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Debugging Skills

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Dave

- **Professional game**
  ... over 9 years

Dave

"One of the world's leading independent driving game studios.."

- **159 developers In UK, Central China & Hong Kong.**
- **London publishing office**
- **Up to 250 when including outsourcers.**
- **Million selling games**
- **MTV's Pimp My Ride for Activision**
- **Ferrari Challenge**

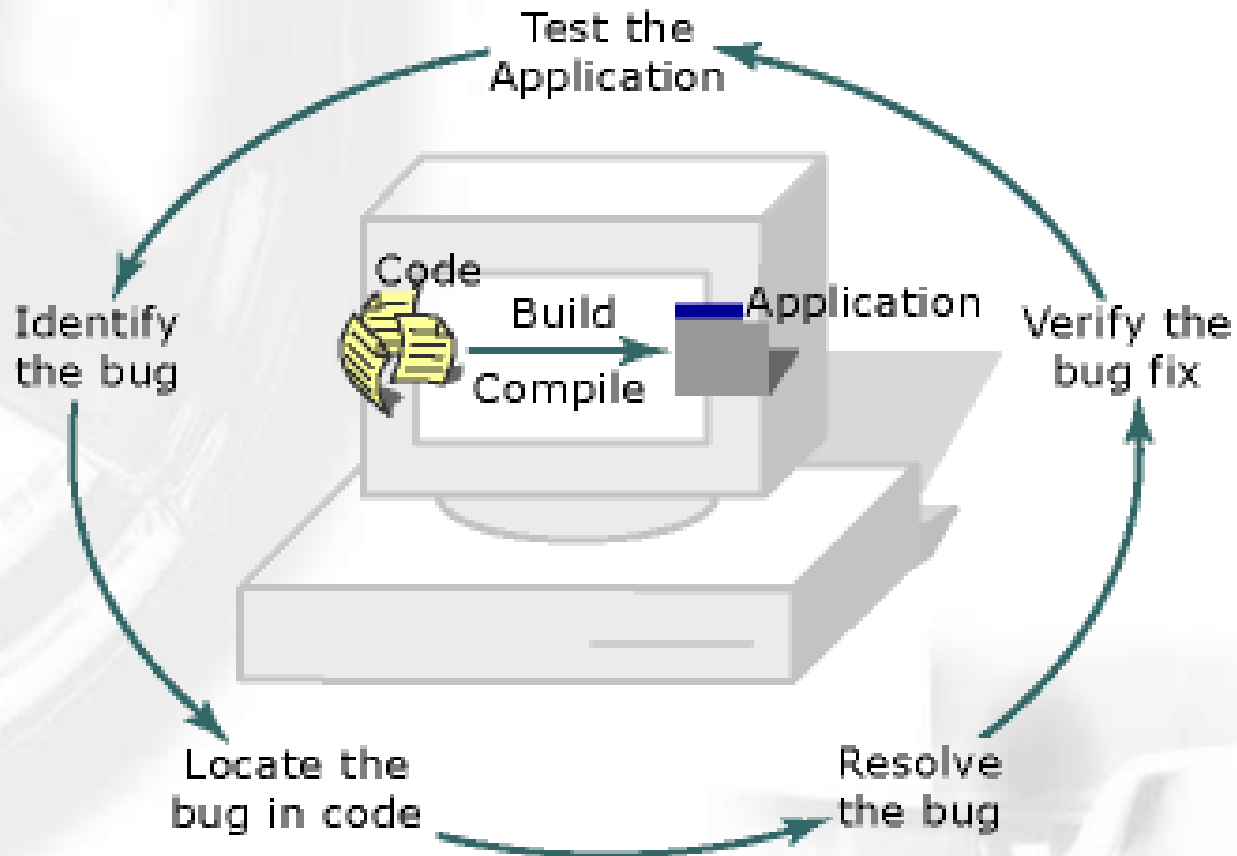ELTECHNYX

ACR TRAILER!!!

