Interacting with numbers

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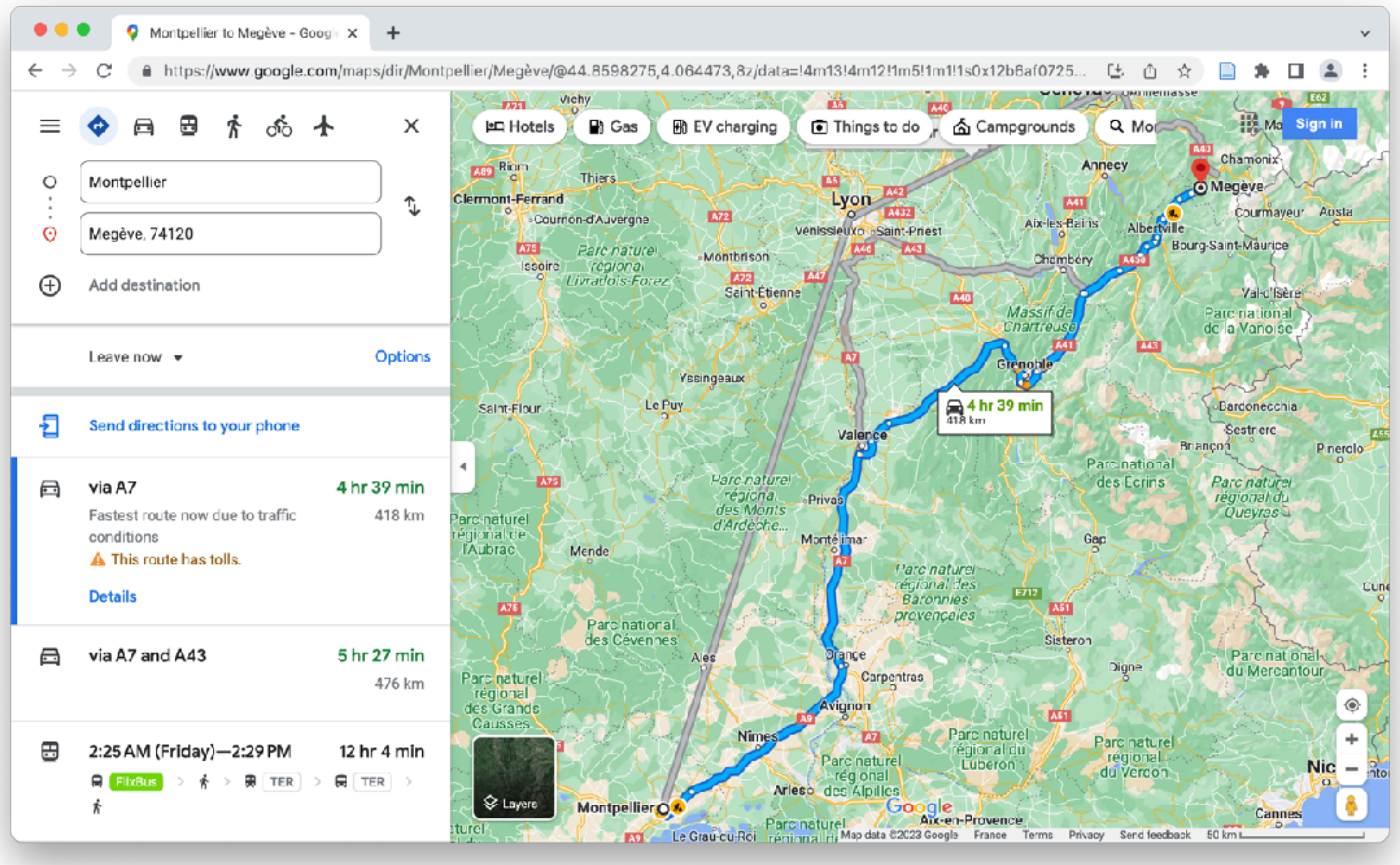
Journées de Rochebrune, 18 January 2023

Interacting with computers



Montpellier to Megève - Googl

https://www.google.com/maps/dir/Montpellier/Megève/@44.8598275,4.064473,8z/data=!4m13!4m12!1m5!1m1!1s0x12b6af0725...

Montpellier

Megève, 74120

Add destination

Leave now

Options

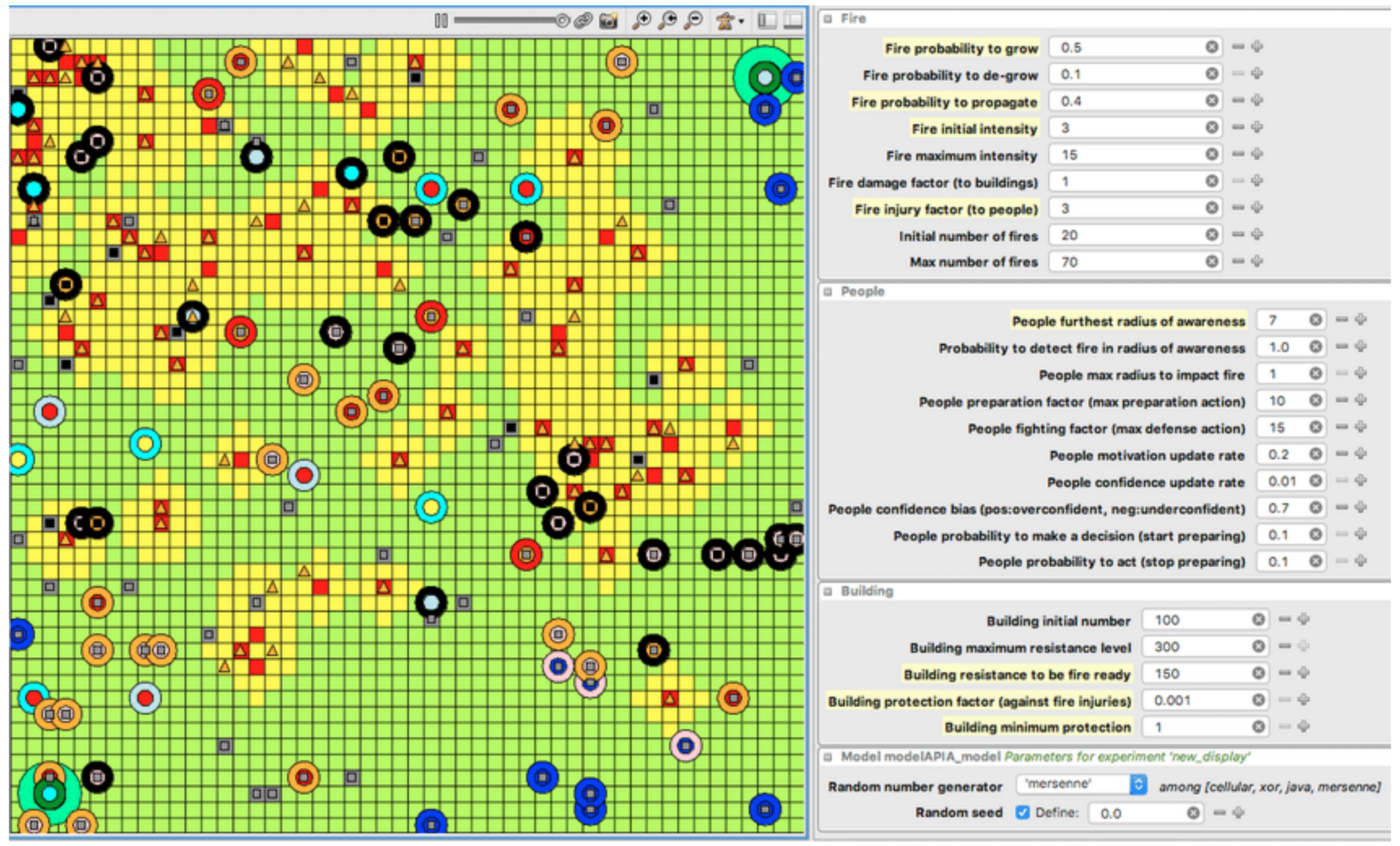
Send directions to your phone

via A7	4 hr 39 min	418 km
via A7 and A43	5 hr 27 min	476 km
2:25 AM (Friday)—2:29 PM	12 hr 4 min	

via A7: Fastest route now due to traffic conditions. This route has tolls.

