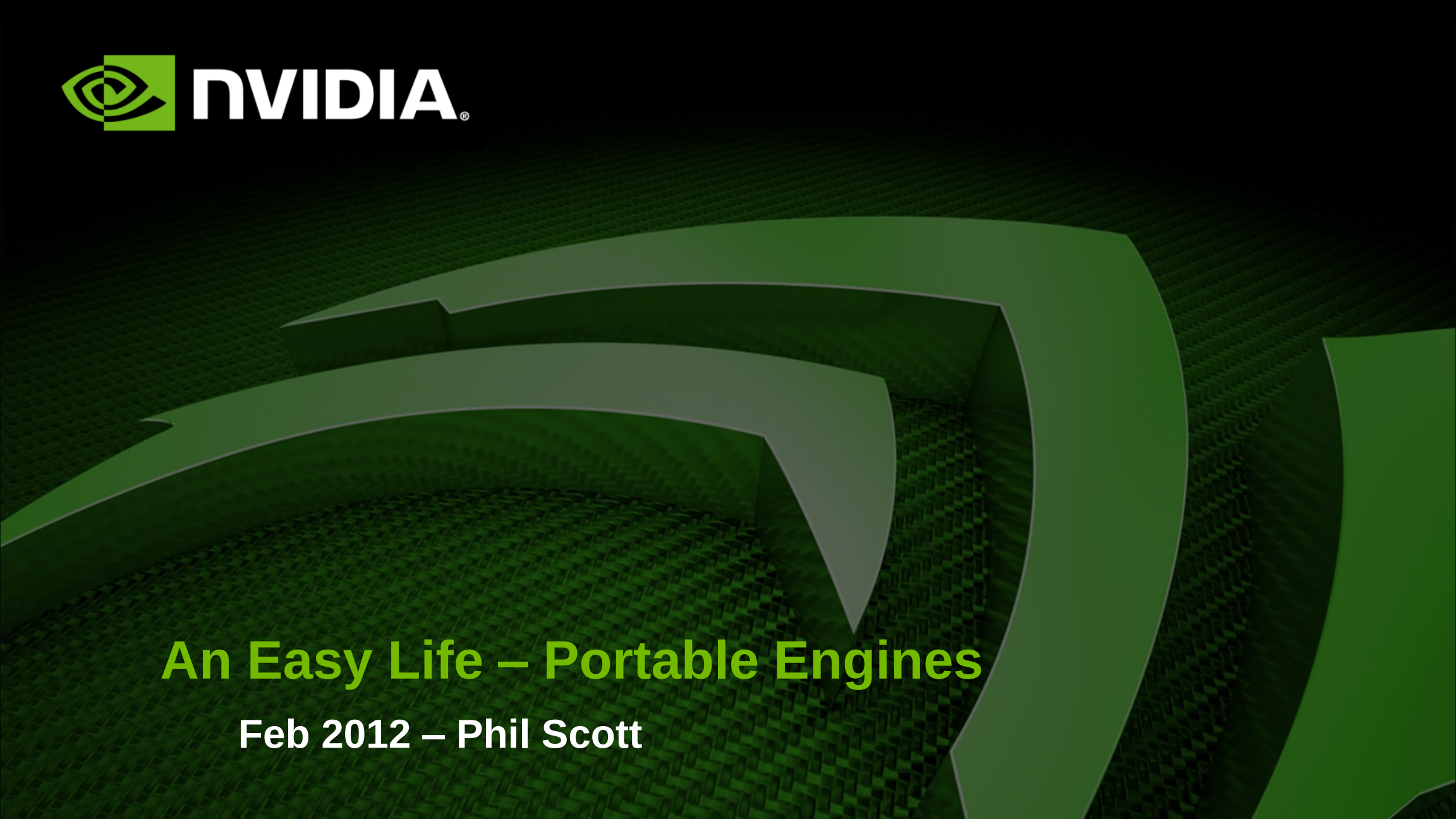

An Easy Life – Portable Engines

Feb 2012 – Phil Scott

A bit about me.

- Been doing this (and getting paid for it) since 1987
  - That makes me feel old.
    - A 8086 was 8mhz
    - A huge 500k of memory that was usable
    - And addressing was in PAGE mode with 2x 16bit registers
- Some reasonable successes
- Major contribution to 50 games+

Life was tough

- We lived in a cardboard box in “t’ middle ‘t road.”
  - Near enough...
- Life back in the stone-age
  - No debugger
  - Assembly times were 5 minutes
  - Tools were scant and you made your own mostly
  - C code was for ‘them other types’
  - But Pacman could be written in Cobol... There was hope yet!
  - SHOCK....

SHOCK...

- No GOOGLE
- No Wikipedia
- No Sourceforge
- No Flipcode
- No developer sites
- No ipad, no laptop...
- No online resources, community, samples or anything.

