Feedback to HW9

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In this solution, denote \( \text{Int1} \) with \( i_1 \) and \( \text{Int2} \) with \( i_2 \).

1 Semaphore

1.1 How many threads will exit from \( \text{wait(c)} \)

\[ i_1 \mod 4 + 4 \]

1.2 Most blocks accessed

\[ i_1 \mod 4 + 3 \]

1.3 Filling the blanks in 2nd version

In \text{init}: c.h = Semaphore(0)
In \text{wait}: V(c.h)
In \text{signal}: P(c.h)
In \text{broadcast}: P(c.h)

2 Stable Network

2.1 Stable solution?

Yes, A: ABE, B: BE, C: CDE, D: DE

2.2 Stable solution 2?

No. Consider the following case:

A: AE
B: BAE (AE is found to be valid)
D: DE
C: CDE
A: ADE (DE is found to be valid and ADE is preferred to AE)
B: BE (AE is found to be invalid)
C: CBE (BE is found to be valid and CBE is preferred to CDE)
D: DCBE (CBE is found to be valid and DCBE is preferred to DE)
A: AE (DE is found to be invalid)
... (infinitely loop)

Any initialization is acceptable. All will fall into this loop.

2.3 Temporary forwarding loop

\[ i_1 = 0: \text{A and D will see temporary forwarding loop.} \]
\[ i_1 = 1: \text{A and D will see temporary forwarding loop. or A, B, D} \]
\[ i_1 \geq 2: \text{A, B, D} \]

3 New Product

Students are supposed to answer this question with one of following assumptions:

- **Each block has only one bit** i.e. all bits in a block flip at the same time

  In this case each block only has two states: correct or failed.
  The answer for this case is: Q3.1: 1, Q3.2: 1.
  Analysis graph are shown in appendix.

- **Each block has a lot of bits, and each of them can be flipped independently**
  - 1 block fails: can be detected and (located + recovered);
  - 2 blocks fail:
    * in same line or same row: can be detected and (located + recovered);
    * in different lines and different rows: can be detected, perhaps can be located and recovered by trail and error;
  - 3 blocks fail: (If students are not considering case as detectable, i.e. giving answer 2, I think is also reasonable.)
    * all in same line or same row: can be detected and located;
    * \(a\) and \(b\) in same line, \(b\) and \(c\) in the same row: can be detected, perhaps can be located and recovered by trail and error;
    * \(a\) and \(b\) in the same line/row, \(c\) in another line/row and in the third row/line: can be detected (there is error), the number cannot be determined(there may be 3 to 6 failure), cannot be located, cannot be recovered;
    * all three are in diff lines and rows: can be detected (there is error), the number cannot be determined(there may be 3 to 9 failure), cannot be located, cannot be recovered;
  - more than 4 blocks fail: can be detected (the exact number may not be detected), cannot be recovered.
4 Appendix

Case analysis: 1 bit per block

WLOG, assume the original state to be like this:

\[
\begin{array}{cccc}
0 & 0 & 0 & \checkmark \\
0 & 0 & 0 & \checkmark \\
0 & 0 & 0 & \checkmark \\
\checkmark & \checkmark & \checkmark & \\
\end{array}
\]

• One block failure

\[
\begin{array}{cccc}
1 & 0 & 0 & \times \\
0 & 0 & 0 & \checkmark \\
0 & 0 & 0 & \checkmark \\
\times & \checkmark & \checkmark & \\
\end{array}
\]

Table 1: 1 failure - detectable and recoverable

• Two block failure

\[
\begin{array}{cccc}
1 & 1 & 0 & \checkmark \\
0 & 0 & 0 & \checkmark \\
0 & 0 & 0 & \checkmark \\
\times & \times & \checkmark & \\
\end{array} \quad \begin{array}{cccc}
0 & 0 & 0 & \checkmark \\
1 & 1 & 0 & \checkmark \\
0 & 0 & 0 & \checkmark \\
\times & \times & \checkmark & \\
\end{array} \quad \begin{array}{cccc}
0 & 0 & 0 & \checkmark \\
0 & 0 & 0 & \checkmark \\
1 & 1 & 0 & \checkmark \\
\times & \times & \checkmark & \\
\end{array}
\]

Table 2: 2 failures - indistinguishable

• Three block failures

• Four failures

You can do this for 5 or more than 5 failures.
Table 3: 2 failures - indistinguishable

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Table 4: 3 failures - indistinguishable

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Table 5: 3 failures - indistinguishable from 1 failure case

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Table 6: 4 failures - indistinguishable from original case

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Table 7: 4 failures - indistinguishable

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Table 8: 4 failures - indistinguishable from 2-failure case

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Table 8: 4 failures - indistinguishable from 2-failure case