

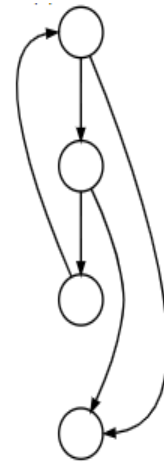
# Program Analysis

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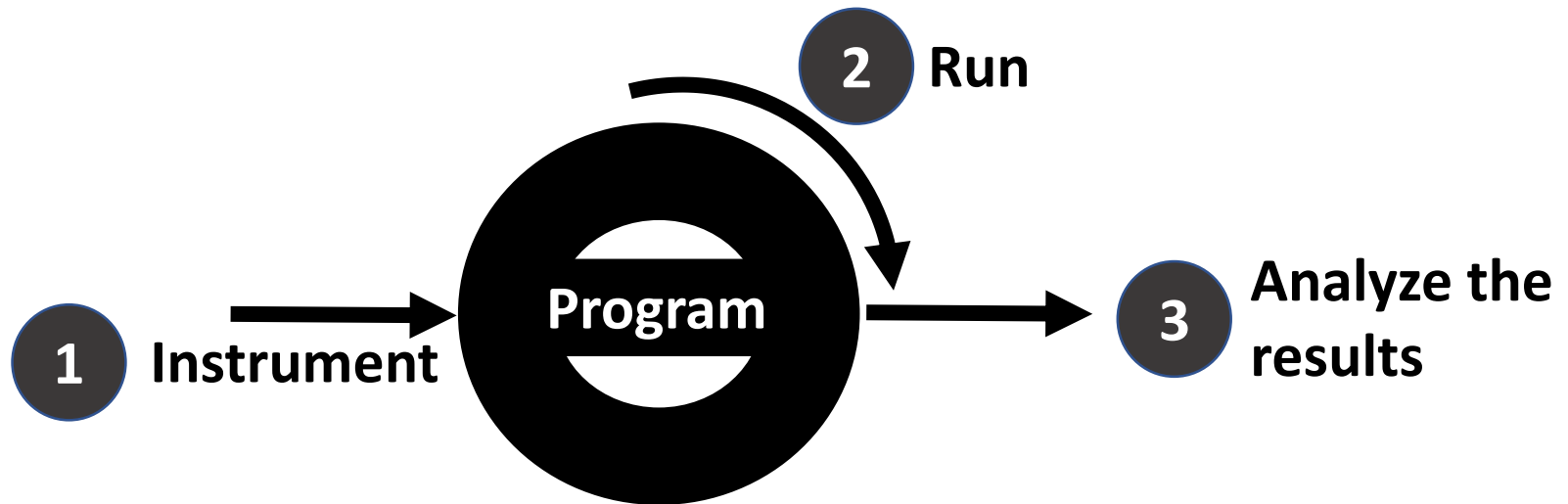
“Static analysis can be efficient but it is imprecise. Dynamic analysis is precise but it is inefficient.”

– Lockwood et al., Mockingbird: A Framework for Enabling Targeted Dynamic Analysis of Java Programs, ICSE 2019, Canada.

