

gamalon

Rapidly Evolving AI
for Better Customer Engagement

Ben Vigoda
CEO
ben.vigoda@gamalon.com

About Gamalon



Gamalon was the largest single investment from **DARPA in 2013-2017 to build next generation Artificial Intelligence technology. (over 40 patent filings)**

BEN VIGODA, FOUNDER & CEO

- MIT PhD, Post-Doctoral Fellow, Scientist, Bayesian Logic
- DARPA Information Science and Technology Committee
- National Academy of Sciences Kavli Fellow
- CEO & Founder, Lyric → General Manager, Analog Devices
- Created the first processor architecture for machine learning (tensor processing unit)
- 140+ patents and scientific publications
- Created the initial code platform for Google knowledge graph
- Intern in David Rumelhart's lab, momentum terms for back-propagation, age 14



RECOGNITION



Technology
Pioneers
2018

MIT
Technology
Review

50 Smartest
Companies
2017

WIRED

Bloomberg
Businessweek

Forbes

TC TechCrunch

Impact examples

| Vertical | Use Case | Impact |
|----------------------|--|--|
| Automotive | Customer feedback/reviews. | 90% accuracy compared to Google AutoML 67% accuracy. 10x more domain coverage. Instantly deep read 1,000,000 customer messages in order to gather quantitative evidence about specific issues and areas for improvement for the product group. |
| Consumer electronics | AI Assistant. Unsupervised discovery of domains, intents, entities, and monitoring for quality issues. | Scale analytics/quality team and capability leveraging non data scientists. Add more new high quality domains faster. |
| Financial services | AI Assistant. Unsupervised discovery of domains, intents, entities, and monitoring for quality issues. | Scale analytics/quality team and capability leveraging non data scientists. Add more new high quality domains faster. |
| Pharmaceutical | AI Assistant to govern and manage stage 2 and stage 3 clinical trials. | \$250 cost per transaction becomes pennies per transaction. Response time drops from 48 hours to seconds. |
| Manufacturing | AI Shopping Assistant for complex products and product lines direct to long tail of B2B purchasers. | Enhance long tail distribution network. Old website causing loss of conversion and loss of satisfaction for long tail of buyers. |

Supervised learning is great once you know what the categories are

Top 10 Reasons Why College is Important

Why Is College Important?

College is important for many reasons, including long-term financial gain, job stability, career satisfaction and success outside of the workplace.

With more and more occupations requiring advanced education, a college degree is critical to your success in today's workforce. But earning an **accredited college degree** can also have a significant impact on other areas of your life.

1. College graduates earn more on average.

According to the U.S. Bureau of Labor Statistics (**BLS**), workers with a bachelor's degree earned an average of \$464 per week than workers with only a high school diploma - a higher salary that can add up over the course of your lifetime. A 2015 report from the U.S. Department of Education found the average worker with a **bachelor's degree** will earn approximately \$1 million more than a worker without a postsecondary education.

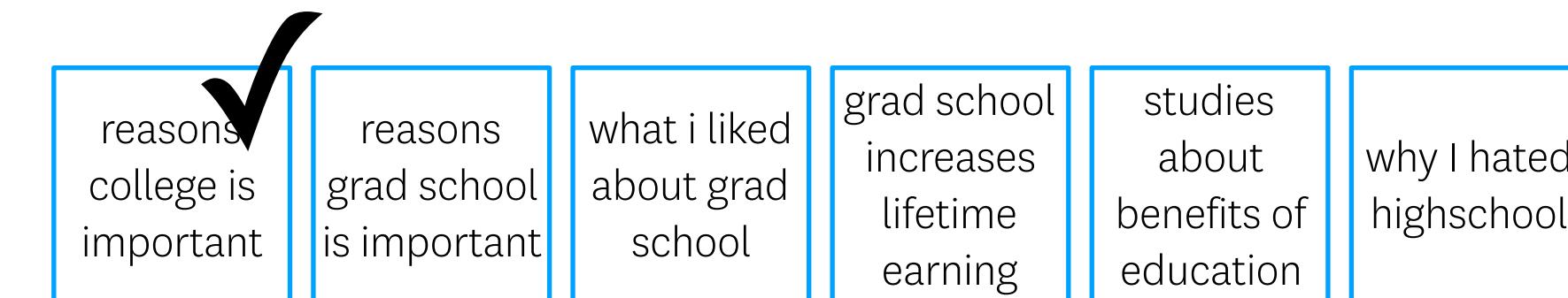
2. Workers with a college degree are less likely to face unemployment.

In addition to the potential to make more money, earning your college degree could also lead to more career stability. According to BLS data, just 2.7% of workers with a bachelor's degree are facing unemployment, compared to 5.2% of workers with only a high school diploma.



A human manually tells the system which category this document belongs in. Each category needs 1,000 manually categorized documents.

Crucially, humans must decide on what the categories are before this can begin.



The importance of a college education

By [Mark A. Heckler](#)

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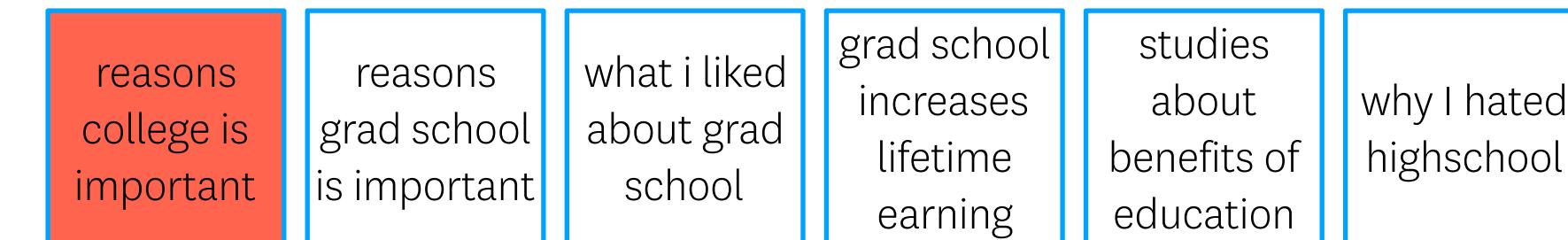
SEPTEMBER 11, 2018, 2:30 PM

There's a narrative commonly circulated in media and political circles about the rising cost of higher education and student indebtedness. The narrative usually begins with this question: is a college education worth the investment? Folks who just read the headlines or rely on the opinion pages for their information might conclude that the value of a college degree is in decline. The facts tell a different story.

Contrary to this false narrative, a college education is more important now than ever before, for both tangible and intangible reasons. A college degree is still the surest way to increase wage potential. In addition, with the rise of artificial intelligence and



After the system learns, then it can try to categorize a new document:



Unsupervised learning current state of the art to discover categories

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The importance of a college education

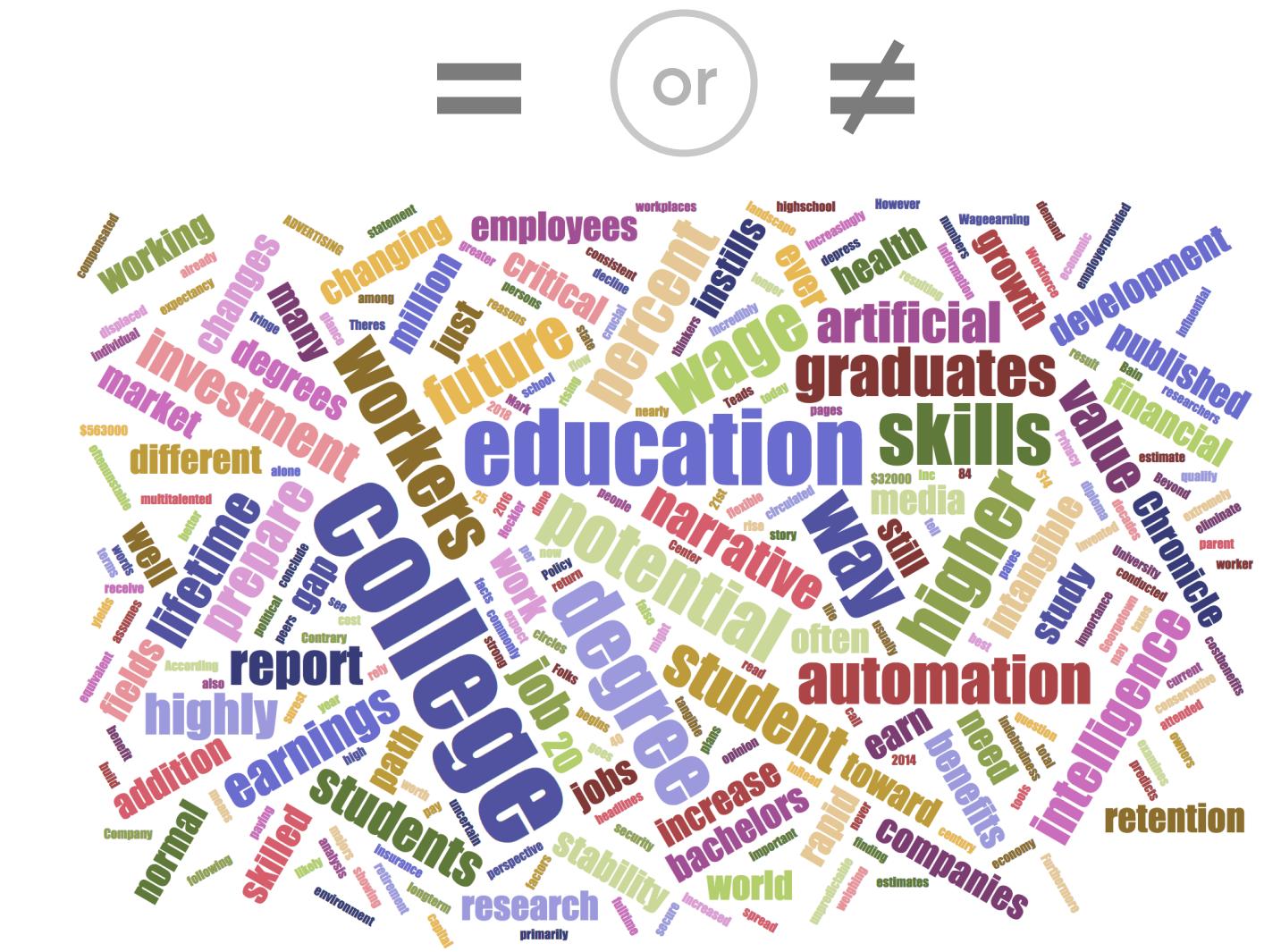
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Word Clouds
count the
number of times
a word occurs

The more it appears the larger the word

But two messages can contain exactly the same words,
and mean entirely different things.

help me please my account shut off

please help me shut off my account

But two messages can contain exactly the same words,
and mean entirely different things.

help me please my account shut off

= Customer asking for help

please help me shut off my account

= Losing customer

Word order matters

help me please my account shut off



= Customer asking for help

please help me shut off my account



= Losing customer

Phrases order also matters

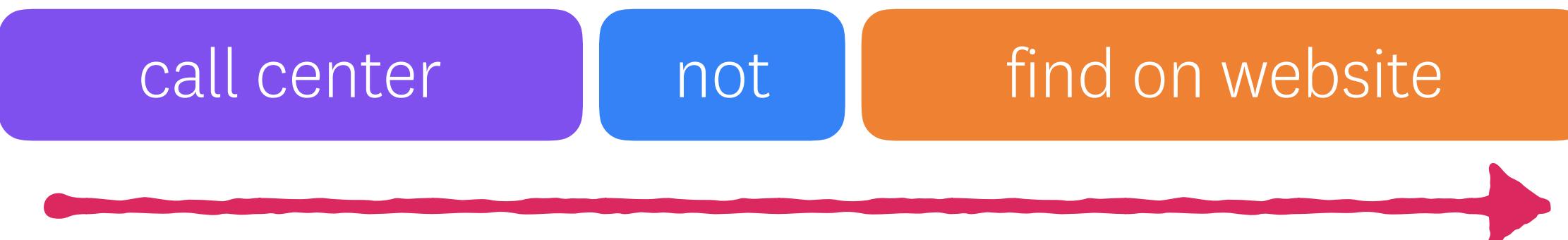
could not find what I needed on the website

so I called the call center to get help



= Complaint about
the Website

I called the call center to get help and they
could not tell me how to find what I needed
on the website



= Complaint about
the Call Center

Understanding ideas in messages, no matter how they are worded

could not find what I needed on the website so I called the call center to get help

did not see what I was looking for on the website so I phoned customer center to get help

It wasn't obvious to find what I needed on the website so I had to talk to an agent.



Failing to take into account word order, word combinations, and alternative words leads to discovery of categories that do not make sense to people.

