Data for Brain Reference Architecture of YS24LongitudinallySegmentedDistalCA1andPeriphery

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Context

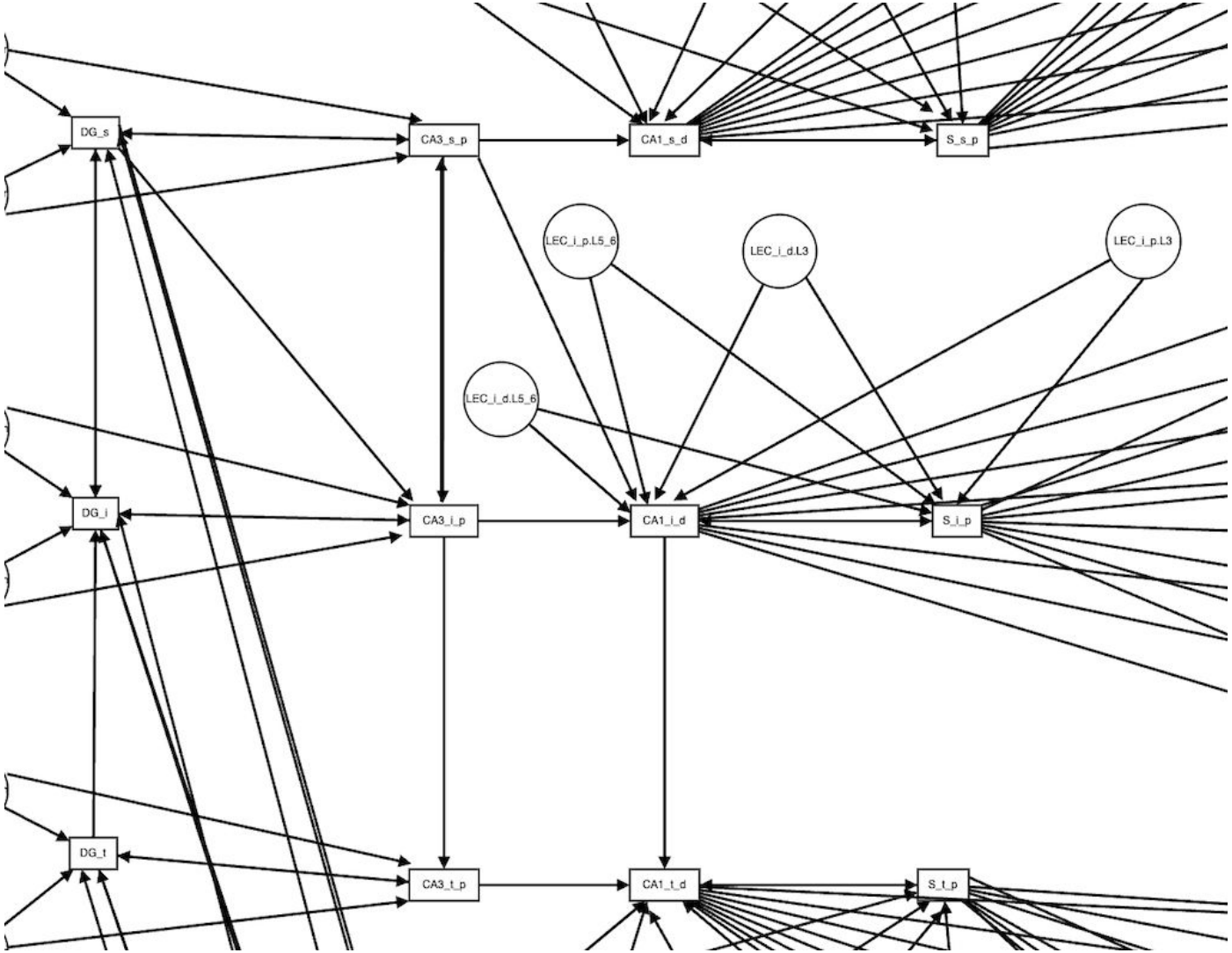
- The hippocampal formation
  - a crucial role in learning, memory, and spatial navigation.
- Regions

