Eero Aarnio

ball chair, designed in 1963

a **chair** is to **sit** on

engineering specs

quiz! what product matches the spec?

attribute	metric	unit	value
damage detection	visible detection	binary	yes/no
solidifies in heat	thermo-sets	binary	yes/no
household usability	curing temperature	Celsius	between 50 and 100
producability	manufacturing time	days	between 1 and 2
food safe	FDA approved mat'ls.	binary	yes/no
Atkins-diet friendly	carbohydrate content	grams/product	less than 1

engineering specs

quiz! what product matches the spec?

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solidifies in heat	thermo-sets
household usability	curing temperature
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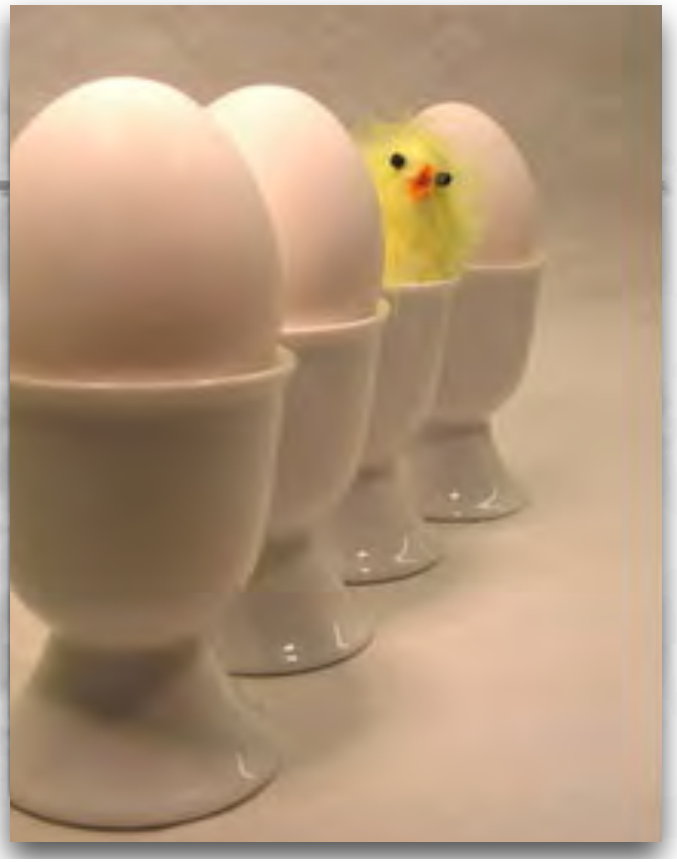
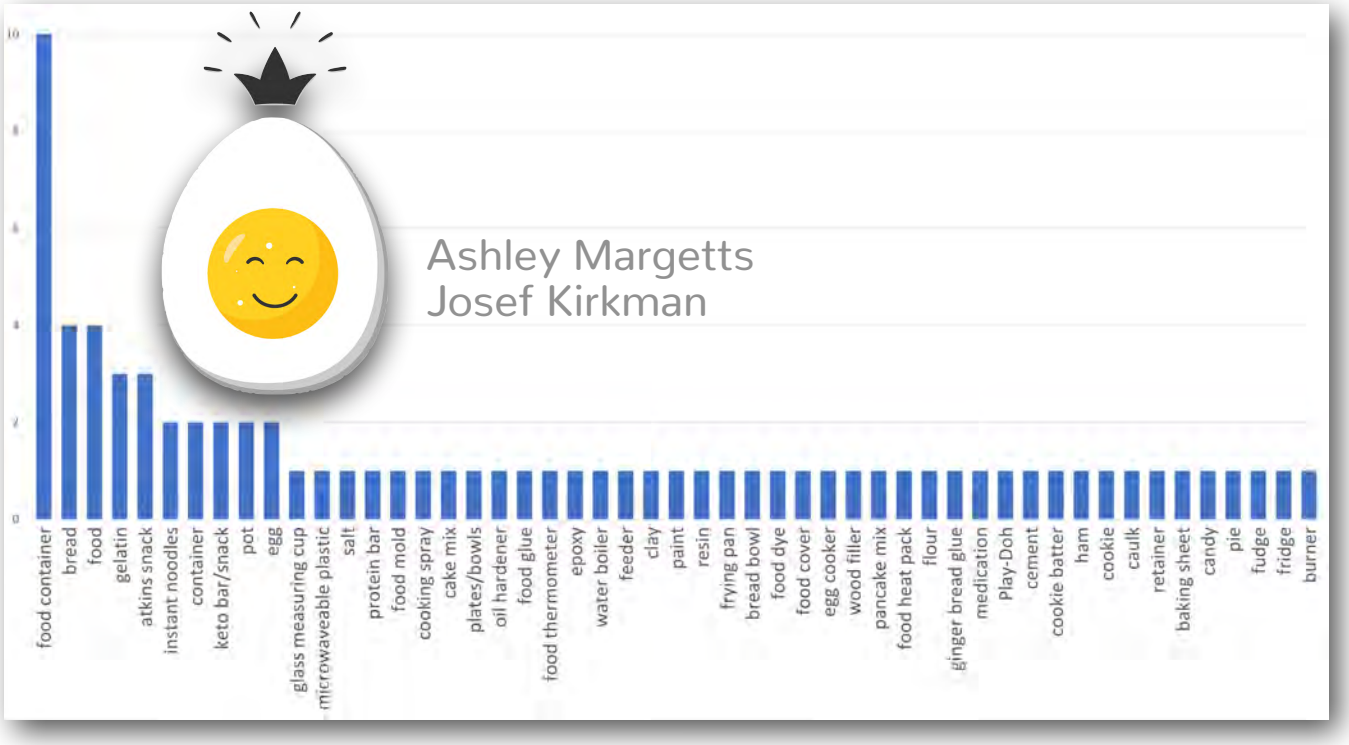
food safe	FDA approved mat'ls.
Atkins-diet friendly	carbohydrate content



engineering specs

quiz! what product matches the spec?



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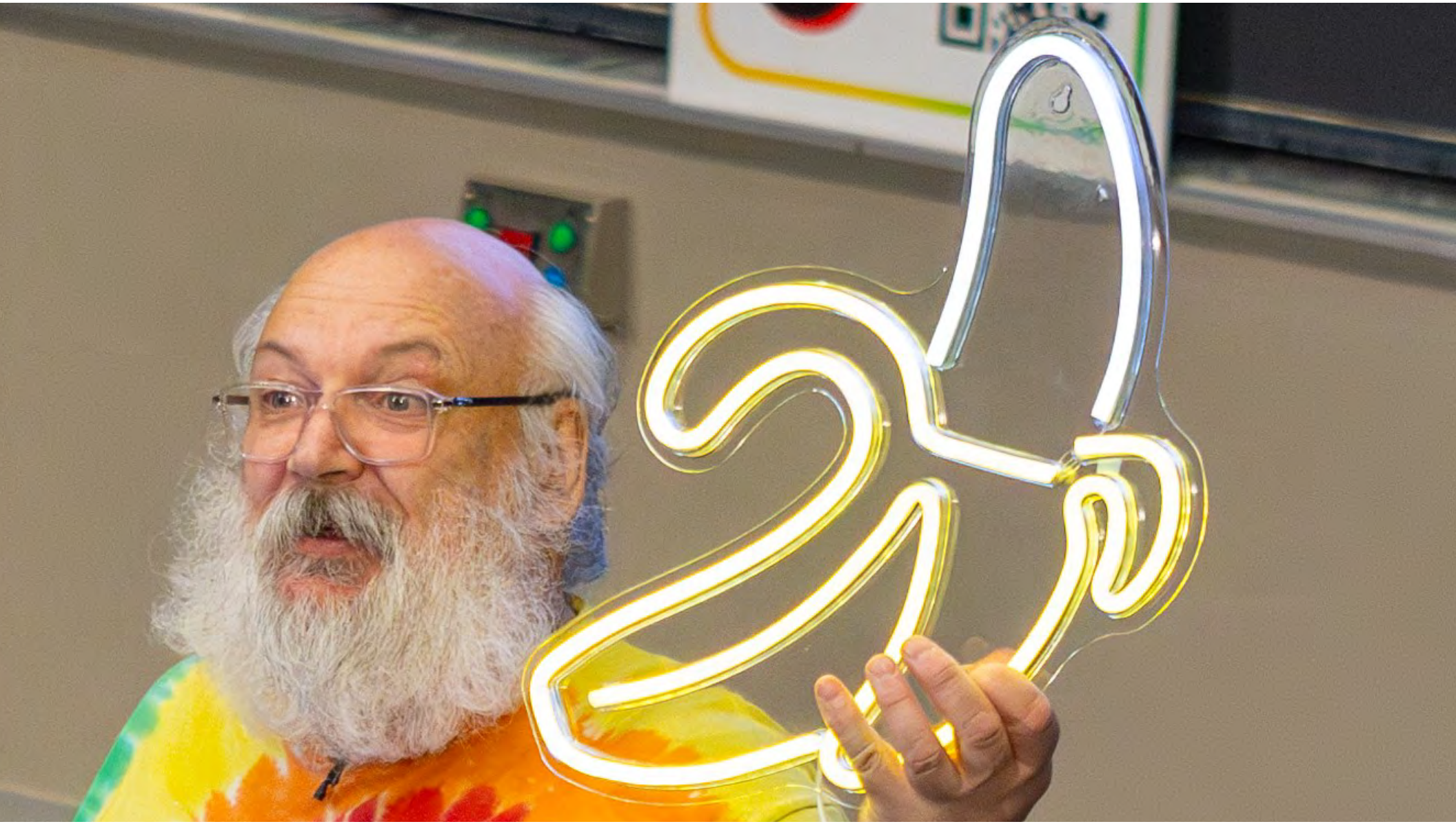


Baran Mensah
Emma Higgason
Shreya Agarwal
Brandon Worrell
Grey Sarmiento
Isabel Sperandio
Josef Kirkman
Hana Ro

specifications

secondary research

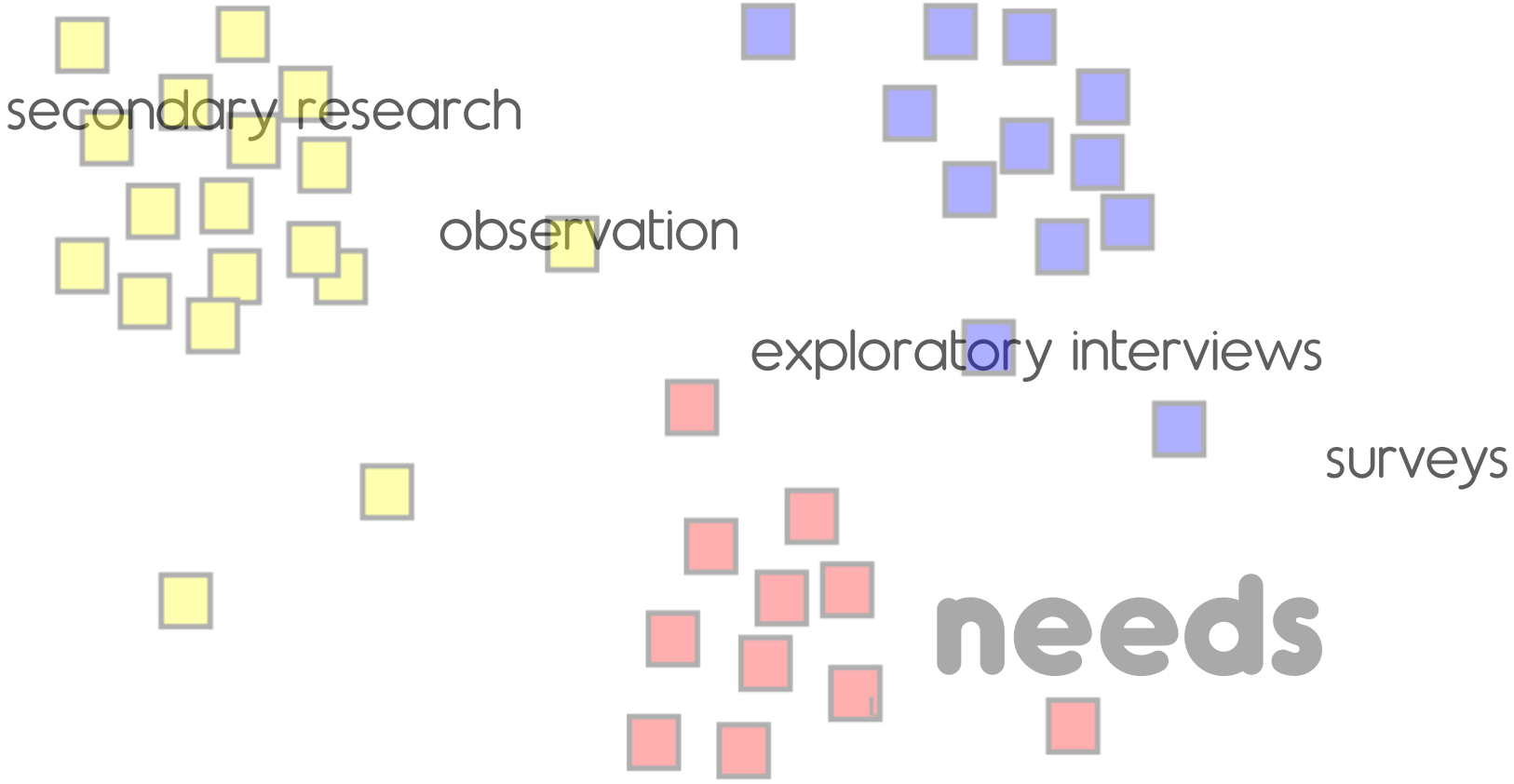
observation

exploratory interviews

surveys

needs

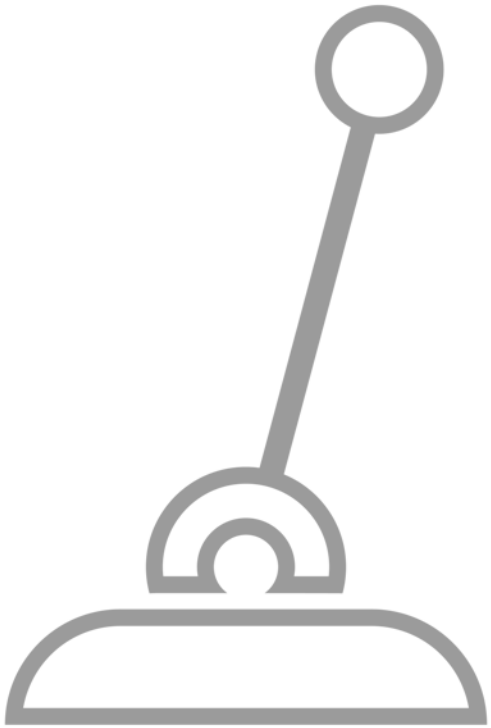
specifications



specifications

user need(s)	product attribute(s)	engineering specification(s)
can be easily transported		
is easily stored in the home garage		
can handle most repair situations		
can be used on many uneven surfaces		

specifications

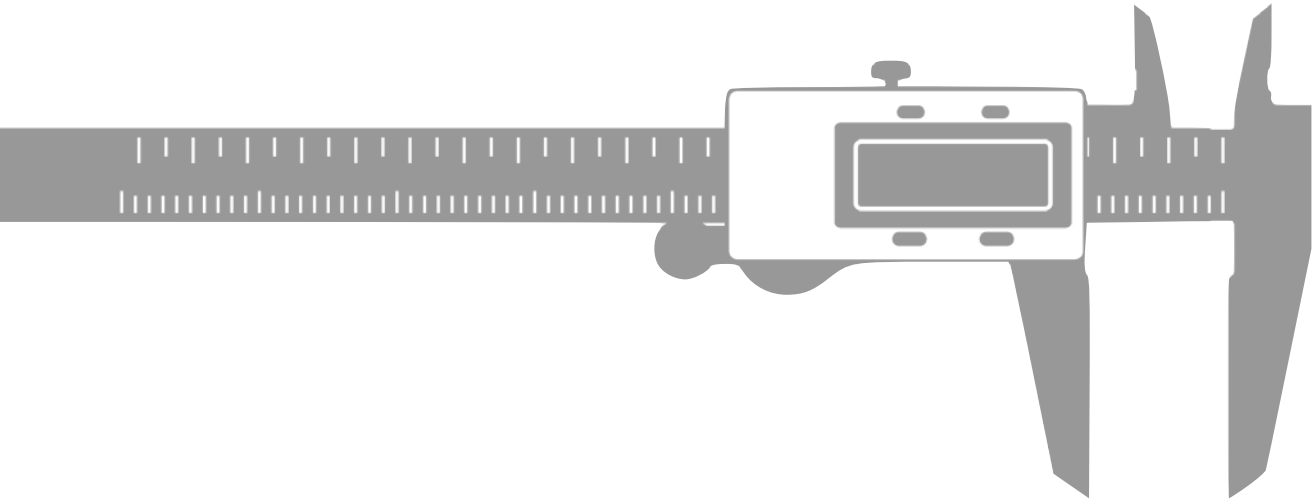


attributes

specifications

user need(s)	product attribute(s)	engineering specification(s)
can be easily transported	weight	
is easily stored in the home garage	size	
can handle most repair situations	capacity	
can be used on many uneven surfaces	stability	

specifications



engineering

specifications

user need(s)	product attribute(s)	engineering specification(s)
can be easily transported	weight	less than 40 pounds
is easily stored in the home garage	size	less than a 24″ cube
can handle most repair situations	capacity	up to 3000 pounds
can be used on many uneven surfaces	stability	stabile at 16″ height with 400 lb side load