Category 1

How much money in **checking**

Make new **checking**

Category 2

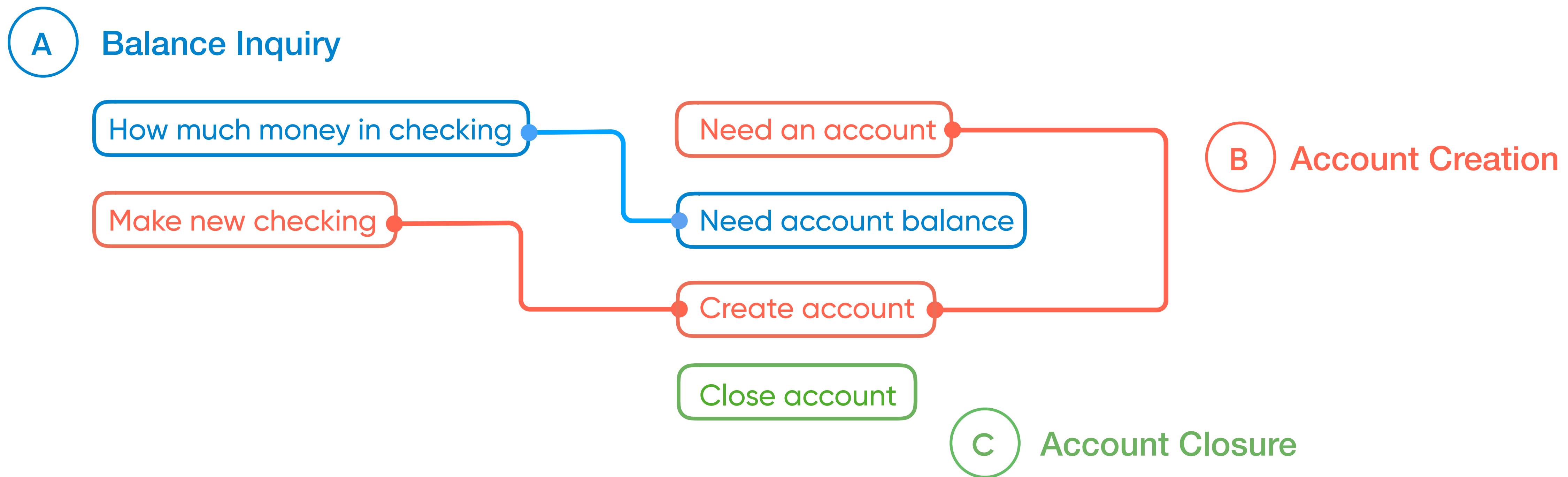
Need an **account**

Need **account balance**

Create **account**

Close **account**

Failing to take into account word order, word combinations, and alternative words leads to discovery of categories that do not make sense to people.



Extracting **multiple ideas** within a single message

I am having a problem. I tried to login on May 20th, but I couldn't login to my account. I called customer service, and they sent a new temporary password, but I do not have access to that old email address anymore. Is there any way I can present an ID or something to get our login turned back on?



New account login problem

Called customer service

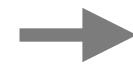
Issue with account recovery email

Present ID for login



Ideas in order are like little “stories”

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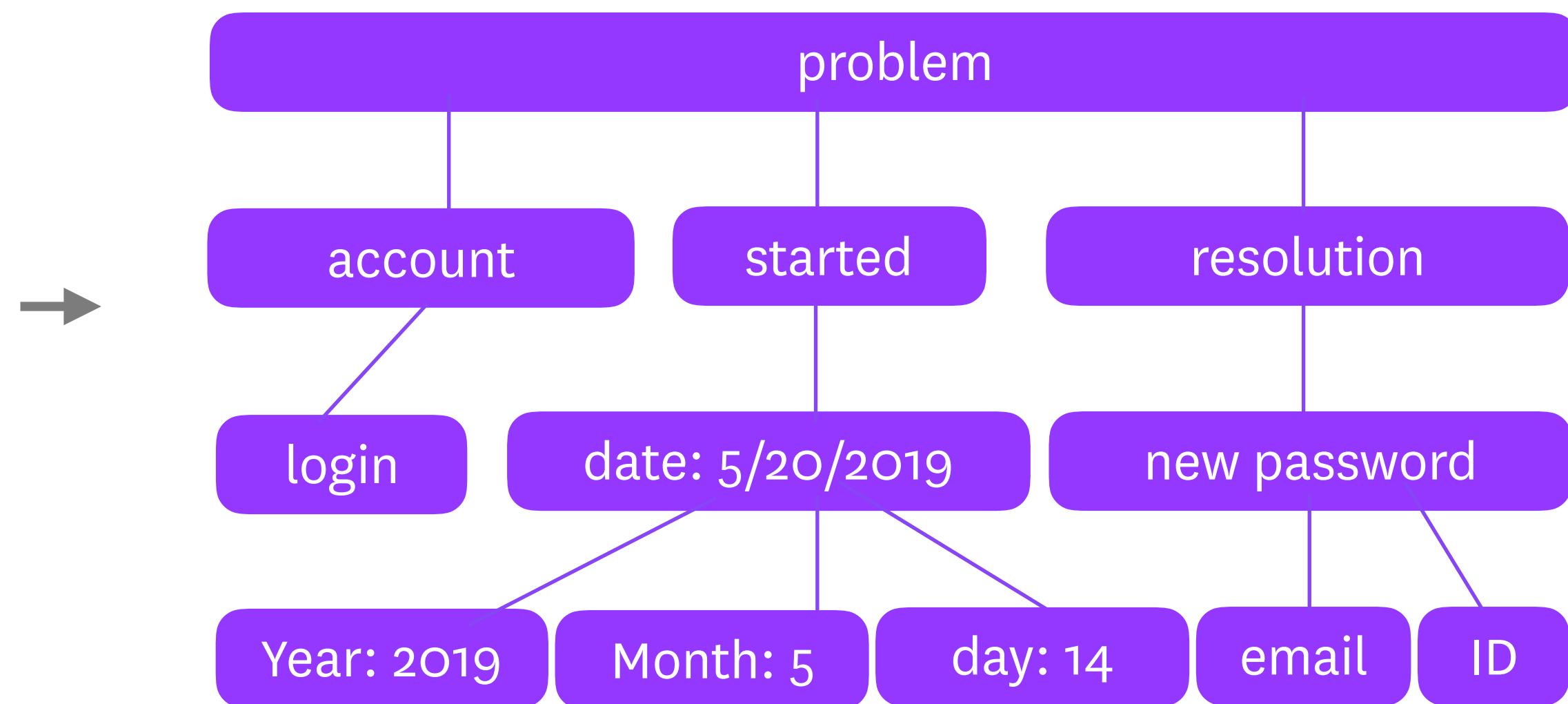
Issue with account recovery email

Present ID for login



Ideas are made of component ideas

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Discovery of new, previously unknown ideas

I am having a problem. I tried to login on May 20th, but I couldn't login to my account. I called customer service, and **they had no record of my account.** Is there any way I can present an ID or something to get our login turned back on?

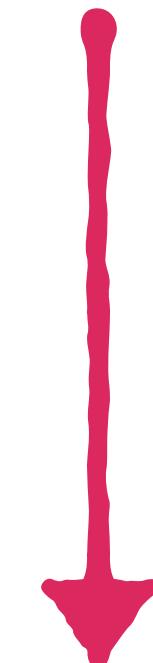


New account login problem

Called customer service

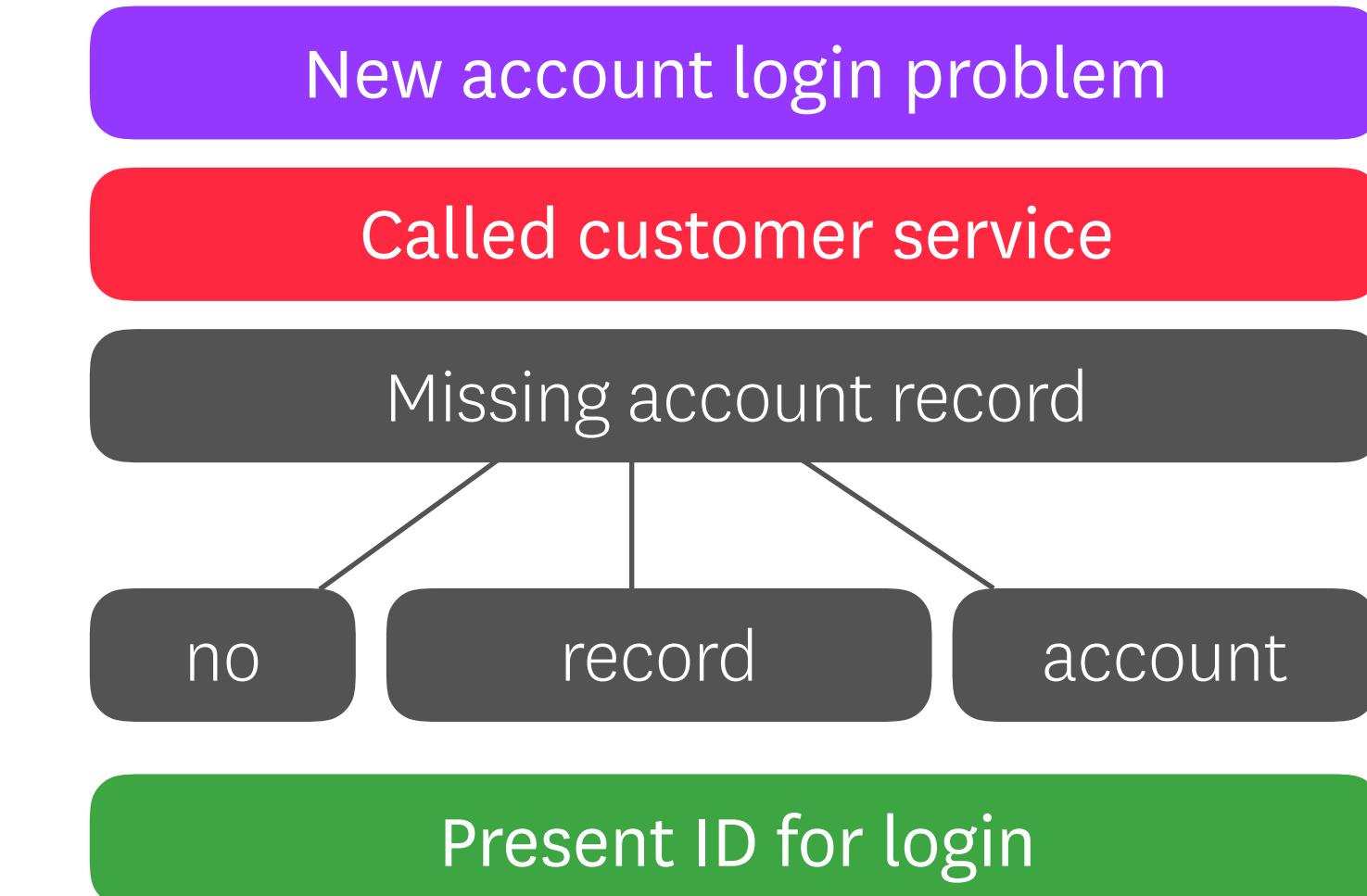
???

Present ID for login



Understanding new previously unknown ideas in terms of previously learned component ideas

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What we need is unsupervised deep learning that understands ...

- Word order
- Phrase order
- Different ways that the same idea can be expressed in different words
- Multiple ideas within one expression or conversation
- Different ways that ideas can be combined together to create new ideas

amazon prime

All ▾

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ApotheCARE Essentials The Replenisher Moisturizing Cleansing... ▾ Customer reviews

Customer reviews

★★★★★ 237
4.1 out of 5 stars ▾

5 star 54%
4 star 25%
3 star 11%
2 star 4%
1 star 6%



ApotheCARE Essentials The Replenisher Moisturizing Clea...
by APC HAIR

Size: 16 ounce | Style Name: Vanilla, Argan Oil, Sweet Almond Conditioner | Change
Price: \$9.83 ✓prime

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Add to Wish List

Top positive review
See all 189 positive reviews ▾

Serena

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July 31, 2018

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12 people found this helpful

Top critical review
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4 people found this helpful



