OpenNARS
for Research
General Overview

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OPENNARS CONTROL CRITERIA

- Operating under AIKR, NARS expects a new task to arrive at any given moment
- System should always stay responsive to new inputs and derivations
- Data structures are always bounded in size
- Operating cycle needs to finish roughly in a constant time
- Short/Long Term Importance: selection of an item is reflected by its *short-term importance* while forgetting relies on its *long-term importance*
- Implementation of relative forgetting: unimportant items have to be forgotten after some time or when resources are not available anymore

CONTROL FLOW DIAGRAM

Sensory Channel 1

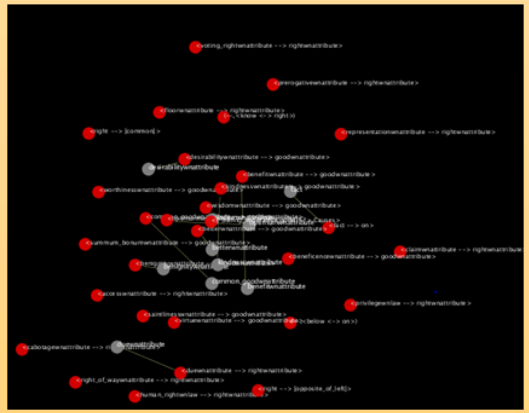
Sensory Channel 2

Sensory Channel n

Input Buffer

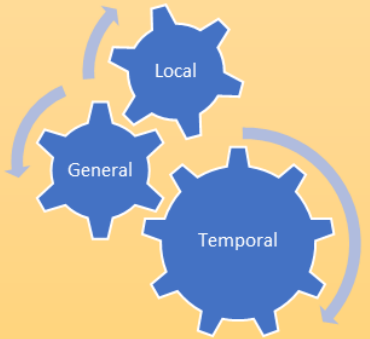
Derivation Buffer

Main Memory



Event Bag

Inference Engine



Functions

- Truth
- Boolean

Rules

- Local
- Inference
  - Compositional
  - Structural

MEMORY OVERVIEW

- System Global Memory is defined as "Memory of Concepts"
- Priority queue data structure called "Bag"
- Limited predefined size
- Element is taken out based on probabilistic priority distribution, meaning even an element with lowest priority has a chance to be selected
- Operations defined: *put()*, *get()* and *get(key)*
- When full, element with lowest priority is removed