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Outline

- **Importance**
- **Some Common Bugs**
- **Prevention**
- **Debugging Methodology**
- **Getting Information Into / Out of the system**
- **Debugger Features**
- **Random Tips**
- **Discussion Exercises**

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Importance

At **least** 50% of time is spent debugging

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Some Common Bugs

- **Uninitialised memory**
- **Divide by zero**
- **Null pointer dereference**
- **Integer overflows**
- **Stack overflow**
- **Invalid stack variables**

- **Memory corruption**
- **Out of Memory**
  - Fragmentation
- **Synchronization Errors**
- **Compiler bug**

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Prevention

- **Defensive Programming**
  - **Reduce source code complexity**

> *'Debugging is twice as hard as writing the code in the first place. Therefore, if you write the code as cleverly as possible, you are, by definition, not smart enough to debug it'*
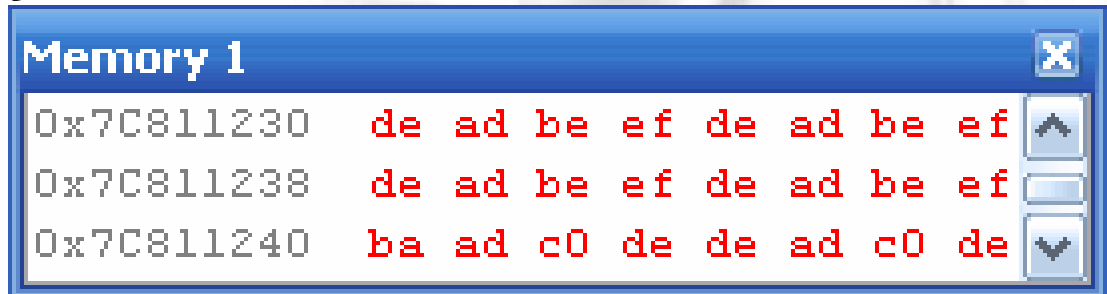> **Brian W. Kernighan**

  - **Code reviews**
  - **Refactor**
  - **Intelligent code reuse**
- **Unit tests**

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Prevention

- **Simple templates to trap array overflows**
- **Use a safer string class - char[ ] is dangerous**
- **Be very careful passing local variables by address**
- **Watch out for initialization order of statics**
- **Custom heap implementation**
  - **Consistency checking**
  - **Pre-seed memory**
    - `0xDEADBEEF`
    - `0xDEADC0DE`
    - `0xBAADC0DE`
    - `0xCDCDCDCD`

```
Memory 1                                        [x]
0x7C811230    de ad be ef de ad be ef  [^]
0x7C811238    de ad be ef de ad be ef  [ ]
0x7C811240    ba ad c0 de de ad c0 de  [v]
```

Debugging Methodology

- **Confidence – lack of confidence stops almost everyone – and looks like laziness!**
- **Relax – and clear you head – stop thinking!**
- **Make it fail**
- **Remove your preconceptions**
- **You can listen but don't believe!**
- **Look for evidence**
- **Divide and conquer**
- **Keep an audit trail**
- **Check assumptions**
- **Explain to others**
- **Fix**
- **Check the fix**

Understand the system?

Know your tools

Stop Thinking!

Getting information out of the system

- **Debugger**
- **printf output**
- **Screen**
  - **likely to be delayed due to double/triple buffering**
- **TV border colour**
- **Hard disk access**
  - **remote or local**
- **Network port**
- **I have never needed:** ☺
  - **Sound!**
  - **Controller rumble!**

Getting information into the system

- **Debugger**
- **Controllers – keyboard is great with an embedded console**
- **Network**
- **Filesystem**

Debugger Features

- **Output logging**
- **Program Counter**
- **Breakpoints**
- **Registers**
- **Watch**
- **Hardware Breakpoints**
- **Call Stack**
- **Disassembly**
- **Memory**

- **Thread and Process**
- **Sample based profiler**
- **Scriptable?**
- **Visualizers**
- **Advanced**
  - **Pipeline stalls**
  - **DMA**

Other
  PIX
  Logic probe tools
    Realtime pc trace
  Purify

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Random Tips

- **Keep track of variables on the heap via casts**
  - **Eg (RaceCar *) 0x80420020**
- **Know how virtual functions are implemented**
  - **vtables**
- **What do floats look like in memory?**
  - **Eg 1.0f looks like 0x3f800000**
- **<nasty> can be faster to change code in place than to recompile+link </nasty>**
- **Hardware breakpoints are you friends!**
  - **But DMA transfers are not trapped (PS3 does though)**
- **Add consistency checking code**
  - **However beware the dreaded 'Heisenbug'!**
- **Try reproducing the bug on another platform**

Discussion Exercises

- **Asset importer works from VS but not from python script.**

- **Leaking memory.**

- **Script data not aligned when loaded.**

- **Global variables changes between two lines of code without being touched on those lines.**

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Questions

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