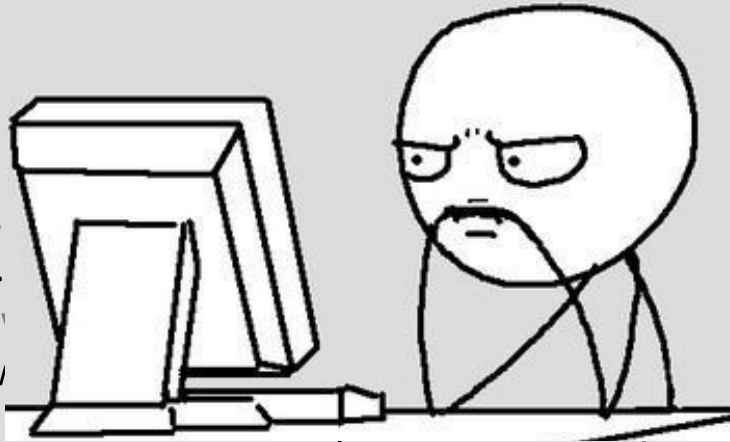


# Genesis: The Beginning of Something Big

Zhutian Yang  
18 Sep 2019

# Comment Your Code!



It doesn't work... why ... It works.  
It works... why... It doesn't work..  
doesn't work... why ... It works...  
works... why... It doesn't work... v  
work... why ... It works... why... It  
why... It doesn't work... why ... It works... why... It doesn't work... why ... It works... why... It doesn't work...  
why ... It works... why... It doesn't work... why ... It works... why... It doesn't work... why ... It works... why...

# This talk is about Genesis System's ...

## Past



11 years  
~ 25 papers  
10 subsystems



Repo: 120 MB  
Codes: 10MB

## Present



## Future

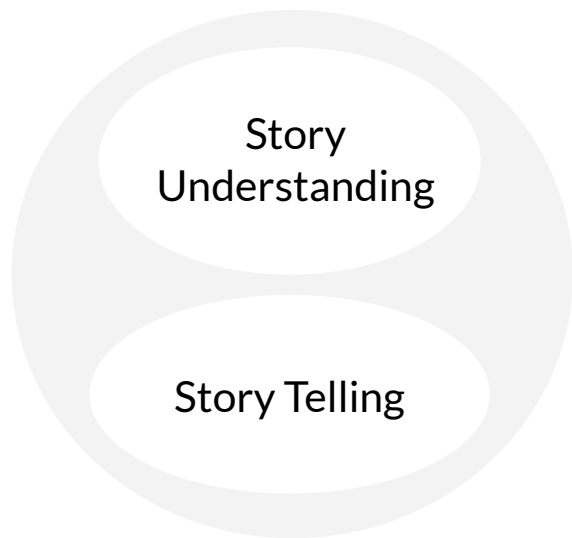


\* Genesis documentation:  
GenesisCore private repo:

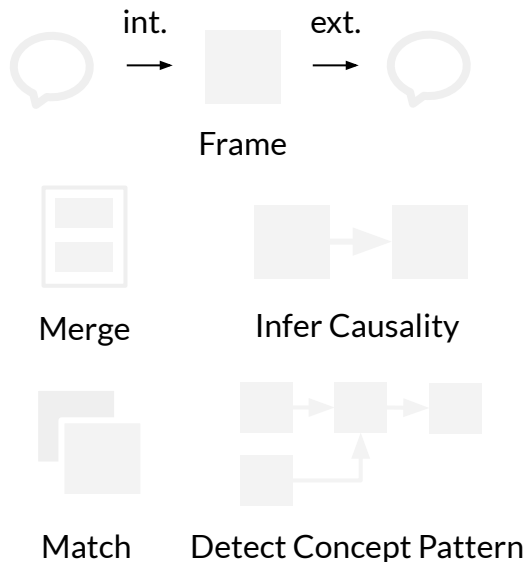
[www.ways2think.ai/genesis/](http://www.ways2think.ai/genesis/)  
<https://github.com/zt-yang/GenesisCore>

# Past > Genesis Legacy includes ...

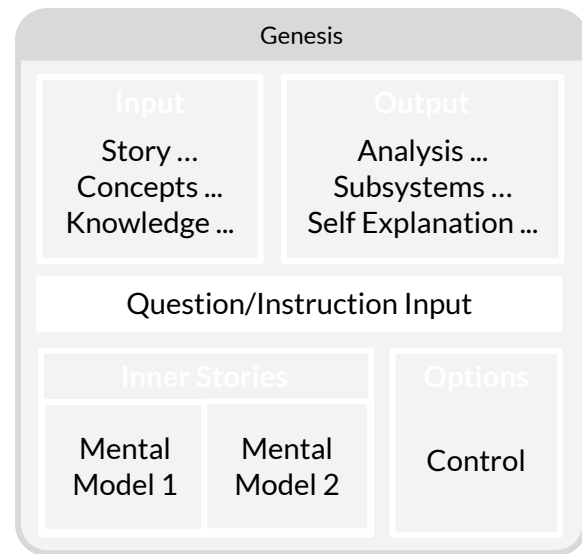
## Problems & Competence



## Representation & Algorithms



## Programs & Systems



\* Winston, Patrick Henry, and Dylan Holmes. The Genesis Enterprise: Taking artificial intelligence to another level via a computational account of human story understanding. 2018.

# Past > Story Understanding & Telling Capacities



Story  
file

xx and yy are persons. zz is a substance.

If xx asks yy for some  $H_2O$  too, then yy may give xx some  $H_2O_2$ .

If xx is given zz, then xx may drink zz.

If xx drinks  $H_2O_2$ , then xx dies.

} Rules

Start description of “surprise”.

aa is an action.

xx performed aa and yy performed aa.

yy’s performing aa leads to yy’s being died.

The end.

} Concept  
Pattern

Two chemists walk into a bar. The first chemist asks the bartender to give him some  $H_2O$ . The second chemist asks the bartender for some  $H_2O$  too. The second chemist died.

} Story

# Past > Story Understanding & Telling Capacities



Story  
file

xx and yy are persons. zz is a substance.

If xx asks yy for some  $\text{H}_2\text{O}$  too, then yy may give xx some  $\text{H}_2\text{O}_2$ .

If xx is given zz, then xx may drink zz.

If xx drinks  $\text{H}_2\text{O}_2$ , then xx dies.

Rules

Start description of “surprise”.

aa is an action.

xx performed aa and yy performed aa.

yy’s performing aa leads to yy’s being died.

The end.

Concept  
Pattern

**Two chemists walk into a bar. The first chemist asks the bartender to give him some  $\text{H}_2\text{O}$ . The second chemist asks the bartender for some  $\text{H}_2\text{O}$  too. The second chemist died.**

Story

# Past > Story Understanding & Telling Capacities



Story  
file

xx and yy are persons. zz is a substance.

If xx asks yy for some  $H_2O$  too, then yy may give xx some  $H_2O_2$ .

If xx is given zz, then xx may drink zz.

If xx drinks  $H_2O_2$ , then xx dies.

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Start description of “surprise”.

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The end.

} Concept  
Pattern

Two chemists walk into a bar. The first chemist asks the bartender to give him some  $H_2O$ . The second chemist asks the bartender for some  $H_2O$  too. The second chemist died.

} Story

# Past > Story Understanding & Telling Capacities



Story  
file

xx and yy are persons. zz is a substance.

If xx asks yy for some  $H_2O$  too, then yy may give xx some  $H_2O_2$ .

If xx is given zz, then xx may drink zz.

If xx drinks  $H_2O_2$ , then xx dies.

Rules

**Start description of "surprise".**

**aa is an action.**

**xx performed aa and yy performed aa.**

**yy's performing aa leads to yy's being died.**

**The end.**

Concept  
Pattern

Two chemists walk into a bar. The first chemist asks the bartender to give him some  $H_2O$ . The second chemist asks the bartender for some  $H_2O$  too. The second chemist died.

