

SV2016 2차 시스템 테스트 보고서

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1 Abstract

이 문서는 2016년 봄 건국대학교 소프트웨어 검증[1] 과목의 과제로 작성되었다.

이 보고서에서는 소프트웨어 모델링 및 분석[2] 과목의 과제로 개발되는, “다수의 C 프로그램을 대상으로 상호 cheating 여부를 정량적으로 판단하고, 해당 내용을 OOO 하게 알려주는 프로그램”을 검증한다. Clone Checking 예제로는 프로그래밍 프로젝트[3]의 과제로 제출되는 코드를 사용한다.

2 OOPT Stage 1000

SMA T1의 *OOPT Stage 1000, Plan and Elaboration* 보고서의 6번째 판을 기준으로 요구 사항 명세 검토를 진행하였다.

2.1 Performance Requirements

“A. 소스 코드 파일 분석 작업은 5초 이내로 수행되어야 한다” 고 명세되어 있는데, 분석 대상이 되는 코드의 최대량 또는 기준량이 명시되어 있지 않았으며, “B. 기준 소스 코드 파일 변경 시 2초 이내로 비교 결과가 변경되어야 한다.” 역시 같은 문제가 있다. 대응서에는 100개 이하의 파일이 들어있는 폴더를 선택해야 한다고 기술되어 있지만 문서에서는 찾아볼수가 없다.

3 OOPT Stage 2030

SMA T1의 *OOPT Stage 2030, Analysis* 보고서의 4번째 판을 기준으로 검토하였다.

3.1 2131 Start

대응서에는 소스 코드 파일의 크기는 무관하다고 적혀 있는데 0바이트인 파일은 안 된다고 적혀 있다.

3.2 2136 Change Center

처음 프로그램을 실행하였을 경우 선택되는 첫 번째 소스코드 파일이 오름차순인지 아닌지 모호하다.

4 OOPT Stage 2040

SMA T1의 *OOPT Stage 2040, Design* 보고서의 3번째 판을 기준으로 검토하였다.

4.1 2141

해당 부분의 이미지는 업데이트 되었으며, 1005와 일치하지 않는다.

4.2 2141 Change Annotation

C 스타일 주석의 /*은 //로 치환한다고 기술되어 있지만 */는 어떻게 처리할지 기술되어 있지 않다.

5 Category-Partition Testing

5.1 Test Specification Language

Ostrand와 Balcers의 1988 CACM 논문[4]에서 Category-Partition Testing을 위해 정의한 도메인 특정 언어인 TSL(Test Specification Language)을 사용해 테스트 카테고리화 선택지를 명세하였다.

Listing 1: TSL로 작성된 테스트 명세

```
Line :
  Lines :
    Zero . [single]
    Positive .

Annotation :
  Comments :
    Zero .
    Positive . [property ContainsComment]
  Style :
    Single-line . [if ContainsComment]
    Multi-line . [if ContainsComment] [property MultiLineComment]
  Matching :
    True . [if MultiLineComment]
    False . [if MultiLineComment]

Function :
  Functions :
    Zero .
    Positive .

Variable :
  Variables :
    Zero .
    Positive .

Preprocessor :
  Includes :
    Zero .
    Positive .
  Defines :
    Zero .
```

Positive .

5.2 Test Frame Generation

Category-Partition 테스트 명세를 TSL로 작성하고, tslgenerator[5]를 사용해 테스트 프레임 생성을 자동화 하였다.

Listing 2: TSL을 통해 생성된 테스트 프레임

```
Test Case 1                                <single>
  Lines : Zero

Test Case 2                                (Key = 2.1.0.0.1.1.1.1.)
  Lines      : Positive
  Comments   : Zero
  Style      : <n/a>
  Matching   : <n/a>
  Functions  : Zero
  Variables  : Zero
  Includes   : Zero
  Defines    : Zero

Test Case 3                                (Key = 2.1.0.0.1.1.1.2.)
  Lines      : Positive
  Comments   : Zero
  Style      : <n/a>
  Matching   : <n/a>
  Functions  : Zero
  Variables  : Zero
  Includes   : Zero
  Defines    : Positive

Test Case 4                                (Key = 2.1.0.0.1.1.2.1.)
  Lines      : Positive
  Comments   : Zero
  Style      : <n/a>
  Matching   : <n/a>
  Functions  : Zero
  Variables  : Zero
  Includes   : Positive
  Defines    : Zero
```

