



# NPCs Have Feelings Too: Verbal Interactions with Emotional Character AI

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## GDC

**GAME DEVELOPERS CONFERENCE**

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# TEAM

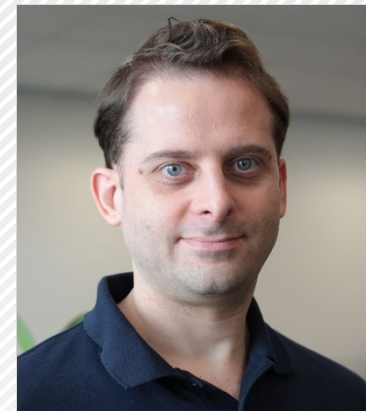
## SQUARE ENIX JAPAN – ADVANCED TECHNOLOGY DIVISION



Gautier Boeda



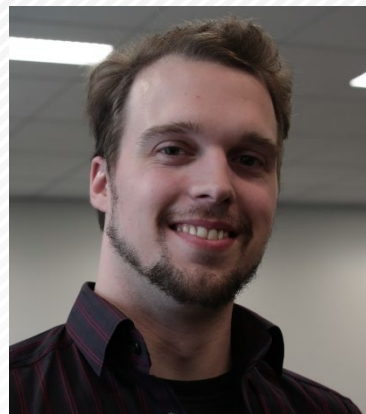
Yuta Mizuno



Remi Driancourt



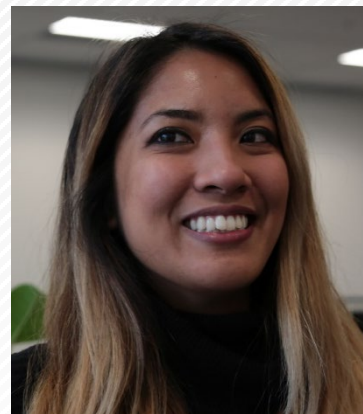
Brian Wanamaker



Perry Leijten



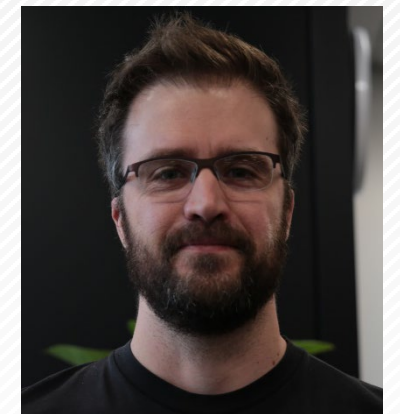
Stephanie Timmins



Adelle Bueno



Eduardo Mosená



Louis-Philippe  
Sanschagrin



# MOTIVATION

## WHAT ARE WE TRYING TO IMPROVE?

- Non-playable characters in virtual reality feel really close!
  - Enhance immersion
- Interacting with them felt sloppy, breaking the immersion
  - Limited to buttons or other classic mechanism
  - No reaction, as if the player was a ghost

# MOTIVATION

## HOW CAN IT BE ACHIEVED?

- Mission
  - Bring more natural interactions:
    - Voice interaction
    - Body interaction
  - Create more aware, expressive and lively agents
    - Interact with the player appropriately (Actions, Emotions, Reactions, ...)
    - Answer their own needs





# DEMO

## FIRST GLANCE AT KOBUN



[View Video \(Click\)](#)

# ■ WHAT'S ON THE MENU TODAY?

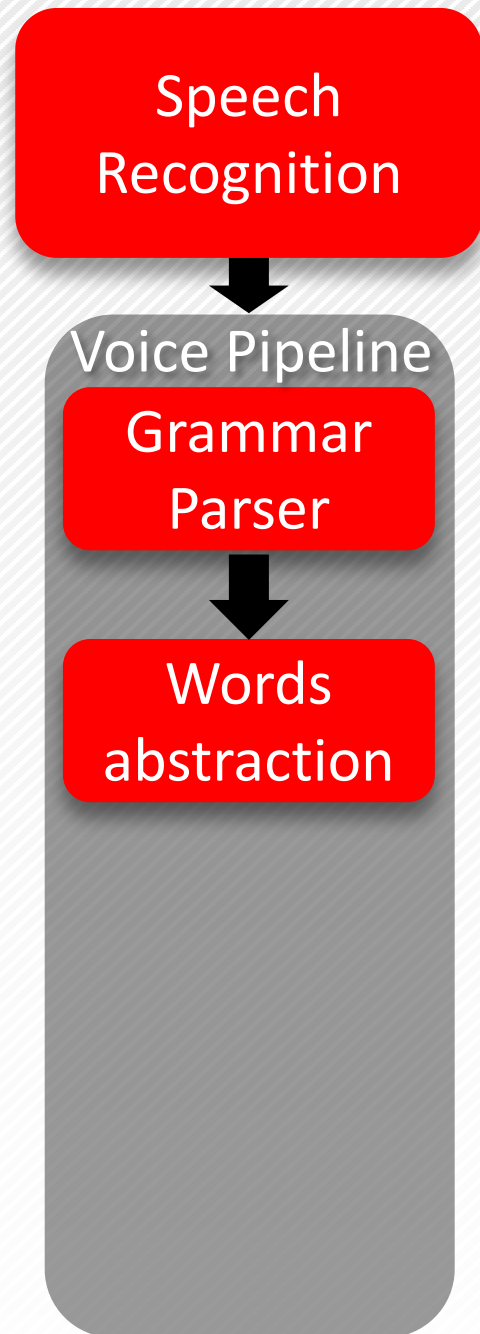
- Speech recognition pipeline
- Decision Making
- Emotional Component
- Factual statement





# SPEECH RECOGNITION PIPELINE

## PIPELINE SUMMARY



Pick up an enormous apple  
[Verb: Pick] [Preposition: up] [Determiner: an] [Adjective: enormous] [Noun: apple]

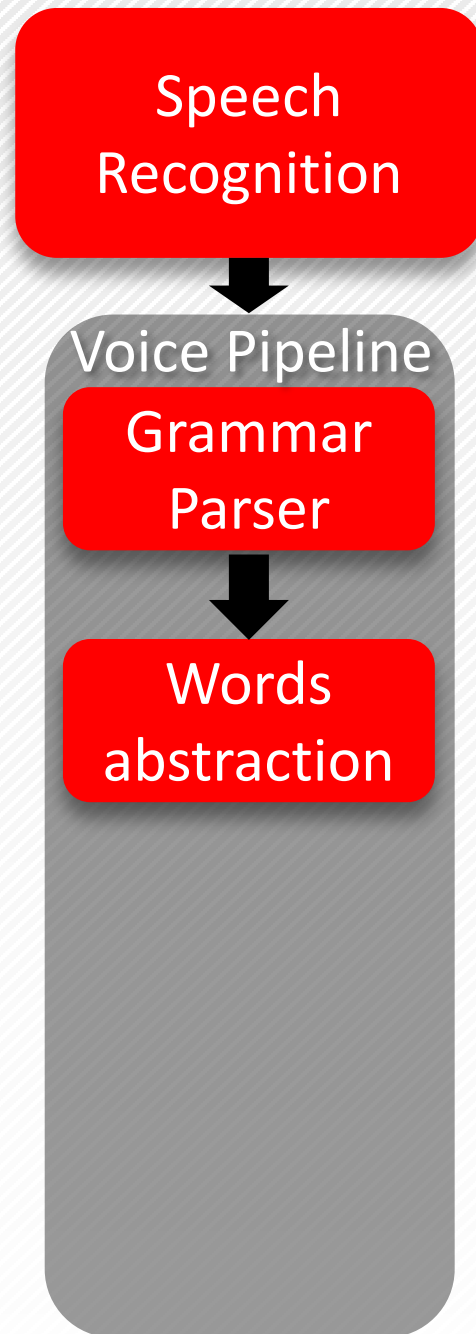
[Verb: Pick up] [Predicate: enormous] [Object: apple]

[Verb: 



# SPEECH RECOGNITION PIPELINE

## WORDS ABSTRACTION



- Problem to solve:
  - Support multiple languages without limiting the player's set of vocabulary
- Cause of the Problem:
  - Words are language-based. They don't have bindings between languages.

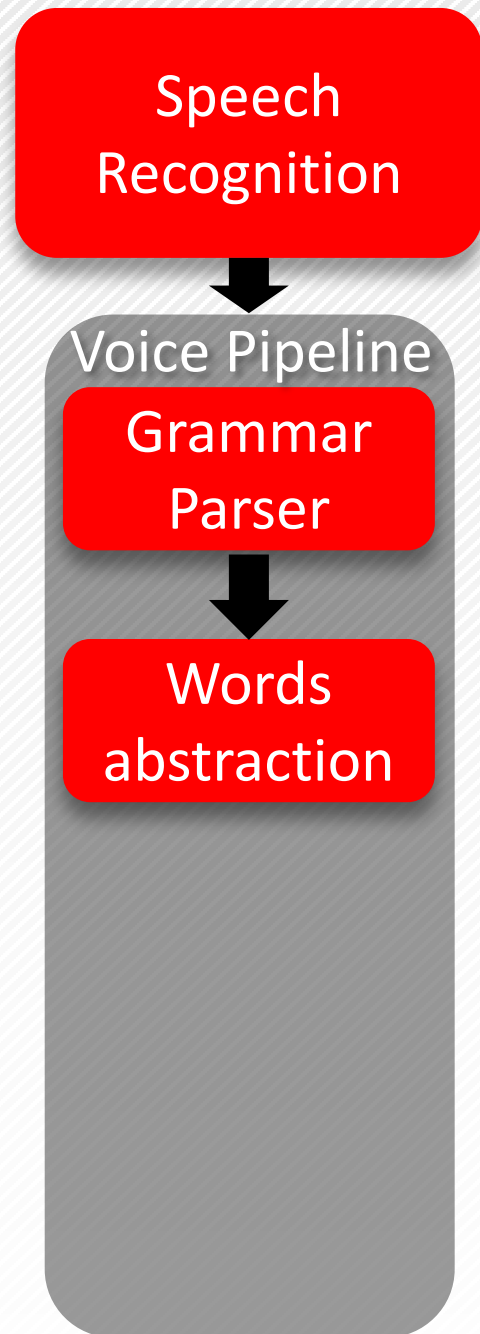
↓

We need to abstract them.
- Idea:
  - Can we create the DNA of a word? What could be the genes?



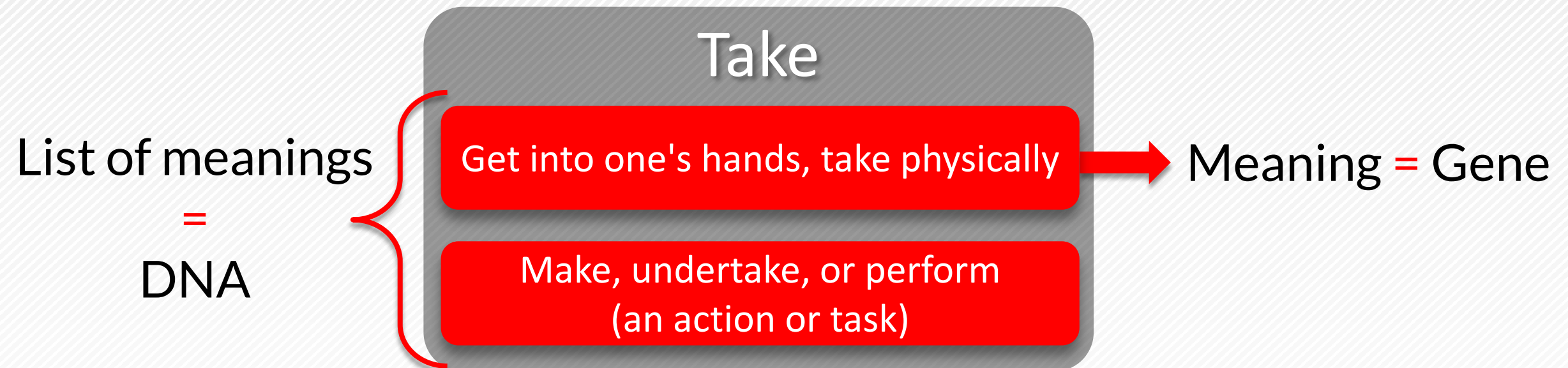
# SPEECH RECOGNITION PIPELINE

## WORDS ABSTRACTION



Take an **apple**  
Get into one's hands, take physically

Take a **break**  
Make, undertake, or perform (an action or task).



How? → **WordNet**

- Database of “sets of cognitive synonyms (synset), each expressing a distinct concept” [wordnet.princeton.edu/](http://wordnet.princeton.edu/)
- Support multiple languages

# SPEECH RECOGNITION PIPELINE

## WORDS ABSTRACTION

Speech  
Recognition

Voice Pipeline

Grammar  
Parser

Words  
abstraction

- Example:
  - We need a concept of “**Big**” in our experience, as in “A **big** apple”

00225892-r	big	on a grand scale
01890752-a (1)	boastful, big, braggart, bragging, braggy, cock-a-hoop, crowing, self-aggrandizing, self-aggrandising	exhibiting self-importance
01488616-a (5)	full-grown, grown, adult, big, fully grown, grownup	(of animals) fully developed
01191780-a	big	marked by intense physical force
00225672-r (2)	boastfully, big, vauntingly, large	in a boastful manner
00226054-r (1)	big	extremely well
01382086-a (246)	large, big	above average in size or number or quantity or magnitude or extent
00225805-r	big	in a major way
01890187-a (1)	swelled, big, vainglorious	feeling self-importance
00173391-a (2)	gravid, big, enceinte, expectant, great, large, heavy, with child	in an advanced stage of pregnancy
01276872-a (7)	big	significant
01114658-a	big, large, magnanimous	generous and understanding and tolerant
01111418-a (6)	handsome, liberal, big, bountiful, bighearted, bounteous, freehanded, giving, openhanded	given or giving freely
02402439-a	big, heavy	prodigious
01510444-a (5)	bad, big	very intense
00579622-a (11)	prominent, big, large	conspicuous in position or importance
01453084-a (2)	big	loud and firm

# SPEECH RECOGNITION PIPELINE

## WORDS ABSTRACTION

Speech  
Recognition

Voice Pipeline

Grammar  
Parser

Words  
abstraction

Which “**big**” meaning  
are we interested in?