ROI

Abbreviations	Formal names
DG	dentate area (dentate gyrus)
CA3	CA3 region of Hipp
CA1	CA1 region of Hipp
S	subiculum
LEC	lateral (anterior) entorhinal cortex

Context

- 138 Circuits & 182 Connections



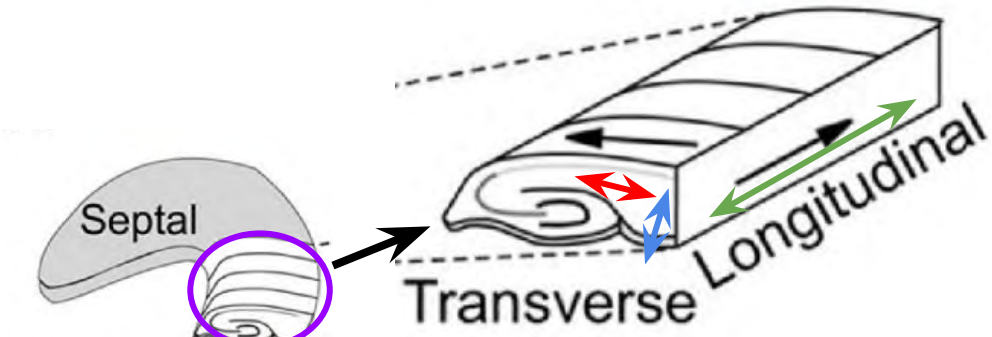
Method: Sampling strategy

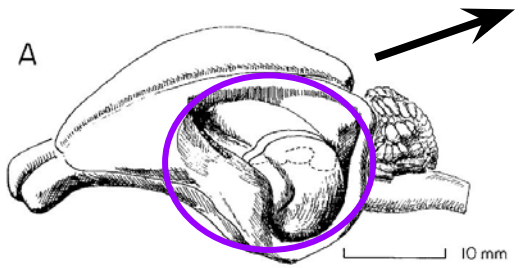
- Surveyed by the authors, including experts in anatomy
- Publications
  - Bienkowski et al. (2018)
  - Dolorfo and Amaral (1998)
  - Honda and Ishizuka (2015)
  - Honda and Shibata (2017)
  - Lee et al. (2020)
  - Ohara et al. (2021)
  - Ohara et al. (2023)
  - Taniguchi, Fukawa, and Yamakawa (2022)

Method: Overview

- Examination in three axes
  - Longitudinal axis
  - Transverse axis
  - Laminar organization

Cataldi and Vigliotti (2018)





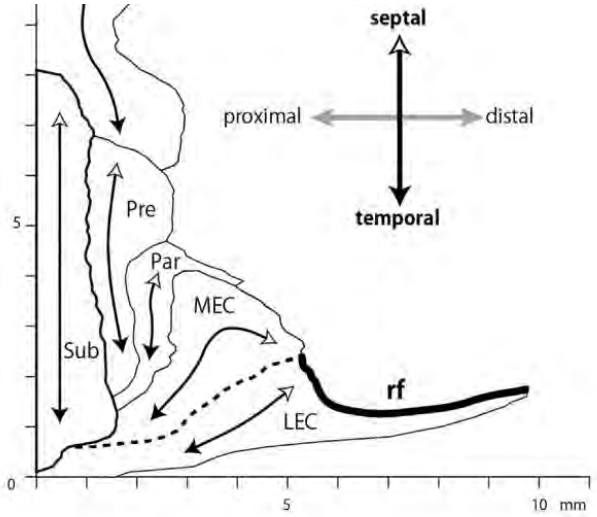
Andersen, Bliss, and Skrede (1971)

- Use algorithm to make Circuit/Connection

Output	Input				Algorithm
Circuit	Cir_Reg	Cir_Long	Cir_Trans	Cir_Lam	Make_Circuit
Connection	Conn_Reg	Conn_Long	Conn_Trans	Conn_Lam	Make_Connection

