ITEM #189 - Existing Calling Path Bridging: A Structural Launch Algorithm for ACLM Gap Bridging

Conversation： ACLM Gap Bridging 发现

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**ITEM #189 —

Existing Calling Path Bridging:
A Structural Launch Algorithm for ACLM Gap Bridging**

English Version

Abstract

This item formalizes a critical structural discovery in ACLM:
both **Horizontal** and **Vertical Gap Bridging** can be launched without fabricating new bridges.
Instead, valid bridges are **re-projections of already existing structures** in the CallingGraph.

In particular, for any given pair of nodes X,YX, YX,Y,
every calling path between an X-parent and a Y-parent constitutes a valid Horizontal Gap Bridge.

This insight converts ACLM Gap Bridging from a heuristic search problem into a **deterministic structural enumeration problem**, enabling immediate engineering deployment.

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1. Background: Gap Bridging in ACLM

ACLM defines two orthogonal types of gaps:

- **Vertical Gaps**: discontinuities across abstraction or hierarchy levels
- **Horizontal Gaps**: discontinuities across semantic neighbors without direct calls

Historically, Horizontal Gap Bridging was assumed to require **bridge construction** or **heuristic synthesis**.

This assumption is corrected here.

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2. Core Discovery: Existing Path Bridging Principle

Structural Observation

Given:

- A CallingGraph GGG
- Two nodes XXX and YYY

Let:

- PX=parents(X)PX = parents(X)PX=parents(X)
- PY=parents(Y)PY = parents(Y)PY=parents(Y)

Then:

For every existing calling path p:xp→ypp: x_p \rightarrow y_pp:xp→yp, where xp∈PXx_p \in PXxp∈PX and yp∈PYy_p \in PYyp∈PY,
ppp itself is a valid Horizontal Gap Bridge between XXX and YYY.

No additional construction is required.

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3. Formal Principle

Existing Path Bridging Principle (EPBP)

ACLM Gap Bridging never fabricates bridges.
It only reprojects existing calling paths under a corrected structural perspective.

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4. Horizontal Gap Bridging: Launch Algorithm

Input

- Node XXX, Node YYY

Algorithm

1. Enumerate PX=parents(X)PX = parents(X)PX=parents(X)
2. Enumerate PY=parents(Y)PY = parents(Y)PY=parents(Y)
3. For each xp∈PX,yp∈PYx_p \in PX, y_p \in PYxp∈PX,yp∈PY:
   enumerate all calling paths xp→ypx_p \rightarrow y_pxp→yp
4. Reproject each path as a Horizontal Gap Bridge for X→YX \rightarrow YX→Y

Properties

- Deterministic
- Exhaustive
- Fully explainable
- Cacheable
- Prunable

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5. Vertical Gap Bridging (Symmetric Closure)

Vertical Bridging follows the same philosophy:

- Enumerate ancestor / descendant relations
- Identify valid abstraction anchors
- Perform downward or upward re-projection

Thus, both Horizontal and Vertical Bridging share a **common structural launch paradigm**.

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6. Engineering Implications

This discovery yields:

- Removal of heuristic bridge fabrication
- Predictable algorithmic behavior
- Lower complexity
- Strong explainability chains
- Immediate testability

ACLM Gap Bridging becomes a **structure-reuse engine**, not a search engine.

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7. Methodological Note

This discovery emerged directly from correcting a **directional error in tree parent–subtree semantics**.

It demonstrates a general rule:

Major algorithmic simplifications often follow
from correcting orientation errors, not adding complexity.

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8. Position in DBM-COT

ITEM #189 is a **convergent structural item** that:

- Closes the ACLM Gap Bridging loop
- Grounds future optimizers, scorers, and policies
- Eliminates speculative bridging assumptions

**ITEM #189 —

基于既有调用路径的 ACLM Gap Bridging
（工程启动算法）**

中文版本

摘要

本文固化 ACLM 中一个关键的结构性发现：

Horizontal 与 Vertical Gap Bridging 均不需要构造新的“桥”。

对于任意给定的节点 X,YX, YX,Y，
所有 X-parent 到 Y-parent 之间已经存在的 Calling Path，本身即构成一条合法的 Horizontal Gap Bridge。

该发现将 ACLM Gap Bridging
从启发式搜索问题，
降阶为 **确定性的结构枚举问题**，
从而具备立即工程落地条件。

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1. ACLM 中的 Gap 类型

ACLM 定义两类 Gap：

- **Vertical Gap（纵向）**：跨抽象层级或层次断裂
- **Horizontal Gap（横向）**：语义相邻但无直接调用路径

传统理解中，Horizontal Bridging 被认为需要“构造桥”。

这一假设在本文中被纠正。

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2. 核心发现：既有路径即桥

结构性观察

给定：

- CallingGraph GGG
- 节点 X,YX, YX,Y

定义：

- PX=parents(X)PX = parents(X)PX=parents(X)
- PY=parents(Y)PY = parents(Y)PY=parents(Y)

则有：

任意一条从 xp∈PXx_p \in PXxp∈PX 到 yp∈PYy_p \in PYyp∈PY 的既有 Calling Path，都是 X→YX \rightarrow YX→Y 的一条合法 Horizontal Gap Bridge。

无需额外构造。

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3. 原则化表述

既有路径桥接原则（Existing Path Bridging Principle）

ACLM 的 Gap Bridging 不制造桥，
只是在正确的结构视角下，重投影已存在的调用路径。

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4. Horizontal Gap Bridging 启动算法

输入

- 节点 X,YX, YX,Y

算法步骤

1. 枚举 PX=parents(X)PX = parents(X)PX=parents(X)
2. 枚举 PY=parents(Y)PY = parents(Y)PY=parents(Y)
3. 对所有 xp∈PX,yp∈PYx_p \in PX, y_p \in PYxp∈PX,yp∈PY：
   枚举全部 Calling Paths xp→ypx_p \rightarrow y_pxp→yp
4. 将每条路径重投影为 X→YX \rightarrow YX→Y 的 Gap Bridge

算法特性

- 确定性
- 完备
- 可解释
- 可缓存
- 可剪枝

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5. Vertical Bridging 的对称闭合

Vertical Bridging 同样遵循：

- 枚举祖先 / 子孙关系
- 寻找抽象锚点
- 执行向上或向下的结构重投影

由此，ACL M 的两类 Bridging 在方法论上完全对称。

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6. 工程意义

该发现直接带来：

- 消除启发式“造桥”
- 算法复杂度显著下降
- 强解释链
- 可测试、可维护

ACLM Gap Bridging
正式成为 **结构复用引擎，而非搜索引擎**。

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7. 方法论注记

该发现直接源于一次
树结构 parent / subtree 方向性错误的纠正。

其启示是：

重大算法简化，
往往来自方向修正，而非复杂度叠加。

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8. 在 DBM-COT 中的位置

ITEM #189 是一个**收敛型结构 ITEM**，用于：

- 闭合 ACLM Gap Bridging 理论
- 为后续 Scorer / Policy / Optimizer 提供稳定启动点
- 消除所有推测式 Bridging 假设