BUDGET AND TRUTH VALUES

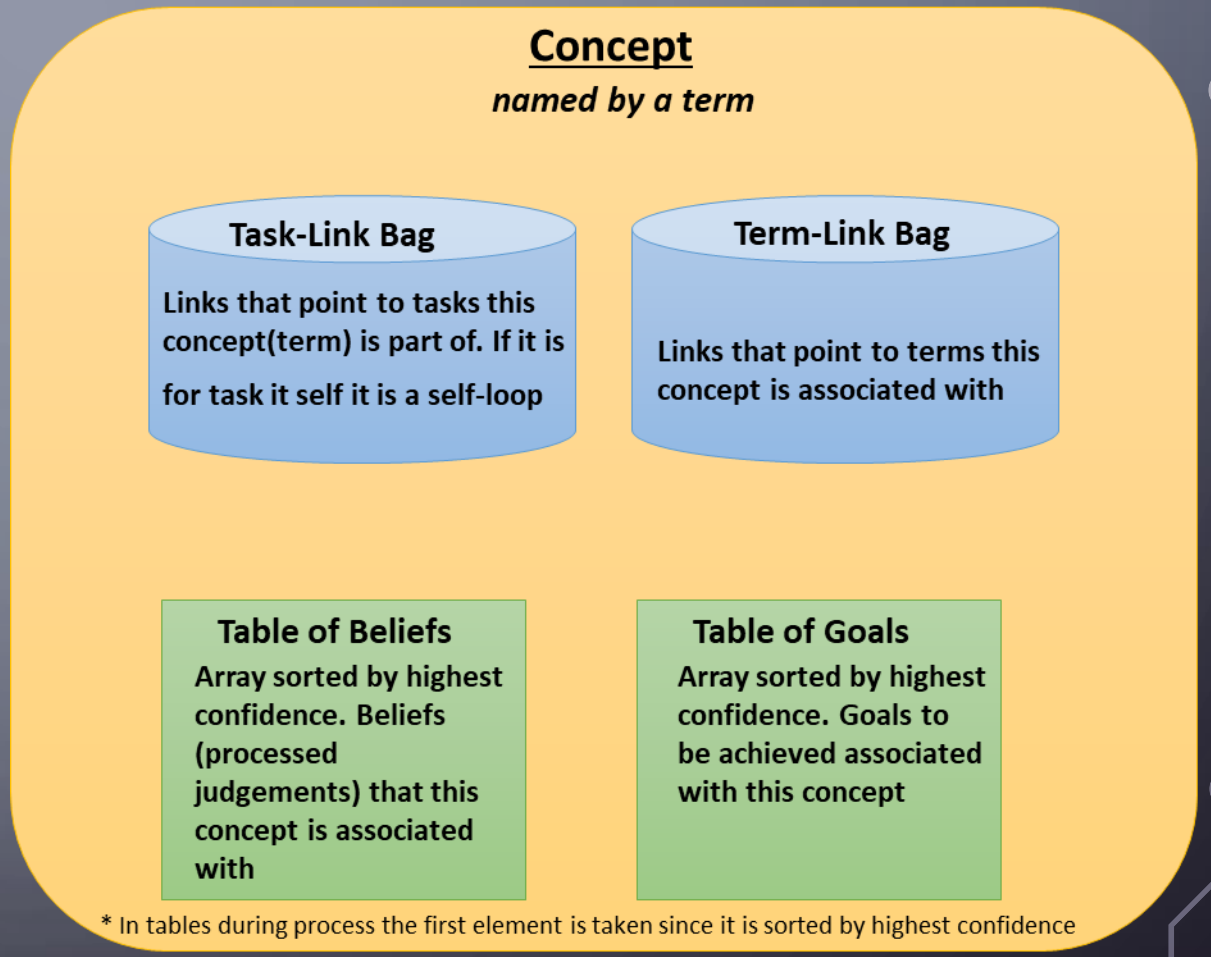
- **Budget Value:** set of three rational numbers assigned to each data item, that controls resources to be dedicated for a data item
  - **Priority:** measures short-term importance
  - **Durability:** a decay rate, describes how fast Priority of an item should decay
  - **Quality:** indicates the long-term importance of the data item

- **Truth Value:** set of two rational numbers which indicate degree of belief based on the evidence collected from system's experience
  - **Frequency** shows amount of positive evidence / total evidence
  - **Confidence** indicates degree of reliability of corresponding *frequency*

**(All values within the budget and truth values range from 0 to 1)*

ROLE OF CONCEPT

- Local memory is defined as a data structures within a Concept unit
- 2 - way role of concept: storage and inference entity
- Efficient and compact: everything necessary is stored within a concept
- Concept has inner data structures