Method: Examination of correspondence in longitudinal axis

- Research findings



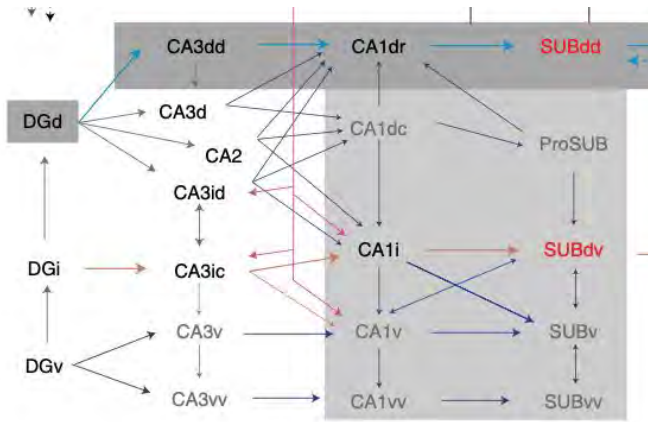
Honda and Ishizuka (2015)

Abbreviations	Formal names
s	septal
i	intermediate
t	temporal

s

i

t



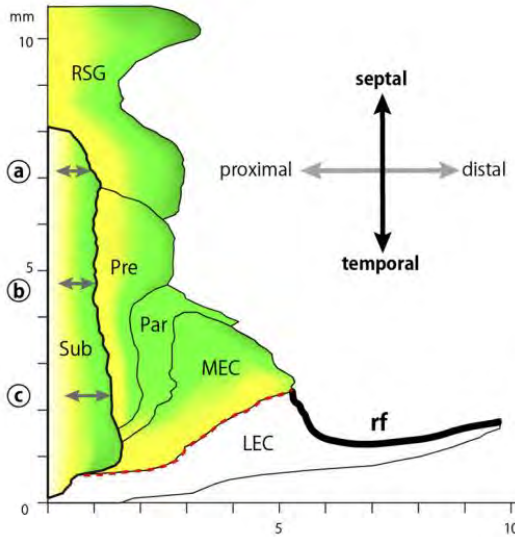
Bienkowski et al. (2018)

Input:
Conn_Long

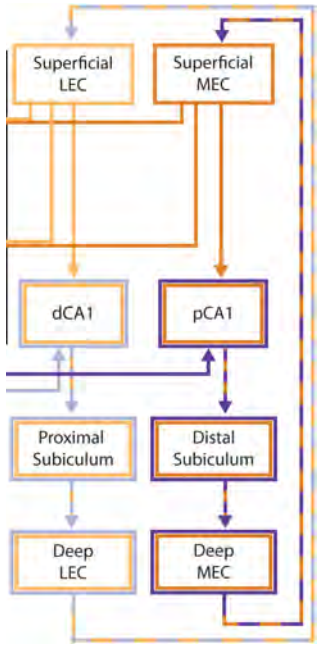
- Hypotheses
  - if the connection of two regions exists, correspondence relationship of the connection would exist.
    - DG_s, CA3_s, CA1_s, S_s, PrS_s, PaS_s, MEC_s, LEC_s
    - DG_i, CA3_i, CA1_i, S_i, PrS_i, PaS_i, MEC_i, LEC_i
    - DG_t, CA3_t, CA1_t, S_t, PrS_t, PaS_t, MEC_t, LEC_t

Method: Examination of correspondence in transverse axis

- Research findings



Honda and Ishizuka (2015)



Lee et al. (2020)