1) Keep adjectives  
r = adverb  
a = adjective

2) Select concepts

<a href="#">01890752-a</a> (1)	boastful, <b>big</b> , braggart, bragging, braggy, cock-a-hoop, crowing, self-aggrandizing, self-aggrandising	✗ exhibiting self-importance
<a href="#">01488616-a</a> (5)	full-grown, grown, adult, <b>big</b> , fully grown, grownup	✗ (of animals) fully developed
<a href="#">01191780-a</a>	<b>big</b>	✗ marked by intense physical force
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<a href="#">00579622-a</a> (11)	prominent, <b>big</b> , large	✗ conspicuous in position or importance
<a href="#">01453084-a</a> (2)	<b>big</b>	✗ loud and firm

# SPEECH RECOGNITION PIPELINE

## WORDS ABSTRACTION

Speech  
Recognition

Voice Pipeline

Grammar  
Parser

Words  
abstraction

- Our “**Big**” predicate DNA will be composed of:  
[01382086-a] above average in size or number or quantity or magnitude or extent  
[01276872-a] Significant

Big

- Check our synsets:  
— Multi languages!

### Japanese

サイズ、数、量、大きさまたは範囲において平均以上の — 大都市; 世界の広範囲; 大都市に出发してください; 多額; 大きい (または大きい) 納屋; 大家族

### English

above average in size or number or quantity or magnitude or extent — a large city; large areas of the world; set out for the big city; a large sum; a big (or large) barn; a large family

### Italian

Superiore a misura ordinaria per dimensioni, quantità, durata e simili

01382086-a 'above average in size or number or quantity or magnitude or extent';

Search WN

English

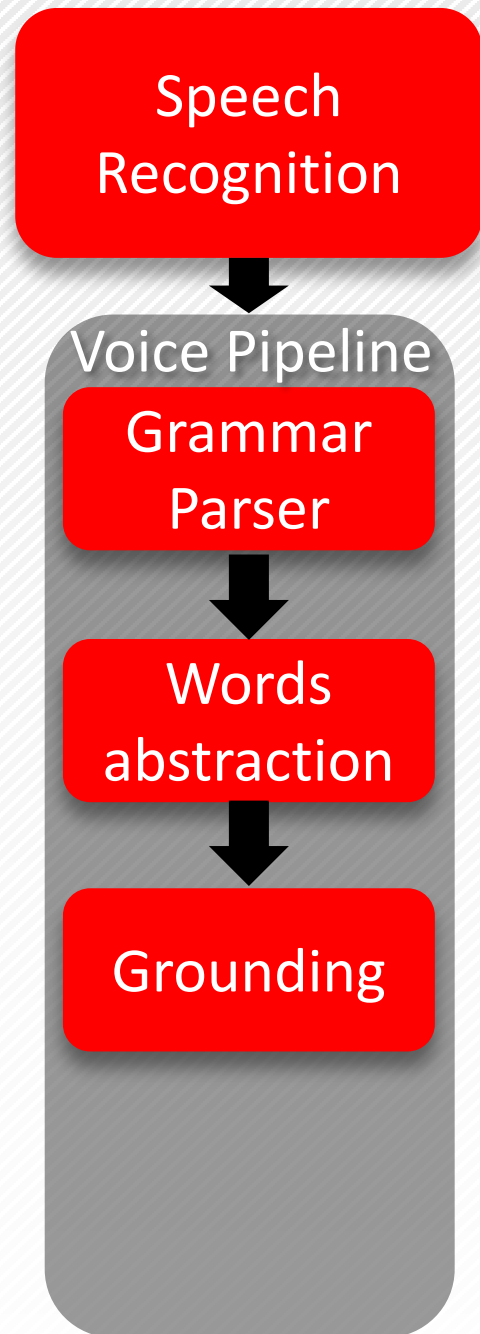
Albanian	<i>i madh , i gjerë</i>
Arabic	كبير
Bulgarian	голям
Catalan	<i>gran</i>
Chinese (simplified)	大+的 , 巨大+的 , 大 , 巨大
Danish	<i>stor</i>
Greek	<i>μεγάλος</i>
English	<i>large</i> <sub>139</sub> (↗ ↘ ↙) , <i>big</i> <sub>107</sub> (↗ ↘)
Finnish	<i>iso , suuri</i>
French	<i>grand , gros , large , nombreux</i>
Hebrew	גדול
Croatian	<i>krupan , obiman , velik</i>
Indonesian	<i>gedang , terbesar , banyak , besar , bidang , luas , gadang , gede , ramai</i>
Icelandic	<i>stór , stæðilegur , fastur fyrir , þéttur fyrir</i>
Italian	<i>grosso , vasto , grande</i>
Japanese	でっかい , 太い , でかい , 大き , 偉い , 大 , おっきい , 大きい , 広い
Lithuanian	<i>didelis</i>
Bokmål	<i>stor</i>
Polish	<i>niemały , duży</i>
Portuguese	<i>grande</i>
Chinese (traditional)	碩 , 大量 , 豪
Romanian	<i>mare</i>
Slovak	<i>veľký , početný , obrovský</i>
Slovene	<i>velik</i>
Spanish	<i>gran , grande</i>
Swedish	<i>stor</i>
Thai	ใหญ่
Malaysian	<i>gedang , terbesar , banyak , besar , bidang , luas , gadang , gede , ramai</i>





# SPEECH RECOGNITION PIPELINE

## PIPELINE SUMMARY



Pick up an enormous apple  
[Verb: Pick] [Preposition: up] [Determiner: an] [Adjective: enormous] [Noun: apple]

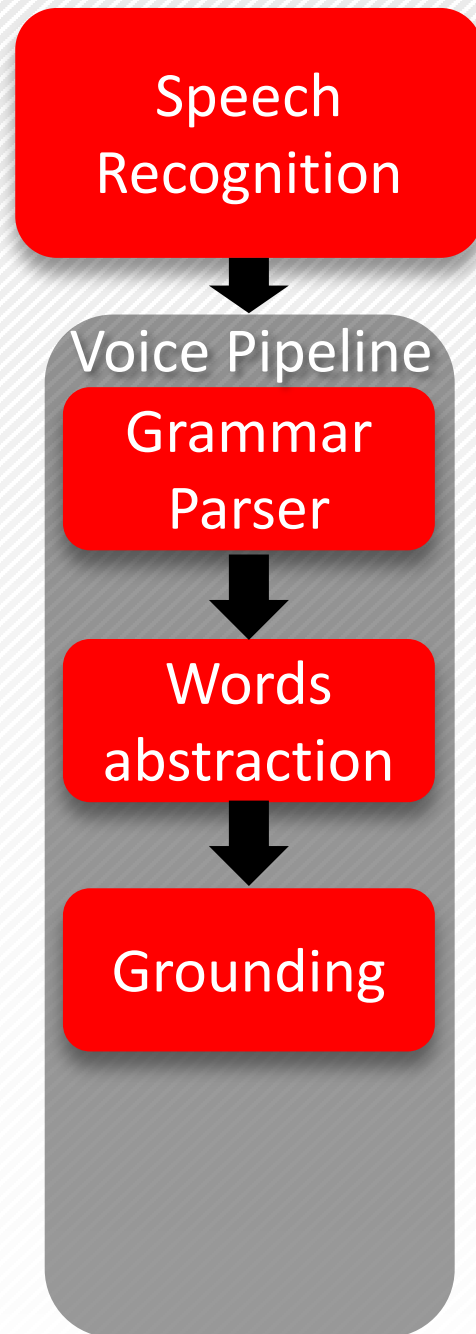
[Verb: Pick up] [Predicate: enormous] [Object: apple]

[Verb: ] [Predicate: ] [Object: ]

[Take] [big] [Object: ]

# SPEECH RECOGNITION PIPELINE

GROUND THE WORDS INTO THE CONCEPTS OF OUR WORLD

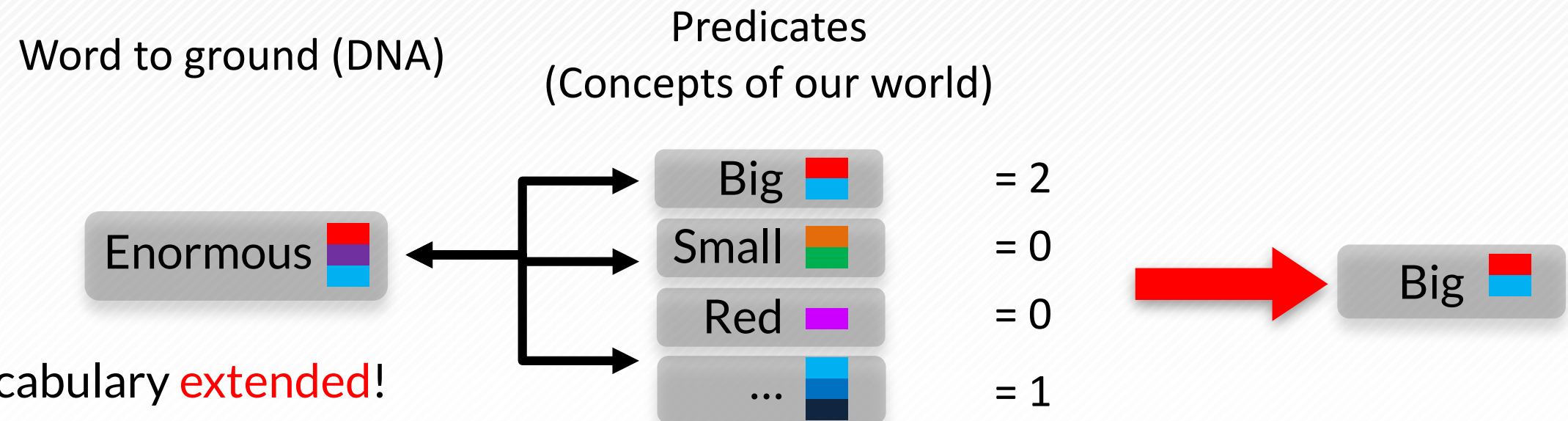


Ground the abstracted words to our concepts:

- Locations (above, behind, left, etc)
- Predicates (color, size, etc)
- Verbs
- ...

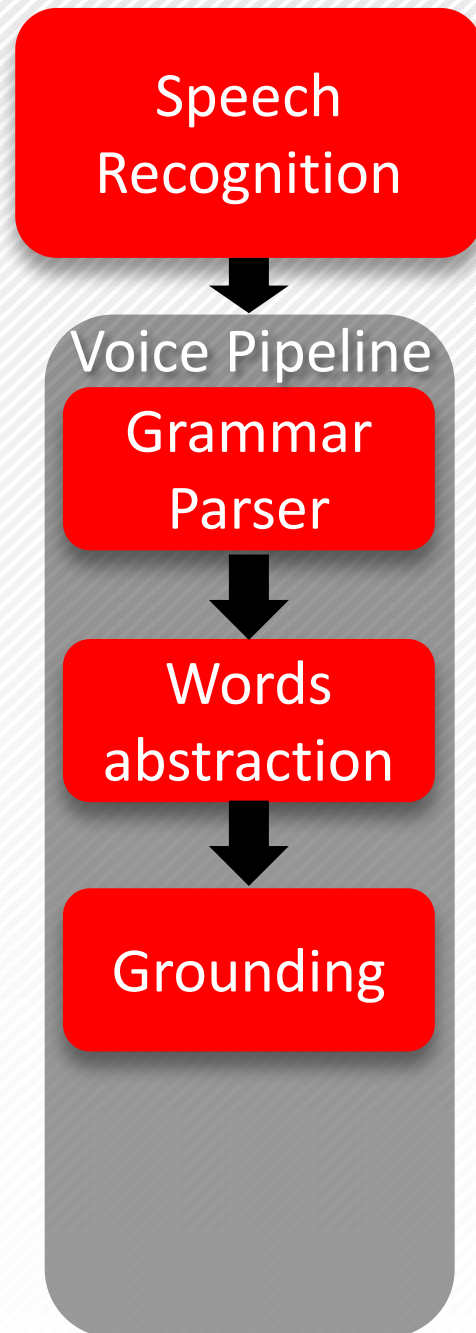
Using a utility-based scoring method.

Example:



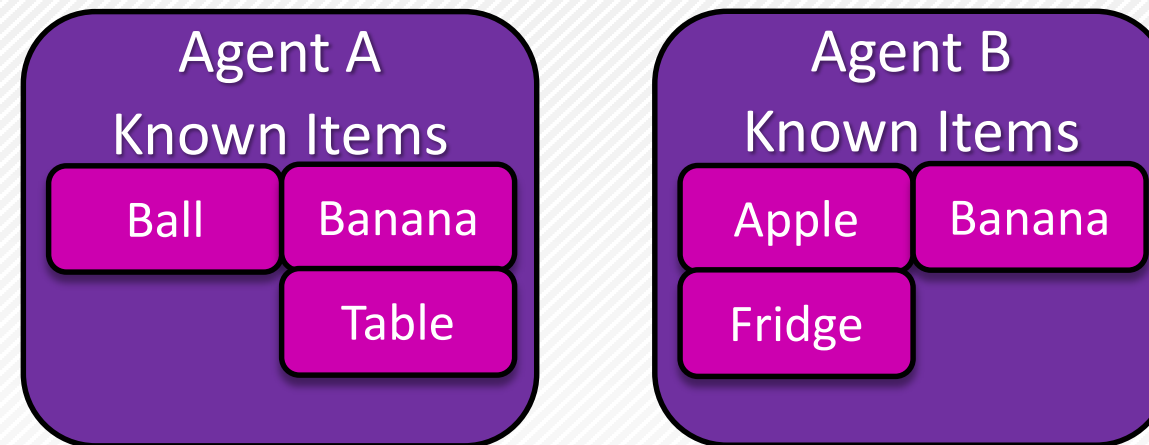
# SPEECH RECOGNITION PIPELINE

GROUND THE WORDS INTO THE CONCEPTS OF OUR WORLD



Everything cannot be grounded!