OPERATING CYCLE

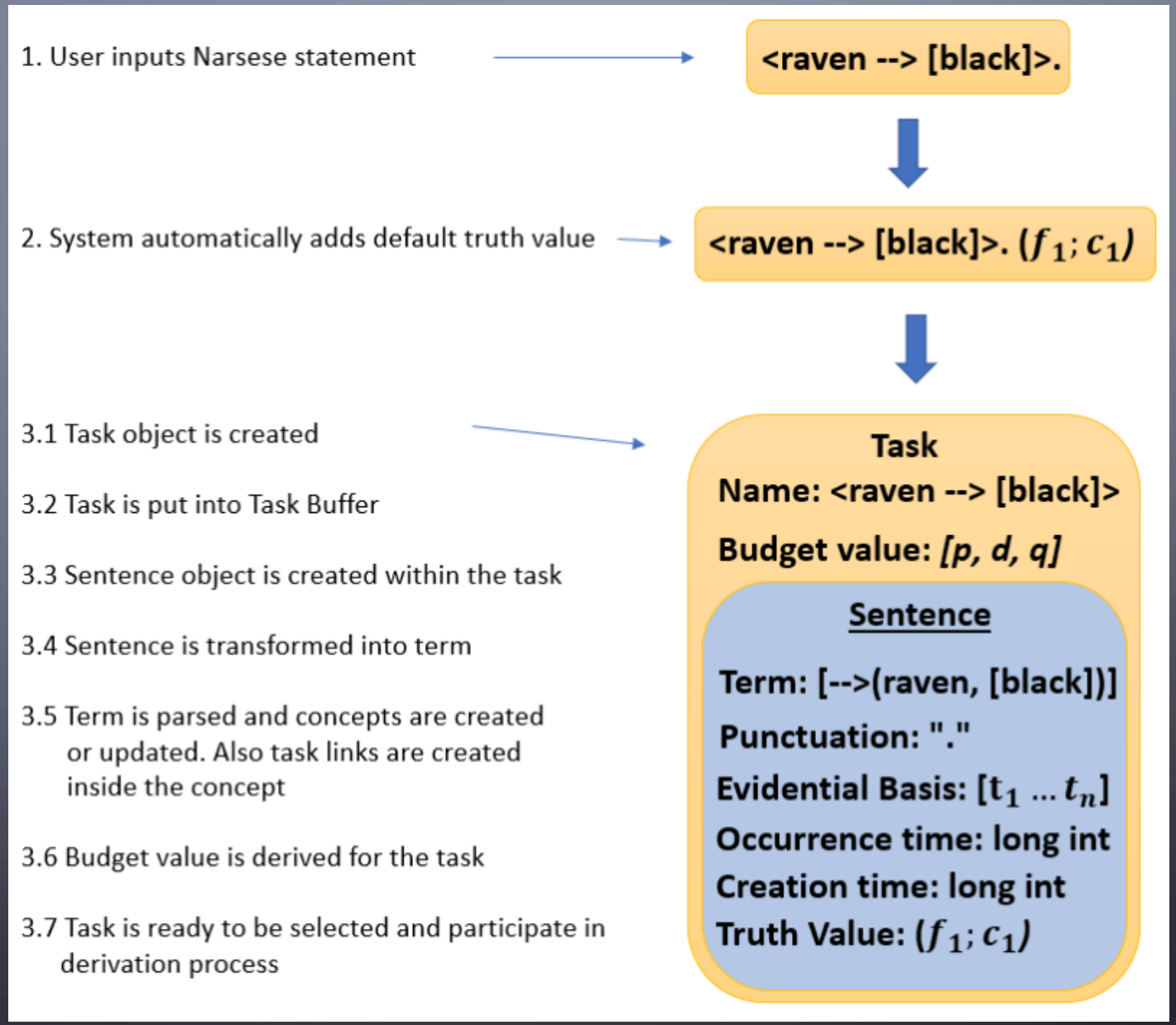
Main operating cycle is data driven, guided by the priority of data items.

1. Add results (derivations and inputs) from global buffer into main memory, triggering potential revisions in the related concepts.
2. Select a concept C from main memory.
3. Select a *tasklink* from C
4. Select a *termlink* from C
5. Obtain the highest-confident belief from the concept the *termlink* points to
6. Apply inference rule with the *tasklink*'s task, and the belief as premises
7. Adjust *budget value* through use of *budget functions* for data items participated in the inference
8. Input conclusions into global buffer.