Details

2:25 AM (Friday)—2:29 PM: FlixBus > TER > TER



Fire

Fire probability to grow	0.5
Fire probability to de-grow	0.1
Fire probability to propagate	0.4
Fire initial intensity	3
Fire maximum intensity	15
Fire damage factor (to buildings)	1
Fire injury factor (to people)	3
Initial number of fires	20
Max number of fires	70

People

People furthest radius of awareness	7
Probability to detect fire in radius of awareness	1.0
People max radius to impact fire	1
People preparation factor (max preparation action)	10
People fighting factor (max defense action)	15
People motivation update rate	0.2
People confidence update rate	0.01
People confidence bias (pos:overconfident, neg:underconfident)	0.7
People probability to make a decision (start preparing)	0.1
People probability to act (stop preparing)	0.1

Building

Building initial number	100
Building maximum resistance level	300
Building resistance to be fire ready	150
Building protection factor (against fire injuries)	0.001
Building minimum protection	1

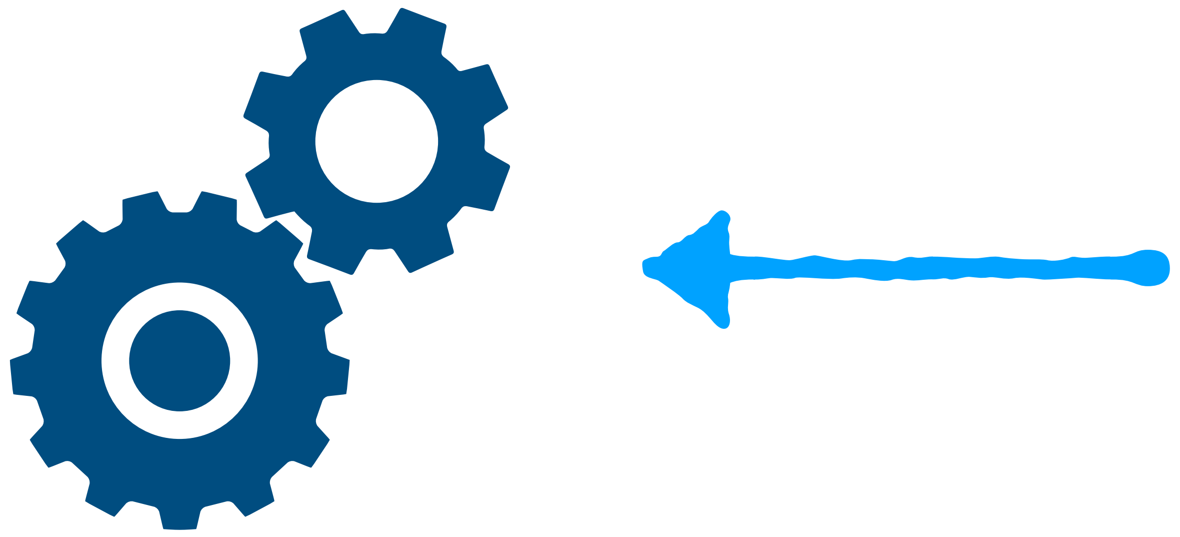
Model modelAPIA_model *Parameters for experiment 'new_display'*

Random number generator: 'mersenne' *among [cellular, xor, java, mersenne]*

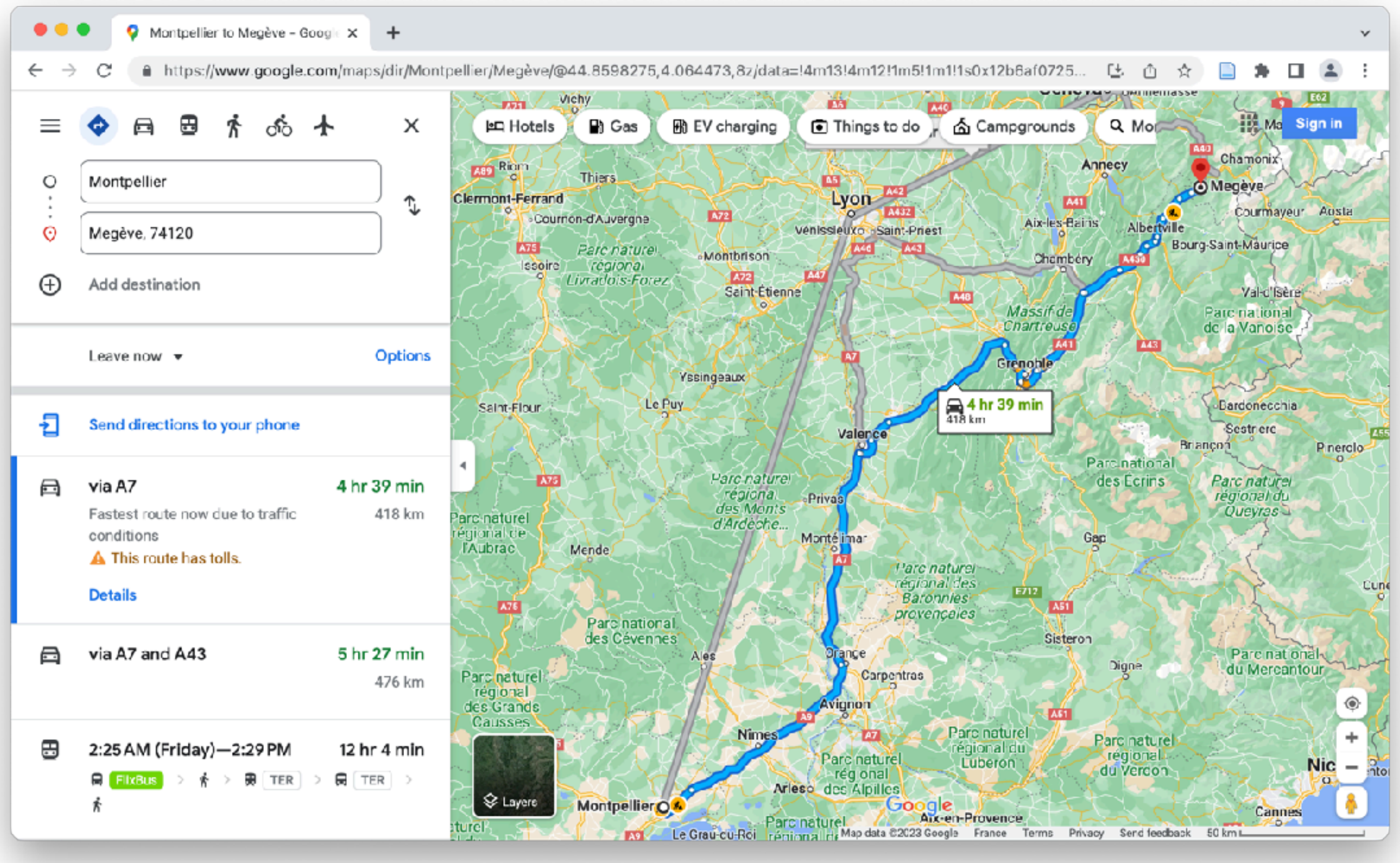
Random seed ☑ Define: 0.0

Interacting with computers

back-end



front-end



Montpellier to Megève - Goog

https://www.google.com/maps/dir/Montpellier/Megève/

Montpellier

Megève, 74120

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Fastest route now due to traffic conditions 418 km