- Sinclair User was our only saviour

Machines of the time

- My first job
  - C64 – C16 – C+4 – BBC micro - 6502 derived – vastly different hardware
  - ZX Spectrum – Amstrad CPC - Z80 ☺ - No hardware just memory
  - ATARI ST - AMIGA - 68000 – hardware differences
  - PC - x86 no two machines alike, no hardware
- I was the PC guy... Aka the ‘12 bit’ department.

All of those machines

- What do you think we did?

All of those machines

- What do you think we did?
- Platform specialists all creating the same game (sorta)
  - Kevin Blake – BBC
  - Mick Hedley – C64
  - Dave Mann – Amiga
  - Bruce Nesbit / Steve Tall – ST
  - Me... PC
  - We didnt even share graphics!

Our Mantra

- Any game , can go on any platform.... It just may need a bit of attention.
  - This meant...
    - It would be different
    - It would be a total rewrite
    - Near nothing would be shared except verbally
    - One version could be great and another utterly dire (sadly happened a lot)


SUMMER OLYMPIAD
PROGRAM GARY GRAY
CHRIS ROBSON
MUSIC HAL BEBAN
ART PAUL DRUMMOND
TYNESOFT


PROGRAMMED
I. DAVISON
M. HEDLEY
GRAPHICS
M.LANDRETH
MUSIC
IAN.CRABTREE
HAL.BEBEN
TYNESOFT
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SUMMER OLYMPIAD

ALL

- All entirely drawn from scratch... Each time.

I was a noob

- Now...
  - Being on a platform that nobody thought was a gaming platform
  - I got NO service
    - You cant ship with programmer art.
- I needed a solution...

Pizza!

- Its a long story!!!
  - PC had 5 different adapter modes
    - CGA – 4 colour – fixed palette
    - EGA – 16 colour – fixed palette
    - VGA – 16 colour – RGB palette
    - MCGA – 256 colour – RGB palette
    - Hercules – 2 colour – Very hires
- Custom conversion software
  - Would take Amiga/ST source art, and retarget it.
  - Did a close enough job to get going...
    - Quite a few games shipped with Pizza-graphics

Then came the beeb

- BBC programmers saw that I could convert graphics
  - And liked it...
  - Pizza replaced 5dotEd (another long story)
  - BBC used low resolution PC assets
  - C64 then rotoscoped these with colour
  - Speccy had dithery patterns
- Our pipeline

WOOT... We developed a pipeline!

- Produce art on ST (Degas Elite & DP2)
  - Push to PC (via a converted floppy drive)
  - All dev systems were on PC for 8bit (PDS)

  - Convert to PC or 8bit target using PIZZA
  - Recolour for C64
  - Use directly on BBC micro

- Reduced art production time vastly / improved output of 5 artists to work on ST only (with touch ups on native)

That sounds awesome!!!

- What happened next?
  - Graphics review scores went up (highlight was 99% in Zzap 64) using converted graphics!
  - You should be minted!!!

Except it came too late

- Tynesoft went bankrupt
- Oh well...

Lesson Learned

- Next company...
  - Please move on!

Enter UBER-ED

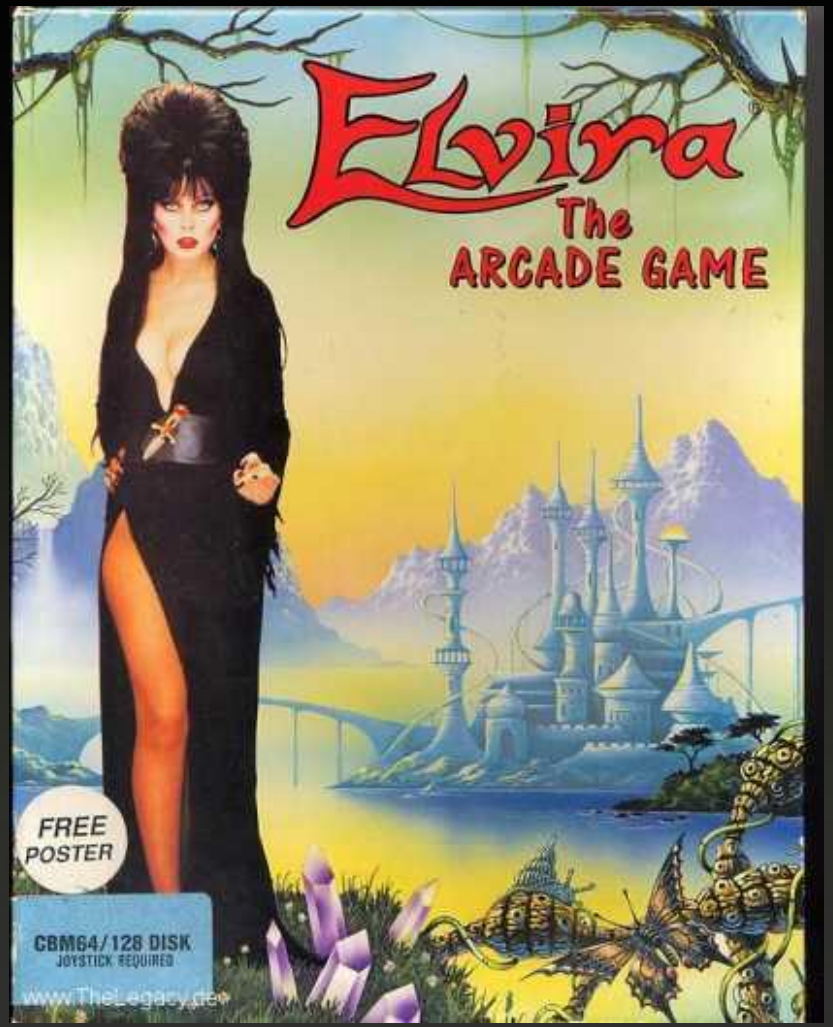
- New company was made up 90% of old team.
- I'd been promoted to lead the games due to Pizza at old place
- We needed a new platform for our games
- UBER-ED
  - Modest but fair ☺