engineering specs

definition: a measurable description of what the **product must do**

user need: easy to setup

interpretation: time to assemble under 60 seconds

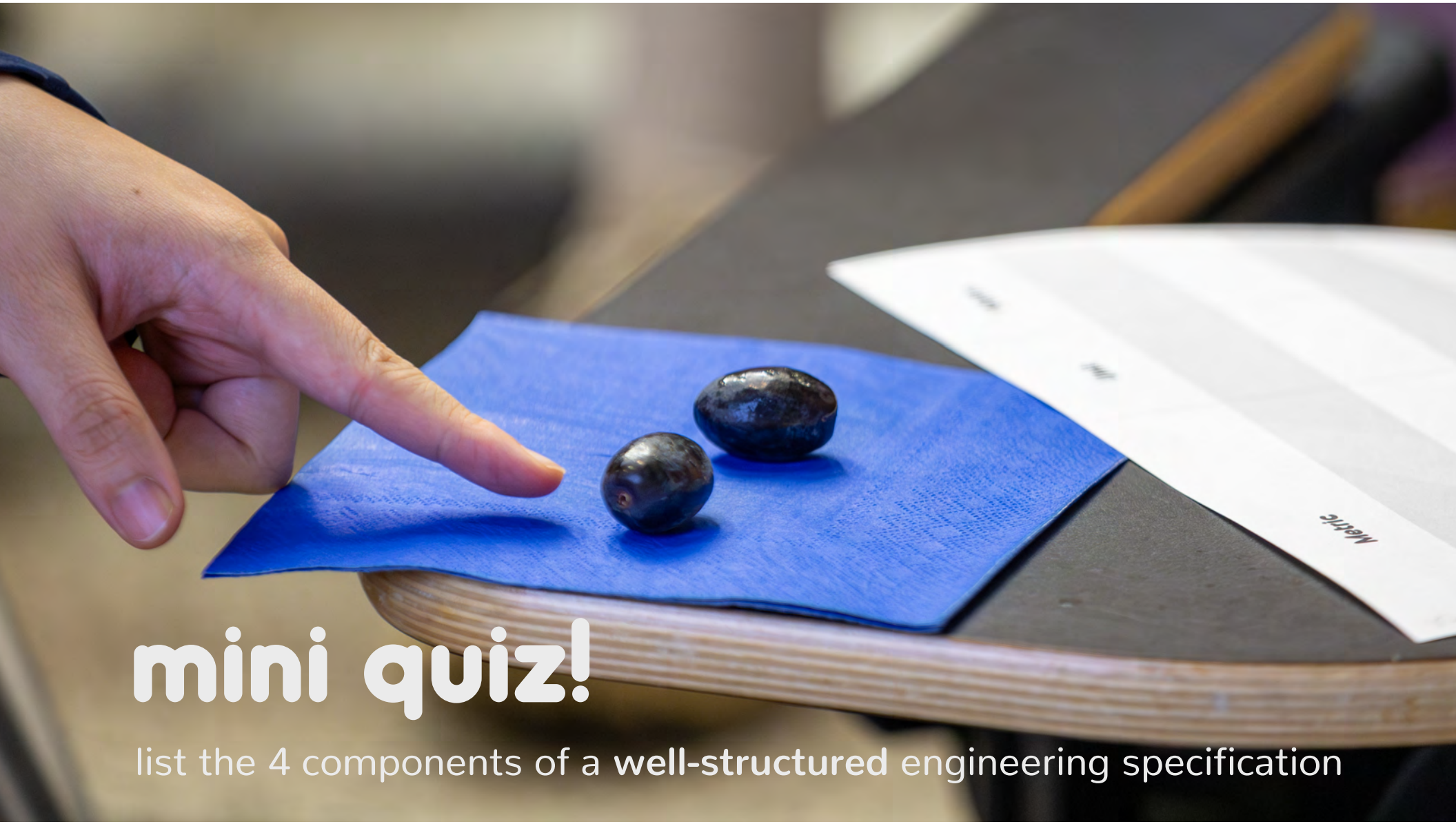
design attribute: assembly

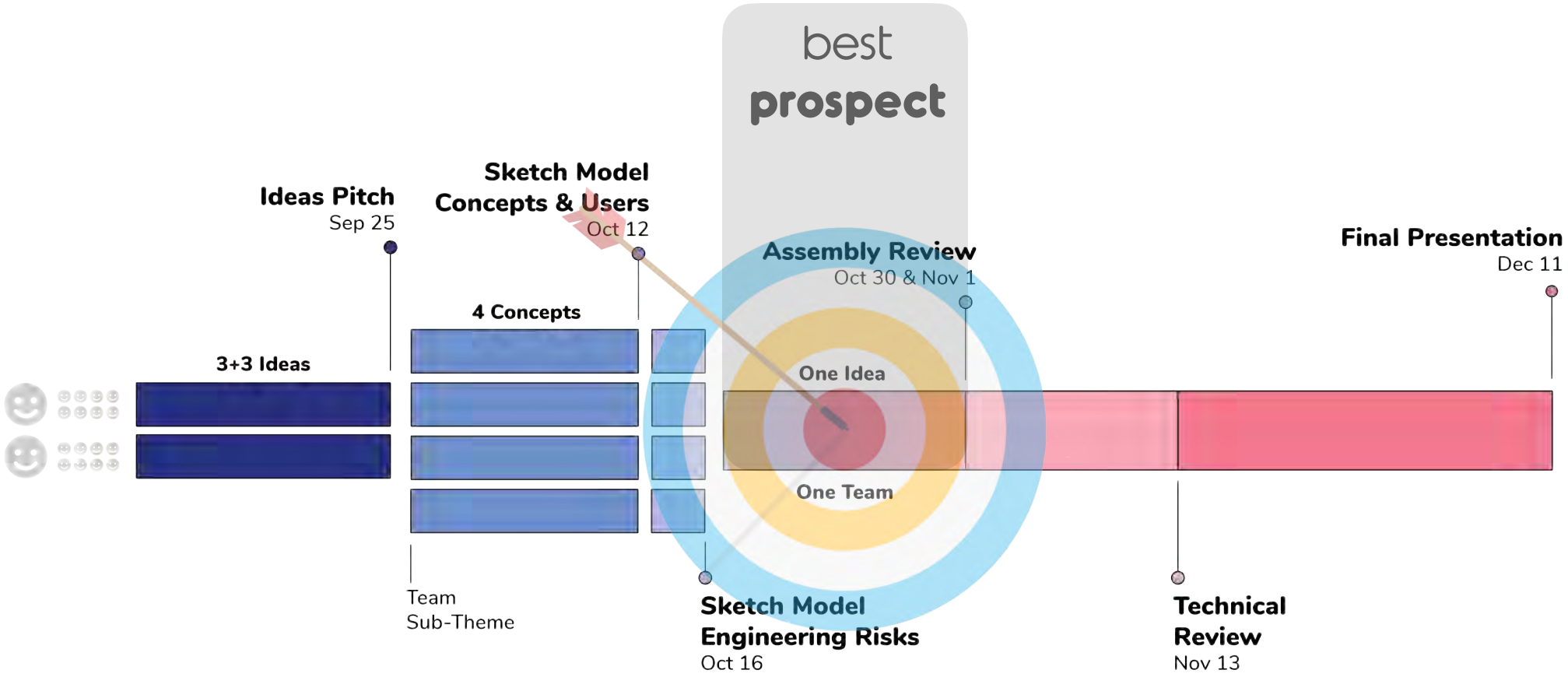
metric: time to assemble

unit: seconds

value: less than 60

owner: Wildy


mini quiz!
list the 4 components of a **well-structured** engineering specification



Process

detail design

G'DAY

mini quiz: meaning is?

G'DAY

an Australian greeting

mini quiz: meaning is?

G'DAY

great are

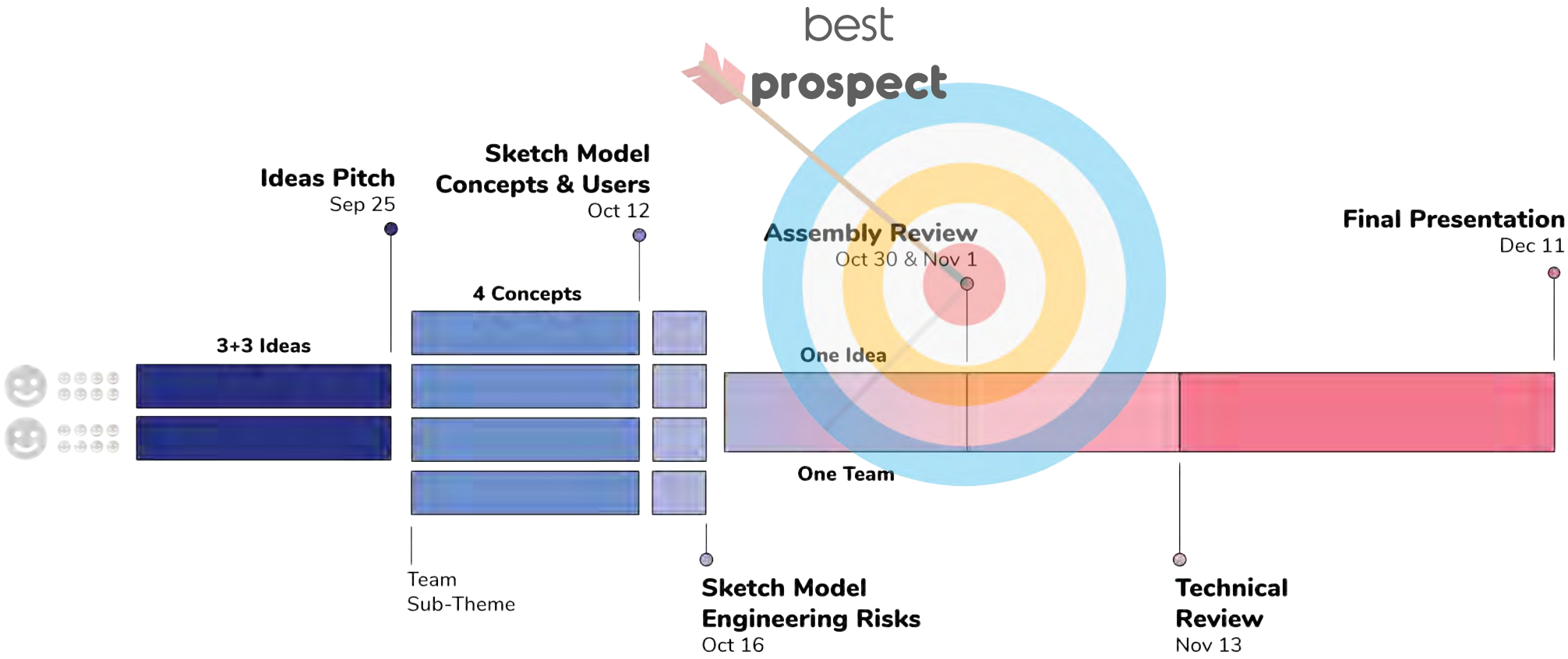
G'DAY

donuts yummy

Michael Chen

G'DAY

give. decide. accept. yo-wup!



Process

detail design

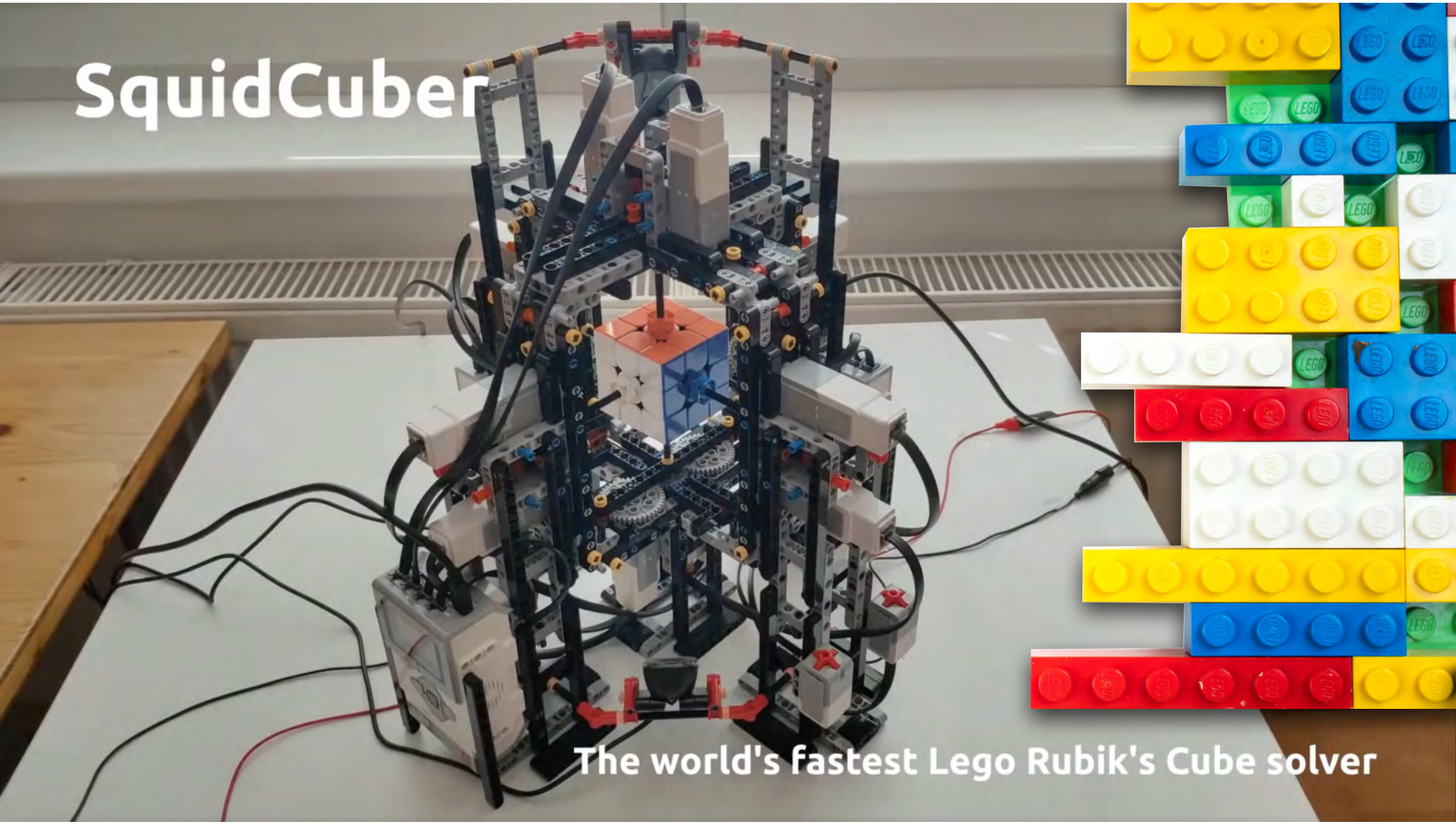
design time!

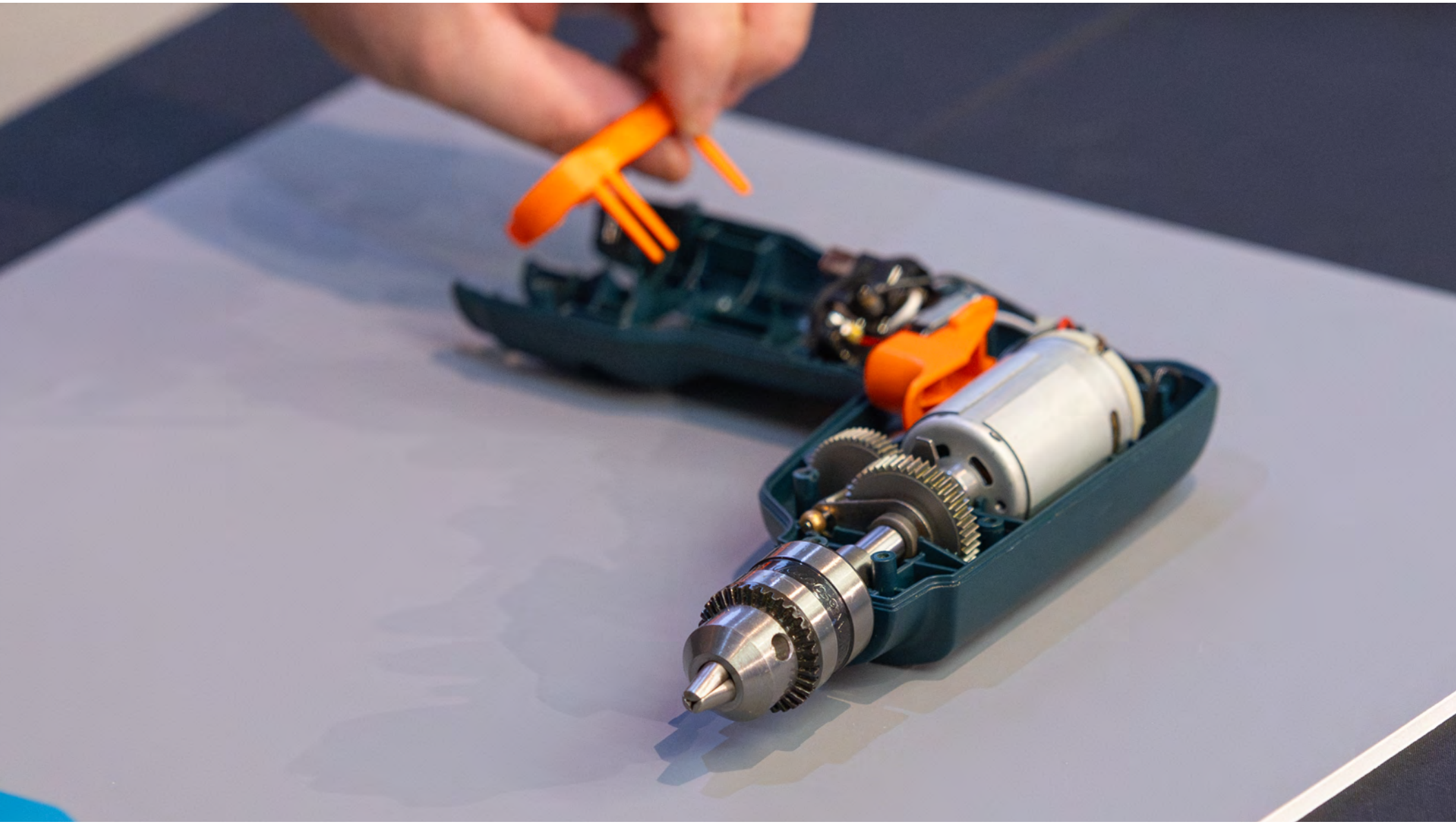
Eero Aarnio

ball chair, designed in 1963

a **chair** is to **sit** on

I will remain **intellectually curious**


SquidCuber
The world's fastest Lego Rubik's Cube solver



40
30
20
10
0
Ansel Garcia-Langley
Tsolmon Bazarragchaa
Sebastián Monsalvo
Randy McLaughlin
James Morin
Haeri Kim
Mathew Reynolds
Vishakk Rajendran
Correct!
Almost, Two Motors
Almost, Parallel
Short Circuit!
Not Quite Correct

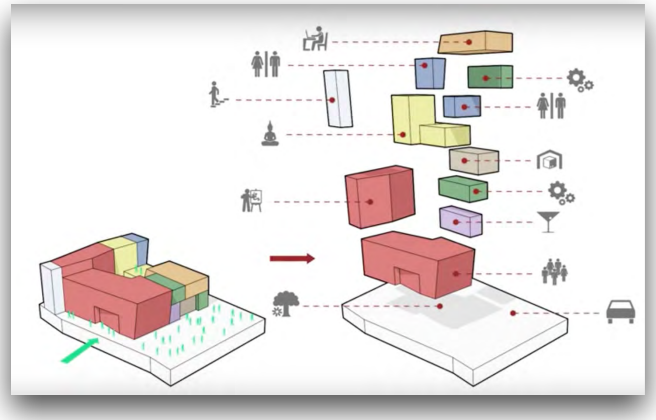
nothing's for free!

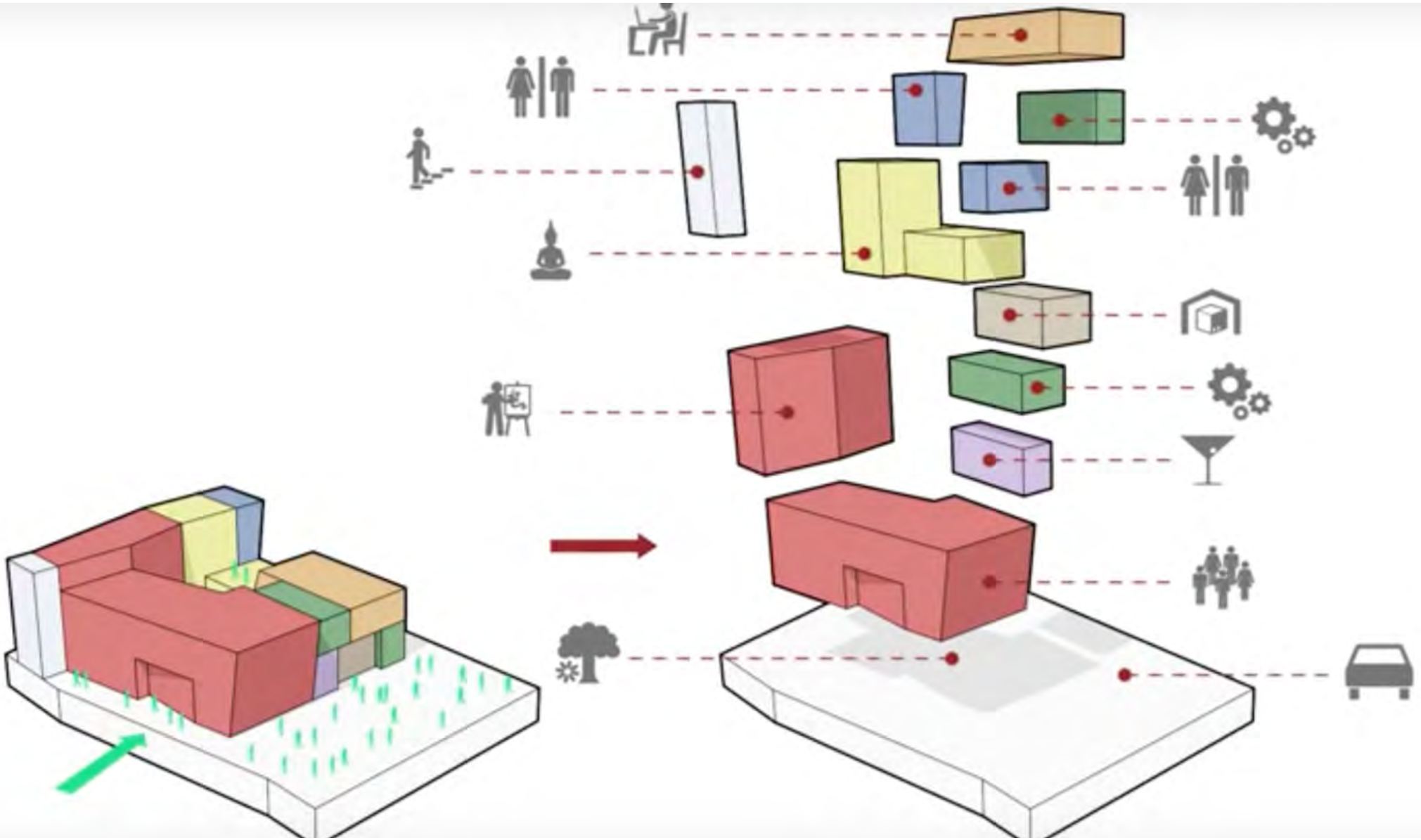
integral

modular

mini quiz

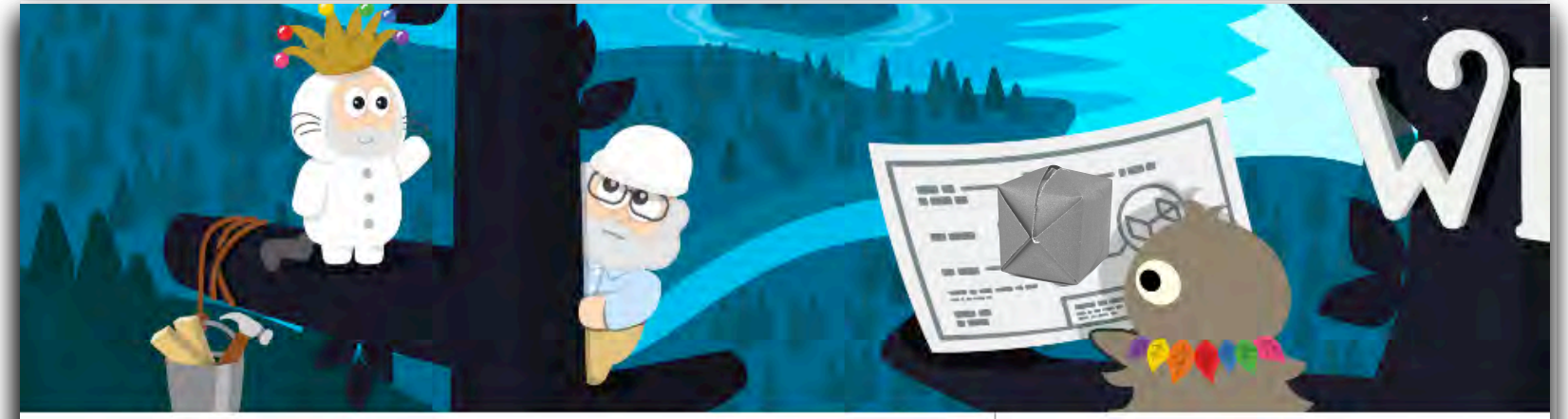
what are **advantages** and **disadvantages** of a modular product architecture?





the bad news is **time flies**
the good news is that **you're the pilot**

Michael Altshuler



Developing product concepts

For in-class exercise: Go to data entry form!