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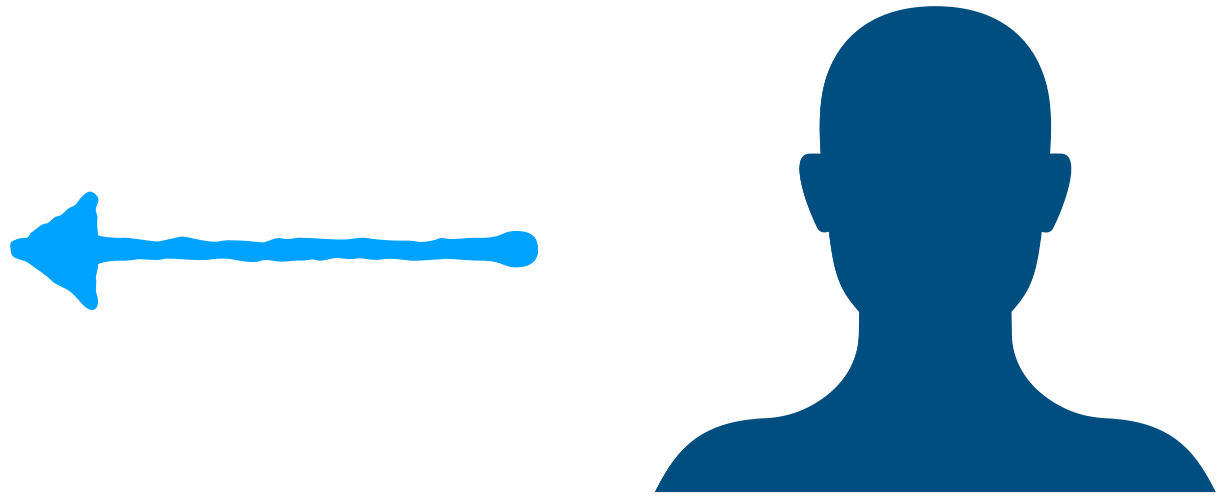
via A7 and A43 5 hr 27 min

476 km

2:25 AM (Friday)—2:29 PM 12 hr 4 min

FlixBus › TER › TER ›

user

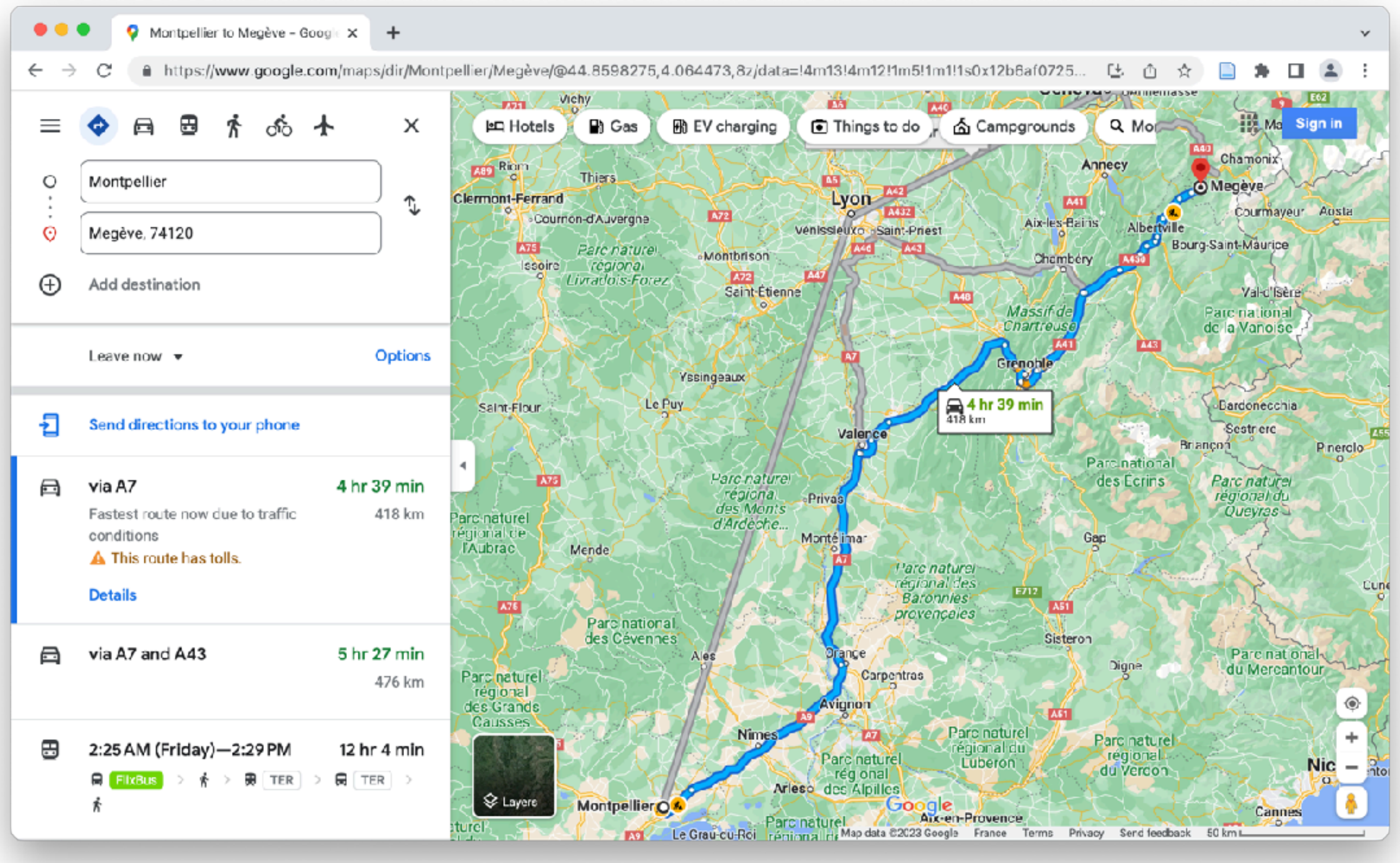


Interacting with computers

back-end

front-end

user


Montpellier to Megève - Goog
https://www.google.com/maps/dir/Montpellier/Megève/
Hotels
Gas
EV charging
Things to do
Campgrounds
Leave now
Options
Send directions to your phone
Details
Layers
Sign in
Lyon
Montpellier
4 hr 39 min

Montpellier

Megève, 74120

Add destination

via A7 — 4 hr 39 min — 418 km
Fastest route now due to traffic conditions
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via A7 and A43 — 5 hr 27 min — 476 km

