Coupling Clarity:

Using Connascence to Write Maintainable Code

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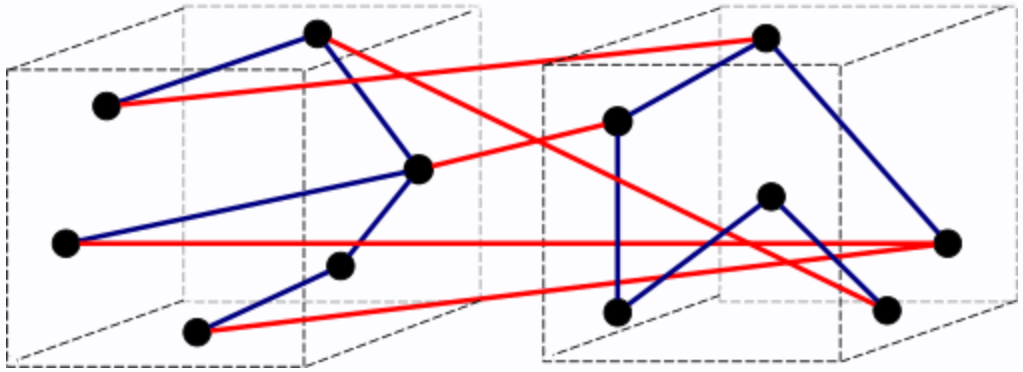
The Challenge of Software Design

Writing maintainable, scalable software requires understanding the relationships between components.

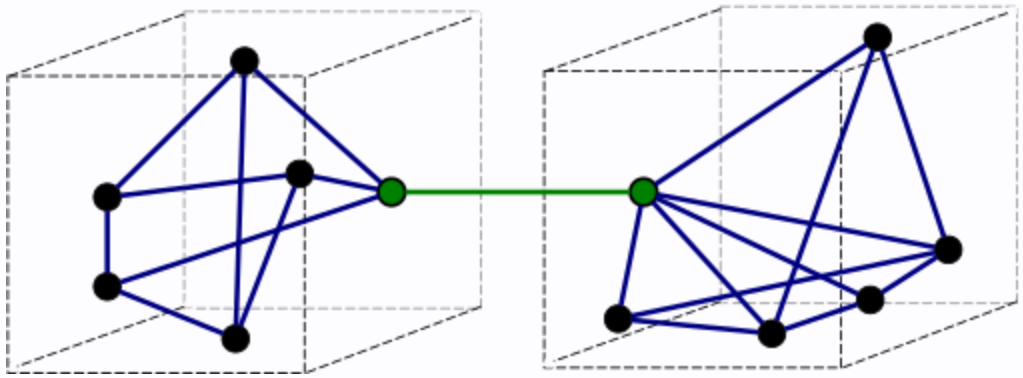
Low Coupling, High Cohesion

The golden rule of software architecture



Problematic: High coupling, low cohesion

- Components tightly bound together
- Changes ripple throughout the system
- Difficult to test and maintain



Ideal: Low coupling, high cohesion

- Components are loosely connected
- Changes are localized
- Easy to test and maintain

What is Connascence?

Connascence quantifies the **degree** and **type** of dependency between software components.

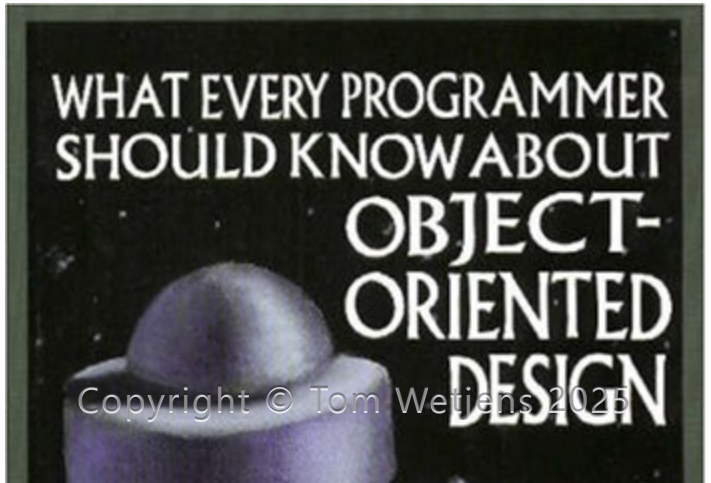
It evaluates their **strength** (difficulty of change) and **locality** (proximity in the codebase).