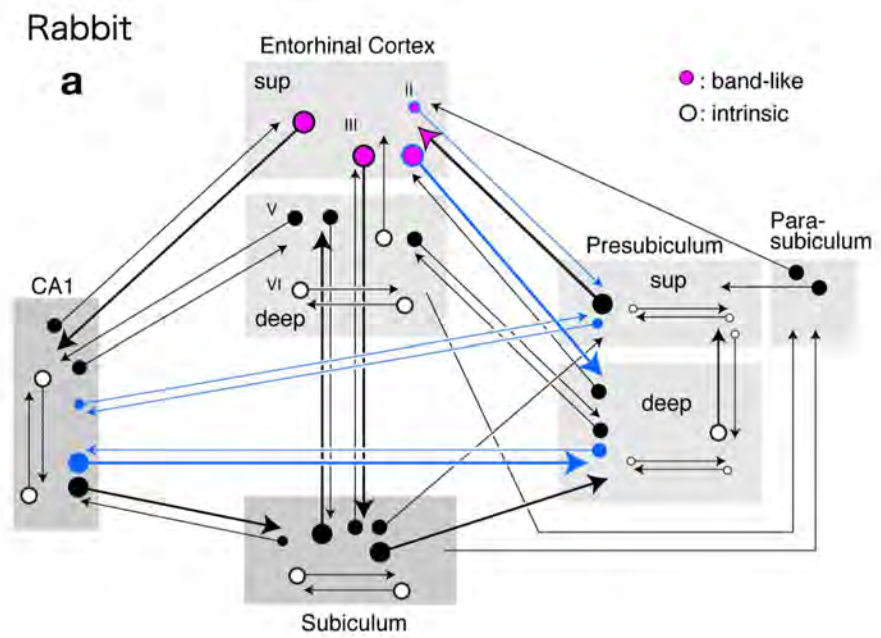
Abbreviations	Formal names
p	proximal
d	distal

- Hypotheses
  - if the connection of two regions exists, correspondence relationship of the connection would exist.
    - CA1_d, S_p, LEC_d
    - CA1_d, S_p, LEC_p
    - CA1_p, S_d, PrS_p, MEC_d
    - CA1_p, S_d, PrS_d, MEC_p

Input:
Conn_Trans

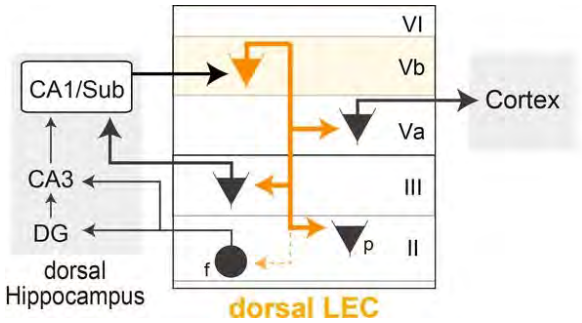
Method: Examination of correspondence in laminar organization

- Research findings



Honda and Shibata (2017)

Abbreviations	Formal names
L1	layer 1
L2_3	layer 2&3
L2	layer 2
L2fan	fan cells in layer 2
L3	layer 3
L5_6	layer 5&6
L5	layer 5
L5a	layer 5a
L5b	layer 5b
L6	layer 6



Ohara et al. (2021)

Input: Conn_Reg	Input: Conn_Lam

Method: Determining ROI and axis classification

- ROI / Axis classification

Region names	Longitudinal axis	Transverse axis	Laminar organization
DG	Septal,Mid,Temporal		
CA3	Septal,Mid,Temporal	Proximal,Distal	
CA1	Septal,Mid,Temporal	Proximal,Distal	
S	Septal,Mid,Temporal	Proximal,Distal	
LEC	Septal,Mid,Temporal	Proximal,Distal	L1,L2fan,L3,L5a,L5b,L6