Story



# Past > Story Understanding & Telling Capacities



Original  
Elements

Two chemists  
walk into a bar

The first  
chemist asks  
the bartender  
to give him  
some  $\text{H}_2\text{O}$

The second  
chemist asks  
the bartender  
for some  $\text{H}_2\text{O}$   
too

The bartender  
gives the  
second chemist  
asks some  $\text{H}_2\text{O}_2$

The second  
chemist died

# Past > Story Understanding & Telling Capacities

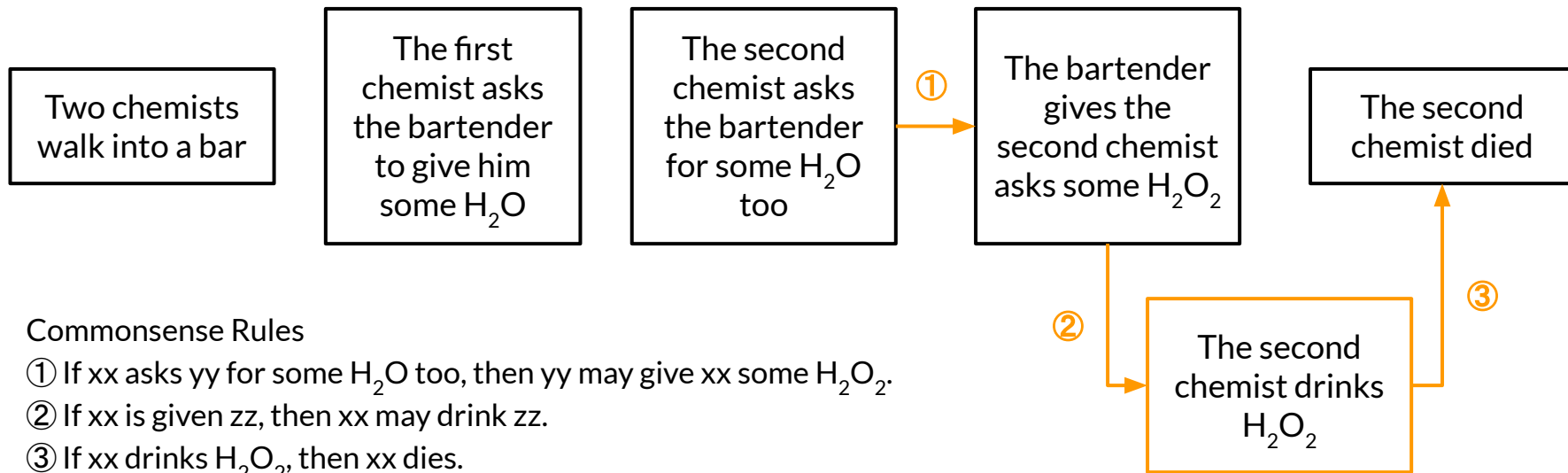


Original  
Elements

+

Inferred  
Elements

Casual  
Connections



# Past > Story Understanding & Telling Capacities



Original  
Elements

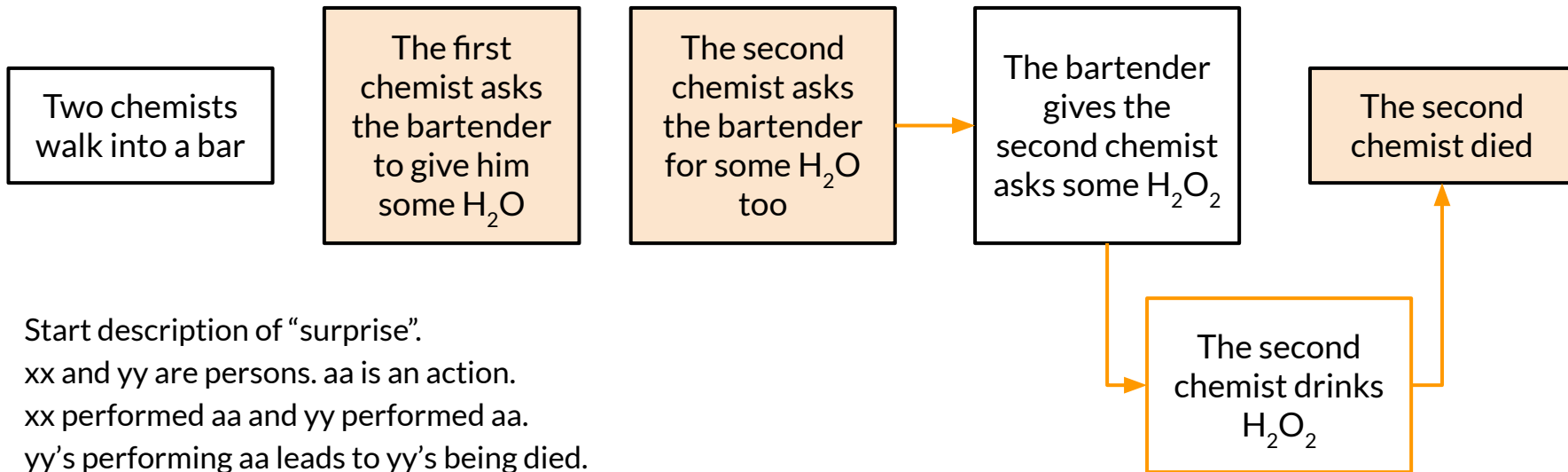
+

Inferred  
Elements

Casual  
Connections

+

Concept  
Patterns



Start description of “surprise”.

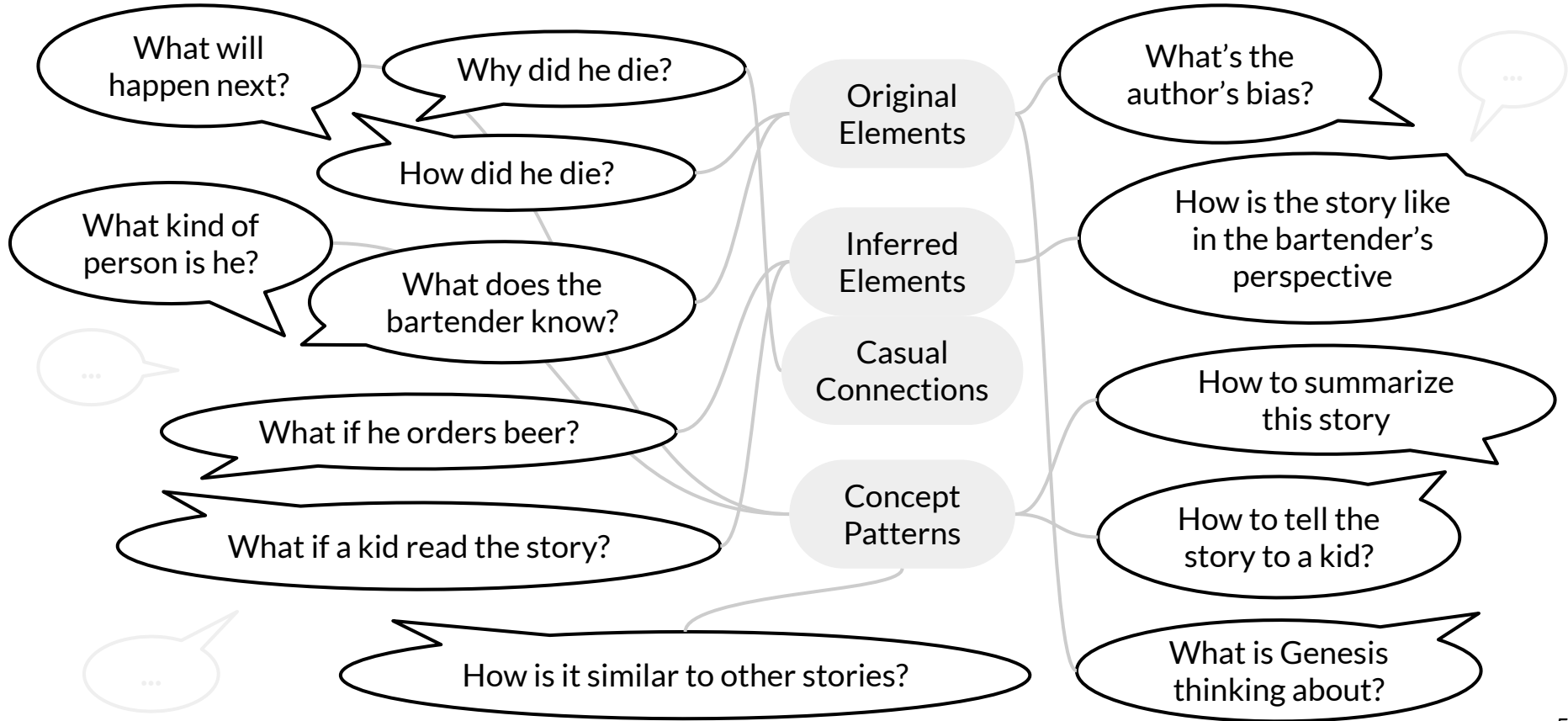
xx and yy are persons. aa is an action.

xx performed aa and yy performed aa.

yy’s performing aa leads to yy’s being died.

The end.

# Past > Story Understanding & Telling Capacities



# Past > Representation: Nested Role Frames

e.g.