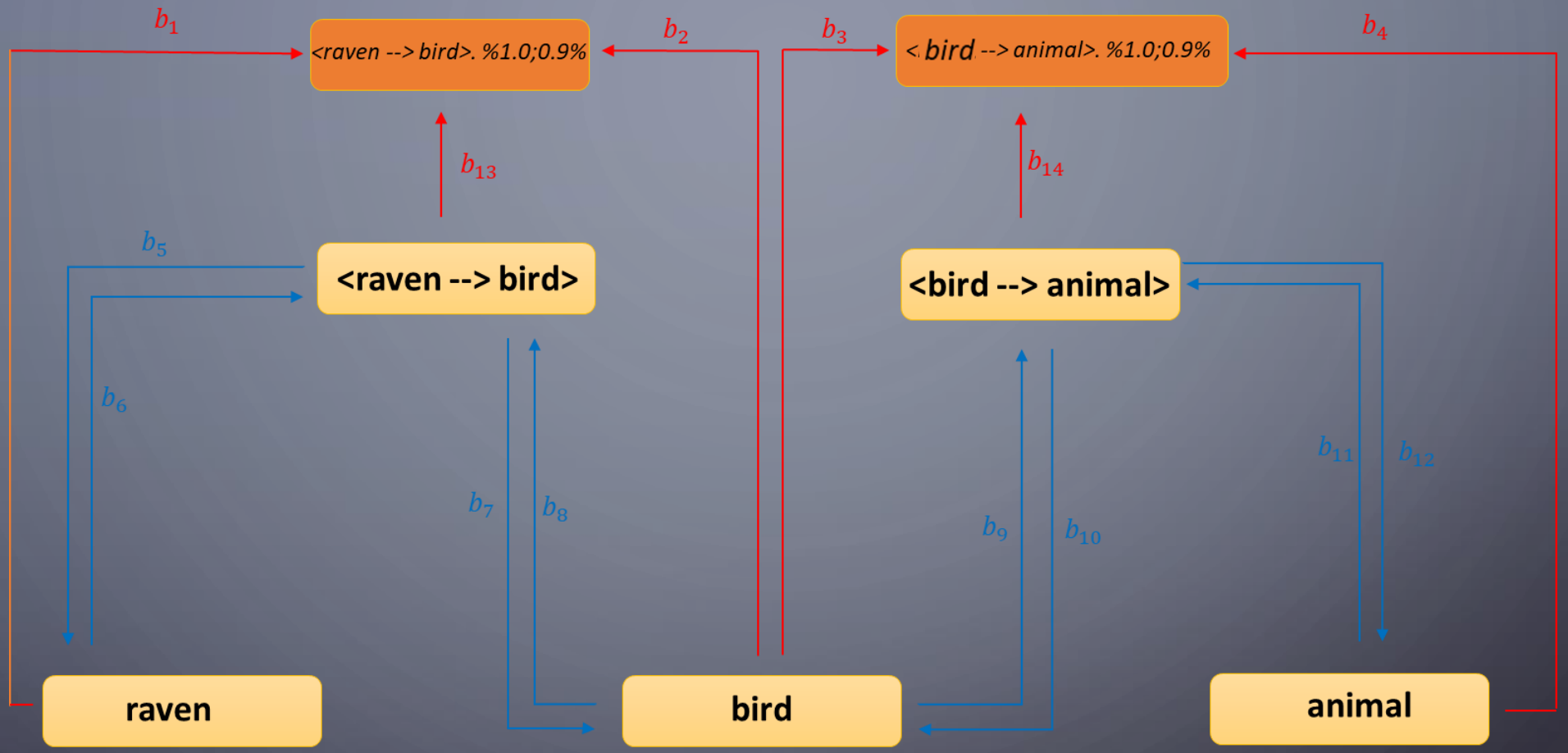
TASK AND BELIEVE

- Sentence is stored in memory as either a task or a belief (or both).
- Judgment needs to be absorbed into beliefs.
- A belief is a judgment that has been absorbed already and will be used to process the tasks
- Task is what to be processed by the system

PROCESSING OF A TASK



TASKLINK AND TERMLINK



b is for budget value which is computed for each link. With each inference cycle budget value of participating link is being re-computed
Yellow: concepts
Orange: Task Objects
Blue: term-links
Red: task-links

BASIC SYLLOGISTIC RULES

Deduction: {M --> P, S --> M} |- S --> P

Abduction: {P --> M, S --> M} |- S --> P

Induction: {M --> P, M --> S} |- S --> P

Exemplification: {P --> M, M --> S} |- S --> P

Comparison: {M --> P, M --> S} |- S <-> P

Analogy: {M --> P, S <-> M} |- S --> P

Resemblance: {M <-> P, S <-> M} |- S <-> P

EXTENDED BOOLEAN AND "TRUTH EXPECTATION"

- Treat all involved variables as Boolean and apply extended Boolean operations

  not(x) = 1 – x
  and(x, y) = x * y
  or(x, y) = 1 – (1 – x) * (1 – y)

- "Truth Expectation" used in local inference and budget computation defined as: $c * (f - 0.5) + 0{,}5$

BUDGET FUNCTIONS

- ***budgetInference()*** creates a budget for derived task and also updates budget for selected concept's *termlink*
- ***merge()*** revises budget when merging identical items
- **activate()** updates currently selected concept's *budget value*
- **revise()** assigns budget to item whose truth value derived using revision rule
- ***truth_to_quality()*** converts truth value to quality of an item

- Publications & reports:
  http://www.cis.temple.edu/~pwang/

- Source code, examples, and documents:
  http://opennars.org/

- Wiki Pages:
  http://github.com/opennart/wiki

- Participations and COLLABORATIONS are welcome!