Test Case 5 (Key = 2.1.0.0.1.1.2.2.)
Lines : Positive
Comments : Zero
Style : <n/a>
Matching : <n/a>
Functions : Zero
Variables : Zero
Includes : Positive
Defines : Positive

Test Case 6 (Key = 2.1.0.0.1.2.1.1.)
Lines : Positive
Comments : Zero
Style : <n/a>
Matching : <n/a>
Functions : Zero
Variables : Positive
Includes : Zero
Defines : Zero

Test Case 7 (Key = 2.1.0.0.1.2.1.2.)
Lines : Positive
Comments : Zero
Style : <n/a>
Matching : <n/a>
Functions : Zero
Variables : Positive
Includes : Zero
Defines : Positive

Test Case 8 (Key = 2.1.0.0.1.2.2.1.)
Lines : Positive
Comments : Zero
Style : <n/a>
Matching : <n/a>
Functions : Zero
Variables : Positive
Includes : Positive
Defines : Zero

Test Case 9 (Key = 2.1.0.0.1.2.2.2.)

Lines : Positive
Comments : Zero
Style : <n/a>
Matching : <n/a>
Functions : Zero
Variables : Positive
Includes : Positive
Defines : Positive

Test Case 10 (Key = 2.1.0.0.2.1.1.1.)

Lines : Positive
Comments : Zero
Style : <n/a>
Matching : <n/a>
Functions : Positive
Variables : Zero
Includes : Zero
Defines : Zero

Test Case 11 (Key = 2.1.0.0.2.1.1.2.)

Lines : Positive
Comments : Zero
Style : <n/a>
Matching : <n/a>
Functions : Positive
Variables : Zero
Includes : Zero
Defines : Positive

Test Case 12 (Key = 2.1.0.0.2.1.2.1.)

Lines : Positive
Comments : Zero
Style : <n/a>
Matching : <n/a>
Functions : Positive
Variables : Zero
Includes : Positive
Defines : Zero

Test Case 13 (Key = 2.1.0.0.2.1.2.2.)

Lines : Positive
Comments : Zero

Style : <n/a>
Matching : <n/a>
Functions : Positive
Variables : Zero
Includes : Positive
Defines : Positive

Test Case 14 (Key = 2.1.0.0.2.2.1.1.)

Lines : Positive
Comments : Zero
Style : <n/a>
Matching : <n/a>
Functions : Positive
Variables : Positive
Includes : Zero
Defines : Zero

Test Case 15 (Key = 2.1.0.0.2.2.1.2.)

Lines : Positive
Comments : Zero
Style : <n/a>
Matching : <n/a>
Functions : Positive
Variables : Positive
Includes : Zero
Defines : Positive

Test Case 16 (Key = 2.1.0.0.2.2.2.1.)

Lines : Positive
Comments : Zero
Style : <n/a>
Matching : <n/a>
Functions : Positive
Variables : Positive
Includes : Positive
Defines : Zero

Test Case 17 (Key = 2.1.0.0.2.2.2.2.)

Lines : Positive
Comments : Zero
Style : <n/a>
Matching : <n/a>

Functions : Positive
Variables : Positive
Includes : Positive
Defines : Positive

Test Case 18 (Key = 2.2.1.0.1.1.1.1.)
Lines : Positive
Comments : Positive
Style : Single-line
Matching : <n/a>
Functions : Zero
Variables : Zero
Includes : Zero
Defines : Zero

Test Case 19 (Key = 2.2.1.0.1.1.1.2.)
Lines : Positive
Comments : Positive
Style : Single-line
Matching : <n/a>
Functions : Zero
Variables : Zero
Includes : Zero
Defines : Positive

Test Case 20 (Key = 2.2.1.0.1.1.2.1.)
Lines : Positive
Comments : Positive
Style : Single-line
Matching : <n/a>
Functions : Zero
Variables : Zero
Includes : Positive
Defines : Zero

Test Case 21 (Key = 2.2.1.0.1.1.2.2.)
Lines : Positive
Comments : Positive
Style : Single-line
Matching : <n/a>
Functions : Zero
Variables : Zero

Includes	:	Positive
Defines	:	Positive

Test Case 22		(Key = 2.2.1.0.1.2.1.1.)
Lines	:	Positive
Comments	:	Positive
Style	:	Single-line
Matching	:	<n/a>
Functions	:	Zero
Variables	:	Positive
Includes	:	Zero
Defines	:	Zero

