Systems Thinking and Wicked Problems

David Ing

Aalto University and
the International Society for the Systems Sciences

Tongji Huangpu School
November 20, 2017

Agenda

1. A personal system

2. Systems thinking – basic language

3. Wicked problems

Systems Thinking and Wicked Problems

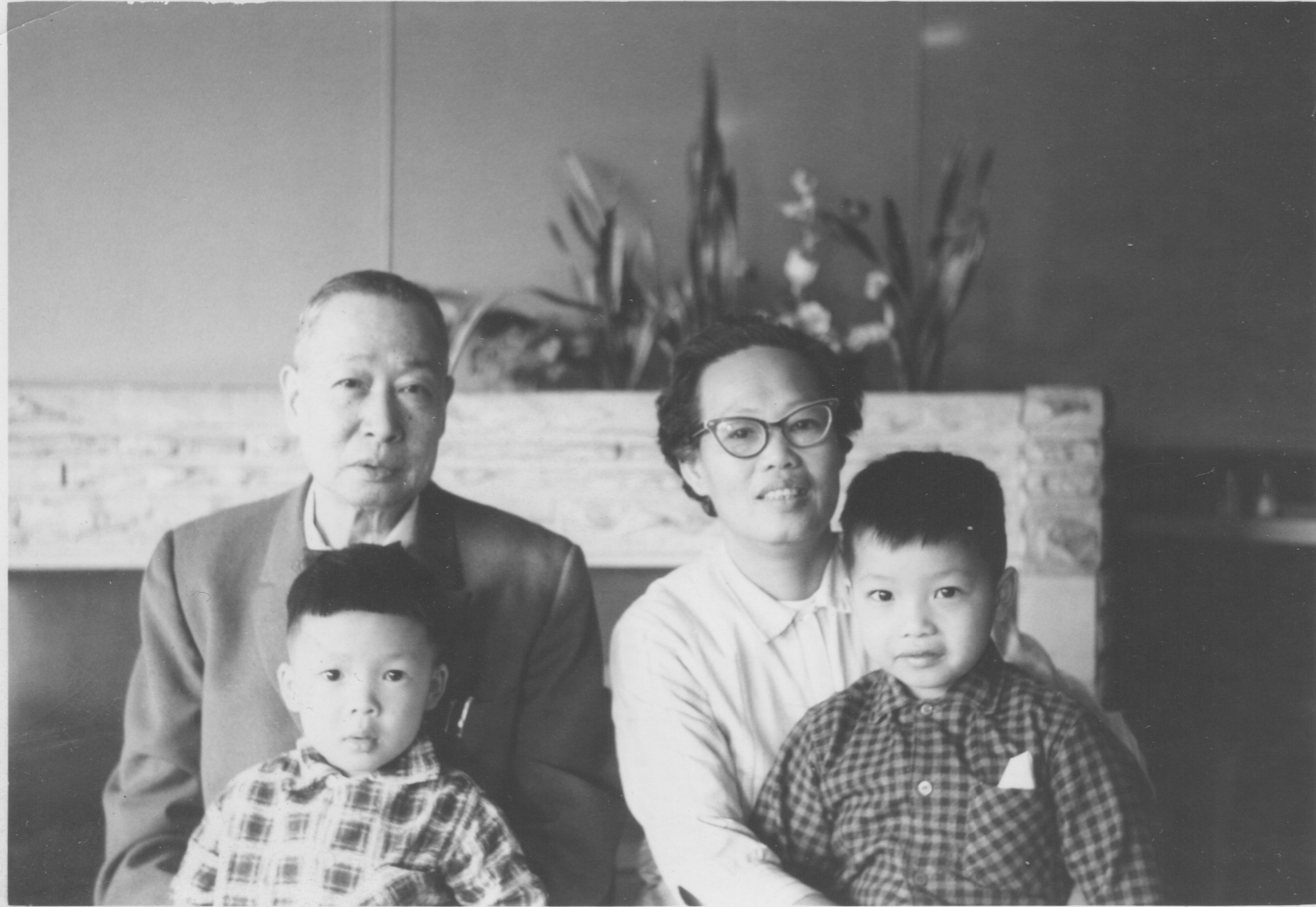November 2017

David Ing, Professional Experience

IBM Canada / North America
(1985-2012; retired early)
Management consultant; market development; marketing scientist