First iteration

- On Atari ST..
  - Was buggy, and crashy
  - Originally art was made on ST, so felt like the natural home
  - Saved to floppy only
- Rewritten on PC
  - Much more stable
  - HDD storage
  - Art moved to PC... Life was good ☺
- It just edited level backdrops

Then the dawning of the future

- 4 platforms
  - Huge game content
  - 5 months
  - OH HELL!

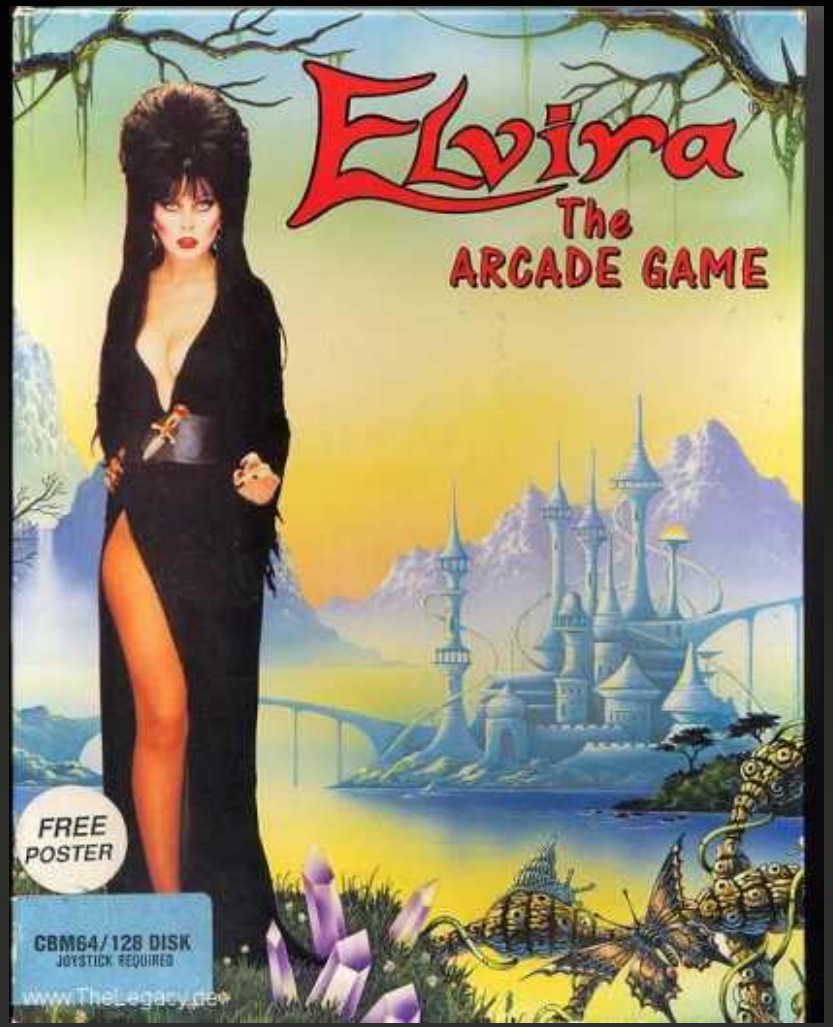


Then the dawning of the future

- The game content
  - Level structure
  - Puzzles
  - Attack waves
  - General game flow