Test Case 23		(Key = 2.2.1.0.1.2.1.2.)
Lines	:	Positive
Comments	:	Positive
Style	:	Single-line
Matching	:	<n/a>
Functions	:	Zero
Variables	:	Positive
Includes	:	Zero
Defines	:	Positive

Test Case 24		(Key = 2.2.1.0.1.2.2.1.)
Lines	:	Positive
Comments	:	Positive
Style	:	Single-line
Matching	:	<n/a>
Functions	:	Zero
Variables	:	Positive
Includes	:	Positive
Defines	:	Zero

Test Case 25		(Key = 2.2.1.0.1.2.2.2.)
Lines	:	Positive
Comments	:	Positive
Style	:	Single-line
Matching	:	<n/a>
Functions	:	Zero
Variables	:	Positive
Includes	:	Positive
Defines	:	Positive

Test Case 26 (Key = 2.2.1.0.2.1.1.1.)
Lines : Positive
Comments : Positive
Style : Single-line
Matching : <n/a>
Functions : Positive
Variables : Zero
Includes : Zero
Defines : Zero

Test Case 27 (Key = 2.2.1.0.2.1.1.2.)
Lines : Positive
Comments : Positive
Style : Single-line
Matching : <n/a>
Functions : Positive
Variables : Zero
Includes : Zero
Defines : Positive

Test Case 28 (Key = 2.2.1.0.2.1.2.1.)
Lines : Positive
Comments : Positive
Style : Single-line
Matching : <n/a>
Functions : Positive
Variables : Zero
Includes : Positive
Defines : Zero

Test Case 29 (Key = 2.2.1.0.2.1.2.2.)
Lines : Positive
Comments : Positive
Style : Single-line
Matching : <n/a>
Functions : Positive
Variables : Zero
Includes : Positive
Defines : Positive

Test Case 30 (Key = 2.2.1.0.2.2.1.1.)
Lines : Positive
Comments : Positive
Style : Single-line
Matching : <n/a>
Functions : Positive
Variables : Positive
Includes : Zero
Defines : Zero

Test Case 31 (Key = 2.2.1.0.2.2.1.2.)
Lines : Positive
Comments : Positive
Style : Single-line
Matching : <n/a>
Functions : Positive
Variables : Positive
Includes : Zero
Defines : Positive

Test Case 32 (Key = 2.2.1.0.2.2.2.1.)
Lines : Positive
Comments : Positive
Style : Single-line
Matching : <n/a>
Functions : Positive
Variables : Positive
Includes : Positive
Defines : Zero

Test Case 33 (Key = 2.2.1.0.2.2.2.2.)
Lines : Positive
Comments : Positive
Style : Single-line
Matching : <n/a>
Functions : Positive
Variables : Positive
Includes : Positive
Defines : Positive

Test Case 34 (Key = 2.2.2.1.1.1.1.1.)
Lines : Positive

Comments : Positive
Style : Multi-line
Matching : True
Functions : Zero
Variables : Zero
Includes : Zero
Defines : Zero

Test Case 35 (Key = 2.2.2.1.1.1.1.2.)

Lines : Positive
Comments : Positive
Style : Multi-line
Matching : True
Functions : Zero
Variables : Zero
Includes : Zero
Defines : Positive

Test Case 36 (Key = 2.2.2.1.1.1.2.1.)

Lines : Positive
Comments : Positive
Style : Multi-line
Matching : True
Functions : Zero
Variables : Zero
Includes : Positive
Defines : Zero

Test Case 37 (Key = 2.2.2.1.1.1.2.2.)

Lines : Positive
Comments : Positive
Style : Multi-line
Matching : True
Functions : Zero
Variables : Zero
Includes : Positive
Defines : Positive

Test Case 38 (Key = 2.2.2.1.1.2.1.1.)