Aalto U.
(2003-)
Since 2010, teaching in master's program in Creative Sustainability
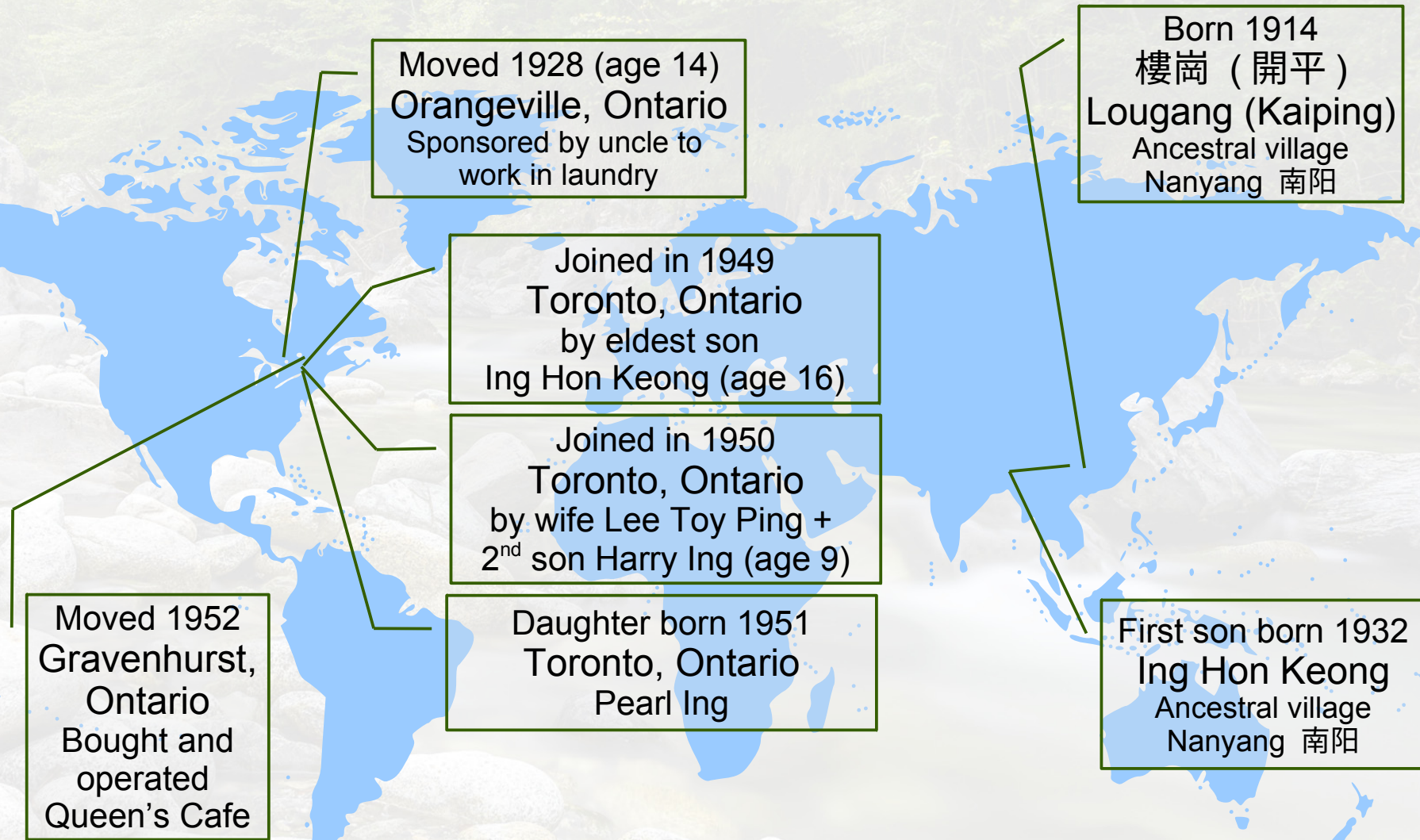
U. of Toronto
Canadian Centre for Marketing Information Technologies (C^{2}MIT) (cofounder 1990-1992)

International Society for the Systems Sciences (President 2011-2012)

Circa 1964,
Gravenhurst, Ontario, Canada

Systems Thinking and Wicked Problems

Ing See Chong (Henry) (my grandfather)

Moved 1928 (age 14)
Orangeville, Ontario
Sponsored by uncle to work in laundry

Born 1914
樓崗（開平）
Lougang (Kaiping)
Ancestral village
Nanyang 南阳

Joined in 1949
Toronto, Ontario
by eldest son
Ing Hon Keong (age 16)

