, T, H, P)$$

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Menu length

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Search - Decision - Pointing Model (SDP)

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$$T = f(L, T, H, P)$$

Selection time

Menu length

Target Position

The model is based on Fitt's law and Hick-Hyman law

Search - Decision - Pointing Model (SDP)

[Cockburn 07]

$$T = f(L, T, H, P)$$

- T: Selection time
- L: Menu length
- T: Target Position
- H: Entropy

The model is based on Fitt's law and Hick-Hyman law

Search - Decision - Pointing Model (SDP)

[Cockburn 07]

$$T = f(L, T, H, P)$$

- T: Selection time
- L: Menu length
- T: Target Position
- H: Entropy
- P: Practice

The model is based on Fitt's law and Hick-Hyman law

"*Satisfy the immediate* ***expectations*** *of their clients*"

From our Interviews

- **Consistency with existing applications**
  - Convention
  - "Cut", "Copy" and "Paste" are frequently in the same group

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$$C = f(O)$$

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Consistency

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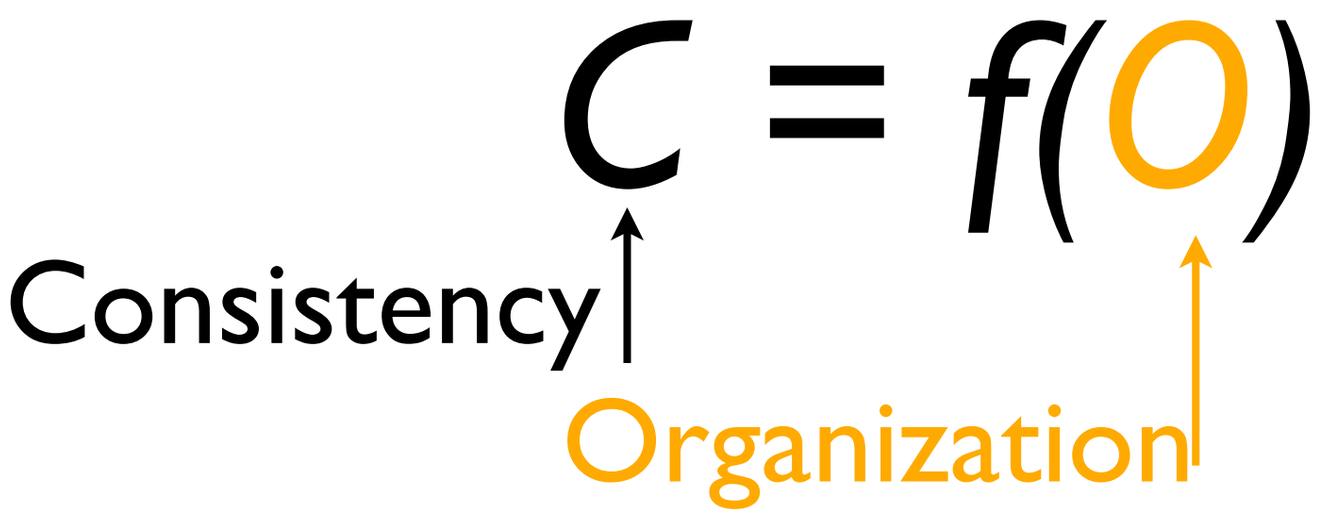


$$T_s = f(L, T, H, P)$$

Selection time

Menu length

Target Position

Entropy

Practice

$$C = f(O)$$

Consistency

Organization

$$T_s = f(L, T, H, P)$$

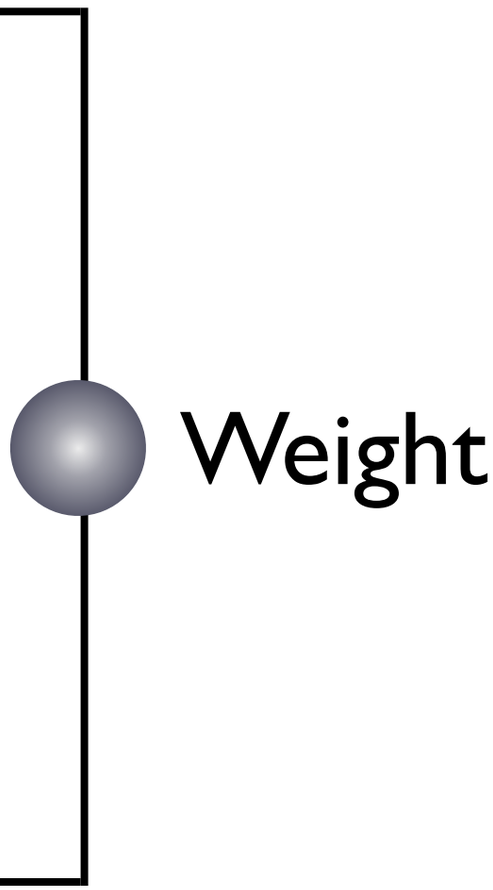
Selection time

Menu length

Target Position

Entropy

Practice



Weight

$$C = f(O)$$

Consistency

Organization

$$T = f(L, T, H, P)$$

Selection time

Menu length

Target Position

Entropy

Practice

Weight

$$C = f(O)$$

Consistency

Organization

$$T_s = f(L, T, H, P)$$

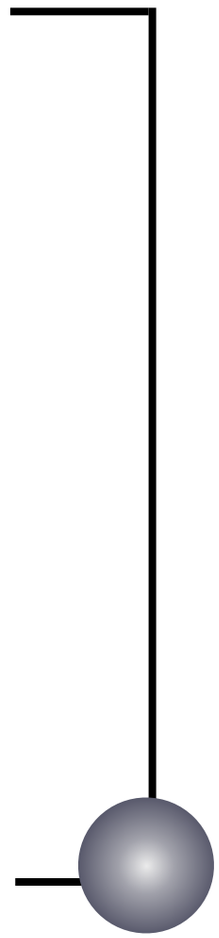
Selection time

Menu length

Target Position

Entropy

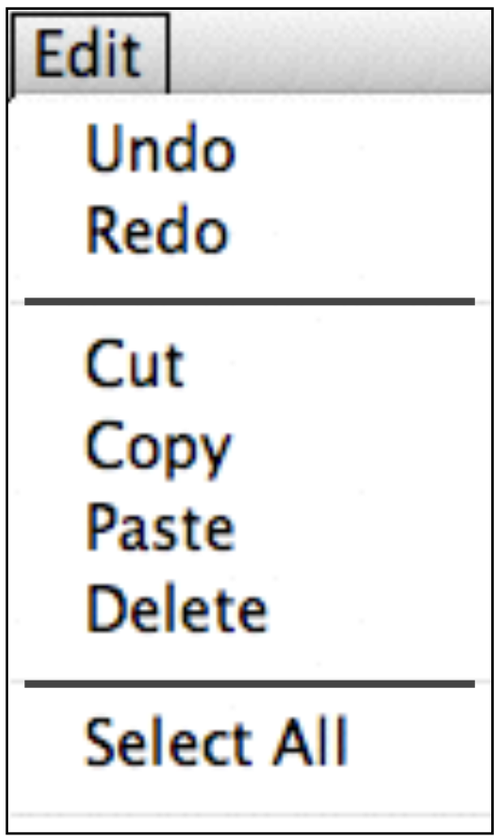
Practice



$$C = f(O)$$

Consistency

Organization


Edit
Undo
Redo
Cut
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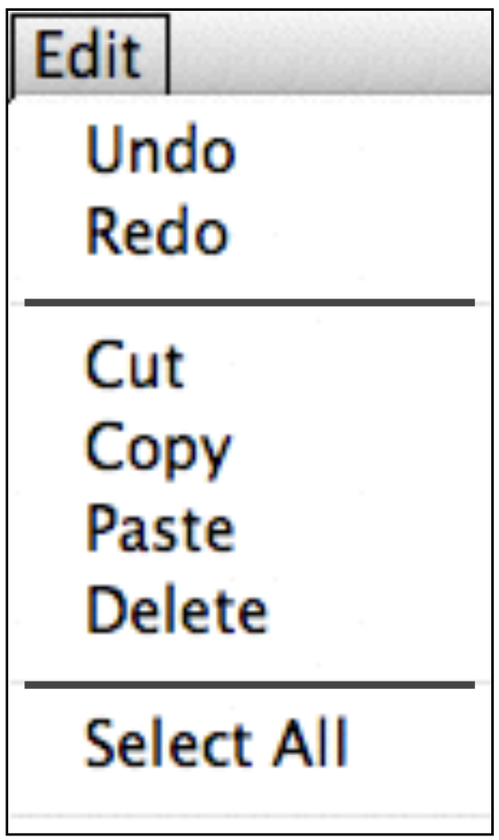
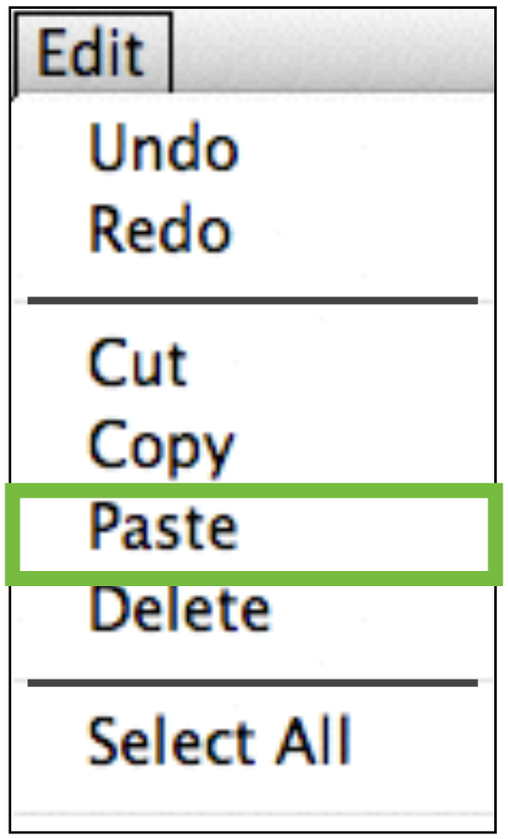
Paste
Delete
Select All



Selection Time

only



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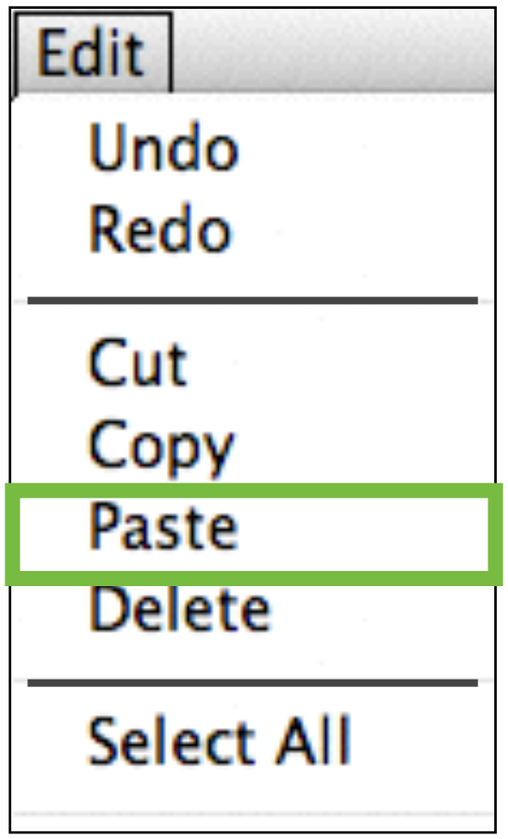