2:25 AM (Friday)—2:29 PM — 12 hr 4 min
FlixBus > TER > TER

(x, y)
(x0, y0, x1, y1)

click
drag&drop
scroll

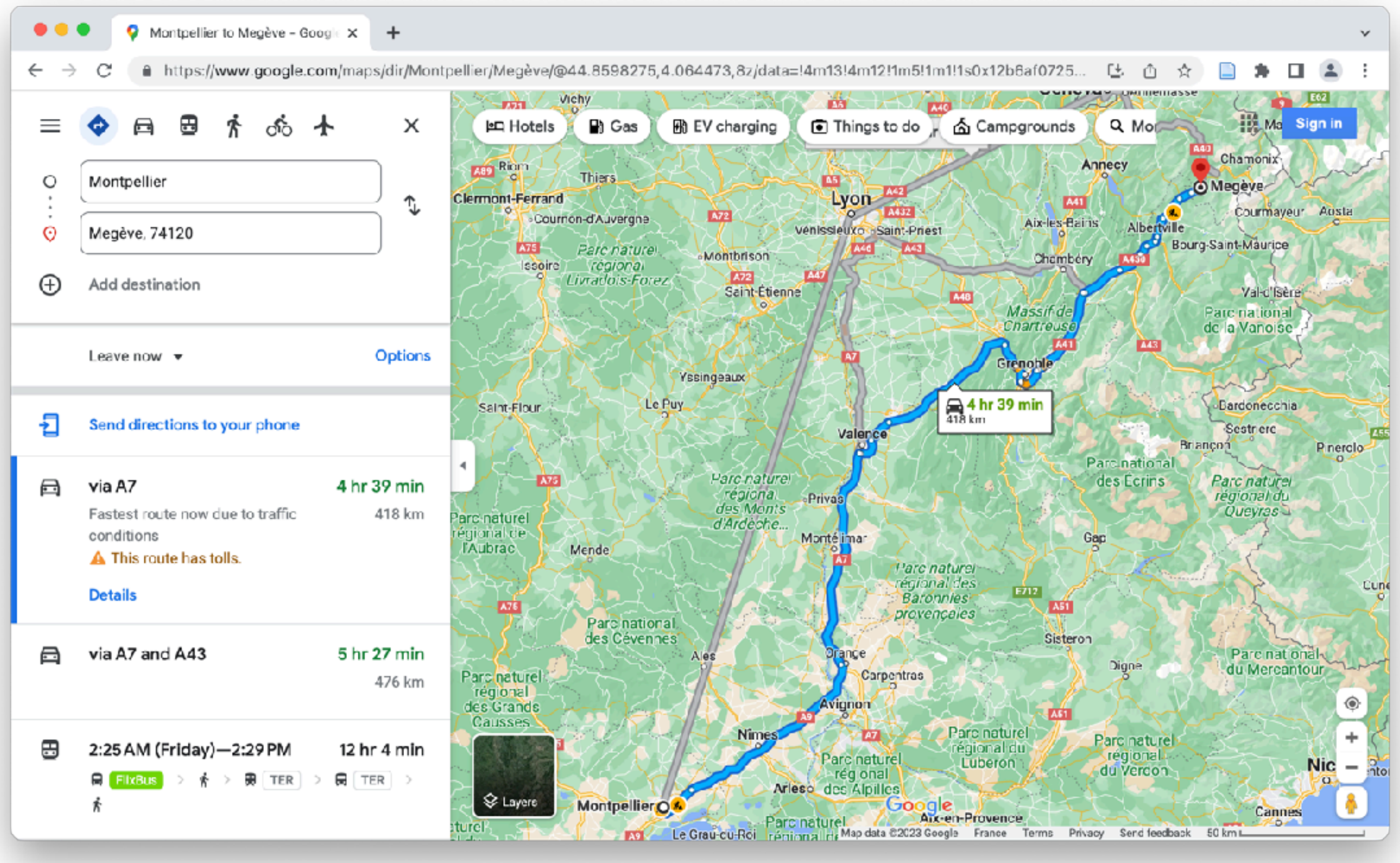
Interacting with controls

OK

value 0/1

zone de texte

character string


Montpellier to Megève - Googl
https://www.google.com/maps/dir/Montpellier/Megève/
Hotels
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EV charging
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Montpellier

Megève, 74120

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Leave now ▾ Options

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FlixBus › TER › TER ›

number in an interval

○ option 1
○ option 2

index in a list

□ choix

value 0/1

jj/mm/aaaa

date

condiments ▾
mayo
ketchup

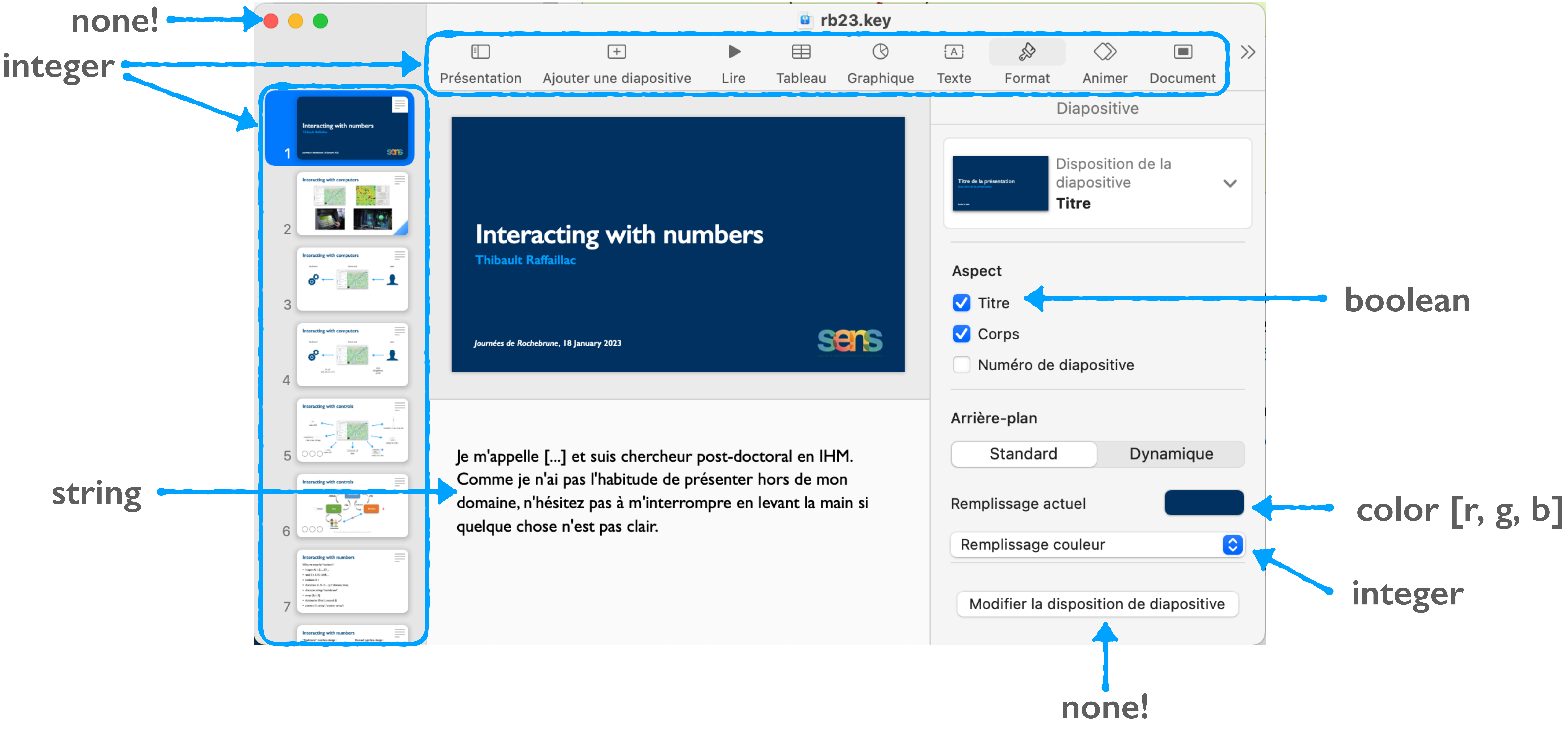
index in a list

Interacting with controls

What we mean by "numbers":

- integers 0, 1, 2, ..., 57, ...
- reals 0.1, 3.14, 1.618, ...
- booleans 0, 1
- characters 'a', 'b', 'c', ... (c.f. Unicode table)
- character strings "rochebrune"
- arrays [0, 1, 2]
- dictionaries {first: 1, second: 2}
- pointers ["a string", "another string"]

Interacting with controls



none!

integer

string

boolean

color [r, g, b]

integer

none!

rb23.key

Je m'appelle [...] et suis chercheur post-doctoral en IHM. Comme je n'ai pas l'habitude de présenter hors de mon domaine, n'hésitez pas à m'interrompre en levant la main si quelque chose n'est pas clair.

