The multifactor recommender system @bol.com

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Topics

- develop an operating recommender system
- crucial customer behavioral factors involved
- impact of visual presentation of item recommended.

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Me

- Computer Science
- 12 Yrs University Utrecht, CS/Mathematics
- @bol since 2010

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This is no hype

Thursday 27 march 2014

Thuiswinkel awards

Bol.com awarded
'Best webshop in the Netherlands'

"Bol.com has put major steps forward in the past year, regarding **personal recommendations and the use of big data**.

Unique products per store

- Average supermarket
- XL supermarket

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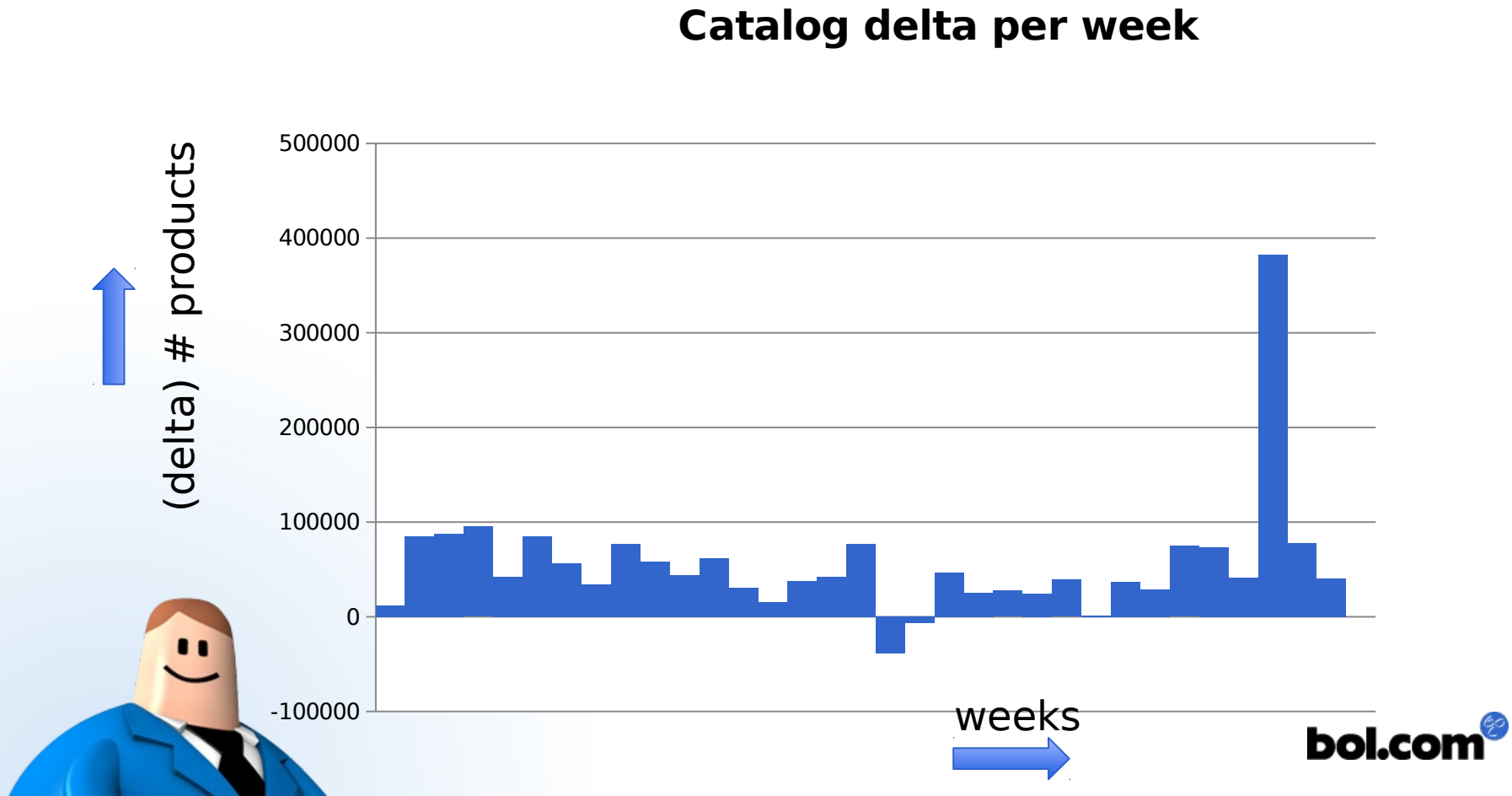
added products per week

+ 1 XL supermarket every 4 days



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> 8.000.000 products online

> 20.000.000 products
total

> 15.000.000 click events each

> 5.500.000.000 click events
per year

Multiple factors give us clues about our visitor

- How long does he look at the product?
- Does he read the product reviews?
- Does he share the product on social media?
- Add item to wishlist
- What products does the visitor click?
- Was the clicked product a recommendation?