ROI

Input:
Cir_Reg

Input:
Cir_Long

Input:
Cir_Trans

Input:
Cir_Lam

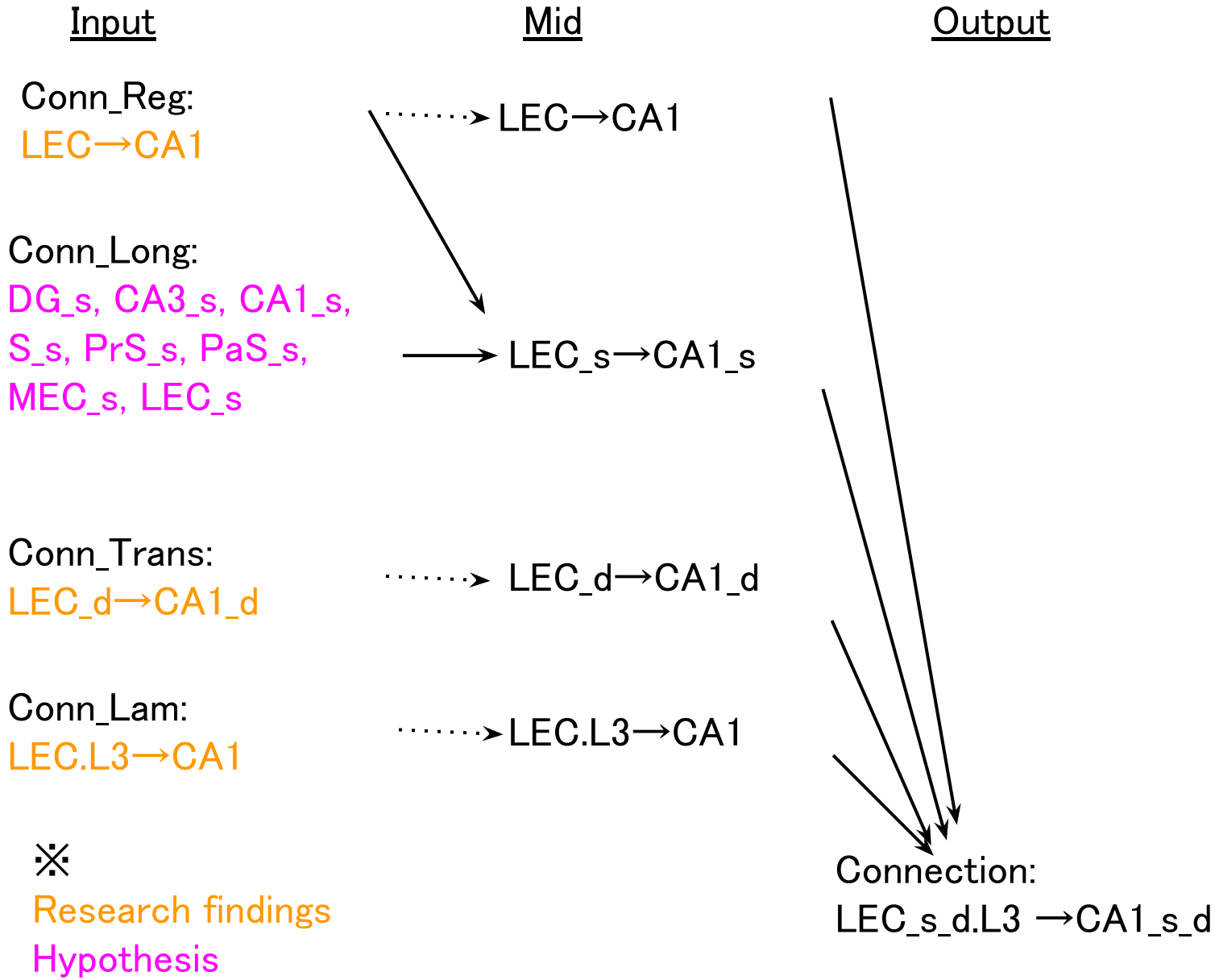
Method: Connection formulation

Algorithm 4 Algorithm for creating Connection: Make_Connection
For DG, line 7, 10, 14, and 15 are not executed
For CA3, CA1, and S, line 10 and 15 is not executed
In line 24, about the internal connections of the DG, CA3, CA1, and S, the widely known connections in Bienkowski et al. (2018) were extracted through discussion with experts.
In line 25, in some connections, if a source in ROI is not Uniform Circuit, add "Source _uc" to Circuit and replace the source of the connection to "Source _uc".

```
List=[]
for extract source i1 and target i2 from a list of information regarding the correspondence of connections in laminar organization do
  append "from i1 to i2" to List
  for extract source j1 and target j2 from a list of information regarding the correspondence of connections in longitudinal axis do
    append "from i1_j1 to i2_j2" to List
  end for
  for extract source k1 and target k2 from a list of information regarding the correspondence of connections in transverse axes do
    append "from i1_k1 to i2_k2" to List
  end for
  for extract source l1 and target l2 from a list of information regarding the correspondence of connections in laminar organization do
    append "from i1.l1 to i2.l2" to List
  end for
  for extract source j1 and target j2 from a list of information regarding the correspondence of connections in longitudinal axis do
    for extract source k1 and target k2 from a list of information regarding the correspondence of connections in transverse axes do
      for extract source l1 and target l2 from a list of information regarding the correspondence of connections in laminar organization do
        Synthesize_process (i1–i2, j1–j2, k1–k2, l1–l2)
      end for
    end for
  end for
  if there is an exception then
    append the exception to List
  end if
end for
append internal connections to List
if there is an exception then
  append the exception to List of circuits and List of connections
end if
return List
```

Algorithm 3 Synthesize_process (i1–i2, j1–j2, k1–k2, l1–l2)

```
append "from i1_j1_k1.l1 to i2_j2_k2.l2" to List
return
```



Method: Circuit formulation