Proactiv Renewing Cleanser, 6 Ounce (90 ...
★★★★★ 559
\$34.13 ✓prime

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Ad feedback

Imagine if machine learning could convert product reviews

MacBook Pro



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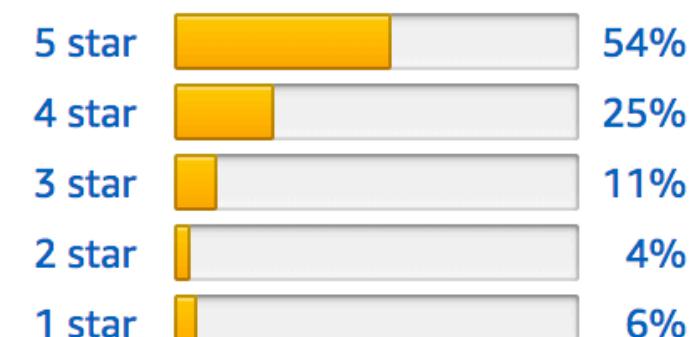
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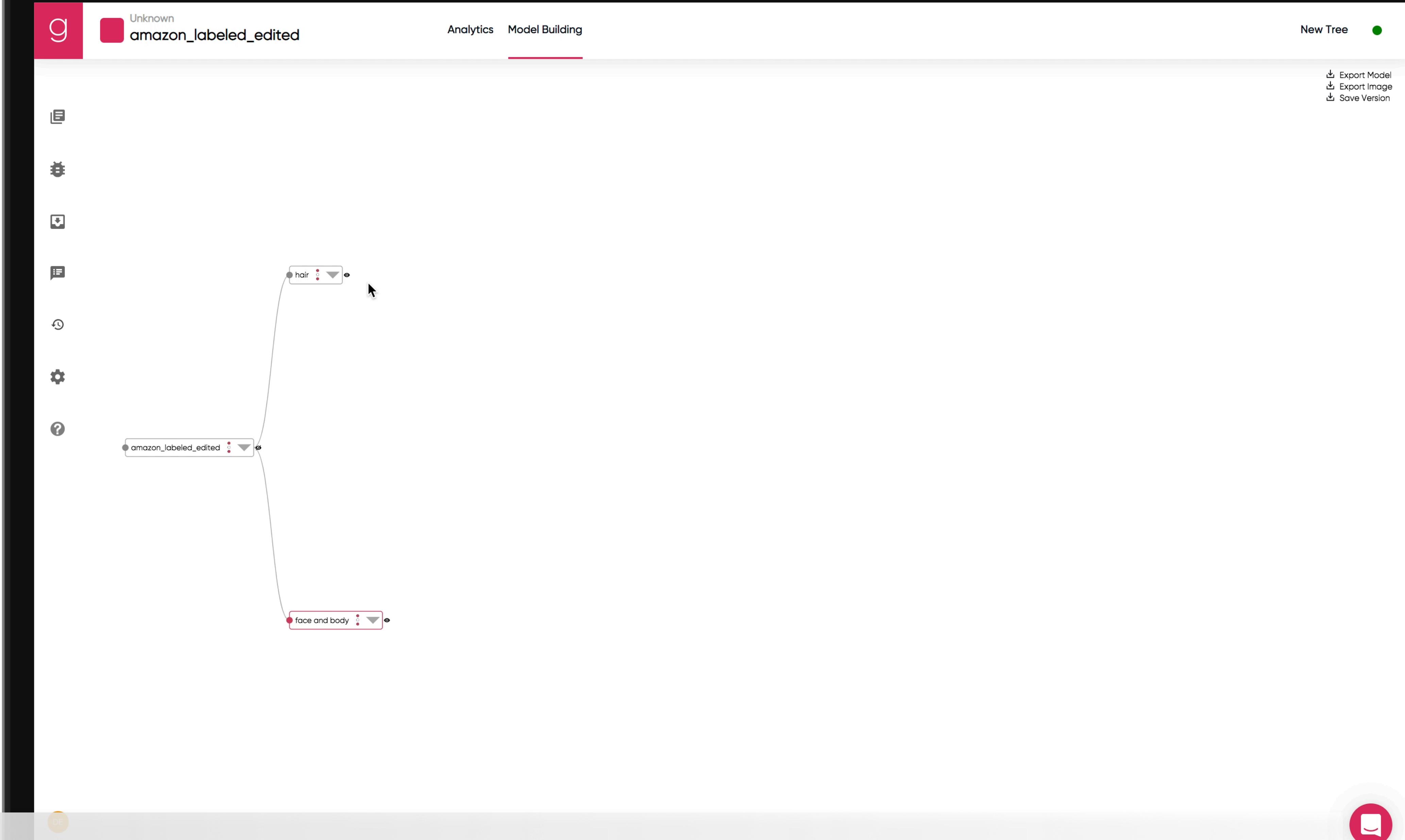
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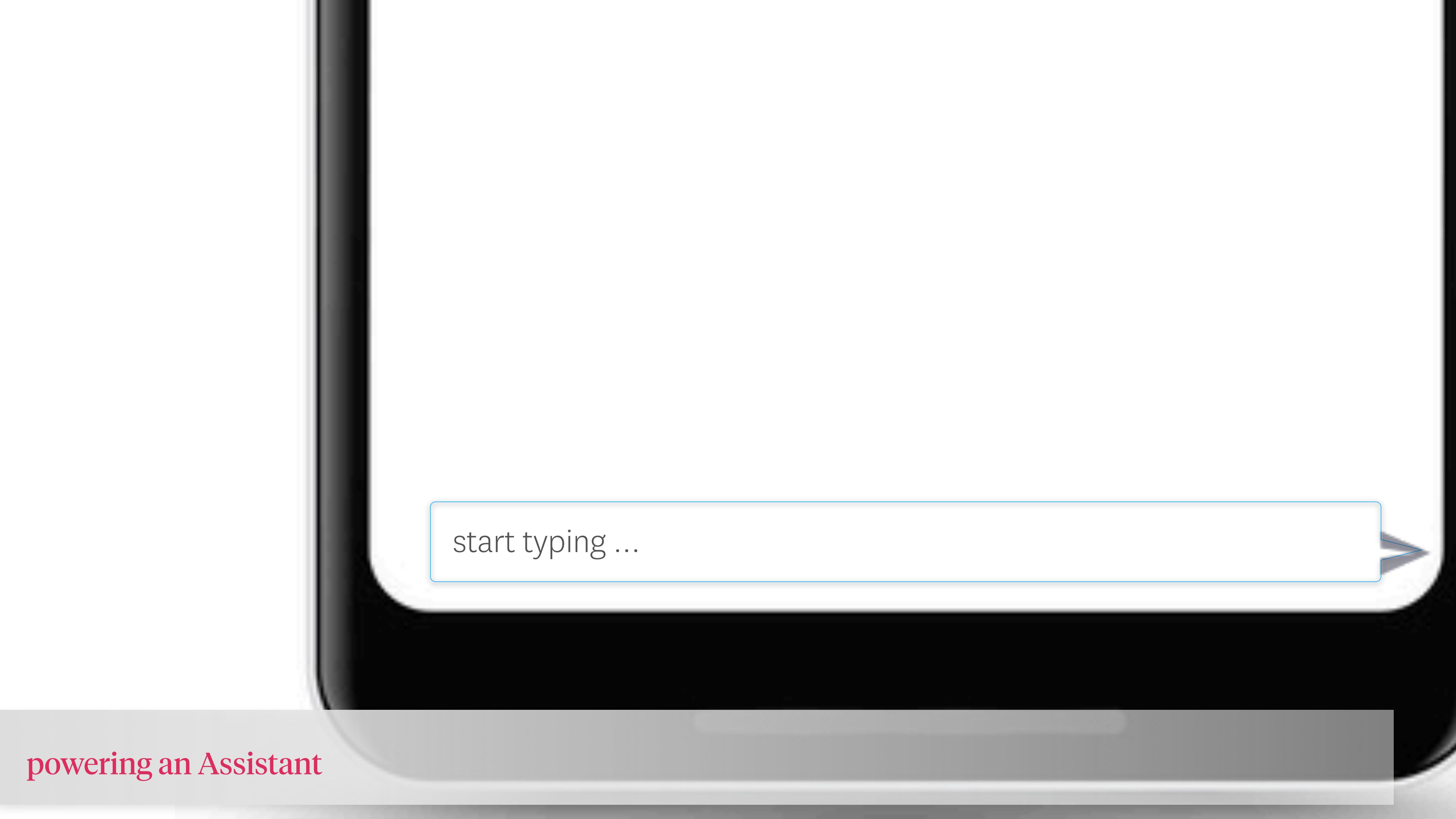
and the ideas inside them into ...

MacBook Pro



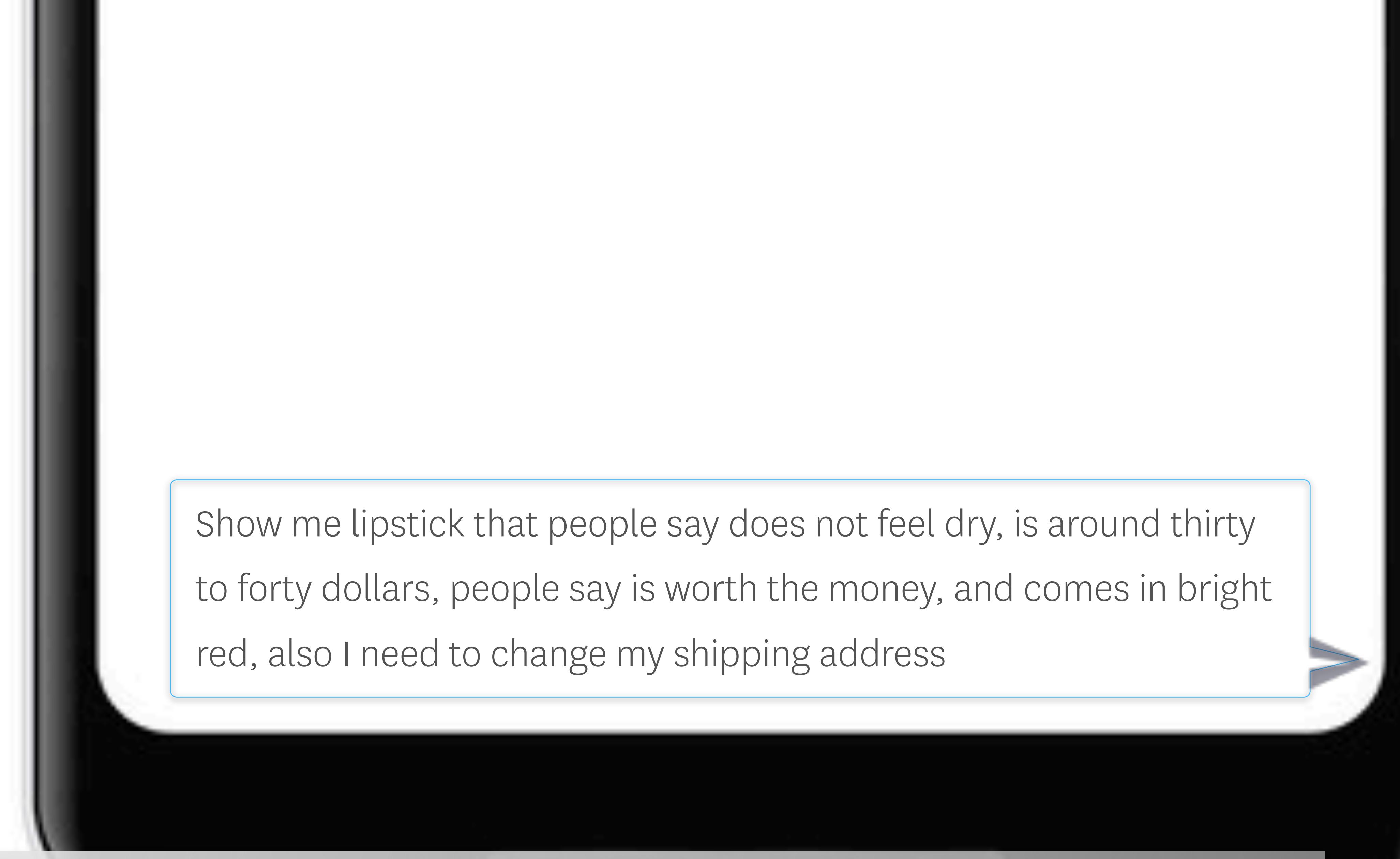
a large scale, probabilistic deep learning, structured, knowledge model ...

MacBook Pro



start typing ...

powering an Assistant



Show me lipstick that people say does not feel dry, is around thirty to forty dollars, people say is worth the money, and comes in bright red, also I need to change my shipping address

that can understand qualitative, subjective ideas that people say, not just factual details.

Show me lipstick *that people say* does not feel dry, is around thirty to forty dollars, *people say* is worth the money, and comes in bright red, also I need to change my shipping address

that can understand qualitative, subjective ideas that people say, not just factual details.

Show me lipstick that people say does not feel dry, is around thirty to forty dollars, people say is worth the money, and comes in bright red, also I need to change my shipping address

g. First, let's get your change of address out of the way. What is your new shipping address?

start typing ...

extract and respond to multiple ideas contained within a single message;

Show me lipstick that people say does not feel dry, is around thirty to forty dollars, people say is worth the money, and comes in bright red, also I need to change my shipping address

g. First, let's get your change of address out of the way. What is your new shipping address?

Ben vigoda, 14garfield rd winchester mass

handle answers containing data quality issues and still parse them cleanly;

red, also I need to change my shipping address

g. First, let's get your change of address out of the way. What is your new shipping address?

Ben Vigoda, 14 Garfield Road, Winchester, MA 01890

g. Great! You're all set on the address change. Second, about the lipstick, are you interested in a lipstick, lip stain, or something else?

start typing ...

ask clarifying questions in order to clarify the user's intent and achieve accuracy;

red, also I need to change my shipping address

g. First, let's get your change of address out of the way. What is your new shipping address?

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g. Great! You're all set on the address change. Second, about the lipstick, are you interested in a lipstick, lip stain, or something else?

stain plase

and understand how to incorporate the user's clarification,

g. Great! You're all set on the address change. Second, about the lipstick, are you interested in a lipstick, lip stain, or something else?

Stain please

g. Based on what other customers say, you might be interested in Giorgio Armani Lip Maestro or Tatouage Couture Liquid Matte Lip Stain - Yves Saint Laurent.

start typing ...

to provide the next best action.

g. Based on what other customers say, you might be interested in Giorgio Armani Lip Maestro or Tatouage Couture Liquid Matte Lip Stain - Yves Saint Laurent.

g. In the past people have discussed formula changes for foundation products. I am now finding people are talking about a formula change for Giorgio Armani Lip Maestro. Should I add formula change as something to watch for in lipstick?

yes

Imagine if it could continue to learn by analogy as people interact with it.

Giorgio Armani Lip Maestro or Tatouage Couture Liquid Matte Lip

Stain - Yves Saint Laurent.

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yes

start typing ...