→ Objects relies on the knowledge of each agent.



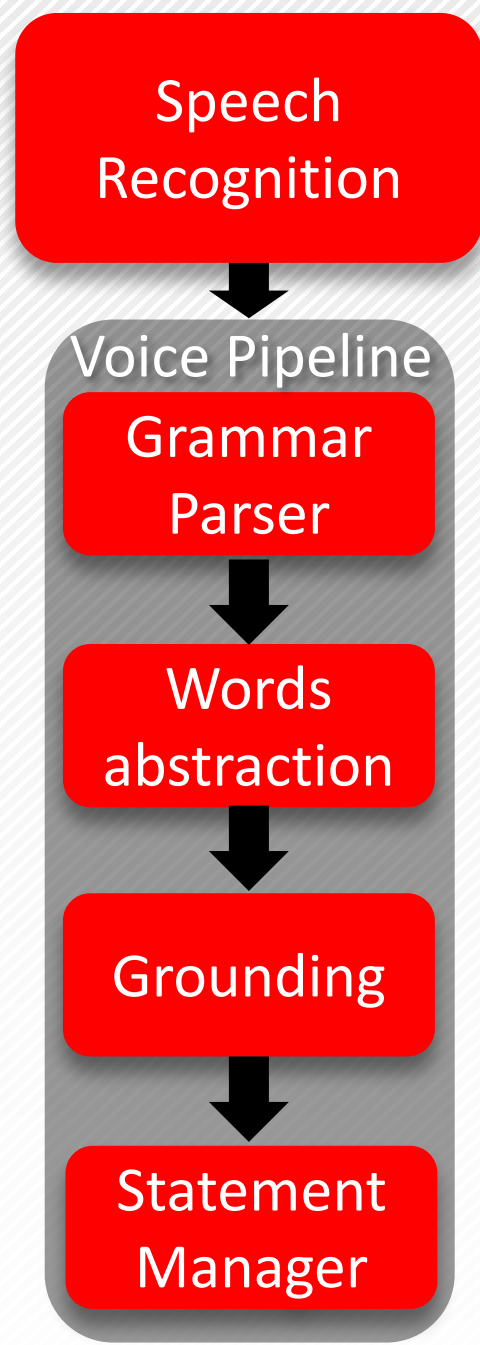
We need to ground them on a per-agent basis.

→ We will do this at a later stage



# SPEECH RECOGNITION PIPELINE

## PIPELINE SUMMARY



Pick up an enormous apple  
[Verb: Pick] [Preposition: up] [Determiner: an] [Adjective: enormous] [Noun: apple]

[Verb: Pick up] [Predicate: enormous] [Object: apple]

[Verb: 

[Take] [big] [Object: 

Store the statement in memory. [Take] [big] [Object: 



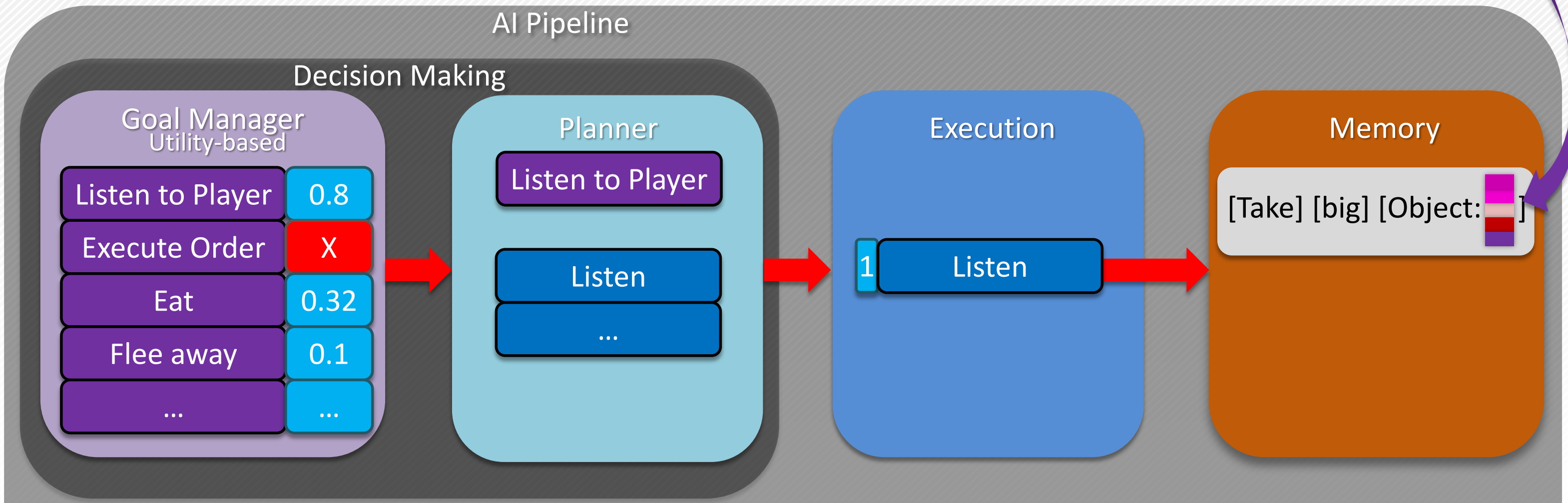
# DECISION MAKING

## GOAL MANAGER

### Voice Pipeline



### AI Pipeline



# DECISION MAKING

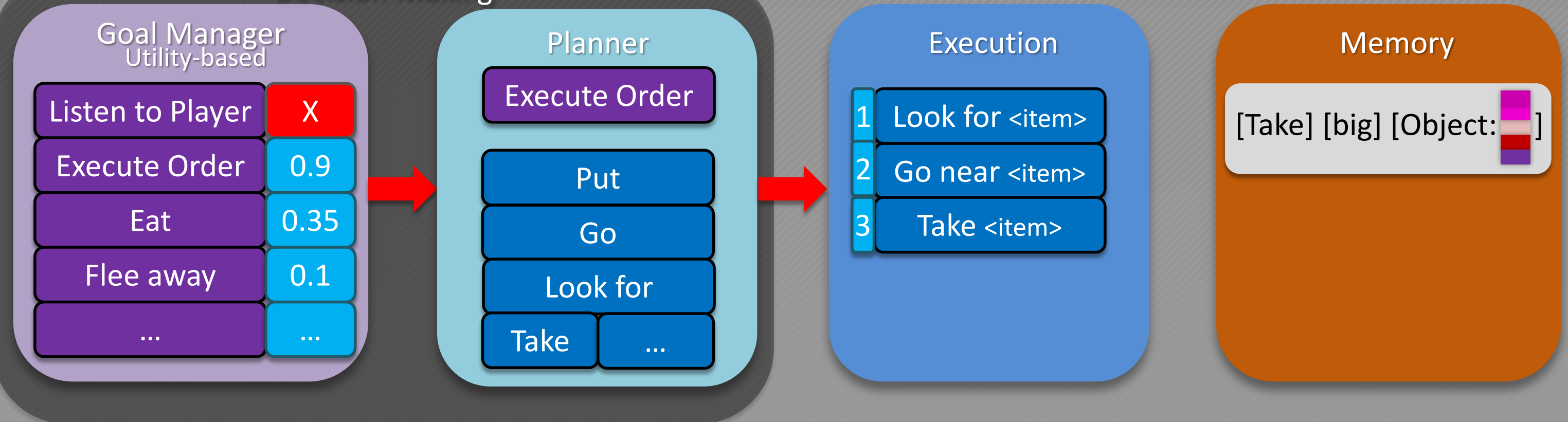
## GOAL MANAGER

### Voice Pipeline



### AI Pipeline

#### Decision Making



# GROUNDING OBJECTS

LOOK FOR "BIG APPLE"

(Pick up an enormous apple)

Look for [Object: ]

Execution

- 1 Look for <item>
- 2 Go near <item>
- 3 Take <item>

How to find a suitable object in our knowledge?

→ Using again an utility-based system  
(Infinite Axis Utility System)

Memory

[Take] [big] [Object: ]

Known Items

Apple A	Banana
Apple B	Table
Apple C	...

Look for [Object: ]

Goals

Targets

Attack	Target A	0.7
Attack	Target B	0.5
Eat	Meat	0.1
Eat	Apple	0.8

Goals

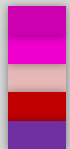
Targets

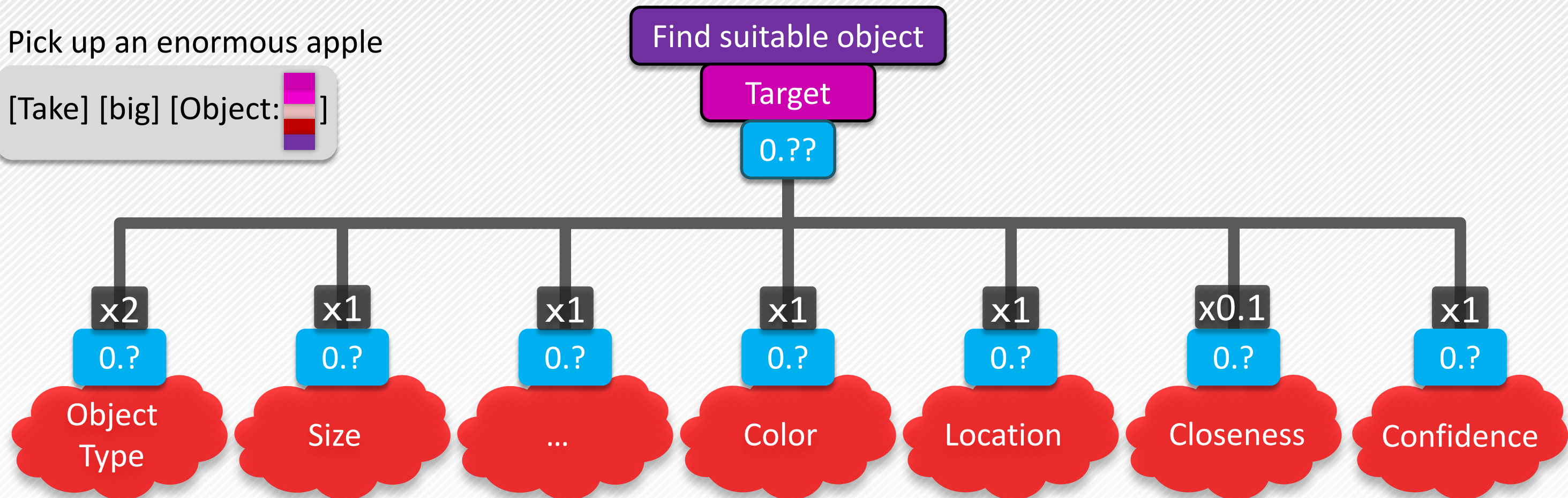
Find suitable object	Item A
Find suitable object	Item B
Find suitable object	Item C
Find suitable object	Item D

# GROUNDING OBJECTS

LOOK FOR “BIG APPLE”

Pick up an enormous apple

[Take] [big] [Object: 

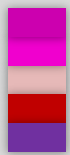




# GROUNDING OBJECTS

LOOK FOR "BIG APPLE"

Pick up an enormous apple

[Take] [big] [Object: 

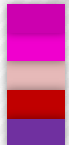

Find suitable object

Apple

x2

1

Object  
Type

[Object: ][:Apple A]

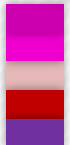

Find suitable object

Banana

x2

0

Object  
Type

[Object: ][:Banana]

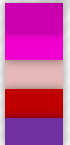

Find suitable object

Table

x2

0

Object  
Type

[Object: ][:Table]

Fruit, edible

# GROUNDING OBJECTS

LOOK FOR "BIG APPLE"

Find suitable object


Target

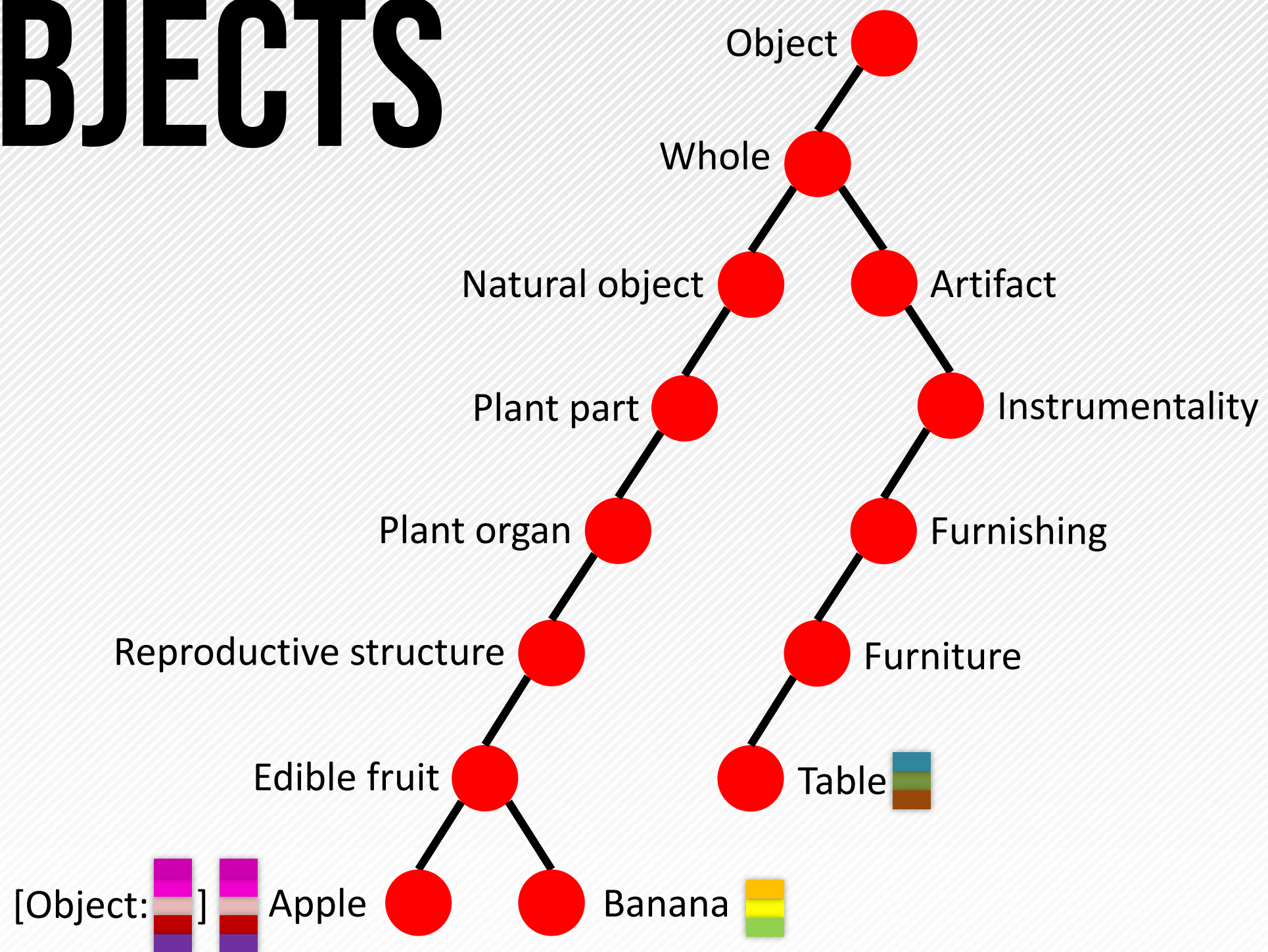
[:Apple]