☑ Titre

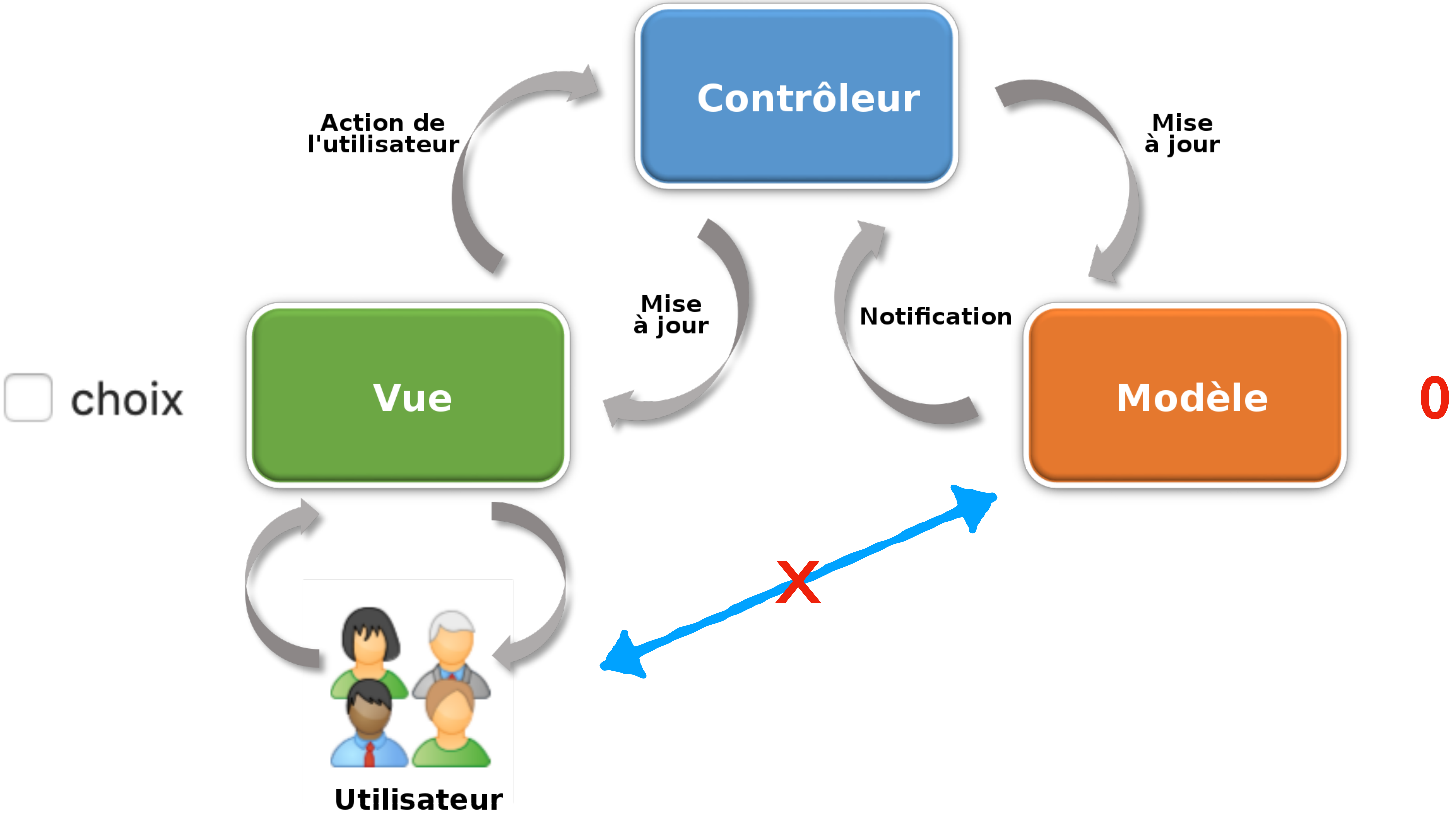
☑ Corps

□ Numéro de diapositive

Remplissage actuel

Remplissage couleur

Interacting with controls



© https://fr.wikipedia.org/wiki/Modèle-vue-contrôleur

Interacting with numbers

“Traditional” interface design :

1. Back-end programming
2. Defining a visual interface by assembling controls (*encapsulating numbers*)
3. Linking the interface with the back-end (e.g. *when users click on this button, execute this function*)

Desired interface design :

1. Back-end programming
2. Designation of the numbers to be controlled, and automatic generation of the interface around them
3. Voilà !

Interacting with numbers

- Who interacts with numbers? ~~Users~~ Programmers

What allows us to move from numbers to interactive controls?