To-dos

- by Sat, 10/21, 5 PM: please complete peer review 2 and team review B for the sketch model phase

Resources

2.009 Store and Store Catalog

Lecture 17: Scheduling and Technical Review

Lecture 16: Feedback and Product Architecture

Estimation

Please start by answering the two questions below.

1. How much origami experience do you have?

- I have never done origami before.
- I have done some origami, but have never made an origami ball.
- I have made an origami ball before.

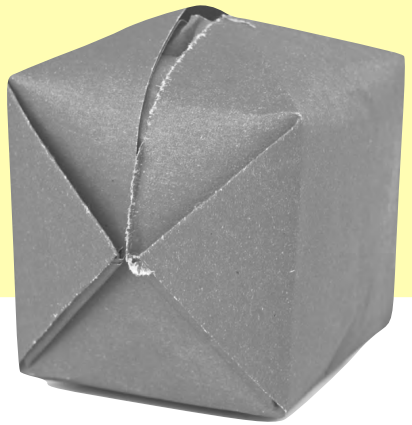
2. Please estimate your time to fold the origami ball.

Minutes

Seconds

Please note that you can only submit once!

Submit



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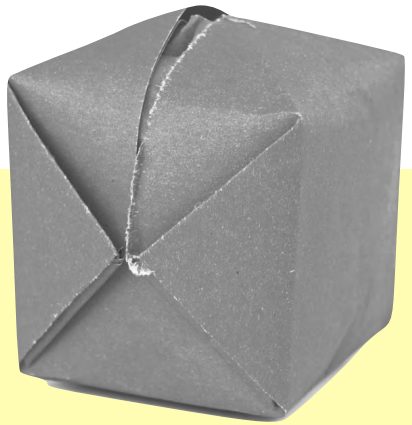


Actual Time

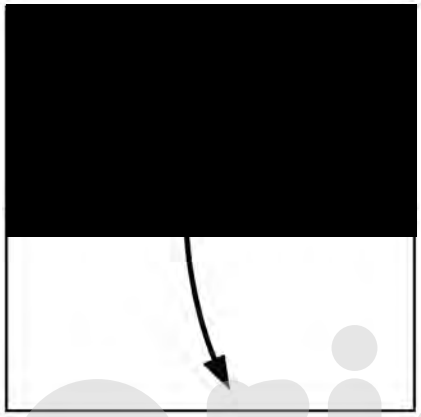
Get ready, start the timer, and then turn over the NPP cover!

Please only hit stop once you have fully inflated the origami ball!

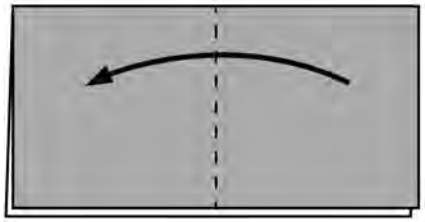
Start Time Timer: 0m 00s

NPP

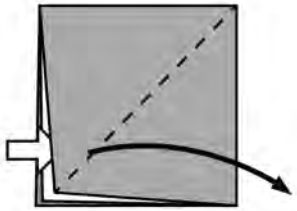
(no peeking please!)



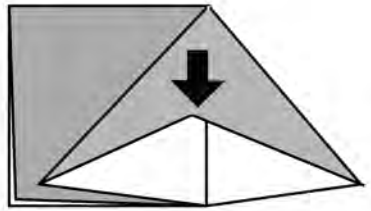
fold square in half 1



fold in half again 2

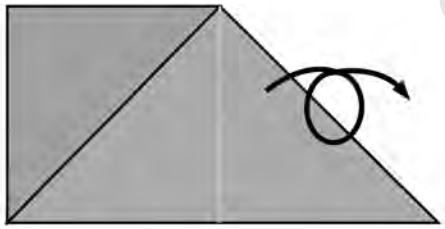


open! 3

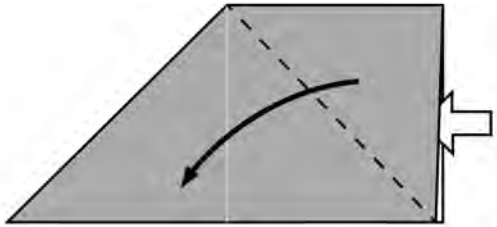


flatten 4

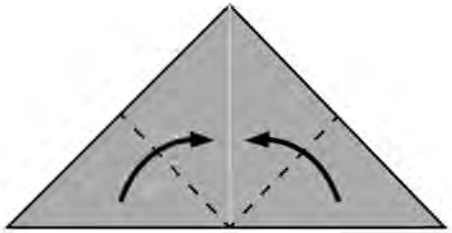
origami ball !



turn over 5



repeat steps 3 and 4 6



fold corners up and crease to form diamond 7

estimate

estimate

estimate = expected time

estimate = multiplier x expected time

estimate = 1.5 x expected time

estimate = multiplier x expected time

multiplier (familiarity)

multiplier (familiarity)

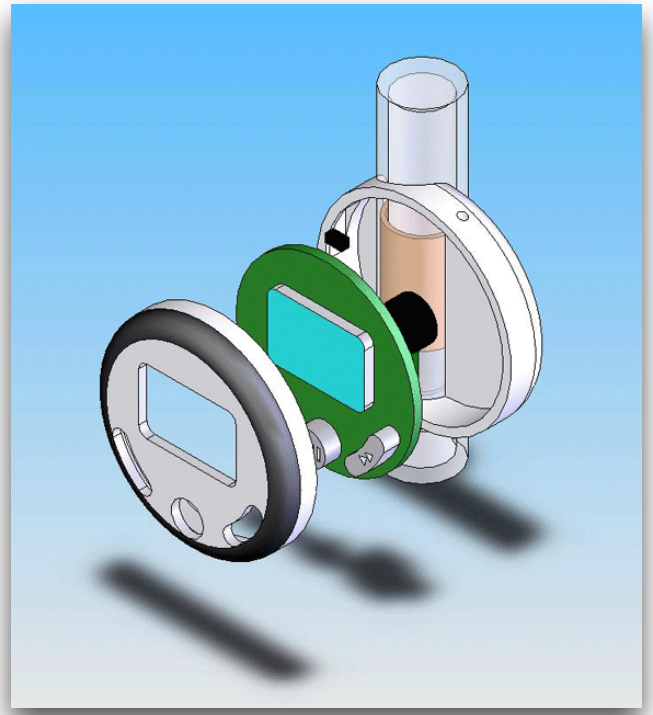
multiplier (familiarity, uncertainty)

multiplier (familiarity, uncertainty)

multiplier (familiarity, uncertainty, complexity)

3 hours

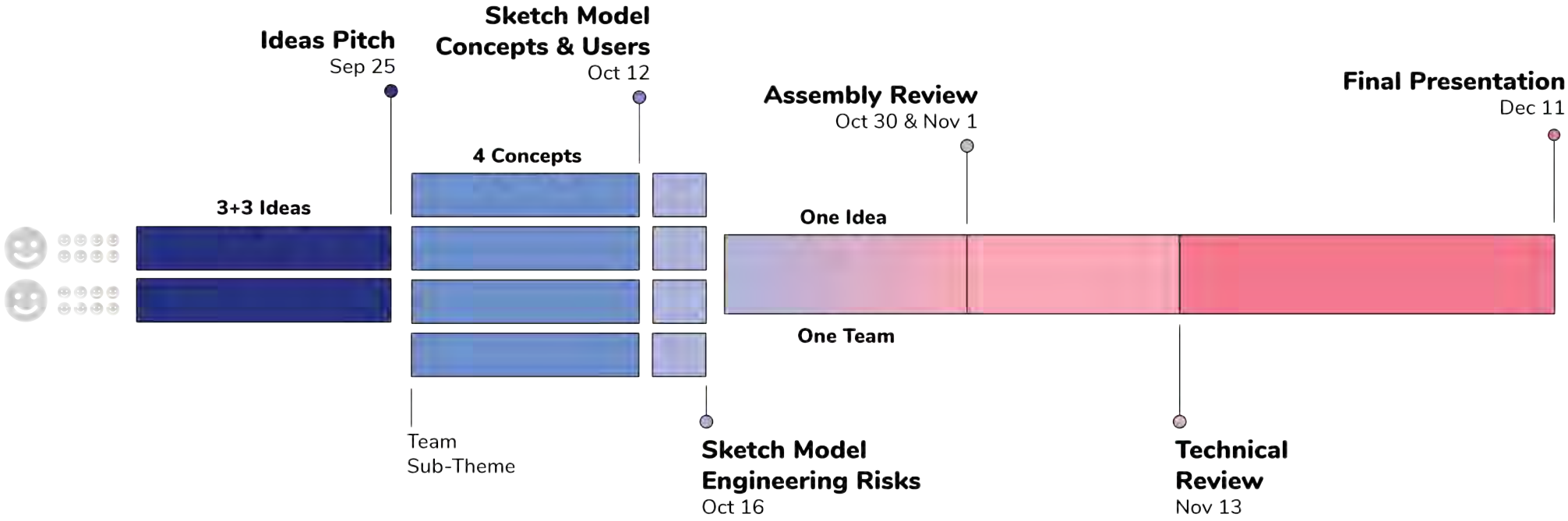
6 hours



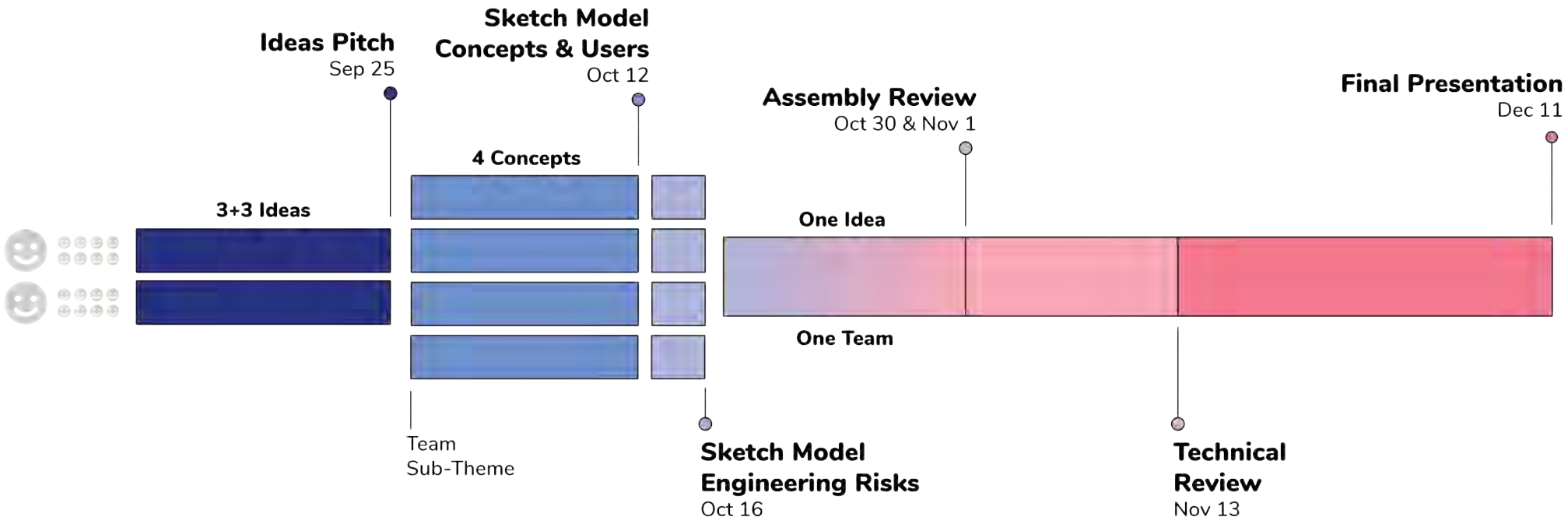
10 hours

30 hours

120 hours


Ideas Pitch
Sep 25
Sketch Model
Concepts & Users
Oct 12
Assembly Review
Oct 30 & Nov 1
Final Presentation
Dec 11
4 Concepts
3+3 Ideas
One Idea
One Team
Team
Sub-Theme
Sketch Model
Engineering Risks
Oct 16
Technical
Review
Nov 13