[:Banana]

[:Table]

Pick up an enormous apple

[Take] [big] [Object:]



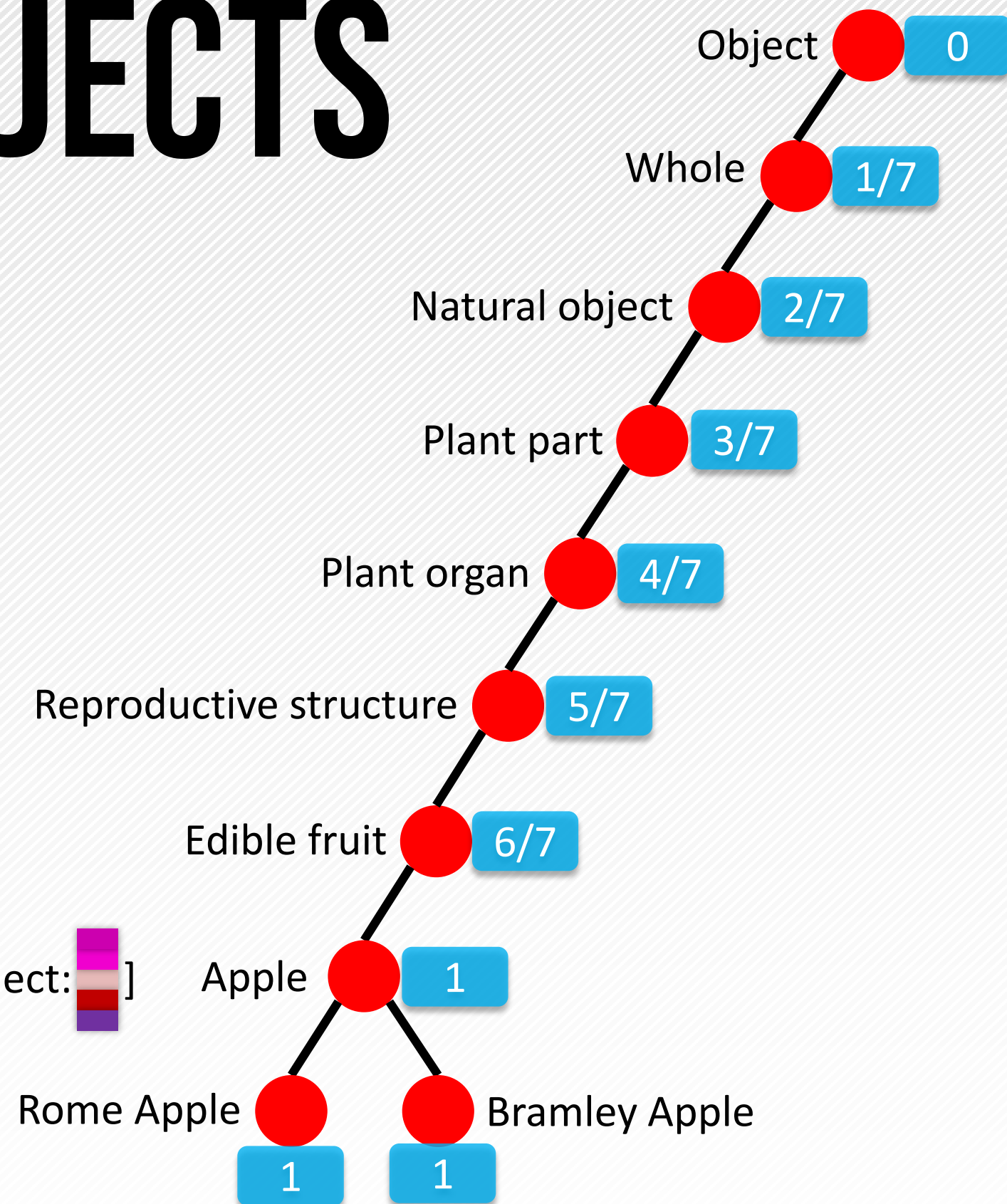
# GROUNDING OBJECTS

LOOK FOR "BIG APPLE"

Pick up an enormous apple

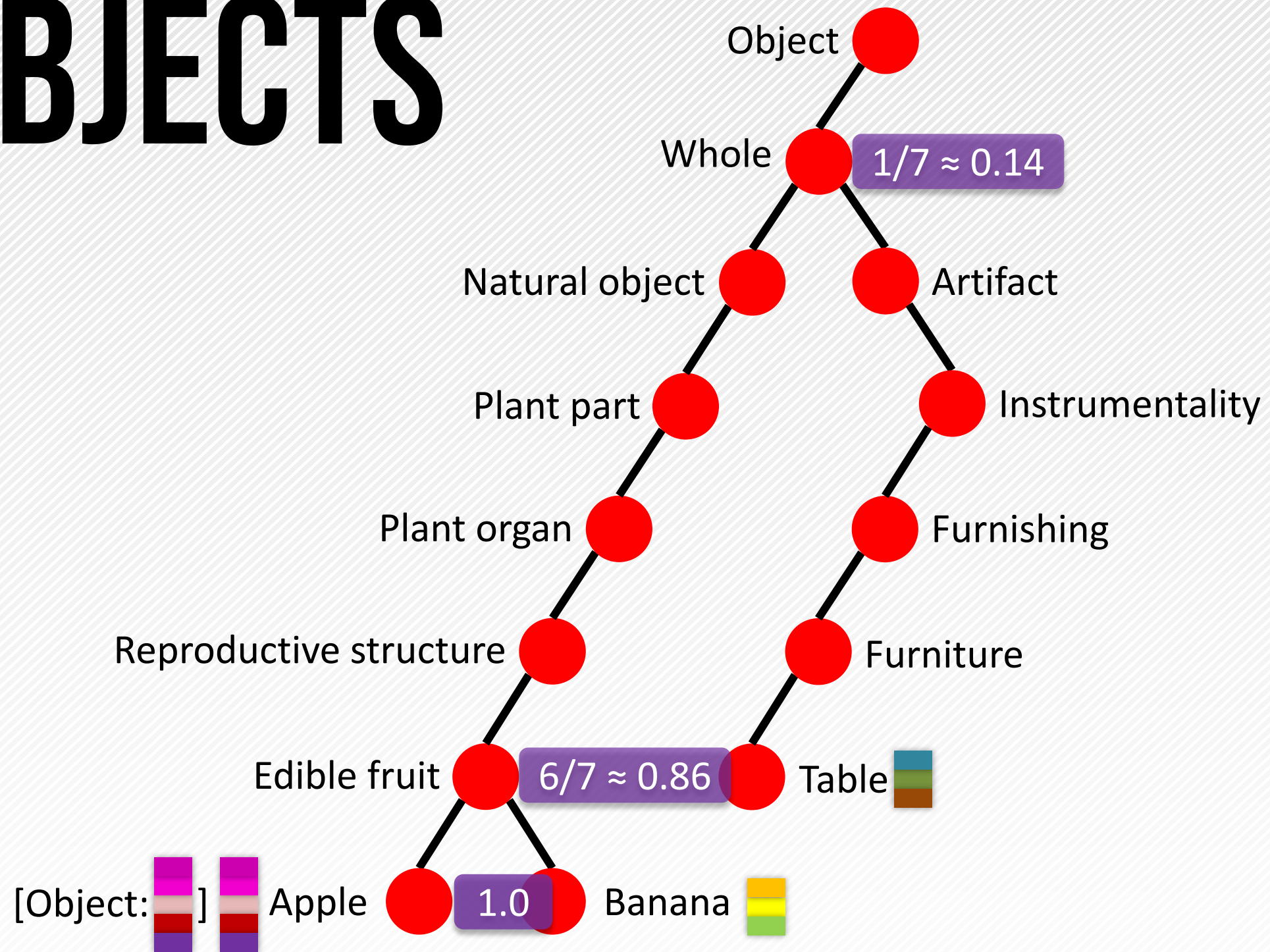
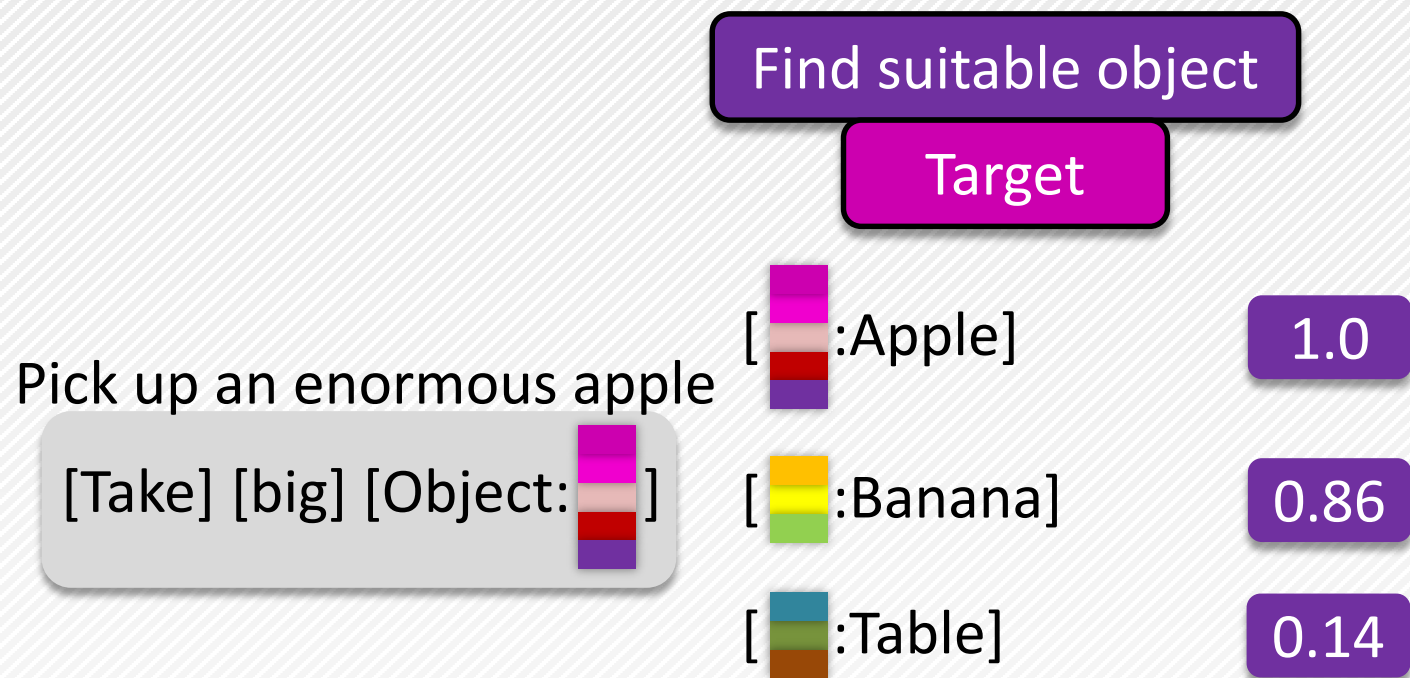
[Take] [big] [Object: ]

[Object: ]



# GROUNDING OBJECTS

LOOK FOR "BIG APPLE"

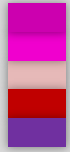




# GROUNDING OBJECTS

LOOK FOR "BIG APPLE"

Pick up an enormous apple

[Take] [big] [Object: 


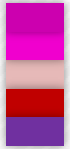
Find suitable object

Apple

x2

1

Object  
Type

[Object: ][:Apple A]



Find suitable object

Banana

x2

0.86

Object  
Type

[Object: ][:Banana]



Find suitable object

Table

x2

0.14

Object  
Type

[Object: ][:Table]

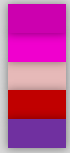
# Pick up an enormous apple



# GROUNDING OBJECTS




LOOK FOR "BIG APPLE"

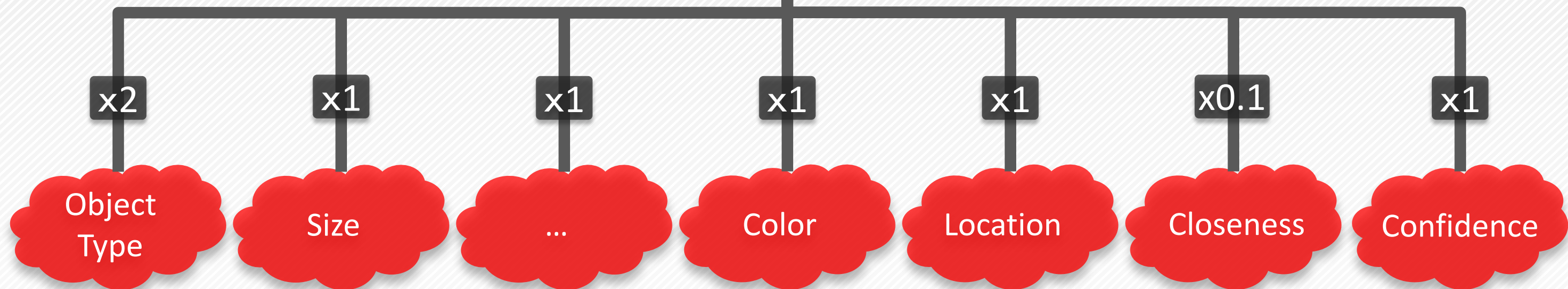
Pick up an enormous apple

[Take] [big] [Object: 

Find suitable object

Known Items	
Apple A	Banana
Apple B	Table
Apple C	...