Historical Context

The term "connascence" was first introduced by **Meilir Page-Jones** in:

Comparing techniques by means of encapsulation and connascence (1992)

and later expanded in:



Classification Framework

Connascence types can be categorized as:

Static: Analyzable at compile-time
Dynamic: Only detectable at runtime

Connascence Types Overview

Static	Dynamic
Name	Execution
Type	Timing
Meaning	Value
Position	Identity
Algorithm	

Static Connascences

Detectable at compile-time

```
class Programmer {
    void work() {}
}
```

```
void main() {
  new Programmer().work();
}
```

Connascence of Name

Multiple components must agree on the name of something (e.g. type, method, parameter, field)

```
class Coffee {
    void brew() {}
}
```

```
class Programmer {
    void drink(Coffee coffee) {
        coffee.brew();
    }
}
```

Connascence of Type

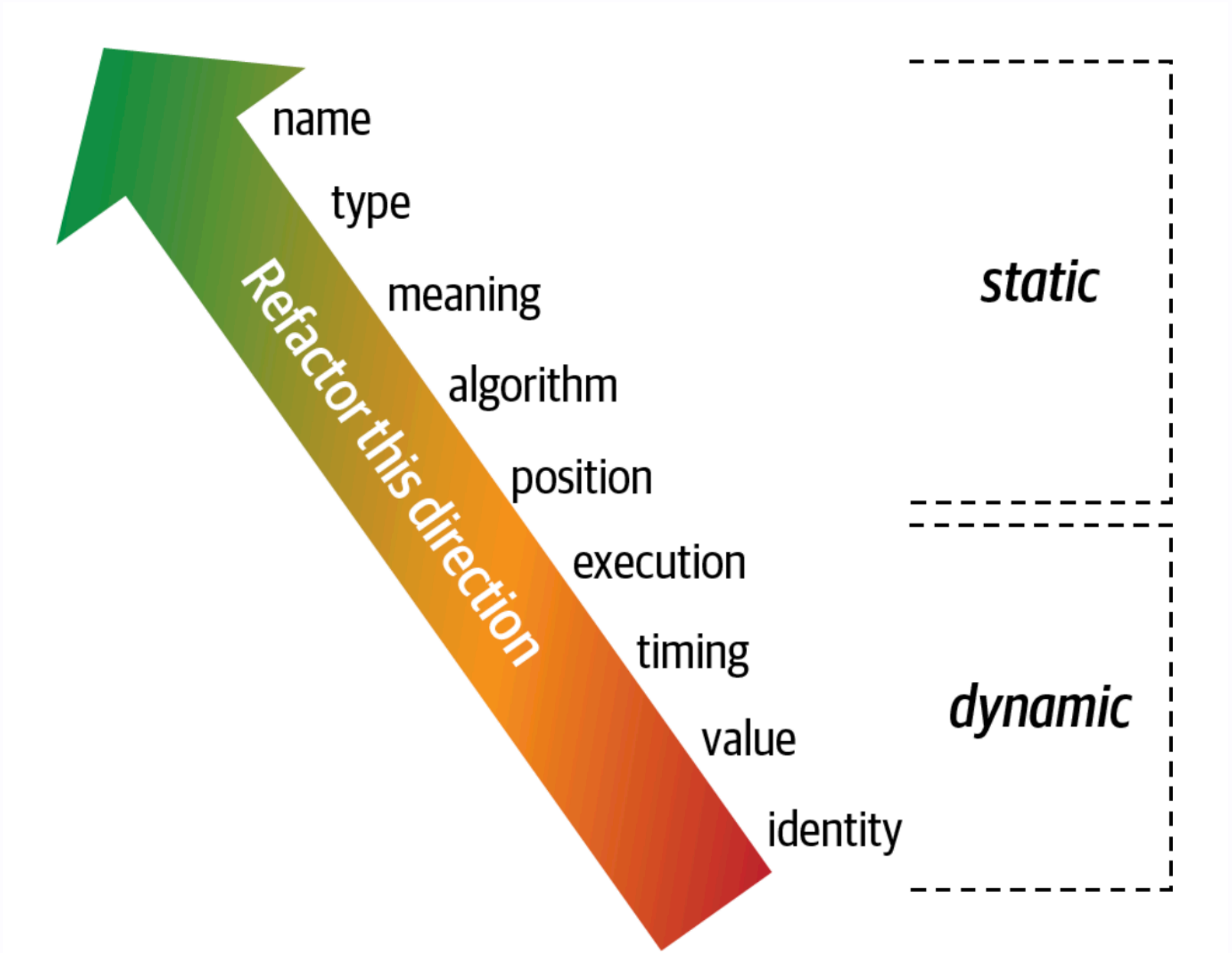
Multiple components must agree on the type of something (e.g. parameter, return value, field)

```
class Programmer {
    void drink(Coffee coffee) {
        coffee.brew();
    }

    void drink(Tea tea) {
        tea.brew();
    }
}
```

```
interface Brewable {
    void brew() {}
}
class Coffee implements Brewable {}
class Tea implements Brewable {}
```

```
class Programmer {
    void drink(Brewable brewable) {
        brewable.brew();
    }
}
```



```
class Coffee {
    int getStrength() {
        return 3;
    }
}
```

```
class Programmer {
    void drink(Coffee coffee) {
        if (coffee.getStrength() > 2)
            throw new IllegalArgumentException("too strong");
    }
}
```

Connascence of Meaning

Multiple components must agree on the meaning of particular values.

