Towards Research for Beginners: A Case Study

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Research is a road for finding truth (new knowledge)
is also a road for solving problems.

Doing research is on the way towards the truth.

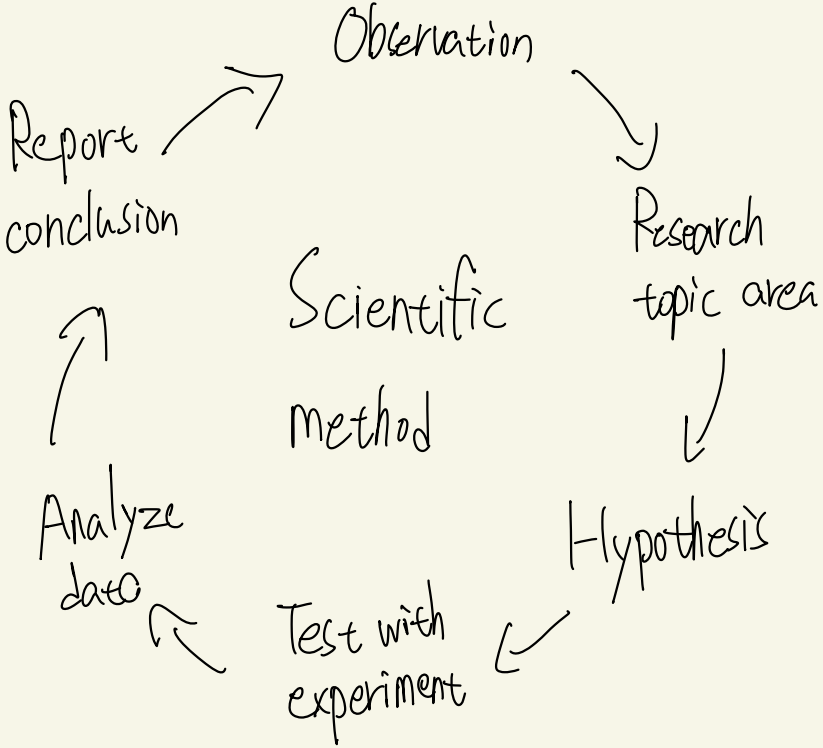
A Scientific Method for Solving Problems

Comprehensive version

- Observation
- Recognition
- Definition
- Hypothesis
- Prediction
- Experiment

Abbreviated version

- Observation
- Hypothesis / Prediction
- Experiment



Research Features

Category	Characteristic	Method
mathematicans	usually care whether the problem has a solution or not	Mathematical proof
computer scientists	typically work on the theoretical side of computation	Mathematical proof or analysis
computer engineers	typically propose a feasible solution to a practical problem	Experiment by simulation

The Complexity of Strong Conflict-free Vertex-connection k-colorability

Graph Coloring

- Let $G = (V, E)$ be a graph vertex set V and edge set E.
- A function $f: V \to \{1, 2, \cdots, k\}$ is a k-coloring of G if for any edge $(u, v) \in E$, $f(u) \neq f(v)$

Conflict-free (Edge-) connection Coloring Problem

A conflict-free path is a colored path with some color that occurs on exactly one edge on the path.

Given a graph G and an integer k, the problem is to ask whether G is k-colorable such that every two vertices have a conflict-free path.

Strong Conflict-free Connection Coloring Problem

- A conflict-free shortest path is a colored path with some color that occurs on exactly one edge on the path.

Given a graph G and an integer k, the problem is to ask whether G is k-colorable such that every two vertices have conflict-free shortest path.

$$scfc(P_n) = 1 + scfc(P_{\lceil n/2 \rceil}) = \lceil \log_2 n \rceil$$