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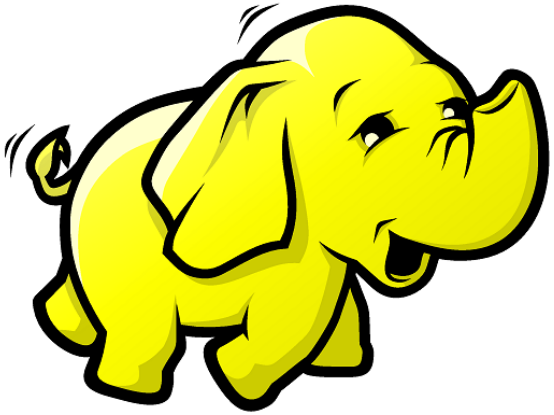
hadoop @bol.com

- Development in 2009
- First applications in production (2010)



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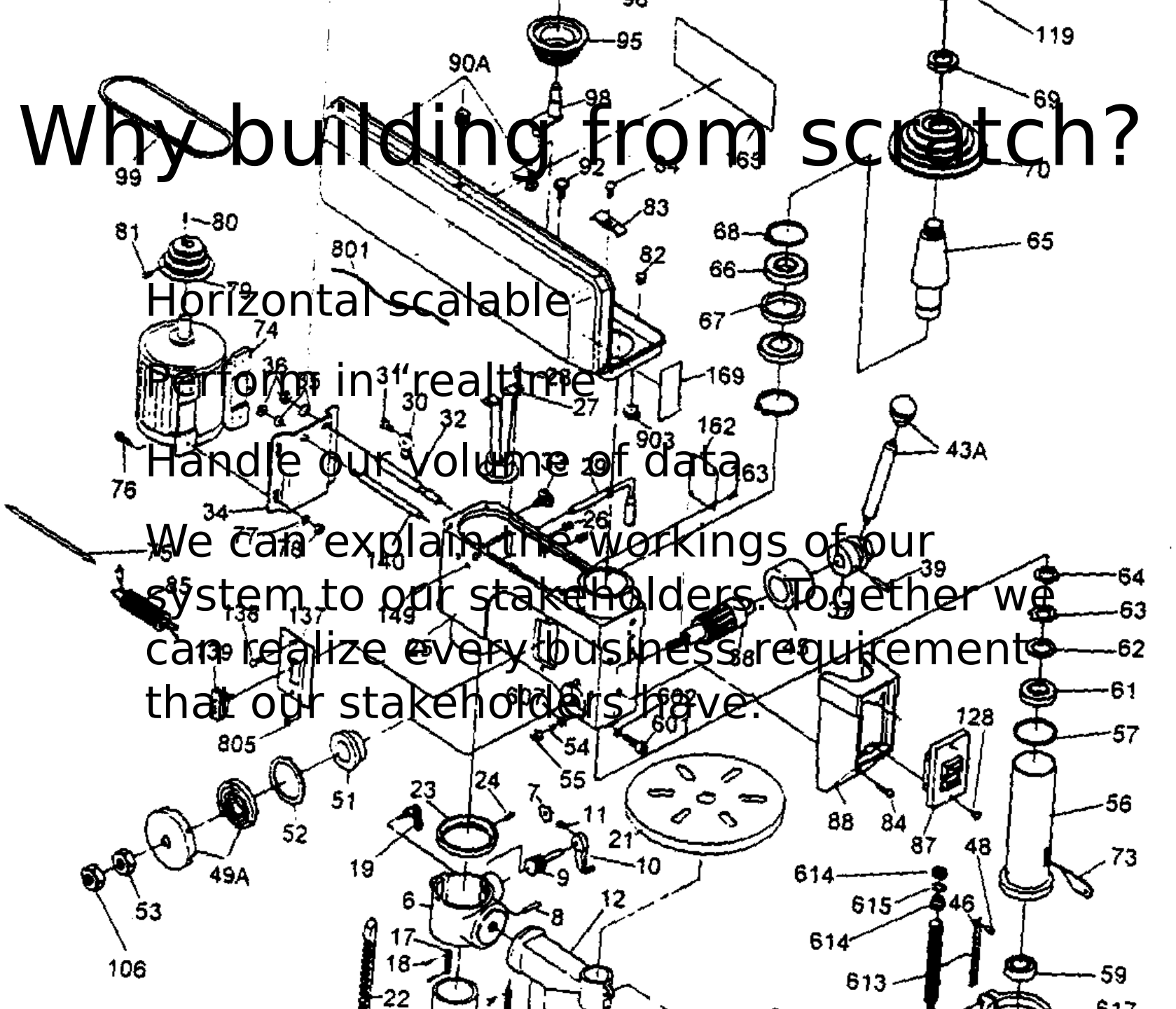
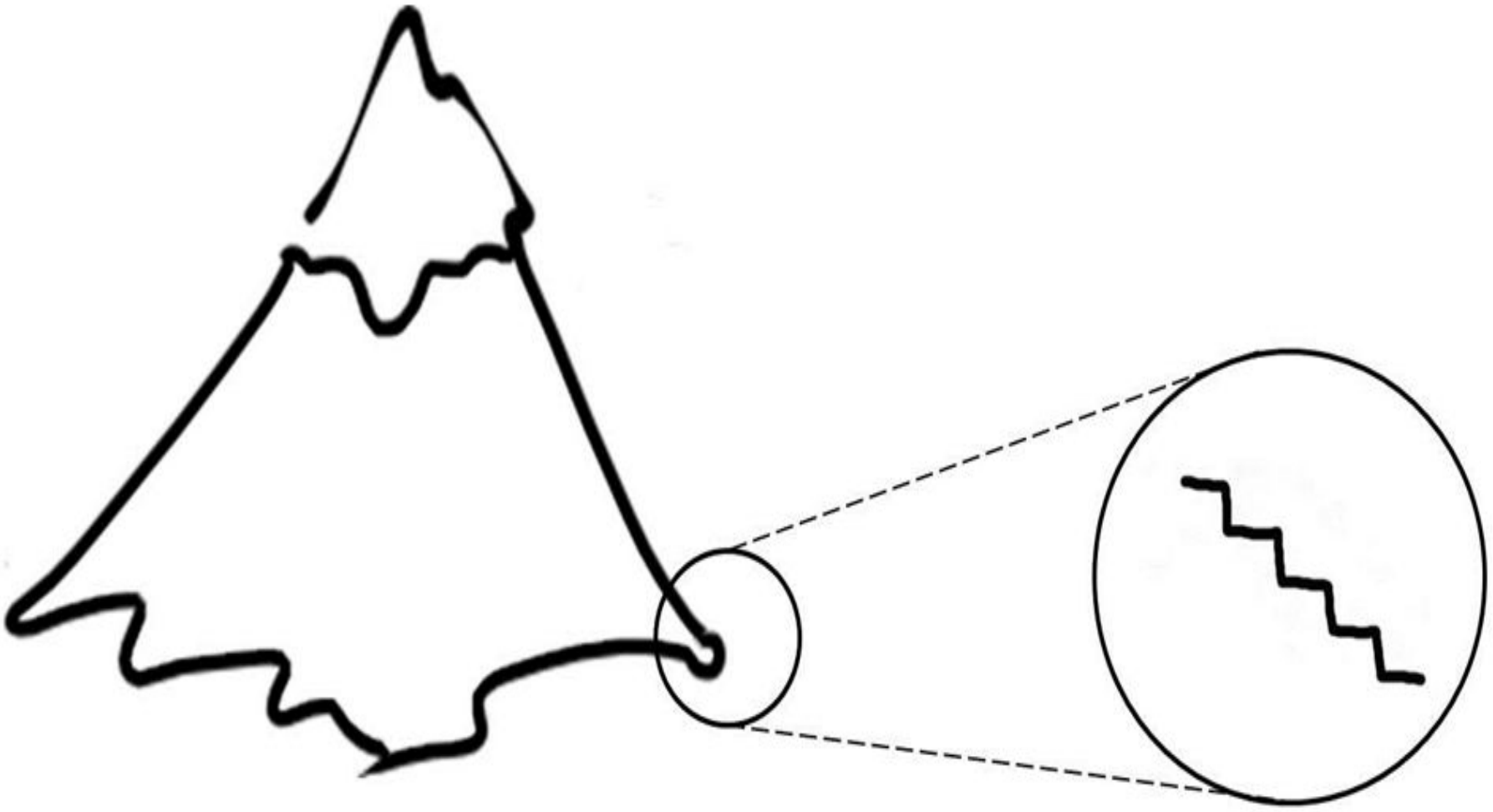
Why building from scratch?