	Apple A	0.91
	Banana	0.89
	Table	0.47
	Apple B	0.97
	Apple C	0.86
	...	0.35



Look for <big apple>  
Apple B 0.97



# GROUNDING OBJECTS

LOOK FOR “BIG APPLE”

Execution

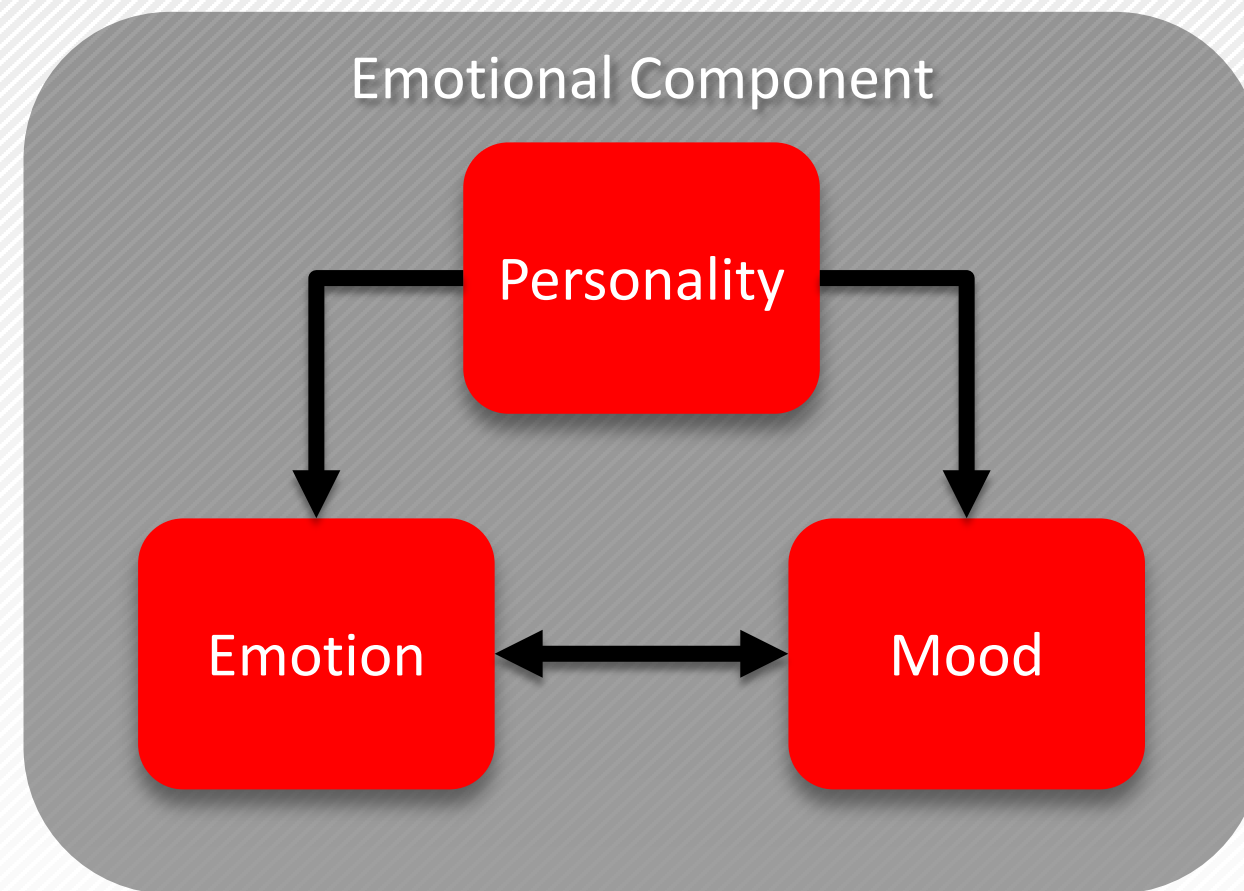
- 1 Look for <item> Apple B
- 2 Go near <item>
- 3 Take <item>



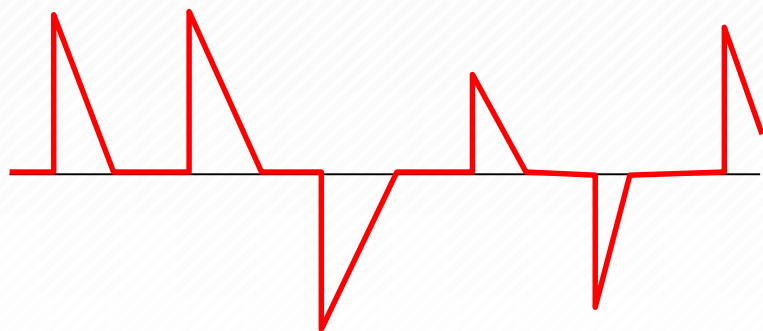
[View Video \(Click\)](#)

# EMOTIONAL COMPONENT

## PIPELINE OVERVIEW

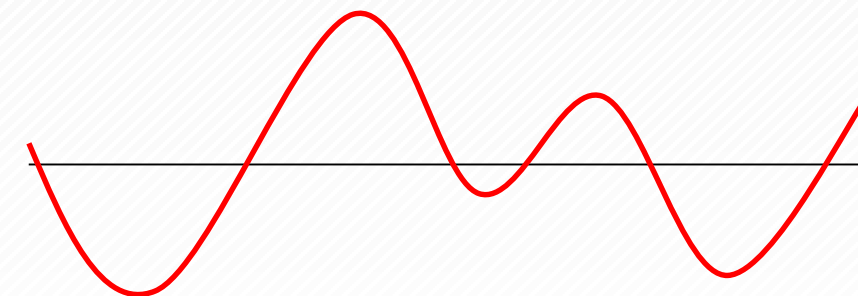


Short term feeling  
Evolve quickly over time  
Joy, Distress, Fear, ...



Defines the agent  
No evolution over time  
Curiosity, Shyness, Laziness, ...

Long term feeling  
Evolve slowly over time  
Exuberant, Depressed, Afraid, ...

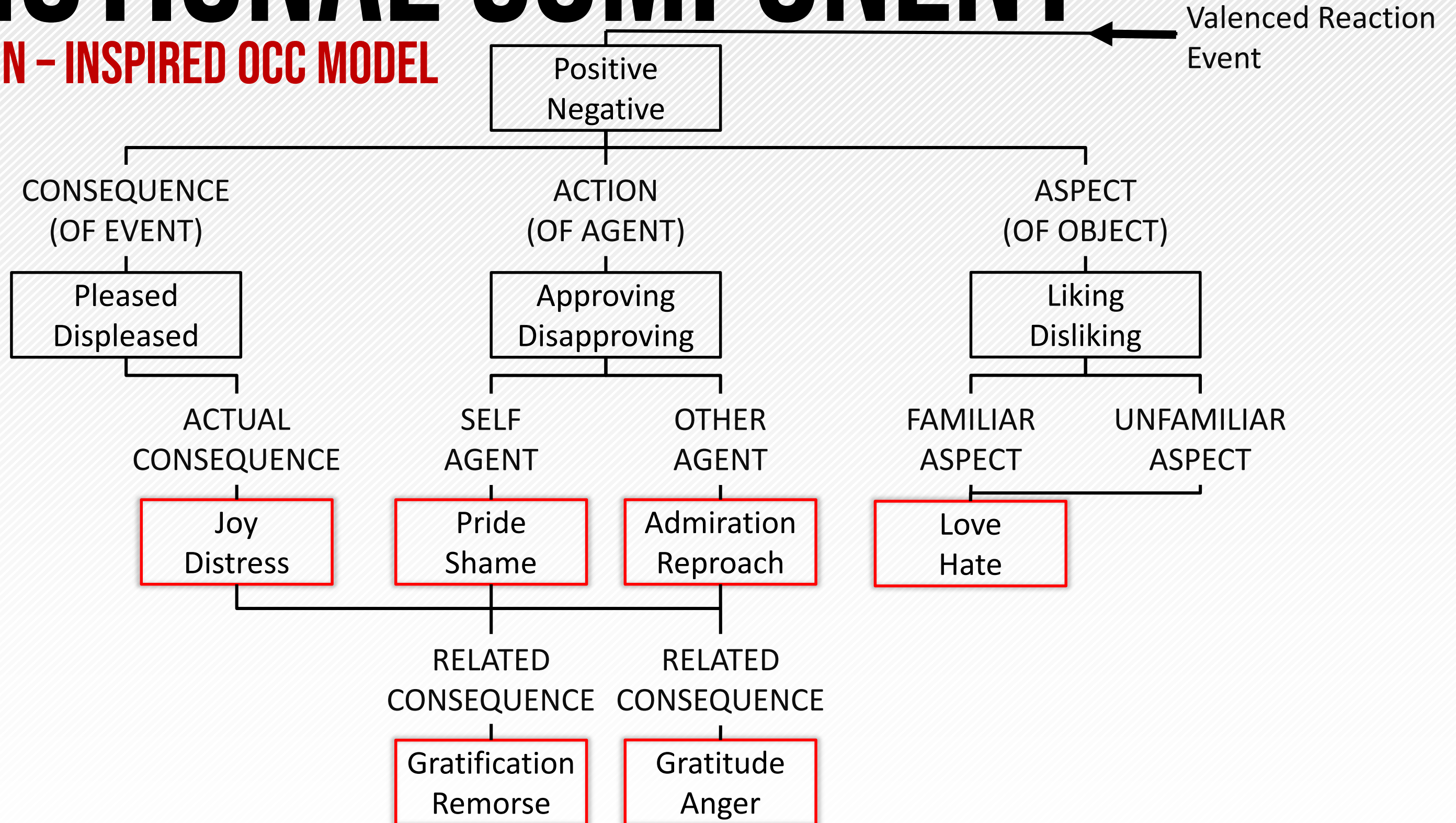






# EMOTIONAL COMPONENT

EMOTION - INSPIRED OCC MODEL



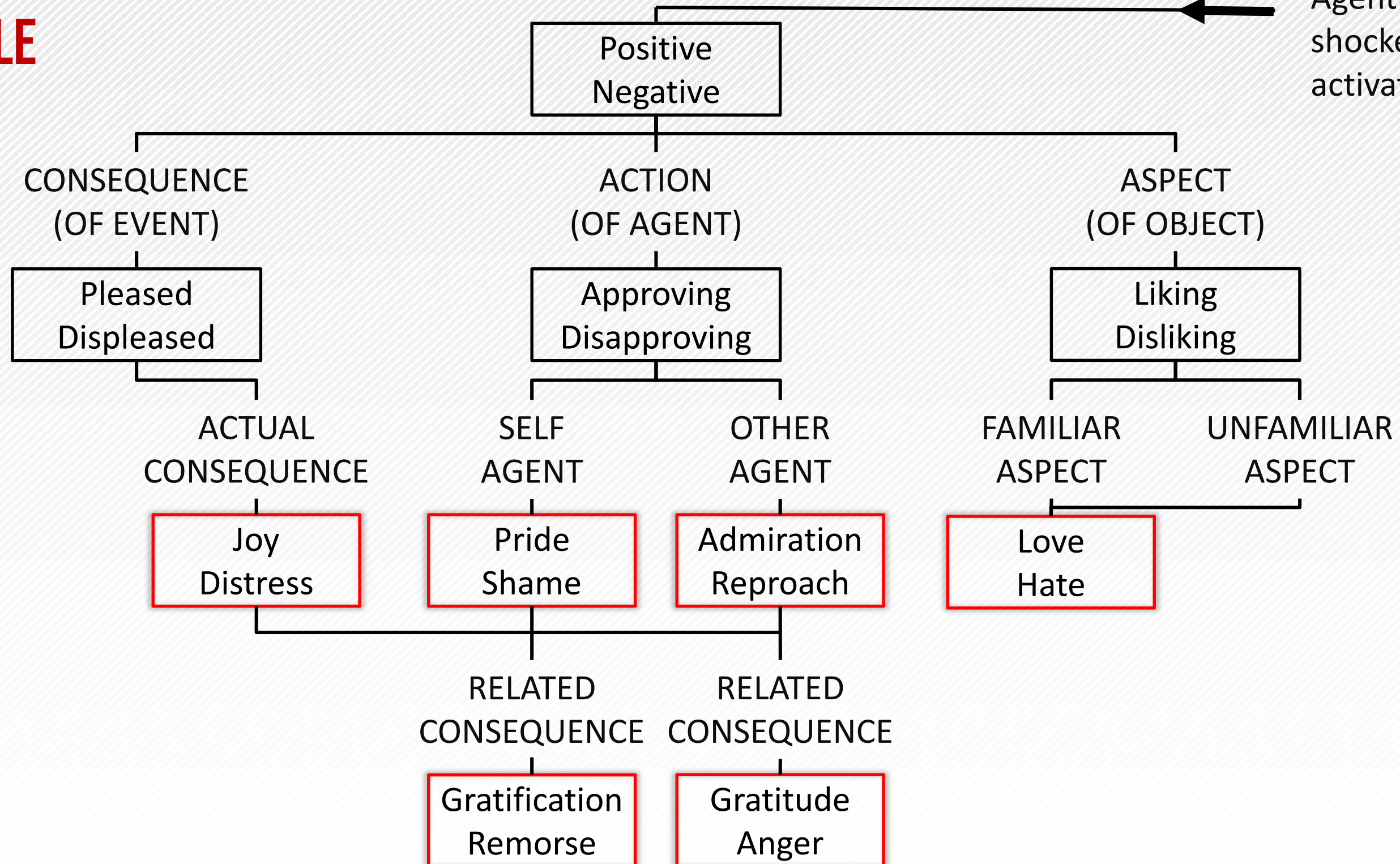


# EMOTIONAL COMPONENT

EXAMPLE



Agent has been shocked by a cable, activated by the player





# EMOTIONAL COMPONENT

DEVELOP A LIKING OR DISLIKING TOWARD WHAT THE AGENT EXPERIENCES IN THE WORLD

CONSEQUENCE  
(OF EVENT)