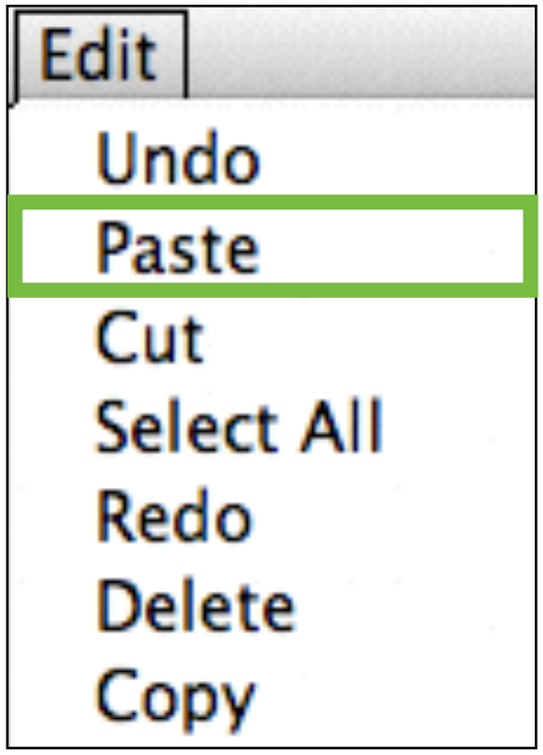

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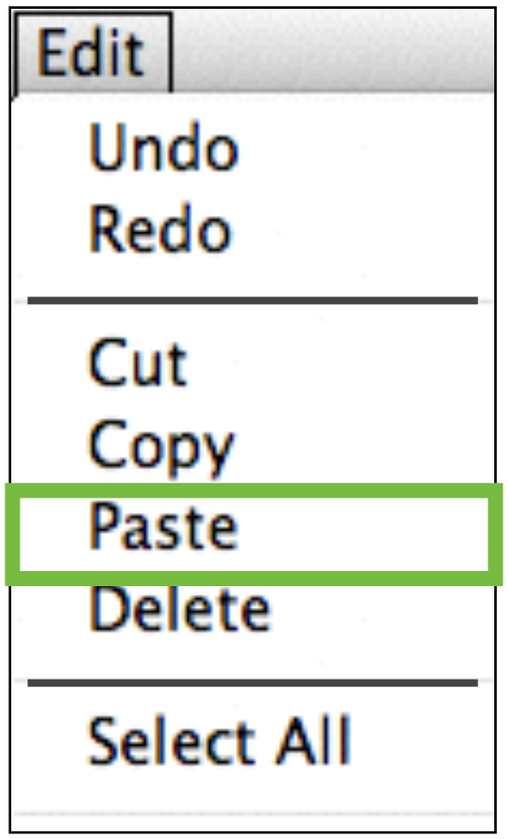

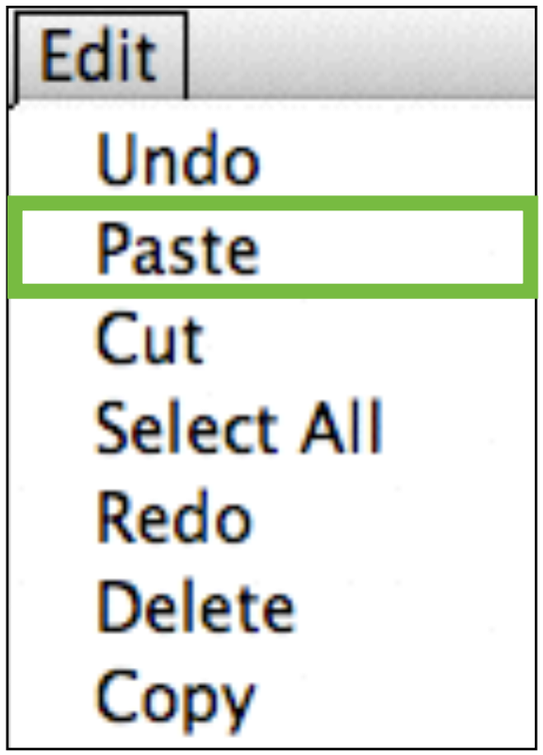

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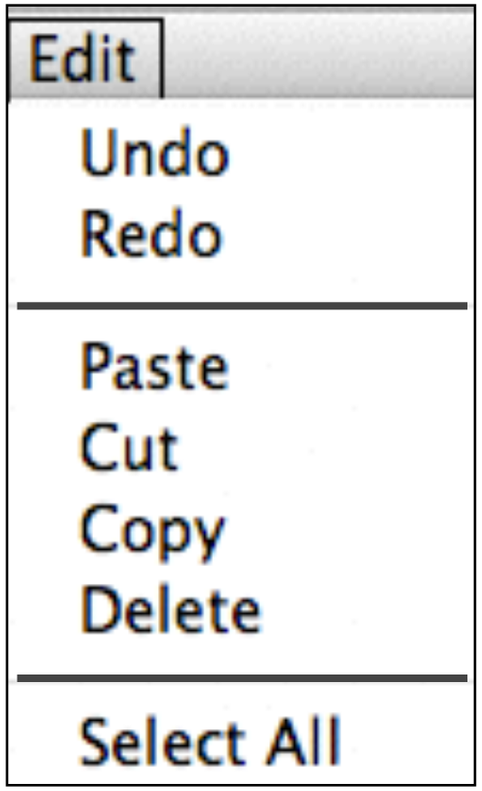
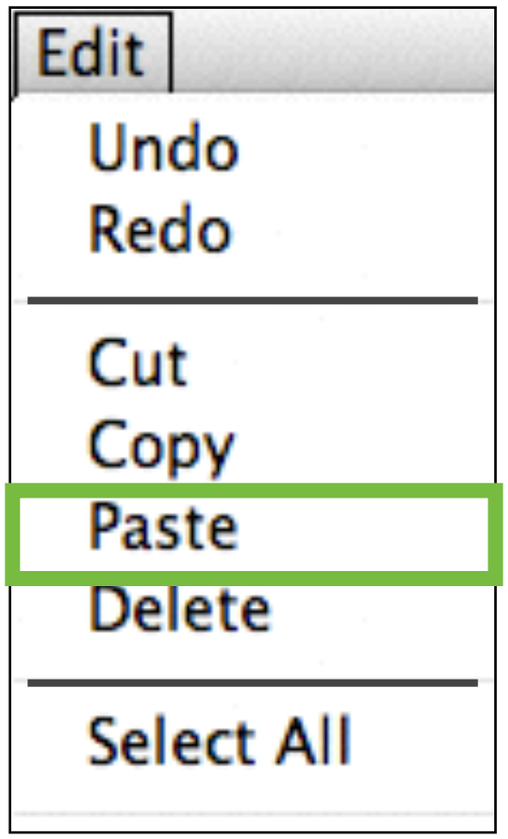
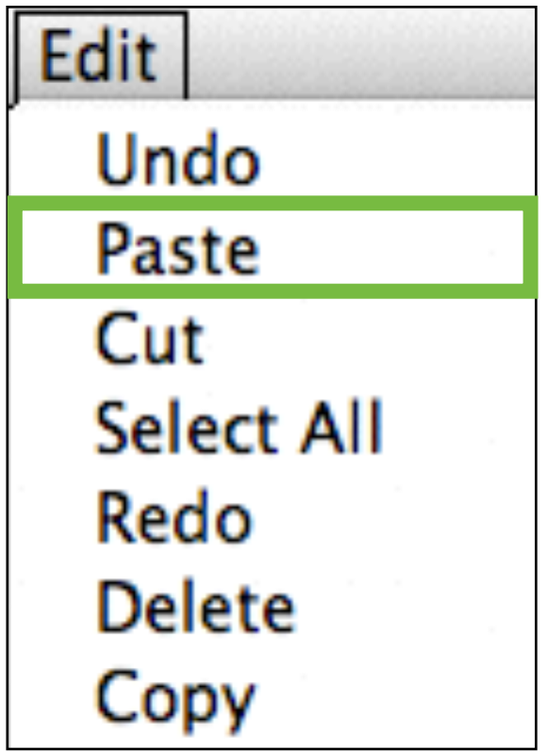