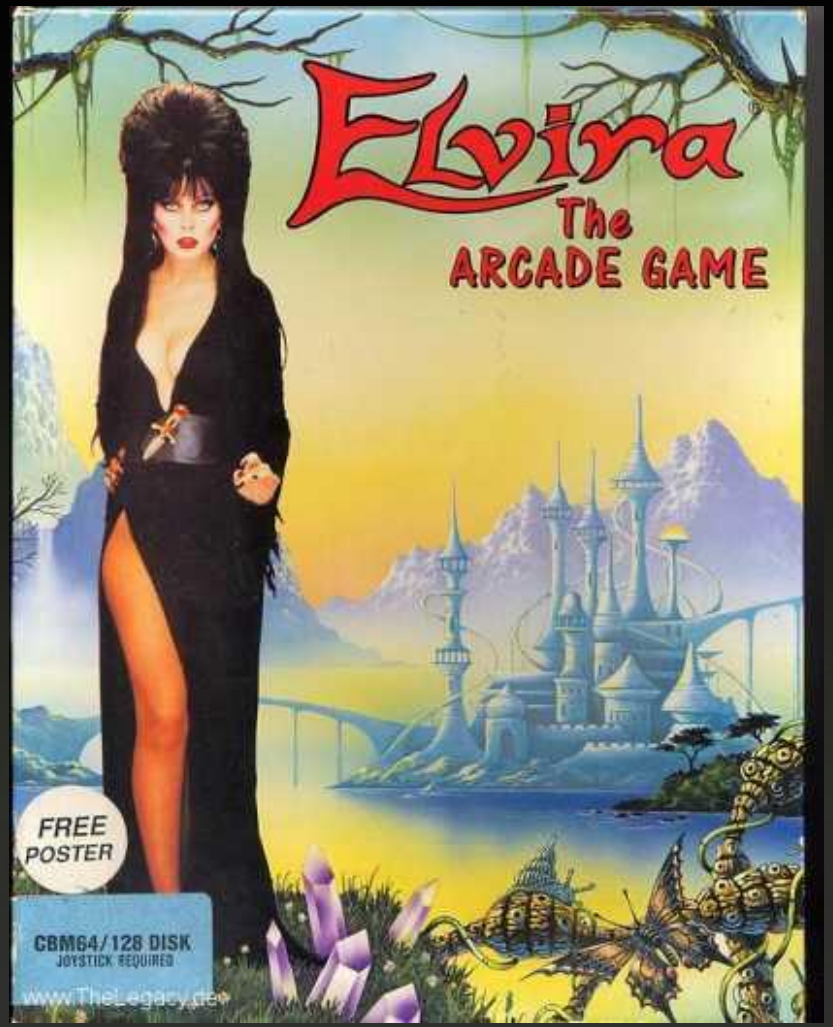
  - ALL created with a VM
    - VM functionality was clunky
    - But it worked

  - PC lead, ST/AMIGA , C64 took VM code
    - Ported by porting the VM
    - Lean and efficient p-code



Then the dawning of the future

- Three more games followed in a year.
- We had accidentally made an ENGINE...
  - We called it IVOR
  - It was DATA driven game mechanics
  - Maybe more could be?
- Rudimentary VM increased our output
- Game code still needed adding though for ‘gameplay’ features and new things to do.



Our VM

- P-Code... A bit like z80.
  - Opcode followed by data
  - Unique opcodes for different subfunctions
  - Why it worked so fast.
    - At tool save time all data was verified...
    - Load data, and generate offset (in place) to interpreted function
    - Grab return address from stack, as the data was sat directly after the call function in memory.
    - Modify stack to adjust return address to next p-code function.

    - NOTHING at runtime was compiled by runtime... Ever...

New engines

- Still in assembly code... Hanging onto that security blanket.
- DOS4GW
  - Dos extender that shipped with Watcom C
  - Doom used it.
    - Changed the world forever in PC game programming
- I guess I need to learn C ... Beuller?

Around this time (1996)

- PSX (playstation 1)
  - All C libraries
  - All samples were C code
  - Enough hardware to hide the shoddy slow C code
- Previously
  - At least 80% of your time was spend rendering / updating the screen with ASM calls... The game was tiny in code
  - On machines with HW (sprites, scrolling), most of the time was spent battling the poor slow processor... C64 had SUB 1mhz

Armed with a C compiler.