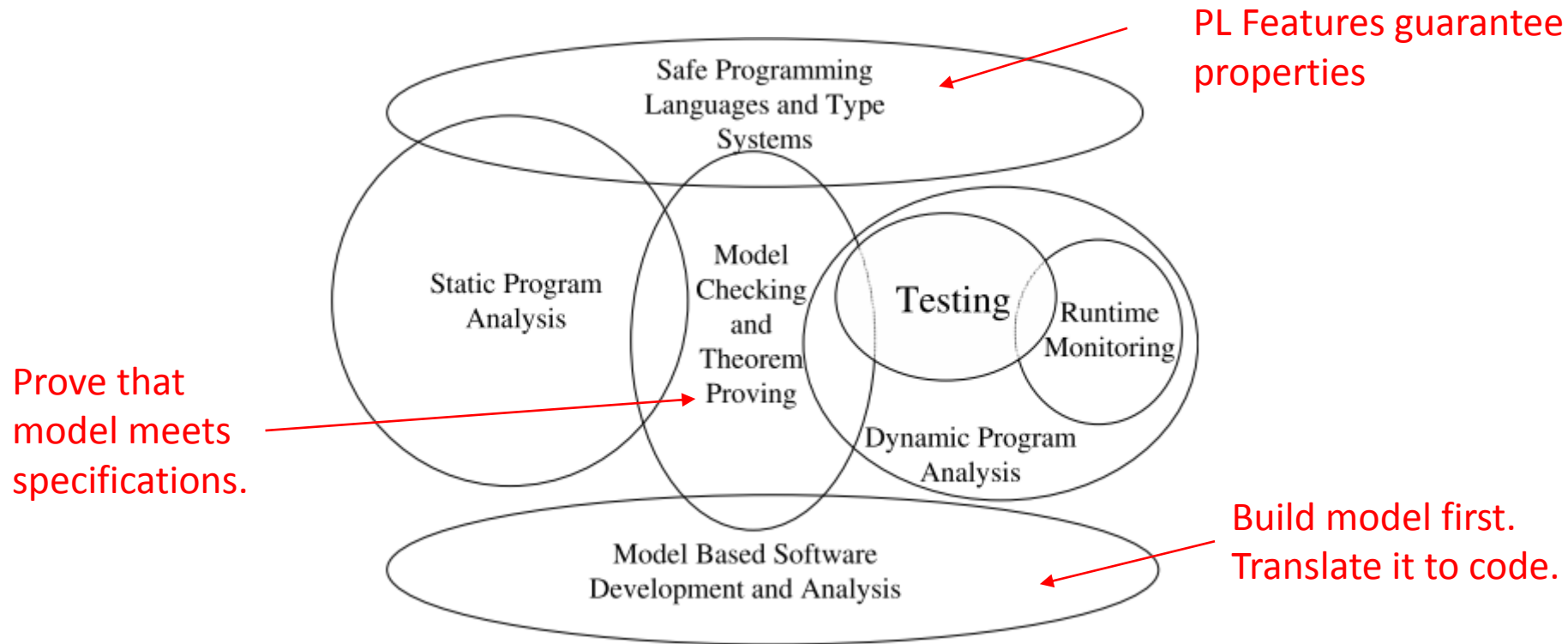
# Dynamic Analysis

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# Dynamic Analysis

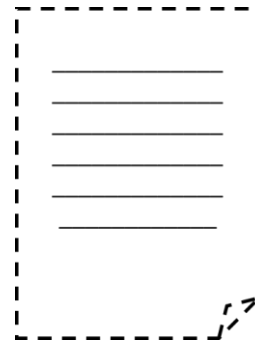


# Sen's Big Picture



# Dynamic Analysis

**Will this code get executed?**



Source  
Code

**Which path executes more often?**

**Which set of lines take the most execution time?**

# Instrumentation

- Objective
  - Monitor some part of the code.
- Implementation
  - Usually through statements in code that monitors specific behavior
- Advantages
  - Better understanding on the rest of the code
  - May switch on or off (production-mode vs debug-mode)
- Disadvantage
  - Causes overhead

```
final boolean DEBUG = false;  
if (DEBUG) {  
    ... some code ...  
}
```

**Java**

```
#if DEBUG  
... some code ...  
#endif
```

**C#**

# Aspect Oriented Programming with AspectJ

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Interleaving Source Code

# Cross-Cutting Concerns

```
public class HomePage extends TestBase{
```



```
    public static final Logger log = Logger.getLogger(HomePage.class.getName());
```

```
    public void clickOnNavigationMenu(String menuName){
```

Example:

Logging as a  
cross-cutting  
concern



```
        driver.findElement(By.xpath("//button[contains(text,"
```

```
        log("clicked on:-"+menuName+" navigation menu");
```

```
    }

    public void clickOnProductInMensSection(String product){
```

```
        waitForElement(driver, 80, driver.findElement(By.xpa
```

```
        driver.findElement(By.xpath("./button[contains(text
```



```
        log("clicked on:-"+product);
```

```
    }
```




# Point-Cut and Advice

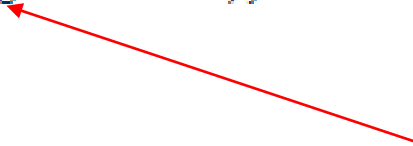
- Point-Cut
  - A way to specify program points
- Advice
  - Additional behavior to be embedded at a program point

```
public void clickOnNavigationMenu(String menuName){  
    driver.findElement(By.xpath("//button[contains(text(  
    log("clicked on:-"+menuName+" navigation menu");  
}
```

pointcut example:  
after a specific  
method is executed



advice example:  
log method  
parameters



# Popular Applications

- Tracing
  - Record information about a program's execution path
- Event Logging
  - Log useful diagnostic information
    - Object creation
    - Major transactions
    - Key decisions
- Profiling
  - Time taken to serve user requests (or for a method execution)

# AspectJ Tutorial

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