Lines : Positive
Comments : Positive
Style : Multi-line

Matching	:	True
Functions	:	Zero
Variables	:	Positive
Includes	:	Zero
Defines	:	Zero

Test Case 39		(Key = 2.2.2.1.1.2.1.2.)
Lines	:	Positive
Comments	:	Positive
Style	:	Multi-line
Matching	:	True
Functions	:	Zero
Variables	:	Positive
Includes	:	Zero
Defines	:	Positive

Test Case 40		(Key = 2.2.2.1.1.2.2.1.)
Lines	:	Positive
Comments	:	Positive
Style	:	Multi-line
Matching	:	True
Functions	:	Zero
Variables	:	Positive
Includes	:	Positive
Defines	:	Zero

Test Case 41		(Key = 2.2.2.1.1.2.2.2.)
Lines	:	Positive
Comments	:	Positive
Style	:	Multi-line
Matching	:	True
Functions	:	Zero
Variables	:	Positive
Includes	:	Positive
Defines	:	Positive

Test Case 42		(Key = 2.2.2.1.2.1.1.1.)
Lines	:	Positive
Comments	:	Positive
Style	:	Multi-line
Matching	:	True
Functions	:	Positive

Variables : Zero
Includes : Zero
Defines : Zero

Test Case 43 (Key = 2.2.2.1.2.1.1.2.)
Lines : Positive
Comments : Positive
Style : Multi-line
Matching : True
Functions : Positive
Variables : Zero
Includes : Zero
Defines : Positive

Test Case 44 (Key = 2.2.2.1.2.1.2.1.)
Lines : Positive
Comments : Positive
Style : Multi-line
Matching : True
Functions : Positive
Variables : Zero
Includes : Positive
Defines : Zero

Test Case 45 (Key = 2.2.2.1.2.1.2.2.)
Lines : Positive
Comments : Positive
Style : Multi-line
Matching : True
Functions : Positive
Variables : Zero
Includes : Positive
Defines : Positive

Test Case 46 (Key = 2.2.2.1.2.2.1.1.)
Lines : Positive
Comments : Positive
Style : Multi-line
Matching : True
Functions : Positive
Variables : Positive
Includes : Zero

Defines	:	Zero
Test Case 47		(Key = 2.2.2.1.2.2.1.2.)
Lines	:	Positive
Comments	:	Positive
Style	:	Multi-line
Matching	:	True
Functions	:	Positive
Variables	:	Positive
Includes	:	Zero
Defines	:	Positive
Test Case 48		(Key = 2.2.2.1.2.2.2.1.)
Lines	:	Positive
Comments	:	Positive
Style	:	Multi-line
Matching	:	True
Functions	:	Positive
Variables	:	Positive
Includes	:	Positive
Defines	:	Zero
Test Case 49		(Key = 2.2.2.1.2.2.2.2.)
Lines	:	Positive
Comments	:	Positive
Style	:	Multi-line
Matching	:	True
Functions	:	Positive
Variables	:	Positive
Includes	:	Positive
Defines	:	Positive
Test Case 50		(Key = 2.2.2.2.1.1.1.1.)
Lines	:	Positive
Comments	:	Positive
Style	:	Multi-line
Matching	:	False
Functions	:	Zero
Variables	:	Zero
Includes	:	Zero
Defines	:	Zero

Test Case 51 (Key = 2.2.2.2.1.1.1.2.)
Lines : Positive
Comments : Positive
Style : Multi-line
Matching : False
Functions : Zero
Variables : Zero
Includes : Zero
Defines : Positive

Test Case 52 (Key = 2.2.2.2.1.1.2.1.)
Lines : Positive
Comments : Positive
Style : Multi-line
Matching : False
Functions : Zero
Variables : Zero
Includes : Positive
Defines : Zero

Test Case 53 (Key = 2.2.2.2.1.1.2.2.)
Lines : Positive
Comments : Positive
Style : Multi-line
Matching : False
Functions : Zero
Variables : Zero
Includes : Positive
Defines : Positive

Test Case 54 (Key = 2.2.2.2.1.2.1.1.)
Lines : Positive
Comments : Positive
Style : Multi-line
Matching : False
Functions : Zero
Variables : Positive
Includes : Zero
Defines : Zero

Test Case 55 (Key = 2.2.2.2.1.2.1.2.)

Lines : Positive
Comments : Positive
Style : Multi-line
Matching : False
Functions : Zero
Variables : Positive
Includes : Zero
Defines : Positive

Test Case 56 (Key = 2.2.2.2.1.2.2.1.)

Lines : Positive
Comments : Positive
Style : Multi-line
Matching : False
Functions : Zero
Variables : Positive
Includes : Positive
Defines : Zero

Test Case 57 (Key = 2.2.2.2.1.2.2.2.)

Lines : Positive
Comments : Positive
Style : Multi-line
Matching : False
Functions : Zero
Variables : Positive
Includes : Positive
Defines : Positive

Test Case 58 (Key = 2.2.2.2.2.1.1.1.)