And learn to understand dialogue context, without human created dialogue flows. [on roadmap]

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g. In the past people have discussed formula changes for foundation products. I am now finding people are talking about a formula change for Giorgio Armani Lip Maestro. Should I add formula change as something to watch for in lipstick?

yes

How much do these each cost?

And learn to understand dialogue context, without human created dialogue flows. [on roadmap]

change for Giorgio Armani Lip Maestro. Should I add formula
change as something to watch for in lipstick?

yes

How much do these each cost?

g. Giorgio Armani Lip Maestro: \$38 USD, Yves Saint Laurent Rouge Pur Couture: \$36 USD.

start typing ...

And learn to understand dialogue context, without human created dialogue flows. [on roadmap]



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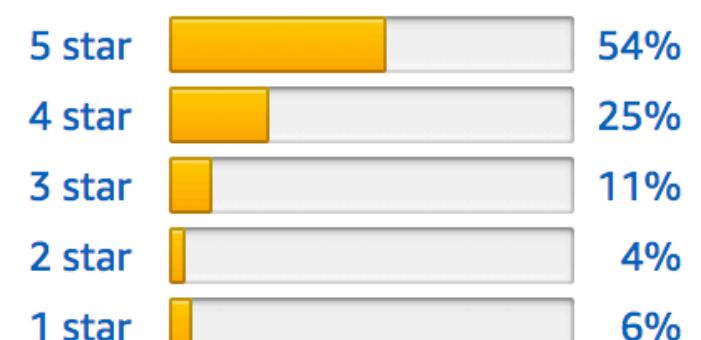
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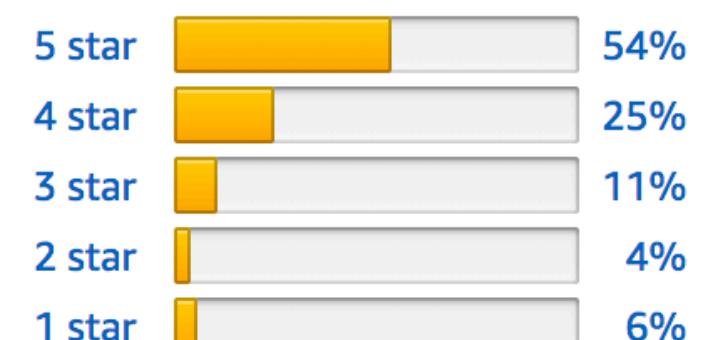
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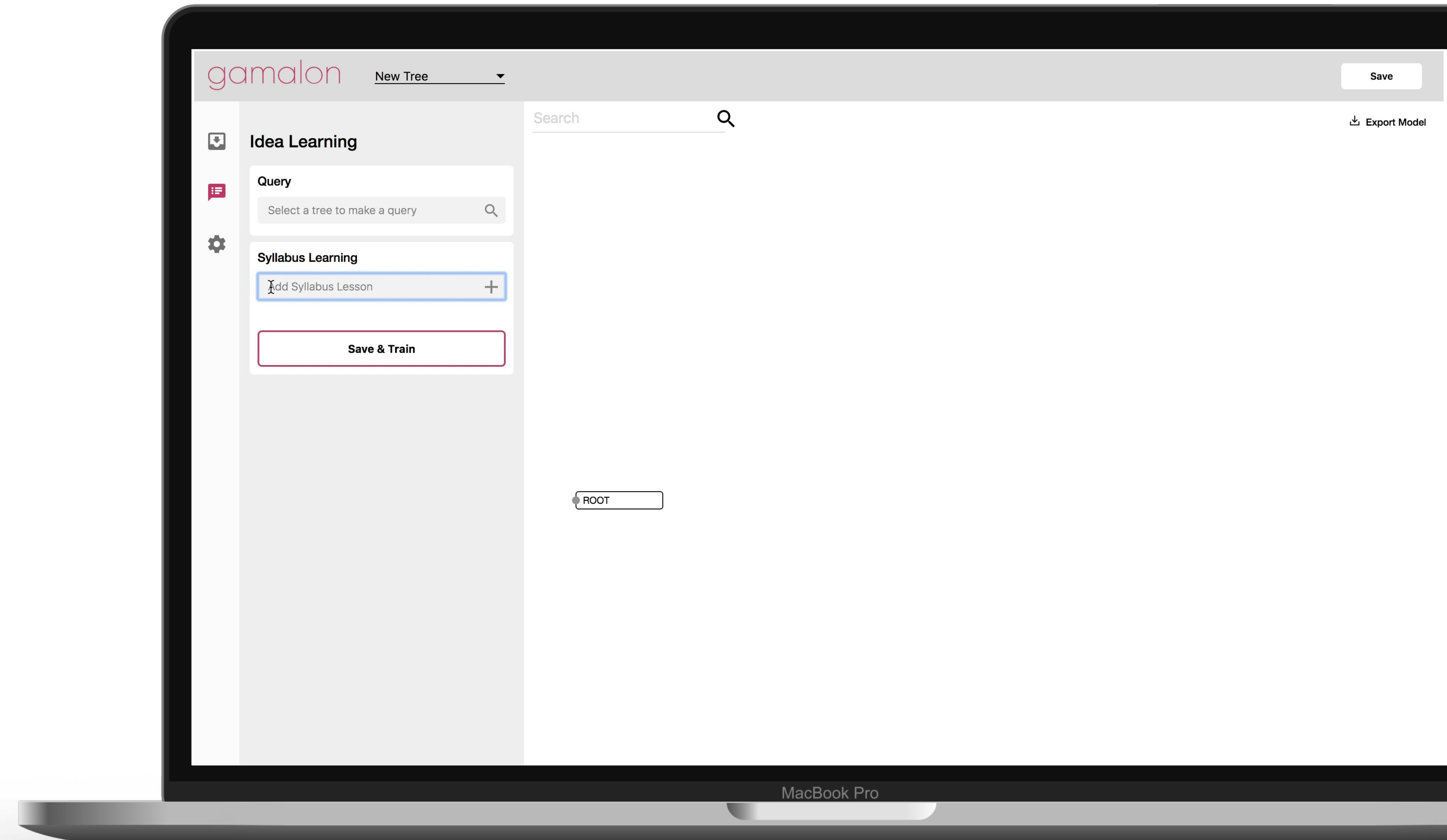
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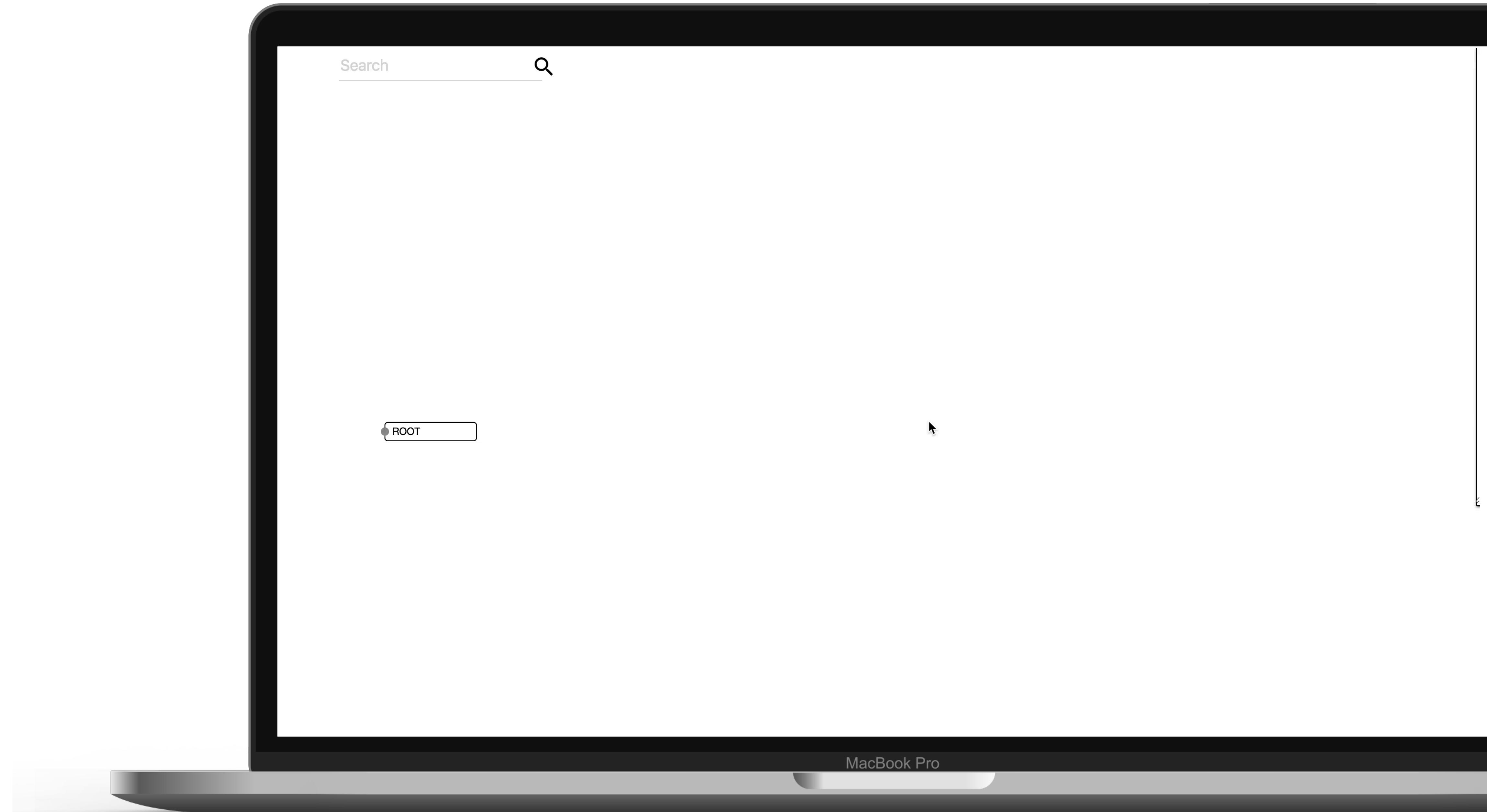
and the ideas inside them ...

MacBook Pro

| Unname d: 0 | reviewe rID | asin | helpfu l | verbatim | | ove rall | summary | time |
|-------------|-------------|-----------------|------------|----------|--|----------|------------------------------|------------|
| 0 | 1298 | A1EZEHP6WTB5DT | B0000530ED | [2, 4] | i wanted a coppery orange color and i had dyed black hair so i picked this up to strip the color out (this is something i've done before with other brands with no problem) however, this formula is so crazy thick it didnt spread at all and my hair turned out so splotchy because of it. this product was not meant to be your standard bleaching kit, its for people with already light hair who want to go lighter, if your dark like me and wanted to go lighter i suggest manic panic bleaching kit or splat. | 1 | Look elsewhere.... | 2013-04-30 |
| 1 | 23014 | A3TPO5PJMPB0F3 | B000I4POL8 | [0, 0] | i purchased this item as a gift for my mom who had ran out of nail polish and i had wished to start a new stash of colors for her. the kit came with quite a variety some i am sure she won't care for but most i believe she will. it had a good mix of different brands all in all a good purchase i would say | 5 | Nice variety | 2014-04-29 |
| 2 | 32981 | A32ZN98ZK0S0HY | B000U0CAYY | [7, 8] | this really like this product, my hair is relaxed and color treated and it makes it feel so silky. it is perfect for roller sets like you wouldn't beleive. its on my list of products to help me stretch my relaxers. | 5 | I love how my hair feels | 2009-12-05 |
| 3 | 186326 | A397T67APEEA SP | B00G36TJKW | [0, 2] | i don't like the taste that most vitamins leave in my mouth so when i saw these i immediately grabbed them. the taste is pretty great, they're not as high in calories as some of the gummies i've seen. they're 15 calories for two and you take two gummies twice a day 30 calories total thats not bad at all and low in sugar as well. my nails have grown like wildfire, i just wish they were stronger, because now they seem to break off more, but that could be because they're longer than i am used to. my hair seems thicker and fuller which says a lot for african american hair. i just wish it was more than 80 gummies in a container, but i definitely like the taste of these over that vitamin taste that gets stuck in the back of your throat. overall, highly recommended!! | 5 | Just what i need | 2014-04-15 |
| 4 | 10876 | AVLALLFRML1D4 | B00060U078 | [1, 1] | i don't know why i haven't had one of these brushes long before now. the theory is clear, that we need to exfoliate the dead cells and stimulate for the new. the brushing action feels wonderful and immediately produces a more clear skin tone. i will get a lot of use from this brush. | 5 | fabulous for the complexion | 2013-10-05 |
| 5 | 136925 | AW0V4IWF6LP0A | B006J5V6ZI | [0, 0] | by far my favorite brushes for applying my foundation. definitely better than that over rated beauty blending sponge. and they're so soft yet firm too. 😍😍😍 | 5 | These brushes are a godsend! | 2014-02-14 |
| 6 | 160179 | A2M34TR2T9YA XV | B0095BWFTY | [0, 0] | the hydra-luxe absolute hydro-nutritive face and body cream rolls on like liquid velvet and smells like a rain freshened spring morning. the cream is not greasy or oily. it doesn't sit on the skin; instead, the skin absorbs it...greedily.i have not seen any firming or 'rejuvenation' but the petal-soft and luxurious feel of this cream has moisturized my skin and made me feel papered.the tube of body cream was not easy to open so i sawed the top off with a knife and lost a blob of cream in the process.i have not found the body cream to be 'anti-cellulite' but i didn't expect it to.if you have realistic expectations and love luxury, you will love this cream. | 5 | Velvet | 2013-01-16 |