Selection Time

&

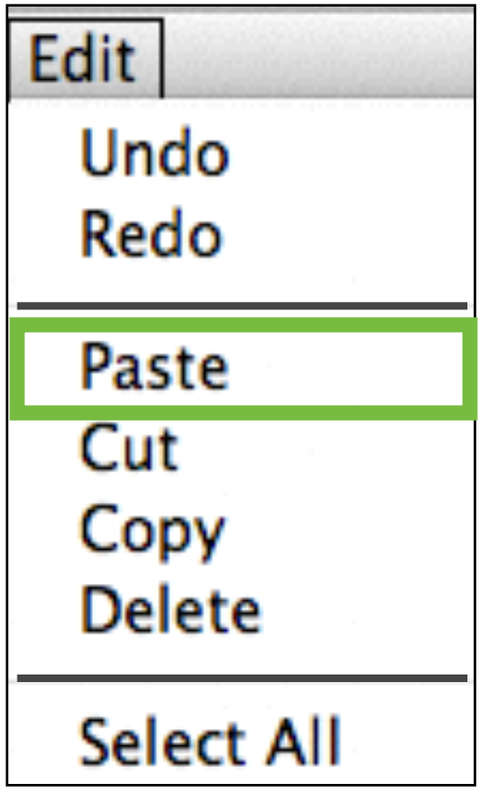
Consistency





Selection Time

only



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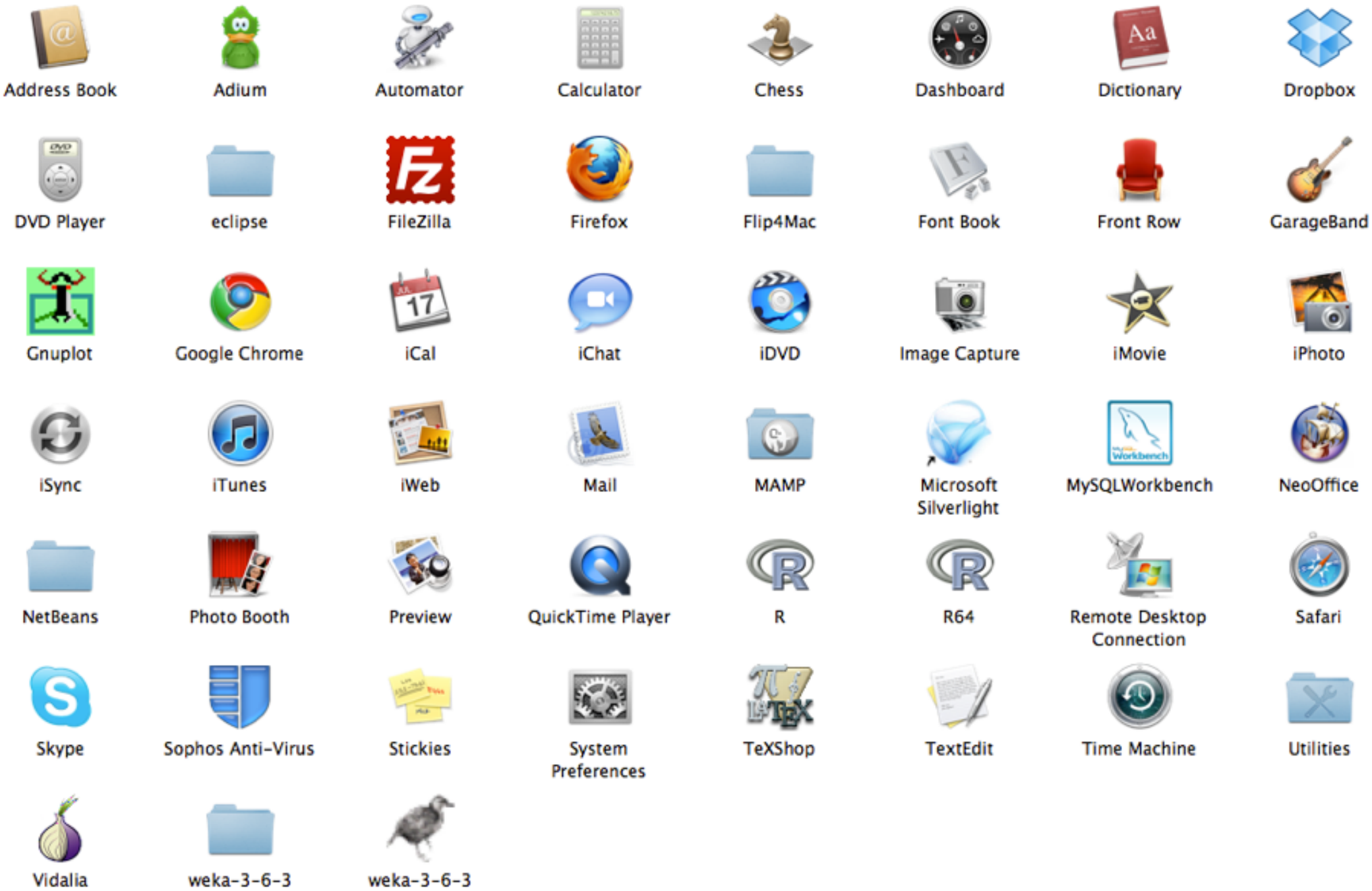

Consistency

68 applications with MenuInspector [Bailly and Malacria13]
more than **100 000** command pairs {i,k}

Average Distance: D(i,k)

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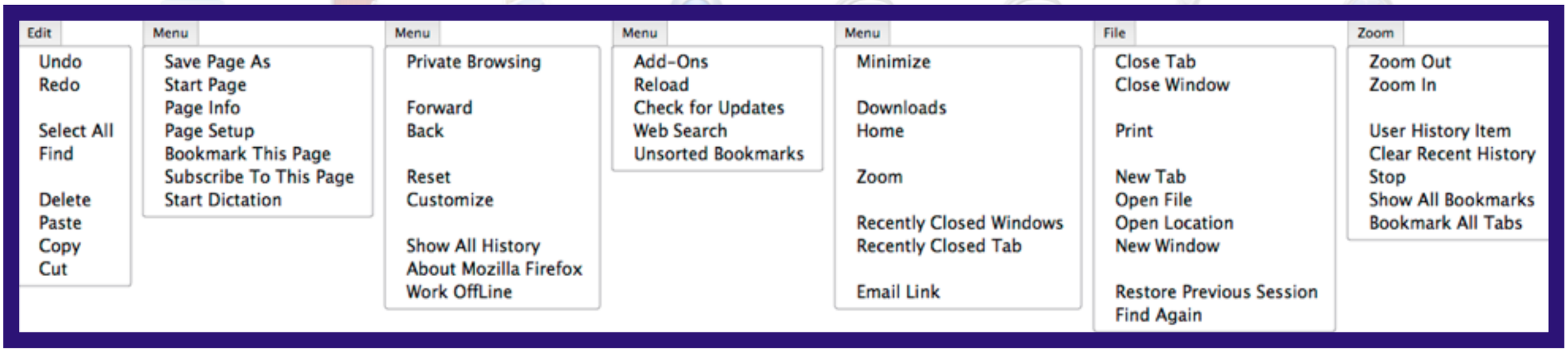

Current menu

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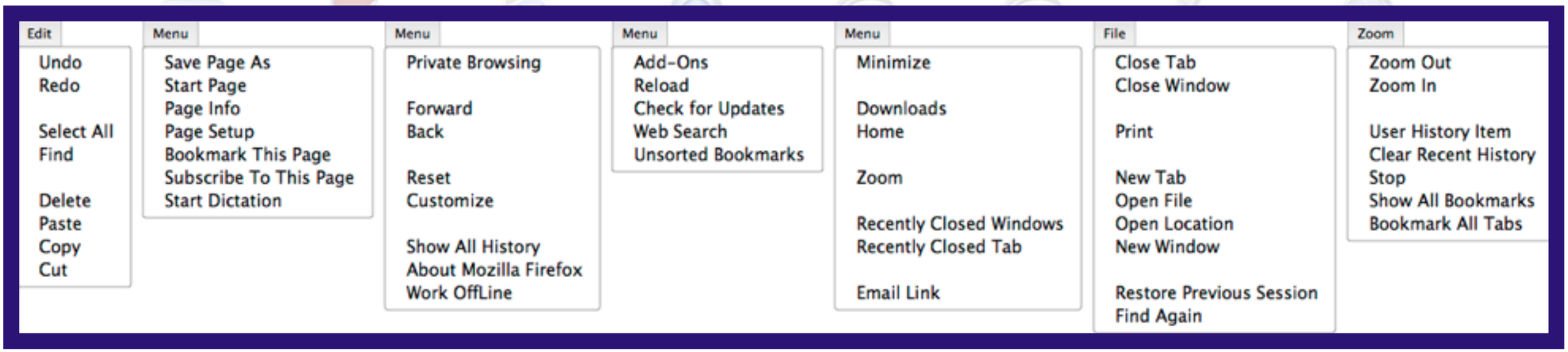
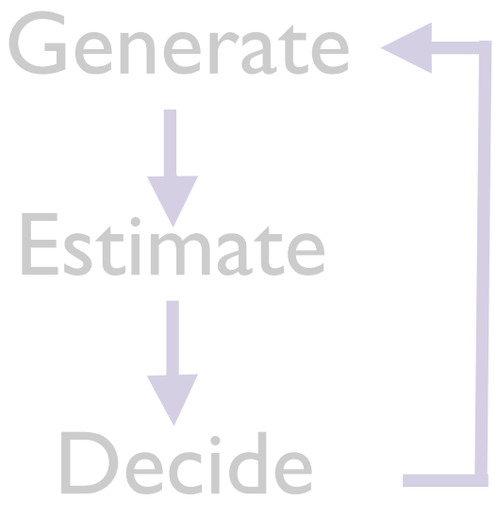
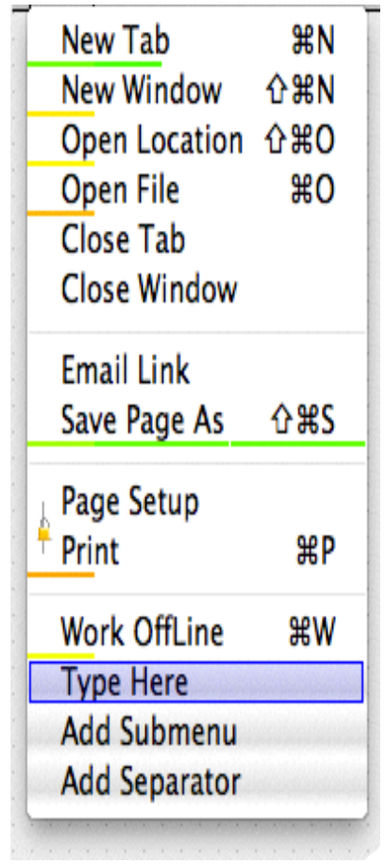


Current menu



Optimizer



Interactions

Challenges

Design Goals

- Feedback for design choices
- Suggestions for improvement
- Editable Menus, objectives and assumptions

MenuOptimizer

Designer File Edit Form View Settings Window Help

86% Tue 4:06 PM

Qt Designer

MainWindow – firefoxLight-single.ui

Firefox Type Here

- Model
- Objective Panel
- Pareto
- User Behavior
- User Performance
- SemanticPanel
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Type to locate (⌘K) 1 Issues 2 Search Results 3 Application Output 4 Compile Output

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Evaluation

- FireFox case
  - 52 commands
  - Logs from 50 users
  - Consistency: 85% - Selection time: 15%
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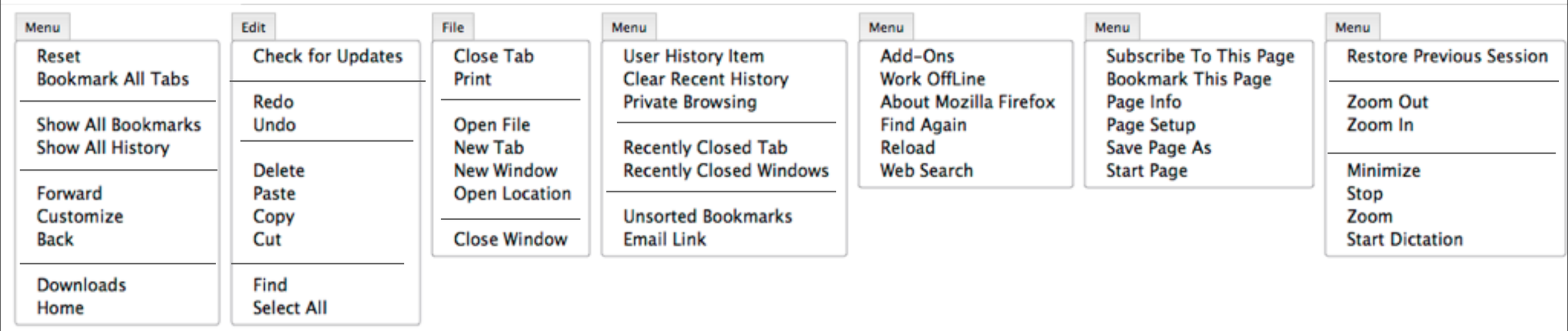