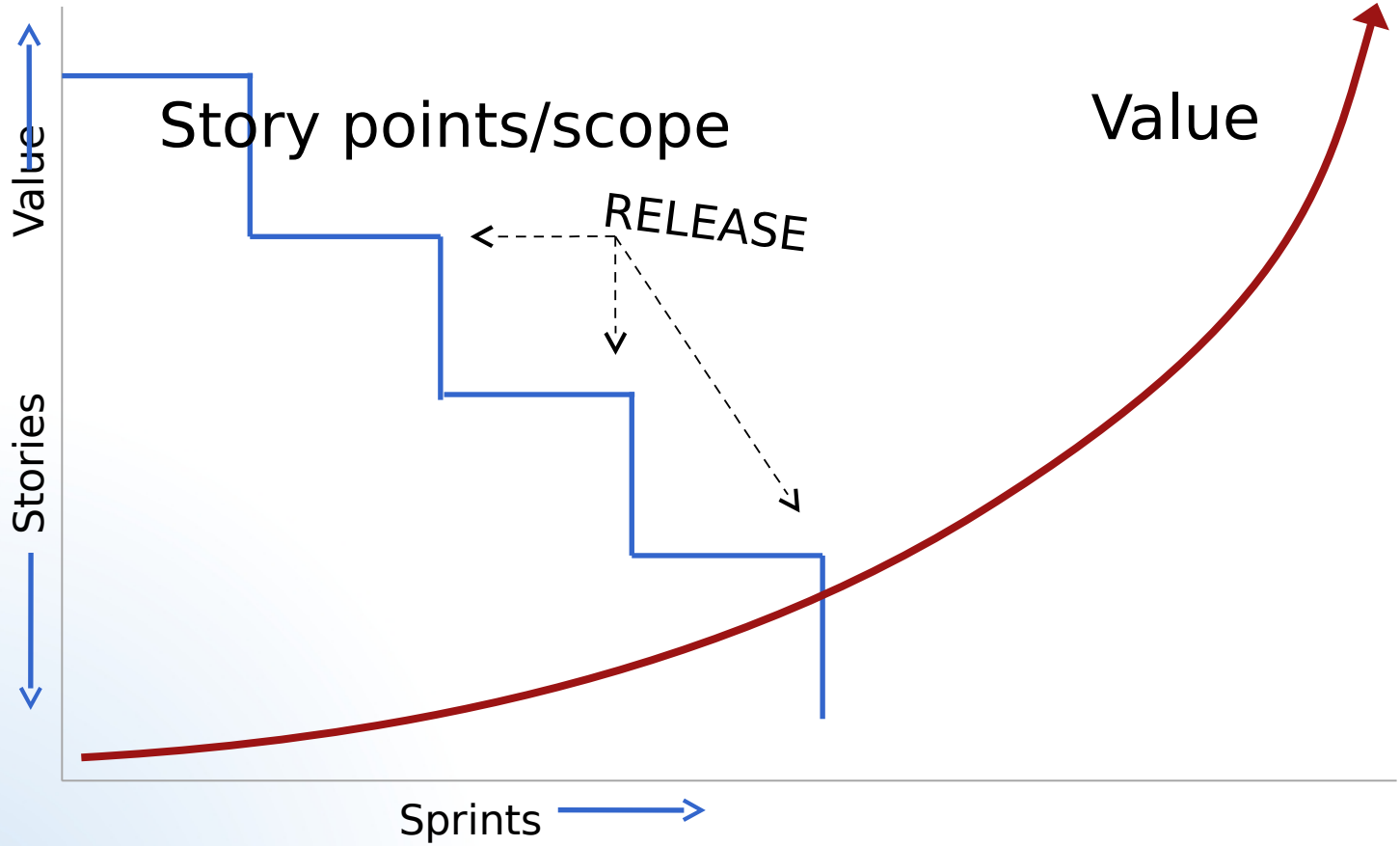


- Horizontal scalable
- Perform in “realtime”
- Handle our volume of data
- We can explain the workings of our system to our stakeholders. Together we can realize every business requirement that our stakeholders have.



scary stuff :(→ definitely do-able!