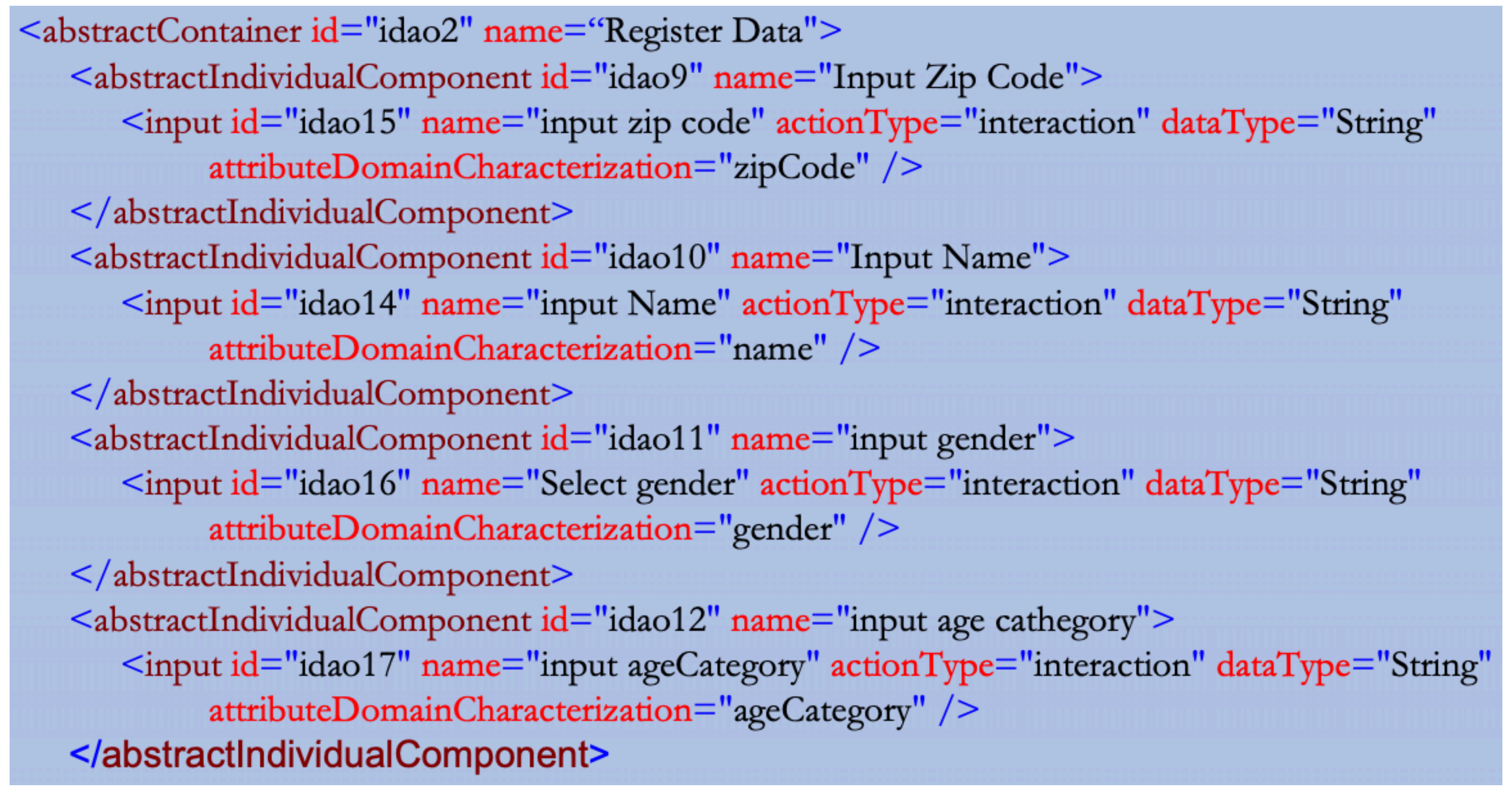
Related works

Model-Based User Interface Development

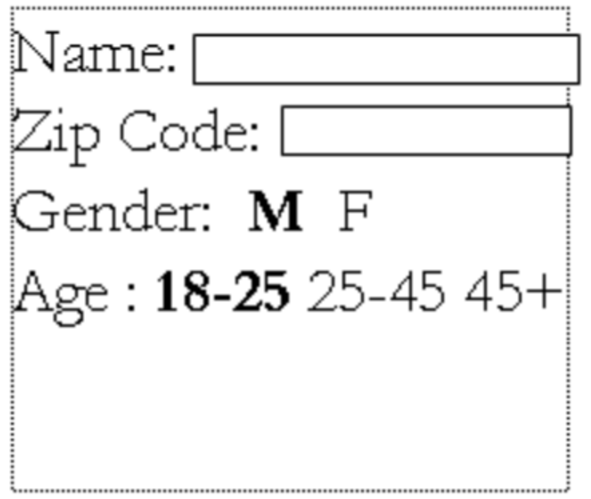
Research field active for 40 years (Meixner et al., 2011)

Brief description of the interface and automatic generation of the rest, 3 types:

- task model
- dialog model
- presentation model



```
<abstractContainer id="idao2" name=“Register Data">
  <abstractIndividualComponent id="idao9" name="Input Zip Code">
    <input id="idao15" name="input zip code" actionType="interaction" dataType="String"
         attributeDomainCharacterization="zipCode" />
  </abstractIndividualComponent>
  <abstractIndividualComponent id="idao10" name="Input Name">
    <input id="idao14" name="input Name" actionType="interaction" dataType="String"
         attributeDomainCharacterization="name" />
  </abstractIndividualComponent>
  <abstractIndividualComponent id="idao11" name="input gender">
    <input id="idao16" name="Select gender" actionType="interaction" dataType="String"
         attributeDomainCharacterization="gender" />
  </abstractIndividualComponent>
  <abstractIndividualComponent id="idao12" name="input age cathegory">
    <input id="idao17" name="input ageCategory" actionType="interaction" dataType="String"
         attributeDomainCharacterization="ageCategory" />
  </abstractIndividualComponent>
```



Name:

Zip Code:

Gender: **M** F

Age : **18-25** 25-45 45+

UsiXML, Vanderdonckt et al., 2009

Related works

Model-Based User Interface Development

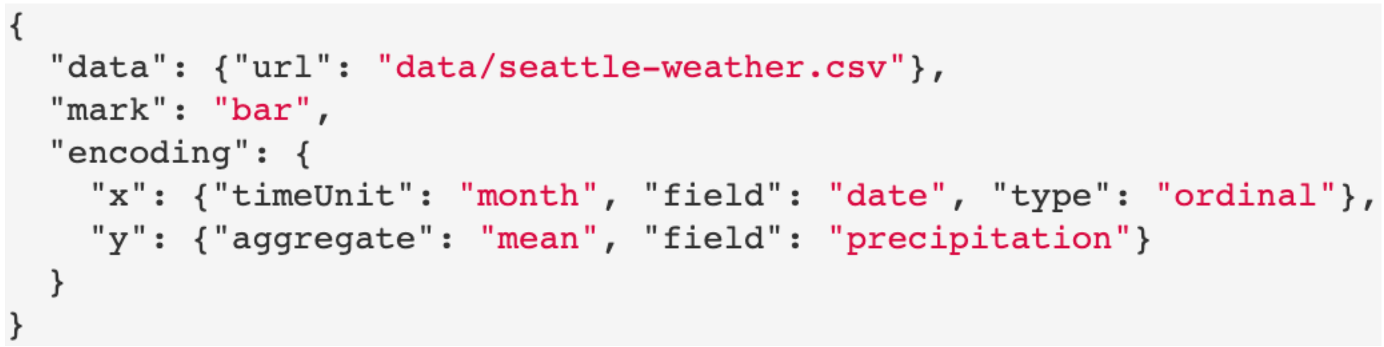
Limits :

- requires a dedicated learning for the tool or language
- still verbose (vs. generated interface)
- often requires fixing the interface proposed by the tool