Joined in 1950
Toronto, Ontario
by wife Lee Toy Ping +
2nd son Harry Ing (age 9)

Moved 1952
Gravenhurst,
Ontario
Bought and
operated
Queen's Cafe

Daughter born 1951
Toronto, Ontario
Pearl Ing

First son born 1932
Ing Hon Keong
Ancestral village
Nanyang 南阳

David Ing, 2017

Ing Hon Keong (Kent)
(my father)

Married 1954
Gravenhurst, Ontario
Lee Suey Chee (Violet)

Daughter born 1956
Gravenhurst, Ontario
Jeanne Ing

Son born 1957
Gravenhurst, Ontario
David Ing

Son born 1961
Gravenhurst, Ontario
Benjamin Ing

Canada recognizes PR Chinese 1970
**Chinese National Table Tennis team
visits Gravenhurst, Ontario 1972**
Birthplace of 白求恩
Dr. Norman Bethune

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David Ing + family

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Family in Nanyang (2013)

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What is the most important decision of your life?

In the past,
a person's status was
largely determined
by where he or she was born.

In today's
highly mobile and interconnected society,
one's life chances are significantly affected
by the ability to move and relocate as well.

Today, location constitutes an additional divisive line
that separates the haves and from the have nots,
along race, education, occupation and income.

Source: Richard Florida, *Who's Your City?: How the Creative Economy Is Making Where to Live the Most Important Decision of Your Life*, (2010), p. 78.

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Systems Thinking and Wicked Problems

Systems thinking is a perspective on wholes, parts and their relations

containing whole

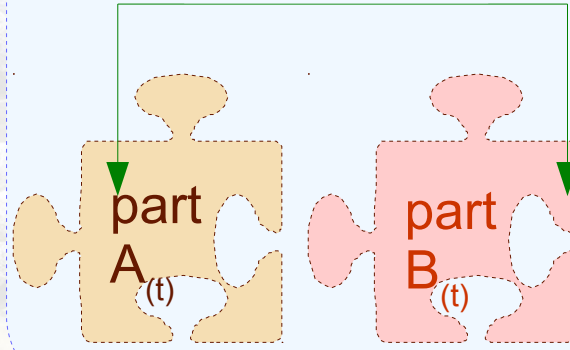*Function (non-living) or role (living)*

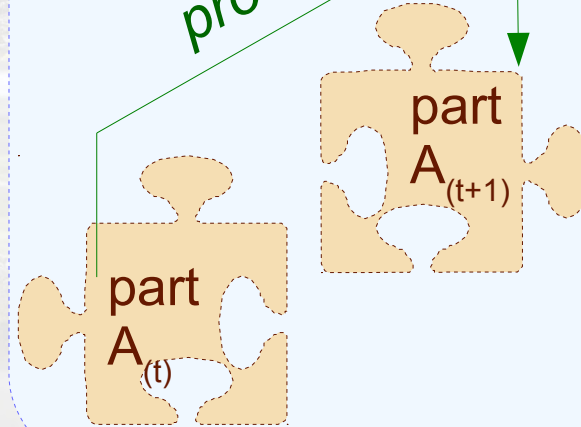part A_(t)
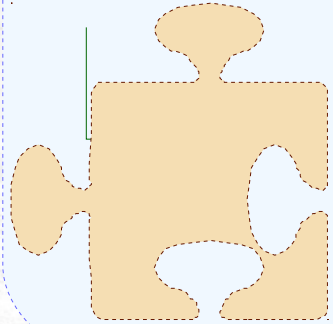
Function
"contribution of the part to the whole"

structure

part A_(t)

part B_(t)

Structure
"arrangement in space"

process

part A_(t)

part A_(t+1)

Process
"arrangement in time"

In authentic systems thinking, synthesis precedes analysis and the containing whole is appreciated

containing whole

Function (non-living)
or role (living)
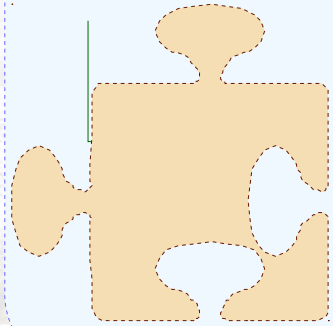
Synthesis precedes analysis
1. Identify a containing whole (system) of which the thing to be explained is a part.
2. Explain the behavior or properties of the containing whole
3. Then explain the behavior or properties of the thing to the explained in terms of its role(s) or function(s) within its containing whole.