Discovering model structure from **unsupervised customer messages**

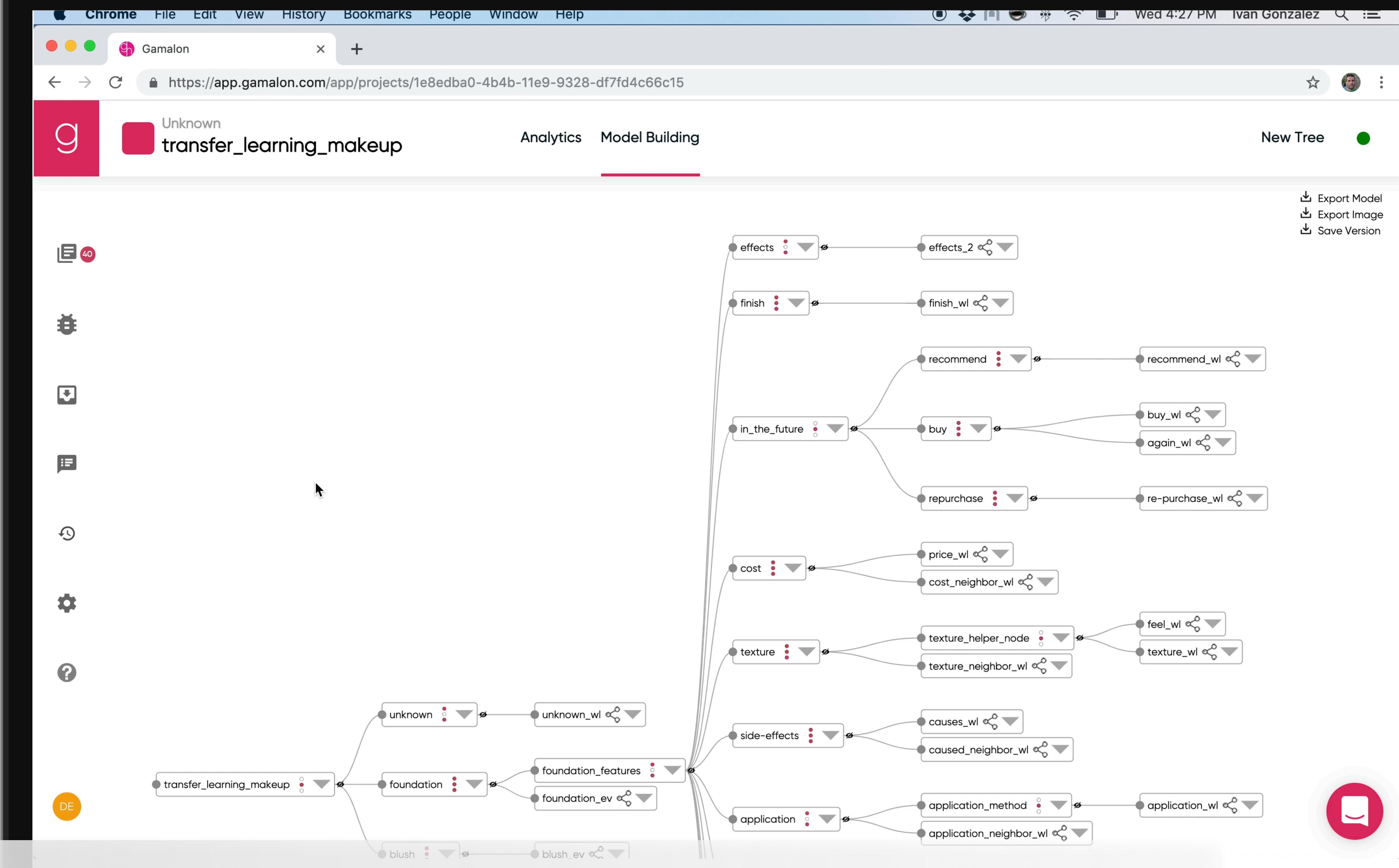


Discovering model structure from **unsupervised customer messages**

Idea Learning**Query**Query **Syllabus Learning**Add Syllabus Lesson

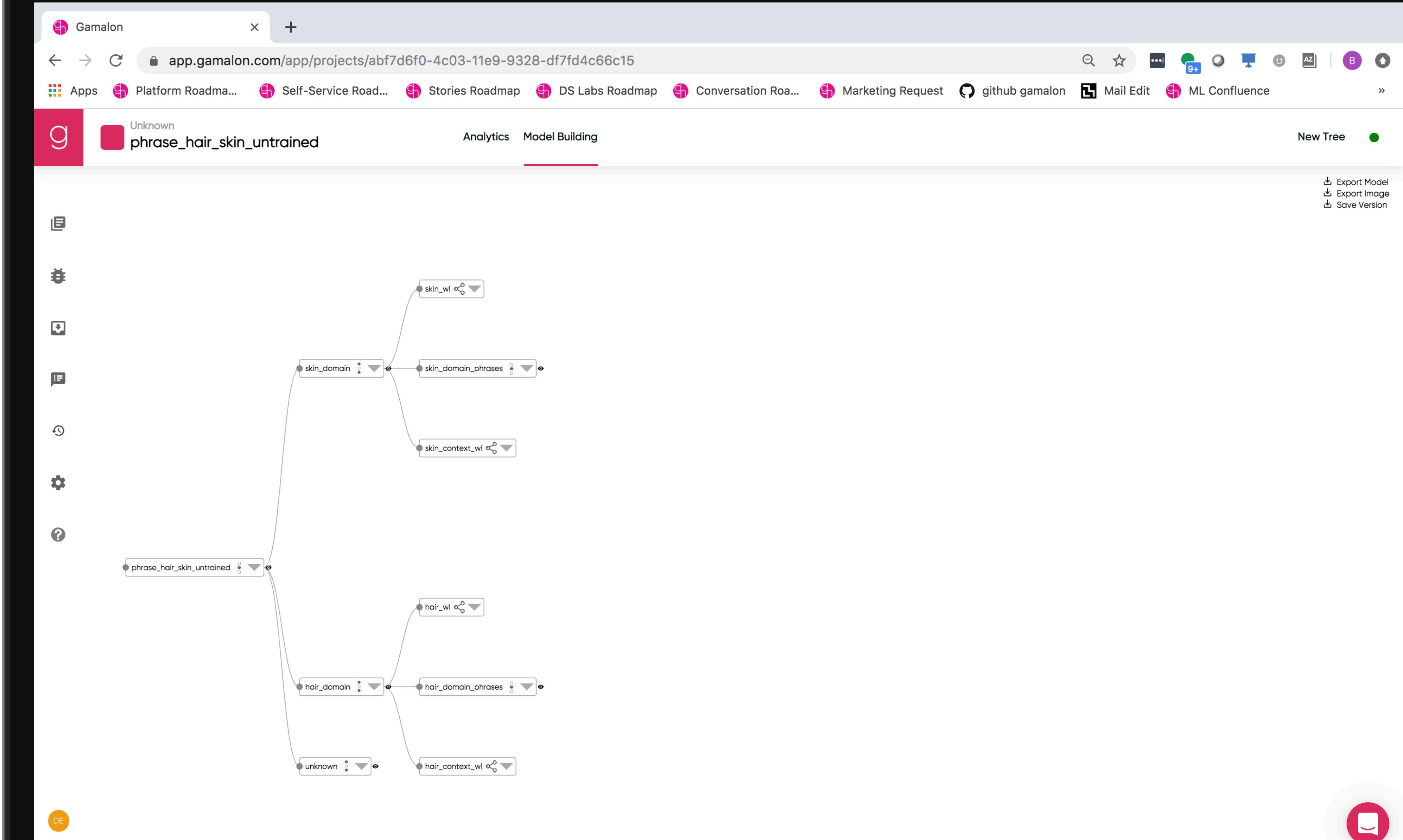
- Cancel that thing. Can you make a booking for me? I want to change my plans.
- I need to fly to Denver next week. Can we move my flight tomorrow to the evening?
- I want to book a table for two at the Samovar in San Francisco. Dinner tonight was cancelled.
- I won't be needing that room at the Marriott this weekend. Can you please see if they can change our room at the four seasons to one with an ocean view?

Search Tree **Customer message****Structured output****Category****Sub-category****Send a message through the model**



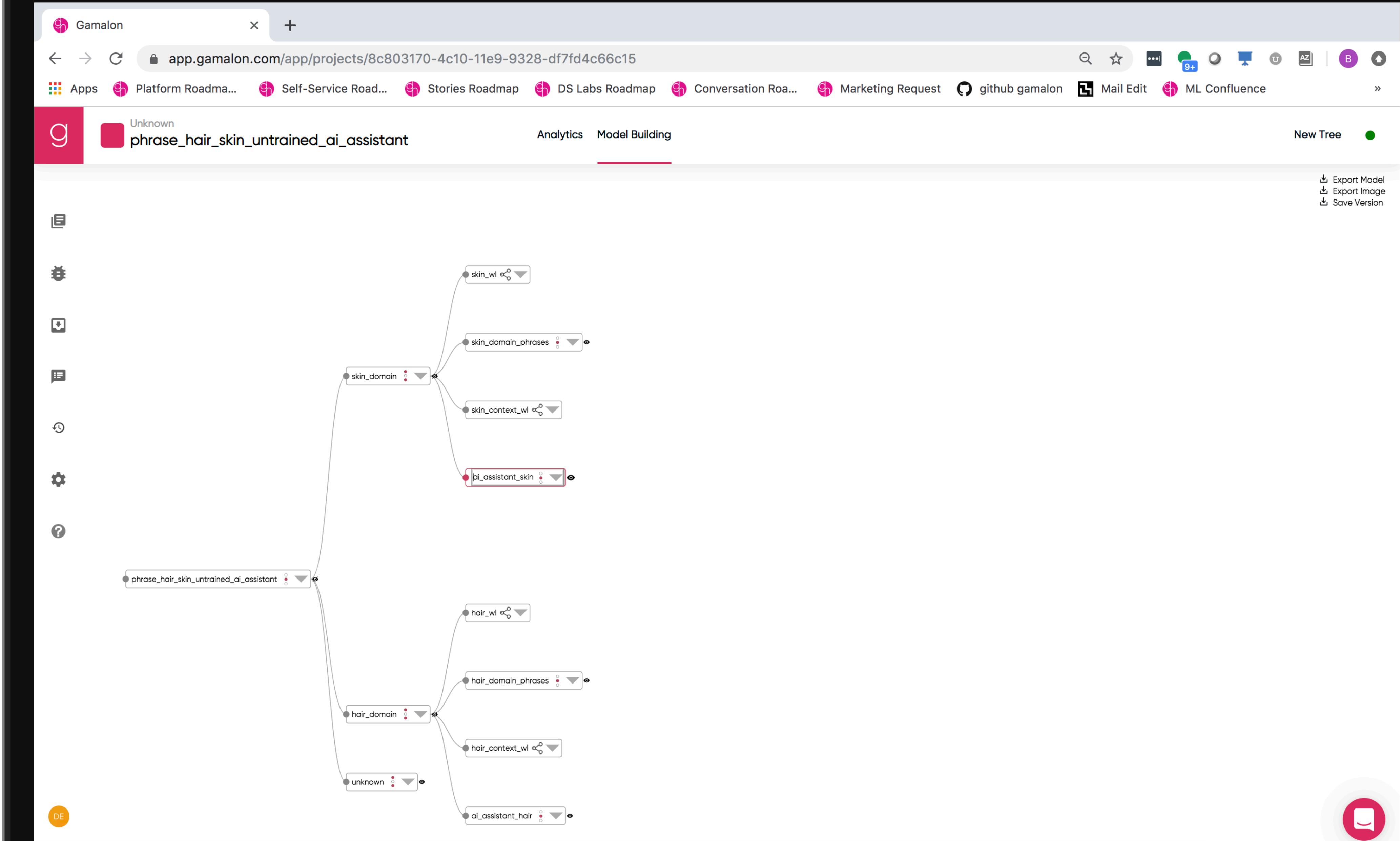
Transfer learning of ideas within and across models

