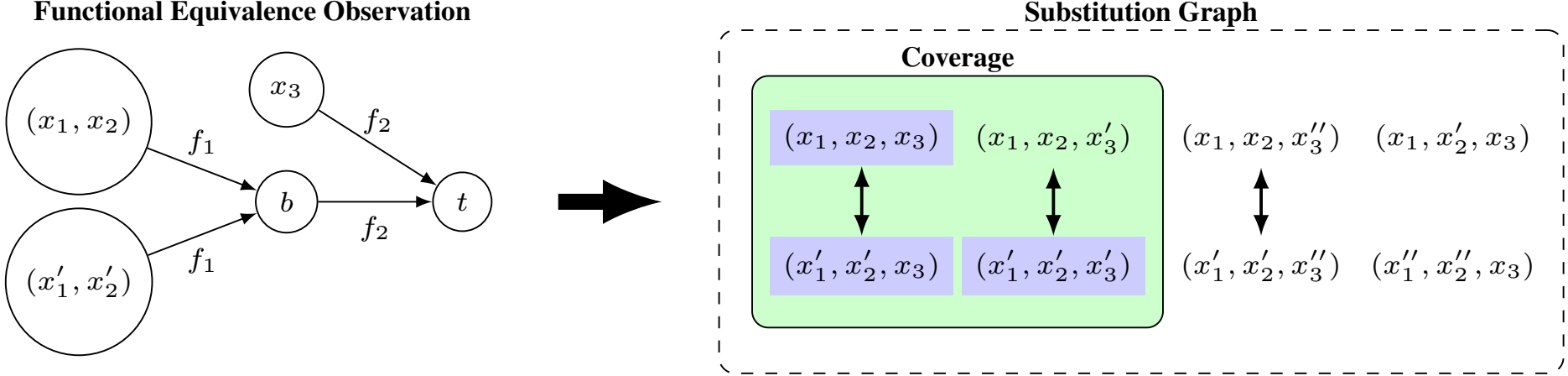

Figure 1: **Illustration of functional equivalence. Left:** In a two-hop task $(x_1, x_2, x_3) \mapsto t$ with $t = f_2(f_1(x_1, x_2), x_3)$, two fragments (x_1, x_2) and (x'_1, x'_2) satisfying $f_1(x_1, x_2) = f_1(x'_1, x'_2) = b$ consistently yield the same final output when combined with the same context x_3, supporting their **functional equivalence**. **Right:** Among all possible inputs (few shown), we draw an edge between any two inputs that differ only by functionally equivalent fragments to form a **substitution graph**. Then, **coverage** is the set of observed inputs (highlighted as blue) and all inputs connected to them. We define pattern matching as a type of generalization that occurs inside the coverage, harnessing functional equivalence.