a schedule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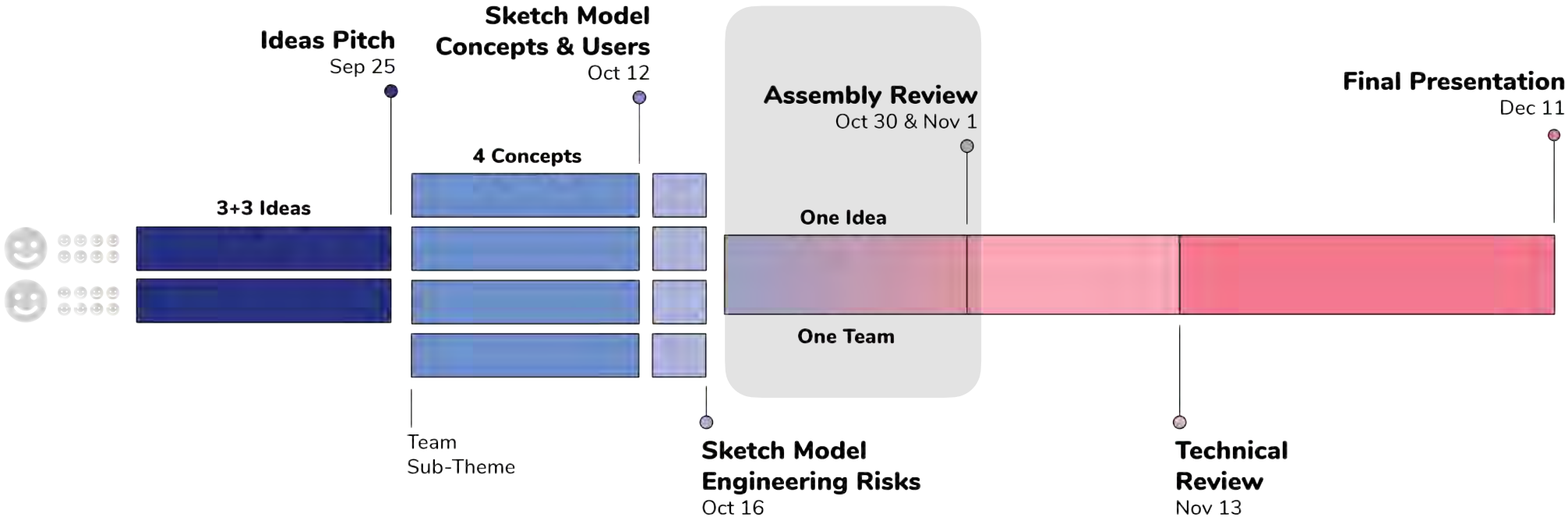
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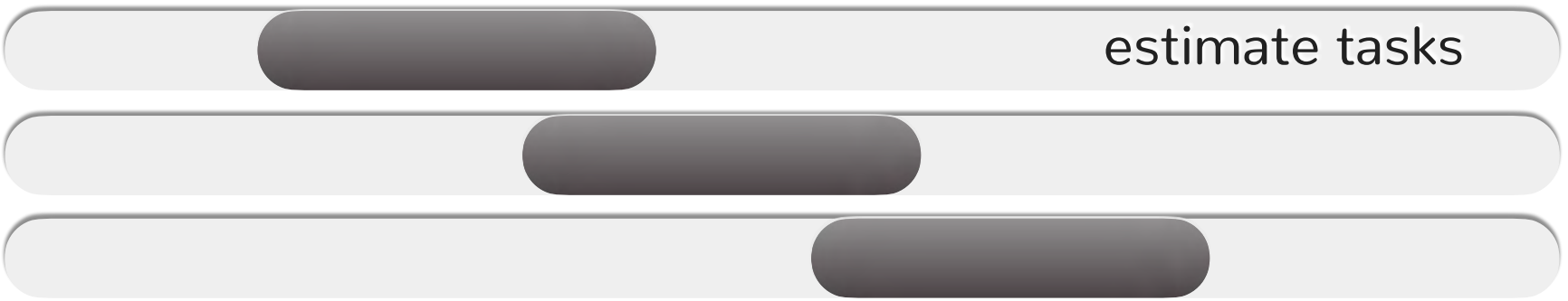
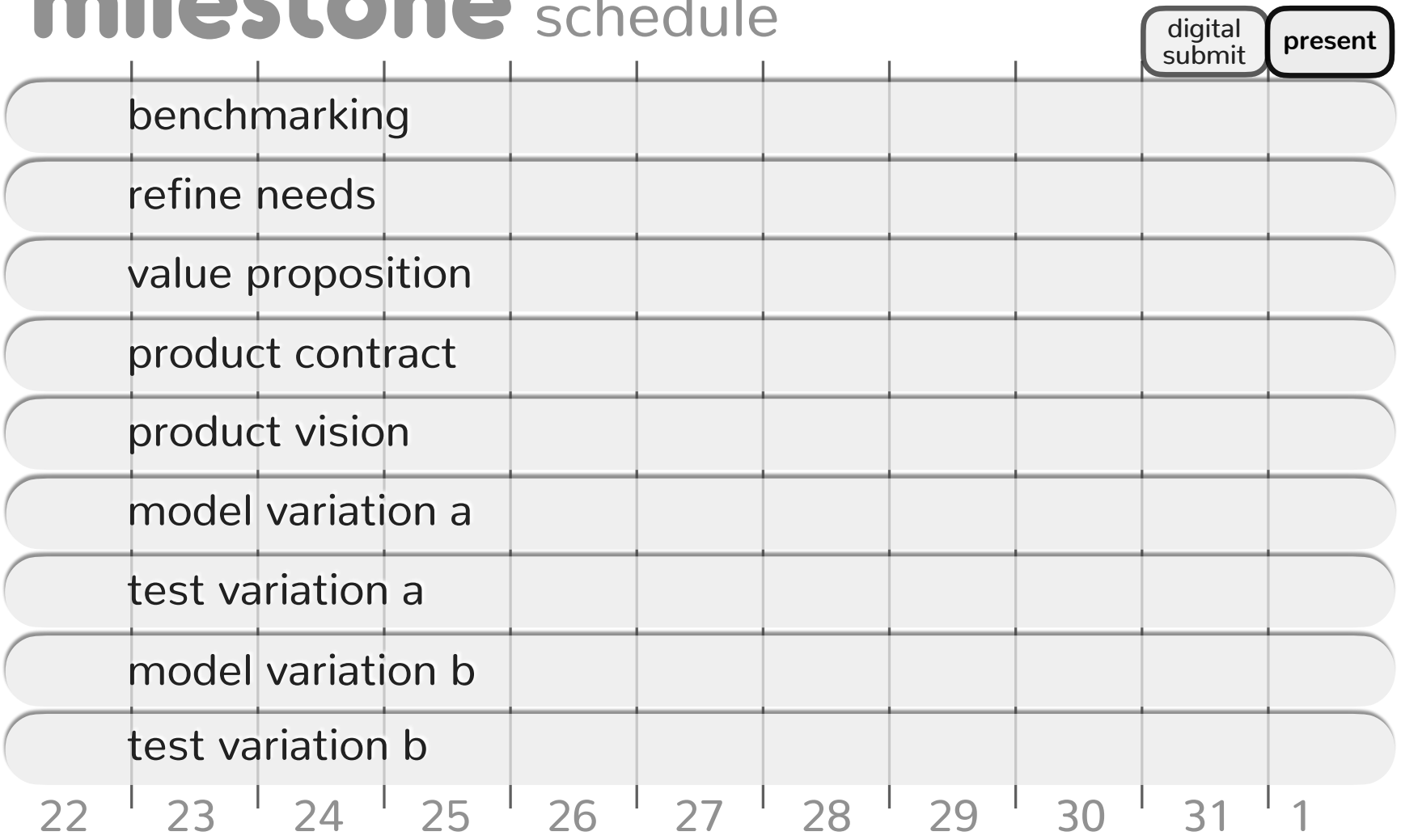
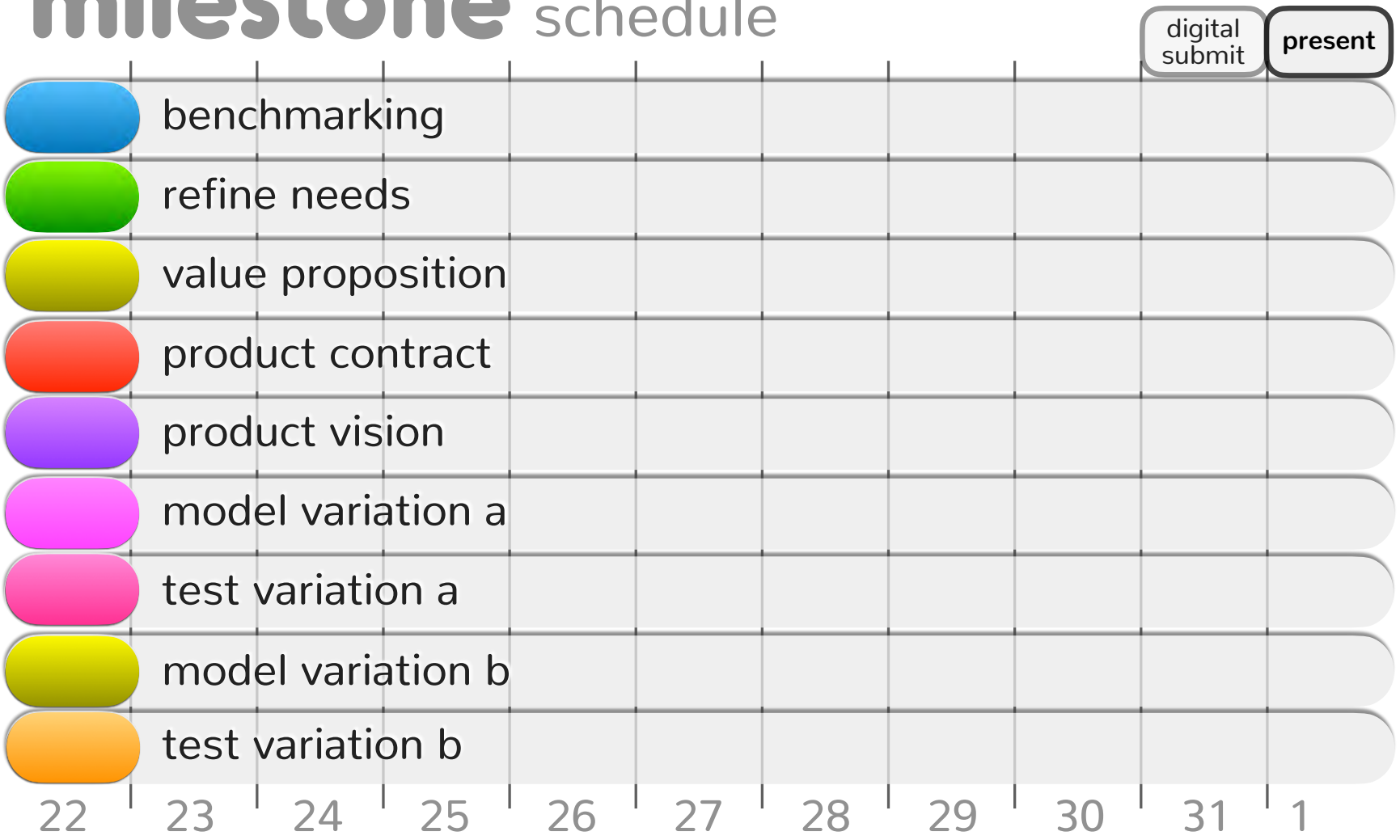
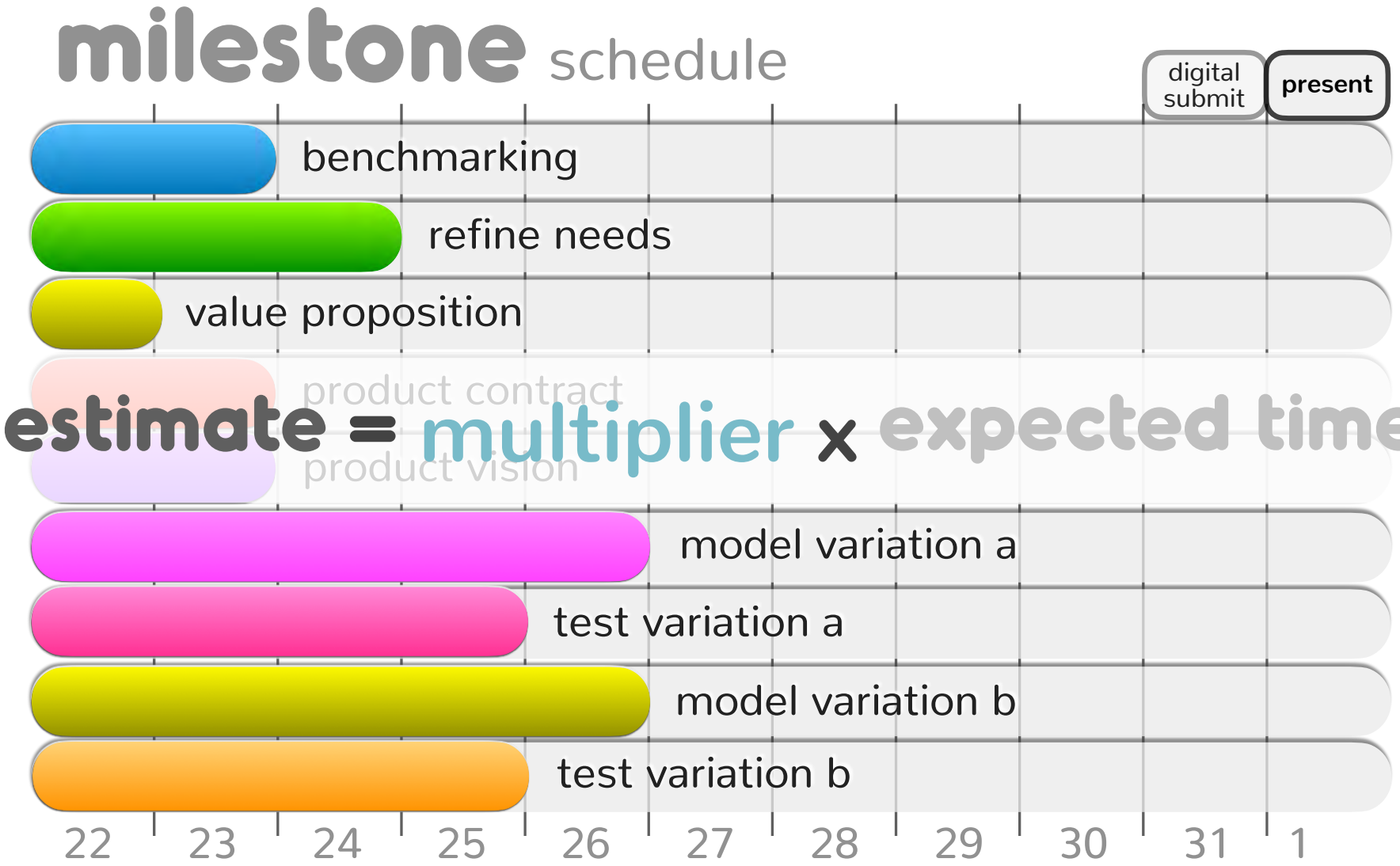


milestone schedule

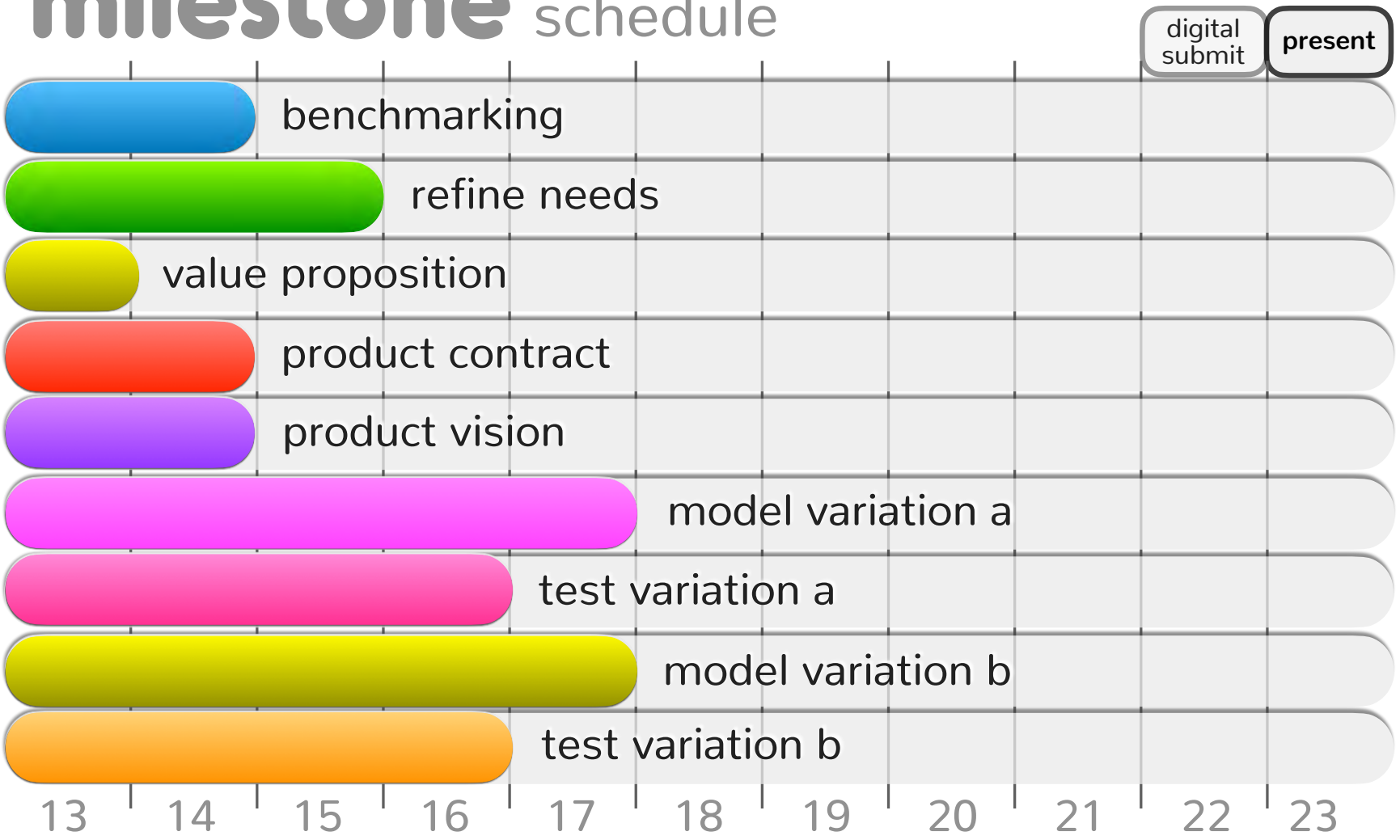


milestone schedule




milestone schedule
digital submit
present
benchmarking
refine needs
value proposition
product contract
product vision
estimate = multiplier x expected time
model variation a
test variation a
model variation b
test variation b
22
23
24
25
26
27
28
29
30
31
1