ACTUAL  
CONSEQUENCE



Agent has been shocked by a cable,  
activated by the player



1. Generate a Distress emotion
  - Intensity computed based on the severity of the shock
2. Add a negative affect to
  - “cable” object
  - “electrified” predicate

An affect has:

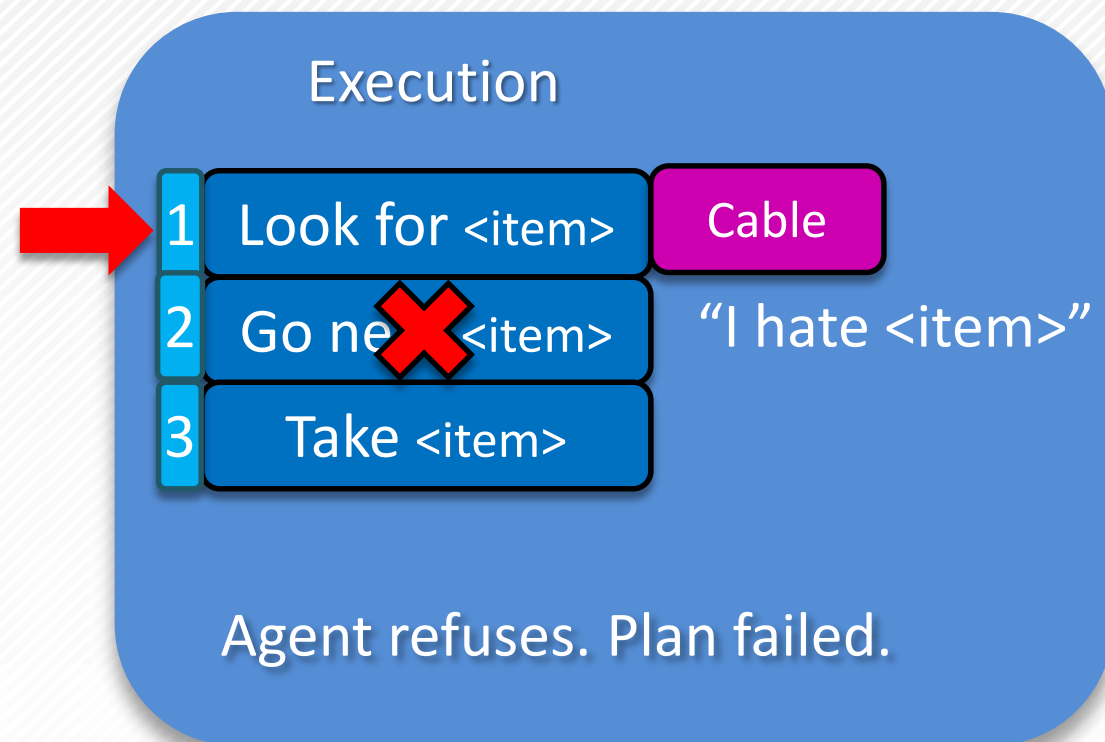
- intensity
- memorable duration



# EMOTIONAL COMPONENT

DEVELOP A LIKING OR DISLIKING TOWARD WHAT THE AGENT EXPERIENCES IN THE WORLD

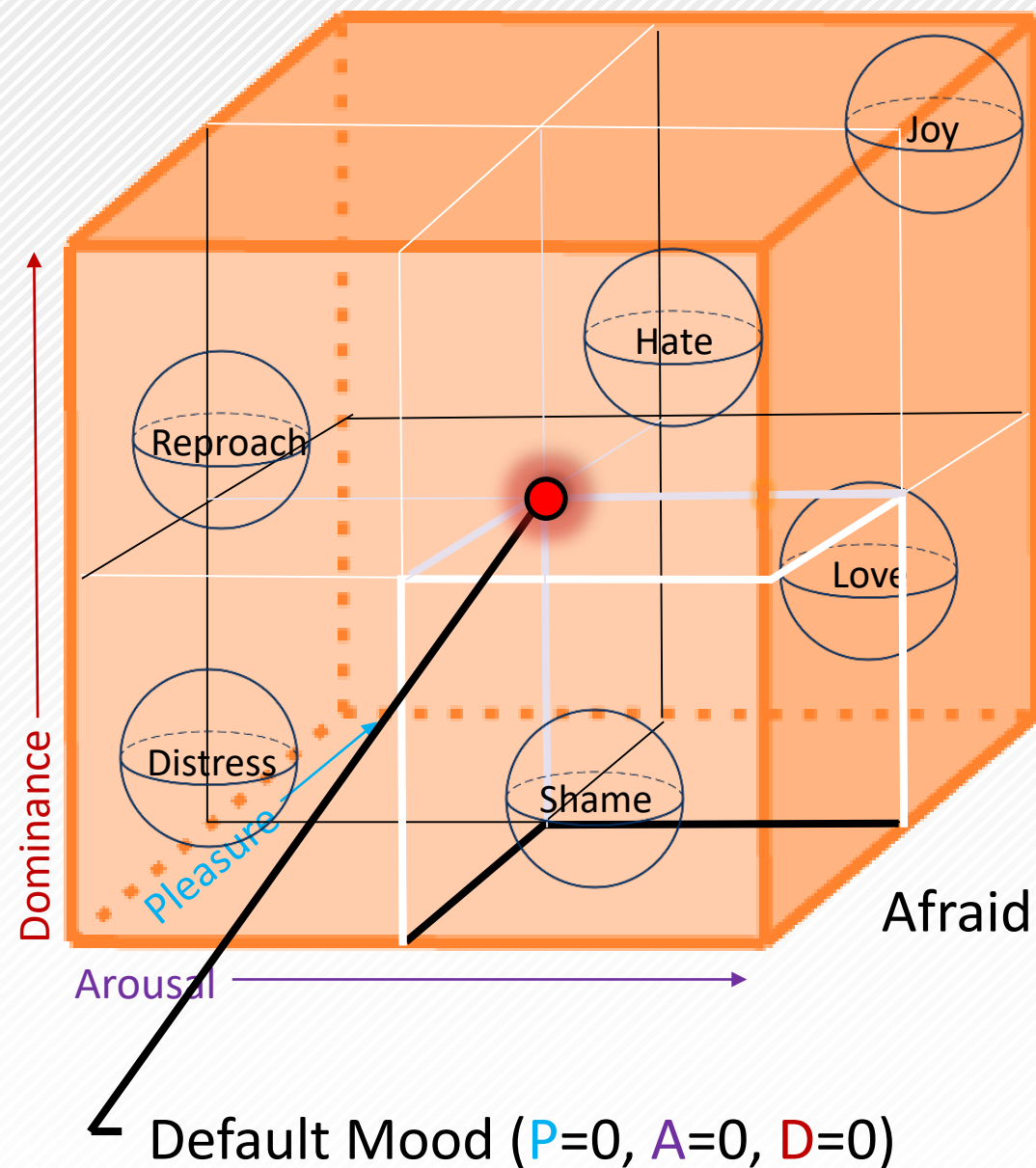
- Great! The agent does not like the “electrified cable” anymore.
- What if we tell him to take it again?





# EMOTIONAL COMPONENT

## MOOD – PAD MODEL (PLEASURE AROUSAL DOMINANCE)



**P** Pleasure Displeasure

How **pleasant** is an emotion.

Joy ↔ Fear

**A** Arousal Nonarousal

How **intense** is an emotion.

Rage ↔ Boredom

**D** Dominance Submissiveness

How much **control** and **influence** the agent has over situations

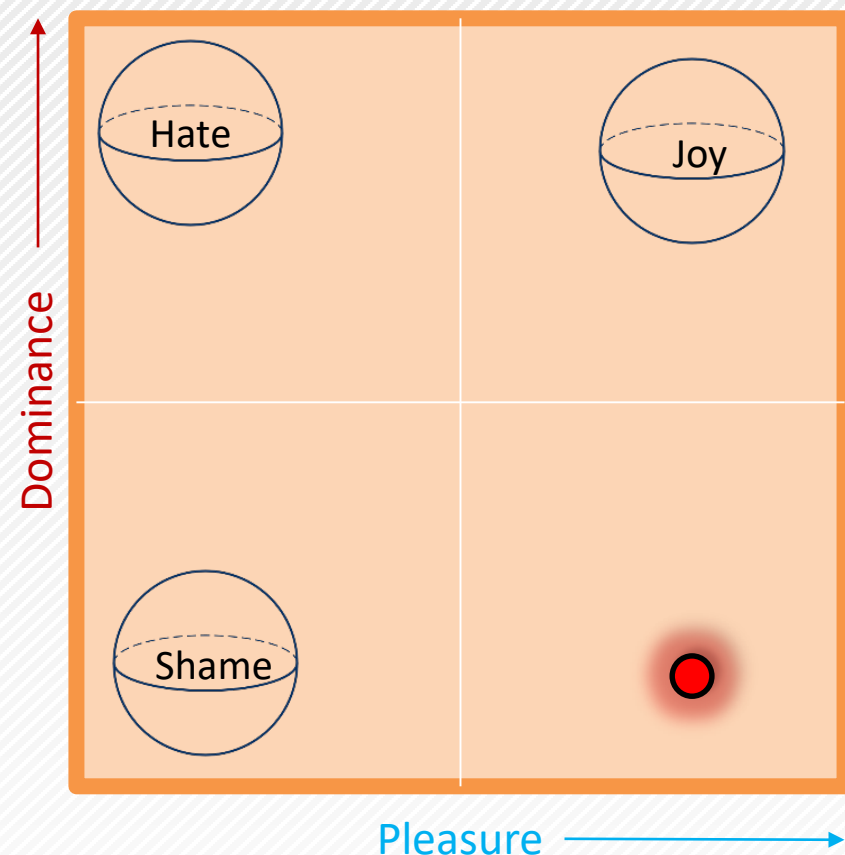
Anger ↔ Distress

MOOD OCTANT	P	A	D	EMOTION
Exuberant	+	+	+	Joy
Dependent	+	+	-	Admiration
Relaxed	+	-	+	
Docile	+	-	-	
Afraid	-	+	-	Shame
Hostile	-	+	+	Hate
Disdainful	-	-	+	Reproach
Depressed	-	-	-	Distress