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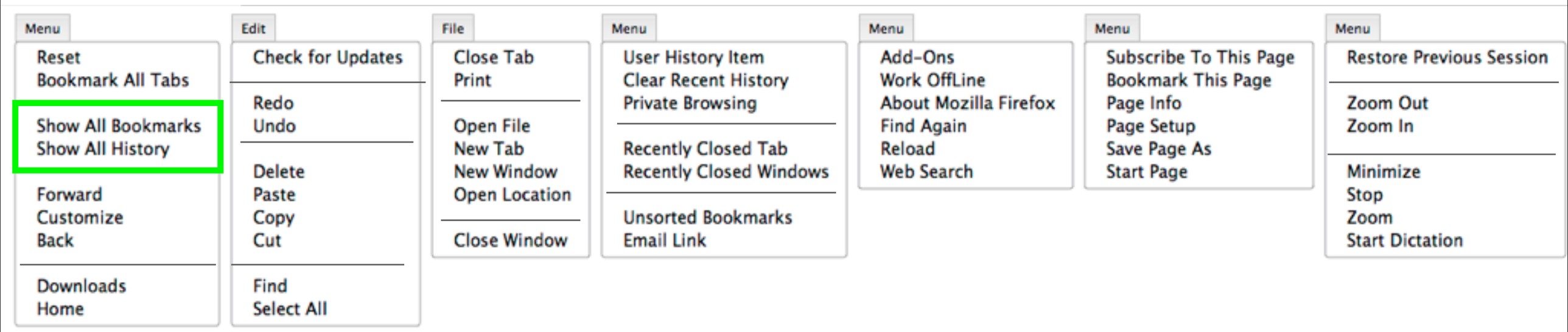

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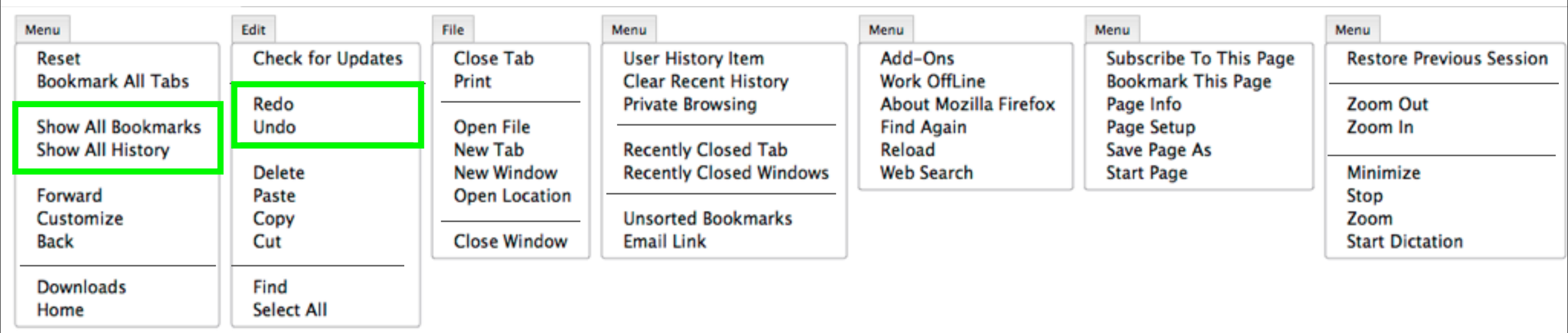

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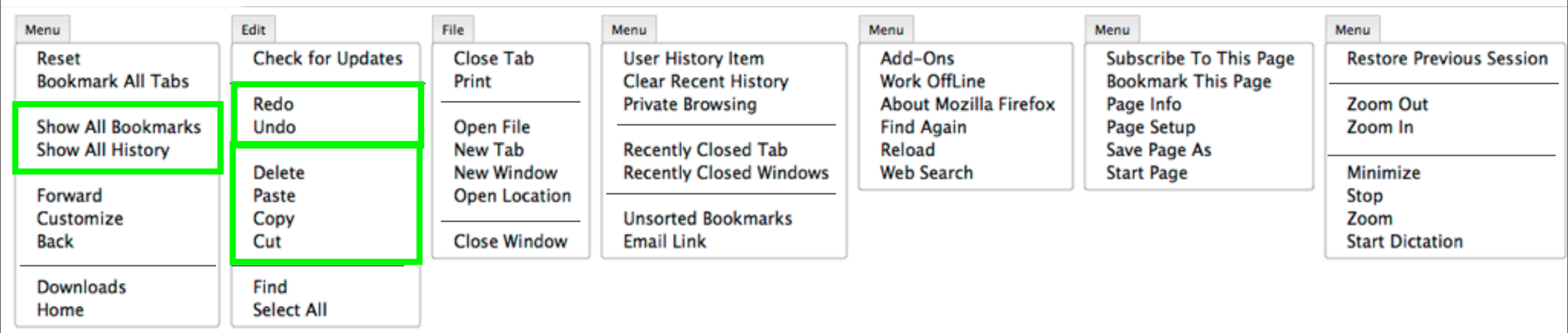

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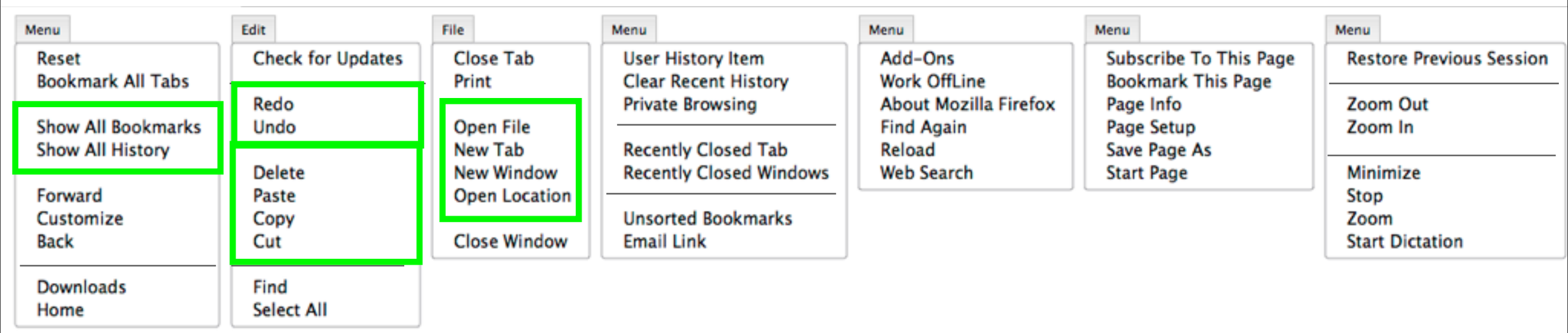

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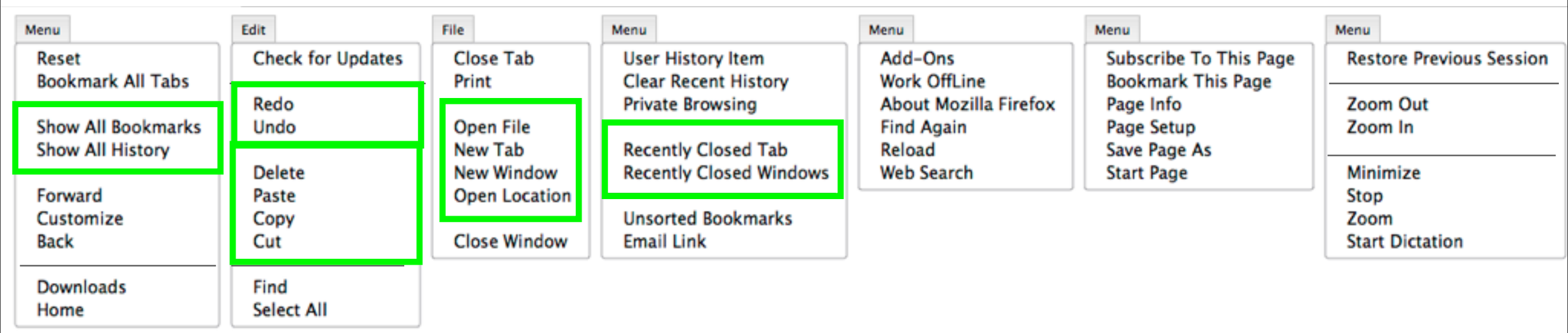

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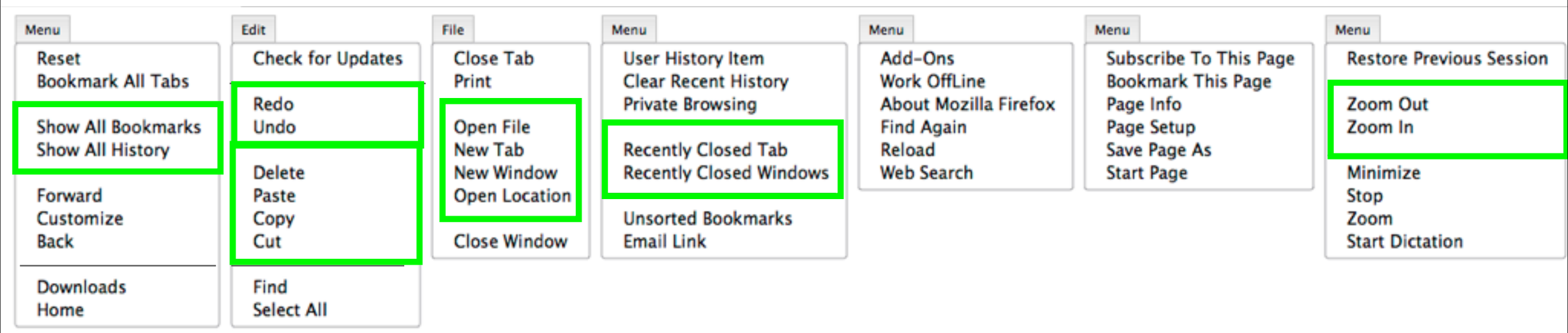