Pacing layers emphasize coevolution and learning

SITE

This is the geographical setting, the urban location, and the legally defined lot, whose boundaries outlast generations of ephemeral buildings. "Site is eternal", Duffy agrees.

STRUCTURE

The foundation and load-bearing elements are perilous and expensive to change, so people don't. These are the building. Structural life ranges from 30 to 300 years (but few buildings make it past 60, for other reasons).

SKIN

Exterior surfaces now change every 20 years or so, to keep up with fashion or technology, or for wholesale repair. Recent focus on energy costs has led to re-engineered Skins that are air-tight and better-insulated.

SERVICES

These are the working guts of a building: communications wiring, electrical wiring, plumbing, sprinkler system, HVAC (heating, ventilation, and air conditioning), and moving parts like elevators and escalators. They wear out or obsolesce every 7 to 15 years. Many buildings are demolished early if their outdated systems are too deeply embedded to replace easily.

SPACE PLAN

The interior layout, where walls, ceilings, floors, and doors go. Turbulent commercial space can change every 3 years; exceptionally quiet homes might wait 30 years.

STUFF

Chairs, desks, phones, pictures; kitchen appliances, lamps, hair brushes; all the things that twitch around daily to monthly. Furniture is called mobilia in Italian for good reason.

Source: Stewart Brand. 1994. *How Buildings Learn: What Happens after They're Built*. New York: Viking.

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The essential idea of a pattern language is: a *solution* to a *problem* in *context*

Every time a designer creates a pattern (or, for that matter, entertains any idea about the physical environment), he essentially goes through a three-step process.

He considers a PROBLEM, invents a PATTERN to solve the problem, and makes mental note of the range of CONTEXTS where the pattern will solve the problem. [….]

The format says that whenever a certain **CONTEXT** exists, a certain **PROBLEM** will arise; the stated **PATTERN** will solve the **PROBLEM** and there should be provided in the **CONTEXT**.

While it is not claimed that the PATTERN specified is the only solution to the PROBLEM, it is implied that unless the PATTERN or an equivalent is provided, the PROBLEM will go unsolved (Alexander, Ishikawa, & Silverstein, 1967, pp. 1–4).

Alexander, Christopher, Sara Ishikawa, and Murray Silverstein. 1967. *Pattern Manual.* Berkeley, California: Center for Environmental Structure

"Dilemmas in a General Theory of Planning", (Rittel + Weber, 1973)

There are at least ten distinguishing properties of planning-type problems, i.e. wicked ones .... We use the term "wicked" in a meaning akin to that of "malignant" (in contrast to "benign") or "vicious" (like a circle) or "tricky" (like a leprechaun) or "aggressive" (like a lion, in contrast to the docility of a lamb). [....]

1. There is no definitive formulation of a wicked problem ....
2. Wicked problems have no stopping rule ....
3. Solutions to wicked problems are not true-or-false, but good-or-bad ....
4. There is no immediate and no ultimate test of a solution to a wicked problem ....
5. Every solution to a wicked problem is a "one-shot operation"; because there is no opportunity to learn by trial-and-error, every attempt counts significantly ....

6. Wicked problems do not have an enumerable (or an exhaustively describable) set of potential solutions, nor is there a well-described set of permissible operations that may be incorporated into the plan ....
7. Every wicked problem is essentially unique ....
8. Every wicked problem can be considered to be a symptom of another problem ....
9. The existence of a discrepancy representing a wicked problem can be explained in numerous ways. The choice of explanation determines the nature of the problem's resolution ....
10. The planner has no right to be wrong ....