Lines : Positive
Comments : Positive
Style : Multi-line
Matching : False
Functions : Positive
Variables : Zero
Includes : Zero
Defines : Zero

Test Case 59 (Key = 2.2.2.2.2.1.1.2.)

Lines : Positive
Comments : Positive

Style : Multi-line
Matching : False
Functions : Positive
Variables : Zero
Includes : Zero
Defines : Positive

Test Case 60 (Key = 2.2.2.2.2.1.2.1.)

Lines : Positive
Comments : Positive
Style : Multi-line
Matching : False
Functions : Positive
Variables : Zero
Includes : Positive
Defines : Zero

Test Case 61 (Key = 2.2.2.2.2.1.2.2.)

Lines : Positive
Comments : Positive
Style : Multi-line
Matching : False
Functions : Positive
Variables : Zero
Includes : Positive
Defines : Positive

Test Case 62 (Key = 2.2.2.2.2.2.1.1.)

Lines : Positive
Comments : Positive
Style : Multi-line
Matching : False
Functions : Positive
Variables : Positive
Includes : Zero
Defines : Zero

Test Case 63 (Key = 2.2.2.2.2.2.1.2.)

Lines : Positive
Comments : Positive
Style : Multi-line
Matching : False

Functions : Positive
Variables : Positive
Includes : Zero
Defines : Positive

Test Case 64 (Key = 2.2.2.2.2.2.2.1.)

Lines : Positive
Comments : Positive
Style : Multi-line
Matching : False
Functions : Positive
Variables : Positive
Includes : Positive
Defines : Zero

Test Case 65 (Key = 2.2.2.2.2.2.2.2.)

Lines : Positive
Comments : Positive
Style : Multi-line
Matching : False
Functions : Positive
Variables : Positive
Includes : Positive
Defines : Positive

6 Pairwise Testing

Pairwise 테스트는 소프트웨어 에러가 대부분 두 개의 파라미터가 잘못 섞여서 발생하는 점에 착안해서 해당 파라미터 쌍에 대해서만 조합해서 테스트하는 방식이다. Category-Partition은 모든 n-pair 에 대한 조합을 exhaustive 하게 생성하며, Pairwise는 튜플에 대해서만 생성한다.

테스트 케이스의 커버리지는 Category-Partition이 높지만 Pairwise는 현실적인 경향에 타협하여 테스트 케이스 갯수 대비 효율이 높다. 조합만 하면 되는 Category-Partition 테스트 케이스 생성기와 다르게 Pairwise 테스트 케이스 생성 도구는 최적화 알고리즘이나 휴리스틱이 중요하다.

6.1 Test Modelling

PICT[7]는 Microsoft에서 개발한 Pairwise 테스트 케이스 생성 도구이다. 우리는 PICT가 정의하는 모델 포맷으로 테스트 모델링을 하였다.

Listing 3: PICT 포맷으로 모델링된 테스트 명세

```
Lines: Zero, Positive
Comments: Zero, Positive
Style: Single-line, Multi-line
Matching: True, False
Functions: Zero, Positive
Variables: Zero, Positive
Includes: Zero, Positive
Defines: Zero, Positive
```

6.2 Test Case Generation

PICT 모델로부터 테스트 케이스 생성을 하였다.

Lines	Comments	Style	Matching	Functions	Variables	Includes	Defines
Positive	Positive	Single-line	False	Positive	Zero	Zero	Zero
Zero	Zero	Multi-line	True	Zero	Positive	Positive	Zero
Zero	Zero	Single-line	False	Zero	Positive	Zero	Positive
Positive	Positive	Multi-line	True	Zero	Zero	Positive	Positive
Zero	Positive	Multi-line	False	Positive	Positive	Positive	Positive
Positive	Zero	Single-line	True	Positive	Positive	Zero	Zero
Zero	Zero	Single-line	True	Zero	Zero	Positive	Positive
Positive	Positive	Multi-line	True	Positive	Zero	Zero	Positive

Table 1: PICT 모델로부터 생성된 테스트 케이스

7 Test Results

java.lang.NullPointerException 에러로 인해 테스트 진행이 되지 않았다.

8 Miscellaneous

OOPT Stage 1000 보고서 Activity 1005 에 첨부된 스크린샷이 테스트 해당 버전으로 아직도 갱신되지 않았다.

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