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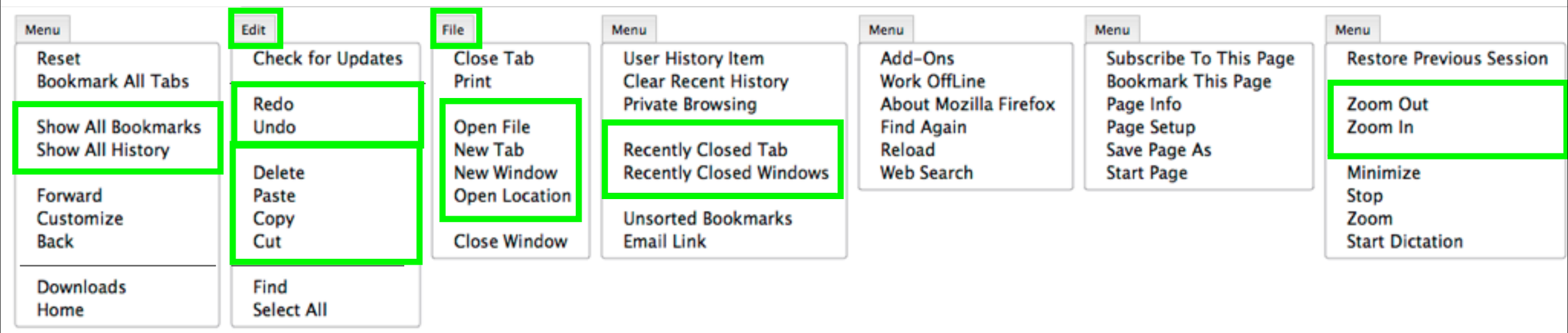

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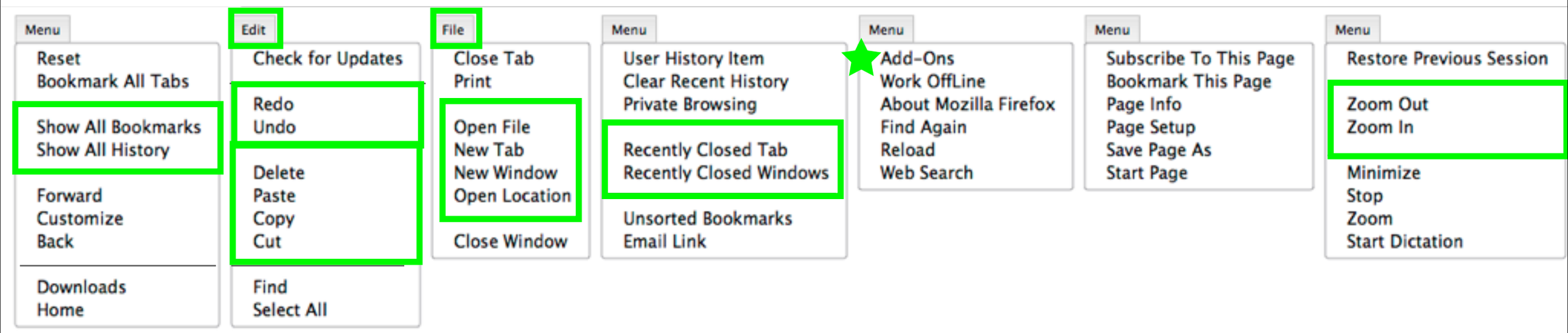

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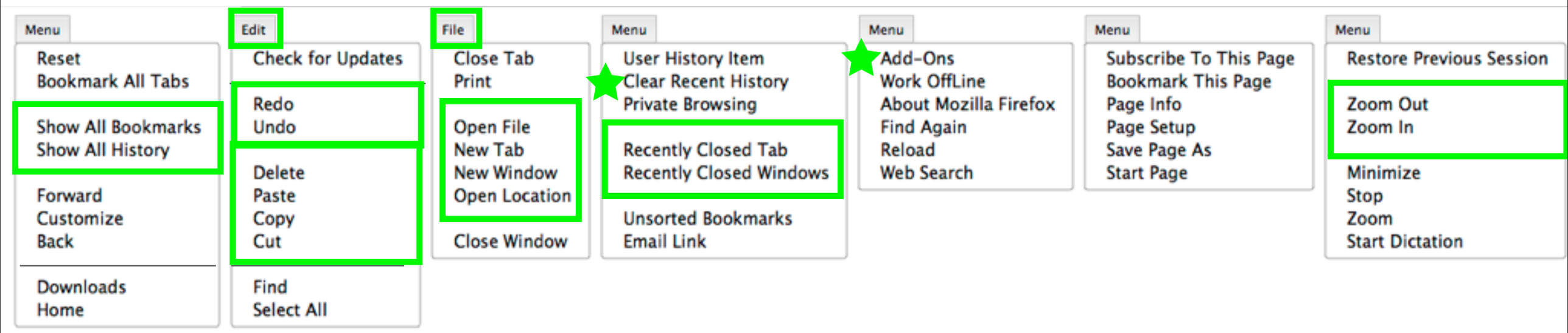

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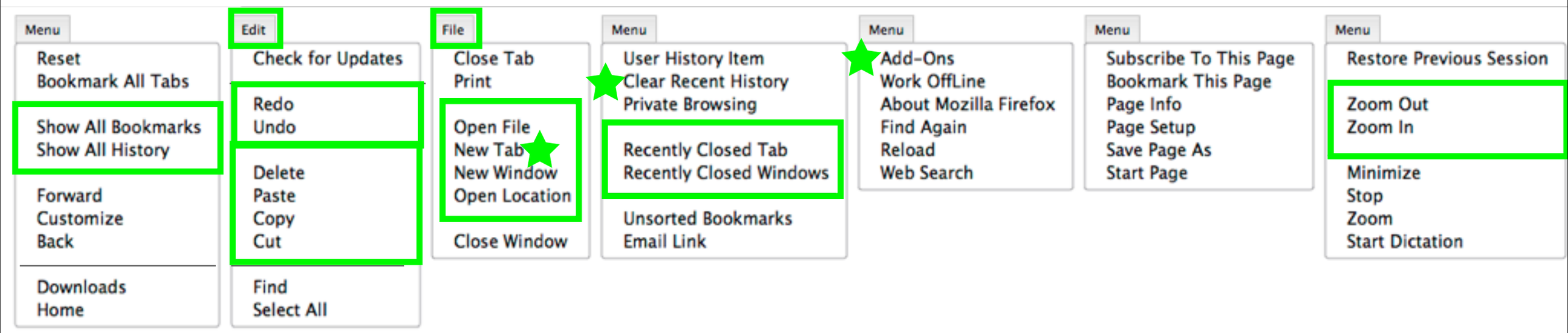

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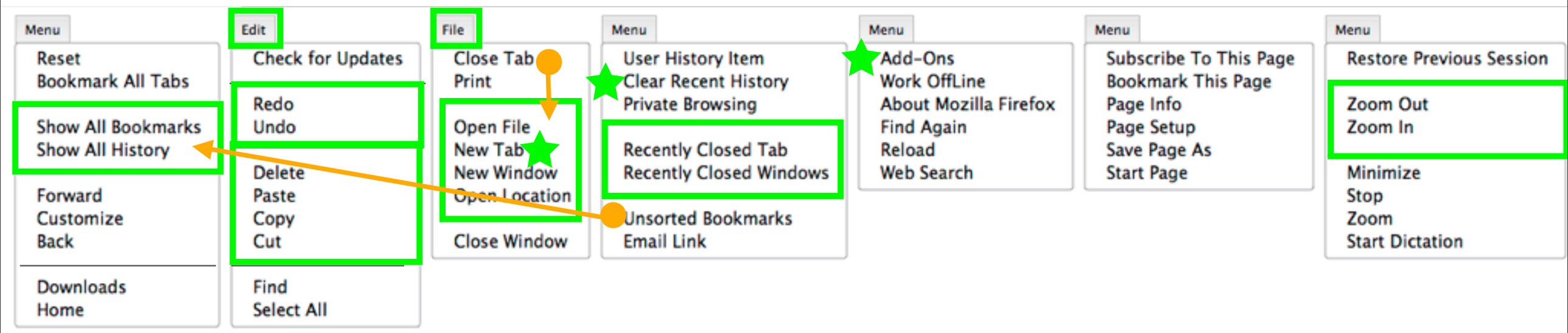
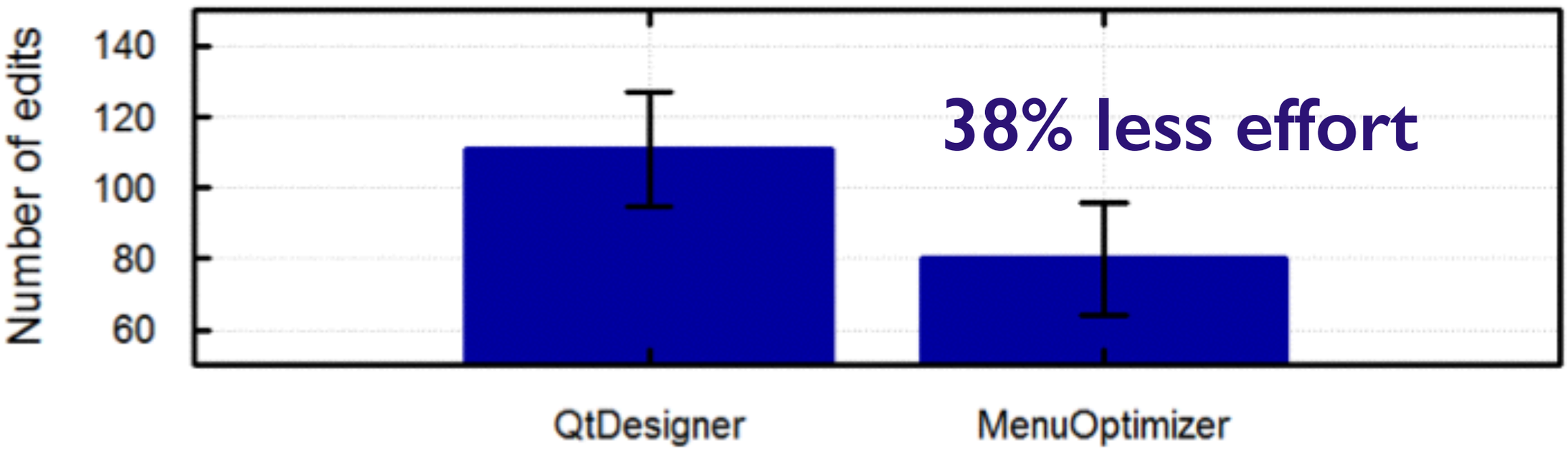


User study

- Task: Designing a menu system
  - With Optimizer (MenuOptimizer)
  - Without Optimizer (Qt Designer): Baseline