# EMOTIONAL COMPONENT

## MOOD – PLEASURE AROUSAL DOMINANCE MODEL

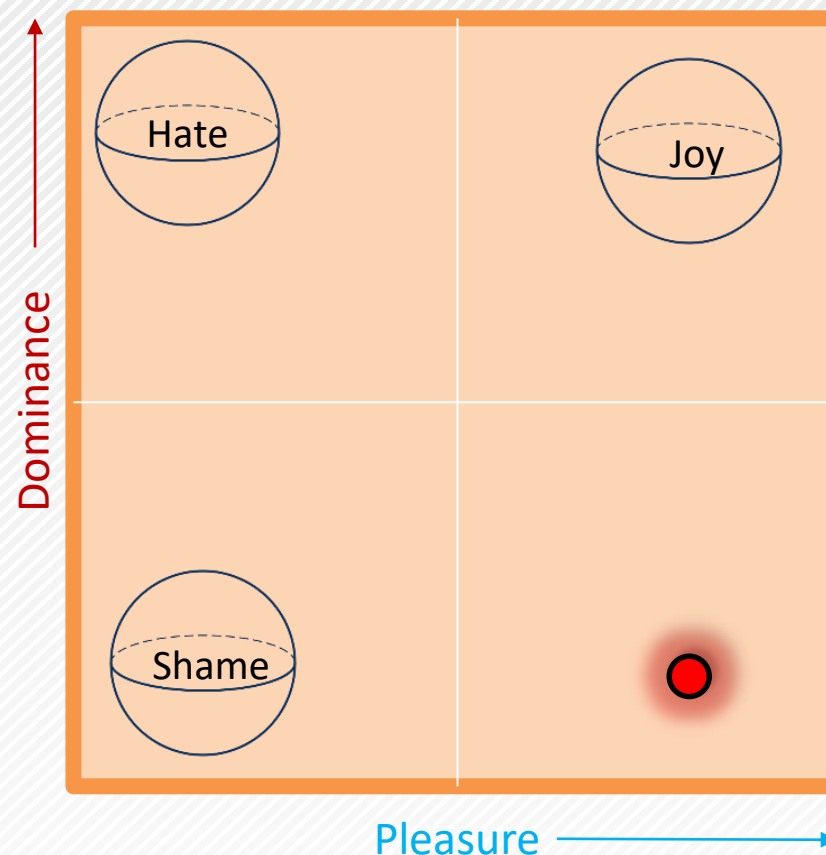


Emotions Intensity Time

Joy

0.5

5s



Emotions Intensity Time

Joy

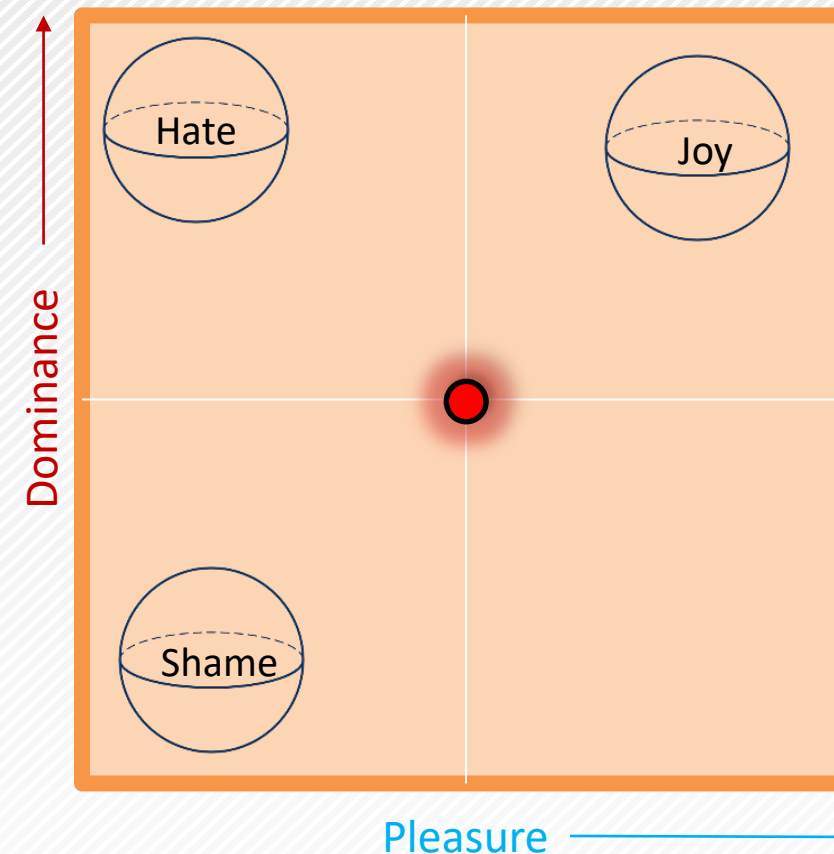
1.0

5s

# EMOTIONAL COMPONENT

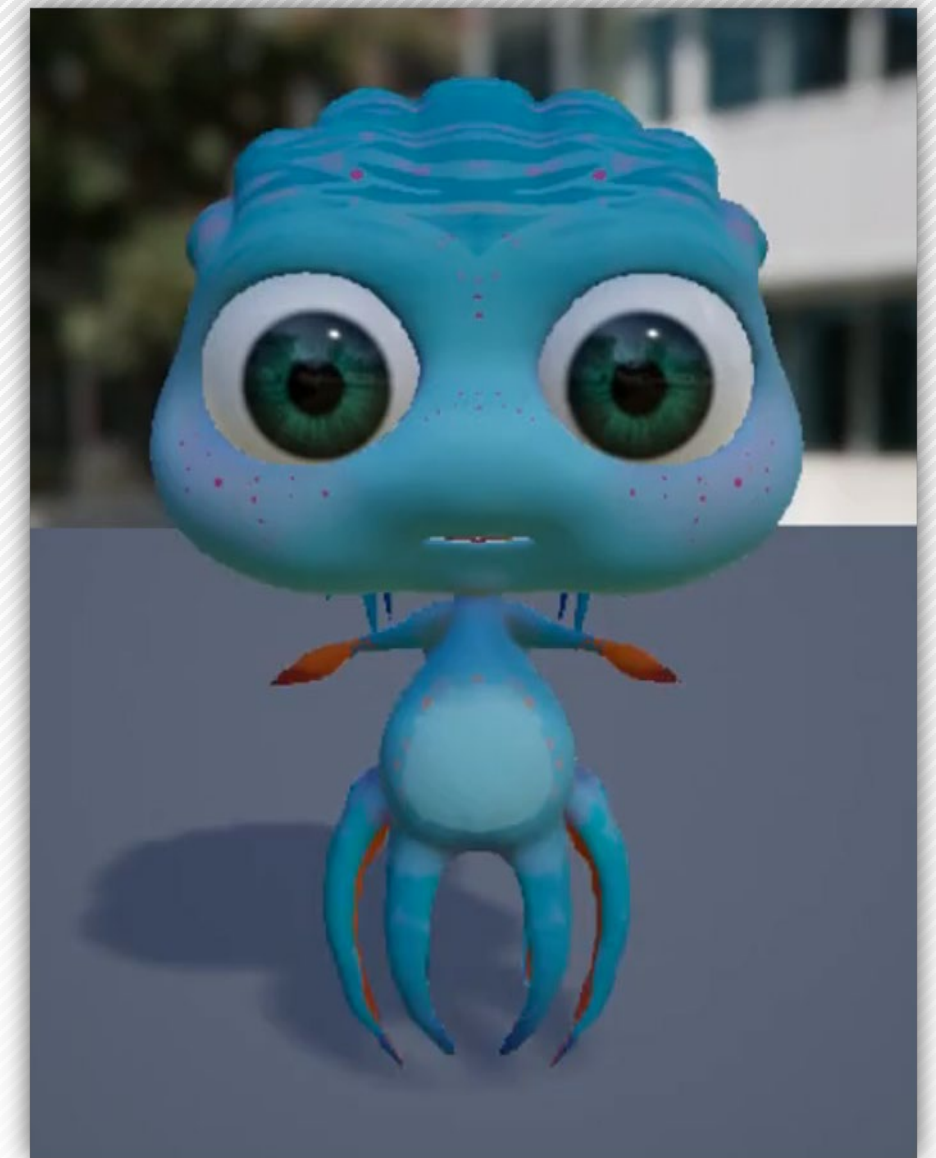
## MOOD – PAD MODEL (PLEASURE AROUSAL DOMINANCE)

Emotions	Intensity
Joy	1.0
Hate	0.5
Shame	0.75
Hate	1.0



Current Mood

Afraid



[View Video \(Click\)](#)

# EMOTIONAL COMPONENT

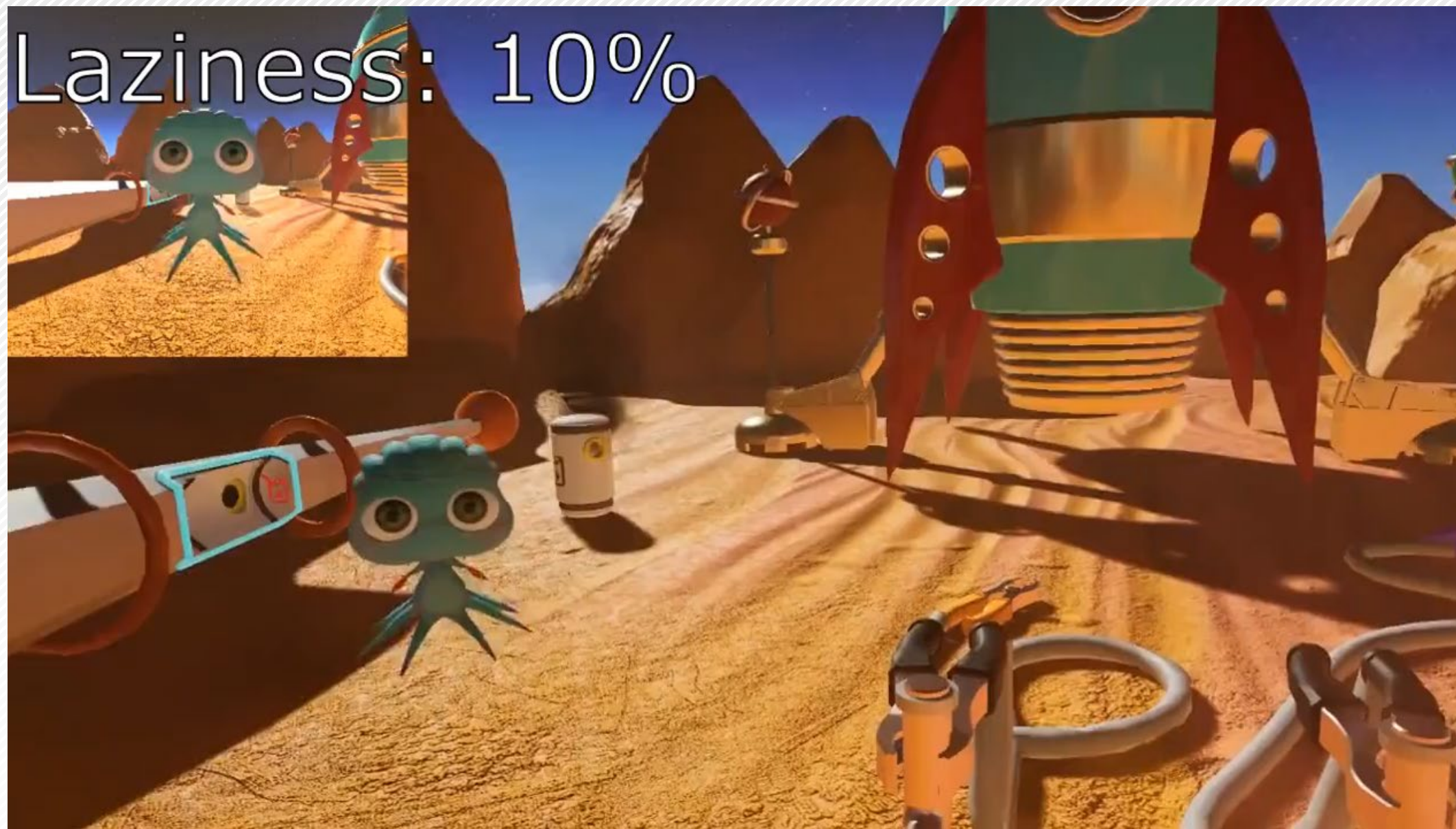
## PERSONALITY

- Simple structure (utility parameters in [0..1])
  - Laziness = 0.8
  - Curiosity = 0.3
  - Honesty = 0.1
  - Obedience = 0.9
  - ...



# EMOTIONAL COMPONENT

## PERSONALITY



[View Video \(Click\)](#)

# EMOTIONAL COMPONENT

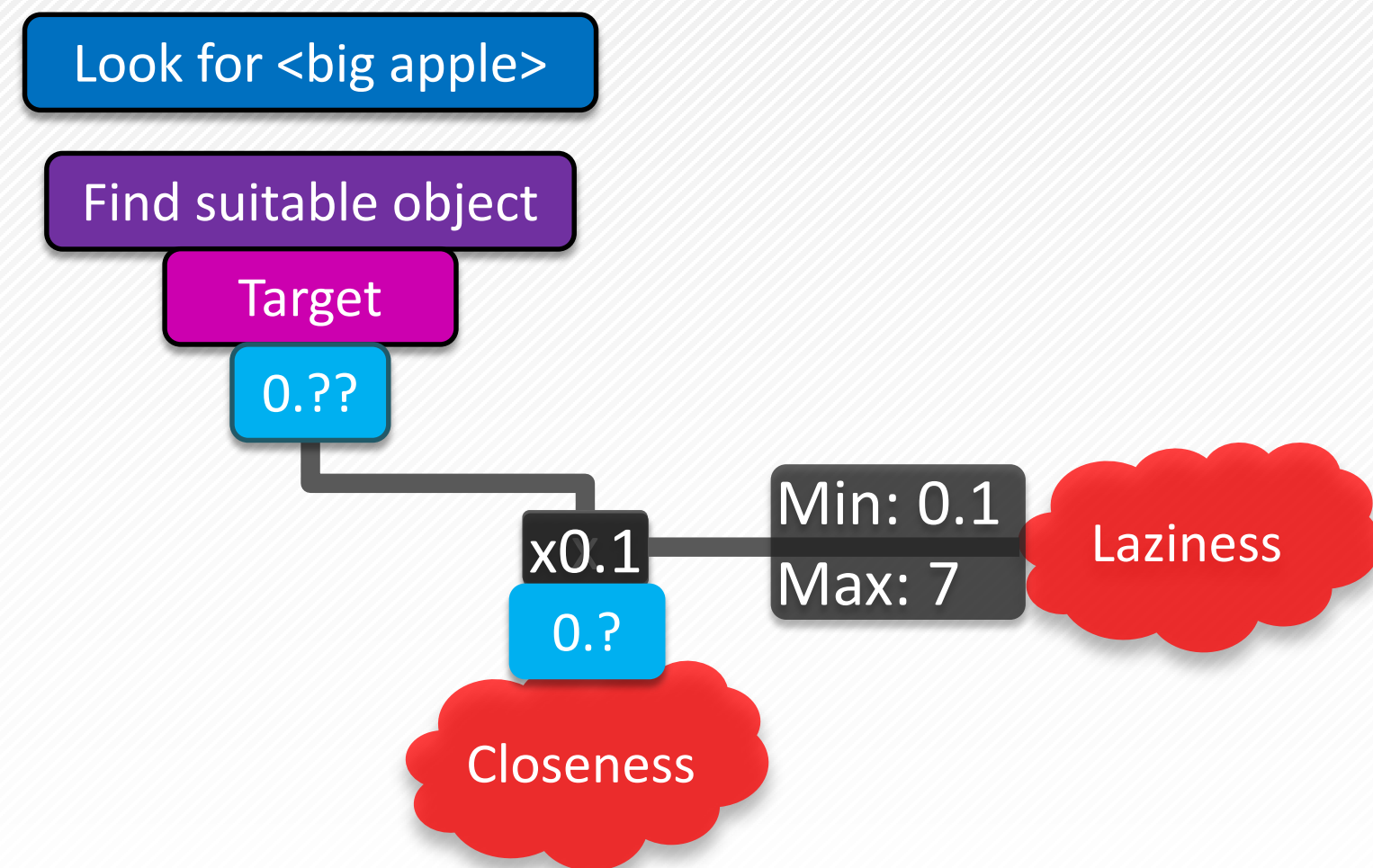
## PERSONALITY: LAZINESS

- Affect “Look For” action
  - Will favor closer object over farther object

How can it be done?