As stories burn down, value increases



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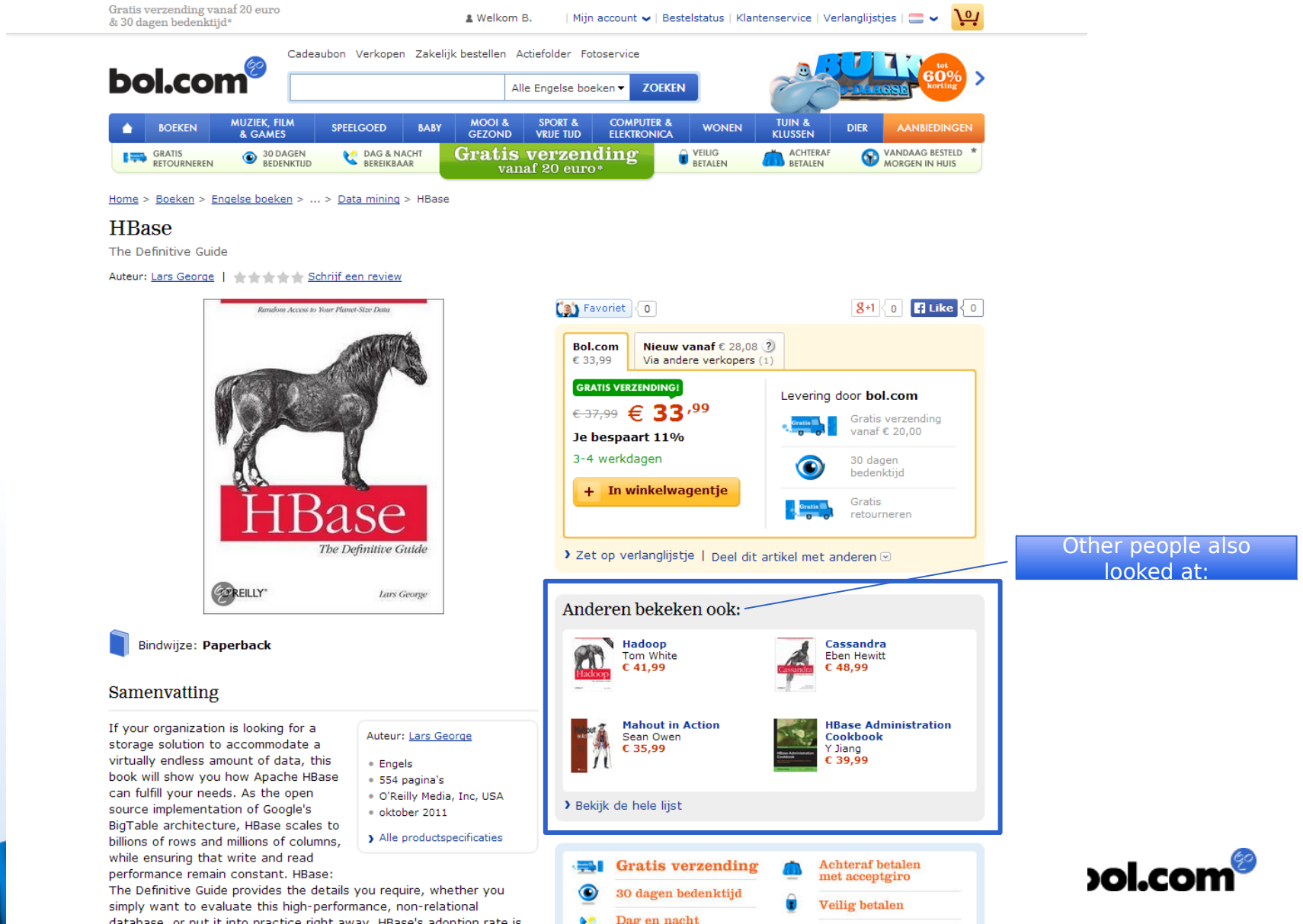
Recommendations



How can we tell the success of these recommendations?

- Visualize output data
- Offline recommender evaluation
  - Run algorithms that express the numerical errors of the recommender output.

Root Mean Squared Error (RMSE)

The square root of the mean/average of the square of all of the error.

The use of RMSE is very common and it makes an excellent general purpose error metric for numerical predictions.

Compared to the similar Mean Absolute Error, RMSE amplifies and severely punishes large errors.

$$\mathrm{RMSE} = \sqrt{\frac{1}{n}\sum_{i=1}^{n}(y_i - \hat{y}_i)^2}$$

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How can we tell the success of these recommendations?

- Is that all we can do?