Without With

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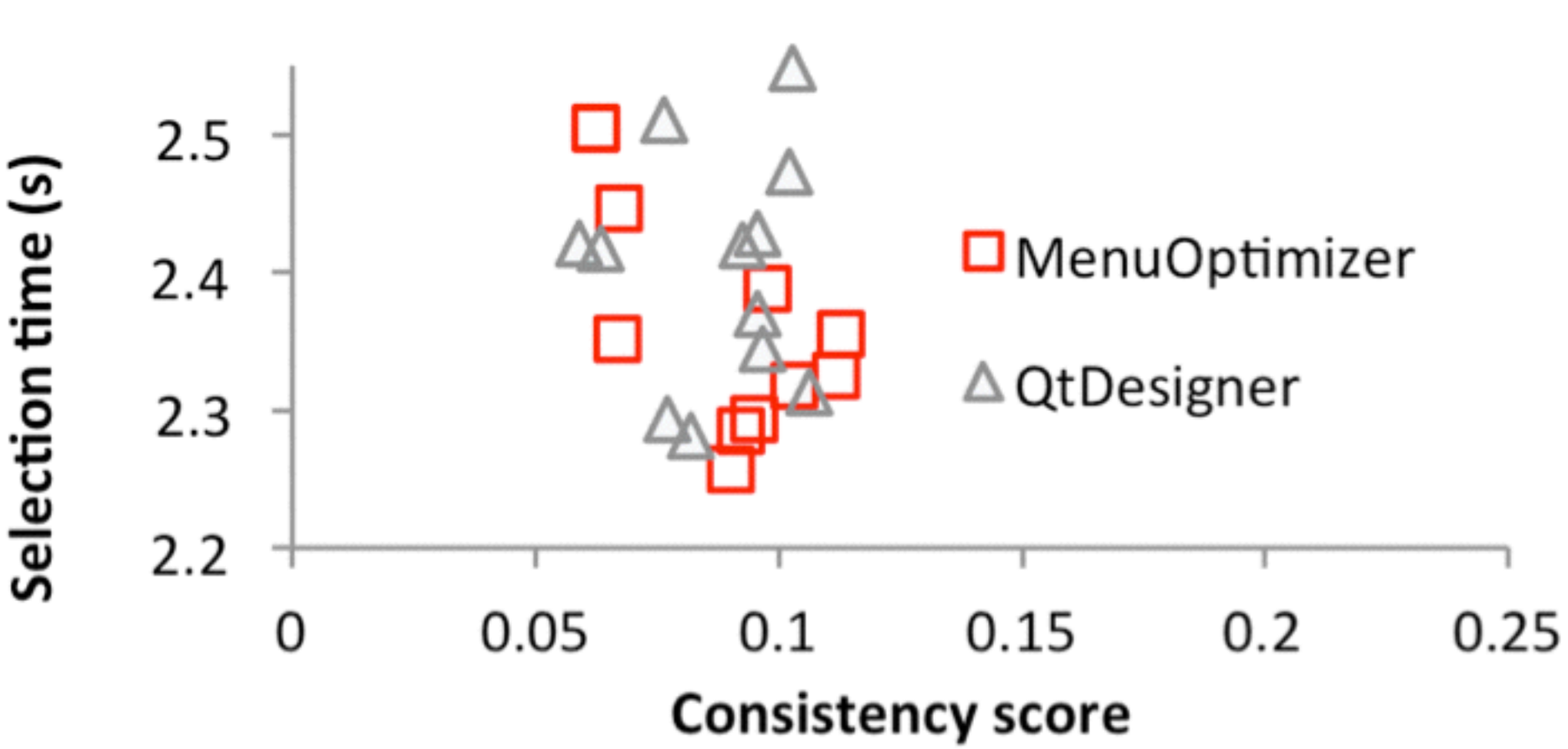

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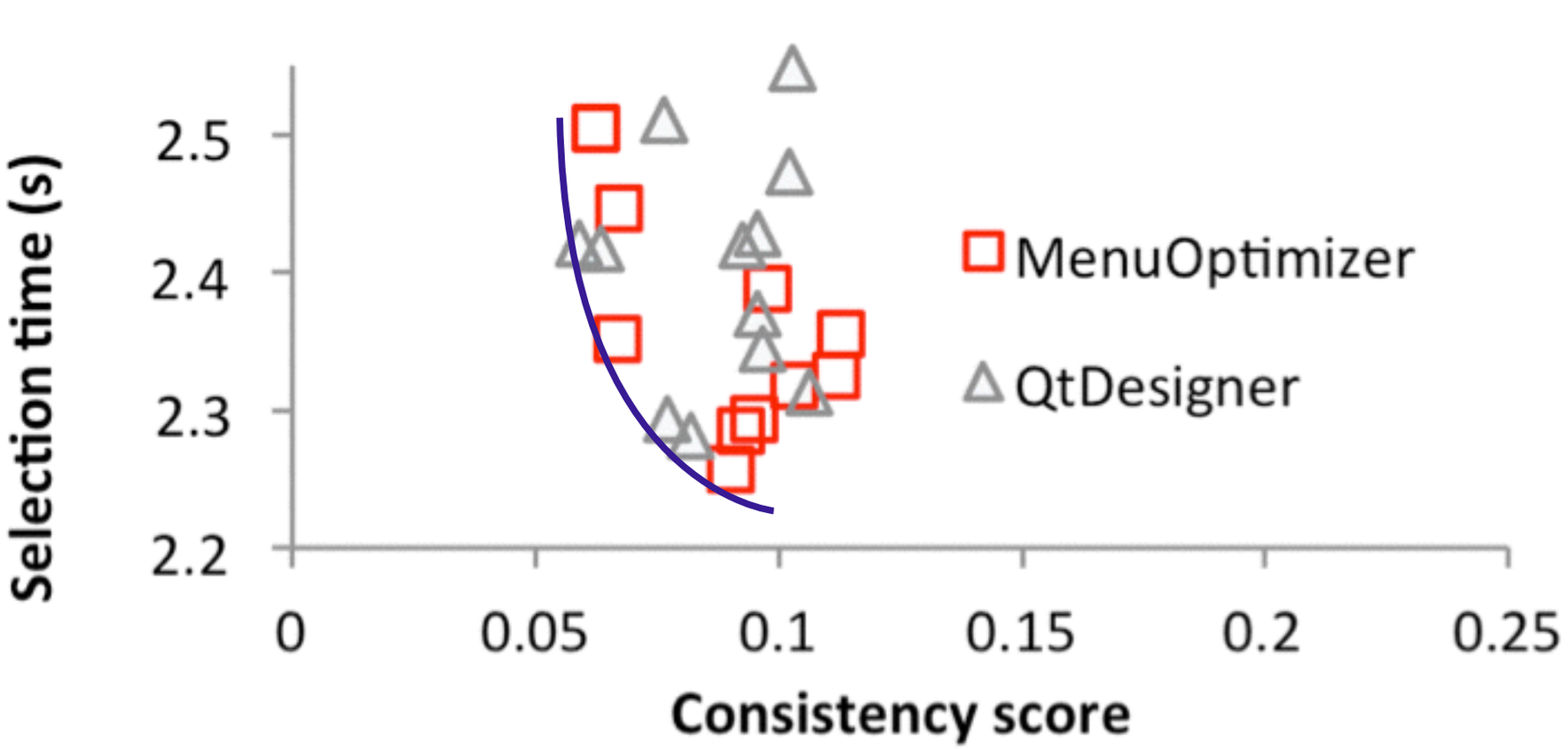

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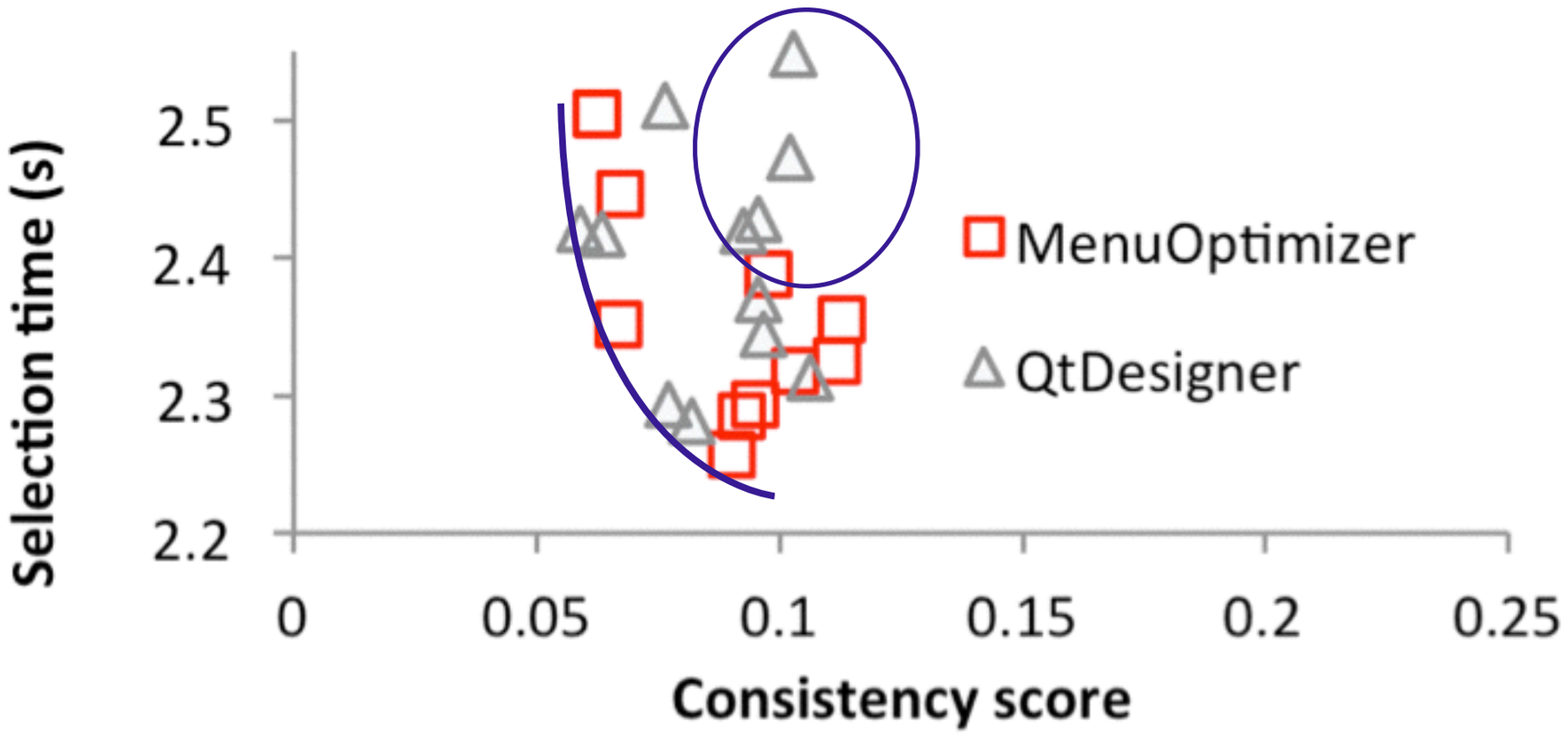


How to help **designers**

to design **usable** **menu** Systems?

Research question

Conclusion

Menu design can be formulated as an **optimization problem**

Interactive Optimization

- Assisting menu designers with an optimizer in the loop

MenuOptimizer

- Express constraints
- Deal with several objectives
- Refine automatically generated solutions
- etc.