*"Genesis is happily reading  
20 short stories for me"*

Build complex, nested symbolic descriptions  
of properties, relations, actions, and events

# Past > Representation: Nested Role Frames

START triples from  
*"Genesis is happily reading  
20 short stories for me"*

Build complex, nested symbolic descriptions  
of properties, relations, actions, and events

[genesis+3043 read+1 stories+3044]  
[read+1 has\_modifier+1 happily]  
[read+1 for+2 i]  
[stories+3044 has\_property+3 short]  
[stories+3044 has\_quantity+4 20]  
[genesis+3043 has\_number singular]  
[genesis+3043 has\_det null]  
[stories+3044 has\_det null]  
[has\_modifier+1 has\_position mid\_verbal]  
[i has\_number singular]  
[i is\_proper yes]  
[for+2 has\_position trailing]  
[read+1 has\_person 3]  
[read+1 has\_tense present]  
[read+1 is\_progressive yes]  
[read+1 is\_main yes]  
[stories+3044 has\_number plural]

# Past > Representation: Nested Role Frames

Build complex, nested symbolic descriptions of properties, relations, actions, and events

read

genesis

36781:

Frame Translation of  
"Genesis is happily reading  
20 short stories for me"

object

stories

36797: Features: short (quantity: 20)

36949:

for

i

36950:

manner

happily

36806:

36952:

36947:

36948: Features: happily present

② “I think Genesis is happily reading 20 short stories for me”

read

genesis  
36781:

object

stories

36797: Features: short (quantity: 20)

36949:

for

i

36950:

manner

happily

36806:

36952:

36947:

36948: Features: happily present

① “Genesis is happily reading 20 short stories for me”

think

i

object

read

genesis

36992:

object

stories

36996: Features: short (quantity: 20)

37163:

for

i

37164:

manner

happily

37004:

37166:

37161:

37162: Features: happily present

37160:

37158:

37159: Features: present

③ “If I think Genesis is happily reading 20 short stories for me, I will say yes”

cause

think

i

object

read

genesis

37231:

object

stories

37235: Features: short (quantity: 20)

37468:

for

i

37469:

manner

happily

37243:

37471:

37466:

37467: Features: happily present

37465:

37463:

37464: Features: present

37475:

say

i

object

yes

37462:

37460:

37461: Features: present (modal: will)

37474: (is\_main: true)(clause\_holders: [])



prediction

conjunction

execute

duncan

25311

roles

object

cawdor

25314

26014

26013

26701

26725

appear

property

cawdor

25314

roles

object

dead

Instantiated  
rule



13426

26729

26728

26727

26726

26724

Mistake because harmed

entail

want

macbeth

25056

roles

object

appear

position

macbeth

25056

roles

object

king

25866

25865

26587

26586

26585

26584

27183

harm

macduff

25329

roles

object

macbeth

25056

26636

26635

32634

34979

34981

Instantiated  
concept pattern



want

macbeth

25056

roles

object

appear

position

macbeth

25056

roles

object

king

25866

25865

26587

26586

26585

26584

27183

semantic-interpretation

make

you

object

coffee

43738: (quantifier: some)

43966:

43964:

43965: Features: present (imperative: true)

write

you

object

chapter

43969:

43967:

43968: Features: present (imperative: true)

write

you

object

rest

43972:

43970:

43971: Features: present (imperative: true)

43684:

Instantiated  
procedure



# Past > Algorithms of Core Operations

## Merge

two frames →  
a new frame

### Merge:

C = A (B)  
C = Cause (A, B)  
C = Categorization (A, B)  
C = Sequence (A, B)  
C = Want (A, B)  
T = Path (A, B, C, ... )  
...

### Extract:

A = C.getSubject()

## Match

two frames →  
binding pairs

### Compare:

C = Teach (Alice, Sam)  
D = Instruct (Bob, Tom)  
→ bindings = {(Alice, Bob),  
(Sam, Tom)}

### Infer:

C = Cause (Teach (Alice, Sam)  
Want (Alice, Drink)  
D = Teach (Bob, Tom)  
→ consequence = Want (Bob, Drink)

## Align

two stories →  
common sequence

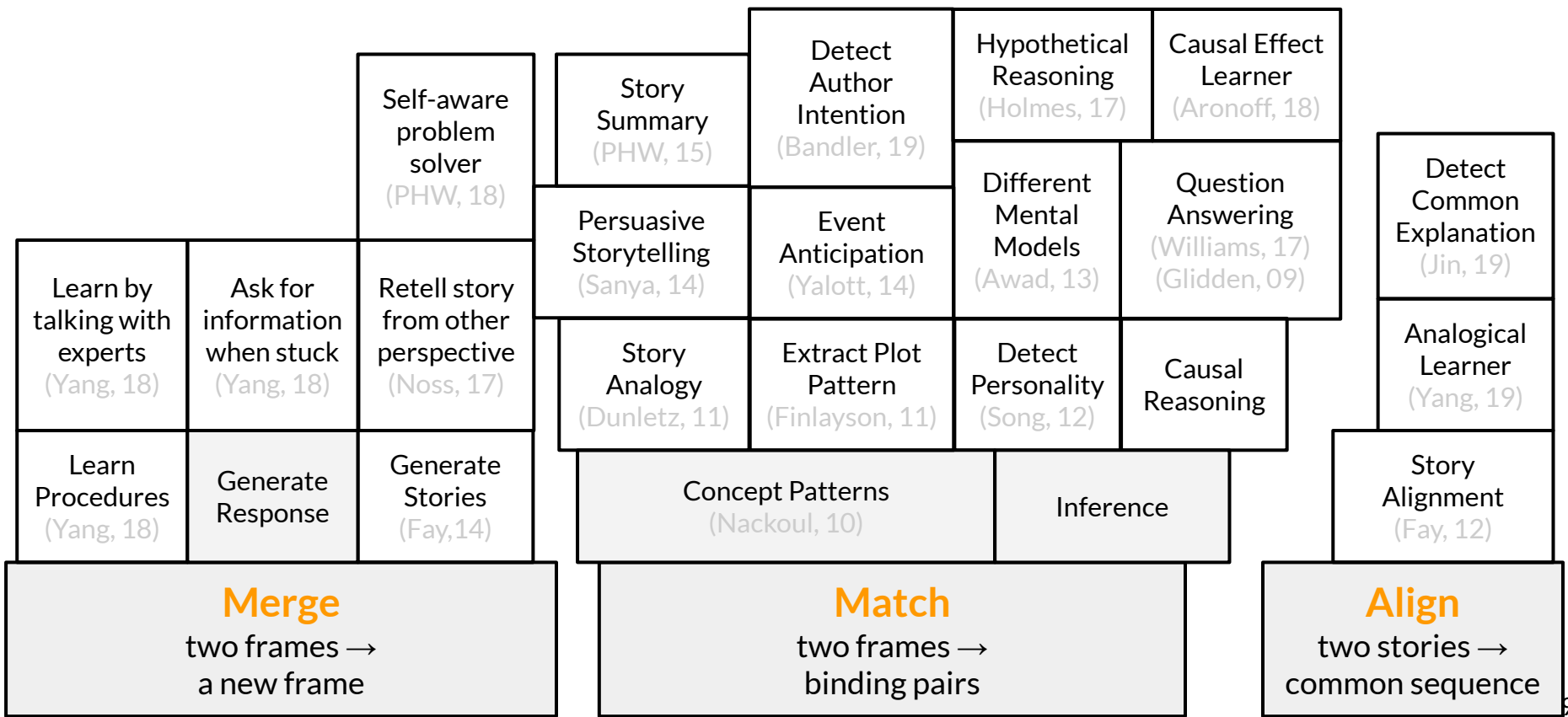
### Compare:

Story I: CTAGDXYM  
Story II: ACBXTVYN  
→ common: CTY  
→ difference:  
{(C, AC), (CT, ACBXT), ...}

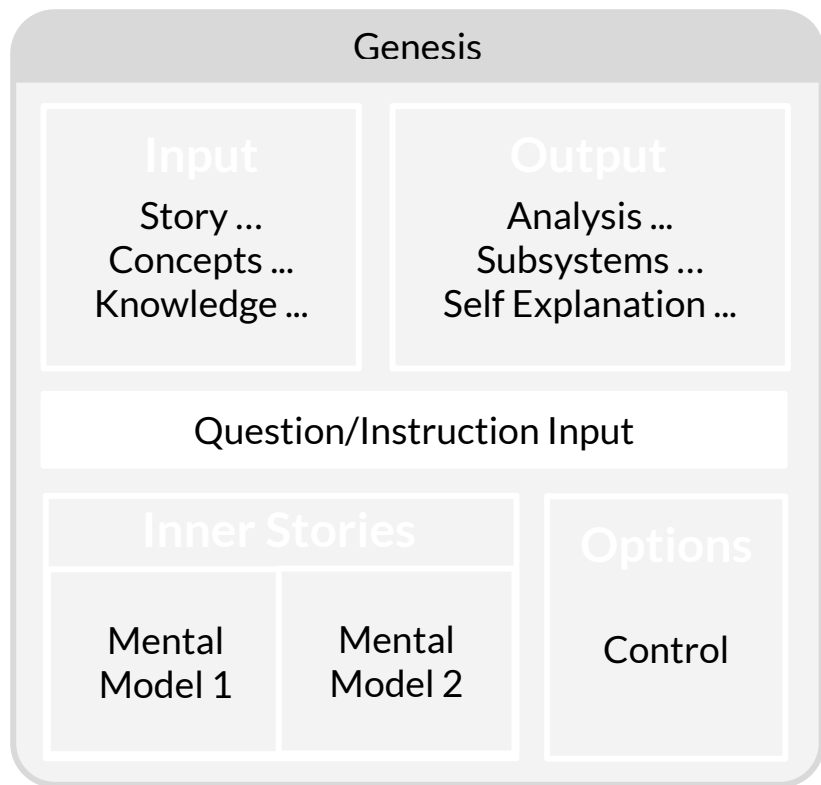
### Anticipate:

Story I: CTAGDXYM  
Pattern: TYMZ  
→ anticipation: Z

# Past > Algorithms of Subsystems

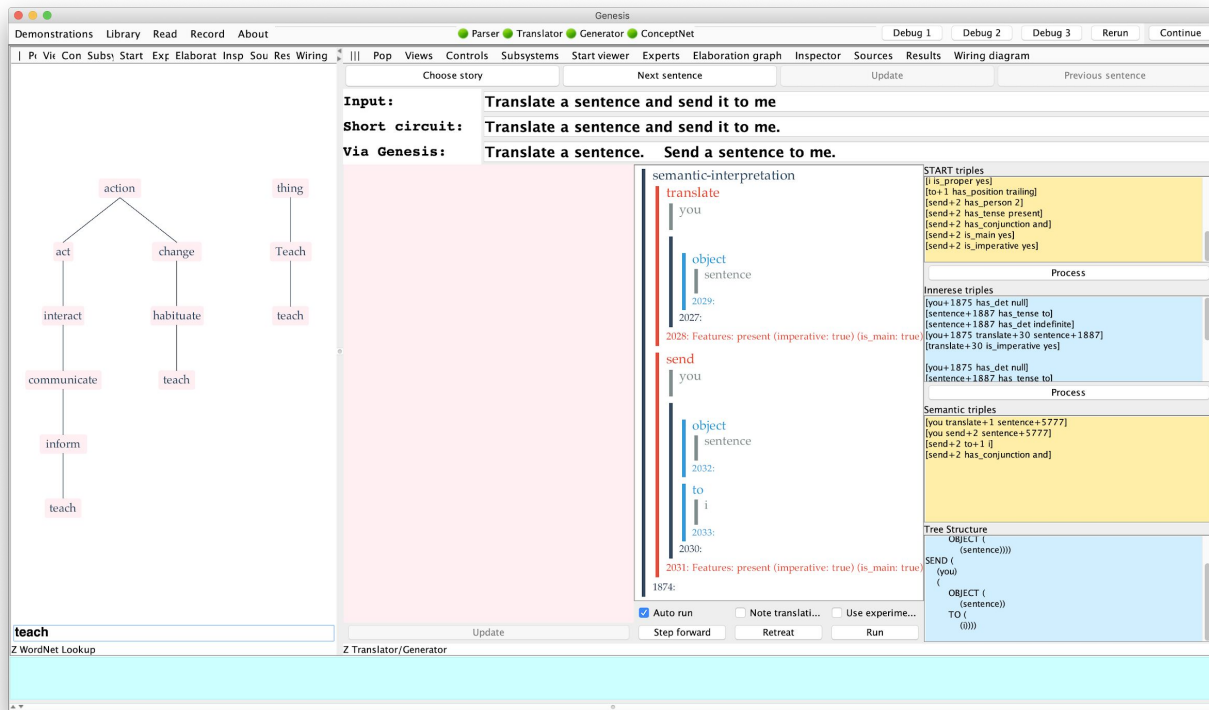
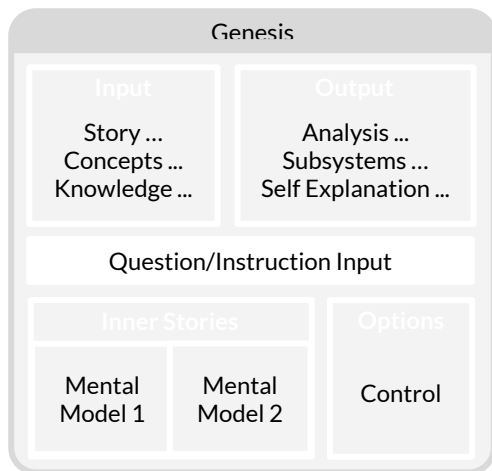


# Past > Genesis System



# Past > Genesis System

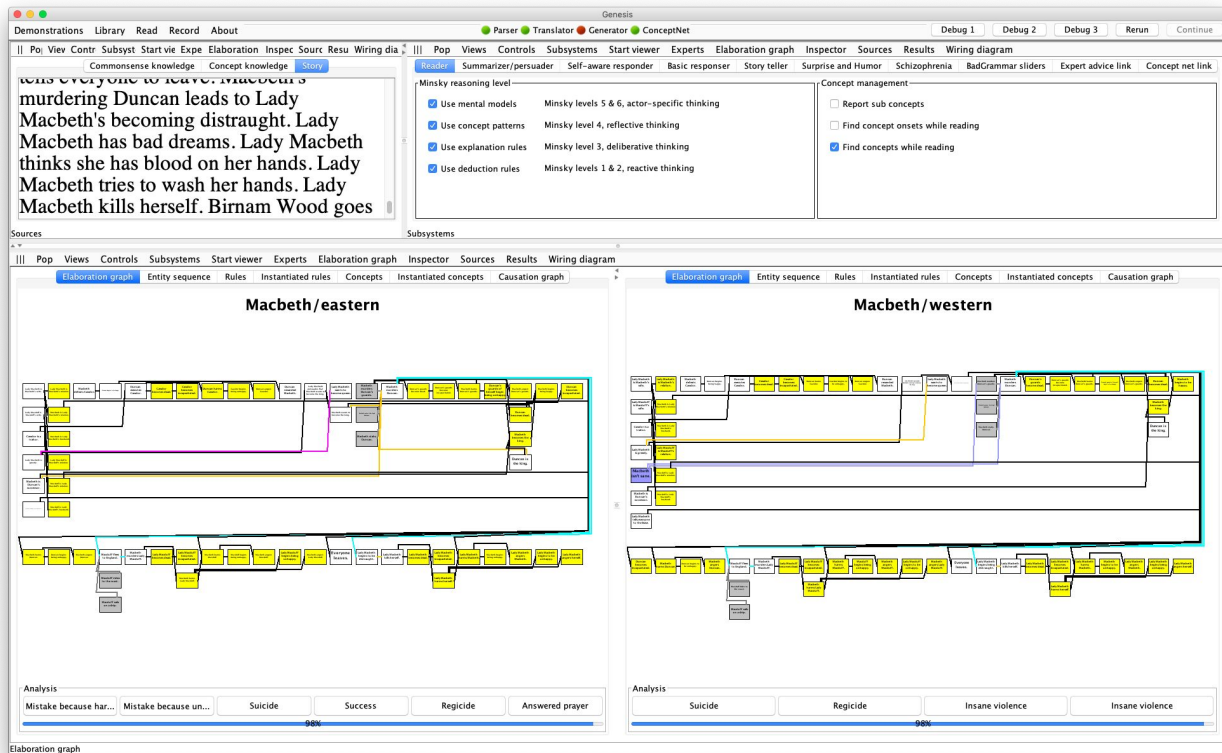
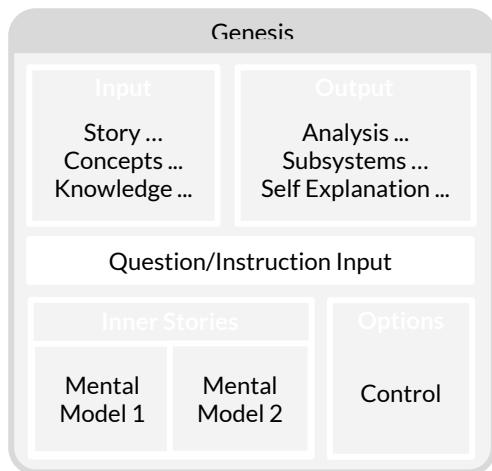
→ As a NLP toolbox (WordNet, Translator)



# Past > Genesis System

→ As a NLP toolbox (WordNet, Translator)

→ As story processors (story analysis & telling)

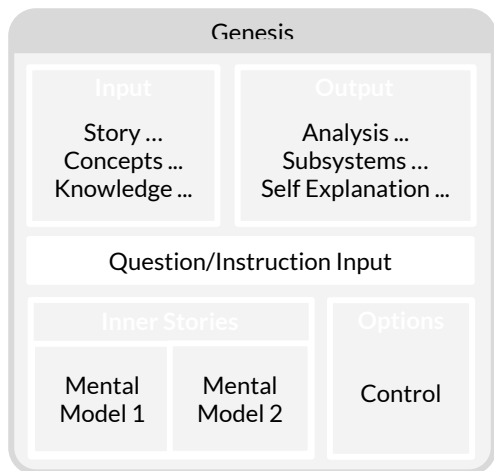


# Past > Genesis System

→ As a NLP toolbox (wordNet, Translator)

→ As story processors (story analysis & telling)

→ **As chattable agent** (problem solving, question answering, procedure learning)



The screenshot shows the Genesis System interface with a 'Novice Learner' scenario. The interface includes a menu bar, a toolbar, and several panels.