MacBook Pro



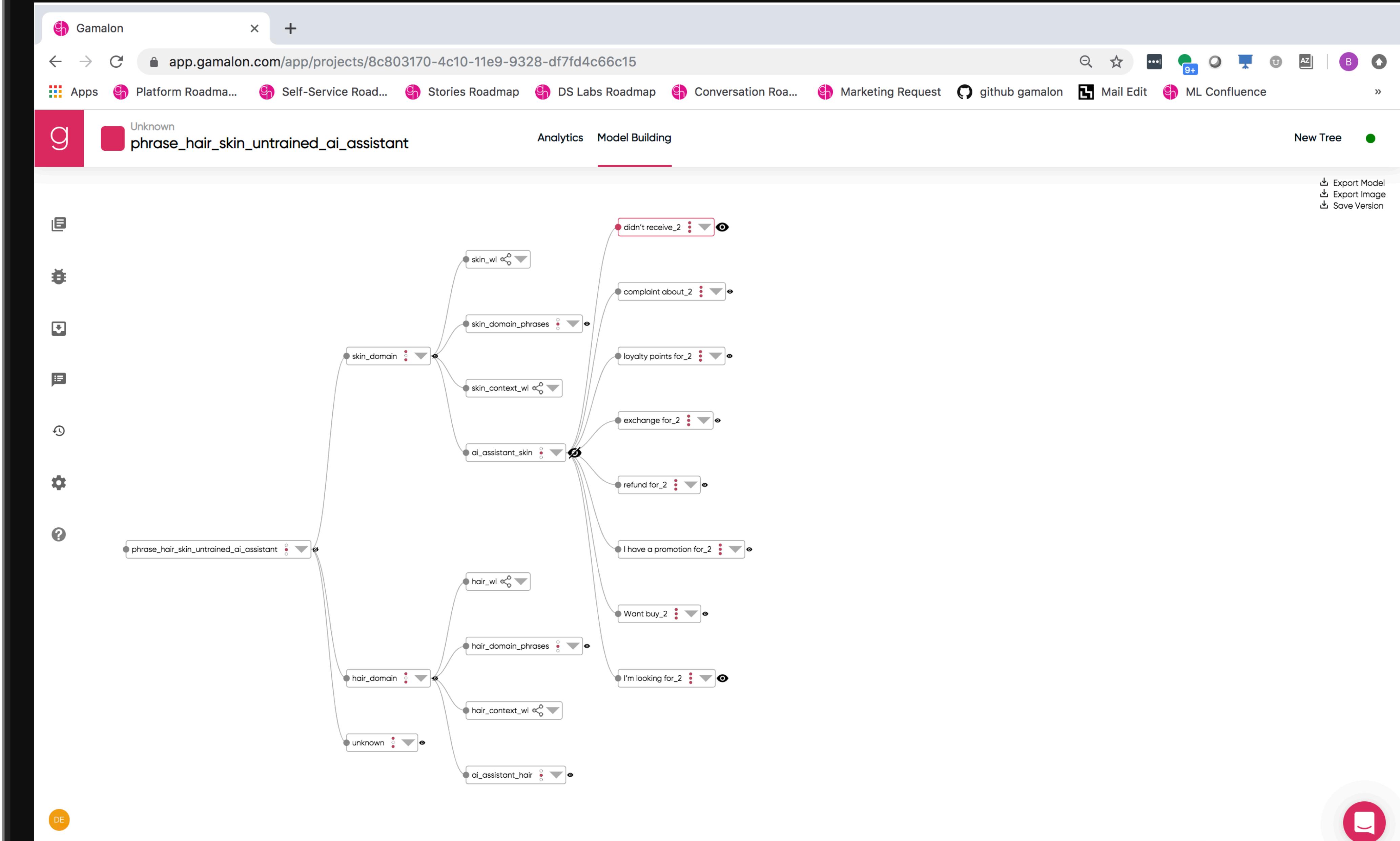
Product model **before** adding Assistant functionality

MacBook Pro



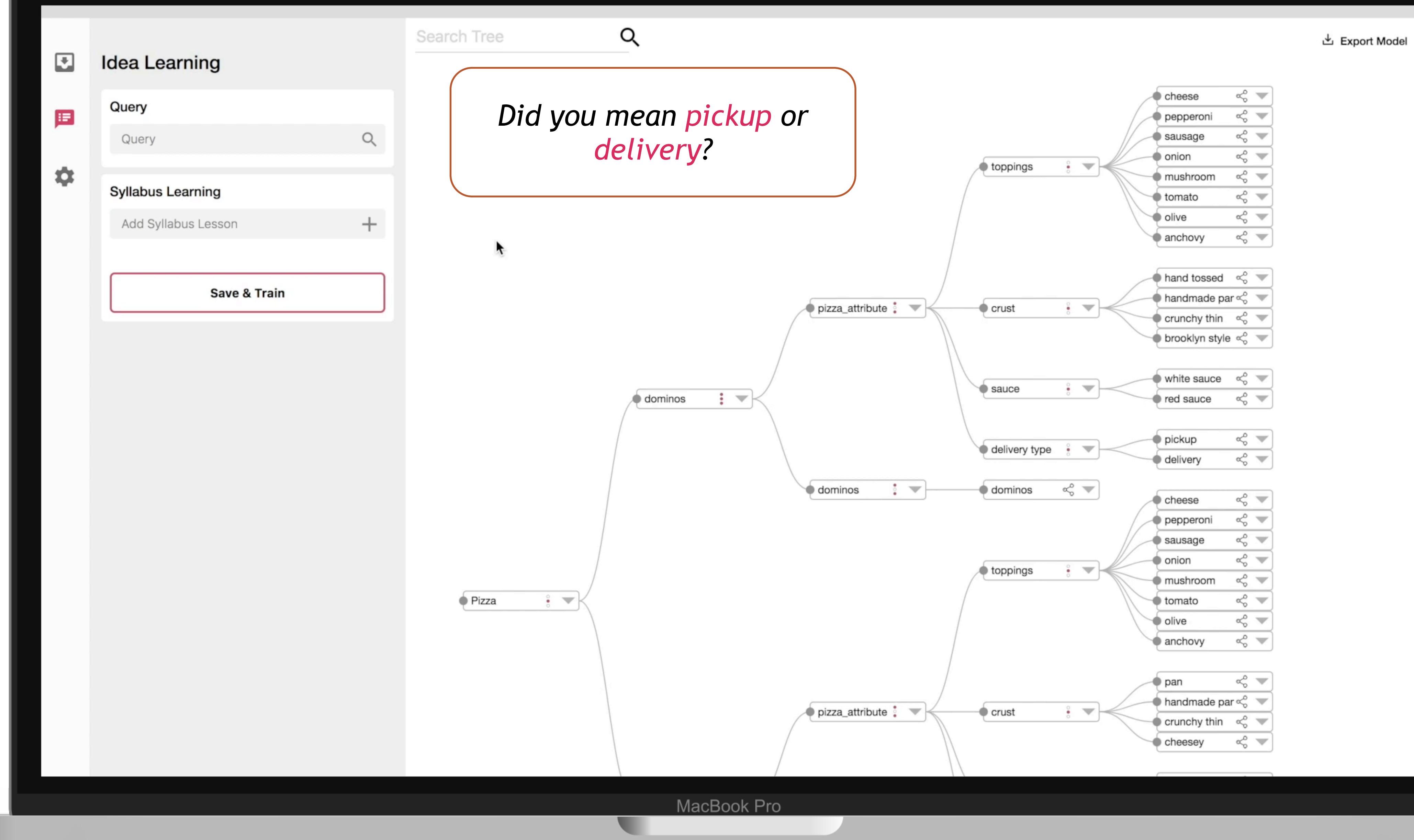
Product model after adding Assistant functionality

MacBook Pro



Product model after adding Assistant functionality

MacBook Pro



Clarifying Questions: the user enters as much information as they want, all at once. The system requests missing information.

Idea Learning

Query

brooklyn pizza with white
sauce and onion

Utterance Classification

dominos:1.00
dominos:1.00
dominos:1.00
pizza_attributes:1.00
crust:1.00
brooklyn style:1.00
sauce:1.00
white sauce:1.00
toppings:1.00
onion:1.00

Syllabus Learning

Add Syllabus Lesson +
Save & Train

Pizza

Search Tree

Did you mean pickup or delivery?

```

graph TD
    Pizza[Pizza] --> dominos1[dominos]
    dominos1 --> dominos2[dominos]
    dominos2 --> dominos3[dominos]
    dominos3 --> toppings1[toppings]
    dominos3 --> crust[crust]
    dominos3 --> sauce[sauce]
    dominos3 --> delivery[delivery type]
    toppings1 --> cheese1[cheese]
    toppings1 --> pepperoni1[pepperoni]
    toppings1 --> sausage1[sausage]
    toppings1 --> onion1[onion]
    toppings1 --> mushroom1[mushroom]
    toppings1 --> tomato1[tomato]
    toppings1 --> olive1[olive]
    toppings1 --> anchovy1[anchovy]
    crust --> hand_tossed1[hand tossed]
    crust --> handmade1[handmade par]
    crust --> crunchy_thin1[crunchy thin]
    crust --> brooklyn_style1[brooklyn style]
    sauce --> white_sauce1[white sauce]
    sauce --> red_sauce1[red sauce]
    delivery --> pickup1[pickup]
    delivery --> delivery1[delivery]
    toppings1 --> pan[pan]
  
```

Clarifying Questions: the user forgets required information. The system clarifies.

Idea Learning

Query

query

brooklyn pizza with white
sauce and onion for pickup
no delivery

Utterance Classification

dominos:1.00
dominos:1.00
dominos:1.00
pizza_attributes:1.00
crust:1.00
brooklyn style:1.00
delivery type:1.00
delivery:0.60
sauce:1.00
white sauce:1.00
toppings:1.00

Syllabus Learning

Add Syllabus Lesson +

Save & Train

Search Tree

Did you mean *dominos* or *pizza hut*?

```

graph TD
    Pizza((Pizza)) --- dominos1[dominos]
    Pizza --- toppings1[toppings]
    dominos1 --- dominos2[dominos]
    dominos1 --- pizza_attribute[pizza_attribute]
    toppings1 --- toppings2[toppings]
    toppings2 --- cheese[cheese]
    toppings2 --- pepperoni[pepperoni]
    toppings2 --- sausage[sausage]
    toppings2 --- onion[onion]
    toppings2 --- mushroom[mushroom]
    toppings2 --- tomato[tomato]
    toppings2 --- olive[olive]
    toppings2 --- anchovy[anchovy]
    pizza_attribute --- crust[crust]
    crust --- hand_tossed[hand tossed]
    crust --- handmade_par[handmade par]
    crust --- crunchy_thin[crunchy thin]
    crust --- brooklyn_style[brooklyn style]
    sauce[white sauce] --- white_sauce[white sauce]
    sauce[red sauce] --- red_sauce[red sauce]
    delivery_type[pickup] --- pickup[pickup]
    delivery_type[delivery] --- delivery[delivery]
    toppings2 --- pan[pan]
  
```

MacBook Pro

Clarifying Questions for accuracy.



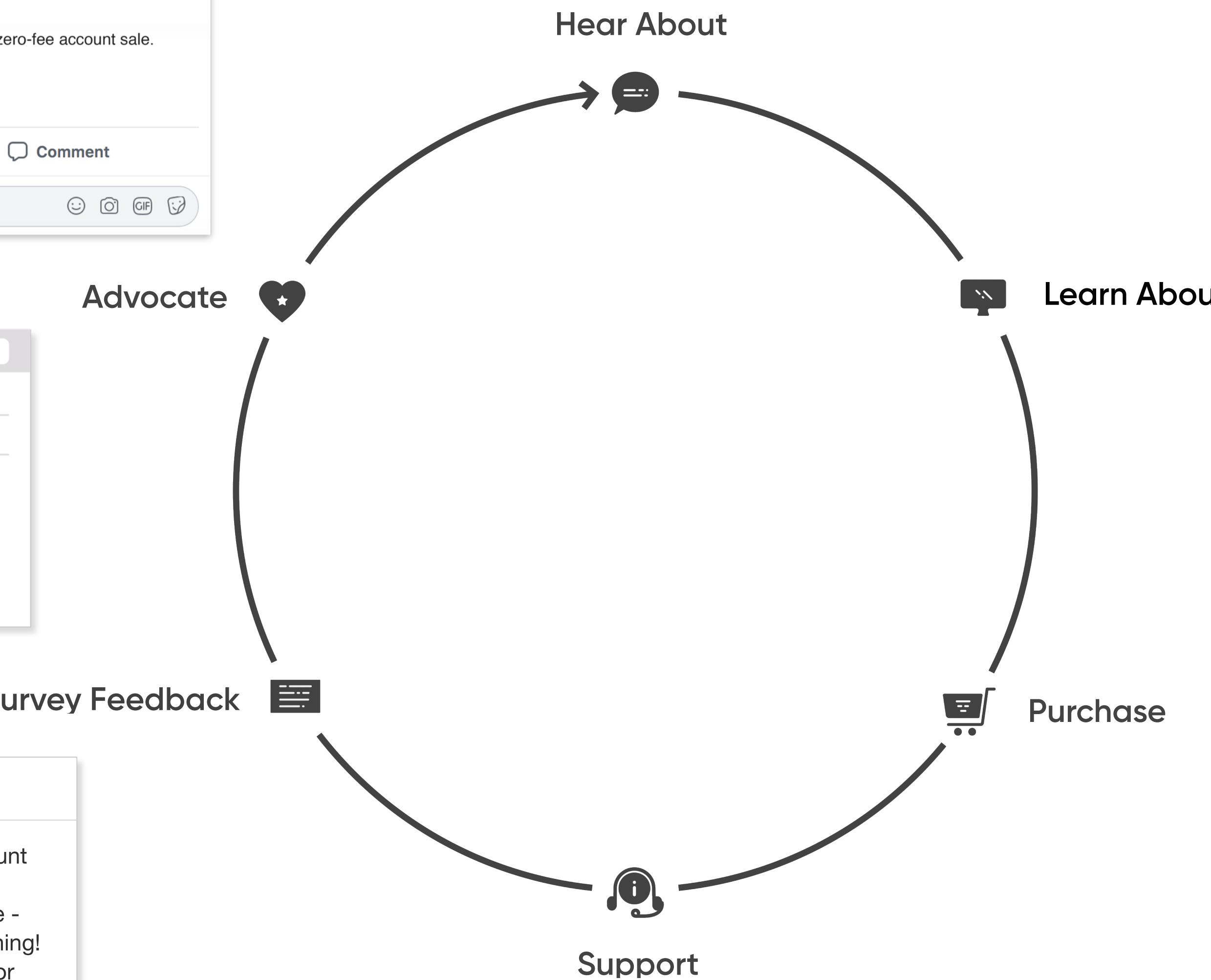
We can also do this for human-human conversations such as website chat, so that we can understand and improve what people are saying.