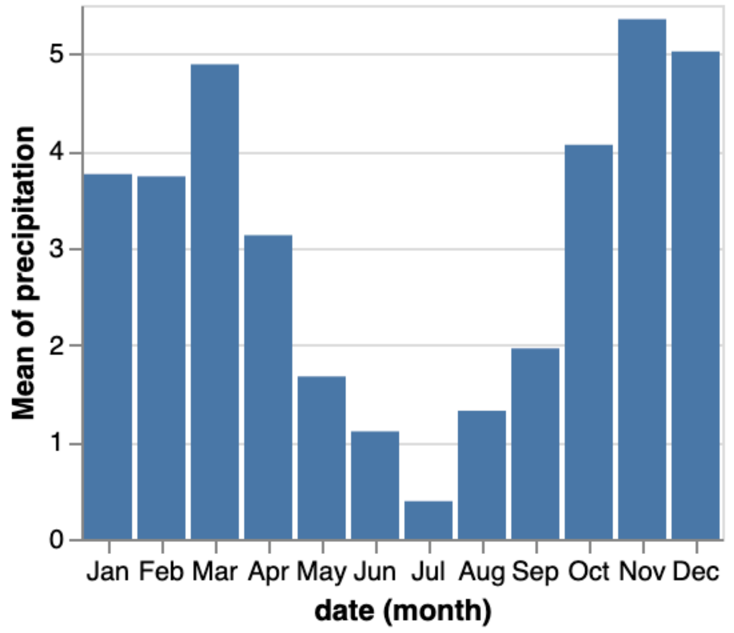
Related works

Ad-hoc tools

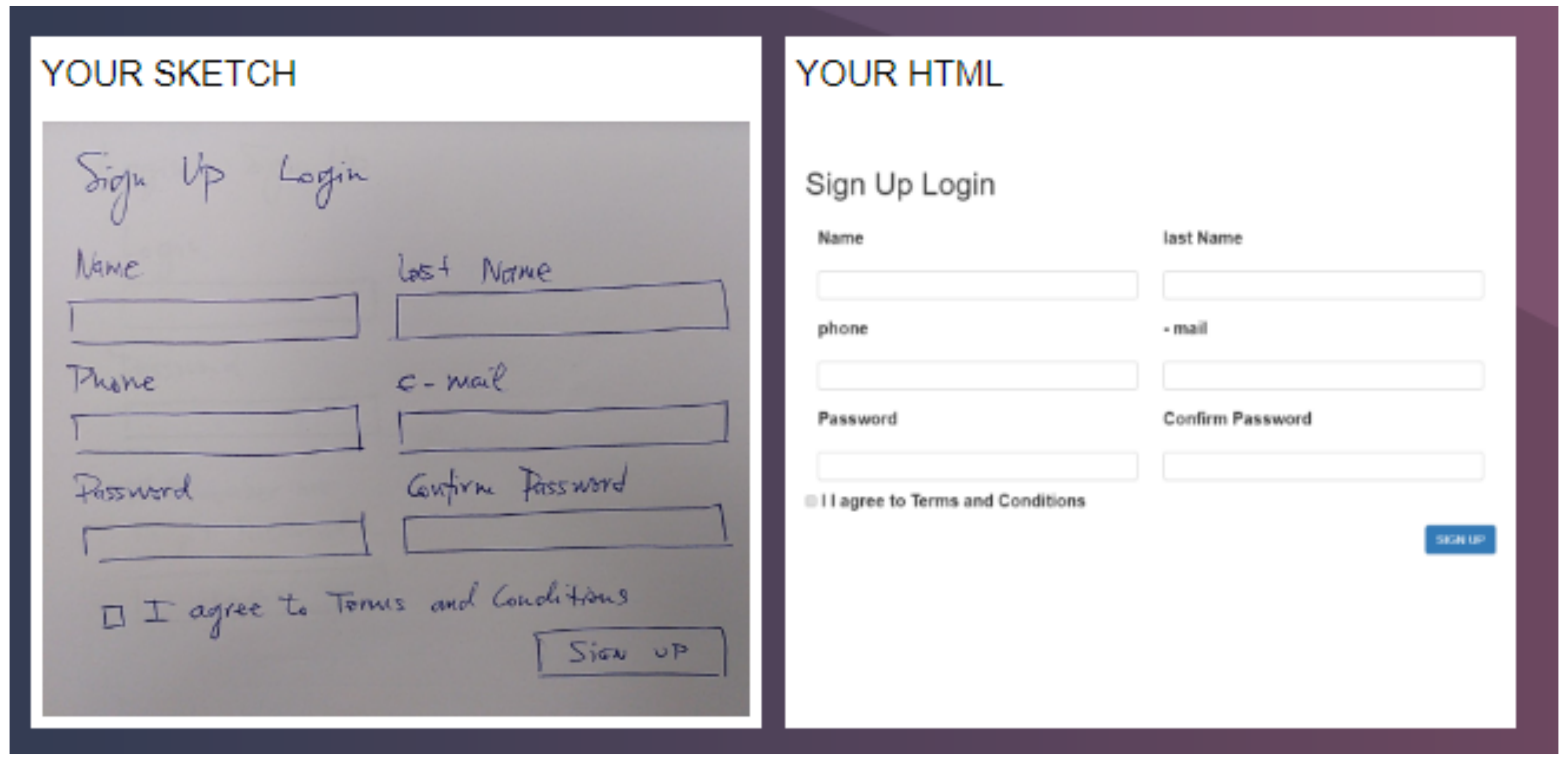
Data → visualization
(ex. *Vega Lite*, Excel)



```
{
  "data": {"url": "data/seattle-weather.csv"},
  "mark": "bar",
  "encoding": {
    "x": {"timeUnit": "month", "field": "date", "type": "ordinal"},
    "y": {"aggregate": "mean", "field": "precipitation"}
  }
}
```

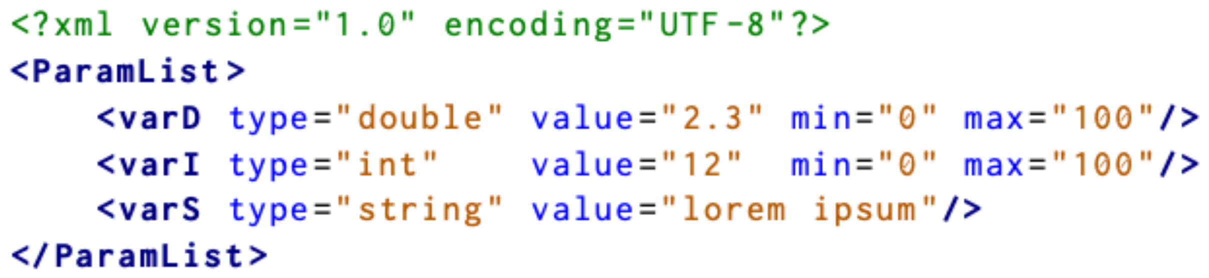


Sketch → interface
(ex. *Sketch2Code*, Uizard)

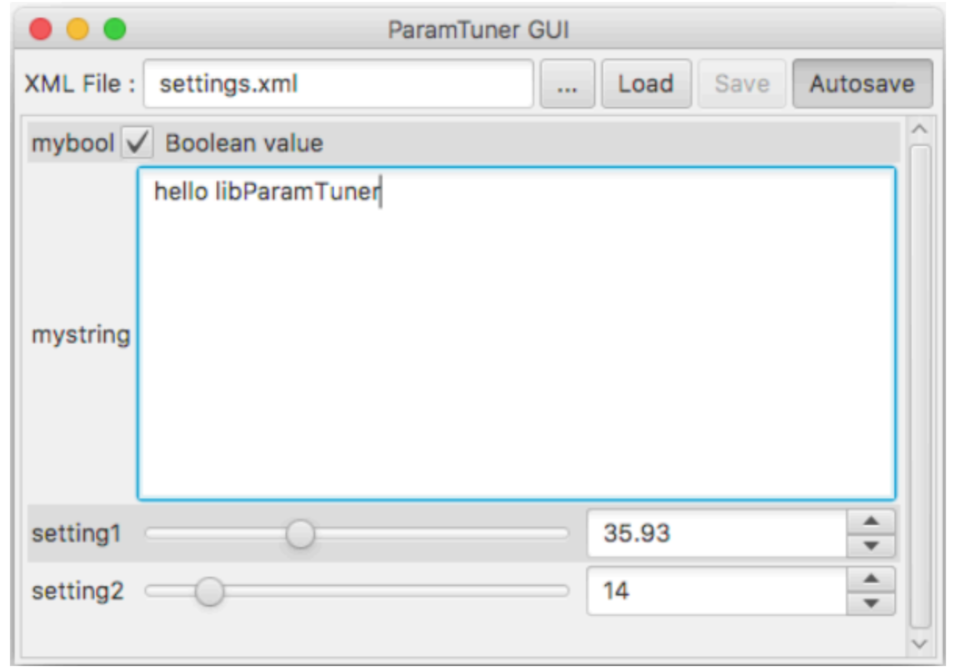


https://jee138doshi.medium.com/sketch2code-a01922fa14c9

Parameters → interface
(ex. *Baloup et al., 2017*)



```
<?xml version="1.0" encoding="UTF-8"?>
<ParamList>
    <varD type="double" value="2.3" min="0" max="100"/>
    <varI type="int"    value="12"  min="0" max="100"/>
    <varS type="string" value="lorem ipsum"/>
</ParamList>
```



XML File : settings.xml

mybool ☑ Boolean value

mystring: hello libParamTuner

setting1: 35.93

setting2: 14

Moving from numbers to interactive controls

No universal solution, but gathering hints from multiple sources:

numbers	structure	environment	user
type (ex. integer → choice in menu, character → keyboard control, boolean → checkbox)	cardinality (ex. pair → 2D point, triplet → date or color, sextuplet → date and time)	relative position (ex. number at the root → full page control, number among others → thin control)	a priori indications (ex. this group of numbers is a date, I want to control this with mouse, this must fit in a small square)
distribution of values (e.g. [1900-2100] → calendar)	hierarchy (ex. list of character strings → menu, list of images → carousel)	domain of the tool (ex. parameters → horizontal stacked controls, avionics → push buttons and rotary dials)	a posteriori indications (ex. rotate this control by 90°, make it taller)

Autograph :
https://www.youtube.com/watch?v=xW_t5q7wqxc

Autograph

Number and structure hints

```
G = [
   [0, 1, 1, 0],
   [0, 0, 1, 0],
   [0, 0, 0, 1],
   [0, 0, 0, 0]]
```