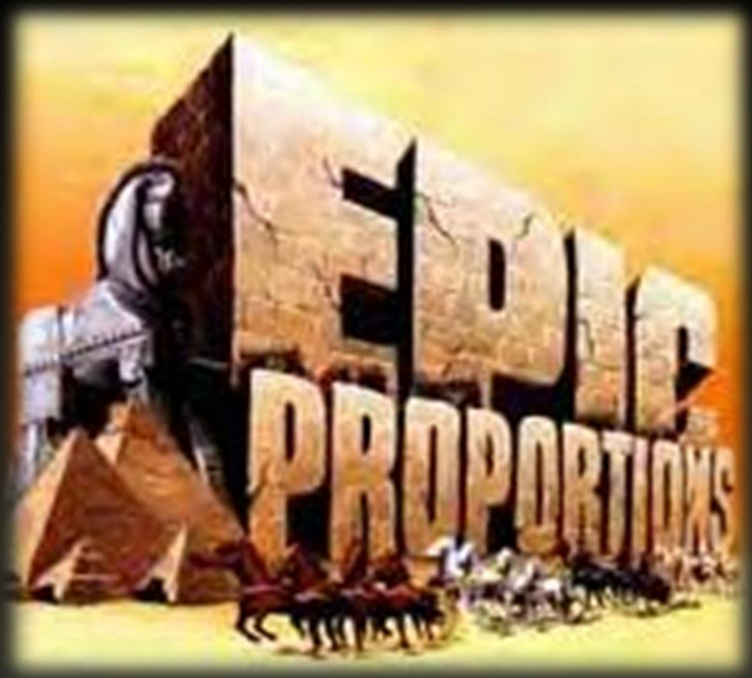
- Set about making a new game (for a new company)
  - Found out quickly a few lessons
- PSX had hardware... PC didn't.
  - I spent a lot of time making rendering libraries that matched PSX
- The core mechanic was there...
- Game was constructed in Editor tools on PC.
- Shared art...
- Shared C code (50%)
- Source level debugging... Nope!

Any questions so far?

- I'll take a breath...

Making of an epic.

- How does a small team make a world class game in 15 months?
  - Core staff was 8.
- No engine, start from scratch...
  - In the space of a year... 3D cards had become way better than we could achieve in software.
- Radical rethink.
  - Time pressure to ship something...



What do we have?

REUSE is good... Be shameless about it. If it ain't broken...

- PSX art tools...
  - Modelling was done in 3DSMax
  - Textured using PSX art tools
  - TM-ED ... A custom tool I'd created for PSX guys 2 years earlier.
- Known workflows if fit for task, are a real home run.

Segregation of work

- I love small teams!
- Easy to manage, and pull together...

- Our division or work was as follows
  - Phil – Anything hardware, Front end,player related, ‘art programming’
  - Kev – Editor, scripting, AI

  - Mick – Working on trying to make our stuff work on PSX

Set lofty targets... Be ambitious, not ambiguous

- Our CEO – Paul Finnegan – "*Shoot for the stars lads*"
  - Err ... Thanks Paul.

- At this stage we had art pipeline, and an idea of work.
  - Whilst I built a renderer
  - Kev would build the editor so we could pull stuff together.
  - Art guys would make a 'look and feel'

  - ...go... 2 months of 3 for the prototype to be up and running.

2 months in

- We could render some stuff.
  - Models
  - Heightmap
  - Basic animation (wobbly stickman)
  - Lighting of sorts
  - Camera logic

  - Crucially... (slight of hand)
    - Score / lives / bullet count
    - Player controls (basic)
    - 2 players on one screen (coop)

By the way guys...

- The approval meeting will be pulled in 2 weeks...
- We had 2 weeks to make stuff work...
  - Time for the pub!
  - Plan put together as to what we would show.
    - Studio head wasn't convinced
- And one late night... When the shoemaker went to bed.
  - The game making elves came...

The all-nighter.

- By elves...
  - 3 of us stopped late one Thursday night (approval meeting was Monday the following week)
  - With a plan to ignore the studio head, and have belief in our own way.
    - Added some explosion code / chain reaction code ... And sound effects. (critically)
    - We made a few monsters move
    - And listened to Eye of the Tiger 55x....

Following day

- *‘Wow’... I knew I was right all along – Studio Head*

- **It looked great.**
  - **The editor had been our savior because we could iterate quickly and test.**

  - **Crucially...**
    - **The game was running INSIDE the editor... Kev pulled a masterstroke.**
    - **We could iterate on content at the drop of a hat.**

    - **This set the tone for the rest of development from here out.**

The big day

- Of course we passed approval ☺
- Now the hard work began!
  - The race was on...

5 months of work... Next target.

- 4 playable (fully) vertical slice levels
- Weapons
- Multiplayer
- Rendering niceness
- AI

- Basically a full game.

The evolution.

- The editor became the tool that EVERYBODY used.
  - Except me.
- The “game” was “entirely” data driven.
  - I would add new features, and they would be wired up to editor functions.
  - Visual scripting...
    - Like sinclair basic. You couldn’t make a typo.
  - Used the same very fast execution logic we previously had used.
- Management thought we were nuts!

5 months pass

- We have a 4 month vertical (which became an OEM version)
- We did a full QA pass at that point.
  - Again, modifying script ‘live’ was such a good thing.
- The game was porting nicely to PSX
  - No rewriting of game code... Only systems... Now we’re cooking!

The run in...

- We ended up shipping a full game 6 months afterwards
- We sold in excess of 3 million copies
- Ported to 14 languages
- On 4 platforms
- We finished with 10 staff members.

- With 4 weeks to go we had ZERO ‘A’ bugs.
  - 393 script bugs... No coder needed (art guys did the scripts)
  - Gameplay tuning... And more tuning.
  - We added the front end at this stage.