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The gasoline recommender system

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The gasoline recommender system

Requirements:

- Support anonymous customers
- Realtime: response 100ms
- Low numerical error value
- Recommendation is successful if customer buys the item after seeing it first as a recommendation.

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The gasoline recommender system

- Customer: new customer
- Cartype: Tow Truck
- Recommendation: **Diesel**
- Does customer buy item after seeing this as recommendation? : yes

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The gasoline recommender system

- Customer: new customer
- Cartype: sportscar
- Recommendation: **Petrol (gasoline)**
- Does customer buy item after seeing this as recommendation? : yes

The gasoline recommender system

- Offline evaluation:
  - Visual data inspection
  - Low error value
- Online evaluation:
  - Accurately predict the recommendations
  - Almost everything we recommend gets bought

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The gasoline recommender system

Is this a good recommender system?

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What is a good recommendation?

Common error metrics	Commerce
The accuracy to predict	Add value to customer experience

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How can we tell the success of this recommender?

- Visualize output data
- Offline recommender evaluation
  - Run algorithms that express the error of the recommender output in a numerical form.

- Long Term analyses
  - Analyze the performance of the recommender over time.
  - Do visitors return after buying a recommendation?
  - Analyze behavior to learn more from our visitors.

- Online recommender evaluation
  - Live user experiment ’s

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Live user experiments?

Recommendations = Data-driven decisions

- Optimize combinations of recommendation algorithms
- User Interface
- User Interaction Flows

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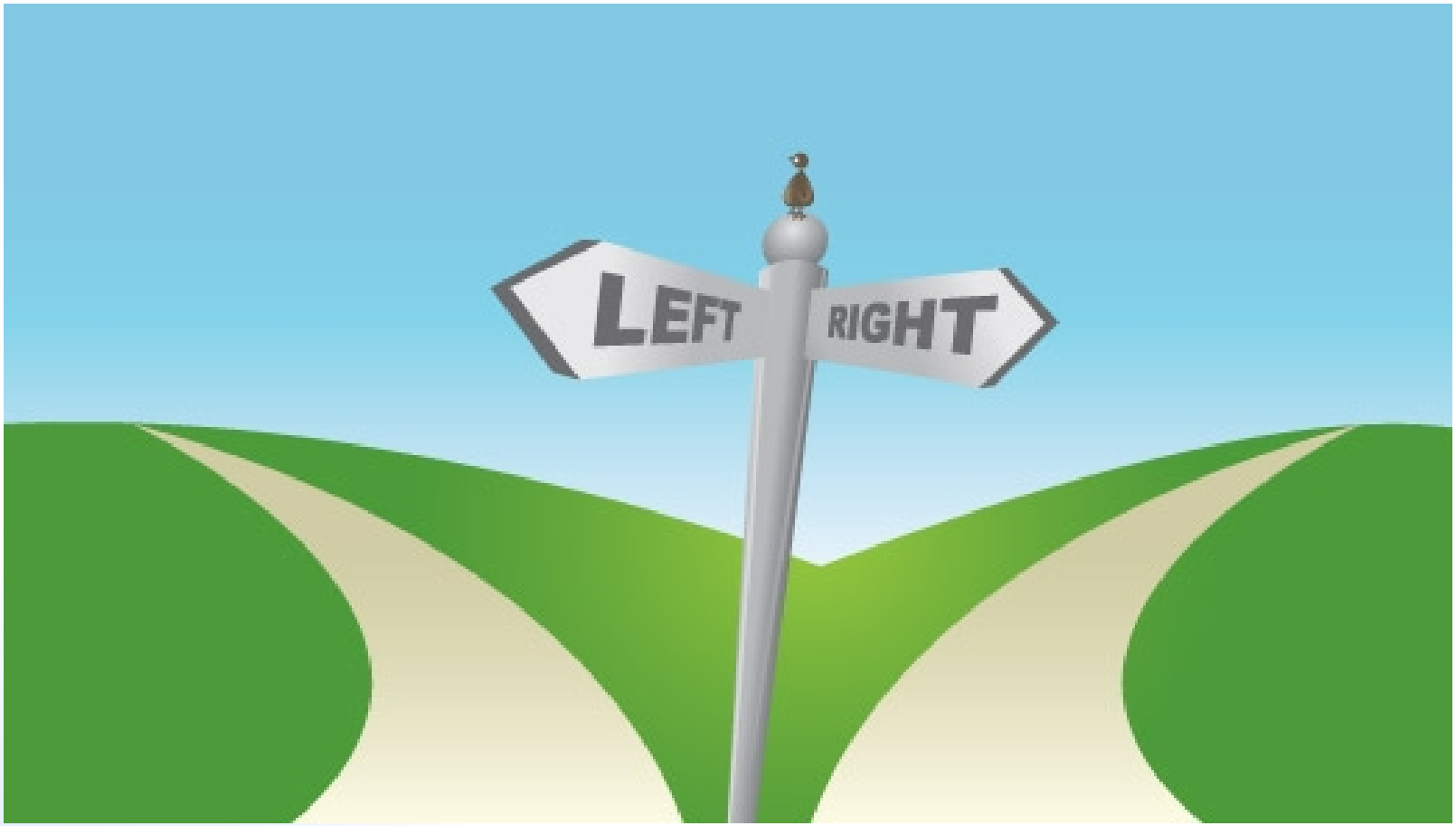
Live experiments: What do visitors really prefer?