milestone schedule

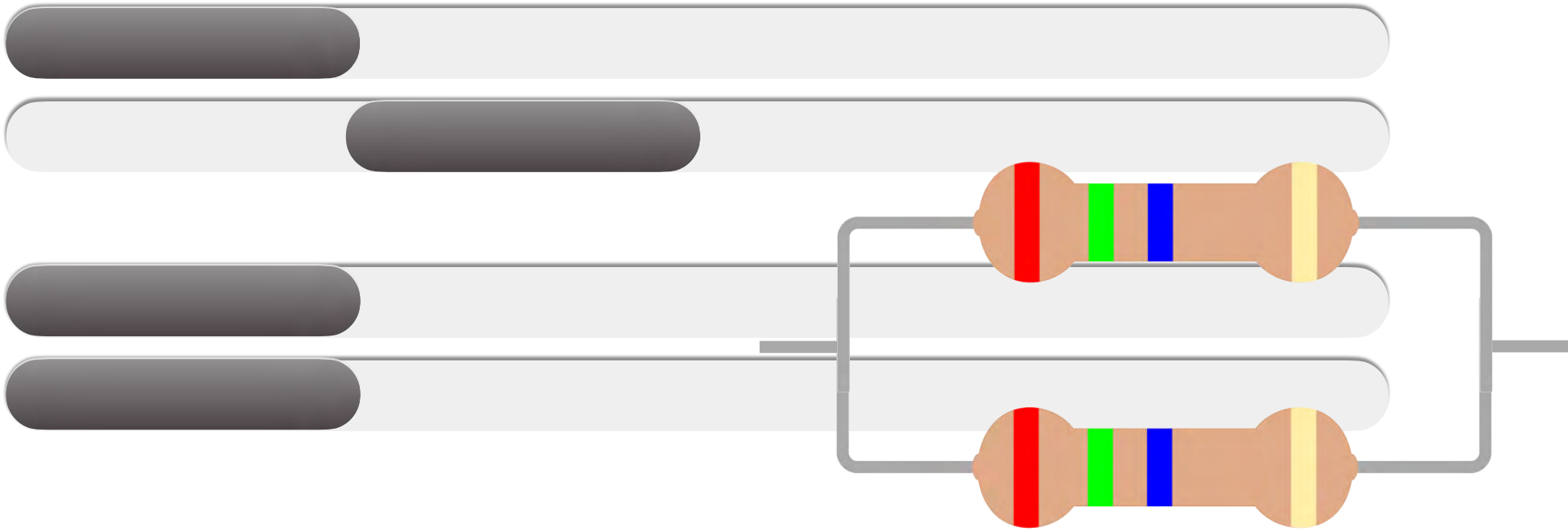


task sequencing

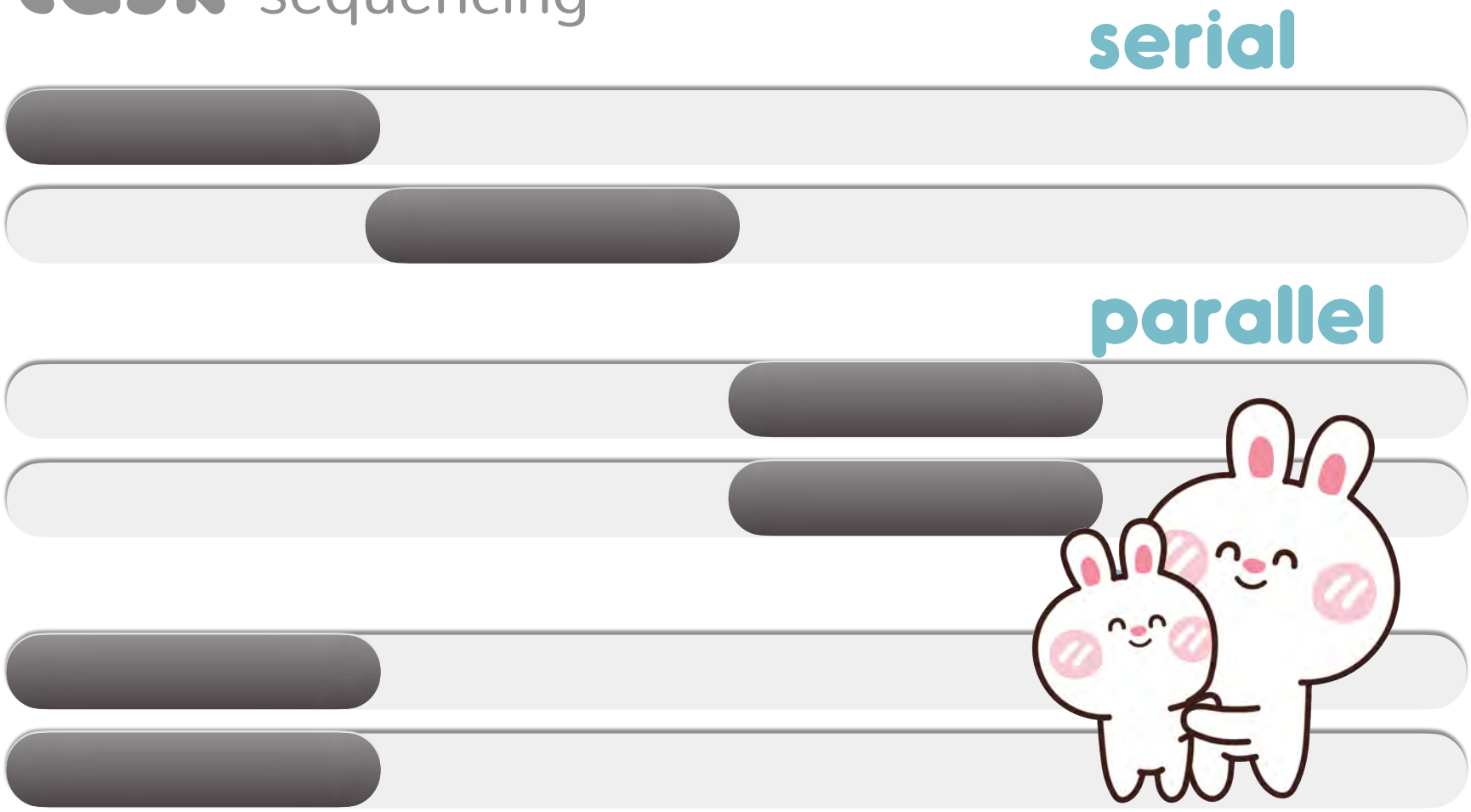
task sequencing

task sequencing

serial



task sequencing

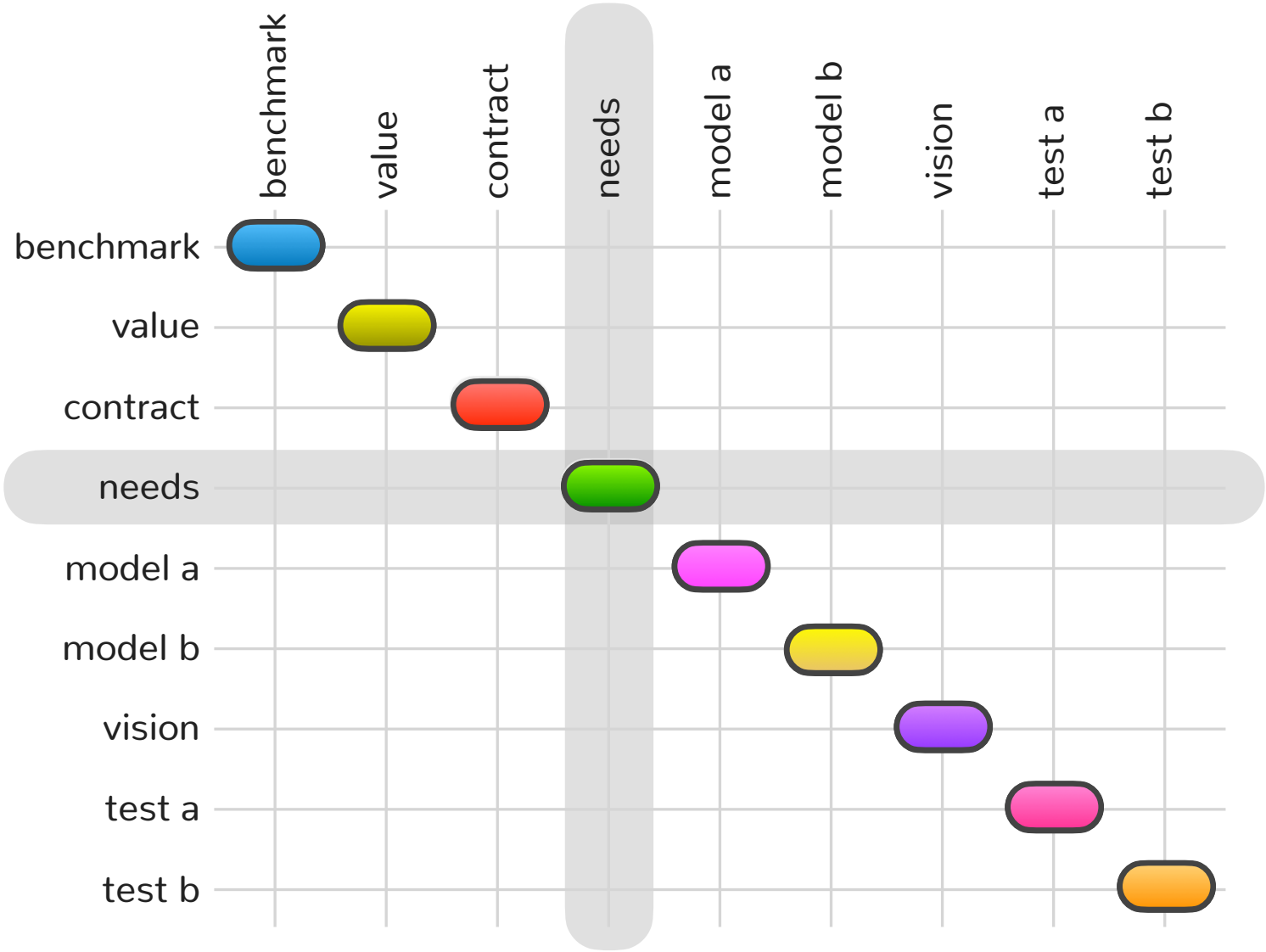


task sequencing

serial

parallel

task dependency


benchmark
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contract
needs
model a
model b
vision
test a
test b
benchmark
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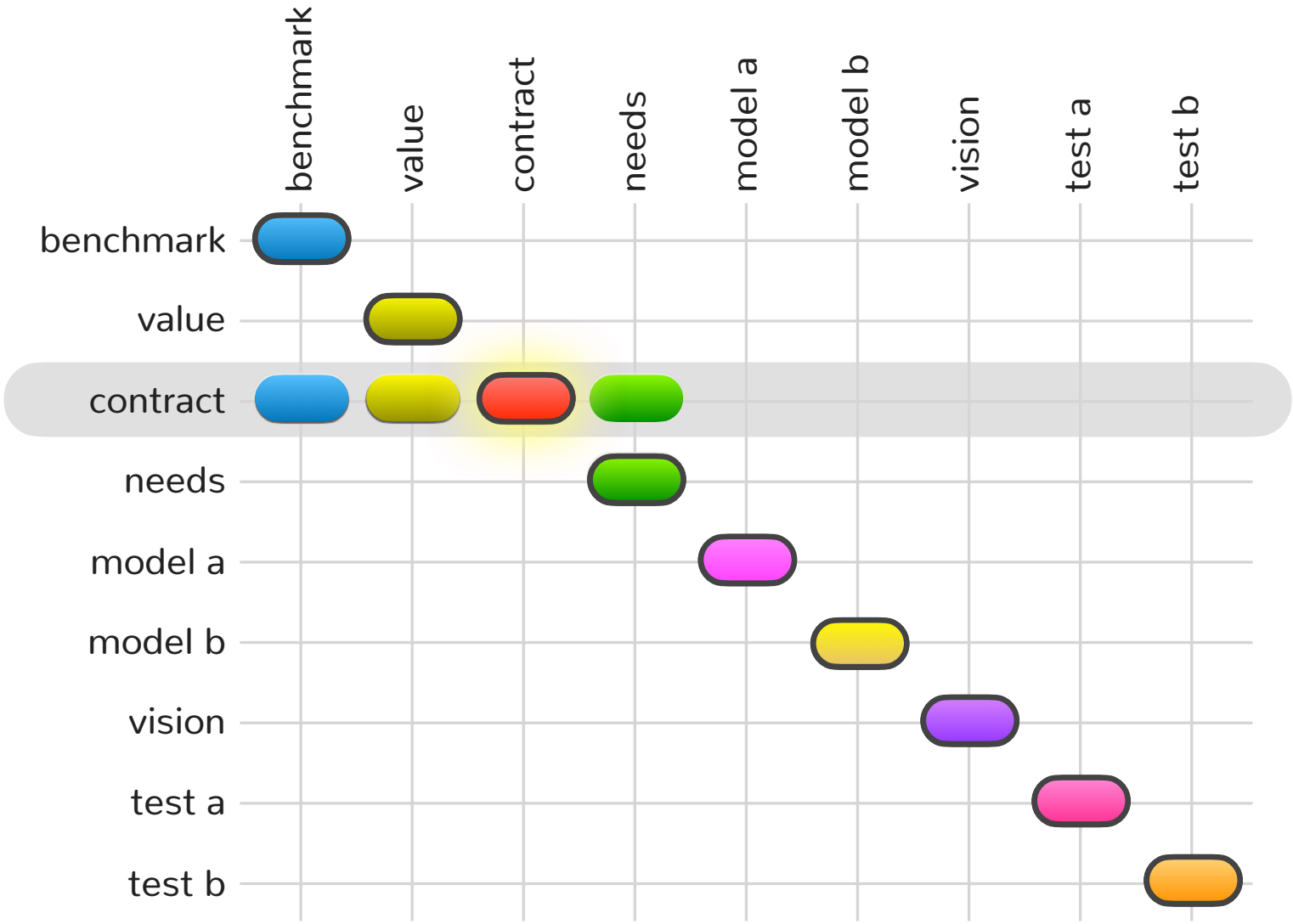
test a
test b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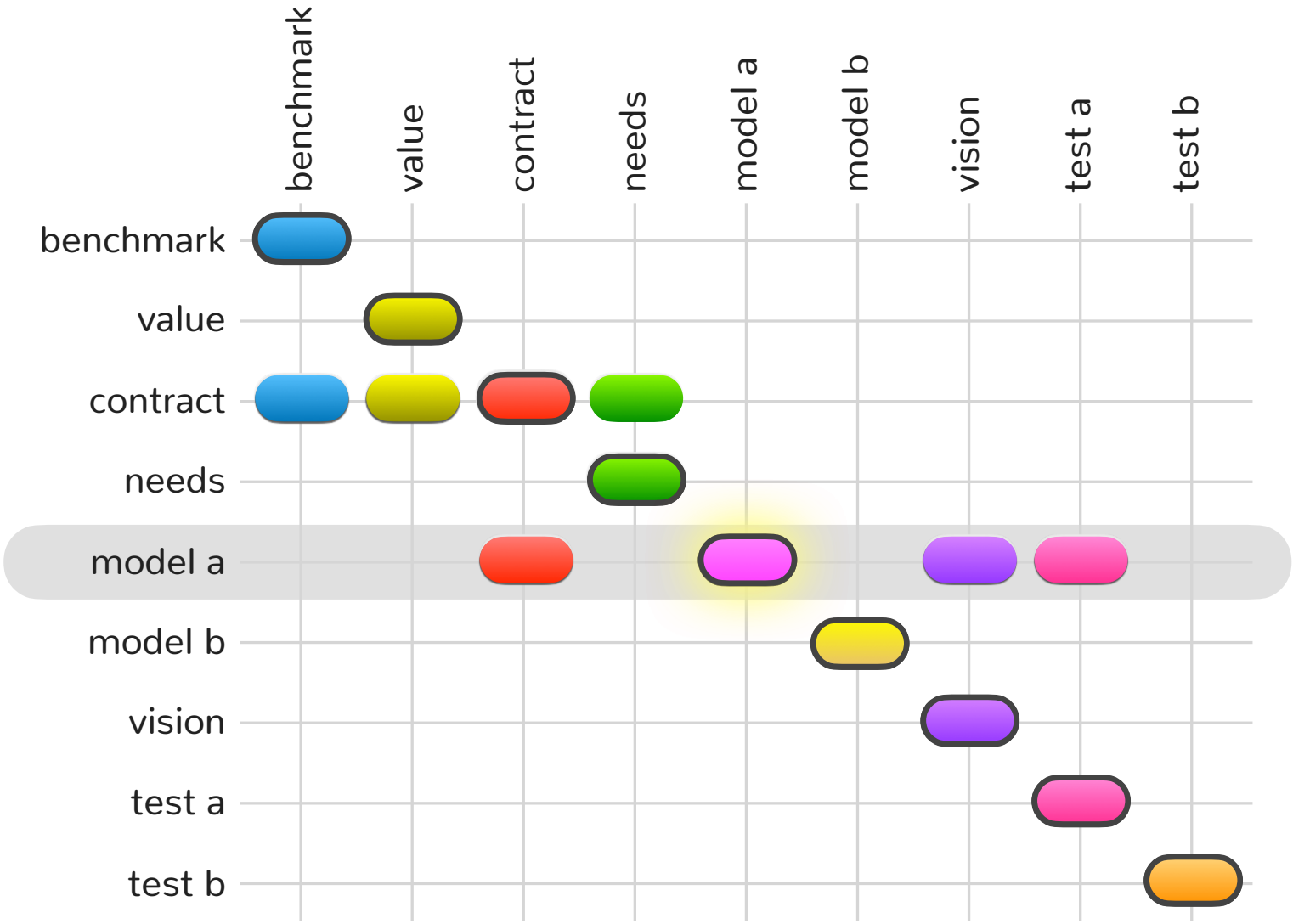
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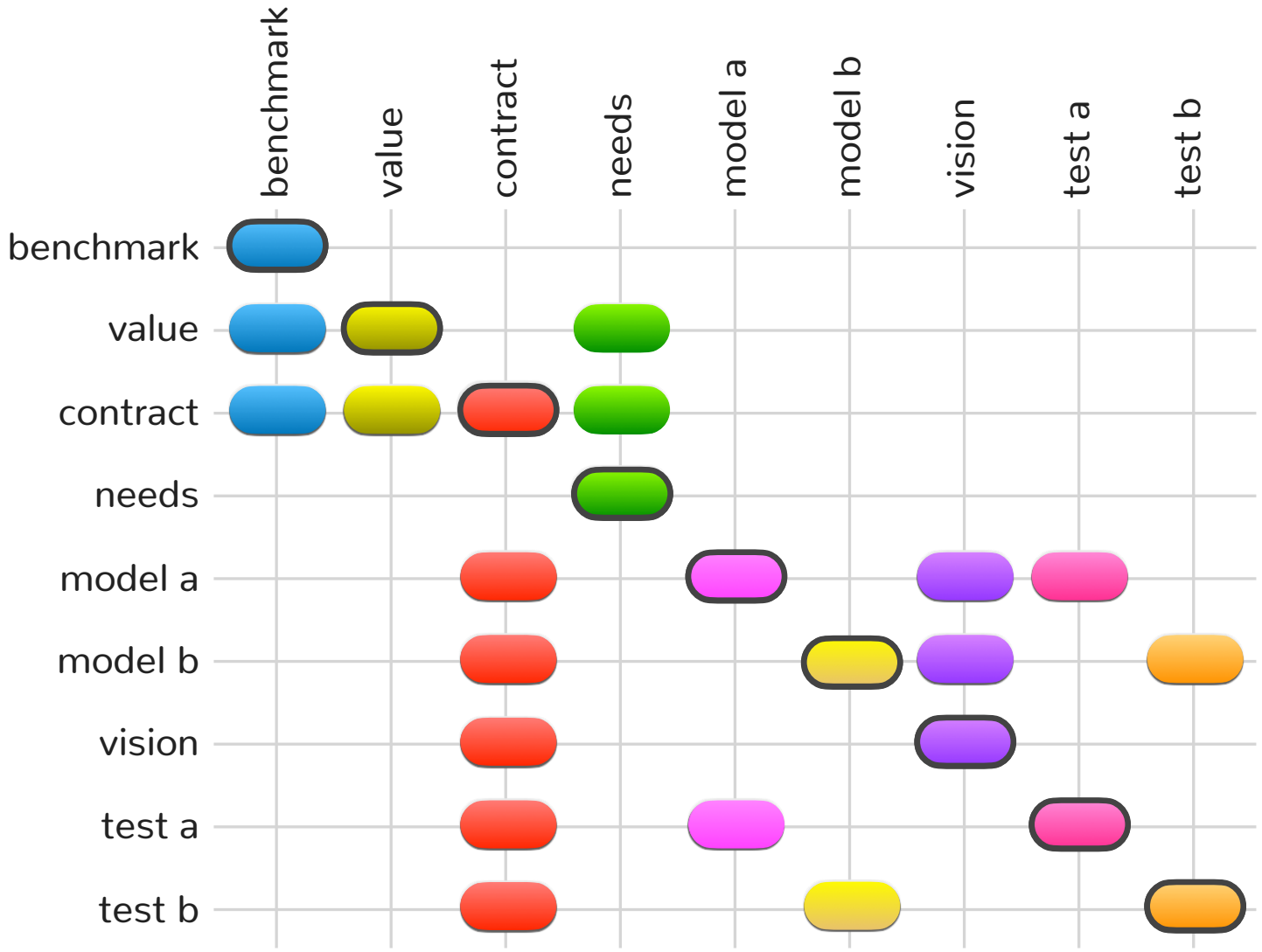
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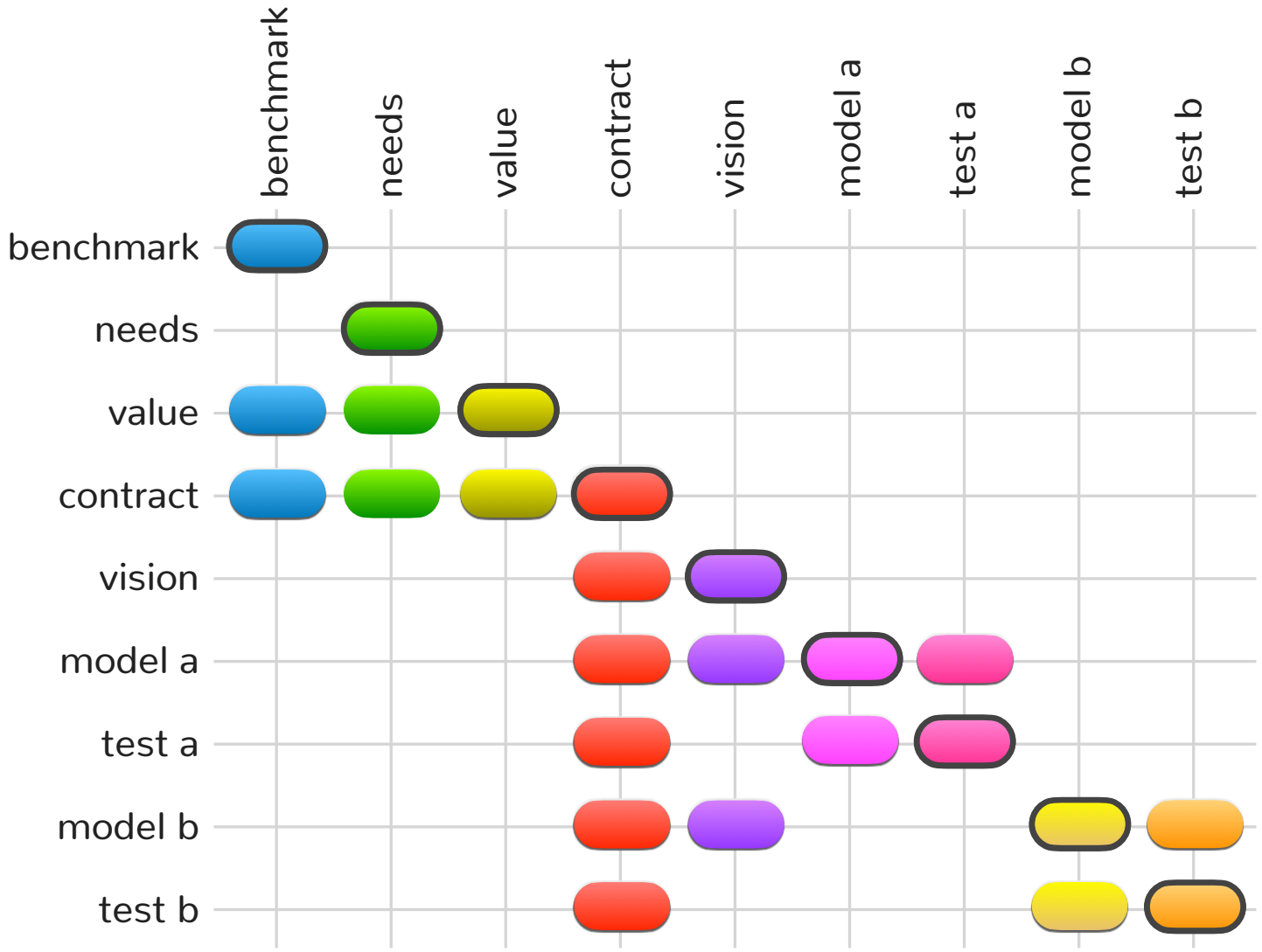
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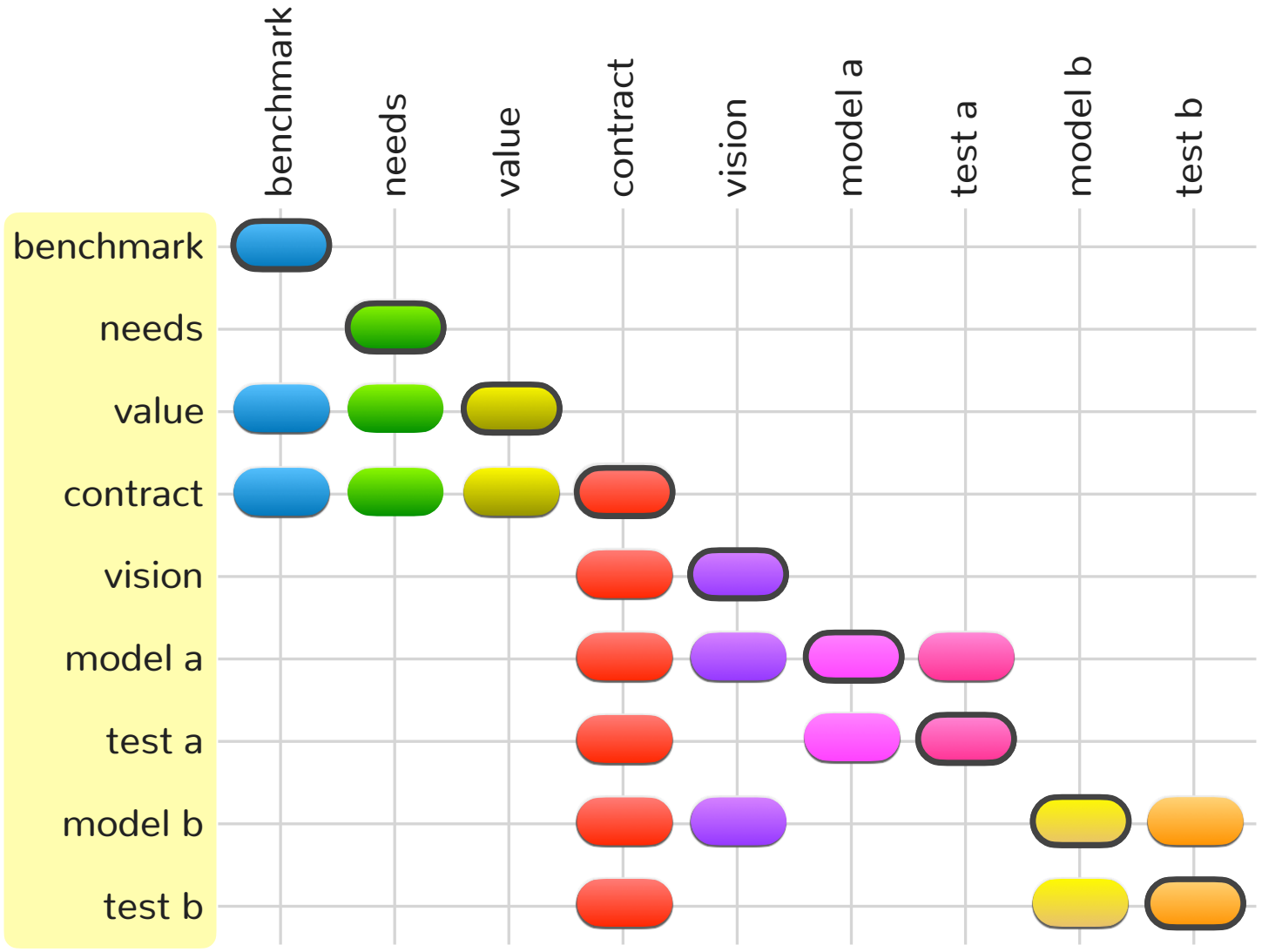
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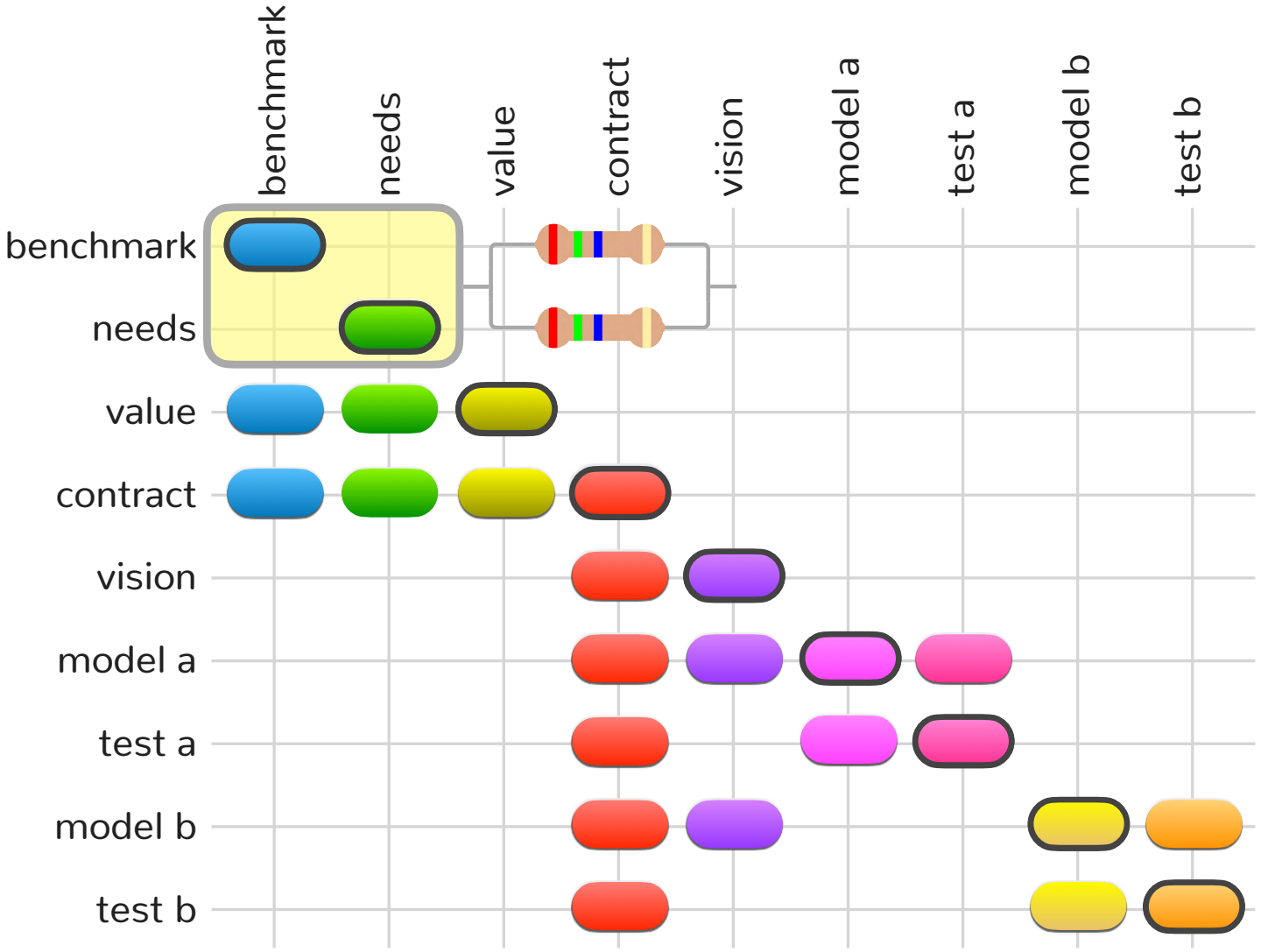
model b
test b