Code level...

- How did we do it.

Old adage

- *There is no substitute for hard work...*

Code level...

- How did we do it.

***NEW** adage*

- *There is no substitute for **PLANNING** hard work...*

Firstly... planning

- Learn to ask questions
  - Employers like this... (except ‘can I have more money?’)
- Don’t take a schedule as a bible / talmut
  - Its there to help, not be a rod to hit you with
  - If its unrealistic... Saying at the start, is better than the end.
- Break down the tasks uniformly

Planning

- Understand ownership...
  - Take what you own and make it excellent.
  - Make it easy for them to interact with
  - Think of it in reverse...
- Establish the ground rules for
  - Naming... Hungarian or not?
  - Code style... What is verboten?
  - File organisation...
  - Don’t invent acronyms and jargon if established verbage works

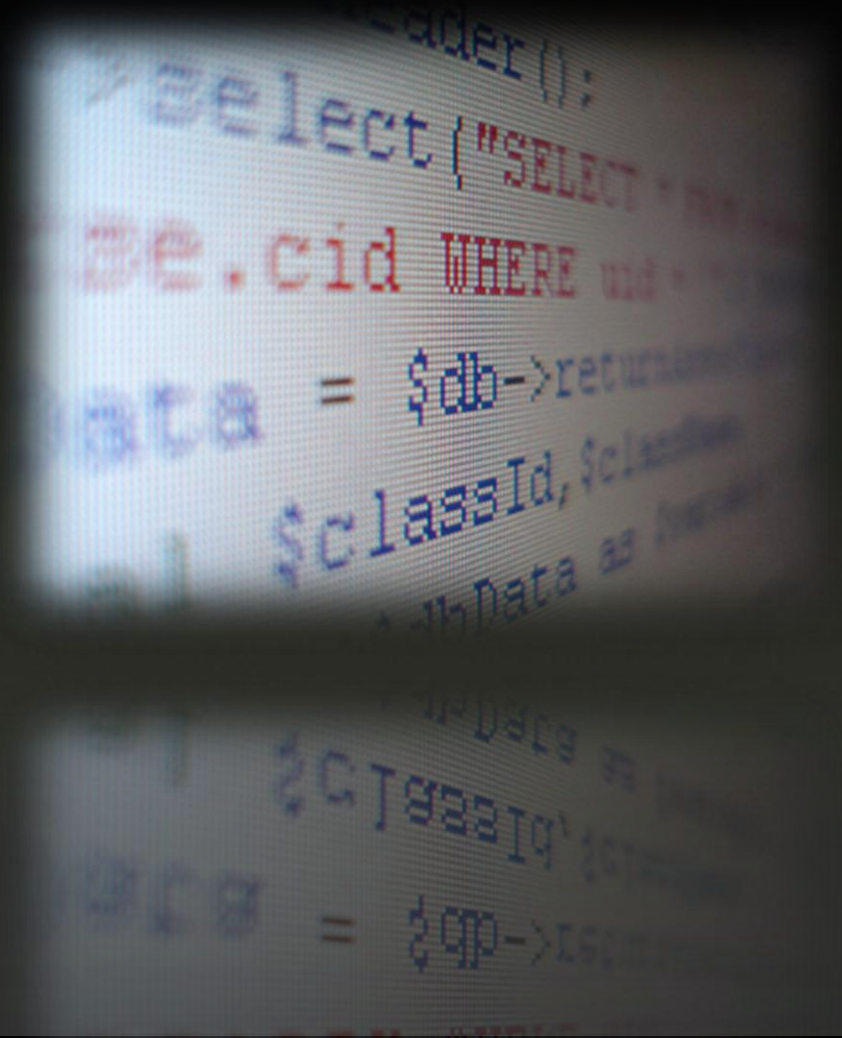
Simple code = good code.

- Basic rules
  - Fancy code = slow code (mostly)
  - No substitute for slight of hand

  Our engine

  - Class::Init()
  - Class::Process()
  - Class::Draw()
  - Class::Destroy()

  - THATS IT!



How deep?

- Derive your classes well
  - You can run anything in the Process function
  - Essentially its just a state machine anyway
  - A well derived base class gives you tons of flexibility
    - Let the data do the work...