David Ing, 2017

Ask Not What's Inside Your Head, but What Your Head's Inside of

Stimulus – Response
(Behavioral Psychology)

Ecological Approach to Perception

[In the 1950] psychophysics of perception … "givens" in the light to the eye could not support perceptual phenomena, but only elementary experiences such as sensations. [….] Succinctly put, the psycho-physical program was … traditional in considering perception to be a set of responses to presented stimuli (albeit "higher order" stimuli).
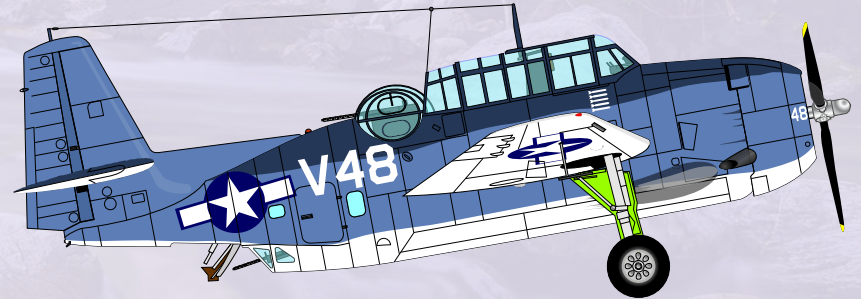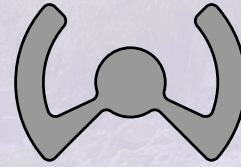
Over the last 10-15 years [James J. Gibson] has tried to develop enough theory … to demonstrate that direct perception is indeed plausible even if hordes of difficult details remain to be worked out. The … analysis of the optic array, stimulus organization, and the functional organization of perceptual systems are what Gibson oftens points to as radical features ….

William M. Mace 1977. "James J. Gibson's Strategy for Perceiving: Ask Not What's inside Your Head, but What Your Head's inside of." In *Perceiving, Acting, and Knowing: Toward an Ecological Psychology*, edited by Robert Shaw and John Bransford, 43–65.

How do we recognize a living system? As (a) the being of an organism; or (b) an animate becoming?
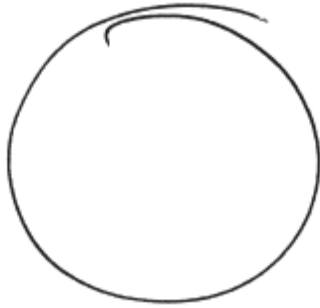
I have folded the organism in on itself such that it is delineated and contained within a perimeter boundary, set off against a surrounding world – an environment – with which it is destined to interact according to its nature. The organism is 'in here', the environment 'out there'.

In this depiction there is no inside or outside, and no boundary separating the two domains. Rather there is a trail of movement or growth. Every such trail discloses a relation. But the relation is not between one thing and another – between the organism 'here' and the environment 'there'. It is rather a trail along which life is lived. Neither beginning here and ending there, nor vice versa ….
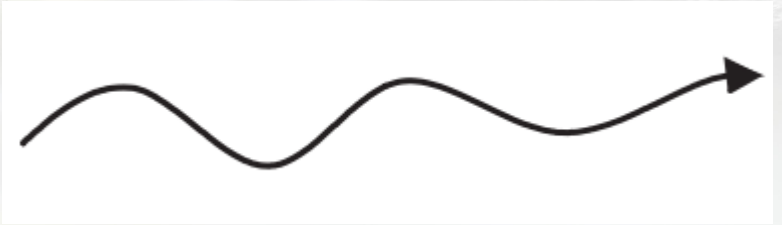
Tim Ingold. 2011. "Rethinking the animate, reanimating thought." In *Being Alive: Essays on Movement, Knowledge and Description,* p. 69.

How do we interpret a line? As (a) a static perimeter; or (b) a trajectory of movement?
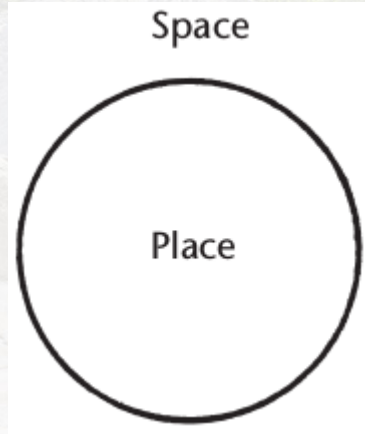

For the Inuit, as soon as a person moves he becomes a line.

… lineal movement *along* paths of travel [is] referred to ... as wayfaring.

… lateral movement *across* a surface, … I call transport.

My contention is that lives are led not inside places but through, around, to and from them, from and to places elsewhere ….