benchmark
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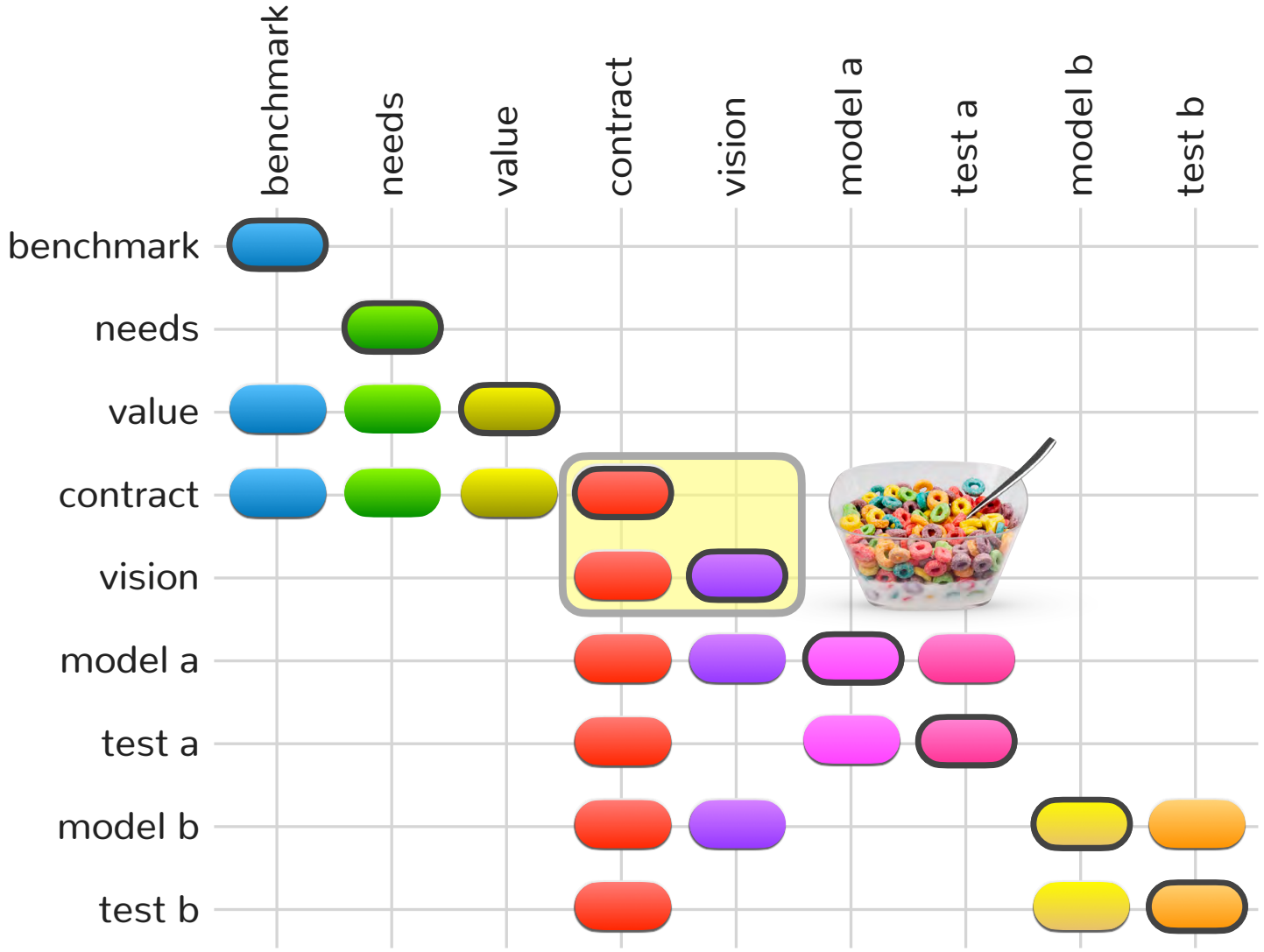
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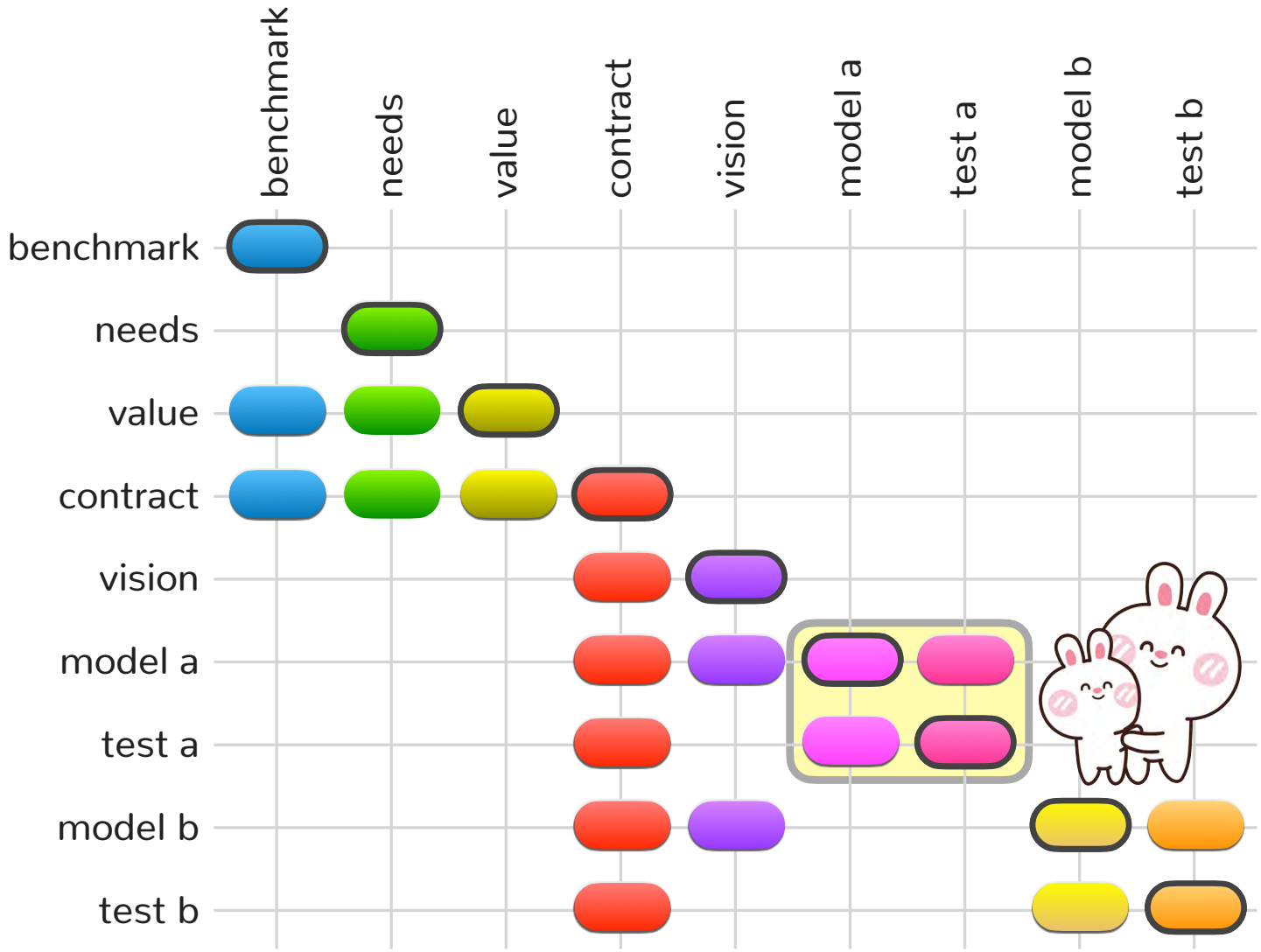
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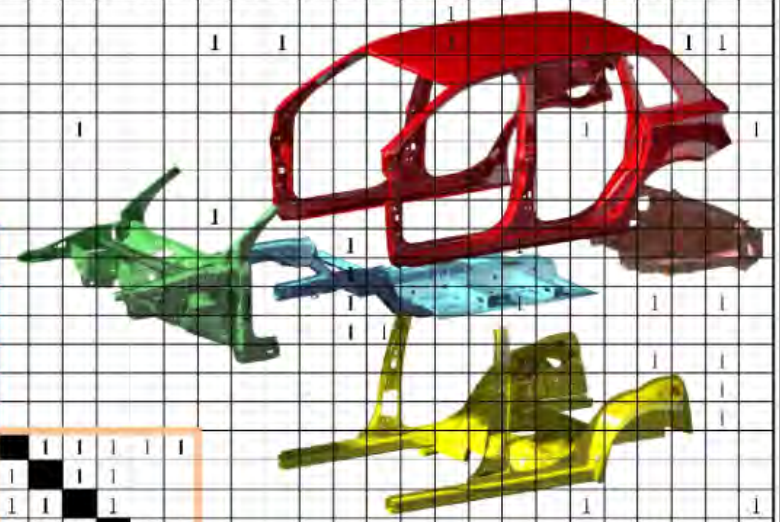
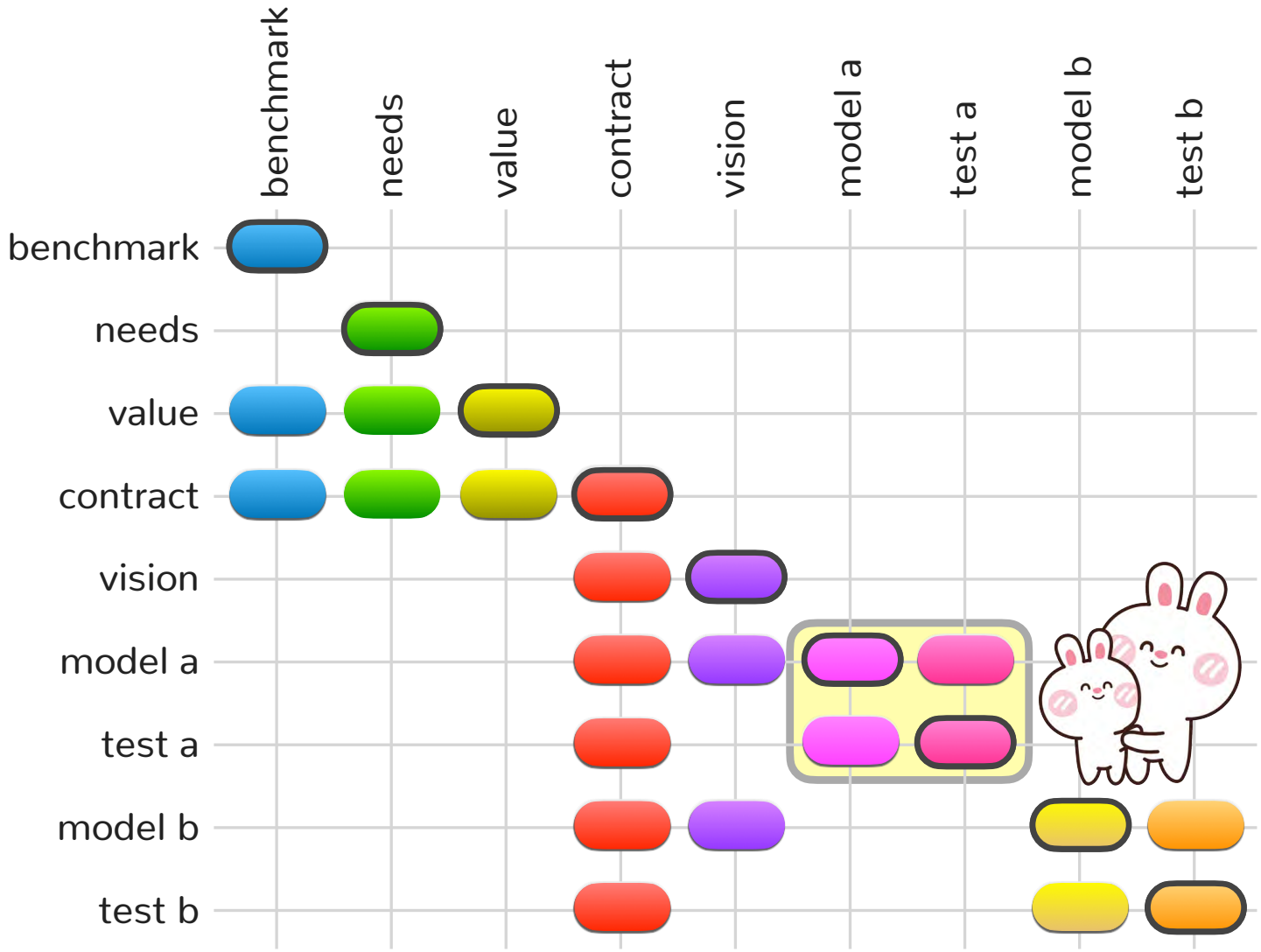
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38
'Ad., B-pil. roof rail'	1		1						1																				1										
'Body side'	2	1				1	1	1	1			1			1	1							1		1												1	1	
'Front header'	3							1	1																														
'Rear header'	4							1																															
'Rear pan. In. Upp.'	5		1					1											1															1				1
'Roof bow'	6		1					1	1																													
'Roof panel'	7		1	1	1	1	1		1																													
'Roof rail'	8	1	1	1			1	1															1															
'Channel'	9										1				1	1											1											
'Dash cross mem.'	10									1																													
'Floor panel'	11		1										1	1													1								1		1	
'Front side rail'	12											1		1													1	1										
'R. side rail center'	13											1	1																						1		1	
'Seat crossm. fr.'	14		1							1																												
'Seat crossm. rear'	15		1							1																											1	
'Back panel'	16																	1	1	1	1	1																
'Back panel side'	17																1		1	1																		
'Back panel upper'	18					1											1	1		1														1				1
'Rear floor side'	19																1	1	1		1	1													1	1		1
'Rear side rail'	20																1			1		1													1	1		1
'Spare wheel well'	21																1			1	1									1		1						
'Ad. A-pil. roof rail'	22		1						1															1	1	1			1									
'A-pillar inner'	23											1											1			1	1		1								1	
'A-pillar reinforc.'	24		1																				1				1		1								1	
'Cowl'	25																						1	1			1	1	1									
'Dash panel'	26									1	1	1	1											1	1	1		1										
'Front susp. Hous.'	27												1													1	1		1									
'Shotgun'	28																						1	1	1	1		1										
'B-Pillar'	29	1	1																																	1	1	
'Crosstr. rear floor'	30																					1										1				1		
'Heelkick'	31									1		1																					1		1	1	1	
'Rear floor panel'	32																					1									1	1		1	1			
'R. panel in. lower'	33		1			1													1																	1	1	1
'Rear side floor'	34																			1	1											1	1		1		1	1
'Rear side rail frt'	35											1		1						1	1										1	1	1	1	1	1	1	1
'Reinf. rocker rear'	36		1																											1		1		1	1	1	1	
'Rocker'	37		1									1		1	1	1								1	1					1		1		1	1	1	1	
'Wheelhouse'	38					1													1	1	1									1				1	1	1	1	