Refactoring *Connascence of Meaning* to *Connascence of Name*

```
class Coffee {
    static final int WEAK = 1, MEDIUM = 2, STRONG = 3;

    int getStrength() {
        return STRONG;
    }
}
```

```
class Programmer {
    void drink(Coffee coffee) {
        if (coffee.getStrength() > Coffee.MEDIUM)
            throw new IllegalArgumentException("too strong");
    }
}
```

Another example:

```
class CreditCardNumber {
    boolean isValid(String str) {
        if (str.equals("9999-9999-9999-9999")) {
            // Test credit card number
            return true;
        }
        /* else normal validation */
    }
}
```

```
class CreditCardNumber {

    static final String TEST_VALUE = "9999-9999-9999-9999";

    boolean isValid(String str) {
        if (str.equals(TEST_VALUE)) {
            // Test credit card number
            return true;
        }
        /* else normal validation */
    }
}
```

Yet another example:

```
class Order {
    enum Status { PLACED, PAID, FULFILLED }
    Status getStatus() { /*...*/ }
}
```

```
class Client {
    void checkOrder(Order order) {
        if (order.getStatus() != FULFILLED) {
            System.out.println("order not completed yet");
        }
    }
}
```

Let's add an enum value:

```
class Order {
    enum Status { PLACED, PAID, FULFILLED, ARCHIVED }
    Status getStatus() { /*...*/ }
}
```

```
class Client {
    void checkOrder(Order order) {
        if (order.getStatus() != FULFILLED) { // BUG!
            System.out.println("order not completed yet");
        }
    }
}
```

Refactor idea 1

```
class Order {
    enum Status { PLACED, PAID, FULFILLED, ARCHIVED }
    Status getStatus() { /*...*/ }
    boolean isComplete() { /*...*/ }
}
```

```
class Client {
    void checkOrder(Order order) {
        if (!order.isComplete()) {
            System.out.println("order not completed yet");
        }
    }
}
```

Refactor idea 2

```
class Order {
    enum Status {
        PLACED, PAID, FULFILLED, ARCHIVED;
        static final Set<Status> COMPLETE = EnumSet.of(FULFILLED, ARCHIVED);
    }
    Status getStatus() { /*...*/ }
}
```

```
class Client {
    void checkOrder(Order order) {
        if (!Status.COMPLETE.contains(order.getStatus())) {
            System.out.println("order not completed yet");
        }
    }
}
```

Connascence of Position

```
class Customer {
    Customer(String id, String name, String email) { /*...*/ }
}
```

```
class Controller {
    void create() {
        new Customer("1", "john@doe.com", "John Doe"); // BUG!
    }
}
```

using stronger types:

```
class Customer {
    Customer(UUID id, String name, Email email) { /*...*/ }
}
```

we force the correct positions on the caller

or using a builder pattern:

```
class Controller {
    void create() {
        Customer.builder()
                .id("1")
                .email("john@doe.com")
                .name("John Doe")
                .build();
    }
}
```

the position doesn't matter

Connascence of Algorithm

Multiple components must use the same algorithm or computational method.

```
class Coffee {
    void brew() {
        int brewTime = 10 + getStrength() * 5;
        /*...*/
    }
}
```

```
class Programmer {
    int getBreakTime(Coffee coffee) {
        return 10 + coffee.getStrength() * 5 + 300;
    }
}
```

```
class Coffee {
    void brew() {
        int brewTime = getBrewTime();
        /*...*/
    }
    int getBrewTime() {
        return 10 + getStrength() * 5;
    }
}
```

```
class Programmer {
    int getBreakTime(Coffee coffee) {
        return coffee.getBrewTime() + 300;
    }
}
```

Another example:

```
class UserTest {
    User user = new User("John Doe");
    void test() {
        assertThat(user.fingerprint())
                .isEqualTo(MD5.digest(user.name));
        // connascence of algorithm!
    }
}
```

```
class UserTest {
    User user = new User("John Doe");
    void testEqual() {
        assertThat(user.fingerprint())
                .isEqualTo(new User(user.name).fingerprint());
    }
    void testNotEqual() {
        assertThat(user.fingerprint())
                .isNotEqualTo(new User("Someone Else").fingerprint());
    }
}
```