Keep it simple

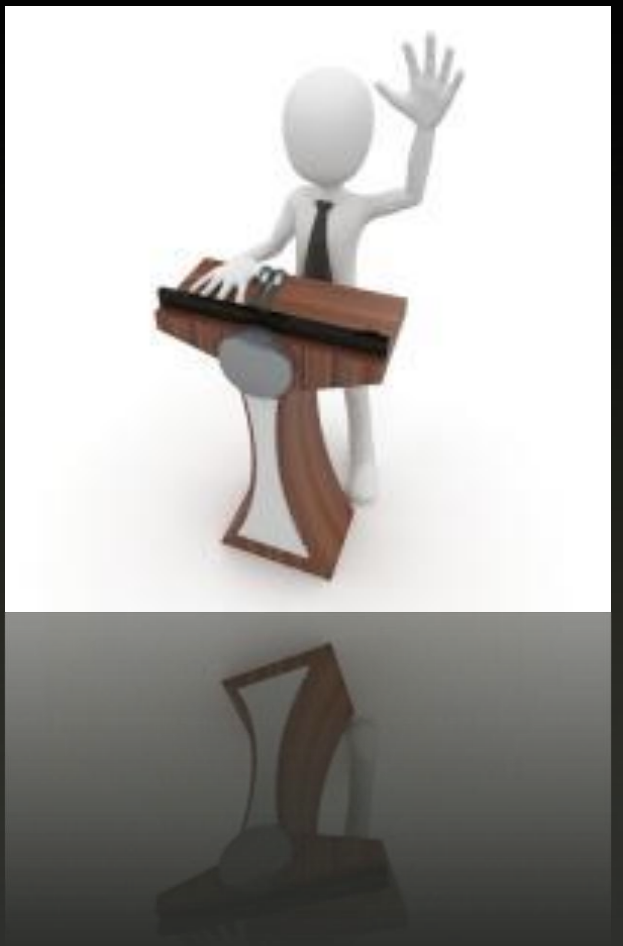
- Eg. Particles were entities within a global Particle system class.

Don’t be fooled by fancy indirection

- Stay as shallow as possible... Each pointer indirection is cycles lost.

The religious argument

- STL looks all fancy
  - Does loads of stuff for you.
  - Does loads of stuff behind your back that you don't know.
  - I'm not saying dont use it.
    - Know what it does first (look at the ASM code)
- Virtual functions ARE ALSO EVIL.
  - Topic of lively debate.
  - No... They arent...
    - They're dangerous, but useful... Like a chainsaw!
- I dislike templates except for INLINE code.
  - Math functions etc.
  - Small chunks of code, easy to debug.

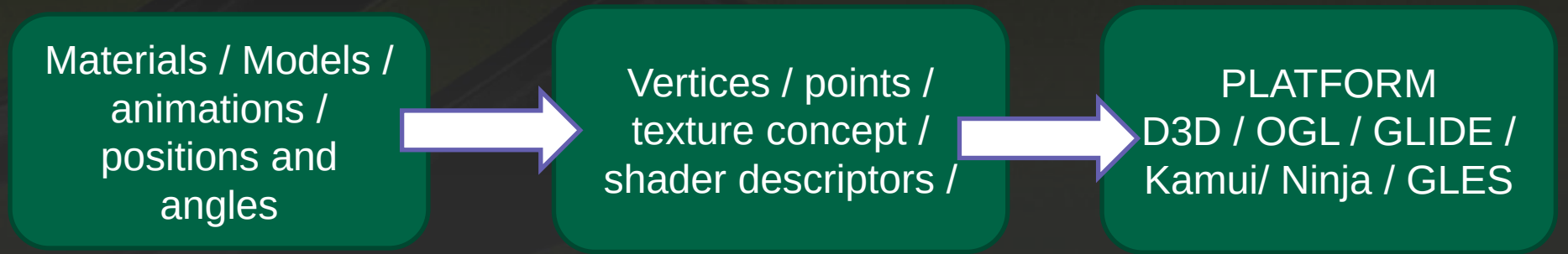


Main loop memory allocation

- A source of much mirth amongst the more experienced ones of us.
  - AS MUCH AS ITS TEMPTING ***DONT DO IT***..
  - YOU WILL FEEL PAIN
    - PAIN LEEDS TO SUFFERING...
    - You know the rest
  - Stable memory behaviour makes code portability workable.
    - Stable memory behaviour gives determinism
    - Use memory pools, that are pre-allocated and find slots (round robin or similar)

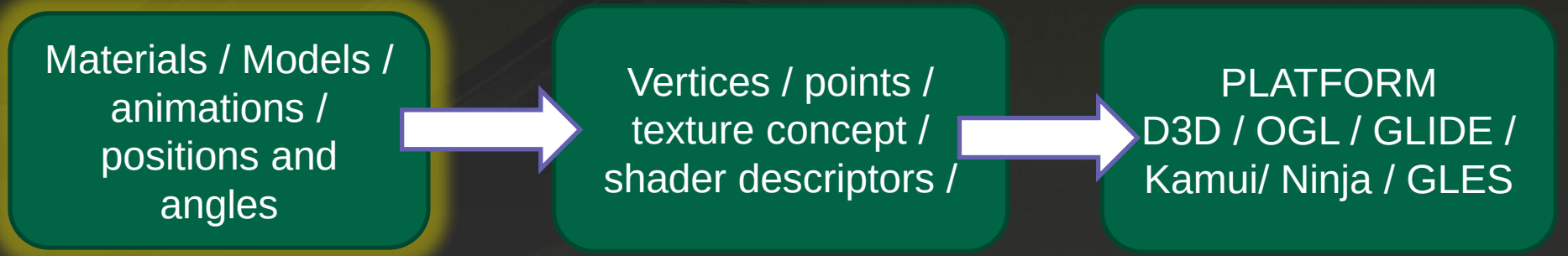
Learn to be abstract – this is true of all our code