benchmark
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model b
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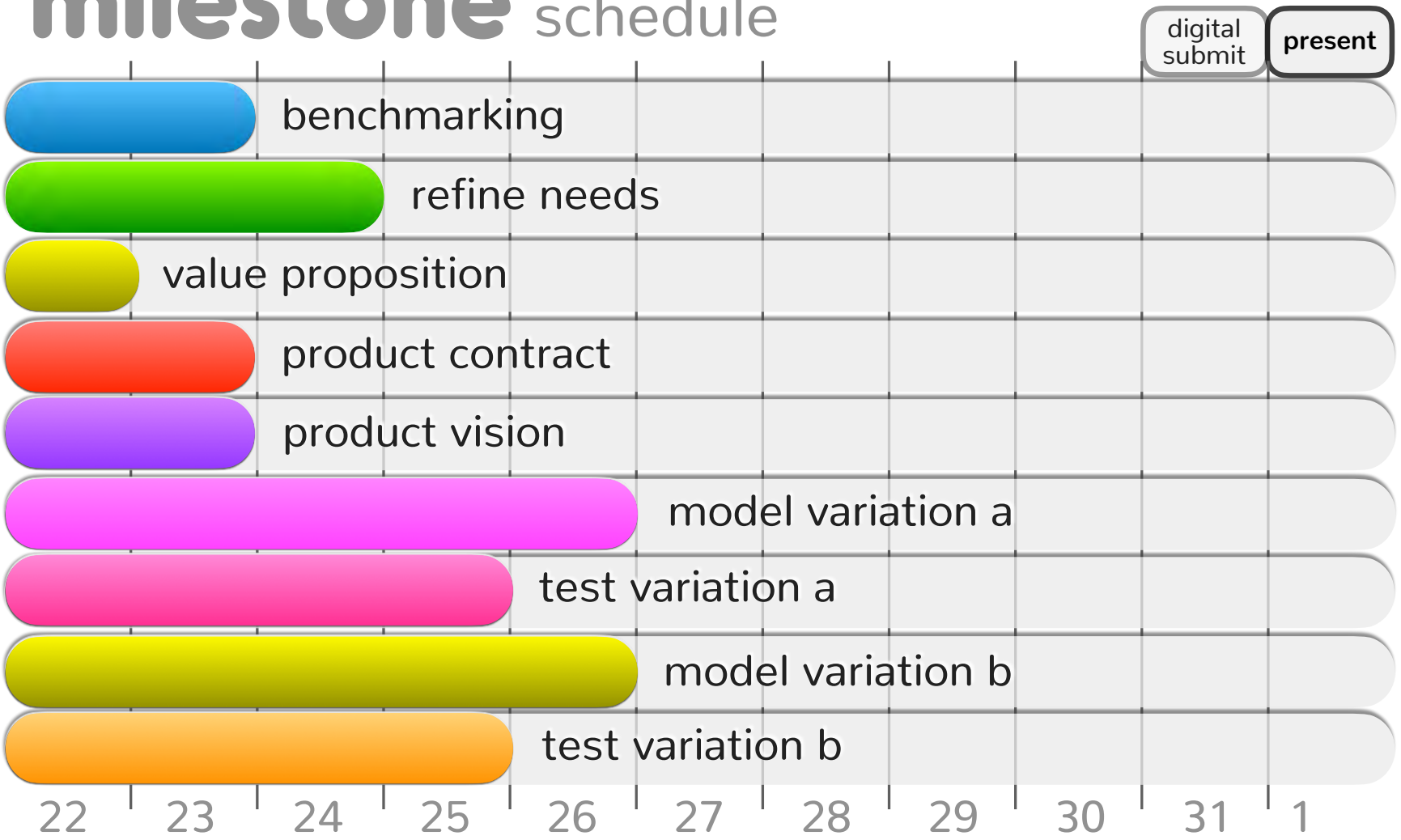
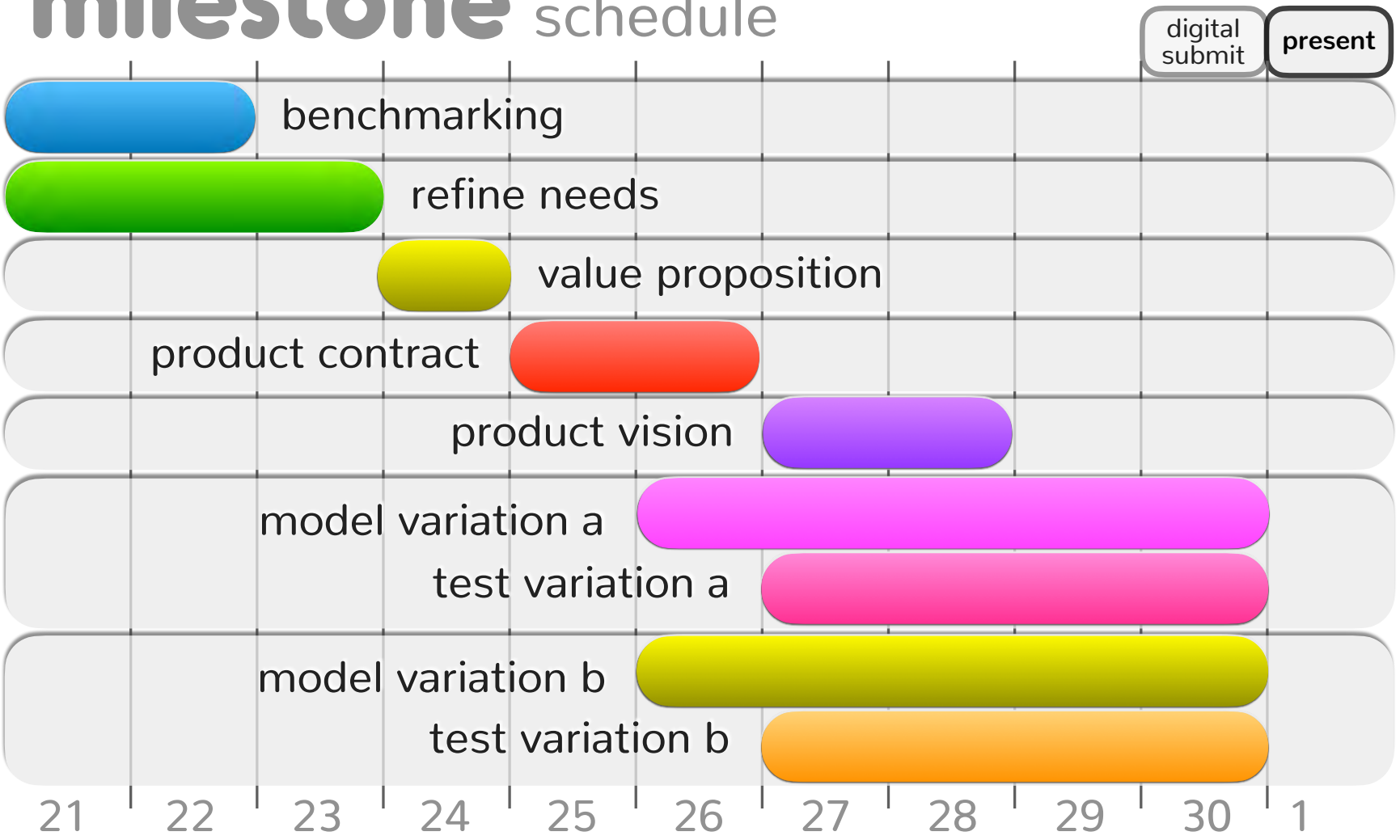
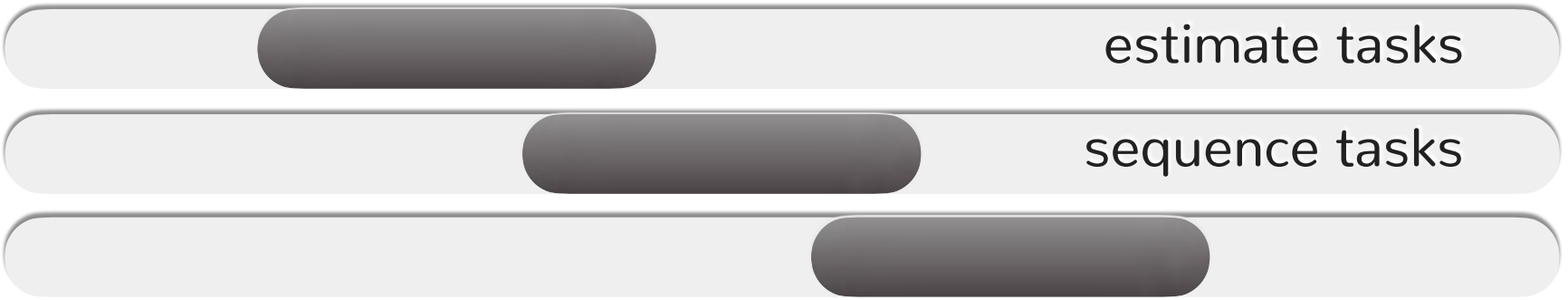
milestone schedule



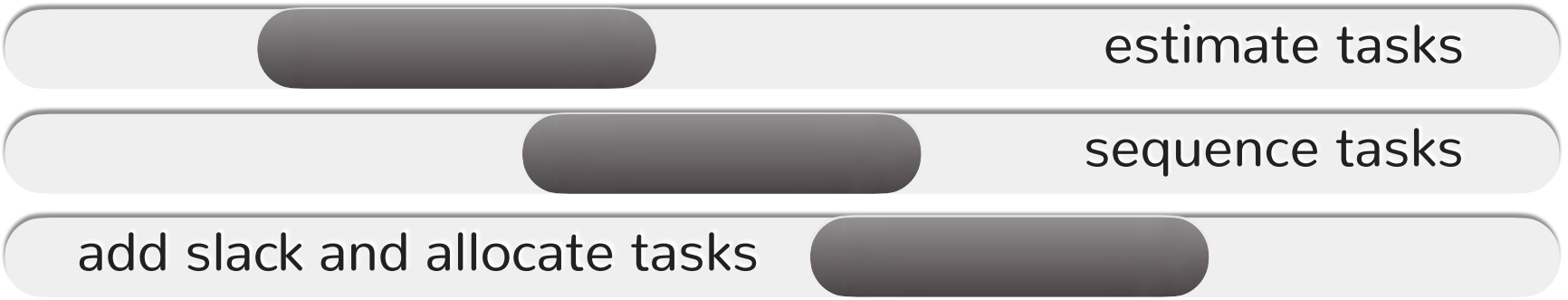
milestone schedule

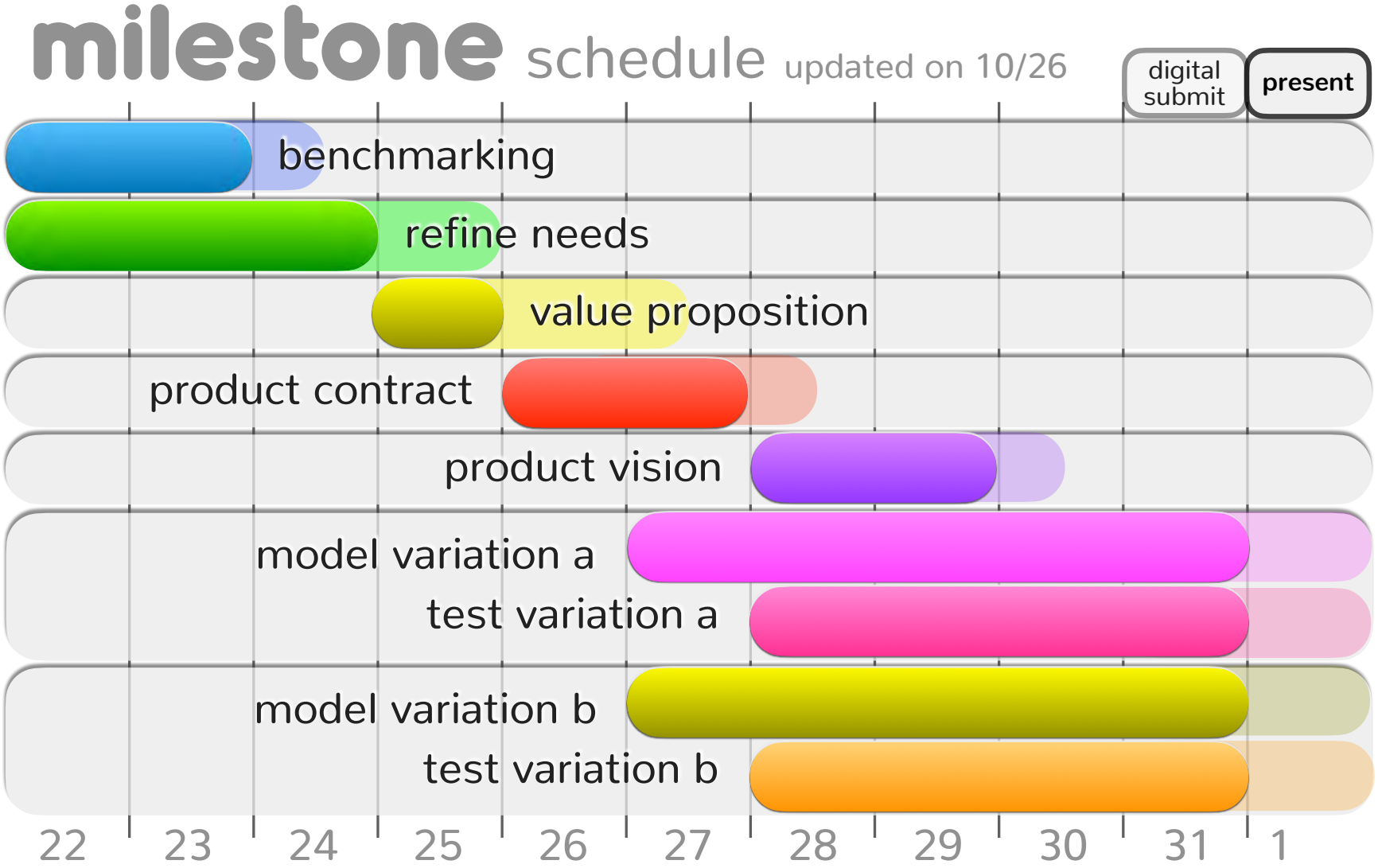


a schedule



a schedule


estimate tasks
sequence tasks
add slack and allocate tasks


milestone schedule updated on 10/26
digital submit
present
benchmarking
refine needs
value proposition
product contract
product vision
model variation a
test variation a
model variation b
test variation b
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milestone schedule updated on 10/26

digital submit | present

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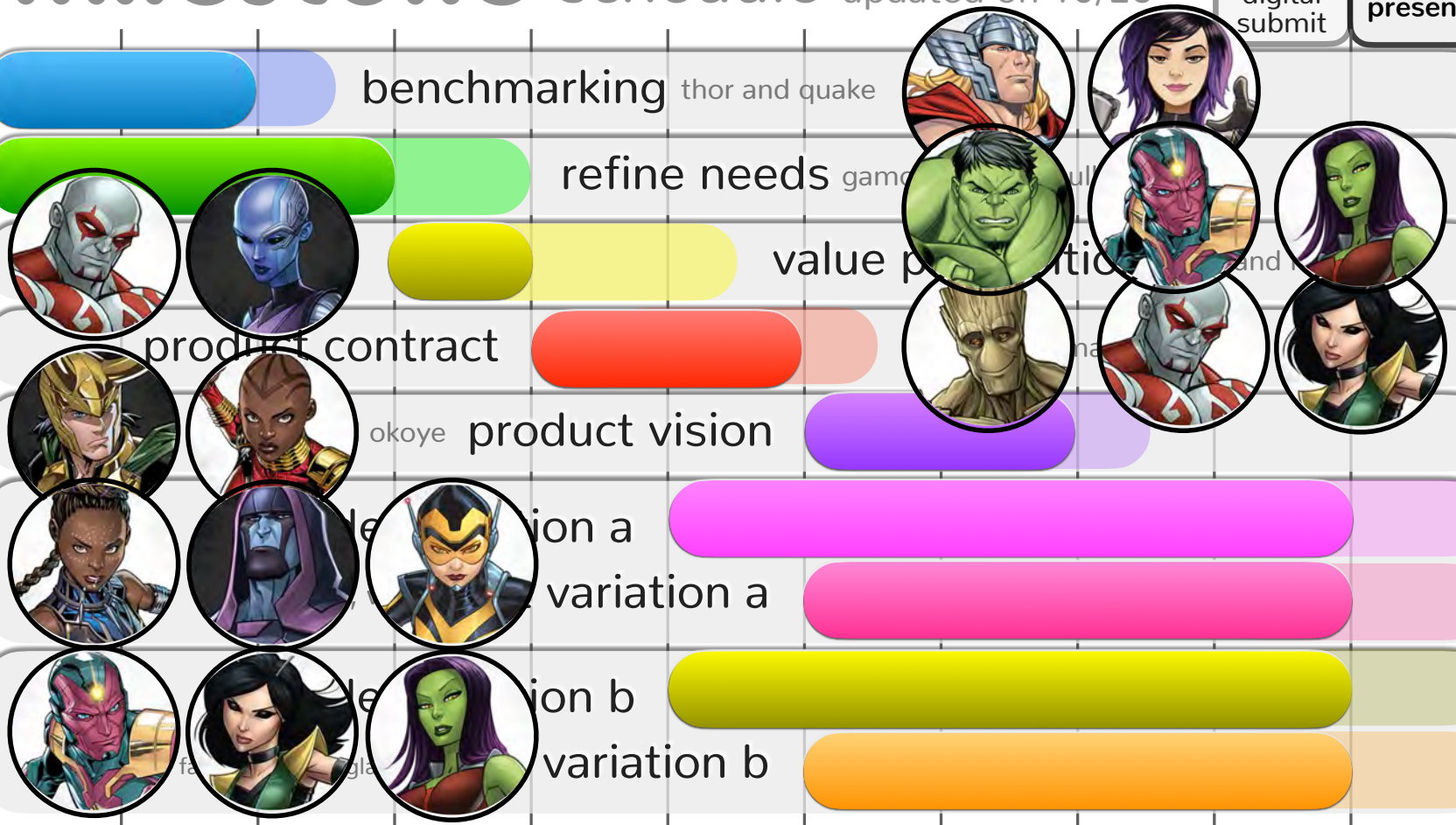
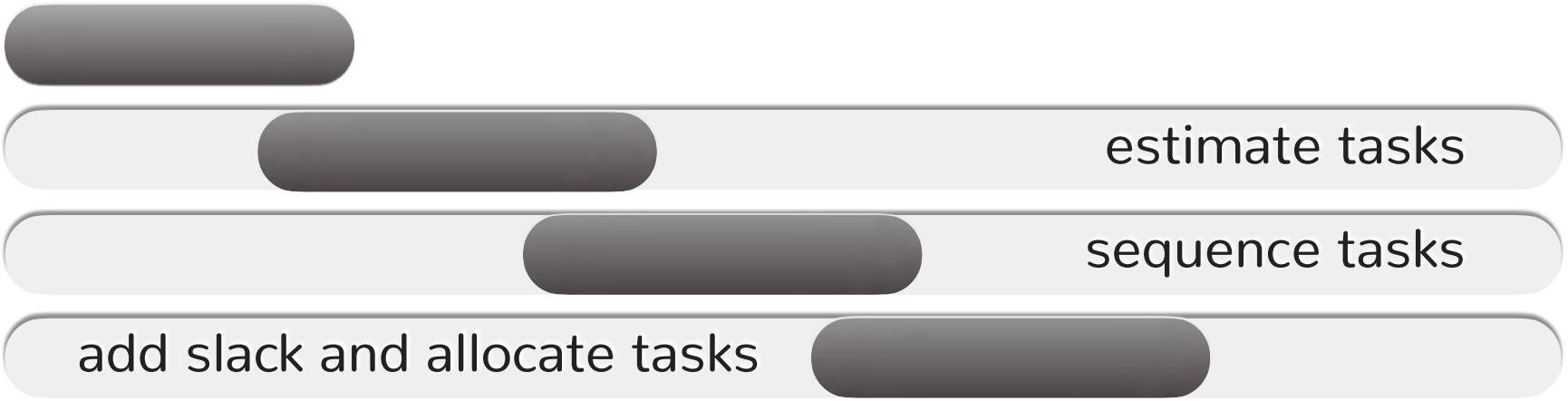
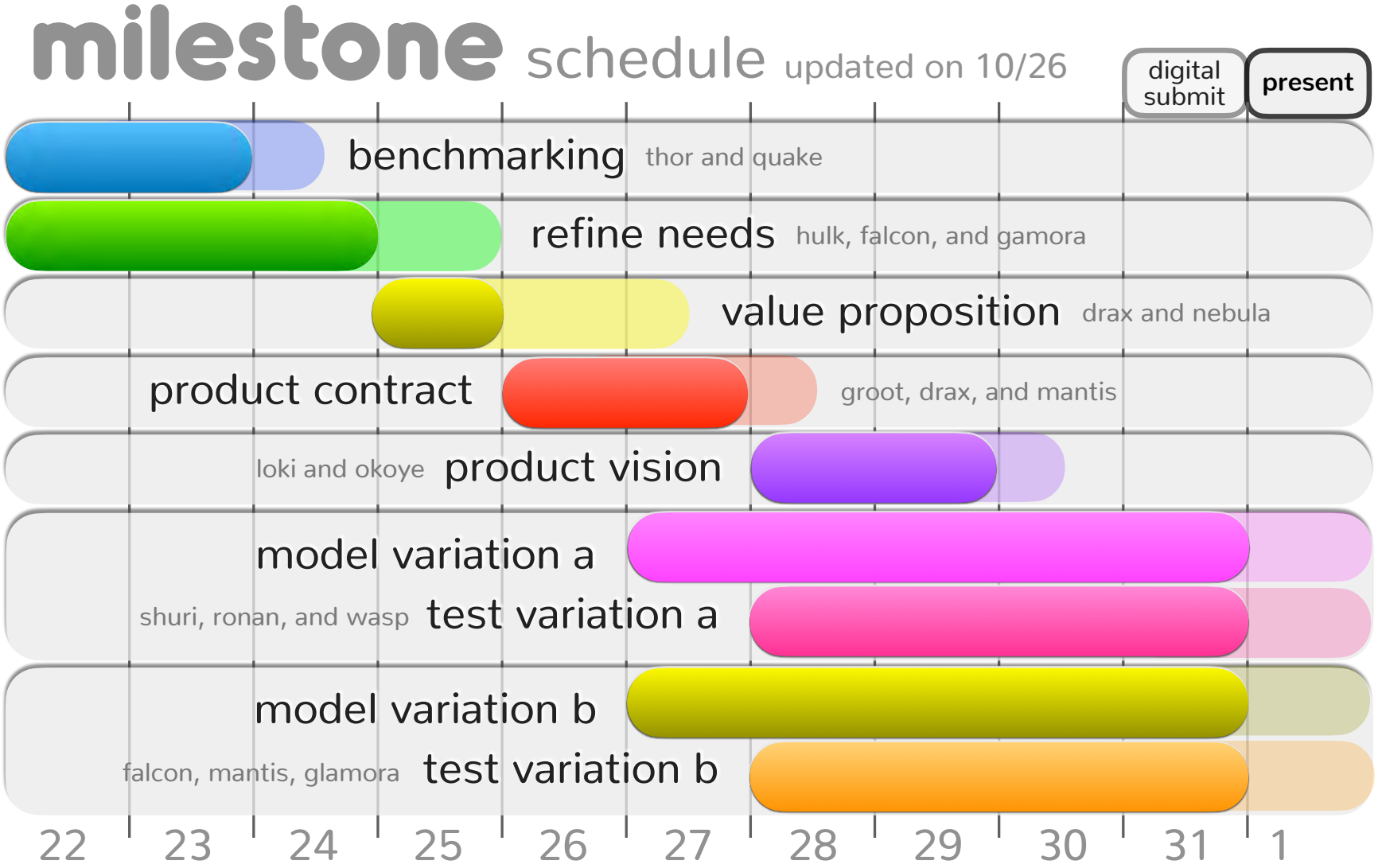