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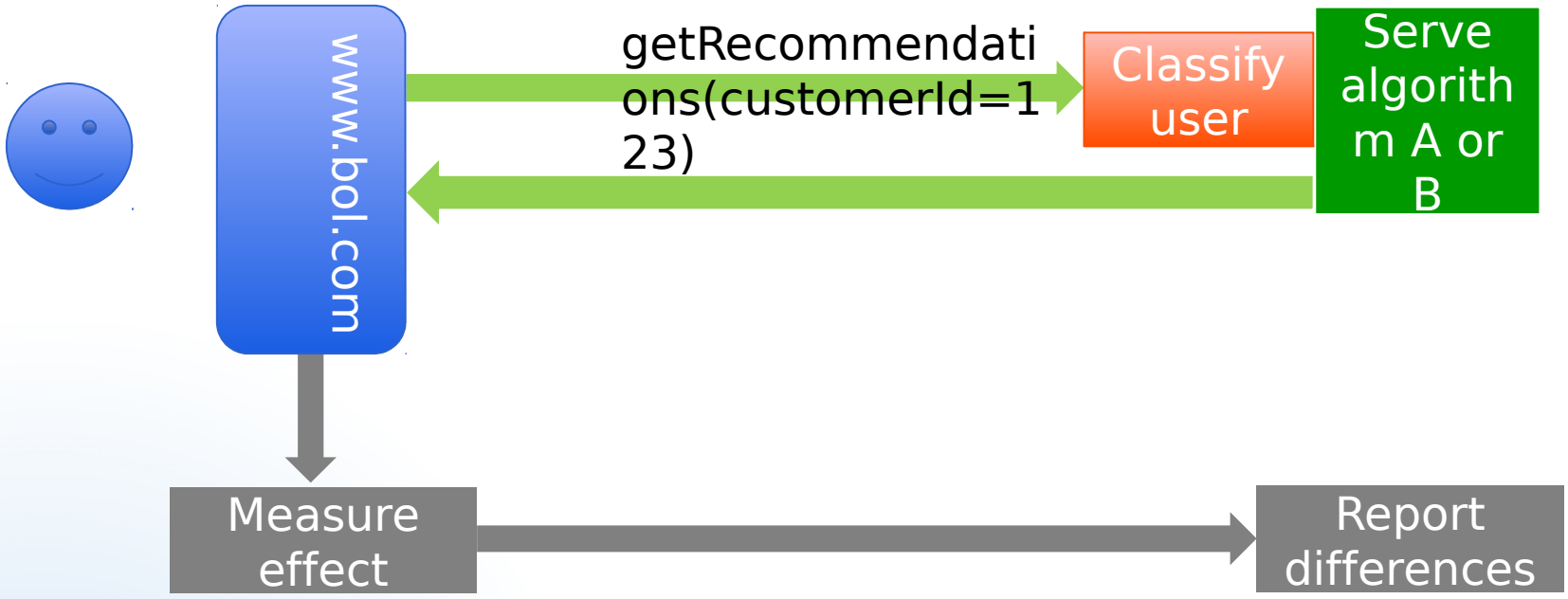
Live experiments: our experimentation framework



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Experimentation results

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Impact of presenting the recommendations to the customer

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Impact of presenting the recommendations to the customer

Recommendation interaction

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Recommendations

General personal reco's

Recommend a deal

Recommend wishlist items

Recommend price change

Recommend search queries

Recommend a category to the visitor

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What did we just recommend?

- Algorithms with outcome
- Personalized content
  - Products
  - Authors
  - Artists
  - Deals
  - Categories
- Personalized User Interface
- Determine the priority of algorithm outcome on a page
- Over channels (webshop, mobile, email)

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Level of personalization?