Human existence … unfolds not in places but along paths. Proceeding along a path, every inhabitant lays a trail.
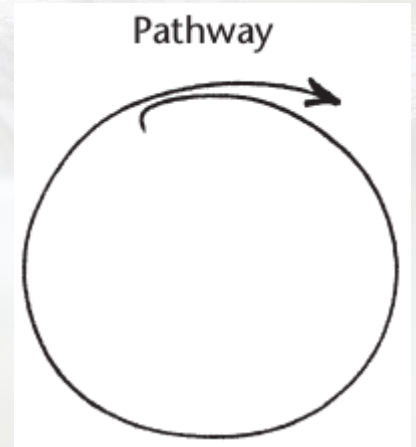
Tim Ingold. 2011. "A storied world." In *Being Alive: Essays on Movement, Knowledge and Description,* p. 148-149.

How are lives lived? As
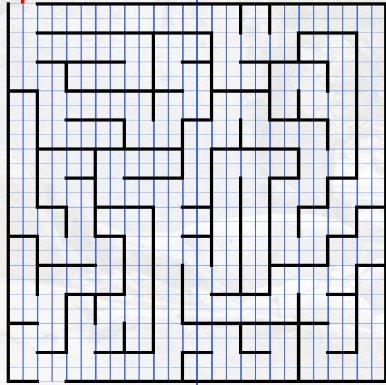## (a) a network of connected points; or (b) a meshwork of entangled lines?
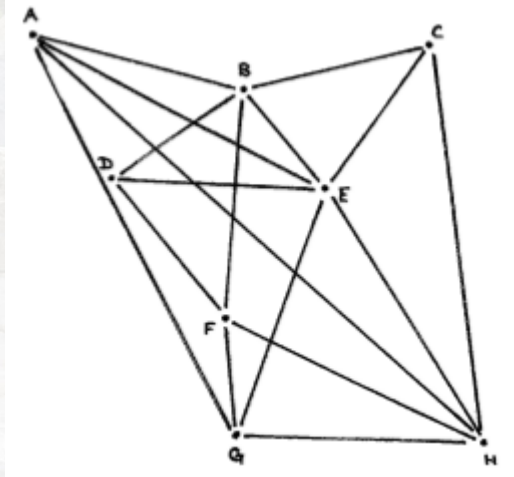
The lines of a network, in its contemporary sense, join the dots. They are connectors.
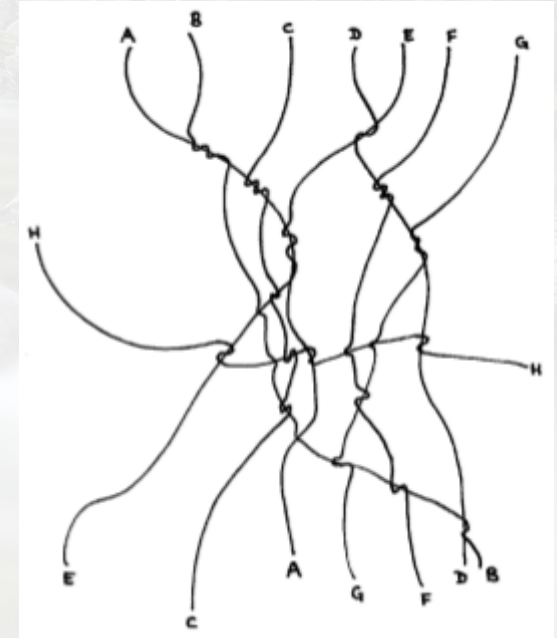
The lines of the meshwork are the trails *along* which life is lived.

Tim Ingold. 2007. "Up, across and along." In *Lines: A Brief History,* p. 80-82.

What is learning? (a) transmission of representations; or (b) an education of attention?

The maze … offers not one path, but multiple choices, of which each may be freely made but most lead to dead ends. It also differs, however, in that its avenues are demarcated by barriers which obstruct any view other than straight ahead. The maze does not open up to the world …, it encloses, trapping its inmates within the false antimony of freedom and necessity

In walking the labyrinth, by contrast, choice is not an issue. The path leads, and the walker is under the imperative to go where it takes him. But the path is not always easy to follow. …. The danger lies not in coming to a dead end, but in wandering off the track. …. You are, rather, fated to carry on nevertheless, along a path that, if you are not careful, may take you ever further from the living, to whose community you may never make it back.

Tim Ingold, 2013. "The Maze and the Labyrinth: Walking and The Education of Attention." In *Walk On: From Richard Long to Janet Cardiff -- 40 Years of Art Walking*, edited by Cynthia Morrison-Bell and Mike Collier, pp. 6–11, https://issuu.com/stereographic/docs/walkon_for_issuu.

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