**Short Term Memory:**

- Information Extracted:** [Put the gin into the glass first, Put the vermouth into the glass first, Put the orange bitters into the glass first] [ goal ] Make an old-fashioned martini
- Skills Unknown:** Put the orange bitters into the glass, Put the vermouth into the glass

**Long Term Memory:**

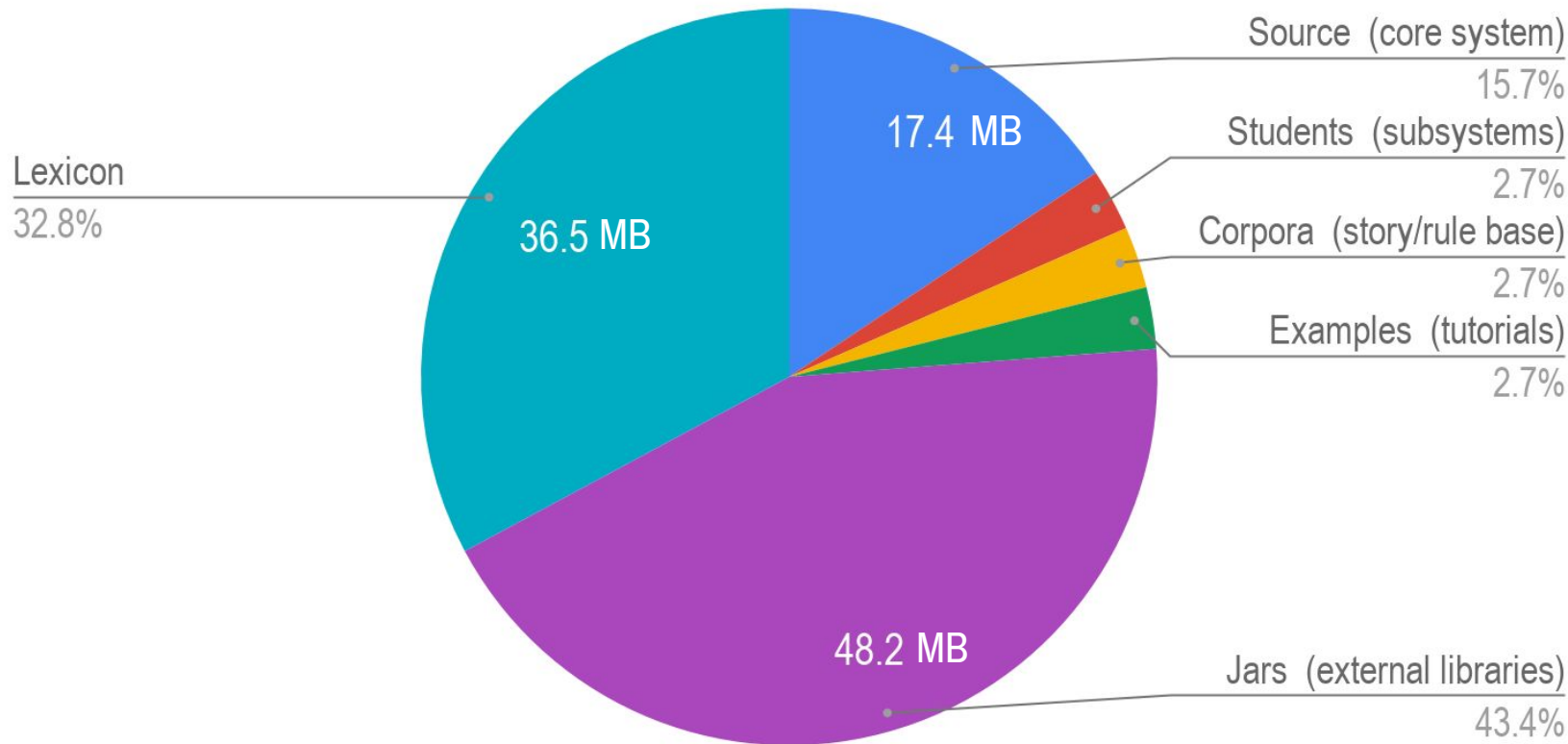
- Knowledge Learned:** Method: Assume success. The end. If the problem is "Put the orange bitters into the glass", Intention: Put the orange bitters into the glass. The end. If the intention is "Put the orange bitters into the glass", Method: Assume success. The end.
- All Knowledge Remembered:** martini\_0918\_122123.txt Put the vermouth into the glass @ Make an old-fashioned martini\_0918\_122123.txt Put the orange bitters into the glass @ Make an old-fashioned martini\_0918\_122123.txt

**Table:**

Initialize on table		Initialize for mixing	
B3	B4	B5	
B3	B4	B5	

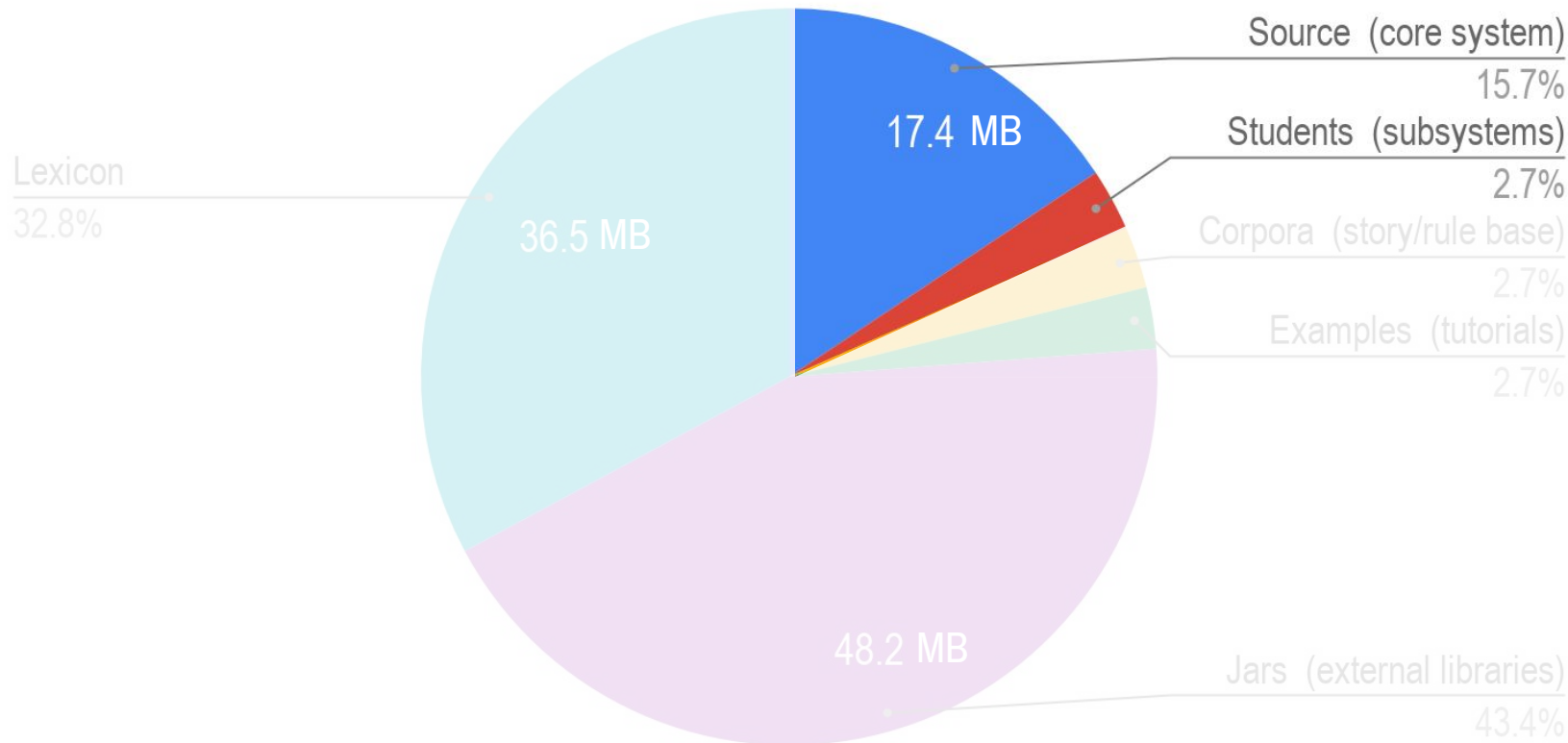
**Blocks:** B1, B2, B3, B4, B5, B6, B7, B8