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How does the real time behavior of the visitor constrain the recommender system?

- What would add value to the customer given his current context?
- What do we already know about the visitor? (previous behavior)
- Determine the level of personalization

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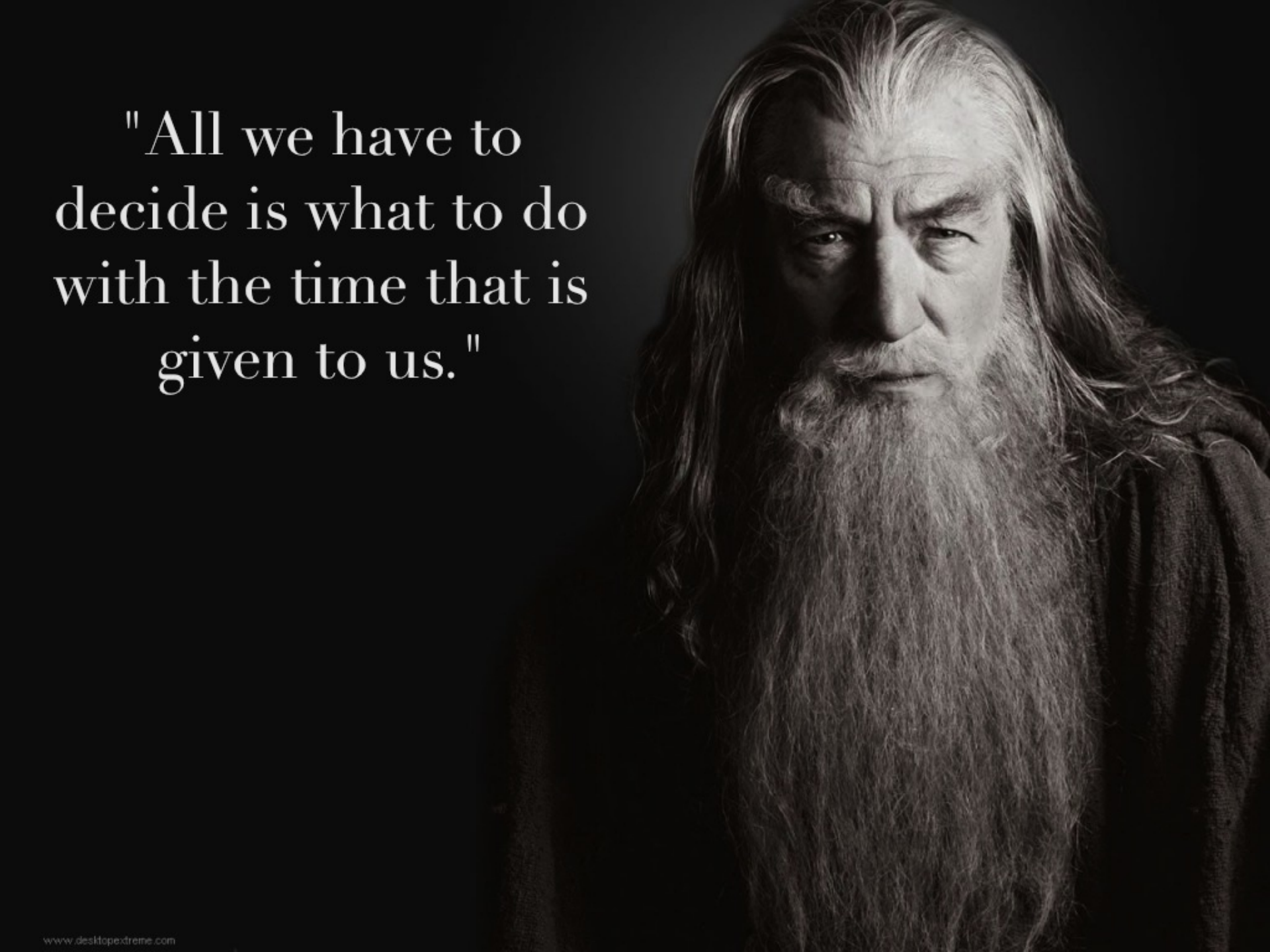
"All we have to decide is what to do with the time that is given to us."



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What to do with given time

- Cache ‘expensive’ data
- Tune/(try different) jdbc connectivity components
- Profile your code (Java VisualVM)

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Contact me **bkersbergen@bol.com**

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The end