Algorithm 2 Algorithm for creating Circuit: Make_Circuit
For DG, only line 3-5 are executed, with uniform circuit=True.
For CA3, CA1, and S, line 9 and 14 are not executed.
For LEC, "i_j.l" is appended in line 19-21, because connections to DG as "i_j" exists.
For LEC, as l = L2_3, L2, L5_6, and L5, "i.l" and "i_j_k.l" are appended in line 19-21.

```
1: List=[]
2: for extract element i from region name in Table 5 do
3:    for extract element j from longitudinal axis in Table 5 do
4:       append "i_j" to List as uniform circuit = False
5:    end for
6:    for extract element k from transverse axis in Table 5 do
7:       append "i_k" to List as uniform circuit = False
8:    end for
9:    for extract element l from laminar organization in Table 5 do
10:      append "i.l" to List as uniform circuit = False
11:   end for
12:   for extract element j from longitudinal axis in Table 5 do
13:      for extract element k from transverse axis in Table 5 do
14:         for extract element l from laminar organization in Table 5 do
15:            Segmentation_process (i, j, k, l)
16:         end for
17:      end for
18:   end for
19:   if there is an exception then
20:      append the exception to List
21:   end if
22: end for
23: return List
```

Algorithm 1 Segmentation_process (i, j, k, l)

```
1: append "i_j_k.l" to List as uniform circuit = True
2: return
```

Input

Cir_Reg:
LEC

Cir_Long:
LEC_s

Cir_Trans:
LEC_d

Cir_Lam:
LEC.L3

※
Uniform Circuit = False
Uniform Circuit = True

Output

Circuit:
LEC_s_d.L3

Data description

- Repository location
  - BRA Editorial System (BRAES)
- Object name and versions
  - YS24LongitudinallySegmentedDistalCA1andPeriphery.bra
  - YS24LongitudinallySegmentedDistalCA1andPeripheryBIF.xml
- Creation dates
  - From 2022-09-11 to 2024-07-16
- Language
  - English
- License
  - The open license under which the data has been deposited (CC-BY 4.0)
- Publication date
  - 2024-07-16

Caveats for Data Usage

- This data includes hypotheses
  - three hypotheses in longitudinal axis
  - four hypotheses in transverse axes
  - the algorithm "Synthesize_process"
- Verifying the hypotheses
  - anterograde/retrograde tracers
  - transgenic mouse
- Circuits with "Source_uc"
  - a temporary circuit