## Past > Overview of the Codebase ~120MB

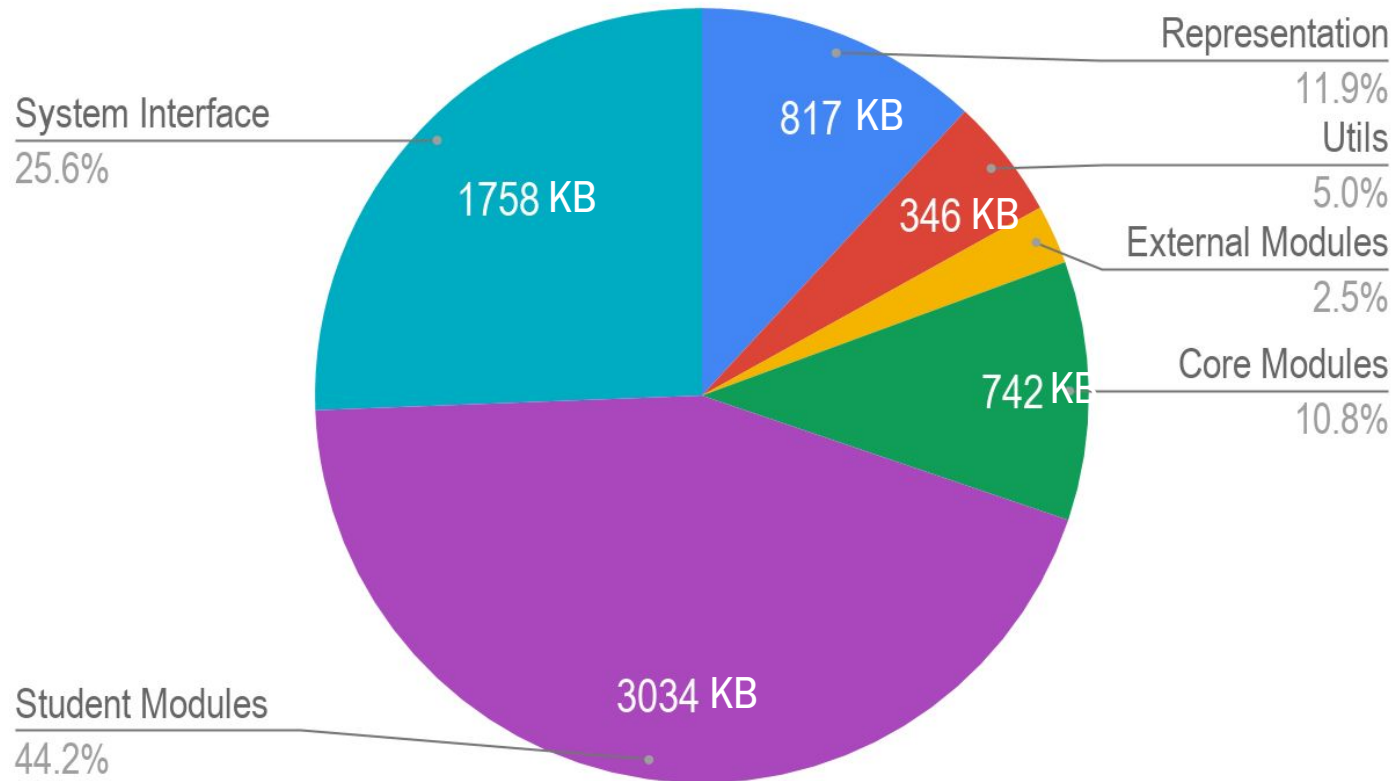




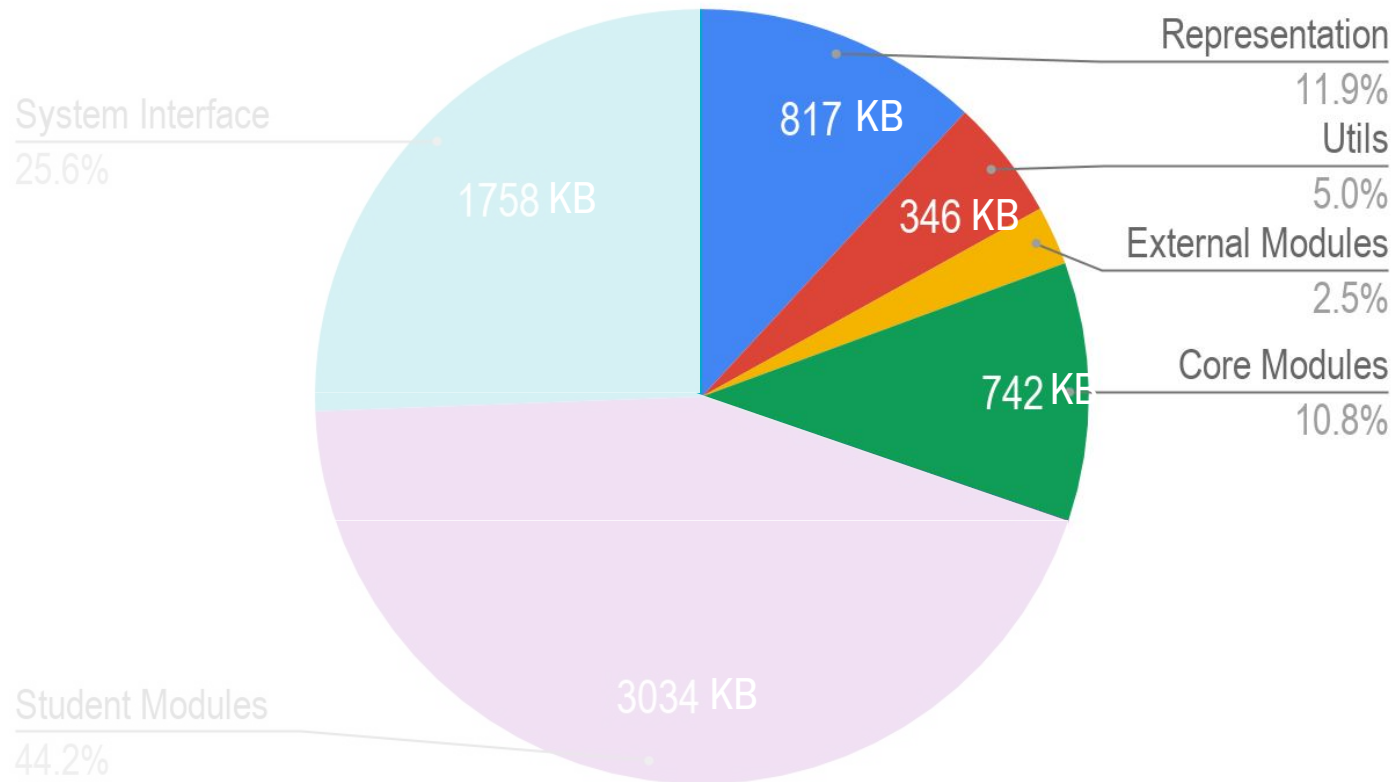
## Past > Overview of the Codebase ~120MB



## Past > Overview of the Source Codes ~10MB



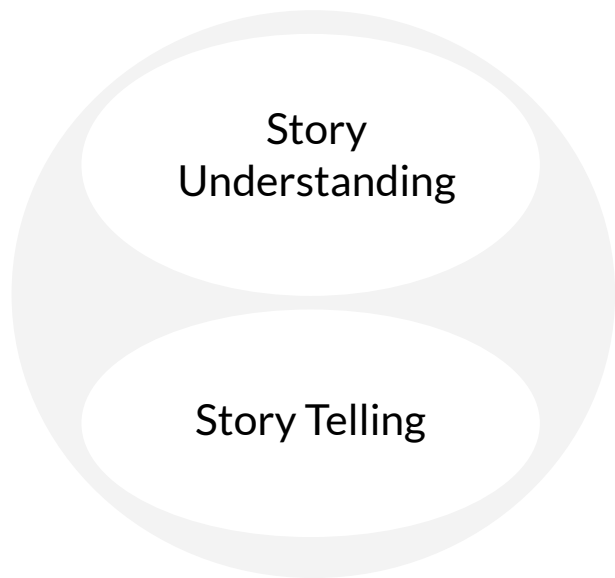
## Past > Overview of the Source Codes ~10MB