- Initial renderer was written in D3D.
- Game code / Script code has to have NO understanding of this.
- Use abstracted terms... Be descriptive... Think ‘artist’ friendly



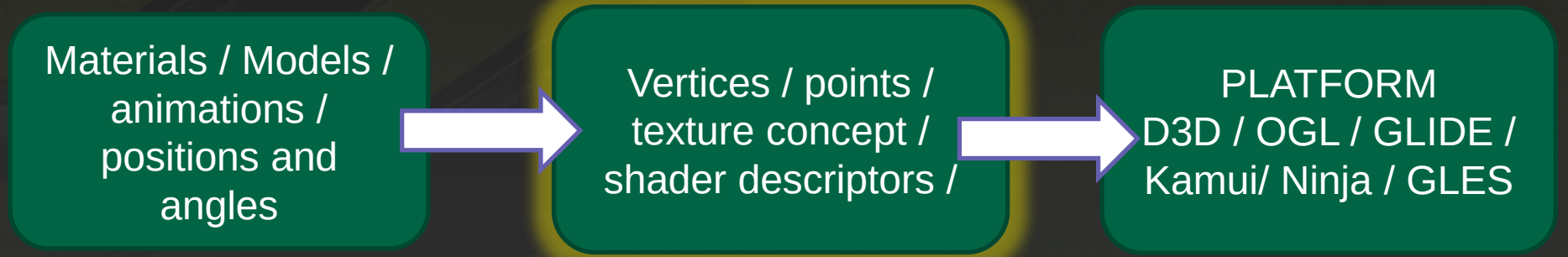
Learn to be abstract

- **Game code level**
  - **Abstraction is critical to success.**
  - **Don’t worry about the cycles... Really...**
  - **Nothing should describe the platform... In code.**
  - **Provide the engine with ‘information’**
  - **‘I want it to look like ‘this’ ‘**



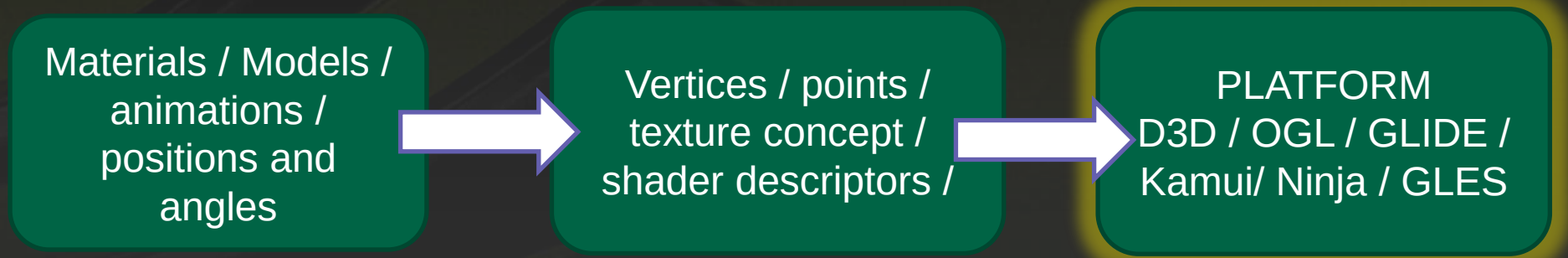
Learn to be abstract

- Critical to get this right. (this is ENGINE code)
  - Its ok to use terms such as ‘ONEONEALPHA’
  - Textures should be referred to as a class, not an object
  - Vertices are still sort of abstract... They’re just data.
  - Its not ok to have anything rendering API in here.



Learn to be abstract

- Gloves off.. Go for the metal
- All the work of your nicely abstracted code comes into here..
- Interpret and run with it.
  - Not all hardware supports all modes. Coping mechanism is here
- A well written renderer should port EASILY.
  - NOTE - I didn't say performantly



How well does this work

- Dreamcast was a new platform at this time
  - We had 1 guy, not in our studio who knew ‘a bit’
  - He ported our game ENTIRELY in 6 weeks (and through QA)
  - We hit JP DC launch and sold 250k copies that day!

Where does this lead us too today.

- Engines
  - UNITY, UDK, UE3.... All work this way
  - We didn’t invent it, but we must have been close.
  - KISS!
    - Keep It Simple Stupid.

What happens when...

- You take a 12 year old D3D game (well written)
  - State of the art in its day
- And port it to OpenGL in your spare time.

- Let me show you... Its far easier.

Questions

- Ask away!