a schedule


estimate tasks
sequence tasks
add slack and allocate tasks


milestone schedule updated on 10/26
digital submit
present
benchmarking
thor and quake
refine needs
hulk, falcon, and gamora
value proposition
drax and nebula
product contract
groot, drax, and mantis
loki and okoye
product vision
model variation a
shuri, ronan, and wasp
test variation a
model variation b
falcon, mantis, glamora
test variation b
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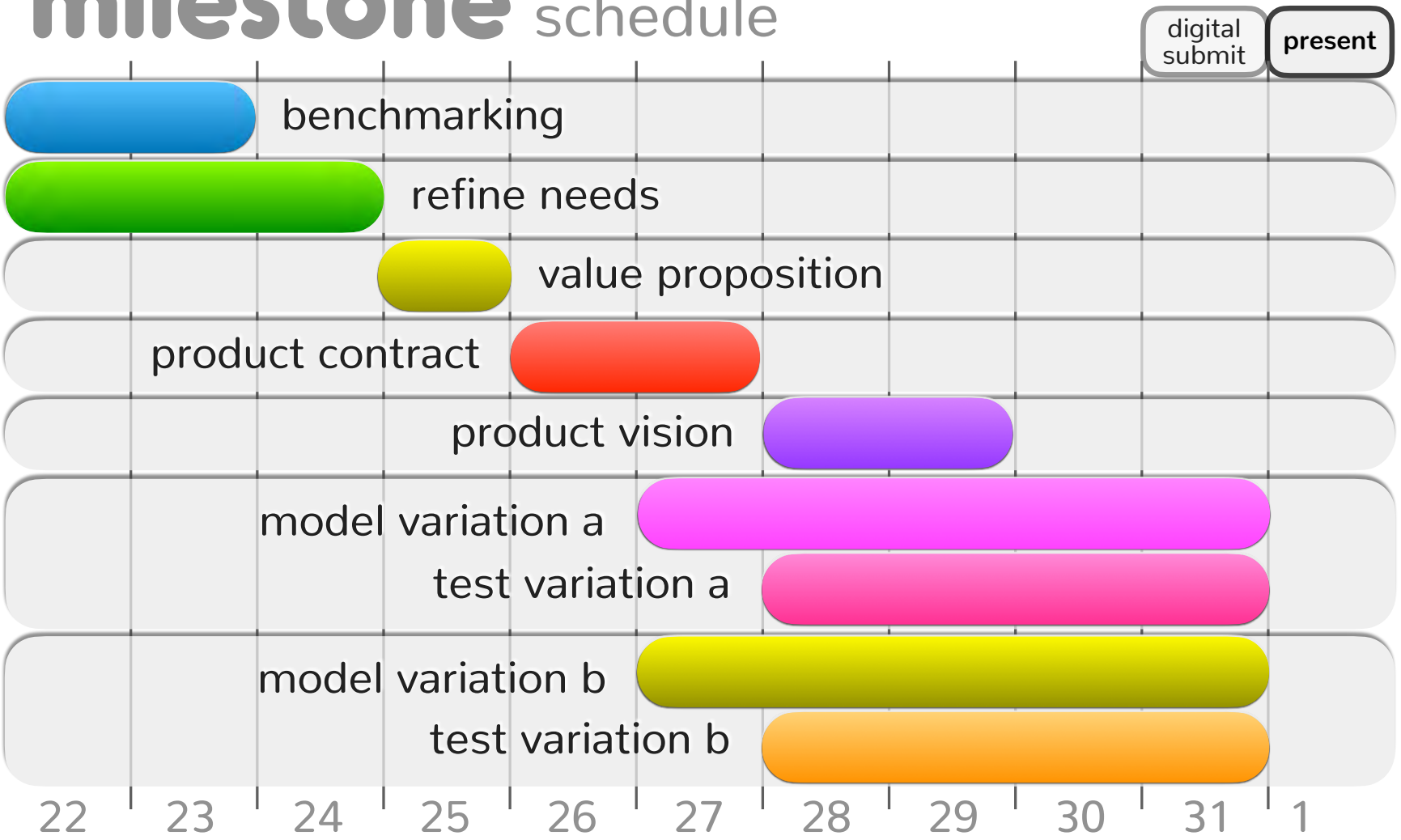
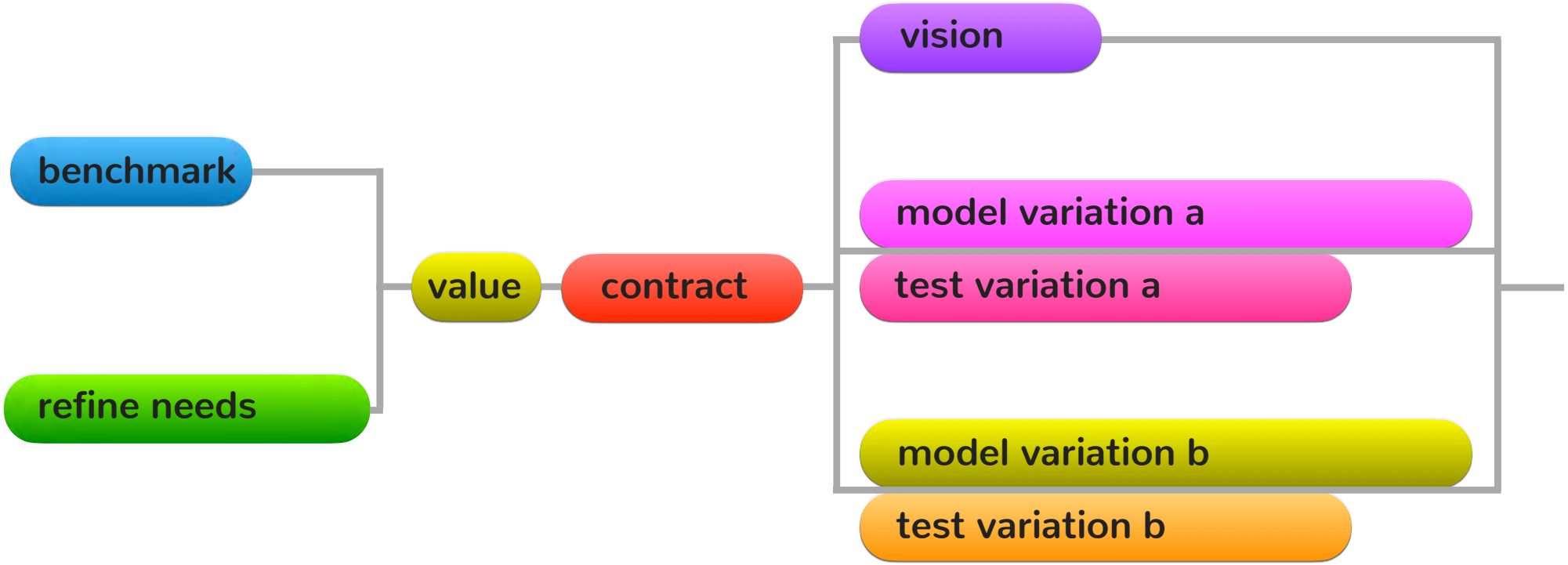
PERT

Program Evaluation and Review Technique

milestone schedule




benchmark
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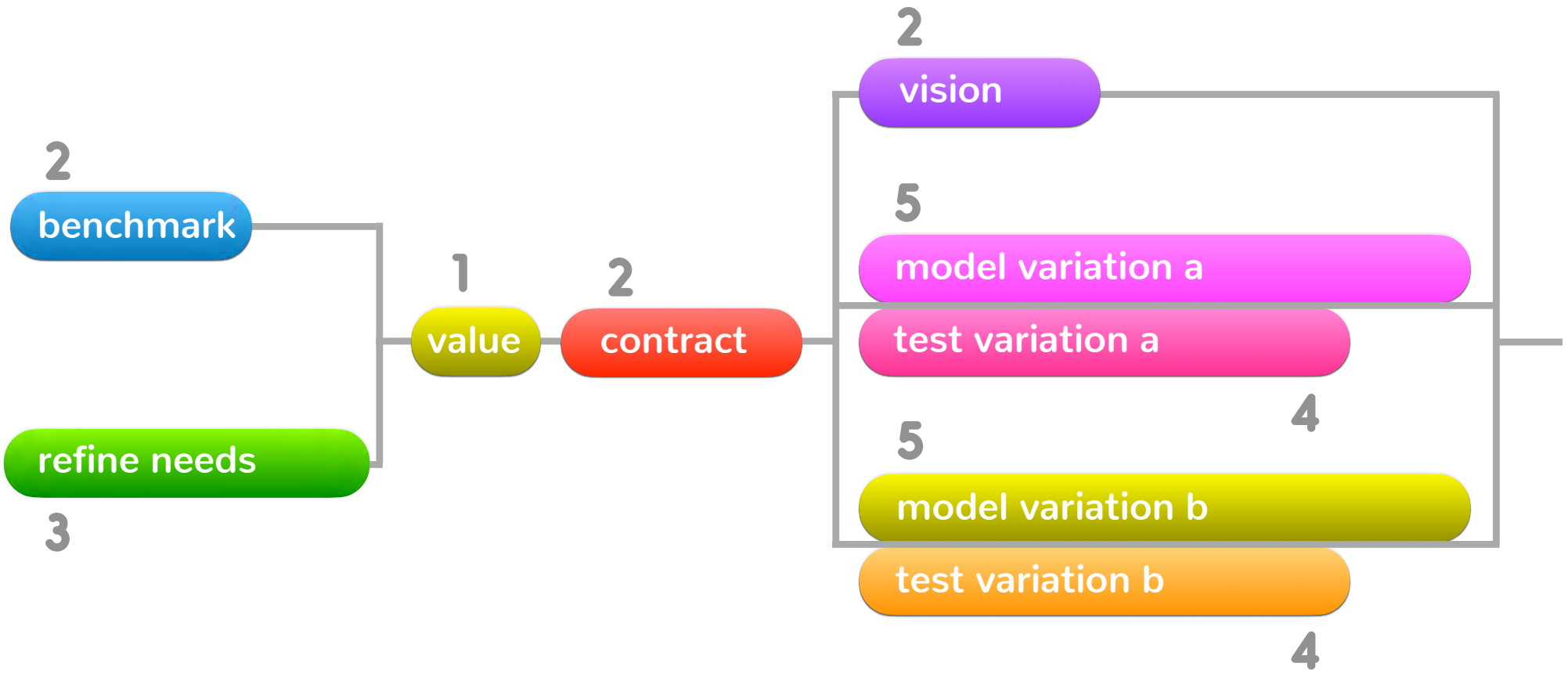
contract
vision
model variation a
test variation a
model variation b
test variation b


2
benchmark
refine needs
3
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value
2
contract
2
vision
5
model variation a
test variation a
4
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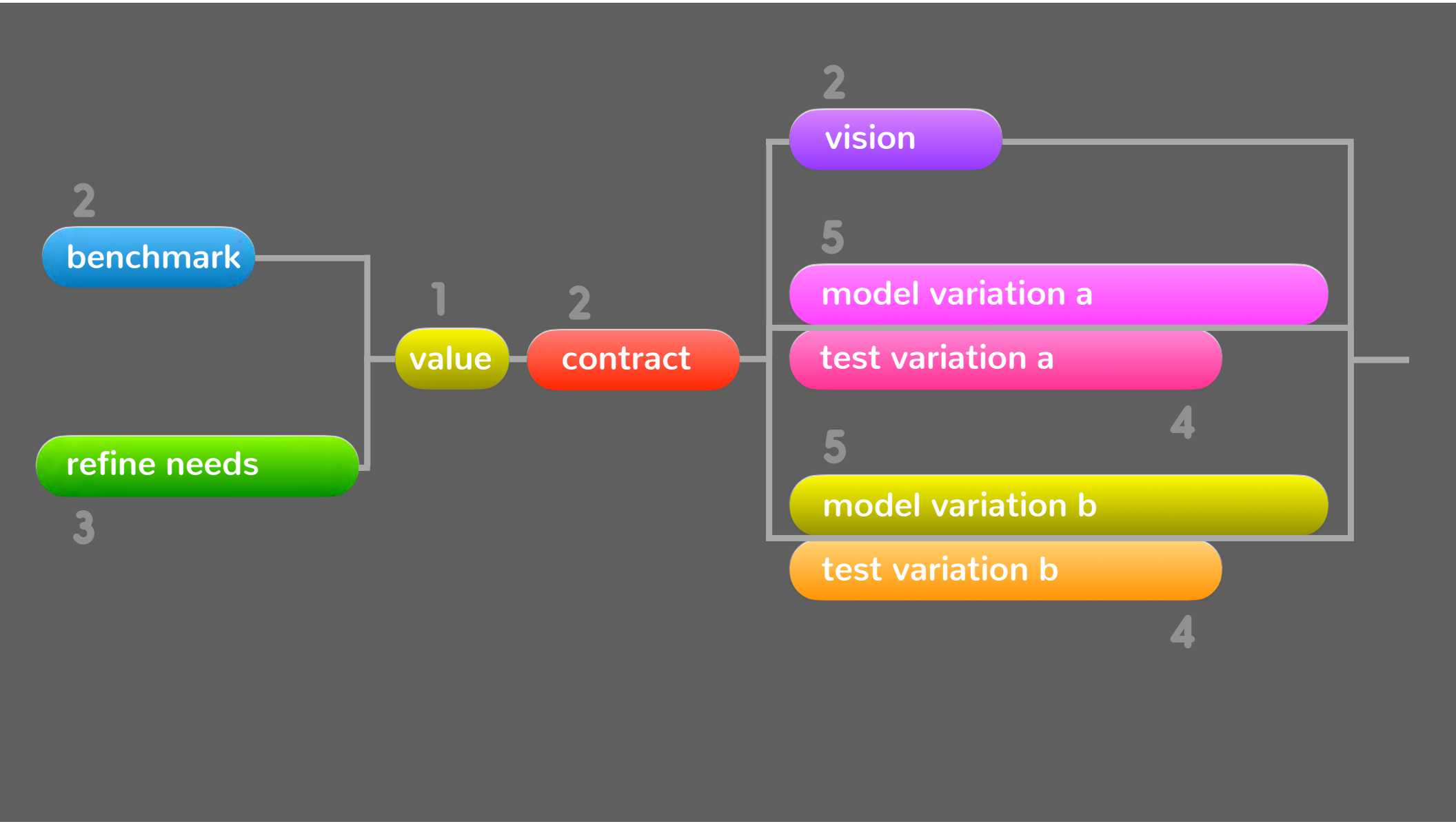
model variation b
test variation b
4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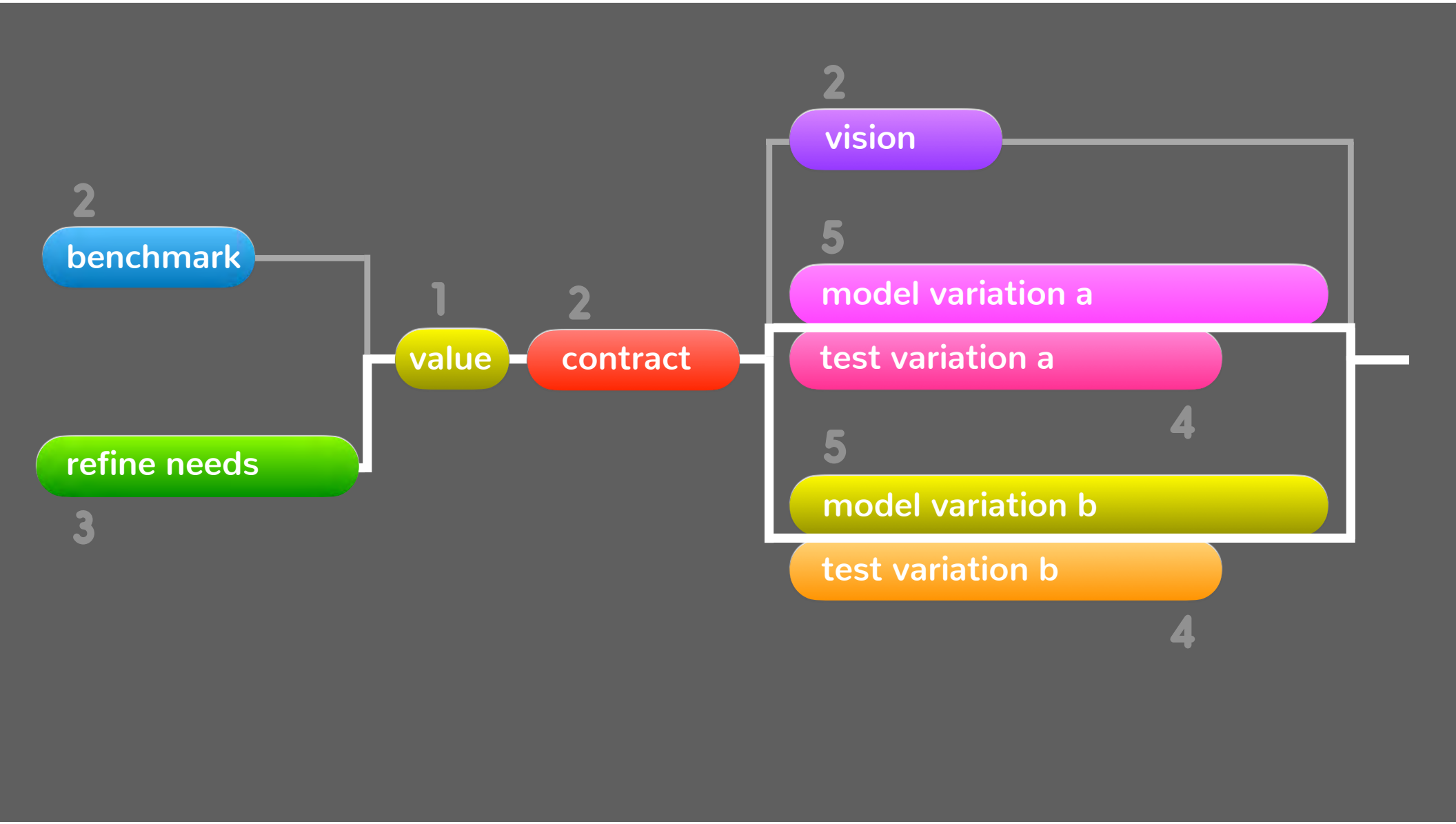
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refine needs
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contract
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vision
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model variation a
test variation a
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model variation b
test variation b
4

management

start early
manage/change deliverable scope
freeze decisions based on timeline
outsource or engage additional resources

reallocate resources to critical path
(eliminate secondary items)

eliminate parts of critical path