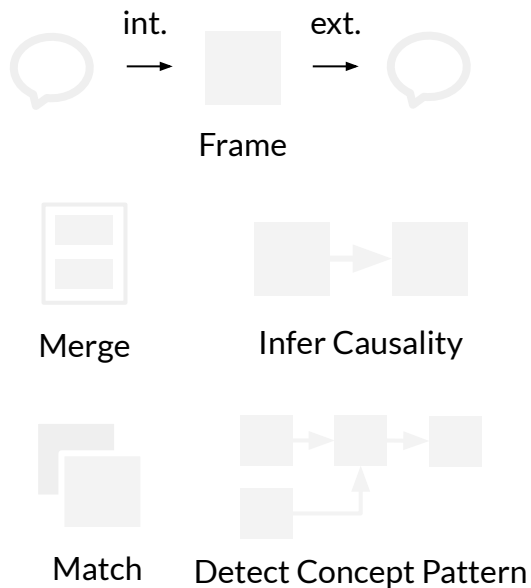
Past >

# Genesis for Story Understanding

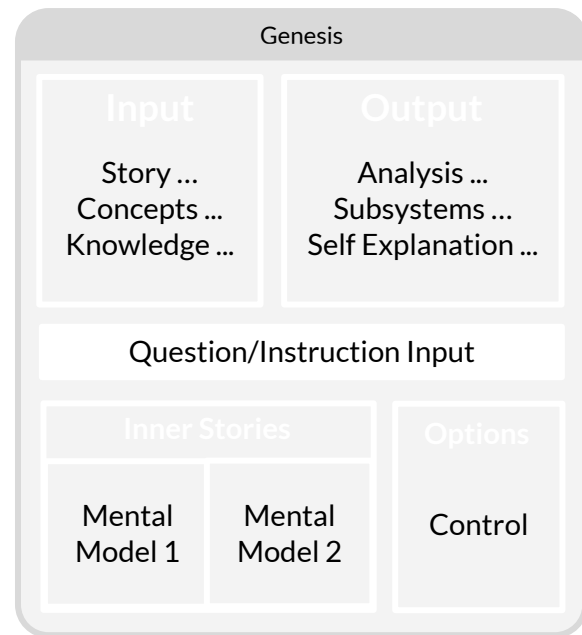
## Problems & Competence



## Representation & Algorithms

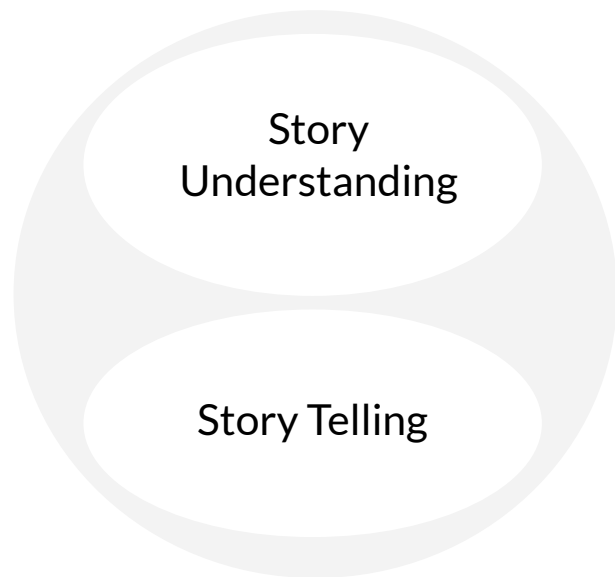


## Programs & Systems

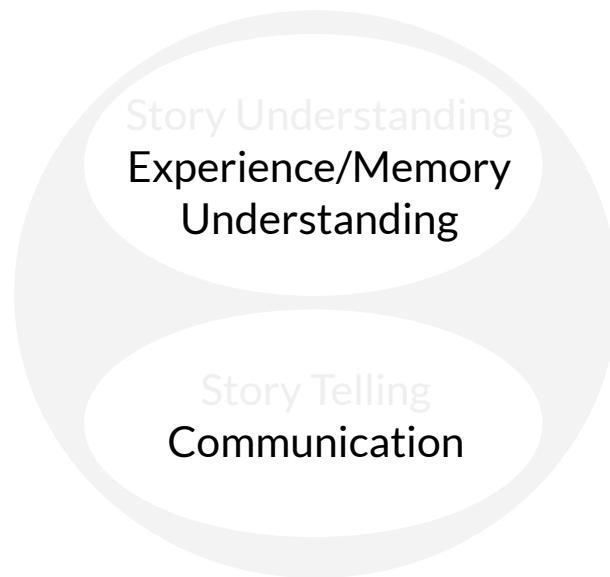


# Present > Genesis for Cognitive Modeling

Problems  
& Competence

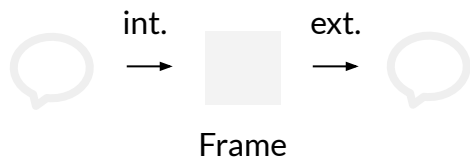


Problems  
& Competence



# Present > Genesis for Cognitive Modeling

## Representation & Algorithms



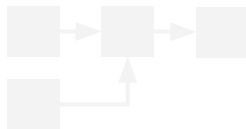
Merge



Infer Causality



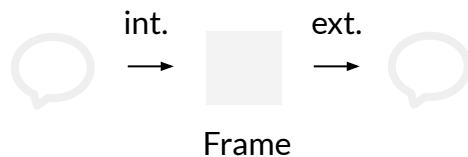
Match



Detect Concept Pattern



## Representation & Algorithms



e.g.

Story elements,  
Inference rules,  
{ Concept patterns, }  
Microstories,  
Stories  
...

### Unified Operations

Infer ~ Anticipate  
Learn recipe ~ Learn concept

# Present > Genesis for Cognitive Modeling

## Rule

Figure 10 consists of two bar charts. The top chart, labeled 'prediction', shows the number of words in the test set for each word in the vocabulary. The words are: 'conjunction' (25311), 'execute' (26013), 'duncan' (26014), 'roles' (26013), 'object' (26014), and 'cawdor' (26014). The bottom chart, labeled 'conjunction', shows the number of words in the test set for each word in the vocabulary. The words are: 'appear' (26725), 'property' (26726), 'cawdor' (26727), 'roles' (26728), 'object' (26729), and 'dead' (13426). The y-axis represents the number of words, ranging from 25311 to 26724.

## Concept Pattern

## Microstory (Procedure)

semantic-interpretation

make  
you

object  
coffee  
43738: (quantifier: some)  
43966:  
43964:

43965: Features: present (imperative: true)

write  
you

object  
chapter  
43969:  
43967:

43968: Features: present (imperative: true)

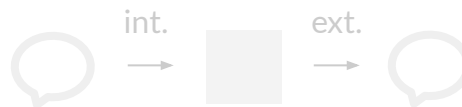
write  
you

object  
rest  
43972:  
43970:

43971: Features: present (imperative: true)

43684:

# Representation & Algorithms



## Frame

e.g.

- Story elements,
- Inference rules,
- { Concept patterns, }
- Microstories,
- Stories

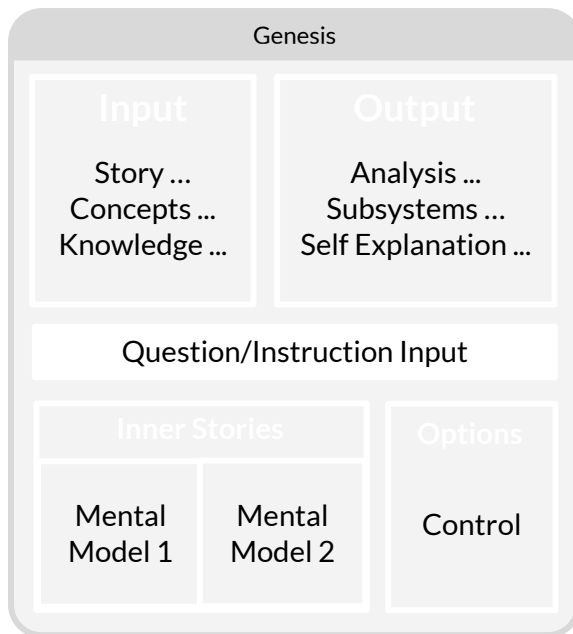
...

