This is a crashing test case

- Crashed Mozilla
- How would you debug the problem?
- A minimal test case is:

```xml
<SELECT>
  <OPTION VALUE="blocker">blocker</OPTION>
  <OPTION VALUE="critical">critical</OPTION>
  <OPTION VALUE="major">major</OPTION>
  <OPTION VALUE="normal">normal</OPTION>
  <OPTION VALUE="minor">minor</OPTION>
  <OPTION VALUE="trivial">trivial</OPTION>
  <OPTION VALUE="enhancement">enhancement</OPTION>
</SELECT>
```

Can we automate the process of minimizing test cases?

What's the naive approach here?

This is a crashing test case

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- How would you debug the problem?
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Can we automate the process of minimizing test cases?

What's the naive approach here?
Minimizing test cases

Test case  Test case  Test case

Minimizing test cases

Test case  Test case  Test case

Failing  Passing  Unknown

Minimizing test cases

Test case  Test case  Test case

Failing  Passing  Unknown

Minimizing test cases

Test case  Test case  Test case

Failing  Passing  Unknown

Goal: Minimize the failing test case

The happy path: binary search

F 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16

Failing test case with 16 lines
The happy path: binary search

1  2  3  4  5  6  7  8  9 10 11 12 13 14 15 16

P  F  P  P

The happy path: binary search

1  2  3  4  5  6  7  8  9 10 11 12 13 14 15 16

P  F  P  P

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1  2  3  4  5  6  7  8  9 10 11 12 13 14 15 16

P  F  P  P

The happy path: binary search

1  2  3  4  5  6  7  8  9 10 11 12 13 14 15 16

P  F  P  P
The happy path: binary search

1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16
P F P P

F

The not so happy path...

1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16
F

F

Delta Debugging: mostly binary search

1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16
P P

F

Delta Debugging: granularity

1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16
P P P P

F

F
Delta Debugging: complements

Delta Debugging: recursion

Delta Debugging: recursion

Delta Debugging: 1-minimality
Delta debugging: live examples

A little quiz

Program and initial test case
- Program \( P \) takes as input a String of \( a \) and \( b \).
- \( P \) crashes whenever the input String contains an even number of \( a \) AND an odd number of \( b \).
- Assume character-level granularity.
- Initial crashing test case is: \( babab \).

Determine the following test cases
1. Smallest
2. Local minimum but not smallest
3. 1-minimal of size 3
4. 2-minimal of size 3

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A little quiz

Program and initial test case
- Program \( P \) takes as input an Array of integers \( a \).
- \( P \) crashes whenever \( a \) contains 42.
- Initial crashing test case is: \( 2424 \).

Complete the following table

<table>
<thead>
<tr>
<th>Iteration</th>
<th>( n )</th>
<th>input</th>
<th>( \Delta_1, \ldots, \Delta_n )</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td></td>
<td>2424</td>
<td></td>
</tr>
</tbody>
</table>
A little quiz

Program and initial test case

- Program $P$ takes as input an Array of integers $a$.
- $P$ crashes whenever $a$ contains 42.
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Complete the following table

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<th>$\Delta_1, \ldots, \Delta_n$</th>
<th>$\nabla_1, \ldots, \nabla_n$</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>2</td>
<td>2424</td>
<td>24, (24)</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>4</td>
<td>2424</td>
<td>2, 4, (2), (4), 424, 224, 244, 242</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>3</td>
<td>424</td>
<td>(4), (2), (4), 24, 44, 42</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>2</td>
<td>42</td>
<td>(4), (2)</td>
<td></td>
</tr>
</tbody>
</table>