Using **introspection**:

```
print(type(G)) # <class 'list'>

print(isinstance(G, list)) # True

print(isinstance(G[0], list)) # True
```

G is the adjacency matrix of an unlabeled directed graph if:

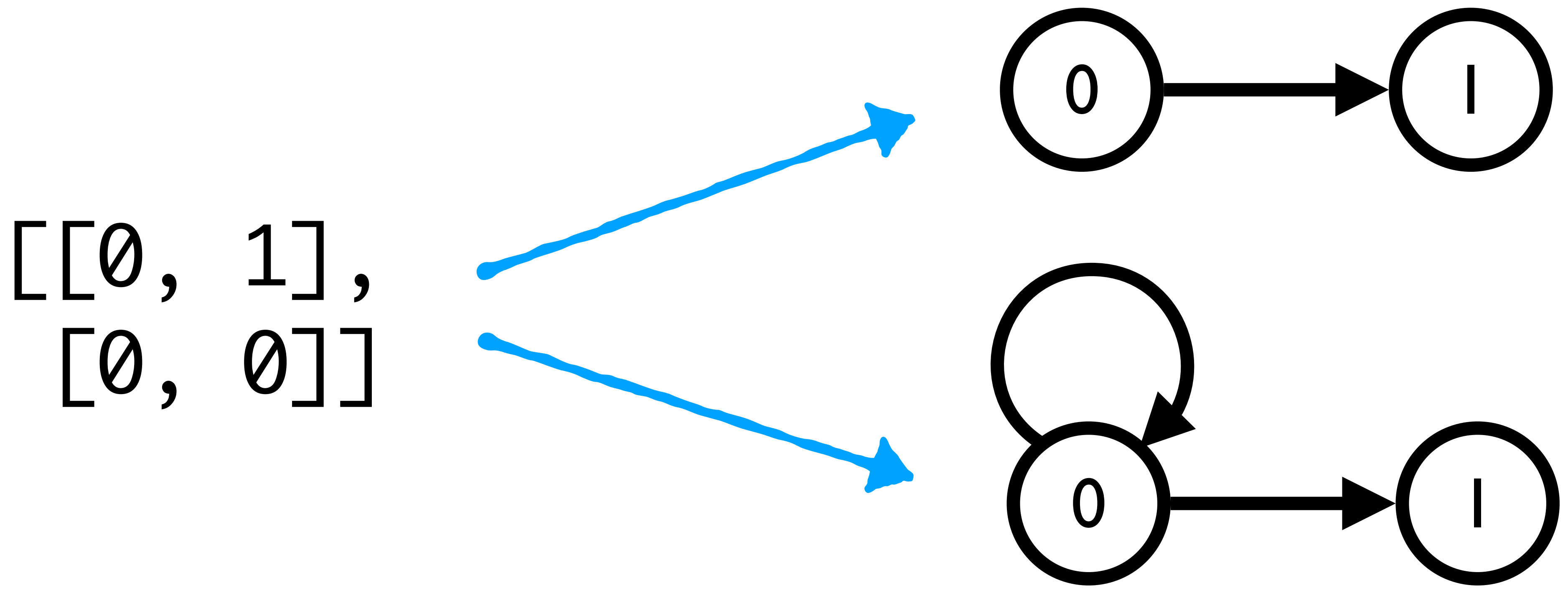
- G is a list
- all elements in G are lists
- G and all its elements have same length
- all elements of elements of G are integers with values 0/1

Autograph

User hints

- Executing `autograph(G)` is an a priori hint that G looks like a graph (hence not `autoviz(G)` or `autoplot(G)`)

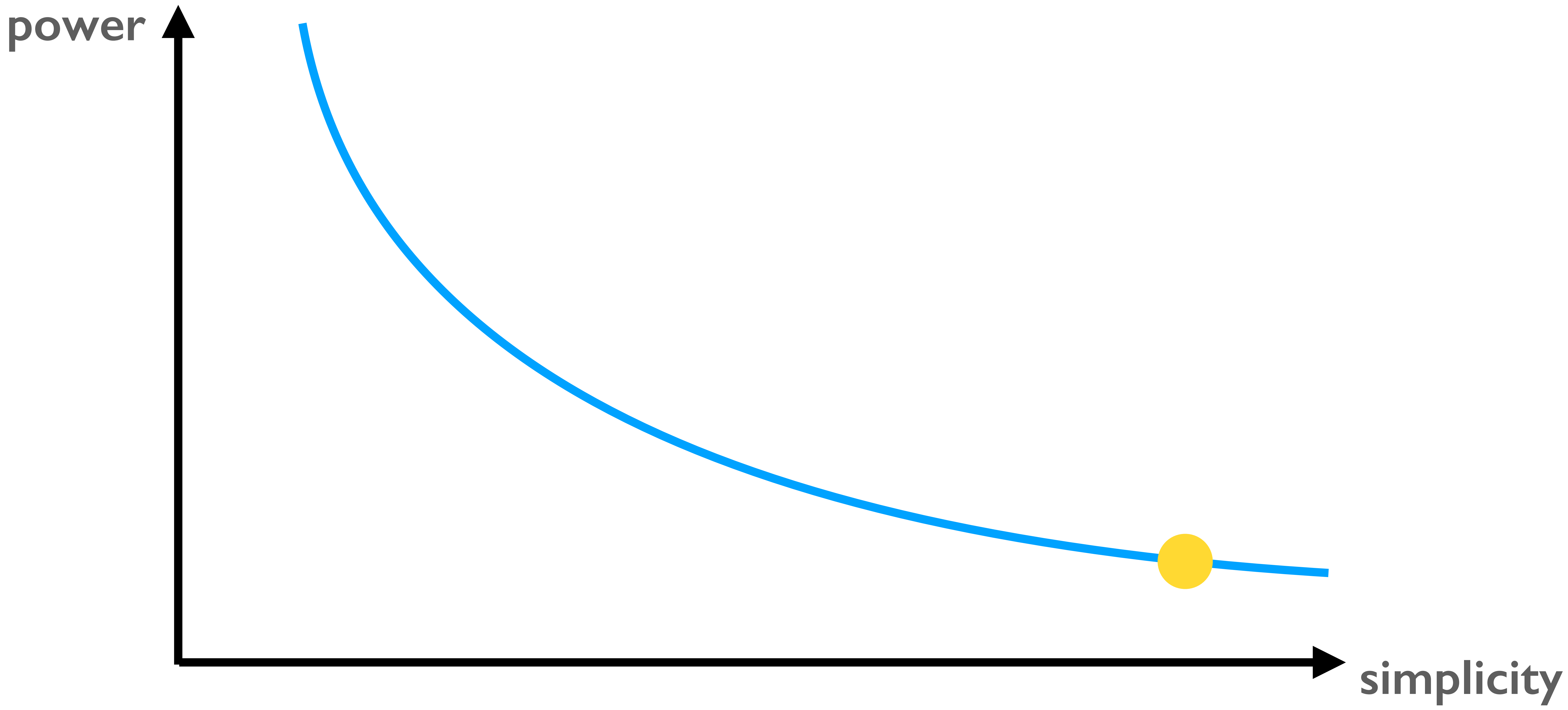
- Users can change the selected interpreted structure to fix ambiguous graphs (a posteriori hint)



```
[[0, 1],
 [0, 0]]
```

Limits

- Autograph generates a control, not a full interface
- Can only display generic graphs (no visual distinction between types of nodes, no hierarchy between elements, ...)



Future work

- Moving from proof of concept to complete demonstration
- Disseminating to high schools for the teaching of graphs in NSI speciality
- Applying this method to other complex structures (e.g. Automap)
- *Can we apply this method (providing a structure of numbers, introspection) to the generation of entire user interfaces??*

Thank you for your attention