Key Tradeoffs in High Volume Test Automation

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Driving Questions

- Is it better to use testing or source code review?
- Is it better to test through an API or the GUI?
- Is it better to test a GUI using capture/playback or manually?
- What is the small scope hypothesis?

C Input/output

```c
#include <stdio.h>

int main(int argc, char* argv[])
{
        int a,b;
        scanf("%d",&a);
        scanf("%d",&b);
        if (a < b)
                printf("Minimum: %d\n", a);
        else
                printf("Minimum: %d\n", b);
        return 0;
}
```

Input/output

Command line arguments

Standard input

```
1
2
```

Standard output

```
Minimum:
```

Previous | Check answer | Next

Message:

Question 1 of 4 (1 Marks)

C Bullseye

```
int binsearch(int x, int v[], int n)
{
        int low = 0, high = n, mid;

        while (low <= high) {
                mid = (low + high) / 2;
                if (x < v[mid]) {
                        high = mid - 1;
                } else if (x > v[mid]) {
                        low = mid + 1;
                } else {
                        return mid;
                }
        }
        return -1;
}
int main(int argc, char* argv[])
{
        int a[] = {1, 3, 5, 7, 9};

        binsearch( , a, 5);
        binsearch( , a, 5);
        return 0;
}
```

Bullseye

Command line arguments

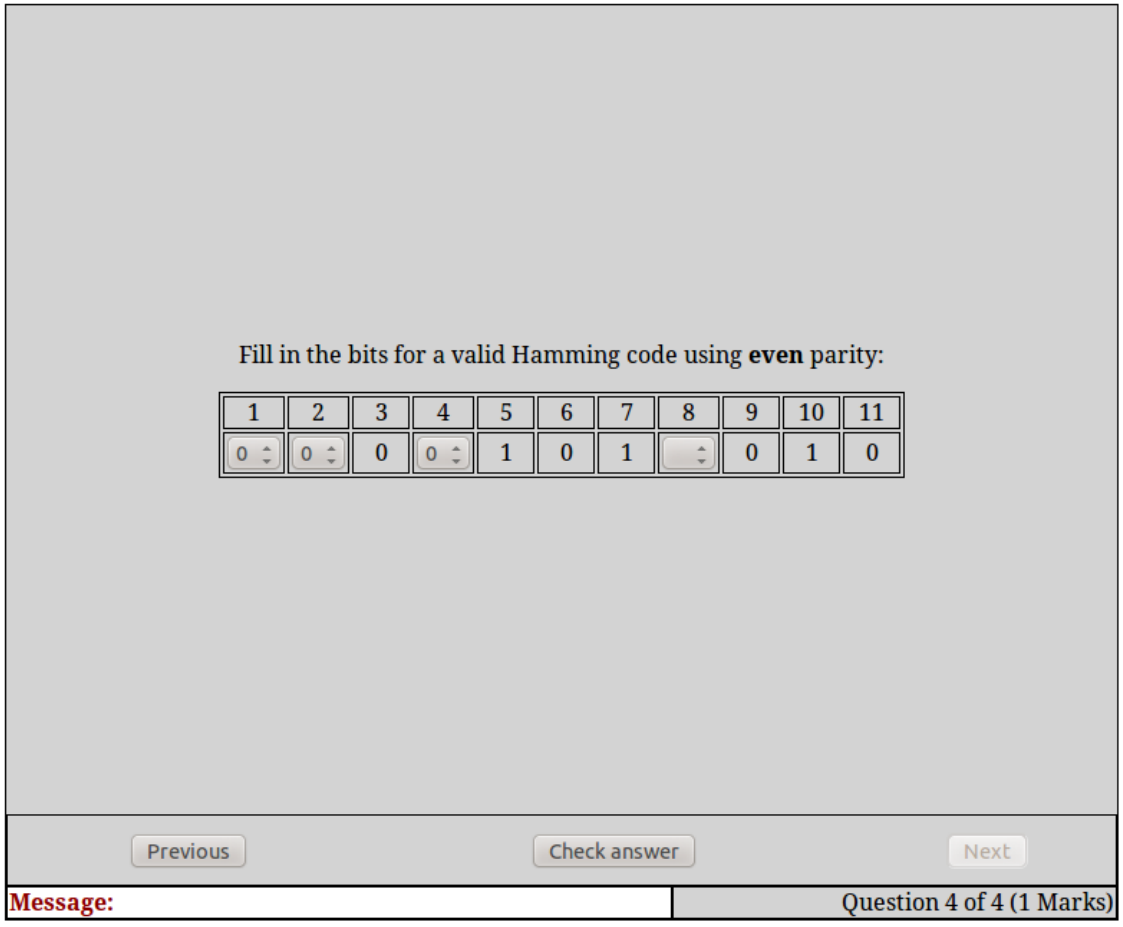
Standard input

Previous | Check answer | Next

Message:

Question 3 of 4 (1 Marks)

Hamming Codes



Hamming Code Example (Even Parity)

Message: 10010

0	0	1	1	0	0	1	0	0
0001	**0010**	**0011**	0100	0101	**0110**	**0111**	1000	1001

Testing or Source Code Review?

```
def generate_code_word(message,parity):
    ...
    code_word = [None] * \
        (get_code_word_length(len(message))+1)

    data_bit_indexes = \
        get_data_bit_indexes(len(code_word)-1)
    m_i = 0
    for d_i in data_bit_indexes:
        code_word[d_i] = int(message[m_i])
        m_i += 1
    ...
```

Test GUI with Capture/playback or Manually?

```
http://localhost:8080/cqg/quiz?spec=test_hamming

---- screen

PF  A Hamming code question appears

PF  One column, with two full-width cells at bottom

PF  All cells have black border

---- bottom of screen

PF  Message cell is 1 line containing "Message: "

PF  "Check answer" button is present
```

Test Through API or GUI?

- Initially developed many automated GUI tests with Selenium
  - tedious to generate; still omitted many interesting cases
  - extremely tedious to maintain
- Switched focus: test only GUI/API data transfer
  - when student clicks check, does the API get the codeword?
  - after API checks answer does the GUI display the message?
- New tests simple to create and maintain
  - only four test cases in total

The Small Scope Hypothesis

Message	Parity	Code word
'0'	0	'000'
'1'	0	'111'
'00',	0	'00000'
'01',	0	'10011'
'10',	0	'11100'
'11',	0	'01111'
'000',	0	'000000'
'001',	0	'010101'
'010',	0	'100110'
'011',	0	'110011'
...	...	...

Driving Questions Revisited

- Is it better to use testing or source code review?
  - testing unless the fault class is hard to reveal with testing
  - or other benefits of review are desired
- Is it better to test through an API or the GUI?
  - API is better unless the GUI-to-API transfer is the test target
  - or there is no suitable API
- Is it better to test a GUI using capture/playback or manually?
  - capture/playback better unless test focus is look and feel
  - or GUI changes frequently and significantly
- What is the small scope hypothesis?
  - most of the bugs can be found by testing a program on all test inputs within some small scope