Dynamic Connascences

Connascence of Execution

When the order of execution across multiple components is important.

```
class Database {
    private boolean initialized;
    void initialize() {
        initialized = true;
    }
    void saveUser(User user) {
        if (!initialized)
            throw new IllegalStateException("not initialized");
        /*..*/
    }
}
```

```
void main() {
    var db = new Database();
    db.initialize();
    db.saveUser(user);
}
```

```
class Database {
    private boolean initialized;
    private void initialize() {
        initialized = true;
    }
    void saveUser(User user) {
        if (!initialized)
            initialize();
        /*..*/
    }
}
```

```
void main() {
    var db = new Database();
    db.saveUser(user);
}
```

Connascence of Timing

real life example:

1. Cron job A places file in S3 bucket at 12:00
2. Cron job B reads file from S3 bucket at 13:00

often found in tests of async behavior:

```
void test() {
    produceEvent();

    Thread.sleep(500);
    assertThat(event).wasProcessed();
}
```

a way to solve it:

```
void test() {
    produceEvent();

    await().untilAsserted(() ->
            assertThat(event).wasProcessed());
}
```

Connascence of Value

When values in different components must change together.

```
class DatabaseService {
    void connect(Map<String, String> config) throws SQLException {
        DriverManager.getConnection(
                "jdbc:postgresql://%s%s".formatted(config.get("db.host"), config.get("db.port")),
                config.get("db.user"),
                config.get("db.password")
        );
    }
}
```

```
void main() {
    var config = new HashMap<String, String>();
    config.put("db.host", "localhost");
    config.put("db.port", "5432");
    config.put("db.user", "postgres");
    config.put("db.password", "postgres");
    new DatabaseService().connect(config);
}
```

You can refactor *Connascence of Value* to *Connascence of Name*:

```
class DatabaseConfig {
    String host, user, password;
    int port;
}
class DatabaseService {
    void connect(DatabaseConfig config) {/*..*/}
}
```

```
void main() {
    var config = new DatabaseConfig();
    config.host = "localhost";
    config.port = 5432;
    config.user = "postgres";
    config.password = "postgres";
    new DatabaseService().connect(config);
}
```

another example

```
class ProductFixture {
    static final Product PRODUCT = new Product("Eggs");
}
```

```
void test() {
    var cart = new ShoppingCart(ProductFixture.PRODUCT);

    assertThat(cart.items()).containsExactly("Eggs");
}
```

```
void test() {
    var cart = new ShoppingCart(ProductFixture.PRODUCT);

    assertThat(cart.items())
            .containsExactly(ProductFixture.PRODUCT.getDescription());
}
```

yet another example

```
class ContractFixture {
    Contract createTestContract() {
        return new Contract(Status.ACTIVE);
    }
}
```

```
void test() {
    var contract = ContractFixture.createTestContract();

    contract.deactivate();

    assertThat(contract.getStatus()).isEqualTo(Status.INACTIVE);
}
```

```
void test() {
    var contract = ContractFixture.createTestContract(Status.ACTIVE);

    contract.deactivate();

    assertThat(contract.getStatus()).isEqualTo(Status.INACTIVE);
}
```

Connascence of Identity

When multiple components must reference the exact same entity.

```
class UserService {
    User currentUser;
}
```

```
class SecurityFilter extends GenericFilterBean {
    UserService userService;
    void doFilter() {
        /*..*/ userService.currentUser = new User();
    }
}
```

```
class AuditLogger {
    UserService userService;
    void auditLog() {
        log("Current user: {}", userService.currentUser);
    }
}
```

another example

```
class Example {
    private static final Long DEFAULT = 1L;

    void doSomething(String str) {
        if (Long.valueOf(str) == DEFAULT) {
            /*..*/
        }
    }
}
```

Key Principles

- **Strength Hierarchy**: Identity > Value > Timing > Execution > Algorithm > Position > Meaning > Type > Name
- **Locality Matters**: Stronger connascence is more acceptable within the same module
- **Refactoring Direction**: Always refactor from stronger to weaker forms
- **Static vs Dynamic**: Static connascence is generally preferable (compile-time detection)

Practical Guidelines

- **Minimize** connascence across module boundaries
- **Prefer** static over dynamic connascence
- **Use** stronger types to eliminate position connascence
- **Extract** constants to convert meaning to name connascence
- **Encapsulate** algorithms in single locations
- **Design** APIs to minimize execution order dependencies

Benefits of Connascence Awareness

- **Better Design Decisions**: Quantify coupling objectively
- **Improved Refactoring**: Know which direction to refactor
- **Clearer Communication**: Common vocabulary for discussing dependencies
- **Maintainable Code**: Reduce hidden dependencies and brittleness

Learn more about connascence at:

https://connascence.io/