The lazier the agent,  
The more important the Closeness axis should be

The weight should depend on the Laziness





# EMOTIONAL COMPONENT

## PERSONALITY

- Affect the Decision Making and the Expression

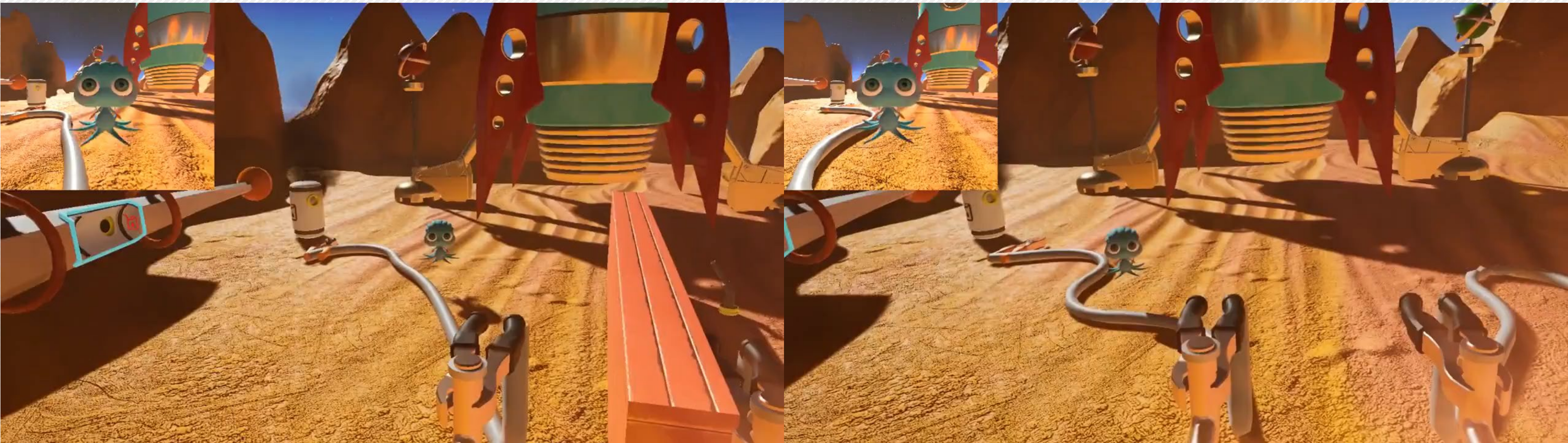
- Goal Manager:
  - Goal score
- Planner:
  - Action cost, changing the plan
  - Different set of actions
- Action
  - Tolerance on Liking/Disliking (objects, etc)
  - Execution
- Emotion:
  - Change the emotions expression (shyness)
  - Reacts to specific events (curiosity)
- Mood:
  - default mood

Great variation of play  
- NPCs will feel different to each other



# FACTUAL STATEMENTS

WHAT ABOUT INFORMING THE AGENT ABOUT THE WORLD?



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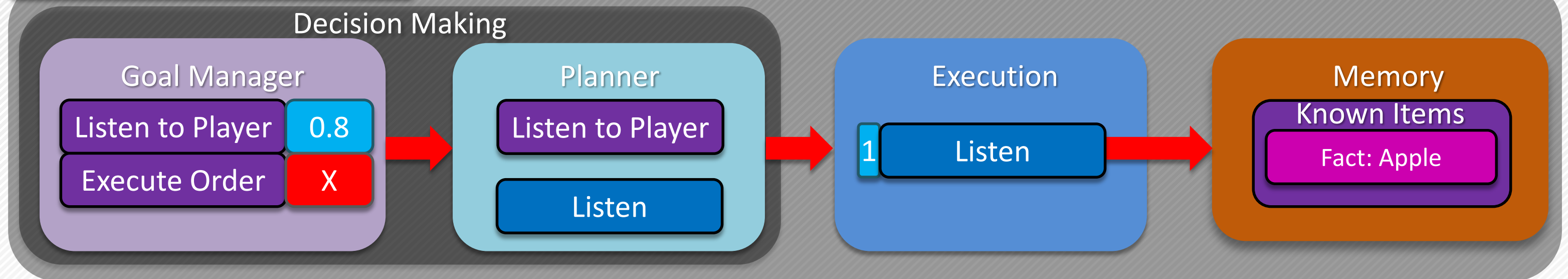
[View Video \(Click\)](#)



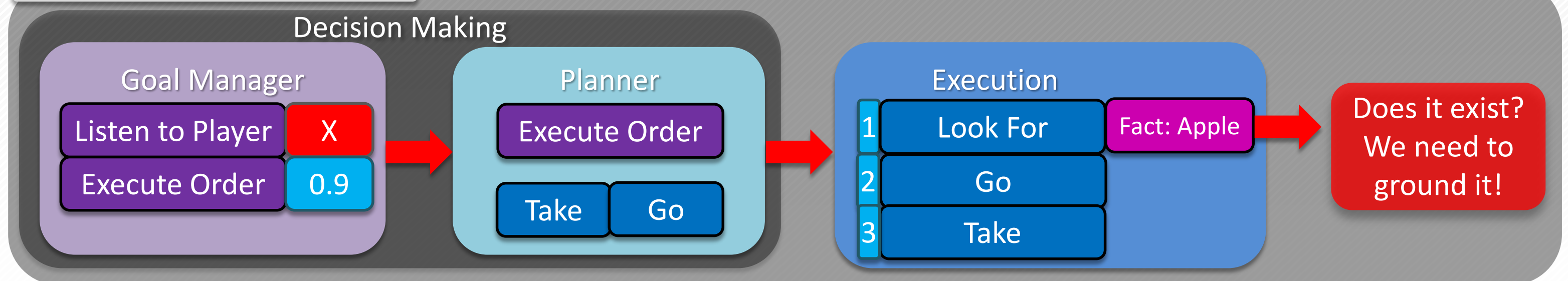
# FACTUAL STATEMENTS

WHAT ABOUT INFORMING THE AGENT ABOUT THE WORLD?

[There is] [Apple] [On] [Table]

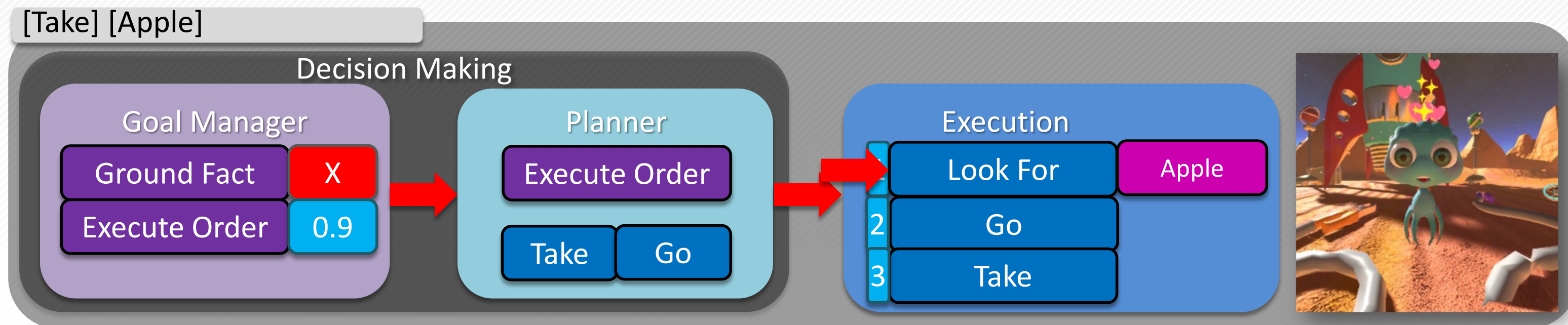
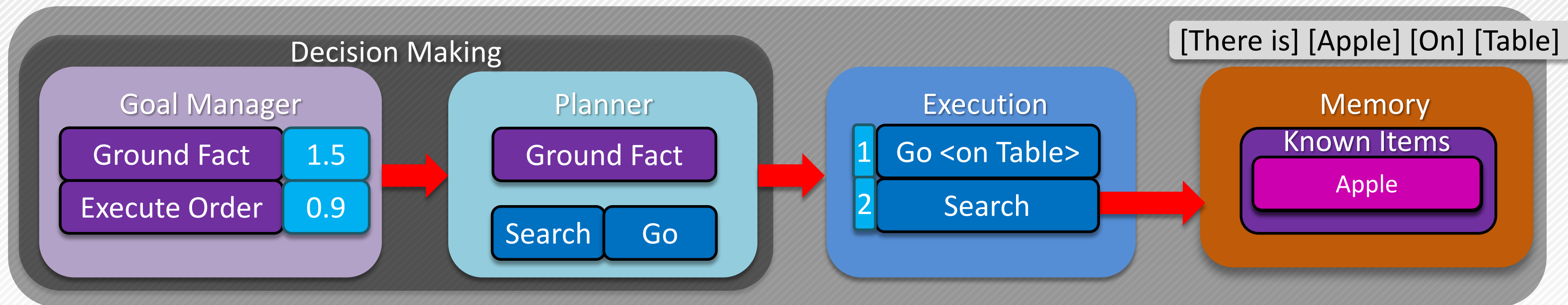
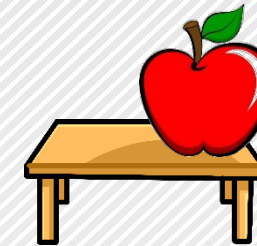


[Take] [Apple]



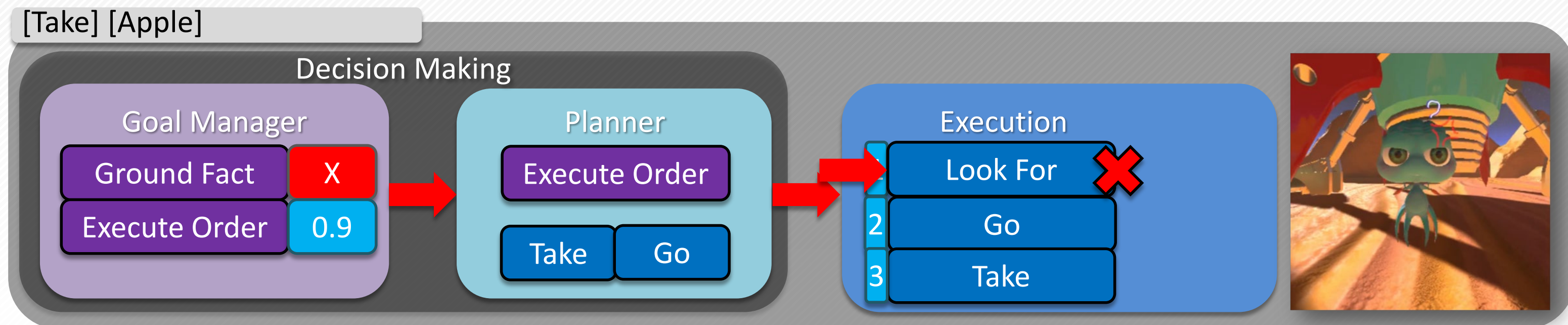
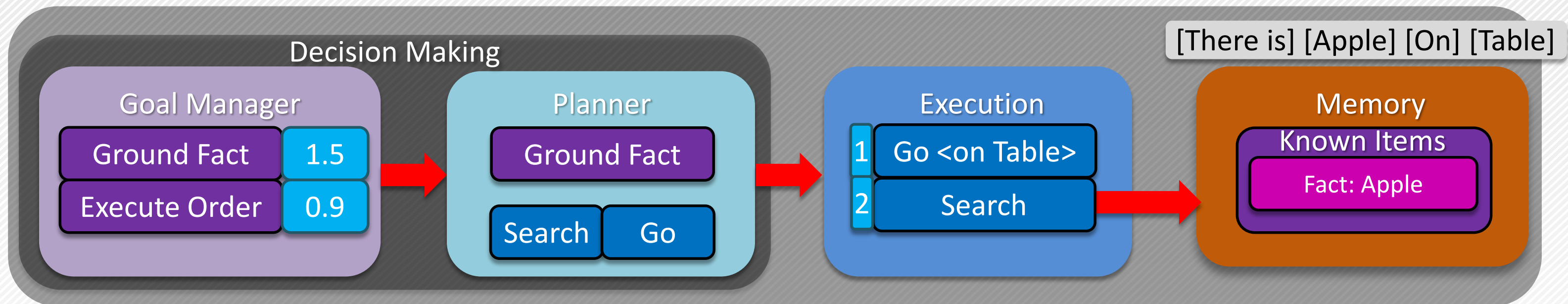
# FACTUAL STATEMENTS

GROUNDING A FACT – CASE OF A TRUTH



# FACTUAL STATEMENTS

## GROUNDING A FACT – CASE OF A LIE





# ■ WHAT DID WE ACHIEVED SO FAR

- Bring more natural interactions:
  - Voice interaction (Speech recognition pipeline)
- Create more aware, expressive and lively agents
  - Emotional reactions (Emotion, Mood)
  - Have great variations (Personality)
  - Environment awareness
    - Can like/dislike, and react appropriately
      - Refuse to do an action involving something it hates
    - NPCs can reacts to truths and lies

# ■ WHAT CAN WE DO FROM HERE?

- Relationship development
- Multi-agents
- More diverse feedback from the AI-agent
  - I did not understand your speech
  - I did not find what you were talking about
  - I understand but I don't have the ability to execute your order
  - I don't like you, therefore I won't listen to you
  - I don't like the object, therefore I won't execute your order.
  - ...



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# NPCs Have Feelings Too: Verbal Interactions with Emotional Character AI

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# GDC

**GAME DEVELOPERS CONFERENCE**

MARCH 18–22, 2019 | #GDC19

# ANNEX 1: PERSONALITY

PLAYER SAID: "TAKE A GREEN APPLE"