Now your marketing department can understand any shape of text,

Facebook Post: Michael Lancaster is commenting about Fin co. 7 hrs · For anyone who is interested, Fin co. is having a zero-fee account sale. Seems like a good deal, think I'll jump on it. 15 likes.

Email Inquiry: To: EnergyCo Subject: Inquiry. I'd like to explore solar subsidies and associated costs for installation. I'm also curious about expected cost savings. Best, TJ

Survey Feedback: Comments? Leave us some feedback. "I called yesterday to try and get the account balance for my husband's account. The person who was helping me was very rude - they acted like I was trying to steal something! You should really make sure it's possible for spouses to get information, since the main account holder isn't always available. It was overall a very frustrating experience."



"I tried login, but was locked out."

Hi I am having an issue with your website and I also need help deciding on a credit card

No problem – let's start with the website problem, then I can help you decide on a card

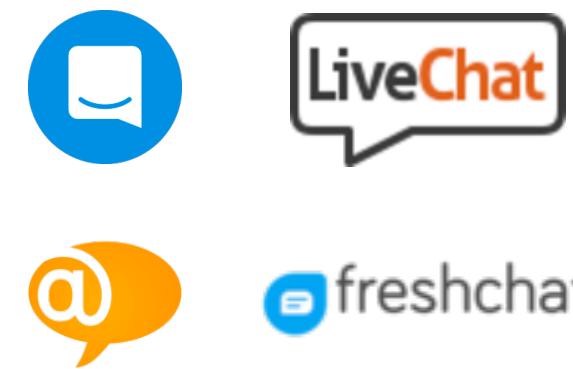
Great - the website crashes every time I try to view the details about your new travel card. SO I can't figure out which one I want. I eat out a lot so I want something that gives me dining benefits.

I understand. We do currently have an outage on our card offering explorer pages, but here is a link to an article that explains the differences. That should be back up shortly, and we apologize for the delay. For dining specifically, I would recommend the gold or silver premier cards, as it is the one that includes 1.5x points for dining specifically. If you give me some additional information, I can help narrow it down for you further.

and rapidly **learn a connector** to the software data formats in existing systems.

gamalon

Website Chat



Botkit

Call Center and CRM



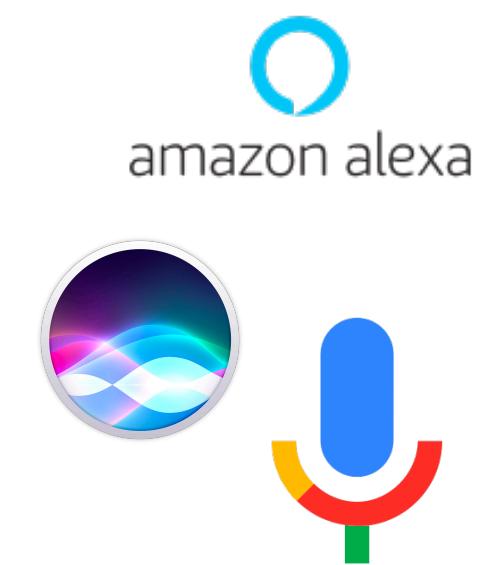
Marketing



Survey



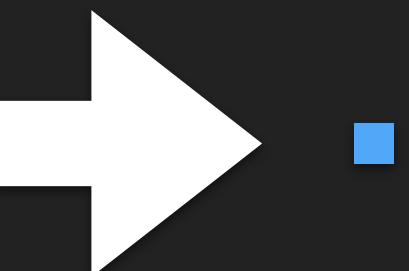
Assistant



gamalon

Probabilistic program that generates triangles:

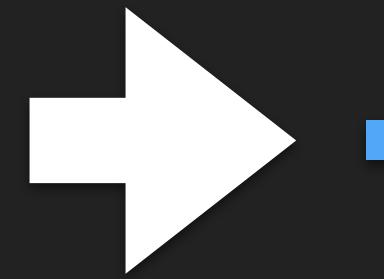
choose random start_location for line_1



Probabilistic program that generates triangles:

choose random start_location for line_1

choose random end_location for line_1

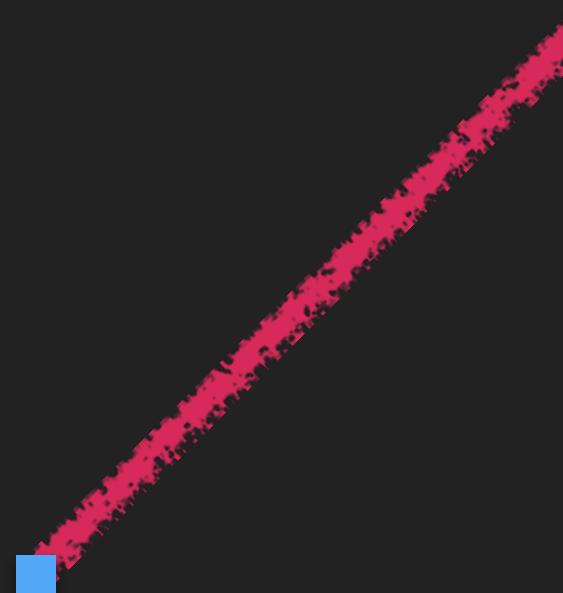


Probabilistic program that generates triangles:

choose random start_location for line_1

choose random end_location for line_1

draw line_1



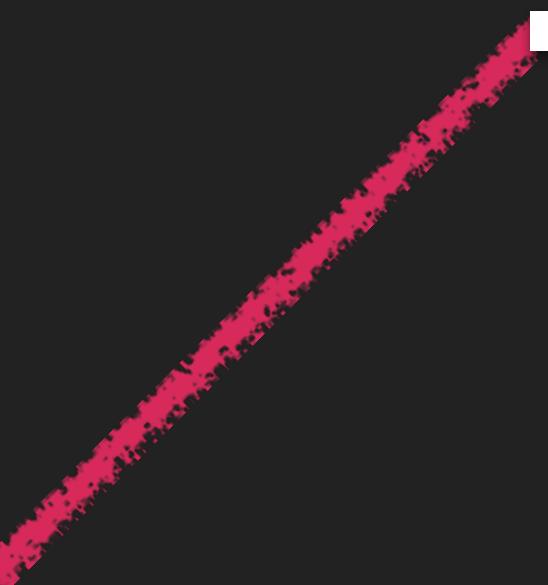
Probabilistic program that generates triangles:

choose random start_location for line_1

choose random end_location for line_1

draw line_1

set start_location for line_2: same as end_location for line_1



Probabilistic program that generates triangles:

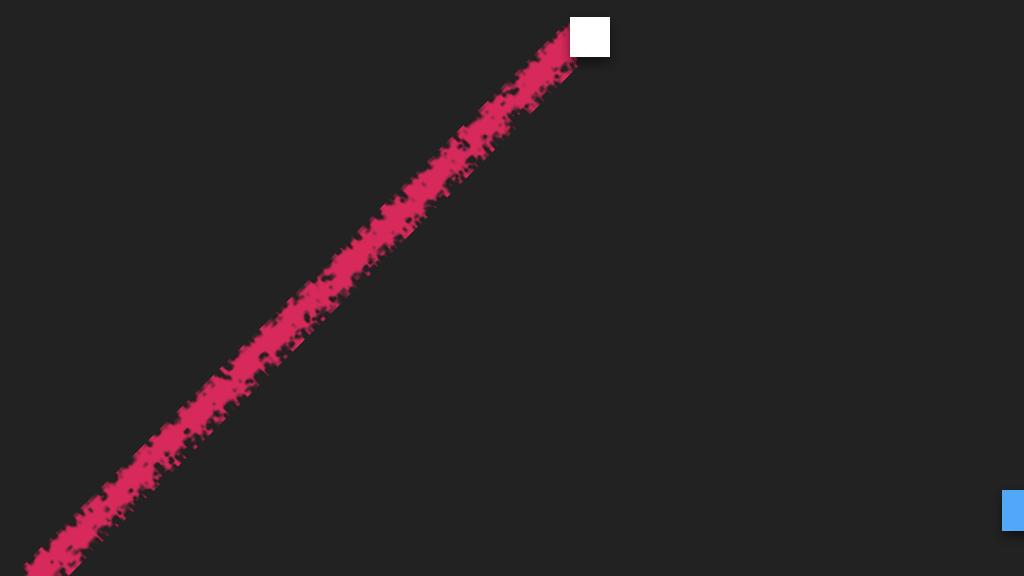
choose random start_location for line_1

choose random end_location for line_1

draw line_1

set start_location for line_2: same as end_location for line_1

choose random end_location for line_2



Probabilistic program that generates triangles:

choose random start_location for line_1

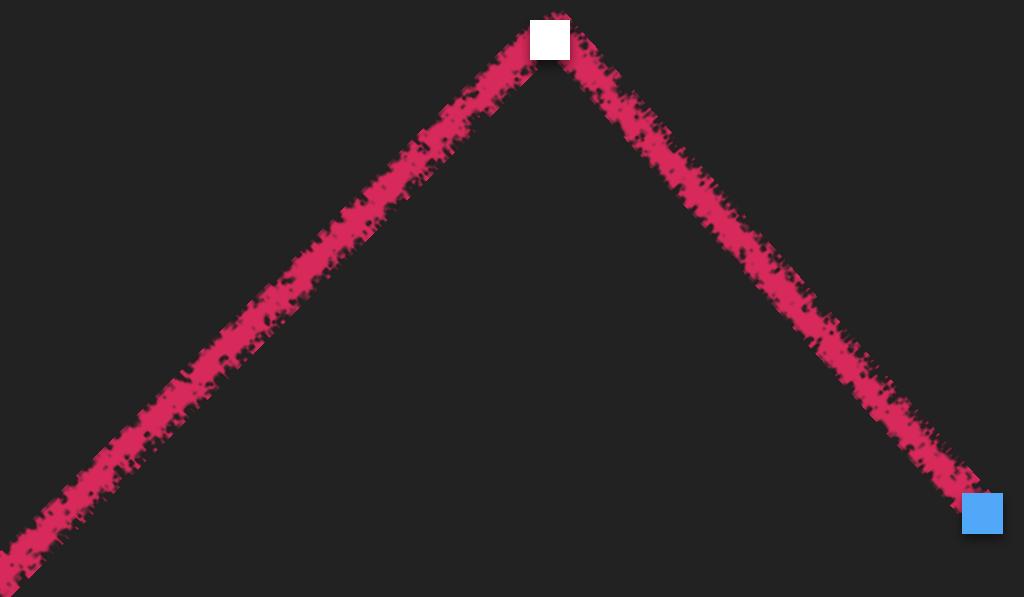
choose random end_location for line_1

draw line_1

set start_location for line_2: same as end_location for line_1

choose random end_location for line_2

draw line_2



Probabilistic program that generates triangles:

choose random start_location for line_1

choose random end_location for line_1

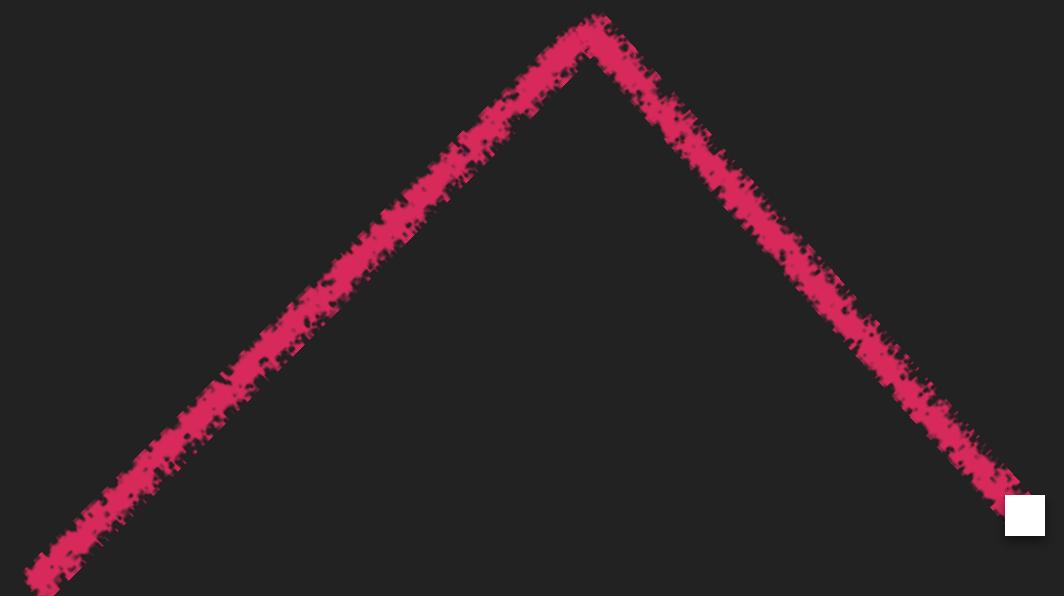
draw line_1

set start_location for line_2: same as end_location for line_1

choose random end_location for line_2

draw line_2

set start_location for line_3. same as end_location for line_2



Probabilistic program that generates triangles:

choose random start_location for line_1

choose random end_location for line_1

draw line_1

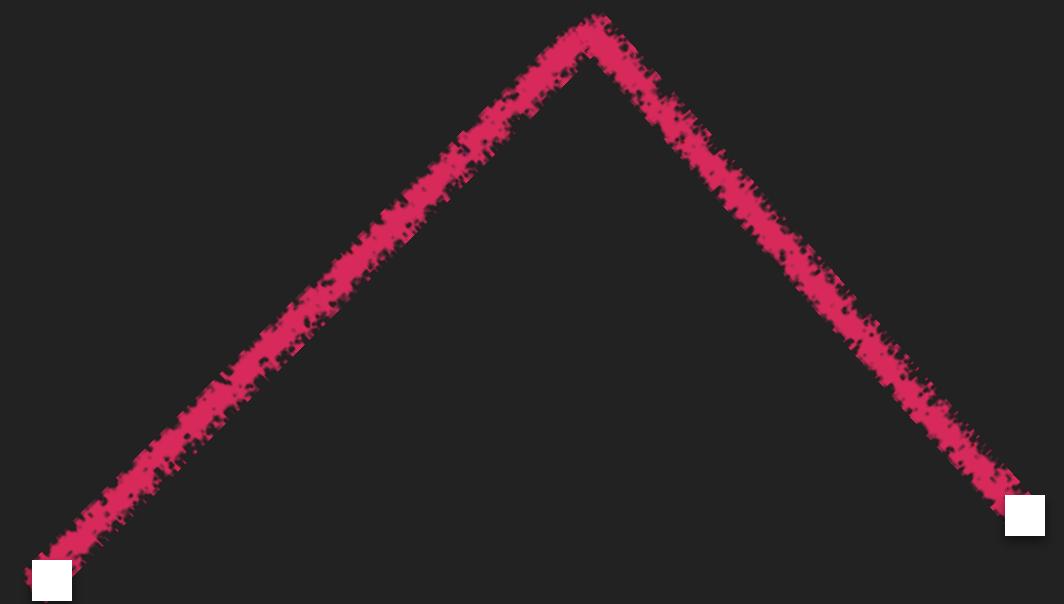
set start_location for line_2: same as end_location for line_1

choose random end_location for line_2

draw line_2

set start_location for line_3. same as end_location for line_2

set end_location for line_3. same as start_location for line_1



Probabilistic program that generates triangles:

choose random start_location for line_1

choose random end_location for line_1

draw line_1

set start_location for line_2: same as end_location for line_1

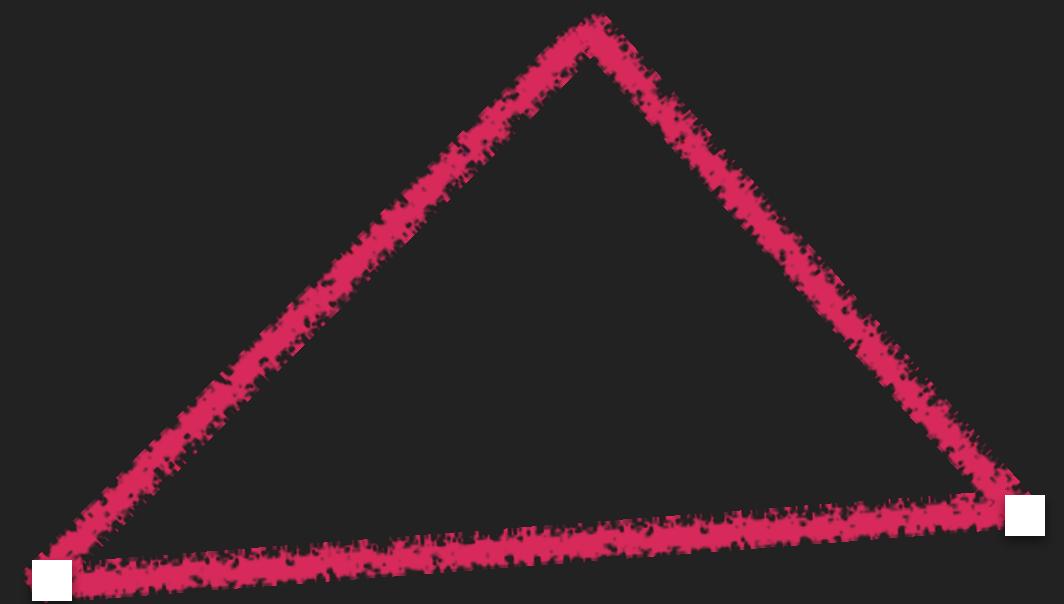
choose random end_location for line_2

draw line_2

set start_location for line_3. same as end_location for line_2

set end_location for line_3. same as start_location for line_1

draw line_3



Probabilistic program that generates triangles:

choose random start_location for line_1

choose random end_location for line_1

draw line_1

set start_location for line_2: same as end_location for line_1

choose random end_location for line_2

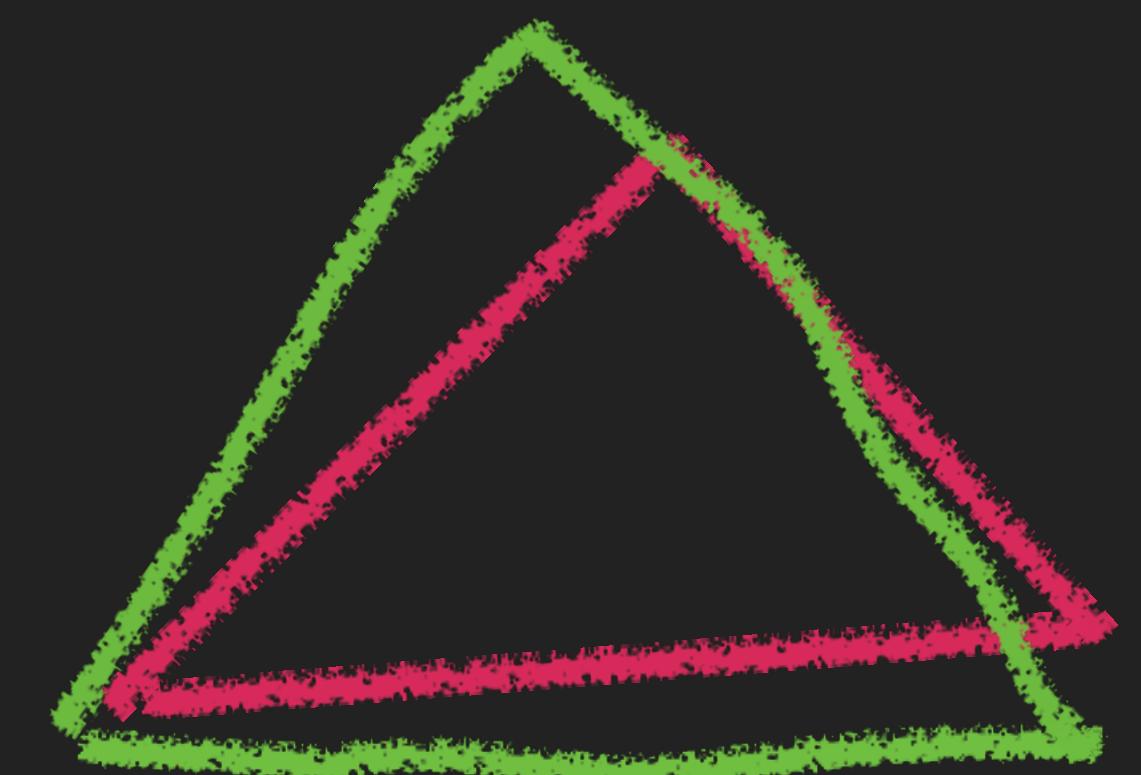
draw line_2

set start_location for line_3. same as end_location for line_2

set end_location for line_3. same as start_location for line_1

draw line_3

compare generated triangle versus a real drawing



Probabilistic program that generates triangles:

choose random start_location for line_1

choose random end_location for line_1

draw line_1

set start_location for line_2: same as end_location for line_1

choose random end_location for line_2

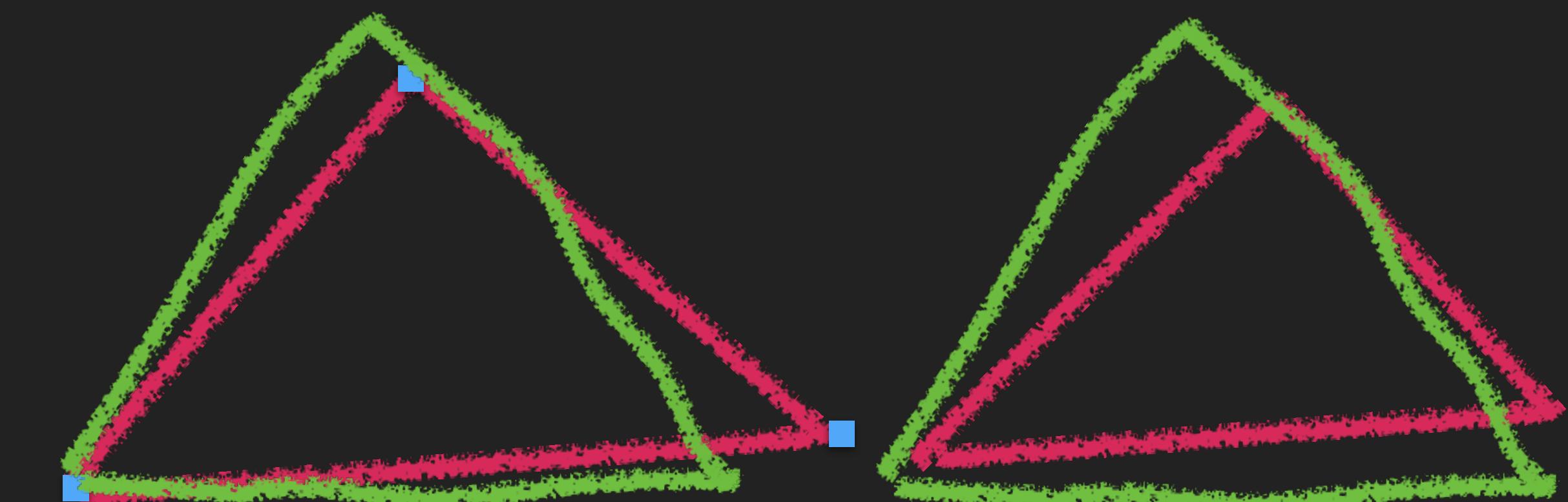
draw line_2

set start_location for line_3. same as end_location for line_2

set end_location for line_3. same as start_location for line_1

draw line_3

compare generated triangle versus a real drawing



Probabilistic program that generates triangles:

choose random start_location for line_1

choose random end_location for line_1

draw line_1

set start_location for line_2: same as end_location for line_1

choose random end_location for line_2

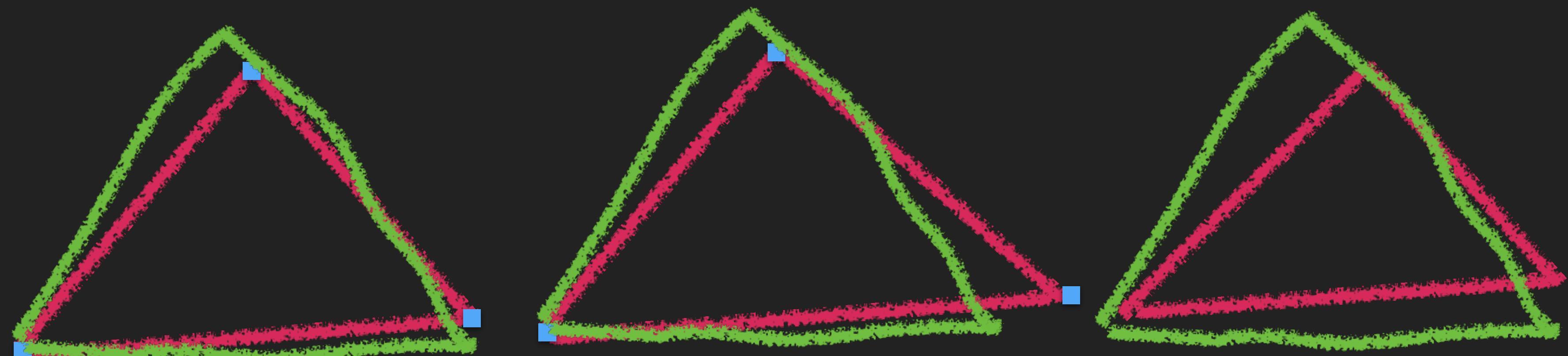
draw line_2

set start_location for line_3. same as end_location for line_2

set end_location for line_3. same as start_location for line_1

draw line_3

compare generated triangle versus a real drawing



Probabilistic program that generates triangles:

choose random start_location for line_1

choose random end_location for line_1

draw line_1

set start_location for line_2: same as end_location for line_1

choose random end_location for line_2

draw line_2

set start_location for line_3. same as end_location for line_2

set end_location for line_3. same as start_location for line_1

draw line_3

compare generated triangle versus a real drawing