MenuOptimizer

Gilles Bailly

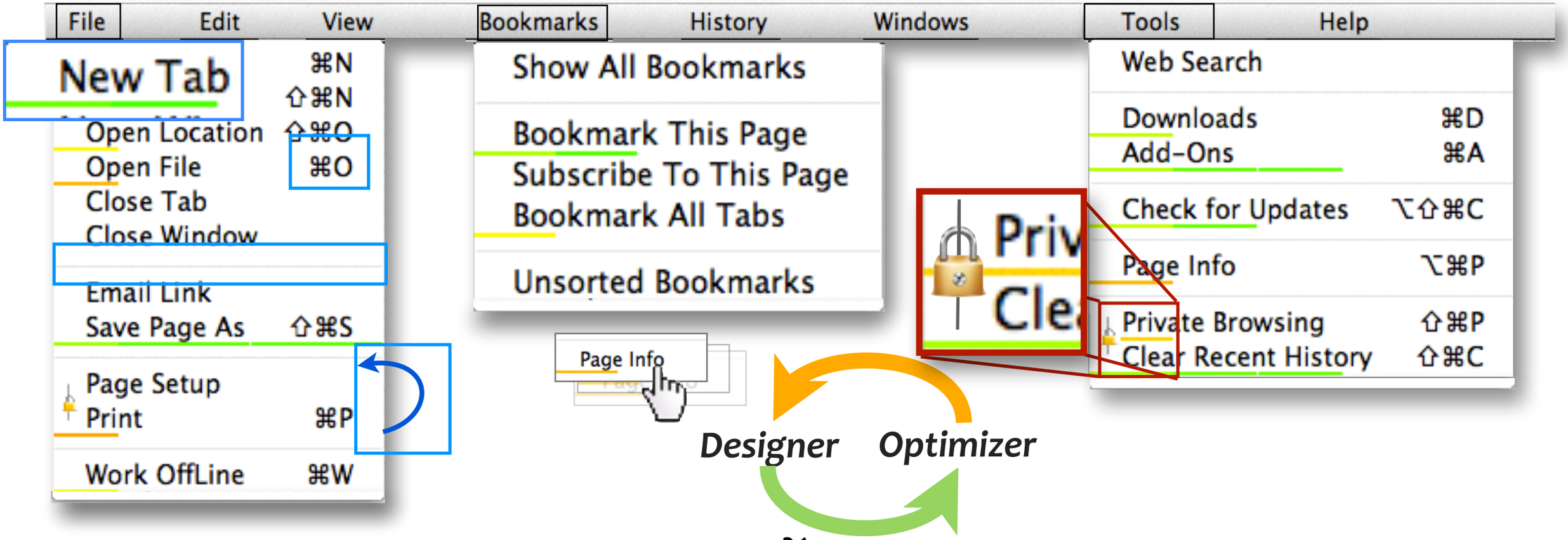
with Antti Oulasvirta, Timo Kötzing, Sabrina Hoppe

UNIVERSITÄT DES SAARLANDES

CLUSTER OF EXCELLENCE

max planck institut informatik

seit 1558



Virtual Keyboard

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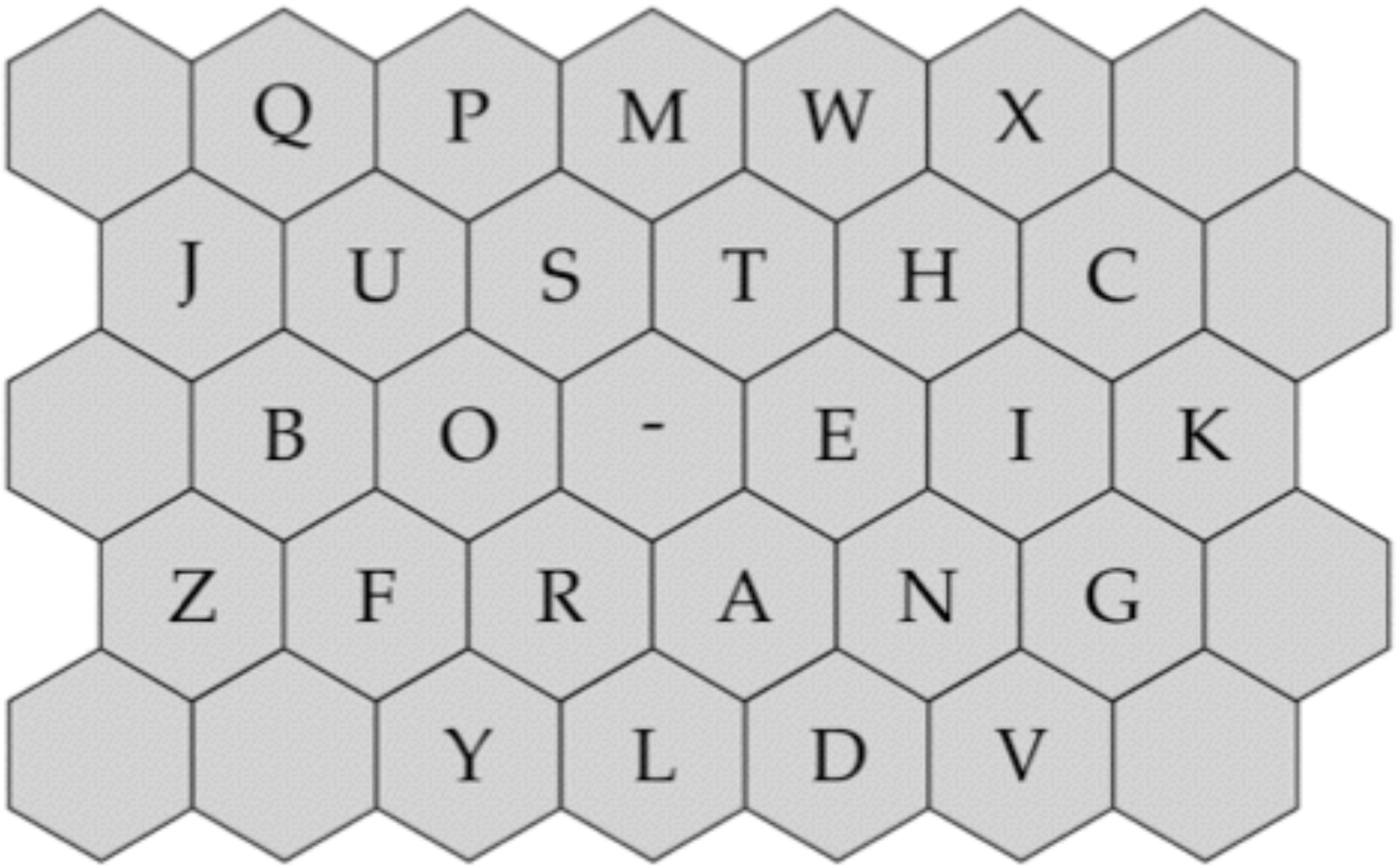

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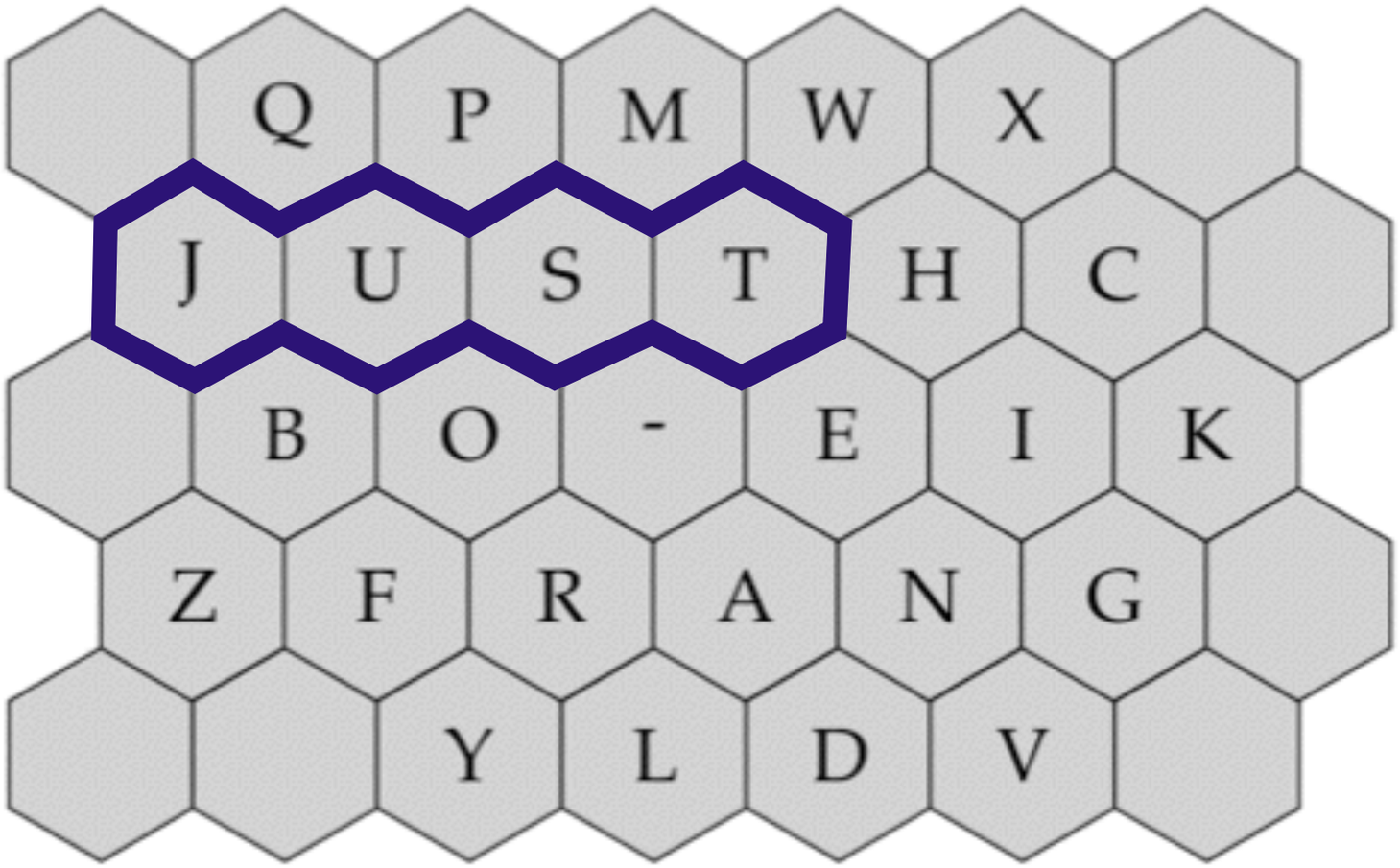