## Unified Operations

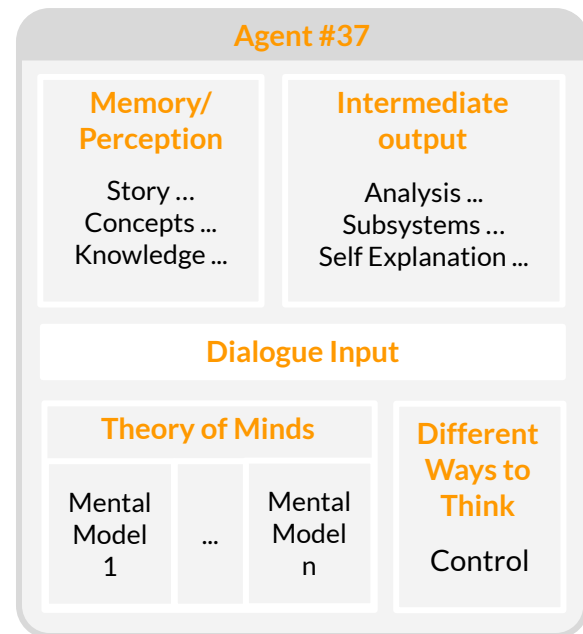
Infer ~ Anticipate  
Learn recipe ~ Learn concept

# Present > Genesis for Cognitive Modeling

## Programs & Systems



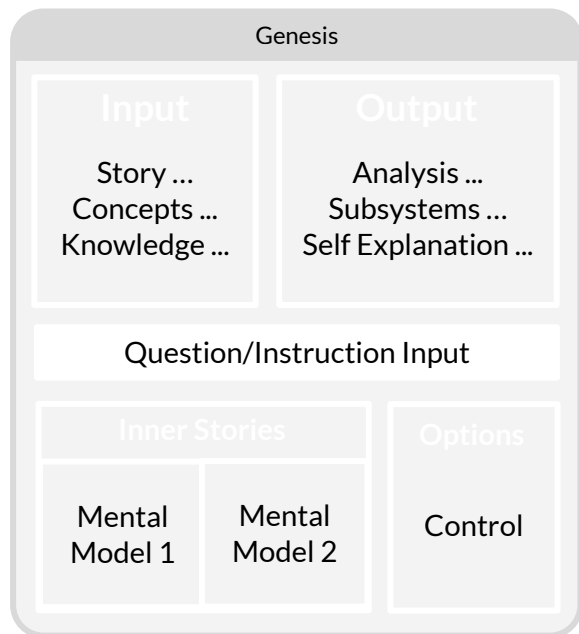
## Programs & Systems



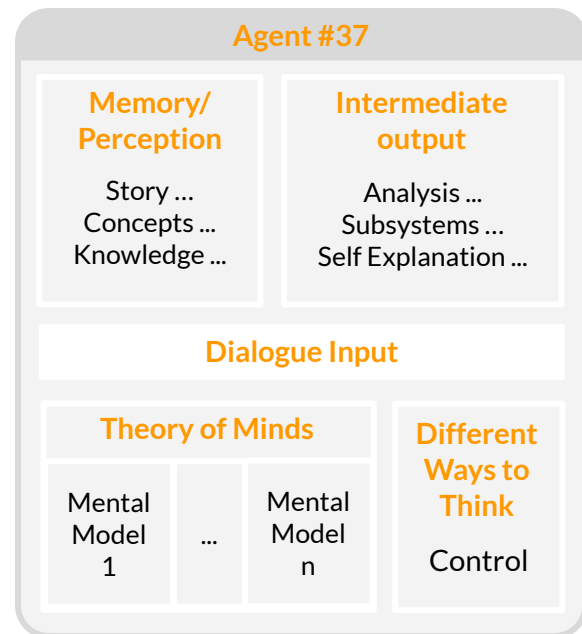


# Future > Steps towards a Cognitive Architecture

## Genesis Story Understanding System

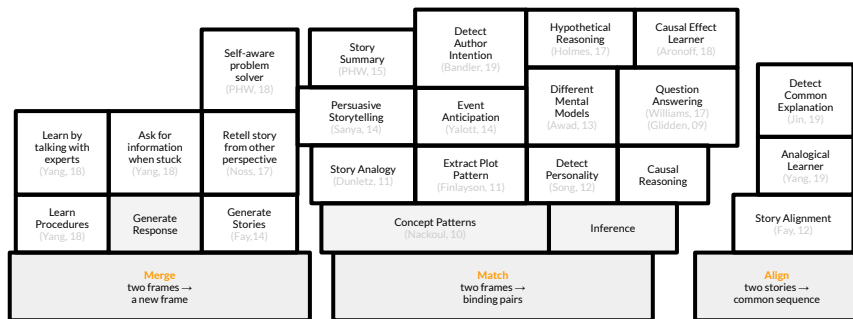


## Story-Grounded Cognitive Architecture



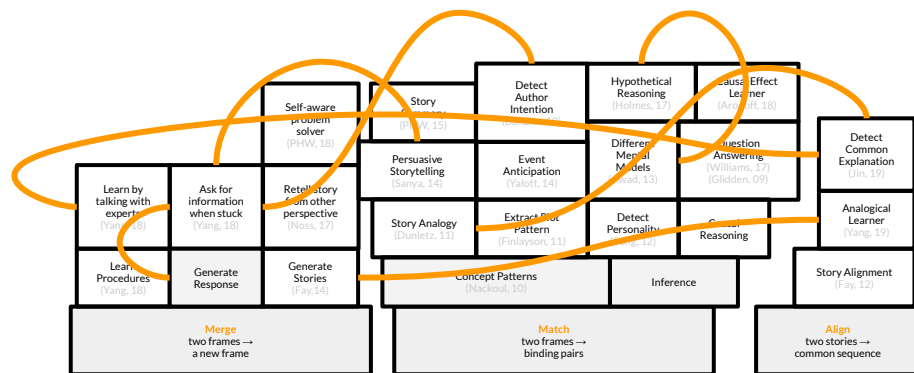
# Future > Steps: Modules → Architecture → Agents

## Genesis Story Understanding System



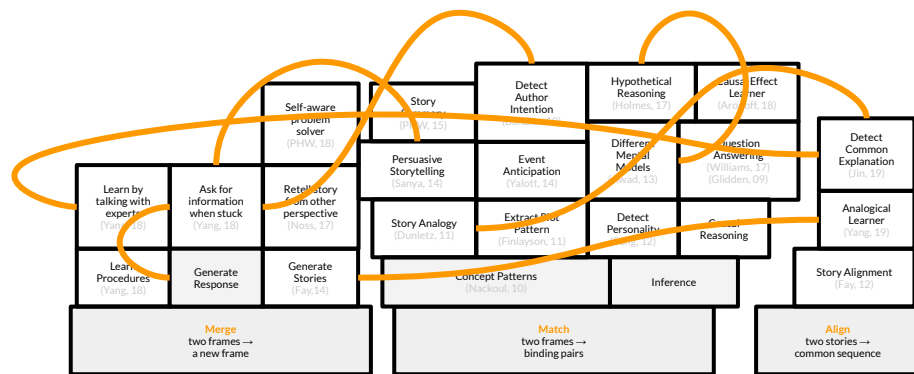
# Future > Steps: Modules → Architecture → Agents

## Story-Grounded Cognitive Architecture

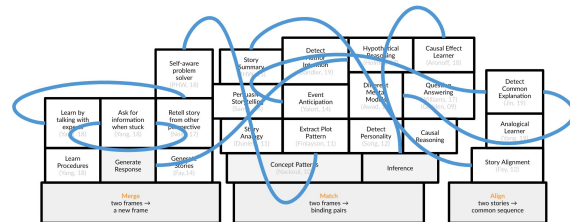
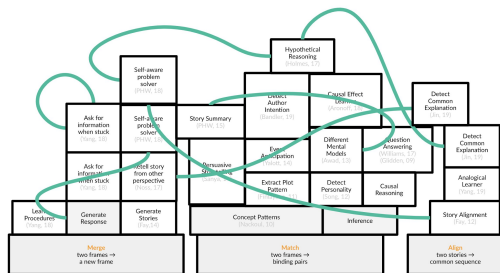


# Future > Steps: Modules → Architecture → Agents

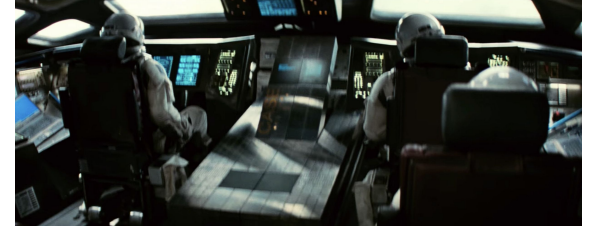
## Story-Grounded Cognitive Architecture



## Interactive Agents with Different Initiation



# Future > New Domain: Cosmic Exploration



\* Scenes from movie, Interstellar (2014)

# Future > New Domain: Cosmic Exploration

This way, about two hundred meters.

This is fast for atmospheric entry.  
Should we use the thrusters to slow?

Got it. Can you maneuver?

\* Scenes from movie, Interstellar (2014)

# Contributions: See a New Beginning of Genesis

## Past



11 years  
~ 25 papers  
10 subsystems



Repo: 120 MB  
Codes: 10MB

## Present



## Future



\* Genesis documentation:  
GenesisCore private repo:

[www.ways2think.ai/genesis/](http://www.ways2think.ai/genesis/)  
<https://github.com/zt-yang/GenesisCore>