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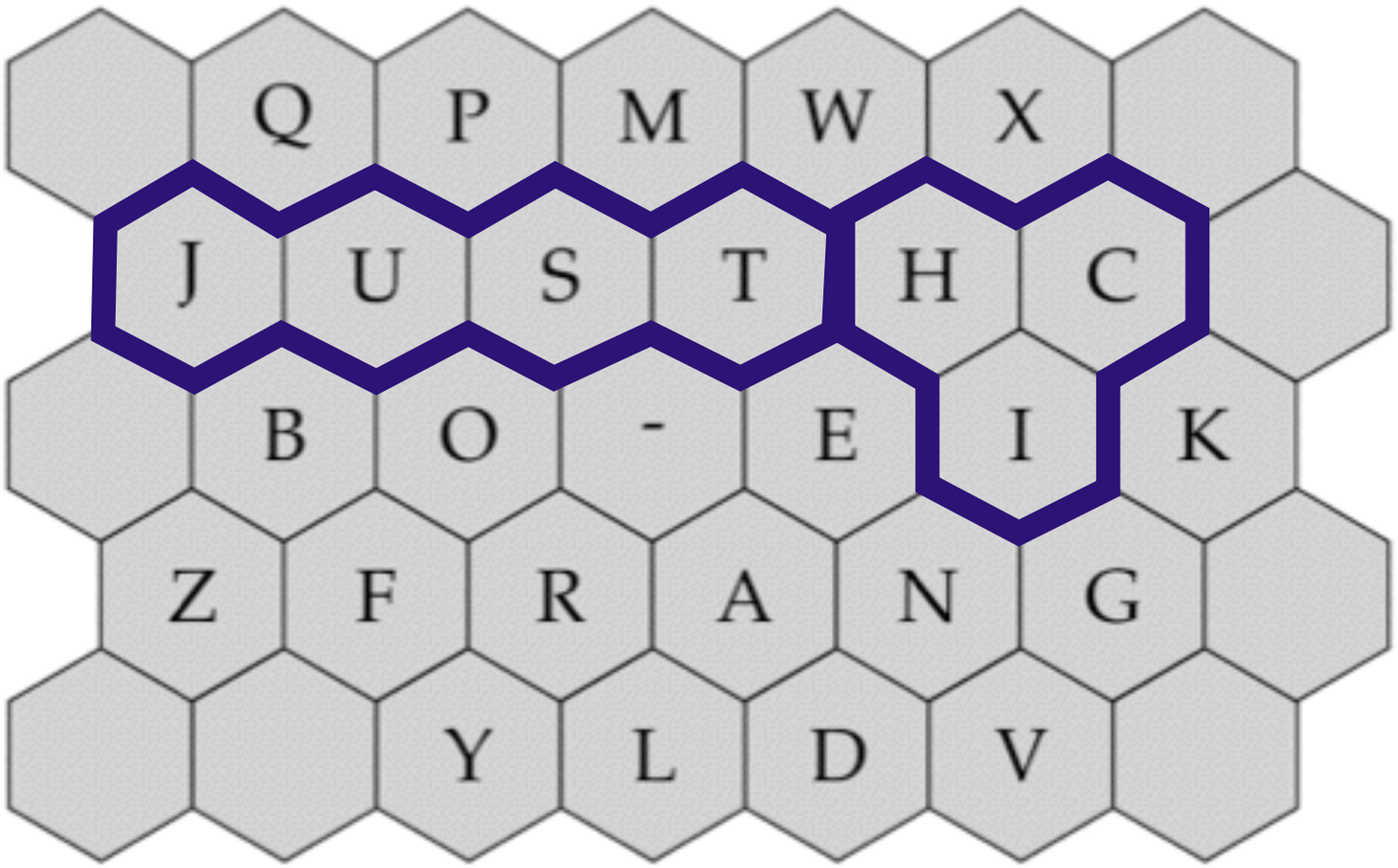
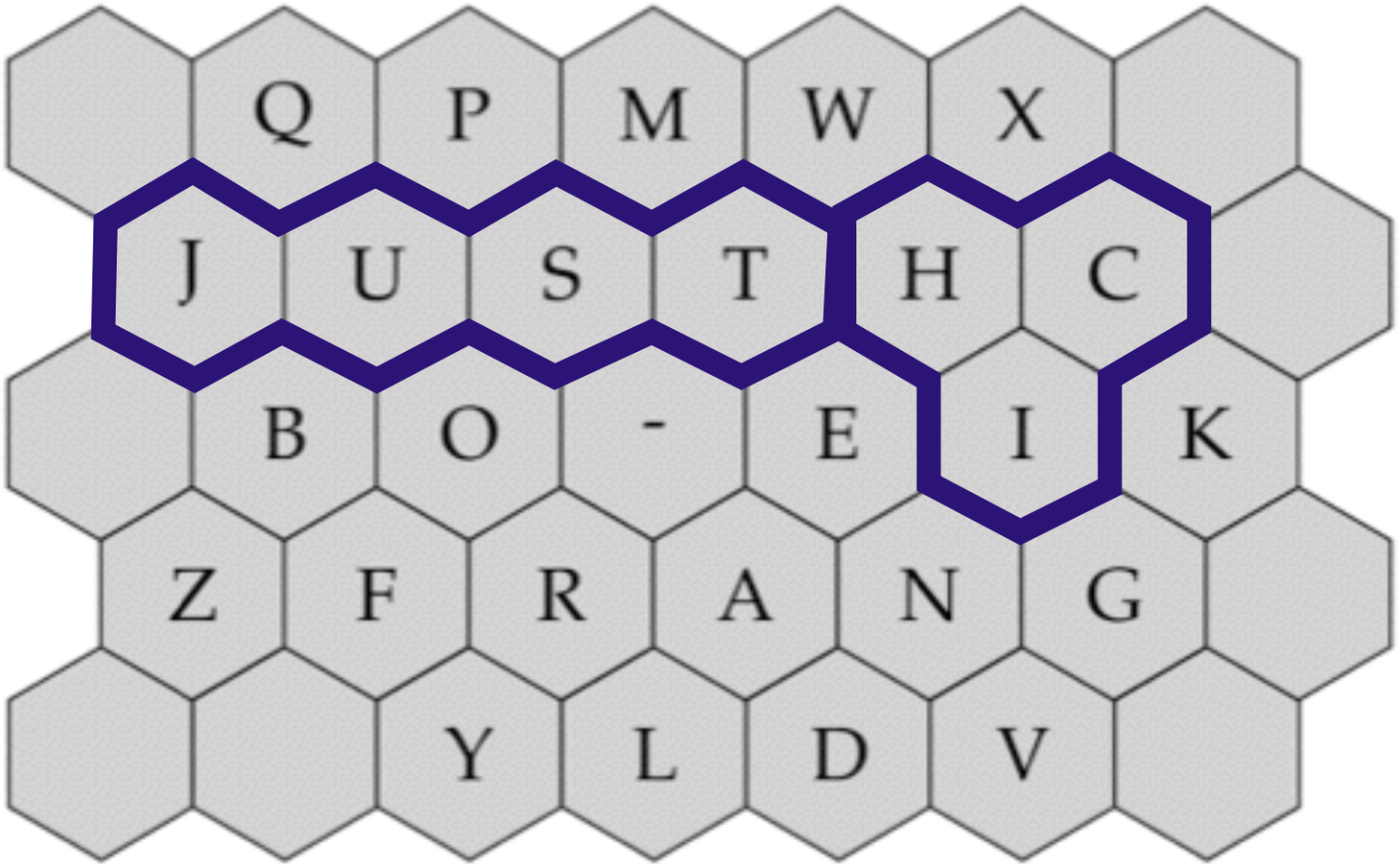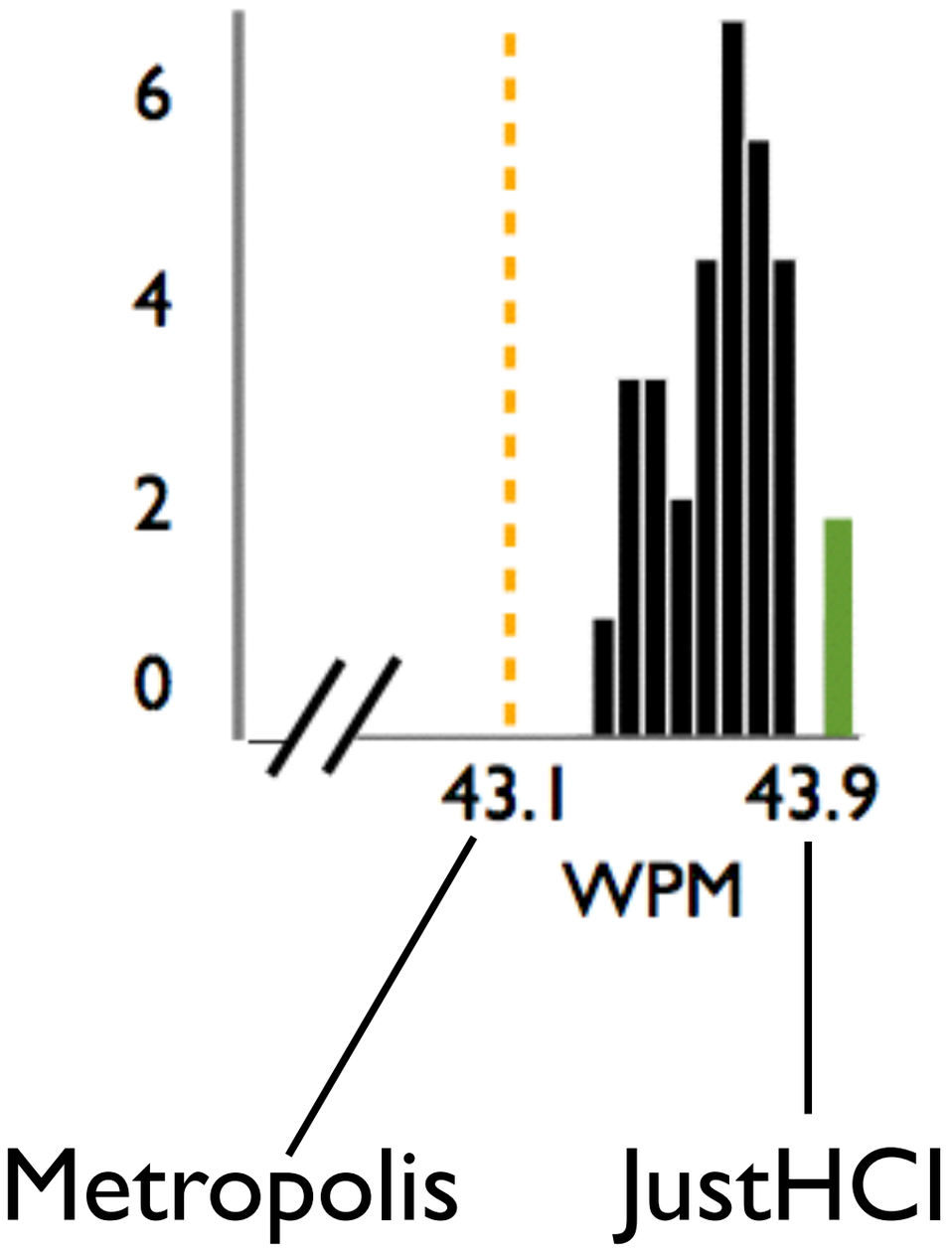
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